

# inter-office communication

To:

Myron Pakush, P.E., District 12 Deputy Director

Attention:

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

From:

David L. Holstein, P.E., Administrator, Office of Roadway Engineering

By:

Brenton Bogard, P.E., Studies Engineer

Date:

June 22<sup>nd</sup>, 2015

Subject:

Interchange Modification Study (IMS) for CUY-271-8.14 (at Cedar/Brainard),

PID 97676, dated March 2015

The Office of Roadway Engineering has reviewed the subject report and determined the proposed improvements at the interchange will not degrade operations on I-271. The study meets ODOT requirements for an Interchange Modification Study (IMS) and therefore is approved.

#### Improvements include:

#### Phase 1

- Widen and extend a second NB thru lane on Brainard Road through the I-271 SB exit intersection to be tapered back to one lane starting around Edenhall Drive.
  - o NB approach from (T) to (T-T)
  - o SB approach is (T-T). No proposed changes
  - o WB approach is (L-LR). No proposed changes
- Widen and reconfigure lane assignments at I-271 NB Ramp intersection with Brainard Road:
  - o NB approach from (TR-R) to (T-R-R)
  - o SB approach is (L-T-T). Left turn storage improved
  - o EB approach from (L-R) to (L-LR-R)
- Widen and reconfigure lane assignments at the Cedar Road and Brainard Road intersection:
  - O NB approach from (L-T-R) to (L-T-TR) and improve storage
  - o EB approach is (L-L-T-TR). No proposed changes
  - o WB approach is (L-T-T-R). No proposed changes
  - O SB approach from (L-L-T-R) to (L-L-TR-R) and improve storage

#### Phase 2

- Switch the NB entrance and exit to and from the NB I-271 express lanes just south of the I-271 & Cedar Rd./Brainard Rd. interchange in order to provide a longer weaving distance from the NB I-271 express lanes to the NB Cedar/Brainard exit ramp.
- Widen NB I-271 to extend NB exit ramp to Brainard Road and Cedar Road.
- Widen NB I-271 exit ramp to Cedar Road and Brainard Road to 2 lanes just past the exit gore.

If you have any questions, please call Brenton Bogard at (614) 752-5575.

#### **DLH:BLB**

FHWA (Naureen Dar); D-12 (Myron Pakush, Lou Hazapis); CO (Rick Bruce, Mike Cronebach) - Reading File - File

### Blayney, Brian

From: Blalock, Andy

**Sent:** Tuesday, June 23, 2015 2:13 PM

To: Bogard, Brenton
Cc: Dar, Naureen

**Subject:** RE: CUY-271-8.14 Cedar/Brainard PID 97676 IMS

#### **Brent**

I agree that this falls into the IOS category so no further FHWA review is required. Give me a call if you want to discuss further.

Andy Blalock Field Operations Team Leader Federal Highway Administration 200 N. High St. Rm. 328 Columbus. OH

TEL: 614-280-6823 FAX: 614-280-6876

**From:** Bogard, Brenton [mailto:Brenton.Bogard@dot.ohio.gov]

**Sent:** Tuesday, June 23, 2015 12:07 PM

**To:** Blalock, Andy (FHWA) **Cc:** Dar, Naureen (FHWA)

Subject: CUY-271-8.14 Cedar/Brainard PID 97676 IMS

Andy,

As my voicemail stated the subject report was originally written as an IMS and has been approved by ODOT and it is our opinion that the improvements fall under an IOS.

I wanted to be sure that FHWA agreed that the modifications shown on page 39 of the IMS PDF fall under the IOS. The express lane entrance/exit will be reversed to allow a longer weave distance for express lane vehicles to exit at Cedar/Brainard. The merge, diverge, and weaves were all analyzed to make sure the changes operated satisfactorily.

O:\Roadway\Interchange Modification Studies\CUY-271-8.14 (Cedar-Brainard); PID 97676

Feel free to give me a call to discuss.

Thanks,

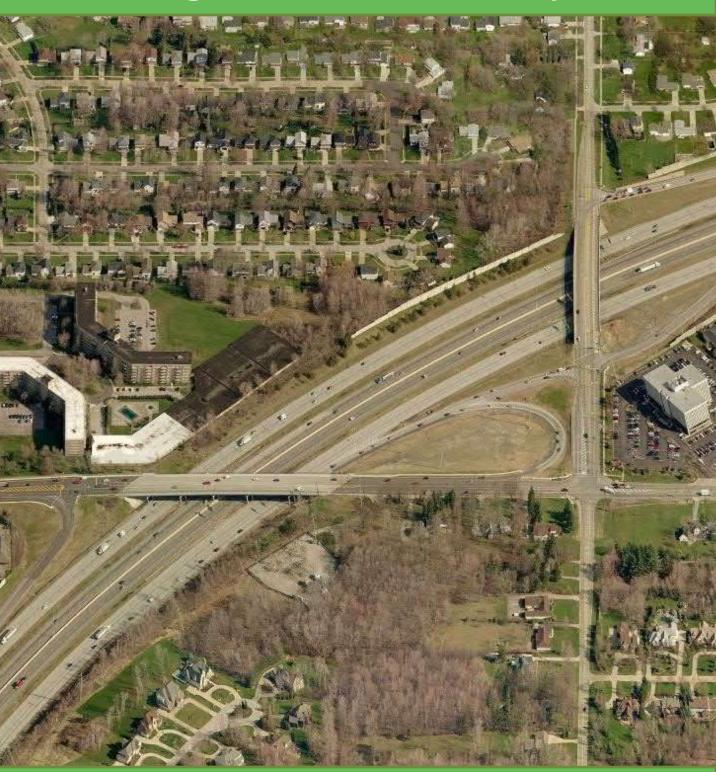
Brenton Bogard, PE Studies Engineer, Office of Roadway Engineering Ohio Department of Transportation 1980 W. Broad Street, Mail Stop 1230 Columbus, OH 43223

 $\boxtimes$  brenton.bogard@dot.ohio.gov

**☎**614.752.5575

# CUY-271-8.14

Interchange Modification Study (PID 97676)



# **Interchange Modification Study**

CUY-271-8.14

Cuyahoga County, OH

PID # 97676

#### Submitted To:

Ohio Department of Transportation – District 12 5500 Transportation Blvd Garfield Heights, OH 44125

## Prepared By:

Parsons Brinckerhoff 1660 West 2<sup>nd</sup> Street – Suite # 820 Cleveland, OH 44113

March 2015 (Revised June 2015)









<u>ı abie</u>	of Contents	
1.0	Executive Summary	1
2.0	Background	3
3.0	Purpose and Need	4
4.0	Study Area	4
5.0	Existing Conditions	6
5.1	Road Geometry and Access Locations	6
5.2	Physical Conditions	7
5	.2.1 Geometric Deficiencies	7
5.3	Crash Data	7
5.4	Demographics	8
5.5	Land Use	9
6.0	Analysis Years	9
7.0	Alternatives Considered	9
8.0	Traffic Volumes	10
9.0	Traffic Analyses	10
9.1	Freeway Segment Analyses	10
9	.1.1 No Build Alternative Freeway Segments	10
9	.1.2 Build Alternative Freeway Segments	11
9.2	Ramp Junction Analyses	13
9	.2.1 No Build Alternative Ramp Junctions	14
9	.2.2 Build Alternative Ramp Junctions	14
9.3	Weave Segment Analyses	16
9	.3.1 No Build Alternative Weave Segments	16
9	.3.2 Build Alternative Weave Segments	
9.4	··· ··· ·· · · · · · · · · · · · · · ·	
9	.4.1 No Build Alternative Intersection Analyses	
9	.4.2 Build Alternative Intersection Analyses	
9.5	Turn Lane Storage Lengths	20
10.0	Cost Estimate	21
11.0	Environmental Overview	
12.0	Conclusion and Recommendations	28
	<u>f Figures</u>	
•	e 1. Aerial view of Study Location Map	
Figure	e 2. Aerial View of the Cedar Road/Brainard Road/I-271 Interchange	6
	f Tables	-
	1. Existing Roadway Conditions	
	2. Crash Summary	
	3. Freeway Segment Level of Service	
	4. Freeway Segment Analyses for the No Build/Build Condition (Northbound)	
	5. Freeway Segment Analyses for the No Build / Build Condition (Southbound)	
rable	6. Ramp Junction Level of Service	14

## CUY-271-8.14 PID 97676 Interchange Modification Study (IMS)



Table 7. Ramp Junction Analyses for the No Build / Build Condition	15
Table 8. Weave Segment Level of Service	16
Table 9. Weave Segment Analyses for the No Build / Build Condition	18
Table 10. Intersection Level of Service	18
Table 11. Intersection Analyses for the No Build / Build Condition	19
Table 12. Turn Lane Storage Lengths for the Build Lanes	20
Table 13. Hazardous Material Sites in the Project Study Area	23
Table 14. UST Sites in the Project Study Area	24
Table 15. Minority Population Data by Census Tracts	26
Table 16. 2014 DHHS Poverty Guidelines	27
·	

#### **List of Exhibits**

Exhibit 1 – Build Condition Phase 1 (view 1 of 2)

Exhibit 2 – Build Condition Phase 1 (view 2 of 2)

Exhibit 3 - Build Condition Phase 2

Exhibit 4 – History/Architecture Properties 50 Years Old or Older Location Map

Exhibit 5 – Wetlands, Streams, and Watercourses Location Map

Exhibit 6 - NRCS Soil Survey Map

Exhibit 7 – Floodplain Location Map

Exhibit 8 – Hazardous Materials and UST Site Location Map

Exhibit 9 - Project Area Census Tract Map

Exhibit 10 – Minority Concentrations Location Map

Exhibit 11 – Low-Income Populations Location Map

Exhibit 12 – Section 4(f) and Section 6(f) Resources Location Map

#### **List of Appendices**

Appendix A – Road Safety Audit (from Safety Study)

Appendix B – Crash Analysis Diagrams (from Safety Study)

Appendix C – Certified Traffic

Appendix D – HCS Results

Figure 1 – HCS Results 2036 AM Peak No-Build/Build

Figure 2 – HCS Results 2036 PM Peak No-Build/Build

Figure 3 – HCS Results 2036 AM Peak No-Build/Build

Figure 4 – HCS Results 2036 PM Peak No-Build//Build

Appendix E – Turn Lane Storage Calculations

Appendix F – Cost Estimate (from Safety Study)

Appendix G – Letters of Support



# 1.0 Executive Summary

The Ohio Department of Transportation (ODOT) in cooperation with the Federal Highway Administration (FHWA) is improving the safety and mobility of the Interstate 271 (I-271) interchange with Cedar Road/Brainard Road. A CUY-271-9.9/10.5 Safety Study dated July 25, 2014 was completed to evaluate the existing safety performance and identify potential countermeasures to reduce crashes and congestion throughout the study area.

The purpose of this study is to compare the future capacity performance of the No Build and Build Alternative and to reduce crashes within the study area.

A number of potential countermeasures were developed to improve the travel conditions within the study area. The findings from the CUY-271-9.9/10.5 Safety Study were focused on short and medium term countermeasures that improve safety performance. The recommended countermeasures will improve safety performance of I-271, Cedar Road, and Brainard Road. Longer term countermeasures should be considered once short and medium term countermeasures are implemented and evaluated for effectiveness. This approach is also consistent with FHWA's 8-point policy for Interchange Access Modification Studies.

The Build Alternative includes improvements to the northbound I-271 ramps and associated improvements to Brainard Road. This alternative will have phased construction. Phase 1 improvements will be limited to improvements that do not require construction adjacent to mainline I-271. Phase 2 improvements will construct a dual-lane northbound exit ramp to Cedar Road/Brainard Road. No improvements are proposed at the southbound I-271 ramp intersection on Cedar Road. Additional phase 2 improvements will consist of reversing the location of the crossover ramps that connect the local lanes and express lanes between Chagrin Boulevard and Cedar Road in the northbound direction.

In terms of interstate operations, an Interchange Modification Study (IMS) must show that the Build Alternative, at a minimum, will not degrade the interstate system's operation below the level of service (LOS) that would have existed in the design year for the No Build Alternative. The design guidelines recommend that an existing highway operate at LOS C or better. However, since the study area is within an urban area LOS D is acceptable with Metropolitan Planning Organization (MPO) and ODOT approval. The second edition of the NOACA Congestion Management System (CMS) Manual of Practice, dated October 2002, states that Level of Service (LOS) "D" will be the threshold for peak periods in urbanized areas and LOS "C" will be the threshold for peak periods in rural areas (Page i, Executive Summary). A level of service below LOS C is acceptable for the Build Alternative provided the level of service is not degraded from what it is in the No Build Alternative, or would be acceptable for a new build.



To provide a level of service comparison, the capacity calculations for the Build Alternative were compared to those for the No Build Alternative in the project's design year (2036). Based on the comparison analysis, every location's level of service will be improved or equal to that of the No Build Alternative throughout the study area with two exceptions:

- There are various weave segments where the No Build Alternative and the Build Alternative are LOS F. Degradation does not occur at these locations as there is no additional traffic at any of these weaves as a result of the Build Alternative.
- There is one location where the Build Alternative results in a higher volume of traffic on the northbound local lanes compared to the No Build, a result of switching the local and express crossover locations. In the No Build, the weave LOS is a C, and in the Build the weave LOS is an E. It is important to distinguish that the weaves occur on different freeway segments, on the express lanes versus on the local lanes in the No Build and Build Alternatives, respectively.

The proposed northbound dual-lane exit ramp to Cedar Road/Brainard Road improves the level of service from "F" to "A", eliminating congestion at this location.

In terms of safety, an IMS must demonstrate that safety will not be degraded when modifications are made to the Interstate System when compared to the existing configuration. A direct relationship often exists between congestion and crashes. The Build Alternative meets the recommended guidelines in ODOT's Location and Design Manual for level of service. With the exception described above, every location's level of service will be equal to that of the No Build Alternative throughout the study area.

For all the reasons noted above, this IMS is recommended for approval, based on satisfying the eight policy statements in the Interstate System Access Information Guide (August 2010).



# 2.0 Background

The Ohio Department of Transportation (ODOT) in cooperation with the Federal Highway Administration (FHWA) is improving the safety and mobility of the Cedar Road/Brainard Road/I-271 interchange (PID 97676). A safety study was completed by LJB in July 2014 to evaluate the existing safety performance and identify potential countermeasures to reduce crashes and congestion throughout the study area.

The Cedar Road/Brainard Road/I-271 interchange has been the focus of numerous studies. Improvements have been completed to relieve congestion and improve the safety within the study area (Cedar Road bridge widening, signal timing upgrades, delineation). A list of previous studies completed in the past twelve years is shown below:

- CUY-271-9.9/10.5 Safety Study (2014)
- Signal Progression Study (2014)
- Signal Timing Analysis (2013)
- Road Safety Audit (2012)
- Preliminary Engineering Study of NB I-271 Directional Ramp (2010)
- Brainard/Cedar Technical Memorandum (2009)
- I-271/Cedar/Brainard Access Point Modification Study (2002)

A Road Safety Audit (RSA) was conducted at the Cedar Road/Brainard Road interchange by the Northeast Ohio Area Coordinating Agency (NOACA) in 2012. The Executive Summary from the RSA is shown in Appendix A. The study area and associated crash data (279 crashes) was limited to the four signalized intersections included in this IMS – some mainline I-271 crashes not included in the safety analysis. The design year traffic volumes used in the RSA report were created by NOACA's traffic forecasting model.

The CUY-271-9.9/10.5 Safety Study was completed in July 2014 to evaluate the existing safety performance and identify potential countermeasures to reduce crashes and congestion throughout the study area. The proposed countermeasures includes modifications to the existing access points, including an additional lane for the I-271 NB off ramp, additional lanes along Brainard Road, and revised directional lane assignments.



# 3.0 Purpose and Need

The purpose of this study is to compare the future capacity performance of the No Build and Build alternatives and to reduce crashes within the study area. Furthermore, it will be verified that the proposed modifications to the intersections do not adversely affect or degrade the operational performance of the surrounding I-271 interstate system. The modifications proposed in the Safety Study will relieve congestion and reduce delay at the Cedar Road and Brainard Road intersection and adjacent intersections that compromise the I-271 interchange. As a result, the project will enhance the quality of life for residents and commuters as the Cedar/Brainard Road intersection and surrounding intersections become more reliable with the reduction in travel delays and improvements related to safety.

# 4.0 Study Area

I-271 is an interstate highway that runs north-south and passes through suburbs of Cleveland and Akron. It begins at Interstate 71 (I-71) in Medina, Ohio and extends north to Interstate 90 (I-90) in Willoughby Hills, Ohio. The study area lies within the jurisdiction of the following cities in Cuyahoga County, Ohio: Lyndhurst, Beachwood, Pepper Pike, and Mayfield Heights. The surrounding area is urbanized, and includes regional shopping centers and residential developments. The interchange is utilized by both local and regional traffic.

Adjacent interchanges along the I-271 corridor include US-322/Mayfield Road (2 miles north) and US-422/SR87/Chagrin Blvd (3 miles south). These locations mark the northern and southern limits of the study area. The study area is comprised of four signalized intersections that surround the I-271 and Cedar Road/Brainard Road interchange:

- Cedar Road & I-271 SB On Ramp
- Brainard Road & Cedar Road
- Brainard Road & I-271 NB On/Off Ramp
- Brainard Road & I-271 SB Off Ramp

An aerial view of the study area is shown in Figure 1. An aerial view of the I-271 interchange with Cedar Road/Brainard Road is shown in Figure 2.



Figure 1. Aerial view of Study Location Map.





Figure 2. Aerial View of the Cedar Road/Brainard Road/I-271 Interchange.



# **5.0 Existing Conditions**

## 5.1 Road Geometry and Access Locations

According to ODOT's functional roadway classification system, I-271 is classified as an urban interstate. Cedar Road and Brainard Road are classified as urban principal arterials in the study area.

The I-271 interchange with Cedar Road/Brainard Road provides access to the cities of Lyndhurst, Pepper Pike, Beachwood, and Mayfield Heights. The interchange is a hybrid interchange with a system of ramps that intersect with local roadways at signalized



intersections. As shown in Figure 2, the Cedar Road/Brainard Road/I-271 interchange is a split diamond interchange with an auxiliary Parclo B exit ramp (NB I-271 to WB Cedar Road).

The lane configuration along Cedar Road varies from 5 to 7 lanes within the study area while the lane configuration along Brainard Road varies from 3 to 6 lanes. Cedar Road and Brainard road intersect to form an at-grade intersection just southeast of the I-271 interchange. The three signalized intersections along Brainard Road are coordinated with one another. The Cedar Road & I-271 SB on ramp intersection is not coordinated with the Brainard Road system.

Table 1 summarizes the ADT, functional classification, existing number of lanes, and posted speed limits of the roadways within the study area.

**Table 1. Existing Roadway Conditions** 

Study Location	ADT (vpd)	Functional Classification	Existing Number of Lanes	Posted Speed Limit
I-271	129,550 (2011)	Interstate	Express Lanes 2 to 3 Local Lanes 3 to 4	60 mph
Cedar Road (west of Brainard Road)	34,000 (2008)	Principal Arterial	5 to 6	35 mph
Cedar Road (east of Brainard Road)	24,000 (2008)	Collector	5	35 mph
Brainard Road (Cedar Road to I-271 NB Ramps)	18,000 (2008)	Principal Arterial	4 to 6	35 mph
Brainard Road (south of Cedar Road)	10,000 (2008)	Minor Arterial	4	35 mph
Brainard Road (north of I-271)	11,600 (2012)	Minor Arterial	3	35 mph

#### 5.2 Physical Conditions

The terrain is generally flat throughout the study area. Cedar Road and Brainard Road intersect to form an at-grade intersection. I-271 experiences little change in grade, and passes under and over intersecting roadways.

#### 5.2.1 Geometric Deficiencies

No design/geometric deficiencies were identified for the improvement areas. The study section adheres to the current state and federal design standards.

#### 5.3 Crash Data

The crash analysis for this improvement was completed as part of the CUY-271-9.9/10.5 Safety Study. Crash data was compiled by ODOT for the I-271 interchange with Cedar Road/Brainard Road. The following data was obtained from the Safety Study.

A total of 445 crashes occurred within the study area during the three year crash analysis period, from January 1, 2009 to December 31, 2011. Of these crashes, thirty-six percent (159)



total crashes) occurred along the I-271 corridor. The remaining sixty-four percent (286 total crashes) occurred on the surface streets and surrounding intersections.

Of the crashes that occurred on I-271, seventy-six percent (121 total crashes) were rear end crashes. Roughly thirty-one percent (50 total crashes) of these crashes resulted in injury. Of the crashes that occurred on the surface streets and associated intersections, sixty percent (172 total crashes) were rear end crashes. Twenty-six percent (74 total crashes) of the surface street crashes resulted in injury. Roughly thirty-four percent (96 total crashes) of these crashes occurred on wet pavement.

Of the 445 crashes that occurred throughout the study area, thirty percent (132 total crashes) occurred during the PM peak period. The highest percentage of crashes that occurred was rear end crashes, accounting for 66 percent of all total crashes throughout the study section. This crash frequency suggests that sudden slow-downs and congestion is a contributing factor to the safety performance of the study area.

A more detailed discussion of the crash data, including analysis by individual locations, can be found in the CUY-271-9.9/10.5 Safety Study, completed in July 2014. The crash analysis summary from the Safety Study is shown in Table 2.

**Table 2. Crash Summary** 

Study Location	Total Crashes By Location	Rear- End (20.6%)	Angle/LT (21.7%)	S.S. Passing (6.9%)	Injury (23.8%)	TOD (7- 10AM)	TPD (5- 8PM)	ODOT RSI
Brainard Rd/I-271 NB Ramps	96	40 (41.7%)	43 (44.8%)	11 (11.5%)	33 (34.4%)	20%	24%	20538
Cedar Rd/I-271 SB Entrance Ramp	98	70 (71.4%)	2 (2.0%)	23 (23.5%)	20 (20.4%)	12%	17%	17706
Cedar Rd/Brainard Rd	58	36 (62.1%)	4 (6.9%)	15 (25.9%)	12 (20.7%)	14%	26%	18292
Brainard Rd/I-271 SB Exit Ramp	34	26 (76.5%)	2 (5.9%)	2 (5.9%)	9 (26.5%)	12%	15%	18952
I-271 NB Mainline	159	121 (76.1%)	-	25 (15.7%)	50 (31.4%)	9%	62%	21623

(29.9%) (3.4%) (18.6%) (23.9%)

Data Source: CUY-271-9.9/10.5 Safety Study, July 25, 2014.

Crash Diagrams from the CUY-271-9.9/10.5 Safety Study can be found in Appendix B of this report.

#### 5.4 Demographics

Demographic data for the study area were obtained from Cuyahoga County Geographic Information Systems (GIS) data and the U.S. Census Bureau. For additional demographic information, see the Environmental Justice information in Section 11.0.



#### 5.5 Land Use

Land use within the project study area is highly urbanized. The area consists predominately of commercial properties, employment/office centers, residential subdivisions, and regional shopping centers. In addition, there are several community facilities, parks, and a large cemetery adjacent to the I-271 corridor.

# 6.0 Analysis Years

Opening Year for the CUY-271-8.14 project is 2016 with the Design Year established as 2036. Design Year traffic analyses are provided for the No Build Alternative and Build Alternative for the CUY-271-8.14 study area.

#### 7.0 Alternatives Considered

The No-Build condition for the Cedar Road/Brainard Road/I-271 interchange assumed that no improvements were made to the existing interchange area.

This study analyzes the countermeasures from the CUY-271-9.9/10.5 Safety Study as it compares to the No Build condition. The conceptual plans of the proposed countermeasures are shown in Exhibits 1-3 which represent the Build alternative. The Build Alternative includes improvements to the northbound I-271 ramps and associated improvements to Brainard Road. This alternative will have phased construction. Phase 1 improvements will be limited to improvements that do not require construction adjacent to mainline I-271. Phase 2 improvements will construct a dual northbound exit ramp to Cedar Road/Brainard Road. Additional phase 2 improvements will consist of reversing the location of the crossover ramps that connect the local lanes and express lanes between Chagrin Boulevard and Cedar Road in the northbound direction.

An addition to the alternatives presented in the Safety Study is switching the local lane and express lane crossover locations. Switching the crossover locations provides for a greater weaving distance from the express lanes to the Cedar Road/Brainard Road exit. In the No Build Alternative, the traffic enters the express lanes as an add-lane and the lane subsequently drops from the express lanes where the traffic exits to the local lanes. However, in the Build Alternative, the traffic enters the local lanes as an add-lane and the lane subsequently drops from the local lanes where the traffic exits to the express lanes.

No improvements are proposed at the I-271 southbound ramp intersection on Cedar Road.

For the purpose of this report, it was not necessary to evaluate multiple alternatives. The Safety Study analyzed multiple countermeasures. The selected countermeasures are combined to create this Build Alternative. The IMS was initiated and based solely on the Build Alternative from the Safety Study.



#### 8.0 Traffic Volumes

The Modeling and Forecasting Section of ODOT provided mainline certified traffic volumes and certified traffic volume forecasts for the ramps and side roads. This was done for Opening Year (2016) and Design Year (2036) as presented in Appendix C. The certified traffic was used to complete the evaluation of the No Build Alternative and the Build Alternative.

# 9.0 Traffic Analyses

Traffic conditions were analyzed for the No Build Alternative and the Build Alternative using ODOT certified traffic and standard traffic analysis procedures with the Highway Capacity Software 2010 (HCS 2010). AM and PM peak hour analyses were conducted for the 2036 Design Year.

Capacity analyses are performed to estimate the maximum amount of traffic that can be accommodated by a roadway while maintaining prescribed operational qualities. Levels of service were determined for freeway segments, ramp junctions, weave segments, and intersections for the No Build Alternative and the Build Alternative. Tables with level of service information are presented in the following sections. Graphics of the level of service at each freeway segment, ramp junction, weave segment, and intersection are included in Appendix D to show the effects of proposed improvements on the interstate system and the local road network. These graphics also show an overall comparison of operations between the No Build Alternative and the Build Alternative. The individual HCS analyses for the No Build Alternative and the Build Alternative are also provided in Appendix D.

#### 9.1 Freeway Segment Analyses

The freeway segment level of service criteria as defined by the Transportation Research Board for freeway segment density is shown in Table 3.

Table 3. Freeway Segment Level of Service

Level of Service (LOS)	Freeway Segment Density (pc/mi/ln)
A	≤ 11
В	> 11 – 18
С	> 18 – 26
D	> 26 – 35
E	> 35 – 45
_	Demand exceeds capacity
Г	> 45

#### 9.1.1 No Build Alternative Freeway Segments

The operating goal is to maintain LOS D or better for all roadway segments. As a result, degradation from the No Build condition to the Build condition only occurs when the level of service for the Build condition is LOS E or LOS F and it has a lower level of service than the No Build condition. For this reason, only the number of locations which have LOS E or LOS F are discussed below.



Twenty-four (24) freeway segments were analyzed for the No Build Alternative.

#### AM Peak

During the AM peak period, one (1) freeway segment operated at LOS F. The freeway segment operating at LOS F occurred on southbound I-271 – no improvements are proposed at the Cedar Road/Brainard Road interchange that impact southbound I-271 operations. In addition, two (2) freeway segments operated at LOS E. The remaining twenty-one (21) freeway segments operated at LOS D or better.

#### PM Peak

During the PM peak period, all twenty-four (24) freeway segments operated at LOS D or better.

#### 9.1.2 Build Alternative Freeway Segments

Twenty-four (24) freeway segments were analyzed along the Build Alternative.

#### AM Peak

During the AM peak period, one (1) freeway segment operated at LOS F. The freeway segment operating at LOS F occurred on southbound I-271 – no improvements are proposed at the Cedar Road/Brainard Road interchange that impact southbound I-271 operations. By comparison, the level of service for this freeway segment in the No Build Alternative would also be LOS F. In addition, two (2) freeway segments operated at LOS E. The level of service for these freeway segments in the No Build Alternative would also be LOS E. The remaining twenty-one (21) freeway segments operated at LOS D or better.

#### PM Peak

During the PM peak period, all twenty-four (24) freeway segments operated at LOS D or better.

The freeway segment analysis for the No Build Alternative and the Build Alternative is presented in Table 4 and Table 5.



Table 4. Freeway Segment Analyses for the No Build/Build Condition (Northbound)

					LC	DS .	
Ref	Figure(s)	Facility	Location (segment	No Buil	d-2036	Build	-2036
Kei	rigure(s)	racility	boundary from/to)	AM Peak	PM Peak	AM Peak	PM Peak
F-1	1, 2	I-271 NB	Chagrin Blvd Overpass to Chagrin Blvd On Ramp	В	С	В	С
F-2a	1, 2	I-271 NB (4-lane)	Chagrin Blvd On Ramp to I-271 NB Crossover Ramp (to Express lanes)	В	С	В	С
F-2b	1, 2	I-271 NB (3-lane)	Chagrin Blvd On Ramp to I-271 NB Crossover Ramp (to Express lanes)	С	D	С	D
F-3	1, 2	I-271 NB (Express Lanes)	Chagrin Blvd overpass to I-271 NB Crossover Ramp (to Express lanes)	С	D	С	D
F-4	1, 2	I-271 NB	I-271 NB crossover Ramp (to Express lanes) to I-271 NB Crossover Ramp (to Local lanes)	В	С	С	С
F-5	1, 2	I-271 NB (Express Lanes)	I-271 NB crossover Ramp(to Express lanes) to I-271 NB Crossover Ramp (to Local lanes)	В	С	В	В
F-6	1, 2	I-271 NB	I-271 NB Crossover Ramp (to Local lanes) to Cedar/Brainard Rd Off Ramp	D	D	D	D
F-7	1, 2	I-271 NB (Express Lanes)	I-271 NB Crossover Ramp (to Local lanes) to Brainard Road overpass	В	В	В	В
F-8	1, 2	I-271 NB	Cedar/Brainard Rd Off Ramp to Brainard Rd On Ramp	В	С	В	С
F-9	1, 2	I-271 NB	Brainard Rd On Ramp to I-271 NB Crossover Ramp (to Local lanes)	С	D	С	D
F-10	1, 2	I-271 NB	I-271 NB Crossover Ramp (to Local lanes) to Mayfield Rd Off Ramp	С	D	С	D
F-11	1, 2	I-271 NB (Express Lanes)	I-271 NB Crossover Ramp (to Local lanes) to the Mayfield Rd overpass	В	В	В	В
F-12	1, 2	I-271 NB	Mayfield Rd Off Ramp to the Mayfield Rd overpass	В	D	В	D

Figure(s) number refers to Appendix D HCS Results.



Table 5. Freeway Segment Analyses for the No Build / Build Condition (Southbound)

					LC	DS .	
Ref	Figure(s)	Facility	Location (segment	No Buil	d-2036	Build	-2036
iver Figure(s) Facility		racility	boundary from/to)	AM Peak	PM Peak	AM Peak	PM Peak
F-13	1, 2	I-271 SB	Mayfield Rd overpass to Mayfield Rd On Ramp	F	С	F	С
F-14	1, 2	I-271 SB	Mayfield Rd On Ramp to I-271 SB Crossover Ramp (to Express lanes)	D	С	D	С
F-15	1, 2	I-271 SB (Express Lanes)	Mayfield Rd overpass to I-271 SB Crossover Ramp (to Express Lanes)	С	В	С	В
F-16	1, 2	I-271 SB	I-271 SB Crossover Ramp (to Express lanes) to Brainard Rd Off Ramp	D	В	D	В
F-17	1, 2	I-271 SB	Brainard Rd Off Ramp to Cedar Rd On Ramp	С	В	С	В
F-18	1, 2	I-271 SB	Cedar Rd On Ramp to I-271 SB Crossover Ramp (to Express lanes)	Е	D	Е	D
F-19	1, 2	I-271 SB (Express Lanes)	Brainard Road overpass to Cedar Road overpass	D	В	D	В
F-20	1, 2	I-271 SB	I-271 SB Crossover Ramp (to Express lanes) to I-271 SB Crossover Ramp (to Local lanes)	D	С	D	С
F-21	1, 2	I-271 SB (Express Lanes)	I-271 SB Crossover Ramp (to Express lanes) to I-271 SB Crossover Ramp (to Local lanes)	С	В	С	В
F-22a	1, 2 (3-lane)	I-271 SB	I-271 SB Crossover Ramp (to Local lanes) to Chagrin Blvd Off Ramp	E	С	E	С
F-22b	1, 2 (4 lane)	I-271 SB	I-271 SB Crossover Ramp (to Local lanes) to Chagrin Blvd Off Ramp	D	С	D	С
F-23	1, 2	I-271 SB (Express Lanes)	I-271 SB Crossover Ramp (to Local lanes) to Chagrin Blvd Overpass	D	С	D	С
F-24	1, 2	I-271 SB	Chagrin Blvd Off Ramp to Chagrin Blvd Overpass	D	С	D	С

Figure(s) number refers to Appendix D HCS Results.

# 9.2 Ramp Junction Analyses

The ramp junction level of service criteria as defined by the Transportation Research Board for ramp junction density is shown in Table 6.



**Table 6. Ramp Junction Level of Service** 

Level of Service (LOS)	Ramp Junction Density (pc/mi/ln)
A	≤ 10
В	> 10 – 20
С	> 20 – 28
D	> 28 – 35
Ē	> 35
F	Demand Exceeds Capacity

#### 9.2.1 No Build Alternative Ramp Junctions

The operating goal is to maintain LOS D or higher for all ramp junctions. As a result, degradation from the No Build condition to the Build condition only occurs when the level of service for the Build condition is LOS E or LOS F and it has a lower level of service than the No Build condition. For this reason, only the number of locations which have LOS E or LOS F are discussed below.

Twenty (20) ramp junctions were identified for the No Build Alternative. Of these, ten (10) were merges and ten (10) were diverges. HCS analysis was not completed for six (6) of these junctions due to the presence of an add lane or a drop lane; these areas were analyzed as freeway segments.

#### AM Peak

During the AM peak period, one (1) diverge location operated at LOS F – the No Build (2036) scenario at the NB I-271 ramp at the Cedar/Brainard Road interchange. In addition, two (2) merge locations operated at LOS E. The remaining eleven (11) locations operated a LOS C or better.

#### PM Peak

During the PM peak period, one (1) diverge location operated at LOS F -- the No Build (2036) scenario at the NB I-271 ramp at the Cedar/Brainard Road interchange. The remaining thirteen (13) locations operated at LOS D or better.

#### 9.2.2 Build Alternative Ramp Junctions

Twenty (20) ramp junctions were analyzed along the Build Alternative. Of these, ten (10) were merges and ten (10) were diverges. HCS analysis was not completed for six (6) of these junctions due to the presence of an add lane or a drop lane; these areas were analyzed as freeway segments.

#### AM Peak

During the AM peak period, two (2) merge locations operated at LOS E. The remaining twelve (12) locations operated a LOS D or better.

#### PM Peak

During the PM peak period, all fourteen (14) of the locations operated at LOS C or better.



The ramp junction analysis for the No Build Alternative and the Build Alternative is presented in Table 7.

Table 7. Ramp Junction Analyses for the No Build / Build Condition

				LC	)S	LC	OS
Ref	Figure	Facility	Location	No Build	d - 2036	Build -	- 2036
Rei Figure Facility		Facility	Location	AM	PM	AM	PM
				Peak	Peak	Peak	Peak
R-1	1, 2	I-271 NB	Chagrin Blvd Off Ramp	Α	В	Α	В
R-2	1, 2	I-271 NB	I-271 NB Off Ramp between Chagrin Blvd & Cedar Rd	В	С	В	В
R-3	N/A	I-271 NB (Express Lanes)	I-271 NB (Express Lanes) On Ramp between Chagrin Blvd & Cedar Rd	_	not show ence of a		
R-4	N/A	I-271 NB (Express Lanes)	I-271 NB (Express Lanes) Off Ramp between Chagrin Blvd & Cedar Rd		not show ence of a		
R-5	1, 2	I-271 NB	I-271 NB On Ramp between Chagrin Blvd & Cedar Rd	С	D	А	В
R-6	1, 2	I-271 NB	Cedar/Brainard Rd Off Ramp	F	F	Α	Α
R-7	1, 2	I-271 NB	Cedar Rd Off Ramp	В	С	В	С
R-8	1, 2	I-271 NB (Express Lanes)	I-271 NB (Express Lanes) Off Ramp between Brainard Rd & Mayfield Rd	А	В	А	В
R-9	1, 2	I-271 NB	I-271 NB On Ramp between Brainard Rd & Mayfield Rd	В	С	В	С
R-10	1, 2	I-271 NB	Mayfield Rd Off Ramp		Drop L	ane (*)	
R-11	1, 2	I-271 SB	Mayfield Rd On Ramp		Add La	ne (*)	
R-12	1, 2	I-271 SB	I-271 SB Off Ramp between Brainard Rd & Mayfield Rd	С	В	C	В
R-13	1, 2	I-271 SB (Express Lanes)	I-271 SB (Express Lanes) On Ramp between Brainard Rd & Mayfield Rd	С	В	С	В
R-14	1, 2	I-271 SB	Brainard Rd Off Ramp	С	В	С	В
R-15	1, 2	I-271 SB	Cedar Rd On Ramp	Е	С	E	С
R-16	1, 2	I-271 SB	I-271 SB Off Ramp between Chagrin Blvd & Cedar Rd	С	С	С	С
R-17	1, 2	I-271 SB (Express Lanes)	I-271 SB (Express Lanes) On Ramp between Chagrin Blvd & Cedar Rd	Add Lane (*)			
R-18	1, 2	I-271 SB (Express Lanes)	I-271 SB (Express Lanes) Off Ramp between Chagrin Blvd & Cedar Rd	Drop Lane (*)			
R-19	1, 2	I-271 SB	I-271 SB On Ramp between Chagrin Blvd & Cedar Rd	E	С	E	С
R-20	1, 2	I-271 SB	Chagrin Blvd Off Ramp	С	В	С	В

Figure(s) number refers to Appendix D HCS Results. (\*) Location was analyzed as a freeway segment.



#### 9.3 Weave Segment Analyses

The weaving segment level of service criteria as defined by the Transportation Research Board for weaving segments density is shown in Table 8.

**Table 8. Weave Segment Level of Service** 

Level of Service (LOS)	Weave Segment Density (pc/mi/ln)
А	0 – 10
В	> 10 – 20
С	> 20 – 28
D	> 28 – 35
E	> 35
F	Demand exceeds capacity

The weave analysis focused on movements to/from the Express Lanes and the Local Lanes on I-271. For the purpose of analysis, all traffic on the crossover between the Express and Local lanes were assumed to be destined to the exit ramp of the nearest interchange. This assumption is considered to be conservative indicating that LOS values calculated for these movements are to operate equal or better than summarized in this report.

#### 9.3.1 No Build Alternative Weave Segments

The operating goal is to maintain LOS D or better for all weave segments. As a result, degradation from the No Build condition to the Build condition only occurs when the level of service for the Build condition is LOS E or LOS F and it has a lower level of service than the No Build condition. For this reason, only the number of locations which have LOS E or LOS F are discussed below. The certified traffic does not include weaving data for the crossovers between the express lanes and the general purpose lanes of I-271. For analysis purposes, it was assumed that every vehicle using the crossover lanes are destined to the next interchange (worst case scenario).

Six (6) weave segments were analyzed for the No Build Alternative.

#### AM Peak

During the AM peak period, four (4) weave segments operated at LOS F. The remaining two (2) locations operated at LOS C.

#### PM Peak

During the PM peak period, one (1) weave segment operated at LOS F and two (2) weave segments operated at LOS E. The remaining three (3) locations operated at LOS D or better.

#### 9.3.2 Build Alternative Weave Segments

Six (6) weave segments were analyzed for the Build Alternative.

The crossover locations were switched to provide for a greater weaving distance from the express lanes to the Cedar Road/Brainard Road exit. In the No Build Alternative, the traffic enters the express lanes as an add-lane and the lane subsequently drops from the express



lanes where the traffic exits to the local lanes. However, in the Build Alternative, the traffic enters the local lanes as an add-lane and the lane subsequently drops from the local lanes where the traffic exits to the express lanes. This weave is identified as W-2. It is important to distinguish that weave W-2 occurs on different freeway segments, on the express lanes versus on the local lanes in the No Build and Build Alternatives, respectively.

#### AM Peak

During the AM peak period, four (4) weave segments operated at LOS F. One (1) weave segment operated at LOS C. One (1) weave segment (W-1) resulted in an undefined LOS because the actual weave length exceeded the maximum weave length. As a result, the location was treated as an isolated merge and diverge area.

In the No Build, W-2 LOS is a C, and in the Build the weave LOS is also a C.

#### PM Peak

During the PM peak period, one (1) weave segment operated at LOS F and two (2) weave segments operated at LOS E. One (1) weave segment (W-1) resulted in an undefined LOS because the actual weave length exceeded the maximum weave length. As mentioned, this location was treated as an isolated merge and diverge area. The remaining two (2) locations operated at LOS D or better.

In the No Build, W-2 LOS is a C, and in the Build the weave LOS is an E.

# The weave segment analysis for the No Build Alternative and the Build Alternative is presented in Table 9.

There are various weave segments that operate at LOS E and LOS F. There is one weave location where the Build Alternative results in a higher volume of traffic when compared to the No Build, dropping the level of service from a LOS C to a LOS E. This occurs as a result of switching the crossover ramps that connect the local lanes and express lanes between Chagrin Boulevard and Cedar Road in the northbound direction.



Table 9. Weave Segment Analyses for the No Build / Build Condition

					LO	S	
Ref Figure(s) Facility		Facility	Location (segment	No Buile	d - 2036	Build - 2036	
i.e.	1.84.5(3)	i demey	boundary from/to)	AM	PM	AM	PM
				Peak	Peak	Peak	Peak
W-1	1, 2	I-271 NB	Chagrin Blvd On Ramp to I-271 NB Crossover Ramp (to Express lanes)	С	Е	-	-
W-2	1, 2	I-271 NB (Express Lanes)	I-271 NB Crossover (to Express lanes) to I-271 NB Crossover Ramp (to Local lanes)	С	С	-	-
W-2	1, 2	I-271 NB (Express Lanes)	I-271 NB Crossover (to Local lanes) to I-271 NB Crossover Ramp (to Express lanes)	-	1	С	E
W-3	1, 2	I-271 NB	I-271 NB Crossover Ramp (to Local lanes) to Cedar Rd Off Ramp	F	F	F	F
W-4	1, 2	I-271 SB	Mayfield Rd On Ramp to I-271 SB Crossover Ramp (to Express lanes)	F	С	F	С
W-5	1, 2	I-271 SB	Cedar Rd On Ramp to I-271 SB Crossover Ramp (to Express lanes)	F	E	F	Е
W-6	1, 2	I-271 SB	I-271 SB Crossover Ramp (to Local lanes) to Chagrin Blvd Off Ramp	F	D	F	D

Figure(s) number refers to Appendix D HCS Results.

#### 9.4 Intersection Analyses

The average vehicle delay calculation at each intersection is assigned a level of service ranging from LOS A, the best, to LOS F, the worst or failure. LOS D is considered acceptable. The intersection level of service criteria as defined by the Transportation Research Board for signalized intersections is shown in Table 10.

Table 10. Intersection Level of Service

Level of Service (LOS)	Signalized Intersection Control Delay per Vehicle (seconds)
А	≤ 10
В	> 10 – 20
С	> 20 – 35
D	> 35 – 55
E	> 55 – 80
F	> 80

Note: Control Delay assumes v/c ratio ≤ 1.0. If v/c ratio > 1.0, LOS F.

#### 9.4.1 No Build Alternative Intersection Analyses

A total of four (4) intersections were analyzed in the No Build Alternative.



#### AM Peak

During the AM peak period, one (1) intersection operated at LOS D, two (2) intersections operated at LOS E, and one (1) intersection operated at LOS F.

#### PM Peak

During the PM peak period, three (3) intersections operated at LOS E while one (1) intersection operated at LOS F.

#### 9.4.2 Build Alternative Intersection Analyses

A total of four (4) intersections were analyzed in the Build Alternative.

#### AM Peak

During the AM peak period, one (1) intersection operated at LOS F. The remaining three (3) intersections operated at LOS C. The volume to capacity (v/c) ratio for the signalized intersections on the Brainard Road corridor do not exceed 1.0 - constrained analysis is not applicable to the study area.

#### PM Peak

During the PM peak period, two (2) intersections operated at LOS D, one (1) intersection operated at LOS E, and one (1) intersection operated at LOS F.

# The intersection analysis for the No Build Alternative and Build Alternative is presented in Table 11.

The Cedar Road and I-271 SB on-ramp intersection operates at an LOS F where no work is being proposed at this time. By comparison, the level of service for this intersection in the No Build Alternative would also be LOS F.

Table 11. Intersection Analyses for the No Build / Build Condition

	Ref Figure(s) Intersection		LOS			
Ref			No Build	d - 2036	Build	- 2036
			AM Peak	PM Peak	AM Peak	PM Peak
I-1	3, 4	Cedar Rd & I-271 SB On Ramp	F	F	F	F
1-2	3, 4	Brainard Rd & Cedar Rd	E	E	С	E
I-3	3, 4	Brainard Rd & I-271 NB On/Off Ramp	Е	E	С	D
I-4	3, 4	Brainard Rd & I-271 SB Off Ramp	D	E	С	С

Figure(s) number refers to Appendix D HCS Results.

The Build Alternative for the Brainard Rd & I-271 NB On/Off Ramps (I-3) presents a condition that HCS has limitations on modeling. The HCS model does not allow the NB right turn movement to overlap with the I-271 ramp movement, therefore the level of service will be equal to or better than the HCS output. Analysis of downstream locations NB along I-271 will not be affected.



#### 9.5 Turn Lane Storage Lengths

Turn lane lengths were calculated at the Cedar Road and Brainard Road intersections based on the methodology of ODOT's Location and Design Manual section 401-9 criteria using the certified traffic volumes. Existing and recommended lane sizing lengths are summarized in Table 12. Appendix E includes the storage length calculation worksheets.

Table 12. Turn Lane Storage Lengths for the Build Lanes

INTERSECTION		ODOT STORAGE		NO BLOCK DISTANCE		RECOMMENDED		
MOVEMENT	EXISTING	AM PEAK HOUR	PM PEAK HOUR	AM PEAK HOUR	PM PEAK HOUR	LENGTH		
BRAINARD @ CEDA	BRAINARD @ CEDAR RD							
EB LEFT (DUAL)	1350'-650'	320'	515'	NA <sup>1</sup>	NA <sup>1</sup>	No change		
WB LEFT	140'	115'	115'	395'	640'	No change		
WB RIGHT	420'	220'	595'	395'	640'	No change <sup>2</sup>		
NB LEFT	410'	210'	200'	165'	190'	No change		
SB LEFT (DUAL)	450'-350'	585'	395'	775'	640'	450'-330' <sup>3</sup>		
SB RIGHT	350'	825'	690'	NA <sup>4</sup>	NA <sup>4</sup>	365¹³		
BRAINARD @ NB I-271 RAMP								
EB LEFT	460'	320'	385'	515' <sup>8</sup>	330'8	750'		
EB LEFT-RIGHT	-	-	-			Add lane		
EB RIGHT	THRU	820'	635'	265'	335'	250'		
NB RIGHT (DUAL)	440'	400'	675'	200'	485'	400'-400' <sup>5</sup>		
SB LEFT	390'	210'	200'	885'	780'	460'3		
BRAINARD @ SB I-271 EXIT RAMP								
WB LEFT	370'	610'	375'	555'	550'	No change <sup>6</sup>		
CEDAR @ SB I-271 ENTRANCE RAMP								
EB RIGHT	265'	1900'	1900'	1515'	1850'	No change		
WB LEFT (DUAL)	640'-1400'	645'	995'	1850'	1850'	No change <sup>7</sup>		

Note 1 – Inside through lane from the I-271 ent. ramp intersection drops as a left turn only lane, through blockage is not applicable Note 2 - A right turn overlap phase for westbound right with southbound split phase minimizes the need for the entire storage length.

Brainard Road and I-271 NB ramps intersection: The proposed dedicated EB right turn lane is a short 250 foot lane. To ensure through blockage does not affect left turn vehicles during AM peak, the storage for turn lanes on this eastbound approach were calculated as single lane per movement. The short right turn lane is accounted for by reducing the through blockage for left turn lane by 250 feet.

The northbound I-271 exit loop ramp to westbound Cedar Road carries significant traffic, hence this movement has a dedicated lane from I-271, whereas the additional exit ramp lane from the mainline will be delineated for Brainard Road/eastbound Cedar road traffic.

Note 3 – Turn lane extends to the upstream signalized intersection

Note 4 - Curbside through lane from the I-271 exit ramp intersection drops as a right turn only lane, thru blockage is not applicable

Note 5- Turn lane provided for the entire length of the roadway segment

Note 6 - Residual queue spillback for the left turn movement can be accommodated on the ramp without impacting mainline IR-271.

Note 7 - The outside left turn lane (adjacent to through lane) extends to the upstream signalized intersection

Note 8 – Through blockage reduced by 250' to account for a short EB right turn lane of 250'.



#### **10.0 Cost Estimate**

The cost estimates for the Build Alternative were developed for the CUY-271-9.9/10.5 Safety Study and are included in this report. Cost estimates were broken down into two parts: (1) Brainard Rd improvements and (2) the I-271 NB off ramp (which requires the acquisition of right-of-way). Preliminary construction estimates were developed along with right-of-way costs, engineering design costs, and contingency costs. The total cost for the Brainard Rd improvements is \$2.41 million in 2015 dollars. The total cost for the I-271 NB off ramp addition is \$5.06 million in 2015 dollars. The total project cost is \$7.47 million in 2015 dollars. A detailed breakdown of the project costs, including inflation, can be seen in Appendix F.

The cost estimates discussed in this IMS do not include the cost for switching the express lane crossover ramps.

#### 11.0 Environmental Overview

An environmental overview of the IMS study area was undertaken using Geographic Information Systems (GIS) data obtained from Cuyahoga County, various other online sources, and a windshield survey of the project area. The area examined includes a corridor 0.5 mile to either side of the existing right-of-way along the approximate 5.0 mile corridor of I-271 from the interchange of I-271 at Chagrin Boulevard (US-422) to the interchange of I-271 at Mayfield Road (US-322).

#### **Cultural Resources**

#### History/Architecture

Due to the size of the project area a comprehensive survey for historic/architectural and archaeological sites was not conducted. The project area was reviewed using Cuyahoga County GIS data and the U.S. Department of Interior, National Register of Historic Places (NRHP) website.

There are two properties listed on the NRHP in the project study area, the W.A. Thorp House and the Frances and Chester Bolton House. The Thorp House appears to have been razed. The property address is now the site of the Marshall Lincoln Superstore. The Bolton House is shown on the NRHP list as having a restricted address. For this reason, it is not known if this resource is in the study area.

In addition to the two NRHP listed properties, there are approximately 2,070 properties 50 years old or older within the study boundary that could be potentially eligible for listing on the NRHP. The large majority of these properties are located north of Cedar Road and west of I-271. Refer to Exhibit 4 for the locations of all properties 50 years old or older.

#### Archaeology

The project area is highly urbanized. For this reason, the likelihood that an archaeological site exists within the study boundary is low; however, the discovery of archaeological sites cannot



be ruled out until all undisturbed areas to be acquired have been surveyed. No archaeological sites within the project area were found on the NRHP.

#### Wetlands, Streams, Watercourses

Within the project study area numerous waters of the U.S. and wetlands were identified from the Cuyahoga County GIS dataset. Refer to Exhibit 5 for the locations of the wetlands, streams and watercourses located in the project. Most of the streams identified were found outside of the project study area east of I-271 and appear to be tributaries to the Chagrin River. West of the project corridor Euclid Creek intersects the project corridor.

A few small wetlands were also identified on the projects southern terminus. A review of the Natural Resource Conservation Service (NRCS) Soil Survey Map for the project area indicates the majority of the project area consists of non-hydric soils. Two small areas contain soils denoted as being 85 percent hydric. The areas are represented on Exhibit 6 by the symbols Ho (Holly silt loam) and Ct (Condit silty clay loam). Ho is found in approximately 0.2 percent of the project area and Ct is found in approximately 0.5 percent of the project area. Refer to Exhibit 6 for the NRCS Soil Survey Map.

A comprehensive survey of the project study area would be necessary to verify any wetlands, streams, or watercourses identified.

#### **Floodplains**

The project study area is located on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) 39035C0113E, 39035C0114E, 39035C0118E, 39035C0207E, 39035C0226E, 39035C0227E, and 39035C0228E. As seen on the GIS Floodplain Map, Exhibit 7, there are no encroachments on the regulatory floodway (Zone AE) within the study area; however, there are encroachments associated with the 100-year floodplain (Zone A).

#### Hazardous Materials

Within the project study area, a total of 15 Underground Storage Tank (UST) and 10 hazardous material sites were identified. No toxic release facilities or brownfield sites were identified. The majority of the UST sites are located near the southern end of the project study area. Refer to Tables 13 and 14 for the locations of the hazardous materials sites and UST sites found within the project study area. Refer to Exhibit 8 for a map depicting the site locations of the hazardous material sites and UST sites found.



Table 13. Hazardous Material Sites in the Project Study Area

Map Key	Facility Name	Address	City
Α	Marshall Ford Lincoln	6200 Mayfield Road	Mayfield Heights
В	Michelle Cleaners	6228 Mayfield Road	Mayfield Heights
С	Midas Auto	6288 Mayfield Road	Mayfield Heights
D	Lube Stop	6668 Mayfield Road	Mayfield Heights
Е	Chagrin Cleaners & Tailors	27313 Chagrin Boulevard	Woodmere
F	Village Auto Wash	27330 Chagrin Boulevard	Beachwood

Table 13. Hazardous Material Sites in the Project Study Area (Continued)

Map Key	Facility Name	Address	City
G	BH Coin Laundry	27621 Chagrin Boulevard	Woodmere
Н	Bill's Discount Cleaners	27730 Chagrin Boulevard	Beachwood
I	Drapery Masters Coit	3445 Richmond Road	Beachwood
J	National Tire and Battery	3550 Park East Drive	Beachwood

Source: Google Earth 2014/Windshield Survey



Table 14. UST Sites in the Project Study Area

Map Key	Facility #	Facility Name	Address	City
1	18000113	Ohio Bell Telephone Co.	3445 Richmond Road	Beachwood
	18002290	25705 Chagrin Beachwood, LLC	25705 Chagrin Boulevard	Beachwood
2	18002290	25705 Chagrin Beachwood, LLC	25705 Chagrin Boulevard	Beachwood
	18002290	25705 Chagrin Beachwood, LLC	25705 Chagrin Boulevard	Beachwood
	18001662	True North #315	26100 Chagrin Boulevard	Beachwood
3	18001662	True North #315	26100 Chagrin Boulevard	Beachwood
	18001662	True North #315	26100 Chagrin Boulevard	Beachwood
	18008951	Mooney's Gulf Service	27000 Chagrin Boulevard	Orange Village
4	18008951	Mooney's Gulf Service	27000 Chagrin Boulevard	Orange Village
	18008951	Mooney's Gulf Service	27000 Chagrin Boulevard	Orange Village
	18000469	True North # 346	27010 Chagrin Boulevard	Orange village
5	18000469	True North # 346	27010 Chagrin Boulevard	Orange village
	18000469	True North # 346	27010 Chagrin Boulevard	Orange village
	18000628	Speedway #3321	27939 Chagrin Boulevard	Woodmere
6	18000628	Speedway #3321	27939 Chagrin Boulevard	Woodmere
	18000628	Speedway #3321	27939 Chagrin Boulevard	Woodmere
7	18010881	Cleveland Clinic	3175 Science Park Drive	Beachwood
8	18007520	Cleveland Clinic	3050 Science Park Drive	Beachwood
9	18000264	Cleveland Clinic	25875 Science Park Drive	Beachwood
10	18002670	Cleveland Clinic	25900 Science Park Drive	Beachwood
11	18000583	True North (Tony's Shell)	6411 Mayfield Road	Beachwood
12	18001632	Mayfield Corners, LLC (Sunmart)	6665 Mayfield Road	Mayfield Heights
14	18001632	Mayfield Corners, LLC (Sunmart)	6665 Mayfield Road	Mayfield Heights



Table 14. UST Sites in the Project Study Area (Continued)

Map Key	Facility #	Facility Name	Address	City
	18001632	Mayfield Corners, LLC (Sunmart)	6665 Mayfield Road	Mayfield Heights
	18002138	7-Eleven Store #36235	6680 Mayfield Road	Mayfield Heights
12	18002138	7-Eleven Store #36235	6680 Mayfield Road	Mayfield Heights
13	18002138	7-Eleven Store #36235	6680 Mayfield Road	Mayfield Heights
	18002138	7-Eleven Store #36235	6680 Mayfield Road	Mayfield Heights
1.4	18009541	Hillcrest Hospital	6780 Mayfield Road	Mayfield Heights
14	18009541	Hillcrest Hospital	6780 Mayfield Road	Mayfield Heights
	18011168	Costco Gasoline	1409 Golden Gate Boulevard	Mayfield Heights
15	18011168	Costco Gasoline	1409 Golden Gate Boulevard	Mayfield Heights
	18011168	Costco Gasoline	1409 Golden Gate Boulevard	Mayfield Heights
	18011168	Costco Gasoline	1409 Golden Gate Boulevard	Mayfield Heights

Source: Cuyahoga County GIS Dataset

#### Threatened and Endangered Species

Per the U.S. Fish and Wildlife Endangered Species (USFWS) website, five federally listed threatened, endangered, candidate or proposed species exist within Cuyahoga County. These include:

- Indiana bat (Myotis sodalis) Endangered
- Northern long-eared bat (Myotis septentrionalis) Proposed as Endangered
- Kirtland's Warbler (Dendroica kirtlandii) Endangered
- Piping plover (Charadrius melodus) Endangered
- Red Knot (Rufa) (Calidris canutus rufa) Proposed as Threatened

A review of the Cuyahoga County GIS data indicates there are no threatened or endangered species habitats in the project area; however, the area does contain several large wooded tracts that could contain suitable summer roosting habitat for the Indiana bat and Northern long-eared bat.

#### **Environmental Justice**

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, directs Federal agencies to take the appropriate and necessary steps to identify and address disproportionately high and adverse effects of Federal



projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law.

Environmental Justice protected minority populations are defined as African American, Hispanic, Asian or Native American/Alaskan Native. Low-income populations are defined as any person whose median household income is at or below the Department of Health and Human Services (DHHS) poverty guidelines.

As shown in Table 15, there are several areas with minority concentrations located within the project area. The largest of these is on the south end of the project area in census tracts 1948 and 1311.02. In these tract areas, African Americans represent 61.9 percent and 23.2 percent of total population, respectively. A smaller, yet still relevant, minority population can also be found on the projects north end in census tracts 14722.02 and 1721.03. Refer to Table 15 for a breakdown of minority populations in the project area by census tract. The bold text represents the census areas that have a higher concentration of minority or low income population. Refer to Exhibit 9 for the locations of the project area census tracts and Exhibit 10 for locations of the minority concentrations in the project area.

Table 15. Minority Population Data by Census Tracts

	Total Population	White <u>Total</u> Percent	African American <u>Total</u> Percent	Hispanic <u>Total</u> Percent	Native American/ Alaskan Native <u>Total</u> Percent
Cuyahoga County	1,280,122	<u>826,959</u> 64.6	386,597 12.5	<u>66,566</u> 5.2	<u>3,840</u> 0.3
CT 1311.02	3,362	<u>2,465</u> 73.3	780 23.2	<u>16</u> 0.5	<u>3</u> 0.1
CT 1311.04	4,302	<u>3,503</u> 81.4	324 7.5	<u>104</u> 2.4	<u>2</u> 0
CT 1702.02	3,898	<u>3,581</u> 91.9	<u>207</u> 5.3	<u>49</u> 1.3	<u>0</u> 0
CT 1721.02	3,782	<u>3,325</u> 87.9	<u>227</u> 6.0	<u>66</u> 1.7	<u>12</u> 0.3
CT 1721.03	4,914	<u>3,175</u> 64.6	<u>851</u> 17.3	<u>119</u> 2.4	<u>3</u> 0.1
CT 1722.01	3,719	<u>3,351</u> 90.1	140 3.8	<u>63</u> 1.7	<u>1</u> 0
CT1722.02	4,115	<u>3,207</u> 77.9	<u>611</u> 14.8	<u>80</u> 1.9	<u>3</u> 0.1
CT 1791.01	3,105	3,059 98.5	272 8.8	<u>44</u> 1.4	<u>1</u> 0
CT 1948	884	<u>261</u> 29.5	<u>547</u> 61.9	33 3.7	<u>0</u> 0
CT 1949	3,323	<u>2,562</u> 77	480 14.4	<u>52</u> 1.6	<u>2</u> 0.1

Source: U.S. Census Bureau Data Set QT-P3 2000



As shown on Exhibit 11 there are also pockets of low-income populations located near the projects north and south termini. These areas are located within census tracts 1948, 1721.02, and 1722.02. Refer to Table 16 for the 2014 DHHS poverty guidelines.

**Table 16. 2014 DHHS Poverty Guidelines** 

Persons in Family/Household	Poverty Guideline		
1	\$11,670		
2	\$15,730		
3	\$19,790		
4	\$23,850		
5	\$27,970		
6	\$31,970		
7	\$36,030		
8	\$40,090		
For families/households with more than 8 persons, add \$4,060 for each additional person.			

Source: Dept. Health and Human Services

#### Section 4(f) and Section 6(f)

Section 4(f) provides regulations governing the 'use' of land from publicly owned parks, recreation areas, wildlife and waterfowl refuges, as well as public or private historic sites for Federal highway projects.

A survey and eligibility determination for each of the 2,070 identified historic resources would be necessary to determine if Section 4(f) would apply. A resource merely has to be deemed eligible for listing on the NRHP for Section 4(f) to apply. It does not have to be listed on the NRHP.

No wildlife or waterfowl refuge areas are located in the project area; however, there are several parks/recreation areas within the project study boundary. Brainard Park, Beachwood City Park East, the Mayfield Heights City Park, the Acacia Reservation Metropark, and the Mayfield Heights Recreational Park are all located within the 0.5 mile study area west of the I-271 right-of-way. Both the Beachwood City Park East and the Mayfield Heights Recreation Park are located adjacent to the right-of-way of I-271.

One park was identified on the National Park Service Land and Water Conservation Fund (LWCF) grant list, and is thus protected under Section 6(f). This park is listed as the Mayfield Heights Park. The LWCF list does not specify to which of the two Mayfield Heights Parks the funds apply.



Refer to Exhibit 12 for the locations of all Section 4(f) and Section 6(f) resource including potential historic Section 4(f) resources.

#### Other

Although not a category scoped for environmental review, it should be noted that the Knollwood Cemetery and Mausoleum is located immediately adjacent to northbound I-271, north of Woodhawk Drive and south of Marsol Road.

# 12.0 Conclusion and Recommendations

The CUY-271-8.14 (PID 97676) study was initiated due to safety concerns with the interchange area. The proposed countermeasures were recommended in the CUY-271-9.9/10.5 Safety Study and are intended to address these issues, and improve traffic operations within the study area. The cities of Lyndhurst and Mayfield Heights support these improvements. Letters of support from the two cities are included in Appendix G.

The Build Alternative includes improvements to the northbound I-271 ramps and associated improvements to Brainard Road. This alternative will have phased construction. Phase 1 improvements will be limited to improvements that do not require construction adjacent to mainline I-271. Phase 2 improvements will construct a dual northbound exit ramp to Cedar Road/Brainard Road.

No improvements are proposed at the I-271 southbound ramp intersection on Cedar Road.

The Build Alternative provides the necessary changes that are expected to mitigate crashes on northbound I-271 and on Brainard Road. The I-271 northbound exit to Cedar Road/Brainard Road will improve from LOS F to LOS A by adding a second exit lane. The added capacity is needed to accommodate 2036 traffic projections. Furthermore, the HCS results show that the level of service along the interstate remains acceptable throughout the study area, with the exception of a weave location during the PM peak period.

• The Build Alternative results in a higher volume of traffic on the northbound local lanes compared to the No Build, a result of switching the local and express crossover locations. In the No Build, the weave LOS is a C, and in the Build the weave LOS is an E. It is important to distinguish that the weaves occur on different freeway segments, on the express lanes versus on the local lanes in the No Build and Build Alternatives, respectively.

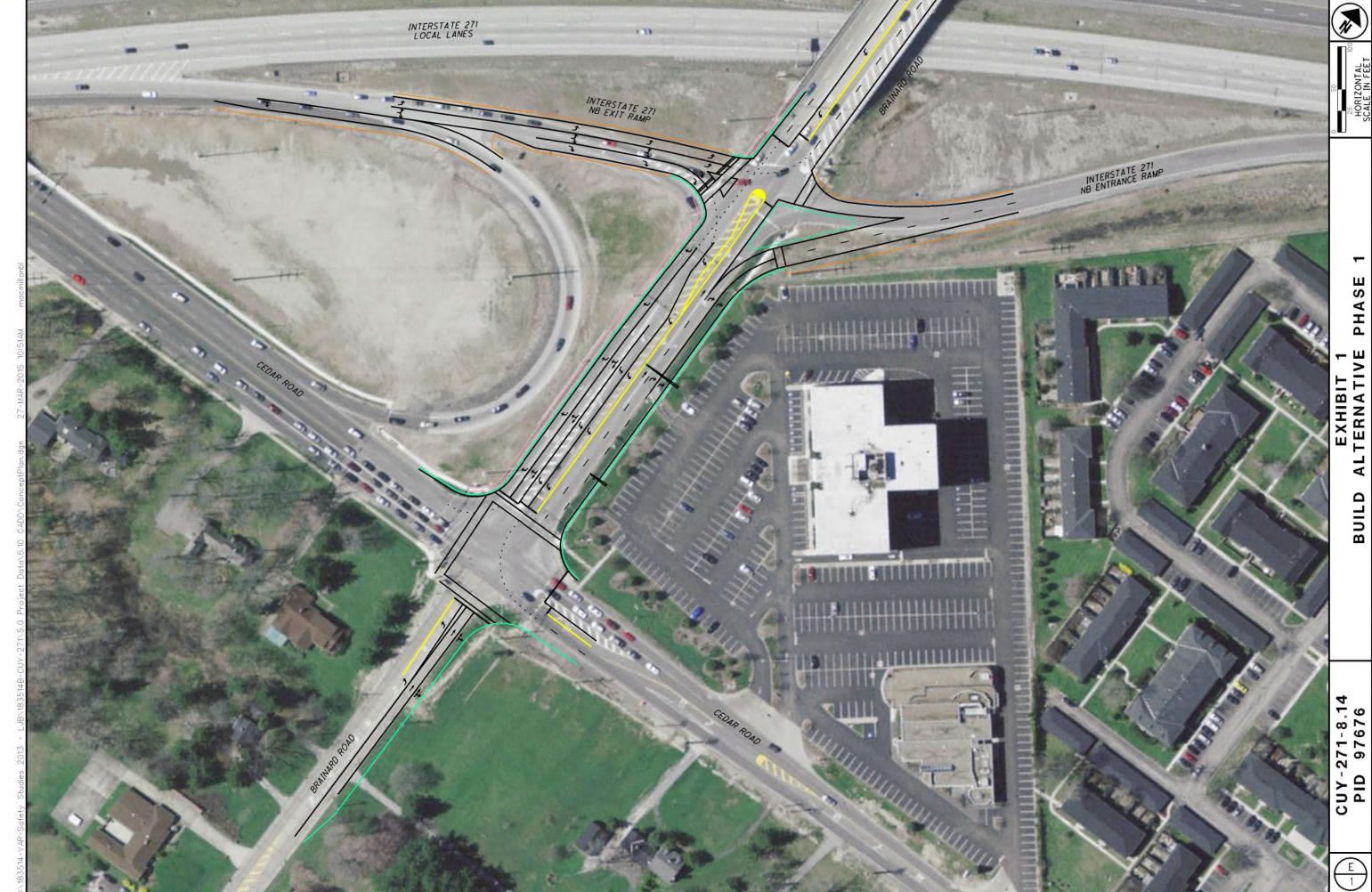
The second edition of the NOACA Congestion Management System (CMS) Manual of Practice, dated October 2002, states that Level of Service (LOS) "D" will be the threshold for peak periods in urbanized areas and LOS "C" will be the threshold for peak periods in rural areas (Page i, Executive Summary). A copy of the document can be found at:

http://www.noaca.org/modules/showdocument.aspx?documentid=3333

For all the reasons noted above, this IMS is recommended for approval, based on satisfying the eight policy statements in the Interstate System Access Information Guide (August 2010).

# Exhibit 1

**Build Alternative – Phase 1 (view 1 of 2)** 



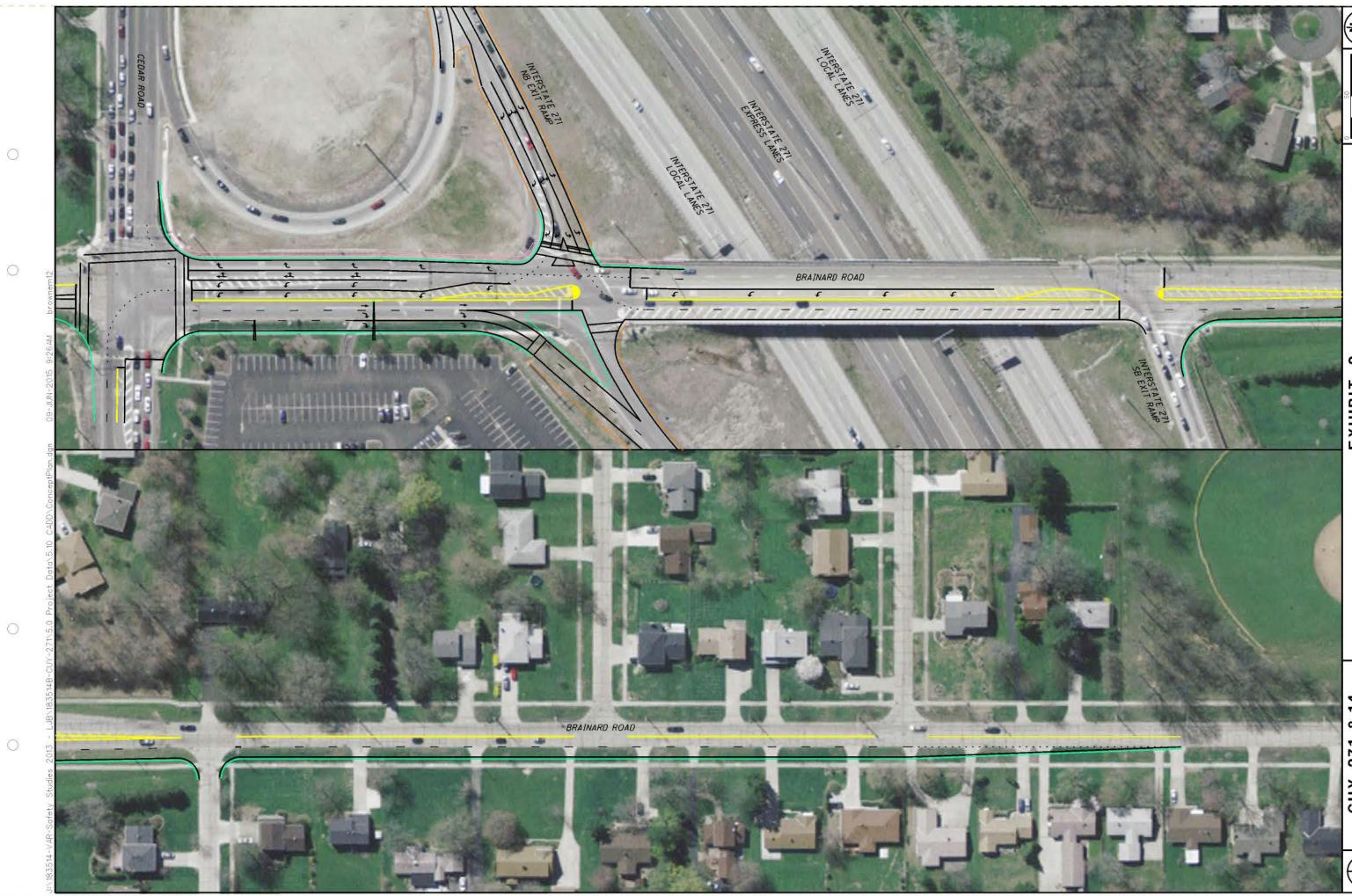
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PHASE EXHIBIT 1 ALTERNATIVE BUILD

CUY-271-8,14 PID 97676

**Build Alternative – Phase 1 (view 2 of 2)** 



CUY-271-8,14 PID 97676

EXHIBIT 2 ALTERNATIVE BUILD

PHASE

**Build Alternative - Phase 2** 

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EXHIBIT 3
BUILD CONDITION PHASE 2

CUY-271-8.14 PID 97676

E 3

N

1-271



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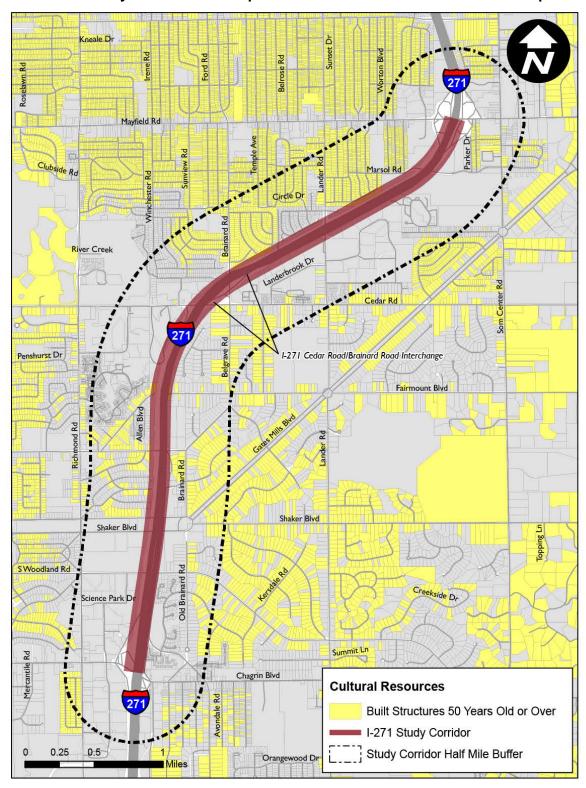
**EXISTING CONDITION** 



History/Architecture Properties 50 Years Old or Older Location Map

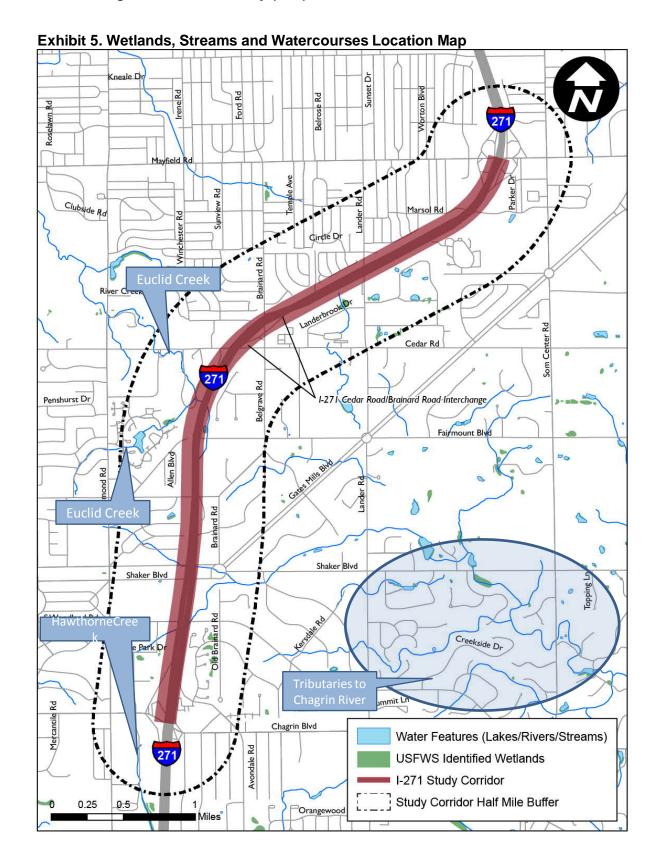


Exhibit 4. History/Architecture Properties 50 Years Old or Older Location Map



Wetlands, Streams, and Watercourse Location Map

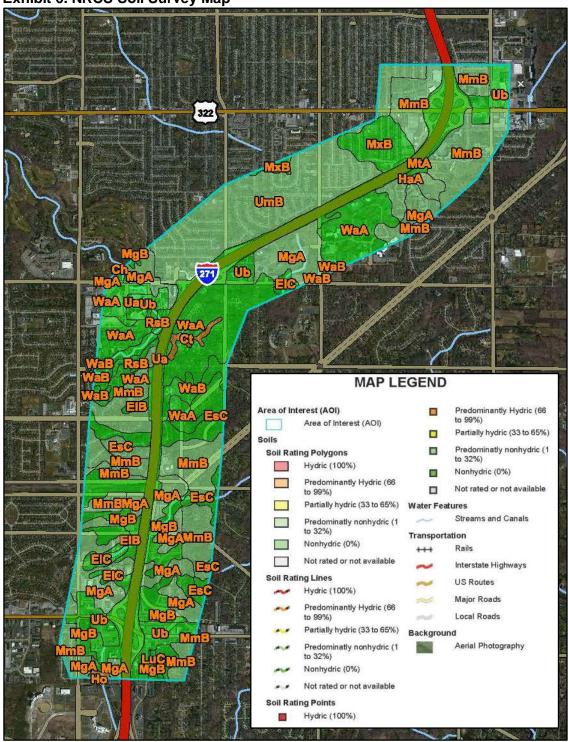




**NRCS Soil Survey Map** 



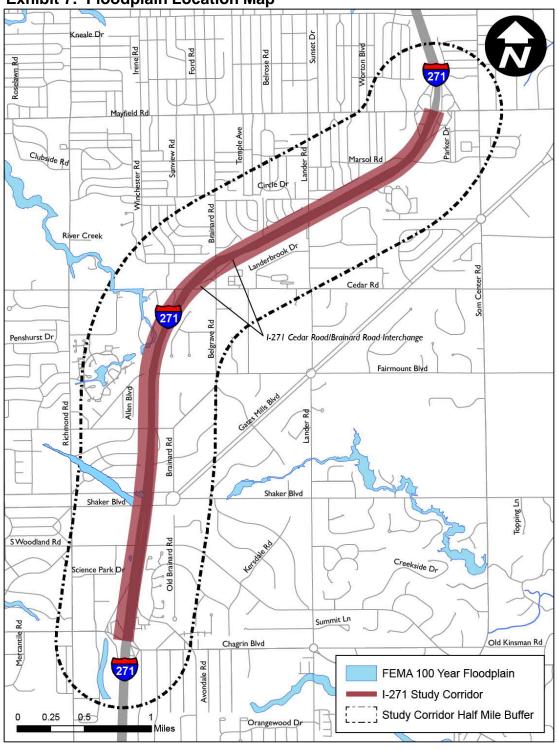
**Exhibit 6. NRCS Soil Survey Map** 



**Floodplain Location Map** 



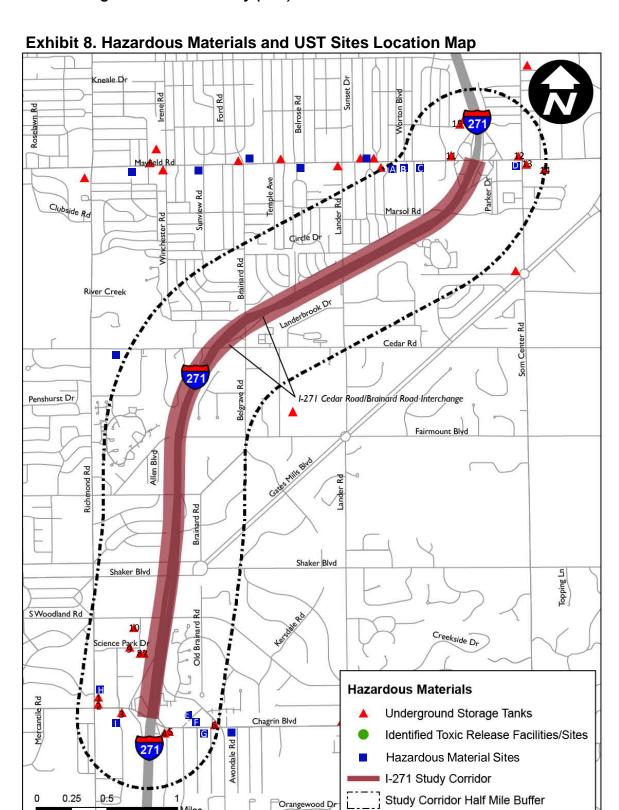
**Exhibit 7. Floodplain Location Map** 





**Hazardous Materials and UST Site Location Map** 

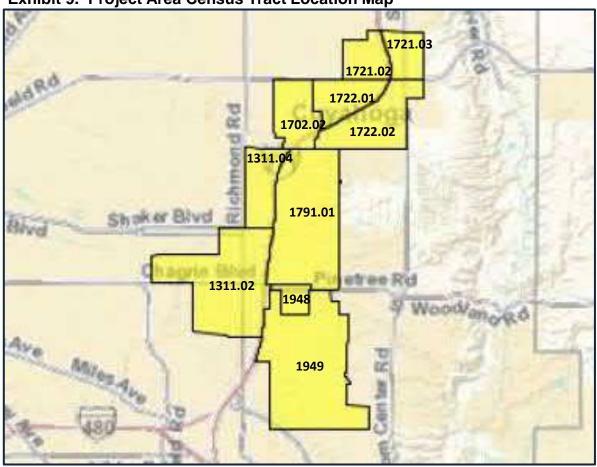




**Project Area Census Tract Location Map** 



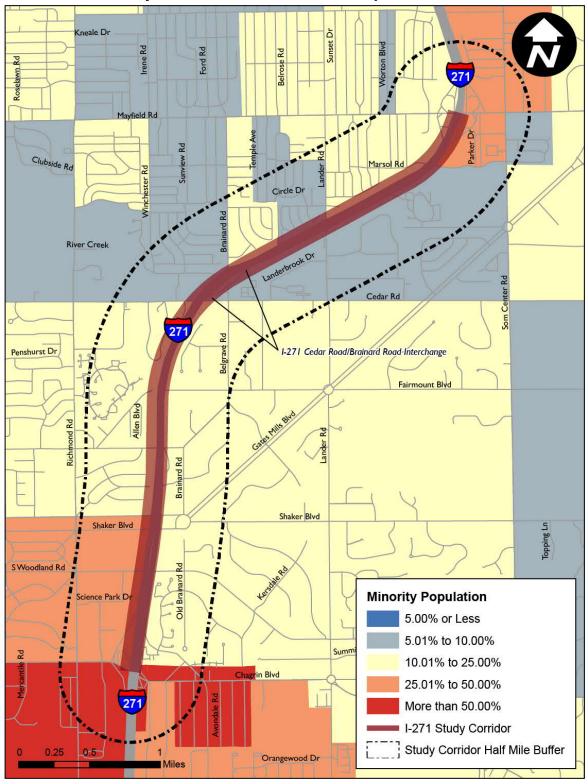




**Minority Concentrations Location Map** 



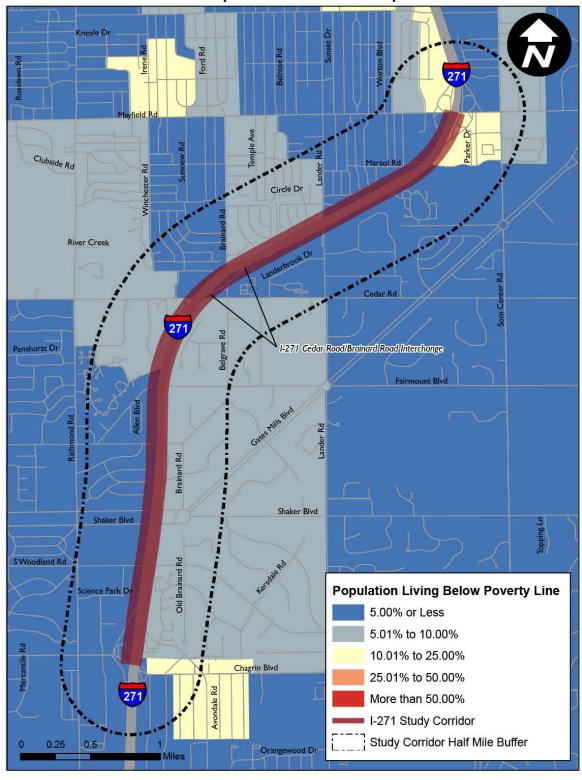
**Exhibit 10. Minority Concentrations Location Map** 



**Low-Income Populations Location Map** 



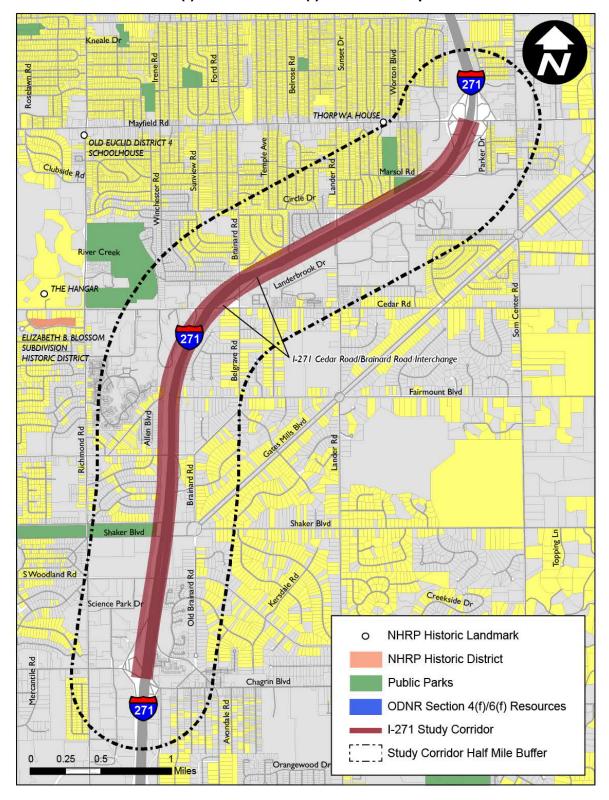
**Exhibit 11. Low-Income Populations Location Map** 



Section 4(f) and 6(f) Location Map



Exhibit 12. Section 4(f) and Section 6(f) Location Map



## Appendix A

**Road Safety Audit** 

# Road Safety Audit for the Intersection of Cedar Road and Brainard Road and I-271 Interchange with Brainard Road and Cedar Road

Cities of
Lyndhurst, Pepper Pike, Mayfield Heights, and Beachwood
Ohio

February 2013

#### **Authors**

Maher Holozadah, Senior Transportation Engineer Sahar Tawfiq, Transportation Engineer

#### **Contributors**

The Road Safety Audit Team

Prepared by
Northeast Ohio Areawide Coordinating Agency
1299 Superior Avenue
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1) Title & Subtitle  Road Safety Audit for the Intersection of Cedar Road and Brainard Road at the I-271 Interchange in the Cities of Lyndhurst and Pepper Pike	2) NOACA Report No. TR-13-02
3) Author(s) Maher Holozadah, Senior Transportation Engineer; and Sahar Tawfiq, Transportation Engineer	4) Report Date February 2013
5) Performing Organization Name & Address Northeast Ohio Areawide Coordinating Agency 1299 Superior Avenue, Cleveland, OH 44114-3204 Phone: (216) 241-2414 FAX: (216) 621-3024 Website: www.noaca.org	6) Project Task No. 6251-02  7) NOACA Contract/Grant No.
8) Sponsoring Agency Name & Address Ohio Department of Transportation 1980 W. Broad St., Box 899 Columbus, OH 43216-0899	9) Type of Report & Period Covered  10) Sponsoring Agency Code

#### 11) Supplementary Notes

Federal funding for this project was provided by the Federal Highway Administration and administered by the Ohio Department of Transportation.

#### 12) Abstracts

This study report is for a Road Safety Audit conducted for the intersection of Cedar Road and Brainard Road and the I-271 Interchange in the City of Lyndhurst. The purpose of the audit is to examine the existing conditions at this and adjacent freeway ramp intersections, and suggest short-term, low-cost and longer-term, higher-cost safety improvement solutions

#### 13) Key Words & Document Analysis

#### A. Descriptors

Road Safety Audit, Cedar Road, Brainard Road, I-271 Interchange, City of Lyndhurst, City of Pepper Pike, City of Mayfield Heights, and City or Beachwood

#### B. Identifiers/Open Ended Terms

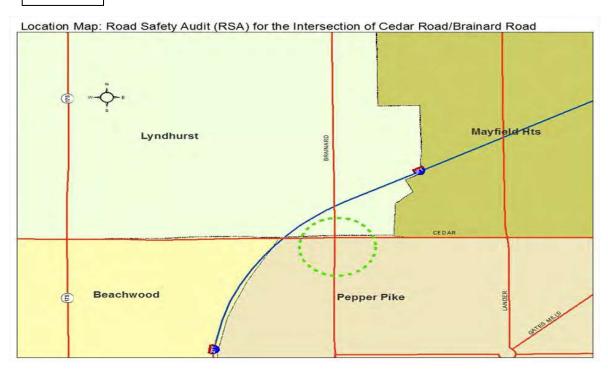
RSA, Safety Study

## 14) Availability Statement 1. On the NOACA website 2. In hard copy and electronic print 15) No. Pages: 62 16) Price Cost of Reproduction

#### **Executive Summary**

The Road Safety Audit (RSA) for the intersection of Cedar Road and Brainard Road in the Cities of Lyndhurst and Pepper Pike (Figure 1) is one of several audits conducted by the Northeast Ohio Areawide Coordinating Agency (NOACA) as part of NOACA's safety studies program for State Fiscal Years 2012 and 2013 (FY2012 and FY2013). The intersection was identified as a high-crash location based on NOACA's 2009 Crash Report titled *Accident Characteristics & Intersection Accident Analysis*, and ranks number 38 on the list. It ranks number 108th on ODOT's Urban Freeway Safety Analyst List. This intersection has a particularly unusual geographic environment. It is located within the expanse of a vast, spread-out interchange with ramps straddling Cedar Road and Brainard Road (Figure 2). In addition to serving local traffic, the intersection is also used as a pass-through by regional traffic entering and exiting the I-271 Freeway in the area. Furthermore, the pattern of traffic movements is greatly influenced by many local traffic generators and a peculiar set of freeway ramp connections serving the area.

#### Figure 1



The purpose of this RSA is to have an independent road safety audit team (RSA team) examine the particulars of this intersection and other nearby roadway intersections with the I-271 Interchange ramps to enable the RSA team to make suggestions for short-term, low-cost safety improvements, as well as possible long-term, higher-cost improvements. The various intersections were referenced as Location 1, Location 2, Location 3, and Location 4, shown in Figure 2.

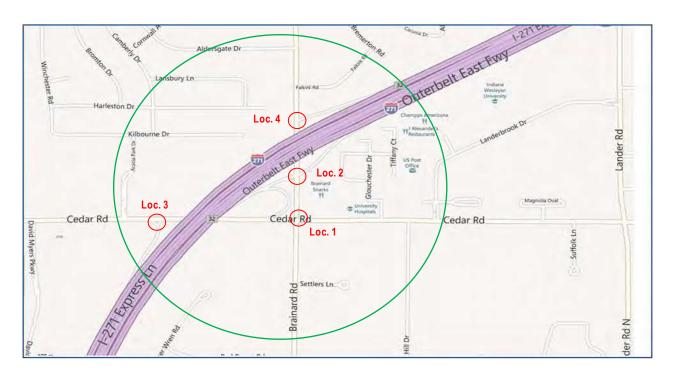


Figure 2: Intersection Identification Labels

The RSA team, therefore, recommends the following low-cost, short-term; low-cost, medium-term; medium-cost, longer term, and higher-cost, long-term improvements to increase the overall level of safety at this intersection. Stakeholders and municipalities affected by the prevailing traffic conditions are encouraged to evaluate the various high-cost, long-term, major, capital improvement scenarios presented in this study report that are outside the scope of ordinary safety improvements in order to identify a preferred alternative and to establish a more comprehensive solution.

Suggested high-cost, long-term improvements presented in this study that are outside the scope of ordinary safety improvements (greater than \$5,000,000 in total cost), and are not fundable with safety funds, are conceptual in nature and require further analysis and evaluation. Stakeholders and municipalities affected by the prevailing traffic conditions are encouraged to evaluate these high-cost, long-term conceptual alternatives and identify a preferred alternative that provides a comprehensive solution to improve access in addition to improving safety. Stakeholders and municipalities may wish to consider establishing a special improvement district to fund studies to evaluate improvement alternatives, and ultimately, perhaps, fund or contribute toward funding the design and construction of a preferred alternative.

The main recommendations, described separately for each location, are:

#### Location 1: Cedar Road/Brainard Road

- Conduct a traffic signal progression study to coordinate the timing and phasing of the traffic control signals along Brainard Road to facilitate better traffic flow and reduce delay
- Perform capacity analysis to:
  - o Provide a shorter cycle length
  - Examine introducing a phasing sequence that includes a phase for an exclusive, protected leftturn movement from the Brainard Road northbound approach to eliminate potential conflicts of traffic movements
  - Examine introducing a leading and lagging protected left-turn phase on the Brainard Road southbound approach to provide for serving this heavy left-turn traffic movement twice during the phase in the A.M peak period
  - Examine and consider converting the exclusive through-lane on the Brainard Road southbound approach to a through- and right-turn lane (Diagram 1-1)

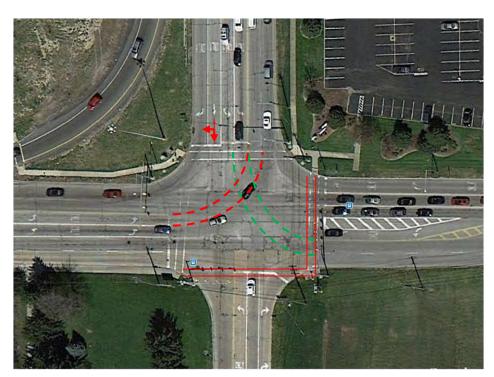


Diagram 1-1: Cedar Road/Brainard Road

- Provide more pronounced dashed lane-extension lines through the intersection to help traffic avoid encroaching upon adjacent turn lanes, and to help drivers stay more closely in their travel paths
- Examine the width of the Cedar Road receiving lanes on the east side of Brainard Road and widen, if
  necessary, to ensure availability of adequate curvature for the installation of lane-extension lines
  (Diagram 1-1) to enable a smoother transition for the left-turn traffic movements, and to encourage the
  use of the outermost left-turn lane on the southbound approach of Brainard Road which currently
  appears to be underutilized

- Examine whether the present heavier use of the innermost left-turn lane of the Brainard Road southbound approach at Cedar Road compared with the lighter use of the outermost left-turn lane is due to a real or perceived narrowness of the roadway, the narrowing of Cedar Road to one lane after a short distance from the end of the initial two receiving lanes, or due to a need to stay in the innermost left-turn lane in order to turn left again into driveways of businesses or establishments located on the northern side of Cedar Road
- Improve the pavement sub-grade and surface conditions on all approaches of the intersection as well
  as within it to improve friction and to provide a better surface conducive to receiving lane-marking paint
  for a longer lasting, more durable lane demarcation
- Improve pavement markings where needed
- Set back the stop bar for the exclusive left-turn lane on the Cedar Road westbound approach.
- Delete the present pedestrian crosswalk across Cedar Road located on the west side of the intersection (west of Brainard Road) and emphasize the one on the east side of the intersection (east of Brainard Road). The heavy right-turn traffic movements inhibit pedestrians from attempting to cross the road at this location, even during the recall pedestrian crossing phase. Ensure there will be pedestrian crossings on the remaining 3 of the 4 approaches. Provide a pedestrian crosswalk across Brainard Road, on the south side of Cedar Road. Provide needed sidewalks and pedestrian ramps
- Consider combining elements from the I-271--Cedar/Brainard Access-Point Modification Study with recommendations and suggested safety improvements presented in this RSA report to develop a more comprehensive and common approach toward addressing the issues identified in the two study reports
- Consider adding an exit ramp from the I-271 northbound mainline connected directly to Cedar Road
  eastbound to: (a) Prevent backups presently reoccurring on the freeway mainline near the gore area of
  the Cedar Road/Brainard Road exit ramp; and (b) Alleviate the impact of the present pattern of heavy
  traffic volumes, particularly during the morning peak period, on the capacities and safe operation of the
  intersections of Brainard Road with the I-271 northbound exit and entrance ramps, and Brainard Road
  with Cedar Road

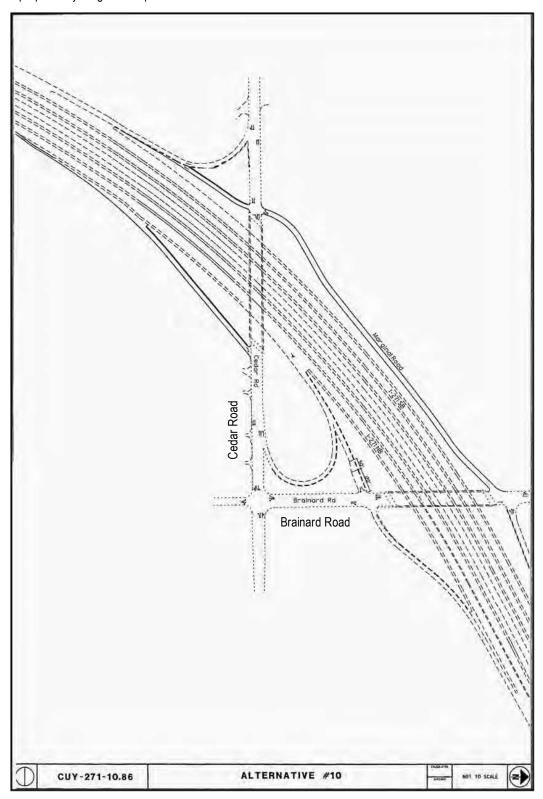
#### Location 2: Brainard Road and I-271 northbound Exit Ramp-northbound Entrance Ramp

- Remove all obstructions to the line of site, especially a part of the fence protecting against vandalism
  on the Brainard Road Bridge parapet over I-271, and nearby shrubberies that block the line of vision of
  vehicle drivers stopped at the traffic control signal for the I-271 northbound exit ramp and looking to
  their left to check for oncoming southbound traffic on Brainard Road
- Set back the stop bar for the exclusive left-turn bay on Brainard Road southbound approach
- Improve pavement conditions, especially any crumbling or rutted pavements, to provide for better traction, smoother ride, and a pavement condition conducive to proper and longer lasting marking
- Consider providing dual right-turn bays on the I-271 northbound exit ramp at Brainard Road to increase the storage capacity and increase the volume of traffic flow through the intersection during the green interval, to lessen traffic backups that often reach the freeway mainline
- Consider building a marginal road from Brainard Road to Lander Road commencing at the opposite side of the I-271 northbound exit ramp, aligned with the exit ramp through-lane and relatively alongside the I-271 northbound entrance ramp, to help take traffic directly to Landerbrook Drive and Lander Haven Drive. This marginal Road will carry or service traffic bound for Landerbrook Drive and Lander Haven Drive and will alleviate the traffic demand on the Cedar Road/Brainard Road intersection caused by the zigzag traffic movement pattern created by traffic exiting I-271 at the northbound exit ramp to Brainard Road, which then turns right to proceed to Cedar Road to turn left to reach Lander Road and Landerbrook Drive and Lander Haven Drive (Diagrams 2-2 and 2-3)
- Consider adding a northbound I-271 exit ramp connected directly to eastbound Cedar Road to prevent backups presently reoccurring on the I-271 freeway mainline near the mouth of the northbound Brainard Road/Cedar Road exit ramp, and to alleviate the impact of heavy traffic volumes, particularly during the morning peak period, on the intersections of the Brainard Road/I-271 northbound exit ramp, and Brainard Road/Cedar Road
- Restripe the stop line for the southbound approach and make it perpendicular to the curb of the roadway instead of the present slanted stop line
- Add overhead lane use signs on the Brainard Road Bridge over I-271. The present sign is erected on the bridge parapet and cannot be seen by traffic coming from the I-271 southbound exit ramp
- Remove the pedestrian crosswalk across Brainard Road. It is very unlikely pedestrians will cross to or
  from the southern side of the Brainard Road Bridge. That side of the Bridge is not connected with or
  serviced by any sidewalks. Maintain the pedestrian crosswalk across the I-271 northbound entrance
  ramp, as pedestrians will more likely use it because the sidewalk on the northern side of the bridge is
  connected to sidewalks along Brainard Road
- Reexamine the presently closed outer through-lane on northbound Brainard Road. This through-lane
  may be reinstated if a tapered northbound receiving lane is built on Brainard Road north of the I-271
  southbound exit ramp. The tapered through lane may also serve traffic that exits at the I-271
  southbound exit ramp and turns right to go north from an exclusive right-turn bay recommended for the
  exit ramp (see recommendations for Location 4)
- Make the southbound left-turn movement a 'lag' not 'lead' movement

#### Location 3: Cedar Road/I-271 Southbound Entrance Ramp

- Improve the curb and curvature near the Bridge. Move the curb back and increase its curvature to
  permit vehicles in the inner left-turn bay on the Cedar Road westbound approach to transition more
  easily to the I-271 southbound entrance ramps without encroaching on the adjacent left-turn lane
  extension line in order to minimize the potential for sideswipe passing crashes
- Emphasize or highlight the island and extension line markings
- Revisit 'Alternative 10' that was presented in the 'I-271 Access Point Modification Study' prepared for ODOT and completed in 2002, and shown here as Exhibit A, which provides for, retains, or reinstates a free-flow entrance ramp to I-271 southbound at the Cedar Road eastbound approach
- Consider combining or integrating elements from the various alternatives presented in the I-271-Cedar/Brainard Access-Point Modification Study, particularly *Alternative 10* (Exhibit A), with the overall
  suggested safety improvements and recommendations presented in this RSA report to provide long
  term solutions for the issues identified in the two study reports
- Install additional overhead lane assignment signs on the Cedar Road Bridge over I-271 similar to but in advance of those that exist near the westbound approach at the I-271 southbound entrance ramp
- Consider adding an entrance ramp from Brainard Road to I-271 southbound (Diagram E-1) if the
  minimum required spacing between consecutive ramps can be achieved, and provided that there will
  not be any or a significant increase in traffic flow to the freeway that might degrade its operation

**Exhibit-A:** Alternative #10 presented in the '*I-271--Cedar/Brainard Access Point Modification Study*' prepared by Burgess & Niple in 2002 for ODOT District-12 under PID #21029



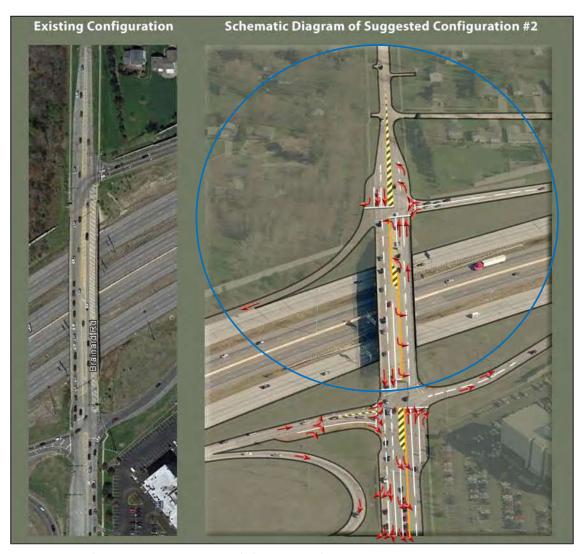
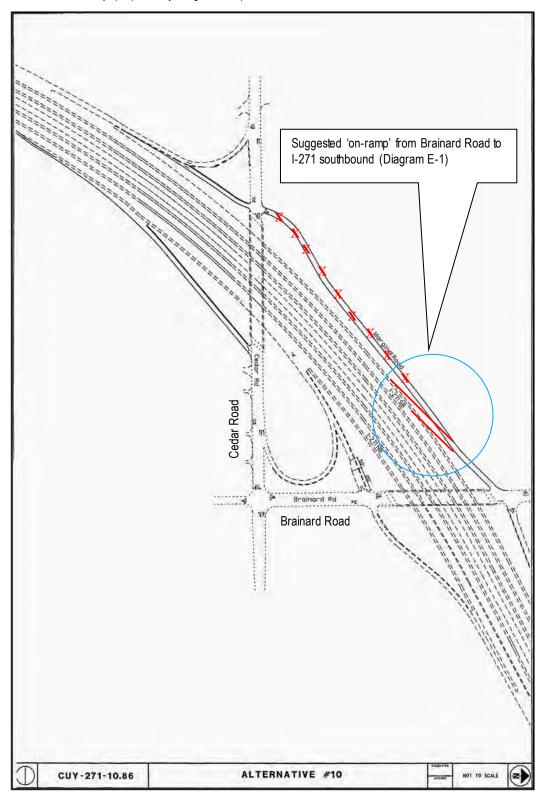


Diagram E-1: Suggested entrance ramp to I-271 southbound from Brainard Road

#### Location 4: Brainard Road/I-271 Southbound Exit Ramp

- Place overhead lane assignment signs on the bridge as the sign erected on the bridge parapet is not visible to traffic exiting at the I-271 southbound exit ramp and turning left to go south on Brainard
- Re-examine the need for the "no-turn-on-red" sign posted opposite the exit ramp, and based on the
  results of the examination consider removing the 'no-turn-on-red' signage
- Consider adding an exclusive right-turn bay on the exit ramp and convert the present through- and leftturn lane to an exclusive left-turn lane to make it a second left-turn lane for a dual left-turn configuration
- Build a long taper, through-lane on Brainard Road in the northbound direction to receive traffic from the outer through lane on the bridge after opening it to traffic as it is currently closed by hatching
- Place destination signs on the exit ramp to help drivers occupy the respective lane for the respective destination
- Consider adding an entrance ramp to I-271 southbound commencing at the Brainard Road/I-271 southbound exit ramp, as shown in Appended Exhibit-A and Diagram E-1
- Reexamine the viability and feasibility of adding a marginal road, running parallel to I-271, between the intersection of Brainard Road/I-271 southbound exit ramp and the intersection of Cedar Road/I-271 southbound entrance ramp, with a 'slip' entrance ramp from it to I-271 southbound. Perform capacity analysis for the resulting four-approach intersection of the marginal road with Cedar Road and I-271 southbound entrance ramp as part of the reexamination to determine whether such marginal road would be viable and feasible. Appended Exhibit-A shows the subject marginal road tentatively crossed-out to signify the need to address the presence of physical impediments, and the cost of any potential acquisition of right-of-way. The marginal road suggested may provide access to I-271 southbound via a slip entrance ramp from it to I-271 southbound and a direct access to Cedar Road westbound at or near its intersection with the I-271 southbound entrance ramp as shown in schematic Diagram 3-1

**Appended Exhibit-A:** Alternative #10 presented in the '*I-271--Cedar/Brainard Access Point Modification Study*' prepared by Burgess & Niple in 2002 for ODOT District-12 under PID #21029



## Appendix B

**Collision Diagrams** 



#### **NUMBER OF CRASHES**

5 INJURY OR FATAL

20 TOTAL CRASHES

	SYMBOLS	TYPES OF COLLISION
•	MOVING VEHICLE	REAR END
<b>→</b> >>>	BACKING VEHICLE NON-INVOLVED VEH.	RIGHT ANGLE
<b>←</b>	PEDESTRIAN	SIDE SWIPE
	PARKED VEHICLE	OUT OF CONTR
•	FIXED OBJECT FATAL CRASH	LEFT TURN
0	INJURY CRASH	─── HEAD ON
,		

#### SHOW FOR EACH CRASH 1. TIME, DAY, DATE

2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED

#### 3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

LOG POINT No	o	8.633	то		8.750	
PERIOD	3 years	FROM	2009	то	2011	
CITY	Beachwood & Ly	ndhurst, Ohio	ROUTE NUMB	BER	Cedar Road (CR-23)	



DATE: 5/20/13

PAGE: 1 of 26



#### **NUMBER OF CRASHES**

33 PROPERTY DAMAGE ONLY

10 INJURY OR FATAL

→ MOVING VEHICLE → REAR END	EACH CRASH
BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH  RIGHT ANGLE 2.5 OUT OF CONTROL LEFT TURN 3.1	TIME, DAY, DATE WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

 LOG POINT No.
 8.750
 TO
 8.859

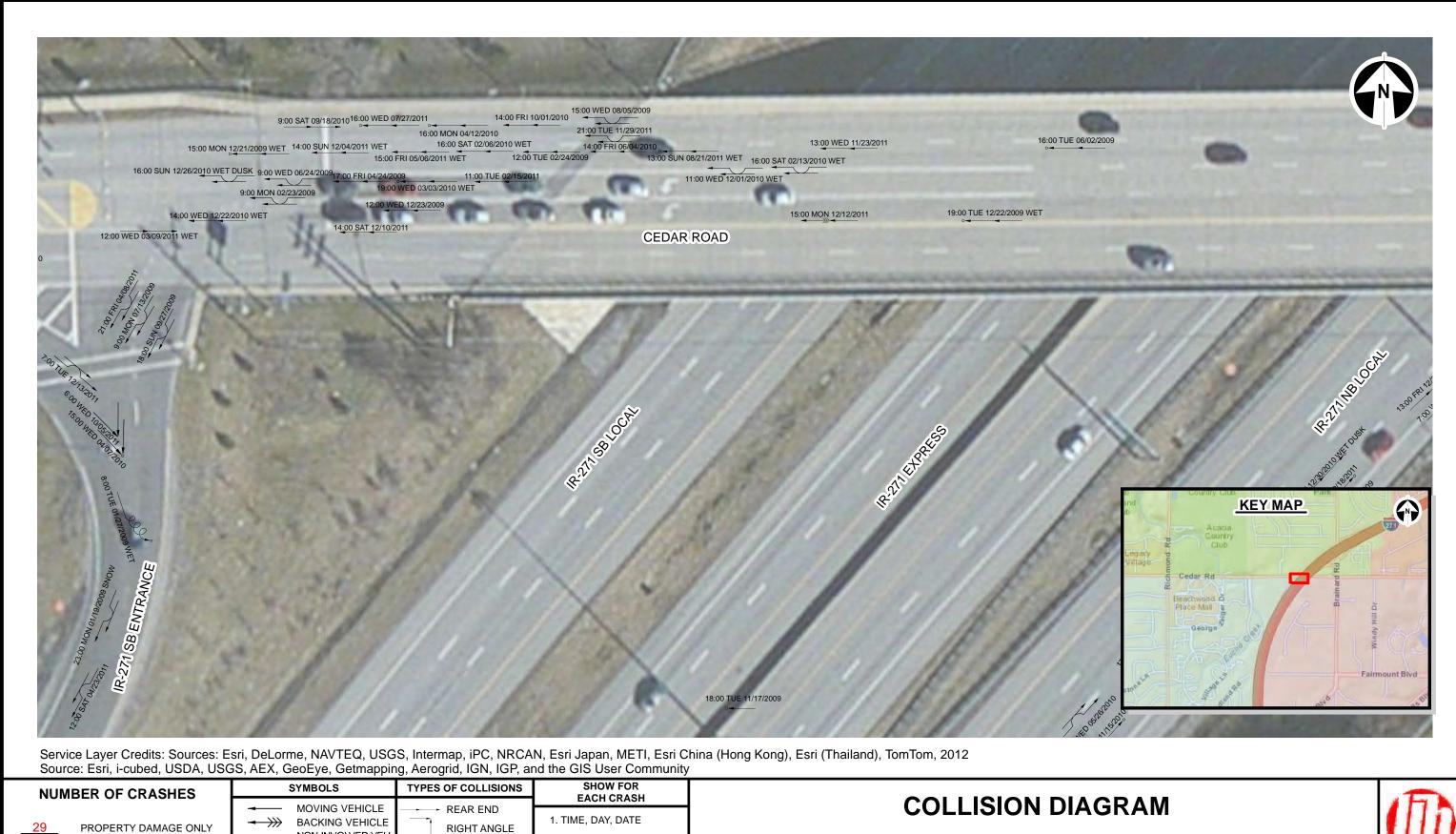
 PERIOD
 3 years
 FROM
 2009
 TO
 2011

 CITY
 Beachwood & Lyndhurst, Ohio
 ROUTE NUMBER
 Cedar Road (CR-23)



DATE: 5/20/13

PAGE: 2 of 26



LOG POINT No.

PERIOD

3 years

2. WEATHER AND ROAD SURFACE IF UNUSUAL

**CONDITION EXISTED** 

3. NITE - IF BETWEEN

DUSK AND DAWN

NON-INVOLVED VEH.

PARKED VEHICLE

PEDESTRIAN

FIXED OBJECT

FATAL CRASH

INJURY CRASH

0

INJURY OR FATAL

TOTAL CRASHES

SIDE SWIPE

Jount of Control

LEFT TURN

HEAD ON

#### 8.859 FROM \_ Beachwood & Lyndhurst, Ohio Cedar Road (CR-23) ROUTE NUMBER \_

DATE: 5/20/13

PAGE: 3 of 26



#### NUMBER OF CRASHES

5 PROPERTY DAMAGE ONLY

3 INJURY OR FATAL

8 TOTAL CRASHES

SYMBOLS	TYPES OF COLLISIONS	
MOVING VEHICLE BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH INJURY CRASH	REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTROL LEFT TURN HEAD ON	

# SHOW FOR EACH CRASH 1. TIME, DAY, DATE

2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED

3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

 LOG POINT No.
 8.966
 TO
 9.081

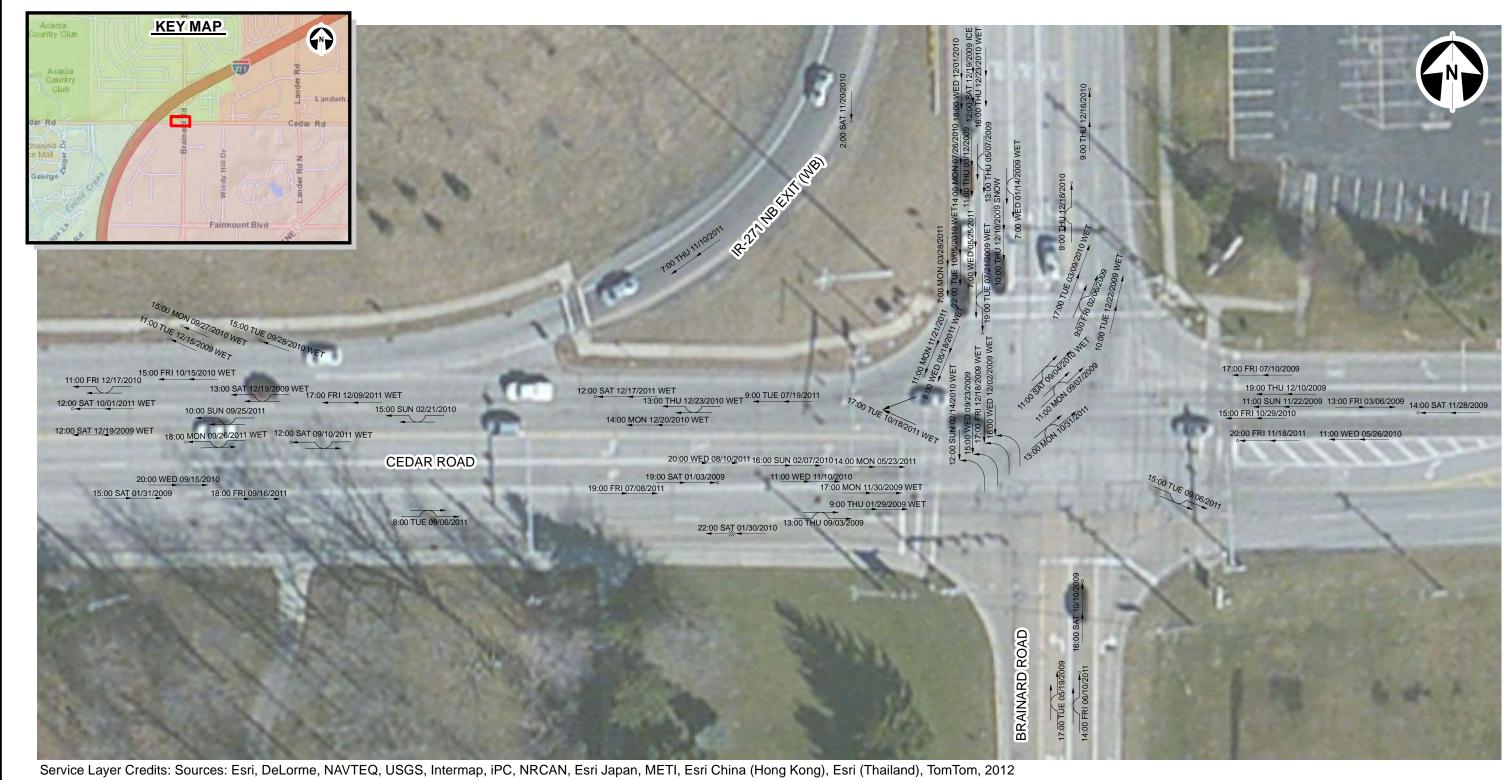
 PERIOD
 3 years
 FROM
 2009
 TO
 2011

 CITY
 Pepper Pike & Lyndhurst, Ohio
 ROUTE NUMBER
 Cedar Road (CR-23)



DATE: 5/20/13

PAGE: 4 of 26



#### **NUMBER OF CRASHES**

PROPERTY DAMAGE ONLY

INJURY OR FATAL

TOTAL CRASHES

-	MOVING VEHICLE
<b>→&gt;&gt;&gt;</b>	BACKING VEHICLE
<b></b>	NON-INVOLVED VEH.
◄	PEDESTRIAN
	PARKED VEHICLE
	FIXED OBJECT
•	FATAL CRASH
0	INJURY CRASH
_	FATAL CRASH

#### SYMBOLS **TYPES OF COLLISIONS** REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTROL LEFT TURN HEAD ON

## **EACH CRASH** 1. TIME, DAY, DATE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED 3. NITE - IF BETWEEN

DUSK AND DAWN

SHOW FOR

## **COLLISION DIAGRAM**

LOG POINT N	lo	9.081	TO		9.195	
PERIOD	3 years	FROM	2009	то	2011	
CITY	Pepper Pike & Ly	ndhurst, Ohio	ROUTE NUMB	ER	Cedar Rd. (CR-23)	



DATE: 5/20/13

PAGE: 5 of 26



#### NUMBER OF CRASHES

5 PROPERTY DAMAGE ONLY

4

INJURY OR FATAL

<u>9</u> TO

TOTAL CRASHES

	SYMBOLS	TYPES OF COLLISION
<b>→</b>	MOVING VEHICLE BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH	REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTR LEFT TURN
0	INJURY CRASH	HEAD ON

## EACH CRASH 1. TIME, DAY, DATE

SHOW FOR

- I. HIVIL, DAI, DAIL
- 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
- 3. NITE IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

 LOG POINT No.
 9.195
 TO
 9.309

 PERIOD
 3 years
 FROM
 2009
 TO
 2011

 CITY
 Pepper Pike & Lyndhurst, Ohio
 ROUTE NUMBER
 Cedar Road (CR-23)



DATE: 5/20/13

PAGE: 6 of 26



#### **NUMBER OF CRASHES**

PROPERTY DAMAGE ONLY

INJURY OR FATAL

TOTAL CRASHES

SYMBOLS TY	PES OF COLLISIONS
MOVING VEHICLE	REAR END
→ → → → BACKING VEHICLE → ON-INVOLVED VEH.	RIGHT ANGLE
→ PEDESTRIAN —	SIDE SWIPE
PARKED VEHICLE	OUT OF CONTROL
☐ FIXED OBJECT	LEFT TURN
● FATAL CRASH —-	, LEITTOKK
O INJURY CRASH —-	HEAD ON

## SHOW FOR EACH CRASH 1. TIME, DAY, DATE

2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED

3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

LOG POINT No.		6.633	то _		6.516	
PERIOD	3 years	FROM	2009	то _	2011	
CITY	Pepper Pik	ce, Ohio	ROUTE NUMBE	ER	Brainard Road (CR-28)	



DATE: 5/20/13

PAGE: 7 of 26



#### **NUMBER OF CRASHES**

52 PROPERTY DAMAGE ONLY

27 INJURY OR FATAL

79 TOTAL CRASHES

SYMBOLS	TYPES OF COLLISIONS	SHOW FOR EACH CRASH
MOVING VEHICLE BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH O INJURY CRASH	REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTROL LEFT TURN HEAD ON	1. TIME, DAY, DATE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED 3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

LOG POINT No.6.818TO6.962PERIOD3 yearsFROM2009TO2011CITYPepper Pike & Lyndhurst, OhioROUTE NUMBERBrainard Road (CR-28)



DATE: 5/20/13

PAGE: 8 of 26



#### NUMBER OF CRASHES

PROPERTY DAMAGE ONLY

2 INJURY OR FATAL

4 TOTAL CRASHES

SYMBOLS				
-	MOVING VEHICLE			
<b>→&gt;&gt;&gt;</b>	BACKING VEHICLE			
<b></b>	NON-INVOLVED VEH.			
<b></b>	PEDESTRIAN			
	PARKED VEHICLE			
	FIXED OBJECT			
•	FATAL CRASH			
0	INJURY CRASH			

# VEHICLE VEHICLE VEHICLE DLVED VEH. RIAN VEHICLE BJECT AASH RRASH VEHICLE BJECT AASH RRASH VEHICLE BJECT ASH RRASH VEHICLE BJECT ASH RRASH RRASH RRASH RRASH REAR END RIGHT ANGLE OUT OF CONTROL LEFT TURN READ ON

#### SHOW FOR EACH CRASH 1. TIME, DAY, DATE

2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED

3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

LOG POINT No.		0.047	то		0.112
PERIOD	3 years	FROM	2009	то	2011
CITY	Lyndhurs	t, Ohio	ROUTE NUMBER		-275 EB Exit at Brainard Road



DATE: 5/20/13

PAGE: 9 of 26



SHOW FOR EACH CRASH

#### **NUMBER OF CRASHES**

PROPERTY DAMAGE ONLY

INJURY OR FATAL

TOTAL CRASHES

SYMBOLS				
-	MOVING VEHICLE			
<b>→&gt;&gt;&gt;</b>	BACKING VEHICLE			
<del></del>	NON-INVOLVED VEH.			
→ PEDESTRIAN				
PARKED VEHICI				
	FIXED OBJECT			
•	FATAL CRASH			
0	INJURY CRASH			

#### TYPES OF COLLISIONS REAR END 1. TIME, DAY, DATE RIGHT ANGLE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED SIDE SWIPE OUT OF CONTROL LEFT TURN 3. NITE - IF BETWEEN DUSK AND DAWN HEAD ON

## **COLLISION DIAGRAM**

LOG POINT No.		6.821	ТО		6.934	
PERIOD	3 years	FROM	2009	то _	2011	
CITY	Lyndhurst	, Ohio	ROUTE NUMB	ER	Brainard Road (CR-28)	



DATE: 5/20/13

PAGE: 10 of 26



#### **NUMBER OF CRASHES**

20 PROPERTY DAMAGE ONLY

9 INJURY OR FATAL

\_\_\_\_\_\_\_ TOTAL CRASHES

SYMBOLS	TYPES OF COLLISIONS	SHOW FOR
MOVING VEHICLE BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH INJURY CRASH	REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTROL LEFT TURN HEAD ON	EACH CRASH  1. TIME, DAY, DATE  2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED  3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

LOG POINT I	No	9.197	то		9.341	
PERIOD	3 years	FROM	2009	то	2011	
CITY	Beachwood & Per	per Pike, Ohio	ROUTE NUM	BER	I-275	



DATE: 5/20/13

PAGE: 11 of 26



#### **NUMBER OF CRASHES**

10 PROPERTY DAMAGE ONLY

3 INJURY OR FATAL

13 TOTAL CRASHES

	SYMBOLS TYPES OF COLLISIONS		SHOW FOR EACH CRASH
	MOVING VEHICLE BACKING VEHICLE	REAR END	1. TIME, DAY, DATE
	NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE	SIDE SWIPE  OUT OF CONTROL	2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED
<ul><li>□</li><li>○</li></ul>	FIXED OBJECT FATAL CRASH INJURY CRASH	LEFT TURN  HEAD ON	3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

 LOG POINT No.
 9.349
 TO
 9.496

 PERIOD
 3 years
 FROM
 2009
 TO
 2011

 CITY
 Beachwood & Pepper Pike, Ohio
 ROUTE NUMBER
 I-275



DATE: 5/20/13

PAGE: 12 of 26



#### **NUMBER OF CRASHES**

2 PROPERTY DAMAGE ONLY

2 INJURY OR FATAL

4 TOTAL CRASHES

SYMBOLS	TYPES OF COLLISIONS	SHOW FOR
MOVING VEHICLE BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH O INJURY CRASH	REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTROL LEFT TURN HEAD ON	EACH CRASH  1. TIME, DAY, DATE  2. WEATHER AND ROAD SURFACE IF UNUSUA CONDITION EXISTED  3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

 LOG POINT No.
 9.493
 TO
 9.639

 PERIOD
 3 years
 FROM
 2009
 TO
 2011

 CITY
 Pepper Pike & Lyndhurst, Ohio
 ROUTE NUMBER
 I-275



DATE: 5/20/13

PAGE: 13 of 2



## **NUMBER OF CRASHES** PROPERTY DAMAGE ONLY

INJURY OR FATAL

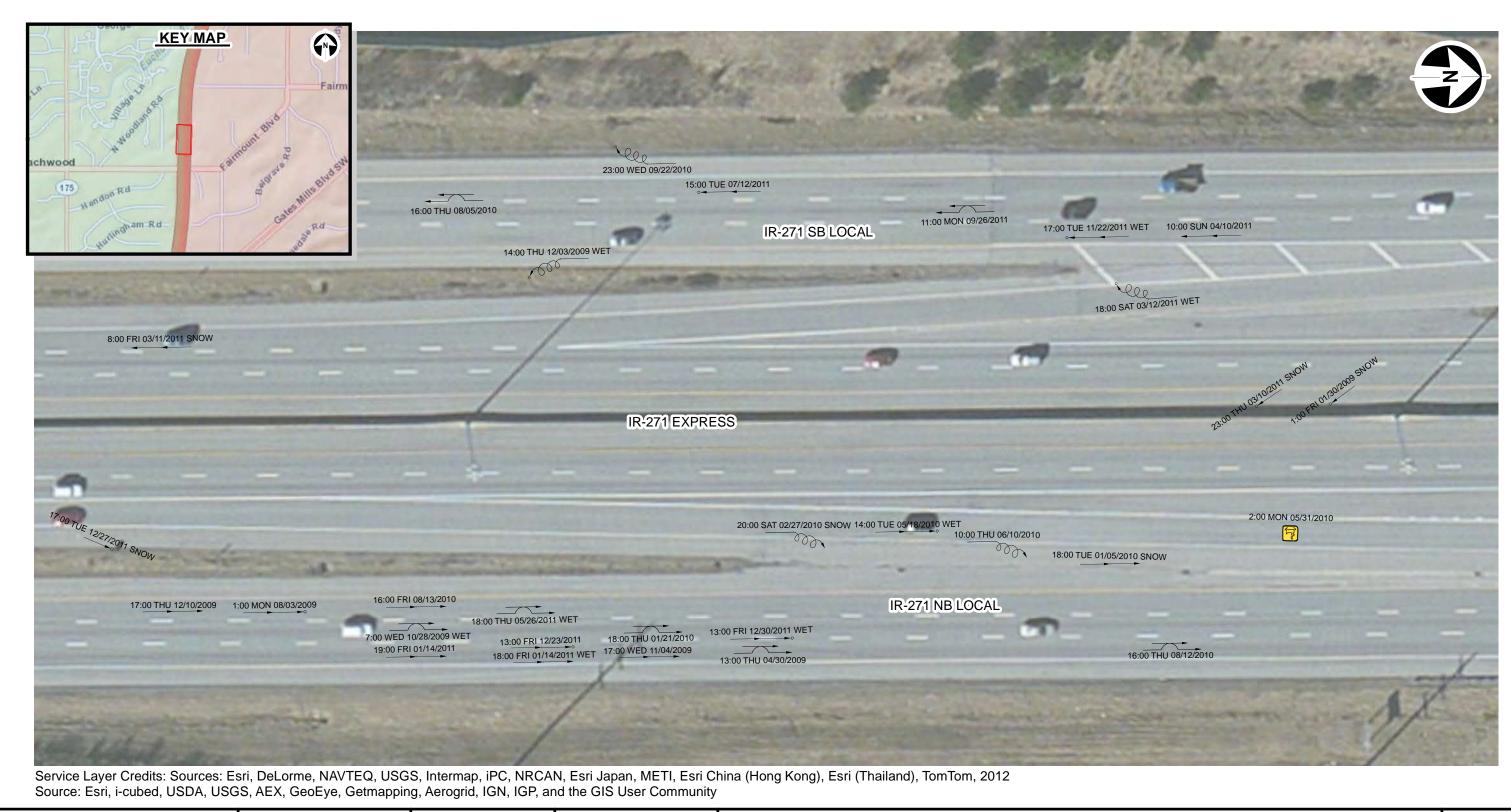
TOTAL CRASHES

SYMBOLS	TYPES OF COLLISIONS	SHOW FOR
MOVING VEHICLE BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH O INJURY CRASH	REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTROL LEFT TURN HEAD ON	1. TIME, DAY, DATE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED 3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

LOG POINT N	lo	9.640	TO		9.786	
PERIOD	3 years	FROM	2009	то	2011	
CITY	Pepper Pike & Ly	ndhurst, Ohio	ROUTE NUMB	BER	I-275	





### NUMBER OF CRASHES

20 PROPERTY DAMAGE ONLY

10 INJURY OR FATAL

SYMBOLS	TYPES OF COLLISIONS	SHOW FOR EACH CRASH
MOVING VEHICLE BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH O INJURY CRASH	REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTROL LEFT TURN HEAD ON	1. TIME, DAY, DATE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED 3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

 LOG POINT No.
 9.807
 TO
 9.953

 PERIOD
 3 years
 FROM
 2009
 TO
 2011

 CITY
 Beachwood & Pepper Pike, Ohio
 ROUTE NUMBER
 I-275



DATE: 5/20/13

PAGE: 15 of 26



#### **NUMBER OF CRASHES**

20 PROPERTY DAMAGE ONLY

8 INJURY OR FATAL

;	SYMBOLS	TYPES OF COLLISIONS
<b>-</b>	MOVING VEHICLE	REAR END
<del></del>	BACKING VEHICLE NON-INVOLVED VEH.	RIGHT ANGLE
◄	PEDESTRIAN	SIDE SWIPE
	PARKED VEHICLE	OUT OF CONTROL
•	FIXED OBJECT FATAL CRASH	LEFT TURN
0	INJURY CRASH	─── HEAD ON

## EACH CRASH

- 1. TIME, DAY, DATE
- 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED

SHOW FOR

3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

 LOG POINT No.
 9.968
 TO
 10.115

 PERIOD
 3 years
 FROM
 2009
 TO
 2011

 CITY
 Beachwood & Pepper Pike, Ohio
 ROUTE NUMBER
 I-275



DATE: 5/20/13

PAGE: 16 of 26



Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

#### **NUMBER OF CRASHES**

PROPERTY DAMAGE ONLY

INJURY OR FATAL

TOTAL CRASHES

SYMB	OLS	TYPES	OF COLLISIONS	SHOW FOR EACH CRASH
BACI NON- PEDI PARI FIXE FATA	ING VEHICLE KING VEHICLE INVOLVED VEH. ESTRIAN KED VEHICLE D OBJECT IL CRASH RY CRASH		REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTROL LEFT TURN HEAD ON	1. TIME, DAY, DATE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED 3. NITE - IF BETWEEN DUSK AND DAWN

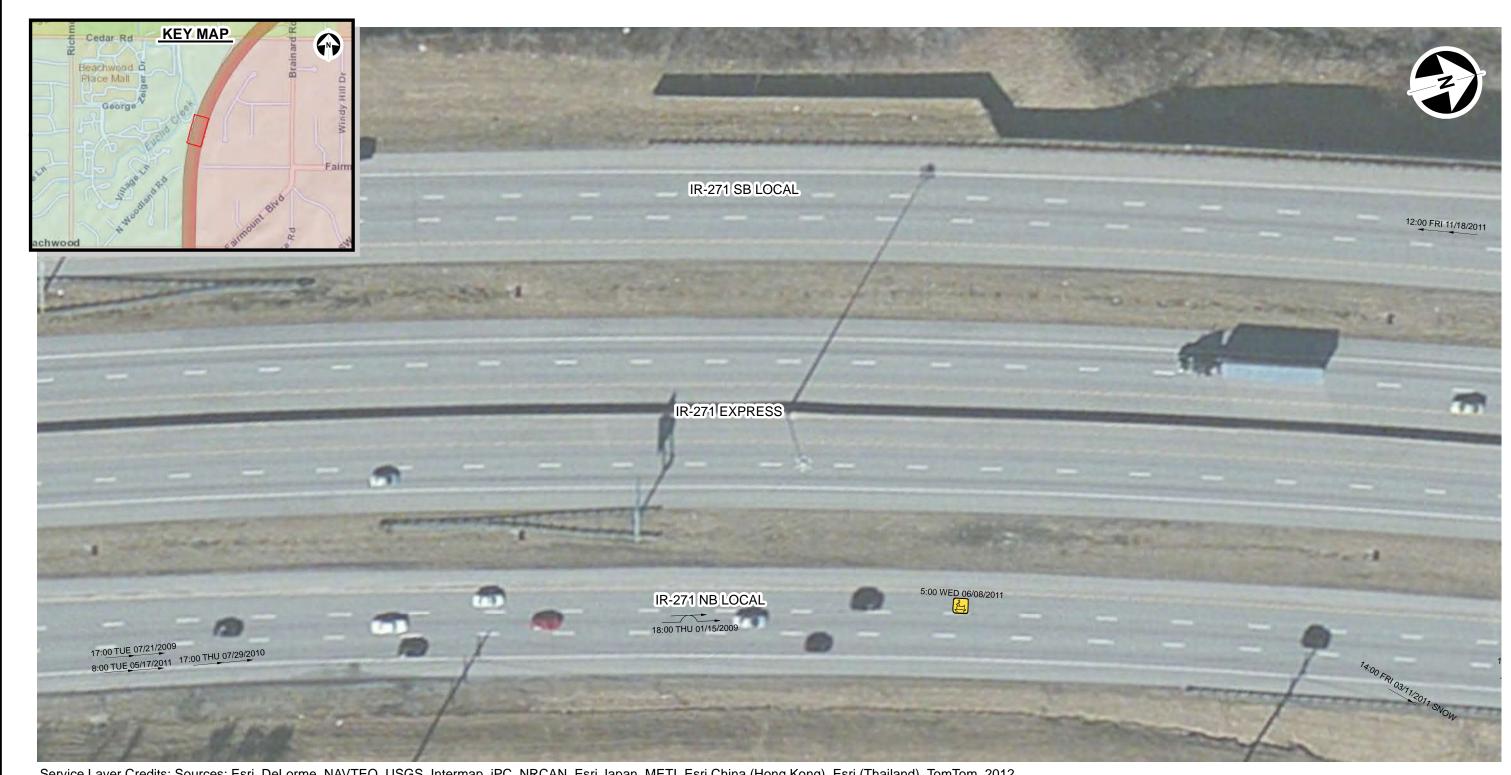
## **COLLISION DIAGRAM**

10.111 3 years FROM \_\_\_ Beachwood & Pepper Pike, Ohio ROUTE NUMBER \_\_\_\_\_



DATE: 5/20/13

PAGE: 17 of 2



SHOW FOR EACH CRASH

#### **NUMBER OF CRASHES**

PROPERTY DAMAGE ONLY

INJURY OR FATAL

TOTAL CRASHES

SYMBOLS			
MOVING VEHICLE			
BACKING VEHICLE	<u> </u>		
NON-INVOLVED VEH.			
PEDESTRIAN			
PARKED VEHICLE	روه		
FIXED OBJECT			
FATAL CRASH			
INJURY CRASH			
	MOVING VEHICLE BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH		

## S OF COLLISIONS → REAR END RIGHT ANGLE → SIDE SWIPE

#### 1. TIME, DAY, DATE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED OUT OF CONTROL LEFT TURN 3. NITE - IF BETWEEN DUSK AND DAWN HEAD ON

## **COLLISION DIAGRAM**

LOG POINT	No	10.254	ТО		10.400	
PERIOD	3 years	FROM	2009	то	2011	
CITY	Beachwood & Pep	per Pike, Ohio	ROUTE NUME	BER	I-275	



DATE: 5/20/13

PAGE: 18 of 26



#### **NUMBER OF CRASHES**

PROPERTY DAMAGE ONLY

INJURY OR FATAL

TOTAL CRASHES

SYMBOLS		TYPES	OF COLLISIONS	SHOW FOR
BACKII NON-IN PEDES PARKE FIXED FATAL	NG VEHICLE NG VEHICLE NVOLVED VEH. STRIAN ED VEHICLE OBJECT CRASH Y CRASH		REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTROL LEFT TURN HEAD ON	1. TIME, DAY, DATE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED 3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

LOG POINT N	No	10.400	то		10.547	
PERIOD	3 years	FROM	2009	то	2011	
CITY	Beachwood & Per	per Pike, Ohio	ROUTE NUME	BER	I-275	



DATE: 5/20/13

PAGE: 19 of 2



#### **NUMBER OF CRASHES**

PROPERTY DAMAGE ONLY

INJURY OR FATAL

TOTAL CRASHES

SYMBOLS		TYPES OF COLLISIONS	SHOW FOR
	MOVING VEHICLE BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH	REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTROL LEFT TURN	EACH CRASH  1. TIME, DAY, DATE  2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED  3. NITE - IF BETWEEN
0	INJURY CRASH	─── HEAD ON	DUSK AND DAWN

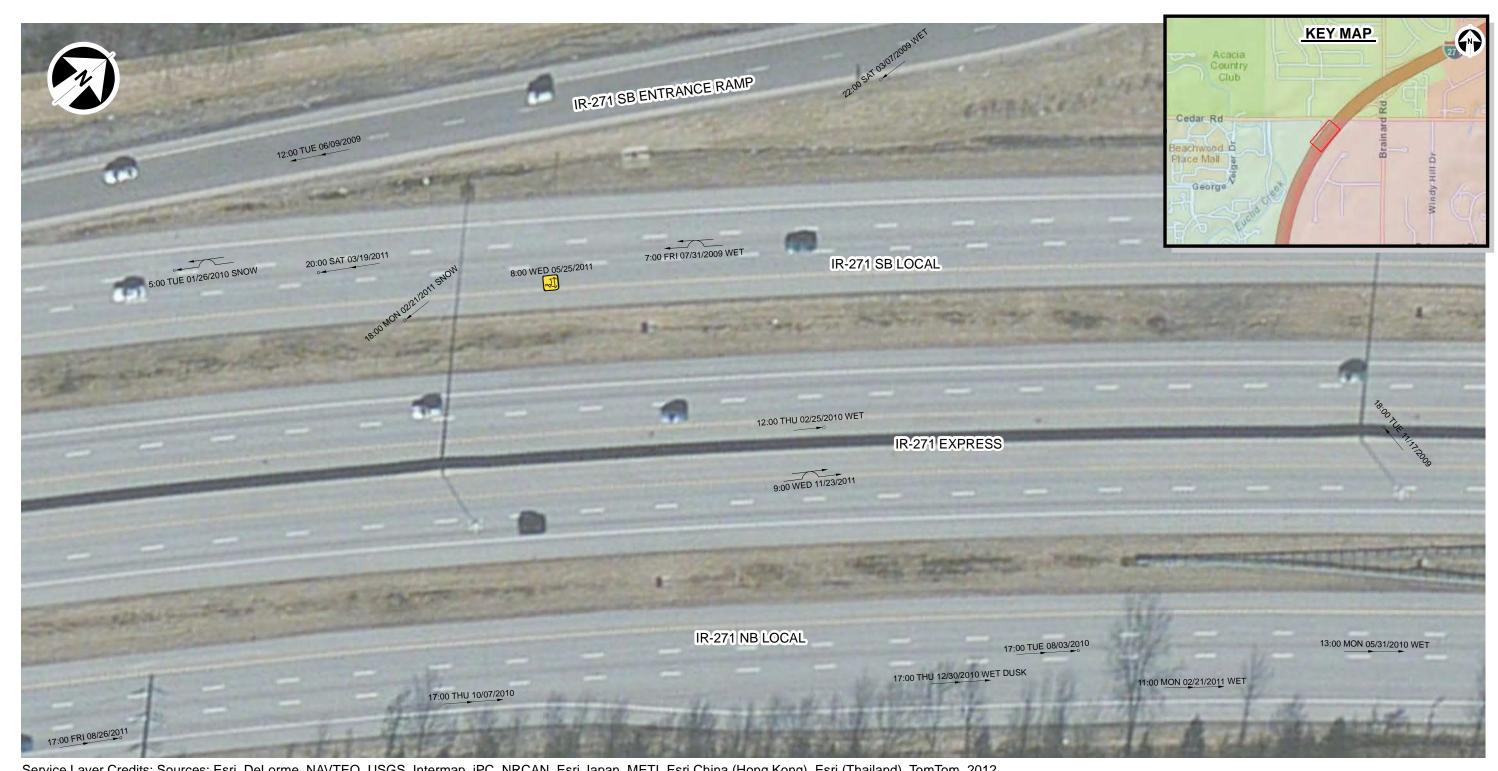
## **COLLISION DIAGRAM**

10.684 LOG POINT No. FROM \_ Beachwood & Pepper Pike, Ohio ROUTE NUMBER \_\_\_\_\_



DATE: 5/20/13

PAGE: 20 of 2



#### **NUMBER OF CRASHES**

11 PROPERTY DAMAGE ONLY

\_\_5

INJURY OR FATAL

<u> 16</u>

TOTAL CRASHES

SYMBO	LS	TYPES	OF COLLISIONS	SHOW FOR EACH CRASH
BACK NON-II PEDE PARKI FIXED FATAL	NG VEHICLE ING VEHICLE NVOLVED VEH. STRIAN ED VEHICLE O OBJECT CRASH		REAR END RIGHT ANGLE SIDE SWIPE OUT OF CONTROL LEFT TURN HEAD ON	1. TIME, DAY, DATE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED 3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

 LOG POINT No.
 10.672
 TO
 10.819

 PERIOD
 3 years
 FROM
 2009
 TO
 2011

 CITY
 Beachwood & Pepper Pike, Ohio
 ROUTE NUMBER
 I-275



DATE: 5/20/13

PAGE: 21 of 2



#### **NUMBER OF CRASHES**

PROPERTY DA

INJURY OR FA

TOTAL CRASH

	-	MOVING VEHIC
DAMAGE ONLY	<b>→&gt;&gt;&gt;</b>	BACKING VEH
DAINAGE ONET	<del></del>	NON-INVOLVED
ATAL	<b>⊸</b>	PEDESTRIAN
AIAL		PARKED VEHIC
HES		FIXED OBJECT
IILO	•	FATAL CRASH
	0	INJURY CRASH

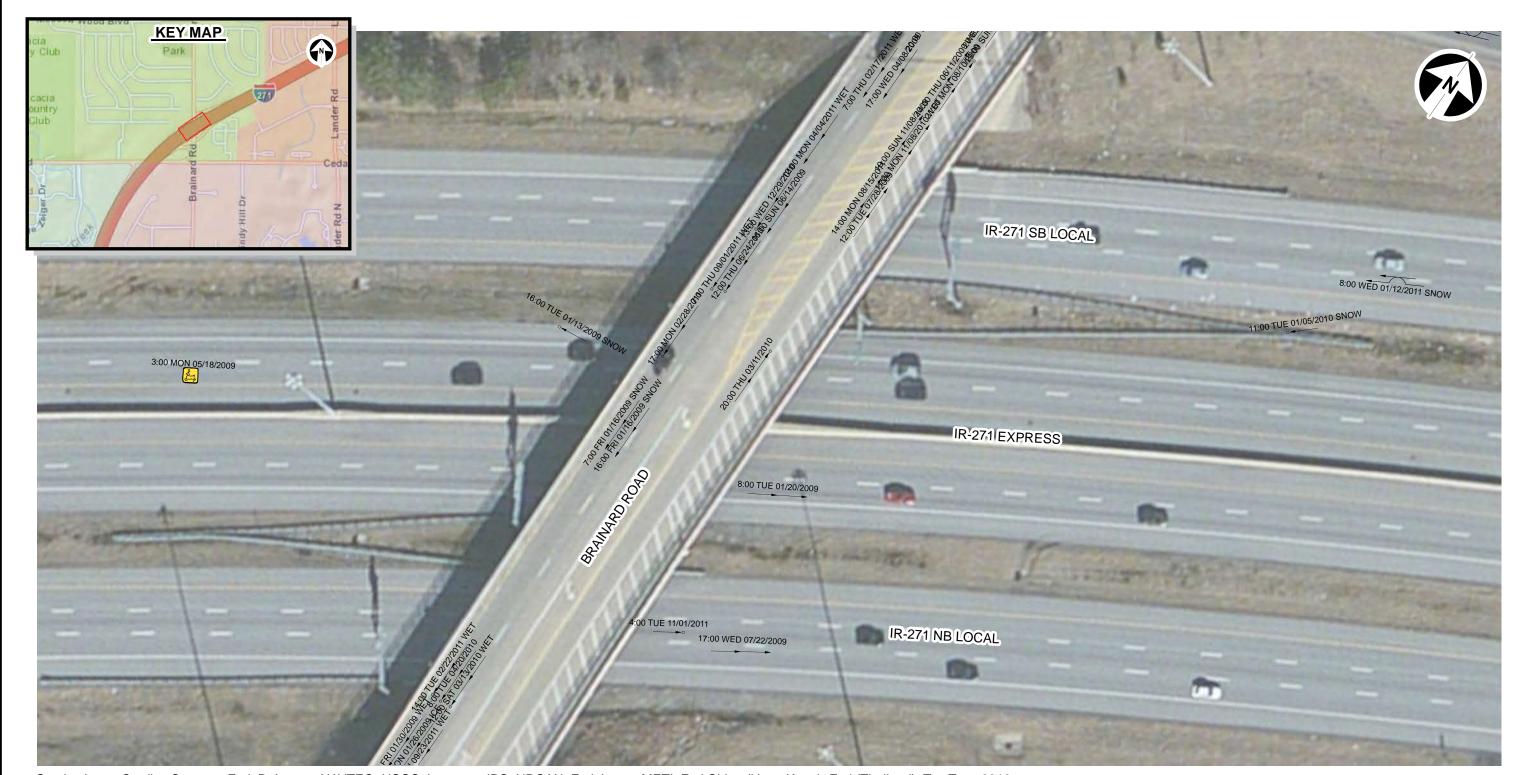
	2,412.21.2		SHOW FOR
	SYMBOLS	TYPES OF COLLISIONS	SHOW FOR EACH CRASH
_	MOVING VEHICLE	DEAD END	EACH CRASH
	MOVING VEHICLE	REAR END	4 TIME DAY DATE
$\longrightarrow \gg$	BACKING VEHICLE	RIGHT ANGLE	1. TIME, DAY, DATE
<del></del>	NON-INVOLVED VEH.	RIGITI ANGLE	
<b></b>	PEDESTRIAN	SIDE SWIPE	2. WEATHER AND ROAD
	-	0.52 0 2	SURFACE IF UNUSUAL
	PARKED VEHICLE	99 OUT OF CONTROL	CONDITION EXISTED
	FIXED OBJECT		
	FATAL CRASH	∫ LEFT TURN	3. NITE - IF BETWEEN
		<del>-</del>	DUSK AND DAWN
$\circ$	INJURY CRASH	HEAD ON	DOSK AND DAWN

## **COLLISION DIAGRAM**

10.967 10.822 LOG POINT No. \_\_\_ FROM \_\_\_ CITY Beachwood, Lyndhurst & Pepper Pike, Ohio ROUTE NUMBER



DATE: 5/20/13 PAGE: 22 of 26



SHOW FOR EACH CRASH

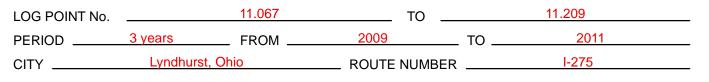
#### **NUMBER OF CRASHES**

PROPERTY DAMAGE ONLY

INJURY OR FATAL TOTAL CRASHES

	SYMBOLS	TYPES OF COLLISIONS	SHOW FOR EACH CRASH
	MOVING VEHICLE	DEAD END	EACH CRASH
		REAR END	4 71145 0 0 0 0 0 0 0 0 0
$\rightarrow\!$	BACKING VEHICLE	RIGHT ANGLE	1. TIME, DAY, DATE
	NON-INVOLVED VEH.	RIGHT ANGLE	
		SIDE SWIPE	2. WEATHER AND ROAD
	PEDESTRIAN	→ SIDE SWILE	SURFACE IF UNUSUAL
$\overline{}$	PARKED VEHICLE	OUT OF CONTROL	CONDITION EXISTED
1	FIXED OBJECT		OUNDITION EXICIES
_		LEFT TURN	O NUTE IE DETWEEN
	FATAL CRASH		3. NITE - IF BETWEEN
$\circ$	INJURY CRASH	—→ HEAD ON	DUSK AND DAWN

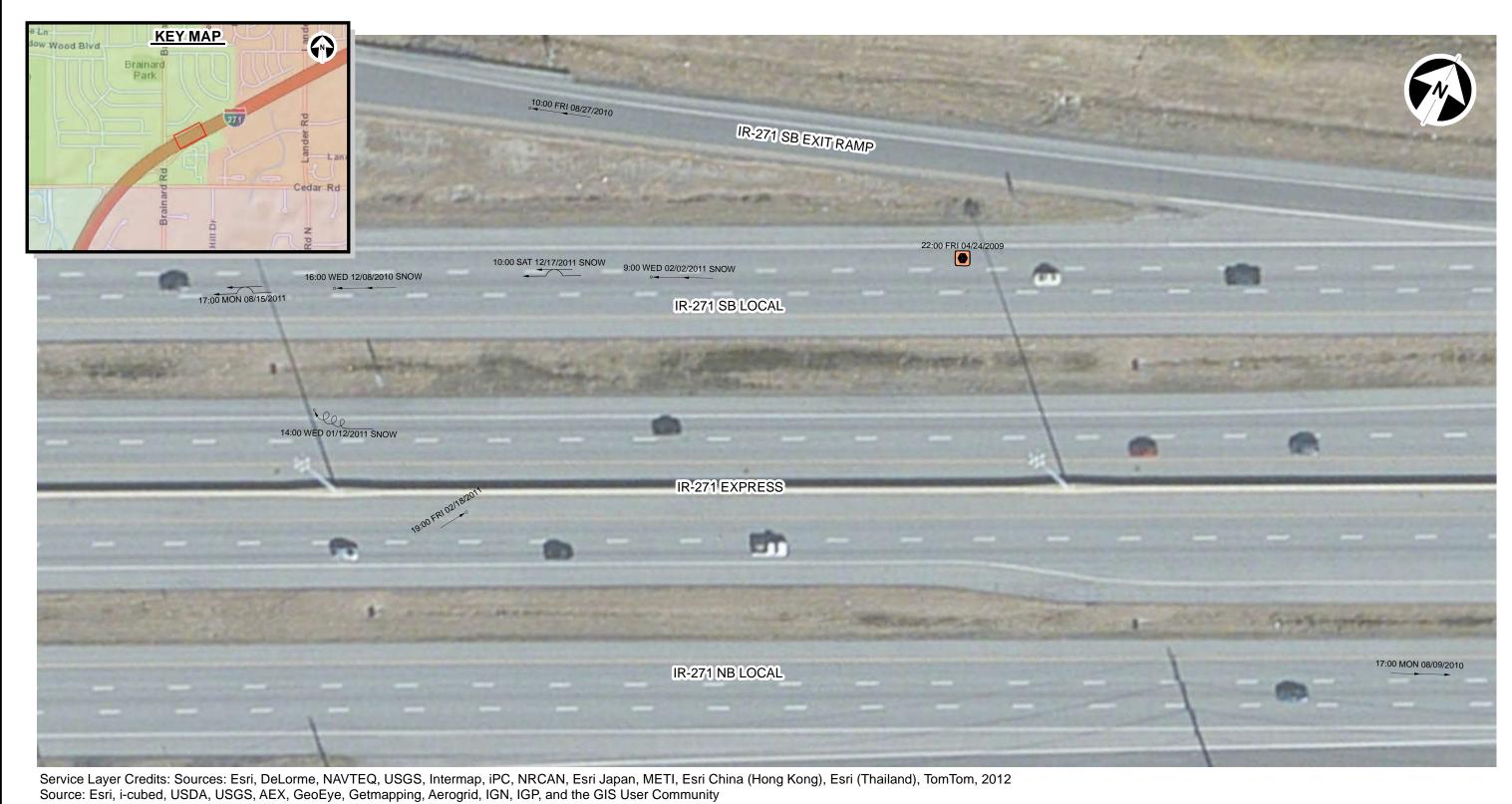
## **COLLISION DIAGRAM**





DATE: 5/20/13

PAGE: 23 of 26



#### **NUMBER OF CRASHES**

PROPERTY DAMAGE ONLY

INJURY OR FATAL

TOTAL CRASHES

SYMBOLS  MOVING VEHICLE  BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH  O INJURY CRASH  MOVING VEHICLE REAR END RIGHT ANGLE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED 3. NITE - IF BETWEEN DUSK AND DAWN				
MOVING VEHICLE BACKING VEHICLE NON-INVOLVED VEH. PEDESTRIAN PARKED VEHICLE FIXED OBJECT FATAL CRASH  REAR END RIGHT ANGLE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED 3. NITE - IF BETWEEN	SYMI	BOLS	TYPES OF COLLISIONS	
C MOUNT CITYON	BAC NOI	CKING VEHICLE N-INVOLVED VEH. DESTRIAN RKED VEHICLE ED OBJECT TAL CRASH	RIGHT ANGLE SIDE SWIPE OUT OF CONTROL	1. TIME, DAY, DATE  2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED  3. NITE - IF BETWEEN

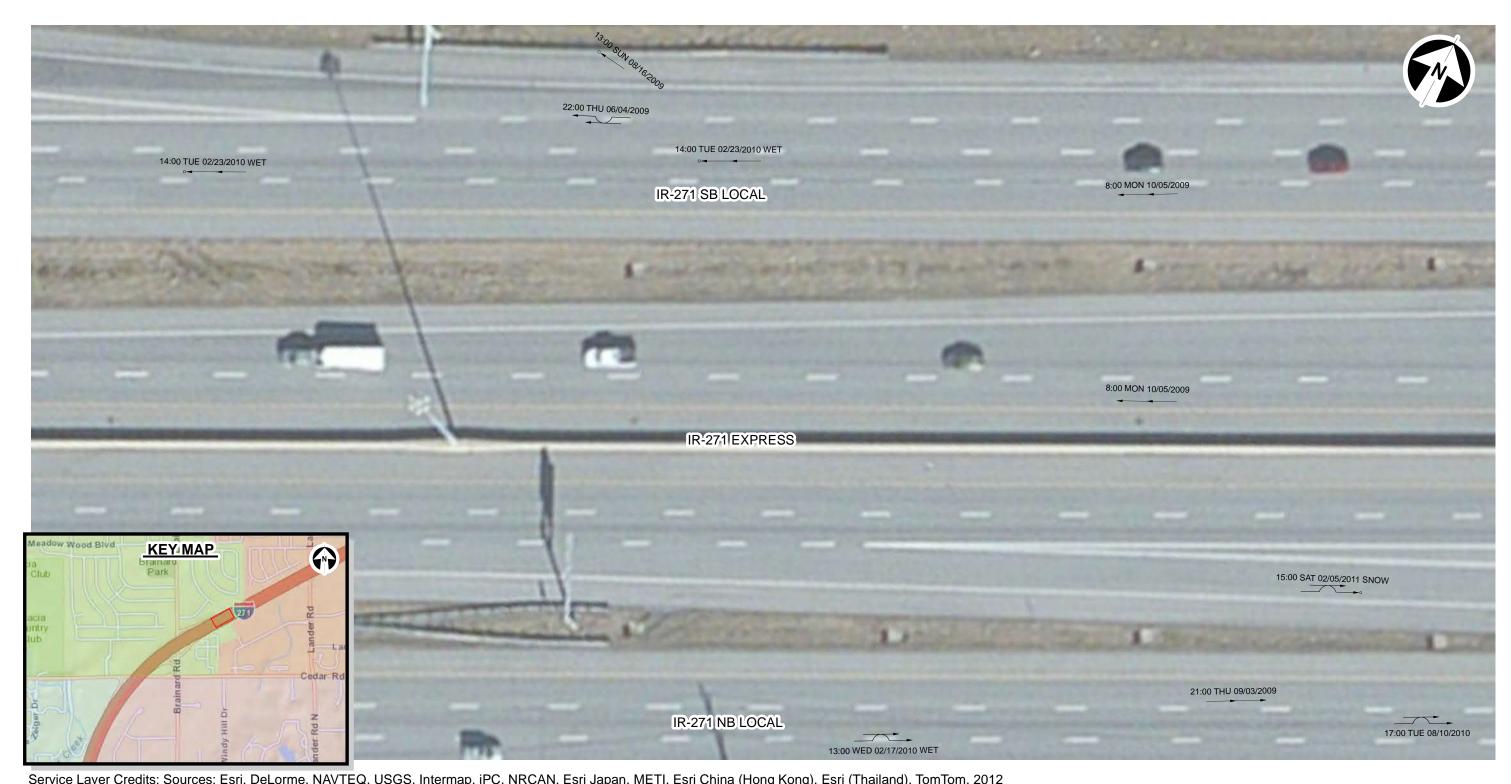
## **COLLISION DIAGRAM**

11.207 11.349 LOG POINT No. 3 years PERIOD \_ FROM \_\_\_ Cleveland ROUTE NUMBER \_\_\_\_ CITY \_\_\_\_



DATE: 5/20/13

PAGE: 24 of 2



HEAD ON

#### SHOW FOR TYPES OF COLLISIONS SYMBOLS **NUMBER OF CRASHES EACH CRASH** MOVING VEHICLE → REAR END 1. TIME, DAY, DATE **→>>>** BACKING VEHICLE PROPERTY DAMAGE ONLY RIGHT ANGLE NON-INVOLVED VEH. 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED SIDE SWIPE PEDESTRIAN INJURY OR FATAL PARKED VEHICLE OUT OF CONTROL FIXED OBJECT TOTAL CRASHES LEFT TURN 3. NITE - IF BETWEEN FATAL CRASH DUSK AND DAWN

INJURY CRASH

0

## **COLLISION DIAGRAM**

LOG POINT No.		11.346	TO		11.452	
PERIOD	3 years	FROM	2009	то	2011	
CITY	Lyndhurst	t, Ohio	ROUTE NUMB	ER	I-275	



DATE: 5/20/13

PAGE: 25 of 2



#### NUMBER OF CRASHES

1 TOTAL CRASHES

;	SYMBOLS
	MOVING VEHICLE
<b>→&gt;&gt;&gt;</b>	BACKING VEHICLE
<b></b>	NON-INVOLVED VEH.
<b>←</b>	PEDESTRIAN
$\overline{}$	PARKED VEHICLE
	FIXED OBJECT
•	FATAL CRASH
0	INJURY CRASH

DLS	TYPES OF COLLISIONS	
ING VEHICLE	→ REAR END	
KING VEHICLE	RIGHT ANGLE	· '
INVOLVED VEH. ESTRIAN	SIDE SWIPE	:
KED VEHICLE	OUT OF CONTROL	
D OBJECT	_	
L CRASH	LEFT TURN	;
RY CRASH	HEAD ON	

# SHOW FOR EACH CRASH 1. TIME, DAY, DATE 2. WEATHER AND ROAD SURFACE IF UNUSUAL CONDITION EXISTED 3. NITE - IF BETWEEN DUSK AND DAWN

## **COLLISION DIAGRAM**

LOG POINT No.		11.668		то _		11.773	_
PERIOD	3 years	FROM _	2009		_ TO	2011	_
CITY	Mayfield Heights, Ohio		ROUTE	NUMBER	₹	I-275	_



DATE: 5/20/13

# Appendix C

**Certified Traffic** 

### Appendix C

## INTER-OFFICE COMMUNICATION

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

**FROM:** Joshua Kieselbach, P.E., Transportation Engineer, Division of Statewide Planning

& Research, Modeling & Forecasting Section

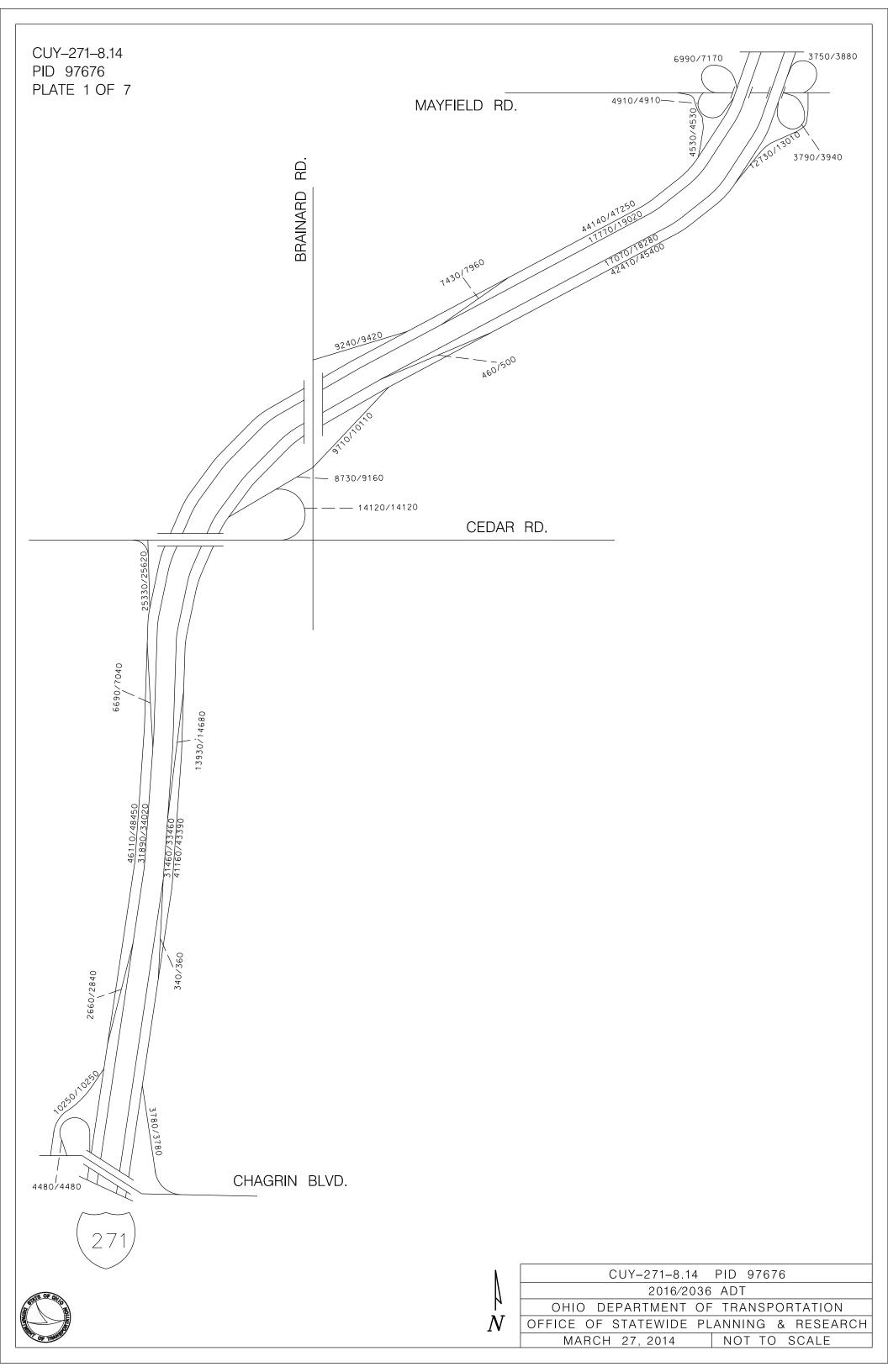
SUBJECT: CUY-271-8.14, PID 97676

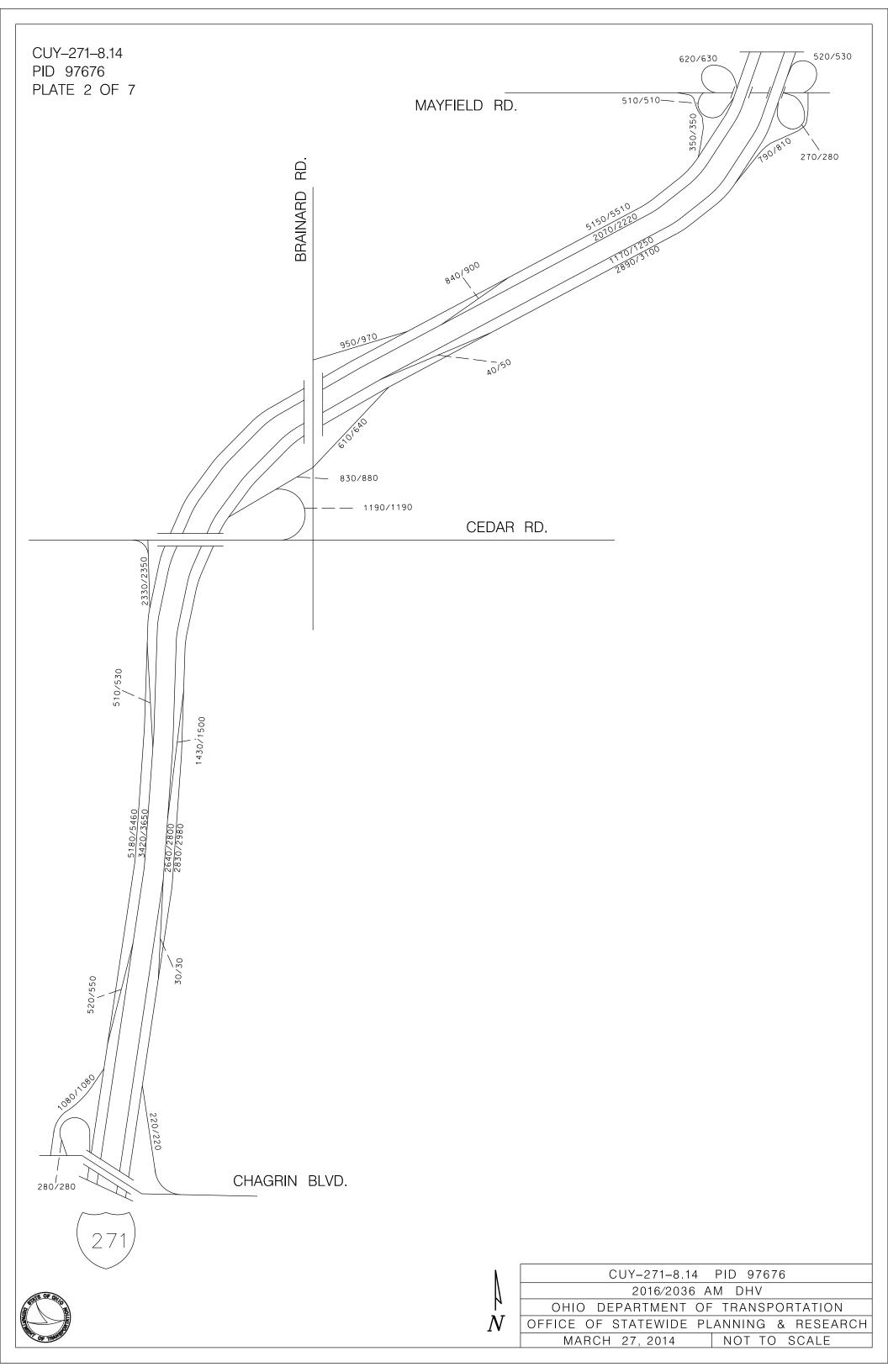
**DATE:** March 27, 2014

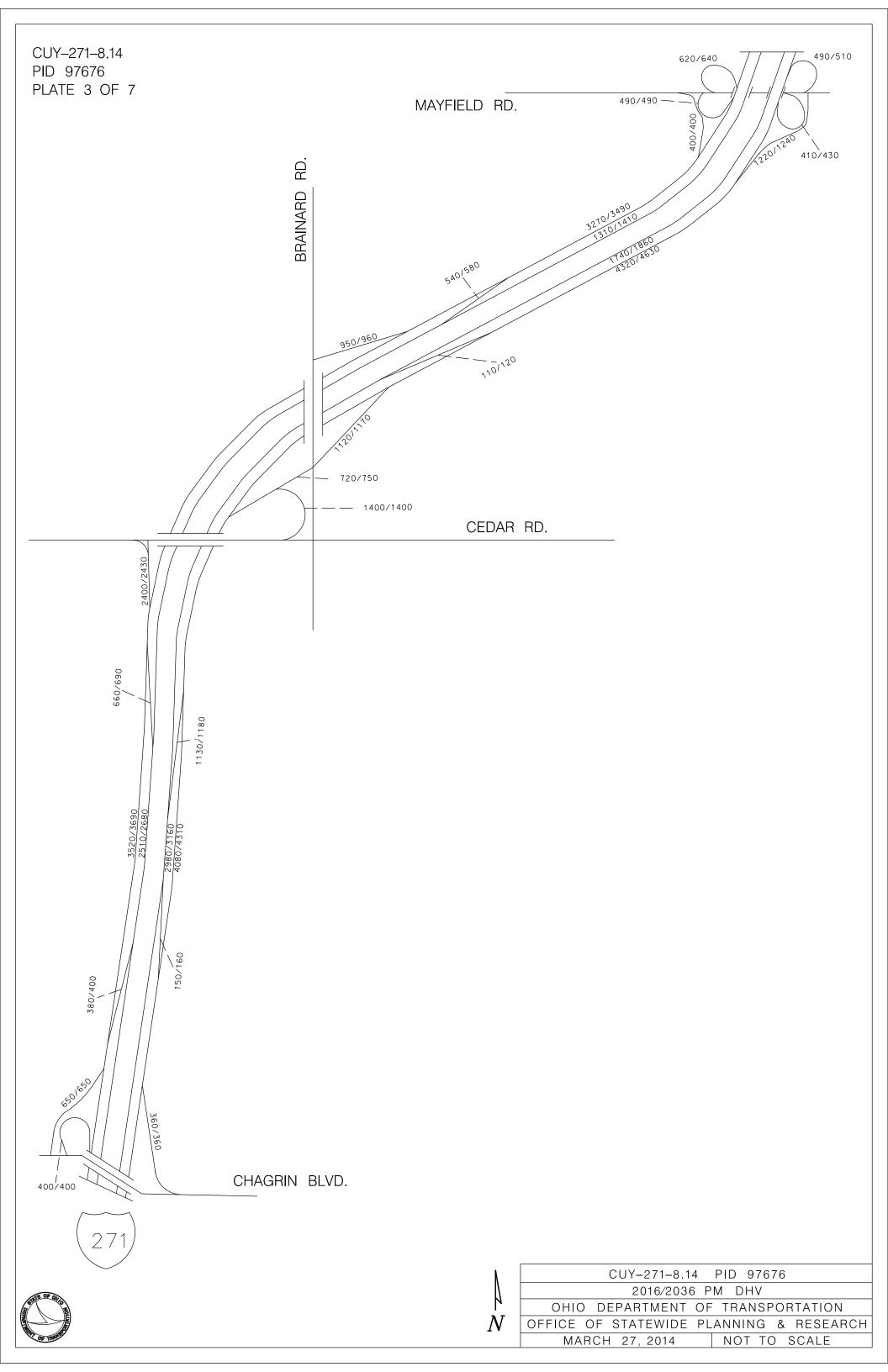
In reply to a request dated March 25, 2014, the request to update subject project has been completed. Based on our conversation the truck factors for the loop ramp from I-271 northbound to westbound Cedar Road have been reduced. In addition the two loop ramps for westbound Mayfield Road have been added to the traffic plates. The updated plates have been attached to this memo. All plates have been updated to include the PID for this project since it was not available prior to completion of the memo dated March 14, 2014.

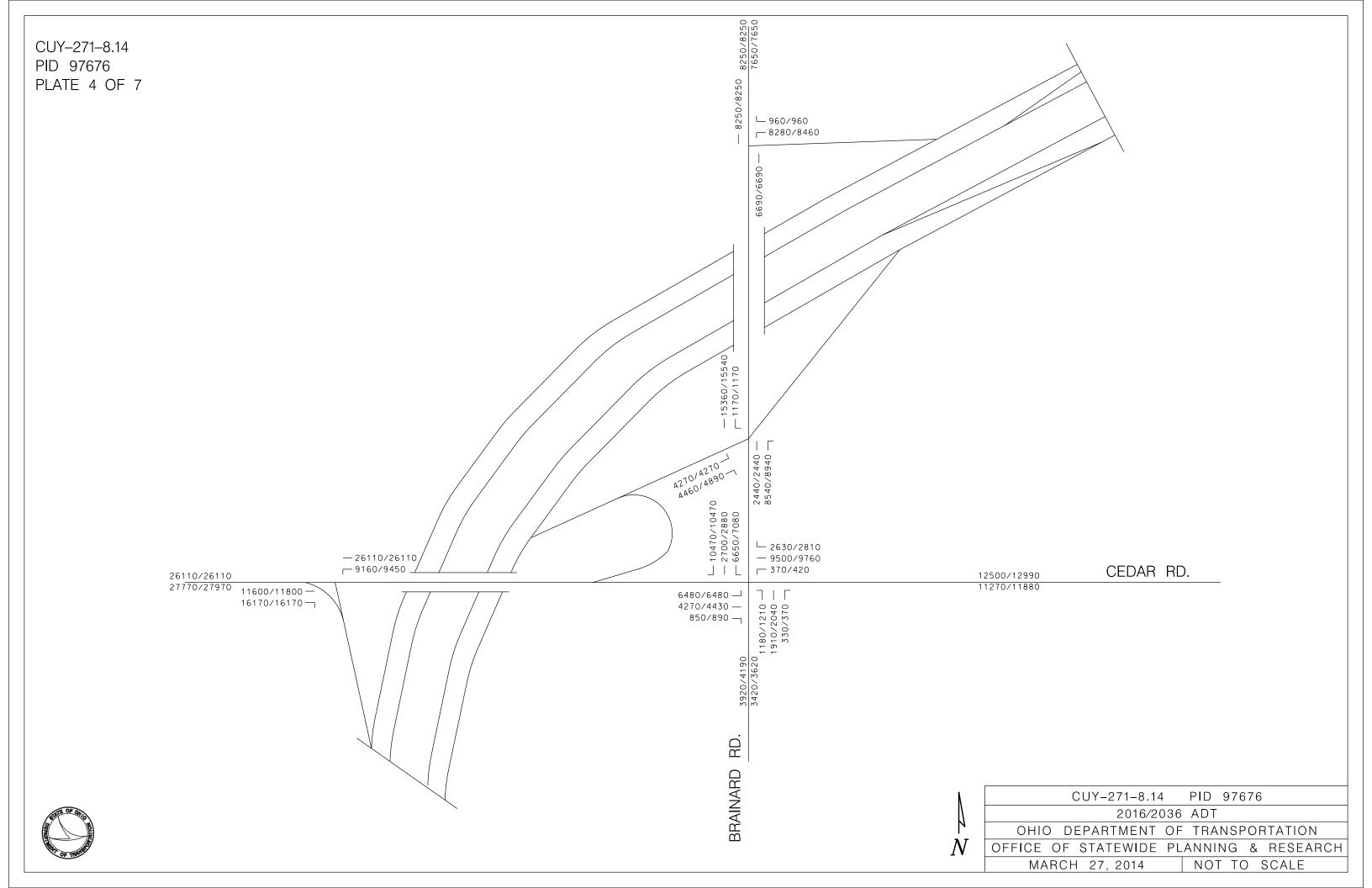
If you have any questions, please contact me at <u>Joshua.Kieselbach@dot.state.oh.us</u> or (614) 752-5747.

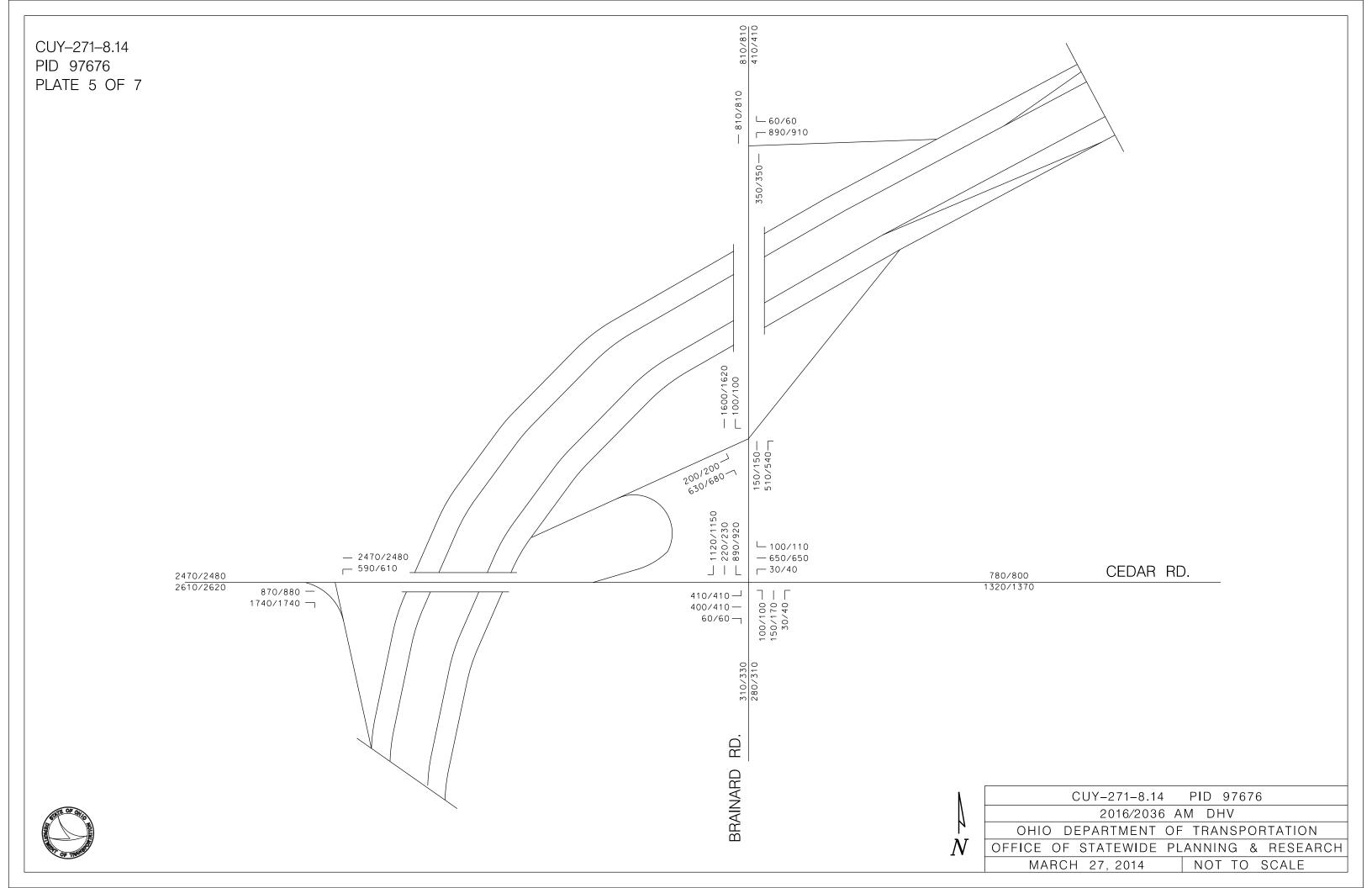
c: M. Byram, OSPR – G. Giaimo, OSPR – File

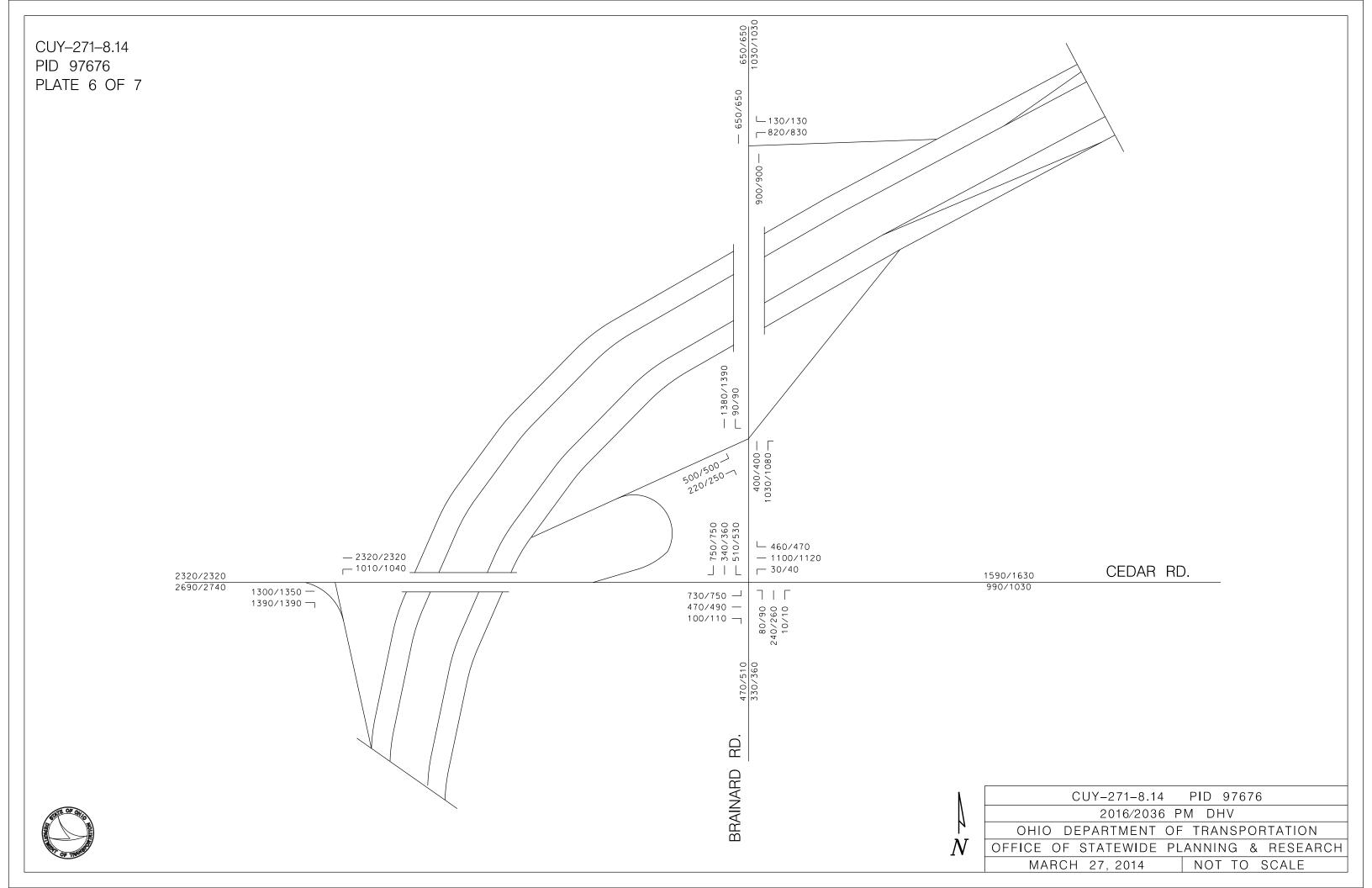


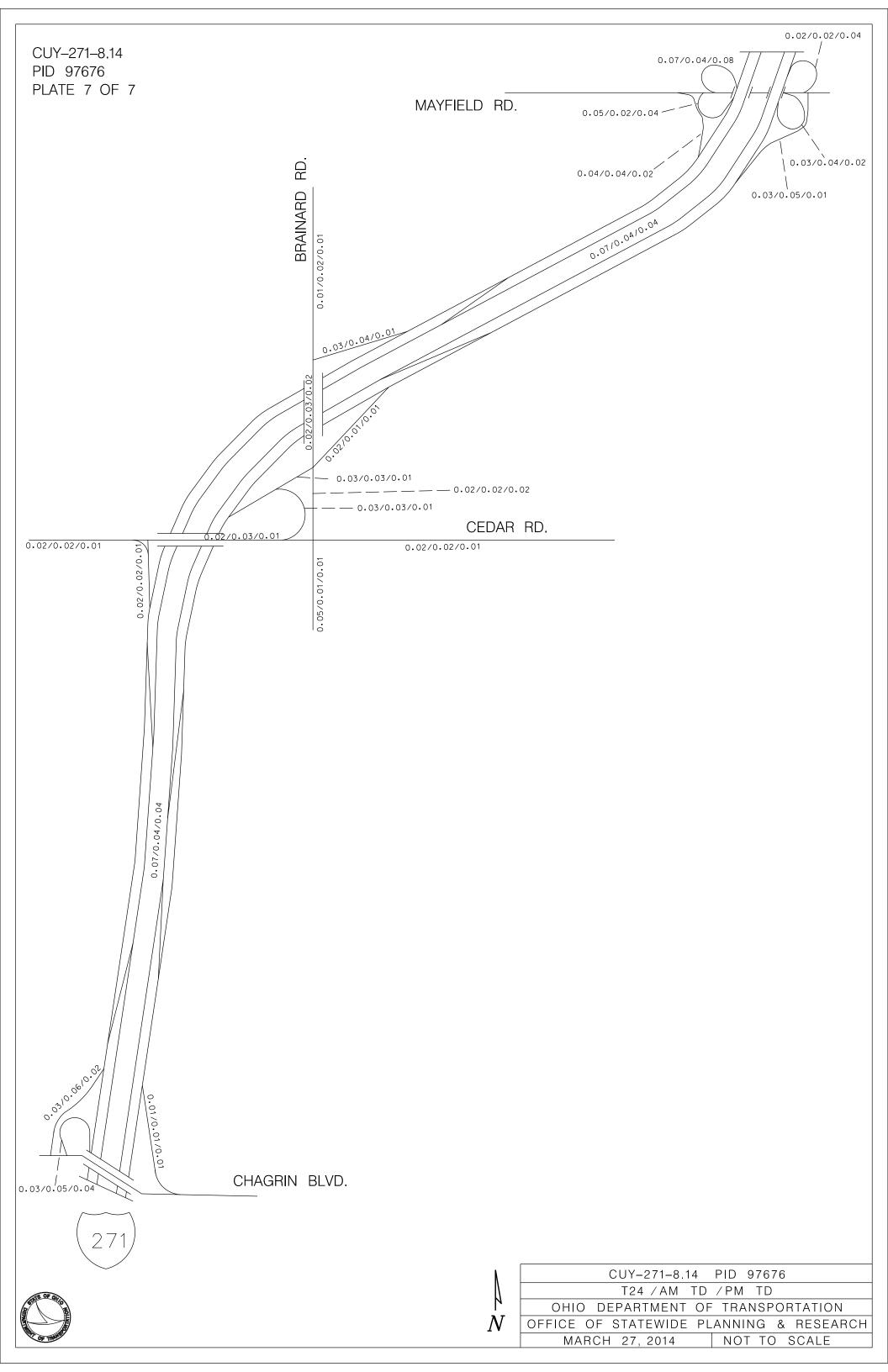






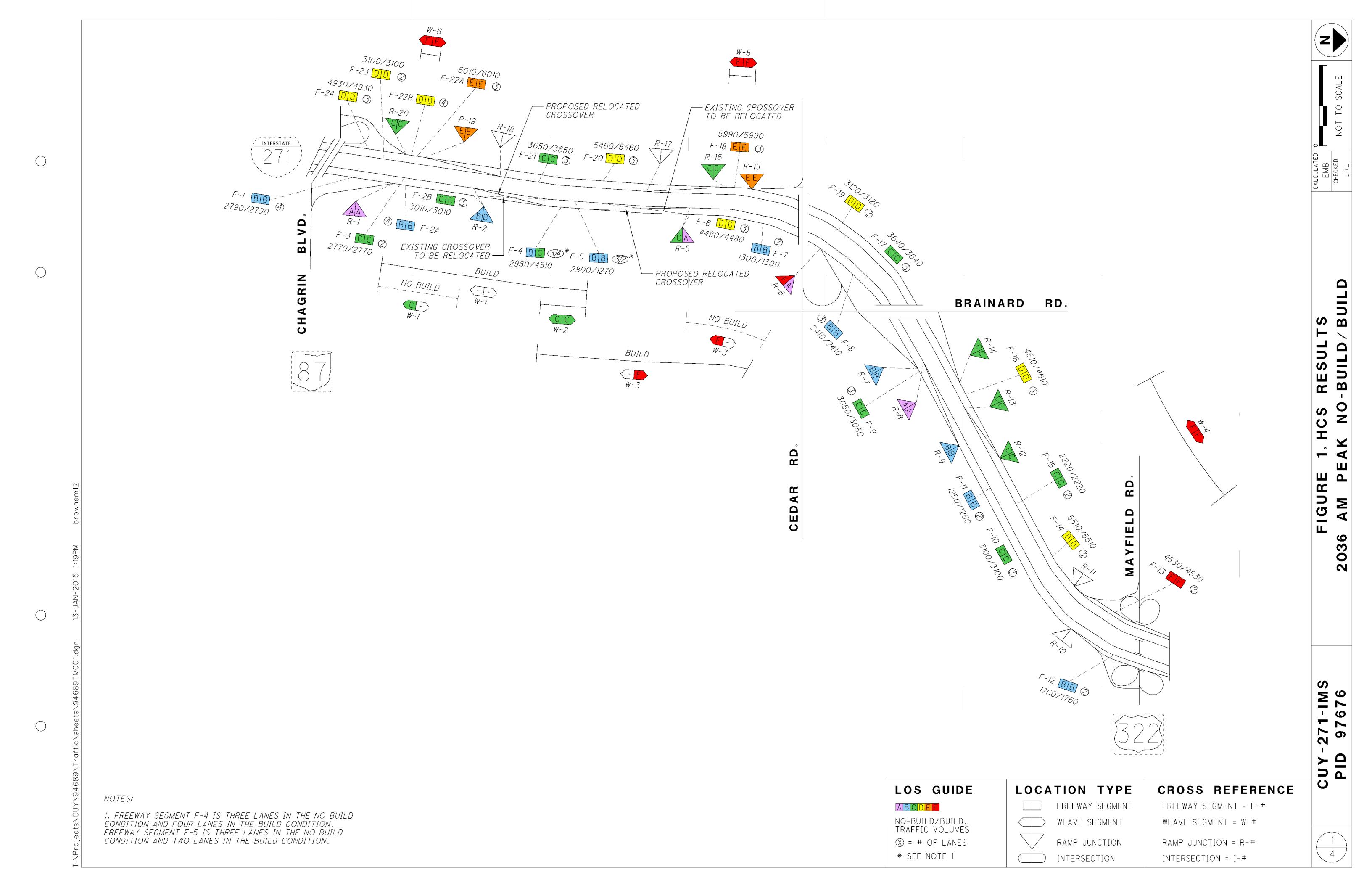


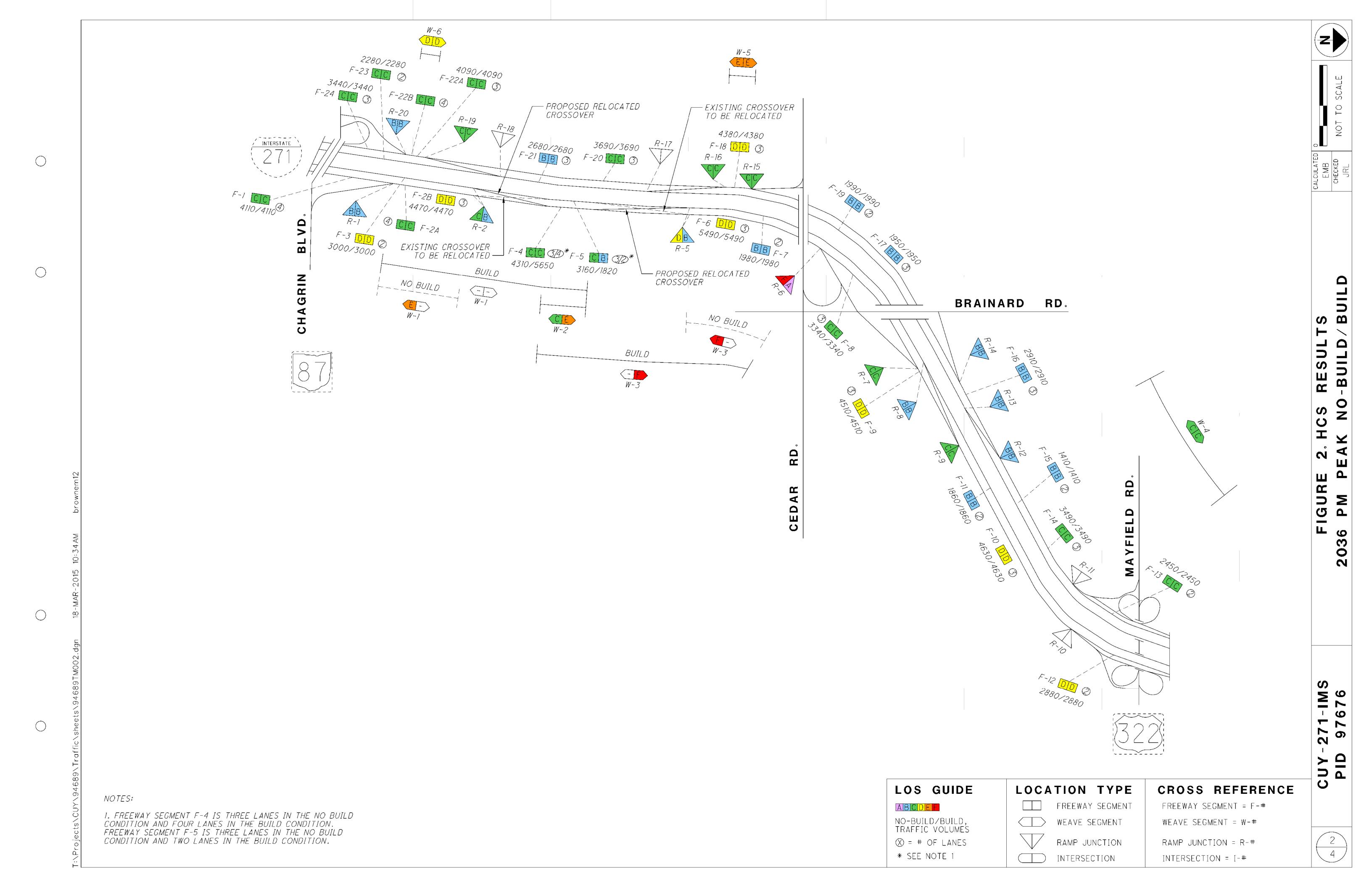




## Appendix D

**HCS Results** 





<u>5</u> 4

-271-IMS 97676

Phone: E-mail:		Fax:	
	Operational Analys	is	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB Chagrin Blvd to R-1 ODOT District 12 2036 1.14 - Build F-1	Merge	
	Flow Inputs and Ad	Justments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles		2790 0.94 742 4	veh/h v %
Terrain type: Grade Segment length		Level	% mi
Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor	E, ER t, fhV	1.5 1.2 0.980 1.00	<u>-</u>
Flow rate, vp		757	pc/h/ln
	Speed Inputs and A	djustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, Lateral clearance adjus	fLW	- - 4 Measured 60.0	ft ft ramps/mi mi/h mi/h mi/h
TRD adjustment Free-flow speed, FFS	remerie, ille	- 60.0	mi/h mi/h mi/h
	LOS and Performand	e Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	757 60.0 60.0 4 12.6 B	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company:
Date Performed: Parsons Brinckerhoff 8/21/2014 Analysis Time Period: AM Peak Freeway/Direction: I-271 NB From/To: R-1 Merge to R-3 Merge Analysis Year: ODOT District 12 Description: CUY-271-8.14 - Build F-2a \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 3010 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 801 v Trucks and buses 4 ે Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 817 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h Lane width adjustment, fLW mi/h Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 817 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N 4 Density, D 13.6 pc/mi/ln

В

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company:
Date Performed: Parsons Brinckerhoff 8/21/2014 Analysis Time Period: AM Peak Freeway/Direction: I-271 NB From/To: R-1 Merge to R-3 Merge Analysis Year: ODOT District 12 Description: CUY-271-8.14 - Build F-2b \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 3010 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 801 v Trucks and buses 4 ે Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1089 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h Lane width adjustment, fLW mi/h Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1089 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 18.1 pc/mi/ln

C

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/21/2014 Analysis Time Period: AM Peak
Freeway/Direction: I-271 NB (Express Lanes) From/To: Chagrin Blvd to R-2 Diverge ODOT District 12 Jurisdiction: Analysis Year: 2036 Description: CUY-271-8.14 - Build F-3 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ 2770 Volume, V veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 737 v Trucks and buses 4 કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1503 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h mi/h Lane width adjustment, fLW Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1503 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 25.0 pc/mi/ln

C

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Date Performed: Parsons Brinckerhoff 8/21/2014 Analysis Time Period: AM Peak Freeway/Direction: I-271 NB From/To: R-3 Merge to R-4 Diverge Analysis Year: ODOT District 12 Description: CUY-271-8.14 - Build F-4 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 4510 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 1199 v Trucks and buses કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1223 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h Lane width adjustment, fLW mi/h Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1223 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 20.4 pc/mi/ln

C

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/21/2014 Analysis Time Period: AM Peak
Freeway/Direction: I-271 NB (Express Lanes)
From/To: R-2 Diverge to R-5 Merge Analysis Year: 2036 Description: CUY-271-8.14 - Build F-5 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 1270 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 338 v Trucks and buses 4 કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 689 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h Lane width adjustment, fLW mi/h Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 689 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 11.5 pc/mi/ln

В

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Date Performed: Parsons Brinckerhoff 8/21/2014 Analysis Time Period: AM Peak Freeway/Direction: I-271 NB From/To: R-4 Diverge to R-6 Diverge Analysis Year: 2036 Description: CUY-271-8.14 - Build F-6 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 4480 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 1191 v Trucks and buses કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1620 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h Lane width adjustment, fLW mi/h Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1620 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 27.0 pc/mi/ln

D

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/21/2014 Analysis Time Period: AM Peak
Freeway/Direction: I-271 NB (Express Lanes)
From/To: R-5 Merge to R-8 Diverge Analysis Year: ODOT District 12 Description: CUY-271-8.14 - Build F-7 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 1300 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 346 v Trucks and buses 4 કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 705 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h mi/h Lane width adjustment, fLW Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ 705 Flow rate, vp pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 11.8 pc/mi/ln

В

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-6 Diverge to I ODOT District 1: 2036	R-7 Merge 2	
Volume, V		2410	veh/h
Peak-hour factor, PHF		0.94	V E11 / 11
Peak 15-min volume, v15		641	V
Trucks and buses		4	ર ૪
Recreational vehicles		0	96
Terrain type:		Level	
Grade		-	8
Segment length		_	mi
Trucks and buses PCE, ET		1.5	
Recreational vehicle PCE, ER		1.2	
Heavy vehicle adjustment, fHV		0.980	
Driver population facto	r, fp	1.00	
Flow rate, vp		872	pc/h/ln
	Speed Inputs ar	nd Adjustments_	
Lane width		_	ft
Right-side lateral clea	rance	_	ft
Total ramp density, TRD		_	ramps/mi
Number of lanes, N		3	<u> </u>
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	fLW	-	mi/h
Lateral clearance adjus	tment, fLC	-	mi/h
TRD adjustment		_	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Perform	mance Measures_	
Flow rate, vp		872	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	peed, S	60.0	mi/h
Number of lanes, N		3	
Density, D		14.5	pc/mi/ln
Level of service, LOS		В	

Phone: E-mail:		Fax:		
	Operational Ana	alysis		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-7 Merge to R-1 ODOT District 1: 2036 .14 - Build F-9	9 Merge		
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PCE Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3050 0.94 811 4 0 Level - 1.5 1.2 0.980 1.00	<pre>veh/h v % % % mi</pre>	
Speed Inputs and Adjustments				
Lane width Right-side lateral clea Total ramp density, TRE Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>	
LOS and Performance Measures				
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1103 60.0 60.0 3 18.4	pc/h/ln mi/h mi/h pc/mi/ln	

Phone: E-mail:		Fax:		
	Operational Ana	lysis		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brincker 8/22/2014 AM Peak I-271 NB R-9 Merge to R-1 ODOT District 12 2036 .14 - Build F-10	hoff O Diverge		
	Flow Inputs and	Adjustments		
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses		3100 0.94 824 4	veh/h v %	
Recreational vehicles Terrain type: Grade		0 Level	8	
Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustmen Driver population factor	E, ER t, fHV	1.5 1.2 0.980 1.00	mi	
Flow rate, vp		1121	pc/h/ln	
Speed Inputs and Adjustments				
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed: FFS or BFFS		- - 3 Measured	ft ft ramps/mi mi/h	
Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS		60.0 - - - 60.0	mi/h mi/h mi/h mi/h mi/h	
	LOS and Perform	ance Measures		
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1121 60.0 60.0 3 18.7 C	pc/h/ln mi/h mi/h pc/mi/ln	

Phone: E-mail:		Fax:		
	Operational Anal	vsis		
	operacional imai	7515		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB (Express R-8 Diverge to Mag ODOT District 12 2036 3.14 - Build F-11	Lanes) yfield Rd		
	Flow Inputs and .	Ad Justillelits		
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15	5	1250 0.94 332	veh/h v	
Trucks and buses Recreational vehicles Terrain type:		4 0 Level	% %	
Grade Segment length Trucks and buses PCE, F	CT	- - 1.5	% mi	
Recreational vehicle PO Heavy vehicle adjustment Driver population factor	nt, fHV	1.2 0.980 1.00		
Flow rate, vp		678	pc/h/ln	
Speed Inputs and Adjustments				
Lane width		_	ft	
Right-side lateral clea	arance	_	ft	
Total ramp density, TRI		_	ramps/mi	
Number of lanes, N		2		
Free-flow speed:		Measured		
FFS or BFFS		60.0	mi/h	
Lane width adjustment,		_	mi/h	
Lateral clearance adjus	stment, fLC	_	mi/h	
TRD adjustment		-	mi/h	
Free-flow speed, FFS		60.0	mi/h	
LOS and Performance Measures				
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D	speed, S	678 60.0 60.0 2 11.3	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>	
Level of service, LOS		В		

Phone: E-mail:		Fax:	
	Operational Ana	lysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-10 Diverge to M ODOT District 12 2036	Mayfield Rd	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15		1760 0.94 468	veh/h
Trucks and buses Recreational vehicles Terrain type:	,	400 4 0 Level	V % %
Grade Segment length Trucks and buses PCE, E	T	- - 1.5	% mi
Recreational vehicle PO Heavy vehicle adjustment Driver population factor	it, fHV	1.2 0.980 1.00	
Flow rate, vp		955	pc/h/ln
	Speed Inputs and	d Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:		- - - 2 Measured	ft ft ramps/mi
FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment		60.0	mi/h mi/h mi/h mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Performa	ance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D	speed, S	955 60.0 60.0 2 15.9	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>
Level of service, LOS		В	

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Analyse.
Agency or Company: Parsons Brinckerhoff Date Performed: 8/22/2014 Analysis Time Period: AM Peak Freeway/Direction: I-271 SB From/To: Mayfield Rd to R-11 Merge Analysis Year: ODOT District 12 Description: CUY-271-8.14 - Build F-13 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 4530 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 1205 v Trucks and buses કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 2458 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h Lane width adjustment, fLW mi/h Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 2458 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 46.6 mi/h Number of lanes, N Density, D 52.7 pc/mi/ln

F

Phone: E-mail:		Fax:	
	Operational Ana	llysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-11 Merge to R- ODOT District 12 2036	12 Diverge	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses		5510 0.94 1465 4	veh/h v %
Recreational vehicles Terrain type: Grade Segment length		0 Level - -	% % mi
Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor	E, ER t, fHV	1.5 1.2 0.980 1.00	
Flow rate, vp		1993	pc/h/ln
	Speed Inputs an	d Adjustments	
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed:		- - - 3 Measured	ft ft ramps/mi
FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS		60.0 - - - 60.0	mi/h mi/h mi/h mi/h mi/h
	LOS and Perform	nance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1993 60.0 57.2 3 34.8	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:		
	Operational Ana	lysis		
Freeway/Direction:	gency or Company: Parsons Brinckerhoff the Performed: 8/22/2014 talysis Time Period: AM Peak			
From/To: Jurisdiction: Analysis Year:	Mayfield Rd to R ODOT District 12 2036			
Description: CUY-271-8	3.14 - Build F-15			
	Flow Inputs and	Adjustments		
Volume, V Peak-hour factor, PHF		2220 0.94	veh/h	
Peak 15-min volume, v15	5	590	v	
Trucks and buses		4	96	
Recreational vehicles Terrain type:		0 Level	8	
Grade		- Level	90	
Segment length		_	mi	
Trucks and buses PCE, I	T	1.5		
Recreational vehicle PCE, ER		1.2		
Heavy vehicle adjustment, fHV		0.980		
Driver population factor	or, fp	1.00		
Flow rate, vp		1204	pc/h/ln	
Speed Inputs and Adjustments				
Lane width		_	ft	
Right-side lateral clea	arance	_	ft	
Total ramp density, TRI		-	ramps/mi	
Number of lanes, N		2		
Free-flow speed:		Measured		
FFS or BFFS	_	60.0	mi/h	
Lane width adjustment,		-	mi/h	
Lateral clearance adjus	stment, fLC	-	mi/h	
TRD adjustment		-	mi/h	
Free-flow speed, FFS		60.0	mi/h	
	LOS and Perform	ance Measures		
Flow rate, vp		1204	pc/h/ln	
Free-flow speed, FFS		60.0	mi/h	
Average passenger-car	speed, S	60.0	mi/h	
Number of lanes, N		2		
Density, D Level of service, LOS		20.1	pc/mi/ln	
Level of service, LOS		С		

Phone: E-mail:		Fax:		
	Operational Ana	alysis		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-12 Diverge to ODOT District 1: 2036 1.14 - Build F-16	R-14 Diverge		
Waluma W				
Volume, V Peak-hour factor, PHF		4610 0.94	veh/h	
Peak 15-min volume, v15		1226	V	
Trucks and buses	•	4	v %	
Recreational vehicles		0	%	
Terrain type:		Level	•	
Grade		-	90	
Segment length		_	mi	
Trucks and buses PCE, E	T	1.5		
Recreational vehicle PCE, ER		1.2		
Heavy vehicle adjustmen		0.980		
Driver population factor		1.00		
Flow rate, vp		1667	pc/h/ln	
Speed Inputs and Adjustments				
Lane width		_	ft	
Right-side lateral clea	rance	_	ft	
Total ramp density, TRI		_	ramps/mi	
Number of lanes, N		3	<u>_</u>	
Free-flow speed:		Measured		
FFS or BFFS		60.0	mi/h	
Lane width adjustment,	fLW	_	mi/h	
Lateral clearance adjus	tment, fLC	_	mi/h	
TRD adjustment		_	mi/h	
Free-flow speed, FFS		60.0	mi/h	
	LOS and Perfor	mance Measures		
Flow rate, vp		1667	pc/h/ln	
Free-flow speed, FFS		60.0	mi/h	
Average passenger-car s	speed, S	59.9	mi/h	
Number of lanes, N	= '	3		
Density, D		27.8	pc/mi/ln	
Level of service, LOS		D		

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB Brainard Rd to 0 0DOT District 12 2036 .14 - Build F-17	Cedar Rd	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PCE Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3640 0.94 968 4 0 Level - - 1.5 1.2 0.980 1.00 1317	<pre>veh/h v % % % mi pc/h/ln</pre>
	Speed Inputs ar	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1317 60.0 60.0 3 22.0	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Anal	lysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year:	8/22/2014		
Description: CUY-271-8			
-	Flow Inputs and	Adiustments	
	110 1111402 0110	11d j d 2 e e 11 e 2	
Volume, V		5990	veh/h
Peak-hour factor, PHF	_	0.94	
Peak 15-min volume, v15		1593	V
Trucks and buses		4	8
Recreational vehicles		0	8
Terrain type: Grade		Level -	<u>ે</u>
Segment length		_	mi
Trucks and buses PCE, I	TT.	1.5	шт
Recreational vehicle PCE, ER		1.2	
Heavy vehicle adjustment, fHV		0.980	
Driver population factor		1.00	
Flow rate, vp	, , , , , , , , , , , , , , , , , , ,	2167	pc/h/ln
	Speed Inputs and	d Adjustments	
Lane width		_	ft
Right-side lateral clea	arance	_	ft
Total ramp density, TRI		_	ramps/mi
Number of lanes, N		3	
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	fLW	_	mi/h
Lateral clearance adjus	stment, fLC	_	mi/h
TRD adjustment		-	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Performa	ance Measures	
Flow rate, vp		2167	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	speed, S	54.2	mi/h
Number of lanes, N		3	
Density, D		40.0	pc/mi/ln
Level of service, LOS		E	

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB (Expres R-13 Merge to R- ODOT District 12 2036 .14 - Build F-19	ss Lanes) -17 Merge	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3120 0.94 830 4 0 Level - 1.5 1.2 0.980 1.00 1693	veh/h v % % mi pc/h/ln
	Speed Inputs ar	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 2 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1693 60.0 59.8 2 28.3	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:					
	Operational Ana	alysis					
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-16 Diverge to ODOT District 12 2036 1.14 - Build F-20	R-19 Merge					
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		5460 0.94 1452 4 0 Level	veh/h v % %				
Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustmen Driver population factor Flow rate, vp	E, ER t, fhV	- 1.5 1.2 0.980 1.00 1975	% mi pc/h/ln				
	Speed Inputs ar	nd Adjustments					
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>				
LOS and Performance Measures							
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1975 60.0 57.4 3 34.4 D	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>				

Phone: E-mail:		Fax:					
	Operational Analy	vsis					
	operacional imai	, 515					
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	8/21/2014 AM Peak I-271 SB (Express R-17 Merge to R-18 ODOT District 12 2036 3.14 - Build F-21	Lanes) 3 Diverge					
	Flow Inputs and $R$	Adjustments					
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15	5	3650 0.94 971	veh/h v				
Trucks and buses Recreational vehicles Terrain type:		4 0 Level	ે ક				
Grade Segment length		- - TeAET	% mi				
Trucks and buses PCE, Recreational vehicle PCH Heavy vehicle adjustment Driver population factors	CE, ER nt, fHV	1.5 1.2 0.980 1.00					
Flow rate, vp	. , _	1320	pc/h/ln				
	Speed Inputs and	Adjustments					
Lane width			ft				
Right-side lateral clea	arance	_	ft				
Total ramp density, TRI		_	ramps/mi				
Number of lanes, N		3					
Free-flow speed:		Measured					
FFS or BFFS		60.0	mi/h				
Lane width adjustment,	fLW	-	mi/h				
Lateral clearance adjus	stment, fLC	-	mi/h				
TRD adjustment		-	mi/h				
Free-flow speed, FFS		60.0	mi/h				
LOS and Performance Measures							
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D	speed, S	1320 60.0 60.0 3 22.0	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>				
Level of service, LOS		С					

Phone: E-mail:		Fax:					
	Operational Ana	lysis					
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brincker 8/22/2014 AM Peak I-271 SB R-19 Merge to R- ODOT District 12 2036	hoff					
Description: Co1-2/1-0	Flow Inputs and	Adiustments					
Volume, V Peak-hour factor, PHF	Inputs and	6010	veh/h				
Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		1598 4 0 Level	V % %				
Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustmen	E, ER	- 1.5 1.2 0.980	% mi				
Driver population facto Flow rate, vp		1.00 2174	pc/h/ln				
	Speed Inputs and	d Adjustments					
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed: FFS or BFFS		- - 3 Measured 60.0	ft ft ramps/mi mi/h				
Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS		- - 60.0	mi/h mi/h mi/h mi/h				
LOS and Performance Measures							
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	2174 60.0 54.0 3 40.2 E	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>				

Phone: E-mail:		Fax:					
	Operational Ana	alysis					
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-19 Merge to RODOT District 1: 2036	-20 Diverge 2					
Volume, V		6010	veh/h				
Peak-hour factor, PHF		0.94	V C11/ 11				
Peak 15-min volume, v15	5	1598	V				
Trucks and buses		4	90				
Recreational vehicles		0	%				
Terrain type:		Level					
Grade		_	%				
Segment length		_	mi				
Trucks and buses PCE, E	T	1.5					
Recreational vehicle PC	CE, ER	1.2					
Heavy vehicle adjustmer	ıt, fHV	0.980					
Driver population factor	or, fp	1.00					
Flow rate, vp		1630	pc/h/ln				
	Speed Inputs ar	nd Adjustments_					
Lane width		_	ft				
Right-side lateral clea	rance	_	ft				
Total ramp density, TRI		_	ramps/mi				
Number of lanes, N		4	1 17				
Free-flow speed:		Measured					
FFS or BFFS		60.0	mi/h				
Lane width adjustment,	fLW	_	mi/h				
Lateral clearance adjus	stment, fLC	_	mi/h				
TRD adjustment		-	mi/h				
Free-flow speed, FFS		60.0	mi/h				
LOS and Performance Measures							
Flow rate, vp		1630	pc/h/ln				
Free-flow speed, FFS		60.0	mi/h				
Average passenger-car s	speed, S	60.0	mi/h				
Number of lanes, N	,	4	•				
Density, D		27.2	pc/mi/ln				
Level of service, LOS		D					

Phone: E-mail:		Fax:					
	Operational Anal	ysis					
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brinckerk 8/21/2014 AM Peak I-271 SB (Express R-18 Diverge to 0 ODOT District 12 2036	noff s Lanes) Chagrin Blvd					
	riow inputs and	Adjustments					
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade	;	3100 0.94 824 4 0 Level	veh/h v % %				
Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	EE, ER at, fHV	- 1.5 1.2 0.980 1.00 1682	mi pc/h/ln				
	Speed Inputs and	Adiustments					
	bpeca inpues and	Adjusements					
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment	fLW	- - 2 Measured 60.0 -	ft ft ramps/mi mi/h mi/h mi/h mi/h mi/h				
Free-flow speed, FFS		60.0	mi/h				
LOS and Performance Measures							
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS		1682 60.0 59.9 2 28.1	pc/h/ln mi/h mi/h pc/mi/ln				

Operational Analysis							
Agency or Company: Parsons Brinckerhoff Date Performed: 8/22/2014 Analysis Time Period: AM Peak Freeway/Direction: I-271 SB From/To: R-20 Diverge to Chagrin Blvd Jurisdiction: ODOT District 12 Analysis Year: 2036 Description: CUY-271-8.14 - Build F-24  Flow Inputs and Adjustments  Volume, V 4930 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 1311 v Trucks and buses 4 % Recreational vehicles 0 % Terrain type: Level Grade - % Segment length - mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 Flow rate, vp 1783 pc/h/ln  Speed Inputs and Adjustments  Lane width - ft Right-side lateral clearance - ft Right-side lateral clearance - ft Number of lanes, N 3 Free-flow speed: Measured							
Peak-hour factor, PHF Peak 15-min volume, v15 Pecreational vehicles Perrain type: Peak 15-min volume, v15 Pevel Peak 15 Pevel Peak 15-min volume, v15 Pevel Peak 15-mi							
Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Recreational vehicles Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population factor, fp Flow rate, vp  Lane width Right-side lateral clearance Total ramp density, TRD Number of lanes, N Free-flow speed:  Measured  1311 V  V  1311  V  14							
Peak 15-min volume, v15 Trucks and buses Recreational vehicles Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population factor, fp Flow rate, vp  Lane width Right-side lateral clearance Number of lanes, N Free-flow speed:  1311 V  1311 V  0  1311 V  1311 V  1311 V  1311 V  14  8  8  8  8  8  10  10  10  10  10  10							
Trucks and buses  Recreational vehicles  Terrain type: Grade Segment length  Trucks and buses PCE, ET  Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population factor, fp Flow rate, vp  Lane width Right-side lateral clearance Total ramp density, TRD Number of lanes, N Free-flow speed:  Level  *  *  *  *  *  *  *  *  *  *  *  *  *							
Recreational vehicles  Terrain type:  Grade Segment length  Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population factor, fp Flow rate, vp  Speed Inputs and Adjustments  Lane width Right-side lateral clearance Total ramp density, TRD Number of lanes, N Free-flow speed:  Meavel  Level  * Level * * * * * * * * * * * * * * * * * * *							
Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population factor, fp Flow rate, vp  Speed Inputs and Adjustments  Lane width Right-side lateral clearance Total ramp density, TRD Number of lanes, N Free-flow speed:  Measured  1.5  1.2  1.2  1.00  1.00  1783 pc/h/ln  ft ft ft ramps/mi number of lanes, N Reasured							
Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population factor, fp Flow rate, vp  Speed Inputs and Adjustments  Lane width Right-side lateral clearance Total ramp density, TRD Number of lanes, N Free-flow speed:  Measured  1.5  1.2  1.2  1.00  1.00  1783 pc/h/ln  ft ft ft ramps/mi number of lanes, N Reasured							
Trucks and buses PCE, ET  Recreational vehicle PCE, ER  Heavy vehicle adjustment, fHV  Driver population factor, fp  Flow rate, vp  Speed Inputs and Adjustments  Lane width  Right-side lateral clearance  Total ramp density, TRD  Number of lanes, N  Free-flow speed:  1.5  1.2  1.2  1.00  1.783  pc/h/ln  ft  ft  ramps/mi  Namps/mi							
Recreational vehicle PCE, ER  Heavy vehicle adjustment, fHV  Driver population factor, fp  Flow rate, vp  Speed Inputs and Adjustments  Lane width  Right-side lateral clearance  Total ramp density, TRD  Number of lanes, N  Free-flow speed:  1.2  1.2  1.00  1783  pc/h/ln  ft  ft  ramps/mi  Number of lanes, N  Reasured							
Heavy vehicle adjustment, fHV 0.980  Driver population factor, fp 1.00  Flow rate, vp 1783 pc/h/ln Speed Inputs and Adjustments  Lane width - ft Right-side lateral clearance - ft Total ramp density, TRD - ramps/mi Number of lanes, N 3 Free-flow speed: Measured							
Driver population factor, fp 1.00 Flow rate, vp 1783 pc/h/ln Speed Inputs and Adjustments  Lane width - ft Right-side lateral clearance - ft Total ramp density, TRD - ramps/mi Number of lanes, N 3 Free-flow speed: Measured							
Flow rate, vp 1783 pc/h/ln Speed Inputs and Adjustments  Lane width - ft Right-side lateral clearance - ft Total ramp density, TRD - ramps/mi Number of lanes, N 3 Free-flow speed: Measured							
Speed Inputs and Adjustments  Lane width							
Lane width - ft Right-side lateral clearance - ft Total ramp density, TRD - ramps/mi Number of lanes, N 3 Free-flow speed: Measured							
Right-side lateral clearance - ft Total ramp density, TRD - ramps/mi Number of lanes, N 3 Free-flow speed: Measured							
Right-side lateral clearance - ft Total ramp density, TRD - ramps/mi Number of lanes, N 3 Free-flow speed: Measured							
Total ramp density, TRD - ramps/mi Number of lanes, N 3 Free-flow speed: Measured							
Number of lanes, N 3 Free-flow speed: Measured							
Free-flow speed: Measured							
FFS or BFFS 60.0 mi/h							
Lane width adjustment, fLW - mi/h							
Lateral clearance adjustment, fLC - mi/h							
TRD adjustment - mi/h							
Free-flow speed, FFS 60.0 mi/h							
LOS and Performance Measures							
Flow rate, vp 1783 pc/h/ln							
Free-flow speed, FFS 60.0 mi/h							
Average passenger-car speed, S 59.4 mi/h							
Number of lanes, N 3							
Density, D 30.0 pc/mi/ln							
Level of service, LOS D							

Phone: E-mail:		F	ax:				
	Merge	Analy	sis				
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB Chagrin Blvd District 12 2036						
	Free	way Da	ta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Merge 4 60.0 2790		mph vph		
	On R	amp Da	ta				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Right 1 35.0 220 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	e exists	3)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp	:	Yes 30 Downst Off 4700	ream	vph ft		
-	_	7	_				
Junction Components	version to pc/h	Under Freew		Condition Ramp		Adjace	
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC	T	2790 0.90 775 4 0 Level	% mi	220 0.90 61 1 0 Level	% mi	Ramp 30 0.90 8 0 0 Level	vph v % % % mi

```
Heavy vehicle adjustment, fHV 0.980 0.995 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                     33
                                 3162
                                           246
                                                             pcph
               _____Estimation of V12 Merge Areas____
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 0.187 Using Equation 4
                FM
               v = v (P) = 591 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                      Actual
                       3408
                                   9200
    V
                                                No
    FO
                      1285 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 1264
                12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   ___Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  1510
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 7.7 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence A
  _____Speed Estimation_____
Intermediate speed variable,
                                      M = 0.234
                                       S
Space mean speed in ramp influence area,
                                     S = 55.8
                                      R
Space mean speed in outer lanes,
                                      S = 58.4
                                      0
                                     S = 57.2  mph
Space mean speed for all vehicles,
```

Phone: Fax: E-mail:Diverge Analysis								
Analyst:		ge Alla	турт	ъ <u></u>				
Agency/Co.: Date performed: Analysis time period:								
	ravel: I-271 NB (Express Lanes) I-271 NB (Local Lanes) District 12 2036							
_	Free		ıta					
Type of analysis			Dive	rge	<u> </u>			
Number of lanes in free Free-flow speed on free Volume on freeway			3 60.0 2770			mph vph		
	Off R	amp Da	ıta					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Left 1 60.0 1500			mph vph ft ft		
	Adjacent Ramp	Data	(if o	one	e exists	)		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp	mp		Yes 1500 Downs On	str		vph		
Distance to adjacent ra	mp		3600			ft		
Con	version to pc/h	Under	Base	e C	Conditio	ns		
Junction Components		Freew	ay		Ramp		Adjacer Ramp	nt
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		2770 0.90 769 4 0 Level			1500 0.90 417 0 0 Level		1500 0.90 417 0 0 Level	vph v %
Grade Length Trucks and buses PCE, E Recreational vehicle PC		0.00 0.00 1.5 1.2	% m:		0.00 0.00 1.5 1.2	% mi	0.00 0.00 1.5 1.2	% mi

```
3139
                                              1667
                                                         1667
Flow rate, vp
                                                                 pcph
                _____Estimation of V12 Diverge Areas_____
                L =
                               (Equation 13-12 or 13-13)
                 ΕO
                P =
                      0.605 Using Equation 5
                 FD
                v = v + (v - v) P = 2557 pc/h
                 12 R F R FD
                     _____Capacity Checks____
                                                    LOS F?
                        Actual
                                     Maximum
                        3139
                                     6900
    v = v
                                                    No
     Fi F
    v = v - v
                        1472
                                     6900
                                                    No
     FO F R
    V
                        1667
                                     2200
                                                    No
     R
                                    (Equation 13-14 or 13-17)
    v or v
                        582 pc/h
     3 av34
               > 2700 pc/h?
Is
    v or v
                                     No
     3 av34
Is
    v or v
                > 1.5 v /2
                                     No
         av34
     3
                     12
If yes, v
          = 2557
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                   _Flow Entering Diverge Influence Area__
                                Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    2557
                                                     No
     12
            ____Level of Service Determination (if not F)_____
                     D = 4.252 + 0.0086 v - 0.009 L = 13.8 pc/mi/ln
Density,
                                       12
Level of service for ramp-freeway junction areas of influence B
             _____Speed Estimation____
Intermediate speed variable,
                                         D = 0.253
                                         S
Space mean speed in ramp influence area,
                                         S = 55.4
                                                     mph
                                         R
Space mean speed in outer lanes,
                                         S = 65.8
                                                     mph
                                         0
Space mean speed for all vehicles,
                                        S = 56.7
                                                   mph
```

0.980

1.00

1.000

1.00

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:	F	ax:						
Merge Analysis								
Analyst: Eric Brown Agency/Co.: Parsons Brinckerhoff Date performed: 12/11/14 Analysis time period: AM Peak Freeway/Dir of Travel: I-271 NB (Express Lanes) Junction: I-271 NB (Local Lanes) Jurisdiction: District 12 Analysis Year: 2036 Description: CUY-271-8.14 - Build R-5								
	Free	way Da	ta					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	_		Merge 2 60.0 1270		mph vph			
	On R	amp Da	ta					
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Left 1 35.0 30 1500		mph vph ft ft			
	Adjacent Ramp	Data	(if on	e exists	s)			
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp		Yes 1500 Upstre Off 3000	am	vph ft			
Con	Conversion to pc/h Under Base Conditions							
Junction Components	3 5 F G / 11	Freew		Ramp	~	Adjacer Ramp	nt	
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		1270 0.90 353 4 0 Level		30 0.90 8 1 0 Level		1500 0.90 417 0 0 Level	vph v % %	
Grade Length	TT.	1 5	% mi	1 5	% mi	1 E	% mi	
Trucks and buses PCE, E	T	1.5		1.5		1.5		

Recreational vehicle PCE, ER 1.2 1.2

```
1439
                                             34
                                                       1667
Flow rate, vp
                                                               pcph
               ______Estimation of V12 Merge Areas_____
               L =
                             (Equation 13-6 or 13-7)
                ΕO
                P =
                     1.000 Using Equation 0
                FM
                v = v (P) = 1439 pc/h
                12 F FM
                    _____Capacity Checks_____
                                                 LOS F?
                       Actual
                                    Maximum
                       1473
                                    4600
    V
                                                  No
     FΟ
                       0 pc/h (Equation 13-14 or 13-17)
    v or v
    3 av34
Is
    v or v
               > 2700 pc/h?
                                    No
     3
         av34
               > 1.5 v /2
Is
    v or v
                                    No
                  12
     3 av34
If yes, v = 1439
                                 (Equation 13-15, 13-16, 13-18, or 13-19)
       12A
                   ___Flow Entering Merge Influence Area__
                   Actual Max Desirable
                                                   Violation?
                   1645
                               4600
     R12
           ____Level of Service Determination (if not F)_____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 7.5 pc/mi/ln
                          R
                                     12
Level of service for ramp-freeway junction areas of influence A
              _____Speed Estimation_____
                                       M = 0.236
Intermediate speed variable,
                                        S
Space mean speed in ramp influence area,
                                       S = 55.7
                                                   mph
                                        R
Space mean speed in outer lanes,
                                       S = N/A
                                                   mph
```

1.00

0.995

1.00

S = 55.7

mph

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:		F	ax:				
	Diver	ge Anai	lysis_				
	I-271 NB Brainard Rd District 12 2036						
	Free	way Dat	ta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-	:	Diverg 3 60.0 4480		mph vph		
	Off R	amp Dat	ta				
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/d		:	Right 2 35.0 2070 1400 500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	e exist	s)		
Does adjacent ramp exist Volume on adjacent ramp Position of adjacent ramp Type of adjacent ramp Distance to adjacent ramp	mp	( (	Yes 640 Downst On 3500	ream	vph ft		
Con	version to pc/h	Under	Base	Conditio	าทร		
Junction Components	version to bc\u	Freewa		Ramp	7118 <u></u>	Adjace	
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E' Recreational vehicle PC		4480 0.90 1244 4 0 Level 0.00 0.00 1.5 1.2	% mi	2070 0.90 575 3 0 Level 0.00 0.00 1.5 1.2	% mi	Ramp 640 0.90 178 1 0 Level 0.00 0.00 1.5	vph v % % mi

```
Heavy vehicle adjustment, fHV 0.980 0.985 0.995 Driver population factor, fP 1.00 1.00 1.00
                                                      715
Flow rate, vp
                                 5077
                                            2335
                                                               pcph
                _____Estimation of V12 Diverge Areas___
                            (Equation 13-12 or 13-13)
                ΕQ
               P = 0.450 Using Equation 0
                FD
               v = v + (v - v) P = 3569 pc/h
                12 R F R FD
                   _____Capacity Checks____
                                   Maximum
                                              LOS F?
                       Actual
    v = v
                       5077
                                   6900
                                                 Nο
     Fi F
                       2742
                                  6900
    v = v - v
                                                No
     FO F R
                                   4000
                       2335
    V
                                                No
    R
                       1508 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                  No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                   No
3 	 av34
If yes, v = 3569
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                  __Flow Entering Diverge Influence Area__
                   Actual Max Desirable Violation?
                   3569
                               4400
                                                  No
     12
         _____Level of Service Determination (if not F)____
                    D = 4.252 + 0.0086 v - 0.009 L = 5.2 pc/mi/ln
Density,
                                    12 D
                    R
Level of service for ramp-freeway junction areas of influence A
     ______Speed Estimation_____
Intermediate speed variable,
                                       D = 0.638
                                       S
Space mean speed in ramp influence area,
                                      S = 48.5
                                       R
Space mean speed in outer lanes,
                                      S = 63.8
                                       0
Space mean speed for all vehicles,
                                      S = 52.2
                                                  mph
```

Phone: E-mail:	Fax:							
	Merge	Analy	sis					
Analysis time period: Freeway/Dir of Travel: Junction:	I-271 NB Brainard Rd District 12 2036		:					
	Free	way Da	ıta					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Merge 3 60.0 2410		mph vph			
	On R	amp Da	ıta					
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/de Length of second accel/de			Right 1 35.0 640 1500		mph vph ft ft			
	Adjacent Ramp	Data	(if on	e exists	3)			
Does adjacent ramp exist Volume on adjacent Ramp Position of adjacent Ram Type of adjacent Ramp Distance to adjacent Ram	np		Yes 50 Downst On 1400	ream	vph ft			
Con	version to na/h	Under	Bage	Conditio	nn a			
Junction Components	version to pc/h			Ramp		Adjacen Ramp	nt	
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E' Recreational vehicle PC		2410 0.90 669 4 0 Level	% mi	640 0.90 178 1 0 Level	% mi	50 0.90 14 0 0 Level	vph v % % mi	

```
Heavy vehicle adjustment, fHV 0.980 0.995 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                     56
                                 2731
                                           715
                                                             pcph
               _____Estimation of V12 Merge Areas____
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 0.619 Using Equation 1
                FM
               v = v (P) = 1692 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                      Actual
                       3446
                                   6900
    V
                                                Nο
    FO
                       1039 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 1692
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   __Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  2407
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 14.5 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence B
  _____Speed Estimation_____
Intermediate speed variable,
                                      M = 0.259
                                       S
Space mean speed in ramp influence area,
                                     S = 55.3
                                      R
Space mean speed in outer lanes,
                                      S = 58.1
                                      0
                                     S = 56.1 mph
Space mean speed for all vehicles,
```

Phone: E-mail:		1	Fax:					
	Diver	ge Ana	alys	sis_				
Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	nalyst: gency/Co.: Parsons Brinckerhoff ate performed: nalysis time period: AM Peak reeway/Dir of Travel: I-271 NB (Express Lanes) unction: Expressway (Local Lanes) urisdiction: District 12							
	Free	way Da	ala_					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	way		2 60. 130	0		mph vph		
	Off R	amp Da	ata_					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	Data	50 150	0	e exists	mph vph ft ft		
	najacene namp	Dava	(	. 011	C C111505	/		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp			00 stre	am	vph ft		
Con	version to pc/h	Unde	r Ba	ıse	Conditio	ns		
Junction Components		Free			Ramp		Adjacen	.t
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		1300 0.90 361 4 0 Level 0.00 0.00 1.5		% mi	50 0.90 14 0 0 Level 0.00 0.00 1.5 1.2	% mi	Ramp 1500 0.90 417 0 0 Level 0.00 0.00 1.5	vph v % % mi

```
1473
                                               56
                                                          1667
Flow rate, vp
                                                                  pcph
                _____Estimation of V12 Diverge Areas_____
                L =
                               (Equation 13-12 or 13-13)
                 ΕO
                P =
                       1.000 Using Equation 0
                 FD
                v = v + (v - v) P = 1473 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                    LOS F?
                        Actual
                                     Maximum
                        1473
                                     4600
    v = v
                                                    No
     Fi F
    v = v - v
                        1417
                                     4600
                                                    No
     FO F R
    V
                        56
                                     2200
                                                    No
     R
                        0
                                    (Equation 13-14 or 13-17)
    v or v
                            pc/h
     3 av34
               > 2700 pc/h?
Is
    v or v
                                     No
     3 av34
Is
    v or v
                > 1.5 v /2
                                     No
         av34
     3
                     12
If yes, v
          = 1473
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                   _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    1473
                                                     No
     12
            ____Level of Service Determination (if not F)_____
                     D = 4.252 + 0.0086 v - 0.009 L = 3.4 pc/mi/ln
Density,
                                       12
Level of service for ramp-freeway junction areas of influence A
             _____Speed Estimation____
Intermediate speed variable,
                                         D = 0.108
                                         S
Space mean speed in ramp influence area,
                                         S = 58.1
                                                     mph
                                         R
Space mean speed in outer lanes,
                                         S = N/A
                                                     mph
                                         0
Space mean speed for all vehicles,
                                        S = 58.1
                                                     mph
```

1.00

1.000

1.00

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:								
	Merge	Analy	sis					
	I-271 NB Expressway District 12 2036		:					
	Free	way Da	ıta					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Merge 3 60.0 3050		mph vph			
	On R	amp Da	ta					
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Left 1 60.0 50 1500		mph vph ft ft			
	Adjacent Ramp	Data	(if on	e exists	;)			
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp		Yes 640 Upstre On 1400	am	vph ft			
-	_							
Con	version to pc/h		Base ay	Condition Ramp		Adjacen		
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		3050 0.90 847 4 0 Level		50 0.90 14 0 0 Level	% mi	Ramp 640 0.90 178 1 0 Level	vph  v % % % mi	

```
Heavy vehicle adjustment, fHV 0.980 1.000 0.995
Driver population factor, fP 1.00 1.00 1.00
                                                      715
Flow rate, vp
                                 3457
                                           56
                                                             pcph
                _____Estimation of V12 Merge Areas____
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 0.619 Using Equation 1
                FM
               v = v (P) = 2142 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                      Actual
                       3513
                                   6900
    V
                                                Nο
    FO
                      1315 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 2142
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   __Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  2455
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 15.2 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence B
  _____Speed Estimation_____
Intermediate speed variable,
                                      M = 0.186
                                       S
Space mean speed in ramp influence area,
                                     S = 56.6
                                      R
Space mean speed in outer lanes,
                                      S = 58.0
                                      0
                                     S = 57.0  mph
Space mean speed for all vehicles,
```

Phone: E-mail:		F	ax:				
	Diver	ge Ana	lysis				
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brinck 8/20/2014 AM Peak I-271 SB Expressway District 12 2036 .14 - Build R-1	erhoff					
	Free	way Da	ıta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-		Diver 3 60.0 5510		mph vph		
	Off R	amp Da	ıta				
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane decel lane		Left 1 60.0 900 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if o	ne exists	3)		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp		Yes 970 Downs Off 1700	tream	vph ft		
Con	version to pc/h	Under	Base	Condition	ons		
Junction Components  Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade		Freew 5510 0.90 1531 4 0 Level 0.00		Ramp 900 0.90 250 0 Level 0.00	90	Adjacer Ramp 970 0.90 269 4 0 Level 0.00	vph v % %
Length Trucks and buses PCE, E Recreational vehicle PC		0.00 1.5 1.2	mi		mi	0.00 1.5 1.2	mi

```
Heavy vehicle adjustment, fHV 0.980 1.000 0.980 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                      1099
                                 6245
                                           1000
                                                             pcph
               _____Estimation of V12 Diverge Areas___
                     1893.28 (Equation 13-12 or 13-13)
                ΕQ
               P = 0.565 Using Equation 7
                FD
               v = v + (v - v) P = 3964 pc/h
                12 R F R FD
                   _____Capacity Checks____
                                   Maximum
                                              LOS F?
                       Actual
    v = v
                                   6900
                       6245
                                                 Nο
    Fi F
    v = v - v
                       5245
                                  6900
                                                No
    FO F R
                       1000
                                  2200
    V
                                                No
    R
                       2281 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                  No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                  No
3 	 av34
If yes, v = 3964
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                  __Flow Entering Diverge Influence Area__
                   Actual Max Desirable Violation?
                   3964
                               4400
     12
         _____Level of Service Determination (if not F)_____
                   D = 4.252 + 0.0086 v - 0.009 L = 26.5 pc/mi/ln
Density,
                                    12 D
                    R
Level of service for ramp-freeway junction areas of influence C
    _____Speed Estimation_____
                                      D = 0.193
Intermediate speed variable,
                                       S
Space mean speed in ramp influence area,
                                     S = 56.5
                                       R
Space mean speed in outer lanes,
                                      S = 61.6
                                       0
Space mean speed for all vehicles,
                                      S = 58.1
                                                  mph
```

Phone: E-mail:		Fax	:					
	Merge	Analysi	s					
Analyst: Eric Brown Agency/Co.: Parsons Brinckerhoff Date performed: 8/20/2014 Analysis time period: AM Peak Freeway/Dir of Travel: I-271 SB (Express Lanes) Junction: I-271 SB (Local Lanes) Jurisdiction: District 12 Analysis Year: 2036 Description: CUY-271-8.14 - Build R-13								
	Free	way Data						
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway		2 60	rge .0 20		mph vph			
	On R	amp Data						
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane decel lane	1 60 90 15	.00		mph vph ft ft			
	Adjacent Ramp	Data (1	i on	e exists	5)			
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp	mp	No			vph			
Distance to adjacent Ra	mp				ft			
Con	version to pc/h	Under B	ase	Conditio	ns			
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15		Freeway 2220 0.90 617		Ramp 900 0.90 250		Adjacent Ramp	vph v	
Trucks and buses Recreational vehicles Terrain type: Grade		4 0 Level	0/0	0 0 Level	%		% %	
Length Trucks and buses PCE, E Recreational vehicle PC		1.5 1.2	mi	1.5	mi		mi	

```
2516
                                             1000
                                                                 pcph
Flow rate, vp
               _____Estimation of V12 Merge Areas____
                L =
                              (Equation 13-6 or 13-7)
                 ΕO
                P =
                      1.000 Using Equation 0
                FM
                v = v (P) = 2516 pc/h
                 12 F FM
                    _____Capacity Checks_____
                                                 LOS F?
                        Actual
                                    Maximum
                        3516
                                    4600
    V
                                                  No
     FΟ
                        0 pc/h (Equation 13-14 or 13-17)
    v or v
    3 av34
Is
    v or v
               > 2700 pc/h?
                                    No
     3
         av34
                > 1.5 v /2
Is
    v or v
                                    No
                  12
     3 av34
If yes, v = 2516
                                  (Equation 13-15, 13-16, 13-18, or 13-19)
       12A
                   ___Flow Entering Merge Influence Area__
                   Actual Max Desirable
                                                   Violation?
                   3516
                                4600
     R12
           ____Level of Service Determination (if not F)_____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 23.0 pc/mi/ln
                          R
                                     12
Level of service for ramp-freeway junction areas of influence C
               _____Speed Estimation_____
                                        M = 0.272
Intermediate speed variable,
                                        S
Space mean speed in ramp influence area,
                                        S = 55.1
                                                   mph
                                        R
Space mean speed in outer lanes,
                                        S = N/A
                                                   mph
```

1.00

1.000

1.00

S = 55.1

mph

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:		F	ax:				
	Diver	ge Ana	lysis_				
	I-271 SB Brainard Rd District 12 2036						
	Free	way Da	ta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-		Diverg 3 60.0 4610		mph vph		
	Off R	amp Da	ta				
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Right 1 35.0 970 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	e exist	s)		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp	1	Yes 900 Upstre Off 1700	am	vph ft		
Con	version to pc/h	Under	Base	Conditio	ons		
Junction Components		Freew		Ramp		Adjacen Ramp	
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Length Trucks and buses PCE, E Recreational vehicle PC	T	4610 0.90 1281 4 0 Level 0.00 0.00 1.5	% mi	970 0.90 269 4 0 Level 0.00 0.00 1.5	% mi	900 0.90 250 0 0 Level 0.00 0.00 1.5	vph v % % mi

```
Heavy vehicle adjustment, fHV 0.980 0.980 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                      1000
                                 5225
                                           1099
                                                               pcph
                _____Estimation of V12 Diverge Areas___
                            (Equation 13-12 or 13-13)
                ΕQ
               P = 0.579 Using Equation 5
                FD
               v = v + (v - v) P = 3487 pc/h
                12 R F R FD
                   _____Capacity Checks____
                                   Maximum
                                              LOS F?
                       Actual
    v = v
                                   6900
                       5225
                                                 Nο
    Fi F
    v = v - v
                                  6900
                       4126
                                                No
    FO F R
                       1099
                                  2000
    V
                                                No
    R
                      1738 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                  No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                  No
3 	 av34
If yes, v = 3487
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                 __Flow Entering Diverge Influence Area__
                   Actual Max Desirable Violation?
                   3487
                               4400
     12
         _____Level of Service Determination (if not F)_____
                    D = 4.252 + 0.0086 v - 0.009 L = 20.7 pc/mi/ln
Density,
                                    12 D
                    R
Level of service for ramp-freeway junction areas of influence C
    _____Speed Estimation_____
Intermediate speed variable,
                                      D = 0.527
                                       S
Space mean speed in ramp influence area,
                                      S = 50.5
                                       R
Space mean speed in outer lanes,
                                      S = 62.9
                                       0
Space mean speed for all vehicles,
                                      S = 54.1
                                                  mph
```

Phone: E-mail:		F	ax:				
	Merge	Analy	sis				
Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB Cedar Rd District 12 2036 .14 - Build R-1	5					
	Free	way Da	ita				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Merge 3 60.0 3640		mph vph		
	On R	amp Da	ata				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane decel lane		Right 1 35.0 2350 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	ie exists	3)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp		Yes 530 Downst Off 2200	ream	vph ft		
Con	version to pc/h	Under	Base	Conditio	ons		
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15  Trucks and buses		Freew 3640 0.90 1011 4		Ramp 2350 0.90 653 2		Adjacer Ramp 530 0.90 147	vph v v %
Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		0 Level 1.5 1.2	* mi	0 Level 1.5 1.2	% mi	0 Level 1.5 1.2	% mi

```
4125
                                               2637
                                                          589
Flow rate, vp
                                                                  pcph
                ______Estimation of V12 Merge Areas_____
                L =
                        2180.67 (Equation 13-6 or 13-7)
                 ΕO
                        0.619 Using Equation 1
                 FM
                v = v (P) = 2555 pc/h
                 12 F FM
                     _____Capacity Checks_____
                                                   LOS F?
                         Actual
                                     Maximum
                         6762
                                     6900
    V
                                                    No
     FΟ
                        1570 pc/h (Equation 13-14 or 13-17)
    v or v
     3 av34
Is
    v or v
               > 2700 pc/h?
                                     No
     3
          av34
                > 1.5 v /2
Is
    v or v
                                     Yes
                   12
     3 av34
If yes, v = 2555
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    ___Flow Entering Merge Influence Area__
                    Actual Max Desirable
                                                     Violation?
                    5192
                                 4600
     12A
             ____Level of Service Determination (if not F)_____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 35.4 pc/mi/ln
                           R
                                      12
Level of service for ramp-freeway junction areas of influence \, \, \mathbf{E} \,
               _____Speed Estimation_____
                                         M = 0.917
Intermediate speed variable,
                                          S
Space mean speed in ramp influence area,
                                         S = 43.5
                                                     mph
                                         R
Space mean speed in outer lanes,
                                         S = 56.1
                                                     mph
```

1.00

0.990

1.00

S = 45.9

mph

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:		1	Fax	:				
	Diver	ge Ana	aly	sis_				
Jurisdiction: Analysis Year: Description: CUY-271-8	AM Peak I-271 SB Expressway District 12 2036	6						
	free	way Da	ala_					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	way		3 60 599	.0 90		mph vph		
	Off R	amp Da	ata <sub>-</sub>					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	Data	53 15	.0 0 00	e exists	mph vph ft ft		
		20.00	(	_ 011	0111202	/		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp			50 stre	am	vph ft		
Con	version to pc/h	Unde	r Ba	ase	Conditio	ns		
Junction Components	verbron to pe/ii	Free			Ramp		Adjacen	.t
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		5990 0.90 1664 4 0 Leve: 0.00 0.00 1.5	1	% mi	530 0.90 147 0 0 Level 0.00 0.00 1.5	% mi	Ramp 2350 0.90 653 2 0 Level 0.00 0.00 1.5	vph v % % mi

```
2637
Flow rate, vp
                                                                   pcph
                 _____Estimation of V12 Diverge Areas_____
                L =
                        14458.58 Equation 13-12 or 13-13)
                 ΕO
                        0.563 Using Equation 5
                P =
                 FD
                 v = v + (v - v) P = 4081 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                    LOS F?
                                      Maximum
                         Actual
                         6789
                                      6900
    v = v
                                                     No
     Fi F
    v = v - v
                         6200
                                      6900
                                                     No
     FO F R
    V
                         589
                                      2200
                                                     No
     R
                                     (Equation 13-14 or 13-17)
    v or v
                         2708 pc/h
     3 av34
                > 2700 pc/h?
Is
    v or v
                                      Yes
     3 av34
Is
    v or v
                > 1.5 v /2
                                      No
          av34
     3
                      12
If yes, v
          = 4089
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    4089
                                                      No
     12A
            ____Level of Service Determination (if not F)_____
                     D = 4.252 + 0.0086 v - 0.009 L = 27.7 pc/mi/ln
Density,
                                        12
Level of service for ramp-freeway junction areas of influence C
              _____Speed Estimation___
Intermediate speed variable,
                                         D = 0.156
                                          S
Space mean speed in ramp influence area,
                                         S = 57.2
                                                      mph
                                          R
Space mean speed in outer lanes,
                                         S = 60.0
                                                      mph
                                          0
Space mean speed for all vehicles,
                                         S = 58.2
                                                      mph
```

1.00

6789

1.000

1.00

589

0.990 1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:		Fa	ax:				
	Merge	Analys	sis				
Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB Expressway District 12 2036 .14 - Build R-1	9					
	Free	way Dat	La				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway		3	Merge 3 60.0 5460		mph vph		
	On R	amp Dat	ta				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane decel lane	] 6 5	Left 1 60.0 550 1500		mph vph ft ft		
	Adjacent Ramp	Data (	(if on	e exists	s)		
Does adjacent ramp exist Volume on adjacent Ramp Position of adjacent Ramp Type of adjacent Ramp Distance to adjacent Ramp	mp	1 I (	Yes 1080 Downst Off 1850	ream	vph ft		
Con	version to pc/h	Under	Base	Conditio	ns		
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15  Trucks and buses		Freewa 5460 0.90 1517		Ramp 550 0.90 153		Adjacer Ramp 1080 0.90 300	vph
Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		0 Level	% mi	0 Level	% mi	0 Level 1.5	% mi

```
6188
                                               611
                                                          1236
Flow rate, vp
                                                                  pcph
                ______Estimation of V12 Merge Areas_____
                L =
                        4576.08 (Equation 13-6 or 13-7)
                 ΕO
                        0.724 Using Equation 3
                 FM
                v = v (P) = 4482 pc/h
                 12 F FM
                     _____Capacity Checks_____
                                                   LOS F?
                         Actual
                                     Maximum
                         6799
                                     6900
    V
                                                    No
     FΟ
                        1706 pc/h (Equation 13-14 or 13-17)
    v or v
     3 av34
Is
    v or v
               > 2700 pc/h?
                                     No
     3
          av34
                > 1.5 v /2
Is
    v or v
                                     Yes
                   12
     3 av34
If yes, v = 4482
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    __Flow Entering Merge Influence Area__
                    Actual Max Desirable
                                                     Violation?
                    5630
                                 4600
     12A
             ____Level of Service Determination (if not F)______
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 39.7 pc/mi/ln
                           R
                                      12
Level of service for ramp-freeway junction areas of influence \, \, \mathbf{E} \,
               _____Speed Estimation_____
                                         M = 1.228
Intermediate speed variable,
                                          S
Space mean speed in ramp influence area,
                                         S = 37.9
                                                     mph
                                         R
Space mean speed in outer lanes,
                                         S = 57.6
                                                     mph
```

1.00

1.000

1.00

S = 40.3

mph

0.971

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:		1	Fax	:				
	Diver	ge Ana	alys	sis_				
Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brinck 8/20/2014 AM Peak I-271 SB Chagrin Blvd District 12 2036 .14 - Build R-2	erhof:	f					
	Free	way Da	ata_					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	way		3 60 603	.0 10		mph vph		
	Off R	amp Da	ata_					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	Data	1 35 108 150	.0 80 00		mph vph ft ft		
		20.00	(	_ 011	0111202	/		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp		Yes 550 Ups On 18!	0 stre	am	vph ft		
Con	version to pc/h	Unde:	r Ba	ase	Conditio	ns		
Junction Components	version to pe/ii	Free			Ramp		Adjacen	.t
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		6010 0.90 1669 4 0 Leve 0.00 0.00 1.5	1	% mi	1080 0.90 300 6 0 Level 0.00 0.00 1.5	% mi	Ramp 550 0.90 153 0 0 Level 0.00 0.00 1.5	vph v % % mi

```
6811
                                               1236
                                                          611
Flow rate, vp
                                                                    pcph
                 _____Estimation of V12 Diverge Areas_____
                L =
                        4569.35 (Equation 13-12 or 13-13)
                 ΕO
                        0.533 Using Equation 5
                P =
                 FD
                 v = v + (v - v) P = 4207 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                     LOS F?
                         Actual
                                      Maximum
                         6811
                                      6900
    v = v
                                                     No
     Fi F
    v = v - v
                         5575
                                      6900
                                                     No
     FO F R
    V
                         1236
                                      2000
                                                     No
     R
                                     (Equation 13-14 or 13-17)
    v or v
                         2604 pc/h
     3 av34
                > 2700 pc/h?
Is
    v or v
                                      No
     3 av34
Is
    v or v
                > 1.5 v /2
                                      No
          av34
     3
                      12
If yes, v
          = 4207
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    4207
                                                      No
     12
             ___Level of Service Determination (if not F)______
                     D = 4.252 + 0.0086 v - 0.009 L = 26.9 pc/mi/ln
Density,
                                        12
Level of service for ramp-freeway junction areas of influence C
              _____Speed Estimation___
Intermediate speed variable,
                                         D = 0.539
                                          S
Space mean speed in ramp influence area,
                                         S = 50.3
                                                      mph
                                          R
Space mean speed in outer lanes,
                                         S = 59.6
                                                      mph
                                          0
Space mean speed for all vehicles,
                                        S = 53.5
                                                      mph
```

1.00

0.971

1.00

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Fax:

Phone: E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 12/11/14
Analysis Time Period: AM Peak
Freeway/Dir of Travel: I-271 NB

Weaving Location: R-1 Merge to R-4 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - Build W-1

\_\_\_\_\_Inputs\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	7300	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume	Compone	nts		
	VFF	VRF	VFR	VRR	
Volume, V	4290	190	0	30	veh/h
Peak hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	1192	53	0	8	
Trucks and buses	0	0	0	0	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.00	0
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	4767	211	0	33	pc/h

Volume ratio, VR 0.007

Configuration	Characterist	cics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	4	lc/pc	
Minimum weaving lane changes, LCMIN	132	lc/h	
Weaving lane changes, LCW		lc/h	
Non-weaving vehicle index, INW			
Non-weaving lane change, LCNW		lc/h	
Total lane changes, LCALL		lc/h	

Weaving intensity factor, W

Average non-weaving spee	d, SNW	mı/h			
Weaving Segment	Speed, Dens	ity, Level of S	ervice and Ca	pacity	
Weaving segment speed, S	_	_	mi/h	_	
Weaving segment density,	D		pc/mi/ln		
Level of service, LOS			_		
Weaving segment v/c rati	0				
Weaving segment flow rat	e, v		veh/h		
Weaving segment capacity	, cW		veh/h		
L	imitations of	n Weaving Segme	nts		
If limit reached, see no		5 5			
	Minimum	Maximum	Actual	Note	
Weaving length (ft)	300	5788	7300	a,b	
		Maximum	Analyzed		
Density-based capacty,		2300		С	
cIWL (pc/h/ln)					
		Maximum	Analyzed		
v/c ratio		1.00		d	

mi/h

#### Notes:

Average weaving speed, SW

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

Undefined LOS in HCS, calculated as LOS D at 5787 ft. Location cannot be analyzed as a weave. See note b.

Fax:

Phone: E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_\_ Eric Brown Parsons Brinckerhoff Analyst: Agency/Co.: Date Performed: 12/11/14 AM Peak
I-271 NB (Local Lanes)
R-3 Merge to R-4 Diverge Analysis Time Period: Freeway/Dir of Travel: Weaving Location: Analysis Year: 2036 Description: CUY-271-8.14 - Build W-2 \_\_\_\_\_Inputs\_\_\_\_\_ Segment Type Freeway Weaving configuration One-Sided Number of lanes, N 4 ln Weaving segment length, LS 1400 ft. Freeway free-flow speed, FFS 60 mi/h Minimum segment speed, SMIN 45 mi/h 2300 Freeway maximum capacity, cIFL pc/h/ln Terrain type Level Grade 0.00 Length 0.00 тi \_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_ Volume Components Volume Components
VFF VRF VFR VRR

Volume, V
Peak hour factor, PHF 0.90 0.90 0.90 0.90
Peak 15-min volume, v15 828 417 8 0
Trucks and buses
Recreational vehicles 0 0 0 0 0 %
Trucks and buses PCE, ET 1.5 1.5 1.5
Recreational vehicle PCE, ER 1.2 1.2 1.2
Heavy vehicle adjustment, fHV 1.000 1.000 1.000
Driver population adjustment, fP 1.00 1.00 1.00 1.00
Flow rate, v 3311 1667 33 0 pc/h 용 Volume ratio, VR 0.339 \_\_\_\_\_Configuration Characteristics\_\_ Number of maneuver lanes, NWL 2
Interchange density, ID 0.6 1 n 0.6 int/mi Minimum RF lane changes, LCRF 1 lc/pc Minimum FR lane changes, LCFR 1 lc/pc Minimum RR lane changes, LCRR lc/pc Minimum weaving lane changes, LCMIN 1700 lc/h Weaving lane changes, LCW 2001 lc/h Non-weaving vehicle index, INW 278 Non-weaving lane change, LCNW 670 lc/h 2671

\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_ Weaving intensity factor, W 0.376

lc/h

Total lane changes, LCALL

Average weaving speed, S	W	55.9	mi/h		
Average non-weaving spee	d, SNW	41.7	mi/h		
Weaving Segment	Speed, Densi	ty, Level of S	ervice and Ca	pacity	
Weaving segment speed, S	_	45.7			
Weaving segment density,	D	27.4	pc/mi/ln		
Level of service, LOS		С	_		
Weaving segment v/c rati	0	0.708			
Weaving segment flow rat		5012	veh/h		
Weaving segment capacity		7074	veh/h		
ī	imitations or	n Weaving Segme	nts		
If limit reached, see no		-			
	Minimum	Maximum	Actual	Note	
Weaving length (ft)	300	6009	1400	a,b	
		Maximum	Analyzed		
Density-based capacty,		2300	1947	C	
cIWL (pc/h/ln)					
-		Maximum	Analyzed		

# Notes:

v/c ratio

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

1.00

0.708

d

- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

Fax:

Phone: E-mail:

\_\_\_\_\_\_Operational Analysis\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 12/11/14
Analysis Time Period: AM Peak
Freeway/Dir of Travel: I-271 NB

Weaving Location: R-3 Merge to R-6 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - Build W-3

\_\_\_\_\_Inputs\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	4350	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Marson in the second	T 1	
Terrain type	Level	
Grade	0.00	8
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume	Compone	nts		
	VFF	VRF	VFR	VRR	
Volume, V	2440	0	570	1500 veh/h	
Peak hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	678	0	158	417	
Trucks and buses	0	0	0	0 %	
Recreational vehicles	0	0	0	0 %	
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.000	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	2711	0	633	1667 pc/h	

Volume ratio, VR 0.333

Configuration	Characterist	ics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	3	lc/pc	
Minimum weaving lane changes, LCMIN		lc/h	
Weaving lane changes, LCW	5326	lc/h	
Non-weaving vehicle index, INW	873		
Non-weaving lane change, LCNW	2469	lc/h	
Total lane changes, LCALL	7795	lc/h	

Weaving intensity factor, W

Average weaving speed, S	W	56.0	mi/h		
Average non-weaving spee	d, SNW	16.0	mi/h		
Weaving Segment	Speed, Densi	ty, Level of S	ervice and Ca	pacity	
Weaving segment speed, S		21.0	mi/h		
Weaving segment density,	D	79.7	pc/mi/ln		
Level of service, LOS		F	_		
Weaving segment v/c rati	0	0.861			
Weaving segment flow rat		5012	veh/h		
Weaving segment capacity		5817	veh/h		
Ti	imitations or	n Weaving Segme:	nts		
If limit reached, see no		a.,			
	Minimum	Maximum	Actual	Note	
Weaving length (ft)	300	9069	4350	a,b	
-		Maximum	Analyzed		
Density-based capacty, cIWL (pc/h/ln)		2300	1939	С	
_		Maximum	Analyzed		

1.00

0.861

d

# Notes:

v/c ratio

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

Fax:

Phone: E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 8/26/2014 AM Peak Analysis Time Period: Freeway/Dir of Travel: I-271 SB

Weaving Location: R-11 Merge to R-12 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - Build W-4

\_\_\_\_\_Inputs\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	4100	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Terrain type	Level	
Grade	0.00	90
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume	Compone	nts		
	VFF	VRF	VFR	VRR	
Volume, V	4530	80	0	900 veh/h	
Peak hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	1258	22	0	250	
Trucks and buses	0	0	0	0 %	
Recreational vehicles	0	0	0	0 %	
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.000	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	5033	89	0	1000 pc/h	

Volume ratio, VR 0.163

cteristics
ln
.6 int/mi
lc/pc
lc/pc
lc/pc
lc/h
315 lc/h
260
700 lc/h
015 lc/h

\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_ 0.265

Weaving intensity factor, W

Average weaving speed, S	W	56.9	mi/h		
Average non-weaving spee	d, SNW	35.8	mi/h		
Weaving Segment	Speed, Densi	ty, Level of S	ervice and Ca	pacity	
Weaving segment speed, S	_	38.1	mi/h	<u> </u>	
Weaving segment density,		53.5	pc/mi/ln		
Level of service, LOS		F	_		
Weaving segment v/c rati	0	0.993			
Weaving segment flow rat		6123	veh/h		
Weaving segment capacity		6165	veh/h		
T.	imitations or	n Weaving Segme:	nts		
If limit reached, see no		r weaving begine			
	Minimum	Maximum	Actual	Note	
Weaving length (ft)	300	7297	4100	a,b	
-		Maximum	Analyzed		
Density-based capacty, cIWL (pc/h/ln)		2300	2055	С	
-		Maximum	Analyzed		

1.00

0.993

d

# Notes:

v/c ratio

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

Fax:

Phone: E-mail:

Weaving lane changes, LCW

Total lane changes, LCALL

Non-weaving vehicle index, INW Non-weaving lane change, LCNW

E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Eric Brown Analyst: Agency/Co.: Parsons Brinckerhoff 8/26/2014 Date Performed: Analysis Time Period: AM Peak Freeway/Dir of Travel: I-271 SB R-15 Merge to R-16 Diverge I-271 SB Weaving Location: Analysis Year: 2036 CUY-271-8.14 - Build W-5 Description: \_\_\_\_\_Inputs\_\_\_\_\_ Segment Type Freeway Weaving configuration Two-Sided Number of lanes, N ln ft Weaving segment length, LS 2400 mi/h Freeway free-flow speed, FFS 60 Minimum segment speed, SMIN 45 mi/h pc/h/ln Freeway maximum capacity, cIFL 2300 Terrain type Level 0.00 응 Grade Length 0.00 mi \_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_ Volume Components VRR VFF VRF VFR 3640 1820 0 530 0.90 0.90 0.90 0.90 1011 506 0 147 0 0 0 0 0 530 veh/h Volume, V Peak hour factor, PHF 0.90 Peak 15-min volume, v15 Trucks and buses કૃ Recreational vehicles % 1.5 1.5 1.5 1.5 1.2 1.2 1.2 1.2 Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV 1.000 1.000 1.000 1.000 1.00 1.00 1.00 1.00 4044 2022 0 589 pc/h Driver population adjustment, fP Flow rate, v Volume ratio, VR 0.089 \_\_\_\_\_Configuration Characteristics\_ Number of maneuver lanes, NWL 0 ln Interchange density, ID 0.6 int/mi Minimum RF lane changes, LCRF 0 lc/pc Minimum FR lane changes, LCFR 0 lc/pc 3 Minimum RR lane changes, LCRR lc/pc Minimum weaving lane changes, LCMIN lc/h

\_\_\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_\_\_\_Weaving intensity factor, W

lc/h

lc/h

lc/h

Average non-weaving speed, SNW	ge non-weaving speed, SNW					
Weaving Segment Speed, Density,	Level of Serv	ice and Capacity				
Weaving segment speed, S		mi/h				
Weaving segment density, D		pc/mi/ln				
Level of service, LOS	F					
Weaving segment v/c ratio	1.119					
Weaving segment flow rate, v	6656	veh/h				
Weaving segment capacity, cW	5946	veh/h				
Limitations on Wea	ving Segments					
If limit reached, see note.						

mi/h

	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	6560	2400	a,b
		Maximum	Analyzed	
Density-based capacty, cIWL (pc/h/ln)		2300	1982	С
		Maximum	Analyzed	
v/c ratio		1.00	1.119	d

#### Notes:

Average weaving speed, SW

- In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- 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."
- C. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

Fax:

Phone: E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 9/11/14
Analysis Time Period: AM Peak
Freeway/Dir of Travel: I-271 SB

Weaving Location: R-19 Merge to R-20 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - Build W-6

\_\_\_\_\_Inputs\_\_\_\_\_\_Inputs\_\_\_\_\_

Segment Type	Freeway						
Weaving configuration	Two-Sided	Two-Sided					
Number of lanes, N	3	ln					
Weaving segment length, LS	1900	ft					
Freeway free-flow speed, FFS	60	mi/h					
Minimum segment speed, SMIN	45	mi/h					
Freeway maximum capacity, cIFL	2300	pc/h/ln					
Terrain type	Level						
Grade	0.00	9					
Length	0.00	mi					

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume Components					
	VFF	VRF	VFR	VRR		
Volume, V	4930	0	530	550	veh/h	
Peak hour factor, PHF	0.90	0.90	0.90	0.90		
Peak 15-min volume, v15	1369	0	147	153		
Trucks and buses	0	0	0	0	%	
Recreational vehicles	0	0	0	0	%	
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.00	0	
Driver population adjustment, fP	1.00	1.00	1.00	1.00		
Flow rate, v	5478	0	589	611	pc/h	

Volume ratio, VR 0.091

Configuration	Characterist	cics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	3	lc/pc	
Minimum weaving lane changes, LCMIN		lc/h	
Weaving lane changes, LCW		lc/h	
Non-weaving vehicle index, INW			
Non-weaving lane change, LCNW		lc/h	
Total lane changes, LCALL		lc/h	

\_\_\_\_\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_

Weaving intensity factor, W

Average non-weaving spee	mi/n						
Weaving Segment	Speed, Densi	ity, Level of Se	ervice and Car	pacity			
Weaving segment speed, S			mi/h				
Weaving segment density,	pc/mi/ln	pc/mi/ln					
Level of service, LOS		F					
Weaving segment v/c rati	.0	1.147					
Weaving segment flow rat	ce, v	6678	veh/h				
Weaving segment capacity	, cW	5823	5823 veh/h				
I	imitations or	n Weaving Segmen	nts				
If limit reached, see no							
	Minimum	Maximum	Actual	Note			
Weaving length (ft)	300	6589	1900	a,b			
		Maximum	Analyzed				
Density-based capacty,		2300	1941	С			

mi/h

Analyzed

1.147

d

#### Notes:

v/c ratio

cIWL (pc/h/ln)

Average weaving speed, SW

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

Maximum

1.00

- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

HCS 2010 Signalized Intersection Results Summary															
General Information Intersection Information															
	iation	Parsons Brinckerho	rf						V V						
Agency								Duration, h 0.25						<u>د</u> ا	
Analyst		Eric Brown	Analysis Date Aug 25, 2014  12 Time Period AM Peak					-	Area Typ PHF	е	Other			e je	소 
Jurisdiction		ODOT District 12				еак	_		Daviad	0.92	20	-		- <del>-</del> +	
Intersection		I-271 SB On Ramp		Analysis Year 2036 Analy					Analysis	Period	1> 7:0	JU			
File Name														4 * 4.50	
Project Descript	tion													<b>ቀተቀ</b> ሞ	_P_[]
Demand Inforn	nation				EB		Т	WE	3	Т	NB			SB	
Approach Move	ment			L	Т	R	L	Т	R	L	Т	R	L T R		
Demand (v), ve	h/h				880	1740	610	248	0						
Signal Informa		Υ				_ •	4								
Cycle, s	200.0	Reference Phase	2		6	ୗୣଽ						1	<b>→</b> 2	3	4
Offset, s	0	Reference Point	End	Green	48.2	141.8	0.0	0.0	0.0	0.0		5	_	5	5
Uncoordinated	No	Simult. Gap E/W	On	Yellow	-	4.0	0.0	0.0	0.0	0.0			•		
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	0.0	0.0	0.0	0.0		5	6	7	8
							\.\/D		VA (D.T.	NE		NET	0.01		ODT
Timer Results				EBI	-	EBT	WB 1	L	WBT 6	NBL		NBT	SBL	-	SBT
Assigned Phase Case Number	<del>)</del>					7.3	2.0		4.0	_				$\rightarrow$	
					-	7.3 146.8	53.2	_	200.0		_			+	
Phase Duration								_		_					
Change Period,					-	5.0	5.0		5.0		_			_	
Max Allow Head				_	_	0.0	3.1		0.0		_	_		+	
Queue Clearand					-		50.2	_	0.0		_	_		+	
Green Extension Time ( ge), s			_	0.0	0.0		0.0		_			+			
Phase Call Prob					-		1.00	_			-			+	
Max Out Probab	Ollity						1.00	,							
Movement Gro	up Res	ults			EB			WB			NB			SB	
Approach Move	ment			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Move	ment				2	12	1	6							
Adjusted Flow F	Rate ( v)	, veh/h			957	1891	663	2696							
Adjusted Satura	ation Flo	w Rate (s), veh/h/ln			950	1579	887	950							
Queue Service	Time ( g	/s), S			59.0	141.8	48.2	195.0							
Cycle Queue Cl	earance	e Time ( <i>gc</i> ), s			59.0	141.8	48.2	195.0							
Green Ratio (g/	(C)				0.71	0.71	0.24	0.98							
Capacity (c), ve	h/h				1347	1119	428	1853							
Volume-to-Capa	acity Ra	tio (X)			0.710	1.690	1.551	1.455							
Available Capad					1347	_	428	1853							
Back of Queue	( Q), veh	n/ln (50th percentile)			13.2	147.9	26.4	53.5							
Queue Storage	Ratio (	RQ) (50th percentile)			0.00	18.79	1.03	0.00	1						
Uniform Delay (					17.1	29.1	75.9	2.5							
Incremental Del					3.2	314.3	259.2	207.9							
Initial Queue De					0.0	0.0	0.0	0.0							
Control Delay ( d), s/veh			20.2	343.4		210.4									
Level of Service (LOS)			С	F	F	F									
Approach Delay		/LOS		234.	9	F	235.	0	F	0.0			0.0		
Intersection Del						23	4.9		F						
Multimodal Re					EB			WB			NB			SB	
Pedestrian LOS				2.4	_	В	0.5	_	Α	3.0	_	С	2.9		С
Bicycle LOS Sc	ore / LO	S		2.8		С	3.3		С						

## **HCS 2010 Signalized Intersection Results Summary** 14741747 Intersection Information **General Information** $\mathsf{J}A\mathsf{L}\mathsf{L}$ Parsons Brinckerhoff Duration, h 0.25 Agency Analyst Eric Brown Analysis Date Aug 29, 2014 Area Type Other PHF Jurisdiction ODOT District 12 Time Period AM Peak Build 0.92 Intersection Cedar Rd Analysis Year 2036 **Analysis Period** 1>7:00 I-2, I-3, I-4 CUY-271-8.14 AM Peak.xus File Name **Project Description Demand Information** EB **WB** NB SB Approach Movement L R L R L R L R 40 Demand (v), veh/h 410 410 60 40 650 110 100 170 920 230 1150 **Signal Information** ᄴ Щ, Cycle, s 120.0 Reference Phase 2 Offset, s 0 Reference Point End Green 32.5 21.5 17.0 29.0 0.0 0.0 Uncoordinated No Simult. Gap E/W On Yellow 0.0 3.6 3.6 3.6 3.6 0.0 Force Mode Simult. Gap N/S 0.0 Fixed On Red 1.4 1.4 1.4 1.4 0.0 **Timer Results EBL EBT** WBL **WBT NBL NBT** SBL SBT Assigned Phase 8 7 4 2 1 6 Case Number 2.0 4.0 5.3 6.3 1.0 3.0 Phase Duration, s 22.0 56.0 34.0 26.5 37.5 64.0 5.0 5.0 5.0 Change Period, (Y+Rc), s 5.0 5.0 5.0 Max Allow Headway (MAH), s 3.1 3.1 3.1 0.0 3.1 0.0 Queue Clearance Time (gs), s 17.0 13.3 24.6 21.8 Green Extension Time ( $g_e$ ), s 0.0 3.3 1.7 0.0 1.8 0.0 Phase Call Probability 1.00 1.00 1.00 1.00 1.00 0.00 0.73 0.03 Max Out Probability WB **Movement Group Results** EΒ NB SB Approach Movement Т R L Т R L Т R Т R L L Assigned Movement 7 4 14 3 8 18 5 2 12 1 6 16 Adjusted Flow Rate (v), veh/h 446 260 251 43 707 120 109 116 113 831 291 956 Adjusted Saturation Flow Rate (s), veh/h/ln 1757 1863 903 1610 1193 1881 1759 1757 1779 1773 1791 1610 15.0 11.2 22.6 7.3 9.9 6.5 6.7 59.0 Queue Service Time (gs), s 11.3 4.6 19.8 11.4 Cycle Queue Clearance Time ( qc), s 15.0 11.2 11.3 4.6 22.6 7.3 9.9 6.5 6.7 19.8 11.4 59.0 0.24 Green Ratio (g/C) 0.14 0.42 0.42 0.24 0.24 0.18 0.18 0.18 0.47 0.49 0.63 Capacity (c), veh/h 498 792 756 278 857 389 274 337 315 1360 880 1020 Volume-to-Capacity Ratio (X) 0.895 0.328 0.332 0.156 0.824 0.307 0.397 0.343 0.357 0.611 0.330 0.937 Available Capacity (ca), veh/h 498 792 756 278 857 389 274 337 315 1360 880 1020 Back of Queue (Q), veh/ln (95th percentile) 12.3 8.5 8.3 1.8 15.8 5.2 5.8 5.8 5.7 9.8 6.1 7.4 Queue Storage Ratio (RQ) (95th percentile) 0.53 0.00 0.00 0.37 0.00 0.35 0.42 0.00 0.00 0.85 0.00 0.64 43.1 Uniform Delay (d1), s/veh 50.6 23.1 23.1 36.2 43.1 37.3 44.5 43.2 22.5 17.6 13.1 Incremental Delay (d2), s/veh 18.0 0.1 0.1 0.1 6.2 0.2 4.3 2.8 3.1 0.1 0.2 4.3 Initial Queue Delay ( d3), s/veh 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 Control Delay (d), s/veh 68.7 23.1 23.2 36.3 49.3 37.4 48.7 45.8 46.3 22.6 17.8 17.4 Level of Service (LOS) Ε С С D D D D D D С В В 44.4 D 47.0 D 46.9 D 19.5 В Approach Delay, s/veh / LOS Intersection Delay, s/veh / LOS 32.9 С **Multimodal Results** ΕB WB NB SB Pedestrian LOS Score / LOS 2.4 В С С 3.0 3.0 С 2.9 Bicycle LOS Score / LOS 1.3 Α 1.2 Α 0.8 Α 4.6

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## **HCS 2010 Signalized Intersection Results Summary** Intersection Information **General Information** Agency Parsons Brinckerhoff Duration, h 0.25 Analyst Eric Brown Analysis Date Aug 29, 2014 Area Type Other PHF Jurisdiction ODOT District 12 Time Period AM Peak Build 0.92 Intersection I-271 NB On/Off Ramp Analysis Year 2036 **Analysis Period** 1> 7:00 I-2 I-3 I-4 CUY-271-8.14 AM Peak Revised.xus File Name **Project Description** WB **Demand Information** EB NB SB Approach Movement Т R L R L R L R 540 Demand (v), veh/h 200 1 680 150 100 1620 Signal Information Ц IJ, Cycle, s 120.0 Reference Phase 2 Offset, s 0 Reference Point End 57.0 Green 6.0 42.0 0.0 0.0 0.0 Uncoordinated No Simult. Gap E/W On Yellow 3.6 3.6 3.6 0.0 0.0 0.0 Force Mode Fixed Simult. Gap N/S 0.0 On Red 1.4 1.4 1.4 0.0 0.0 **Timer Results EBL EBT WBL WBT NBL NBT** SBL SBT Assigned Phase 4 2 1 6 Case Number 9.0 7.3 1.0 4.0 11.0 Phase Duration, s 47.0 62.0 73.0 Change Period, (Y+Rc), s 5.0 5.0 5.0 5.0 Max Allow Headway (MAH), s 3.2 0.0 3.1 0.0 Queue Clearance Time (gs), s 26.2 5.1 Green Extension Time (ge), s 1.9 0.0 0.0 0.0 1.00 1.00 Phase Call Probability 0.01 1.00 Max Out Probability WB SB **Movement Group Results** EΒ NB Approach Movement L Т R L Т R L Т R L Т R **Assigned Movement** 7 4 14 2 12 1 6 Adjusted Flow Rate (v), veh/h 217 371 370 163 587 94 1531 1792 Adjusted Saturation Flow Rate (s), veh/h/ln 1757 1564 1563 1863 1411 1756 24.2 24.1 21.6 3.1 44.4 Queue Service Time (gs), s 11.0 9.6 Cycle Queue Clearance Time (qc), s 11.0 24.2 24.1 9.6 21.6 3.1 44.4 0.54 Green Ratio (g/C) 0.35 0.35 0.35 0.48 0.48 0.57 Capacity (c), veh/h 615 547 547 885 1340 636 1990 Volume-to-Capacity Ratio (X) 0.354 0.677 0.675 0.184 0.438 0.149 0.769 Available Capacity (ca), veh/h 615 547 547 885 1340 636 1990 Back of Queue (Q), veh/ln (95th percentile) 8.1 14.5 14.4 7.8 12.7 2.2 22.8 Queue Storage Ratio (RQ) (95th percentile) 0.00 0.00 0.00 0.00 0.00 0.17 0.00 Uniform Delay (d1), s/veh 28.9 33.2 33.2 32.5 33.1 14.4 27.2 Incremental Delay (d2), s/veh 0.1 2.7 2.7 0.3 0.7 0.0 0.8 Initial Queue Delay (d3), s/veh 0.0 0.0 0.0 0.0 0.0 0.0 0.0 Control Delay (d), s/veh 29.1 36.0 35.9 32.8 33.9 14.4 28.0 Level of Service (LOS) С D С С В D С 34.4 С 0.0 33.6 С 27.2 С Approach Delay, s/veh / LOS Intersection Delay, s/veh / LOS 30.7 С **Multimodal Results** ΕB WB NB Pedestrian LOS Score / LOS 2.9 С 2.5 В 2.4 В 1.9 Α Bicycle LOS Score / LOS 2.1 В 1.7 Α 2.0

	HCS 2010 Signalized Intersection Results Summary																
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General Inform	nation	Daniel Difference	"						-	Interse		1		<u> </u>	- 1		
Agency		Parsons Brinckerho	т						_	Duratio			0.25				۲
Analyst		Eric Brown		Analys			_	9, 2014	_	Area Ty	/pe		Other		A _→		)- 
Jurisdiction		ODOT District 12		Time P				ak Build		PHF			0.92	_	<b>♦</b>	•/ <b>+</b> €	<del>♦</del> ⊕ <b>,</b> =
Intersection		I-271 SB Off Ramp		Analys		ar   203	36			Analysi	s Per	riod	1> 7:0	0	¥ ¬		<u>r</u>
File Name		I-2, I-3, I-4 CUY-27	1-8.14 A	M Peak	.xus											11	
Project Descript	tion															1 4 ተቀነ	*   *   *
Demand Inform	nation				EB	3			WE	3			NB		Т	SB	
Approach Move	ment			L	Т	F	₹	L	Т	R		L	Т	R	L	T	R
Demand (v), ve	h/h							910	1	60	)		350			810	
Signal Informa	tion						5						_				
	ır	Deference Dhase		-	+		$\Rightarrow$								<b>1</b>		
Cycle, s	120.0	Reference Phase	2	-	1		E.							1	2	3	4
Offset, s	0	Reference Point	End	Green				0.0	0.0			0.0					<u> </u>
Uncoordinated	No	Simult. Gap E/W	On	Yellow	_	4.0		0.0	0.0			0.0		1			
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.4	0.0	)	0.0	0.0	0.0	)	0.0		5	6	7	8
Timer Results				EBL	T	EBT	T	WBI	L	WBT	т	NBL	1	NBT	SBI	L	SBT
Assigned Phase	Э						7		$\top$	8	т			2			6
Case Number										10.0				8.0			8.0
Phase Duration	, s									53.4			- 6	6.6			66.6
Change Period,	(Y+Rc)	, S								4.0				5.0			5.0
Max Allow Head	dway ( <i>N</i>	//AH), s								3.2	Т			0.0			0.0
Queue Clearan	ce Time	( gs), s								31.6	Т						
Green Extensio	n Time (	( <i>g</i> e), s					T			2.4	$\top$			0.0			0.0
Phase Call Prob	oability						T			1.00							
Max Out Probal	oility									0.01							
Movement Gro	un Pac	ulte			EB				WB				NB			SB	
Approach Move		uito		L	T	R	-	1	T	R	+	L	T	R	L	T	R
Assigned Move					<u>'</u>	1	-	3	8	18	+	_	2	IX		6	IX
Adjusted Flow F		veh/h					-	534	521	10	+	-	380			880	
		w Rate ( s), veh/h/ln					-	1810	1785		+		1809			1809	
Queue Service						+	7	29.6	29.1		+	_	11.7			18.8	
Cycle Queue Cl								29.6	29.1			_	11.7			18.8	
Green Ratio (g/		(0)						0.41	0.41	1	$\top$		0.51			0.51	
Capacity (c), ve								745	735				1857			1857	
Volume-to-Capa		tio (X)				1	7	0.717	0.710		_	_	0.205			0.474	
Available Capa								745	735		1		1857			1857	
		n/ln (95th percentile)						19.1	18.6				9.8			12.4	
	` '	RQ) (95th percentile						0.00	0.00	_			0.00			0.00	
Uniform Delay (	(d1), s/ve	eh						29.5	29.3				32.0			18.8	
Incremental Del	lay ( <i>d</i> 2),	, s/veh						2.9	2.7				0.2			0.9	
Initial Queue De	elay ( <i>d</i> 3)	), s/veh						0.0	0.0				0.0			0.0	
Control Delay ( d), s/veh						32.3	32.1				32.2			19.7			
Level of Service (LOS)						С	С				С			В			
Approach Delay, s/veh / LOS		0.0				32.2	2	С		32.2		С	19.7	7	В		
Intersection Del	ay, s/ve	h/LOS					27	.4							С		
Multimadal Da	oulto.				ED				\A/D				NID			CD	
Multimodal Re Pedestrian LOS		/1.08		2.8	EB	С	-	2.8	WB	С	-	1.7	NB	A	1.9	SB	Λ
				2.8		U	-		_		+					_	A
Bicycle LOS Sc	ore / LO	NO.						2.2		В		0.8		Α	1.2		Α

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Phone: E-mail:		Fax:	
	Operational Analys	is	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB Chagrin Blvd to R-1 ODOT District 12 2036	Merge	
	<u>-</u>		
Volume, V		2790	veh/h
Peak-hour factor, PHF Peak 15-min volume, v15		0.94 742	77
Trucks and buses	)	4	V %
Recreational vehicles		0	0 00
Terrain type:		Level	0
Grade		_	90
Segment length		_	mi
Trucks and buses PCE, E	T.	1.5	
Recreational vehicle PC		1.2	
Heavy vehicle adjustmen		0.980	
Driver population factor		1.00	
Flow rate, vp	· -	757	pc/h/ln
	Speed Inputs and A	djustments	
Lane width			ft
Right-side lateral clea	rance	_	ft
Total ramp density, TRI		_	ramps/mi
Number of lanes, N		4	ramps, mr
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	fLW	_	mi/h
Lateral clearance adjus	stment, fLC	_	mi/h
TRD adjustment		-	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Performanc	e Measures	
Flow rate, vp		757	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	speed, S	60.0	mi/h
Number of lanes, N	<u>.</u> ,	4	•
Density, D		12.6	pc/mi/ln
Level of service, LOS		В	

Phone: E-mail:		Fax:		
	Operational Ana	alysis		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-1 Merge to R-2 ODOT District 12 2036 .14 - No Build F-	2 Diverge 2		
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3010 0.94 801 4 0 Level - 1.5 1.2 0.980 1.00 817	<pre>veh/h v % % % mi pc/h/ln</pre>	
	Speed Inputs an	nd Adjustments		
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 4 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>	
LOS and Performance Measures				
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	817 60.0 60.0 4 13.6 B	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>	

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/21/2014 Analysis Time Period: AM Peak Freeway/Direction: I-271 NB From/To: R-1 Merge to R-2 Diverge Jurisdiction: ODOT District 12 Analysis Year: 2036 Description: CUY-271-8.14 - No Build F-2b			
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, F Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3010 0.94 801 4 0 Level - - 1.5 1.2 0.980 1.00 1089	<pre>veh/h v % % % mi pc/h/ln</pre>
	Speed Inputs an	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	nance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1089 60.0 60.0 3 18.1 C	pc/h/ln mi/h mi/h pc/mi/ln

Phone: E-mail:		Fax:		
	Operational An	alysis		
		<i>1</i> · · · · · · · · · · · · · · · · · · ·		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year:	8/21/2014	ss Lanes) R-3 Merge		
Description: CUY-271-8	3.14 - No Build F	-3		
	Flow Inputs and	d Adjustments		
****		0770	. 1- /1-	
Volume, V		2770	veh/h	
Peak-hour factor, PHF Peak 15-min volume, v15		0.94		
Trucks and buses	)	737 4	V %	
Recreational vehicles		0	% %	
			6	
Terrain type: Grade		Level -	%	
		_	mi	
Segment length	יתי	1.5	шт	
Trucks and buses PCE, E Recreational vehicle PC		1.3		
		0.980		
Heavy vehicle adjustmer				
Driver population facto	or, Ip	1.00 1503	ng/h/ln	
Flow rate, vp		1503	pc/h/ln	
	Speed Inputs a	nd Adjustments_		
Lane width		_	ft	
Right-side lateral clea	rance	_	ft	
Total ramp density, TRI		_	ramps/mi	
Number of lanes, N		2	<u>_</u> ,	
Free-flow speed:		Measured		
FFS or BFFS		60.0	mi/h	
Lane width adjustment,	fLW	_	mi/h	
Lateral clearance adjus		_	mi/h	
TRD adjustment		_	mi/h	
Free-flow speed, FFS		60.0	mi/h	
	LOS and Perfor	mance Measures_		
-1		1.500	(1 / 7	
Flow rate, vp		1503	pc/h/ln	
Free-flow speed, FFS	1 . 0	60.0	mi/h	
Average passenger-car s	speea, S	60.0	mi/h	
Number of lanes, N		2	m m / m i / 1	
Density, D Level of service, LOS		25.0 C	pc/mi/ln	
Level of service, LOS		C		

Phone: E-mail:		Fax:	
	Operational Ana	lysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-2 Diverge to R- ODOT District 12 2036	-5 Merge 4	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	2980 0.94 793 4 0 Level - 1.5 1.2 0.980 1.00 1078	<pre>veh/h v % % % mi pc/h/ln</pre>
	Speed Inputs and	d Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Performa	ance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1078 60.0 60.0 3 18.0-	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:		
	Operational Ana	alysis		
	operacional ime			
Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/21/2014 Analysis Time Period: AM Peak Freeway/Direction: I-271 NB (Express Lanes) From/To: R-3 Merge to R4 Diverge Jurisdiction: ODOT District 12 Analysis Year: 2036 Description: CUY-271-8.14 - No Build F-5				
	Flow Inputs and	d Adjustments		
*** 1 **		2000	. 1- /1-	
Volume, V		2800	veh/h	
Peak-hour factor, PHF	-	0.94		
Peak 15-min volume, v15		745	V •.	
Trucks and buses Recreational vehicles		4 0	%	
		Level	6	
Terrain type: Grade		- rever	%	
Segment length		_	mi	
Trucks and buses PCE, E	r Tr	1.5	шт	
Recreational vehicle PO		1.2		
Heavy vehicle adjustmer		0.980		
Driver population factor		1.00		
Flow rate, vp	DI, ID	1013	pc/h/ln	
riow race, vp		1013	PC/11/111	
	Speed Inputs ar	nd Adjustments		
Lane width		_	ft	
Right-side lateral clea	arance	_	ft	
Total ramp density, TRI		_	ramps/mi	
Number of lanes, N		3	1,	
Free-flow speed:		Measured		
FFS or BFFS		60.0	mi/h	
Lane width adjustment,	fLW	_	mi/h	
Lateral clearance adjus		_	mi/h	
TRD adjustment		_	mi/h	
Free-flow speed, FFS		60.0	mi/h	
	LOS and Perform	nance Measures		
Elou meto		1012	m a /h /l	
Flow rate, vp		1013	pc/h/ln	
Free-flow speed, FFS	2 been	60.0	mi/h	
Average passenger-car s	preed, b	60.0	mi/h	
Number of lanes, N Density, D		3 16.9	pc/mi/ln	
Level of service, LOS		16.9 B	PC/ m1/ 111	
LCVCI OI BCIVICE, HOS		D		

Phone: E-mail:		Fax:	
	Operational Ar	nalysis	
	operacional in	10.17.21.2	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction:	8/21/2014	-6 Diverge	
Analysis Year:	2036		
Description: CUY-271-8	.14 - No Build F	7-6	
	Flow Inputs ar	nd Adjustments	
Volume, V		4480	veh/h
Peak-hour factor, PHF		0.94	V E11 / 11
Peak 15-min volume, v15		1191	V
Trucks and buses		4	v oo
Recreational vehicles		0	ତ୍ୱ ତ୍ୱ
Terrain type:		Level	· ·
Grade		-	<b>ે</b>
Segment length		_	mi
Trucks and buses PCE, E	T	1.5	
Recreational vehicle PC		1.2	
Heavy vehicle adjustmen	t, fHV	0.980	
Driver population factor		1.00	
Flow rate, vp		1620	pc/h/ln
	Speed Inputs a	and Adjustments_	
Lane width			ft
Right-side lateral clea	rance	_	ft
Total ramp density, TRI		_	ramps/mi
Number of lanes, N		3	ramps/ mr
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	fLW	-	mi/h
Lateral clearance adjus		_	mi/h
TRD adjustment	·	_	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Perfor	rmance Measures_	
Flow rate wa		1620	ng/h/ln
Flow rate, vp			pc/h/ln mi/h
Free-flow speed, FFS Average passenger-car s	need S	60.0 60.0	mi/h
Number of lanes, N	peed, s	3	шт/п
Density, D		27.0	pc/mi/ln
Level of service, LOS		D D	PC/ 1111

Phone: E-mail:		Fax:		
	Operational And	alysis		
	operacional ini	<u> </u>		
Analyst: Eric Brown  Agency or Company: Parsons Brinckerhoff  Date Performed: 8/21/2014  Analysis Time Period: AM Peak  Freeway/Direction: I-271 NB (Express Lanes)  From/To: R-4 Diverge R-8 Diverge  Jurisdiction: ODOT District 12  Analysis Year: 2036  Description: CUY-271-8.14 - No Build F-7				
	Flow Inputs and	d Adjustments		
Volume, V		1300	veh/h	
Peak-hour factor, PHF		0.94		
Peak 15-min volume, v15	5	346	V	
Trucks and buses		4	%	
Recreational vehicles		0	%	
Terrain type:		Level	•	
Grade		-	8	
Segment length		- 1 F	mi	
Trucks and buses PCE, I		1.5		
Recreational vehicle PC		1.2		
Heavy vehicle adjustmer		0.980		
Driver population facto	or, ip	1.00 705	ng/h/ln	
Flow rate, vp		703	pc/h/ln	
	Speed Inputs a	nd Adjustments		
Lane width		_	ft	
Right-side lateral clea	arance	_	ft	
Total ramp density, TRI		_	ramps/mi	
Number of lanes, N		2	<u>-</u>	
Free-flow speed:		Measured		
FFS or BFFS		60.0	mi/h	
Lane width adjustment,	fLW	_	mi/h	
Lateral clearance adjus	stment, fLC	-	mi/h	
TRD adjustment		-	mi/h	
Free-flow speed, FFS		60.0	mi/h	
	LOS and Perfor	mance Measures		
Flow rate, vp		705	pc/h/ln	
Free-flow speed, FFS		60.0	mi/h	
Average passenger-car s	speed, S	60.0	mi/h	
Number of lanes, N		2		
Density, D		11.8	pc/mi/ln	
Level of service, LOS		В		

Phone: E-mail:		Fax:	
	Operational An	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-6 Diverge to 1 ODOT District 1 2036 .14 - No Build F	R-7 Merge 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	2410 0.94 641 4 0 Level - 1.5 1.2 0.980 1.00 872	<pre>veh/h  v % % % mi</pre>
_	Speed Inputs a:		-
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	rance fLW	- - 3 Measured 60.0 - - - 60.0	ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h
	LOS and Perfor	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	872 60.0 60.0 3 14.5 B	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	lysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-7 Merge to R-9 ODOT District 12 2036	Merge 9	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3050 0.94 811 4 0 Level - 1.5 1.2 0.980 1.00 1103	veh/h v % % mi pc/h/ln
	Speed Inputs an	d Adjustments	
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	ance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1103 60.0 60.0 3 18.4	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	lysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brincker 8/22/2014 AM Peak I-271 NB R-9 Merge to R-1 ODOT District 12 2036 .14 - Build F-10	hoff O Diverge	
	Flow Inputs and	Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses		3100 0.94 824 4	veh/h v %
Recreational vehicles Terrain type: Grade		0 Level	8
Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustmen Driver population factor	E, ER t, fHV	1.5 1.2 0.980 1.00	mi
Flow rate, vp		1121	pc/h/ln
	Speed Inputs and	d Adjustments	
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed: FFS or BFFS		- - 3 Measured	ft ft ramps/mi mi/h
Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS		60.0 - - - 60.0	mi/h mi/h mi/h mi/h mi/h
	LOS and Perform	ance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1121 60.0 60.0 3 18.7 C	pc/h/ln mi/h mi/h pc/mi/ln

Phone: E-mail:		Fax:	
	Operational Anal	vsis	
	operacional imai	7515	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB (Express R-8 Diverge to Mag ODOT District 12 2036 3.14 - Build F-11	Lanes) yfield Rd	
	Flow Inputs and .	Ad Justillelits	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15	5	1250 0.94 332	veh/h v
Trucks and buses Recreational vehicles Terrain type:		4 0 Level	% %
Grade Segment length Trucks and buses PCE, F	CT	- - 1.5	% mi
Recreational vehicle PO Heavy vehicle adjustment Driver population factor	nt, fHV	1.2 0.980 1.00	
Flow rate, vp		678	pc/h/ln
	Speed Inputs and	Adjustments	
Lane width		_	ft
Right-side lateral clea	arance	_	ft
Total ramp density, TRI		_	ramps/mi
Number of lanes, N		2	
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,		_	mi/h
Lateral clearance adjus	stment, fLC	_	mi/h
TRD adjustment		-	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Performa:	nce Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D	speed, S	678 60.0 60.0 2 11.3	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>
Level of service, LOS		В	

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-10 Diverge to ODOT District 12 2036 .14 - No Build F	Mayfield Rd 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	1760 0.94 468 4 0 Level - - 1.5 1.2 0.980 1.00 955	<pre>veh/h  v % % % mi  pc/h/ln</pre>
	Speed Inputs an	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRE Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 2 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	955 60.0 60.0 2 15.9 B	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Analyse.
Agency or Company: Parsons Brinckerhoff Date Performed: 8/22/2014 Analysis Time Period: AM Peak Freeway/Direction: I-271 SB From/To: Mayfield Rd to R-11 Merge ODOT District 12 Jurisdiction: Analysis Year: 2036 Description: CUY-271-8.14 - No Build F-13 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 4530 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 1205 v Trucks and buses કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 2458 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h Lane width adjustment, fLW mi/h Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 2458 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 46.6 mi/h Number of lanes, N Density, D 52.7 pc/mi/ln

F

Level of service, LOS

Phone: E-mail:		Fax:	
	Operational Ana	lysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-11 Merge to R- ODOT District 12 2036	12 Diverge 14	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	5510 0.94 1465 4 0 Level - 1.5 1.2 0.980 1.00 1993	<pre>veh/h  v % % % mi</pre>
_	Speed Inputs an		-
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	rance	- - - 3 Measured 60.0 - - - 60.0	ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h
	LOS and Perform	ance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1993 60.0 57.2 3 34.8	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:			
	Operational Ana	alysis			
Analyst:	Eric Brown				
Agency or Company: Date Performed:	Parsons Brincker 8/22/2014	choff			
Analysis Time Period:		- \			
<pre>Freeway/Direction: From/To:</pre>	I-271 SB (Express Lanes) Mayfield Rd to R-13 Merge				
Jurisdiction:	ODOT District 12				
Analysis Year: Description: CUY-271-8	2036 R 14 - No Build F-	-15			
Description: Co1-2/1-0	o.14 - NO Bullu F-	-13			
	Flow Inputs and	d Adjustments			
Volume, V		2220	veh/h		
Peak-hour factor, PHF	_	0.94			
Peak 15-min volume, v15		590	V		
Trucks and buses Recreational vehicles		4 0	% %		
Terrain type:		Level	6		
Grade		-	%		
Segment length		_	mi		
Trucks and buses PCE, I	GT .	1.5			
Recreational vehicle PO		1.2			
Heavy vehicle adjustmen	nt, fHV	0.980			
Driver population factor	or, fp	1.00			
Flow rate, vp		1204	pc/h/ln		
	Speed Inputs ar	nd Adjustments			
Lane width		_	ft		
Right-side lateral clea	arance	-	ft		
Total ramp density, TRI		-	ramps/mi		
Number of lanes, N		2			
Free-flow speed:		Measured			
FFS or BFFS	5	60.0	mi/h		
Lane width adjustment,		_	mi/h		
Lateral clearance adjus	stment, ILC	-	mi/h		
TRD adjustment Free-flow speed, FFS		60.0	mi/h mi/h		
riee-liow speed, rrs		00.0	111 / 11		
	LOS and Perform	mance Measures			
Flow rate, vp		1204	pc/h/ln		
Free-flow speed, FFS		60.0	mi/h		
Average passenger-car	speed, S	60.0	mi/h		
Number of lanes, N		2			
Density, D		20.1	pc/mi/ln		
Level of service, LOS		С			

Phone: E-mail:		Fax:	
	Operational Ar	nalysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To:	8/22/2014		
Jurisdiction:	ODOT District 1	. 2	
Analysis Year:	2036		
Description: CUY-271-8	1.14 - No Build F	7-16	
	Flow Inputs ar	nd Adjustments	
Volume, V		4610	veh/h
Peak-hour factor, PHF		0.94	
Peak 15-min volume, v15		1226	V
Trucks and buses		4	8
Recreational vehicles		0	%
Terrain type:		Level	
Grade		_	%
Segment length		_	mi
Trucks and buses PCE, E		1.5	
Recreational vehicle PC	•	1.2	
Heavy vehicle adjustmen		0.980	
Driver population factor	or, fp	1.00	(1) (2)
Flow rate, vp		1667	pc/h/ln
	Speed Inputs a	and Adjustments_	
Lane width		_	ft
Right-side lateral clea	rance	_	ft
Total ramp density, TRI		_	ramps/mi
Number of lanes, N		3	
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	fLW	_	mi/h
Lateral clearance adjus	tment, fLC	_	mi/h
TRD adjustment		_	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Perfor	rmance Measures_	
Flow rate, vp		1667	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	speed. S	59.9	mi/h
Number of lanes, N	F = 200 / 0	3	,
Density, D		27.8	pc/mi/ln
Level of service, LOS		D	<b>.</b>

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB Brainard Rd to ( ODOT District 12 2036 1.14 - No Build F	Cedar Rd 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3640 0.94 968 4 0 Level - 1.5 1.2 0.980 1.00 1317	<pre>veh/h v % % % mi pc/h/ln</pre>
	Speed Inputs ar	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRE Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1317 60.0 60.0 3 22.0	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	lysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-15 Merge to R- ODOT District 12 2036	16 Diverge 18	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment	T E, ER t, fHV	5990 0.94 1593 4 0 Level - 1.5 1.2 0.980	veh/h v % % % mi
Driver population factor Flow rate, vp	or, fp	1.00 2167	pc/h/ln
	Speed Inputs an	d Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjustment TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	ance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	2167 60.0 54.2 3 40.0	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB (Expres R-13 Merge to R- ODOT District 12 2036 .14 - No Build F-	ss Lanes) -17 Merge	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3120 0.94 830 4 0 Level - - 1.5 1.2 0.980 1.00 1693	veh/h v % % % mi
	Speed Inputs an	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 2 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	nance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1693 60.0 59.8 2 28.3	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-16 Diverge to ODOT District 12 2036 .14 - No Build F-	R-19 Merge 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	5460 0.94 1452 4 0 Level - 1.5 1.2 0.980 1.00 1975	veh/h v % % % mi
_	Speed Inputs ar		-
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	rance	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1975 60.0 57.4 3 34.4	pc/h/ln mi/h mi/h pc/mi/ln

Phone: E-mail:		Fax:	
	Operational Ana	lvsis	
	Operacional inia.	1,010	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	8/21/2014 AM Peak I-271 SB (Express R-17 Merge to R-1 ODOT District 12 2036	s Lanes) 18 Diverge	
	Flow Inputs and	Adjustments	
Volume, V		3650	veh/h
Peak-hour factor, PHF	-	0.94	
Peak 15-min volume, v15		971	V
Trucks and buses Recreational vehicles		4 0	%
		Level	6
Terrain type: Grade		- Level	8
Segment length			mi
Trucks and buses PCE, I	.T	1.5	шт
Recreational vehicle PO		1.2	
Heavy vehicle adjustmen		0.980	
Driver population factor		1.00	
Flow rate, vp	)	1320	pc/h/ln
	Speed Inputs and	d Adjustments	
Lane width		-	ft
Right-side lateral clea		_	ft , .
Total ramp density, TRI	)	-	ramps/mi
Number of lanes, N		3	
Free-flow speed:		Measured	m.i /h
FFS or BFFS	£T W	60.0	mi/h
Lane width adjustment, Lateral clearance adjus		_	mi/h mi/h
TRD adjustment	schieffe, The		mi/h
Free-flow speed, FFS		60.0	mi/h
rice flow speed, rrs		00.0	1117 11
	LOS and Performa	ance Measures	
Flow rate, vp		1320	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	speed, S	60.0	mi/h
Number of lanes, N		3	
Density, D		22.0	pc/mi/ln
Level of service, LOS		C	

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-19 Merge to R- ODOT District 12 2036 .14 - No Build F-	-20 Diverge 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	6010 0.94 1598 4 0 Level - 1.5 1.2 0.980 1.00 2174	<pre>veh/h v % % % mi pc/h/ln</pre>
	Speed Inputs ar	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	2174 60.0 54.0 3 40.2	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:		
	Operational An	alysis		
	operacional ini	arybrb		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction:	8/22/2014	rhoff		
From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	R-19 Merge to R ODOT District 1 2036	2		
Description: Co1-2/1-0				
	Flow Inputs an	d Adjustments		
Volume, V Peak-hour factor, PHF		6010 0.94	veh/h	
Peak 15-min volume, v15		1598	v	
Trucks and buses		4	%	
Recreational vehicles		0	%	
Terrain type: Grade		Level -	%	
Segment length		_	mi	
Trucks and buses PCE, F	T	1.5		
Recreational vehicle PO		1.2		
Heavy vehicle adjustmer	nt, fHV	0.980		
Driver population factor	or, fp	1.00		
Flow rate, vp		1630	pc/h/ln	
	Speed Inputs a	nd Adjustments_		
Lane width		_	ft	
Right-side lateral clea	arance	_	ft	
Total ramp density, TRI		_	ramps/mi	
Number of lanes, N		4	<del>-</del>	
Free-flow speed:		Measured		
FFS or BFFS		60.0	mi/h	
Lane width adjustment,		_	mi/h	
Lateral clearance adjus	stment, fLC	-	mi/h	
TRD adjustment		-	mi/h	
Free-flow speed, FFS		60.0	mi/h	
	LOS and Perfor	mance Measures_		
Flow rate, vp		1630	pc/h/ln	
Free-flow speed, FFS		60.0	mi/h	
Average passenger-car	speed, S	60.0	mi/h	
Number of lanes, N		4		
Density, D		27.2	pc/mi/ln	
Level of service, LOS		D		

Phone: E-mail:		Fax:			
	Operational Anal	vsis			
	operational imar	7515			
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB (Express Lanes) R-18 Diverge to Chagrin Blvd ODOT District 12 2036				
	Flow Inputs and	Adjustments			
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15	5	3100 0.94 824	veh/h v		
Trucks and buses Recreational vehicles Terrain type:		4 0 Level	ું કુ		
Grade Segment length Trucks and buses PCE, E		- - 1.5	% mi		
Recreational vehicle PO Heavy vehicle adjustment Driver population factor	nt, fHV	1.2 0.980 1.00			
Flow rate, vp		1682	pc/h/ln		
	Speed Inputs and	Adjustments			
Lane width		_	ft		
Right-side lateral clea	arance	_	ft		
Total ramp density, TRI	)	-	ramps/mi		
Number of lanes, N		2			
Free-flow speed:		Measured			
FFS or BFFS		60.0	mi/h		
Lane width adjustment,		-	mi/h		
Lateral clearance adjus	stment, ILC	_	mi/h		
TRD adjustment Free-flow speed, FFS		60.0	mi/h mi/h		
riee-liow speed, rrs		00.0	1111/11		
	LOS and Performa	nce Measures			
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	speed, S	1682 60.0 59.9 2 28.1	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>		
Level of Bervice, Hob		D			

Phone: E-mail:		Fax:	
	Operational Ana	llysis	
	Eric Brown		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To:			
Jurisdiction:	ODOT District 12		
Analysis Year:	2036	2.4	
Description: CUY-271-8	3.14 - NO BULLO F-	- 24	
	Flow Inputs and	l Adjustments	
Volume, V		4930	veh/h
Peak-hour factor, PHF		0.94	
Peak 15-min volume, v15	5	1311	V
Trucks and buses		4	%
Recreational vehicles		0	%
Terrain type:		Level	
Grade		-	%
Segment length		-	mi
Trucks and buses PCE, E		1.5	
Recreational vehicle PC	·	1.2	
Heavy vehicle adjustmer		0.980	
Driver population factor	or, fp	1.00	(3. (3.
Flow rate, vp		1783	pc/h/ln
	Speed Inputs an	d Adjustments	
Lane width		_	ft
Right-side lateral clea	rance	_	ft
Total ramp density, TRI		_	ramps/mi
Number of lanes, N		3	<b>-</b> ·
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	fLW	-	mi/h
Lateral clearance adjus	stment, fLC	-	mi/h
TRD adjustment		-	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Perform	nance Measures	
Flow rate, vp		1783	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	speed. S	59.4	mi/h
Number of lanes, N	·F = 200 / 0	3	,
Density, D		30.0	pc/mi/ln
Level of service, LOS		D	-

Phone: E-mail:	F	ax:					
	Merge	Analy	sis				
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB Chagrin Blvd District 12 2036						
	Free	way Da	ta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Merge 4 60.0 2790		mph vph		
	On R	amp Da	ta				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Right 1 35.0 220 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	e exists	3)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp		Yes 30 Downst Off 4700	ream	vph ft		
-	_						
Con Junction Components	version to pc/h		Base ay	Condition Ramp		Adjacen	
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		2790 0.90 775 4 0 Level		220 0.90 61 1 0 Level	% mi	Ramp 30 0.90 8 0 Level	vph v % % % mi

```
Heavy vehicle adjustment, fHV 0.980 0.995 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                     33
                                 3162
                                           246
                                                             pcph
               _____Estimation of V12 Merge Areas____
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 0.187 Using Equation 4
                FM
               v = v (P) = 591 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                      Actual
                       3408
                                   9200
    V
                                                No
    FO
                      1285 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 1264
                12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   ___Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  1510
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 7.7 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence A
  _____Speed Estimation_____
Intermediate speed variable,
                                      M = 0.234
                                       S
Space mean speed in ramp influence area,
                                     S = 55.8
                                      R
Space mean speed in outer lanes,
                                      S = 58.4
                                      0
                                     S = 57.2  mph
Space mean speed for all vehicles,
```

Phone: E-mail:	Fa	ax:						
	Diver	ge Anal	ysis_					
	I-271 NB Expressway District 12 2036							
	Free	way Dat	:a					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	=	3 6	Diverg 8 50.0 8010		mph vph			
	Off R	amp Dat	:a					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/decel lane Length of second accel/decel lane		1 6 3	30 vj 740 fr			mph vph ft ft		
	Adjacent Ramp	Data (	if on	e exista	s)			
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp	1 D C	Yes 1500 Downst On 3600	ream	vph ft			
Con	version to pc/h	Under	Base	Conditio	ons			
Junction Components	version to pe/ii	Freewa		Ramp	7116	Adjacen Ramp	nt	
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Length Trucks and buses PCE, E Recreational vehicle PC	T	3010 0.90 836 4 0 Level 0.00 0.00 1.5	% mi	30 0.90 8 0 0 Level 0.00 0.00 1.5 1.2	% mi	1500 0.90 417 0 0 Level 0.00 0.00 1.5	vph v % % mi	

```
Heavy vehicle adjustment, fHV 0.980 1.000 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                 3411
                                           33
                                                      1667
                                                               pcph
                _____Estimation of V12 Diverge Areas___
                            (Equation 13-12 or 13-13)
                ΕQ
               P = 0.673 Using Equation 5
                FD
               v = v + (v - v) P = 2307 pc/h
                12 R F R FD
                 _____Capacity Checks____
                                   Maximum
                                              LOS F?
                       Actual
    v = v
                                   6900
                       3411
                                                 Nο
    Fi F
    v = v - v
                       3378
                                  6900
                                                No
    FO F R
                                   2200
                       33
    V
                                                No
    R
                      1104 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                  No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                   No
3 	 av34
If yes, v = 2307
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                 __Flow Entering Diverge Influence Area__
                   Actual Max Desirable Violation?
                   2307
                               4400
                                                 No
     12
         _____Level of Service Determination (if not F)_____
                    D = 4.252 + 0.0086 v - 0.009 L = 18.4 pc/mi/ln
Density,
                                    12 D
                    R
Level of service for ramp-freeway junction areas of influence B
    ______Speed Estimation_____
Intermediate speed variable,
                                      D = 0.106
                                       S
Space mean speed in ramp influence area,
                                     S = 58.1
                                       R
Space mean speed in outer lanes,
                                      S = 65.8
                                       0
Space mean speed for all vehicles,
                                      S = 60.1
                                                  mph
```

Phone: Fax: E-mail:							
	Merge	Analy	sis				
Analyst: Eric Brown Agency/Co.: Parsons Brinckerhoff Date performed: 8/18/2014 Analysis time period: AM Peak Freeway/Dir of Travel: I-271 NB Junction: Expressway Jurisdiction: District 12 Analysis Year: 2036 Description: CUY-271-8.14 - No Build R-5							
	Free	way Da	ıta				
Type of analysis Number of lanes in freev Free-flow speed on freev Volume on freeway			Merge 3 60.0 2980		mph vph		
	On R	amp Da	ıta				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/de Length of second accel/de			Left 1 60.0 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	e exists.	3)		
Does adjacent ramp exist Volume on adjacent Ramp Position of adjacent Ram Type of adjacent Ramp Distance to adjacent Ram	np		Yes 30 Upstre Off 3600		vph ft		
Conv	version to pc/h	Under	Base	Conditio	ons		
Junction Components	, ersion to po, n			Ramp		Adjacen Ramp	nt
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, ET	r	2980 0.90 828 4 0 Level	% mi	1500 0.90 417 0 0 Level	% mi	30 0.90 8 0 0 Level	vph v % % mi
Recreational vehicle PCF		1.5		1.5		1.5	

```
Heavy vehicle adjustment, fHV 0.980 1.000 1.000 Driver population factor, fP 1.00 1.00 1.00
                                                      33
Flow rate, vp
                                 3377
                                           1667
                                                              pcph
               _____Estimation of V12 Merge Areas___
                     2481.62 (Equation 13-6 or 13-7)
                ΕQ
               P = 0.619 Using Equation 1
                FM
               v = v (P) = 2092 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                       Actual
                       5044
                                   6900
    V
                                                 No
    FO
                       1285 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 2092
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   __Flow Entering Merge Influence Area__
                   Actual Max Desirable Violation?
                   4010
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 26.6 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence C
  _____Speed Estimation_____
Intermediate speed variable,
                                       M = 0.356
                                       S
Space mean speed in ramp influence area,
                                      S = 53.6
                                       R
Space mean speed in outer lanes,
                                       S = 58.1
                                       0
                                      S = 54.5 \quad mph
Space mean speed for all vehicles,
```

Phone: E-mail:								
Diverge Analysis								
Jurisdiction: Analysis Year: Description: CUY-271-8	AM Peak I-271 NB Brainard Rd District 12 2036 .14 - No Build	R-6						
	Free	way Da	ata <sub>-</sub>					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	way		3 60 448	.0 80		mph vph		
	Off R	amp Da	ata <sub>-</sub>					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/de Length of second accel/de		Data	1 35 20' 140	.0 70 00		mph vph ft ft		
	najacene namp	Daca	(	_ 011	C CAIDCE	, ,		
Does adjacent ramp exist Volume on adjacent ramp Position of adjacent ramp Type of adjacent ramp Distance to adjacent ram	qm		Yes 640 Dow On 350	0 wnst	ream	vph ft		
Con	version to pc/h	Unde	r Ba	ase	Conditio	ns		
Junction Components	CIBION CO PC/II	Free			Ramp	, 11D	Adjacen	.t
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, ETR		4480 0.90 1244 4 0 Level 0.00 0.00 1.5 1.2	1	% mi	2070 0.90 575 3 0 Level 0.00 0.00 1.5	% mi	Ramp 640 0.90 178 1 0 Level 0.00 0.00 1.5	vph v % % mi

```
715
Flow rate, vp
                                                                   pcph
                _____Estimation of V12 Diverge Areas____
                L =
                               (Equation 13-12 or 13-13)
                 ΕO
                        0.526 Using Equation 5
                P =
                 FD
                v = v + (v - v) P = 3776 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                    LOS F?
                         Actual
                                     Maximum
                         5077
                                      6900
    v = v
                                                    No
     Fi F
    v = v - v
                         2742
                                      6900
                                                    No
     FO F R
    V
                         2335
                                     2000
                                                    Yes
     R
                                    (Equation 13-14 or 13-17)
    v or v
                         1301 pc/h
     3 av34
                > 2700 pc/h?
Is
    v or v
                                     No
     3 av34
Is
    v or v
                > 1.5 v /2
                                     No
         av34
     3
                      12
If yes, v
          = 3776
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    3776
                                                     No
     12
             ___Level of Service Determination (if not F)______
                     D = 4.252 + 0.0086 v - 0.009 L = 24.1 pc/mi/ln
Density,
                                       12
Level of service for ramp-freeway junction areas of influence F
             _____Speed Estimation___
Intermediate speed variable,
                                         D = 0.638
                                          S
Space mean speed in ramp influence area,
                                         S = 48.5
                                                     mph
                                         R
Space mean speed in outer lanes,
                                         S = 64.6
                                                     mph
                                          0
Space mean speed for all vehicles,
                                        S = 51.8
                                                     mph
```

1.00

5077

0.985

1.00

2335

0.995

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:		Fax	:				
	Merge	Analysi	.s				
Analysis time period: Freeway/Dir of Travel: Junction:	I-271 NB Brainard Rd District 12 2036						
	Free	way Data	L				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-	3 60	erge 0.0 :10		mph vph		
	On R	amp Data	L				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	1 35 64	ght 6.0 600		mph vph ft ft		
	Adjacent Ramp	Data (i	f on	e exists	3)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp	On	wnst	ream	vph ft		
Con	version to pc/h	Under B	ase	Conditio	ns		
Junction Components		Freeway		Ramp		Adjacer Ramp	
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length		2410 0.90 669 4 0 Level	% mi	640 0.90 178 1 0 Level	% mi	50 0.90 14 0 0 Level	vph v % % mi
Trucks and buses PCE, E Recreational vehicle PC		1.5 1.2		1.5 1.2		1.5 1.2	

```
Heavy vehicle adjustment, fHV 0.980 0.995 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                      56
                                 2731
                                            715
                                                              pcph
                _____Estimation of V12 Merge Areas____
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 0.619 Using Equation 1
                FM
               v = v (P) = 1692 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                       Actual
                       3446
                                   6900
    V
                                                 Nο
    FO
                       1039 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 1692
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   __Flow Entering Merge Influence Area__
                   Actual Max Desirable Violation?
                   2407
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 14.5 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence B
  _____Speed Estimation_____
Intermediate speed variable,
                                      M = 0.259
                                       S
Space mean speed in ramp influence area,
                                      S = 55.3
                                       R
Space mean speed in outer lanes,
                                      S = 58.1
                                       0
                                      S = 56.1 \quad mph
Space mean speed for all vehicles,
```

Phone: E-mail:	Fax:							
	Diver	ge Ana	alys	sis_				
	I-271 NB Expressway District 12 2036		-					
	Free	way Da	ata_					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	way		2 60. 130	0		mph vph		
	Off R	amp Da	ata_					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/decel lane Length of second accel/decel lane			Rig 1 60. 50 150	0		mph vph ft ft		
	Adjacent Ramp	Data	(if	on	e exists	;)		
Does adjacent ramp exist Volume on adjacent ramp Position of adjacent ram Type of adjacent ramp Distance to adjacent ram	np		Yes 150 Ups Off 800	0 stre	am	vph ft		
Con	version to pc/h	Under	: Ва	se	Conditio	ns		
Junction Components Volume, V (vph)		Freev			Ramp		Adjacer Ramp 1500	nt vph
Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E' Recreational vehicle PC		0.90 361 4 0 Level 0.00 0.00 1.5 1.2	_	% mi	0.90 14 0 0 Level 0.00 0.00 1.5 1.2	% mi	0.90 417 0 0 Level 0.00 0.00 1.5 1.2	V % % mi

```
Heavy vehicle adjustment, fHV 0.980 1.000 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                 1473
                                          56
                                                     1667
                                                             pcph
               _____Estimation of V12 Diverge Areas___
                            (Equation 13-12 or 13-13)
               ΕQ
               P = 1.000 Using Equation 0
               FD
               v = v + (v - v) P = 1473 pc/h
               12 R F R FD
                   _____Capacity Checks____
                                  Maximum
                                             LOS F?
                      Actual
    v = v
                                  4600
                      1473
                                                Nο
    Fi F
                      1417
                                 4600
    v = v - v
                                               No
    FO F R
                                  2200
                      56
    V
                                               No
    R
                     0 pc/h
                                 (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                 No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                  No
                 12
    3 av34
If yes, v = 1473
                               (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                 __Flow Entering Diverge Influence Area__
                  Actual Max Desirable Violation?
                  1473
                              4400
                                                No
    12
         _____Level of Service Determination (if not F)____
                   D = 4.252 + 0.0086 v - 0.009 L = 3.4 pc/mi/ln
Density,
                                   12 D
                   R
Level of service for ramp-freeway junction areas of influence A
    ______Speed Estimation_____
Intermediate speed variable,
                                      D = 0.108
                                      S
                                     S = 58.1
Space mean speed in ramp influence area,
                                      R
Space mean speed in outer lanes,
                                     S = N/A
                                      0
Space mean speed for all vehicles,
                                     S = 58.1
                                                 mph
```

Phone: E-mail:	Fax:						
	Merge	Analy	sis				
Analysis time period: Freeway/Dir of Travel: Junction:	I-271 NB Expressway District 12 2036		₹				
	Free	way Da	ata				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Merge 3 60.0 3050		mph vph		
	On R	amp Da	ata				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/de Length of second accel/de			Left 1 60.0 50 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	e exists	3)		
Does adjacent ramp exist Volume on adjacent Ramp Position of adjacent Ram Type of adjacent Ramp Distance to adjacent Ram	np		Yes 640 Upstre On 1400	am	vph ft		
Con	version to pc/h	Under	Base	Conditio	ons		
Junction Components	version to pe/n			Ramp		Adjace Ramp	nt
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E' Recreational vehicle PC		3050 0.90 847 4 0 Level	l % mi	50 0.90 14 0 0 Level	% mi	640 0.90 178 1 0 Level	vph v % % mi

```
Heavy vehicle adjustment, fHV 0.980 1.000 0.995
Driver population factor, fP 1.00 1.00 1.00
                                                      715
Flow rate, vp
                                 3457
                                           56
                                                             pcph
                _____Estimation of V12 Merge Areas____
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 0.619 Using Equation 1
                FM
               v = v (P) = 2142 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                      Actual
                       3513
                                   6900
    V
                                                Nο
    FO
                      1315 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 2142
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   __Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  2455
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 15.2 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence B
  _____Speed Estimation_____
Intermediate speed variable,
                                      M = 0.186
                                       S
Space mean speed in ramp influence area,
                                     S = 56.6
                                      R
Space mean speed in outer lanes,
                                      S = 58.0
                                      0
                                     S = 57.0  mph
Space mean speed for all vehicles,
```

Phone: E-mail:	Fax:								
	Diver	ge Ana	lysis_						
	I-271 SB Expressway District 12 2036								
	Free	way Da	ta						
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	<del>-</del>		Diverg 3 60.0 5510		mph vph				
	Off R	amp Da	ta						
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/decel lane Length of second accel/decel lane						mph vph ft ft			
	Adjacent Ramp	Data	(if on	ne exist	s)				
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ramp Type of adjacent ramp Distance to adjacent ra	mp		Yes 970 Downst Off 1700	ream	vph ft				
Con	version to pc/h	Under	Base	Conditio	าทร				
Junction Components	version to bc/H	Freew		Ramp	7118 <u></u>	Adjace	nt		
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Length Trucks and buses PCE, E Recreational vehicle PC	T	5510 0.90 1531 4 0 Level 0.00 0.00 1.5 1.2	% mi	900 0.90 250 0 0 Level 0.00 0.00 1.5	% mi	Ramp 970 0.90 269 4 0 Level 0.00 0.00 1.5	vph v % % mi		

```
Heavy vehicle adjustment, fHV 0.980 1.000 0.980 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                      1099
                                 6245
                                           1000
                                                             pcph
               _____Estimation of V12 Diverge Areas___
                     1893.28 (Equation 13-12 or 13-13)
                ΕQ
               P = 0.565 Using Equation 7
                FD
               v = v + (v - v) P = 3964 pc/h
                12 R F R FD
                   _____Capacity Checks____
                                   Maximum
                                              LOS F?
                       Actual
    v = v
                                   6900
                       6245
                                                 Nο
    Fi F
    v = v - v
                       5245
                                  6900
                                                No
    FO F R
                       1000
                                  2200
    V
                                                No
    R
                       2281 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                  No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                  No
3 	 av34
If yes, v = 3964
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                  __Flow Entering Diverge Influence Area__
                   Actual Max Desirable Violation?
                   3964
                               4400
     12
         _____Level of Service Determination (if not F)_____
                   D = 4.252 + 0.0086 v - 0.009 L = 26.5 pc/mi/ln
Density,
                                    12 D
                    R
Level of service for ramp-freeway junction areas of influence C
    _____Speed Estimation_____
                                      D = 0.193
Intermediate speed variable,
                                       S
Space mean speed in ramp influence area,
                                     S = 56.5
                                       R
Space mean speed in outer lanes,
                                      S = 61.6
                                       0
Space mean speed for all vehicles,
                                      S = 58.1
                                                  mph
```

Phone: E-mail:		Fax	:			
	Merge	Analysis	5			
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB Expressway District 12 2036					
	Free	way Data_				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-	2	. 0		mph vph	
	On R	amp Data_				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane decel lane	Rig 1 60. 900 150	. 0 ) ) 0		mph vph ft ft	
	Adjacent Ramp	Data (if	E on	e exists	3)	
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp	No			vph ft	
Con	version to pc/h	Under Ba	ase	Conditio	ons	
Junction Components  Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade		Freeway 2220 0.90 617 4 0 Level	06	Ramp 900 0.90 250 0 0 Level	% .	Adjacent Ramp vph v %
Length Trucks and buses PCE, E Recreational vehicle PC		1.5 1.2	mi	1.5 1.2	mi	mi

```
Heavy vehicle adjustment, fHV 0.980 1.000 Driver population factor, fP 1.00 1.00
Flow rate, vp
                                 2516
                                           1000
                                                              pcph
                _____Estimation of V12 Merge Areas____
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 1.000 Using Equation 0
                FM
               v = v (P) = 2516 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                       Actual
                       3516
                                   4600
    V
                                                No
    FO
                       0 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  No
Is
3 	 av34
If yes, v = 2516
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   ___Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  3516
                              4600
    R12
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 23.0 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence C
  _____Speed Estimation_____
Intermediate speed variable,
                                      M = 0.272
                                       S
Space mean speed in ramp influence area,
                                      S = 55.1
                                      R
Space mean speed in outer lanes,
                                      S = N/A
                                      0
                                     S = 55.1 \quad mph
Space mean speed for all vehicles,
```

Phone: E-mail:	Fax:								
	Diver	ge Ana	lysis_						
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB Brainard Rd District 12 2036								
	Free	way Da	ta						
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-		Diverg 3 60.0 4610		mph vph				
	Off R	amp Da	ta						
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/decel lane Length of second accel/decel lane			970 1500			mph vph ft ft			
	Adjacent Ramp	Data	(if on	e exist	s)				
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp	1	Yes 900 Upstre Off 1700	am	vph ft				
Con	version to pc/h	Under	Base	Condition	ons				
Junction Components		Freew		Ramp	<u></u> .	Adjace:	nt		
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC	T	4610 0.90 1281 4 0 Level 0.00 0.00 1.5	% mi	970 0.90 269 4 0 Level 0.00 0.00 1.5	% mi	900 0.90 250 0 0 Level 0.00 0.00 1.5	vph v % % mi		

```
Heavy vehicle adjustment, fHV 0.980 0.980 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                      1000
                                 5225
                                           1099
                                                               pcph
                _____Estimation of V12 Diverge Areas___
                            (Equation 13-12 or 13-13)
                ΕQ
               P = 0.579 Using Equation 5
                FD
               v = v + (v - v) P = 3487 pc/h
                12 R F R FD
                   _____Capacity Checks____
                                   Maximum
                                              LOS F?
                       Actual
    v = v
                                   6900
                       5225
                                                 Nο
    Fi F
    v = v - v
                                  6900
                       4126
                                                No
    FO F R
                       1099
                                  2000
    V
                                                No
    R
                      1738 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                  No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                  No
3 	 av34
If yes, v = 3487
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                 __Flow Entering Diverge Influence Area__
                   Actual Max Desirable Violation?
                   3487
                               4400
     12
         _____Level of Service Determination (if not F)_____
                    D = 4.252 + 0.0086 v - 0.009 L = 20.7 pc/mi/ln
Density,
                                    12 D
                    R
Level of service for ramp-freeway junction areas of influence C
    _____Speed Estimation_____
Intermediate speed variable,
                                      D = 0.527
                                       S
Space mean speed in ramp influence area,
                                      S = 50.5
                                       R
Space mean speed in outer lanes,
                                      S = 62.9
                                       0
Space mean speed for all vehicles,
                                      S = 54.1
                                                  mph
```

Phone: E-mail:		F	ax:				
	Merge	Analy	sis				
Analysis time period: Freeway/Dir of Travel: Junction:	I-271 SB Cedar Rd District 12 2036						
	Free	way Da	ıta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Merge 3 60.0 3640		mph vph		
	On R	amp Da	ıta				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane decel lane		Right 1 35.0 2350 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	e exists	3)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp		Yes 530 Downst Off 2200	ream	vph ft		
Con	version to pc/h	Under	Base	Conditio	ns		
Junction Components  Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles		Freew 3640 0.90 1011 4		Ramp 2350 0.90 653 2		Adjacer Ramp 530 0.90 147 0	vph v v %
Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		1.5 1.2	* mi	1.5 1.2	% mi	1.5 1.2	% mi

```
4125
                                               2637
                                                          589
Flow rate, vp
                                                                  pcph
                ______Estimation of V12 Merge Areas_____
                L =
                        2180.67 (Equation 13-6 or 13-7)
                 ΕO
                        0.619 Using Equation 1
                 FM
                v = v (P) = 2555 pc/h
                 12 F FM
                     _____Capacity Checks_____
                                                   LOS F?
                         Actual
                                     Maximum
                         6762
                                     6900
    V
                                                    No
     FΟ
                        1570 pc/h (Equation 13-14 or 13-17)
    v or v
     3 av34
Is
    v or v
               > 2700 pc/h?
                                     No
     3
          av34
                > 1.5 v /2
Is
    v or v
                                     Yes
                   12
     3 av34
If yes, v = 2555
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    ___Flow Entering Merge Influence Area__
                    Actual Max Desirable
                                                     Violation?
                    5192
                                 4600
     12A
             ____Level of Service Determination (if not F)_____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 35.4 pc/mi/ln
                           R
                                      12
Level of service for ramp-freeway junction areas of influence \, \, \mathbf{E} \,
               _____Speed Estimation_____
                                         M = 0.917
Intermediate speed variable,
                                          S
Space mean speed in ramp influence area,
                                         S = 43.5
                                                     mph
                                         R
Space mean speed in outer lanes,
                                         S = 56.1
                                                     mph
```

1.00

0.990

1.00

S = 45.9

mph

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:	Fax:								
	Diver	ge Ana	lys	sis_					
Analysis time period: Freeway/Dir of Travel:	I-271 SB Expressway District 12 2036		:						
	Free	way Da	ıta_						
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	_		3 60.	verg 0		mph vph			
	Off R	amp Da	ıta_						
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/decel lane Length of second accel/decel lane			Left 1 60.0 mph 530 vph 1500 ft						
	Adjacent Ramp	Data	(if	on	e exists	s)			
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp		_	50 stre		vph ft			
Con	version to pc/h	Under	· Ba	ase	Conditio	ons			
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15	- '	Freew 5990 0.90 1664			Ramp 530 0.90 147		Adjacer Ramp 2350 0.90 653		
Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		4 0 Level 0.00 0.00 1.5		% mi	0 0 Level 0.00 0.00 1.5	% mi	2 0 Level 0.00	% % mi	

```
2637
Flow rate, vp
                                                                   pcph
                 _____Estimation of V12 Diverge Areas_____
                L =
                        14458.58 Equation 13-12 or 13-13)
                 ΕO
                        0.563 Using Equation 5
                P =
                 FD
                 v = v + (v - v) P = 4081 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                    LOS F?
                                      Maximum
                         Actual
                         6789
                                      6900
    v = v
                                                     No
     Fi F
    v = v - v
                         6200
                                      6900
                                                     No
     FO F R
    V
                         589
                                      2200
                                                     No
     R
                                     (Equation 13-14 or 13-17)
    v or v
                         2708 pc/h
     3 av34
                > 2700 pc/h?
Is
    v or v
                                      Yes
     3 av34
Is
    v or v
                > 1.5 v /2
                                      No
          av34
     3
                      12
If yes, v
          = 4089
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    4089
                                                      No
     12A
            ____Level of Service Determination (if not F)_____
                     D = 4.252 + 0.0086 v - 0.009 L = 27.7 pc/mi/ln
Density,
                                        12
Level of service for ramp-freeway junction areas of influence C
              _____Speed Estimation___
Intermediate speed variable,
                                         D = 0.156
                                          S
Space mean speed in ramp influence area,
                                         S = 57.2
                                                      mph
                                          R
Space mean speed in outer lanes,
                                         S = 60.0
                                                      mph
                                          0
Space mean speed for all vehicles,
                                         S = 58.2
                                                      mph
```

1.00

6789

1.000

1.00

589

0.990 1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:	Fax:						
	Merge	Analy	ysis				
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year:	Eric Brown Parsons Brinck 8/20/2014 AM Peak I-271 SB Expressway District 12 2036	erhof:	_				
Description: CUY-271-8			a+a				
	Free	way Da	aud				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	<del>-</del>		Merge 3 60.0 5460		mph vph		
	On R	amp Da	ata				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Left 1 60.0 550 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if or	ne exists	s)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp		Yes 1080 Downst Off 1850	ream	vph ft		
Con	version to pc/h	Unde	r Base	Conditio	ons		
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15		Freev 5460 0.90 1517	way	Ramp 550 0.90 153		Adjacer Ramp 1080 0.90 300	vph
Trucks and buses Recreational vehicles Terrain type: Grade		4 0 Level	%	0 0 Level	% .	6 0 Level	% % %
Length Trucks and buses PCE, E Recreational vehicle PC		1.5 1.2	mi	1.5 1.2	mi	1.5 1.2	mi

```
6188
                                               611
                                                          1236
Flow rate, vp
                                                                  pcph
                ______Estimation of V12 Merge Areas_____
                L =
                        4576.08 (Equation 13-6 or 13-7)
                 ΕO
                        0.724 Using Equation 3
                 FM
                v = v (P) = 4482 pc/h
                 12 F FM
                     _____Capacity Checks_____
                                                   LOS F?
                         Actual
                                     Maximum
                         6799
                                     6900
    V
                                                    No
     FΟ
                        1706 pc/h (Equation 13-14 or 13-17)
    v or v
     3 av34
Is
    v or v
               > 2700 pc/h?
                                     No
     3
          av34
                > 1.5 v /2
Is
    v or v
                                     Yes
                   12
     3 av34
If yes, v = 4482
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    __Flow Entering Merge Influence Area__
                    Actual Max Desirable
                                                     Violation?
                    5630
                                 4600
     12A
             ____Level of Service Determination (if not F)______
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 39.7 pc/mi/ln
                           R
                                      12
Level of service for ramp-freeway junction areas of influence \, \, \mathbf{E} \,
               _____Speed Estimation_____
                                         M = 1.228
Intermediate speed variable,
                                          S
Space mean speed in ramp influence area,
                                         S = 37.9
                                                     mph
                                         R
Space mean speed in outer lanes,
                                         S = 57.6
                                                     mph
```

1.00

1.000

1.00

S = 40.3

mph

0.971

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:						Fax:					
	Diver	ge Ana	lysis								
	Eric Brown Parsons Brinck 8/20/2014 AM Peak I-271 SB Chagrin Blvd District 12 2036	erhoff	_								
	Free	way Da	ta								
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Diver 3 60.0 6010		mph vph						
	Off R	amp Da	ta								
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Right 1 35.0 1080 1500		mph vph ft ft						
	Adjacent Ramp	Data	(if o	ne exists	s)						
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp		Yes 550 Upstr On 1850	eam	vph ft						
Con	version to pc/h	Under	Base	Conditio	าทร						
Junction Components	vergion co bc/u	Freew		Ramp	วเเธ	Adjacen	t				
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC	T	6010 0.90 1669 4 0 Level 0.00 0.00 1.5			% mi	Ramp 550 0.90 153 0 0 Level 0.00 0.00 1.5	vph v % % mi				

```
6811
                                               1236
                                                          611
Flow rate, vp
                                                                    pcph
                 _____Estimation of V12 Diverge Areas_____
                L =
                        4569.35 (Equation 13-12 or 13-13)
                 ΕO
                        0.533 Using Equation 5
                P =
                 FD
                 v = v + (v - v) P = 4207 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                     LOS F?
                         Actual
                                      Maximum
                         6811
                                      6900
    v = v
                                                     No
     Fi F
    v = v - v
                         5575
                                      6900
                                                     No
     FO F R
    V
                         1236
                                      2000
                                                     No
     R
                                     (Equation 13-14 or 13-17)
    v or v
                         2604 pc/h
     3 av34
                > 2700 pc/h?
Is
    v or v
                                      No
     3 av34
Is
    v or v
                > 1.5 v /2
                                      No
          av34
     3
                      12
If yes, v
          = 4207
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    4207
                                                      No
     12
             ___Level of Service Determination (if not F)______
                     D = 4.252 + 0.0086 v - 0.009 L = 26.9 pc/mi/ln
Density,
                                        12
Level of service for ramp-freeway junction areas of influence C
              _____Speed Estimation___
Intermediate speed variable,
                                         D = 0.539
                                          S
Space mean speed in ramp influence area,
                                         S = 50.3
                                                      mph
                                          R
Space mean speed in outer lanes,
                                         S = 59.6
                                                      mph
                                          0
Space mean speed for all vehicles,
                                        S = 53.5
                                                      mph
```

1.00

0.971

1.00

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

HCS 2	2010: Free	way Wear	ving Rele	ease 6.60	)		
Phone:		Fa	ax:				
E-mail:							
	Operatio	nal Ana	lysis				
Analyst:	Eric Bro	wn					
Agency/Co.:	Parsons	Brincker	rhoff				
Date Performed:	9/11/14						
Analysis Time Period:	AM Peak	AM Peak					
Freeway/Dir of Travel:	I-271 NB						
Weaving Location:	R-1 Merg	R-1 Merge to R-2 Diverge					
Analysis Year:	2036						
Description:	CUY-271-	8.14 - 1	No Build	W-1			
	Tnn	11 t G					
		uts					
Segment Type			reeway				
Weaving configuration		7T	wo-Sided				
Number of lanes, N		3		ln			
Weaving segment length, LS			000	ft			
Freeway free-flow speed, FFS		60		mi/h			
Minimum segment speed, SMIN			5	mi/h			
Freeway maximum capacity, cIF	FL	23	300	pc/h/l	ln		
Terrain type		Le	evel				
Grade		0	.00	%			
Length		0	.00	mi			
Conversion	to na/h	Under B	age Condi	itions			
CONVELSION	1 CO PC/II		Componer				
		VFF	VRF	VFR	VRR		
Volume, V		2790	190	0	30	veh/h	
Peak hour factor, PHF		0.90	0.90	0.90	0.90	V C11/ 11	
Peak 15-min volume, v15		775	53	0	8		
Trucks and buses		0	0	0	0	%	
Recreational vehicles		0	0	0	0	%	
Trucks and buses PCE, ET		1.5	1.5	1.5	1.5	v	
Recreational vehicle PCE, ER		1.2	1.2	1.2	1.2		
Heavy vehicle adjustment, fHV		1.000	1.000	1.000	1.000	)	
Driver population adjustment,		1.00	1.00	1.00	1.00		
Flow rate, v	,	3100	211	0	33	pc/h	
·						1 - /	
Volume ratio, VR			0.010				
	iguration		teristics				
Number of maneuver lanes, NWI	_	0		ln			
Interchange density, ID		0.0	5	int/mi			
Minimum RF lane changes, LCRF		0		lc/pc			
Minimum FR lane changes, LCFF		0		lc/pc			
Minimum RR lane changes, LCRF	3	4		lc/pc			
Minimum weaving lane changes,	, LCMIN	132	2	lc/h			
Weaving lane changes, LCW		443	3	lc/h			
Non-weaving vehicle index, IN	1M	79!	5				
Non-weaving lane change, LCNV		22	72	lc/h			
Total lane changes, LCALL		27	15	lc/h			
	_						

Average weaving speed, SW		57.9	mi/h	
Average non-weaving speed,	SNW	53.7	mi/h	
Weaving Segment S	Speed, Density,	Level of Se	ervice and Cap	acity
Weaving segment speed, S		53.7	mi/h	
Weaving segment density, I	)	20.7	pc/mi/ln	
Level of service, LOS		С		
Weaving segment v/c ratio		0.516		
Weaving segment flow rate,	V	3345	veh/h	
Weaving segment capacity,	CM	6483	veh/h	
Lin	nitations on We	aving Segmer	nts	
If limit reached, see note	2.			
	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	5819	4000	a,b
		Maximum	Analyzed	
Density-based capacty,				
Deliaity-Dased Capacty,		2300	2161	С
cIWL (pc/h/ln)		2300	2161	С
		2300 Maximum	2161 Analyzed	С

# Notes:

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

Phone: E-mail: Fax:

E-mail:					
	Operational An	alysis			
Analyst:	Eric Brown				
<u>2</u>	Parsons Brinck	erhoff			
	9/11/14				
Analysis Time Period:	AM Peak				
	I-271 NB (Expr	_			
	R-3 Merge to R-4 Diverge				
1	2036				
Description:	CUY-271-8.14 -	No Build	W-2		
	Inputs				
Segment Type		Freeway			
Weaving configuration		One-Sided			
Number of lanes, N		3	ln		
Weaving segment length, LS		1400	ft		
Freeway free-flow speed, FFS		60	mi/h		
Minimum segment speed, SMIN		45	mi/h	7	
Freeway maximum capacity, cIFL		2300	pc/h/	тn	
Terrain type		Level			
Q 1		0.00	%		
Grade					
Grade Length		0.00	mi		
Length					
Length	to pc/h Under		itions		
Length	to pc/h Under	Base Cond	itions	VRR	
LengthConversion	to pc/h Under Volum	Base Cond e Compone	itions nts	VRR 0	veh/h
LengthConversion to the state of the s	to pc/h Under Volum VFF	Base Cond e Compone VRF	itions nts VFR		veh/h
LengthConversion to the state of the st	to pc/h Under Volum VFF 1270	Base Cond e Compone VRF 30 0.90 8	itions nts VFR 1500	0 0.90 0	·
Length Conversion to the state of the	to pc/h Under Volum VFF 1270 0.90	Base Cond e Compone VRF 30 0.90	itions nts VFR 1500 0.90	0 0.90	ે જે
LengthConversion of the conversion of the c	to pc/h Under Volum VFF 1270 0.90 353 0	Base Cond e Compone VRF 30 0.90 8 0	itions nts VFR 1500 0.90 417 0	0 0.90 0 0	·
Length  Conversion of the conv	to pc/h Under Volum VFF 1270 0.90 353 0 0	Base Cond e Compone VRF 30 0.90 8 0 0	itions nts VFR 1500 0.90 417 0 0.1.5	0 0.90 0 0 0	ે જે
Length  Conversion of the conv	to pc/h Under Volum VFF 1270 0.90 353 0 0 1.5 1.2	Base Cond e Compone VRF 30 0.90 8 0 0	itions nts VFR 1500 0.90 417 0 0 1.5 1.2	0 0.90 0 0 0 1.5 1.2	90
Length  Conversion  Volume, V  Peak hour factor, PHF  Peak 15-min volume, v15  Trucks and buses  Recreational vehicles  Trucks and buses PCE, ET  Recreational vehicle PCE, ER  Heavy vehicle adjustment, fHV	to pc/h Under Volum VFF 1270 0.90 353 0 0 1.5 1.2 1.000	Base Cond e Compone VRF 30 0.90 8 0 0 1.5 1.2 1.000	itions nts VFR 1500 0.90 417 0 0 1.5 1.2 1.000	0 0.90 0 0 0 1.5 1.2	90
Length  Conversion of the conv	to pc/h Under Volum VFF 1270 0.90 353 0 0 1.5 1.2 1.000 fP 1.00	Base Cond e Compone VRF 30 0.90 8 0 0 1.5 1.2 1.000 1.00	itions nts VFR 1500 0.90 417 0 0 1.5 1.2 1.000 1.00	0 . 90 0 0 0 0 1 . 5 1 . 2 1 . 000 1 . 00	% %
Length  Conversion  Volume, V  Peak hour factor, PHF  Peak 15-min volume, v15  Trucks and buses  Recreational vehicles  Trucks and buses PCE, ET  Recreational vehicle PCE, ER  Heavy vehicle adjustment, fHV  Driver population adjustment,	to pc/h Under Volum VFF 1270 0.90 353 0 0 1.5 1.2 1.000	Base Cond e Compone VRF 30 0.90 8 0 0 1.5 1.2 1.000	itions nts VFR 1500 0.90 417 0 0 1.5 1.2 1.000	0 0.90 0 0 0 1.5 1.2	90
Length  Conversion of the conv	to pc/h Under Volum VFF 1270 0.90 353 0 0 1.5 1.2 1.000 fP 1.00	Base Cond e Compone VRF 30 0.90 8 0 0 1.5 1.2 1.000 1.00	itions nts VFR 1500 0.90 417 0 0 1.5 1.2 1.000 1.00	0 . 90 0 0 0 0 1 . 5 1 . 2 1 . 000 1 . 00	% %
Length  Conversion of the conv	to pc/h Under Volum VFF 1270 0.90 353 0 1.5 1.2 1.000 fP 1.00 1411	Base Cond e Compone VRF 30 0.90 8 0 1.5 1.2 1.000 1.00 33 0.546 cteristic	itions nts VFR 1500 0.90 417 0 0 1.5 1.2 1.000 1.00	0 . 90 0 0 0 0 1 . 5 1 . 2 1 . 000 1 . 00	% %
Length  Conversion of Volume, V  Peak hour factor, PHF  Peak 15-min volume, v15  Trucks and buses  Recreational vehicles  Trucks and buses PCE, ET  Recreational vehicle PCE, ER  Heavy vehicle adjustment, fHV  Driver population adjustment, sellow rate, v  Volume ratio, VR  Configuration of maneuver lanes, NWL	to pc/h Under Volum VFF 1270 0.90 353 0 1.5 1.2 1.000 fP 1.00 1411	Base Cond e Compone VRF 30 0.90 8 0 1.5 1.2 1.000 1.00 33 0.546 cteristic	itions nts VFR 1500 0.90 417 0 0 1.5 1.2 1.000 1.00 1.667	0 0.90 0 0 1.5 1.2 1.00 0	% %
Length  Conversion of Volume, V  Peak hour factor, PHF  Peak 15-min volume, v15  Trucks and buses  Recreational vehicles  Trucks and buses PCE, ET  Recreational vehicle PCE, ER  Heavy vehicle adjustment, fHV  Driver population adjustment, sellow rate, v  Volume ratio, VR  Configuration of maneuver lanes, NWL  Interchange density, ID	to pc/h Under Volum VFF 1270 0.90 353 0 1.5 1.2 1.000 fP 1.00 1411  guration Chara	Base Cond e Compone VRF 30 0.90 8 0 1.5 1.2 1.000 1.00 33 0.546 cteristic	itions nts VFR 1500 0.90 417 0 0 1.5 1.2 1.000 1.667	0 0.90 0 0 1.5 1.2 1.00 0	% %
Length  Conversion of Volume, V Peak hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population adjustment, sellow rate, v Volume ratio, VR  Confident Number of maneuver lanes, NWL Interchange density, ID Minimum RF lane changes, LCRF	to pc/h Under Volum VFF 1270 0.90 353 0 1.5 1.2 1.000 fP 1.00 1411  guration Chara 2 0 1	Base Cond e Compone VRF 30 0.90 8 0 1.5 1.2 1.000 1.00 33 0.546 cteristic	itions nts VFR 1500 0.90 417 0 0 1.5 1.2 1.000 1.667  s In int/mi lc/pc	0 0.90 0 0 1.5 1.2 1.00 0	% %
Length  Conversion of Volume, V Peak hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population adjustment, sellow rate, v Volume ratio, VR  Configuration of Maneuver lanes, NWL Interchange density, ID Minimum RF lane changes, LCRF Minimum FR lane changes, LCFR	to pc/h Under Volum VFF 1270 0.90 353 0 1.5 1.2 1.000 fP 1.00 1411  guration Chara	Base Cond e Compone VRF 30 0.90 8 0 1.5 1.2 1.000 1.00 33 0.546 cteristic	itions nts VFR 1500 0.90 417 0 0 1.5 1.2 1.000 1.667  s In int/mi lc/pc lc/pc	0 0.90 0 0 1.5 1.2 1.00 0	% %
Length  Conversion of Volume, V Peak hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population adjustment, sellow rate, v Volume ratio, VR  Configuration of Maneuver lanes, NWL Interchange density, ID Minimum RF lane changes, LCRF Minimum FR lane changes, LCFR	to pc/h Under Volum VFF 1270 0.90 353 0 1.5 1.2 1.000 fP 1.00 1411  guration Chara 2 0 1	Base Cond e Compone VRF 30 0.90 8 0 1.5 1.2 1.000 1.00 33 0.546 cteristic	itions nts VFR 1500 0.90 417 0 0 1.5 1.2 1.000 1.667  s In int/mi lc/pc	0 0.90 0 0 1.5 1.2 1.00 0	% %
Length  Conversion of Volume, V Peak hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population adjustment, sellow rate, v Volume ratio, VR  Configuration of maneuver lanes, NWL Interchange density, ID Minimum RF lane changes, LCRF Minimum RR lane changes, LCRR Minimum weaving lane changes, I	to pc/h Under Volum VFF 1270 0.90 353 0 1.5 1.2 1.000 fP 1.00 1411  guration Chara 2 0 1 1	Base Cond e Compone VRF	itions nts VFR 1500 0.90 417 0 1.5 1.2 1.000 1.667  s ln int/mi lc/pc lc/pc lc/pc	0 0.90 0 0 1.5 1.2 1.00 0	% %
Length  Conversion of Volume, V Peak hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population adjustment, sellow rate, v Volume ratio, VR  Configuration of maneuver lanes, NWL Interchange density, ID Minimum RF lane changes, LCRF Minimum RR lane changes, LCRR Minimum weaving lane changes, ICRR Minimum weaving lane changes, ICW	to pc/h Under Volum VFF 1270 0.90 353 0 1.5 1.2 1.000 fP 1.00 1411  guration Chara 2 0 1 1 1 LCMIN 1	Base Cond e Compone VRF 30 0.90 8 0 1.5 1.2 1.000 1.00 33 0.546 cteristic .6	itions nts VFR 1500 0.90 417 0 1.5 1.2 1.000 1.667  s ln int/mi lc/pc lc/pc lc/pc	0 0.90 0 0 1.5 1.2 1.00 0	% %
Length  Conversion of Volume, V Peak hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Driver population adjustment, sellow rate, v  Volume ratio, VR  Configuration of maneuver lanes, NWL Interchange density, ID Minimum RF lane changes, LCRF Minimum RR lane changes, LCRR Minimum weaving lane changes, ICW Non-weaving vehicle index, INW	to pc/h Under Volum VFF 1270 0.90 353 0 1.5 1.2 1.000 fP 1.00 1411  guration Chara 2 0 1 1 1 LCMIN 1 1	Base Cond e Compone VRF 30 0.90 8 0 1.5 1.2 1.000 1.00 33 0.546 Cteristic .6	itions nts VFR 1500 0.90 417 0 1.5 1.2 1.000 1.00 1.667  s ln int/mi lc/pc lc/pc lc/pc lc/h lc/h	0 0.90 0 0 1.5 1.2 1.00 0	% %
Length  Conversion of Volume, V  Peak hour factor, PHF  Peak 15-min volume, v15  Trucks and buses  Recreational vehicles  Trucks and buses PCE, ET  Recreational vehicle PCE, ER  Heavy vehicle adjustment, fHV  Driver population adjustment, sellow rate, v  Volume ratio, VR  Configuration of maneuver lanes, NWL	to pc/h Under Volum VFF 1270 0.90 353 0 1.5 1.2 1.000 fP 1.00 1411  guration Chara 2 0 1 1 1 LCMIN 1 1	Base Cond e Compone VRF 30 0.90 8 0 1.5 1.2 1.000 1.00 33 0.546 cteristic .6	itions nts VFR 1500 0.90 417 0 1.5 1.2 1.000 1.667  s ln int/mi lc/pc lc/pc lc/pc	0 0.90 0 0 1.5 1.2 1.00 0	% %

Average non-weaving speed, SNW 42.8 mi/h Weaving Segment Speed, Density, Level of Service and Capacity Weaving segment speed, S 49.2 mi/h Weaving segment density, D 21.1 pc/mi/ln Level of service, LOS C Weaving segment v/c ratio 0.708 Weaving segment flow rate, v 3112 veh/h Weaving segment capacity, cW 4392 veh/h
Weaving segment speed, S 49.2 mi/h Weaving segment density, D 21.1 pc/mi/ln Level of service, LOS C Weaving segment v/c ratio 0.708 Weaving segment flow rate, v 3112 veh/h
Weaving segment speed, S 49.2 mi/h Weaving segment density, D 21.1 pc/mi/ln Level of service, LOS C Weaving segment v/c ratio 0.708 Weaving segment flow rate, v 3112 veh/h
Weaving segment density, D 21.1 pc/mi/ln Level of service, LOS C Weaving segment v/c ratio 0.708 Weaving segment flow rate, v 3112 veh/h
Level of service, LOS C Weaving segment v/c ratio 0.708 Weaving segment flow rate, v 3112 veh/h
Weaving segment v/c ratio 0.708 Weaving segment flow rate, v 3112 veh/h
Weaving segment flow rate, v 3112 veh/h
Weaving segment flow rate, v 3112 veh/h
Limitations on Weaving Segments
If limit reached, see note.
Minimum Maximum Actual Note
Weaving length (ft) 300 8374 1400 a,b
Maximum Analyzed
Density-based capacty, 2300 1766 c
cIWL (pc/h/ln)
Maximum Analyzed
v/c ratio 1.00 0.708 d

# Notes:

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

Phone: Fax:

E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_ Eric Brown Analyst: Agency/Co.: Parsons Brinckerhoff Date Performed: 8/25/2014 Date Performed:
Analysis Time Period:
Freeway/Dir of Travel:
Weaving Location:

AM Peak
I-271 NB
R-5 Merge to R-6 Diverge Analysis Year: 2036 Description: CUY-271-8.14 - No Build W-3 \_\_\_\_\_Inputs\_\_\_ Segment Type Freeway Weaving configuration Two-Sided ln Number of lanes, N 3300 ft Weaving segment length, LS Freeway free-flow speed, FFS 60 mi/h 45 mi/h Minimum segment speed, SMIN Freeway maximum capacity, cIFL 2300 pc/h/ln Level Terrain type 0.00 ્ર Grade Length 0.00 mi \_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_ 
 Volume Components

 VFF
 VRF
 VFR
 VRR

 Volume, V
 2410
 0
 570
 1500 veh/h

 Peak hour factor, PHF
 0.90
 0.90
 0.90
 0.90

 Peak 15-min volume, v15
 669
 0
 158
 417

 Trucks and buses
 0
 0
 0
 0
 %

 Recreational vehicles
 0
 0
 0
 %
 %

 Trucks and buses PCE, ET
 1.5
 1.5
 1.5
 1.5
 1.5

 Recreational vehicle PCE, ER
 1.2
 1.2
 1.2
 1.2
 1.2

 Heavy vehicle adjustment, fHV
 1.000
 1.000
 1.000
 1.000
 1.000

 Driver population adjustment, fP
 1.00
 1.00
 1.00
 1.00
 1.00

 Flow rate, v
 2678
 0
 633
 1667
 pc/h
 Volume Components % 왕 0.335 Volume ratio, VR \_\_\_\_Configuration Characteristics\_\_ Number of maneuver lanes, NWL 0 ln Interchange density, ID 0.6 int int/mi Minimum RF lane changes, LCRF 0 lc/pc Minimum FR lane changes, LCFR 0 lc/pc Minimum RR lane changes, LCRR 3 lc/pc Minimum weaving lane changes, LCMIN lc/h 5281 Weaving lane changes, LCW lc/h Non-weaving vehicle index, INW 656 Non-weaving lane change, LCNW 1893 lc/h Total lane changes, LCALL 7174 lc/h

\_\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_\_ Weaving intensity factor, W 0.417

Average weaving speed, SV	<b>J</b>	55.6	mi/h		
Average non-weaving speed	l, SNW	16.0	mi/h		
Weaving Segment	Speed, Densit	y, Level of Se	ervice and Cap	acity	
Weaving segment speed, S		21.0	mi/h		
Weaving segment density,	D	78.9	pc/mi/ln		
Level of service, LOS		F			
Weaving segment v/c ratio		0.894			
Weaving segment flow rate	e, v	4978	veh/h		
Weaving segment capacity,	cW	5571	veh/h		
Li	mitations on	Weaving Segmen	nts		
					_
If limit reached, see not	ce.				-
If limit reached, see not	ce.				
If limit reached, see not	ce. Minimum	Maximum	Actual	Note	_
If limit reached, see not Weaving length (ft)		Maximum 9093	Actual 3300	Note a,b	
,	Minimum				
,	Minimum	9093	3300		
Weaving length (ft)	Minimum	9093 Maximum	3300 Analyzed	a,b	
Weaving length (ft) Density-based capacty,	Minimum	9093 Maximum	3300 Analyzed	a,b	
Weaving length (ft) Density-based capacty,	Minimum	9093 Maximum 2300	3300 Analyzed 1857	a,b	

# Notes:

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

Fax:

Phone: E-mail:

\_\_\_\_\_\_Operational Analysis\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 8/26/2014
Analysis Time Period: AM Peak
Freeway/Dir of Travel: I-271 SB

Weaving Location: R-11 Merge to R-12 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - No Build W-4

\_\_\_\_\_\_Inputs\_\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	4100	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume	Compone	nts		
	VFF	VRF	VFR	VRR	
Volume, V	4530	80	0	900	veh/h
Peak hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	1258	22	0	250	
Trucks and buses	0	0	0	0	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.00	0
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	5033	89	0	1000	pc/h

Volume ratio, VR 0.163

Configuration	Characterist	ics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	2	lc/pc	
Minimum weaving lane changes, LCMIN		lc/h	
Weaving lane changes, LCW	2315	lc/h	
Non-weaving vehicle index, INW	1260		
Non-weaving lane change, LCNW	2700	lc/h	
Total lane changes, LCALL	5015	lc/h	

\_\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_

Weaving intensity factor, W

Average weaving speed, S	W	56.9	mi/h		
Average non-weaving spee	d, SNW	35.8	mi/h		
Weaving Segment	Speed, Densi	ty, Level of S	ervice and Ca	pacity	
Weaving segment speed, S	_	38.1	mi/h	<u> </u>	
Weaving segment density,		53.5	pc/mi/ln		
Level of service, LOS		F	_		
Weaving segment v/c rati	0	0.993			
Weaving segment flow rat		6123	veh/h		
Weaving segment capacity		6165	veh/h		
T.	imitations or	n Weaving Segme:	nts		
If limit reached, see no		r weaving begine			
	Minimum	Maximum	Actual	Note	
Weaving length (ft)	300	7297	4100	a,b	
-		Maximum	Analyzed		
Density-based capacty, cIWL (pc/h/ln)		2300	2055	С	
-		Maximum	Analyzed		

1.00

0.993

d

# Notes:

v/c ratio

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

Fax:

Phone: E-mail:

\_\_\_\_\_\_Operational Analysis\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 8/26/2014
Analysis Time Period: AM Peak
Freeway/Dir of Travel: I-271 SB

Weaving Location: R-15 Merge to R-16 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - No Build W-5

\_\_\_\_\_\_Inputs\_\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	l
Number of lanes, N	3	ln
Weaving segment length, LS	2400	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume	Compone	nts		
	VFF	VRF	VFR	VRR	
Volume, V	3640	1820	0	530	veh/h
Peak hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	1011	506	0	147	
Trucks and buses	0	0	0	0	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.00	0
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	4044	2022	0	589	pc/h

Volume ratio, VR 0.089

Configuration	Characterist	cics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	3	lc/pc	
Minimum weaving lane changes, LCMIN		lc/h	
Weaving lane changes, LCW		lc/h	
Non-weaving vehicle index, INW			
Non-weaving lane change, LCNW		lc/h	
Total lane changes, LCALL		lc/h	

Weaving intensity factor, W

Average non-weaving speed, SNW		mi/h	mi/h		
Weaving Segment Speed, Den	sity, Level of Se	rvice and Ca	pacity		
Weaving segment speed, S		mi/h			
Weaving segment density, D		pc/mi/ln			
Level of service, LOS	F				
Weaving segment v/c ratio	1.119				
Weaving segment flow rate, v	6656	veh/h			
Weaving segment capacity, cW	5946	veh/h			
Limitations	on Weaving Segmen	ts			
If limit reached, see note.					
Minimum	Maximum	Actual	Note		
Weaving length (ft) 300	6560	2400	a,b		

mi/h

	MIIIIIIIIIIIII	Maximum	ACCUAI	Note
Weaving length (ft)	300	6560	2400	a,b
		Maximum	Analyzed	
Density-based capacty, cIWL (pc/h/ln)		2300	1982	С
_		Maximum	Analyzed	
v/c ratio		1.00	1.119	d

# Notes:

Average weaving speed, SW

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- Volumes exceed the weaving segment capacity. The level of service is F.

Fax:

Phone: E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 9/11/14
Analysis Time Period: AM Peak
Freeway/Dir of Travel: I-271 SB

Weaving Location: R-19 Merge to R-20 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - No Build W-6

\_\_\_\_\_\_Inputs\_\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	1900	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Terrain type	Level	
Grade	0.00	9
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume Components						
	VFF	VRF	VFR	VRR			
Volume, V	4930	0	530	550	veh/h		
Peak hour factor, PHF	0.90	0.90	0.90	0.90			
Peak 15-min volume, v15	1369	0	147	153			
Trucks and buses	0	0	0	0	%		
Recreational vehicles	0	0	0	0	%		
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5			
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2			
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.00	0		
Driver population adjustment, fP	1.00	1.00	1.00	1.00			
Flow rate, v	5478	0	589	611	pc/h		

Volume ratio, VR 0.091

Configuration	Characterist	cics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	3	lc/pc	
Minimum weaving lane changes, LCMIN		lc/h	
Weaving lane changes, LCW		lc/h	
Non-weaving vehicle index, INW			
Non-weaving lane change, LCNW		lc/h	
Total lane changes, LCALL		lc/h	

\_\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_

Weaving intensity factor, W

Average non-weaving spee	mi/n					
Weaving Segment	Speed, Densi	ity, Level of Se	ervice and Car	pacity		
Weaving segment speed, S			mi/h			
Weaving segment density,	pc/mi/ln	pc/mi/ln				
Level of service, LOS		F				
Weaving segment v/c rati	.0	1.147				
Weaving segment flow rat	veh/h					
Weaving segment capacity	, cW	5823	veh/h			
I	imitations or	n Weaving Segmen	nts			
If limit reached, see no						
	Minimum	Maximum	Actual	Note		
Weaving length (ft)	300	6589	1900	a,b		
		Maximum	Analyzed			
Density-based capacty,	2300	1941	С			

mi/h

Analyzed

1.147

d

# Notes:

v/c ratio

cIWL (pc/h/ln)

Average weaving speed, SW

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

Maximum

1.00

- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

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HCS 2010 Signalized Intersection Results Summary															
General Information Intersection Information															
							Duration, h 0.25			,,,					
Agency								<u> </u>					<u>د</u> ا		
Analyst		Eric Brown		Analysis Date Aug 25, 2014  Time Period AM Peak No Build			امانين	Area Typ	be	Other		- → - →	e je	소 	
Jurisdiction		ODOT District 12					eak ino i	Bulla	PHF	Daviad	0.92	20	- E	. 1.	- 
Intersection		I-271 SB On Ramp		Anaiys	is Year	2036			Analysis	Period	1> 7:0	00			
File Name														4 * 4.50	
Project Descript	ion													<b>ቀተቀ</b> ሞ	_P_[]
Demand Inforn	nation			EB			WI	WB		NB		SB			
Approach Move	ment			LT		R	LT		R	L T R		L T		R	
Demand (v), ve	h/h				880	1740	0 610 2480								
				lt-											
Signal Informa		Y			-							_			
Cycle, s	200.0	Reference Phase	2		4	ୗୣଽ						1	<b>→</b> 2	3	4
Offset, s	0	Reference Point	End	Green	48.2	141.8	0.0	0.0	0.0	0.0				3	- 5
Uncoordinated	No	Simult. Gap E/W	On	Yellow	-	4.0	0.0	0.0		0.0					
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.0	1.0	0.0	0.0	0.0	0.0		5	6	7	8
							14/5		MET	N.D.		NDT.	ODI		ODT
Timer Results				EBI	-	EBT	WB 1	_	WBT 6	NBL		NBT	SBL	-	SBT
Assigned Phase Case Number	<del>)</del>					7.3	2.0	-	4.0	-				+	
							53.2	_		-	_			+	
Phase Duration				146.8											
Change Period,					-	5.0	5.0	+	5.0	-	-			+	
Max Allow Head	_ •				_	0.0	3.1	+	0.0		_			_	
Queue Clearand					_	0.0	50.2	_	0.0	-	-			+	
	Green Extension Time ( g <sub>e</sub> ), s			_	0.0	0.0	_	0.0	-	_			-		
Phase Call Prob					-		1.00	-		-	+			+	
Max Out Probab	ollity						1.00	,							
Movement Gro	up Res	ults			EB			WB			NB			SB	
Approach Move	ment			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Move	ment				2	12	1	6							
Adjusted Flow F	Rate ( v)	, veh/h			957	1891	663	2696	5						
Adjusted Satura	tion Flo	w Rate ( s), veh/h/ln			950	1579	887	950							
Queue Service	Time (g	gs), S			59.0	141.8	48.2	195.0							
Cycle Queue Cl	earance	e Time ( gc), s			59.0	141.8	48.2	195.0							
Green Ratio (g/	(C)				0.71	0.71	0.24	0.98							
Capacity (c), ve	h/h				1347	1119	428	1853	3						
Volume-to-Capa	acity Ra	tio ( X)			0.710	1.690	1.551	1.45	5						
Available Capac	city (ca),	, veh/h			1347	1119	428	1853	3						
Back of Queue	( Q), veł	n/ln (95th percentile)			19.1	234.6	42.3	86.9							
Queue Storage	Ratio (	RQ) (95th percentile)	)		0.00	29.80	1.65	0.00							
Uniform Delay ( d1), s/veh			17.1	29.1	75.9	2.5									
Incremental Delay ( d2), s/veh			3.2	314.3	259.2	207.9	9								
Initial Queue Delay ( d3), s/veh			0.0	0.0	0.0	0.0									
Control Delay ( d), s/veh			20.2	343.4	335.1	210.4	1								
Level of Service (LOS)			С	F	F	F									
Approach Delay, s/veh / LOS		234.	9	F	235.	0	F	0.0			0.0				
Intersection Del	ay, s/ve	h/LOS				23	4.9	)		F		F			
Multimodal Results				EB			WB			NB			SB		
Pedestrian LOS				2.4	_	В	0.5	-	A	3.0		С	2.9		С
Bicycle LOS Score / LOS		2.8		С	3.3		С								

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### **HCS 2010 Signalized Intersection Results Summary** 14741747 Intersection Information **General Information** Parsons Brinckerhoff Duration, h 0.25 Agency Analyst Eric Brown Analysis Date Aug 29, 2014 Area Type Other PHF 0.92 Jurisdiction ODOT District 12 Time Period AM Peak No Build Intersection Cedar Rd Analysis Year 2036 Analysis Period 1>7:00 I-2, I-3, I-4 CUY-271-8.14 AM Peak.xus File Name **Project Description Demand Information** EB **WB** NB SB Approach Movement L R L R L R L R 40 Demand (v), veh/h 410 410 60 40 650 110 100 170 920 230 1150 **Signal Information** ᄴ Ų Cycle, s 120.0 Reference Phase 2 Offset, s 0 Reference Point End Green 33.3 22.7 14.0 30.0 0.0 0.0 Uncoordinated No Simult. Gap E/W On Yellow 0.0 3.6 3.6 3.6 3.6 0.0 Force Mode Simult. Gap N/S 0.0 Fixed On Red 1.4 1.4 1.4 1.4 0.0 **Timer Results EBL EBT** WBL **WBT NBL NBT** SBL SBT Assigned Phase 8 7 4 2 1 6 Case Number 2.0 4.0 5.3 5.3 2.0 3.0 Phase Duration, s 19.0 54.0 35.0 27.7 38.3 66.0 5.0 5.0 Change Period, (Y+Rc), s 5.0 5.0 5.0 5.0 Max Allow Headway (MAH), s 3.1 3.1 3.1 0.0 3.1 0.0 Queue Clearance Time (gs), s 16.0 13.7 24.4 33.8 Green Extension Time ( $g_e$ ), s 0.0 3.3 2.0 0.0 0.0 0.0 1.00 Phase Call Probability 1.00 1.00 1.00 1.00 0.00 0.53 1.00 Max Out Probability WB **Movement Group Results** EΒ NB SB Approach Movement Т R L Т R L Т R Т R L L Assigned Movement 7 4 14 3 8 18 5 2 12 1 6 16 Adjusted Flow Rate (v), veh/h 446 260 251 43 707 120 109 185 43 939 235 1174 Adjusted Saturation Flow Rate (s), veh/h/ln 1757 903 1773 1610 1164 1881 1610 1757 1863 1610 1863 1779 22.4 7.2 2.7 Queue Service Time (gs), s 14.0 11.5 11.7 4.6 10.0 10.6 31.8 8.6 61.0 Cycle Queue Clearance Time ( qc), s 14.0 11.5 11.7 4.6 22.4 7.2 10.0 10.6 2.7 31.8 8.6 61.0 0.25 Green Ratio (g/C) 0.12 0.41 0.41 0.25 0.25 0.19 0.19 0.19 0.28 0.51 0.63 Capacity (c), veh/h 410 761 727 286 887 403 280 356 305 975 947 1006 Volume-to-Capacity Ratio (X) 1.087 0.342 0.345 0.152 0.797 0.297 0.388 0.519 0.143 0.963 0.248 1.166 Available Capacity (ca), veh/h 410 761 727 286 887 403 280 356 305 975 947 1006 Back of Queue (Q), veh/ln (50th percentile) 10.1 5.0 4.9 1.0 10.2 2.8 3.2 5.4 1.2 14.6 3.6 44.2 Queue Storage Ratio (RQ) (50th percentile) 0.43 0.00 0.00 0.20 0.00 0.19 0.23 0.00 0.29 1.26 0.00 3.81 43.7 46.8 Uniform Delay (d1), s/veh 53.0 24.4 24.5 35.5 42.1 36.5 43.5 40.5 16.9 21.5 Incremental Delay (d2), s/veh 69.9 0.1 0.1 0.1 4.7 0.2 4.0 5.3 1.0 3.3 0.1 75.9 Initial Queue Delay ( d3), s/veh 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 Control Delay (d), s/veh 122.9 24.5 24.6 35.5 46.9 36.6 47.5 49.1 41.5 50.1 16.9 97.4 Level of Service (LOS) F С С D D D D D D D В F 70.4 F 44.9 D 47.6 D 70.5 Ε Approach Delay, s/veh / LOS Intersection Delay, s/veh / LOS 63.8 Е **Multimodal Results** ΕB WB NB SB Pedestrian LOS Score / LOS 2.4 В С С 3.0 3.0 С 2.9 Bicycle LOS Score / LOS 1.3 Α 1.2 Α 1.0 Α 4.6

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### **HCS 2010 Signalized Intersection Results Summary** 14747*4*7 Intersection Information **General Information** Agency Parsons Brinckerhoff Duration, h 0.25 Analyst Eric Brown Analysis Date Aug 29, 2014 Area Type Other PHF 0.92 Jurisdiction ODOT District 12 Time Period AM Peak No Build Intersection I-271 NB On/Off Ramp Analysis Year 2036 Analysis Period 1>7:00 I-2, I-3, I-4 CUY-271-8.14 AM Peak.xus File Name **Project Description Demand Information** EB **WB** NB SB Approach Movement L R L R L R L R 540 Demand (v), veh/h 200 680 150 100 1620 **Signal Information** Ж IJ, Cycle, s 120.0 Reference Phase 2 Offset, s 0 Reference Point End Green 6.0 53.7 0.0 0.0 45.3 0.0 Uncoordinated No Simult. Gap E/W On Yellow 3.6 0.0 0.0 3.6 3.6 0.0 Force Mode Fixed Simult. Gap N/S 0.0 On Red 1.4 1.4 1.4 0.0 0.0 **Timer Results EBL EBT WBL WBT NBL NBT** SBL SBT Assigned Phase 2 4 1 6 Case Number 9.0 7.3 1.0 4.0 Phase Duration, s 58.7 50.3 11.0 61.3 Change Period, (Y+Rc), s 5.0 5.0 5.0 5.0 Max Allow Headway (MAH), s 3.3 0.0 3.1 0.0 Queue Clearance Time (gs), s 55.7 6.3 Green Extension Time ( $g_e$ ), s 0.0 0.0 0.0 0.0 Phase Call Probability 1.00 1.00 1.00 1.00 Max Out Probability WB SB **Movement Group Results** EΒ NB Approach Movement Т R L Т R Т R Т R L L L Assigned Movement 7 14 2 12 6 1 Adjusted Flow Rate (v), veh/h 217 739 155 559 109 1761 Adjusted Saturation Flow Rate (s), veh/h/ln 1757 1863 1594 1792 1756 1563 9.4 9.3 41.3 4.3 56.3 Queue Service Time (gs), s 53.7 41.3 Cycle Queue Clearance Time ( $g_c$ ), s 9.4 53.7 9.3 4.3 56.3 0.38 0.44 Green Ratio (g/C) 0.45 0.38 0.47 0.45 Capacity (c), veh/h 786 700 703 602 522 1648 Volume-to-Capacity Ratio (X) 0.277 1.057 0.221 0.929 0.208 1.069 Available Capacity (ca), veh/h 786 700 703 602 522 1648 Back of Queue (Q), veh/ln (50th percentile) 3.8 29.1 4.6 21.9 1.8 32.0 Queue Storage Ratio (RQ) (50th percentile) 0.00 0.00 0.00 0.00 0.14 0.00 38.1 Uniform Delay (d1), s/veh 20.9 33.2 45.3 20.7 34.9 Incremental Delay ( d2), s/veh 0.1 49.9 0.3 12.9 0.0 37.2 Initial Queue Delay (d3), s/veh 0.0 0.0 0.0 0.0 0.0 0.0 Control Delay (d), s/veh 21.0 83.1 38.4 58.2 20.7 72.1 Level of Service (LOS) С F D Е С F 69.0 F 0.0 53.9 D 69.1 Ε Approach Delay, s/veh / LOS Intersection Delay, s/veh / LOS 66.0 Е **Multimodal Results** ΕB WB NB SB Pedestrian LOS Score / LOS 2.8 С В 1.7 2.5 1.9 Α Α Bicycle LOS Score / LOS F 1.7 Α 2.0

	HCS 20	010 Si	ignaliz	ed Ir	nterse	ction	Res	ults Su	ımma	ry				
													14721	10(10)
General Information	J	••						Intersect		v	n	- 1		<b>4</b> 4
Agency	Parsons Brinckerho	ff	I		1.			Duration,		0.25				·
Analyst	Eric Brown		Analys			9, 2014		Area Typ	е	Other		_ <u> </u>		~_ \$
Jurisdiction	ODOT District 12		Time P			eak No E	Build	PHF		0.92			*/ <b>+</b>	√ ÷
Intersection	I-271 SB Off Ramp		Analys		2036			Analysis	Period	1> 7:0	00	<b>→</b>		† 47
File Name	I-2, I-3, I-4 CUY-27	1-8.14 A	M Peak	.xus									1	
Project Description		_	_	_	_	_			_	_	_		1 <b>1</b> 1 1 1 1 1	7 4
Demand Information				EB		T	W	В		NB			SB	
Approach Movement			L	Т	R	L	T	R	L	Т	R	L	Т	R
Demand (v), veh/h						910		60		350			810	
Signal Information					18	4	Т				3			
Cycle, s 120.0	Reference Phase	2		•	2	7								
Offset, s 0	Reference Point	End	Green	44.7	66.3	0.0	0.0	0.0	0.0	-	1	2	3	4
Uncoordinated No	Simult. Gap E/W	On	Yellow		4.0	0.0	0.0		0.0	_				<b>&gt;</b>
Force Mode Fixed	Simult. Gap N/S	On	Red	1.4	0.0	0.0	0.0		0.0		5	6	7	8
Timer Results			EBL		EBT	WBI		WBT	NBI		NBT	SBI	L L	SBT
Assigned Phase								8			2			6
Case Number								9.0			8.0			8.0
Phase Duration, s								70.3			49.7			49.7
Change Period, (Y+Rc)	), s							4.0			5.0			5.0
Max Allow Headway ( A	<i>ИАН</i> ), s							3.1			0.0			0.0
Queue Clearance Time	e ( gs), s							66.7						
Green Extension Time	( <i>g</i> <sub>e</sub> ), s							0.0			0.0			0.0
Phase Call Probability								1.00						
Max Out Probability								1.00						
Movement Group Res	sults			EB			WE			NB —		<b>.</b>	SB	
Approach Movement			L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement			$\vdash$			3		18		2		_	6	-
Adjusted Flow Rate ( v)						989		65		373		_	880	-
Adjusted Saturation Flo			$\vdash$			1810		1610		1900	-	_	1809	-
Queue Service Time ( g			$\vdash$			64.7		2.3		23.0		_	24.2	-
Cycle Queue Clearance	e Time ( $g_c$ ), s				-	64.7		2.3		23.0		_	24.2	-
Green Ratio (g/C)						0.55		0.55		0.37			0.37	
Capacity (c), veh/h	: ()0					1000		890		708			1348	
Volume-to-Capacity Ra						0.989		0.073		0.527			0.653	
Available Capacity ( ca)						1000		890		708			1348	
Back of Queue (Q), ve						32.9		0.8		12.5			10.8	
Queue Storage Ratio (		)				0.00		0.06		0.00			0.00	
Uniform Delay ( d1), s/v						26.5		12.5		46.8			31.2	
Incremental Delay ( d2)						25.7		0.0		2.7			2.5	
Initial Queue Delay ( da	•					0.0		0.0		0.0			0.0	
Control Delay ( d), s/ve	h					52.2		12.5		49.5			33.7	
Level of Service (LOS)						D		В		D			С	
Approach Delay, s/veh			0.0			49.8	3	D	49.5	5	D	33.7	7	С
Intersection Delay, s/ve	eh / LOS				43	3.6						D		
88 1d										A IP				
Multimodal Results	/1.00			EB			WE			NB			SB	
Pedestrian LOS Score			2.6		В	2.3		В	1.7	_	A	0.7		A
Bicycle LOS Score / LO	)S							F	1.1		Α	1.2		Α

Phone: E-mail:		Fax:			
	Operational Anal	ysis			
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB Chagrin Blvd to R ODOT District 12 2036 .14 - Build F-1	-1 Merge			
	Flow Inputs and	Adjustments			
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15		4110 0.94 1093	veh/h v		
Trucks and buses Recreational vehicles Terrain type: Grade		4 0 Level	96 96		
Segment length Trucks and buses PCE, E Recreational vehicle PC	E, ER	- 1.5 1.2	mi		
Heavy vehicle adjustmen Driver population facto Flow rate, vp		0.980 1.00 1115	pc/h/ln		
	Speed Inputs and	Adjustments			
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N		- - - 4	ft ft ramps/mi		
Free-flow speed: FFS or BFFS Lane width adjustment,	fLW	Measured 60.0 -	mi/h mi/h		
Lateral clearance adjus TRD adjustment Free-flow speed, FFS		- - 60.0	mi/h mi/h mi/h		
LOS and Performance Measures					
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1115 60.0 60.0 4 18.6 C	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>		

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Analyst.
Agency or Company: Parsons Brinckerhoff Date Performed: 8/21/2014 Analysis Time Period: PM Peak Freeway/Direction: I-271 NB From/To: R-1 Merge to R-3 Merge Analysis Year: ODOT District 12 Description: CUY-271-8.14 - Build F-2a \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ veh/h Volume, V 4470 Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 1189 v Trucks and buses કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1213 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h Lane width adjustment, fLW mi/h Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1213 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 20.2 pc/mi/ln

С

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company:
Date Performed: Parsons Brinckerhoff 8/21/2014 Analysis Time Period: PM Peak Freeway/Direction: I-271 NB From/To: R-1 Merge to R-3 Merge Analysis Year: ODOT District 12 Description: CUY-271-8.14 - Build F-2b \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ veh/h Volume, V 4470 Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 1189 v Trucks and buses કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1617 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h Lane width adjustment, fLW mi/h Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1617 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 27.0 pc/mi/ln

D

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/21/2014 Analysis Time Period: PM Peak
Freeway/Direction: I-271 NB (Express Lanes) From/To: Chagrin Blvd to R-2 Diverge ODOT District 12 Jurisdiction: Analysis Year: 2036 Description: CUY-271-8.14 - Build F-3 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 3000 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 798 v Trucks and buses 4 કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1628 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h mi/h Lane width adjustment, fLW Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1628 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 27.1

D

Level of service, LOS

pc/mi/ln

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Parsons Brinckerhoff Agency or Company: Date Performed: 12/19/2014 Analysis Time Period: PM Peak Freeway/Direction: I-271 NB From/To: R-3 Merge to R-4 Diverge Analysis Year: ODOT District 12 Description: CUY-271-8.14 - Build F-4 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 5650 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 1503 v Trucks and buses 4 કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1533 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h Lane width adjustment, fLW mi/h Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1533 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 25.5 pc/mi/ln

C

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/21/2014 Analysis Time Period: PM Peak
Freeway/Direction: I-271 NB (Express Lanes)
From/To: R-2 Diverge to R-5 Merge Analysis Year: 2036 Description: CUY-271-8.14 - Build F-5 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 1820 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 484 v Trucks and buses 4 કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 987 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h mi/h Lane width adjustment, fLW Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ 987 Flow rate, vp pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 16.5 pc/mi/ln

В

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Parsons Brinckerhoff Agency or Company: Date Performed: 8/21/2014 Analysis Time Period: PM Peak Freeway/Direction: I-271 NB From/To: R-4 Diverge to R-6 Diverge Analysis Year: 2036 Description: CUY-271-8.14 - Build F-6 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 5490 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 1460 v Trucks and buses 4 કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1986 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h Lane width adjustment, fLW mi/h Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1986 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 57.3 mi/h Number of lanes, N Density, D 34.7 pc/mi/ln

D

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/21/2014 Analysis Time Period: PM Peak
Freeway/Direction: I-271 NB (Express Lanes)
From/To: R-5 Merge to R-8 Diverge Analysis Year: ODOT District 12 Description: CUY-271-8.14 - Build F-7 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 1980 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 527 v Trucks and buses 4 કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1074 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h mi/h Lane width adjustment, fLW Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1074 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N 2 Density, D 17.9 pc/mi/ln

В

Phone: E-mail:		Fax:			
	Operational Ana	lysis			
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-6 Diverge to R ODOT District 12 2036	2-7 Merge			
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, F Recreational vehicle PCH Heavy vehicle adjustment	T E, ER t, fHV	3340 0.94 888 4 0 Level - 1.5 1.2 0.980 1.00	veh/h v % % mi		
Driver population factor Flow rate, vp	л, гр	1208	pc/h/ln		
	Speed Inputs an	d Adjustments			
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h mi/h</pre>		
LOS and Performance Measures					
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1208 60.0 60.0 3 20.1	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>		

Phone: E-mail:		Fax:		
	Operational Ar	nalysis		
	Operacional Ai	lalysis		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	8/21/2014 PM Peak I-271 NB R-7 Merge to R- ODOT District 1 2036	-9 Merge		
	Flow Inputs ar	nd Adjustments		
Volume, V		4510	veh/h	
Peak-hour factor, PHF		0.94		
Peak 15-min volume, v15		1199	V	
Trucks and buses		4	०	
Recreational vehicles		0	%	
Terrain type:		Level		
Grade		_	%	
Segment length		_	mi	
Trucks and buses PCE, ET		1.5		
Recreational vehicle PO		1.2		
Heavy vehicle adjustmen		0.980		
		1.00		
Driver population factor, fp				
Flow rate, vp		1631	pc/h/ln	
	Speed Inputs a	and Adjustments		
Lane width		_	ft	
Right-side lateral clea	rance	_	ft	
Total ramp density, TRI		_	ramps/mi	
Number of lanes, N	,	3	ramps/mr	
		Measured		
Free-flow speed:				
FFS or BFFS	CT II	60.0	mi/h	
Lane width adjustment,		-	mi/h	
Lateral clearance adjus	stment, ILC	-	mi/h	
TRD adjustment		-	mi/h	
Free-flow speed, FFS		60.0	mi/h	
	LOS and Perfor	rmance Measures		
Flow rate, vp		1631	pc/h/ln	
<del>-</del>				
Free-flow speed, FFS	rnood C	60.0	mi/h mi/h	
Average passenger-car s	ppeed, s	60.0	mi/h	
Number of lanes, N		3		
Density, D		27.2	pc/mi/ln	
Level of service, LOS		D		

Phone: E-mail:		Fax:			
	Operational Ana	lysis			
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-9 Merge to R-1 ODOT District 12 2036	0 Diverge			
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	4630 0.94 1231 4 0 Level - 1.5 1.2 0.980 1.00 1675	veh/h v % % mi pc/h/ln		
	Speed Inputs an	d Adjustments			
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>		
LOS and Performance Measures					
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1675 60.0 59.9 3 28.0	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>		

Phone: E-mail:		Fax:	
	Operational Ana	lysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brincker 8/21/2014 PM Peak I-271 NB (Expres R-8 Diverge to M ODOT District 12 2036	hoff s Lanes) ayfield Rd	
	Flow Inputs and	Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses		1860 0.94 495	veh/h v %
Recreational vehicles Terrain type: Grade Segment length		0 Level -	% % mi
Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor	E, ER t, fHV	1.5 1.2 0.980 1.00	
Flow rate, vp		1009	pc/h/ln
	Speed Inputs and	d Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 2 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h mi/h</pre>
rice from Speed, fro	IOC and Danfarm		·
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	LOS and Perform	1009 60.0 60.0 2 16.8 B	pc/h/ln mi/h mi/h pc/mi/ln

Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/22/2014 Analysis Time Period: PM Peak					
Agency or Company: Parsons Brinckerhoff Date Performed: 8/22/2014					
Freeway/Direction: I-271 NB From/To: R-10 Diverge to Mayfield Rd Jurisdiction: ODOT District 12 Analysis Year: 2036 Description: CUY-271-8.14 - Build F-12Flow Inputs and Adjustment	s				
Volume, V 2880 Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 766	veh/h v				
Trucks and buses 4  Recreational vehicles 0  Terrain type: Level  Grade -	96 96				
Segment length - Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980	mi				
Driver population factor, fp 1.00 Flow rate, vp 1563	pc/h/ln				
Speed Inputs and Adjustmen	ts				
Lane width Right-side lateral clearance Total ramp density, TRD Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, fLW	ft ft ramps/mi d mi/h mi/h				
Lateral clearance adjustment, fLC - TRD adjustment - Free-flow speed, FFS 60.0	mi/h mi/h mi/h mi/h				
LOS and Performance Measures					
Flow rate, vp 1563 Free-flow speed, FFS 60.0 Average passenger-car speed, S 60.0 Number of lanes, N 2 Density, D 26.0+ Level of service, LOS D	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>				

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/22/2014 Analysis Time Period: PM Peak Freeway/Direction: I-271 SB From/To: Mayfield Rd to R-11 Merge Analysis Year: ODOT District 12 Description: CUY-271-8.14 - Build F-13 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 2450 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 652 v Trucks and buses 4 કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1329 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h mi/h Lane width adjustment, fLW Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1329 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 22.1 pc/mi/ln

С

Phone: E-mail:		Fax:	
	Operational Ana	lysis	
7 no least :		-1	
Analyst: Agency or Company:	Eric Brown Parsons Brincker	hoff	
Date Performed:	8/22/2014		
Analysis Time Period:			
Freeway/Direction:	I-271 SB	10 Dimongo	
From/To: Jurisdiction:	R-11 Merge to R- ODOT District 12	_	
Analysis Year:	2036		
Description: CUY-271-8	3.14 - Build F-14		
	Flow Inputs and	Adjustments	
Volume, V		3490	veh/h
Peak-hour factor, PHF		0.94	
Peak 15-min volume, v15	5	928	V
Trucks and buses Recreational vehicles		4	% %
Terrain type:		0 Level	6
Grade		_ 	%
Segment length		_	mi
Trucks and buses PCE, I	T	1.5	
Recreational vehicle Po		1.2	
Heavy vehicle adjustment, fHV		0.980	
Driver population factor, fp		1.00 1262	ng/h/ln
Flow rate, vp		1202	pc/h/ln
	Speed Inputs an	d Adjustments	
Lane width		_	ft
Right-side lateral clea	arance	_	ft
Total ramp density, TRI	)	_	ramps/mi
Number of lanes, N		3	
Free-flow speed: FFS or BFFS		Measured 60.0	mi/h
Lane width adjustment,	fT.W	-	mi/h
Lateral clearance adjust		_	mi/h
TRD adjustment	•	_	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Perform	ance Measures	
Flow rate, vp		1262	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	speed, S	60.0	mi/h
Number of lanes, N		3	
Density, D		21.0	pc/mi/ln
Level of service, LOS		С	

Phone: E-mail:		Fax:			
	Operational An	alysis			
	operacionar im	d1/515			
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction:	8/22/2014	ss Lanes) R-13 Merge			
Analysis Year:	2036	_			
Description: CUY-271-8					
	Flow inputs an	a Adjustments			
Volume, V		1410	veh/h		
Peak-hour factor, PHF		0.94			
Peak 15-min volume, v15	)	375	V		
Trucks and buses		4	8		
Recreational vehicles		0	8		
Terrain type:		Level			
Grade		-	%		
Segment length		-	mi		
Trucks and buses PCE, E	ET .	1.5			
Recreational vehicle PC	CE, ER	1.2			
Heavy vehicle adjustment, fHV		0.980			
= =	Driver population factor, fp				
Flow rate, vp		765	pc/h/ln		
	Speed Inputs a	nd Adjustments_			
Lane width		_	ft		
Right-side lateral clea	rance	_	ft		
Total ramp density, TRI		_	ramps/mi		
Number of lanes, N		2	10p 2 /1		
Free-flow speed:		Measured			
FFS or BFFS		60.0	mi/h		
Lane width adjustment,	fLW	_	mi/h		
Lateral clearance adjus		_	mi/h		
TRD adjustment		_	mi/h		
Free-flow speed, FFS		60.0	mi/h		
LOS and Performance Measures					
Elou meto		765	m a /h /l		
Flow rate, vp		765	pc/h/ln		
Free-flow speed, FFS	unood C	60.0	mi/h mi/h		
Average passenger-car s	preed, b	60.0 2	mi/h		
Number of lanes, N Density, D		12.8	pc/mi/ln		
Level of service, LOS		12.0 B	PC/ III.		
LOUGH OF BETVICE, HOB		2			

Phone: E-mail:		Fax:			
	Operational Ana	lysis			
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-12 Diverge to ODOT District 12 2036	R-14 Diverge			
Volume, V		2910	veh/h		
Peak-hour factor, PHF		0.94	V = 11 / 11		
Peak 15-min volume, v15		774	V		
Trucks and buses		4	%		
Recreational vehicles		0	%		
Terrain type:		Level			
Grade		-	8		
Segment length		_	mi		
Trucks and buses PCE, E	T	1.5			
Recreational vehicle PC	CE, ER	1.2			
Heavy vehicle adjustmer		0.980			
Driver population factor	or, fp	1.00			
Flow rate, vp		1053	pc/h/ln		
	Speed Inputs an	d Adjustments			
Lane width		_	ft		
Right-side lateral clea	rance	_	ft		
Total ramp density, TRI		_	ramps/mi		
Number of lanes, N		3			
Free-flow speed:		Measured			
FFS or BFFS		60.0	mi/h		
Lane width adjustment,	fLW	_	mi/h		
Lateral clearance adjus	stment, fLC	_	mi/h		
TRD adjustment		-	mi/h		
Free-flow speed, FFS		60.0	mi/h		
LOS and Performance Measures					
Flow rate, vp		1053	pc/h/ln		
Free-flow speed, FFS		60.0	mi/h		
Average passenger-car s	speed, S	60.0	mi/h		
Number of lanes, N	,	3	•		
Density, D		17.5	pc/mi/ln		
Level of service, LOS		В	-		

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB Brainard Rd to C ODOT District 12 2036	Cedar Rd	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, Recreational vehicle PCE Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	1950 0.94 519 4 0 Level - - 1.5 1.2 0.980 1.00 705	<pre>veh/h  v % % % mi  pc/h/ln</pre>
	Speed Inputs ar	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	nance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	705 60.0 60.0 3 11.8	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:			
	Operational Ana	lysis			
	_				
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year:	Eric Brown Parsons Brincker 8/22/2014 PM Peak I-271 SB R-15 Merge to R- ODOT District 12 2036	16 Diverge			
Description: CUY-271-8	.14 - Build F-18				
	Flow Inputs and	Adjustments			
Volume, V		4380	veh/h		
Peak-hour factor, PHF		0.94	V CII / II		
Peak 15-min volume, v15	i	1165	V		
Trucks and buses		4	%		
Recreational vehicles		0	%		
Terrain type:		Level			
Grade		-	%		
Segment length		-	mi		
Trucks and buses PCE, E	T	1.5			
Recreational vehicle PC	E, ER	1.2			
Heavy vehicle adjustmen	it, fHV	0.980			
Driver population facto	or, fp	1.00			
Flow rate, vp		1584	pc/h/ln		
	Speed Inputs an	d Adjustments			
Lane width		_	ft		
Right-side lateral clea	rance	_	ft		
Total ramp density, TRI		_	ramps/mi		
Number of lanes, N		3	1 1 1		
Free-flow speed:		Measured			
FFS or BFFS		60.0	mi/h		
Lane width adjustment,	fLW	_	mi/h		
Lateral clearance adjus	tment, fLC	-	mi/h		
TRD adjustment		-	mi/h		
Free-flow speed, FFS		60.0	mi/h		
LOS and Performance Measures					
Flow rate, vp		1584	pc/h/ln		
Free-flow speed, FFS		60.0	mi/h		
Average passenger-car s	speed, S	60.0	mi/h		
Number of lanes, N	1	3	,		
Density, D		26.4	pc/mi/ln		
Level of service, LOS		D	-		

Phone: E-mail:		Fax:			
	Operational Ana	lysis			
Analyst:  Agency or Company:  Parsons Brinckerhoff  Date Performed:  8/21/2014  Analysis Time Period:  PM Peak  Freeway/Direction:  I-271 SB (Express Lanes)  From/To:  R-13 Merge to R-17 Merge  Jurisdiction:  ODOT District 12  Analysis Year:  2036  Description:  CUY-271-8.14 - Build F-19  Flow Inputs and Adjustments					
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		1990 0.94 529 4 0 Level	veh/h v % %		
Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustmen Driver population factor Flow rate, vp	E, ER t, fHV	- 1.5 1.2 0.980 1.00 1080	% mi pc/h/ln		
_	Speed Inputs an		-		
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	rance fLW	- - - 2 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h mi/h</pre>		
	LOS and Perform	ance Measures			
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1080 60.0 60.0 2 18.0 B	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>		

Phone: E-mail:		Fax:		
	Operational Ana	alysis		
	OPCIACIONAL AND	x1 y 5 1 5		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	8/22/2014 PM Peak I-271 SB R-16 Diverge to ODOT District 12 2036	R-19 Merge		
	Flow Inputs and	d Adjustments		
Volume, V		3690	veh/h	
Peak-hour factor, PHF		0.94		
Peak 15-min volume, v15		981	V	
Trucks and buses		4	%	
Recreational vehicles		0	8	
Terrain type:		Level	0	
Grade		_	%	
Segment length	100	- 1 F	mi	
Trucks and buses PCE, E		1.5		
Recreational vehicle PC	·	1.2		
Heavy vehicle adjustmer		0.980		
Driver population facto	or, ip	1.00	m a /h /l m	
Flow rate, vp		1335	pc/h/ln	
	Speed Inputs ar	nd Adjustments		
Lane width		_	ft	
Right-side lateral clea	rance	_	ft	
Total ramp density, TRI		_	ramps/mi	
Number of lanes, N		3	I,	
Free-flow speed:		Measured		
FFS or BFFS		60.0	mi/h	
Lane width adjustment,	fLW	_	mi/h	
Lateral clearance adjus		_	mi/h	
TRD adjustment		_	mi/h	
Free-flow speed, FFS		60.0	mi/h	
	LOS and Perform	mance Measures		
Flow rate wa		1225	ng/h/ln	
Flow rate, vp Free-flow speed, FFS		1335 60.0	pc/h/ln mi/h	
Average passenger-car s	sneed S	60.0	mi/h	
Number of lanes, N	peca, b	3	III / II	
Density, D		22.3	pc/mi/ln	
Level of service, LOS		C C	p 0 / / ±11	

Phone: E-mail:		Fax:				
	Operational Anal	lysis				
From/To: Jurisdiction: Analysis Year:	8/21/2014 Period: PM Peak ion: I-271 SB (Express Lanes) R-17 Merge to R-18 Diverge ODOT District 12					
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		2680 0.94 713 4 0 Level	veh/h v % %			
Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor	E, ER t, fHV	- 1.5 1.2 0.980 1.00	% mi			
Flow rate, vp		969	pc/h/ln			
	Speed Inputs and	d Adjustments				
Lane width Right-side lateral clea Total ramp density, TRE Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>			
	LOS and Performa	ance Measures				
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	speed, S	969 60.0 60.0 3 16.1 B	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>			

Phone: E-mail:		Fax:	
	Operational Anal	ysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brinckerh 8/22/2014 PM Peak I-271 SB R-19 Merge to R-2 ODOT District 12 2036	off	
	Flow Inputs and	Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses	5	4090 0.94 1088 4	veh/h v %
Recreational vehicles Terrain type: Grade Segment length		0 Level - -	% % mi
Trucks and buses PCE, F Recreational vehicle PC Heavy vehicle adjustment Driver population factor	CE, ER nt, fHV	1.5 1.2 0.980 1.00	
Flow rate, vp		1479	pc/h/ln
	Speed Inputs and	Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Performa	nce Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	speed, S	1479 60.0 60.0 3 24.6	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-19 Merge to R- ODOT District 12 2036	-20 Diverge 2	
Volume, V		4090	veh/h
Peak-hour factor, PHF		0.94	,
Peak 15-min volume, v15		1088	V
Trucks and buses		4	%
Recreational vehicles		0	8
Terrain type:		Level	
Grade		_	%
Segment length		-	mi
Trucks and buses PCE, E	IT .	1.5	
Recreational vehicle PC	CE, ER	1.2	
Heavy vehicle adjustmen		0.980	
Driver population factor	or, fp	1.00	
Flow rate, vp		1110	pc/h/ln
	Speed Inputs ar	nd Adjustments	
Lane width		_	ft
Right-side lateral clea	rance	_	ft
Total ramp density, TRI		_	ramps/mi
Number of lanes, N		4	1 1 1
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	fLW	_	mi/h
Lateral clearance adjus	stment, fLC	-	mi/h
TRD adjustment		-	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Perform	nance Measures	
Flow rate, vp		1110	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	speed. S	60.0	mi/h
Number of lanes, N	· /	4	,
Density, D		18.5	pc/mi/ln
Level of service, LOS		C	<b>-</b>

Phone: E-mail:		Fax:				
	On anotional Ana	1				
	Operational Ana	alysis				
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	gency or Company: Parsons Brinckerhoff  ate Performed: 8/21/2014  analysis Time Period: PM Peak  Preeway/Direction: I-271 SB (Express Lanes)  R-18 Diverge to Chagrin Blvd  Gurisdiction: ODOT District 12  analysis Year: 2036					
	Flow Inputs and	d Adjustments				
Volume, V		2280	veh/h			
Peak-hour factor, PHF		0.94				
Peak 15-min volume, v15	5	606	V			
Trucks and buses		4	%			
Recreational vehicles		0	%			
Terrain type:		Level				
Grade		-	% .			
Segment length		<del>-</del>	mi			
Trucks and buses PCE, E		1.5				
Recreational vehicle PO	·	1.2				
Heavy vehicle adjustmer		0.980				
Driver population factor	or, fp	1.00				
Flow rate, vp		1237	pc/h/ln			
	Speed Inputs ar	nd Adjustments				
Lane width		_	ft			
Right-side lateral clea	rance	_	ft			
Total ramp density, TRI		_	ramps/mi			
Number of lanes, N		2	ramps, mr			
Free-flow speed:		Measured				
FFS or BFFS		60.0	mi/h			
Lane width adjustment,	fLW	-	mi/h			
Lateral clearance adjus		_	mi/h			
TRD adjustment		_	mi/h			
Free-flow speed, FFS		60.0	mi/h			
	LOS and Perform	mance Measures				
71		1005	/la /l			
Flow rate, vp		1237	pc/h/ln			
Free-flow speed, FFS	2 been	60.0	mi/h			
Average passenger-car s	speed, S	60.0	mi/h			
Number of lanes, N		2	ng/mi/l=			
Density, D Level of service, LOS		20.6 C	pc/mi/ln			
never or service, nos		C				

Phone: E-mail:		Fax:			
	Operational Anal	vsis			
	oporaoromar imar	722			
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-20 Diverge to Chagrin Blvd ODOT District 12 2036				
	Flow Inputs and	Adjustments			
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15		3440 0.94 915	veh/h v		
Trucks and buses Recreational vehicles Terrain type:	,	4 0 Level	े १ १		
Grade Segment length		-	% mi		
Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor	CE, ER nt, fHV	1.5 1.2 0.980 1.00			
Flow rate, vp		1244	pc/h/ln		
	Speed Inputs and	Adjustments			
Lane width		_	ft		
Right-side lateral clea	arance	_	ft		
Total ramp density, TRI		-	ramps/mi		
Number of lanes, N		3			
Free-flow speed:		Measured			
FFS or BFFS	£ T 1.1	60.0	mi/h		
Lane width adjustment, Lateral clearance adjus		_	mi/h mi/h		
TRD adjustment	cilient, The	_	mi/h		
Free-flow speed, FFS		60.0	mi/h		
	LOS and Performa	nce Measures			
-1		1044	(1. (2.		
Flow rate, vp		1244	pc/h/ln		
Free-flow speed, FFS	nood C	60.0	mi/h mi/h		
Average passenger-car s Number of lanes, N	ppeed, s	60.0 3	шт / 11		
Density, D		20.7	pc/mi/ln		
Level of service, LOS		C C	F 0 / 111 / 111		

Phone: E-mail:		Fa	х:				
	Merge	Analys	is				
	_	-					
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB Chagrin Blvd District 12 2036						
	Free	way Dat	a				
Type of analysis Number of lanes in free	way		erge				
Free-flow speed on free Volume on freeway	way		0.0 110		mph vph		
	On R	amp Dat	a				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	1 3 3	ight 5.0 60 500		mph vph ft ft		
	Adjacent Ramp	Data (	if on	e exista	s)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp	1 D O	es 60 ownst ff 700	ream	vph ft		
Con	version to pc/h	Under	Base	Conditio	ons		
Junction Components	, erbron co pe/11	Freewa		Ramp		Adjacer	nt
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC	T	4110 0.90 1142 4 0 Level	% mi	360 0.90 100 1 0 Level	% mi	Ramp 160 0.90 44 0 Level	vph v % % mi

```
Heavy vehicle adjustment, fHV 0.980 0.995 1.000 Driver population factor, fP 1.00 1.00 1.00
                                                      178
Flow rate, vp
                                 4658
                                           402
                                                              pcph
                _____Estimation of V12 Merge Areas____
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 0.168 Using Equation 4
                FM
               v = v (P) = 780 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                       Actual
                       5060
                                   9200
    V
                                                 Nο
    FO
                       1939 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 1863
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   __Flow Entering Merge Influence Area__
                   Actual Max Desirable Violation?
                   2265
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 13.6 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence B
  ______Speed Estimation_____
Intermediate speed variable,
                                       M = 0.254
                                       S
Space mean speed in ramp influence area,
                                      S = 55.4
                                       R
Space mean speed in outer lanes,
                                       S = 56.8
                                       0
                                      S = 56.2 \quad mph
Space mean speed for all vehicles,
```

Phone: E-mail:	Fax:							
Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year:	ncy/Co.: Parsons Brinckerhoff e performed: 8/18/2014 lysis time period: PM Peak eway/Dir of Travel: I-271 NB (Express Lanes)							
	Free	way Da	ata_					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway						mph vph		
	Off R	amp Da	ata_					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/de Length of second accel/de		Data	Rig 1 60. 118 150	0 0 0	e exists	mph vph ft ft		
Does adjacent ramp exist Volume on adjacent ramp Position of adjacent ramp Type of adjacent ramp Distance to adjacent ramp	qm	Unde	On 360	0 nst 0		vph ft		
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15  Trucks and buses  Recreational vehicles  Terrain type:  Grade  Length  Trucks and buses PCE, E'  Recreational vehicle PC:		3000 0.90 833 4 0 Level 0.00 0.00 1.5 1.2	1	% mi	Ramp  1180 0.90 328 0 0 Level 0.00 0.00 1.5 1.2	% mi	Adjacer Ramp 1180 0.90 328 0 0 Level 0.00 0.00 1.5 1.2	vph  v % % % mi

```
3400
                                              1311
                                                         1311
Flow rate, vp
                                                                  pcph
                ______Estimation of V12 Diverge Areas_____
                L =
                               (Equation 13-12 or 13-13)
                 ΕO
                P =
                      0.615 Using Equation 5
                 FD
                v = v + (v - v) P = 2595 pc/h
                 12 R F R FD
                     _____Capacity Checks____
                                                    LOS F?
                        Actual
                                     Maximum
                        3400
                                     6900
    v = v
                                                    No
     Fi F
    v = v - v
                        2089
                                     6900
                                                    No
     FO F R
    V
                        1311
                                     2200
                                                    No
     R
                                    (Equation 13-14 or 13-17)
    v or v
                        805 pc/h
     3 av34
               > 2700 pc/h?
Is
    v or v
                                     No
     3 av34
Is
    v or v
                > 1.5 v /2
                                     No
         av34
     3
                     12
If yes, v
          = 2595
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                   _Flow Entering Diverge Influence Area__
                                Max Desirable
                    Actual
                                                    Violation?
                    2595
                                 4400
                                                     No
     12
            ____Level of Service Determination (if not F)_____
                     D = 4.252 + 0.0086 v - 0.009 L = 13.1 pc/mi/ln
Density,
                                       12
Level of service for ramp-freeway junction areas of influence B
             _____Speed Estimation____
Intermediate speed variable,
                                         D = 0.221
                                         S
Space mean speed in ramp influence area,
                                         S = 56.0
                                                     mph
                                         R
Space mean speed in outer lanes,
                                         S = 65.8
                                                     mph
                                         0
Space mean speed for all vehicles,
                                        S = 58.1
                                                   mph
```

1.00

1.000

1.00

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:		Fax:					
	Merge	Analysis_					
Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	me period: PM Peak of Travel: I-271 NB (Local Lanes) I-271 NB (Express Lanes) n: District 12						
	Free	way Data					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway		Merg 3 60.0 4470		mph vph			
	On R	amp Data					
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane decel lane	Left 1 35.0 1500 1180		mph vph ft ft			
	Adjacent Ramp	Data (if	one exist:	s)			
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp	Yes 160 Down Off 1400	stream	vph ft			
Con	version to pc/h	Under Bas	e Conditio	ons			
Junction Components	version to pe/ii	Freeway	Ramp	J11D	Adjacen	t	
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length		4470 0.90 1242 4 0 Level	i	% mi	Ramp 160 0.90 44 0 0 Level	vph v % % mi	
Trucks and buses PCE, E Recreational vehicle PC		1.5 1.2	1.5 1.2		1.5 1.2		

```
Driver population factor, fP
                                                          1.00
                                    5066
                                               1675
                                                          178
Flow rate, vp
                                                                  pcph
                ______Estimation of V12 Merge Areas_____
                L =
                        754.68 (Equation 13-6 or 13-7)
                 ΕO
                       0.611 Using Equation 1
                P =
                 FM
                v = v (P) = 3093 pc/h
                 12 F FM
                     _____Capacity Checks_____
                                                   LOS F?
                         Actual
                                     Maximum
                         6741
                                     6900
    V
                                                    No
     FΟ
                        1973 pc/h (Equation 13-14 or 13-17)
    v or v
     3 av34
Is
    v or v
               > 2700 pc/h?
                                     No
     3
          av34
                > 1.5 v /2
Is
    v or v
                                     Yes
                   12
     3 av34
If yes, v = 3093
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    ___Flow Entering Merge Influence Area__
                    Actual Max Desirable
                                                     Violation?
                    5139
                                 4600
     12A
             ____Level of Service Determination (if not F)______
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 37.4 pc/mi/ln
                           R
                                      12
Level of service for ramp-freeway junction areas of influence \, \, \mathbf{E} \,
               _____Speed Estimation_____
                                         M = 0.904
Intermediate speed variable,
                                          S
Space mean speed in ramp influence area,
                                         S = 43.7
                                                     mph
                                         R
Space mean speed in outer lanes,
                                         S = 56.0
                                                     mph
```

1.00

0.995

1.00

S = 46.1

mph

1.000

Heavy vehicle adjustment, fHV

Space mean speed for all vehicles,

Phone: E-mail:	Fax: Diverge Analysis							
	Diver	ge Ana.	TYSIS_					
Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	ency/Co.: Parsons Brinckerhoff te performed: 12/11/14 alysis time period: PM Peak eeway/Dir of Travel: I-271 NB (Local Lanes)							
	Free	way Dat	ta					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway		(	Divers 3 60.0 5650		mph vph			
	Off R	amp Dat	ta					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	-	Left 1 35.0 160 1500 (if or		mph vph ft ft			
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra  Con	mp	; (	Yes 1180 Upstre On 1400 Base		vph ft			
	version se pe, n	0110.01	20.20	00110110110				
Junction Components  Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		5650 0.90 1569 4 0 Level 0.00 0.00 1.5 1.2		Ramp  160 0.90 44 3 0 Level 0.00 0.00 1.5 1.2	% mi	Adjacen Ramp 1180 0.90 328 1 0 Level 0.00 0.00 1.5 1.2	vph v % % mi	

```
6403
                                               180
                                                          1318
Flow rate, vp
                                                                  pcph
                 _____Estimation of V12 Diverge Areas_____
                L =
                        6442.18 (Equation 13-12 or 13-13)
                 ΕO
                        0.592 Using Equation 5
                P =
                 FD
                v = v + (v - v) P = 3862 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                    LOS F?
                         Actual
                                      Maximum
                         6403
                                      6900
    v = v
                                                     No
     Fi F
    v = v - v
                         6223
                                      6900
                                                    No
     FO F R
    V
                         180
                                      2000
                                                    No
     R
                                     (Equation 13-14 or 13-17)
    v or v
                         2541 pc/h
     3 av34
                > 2700 pc/h?
Is
    v or v
                                      No
     3 av34
Is
    v or v
                > 1.5 v /2
                                      No
         av34
     3
                      12
If yes, v
          = 3862
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    3862
                                                     No
     12
             ____Level of Service Determination (if not F)______
                     D = 4.252 + 0.0086 v - 0.009 L = 25.6 pc/mi/ln
Density,
                                        12
Level of service for ramp-freeway junction areas of influence C
              _____Speed Estimation___
Intermediate speed variable,
                                         D = 0.444
                                          S
Space mean speed in ramp influence area,
                                         S = 52.0
                                                     mph
                                          R
Space mean speed in outer lanes,
                                         S = 60.6
                                                     mph
                                          0
Space mean speed for all vehicles,
                                        S = 54.8
                                                     mph
```

1.00

0.985

1.00

0.995

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:		Ι	?ax:				
	Merge	e Analy	zsis				
Analyst:	Eric Brown						
Agency/Co.:	Parsons Brinck	erhof	=				
<u> -</u>	12/11/14						
Analysis time period: Freeway/Dir of Travel:	PM Peak						
Freeway/Dir of Travel:	I-271 NB (Expr	ess La	anes)				
	I-271 NB (Loca	ıl Lane	es)				
	District 12						
Analysis Year:							
Description: CUY-271-8	.14 - Build R-5	)					
	Free	eway Da	ata				
Type of analysis			Merge				
Number of lanes in free	_		2		_		
Free-flow speed on free	way		60.0		mph		
Volume on freeway			1820		vph		
	On R	Ramp Da	ata				
Side of freeway			Left				
Number of lanes in ramp			1				
Free-flow speed on ramp		35.0 mph					
Volume on ramp		160 vph					
Length of first accel/d			1500		ft		
Length of second accel/	decel lane				ft		
	Adjacent Ramp	Data	(if o	ne exists	s)		
Does adjacent ramp exis			Yes				
Volume on adjacent Ramp			1180		vph		
Position of adjacent Ra	mp		Upstr	eam			
Type of adjacent Ramp			Off		e L		
Distance to adjacent Ra	mp		3000		ft		
Con	version to pc/h	unde:	Base	Condition	ons		
Junction Components		Free	way	Ramp		Adjacer Ramp	ıt
Volume, V (vph)		1820		160		1180	vph
Peak-hour factor, PHF		0.90		0.90		0.90	· <u>r</u>
Peak 15-min volume, v15		506		44		328	v
Trucks and buses		4		1		0	%
Recreational vehicles		0		0		0	%
Terrain type:		Level		Level		Level	
Grade			왕		%		%
Length	_		mi	<b>.</b> -	mi		mi
Trucks and buses PCE, E		1.5		1.5		1.5	
Recreational vehicle PC	E, ER	1.2		1.2		1.2	

```
2063
Flow rate, vp
                                             179
                                                       1311
                                                               pcph
               ______Estimation of V12 Merge Areas_____
               L =
                              (Equation 13-6 or 13-7)
                ΕO
                P =
                     1.000 Using Equation 0
                FM
                v = v (P) = 2063 pc/h
                12 F FM
                    _____Capacity Checks_____
                                                 LOS F?
                       Actual
                                    Maximum
                        2242
                                    4600
    V
                                                  No
     FΟ
                        0 pc/h (Equation 13-14 or 13-17)
    v or v
    3 av34
Is
    v or v
               > 2700 pc/h?
                                    No
     3
         av34
               > 1.5 v /2
Is
    v or v
                                    No
                  12
     3 av34
If yes, v = 2063
                                 (Equation 13-15, 13-16, 13-18, or 13-19)
       12A
                   ___Flow Entering Merge Influence Area__
                   Actual Max Desirable
                                                   Violation?
                   2489
                               4600
     R12
           ____Level of Service Determination (if not F)_____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 13.5 pc/mi/ln
                          R
                                     12
Level of service for ramp-freeway junction areas of influence B
              _____Speed Estimation_____
                                       M = 0.263
Intermediate speed variable,
                                        S
Space mean speed in ramp influence area,
                                       S = 55.3
                                                   mph
                                        R
Space mean speed in outer lanes,
                                       S = N/A
                                                   mph
```

1.00

0.995

1.00

S = 55.3

mph

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:		F	ax:					
	Diver	ge Ana	alysi	.s_				
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB Brainard Rd District 12 2036		Ē					
	Free	way Da	ata					
Type of analysis			Dive	~~	•			
Number of lanes in free	way.		3	19	е			
Free-flow speed on free	-		60.0			mph		
Volume on freeway	·way		5490			vph		
-						-		
	Off R	amp Da	ata					
Side of freeway			Righ	t				
Number of lanes in ramp	)		2					
Free-Flow speed on ramp			35.0			mph		
Volume on ramp			2150			vph		
Length of first accel/d	ecel lane		1400			ft		
Length of second accel/			500			ft		
	Adjacent Ramp	Data	(if	on	e exists	s)		
Does adjacent ramp exis	+ 2		Yes					
Volume on adjacent ramp			1170			vph		
Position of adjacent ra					ream	VPII		
Type of adjacent ramp	·····E		On					
Distance to adjacent ra	mp		3500			ft		
Con	version to pc/h	Under	Bas	е	Conditio	ons		
Junction Components		Freev	<i>ı</i> ay		Ramp		Adjacer	nt
							Ramp	
Volume, V (vph)		5490			2150		1170	vph
Peak-hour factor, PHF		0.90			0.90		0.90	
Peak 15-min volume, v15		1525			597		325	V
Trucks and buses		4			1		1	%
Recreational vehicles		0			0		0	%
Terrain type:		Level			Level	0	Level	•
Grade		0.00	%		0.00	%	0.00	% .
Length	m	0.00	m	ıi	0.00	mi	0.00	mi
Trucks and buses PCE, E Recreational vehicle PC		1.5			1.5 1.2		1.5 1.2	
Recreational venicle PC	e, er	1.2			1.4		⊥.∠	

```
Heavy vehicle adjustment, fHV 0.980 0.995 0.995
Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                      1307
                                 6222
                                            2401
                                                             pcph
                _____Estimation of V12 Diverge Areas___
                            (Equation 13-12 or 13-13)
                ΕQ
               P = 0.450 Using Equation 0
                FD
               v = v + (v - v) P = 4120 pc/h
                12 R F R FD
                   _____Capacity Checks____
                                   Maximum
                                              LOS F?
                      Actual
    v = v
                                   6900
                       6222
                                                 Nο
    Fi F
    v = v - v
                       3821
                                  6900
                                                No
    FO F R
                                  4000
                       2401
    V
                                                No
    R
                       2102 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                  No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                  No
3 	 av34
If yes, v = 4120
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                 __Flow Entering Diverge Influence Area__
                  Actual Max Desirable Violation?
                  4120
                              4400
                                                 No
     12
         _____Level of Service Determination (if not F)_____
                   D = 4.252 + 0.0086 v - 0.009 L = 10.0- pc/mi/ln
Density,
                                    12 D
                    R
Level of service for ramp-freeway junction areas of influence A
    ______Speed Estimation_____
Intermediate speed variable,
                                      D = 0.644
                                       S
Space mean speed in ramp influence area,
                                     S = 48.4
                                       R
Space mean speed in outer lanes,
                                      S = 61.5
                                       0
Space mean speed for all vehicles,
                                     S = 52.2 mph
```

Phone: E-mail:		Fax	:			
	Merge	Analysis	5			
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB Brainard Rd District 12 2036 .14 - Build R-7					
	Free	way Data_				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	=	3	. 0	mph vph		
	On R	amp Data_				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	1 35	. 0 7 0	mph vph ft ft		
	Adjacent Ramp	Data (ii	E one e	xists)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp	Yes 120 Dow On 140	) wnstrea	vph m ft		
Con	version to pc/h	Under Ba	ase Con	ditions		
Junction Components	version to pe/ii	Freeway	Ra		Adjacent	
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Length Trucks and buses PCE, E Recreational vehicle PC	T	3340 0.90 928 4 0 Level	0. 32 1 0	5 vel % mi 5		vph v % % i

```
Heavy vehicle adjustment, fHV 0.980 0.995 1.000 Driver population factor, fP 1.00 1.00 1.00
                                                     133
Flow rate, vp
                                 3785
                                           1307
                                                             pcph
                _____Estimation of V12 Merge Areas___
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 0.619 Using Equation 1
                FM
               v = v (P) = 2345 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                       Actual
                       5092
                                   6900
    V
                                                Nο
    FO
                      1440 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 2345
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   __Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  3652
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 24.0 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence C
  _____Speed Estimation_____
Intermediate speed variable,
                                      M = 0.366
                                       S
Space mean speed in ramp influence area,
                                     S = 53.4
                                      R
Space mean speed in outer lanes,
                                      S = 56.6
                                      0
                                     S = 54.3 mph
Space mean speed for all vehicles,
```

Phone: E-mail:		F	ax:						
	Diver	ge Ana	alysi	s					
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brinck 8/19/2014 PM Peak I-271 NB Expressway District 12 2036 .14 - Build R-8	erhoff	-						
	Free	way Da	ıta						
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-		Dive 2 60.0 1980		9	mph vph			
	Off R	amp Da	ıta						
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Righ 1 60.0 120 1500			mph vph ft ft			
	Adjacent Ramp	Data	(if	one	e exists	)			
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp		Yes 1180 Upst Off 8000	rea	am	vph ft			
Con	version to pc/h	Under	Bas	e (	Conditio	ns			
Junction Components  Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		Freew 1980 0.90 550 4 0 Level			Ramp 120 0.90 33 0 0 Level		Adjacer Ramp 1180 0.90 328 0 0	vpl v v %	a
Grade Length Trucks and buses PCE, E Recreational vehicle PC		0.00 0.00 1.5 1.2	- % m		0.00 0.00 1.5 1.2	% mi	0.00 0.00 1.5 1.2	% mi	

```
Heavy vehicle adjustment, fHV 0.980 1.000 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                    1311 pcph
                                2244
                                          133
               _____Estimation of V12 Diverge Areas____
                           (Equation 13-12 or 13-13)
               ΕQ
               P = 1.000 Using Equation 0
               FD
               v = v + (v - v) P = 2244 pc/h
               12 R F R FD
                 _____Capacity Checks____
                                  Maximum
                                            LOS F?
                     Actual
    v = v
                      2244
                                  4600
                                               Nο
    Fi F
    v = v - v
                      2111
                                 4600
                                              No
    FO F R
                                 2200
                      133
                                              No
    V
    R
                     0 pc/h
                                 (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                 No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                  No
                12
    3 av34
If yes, v = 2244
                               (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                 __Flow Entering Diverge Influence Area__
                  Actual Max Desirable Violation?
                  2244
                              4400
                                                No
    12
         _____Level of Service Determination (if not F)_____
                   D = 4.252 + 0.0086 v - 0.009 L = 10.1 pc/mi/ln
Density,
                                   12 D
                   R
Level of service for ramp-freeway junction areas of influence B
    _____Speed Estimation_____
Intermediate speed variable,
                                     D = 0.115
                                      S
                                    S = 57.9
Space mean speed in ramp influence area,
                                      R
Space mean speed in outer lanes,
                                     S = N/A
                                      0
Space mean speed for all vehicles,
                                    S = 57.9
                                                mph
```

Phone: E-mail:		Fa	ax:				
	Merge	Analys	sis				
Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction:	I-271 NB Expressway District 12 2036						
	Free	way Dat	ta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-	3	Merge 3 50.0 4510		mph vph		
	On R	amp Dat	ta				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	1 6 1	Left 1 50.0 120 1500		mph vph ft ft		
	Adjacent Ramp	Data (	(if on	e exists	3)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ramp Type of adjacent Ramp Distance to adjacent Ramp	mp	1 t 0	Yes 1170 Upstre On 1400	am	vph ft		
Con	version to pc/h	Under	Base	Conditio	ons		
Junction Components	2_ 2 00	Freewa		Ramp		Adjacer Ramp	
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Length Trucks and buses PCE, E Recreational vehicle PC		4510 0.90 1253 4 0 Level	% mi	120 0.90 33 0 0 Level	% mi	1170 0.90 325 1 0 Level	vph v % % mi

```
Heavy vehicle adjustment, fHV 0.980 1.000 0.995
Driver population factor, fP 1.00 1.00 1.00
                                                     1307
Flow rate, vp
                                 5111
                                           133
                                                             pcph
                _____Estimation of V12 Merge Areas___
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 0.619 Using Equation 1
                FM
               v = v (P) = 3166 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                      Actual
                       5244
                                   6900
    V
                                                Nο
    FO
                      1945 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 3166
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   __Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  3678
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 24.7 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence C
  _____Speed Estimation_____
Intermediate speed variable,
                                      M = 0.295
                                       S
Space mean speed in ramp influence area,
                                     S = 54.7
                                      R
Space mean speed in outer lanes,
                                      S = 56.2
                                      0
                                     S = 55.1  mph
Space mean speed for all vehicles,
```

Phone: E-mail:		F	ax:					
	Diver	ge Ana	alysi	s				
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brinck 8/20/2014 PM Peak I-271 SB Expressway District 12 2036 .14 - Build R-1	erhoff	-					
	Free	way Da	ata					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-		Dive 3 60.0 3490		е	mph vph		
	Off R	amp Da	ata					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane decel lane		Left 1 60.0 580 1500			mph vph ft ft		
	Adjacent Ramp	Data	(if	one	e exists	s)		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp		Yes 960 Down Off 1700		ream	vph ft		
Con	version to pc/h	Under	Bas	е (	Conditio	ns		
Junction Components  Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade		3490 0.90 969 4 0 Level			Ramp 580 0.90 161 0 0 Level 0.00	%	Adjacer Ramp 960 0.90 267 1 0 Level 0.00	vph v % %
Length Trucks and buses PCE, E Recreational vehicle PC		0.00 1.5 1.2	m	1	0.00 1.5 1.2	mi	0.00 1.5 1.2	mi

```
Heavy vehicle adjustment, fHV 0.980 1.000 0.995
Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                      1072
                                 3955
                                           644
                                                               pcph
               _____Estimation of V12 Diverge Areas___
                     1364.96 (Equation 13-12 or 13-13)
                ΕQ
               P = 0.632 Using Equation 5
                FD
               v = v + (v - v) P = 2735 pc/h
                12 R F R FD
                   _____Capacity Checks____
                                   Maximum
                                              LOS F?
                       Actual
    v = v
                       3955
                                   6900
                                                 Nο
    Fi F
    v = v - v
                       3311
                                  6900
                                                No
    FO F R
                                  2200
                       644
    V
                                                No
    R
                      1220 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                  No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                   No
3 	 av34
If yes, v = 2735
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                 __Flow Entering Diverge Influence Area__
                   Actual Max Desirable Violation?
                   2735
                               4400
                                                 No
    V
     12
         _____Level of Service Determination (if not F)_____
                    D = 4.252 + 0.0086 v - 0.009 L = 15.4 pc/mi/ln
Density,
                                    12 D
                    R
Level of service for ramp-freeway junction areas of influence B
    _____Speed Estimation_____
Intermediate speed variable,
                                      D = 0.161
                                       S
Space mean speed in ramp influence area,
                                     S = 57.1
                                       R
Space mean speed in outer lanes,
                                      S = 65.5
                                       0
Space mean speed for all vehicles,
                                      S = 59.2
                                                 mph
```

Phone: E-mail:		Fa	x:				
	Merge	Analys	is				
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	PM Peak I-271 SB Expressway District 12 2036						
	Free	way Dat	a				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-	2 6	0.0 410		mph vph		
	On R	amp Dat	a				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane decel lane	1 6 5 1	ight 0.0 80 500		mph vph ft ft		
	Adjacent Ramp	Data (	11 on	e exists	3)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp	N	·o		vph ft		
Con	version to pc/h	Under	Base	Conditio	ns		
Junction Components		Freewa		Ramp	<u></u> -	Adjacent Ramp	======================================
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		1410 0.90 392 4 0 Level		580 0.90 161 0 0 Level		<u></u> -	vph v %
Grade Length Trucks and buses PCE, E Recreational vehicle PC		1.5	% mi	1.5	% mi		% mi

```
Heavy vehicle adjustment, fHV 0.980 1.000 Driver population factor, fP 1.00 1.00
Flow rate, vp
                                 1598
                                           644
                                                             pcph
               _____Estimation of V12 Merge Areas____
                            (Equation 13-6 or 13-7)
               ΕQ
               P = 1.000 Using Equation 0
               FM
               v = v (P) = 1598 pc/h
                12 F FM
                   _____Capacity Checks_____
                                 Maximum LOS F?
                      Actual
                       2242
                                  4600
    V
                                                Nο
    FO
    v or v
                      0 pc/h
                                 (Equation 13-14 or 13-17)
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  No
Is
3 	 av34
If yes, v = 1598
                12
                               (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   ___Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  2242
                              4600
    R12
          ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 13.3 pc/mi/ln
                        R 12 A
Level of service for ramp-freeway junction areas of influence B
  ______Speed Estimation______
Intermediate speed variable,
                                      M = 0.178
                                       S
Space mean speed in ramp influence area,
                                     S = 56.8
                                      R
Space mean speed in outer lanes,
                                      S = N/A
                                      0
                                     S = 56.8 \quad mph
Space mean speed for all vehicles,
```

Phone: E-mail:		F	ax:				
	Diver	ge Ana	lysis_				
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brinck 8/20/2014 PM Peak I-271 SB Brainard Rd District 12 2036 .14 - Build R-1	erhoff					
	Free	way Da	ta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-		Divers 3 60.0 2910		mph vph		
	Off R	amp Da	ta				
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Right 1 35.0 960 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if or	ne exists	3)		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp		Yes 580 Upstre Off 1700	eam	vph ft		
Con	version to pc/h	Under	Base	Conditio	ns		
Junction Components  Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		Freew 2910 0.90 808 4 0 Level		Ramp 960 0.90 267 1 0 Level		Adjacer Ramp 580 0.90 161 0 0	vph v %
Grade Length Trucks and buses PCE, E Recreational vehicle PC		0.00 0.00 1.5 1.2	% mi	0.00 0.00 1.5 1.2	% mi	0.00 0.00 1.5 1.2	% mi

```
Heavy vehicle adjustment, fHV 0.980 0.995 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                     644
                                 3298
                                           1072
                                                             pcph
               _____Estimation of V12 Diverge Areas___
                            (Equation 13-12 or 13-13)
                ΕQ
               P = 0.628 Using Equation 5
                FD
               v = v + (v - v) P = 2470 pc/h
                12 R F R FD
                 _____Capacity Checks____
                                   Maximum
                                             LOS F?
                      Actual
    v = v
                       3298
                                   6900
                                                Nο
    Fi F
    v = v - v
                       2226
                                  6900
                                               No
    FO F R
                                  2000
                       1072
    V
                                               No
    R
                      828 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                  No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                  No
3 	 av34
If yes, v = 2470
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                 __Flow Entering Diverge Influence Area__
                  Actual Max Desirable Violation?
                  2470
                              4400
     12
         _____Level of Service Determination (if not F)_____
                   D = 4.252 + 0.0086 v - 0.009 L = 12.0 pc/mi/ln
Density,
                                    12 D
                    R
Level of service for ramp-freeway junction areas of influence B
    _____Speed Estimation_____
                                      D = 0.524
Intermediate speed variable,
                                      S
Space mean speed in ramp influence area,
                                     S = 50.6
                                      R
Space mean speed in outer lanes,
                                      S = 65.8
                                      0
Space mean speed for all vehicles,
                                     S = 53.7
                                                mph
```

Phone: E-mail:		Ι	Fax:				
	Merge	Analy	/sis				
Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB Cedar Rd District 12 2036 .14 - Build R-1	5					
	Free	way Da	ata				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Merge 3 60.0 1950		mph vph		
	On R	amp Da	ata				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Right 1 35.0 2430 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	ne exists	3)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp		Yes 690 Downst Off 2200	ream	vph ft		
Con	version to pc/h	Undei	. Base	Condition	ons		
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15  Trucks and buses  Recreational vehicles	_	Freew 1950 0.90 542 4		Ramp 2430 0.90 675 1		Adjacer Ramp 690 0.90 192 0	vph v % %
Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		1.5 1.2	L % mi	1.5 1.2	% mi	1.5 1.2	% mi

```
2714
                                   2210
                                                         767
Flow rate, vp
                                                                pcph
                ______Estimation of V12 Merge Areas_____
                L =
                       2839.69 (Equation 13-6 or 13-7)
                 ΕO
                       0.640 Using Equation 3
                 FM
                v = v (P) = 1415 pc/h
                 12 F FM
                     _____Capacity Checks_____
                                                  LOS F?
                        Actual
                                     Maximum
                        4924
                                     6900
    V
                                                   No
     FΟ
                        795 pc/h (Equation 13-14 or 13-17)
    v or v
    3 av34
Is
    v or v
               > 2700 pc/h?
                                    No
     3
          av34
                > 1.5 v /2
Is
    v or v
                                    Yes
                  12
     3 av34
If yes, v = 1415
                                  (Equation 13-15, 13-16, 13-18, or 13-19)
       12A
                    __Flow Entering Merge Influence Area__
                   Actual Max Desirable
                                                    Violation?
                    4129
                                4600
     12A
            ____Level of Service Determination (if not F)______
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 27.0 pc/mi/ln
                           R
                                      12
Level of service for ramp-freeway junction areas of influence C
               _____Speed Estimation_____
                                        M = 0.458
Intermediate speed variable,
                                         S
Space mean speed in ramp influence area,
                                        S = 51.8
                                                    mph
                                        R
Space mean speed in outer lanes,
                                        S = 58.9
                                                    mph
```

1.00

0.995

1.00

S = 52.8

mph

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:		1	∃ax:					
	Diver	ge Ana	alysi	is_				
			_					
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	PM Peak I-271 SB Expressway District 12 2036		Ē					
	Free	way Da	ata					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	way		Dive 3 60.0 4380	)		mph vph		
	Off R	amp Da	ata					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Left 1 60.0 690 1500	)		mph vph ft ft		
	Adjacent Ramp	Data	(if	on	e exists	; )		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp		Yes 2430 Upst On 2200	) cre	am	vph ft		
Con	version to pc/h	Unde	r Bas	se.	Conditio	ns		
Junction Components	version to bc/u	Free		<b>э</b> С	Ramp	nig	Adjacer	.t
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC	T	4380 0.90 1217 4 0 Level 0.00 0.00 1.5	٩	ģ ni	690 0.90 192 0 0 Level 0.00 0.00	% mi	Ramp 2430 0.90 675 1 0 Level 0.00 0.00 1.5	vph v % % mi

```
4964
                                               767
                                                          2714
Flow rate, vp
                                                                   pcph
                 _____Estimation of V12 Diverge Areas_____
                L =
                        21390.29 Equation 13-12 or 13-13)
                 ΕO
                        0.601 Using Equation 5
                P =
                 FD
                 v = v + (v - v) P = 3288 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                    LOS F?
                         Actual
                                      Maximum
                         4964
                                      6900
    v = v
                                                     No
     Fi F
    v = v - v
                         4197
                                      6900
                                                     No
     FO F R
    V
                         767
                                      2200
                                                     No
     R
                                     (Equation 13-14 or 13-17)
    v or v
                         1676 pc/h
     3 av34
                > 2700 pc/h?
Is
    v or v
                                      No
     3 av34
Is
    v or v
                > 1.5 v /2
                                      No
          av34
     3
                      12
If yes, v
          = 3288
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    3288
                                                      No
     12
             ___Level of Service Determination (if not F)______
                     D = 4.252 + 0.0086 v - 0.009 L = 20.4 pc/mi/ln
Density,
                                        12
Level of service for ramp-freeway junction areas of influence C
              _____Speed Estimation___
Intermediate speed variable,
                                         D = 0.172
                                          S
Space mean speed in ramp influence area,
                                         S = 56.9
                                                      mph
                                          R
Space mean speed in outer lanes,
                                         S = 63.8
                                                      mph
                                          0
Space mean speed for all vehicles,
                                        S = 58.8
                                                      mph
```

1.00

1.000

1.00

0.995

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:		F	ax:				
	Merge	Analy	sis				
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	PM Peak I-271 SB Expressway District 12 2036						
	Free	way Da	ıta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	_		Merge 3 60.0 3690		mph vph		
	On R	amp Da	ta				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Left 1 60.0 400 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	e exists	s)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp		Yes 650 Downst Off 1850	ream	vph ft		
Con	version to pc/h	Under	Base	Conditio	ons		
Junction Components		Freew		Ramp	<u></u> -	Adjace Ramp	nt
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		3690 0.90 1025 4 0 Level		400 0.90 111 0 0 Level		650 0.90 181 2 0 Level	vph v %
Grade Length	m	1 -	% mi	1 -	% mi	1 -	% mi
Trucks and buses PCE, E	Т	1.5		1.5		1.5	

Recreational vehicle PCE, ER 1.2 1.2

```
4182
                                              444
                                                         729
Flow rate, vp
                                                                 pcph
                ______Estimation of V12 Merge Areas______
                L =
                       2699.00 (Equation 13-6 or 13-7)
                 ΕO
                       0.652 Using Equation 3
                 FM
                v = v (P) = 2728 pc/h
                 12 F FM
                     _____Capacity Checks_____
                                                  LOS F?
                        Actual
                                     Maximum
                        4626
                                     6900
    V
                                                   No
     FΟ
                        1454 pc/h (Equation 13-14 or 13-17)
    v or v
    3 av34
Is
    v or v
               > 2700 pc/h?
                                    No
     3
          av34
                > 1.5 v /2
Is
    v or v
                                    Yes
                  12
     3 av34
If yes, v = 2728
                                  (Equation 13-15, 13-16, 13-18, or 13-19)
       12A
                    __Flow Entering Merge Influence Area__
                   Actual Max Desirable
                                                    Violation?
                   3499
                                4600
     12A
            ____Level of Service Determination (if not F)______
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 23.2 pc/mi/ln
                           R
                                      12
Level of service for ramp-freeway junction areas of influence C
               _____Speed Estimation_____
                                        M = 0.270
Intermediate speed variable,
                                         S
Space mean speed in ramp influence area,
                                        S = 55.1
                                                    mph
                                         R
Space mean speed in outer lanes,
                                        S = 57.7
                                                    mph
```

1.00

1.000

1.00

S = 55.8

mph

0.990

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:		1	Fax	:				
	Diver	ge Ana	aly	sis_				
Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brinck 8/20/2014 PM Peak I-271 SB Chagrin Blvd District 12 2036 .14 - Build R-2	erhof:	f					
	Free	way Da	ata <sub>-</sub>					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	way		3 60 40	.0 90		mph vph		
	Off R	amp Da	ata <sub>-</sub>					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	Dat a	1 35 65 15	.0 0 00		mph vph ft ft		
	Adjacene Ramp	Data	( 1.	L OII	C CAIBCB	/		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ramp Type of adjacent ramp Distance to adjacent ramp	mp		Yes 400 Ups On 189	0 stre	am	vph ft		
Con	version to pc/h	Unde:	r Ba	ase	Conditio	ns		
Junction Components		Free			Ramp		Adjacen	.t
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		4090 0.90 1136 4 0 Leve 0.00 0.00 1.5 1.2	1	% mi	650 0.90 181 2 0 Level 0.00 0.00	% mi	Ramp 400 0.90 111 0 0 Level 0.00 0.00 1.5	vph v % % mi

```
4635
                                               729
                                                          444
Flow rate, vp
                                                                    pcph
                 _____Estimation of V12 Diverge Areas_____
                L =
                        3633.36 (Equation 13-12 or 13-13)
                 ΕO
                        0.611 Using Equation 5
                P =
                 FD
                 v = v + (v - v) P = 3114 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                     LOS F?
                         Actual
                                      Maximum
                         4635
                                      6900
    v = v
                                                     No
     Fi F
    v = v - v
                         3906
                                      6900
                                                     No
     FO F R
    V
                         729
                                      2000
                                                     No
     R
                                     (Equation 13-14 or 13-17)
    v or v
                         1521 pc/h
     3 av34
                > 2700 pc/h?
Is
    v or v
                                      No
     3 av34
Is
    v or v
                > 1.5 v /2
                                      No
          av34
     3
                      12
If yes, v
          = 3114
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    3114
                                                      No
     12
             ___Level of Service Determination (if not F)______
                     D = 4.252 + 0.0086 v - 0.009 L = 17.5 pc/mi/ln
Density,
                                        12
Level of service for ramp-freeway junction areas of influence B
              _____Speed Estimation___
Intermediate speed variable,
                                         D = 0.494
                                          S
Space mean speed in ramp influence area,
                                         S = 51.1
                                                      mph
                                          R
Space mean speed in outer lanes,
                                         S = 63.8
                                                      mph
                                          0
Space mean speed for all vehicles,
                                         S = 54.7
                                                      mph
```

1.00

0.990

1.00

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Fax:

Phone: E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 12/11/14
Analysis Time Period: PM Peak
Freeway/Dir of Travel: I-271 NB

Weaving Location: R-1 Merge to R-4 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - Build W-1

\_\_\_\_\_Inputs\_\_\_\_\_\_Inputs\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	7300	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Terrain type	Level	
Grade	0.00	9
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume	Compone	nts	
	VFF	VRF	VFR	VRR
Volume, V	5290	200	0	160 veh/h
Peak hour factor, PHF	0.90	0.90	0.90	0.90
Peak 15-min volume, v15	1469	56	0	44
Trucks and buses	0	0	0	0 %
Recreational vehicles	0	0	0	0 %
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.000
Driver population adjustment, fP	1.00	1.00	1.00	1.00
Flow rate, v	5878	222	0	178 pc/h

Volume ratio, VR 0.028

Configuration	Characterist	cics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	4	lc/pc	
Minimum weaving lane changes, LCMIN	712	lc/h	
Weaving lane changes, LCW		lc/h	
Non-weaving vehicle index, INW			
Non-weaving lane change, LCNW		lc/h	
Total lane changes, LCALL		lc/h	

\_\_\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_

Average non-weaving spee		mı/h			
Weaving Segment	Speed, Dens	ity, Level of S	ervice and Ca	pacity	
Weaving segment speed, S	_	_	mi/h	_	
Weaving segment density,	D		pc/mi/ln		
Level of service, LOS			_		
Weaving segment v/c rati	0				
Weaving segment flow rat	e, v		veh/h		
Weaving segment capacity	, cW		veh/h		
T	imitations of	n Weaving Segme	nta		
If limit reached, see no		ir weaving begine			
	Minimum	Maximum	Actual	Note	
Weaving length (ft)	300	5990	7300	a,b	
		Maximum	Analyzed		
Density-based capacty,		2300	_	С	
cIWL (pc/h/ln)					
_		Maximum	Analyzed		
v/c ratio		1.00		d	

mi/h

## Notes:

Average weaving speed, SW

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

Undefined LOS in HCS, calculated as LOS F at 5989 ft. Location cannot be analyzed as a weave. See note b.

Fax:

Phone:

E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_\_ Eric Brown Parsons Brinckerhoff Analyst: Agency/Co.: Date Performed: 12/11/14 PM Peak I-271 NB (Local Lanes) R-3 Merge to R-4 Diverge Analysis Time Period: Freeway/Dir of Travel: Weaving Location: Analysis Year: 2036 Description: CUY-271-8.14 - Build W-2 \_\_\_\_\_Inputs\_\_\_\_\_ Segment Type Freeway Weaving configuration One-Sided Number of lanes, N 4 ln Weaving segment length, LS 1400 ft. Freeway free-flow speed, FFS 60 mi/h Minimum segment speed, SMIN 45 mi/h 2300 Freeway maximum capacity, cIFL pc/h/ln Terrain type Level Grade 0.00 Length 0.00 тi \_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_ Volume Components | Volume | Components | VFF | VFR | VFR | VFR | VFR | VFR | VFF | 용 Volume ratio, VR 0.237 \_\_\_\_\_Configuration Characteristics\_\_ Number of maneuver lanes, NWL 2 1 n 0.6 Interchange density, ID int/mi Minimum RF lane changes, LCRF 1 lc/pc Minimum FR lane changes, LCFR 1 lc/pc Minimum RR lane changes, LCRR lc/pc Minimum weaving lane changes, LCMIN 1489 lc/h Weaving lane changes, LCW 1790 lc/h Non-weaving vehicle index, INW 402 Non-weaving lane change, LCNW 975 lc/h

\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_

2765

lc/h

Weaving intensity factor, W 0.387

Total lane changes, LCALL

Average weaving speed,	SW	55.8	mi/h		
Average non-weaving spe	ed, SNW	41.7	mi/h		
Weaving Segmen	t Speed, Densi	ty, Level of S	ervice and Cap	pacity	
Weaving segment speed,	S	44.4	mi/h		
Weaving segment density	, D	35.3	pc/mi/ln		
Level of service, LOS		E			
Weaving segment v/c rat	io	0.773			
Weaving segment flow ra	te, v	6278	veh/h		
Weaving segment capacity	y, cW	8124	veh/h		
	Limitations or	n Weaving Segme:	nts		
If limit reached, see n					
	Minimum	Maximum	Actual	Note	
Weaving length (ft)	300	4920	1400	a,b	
-		Maximum	Analyzed		
Density-based capacty, cIWL (pc/h/ln)		2300	2031	С	
O= (FO), TII)					

# Notes:

v/c ratio

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

Maximum

1.00

Analyzed 0.773

d

- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

Fax:

Phone: E-mail:

\_\_\_\_\_\_Operational Analysis\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 12/11/14
Analysis Time Period: PM Peak
Freeway/Dir of Travel: I-271 NB

Weaving Location: R-3 Merge to R-6 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - Build W-3

\_\_\_\_\_Inputs\_\_\_\_\_\_Inputs\_\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	4350	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
	_	
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume	Compone	nts		
	VFF	VRF	VFR	VRR	
Volume, V	3340	0	970	1180	veh/h
Peak hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	928	0	269	328	
Trucks and buses	0	0	0	0	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.000	)
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	3711	0	1078	1311	pc/h

Volume ratio, VR 0.215

Configuration	Characterist	ics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	3	lc/pc	
Minimum weaving lane changes, LCMIN		lc/h	
Weaving lane changes, LCW	4258	lc/h	
Non-weaving vehicle index, INW	1250		
Non-weaving lane change, LCNW	2766	lc/h	
Total lane changes, LCALL	7024	lc/h	

\_\_\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_

Average weaving speed, S	W	56.3	mi/h		
Average non-weaving spee	d, SNW	21.9	mi/h		
Weaving Segment	Speed, Densi	ty, Level of S	ervice and Ca	pacity	
Weaving segment speed, S	_	25.2		<u> </u>	
Weaving segment density,		80.6	pc/mi/ln		
Level of service, LOS		F	-		
Weaving segment v/c rati	0	1.000			
Weaving segment flow rat		6100	veh/h		
Weaving segment capacity	, cW	6102	veh/h		
Ţ	imitations or	n Weaving Segme	nta		
If limit reached, see no		r weaving begine			
	Minimum	Maximum	Actual	Note	
Weaving length (ft)	300	7821	4350	a,b	
		Maximum	Analyzed		
Density-based capacty,		2300	2034	С	
cIWL (pc/h/ln)					
		Maximum	Analyzed		

# Notes:

v/c ratio

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

1.00

1.000

d

- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

Fax:

Phone: E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 8/26/2014 PM Peak Analysis Time Period: Freeway/Dir of Travel: I-271 SB

Weaving Location: R-11 Merge to R-12 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - Build W-4

\_\_\_\_\_Inputs\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	4100	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Terrain type	Level	
Grade	0.00	90
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume	Compone	nts		
	VFF	VRF	VFR	VRR	
Volume, V	2450	460	0	580 veh/h	
Peak hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	681	128	0	161	
Trucks and buses	0	0	0	0 %	
Recreational vehicles	0	0	0	0 %	
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.000	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	2722	511	0	644 pc/h	

Volume ratio, VR 0.166

Configuration	Characterist	ics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	2	lc/pc	
Minimum weaving lane changes, LCMIN	1288	lc/h	
Weaving lane changes, LCW	1603	lc/h	
Non-weaving vehicle index, INW	795		
Non-weaving lane change, LCNW	2310	lc/h	
Total lane changes, LCALL	3913	lc/h	

\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_ 0.218

Average non-weaving spee	d, SNW	44.5	mi/h	
Weaving Segment	Speed, Dens:	ity, Level of S	ervice and Car	pacity
Weaving segment speed, S		46.2	mi/h	
Weaving segment density,	D	27.9	pc/mi/ln	
Level of service, LOS		С	_	
Weaving segment v/c rati	0	0.630		
Weaving segment flow rat		3878	veh/h	
Weaving segment capacity		6159	veh/h	
L	imitations or	n Weaving Segmen	nts	
If limit reached, see no				
	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	7325	4100	a,b
<i>5 5</i> , ,		Maximum	Analyzed	,
Density-based capacty, cIWL (pc/h/ln)		2300	2053	С
<u>-</u>		Maximum	Analyzed	

1.00

mi/h

0.630

d

# Notes:

v/c ratio

Average weaving speed, SW

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

Fax:

Phone: E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 8/26/2014
Analysis Time Period: PM Peak
Freeway/Dir of Travel: I-271 SB

Weaving Location: R-15 Merge to R-16 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - Build W-5

\_\_\_\_\_\_Inputs\_\_\_\_\_\_

Segment Type	Freeway					
Weaving configuration	onfiguration Two-Sided					
Number of lanes, N	3	ln				
Weaving segment length, LS	2400	ft				
Freeway free-flow speed, FFS	60	mi/h				
Minimum segment speed, SMIN	45	mi/h				
Freeway maximum capacity, cIFL	2300	pc/h/ln				
Terrain type	Level					
Grade	0.00	%				
Length	0.00	mi				

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume Components							
	VFF	VRF	VFR	VRR				
Volume, V	1950	1740	0	690 veh/	h			
Peak hour factor, PHF	0.90	0.90	0.90	0.90				
Peak 15-min volume, v15	542	483	0	192				
Trucks and buses	0	0	0	0	%			
Recreational vehicles	0	0	0	0	%			
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5				
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2				
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.000				
Driver population adjustment, fP	1.00	1.00	1.00	1.00				
Flow rate, v	2167	1933	0	767 pc/	h			

Volume ratio, VR 0.158

Configuration	Characterist	ics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	3	lc/pc	
Minimum weaving lane changes, LCMIN	2301	lc/h	
Weaving lane changes, LCW	2535	lc/h	
Non-weaving vehicle index, INW	590		
Non-weaving lane change, LCNW	1568	lc/h	
Total lane changes, LCALL	4103	lc/h	

Weaving intensity factor, W

0.345

Average weaving speed,	SW	56.2	mi/h					
Average non-weaving spe	ed, SNW	35.6	mi/h					
Weaving Segmen	t Speed, Densi	ity, Level of Se	ervice and Ca	pacity				
Weaving segment speed,	S	37.8	mi/h	_				
Weaving segment density		42.9	pc/mi/ln					
Level of service, LOS		E	_					
Weaving segment v/c rat	io	0.841						
Weaving segment flow ra	te, v	4867	veh/h					
Weaving segment capacit	y, cW	5790	5790 veh/h					
	Limitations or	n Weaving Segmen	nts					
If limit reached, see n								
	Minimum	Maximum	Actual	Note				
Weaving length (ft)	300	7239	2400	a,b				
		Maximum	Analyzed					
Density-based capacty, cIWL (pc/h/ln)		2300	1930	С				

# Notes:

v/c ratio

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

Maximum

1.00

Analyzed 0.841

d

- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

Fax:

Phone: E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 9/11/14
Analysis Time Period: PM Peak
Freeway/Dir of Travel: I-271 SB

Weaving Location: R-19 Merge to R-20 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - Build W-6

\_\_\_\_\_Inputs\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	1900	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume Components						
	VFF	VRF	VFR	VRR			
Volume, V	3440	0	250	400	veh/h		
Peak hour factor, PHF	0.90	0.90	0.90	0.90			
Peak 15-min volume, v15	956	0	69	111			
Trucks and buses	0	0	0	0	%		
Recreational vehicles	0	0	0	0	%		
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5			
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2			
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.00	0		
Driver population adjustment, fP	1.00	1.00	1.00	1.00			
Flow rate, v	3822	0	278	444	pc/h		

Volume ratio, VR 0.098

Configuration	Characterist	ics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	3	lc/pc	
Minimum weaving lane changes, LCMIN	1332	lc/h	
Weaving lane changes, LCW	1536	lc/h	
Non-weaving vehicle index, INW	467		
Non-weaving lane change, LCNW	1297	lc/h	
Total lane changes, LCALL	2833	lc/h	

\_\_\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_

Average weaving speed,	SW	56.5	mi/h					
Average non-weaving spe	ed, SNW	43.1	mi/h					
Weaving Segmen	t Speed, Densi	ity, Level of S	ervice and Ca	pacity				
Weaving segment speed,	S	44.2	mi/h					
Weaving segment density		34.3	pc/mi/ln					
Level of service, LOS		D	_					
Weaving segment v/c rat	io	0.782						
Weaving segment flow ra	te, v	4545	veh/h					
Weaving segment capacit	y, cW	5811	veh/h	veh/h				
	Limitations or	n Weaving Segme	nts					
If limit reached, see n		, , , , , , , , , , , , , , , , , , ,						
	Minimum	Maximum	Actual	Note				
Weaving length (ft)	300	6649	1900	a,b				
		Maximum	Analyzed	·				
Density-based capacty, cIWL (pc/h/ln)		2300	1937	C				

Maximum

1.00

Analyzed

0.782

d

# Notes:

v/c ratio

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

HCS 2010 Signalized Intersection Results Summary															
On and Information								l (				_	1 0	ላ ጉቀ †	N II
General Information	Danas Baisalas da	"					<del></del>				mation	<u> </u>	- 1	424	
Agency	Parsons Brinckerhoff			_	Duration, h 0.25				4		<b>P.</b>				
Analyst	Eric Brown	1,71,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,				_	Area T	ype		Other				₹ 4 ← 5- ← 4-	
Jurisdiction	ODOT District 12		Time F			eak Build		PHF			0.92			e de	<b>₩</b>
Intersection I-271 SB On Ramp			Analys	is Year	2036			Analys	is Pe	eriod	1> 7:0	0			¥ ,F
File Name															
Project Description													<u> </u>	<b>ተተቀ</b> ዋ	7
Demand Information				EB		1	WE	3			NB			SB	
Approach Movement			L	Т	R	L	Т	F	۲ ا	L	Т	R	L	T	R
Demand (v), veh/h				1350	1390	1040	232	0							
Signal Information															
Cycle, s 200.0	Reference Phase	2	1	2	<b>╡</b> Ĺ⊾ ⁴	┨						<u> </u>	_		
Offset, s 0	Reference Point	End			<u></u>							1	2	3	4
Uncoordinated No	Simult. Gap E/W	On	Green		119.2		0.0	0.0		0.0		"	$\leftarrow$		,
Force Mode Fixed	Simult. Gap N/S	On	Yellow Red	1.0	1.0	0.0	0.0	0.0		0.0	-	5	6	7	Ω
Force wode   Fixed	Simult. Gap 14/3	OII	Neu	1.0	1.0	10.0	10.0	10.	U	10.0		3	0	2	o o
Timer Results			EBL	.	EBT	WB	L	WBT	Т	NBL	1	NBT	SBL	_	SBT
Assigned Phase					2	1		6	$\perp$						
Case Number					7.3	2.0	_	4.0	4						
Phase Duration, s					124.2	75.8	_	200.0	4					$\bot$	
Change Period, (Y+Rc)			5.0		5.0		5.0	_							
Max Allow Headway ( A					0.0	3.1		0.0	_						
Queue Clearance Time	( gs), s					72.8	3		_						
Green Extension Time	( <i>g</i> e), s				0.0	0.0		0.0							
Phase Call Probability						1.00	)								
Max Out Probability						1.00			_						
Movement Group Res	sults			EB			WB		т		NB			SB	
Approach Movement			L	Т	R	L	Т	R	т	L	Т	R	L	Т	R
Assigned Movement				2	12	1	6	1			ĺ				
Adjusted Flow Rate ( v)	, veh/h			1467	1511	1130	2522		$\top$						
Adjusted Saturation Flo	w Rate (s), veh/h/ln			950	1579	887	950	1			ĺ				
Queue Service Time ( g	gs), S			119.2	119.2	70.8	195.0	)							
Cycle Queue Clearance	e Time ( $g_c$ ), s			119.2	119.2	70.8	195.0								
Green Ratio (g/C)				0.60	0.60	0.35	0.98		П						
Capacity (c), veh/h				1132	941	628	1853								
Volume-to-Capacity Ra	atio (X)			1.296	1.606	1.800	1.361		Т						
Available Capacity ( ca)	, veh/h			1132	941	628	1853								
Back of Queue (Q), vel	h/ln (95th percentile)			73.0	182.4	77.6	68.2								
Queue Storage Ratio (		)		0.00	23.16	3.03	0.00								
Uniform Delay ( d1), s/v				40.4	40.4	64.6	2.5	-	+						
Incremental Delay ( d2),				139.8	277.6	366.3	166.2	2	+	-					
Initial Queue Delay ( d3)				0.0	0.0	0.0	0.0		_						$\perp$
Control Delay ( d), s/vel	h			180.2	318.0		168.7								
Level of Service (LOS)	/1.00		050	F	F	F	F		_	0.0					
Approach Delay, s/veh			250.		F	249.	8	F	-	0.0			0.0		
Intersection Delay, s/ve	n / LOS				25	0.0							F		
Multimodal Results				EB			WB				NB			SB	
Pedestrian LOS Score	/LOS		2.4		В	0.5		Α		3.0		С	2.9		С
Bicycle LOS Score / LC	OS		2.9		С	3.5		D							

HCS 2010 Signalized Intersection Results Summary														
On and Information									l			1 1	4 7 4 1 .	W U
General Information	Parsons Brinckerho	"					$\rightarrow$	ntersect		Tr.	n	- 1	747	
Agency		П	A m m li va	ia Data	A	0 0044		Duration,		0.25				K
Analyst	Eric Brown		1	is Date		9, 2014		Area Typ	<u>e</u>	Other			i.	~ ~ ~ 
Jurisdiction	ODOT District 12		Time F			eak Build		PHF	<u> </u>	0.92			• †*	- - - - -
Intersection	Cedar Rd		11	is Year	2036			Analysis	Perioa	1> 7:0	)()			
File Name	I-2, I-3, I-4 CUY-27	1-8.14 F	'M Peak	c.xus								- 1	ጎ † †	
Project Description													N I WI	r n
Demand Information				EB			WE	}		NB			SB	
Approach Movement			L	Т	R	L	Т	R	L	Т	R	L	T	R
Demand (v), veh/h			750	490	110	40	112	0 470	90	260	10	530	360	750
Signal Information								5						7
Cycle, s 135.0	Reference Phase	2			ΤŢ	Lą.	L	温				KTZ.		
Offset, s 0	Reference Point	End	-		. I ™î	<b>"</b>   3	R	-			1	2	3	4
			Green		15.0	30.0	45.0		0.0			<b>+</b>	J _	<b>A</b>
Uncoordinated No Force Mode Fixed	Simult. Gap E/W Simult. Gap N/S	On	Yellow	-	3.6	3.6	3.6	0.0	0.0	_	5		<b>-</b> ∕`_	V
Force Mode Fixed	Simuit. Gap N/S	On	Red	1.4	1.4	1.4	1.4	0.0	0.0		5	6	1	8
Timer Results			EBI		EBT	WBI	L	WBT	NBI		NBT	SBL		SBT
Assigned Phase			7		4			8			2	1		6
Case Number			2.0		4.0			5.3			6.3	2.0		3.0
Phase Duration, s			35.0	)	85.0			50.0			20.0	30.0	)	50.0
Change Period, (Y+Rc)	), S		5.0		5.0			5.0			5.0	5.0		5.0
Max Allow Headway ( M	Max Allow Headway ( MAH), s		3.1		3.2			3.2			0.0	3.1		0.0
Queue Clearance Time	( gs), s		32.0	)	14.2			47.0				19.3	3	
Green Extension Time (	( <i>g<sub>e</sub></i> ), s		0.0		8.0			0.0			0.0	0.7		0.0
Phase Call Probability			1.00	)	1.00			1.00				1.00	)	
Max Out Probability			1.00	)	0.00			1.00				0.19	)	
Movement Group Res	ults			EB			WB			NB			SB	
Approach Movement			L	Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Movement			7	4	14	3	8	18	5	2	12	1	6	16
Adjusted Flow Rate ( v)	, veh/h		815	336	316	43	1217	511	98	147	146	520	353	736
Adjusted Saturation Flo			1757	1863	1744	792	1773	1610	1044	1881	1856	1757	1863	1610
Queue Service Time ( g			30.0	12.1	12.2	5.2	45.0	41.8	12.4	10.2	10.3	17.3	17.8	45.0
Cycle Queue Clearance	e Time ( gc), s		30.0	12.1	12.2	5.2	45.0	41.8	12.4	10.2	10.3	17.3	17.8	45.0
Green Ratio (g/C)			0.22	0.59	0.59	0.33	0.33	0.33	0.11	0.11	0.11	0.19	0.33	0.56
Capacity (c), veh/h			781	1104	1034	317	1182	537	169	209	206	651	621	895
Volume-to-Capacity Ra	tio ( X)		1.044	0.304	0.306	0.137	1.030	0.952	0.578	0.704	0.709	0.799	0.569	0.822
Available Capacity ( ca)	, veh/h		781	1104	1034	317	1182	537	169	209	206	651	621	895
Back of Queue (Q), veh			25.4	8.7	8.3	1.8	33.9	27.8	7.0	9.9	9.8	9.4	11.1	10.6
Queue Storage Ratio (		)	1.10	0.00	0.00	0.36	0.00	1.88	0.51	0.00	0.00	0.81	0.00	0.92
Uniform Delay (d1), s/ve			52.5	13.7	13.7	31.7	45.0	43.9	58.8	57.9	57.9	36.3	26.8	17.0
Incremental Delay ( d2), s/veh		44.2	0.1	0.1	0.1	34.1	26.9	13.6	18.1	18.6	4.7	2.7	6.2	
Initial Queue Delay (d3), s/veh		0.0	0.0	0.0	0.0	0.0	70.0	0.0	0.0	0.0	0.0	0.0	0.0	
Control Delay ( d), s/veh		96.7	13.7	13.7	31.8	79.1	70.9	72.4	75.9	76.5	41.0	29.4	23.2	
Level of Service (LOS)	/1.08		F 50.0	В	В	C 75.6	F	E	E 75.2	E	E	D 20.3	С	С
Approach Delay, s/veh			59.9	7	E 57	75.6	)	E	75.3	)	Е	30.3	0	С
Intersection Delay, s/ve	m / LOS				5/	7.2						E		
Multimodal Results				EB			WB			NB			SB	
Pedestrian LOS Score	/LOS		2.4		В	3.0		С	3.0		С	3.0	-	С
Bicycle LOS Score / LO	os		1.7		Α	1.9		Α	0.8		Α	3.4		С

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## **HCS 2010 Signalized Intersection Results Summary** 14144111 Intersection Information **General Information** Agency Parsons Brinckerhoff Duration, h 0.25 Analyst Eric Brown Analysis Date Aug 29, 2014 Area Type Other PHF Jurisdiction ODOT District 12 Time Period PM Peak Build 0.92 Intersection I-271 NB On/Off Ramp Analysis Year 2036 **Analysis Period** 1> 7:00 I-2 I-3 I-4 CUY-271-8.14 PM Peak Revised.xus File Name **Project Description** WB **Demand Information** EB NB SB Approach Movement Т R L R L R R 400 1080 Demand (v), veh/h 500 1 250 90 1390 **Signal Information** Ц IJ, Cycle, s 135.0 Reference Phase 2 Offset, s 0 Reference Point End Green 6.0 48.0 0.0 0.0 66.0 0.0 Uncoordinated No Simult. Gap E/W On Yellow 3.6 3.6 3.6 0.0 0.0 0.0 Force Mode Fixed Simult. Gap N/S 0.0 On Red 1.4 1.4 1.4 0.0 0.0 **Timer Results EBL EBT WBL WBT NBL NBT** SBL SBT Assigned Phase 4 2 1 6 Case Number 9.0 7.3 1.0 4.0 11.0 Phase Duration, s 53.0 71.0 82.0 Change Period, (Y+Rc), s 5.0 5.0 5.0 5.0 Max Allow Headway (MAH), s 3.1 0.0 3.1 0.0 Queue Clearance Time (gs), s 41.0 4.9 Green Extension Time (ge), s 1.2 0.0 0.0 0.0 1.00 1.00 Phase Call Probability 0.21 1.00 Max Out Probability WB SB **Movement Group Results** EΒ NB Approach Movement L Т R L Т R L Т R L Т R **Assigned Movement** 7 4 14 2 12 1 6 1259 Adjusted Flow Rate (v), veh/h 543 137 136 426 1149 82 1792 Adjusted Saturation Flow Rate (s), veh/h/ln 1757 1566 1563 1863 1411 1756 8.3 8.3 23.6 52.9 2.9 Queue Service Time (gs), s 39.0 39.1 Cycle Queue Clearance Time (qc), s 39.0 8.3 8.3 23.6 52.9 2.9 39.1 0.36 Green Ratio (g/C) 0.36 0.36 0.49 0.49 0.55 0.57 Capacity (c), veh/h 625 557 556 911 1380 437 2003 Volume-to-Capacity Ratio (X) 0.870 0.246 0.244 0.467 0.833 0.187 0.628 Available Capacity (ca), veh/h 625 557 556 911 1380 437 2003 Back of Queue (Q), veh/ln (95th percentile) 25.8 5.7 5.7 13.5 0.4 2.1 20.6 Queue Storage Ratio (RQ) (95th percentile) 0.00 0.00 0.00 0.00 0.00 0.16 0.00 Uniform Delay (d1), s/veh 40.6 30.7 30.7 29.4 49.5 17.6 29.6 Incremental Delay (d2), s/veh 12.2 0.1 0.1 0.3 1.2 0.0 0.3 Initial Queue Delay (d3), s/veh 0.0 0.0 0.0 0.0 0.0 0.0 0.0 Control Delay (d), s/veh 52.7 30.8 30.8 29.8 50.7 17.7 29.9 Level of Service (LOS) D С С D В С С 45.4 D 0.0 45.1 D 29.1 С Approach Delay, s/veh / LOS Intersection Delay, s/veh / LOS 39.4 D **Multimodal Results** ΕB WB NB Pedestrian LOS Score / LOS 2.9 С 2.5 В 2.4 В 1.9 Α Bicycle LOS Score / LOS 1.8 Α 3.1 C 1.8

HCS 2010 Signalized Intersection Results Summary												
Opposed by formation						l	diamine			1 4	4 J. 4 J	N II
General Information					$\rightarrow$	Intersec			n	- Í	11	- x
Agency Parsons Brinckerhoff	<b>1</b> • •		14 0	0.0044	_	Duration		0.25				L
Analyst Eric Brown	Analys		_	9, 2014	-	Area Typ	oe	Other		<b>4</b> →		<u>}</u>
Jurisdiction ODOT District 12	Time F			eak Buil		PHF		0.92		<b>♦</b> -{	**†*	<del>∳</del> ∳
Intersection I-271 SB Off Ramp	Analys		r 2036			Analysis	Period	1> 7:0	00	7		r r
File Name I-2, I-3, I-4 CUY-271-8.14	PM Peak	.xus									11	
Project Description										<u> </u>	4   + 4   4	<b>†</b>
Demand Information		EB			WI	В		NB			SB	
Approach Movement	L	Т	R	L	Т	R	L	Т	R	L	Т	R
Demand (v), veh/h				830	1	130		900			650	
Signal Information									-	-	-	
Cycle, s 135.0 Reference Phase 2	-	*	1 3	Ħ						<b>†</b>		
	-	↑	`					J	1	2	3	4
· · · · · · · · · · · · · · · · · · ·	Green		53.5	0.0	0.0		0.0		- 1	3	i i	
Uncoordinated No Simult. Gap E/W On	Yellow	-	4.0	0.0	0.0		0.0		1	ļ		Y
Force Mode Fixed Simult. Gap N/S On	Red	1.4	0.0	0.0	0.0	0.0	0.0		5	6	7	8
Timer Results	EBL		EBT	WB	L	WBT	NBI	_	NBT	SBL	_	SBT
Assigned Phase						8			2			6
Case Number						10.0			8.0			8.0
Phase Duration, s						57.5			77.5			77.5
Change Period, (Y+Rc), s						4.0			5.0			5.0
Max Allow Headway ( MAH), s						3.2			0.0			0.0
Queue Clearance Time ( gs), s						36.0						
Green Extension Time ( ge), s						2.4			0.0			0.0
Phase Call Probability						1.00						
Max Out Probability						0.02						
Movement Group Results		EB			WB			NB			SB	
Approach Movement	L	T	R		Т	R	L	Т	R	L	T	R
Assigned Movement	_			3	8	18	_	2	- 1		6	
Adjusted Flow Rate ( v), veh/h			_	532	512			969			707	
Adjusted Saturation Flow Rate (s), veh/h/ln				1810	1755			1809			1809	
Queue Service Time ( gs), s			1	34.0	33.6			32.1			15.2	
Cycle Queue Clearance Time ( gc), s				34.0	33.6			32.1			15.2	
Green Ratio (g/C)				0.40	0.40			0.54			0.54	
Capacity (c), veh/h				717	695			1943			1943	
Volume-to-Capacity Ratio ( X)				0.742	0.737	7		0.499			0.364	
Available Capacity ( ca), veh/h				717	695			1943			1943	
Back of Queue (Q), veh/ln (95th percentile)				21.9	21.1			21.5			10.5	
Queue Storage Ratio ( RQ) (95th percentile)				0.00	0.00			0.00			0.00	
Uniform Delay ( d1), s/veh				34.9	34.7			37.9			18.0	
Incremental Delay ( d2), s/veh				3.7	3.6			0.7			0.5	
Initial Queue Delay ( d3), s/veh				0.0	0.0			0.0			0.0	
Control Delay ( d), s/veh				38.5	38.4			38.6			18.5	
Level of Service (LOS)				D	D			D			В	
Approach Delay, s/veh / LOS	0.0			38.5	5	D	38.6	5	D	18.5		В
Intersection Delay, s/veh / LOS			3	3.3						С		
Multimodal Results		EB			WB			NB			SB	
Pedestrian LOS Score / LOS	2.8		С	2.8		С	1.7		Α	1.9		A
Bicycle LOS Score / LOS			-	2.2	_	В	1.3		Α	1.1		A

Operational Analysis	Phone: E-mail:		Fax:	
Agency or Company: Parsons Brinckerhoff Date Performed: 8/21/2014 Analysis Time Period: PM Peak Freeway/Direction: I-271 NB From/To: Chagrin Blvd to R-1 Merge Jurisdiction: ODOT District 12 Analysis Year: 2036 Description: CUY-271-8.14 - No Build F-1		Operational Analys	is	
Peak-hour factor, PHF       0.94         Peak 15-min volume, v15       1093       v         Trucks and buses       4       %         Recreational vehicles       0       %         Terrain type:       Level       %         Grade       -       %         Segment length       -       mi         Trucks and buses PCE, ET       1.5         Recreational vehicle PCE, ER       1.2         Heavy vehicle adjustment, fHV       0.980         Driver population factor, fp       1.00         Flow rate, vp       1115       pc/h/ln         Lane width       -       ft	Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year:	Parsons Brinckerhof 8/21/2014 PM Peak I-271 NB Chagrin Blvd to R-1 ODOT District 12 2036 .14 - No Build F-1	Merge	
Peak-hour factor, PHF       0.94         Peak 15-min volume, v15       1093       v         Trucks and buses       4       %         Recreational vehicles       0       %         Terrain type:       Level       %         Grade       -       %         Segment length       -       mi         Trucks and buses PCE, ET       1.5         Recreational vehicle PCE, ER       1.2         Heavy vehicle adjustment, fHV       0.980         Driver population factor, fp       1.00         Flow rate, vp       1115       pc/h/ln         Lane width       -       ft	****			
Peak 15-min volume, v15  Trucks and buses  Recreational vehicles  Grade  Grade  Segment length  Trucks and buses PCE, ET  Recreational vehicle PCE, ER  Heavy vehicle adjustment, fHV  Driver population factor, fp  Flow rate, vp  Level  -  Speed Inputs and Adjustments  tane width  1093  v  100  100  100  100  1115	-			veh/h
Trucks and buses				77
Recreational vehicles       0       %         Terrain type:       Level       %         Grade       -       %         Segment length       -       mi         Trucks and buses PCE, ET       1.5         Recreational vehicle PCE, ER       1.2         Heavy vehicle adjustment, fHV       0.980         Driver population factor, fp       1.00         Flow rate, vp       1115       pc/h/ln         Lane width       -       ft				
Terrain type:				
Grade Segment length Trucks and buses PCE, ET Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV Oriver population factor, fp Flow rate, vp  Speed Inputs and Adjustments  Lane width  -   \$ mi  1.5  no mi  1.5  pc/h/ln  ft				ů
Segment length - mi  Trucks and buses PCE, ET 1.5  Recreational vehicle PCE, ER 1.2  Heavy vehicle adjustment, fHV 0.980  Driver population factor, fp 1.00  Flow rate, vp 1115 pc/h/ln Speed Inputs and Adjustments  Lane width - ft			-	%
Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 Flow rate, vp 1115 pc/h/ln Speed Inputs and Adjustments  Lane width - ft			_	
Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 Flow rate, vp 1115 pc/h/ln Speed Inputs and Adjustments Lane width - ft		Г	1.5	
Heavy vehicle adjustment, fHV 0.980  Driver population factor, fp 1.00  Flow rate, vp 1115 pc/h/ln Speed Inputs and Adjustments  Lane width - ft			1.2	
Speed Inputs and Adjustments			0.980	
The Flow rate, vp	_		1.00	
Lane width - ft			1115	pc/h/ln
		Speed Inputs and A	djustments	
	Lane width		_	f+
Right-side lateral clearance - ft		rance	_	ft
Total ramp density, TRD - ramps/mi	_	Lance	_	
Number of lanes, N 4	<del>-</del>		4	<u>_</u> _ ,
Free-flow speed: Measured			Measured	
FFS or BFFS 60.0 mi/h	<del>-</del>		60.0	mi/h
Lane width adjustment, fLW - mi/h	Lane width adjustment,	fLW	_	mi/h
Lateral clearance adjustment, fLC - mi/h	Lateral clearance adjus	tment, fLC	_	mi/h
TRD adjustment - mi/h	TRD adjustment		_	mi/h
Free-flow speed, FFS 60.0 mi/h	Free-flow speed, FFS		60.0	mi/h
LOS and Performance Measures		LOS and Performanc	e Measures	
Flow rate, vp 1115 pc/h/ln	Flow rate. vp		1115	pc/h/ln
Free-flow speed, FFS 60.0 mi/h	· •			
Average passenger-car speed, S 60.0 mi/h	<del>-</del>	peed, S		
Number of lanes, N 4		•		•
Density, D 18.6 pc/mi/ln			18.6	pc/mi/ln
Level of service, LOS C	Level of service, LOS		C	

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-1 Merge to R-2 ODOT District 12 2036 .14 - No Build F-	2 Diverge 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	4470 0.94 1189 4 0 Level - 1.5 1.2 0.980 1.00 1213	veh/h v % % % mi
	Speed Inputs ar	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 4 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	nance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1213 60.0 60.0 4 20.2	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:		
	Operational Ar	nalysis		
Analyst:	Eric Brown			
Analyst: Agency or Company:		erhoff		
Date Performed:	8/21/2014			
Analysis Time Period:				
Freeway/Direction:	I-271 NB			
From/To:	R-1 Merge to R-	_		
Jurisdiction: Analysis Year:	ODOT District 1 2036	1.2		
Description: CUY-271-8		₹-2b		
Description out 1/1				
	Flow Inputs ar	nd Adjustments		
Volume, V		4470	veh/h	
Peak-hour factor, PHF		0.94		
Peak 15-min volume, v15		1189	V	
Trucks and buses		4	8	
Recreational vehicles		0 Level	%	
Terrain type: Grade		Level	%	
Segment length		_	mi	
Trucks and buses PCE, I	ET	1.5		
Recreational vehicle Po	CE, ER	1.2		
Heavy vehicle adjustmen	nt, fHV	0.980		
Driver population factor	or, fp	1.00		
Flow rate, vp		1617	pc/h/ln	
	Speed Inputs a	and Adjustments_		
Lane width		_	ft	
Right-side lateral clea	arance	-	ft	
Total ramp density, TRI	)	-	ramps/mi	
Number of lanes, N		3		
Free-flow speed:		Measured	/ la	
FFS or BFFS Lane width adjustment,	f T W	60.0	mi/h mi/h	
Lateral clearance adjust		_	mi/h	
TRD adjustment	Jemene, Ile	_	mi/h	
Free-flow speed, FFS		60.0	mi/h	
	LOS and Perfor	rmance Measures_		
Flow rate un		1617	ng/h/1n	
Flow rate, vp Free-flow speed, FFS		1617 60.0	pc/h/ln mi/h	
Average passenger-car s	speed, S	60.0	mi/h	
Number of lanes, N	,	3	•	
Density, D		27.0	pc/mi/ln	
Level of service, LOS		D		

Phone: E-mail:		Fax:	
	Operational Ana	llysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB (Expres Chagrin Blvd to ODOT District 12 2036	ss Lanes) R-3 Merge	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3000 0.94 798 4 0 Level - - 1.5 1.2 0.980 1.00 1628	<pre>veh/h v % % % mi</pre>
	Speed Inputs an	ıd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 2 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	nance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1628 60.0 60.0 2 27.1	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-2 Diverge to P ODOT District 12 2036	R-5 Merge 2 -4	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	4310 0.94 1146 4 0 Level - 1.5 1.2 0.980 1.00 1559	<pre>veh/h v % % % mi pc/h/ln</pre>
_	Speed Inputs ar		-
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1559 60.0 60.0 3 26.0-	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB (Expres R-3 Merge to R4 ODOT District 12 2036 .14 - No Build F	ss Lanes) Diverge 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, Recreational vehicle PCE Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3160 0.94 840 4 0 Level - 1.5 1.2 0.980 1.00 1143	<pre>veh/h v % % % mi pc/h/ln</pre>
	Speed Inputs a	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1143 60.0 60.0 3 19.0	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational An	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-5 Merge to R- ODOT District 1 2036 .14 - No Build F	6 Diverge 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PCE Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	5490 0.94 1460 4 0 Level - 1.5 1.2 0.980 1.00 1986	<pre>veh/h  v % % % mi  pc/h/ln</pre>
	Speed Inputs a	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1986 60.0 57.3 3	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	lysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brincker 8/21/2014 PM Peak I-271 NB (Expres R-4 Diverge R-8 ODOT District 12 2036 .14 - No Build F-	hoff s Lanes) Diverge	
	Flow Inputs and	Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses		1980 0.94 527 4	veh/h v %
Recreational vehicles Terrain type: Grade		0 Level	9
Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustmen Driver population facto	E, ER t, fHV	1.5 1.2 0.980 1.00	mi
Flow rate, vp		1074	pc/h/ln
	Speed Inputs an	d Adjustments	
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed: FFS or BFFS		- - 2 Measured 60.0	ft ft ramps/mi mi/h
Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS		- - - 60.0	mi/h mi/h mi/h mi/h
	LOS and Perform	ance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1074 60.0 60.0 2 17.9 B	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-6 Diverge to F ODOT District 12 2036	R-7 Merge 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3340 0.94 888 4 0 Level - 1.5 1.2 0.980 1.00 1208	<pre>veh/h v % % % mi pc/h/ln</pre>
	Speed Inputs ar	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1208 60.0 60.0 3 20.1	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational And	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-7 Merge to R-1 ODOT District 1: 2036 .14 - No Build F	9 Merge 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	4510 0.94 1199 4 0 Level - - 1.5 1.2 0.980 1.00 1631	<pre>veh/h v % % % mi pc/h/ln</pre>
	Speed Inputs a	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perfor	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1631 60.0 60.0 3 27.2	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 NB R-9 Merge to R-1 ODOT District 12 2036 .14 - No Build F-	10 Diverge 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	4630 0.94 1231 4 0 Level - 1.5 1.2 0.980 1.00 1675	veh/h v % % % mi
_	Speed Inputs ar		-
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	rance	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1675 60.0 59.9 3 28.0	pc/h/ln mi/h mi/h pc/mi/ln

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/21/2014 Analysis Time Period: PM Peak
Freeway/Direction: I-271 NB (Express Lanes)
From/To: R-8 Diverge to Mayfield Rd Analysis Year: 2036 Description: CUY-271-8.14 - No Build F-11 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 1860 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 495 v Trucks and buses 4 ે Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1009 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h mi/h Lane width adjustment, fLW Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ 1009 Flow rate, vp pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 16.8 pc/mi/ln

В

Level of service, LOS

Phone: E-mail:		Fax:	
	Operational An	alysis	
		•	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction:	8/22/2014	rhoff	
From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	R-10 Diverge to ODOT District 1 2036	2	
Description. Col 2/1 (			
	Flow Inputs and	d Adjustments	
Volume, V Peak-hour factor, PHF		2880 0.94	veh/h
Peak 15-min volume, v15	5	766 4	V •.
Trucks and buses Recreational vehicles		0	% %
Terrain type:		Level	
Grade		-	8
Segment length	. m	-	mi
Trucks and buses PCE, E		1.5 1.2	
Recreational vehicle PCE, ER Heavy vehicle adjustment, fHV		0.980	
Driver population factor		1.00	
Flow rate, vp	)	1563	pc/h/ln
	Speed Inputs a	nd Adjustments	
Lane width		_	ft
Right-side lateral clea	arance	_	ft
Total ramp density, TRI		_	ramps/mi
Number of lanes, N		2	
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,		-	mi/h
Lateral clearance adjus	stment, fLC	-	mi/h
TRD adjustment		-	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Perfor	mance Measures	
Flow rate, vp		1563	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	speed, S	60.0	mi/h
Number of lanes, N		2	
Density, D Level of service, LOS		26.0+ D	pc/mi/ln

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/22/2014 Analysis Time Period: PM Peak Freeway/Direction: I-271 SB From/To: Mayfield Rd to R-11 Merge ODOT District 12 Jurisdiction: Analysis Year: 2036 Description: CUY-271-8.14 - No Build F-13 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 2450 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 652 v Trucks and buses 4 ે Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 1329 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h mi/h Lane width adjustment, fLW Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 1329 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 22.1 pc/mi/ln

С

Level of service, LOS

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-11 Merge to R- ODOT District 12 2036 1.14 - No Build F-	-12 Diverge 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor	T E, ER t, fHV	3490 0.94 928 4 0 Level - 1.5 1.2 0.980 1.00	veh/h v % % mi
Flow rate, vp		1262	pc/h/ln
	Speed Inputs ar	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1262 60.0 60.0 3 21.0	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: Fax: E-mail: \_\_\_\_\_Operational Analysis\_\_\_\_\_ Analyst: Eric Brown Agency or Company: Parsons Brinckerhoff Date Performed: 8/22/2014 Analysis Time Period: PM Peak
Freeway/Direction: I-271 SB (Express Lanes)
From/To: Mayfield Rd to R-13 Merge ODOT District 12 Jurisdiction: Analysis Year: 2036 Description: CUY-271-8.14 - No Build F-15 \_\_\_\_\_Flow Inputs and Adjustments\_\_\_\_\_ Volume, V 1410 veh/h Peak-hour factor, PHF 0.94 Peak 15-min volume, v15 375 v Trucks and buses 4 કૃ Recreational vehicles Terrain type: Level Grade Segment length mi Trucks and buses PCE, ET 1.5 Recreational vehicle PCE, ER 1.2 Heavy vehicle adjustment, fHV 0.980 Driver population factor, fp 1.00 765 pc/h/ln Flow rate, vp \_\_\_\_\_Speed Inputs and Adjustments\_\_\_\_ Lane width ft Right-side lateral clearance ft Total ramp density, TRD ramps/mi Number of lanes, N Free-flow speed: Measured 60.0 FFS or BFFS mi/h mi/h Lane width adjustment, fLW Lateral clearance adjustment, fLC mi/h TRD adjustment mi/h Free-flow speed, FFS 60.0 mi/h \_\_\_\_\_LOS and Performance Measures\_\_\_\_\_ Flow rate, vp 765 pc/h/ln Free-flow speed, FFS 60.0 mi/h Average passenger-car speed, S 60.0 mi/h Number of lanes, N Density, D 12.8 pc/mi/ln

В

Level of service, LOS

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-12 Diverge to ODOT District 12 2036 .14 - No Build F-	R-14 Diverge	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	2910 0.94 774 4 0 Level - 1.5 1.2 0.980 1.00 1053	veh/h v % % % mi
_	Speed Inputs ar		-
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	rance	- - 3 Measured 60.0 - - - 60.0	ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1053 60.0 60.0 3 17.5	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB Brainard Rd to ( ODOT District 12 2036 .14 - No Build F-	Cedar Rd 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	1950 0.94 519 4 0 Level - 1.5 1.2 0.980 1.00	<pre>veh/h v % % % mi pc/h/ln</pre>
	Speed Inputs ar	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	705 60.0 60.0 3 11.8 B	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:		
	Operational Ana	lysis		
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-15 Merge to R- ODOT District 12 2036	16 Diverge 18		
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor	T E, ER t, fHV	4380 0.94 1165 4 0 Level - 1.5 1.2 0.980 1.00	veh/h v % % % mi	
Flow rate, vp		1584	pc/h/ln	
	Speed Inputs and	d Adjustments		
Lane width Right-side lateral clea Total ramp density, TRE Number of lanes, N Free-flow speed: FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>	
LOS and Performance Measures				
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1584 60.0 60.0 3 26.4	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>	

Phone: E-mail:		Fax:	
	Operational Anal	lysis	
		2 ** **	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction:	ed: 8/21/2014 e Period: PM Peak etion: I-271 SB (Express Lanes) R-13 Merge to R-17 Merge		
Analysis Year:	ODOT District 12 2036		
Description: CUY-271-8	3.14 - No Build F-1	19	
	Flow Inputs and	Adjustments	
Volume, V		1990	veh/h
Peak-hour factor, PHF		0.94	V C11/ 11
Peak 15-min volume, v15		529	V
Trucks and buses		4	%
Recreational vehicles		0	%
Terrain type:		Level	
Grade		-	%
Segment length		_	mi
Trucks and buses PCE, E	ET	1.5	
Recreational vehicle PCE, ER		1.2	
Heavy vehicle adjustmer	nt, fHV	0.980	
Driver population factor, fp		1.00	
Flow rate, vp		1080	pc/h/ln
	Speed Inputs and	d Adjustments	
Lane width		_	ft
Right-side lateral clea	arance	_	ft
Total ramp density, TRI		_	ramps/mi
Number of lanes, N		2	-
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	fLW	_	mi/h
Lateral clearance adjus	stment, fLC	_	mi/h
TRD adjustment		-	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Performa	ance Measures	
Flow rate, vp		1080	pc/h/ln
Free-flow speed, FFS		60.0	mi/h
Average passenger-car s	speed, S	60.0	mi/h
Number of lanes, N		2	
Density, D		18.0	pc/mi/ln
Level of service, LOS		В	

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-16 Diverge to ODOT District 12 2036 1.14 - No Build F-	R-19 Merge	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3690 0.94 981 4 0 Level - - 1.5 1.2 0.980 1.00 1335	<pre>veh/h  v % % % mi  pc/h/ln</pre>
_	Speed Inputs ar	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1335 60.0 60.0 3 22.3	pc/h/ln mi/h mi/h pc/mi/ln

Phone: E-mail:		Fax:	
	Operational Ana	lysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB (Expres R-17 Merge to R- ODOT District 12 2036 .14 - No Build F-	s Lanes) 18 Diverge	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	2680 0.94 713 4 0 Level - - 1.5 1.2 0.980 1.00 969	<pre>veh/h v % % % mi pc/h/ln</pre>
	Speed Inputs an	d Adjustments	
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perform	ance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	969 60.0 60.0 3 16.1 B	pc/h/ln mi/h mi/h pc/mi/ln

Phone: E-mail:		Fax:	
	Operational An	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-19 Merge to R ODOT District 1 2036 .14 - No Build F	-20 Diverge 2	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	4090 0.94 1088 4 0 Level - - 1.5 1.2 0.980 1.00 1479	veh/h v % % mi pc/h/ln
	Speed Inputs a	nd Adjustments	
Lane width Right-side lateral clea Total ramp density, TRD Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>
	LOS and Perfor	mance Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1479 60.0 60.0 3 24.6	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>

Phone: E-mail:		Fax:	
	Operational Ana	alysis	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-19 Merge to R- ODOT District 12 2036 8.14 - No Build F-	-20 Diverge 2	
Volume, V		4090	veh/h
Peak-hour factor, PHF		0.94	
Peak 15-min volume, v15		1088	V
Trucks and buses		4	%
Recreational vehicles		0 Level	8
Terrain type: Grade		Tever	%
Segment length			mi
Trucks and buses PCE, E	! <b>Т</b>	1.5	шт
Recreational vehicle PC		1.2	
Heavy vehicle adjustmen		0.980	
Driver population factor		1.00	
Flow rate, vp	/ - <u>-</u> - <u>-</u> -	1110	pc/h/ln
	Speed Inputs ar	nd Adjustments	
			5.
Lane width		_	ft
Right-side lateral clea		_	ft
Total ramp density, TRI Number of lanes, N	)	4	ramps/mi
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,	fT.W	-	mi/h
Lateral clearance adjus		_	mi/h
TRD adjustment	,	_	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Perform	mance Measures	
Eleverate		1110	~ ~ /h /l ~
Flow rate, vp		1110	pc/h/ln
Free-flow speed, FFS	rneed C	60.0	mi/h mi/h
Average passenger-car s Number of lanes, N	preed, s	60.0 4	шт / 11
Density, D		18.5	pc/mi/ln
Level of service, LOS		10.5 C	PC/ m1/ 111
		<u> </u>	

Phone: E-mail:		Fax:	
	Operational Anal	vsis	
	operational imai	7010	
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB (Express R-18 Diverge to C ODOT District 12 2036 3.14 - No Build F-2	Lanes) hagrin Blvd 3	
	Flow Inputs and	Adjustments	
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15	5	2280 0.94 606	veh/h v
Trucks and buses Recreational vehicles Terrain type:		4 0 Level	% %
Grade Segment length Trucks and buses PCE, E	.T.	- - 1.5	% mi
Recreational vehicle PO Heavy vehicle adjustment Driver population factor	CE, ER nt, fHV	1.2 0.980 1.00	
Flow rate, vp	,	1237	pc/h/ln
	Speed Inputs and	Adjustments	
Lane width		_	ft
Right-side lateral clea	rance	_	ft
Total ramp density, TRI		_	ramps/mi
Number of lanes, N		2	
Free-flow speed:		Measured	
FFS or BFFS		60.0	mi/h
Lane width adjustment,		_	mi/h
Lateral clearance adjus	stment, fLC	_	mi/h
TRD adjustment		-	mi/h
Free-flow speed, FFS		60.0	mi/h
	LOS and Performa	nce Measures	
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D	speed, S	1237 60.0 60.0 2 20.6	pc/h/ln mi/h mi/h pc/mi/ln
Level of service, LOS		С	

Phone: E-mail:		Fax:					
	Operational Ana	lysis					
Analyst: Agency or Company: Date Performed: Analysis Time Period: Freeway/Direction: From/To: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB R-20 Diverge to Chagrin Blvd ODOT District 12 2036						
Volume, V Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Segment length Trucks and buses PCE, E Recreational vehicle PC Heavy vehicle adjustment Driver population factor Flow rate, vp	T E, ER t, fHV	3440 0.94 915 4 0 Level - 1.5 1.2 0.980 1.00 1244	<pre>veh/h v % % % mi</pre>				
	Speed Inputs an	d Adjustments					
Lane width Right-side lateral clea Total ramp density, TRI Number of lanes, N Free-flow speed:     FFS or BFFS Lane width adjustment, Lateral clearance adjus TRD adjustment Free-flow speed, FFS	rance fLW	- - 3 Measured 60.0 - - - 60.0	<pre>ft ft ramps/mi  mi/h mi/h mi/h mi/h mi/h mi/h</pre>				
	LOS and Perform	ance Measures					
Flow rate, vp Free-flow speed, FFS Average passenger-car s Number of lanes, N Density, D Level of service, LOS	peed, S	1244 60.0 60.0 3 20.7	<pre>pc/h/ln mi/h mi/h pc/mi/ln</pre>				

Phone: E-mail:	Fax	Fax:						
Merge Analysis								
200.2	T							
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	l: I-271 NB Chagrin Blvd District 12 2036							
	Free	eway Data	L					
Type of analysis		Me	rge					
Number of lanes in free	_	4						
Free-flow speed on free Volume on freeway	way		1.0		mph			
volume on freeway		41	.10		vph	L		
	On R	Ramp Data	L					
Side of freeway		Ri	Right					
Number of lanes in ramp	1							
Free-flow speed on ramp	35	.0		mph	l			
Volume on ramp		0		vph	l			
Length of first accel/d	15	00		ft				
Length of second accel/decel lane					ft			
	Adjacent Ramp	Data (i	f on	e exists	s)			
Does adjacent ramp exis	t?	Ye	s					
Volume on adjacent Ramp	16	0		vph				
Position of adjacent Ra			ream					
Type of adjacent Ramp	Of			C .				
Distance to adjacent Ra	mp	4.7	00		ft			
Cor	version to pc/h	under B	Base	Conditio	ons			
Junction Components		Freeway	-	Ramp		Adjace: Ramp	nt	
Volume, V (vph)		4110		360		160	vph	
Peak-hour factor, PHF		0.90		0.90		0.90		
Peak 15-min volume, v15		1142		100		44	V	
Trucks and buses		4		1		0	%	
Recreational vehicles		0		0		0	%	
Terrain type:		Level	٥.	Level	۰	Level	0.	
Grade			% m <del>i</del>		8 m <del>1</del>		%	
Length Trucks and buses PCE, E	ıπ	1.5	mi	1.5	mi	1.5	mi	
Recreational vehicle PC		1.5		1.2		1.2		
Redicacional venicie Po	,u, uk	1.2		1.2		1.2		

```
Heavy vehicle adjustment, fHV 0.980 0.995 1.000 Driver population factor, fP 1.00 1.00 1.00
                                                      178
Flow rate, vp
                                 4658
                                           402
                                                              pcph
                _____Estimation of V12 Merge Areas____
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 0.168 Using Equation 4
                FM
               v = v (P) = 780 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                       Actual
                       5060
                                   9200
    V
                                                 Nο
    FO
                       1939 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 1863
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   __Flow Entering Merge Influence Area__
                   Actual Max Desirable Violation?
                   2265
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 13.6 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence B
  ______Speed Estimation_____
Intermediate speed variable,
                                       M = 0.254
                                       S
Space mean speed in ramp influence area,
                                      S = 55.4
                                       R
Space mean speed in outer lanes,
                                       S = 56.8
                                       0
                                      S = 56.2 \quad mph
Space mean speed for all vehicles,
```

Phone: E-mail:								
Diverge Analysis								
	I-271 NB Expressway District 12 2036							
	Free	way Da	ta					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Divers 3 60.0 4470		mph vph			
	Off R	amp Da	ta					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/decel lane Length of second accel/decel lane		Left 1 60.0 160 740			mph vph ft ft			
	Adjacent Ramp	Data	(if or	ne exist	s)			
Does adjacent ramp exist? Volume on adjacent ramp Position of adjacent ramp Type of adjacent ramp Distance to adjacent ramp		Yes 1180 Downstream On 3600			vph ft			
Con	version to pc/h	Under	Base	Condition	ons			
Junction Components						Adjace Ramp		
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC	T	4470 0.90 1242 4 0 Level 0.00 0.00 1.5 1.2	% mi	160 0.90 44 0 0 Level 0.00 0.00 1.5	% mi	1180 0.90 328 0 0 Level 0.00 0.00 1.5 1.2	vph v % % mi	

```
Heavy vehicle adjustment, fHV 0.980 1.000 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                      1311
                                 5066
                                           178
                                                               pcph
                _____Estimation of V12 Diverge Areas___
                            (Equation 13-12 or 13-13)
                ΕQ
               P = 0.625 Using Equation 5
                FD
               v = v + (v - v) P = 3234 pc/h
                12 R F R FD
                 _____Capacity Checks____
                                   Maximum
                                              LOS F?
                       Actual
    v = v
                                   6900
                       5066
                                                 Nο
    Fi F
    v = v - v
                       4888
                                  6900
                                                No
    FO F R
                                  2200
                       178
    V
                                                No
    R
                       1832 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                  No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                   No
3 	 av34
If yes, v = 3234
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                  __Flow Entering Diverge Influence Area__
                  Actual Max Desirable Violation?
                   3234
                              4400
     12
         _____Level of Service Determination (if not F)_____
                   D = 4.252 + 0.0086 v - 0.009 L = 26.8 pc/mi/ln
Density,
                                    12 D
                    R
Level of service for ramp-freeway junction areas of influence C
    _____Speed Estimation_____
                                      D = 0.119
Intermediate speed variable,
                                       S
Space mean speed in ramp influence area,
                                     S = 57.9
                                       R
Space mean speed in outer lanes,
                                      S = 63.2
                                       0
Space mean speed for all vehicles,
                                     S = 59.5
                                                  mph
```

Phone: E-mail:	Fa	ax:							
	Merge	Analys	sis						
Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year:	yst: Eric Brown  cy/Co.: Parsons Brinckerhoff  performed: 8/18/2014  ysis time period: PM Peak  way/Dir of Travel: I-271 NB  tion: Expressway  sdiction: District 12								
	Free	way Dat	ca						
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-	3 6	Merge 3 50.0 4310		mph vph				
	On R	amp Dat	ca						
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/decel lane Length of second accel/decel lane		1 6 1	Left 1 60.0 1180 1500			mph vph ft ft			
	Adjacent Ramp	Data (	(if on	e exists	s)				
Does adjacent ramp exist? Volume on adjacent Ramp Position of adjacent Ramp Type of adjacent Ramp Distance to adjacent Ramp		Yes 160 Upstream Off 3600		vph ft					
Con	version to pc/h	Under	Base	Conditio	ons				
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15  Trucks and buses  Recreational vehicles		Freewa 4310 0.90 1197 4	ay	Ramp 1180 0.90 328 0		Adjacer Ramp 160 0.90 44 0	vph v %		
Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		1.5 1.2	% mi	1.5 1.2	% mi	1.5 1.2	% mi		

```
Heavy vehicle adjustment, fHV 0.980 1.000 1.000 Driver population factor, fP 1.00 1.00 1.00
                                                     178
Flow rate, vp
                                 4885
                                           1311
                                                             pcph
               _____Estimation of V12 Merge Areas___
                     2728.14 (Equation 13-6 or 13-7)
                ΕQ
               P = 0.619 Using Equation 1
                FM
               v = v (P) = 3026 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                      Actual
                       6196
                                   6900
    V
                                                Nο
    FO
                       1859 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 3026
                 12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   __Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  4700
                              4600
                                                 Yes
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 32.1 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence D
  _____Speed Estimation_____
Intermediate speed variable,
                                      M = 0.570
                                       S
Space mean speed in ramp influence area,
                                     S = 49.7
                                      R
Space mean speed in outer lanes,
                                      S = 56.4
                                      0
                                     S = 51.2 \quad mph
Space mean speed for all vehicles,
```

Phone: E-mail:								
Diverge Analysis								
Jurisdiction: Analysis Year: Description: CUY-271-8	PM Peak I-271 NB Brainard Rd District 12 2036 .14 - No Build	R-6						
	Free	way D	ala_					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	way		3 60 549	.0 90		mph vph		
	Off R	amp Da	ata_					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/decel lane Length of second accel/decel lane		Right 1 35.0 2150 1400  Data (if one exists			mph vph ft ft			
			(			,		
Does adjacent ramp exist? Volume on adjacent ramp Position of adjacent ramp Type of adjacent ramp Distance to adjacent ramp			Yes 11' Dov On 350	70 wnst	ream	vph ft		
Con	version to pc/h	Unde:	r Ba	ase	Conditio	ns		
Junction Components	verbion to perm	Free			Ramp	,115 <u></u> .	Adjacen	ıt
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		5490 0.90 1525 4 0 Leve 0.00 0.00 1.5	1	% mi	2150 0.90 597 1 0 Level 0.00 0.00	% mi	Ramp 1170 0.90 325 1 0 Level 0.00 0.00 1.5	vph v % % % mi

```
6222
                                              2401
                                                         1307
Flow rate, vp
                                                                 pcph
                ______Estimation of V12 Diverge Areas_____
                L =
                               (Equation 13-12 or 13-13)
                 ΕO
                P =
                      0.494 Using Equation 5
                 FD
                v = v + (v - v) P = 4289 pc/h
                 12 R F R FD
                     _____Capacity Checks____
                                                    LOS F?
                        Actual
                                     Maximum
                        6222
                                     6900
    v = v
                                                    No
     Fi F
    v = v - v
                        3821
                                     6900
                                                    No
     FO F R
    V
                        2401
                                     2000
                                                    Yes
     R
                                    (Equation 13-14 or 13-17)
    v or v
                        1933 pc/h
     3 av34
               > 2700 pc/h?
Is
    v or v
                                     No
     3 av34
Is
    v or v
                > 1.5 v /2
                                     No
         av34
     3
                     12
If yes, v
          = 4289
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                   _Flow Entering Diverge Influence Area__
                                Max Desirable
                    Actual
                                                    Violation?
                                 4400
                    4289
                                                     No
     12
            ____Level of Service Determination (if not F)______
                     D = 4.252 + 0.0086 v - 0.009 L = 28.5 pc/mi/ln
Density,
                                       12
Level of service for ramp-freeway junction areas of influence F
             _____Speed Estimation____
Intermediate speed variable,
                                         D = 0.644
                                         S
Space mean speed in ramp influence area,
                                         S = 48.4
                                                     mph
                                         R
Space mean speed in outer lanes,
                                         S = 62.2
                                                     mph
                                         0
Space mean speed for all vehicles,
                                        S = 52.0
                                                     mph
```

1.00

0.995

1.00

0.995

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:		F	ax:				
	Merge	Analy	sis				
Analysis time period: Freeway/Dir of Travel: Junction:	I-271 NB Brainard Rd District 12 2036						
	Free	way Da	ta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Merge 3 60.0 3340		mph vph		
	On R	amp Da	ta				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane decel lane		Right 1 35.0 1170 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	e exists.	3)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp		Yes 120 Downst On 1400	ream	vph ft		
Con	version to pc/h	Under	Base	Conditio	ons		
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15  Trucks and buses  Recreational vehicles		Freew 3340 0.90 928 4		Ramp 1170 0.90 325 1		Adjacen Ramp 120 0.90 33 0	vph v « «
Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		1.5 1.2	% mi	1.5 1.2	% mi	1.5 1.2	% mi

```
3785
                                             1307
                                                        133
Flow rate, vp
                                                                pcph
                ______Estimation of V12 Merge Areas_____
                L =
                              (Equation 13-6 or 13-7)
                 ΕO
                      0.619 Using Equation 1
                P =
                FM
                v = v (P) = 2345 pc/h
                 12 F FM
                     _____Capacity Checks_____
                                                 LOS F?
                        Actual
                                    Maximum
                        5092
                                    6900
    V
                                                  No
     FΟ
                        1440 pc/h (Equation 13-14 or 13-17)
    v or v
    3 av34
Is
    v or v
               > 2700 pc/h?
                                    No
     3
         av34
                > 1.5 v /2
Is
    v or v
                                    Yes
                  12
     3 av34
If yes, v = 2345
                                  (Equation 13-15, 13-16, 13-18, or 13-19)
       12A
                   ___Flow Entering Merge Influence Area__
                   Actual Max Desirable
                                                   Violation?
                   3652
                                4600
     12A
            ____Level of Service Determination (if not F)_____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 24.0 pc/mi/ln
                          R
                                     12
Level of service for ramp-freeway junction areas of influence C
               _____Speed Estimation_____
                                        M = 0.366
Intermediate speed variable,
                                        S
Space mean speed in ramp influence area,
                                        S = 53.4
                                                   mph
                                        R
Space mean speed in outer lanes,
                                        S = 56.6
                                                   mph
```

1.00

0.995

1.00

S = 54.3

mph

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:							
	Diver	ge Anal	ysis_				
Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year:	Parsons Brinckerhoff performed: 8/19/2014 ysis time period: PM Peak way/Dir of Travel: I-271 NB tion: Expressway sdiction: District 12						
	Free	way Dat	:a				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-	2 6	0iverg 2 50.0 1980		mph vph		
	Off R	amp Dat	:a				
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	1 6 1	Right 50.0 120 1500		mph vph ft ft		
	Adjacent Ramp	Data (	if on	e exista	s)		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp	1 U C	es 180 Jpstre ff 8000	am	vph ft		
Con	version to pc/h	Under	Base	Conditio	ons		
Junction Components	version to pe/ii	Freewa		Ramp	7116	Adjace	nt
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:     Grade     Length Trucks and buses PCE, E Recreational vehicle PC	T	1980 0.90 550 4 0 Level 0.00 0.00 1.5	% mi	120 0.90 33 0 0 Level 0.00 0.00 1.5	% mi	Ramp 1180 0.90 328 0 0 Level 0.00 0.00 1.5	vph v % % mi

```
Heavy vehicle adjustment, fHV 0.980 1.000 1.000 Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                    1311 pcph
                                2244
                                          133
               _____Estimation of V12 Diverge Areas____
                           (Equation 13-12 or 13-13)
               ΕQ
               P = 1.000 Using Equation 0
               FD
               v = v + (v - v) P = 2244 pc/h
               12 R F R FD
                 _____Capacity Checks____
                                  Maximum
                                            LOS F?
                     Actual
    v = v
                      2244
                                  4600
                                               Nο
    Fi F
    v = v - v
                      2111
                                 4600
                                              No
    FO F R
                                 2200
                      133
                                              No
    V
    R
                     0 pc/h
                                 (Equation 13-14 or 13-17)
    v or v
    3 av34
    v 	 or v 	 > 2700 	 pc/h?
                                 No
Ιs
    3 av34
    v 	 or v 	 > 1.5 v / 2
Is
                                  No
                12
    3 av34
If yes, v = 2244
                               (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                 __Flow Entering Diverge Influence Area__
                  Actual Max Desirable Violation?
                  2244
                              4400
                                                No
    12
         _____Level of Service Determination (if not F)_____
                   D = 4.252 + 0.0086 v - 0.009 L = 10.1 pc/mi/ln
Density,
                                   12 D
                   R
Level of service for ramp-freeway junction areas of influence B
    _____Speed Estimation_____
Intermediate speed variable,
                                     D = 0.115
                                      S
                                    S = 57.9
Space mean speed in ramp influence area,
                                      R
Space mean speed in outer lanes,
                                     S = N/A
                                      0
Space mean speed for all vehicles,
                                    S = 57.9
                                                mph
```

Phone: E-mail:	Fax:	Fax:					
	Merge	Analysis					
77		_					
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	me period: PM Peak of Travel: I-271 NB Expressway n: District 12						
	Free	eway Data_					
Type of analysis		Mer	ge				
Number of lanes in free		3	_				
Free-flow speed on free	eway	60.		mph			
Volume on freeway		430	/	vph			
	On R	Ramp Data_					
Side of freeway		Lef	t				
Number of lanes in ramp	)	1					
Free-flow speed on ramp	)	60.		mph			
Volume on ramp		120		vph			
Length of first accel/d		150	0	ft			
Length of second accel/	decel lane			ft			
	Adjacent Ramp	Data (if	one exi	sts)			
Does adjacent ramp exis	st?	Yes					
Volume on adjacent Ramp	)	967		vph			
Position of adjacent Ra	ımp	_	tream				
Type of adjacent Ramp		On		-			
Distance to adjacent Ra	ımp	140	0	ft			
Cor	version to pc/h	n Under Ba	se Condi	tions			
Junction Components		Freeway	Ramp	,	Adjacer Ramp	nt	
Volume, V (vph)		4307	120		967	vph	
Peak-hour factor, PHF		0.90	0.90		0.90	_	
Peak 15-min volume, v15	;	1196	33		269	v	
Trucks and buses		4	0		1	%	
Recreational vehicles		0	0		0	%	
Terrain type:		Level	Leve		Level		
Grade			%	% .		%	
Length	ım		mi 1 -	mi	1 -	mi	
Trucks and buses PCE, E		1.5	1.5		1.5		
Recreational vehicle PC	.c, EK	1.2	1.2		1.2		

```
Heavy vehicle adjustment, fHV 0.980 1.000 0.995
Driver population factor, fP 1.00 1.00 1.00
Flow rate, vp
                                                      1080
                                 4881
                                           133
                                                             pcph
                _____Estimation of V12 Merge Areas___
                            (Equation 13-6 or 13-7)
                ΕQ
               P = 0.619 Using Equation 1
                FM
               v = v (P) = 3024 pc/h
                12 F FM
                   _____Capacity Checks_____
                                  Maximum LOS F?
                       Actual
                       5014
                                   6900
    V
                                                 Nο
    FO
                       1857 pc/h
                                  (Equation 13-14 or 13-17)
    v or v
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  Yes
Is
3 	 av34
If yes, v = 3024
                12
                                (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   ___Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  3519
                              4600
    12A
           ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 23.5 pc/mi/ln
                         R 12 A
Level of service for ramp-freeway junction areas of influence C
  _____Speed Estimation_____
Intermediate speed variable,
                                      M = 0.273
                                       S
Space mean speed in ramp influence area,
                                      S = 55.1
                                       R
Space mean speed in outer lanes,
                                      S = 56.4
                                       0
                                     S = 55.5 \quad mph
Space mean speed for all vehicles,
```

Phone: E-mail:		;	Fax:	:				
	Diver	ge An	alys	sis_				
Jurisdiction: Analysis Year: Description: CUY-271-8	PM Peak I-271 SB Expressway District 12 2036 .14 - No Build	R-12						
	Free	way D	ata_					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	_		3 60.	verg .0 90	е	mph vph		
Off Ramp Data								
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	Data	580 150	. 0	e exists	mph vph ft ft		
		20.00	\	_ 011	0111202	/		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp		Yes 960 Dow Off 170	) wnst E	ream	vph ft		
Con	version to pc/h	Unde	r Ba	ase	Conditic	ns		
Junction Components Volume, V (vph)		Free			Ramp		Adjacer Ramp 960	ıt vph
Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		0.90 969 4 0 Leve			0.90 161 0 0		0.90 267 1 0 Level	V % %
Grade  Length  Trucks and buses PCE, E  Recreational vehicle PC		0.00 0.00 1.5 1.2		% mi	0.00 0.00 1.5 1.2	% mi	0.00 0.00 1.5 1.2	% mi

```
3955
                                               644
                                                          1072
Flow rate, vp
                                                                   pcph
                 _____Estimation of V12 Diverge Areas_____
                L =
                        1364.96 (Equation 13-12 or 13-13)
                 ΕO
                        0.632 Using Equation 5
                P =
                 FD
                v = v + (v - v) P = 2735 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                    LOS F?
                         Actual
                                      Maximum
                         3955
                                      6900
    v = v
                                                     No
     Fi F
    v = v - v
                         3311
                                      6900
                                                    No
     FO F R
    V
                         644
                                      2200
                                                    No
     R
                                     (Equation 13-14 or 13-17)
    v or v
                         1220 pc/h
     3 av34
                > 2700 pc/h?
Is
    v or v
                                      No
     3 av34
Is
    v or v
                > 1.5 v /2
                                      No
         av34
     3
                      12
If yes, v
          = 2735
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    2735
                                                     No
     12
             ____Level of Service Determination (if not F)______
                     D = 4.252 + 0.0086 v - 0.009 L = 15.4 pc/mi/ln
Density,
                                        12
Level of service for ramp-freeway junction areas of influence B
              _____Speed Estimation___
Intermediate speed variable,
                                         D = 0.161
                                          S
Space mean speed in ramp influence area,
                                         S = 57.1
                                                     mph
                                          R
Space mean speed in outer lanes,
                                         S = 65.5
                                                     mph
                                          0
Space mean speed for all vehicles,
                                        S = 59.2
                                                     mph
```

1.00

1.000

1.00

0.995

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:		Fax	:			
	Merge	Analysi	.s			
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB Expressway District 12 2036					
	Free	way Data	L			
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-	2 60	erge 0.0 :10		mph vph	
	On R	amp Data	L			
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane decel lane	1 60 58 15	0.0 80 800		mph vph ft ft	
	Adjacent Ramp	Data (i	f on	e exists	3)	
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp	No			vph ft	
Con	version to pc/h	. Under B	Base	Conditio	ons	
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15  Trucks and buses  Recreational vehicles  Terrain type:  Grade		Freeway 1410 0.90 392 4 0 Level	90	Ramp 580 0.90 161 0 0 Level	90	Adjacent Ramp vph v %
Length Trucks and buses PCE, E Recreational vehicle PC		1.5 1.2	mi	1.5	mi	mi

```
Heavy vehicle adjustment, fHV 0.980 1.000 Driver population factor, fP 1.00 1.00
Flow rate, vp
                                 1598
                                           644
                                                             pcph
               _____Estimation of V12 Merge Areas____
                            (Equation 13-6 or 13-7)
               ΕQ
               P = 1.000 Using Equation 0
               FM
               v = v (P) = 1598 pc/h
                12 F FM
                   _____Capacity Checks_____
                                 Maximum LOS F?
                      Actual
                       2242
                                  4600
    V
                                                Nο
    FO
    v or v
                      0 pc/h
                                 (Equation 13-14 or 13-17)
    3 av34
   v 	 or v 	 > 2700 	 pc/h?
Is
                                  No
    3 av34
    v or v > 1.5 v /2
                                  No
Is
3 	 av34
If yes, v = 1598
                12
                               (Equation 13-15, 13-16, 13-18, or 13-19)
      12A
                   ___Flow Entering Merge Influence Area__
                  Actual Max Desirable Violation?
                  2242
                              4600
    R12
          ____Level of Service Determination (if not F)____
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 13.3 pc/mi/ln
                        R 12 A
Level of service for ramp-freeway junction areas of influence B
  ______Speed Estimation______
Intermediate speed variable,
                                      M = 0.178
                                       S
Space mean speed in ramp influence area,
                                     S = 56.8
                                      R
Space mean speed in outer lanes,
                                      S = N/A
                                      0
                                     S = 56.8 \quad mph
Space mean speed for all vehicles,
```

Phone: E-mail:		1	Fax	:				
	Diver	ge Ana	alys	sis_				
Jurisdiction: Analysis Year: Description: CUY-271-8	PM Peak I-271 SB Brainard Rd District 12 2036 .14 - No Build	R-14						
	Free	way Da	ata_					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	way		3 60. 291	. 0 1 0		mph vph		
Off Ramp Data								
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	Data	960 150	. 0		mph vph ft ft		
	najacene namp	Daca	(	_ 011	C C111505	/		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp		Yes 580 Ups Off 170	) stre E	am	vph ft		
Con	version to pc/h	Unde:	r Ba	ase	Conditio	ns		
Junction Components		Free			Ramp		Adjacen	ıt
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		2910 0.90 808 4 0 Leve 0.00 0.00 1.5	1	% mi	960 0.90 267 1 0 Level 0.00 0.00	% mi	Ramp 580 0.90 161 0 0 Level 0.00 0.00 1.5	vph v % % % mi

```
3298
                                               1072
                                                          644
Flow rate, vp
                                                                   pcph
                _____Estimation of V12 Diverge Areas____
                L =
                               (Equation 13-12 or 13-13)
                 ΕO
                      0.628 Using Equation 5
                P =
                 FD
                v = v + (v - v) P = 2470 pc/h
                 12 R F R FD
                     _____Capacity Checks____
                                                    LOS F?
                        Actual
                                     Maximum
                        3298
                                     6900
    v = v
                                                    No
     Fi F
    v = v - v
                        2226
                                     6900
                                                    No
     FO F R
    V
                        1072
                                     2000
                                                    No
     R
                                    (Equation 13-14 or 13-17)
    v or v
                        828 pc/h
     3 av34
               > 2700 pc/h?
Is
    v or v
                                     No
     3 av34
Is
    v or v
                > 1.5 v /2
                                     No
         av34
     3
                     12
If yes, v
          = 2470
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                   _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    2470
                                                     No
     12
            ____Level of Service Determination (if not F)______
                     D = 4.252 + 0.0086 v - 0.009 L = 12.0 pc/mi/ln
Density,
                                       12
Level of service for ramp-freeway junction areas of influence B
             _____Speed Estimation____
Intermediate speed variable,
                                         D = 0.524
                                          S
Space mean speed in ramp influence area,
                                         S = 50.6
                                                     mph
                                         R
Space mean speed in outer lanes,
                                         S = 65.8
                                                     mph
                                          0
Space mean speed for all vehicles,
                                        S = 53.7
                                                    mph
```

1.00

0.995

1.00

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:		F	ax:				
	Merge	Analy	sis				
Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	I-271 SB Cedar Rd District 12 2036 .14 - No Build	R-15					
	Free	way Da	ta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway			Merge 3 60.0 1950		mph vph		
	On R	amp Da	ta				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane	:	Right 1 35.0 2430 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	e exists	s)		
Does adjacent ramp exist Volume on adjacent Ramp Position of adjacent Ramp Type of adjacent Ramp Distance to adjacent Ramp	mp	]	Yes 690 Downst Off 2200	ream	vph ft		
Con	version to pc/h	Under	Base	Conditio	ns		
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15  Trucks and buses  Recreational vehicles	_	1950 0.90 542 4	ay	Ramp 2430 0.90 675 1		Adjacer Ramp 690 0.90 192 0	vph v v %
Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		1.5 1.2	% mi	1.5 1.2	% mi	1.5 1.2	% mi

```
2714
                                   2210
                                                         767
Flow rate, vp
                                                                pcph
                ______Estimation of V12 Merge Areas_____
                L =
                       2839.69 (Equation 13-6 or 13-7)
                 ΕO
                       0.640 Using Equation 3
                 FM
                v = v (P) = 1415 pc/h
                 12 F FM
                     _____Capacity Checks_____
                                                  LOS F?
                        Actual
                                     Maximum
                        4924
                                     6900
    V
                                                   No
     FΟ
                        795 pc/h (Equation 13-14 or 13-17)
    v or v
    3 av34
Is
    v or v
               > 2700 pc/h?
                                    No
     3
          av34
                > 1.5 v /2
Is
    v or v
                                    Yes
                  12
     3 av34
If yes, v = 1415
                                  (Equation 13-15, 13-16, 13-18, or 13-19)
       12A
                    __Flow Entering Merge Influence Area__
                   Actual Max Desirable
                                                    Violation?
                    4129
                                4600
     12A
            ____Level of Service Determination (if not F)______
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 27.0 pc/mi/ln
                           R
                                      12
Level of service for ramp-freeway junction areas of influence C
               _____Speed Estimation_____
                                        M = 0.458
Intermediate speed variable,
                                         S
Space mean speed in ramp influence area,
                                        S = 51.8
                                                    mph
                                        R
Space mean speed in outer lanes,
                                        S = 58.9
                                                    mph
```

1.00

0.995

1.00

S = 52.8

mph

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:		Ŧ	ax:					
	Diver	ge Ana	lysi	.s_				
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	Eric Brown Parsons Brinck 8/20/2014 PM Peak I-271 SB Expressway District 12 2036	erhoff						
	Free	way Da	ta					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	_		Dive 3 60.0 4380	)		mph vph		
Off Ramp Data								
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Left 1 60.0 690 1500	)		mph vph ft ft		
	Adjacent Ramp	Data	(if	on	e exists	;)		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	mp		Yes 2430 Upst On 2200	re	am	vph ft		
Con	version to pc/h	Under	Bas	se i	Conditio	ns		
Junction Components	version to bc/H	Freew		, c	Ramp	,119 <sup></sup>	Adjacen	.t
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC	T	4380 0.90 1217 4 0 Level 0.00 0.00 1.5 1.2	ę	š ni	690 0.90 192 0 0 Level 0.00 0.00 1.5	% mi	Ramp 2430 0.90 675 1 0 Level 0.00 0.00 1.5	vph v % % mi

```
4964
                                               767
                                                          2714
Flow rate, vp
                                                                   pcph
                 _____Estimation of V12 Diverge Areas_____
                L =
                        21390.29 Equation 13-12 or 13-13)
                 ΕO
                        0.601 Using Equation 5
                P =
                 FD
                 v = v + (v - v) P = 3288 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                    LOS F?
                         Actual
                                      Maximum
                         4964
                                      6900
    v = v
                                                     No
     Fi F
    v = v - v
                         4197
                                      6900
                                                     No
     FO F R
    V
                         767
                                      2200
                                                     No
     R
                                     (Equation 13-14 or 13-17)
    v or v
                         1676 pc/h
     3 av34
                > 2700 pc/h?
Is
    v or v
                                      No
     3 av34
Is
    v or v
                > 1.5 v /2
                                      No
          av34
     3
                      12
If yes, v
          = 3288
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    3288
                                                      No
     12
             ___Level of Service Determination (if not F)______
                     D = 4.252 + 0.0086 v - 0.009 L = 20.4 pc/mi/ln
Density,
                                        12
Level of service for ramp-freeway junction areas of influence C
              _____Speed Estimation___
Intermediate speed variable,
                                         D = 0.172
                                          S
Space mean speed in ramp influence area,
                                         S = 56.9
                                                      mph
                                          R
Space mean speed in outer lanes,
                                         S = 63.8
                                                      mph
                                          0
Space mean speed for all vehicles,
                                        S = 58.8
                                                      mph
```

1.00

1.000

1.00

0.995

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Phone: E-mail:							
	Merge	Analy	sis				
Analyst: Agency/Co.: Date performed: Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year: Description: CUY-271-8	PM Peak I-271 SB Expressway District 12 2036						
	Free	way Da	ta				
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	_		Merge 3 60.0 3690		mph vph		
	On R	amp Da	ıta				
Side of freeway Number of lanes in ramp Free-flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Left 1 60.0 400 1500		mph vph ft ft		
	Adjacent Ramp	Data	(if on	e exists	s)		
Does adjacent ramp exis Volume on adjacent Ramp Position of adjacent Ra Type of adjacent Ramp Distance to adjacent Ra	mp		Yes 650 Downst Off 1850	ream	vph ft		
Con	version to pc/h	Under	Base	Conditio	ons		
Junction Components		Freew		Ramp	<del></del> -	Adjace Ramp	nt
Volume, V (vph) Peak-hour factor, PHF Peak 15-min volume, v15 Trucks and buses Recreational vehicles Terrain type:		3690 0.90 1025 4 0 Level		400 0.90 111 0 0 Level		650 0.90 181 2 0 Level	vph v %
Grade Length			% mi		% mi		% mi
Trucks and buses PCE, E	Т	1.5		1.5		1.5	

Recreational vehicle PCE, ER 1.2 1.2

```
4182
                                              444
                                                         729
Flow rate, vp
                                                                 pcph
                ______Estimation of V12 Merge Areas______
                L =
                       2699.00 (Equation 13-6 or 13-7)
                 ΕO
                       0.652 Using Equation 3
                 FM
                v = v (P) = 2728 pc/h
                 12 F FM
                     _____Capacity Checks_____
                                                  LOS F?
                        Actual
                                     Maximum
                        4626
                                     6900
    V
                                                   No
     FΟ
                        1454 pc/h (Equation 13-14 or 13-17)
    v or v
    3 av34
Is
    v or v
               > 2700 pc/h?
                                    No
     3
          av34
                > 1.5 v /2
Is
    v or v
                                    Yes
                  12
     3 av34
If yes, v = 2728
                                  (Equation 13-15, 13-16, 13-18, or 13-19)
       12A
                    __Flow Entering Merge Influence Area__
                   Actual Max Desirable
                                                    Violation?
                   3499
                                4600
     12A
            ____Level of Service Determination (if not F)______
Density, D = 5.475 + 0.00734 v + 0.0078 v - 0.00627 L = 23.2 pc/mi/ln
                           R
                                      12
Level of service for ramp-freeway junction areas of influence C
               _____Speed Estimation_____
                                        M = 0.270
Intermediate speed variable,
                                         S
Space mean speed in ramp influence area,
                                        S = 55.1
                                                    mph
                                         R
Space mean speed in outer lanes,
                                        S = 57.7
                                                    mph
```

1.00

1.000

1.00

S = 55.8

mph

0.990

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

Space mean speed for all vehicles,

Phone: E-mail:			ax:					
	Diver	ge Ana	lysi	ls_				
Analysis time period: Freeway/Dir of Travel: Junction: Jurisdiction: Analysis Year:	ne period: PM Peak of Travel: I-271 SB Chagrin Blvd n: District 12							
	Free	way Da	ıta					
Type of analysis Number of lanes in free Free-flow speed on free Volume on freeway	-		Dive 3 60.0 4090	)		mph vph		
	Off R	amp Da	ıta					
Side of freeway Number of lanes in ramp Free-Flow speed on ramp Volume on ramp Length of first accel/d Length of second accel/	ecel lane		Righ 1 35.0 650 1500	)		mph vph ft ft		
	Adjacent Ramp	Data	(if	on	e exists	s)		
Does adjacent ramp exis Volume on adjacent ramp Position of adjacent ra Type of adjacent ramp Distance to adjacent ra	t? mp		Yes 400 Upst On 1850	cre	am	vph ft		
Con	version to pc/h	Under	Bas	se	Conditio	ns		
Junction Components  Volume, V (vph)  Peak-hour factor, PHF  Peak 15-min volume, v15  Trucks and buses		Freew 4090 0.90 1136 4	ay		Ramp 650 0.90 181 2		Adjacer Ramp 400 0.90 111	vph v %
Recreational vehicles Terrain type: Grade Length Trucks and buses PCE, E Recreational vehicle PC		0 Level 0.00 0.00 1.5	ş	š ni	0 Level 0.00 0.00 1.5 1.2	% mi	0 Level 0.00 0.00 1.5 1.2	% mi

```
4635
                                               729
                                                          444
Flow rate, vp
                                                                    pcph
                 _____Estimation of V12 Diverge Areas_____
                L =
                        3633.36 (Equation 13-12 or 13-13)
                 ΕO
                        0.611 Using Equation 5
                P =
                 FD
                 v = v + (v - v) P = 3114 pc/h
                 12 R F R FD
                      _____Capacity Checks____
                                                     LOS F?
                         Actual
                                      Maximum
                         4635
                                      6900
    v = v
                                                     No
     Fi F
    v = v - v
                         3906
                                      6900
                                                     No
     FO F R
    V
                         729
                                      2000
                                                     No
     R
                                     (Equation 13-14 or 13-17)
    v or v
                         1521 pc/h
     3 av34
                > 2700 pc/h?
Is
    v or v
                                      No
     3 av34
Is
    v or v
                > 1.5 v /2
                                      No
          av34
     3
                      12
If yes, v
          = 3114
                                   (Equation 13-15, 13-16, 13-18, or 13-19)
        12A
                    _Flow Entering Diverge Influence Area__
                                 Max Desirable
                    Actual
                                                     Violation?
                                 4400
                    3114
                                                      No
     12
             ___Level of Service Determination (if not F)______
                     D = 4.252 + 0.0086 v - 0.009 L = 17.5 pc/mi/ln
Density,
                                        12
Level of service for ramp-freeway junction areas of influence B
              _____Speed Estimation___
Intermediate speed variable,
                                         D = 0.494
                                          S
Space mean speed in ramp influence area,
                                         S = 51.1
                                                      mph
                                          R
Space mean speed in outer lanes,
                                         S = 63.8
                                                      mph
                                          0
Space mean speed for all vehicles,
                                         S = 54.7
                                                      mph
```

1.00

0.990

1.00

1.000

1.00

Heavy vehicle adjustment, fHV

Driver population factor, fP

E-mail: Fax:

E-mail:						
	_Operational	Ana	lysis			
Analyst:	Eric Brown					
Agency/Co.:	Parsons Brin	ncke	rhoff			
Date Performed:	9/11/14	ICILC	IIIOII			
Analysis Time Period:	PM Peak					
Freeway/Dir of Travel:	I-271 NB					
Weaving Location:	R-1 Merge to	) R-	2 Diverge	2		
Analysis Year:	2036		Z DIVCISO			
Description:	CUY-271-8.14	1 -	No Build	W-1		
	Inputs_					
Segment Type		F	reeway			
Weaving configuration		Т	wo-Sided			
Number of lanes, N		3		ln		
Weaving segment length, LS		4	000	ft		
Freeway free-flow speed, FFS		6	0	mi/h		
Minimum segment speed, SMIN		4	5	mi/h		
Freeway maximum capacity, cIF	L	2	300	pc/h/	ln	
Terrain type		L	evel			
Grade		0	.00	%		
Length		0	.00	mi		
Conversion	to pc/h Unde	er B	ase Condi	tions		
	Vol	Lume	Componer	nts		
	VFF		VRF	VFR	VRR	
Volume, V	411	L 0	200	0	160	veh/h
Peak hour factor, PHF	0.9	90	0.90	0.90	0.90	
Peak 15-min volume, v15	114	12	56	0	44	
Trucks and buses	0		0	0	0	%
Recreational vehicles	0		0	0	0	%
Trucks and buses PCE, ET	1.5	5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2		1.2	1.2	1.2	
Heavy vehicle adjustment, fHV		000		1.000		
Driver population adjustment,	fP 1.0	0 0	1.00	1.00	1.00	
Flow rate, v	456	57	222	0	178	pc/h
Volume ratio, VR			0.036			
	iguration Cha	arac	teristics	5		
Number of maneuver lanes, NWL		0		ln		
Interchange density, ID		0.	6	int/mi		
Minimum RF lane changes, LCRF		0		lc/pc		
Minimum FR lane changes, LCFR		0		lc/pc		
Minimum RR lane changes, LCRR		4		lc/pc		
Minimum weaving lane changes,	LCMIN	71		lc/h		
Weaving lane changes, LCW		10		lc/h		
Non-weaving vehicle index, IN	W	11				
Non-weaving lane change, LCNW		25		lc/h		
Total lane changes, LCALL		36	00	lc/h		

Average weaving speed, SW		57.4	mi/h	
Average non-weaving speed	, SNW	46.9	mi/h	
Weaving Segment	Speed, Densi	ty, Level of Se	ervice and Cap	acity
Weaving segment speed, S		47.2	mi/h	
Weaving segment density,	D	35.1+	pc/mi/ln	
Level of service, LOS		E		
Weaving segment v/c ratio		0.773		
Weaving segment flow rate	, V	4967	veh/h	
Weaving segment capacity,	cW	6426	veh/h	
Li	mitations on	Weaving Segmen	nts	
If limit reached, see not	e.			
	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	6060	4000	a,b
		Maximum	Analyzed	
Density-based capacty,		2300	2142	C
cIWL (pc/h/ln)				
		Maximum	Analyzed	
v/c ratio		1.00	0.773	d

## Notes:

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

Phone: Fax:

E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_ Eric Brown Analyst: Agency/Co.: Parsons Brinckerhoff Date Performed: 9/11/14 Analysis Time Period: PM Peak
Freeway/Dir of Travel: I-271 NB (Expressway)
Weaving Location: R-3 Merge to R-4 Diverge Analysis Year: 2036 Description: CUY-271-8.14 - No Build W-2 \_\_\_\_\_Inputs\_\_\_\_\_ Segment Type Freeway Weaving configuration One-Sided ln Number of lanes, N 1400 ft Weaving segment length, LS Freeway free-flow speed, FFS 60 mi/h 45 mi/h Minimum segment speed, SMIN Freeway maximum capacity, cIFL 2300 pc/h/ln Level Terrain type 0.00 % Grade Length 0.00 mi \_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_ Volume Components VRR VFF VRF VFR 1820 160 1180 0 veh/h 0.90 0.90 0.90 0.90 Volume, V Peak hour factor, PHF 

 Peak hour factor, PHF
 0.90
 0.90
 0.90
 0.90
 0.90
 0.90
 0.90
 0.90
 0.90
 0.90
 0.90
 0.90
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 0.90
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 1.00
 1.00
 1.00
 1.00
 1.00
 <t % % 0.424 Volume ratio, VR \_\_\_\_\_Configuration Characteristics\_\_ Number of maneuver lanes, NWL 2 ln Interchange density, ID 0.6 int/mi Minimum RF lane changes, LCRF 1 lc/pc Minimum FR lane changes, LCFR 1 lc/pc Minimum RR lane changes, LCRR lc/pc Minimum weaving lane changes, LCMIN 1489 lc/h Weaving lane changes, LCW 1659 lc/h Non-weaving vehicle index, INW 170 Non-weaving lane change, LCNW 598 lc/h 2257 Total lane changes, LCALL lc/h

Average weaving speed, SW	56.3	mi/h		
Average non-weaving speed, SNW	43.7	mi/h		
Weaving Segment Speed, Dens	sity, Level of S	ervice and Cap	acity	
Weaving segment speed, S	48.3	mi/h		
Weaving segment density, D	24.3	pc/mi/ln		
Level of service, LOS	C			
Weaving segment v/c ratio	0.624			
Weaving segment flow rate, v	3512	veh/h		
Weaving segment capacity, cW	5625	veh/h		
Limitations	on Weaving Segme	nts		
If limit reached, see note.				
Minimum	Maximum	Actual	Note	
Minimum Weaving length (ft) 300	Maximum 6953	Actual 1400	Note a,b	
Weaving length (ft) 300	6953	1400		
	6953 Maximum	1400 Analyzed	a,b	
Weaving length (ft) 300  Density-based capacty,	6953 Maximum	1400 Analyzed	a,b	

## Notes:

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

Phone: Fax:

E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_\_

Eric Brown Analyst:

Agency/Co.: Parsons Brinckerhoff

Date Performed: 8/25/2014
Analysis Time Period: PM Peak
Freeway/Dir of Travel: I-271 NB
R-5 Merge Date Performed: 8/25/2014

Weaving Location: R-5 Merge to R-6 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - No Build W-3

\_\_\_\_\_Inputs\_\_\_\_\_\_

Segment Type	Freeway		
Weaving configuration	Two-Sided		
Number of lanes, N	3	ln	
Weaving segment length, LS	3300	ft	
Freeway free-flow speed, FFS	60	mi/h	
Minimum segment speed, SMIN	45	mi/h	
Freeway maximum capacity, cIFL	2300	pc/h/ln	
Terrain type	Level		
Grade	0.00	%	
Length	0.00	mi	

\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

Volume Components			
VFF	VRF	VFR	VRR
3340	0	970	1180 veh/h
0.90	0.90	0.90	0.90
928	0	269	328
0	0	0	0 %
0	0	0	0 %
1.5	1.5	1.5	1.5
1.2	1.2	1.2	1.2
1.000	1.000	1.000	1.000
1.00	1.00	1.00	1.00
3711	0	1078	1311 pc/h
	VFF 3340 0.90 928 0 0 1.5 1.2 1.000	VFF VRF  3340 0 0.90 0.90 928 0 0 0 0 0 1.5 1.5 1.2 1.2 1.000 1.000 1.00	3340     0     970       0.90     0.90     0.90       928     0     269       0     0     0       1.5     1.5     1.5       1.2     1.2     1.2       1.000     1.000     1.000       1.00     1.00     1.00

0.215 Volume ratio, VR

Configuration	Characterist	ics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	3	lc/pc	
Minimum weaving lane changes, LCMIN		lc/h	
Weaving lane changes, LCW		lc/h	
Non-weaving vehicle index, INW			
Non-weaving lane change, LCNW		lc/h	
Total lane changes, LCALL		lc/h	

\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_\_

Weaving intensity factor, W

Average weaving speed, SW mi/h
Average non-weaving speed, SNW mi/h

Weaving Segment Speed, Dens	ity, Level of Service and Capacity
Weaving segment speed, S	mi/h
Weaving segment density, D	pc/mi/ln
Level of service, LOS	F
Weaving segment v/c ratio	1.041
Weaving segment flow rate, v	6100 veh/h
Weaving segment capacity, cW	5862 veh/h

\_\_\_\_\_Limitations on Weaving Segments\_\_\_\_\_\_

If limit reached, see note.

	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	7821	3300	a,b
		Maximum	Analyzed	
Density-based capacty, cIWL (pc/h/ln)		2300	1954	С
		Maximum	Analyzed	
v/c ratio		1.00	1.041	d

## Notes:

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

Fax:

Phone: E-mail:

\_\_\_\_\_\_Operational Analysis\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 8/26/2014
Analysis Time Period: PM Peak
Freeway/Dir of Travel: I-271 SB

Weaving Location: R-11 Merge to R-12 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - No Build W-4

\_\_\_\_\_\_Inputs\_\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	4100	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume Components			
	VFF	VRF	VFR	VRR
Volume, V	2450	460	0	580 veh/h
Peak hour factor, PHF	0.90	0.90	0.90	0.90
Peak 15-min volume, v15	681	128	0	161
Trucks and buses	0	0	0	0 %
Recreational vehicles	0	0	0	0 %
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.000
Driver population adjustment, fP	1.00	1.00	1.00	1.00
Flow rate, v	2722	511	0	644 pc/h

Volume ratio, VR 0.166

Configuration	Characterist	ics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	2	lc/pc	
Minimum weaving lane changes, LCMIN	1288	lc/h	
Weaving lane changes, LCW	1603	lc/h	
Non-weaving vehicle index, INW	795		
Non-weaving lane change, LCNW	2310	lc/h	
Total lane changes, LCALL	3913	lc/h	

\_\_\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_

Weaving intensity factor, W

Average non-weaving spee	d, SNW	44.5	mi/h	
Weaving Segment	Speed, Dens:	ity, Level of S	ervice and Car	pacity
Weaving segment speed, S		46.2	mi/h	
Weaving segment density,	D	27.9	pc/mi/ln	
Level of service, LOS		С	_	
Weaving segment v/c rati	0	0.630		
Weaving segment flow rat		3878	veh/h	
Weaving segment capacity		6159	veh/h	
L	imitations or	n Weaving Segmen	nts	
If limit reached, see no				
	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	7325	4100	a,b
<i>5 5</i> , ,		Maximum	Analyzed	,
Density-based capacty, cIWL (pc/h/ln)		2300	2053	С
<u>-</u>		Maximum	Analyzed	

1.00

mi/h

0.630

d

# Notes:

v/c ratio

Average weaving speed, SW

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

Fax:

Phone: E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 8/26/2014
Analysis Time Period: PM Peak
Freeway/Dir of Travel: I-271 SB

Weaving Location: R-15 Merge to R-16 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - No Build W-5

\_\_\_\_\_\_Inputs\_\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	2400	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume	Compone	nts	
	VFF	VRF	VFR	VRR
Volume, V	1950	1740	0	690 veh/h
Peak hour factor, PHF	0.90	0.90	0.90	0.90
Peak 15-min volume, v15	542	483	0	192
Trucks and buses	0	0	0	0 %
Recreational vehicles	0	0	0	0 %
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.000
Driver population adjustment, fP	1.00	1.00	1.00	1.00
Flow rate, v	2167	1933	0	767 pc/h

Volume ratio, VR 0.158

Configuration	Characterist	ics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	3	lc/pc	
Minimum weaving lane changes, LCMIN	2301	lc/h	
Weaving lane changes, LCW	2535	lc/h	
Non-weaving vehicle index, INW	590		
Non-weaving lane change, LCNW	1568	lc/h	
Total lane changes, LCALL	4103	lc/h	

\_\_\_\_\_\_\_Weaving and Non-Weaving Speeds\_\_\_\_\_

Weaving intensity factor, W

0.345

Average weaving speed,	SW	56.2	mi/h		
Average non-weaving spe	ed, SNW	35.6	mi/h		
Weaving Segmen	t Speed, Densi	ity, Level of Se	ervice and Ca	pacity	
Weaving segment speed,	S	37.8	mi/h	_	
Weaving segment density		42.9	pc/mi/ln		
Level of service, LOS		E	_		
Weaving segment v/c rat	io	0.841			
Weaving segment flow ra	te, v	4867	veh/h		
Weaving segment capacit	y, cW	5790	veh/h		
	Limitations or	n Weaving Segmen	nts		
If limit reached, see n					
	Minimum	Maximum	Actual	Note	
Weaving length (ft)	300	7239	2400	a,b	
		Maximum	Analyzed		
Density-based capacty, cIWL (pc/h/ln)		2300	1930	С	

# Notes:

v/c ratio

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

Maximum

1.00

Analyzed 0.841

d

- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

\_\_\_\_\_

Fax:

Phone: E-mail:

\_\_\_\_\_Operational Analysis\_\_\_\_\_\_

Analyst: Eric Brown

Agency/Co.: Parsons Brinckerhoff

Date Performed: 9/11/14
Analysis Time Period: PM Peak
Freeway/Dir of Travel: I-271 SB

Weaving Location: R-19 Merge to R-20 Diverge

Analysis Year: 2036

Description: CUY-271-8.14 - No Build W-6

\_\_\_\_\_Inputs\_\_\_\_\_

Segment Type	Freeway	
Weaving configuration	Two-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	1900	ft
Freeway free-flow speed, FFS	60	mi/h
Minimum segment speed, SMIN	45	mi/h
Freeway maximum capacity, cIFL	2300	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

\_\_\_\_\_\_Conversion to pc/h Under Base Conditions\_\_\_\_\_

	Volume				
	VFF	VRF	VFR	VRR	
Volume, V	3440	0	250	400	veh/h
Peak hour factor, PHF	0.90	0.90	0.90	0.90	
Peak 15-min volume, v15	956	0	69	111	
Trucks and buses	0	0	0	0	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	1.00	0
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	3822	0	278	444	pc/h

Volume ratio, VR 0.098

Configuration	Characterist	ics	
Number of maneuver lanes, NWL	0	ln	
Interchange density, ID	0.6	int/mi	
Minimum RF lane changes, LCRF	0	lc/pc	
Minimum FR lane changes, LCFR	0	lc/pc	
Minimum RR lane changes, LCRR	3	lc/pc	
Minimum weaving lane changes, LCMIN	1332	lc/h	
Weaving lane changes, LCW	1536	lc/h	
Non-weaving vehicle index, INW	467		
Non-weaving lane change, LCNW	1297	lc/h	
Total lane changes, LCALL	2833	lc/h	

Weaving intensity factor, W

Average weaving speed,	SW	56.5	mi/h		
Average non-weaving spe	ed, SNW	43.1	mi/h		
Weaving Segmen	t Speed, Densi	ity, Level of S	ervice and Ca	pacity	
Weaving segment speed,	S	44.2	mi/h		
Weaving segment density		34.3	pc/mi/ln		
Level of service, LOS		D	_		
Weaving segment v/c rat	io	0.782			
Weaving segment flow ra	te, v	4545	veh/h		
Weaving segment capacit	y, cW	5811	veh/h		
	Limitations or	n Weaving Segme	nts		
If limit reached, see n		, , , , , , , , , , , , , , , , , , ,			
	Minimum	Maximum	Actual	Note	
Weaving length (ft)	300	6649	1900	a,b	
		Maximum	Analyzed	·	
Density-based capacty, cIWL (pc/h/ln)		2300	1937	C	

Maximum

1.00

Analyzed

0.782

d

# Notes:

v/c ratio

- a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.
- b. 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."
- c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.
- d. Volumes exceed the weaving segment capacity. The level of service is F.

HCS 2010	Signali	zed lı	nterse	ction	Resi	ults S	ummaı	'y				
Our and hef amostic a										l u	4741	N II
General Information					$\rightarrow$		tion Info	Tr.	n	- 1	4241	
Agency Parsons Brinckerhoff			1 0	5 0044		Duration		0.25				<u> </u>
Analyst Eric Brown		sis Date	_	5, 2014	_	Area Ty	pe	Other				~ & ← }-
Jurisdiction ODOT District 12	Time F		PM Pe	eak	_	PHF		0.92			e † E	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Intersection I-271 SB On Ramp	Analys	sis Year	2036			Analysis	Period	1> 7:0	)()			
File Name												
Project Description										1	<b>ቀተ</b>	7 4
Demand Information	Т	EB			WE	3		NB			SB	
Approach Movement	L	T	R	L	Т	R	L	T	R	L	T	R
Demand (v), veh/h		1350	1390	1040	232	:0						
Signal Information					7				-			
Cycle, s 200.0 Reference Phase 2	-	5	<b>≓L, </b> ◆	$\dashv$					<u> </u>			
Offset, s 0 Reference Point End			<b>-</b> 3						1	2	3	4
	Green		119.2		0.0					_		7
	Yellow	-	1.0	0.0	0.0				5	•	-	0
Force Mode   Fixed   Simult. Gap N/S   On	Red	1.0	1.0	10.0	0.0	0.0	0.0		5	6	4	8
Timer Results	EBI	-	EBT	WB	L	WBT	NBL		NBT	SBL		SBT
Assigned Phase			2	1		6						
Case Number			7.3	2.0		4.0						
Phase Duration, s			124.2	75.8	3	200.0						
Change Period, (Y+Rc), s			5.0	5.0		5.0						
Max Allow Headway ( MAH), s			0.0	3.1		0.0						
Queue Clearance Time ( gs), s				72.8	3							
Green Extension Time ( ge), s			0.0	0.0		0.0						
Phase Call Probability				1.00	)							
Max Out Probability				1.00	)							
Movement Group Results		EB			WB			NB			SB	
Approach Movement		Т	R	L	Т	R	L	Т	R	L	Т	R
Assigned Movement		2	12	1	6							
Adjusted Flow Rate ( v), veh/h	-	1467	1511	1130	2522							
Adjusted Saturation Flow Rate (s), veh/h/ln		950	1579	887	950							
Queue Service Time (gs), s	1	119.2	_	70.8	195.0							
Cycle Queue Clearance Time ( gc), s		119.2	119.2	70.8	195.0							
Green Ratio (g/C)		0.60	0.60	0.35	0.98							
Capacity (c), veh/h		1132	941	628	1853							
Volume-to-Capacity Ratio (X)		1.296	1.606	1.800	1.361							
Available Capacity ( ca), veh/h		1132	941	628	1853							
Back of Queue (Q), veh/ln (50th percentile)		49.1	117.6	47.9	42.7							
Queue Storage Ratio ( RQ) (50th percentile)		0.00	14.93	1.87	0.00							
Uniform Delay ( d1), s/veh		40.4	40.4	64.6	2.5							
Incremental Delay ( d <sub>2</sub> ), s/veh	_	139.8	_	366.3	166.2	2						
Initial Queue Delay ( d3), s/veh	$\perp$	0.0	0.0	0.0	0.0							
Control Delay ( d), s/veh	-	180.2	_		168.7	1						
Level of Service (LOS)	_	F	F	F	F	<u> </u>						
Approach Delay, s/veh / LOS	250.	1	F			0.0			0.0			
Intersection Delay, s/veh / LOS			25	0.0						F		
Multimodal Results		EB			WB			NB			SB	
Pedestrian LOS Score / LOS	2.4		В	0.5		A	3.0		С	2.9		С
Bicycle LOS Score / LOS	2.9	_	С	3.5		D	1.0					-

#### **HCS 2010 Signalized Intersection Results Summary** 14741747 Intersection Information **General Information** Parsons Brinckerhoff Duration, h 0.25 Agency Analyst Eric Brown Analysis Date Aug 29, 2014 Area Type Other PHF 0.92 Jurisdiction ODOT District 12 Time Period PM Peak No Build Intersection Cedar Rd Analysis Year 2036 Analysis Period 1>7:00 I-2, I-3, I-4 CUY-271-8.14 PM Peak.xus File Name **Project Description Demand Information** EB **WB** NB SB Approach Movement L R L R L R L R Demand (v), veh/h 750 490 110 40 1120 470 90 260 10 530 360 750 **Signal Information** ᄴ Ų Cycle, s 135.0 Reference Phase 2 **F**(17 Offset, s 0 Reference Point End Green 19.7 21.8 29.5 44.0 0.0 0.0 Uncoordinated No Simult. Gap E/W On Yellow 3.6 0.0 3.6 3.6 3.6 0.0 Force Mode Simult. Gap N/S 0.0 Fixed On Red 1.4 1.4 1.4 1.4 0.0 **Timer Results EBL EBT** WBL **WBT NBL NBT** SBL SBT Assigned Phase 8 7 4 2 1 6 Case Number 2.0 4.0 5.3 5.3 2.0 3.0 Phase Duration, s 34.5 83.5 49.0 26.8 24.7 51.5 5.0 5.0 Change Period, (Y+Rc), s 5.0 5.0 5.0 5.0 Max Allow Headway (MAH), s 3.1 3.2 3.2 0.0 3.1 0.0 Queue Clearance Time (gs), s 31.5 14.5 46.0 21.7 Green Extension Time ( $g_e$ ), s 0.0 8.0 0.0 0.0 0.0 0.0 Phase Call Probability 1.00 1.00 1.00 1.00 1.00 0.00 1.00 1.00 Max Out Probability WB **Movement Group Results** EΒ NB SB Approach Movement Т R L Т R L Т R Т R L L Assigned Movement 7 4 14 3 8 18 5 2 12 1 6 16 Adjusted Flow Rate (v), veh/h 815 336 316 43 1217 511 98 283 11 561 381 794 Adjusted Saturation Flow Rate (s), veh/h/ln 1757 1863 1744 792 1610 1018 1881 1610 1757 1863 1773 1610 44.0 20.0 0.8 23.8 Queue Service Time (gs), s 29.5 12.4 12.5 5.3 42.3 12.0 19.7 46.5 12.0 Cycle Queue Clearance Time ( qc), s 29.5 12.4 12.5 5.3 44.0 42.3 20.0 8.0 19.7 23.8 46.5 Green Ratio (g/C) 0.22 0.58 0.33 0.33 0.33 0.16 0.15 0.34 0.56 0.58 0.16 0.16 Capacity (c), veh/h 768 1083 1014 312 1156 525 218 304 260 513 642 906 Volume-to-Capacity Ratio (X) 1.062 0.310 0.312 0.140 1.053 0.973 0.449 0.930 0.042 1.095 0.594 0.876 Available Capacity (ca), veh/h 768 1083 1014 312 1156 525 218 304 260 513 642 906 Back of Queue (Q), veh/ln (50th percentile) 18.2 5.2 4.9 1.0 25.7 21.3 3.5 12.5 0.3 12.9 11.7 21.5 Queue Storage Ratio (RQ) (50th percentile) 0.78 0.00 0.00 0.21 0.00 1.44 0.25 0.00 0.08 0.00 1.11 1.85 44.9 40.3 Uniform Delay (d1), s/veh 52.8 14.4 14.4 32.5 45.5 52.5 55.9 47.8 55.1 24.5 Incremental Delay (d2), s/veh 50.1 0.1 0.1 0.1 41.6 32.3 6.6 36.5 0.3 62.8 3.0 8.9 Initial Queue Delay (d3), s/veh 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 Control Delay (d), s/veh 102.8 14.5 14.5 32.5 87.1 77.2 59.1 92.4 48.1 117.9 43.2 33.4 Level of Service (LOS) F В В С F Ε Ε F D D С F 82.9 F 82.8 F 62.9 Е Approach Delay, s/veh / LOS 63.6 Intersection Delay, s/veh / LOS 71.1 Е **Multimodal Results** ΕB WB NB SB Pedestrian LOS Score / LOS 2.4 В С С 3.0 3.0 С 3.0 Bicycle LOS Score / LOS 1.7 Α 1.9 Α 1.1 Α 3.4

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#### **HCS 2010 Signalized Intersection Results Summary** 14747*4*7 Intersection Information **General Information** Agency Parsons Brinckerhoff Duration, h 0.25 Analyst Eric Brown Analysis Date Aug 29, 2014 Area Type Other PHF 0.92 Jurisdiction ODOT District 12 Time Period PM Peak No Build Intersection I-271 NB On/Off Ramp Analysis Year 2036 Analysis Period 1>7:00 I-2, I-3, I-4 CUY-271-8.14 PM Peak.xus File Name **Project Description Demand Information** EB **WB** NB SB Approach Movement L R L R L R L R 400 1080 Demand (v), veh/h 500 250 90 1390 **Signal Information** Ж IJ, Cycle, s 135.0 Reference Phase 2 Offset, s 0 Reference Point End Green 6.0 0.0 0.0 78.4 35.6 0.0 Uncoordinated No Simult. Gap E/W On Yellow 3.6 0.0 0.0 3.6 3.6 0.0 Force Mode Fixed Simult. Gap N/S 0.0 On Red 1.4 1.4 1.4 0.0 0.0 **Timer Results EBL EBT WBL WBT NBL NBT** SBL SBT Assigned Phase 2 4 1 6 Case Number 9.0 7.3 1.0 4.0 Phase Duration, s 40.6 83.4 11.0 94.4 Change Period, (Y+Rc), s 5.0 5.0 5.0 5.0 Max Allow Headway (MAH), s 3.2 0.0 3.1 0.0 Queue Clearance Time (gs), s 37.6 4.7 Green Extension Time ( $g_e$ ), s 0.0 0.0 0.0 0.0 Phase Call Probability 1.00 1.00 1.00 1.00 Max Out Probability WB SB **Movement Group Results** EΒ NB Approach Movement Т R L Т R Т R Т R L L L **Assigned Movement** 7 14 2 12 6 1 Adjusted Flow Rate (v), veh/h 543 272 422 1139 95 1465 Adjusted Saturation Flow Rate (s), veh/h/ln 1757 1863 1594 1792 1756 1563 35.6 78.4 2.7 33.6 Queue Service Time (gs), s 20.9 18.7 Cycle Queue Clearance Time ( $g_c$ ), s 35.6 20.9 18.7 78.4 2.7 33.6 0.58 Green Ratio (g/C) 0.26 0.58 0.64 0.66 0.26 412 Capacity (c), veh/h 463 1082 926 562 2326 Volume-to-Capacity Ratio (X) 1.173 0.659 0.390 1.231 0.169 0.630 Available Capacity (ca), veh/h 463 412 1082 926 562 2326 Back of Queue (Q), veh/ln (50th percentile) 28.1 8.4 8.3 26.9 1.1 12.9 Queue Storage Ratio (RQ) (50th percentile) 0.00 0.00 0.00 0.00 0.08 0.00 44.3 Uniform Delay (d1), s/veh 49.7 18.5 46.2 11.2 14.0 Incremental Delay ( d2), s/veh 98.7 3.1 0.1 104.7 0.0 0.7 Initial Queue Delay (d3), s/veh 0.0 0.0 0.0 0.0 0.0 0.0 Control Delay (d), s/veh 148.4 47.4 18.6 150.9 11.2 14.7 Level of Service (LOS) F D В F В В 114.7 F 0.0 115.2 F 14.5 В Approach Delay, s/veh / LOS Intersection Delay, s/veh / LOS 75.2 Ε **Multimodal Results** ΕB WB NB SB Pedestrian LOS Score / LOS 2.8 С В 1.7 2.5 1.9 Α Α Bicycle LOS Score / LOS F 3.1 С 1.8 Α

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#### **HCS 2010 Signalized Intersection Results Summary** 1444444 Intersection Information **General Information** Agency Parsons Brinckerhoff Duration, h 0.25 Analyst Eric Brown Analysis Date Aug 29, 2014 Area Type Other PHF 0.92 Jurisdiction ODOT District 12 Time Period PM Peak No Build Intersection I-271 SB Off Ramp Analysis Year 2036 Analysis Period 1>7:00 I-2, I-3, I-4 CUY-271-8.14 PM Peak.xus File Name **Project Description** <u>ጎ ላ ተቀዋ ክ ለ</u> **Demand Information** EB **WB** NB SB Approach Movement L R L R L R L R Demand (v), veh/h 830 130 900 650 **Signal Information** Cycle, s 135.0 Reference Phase 2 Offset, s 0 Reference Point End 0.0 0.0 Green 62.3 63.7 0.0 0.0 Uncoordinated No Simult. Gap E/W On Yellow 0.0 0.0 0.0 3.6 4.0 0.0 Force Mode Simult. Gap N/S 0.0 Fixed On Red 1.4 0.0 0.0 0.0 0.0 **Timer Results EBL EBT** WBL **WBT NBL NBT** SBL SBT Assigned Phase 8 2 6 Case Number 9.0 8.0 8.0 Phase Duration, s 67.7 67.3 67.3 Change Period, (Y+Rc), s 4.0 5.0 5.0 Max Allow Headway (MAH), s 3.1 0.0 0.0 Queue Clearance Time (gs), s 65.7 Green Extension Time ( $g_e$ ), s 0.0 0.0 0.0 Phase Call Probability 1.00 1.00 Max Out Probability WB NB **Movement Group Results** EΒ SB Approach Movement Т R L Т R Т Т R L L R L Assigned Movement 3 18 2 6 Adjusted Flow Rate (v), veh/h 902 141 885 707 Adjusted Saturation Flow Rate (s), veh/h/ln 1610 1809 1810 1900 62.3 17.6 Queue Service Time (gs), s 63.7 6.9 Cycle Queue Clearance Time ( $g_c$ ), s 63.7 6.9 62.3 17.6 Green Ratio (g/C) 0.47 0.47 0.46 0.46 Capacity (c), veh/h 854 760 877 1669 Volume-to-Capacity Ratio (X) 1.057 0.186 1.010 0.423 Available Capacity (ca), veh/h 854 760 877 1669 Back of Queue (Q), veh/ln (50th percentile) 38.1 2.6 36.5 7.7 Queue Storage Ratio (RQ) (50th percentile) 0.00 0.18 0.00 0.00 Uniform Delay (d1), s/veh 35.7 20.6 51.0 24.3 Incremental Delay ( d2), s/veh 46.9 0.0 22.7 8.0 Initial Queue Delay (d3), s/veh 0.0 0.0 0.0 0.0 Control Delay (d), s/veh 82.5 20.7 73.7 25.1 Level of Service (LOS) F С F С 0.0 74.1 Е 73.7 Е 25.1 С Approach Delay, s/veh / LOS Intersection Delay, s/veh / LOS 60.9 Е **Multimodal Results** ΕB WB NB SB Pedestrian LOS Score / LOS 2.6 В В 2.3 1.7 Α 0.7 Α Bicycle LOS Score / LOS 2.1 В 1.1 Α



**Turn Lane Storage Calculations** 

### Turn Lane Length Calculations Cedar Road @ Brainard Road

MOVEMENT:		
AM PEAK HOUR (2035)		
Movement	NBLT	
Design Speed	35	mph
Cycle Length	120	seconds
Control (Stop or Signal)	Signal	
Through Volume (T-TR)	150	vph
Number of Through Lanes	2	
Turning Volume	58	vph
Number of Turning Lanes	1	
Design Condition	Α	A, B, or C
Turning Percentage	28%	
Vehicles Per Cycle	1.9	
Storage Length	95	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	145	feet
No Block Distance	125	feet
No Block Turn Lane Length	145	feet

MOVEMENT:		
AM PEAK HOUR (2035)		
Movement	EBLT	
Design Speed	35	mph
Cycle Length	120	seconds
Control (Stop or Signal)	Signal	
Through Volume	354	vph
Number of Through Lanes	2	
Turning Volume	390	vph
Number of Turning Lanes	2	
Design Condition	Α	A, B, or C
Turning Percentage	52%	
Vehicles Per Cycle	6.5	
Storage Length	263	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	313	feet
No Block Distance	245	feet
No Block Turn Lane Length	313	feet

MOVEMENT:			
AM PEAK HOUR (	AM PEAK HOUR (2035)		
Movement	SBLT		
Design Speed	35	mph	
Cycle Length	120	seconds	
Control (Stop or Signal)	Signal		
Through Volume	523	vph	
Number of Through Lanes	1		
Turning Volume	932	vph	
Number of Turning Lanes	2		
Design Condition	Α	A, B, or C	
Turning Percentage	64%		
Vehicles Per Cycle	15.5		
Storage Length	538	feet	
Deceleration/Taper	50	feet	
Calculated Turn Lane Length	588	feet	
No Block Distance	610	feet	
No Block Turn Lane Length	610	feet	

MOVEMENT:			
AM PEAK HOUR (2035)			
Movement	WBLT		
Design Speed	35	mph	
Cycle Length	120	seconds	
Control (Stop or Signal)	Signal		
Through Volume	397	vph	
Number of Through Lanes	2		
Turning Volume	36	vph	
Number of Turning Lanes	1		
Design Condition	Α	A, B, or C	
Turning Percentage	8%		
Vehicles Per Cycle	1.2		
Storage Length	60	feet	
Deceleration/Taper	50	feet	
Calculated Turn Lane Length	110	feet	
No Block Distance	265	feet	
No Block Turn Lane Length	265	feet	

MOVEMENT: AM PEAK HOUR (2035)		
Movement	WBRT	
Design Speed	35	mph
Cycle Length	120	seconds
Control (Stop or Signal)	Signal	
Through Volume	397	vph
Number of Through Lanes	2	
Turning Volume	73	vph
Number of Turning Lanes	1	
Design Condition	Α	A, B, or C
Turning Percentage	16%	
Vehicles Per Cycle	2.4	
Storage Length	120	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	170	feet
No Block Distance	265	feet
No Block Turn Lane Length	265	feet

NO Block Turri Larie Lerigin	200	1661	
MOVEMENT: AM PEAK HOUR (2035)			
Movement	SBRT		
Design Speed	35	mph	
Cycle Length	120	seconds	
Control (Stop or Signal)	Signal		
Through Volume	523	vph	
Number of Through Lanes	1		
Turning Volume	523	vph	
Number of Turning Lanes	1		
Design Condition	Α	A, B, or C	
Turning Percentage	50%		
Vehicles Per Cycle	17.4		
Storage Length	610	feet	
Deceleration/Taper	50	feet	
Calculated Turn Lane Length	660	feet	
No Block Distance	610	feet	
No Block Turn Lane Length	660	feet	

### Turn Lane Length Calculations Cedar Road @ Brainard Road

MOVEMENT: PM PEAK HOUR (2035)		
Movement	NBLT	
Design Speed	35	mph
Cycle Length	135	seconds
Control (Stop or Signal)	Signal	
Through Volume	251	vph
Number of Through Lanes	2	
Turning Volume	72	vph
Number of Turning Lanes	1	
Design Condition	Α	A, B, or C
Turning Percentage	22%	
Vehicles Per Cycle	2.7	
Storage Length	135	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	185	feet
No Block Distance	193	feet
No Block Turn Lane Length	193	feet

MOVEMENT: PM PEAK HOUR (2035)		
Movement	EBLT	
Design Speed	35	mph
Cycle Length	135	seconds
Control (Stop or Signal)	Signal	
Through Volume	487	vph
Number of Through Lanes	2	-
Turning Volume	609	vph
Number of Turning Lanes	2	
Design Condition	Α	A, B, or C
Turning Percentage	56%	
Vehicles Per Cycle	11.4	
Storage Length	420	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	470	feet
No Block Distance	353	feet
No Block Turn Lane Length	470	feet

MOVEMENT		
MOVEMENT:		
PM PEAK HOUR (	2035)	
Movement	SBLT	
Design Speed	35	mph
Cycle Length	135	seconds
Control (Stop or Signal)	Signal	
Through Volume	530.5	vph
Number of Through Lanes	1	
Turning Volume	368	vph
Number of Turning Lanes	2	
Design Condition	Α	A, B, or C
Turning Percentage	41%	
Vehicles Per Cycle	6.9	
Storage Length	273	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	323	feet
No Block Distance	670	feet
No Block Turn Lane Length	670	feet

MOVEMENT:			
1	PM PEAK HOUR (2035)		
Movement	WBLT		
Design Speed	35	mph	
Cycle Length	135	seconds	
Control (Stop or Signal)	Signal		
Through Volume	1005	vph	
Number of Through Lanes	2		
Turning Volume	35	vph	
Number of Turning Lanes	1		
Design Condition	Α	A, B, or C	
Turning Percentage	3%		
Vehicles Per Cycle	1.3		
Storage Length	65	feet	
Deceleration/Taper	50	feet	
Calculated Turn Lane Length	115	feet	
No Block Distance	645	feet	
No Block Turn Lane Length	645	feet	

MOVEMENT: PM PEAK HOUR (2035)		
Movement	WBRT	
Design Speed	35	mph
Cycle Length	135	seconds
Control (Stop or Signal)	Signal	
Through Volume	1005	vph
Number of Through Lanes	2	
Turning Volume	451	vph
Number of Turning Lanes	1	
Design Condition	Α	A, B, or C
Turning Percentage	31%	
Vehicles Per Cycle	16.9	
Storage Length	595	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	645	feet
No Block Distance	645	feet
No Block Turn Lane Length	645	feet

NO DIOCK TUITI Lane Length	UTU	1001
MOVEMENT:		
PM PEAK HOUR (2	2035)	
Movement	SBRT	
Design Speed	35	mph
Cycle Length	135	seconds
Control (Stop or Signal)	Signal	
Through Volume	530.5	vph
Number of Through Lanes	1	
Turning Volume	530.5	vph
Number of Turning Lanes	1	
Design Condition	Α	A, B, or C
Turning Percentage	50%	
Vehicles Per Cycle	19.9	
Storage Length	673	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	723	feet
No Block Distance	670	feet
No Block Turn Lane Length	723	feet

### Turn Lane Length Calculations Brainard Road @ NB I-271 Ramps

MOVEMENT:			
AM PEAK HOUR (2035)			
Movement	NBRT		
Design Speed	35	mph	
Cycle Length	120	seconds	
Control (Stop or Signal)	Signal		
Through Volume	98	vph	
Number of Through Lanes	1		
Turning Volume	504	vph	
Number of Turning Lanes	2		
Design Condition	Α	A, B, or C	
Turning Percentage	84%		
Vehicles Per Cycle	8.4		
Storage Length	335	feet	
Deceleration/Taper	50	feet	
Calculated Turn Lane Length	385	feet	
No Block Distance	155	feet	
No Block Turn Lane Length	385	feet	

MOVEMENT: AM PEAK HOUR (2035)		
Movement	EBLT	
Design Speed	35	mph
Cycle Length	120	seconds
Control (Stop or Signal)	Signal	
Through Volume	625	vph
Number of Through Lanes	2	
Turning Volume	210	vph
Number of Turning Lanes	1	
Design Condition	Α	A, B, or C
Turning Percentage	25%	
Vehicles Per Cycle	7.0	
Storage Length	275	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	325	feet
No Block Distance	385	feet
No Block Turn Lane Length	385	feet

MOVEMENT:		
AM PEAK HOUR (	(2035)	
Movement	SBLT	
Design Speed	35	mph
Cycle Length	120	seconds
Control (Stop or Signal)	Signal	
Through Volume	1395	vph
Number of Through Lanes	2	
Turning Volume	103	vph
Number of Turning Lanes	1	-
Design Condition	Α	A, B, or C
Turning Percentage	7%	
Vehicles Per Cycle	3.4	
Storage Length	160	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	210	feet
No Block Distance	780	feet
No Block Turn Lane Length	780	feet

MOVEMENT: AM PEAK HOUR (2035)		
Movement	EBRT	
Design Speed	35	mph
Cycle Length	120	seconds
Control (Stop or Signal)	Signal	
Through Volume	210	vph
Number of Through Lanes	1	
Turning Volume	625	vph
Number of Turning Lanes	2	
Design Condition	Α	A, B, or C
Turning Percentage	75%	
Vehicles Per Cycle	10.4	
Storage Length	385	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	435	feet
No Block Distance	275	feet
No Block Turn Lane Length	435	feet

### Turn Lane Length Calculations Brainard Road @ NB I-271 Ramps

MOVEMENT: PM PEAK HOUR (2035)		
Movement	NBRT	
Design Speed	35	mph
Cycle Length	135	seconds
Control (Stop or Signal)	Signal	
Through Volume	285	vph
Number of Through Lanes	1	
Turning Volume	1049	vph
Number of Turning Lanes	2	
Design Condition	Α	A, B, or C
Turning Percentage	79%	
Vehicles Per Cycle	19.7	
Storage Length	668	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	718	feet
No Block Distance	390	feet
No Block Turn Lane Length	718	feet

MOVEMENT: PM PEAK HOUR (2035)		
Movement	EBLT	
Design Speed	35	mph
Cycle Length	135	seconds
Control (Stop or Signal)	Signal	
Through Volume	213	vph
Number of Through Lanes	1	
Turning Volume	533	vph
Number of Turning Lanes	2	
Design Condition	Α	A, B, or C
Turning Percentage	71%	
Vehicles Per Cycle	10.0	
Storage Length	375	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	425	feet
No Block Distance	320	feet
No Block Turn Lane Length	425	feet

MOVEMENT:		
PM PEAK HOUR (	2035)	
Movement	SBLT	
Design Speed	35	mph
Cycle Length	135	seconds
Control (Stop or Signal)	Signal	
Through Volume	1233	vph
Number of Through Lanes	2	
Turning Volume	96	vph
Number of Turning Lanes	1	
Design Condition	Α	A, B, or C
Turning Percentage	7%	
Vehicles Per Cycle	3.6	
Storage Length	165	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	215	feet
No Block Distance	778	feet
No Block Turn Lane Length	778	feet

MOVEMENT: PM PEAK HOUR (2035)			
Movement	EBRT		
Design Speed	35	mph	
Cycle Length	135	seconds	
Control (Stop or Signal)	Signal		
Through Volume	533	vph	
Number of Through Lanes	2	-	
Turning Volume	213	vph	
Number of Turning Lanes	1	-	
Design Condition	Α	A, B, or C	
Turning Percentage	29%		
Vehicles Per Cycle	8.0		
Storage Length	325	feet	
Deceleration/Taper	50	feet	
Calculated Turn Lane Length	375	feet	
No Block Distance	373	feet	
No Block Turn Lane Length	375	feet	

### Turn Lane Length Calculations Brainard Road @ SB I-271 Exit Ramp

MOVEMENT: AM PEAK HOUR (2035)			
Movement	WBRT		
Design Speed	35	mph	
Cycle Length	120	seconds	
Control (Stop or Signal)	Signal		
Through Volume	934	vph	
Number of Through Lanes	2		
Turning Volume	65	vph	
Number of Turning Lanes	1		
Design Condition	Α	A, B, or C	
Turning Percentage	7%		
Vehicles Per Cycle	2.2		
Storage Length	110	feet	
Deceleration/Taper	50	feet	
Calculated Turn Lane Length	160	feet	
No Block Distance	538	feet	
No Block Turn Lane Length	538	feet	

MOVEMENT:		
PM PEAK HOUR (2035)		
Movement	WBRT	
Design Speed	35	mph
Cycle Length	135	seconds
Control (Stop or Signal)	Signal	
Through Volume	821	vph
Number of Through Lanes	2	
Turning Volume	135	vph
Number of Turning Lanes	1	
Design Condition	Α	A, B, or C
Turning Percentage	14%	
Vehicles Per Cycle	5.1	
Storage Length	205	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	255	feet
No Block Distance	533	feet
No Block Turn Lane Length	533	feet

MOVEMENT: AM PEAK HOUR (2035)		
Movement	WBLT	
Design Speed	35	mph
Cycle Length	120	seconds
Control (Stop or Signal)	Signal	
Through Volume	65	vph
Number of Through Lanes	1	
Turning Volume	934	vph
Number of Turning Lanes	2	
Design Condition	Α	A, B, or C
Turning Percentage	93%	
Vehicles Per Cycle	15.6	
Storage Length	540	feet
Deceleration/Taper	50	feet
Calculated Turn Lane Length	590	feet
No Block Distance	105	feet
No Block Turn Lane Length	590	feet

MOVEMENT:				
PM PEAK HOUR	PM PEAK HOUR (2035)			
Movement	WBLT			
Design Speed	35	mph		
Cycle Length	135	seconds		
Control (Stop or Signal)	Signal			
Through Volume	135	vph		
Number of Through Lanes	1			
Turning Volume	821	vph		
Number of Turning Lanes	2			
Design Condition	Α	A, B, or C		
Turning Percentage	86%			
Vehicles Per Cycle	15.4			
Storage Length	535	feet		
Deceleration/Taper	50	feet		
Calculated Turn Lane Length	585	feet		
No Block Distance	200	feet		
No Block Turn Lane Length	585	feet		

### **Turn Lane Length Calculations**

### **Brainard Road @ SB I-271 Entrance Ramp**

MOVEMENT:									
AM PEAK HOUR (2	2035)								
Movement	WBLT								
Design Speed	35	mph							
Cycle Length	200	seconds							
Control (Stop or Signal)	Signal								
Through Volume	2167	vph							
Number of Through Lanes	2								
Turning Volume	599	vph							
Number of Turning Lanes	2								
Design Condition	Α	A, B, or C							
Turning Percentage	22%								
Vehicles Per Cycle	16.6								
Storage Length	580	feet							
Deceleration/Taper	50	feet							
Calculated Turn Lane Length	630	feet							
No Block Distance	1850	feet							
No Block Turn Lane Length	1850	feet							

MOVEMENT: PM PEAK HOUR (2035)									
Movement	WBLT								
Design Speed	35	mph							
Cycle Length	200	seconds							
Control (Stop or Signal)	Signal								
Through Volume	2037	vph							
Number of Through Lanes	2								
Turning Volume	988	vph							
Number of Turning Lanes	2								
Design Condition	Α	A, B, or C							
Turning Percentage	33%								
Vehicles Per Cycle	27.4								
Storage Length	897	feet							
Deceleration/Taper	50	feet							
Calculated Turn Lane Length	947	feet							
No Block Distance	1745	feet							
No Block Turn Lane Length	1745	feet							

MOVEMENT:								
AM PEAK HOUR (	2035)							
Movement	EBRT							
Design Speed	35	mph						
Cycle Length	200	seconds						
Control (Stop or Signal)	Signal							
Through Volume	703	vph						
Number of Through Lanes	1							
Turning Volume	1506	vph						
Number of Turning Lanes	2							
Design Condition	Α	A, B, or C						
Turning Percentage	68%							
Vehicles Per Cycle	41.8							
Storage Length	1304	feet						
Deceleration/Taper	50	feet						
Calculated Turn Lane Length	1354	feet						
No Block Distance	1225	feet						
No Block Turn Lane Length	1354	feet						

MOVEMENT: PM PEAK HOUR (2035)									
Movement	EBRT								
Design Speed	35	mph							
Cycle Length	200	seconds							
Control (Stop or Signal)	Signal								
Through Volume	1057	vph							
Number of Through Lanes	1	·							
Turning Volume	1148	vph							
Number of Turning Lanes	2								
Design Condition	Α	A, B, or C							
Turning Percentage	52%								
Vehicles Per Cycle	31.9								
Storage Length	1032	feet							
Deceleration/Taper	50	feet							
Calculated Turn Lane Length	1082	feet							
No Block Distance	1811	feet							
No Block Turn Lane Length	1811	feet							

# Appendix F

**Cost Estimate** 



## CUY-271-10.87 NB EXIT AT BRAINARD ROAD CUYAHOGA COUNTY, OHIO PRELIMINARY CONSTRUCTION ESTIMATE - MARCH 10, 2014 (Revised BMB 4/30/2014)

### BRAINARD ROAD IMPROVEMENTS

ITEM	DESCRIPTION	QUANTITY	UNIT COST	TOTAL COST		
201	CLEARING AND GRUBBING	1 LS	\$	15,000.00	\$	15,000.00
202	PAVEMENT REMOVED, ASHPALT ON CONCRETE	2675 SY	\$	15.00	\$	40,125.00
202	WALK REMOVED	2775 SF	\$	1.50	\$	4,162.50
202	CURB REMOVED	2655 FT	\$	3.00		7,965.00
202	CATCH BASIN OR INLET REMOVED	11 EA	\$	350.00		3,850.00
203	EXCAVATION	1225 CY	\$			18,375.00
203	EMBANKMENT	625 CY	\$	12.00	\$	7,500.00
204	SUBGRADE COMPACTION	4610 SY	\$	2.00	\$	9,220.00
206	CEMENT STABILIZED SUBGRADE, 16" DEEP	4430 SY	\$	5.50	\$	24,365.00
252	FULL DEPTH PAVEMENT SAWING	2720 FT	\$	2.00	\$	5,440.00
254	PAVEMENT PLANING, ASPHALT CONCRETE	11485 SY	\$	2.50		28,712.50
304	AGGREGATE BASE, 10"	1200 CY	\$	60.00	\$	72,000.00
407	TACK COAT	1940 GAL	\$	3.00		5,820.00
448	ASPHALT CONCRETE SURFACE COURSE 3"	1335 CY	\$	175.00		233,625.00
452	8" CONCRETE PAVEMENT	3270 SY	\$	75.00		245,250.00
452	6" CONCRETE DRIVE APPROACHES	15 EA	\$	1,500.00		22,500.00
603	15" CONDUIT, TYPE B	380 FT	\$	50.00		19,000.00
604	CATCH BASIN, NO. 3	10 EA	\$	2,500.00	_	25,000.00
SPEC	HAND RAIL	175 FT	\$	50.00	\$	8,750.00
605	6" BASE PIPE UNDERDRAIN	3445 FT	\$	10.00	\$	34,450.00
606	GUARD RAIL	300 FT	\$	20.00	\$	6,000.00
608	4" CONCRETE WALK	5275 SF	\$	5.00		26,375.00
608	CURB RAMPS	10 EA	\$	1,000.00	\$	10,000.00
609	CURB, TYPE 6	2730 FT	\$	16.00		43,680.00
609	CURB, TYPE SPECIAL 18'	100 FT	\$	50.00	\$	5,000.00
609	CONCRETE TRAFFIC ISLAND	300 SY	\$	75.00		22,500.00
630	SIGNAGE INCLUDING OVERHEAD SIGNS	1 LS	\$	32,500.00	\$	32,500.00
632	TRAFFIC SIGNAL UPGRADES	3 EA	\$	120,000.00	\$	360,000.00
638	FIRE HYDRANT RELOCATED	3 EA	\$	7,500.00	\$	22,500.00
644	PAVEMENT MARKINGS	1 LS	\$	20,000.00	\$	20,000.00
659	TOPSOIL	230 CY	\$	25.00	\$	5,750.00
659	SEEDING AND MULCHING	1150 SY	\$	2.00	\$	2,300.00
832	SWPPP	1 LS	\$	15,000.00	\$	15,000.00
832	EROSION CONTROL	18000 EA	\$	1.00	\$	18,000.00
				Subtotal	\$	1,421,000.00
614	MAINTAINING TRAFFIC	1 LS	\$	25,000.00		25,000.00
619	FIELD OFFICE, TYPE B	9 MN	\$	2,000.00	\$	18,000.00
623	CONSTRUCTION LAYOUT STAKES	1 LS	\$	10,000.00		10,000.00
624	MOBILIZATION	1 LS	\$	100,000.00	\$	100,000.00
				Subtotal	\$	1,574,000.00
				Costs (7%)	\$	111,000.00
		Total Base	Со	st Estimate	\$	1,685,000.00

CY14'-18' Business Plan Inflation Calculator:											
Not sure if you have the	latest calculator? Click here.										
Last Modified: March 28, 2014	Today's Date:										
Please Enter Values in the Yellow Areas Only:	April 28, 2014										
Estimation Start Date: Less than or Equal to Today's Date (mm/dd/yyyy)  4/28/2014 Start Date:	Enter Construction Mid-Point Date: (cannot exceed 06/01/2025) (mm/dd/yyyy)  6/30/2015  Construction Mid-Point Date:										
Present-Day Estimated Cost: \$1,000,000.00 Estimated Dollar Amount:											
Estimate Start Date to Construction Mid-Inflation - Start to Mid-Point of Construction											
(compounded growth rate) Inflated Dollar Amount:											
Business Plan 5.8%	\$1,058,064.09										
Estimator's Name:											
County - Route - Section:											
<b>PID</b> : 97676											
Estimator's Notes:											

	Project Cost Estimate	t Estimate	
Project Name	CUY-271-9.90/10.50 Safety Study	Contact Email	brian.blayney@dot.state.oh.us
Project Description	IR-271/Cedar/Brainard Interchange Improvements	Contact Phone	216-584-2102
Reference Number	201405D12-01	Date Performed	3/26/2014
Analyst	Prepared by LJB, Modified by BMB	Analysis Year	2011
\accordcomponia	OBOT District 13		

10%	30%
Engineering Design %	Contingency %

Countermeasures	Construction Costs	Right of Way Costs	Engineering Design Costs	Contingency Amount	Total Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value
Site Characteristic Improvements (i.e. Lane widening)			\$0.00	\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Lighting)			\$0.00	\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)			\$0.00	\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)			\$0.00	\$0.00	\$0.00		
CMF 1 - Provide a left turn lane on one major road approach (ID:4644)	\$741,400.00	\$0.00	\$96,382.00	\$222,420.00	\$1,060,202.00		
CMF 2 - Provide a right turn lane on one major road approach -Signalized (ID:288)	\$572,900.00	\$0.00	\$74,477.00	\$171,870.00	\$819,247.00		
CMF 3 - Improve visibility of signal heads (ID:1430)	\$370,700.00	\$0.00	\$48,191.00	\$111,210.00	\$530,101.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
Totals	\$1,685,000.00	\$0.00	\$219,050.00	\$505,500.00	\$2,409,550.00	\$0.00	\$0.00

Final Costruction Cost: \$2,551,713.45

Final construction cost should match the Project Cost Estimate



### CUY-271-9.9-10.5 LONG TERM NB OFF-RAMP CUYAHOGA COUNTY, OHIO PRELIMINARY CONSTRUCTION ESTIMATE - JUNE 18, 2013

Add NB lane on NB 271 off ramp at Brainard/Cedar

ITEM	DESCRIPTION	QUANTITY	UNIT COST		TOTAL COST
201	CLEARING AND GRUBBING	1 LS	\$ 15,000.00	\$	15,000.00
202	PAVEMENT REMOVED, ASPHALT ON CONCRETE	10000 SY	\$ 15.00	\$	150,000.00
202	CATCH BASIN OR INLET REMOVED	8 EA	\$ 500.00	\$	4,000.00
203	EXCAVATION	24000 CY	\$ 8.00	\$	192,000.00
203	EMBANKMENT	12700 CY	\$ 6.00	\$	76,200.00
204	SUBGRADE COMPACTION	19000 SY	\$ 1.50	\$	28,500.00
206	CEMENT STABILIZED SUBGRADE, 16" DEEP	10000 SY	\$ 5.50	\$	55,000.00
252	FULL DEPTH PAVEMENT SAWING	5000 FT	\$ 1.50	\$	7,500.00
254	PAVEMENT PLANING, ASPHALT CONCRETE	500 SY	\$ 2.50	\$	1,250.00
448	ASPHALT CONCRETE SURFACE COURSE 6"	3200 CY	\$ 175.00	\$	560,000.00
304	AGGREGATE BASE, 10"	5300 CY	\$ 50.00	\$	265,000.00
407	TACK COAT	3000 GAL	\$ 2.00	\$	6,000.00
452	8" CONCRETE PAVEMENT	19000 SY	\$ 75.00	\$	1,425,000.00
603	15" CONDUIT, TYPE B	400 FT	\$ 50.00	\$	20,000.00
603	10' X 10' CONDUIT, TYPE A	40 FT	\$ 1,500.00	\$	60,000.00
604	CATCH BASIN, NO. 2-2-B	8 EA	\$ 2,000.00	\$	16,000.00
604	CONCRETE FLUME	1 EA	\$ 20,000.00	\$	20,000.00
605	6" BASE PIPE UNDERDRAIN	5000 FT	\$ 6.00	\$	30,000.00
606	GUARD RAIL	1500 FT	\$ 15.00	\$	22,500.00
610	RETAINING WALL SOUTH OF STRUCTURE	2250 SF	\$ 35.00	\$	78,750.00
622	CONCRETE BARRIER	250 FT	\$ 60.00	\$	15,000.00
622	CONCRETE BARRIER END SECTIONS	8 EA	\$ 2,500.00	\$	20,000.00
630	SIGNAGE	1 LS	\$ 5,000.00	\$	5,000.00
632	OVERHEAD SIGN RELOCATED/REPLACED	4 EA	\$ 15,000.00	\$	60,000.00
632	TRAFFIC COUNTER RELOCATED	1 EA	\$ 5,000.00	\$	5,000.00
644	PAVEMENT MARKINGS	1 LS	\$ 15,000.00	\$	15,000.00
659	SEEDING AND MULCHING	8000 SY	\$ 1.50	\$	12,000.00
832	SWPPP	1 LS	\$ 5,000.00	\$	5,000.00
832	EROSION CONTROL	40000 EA	\$ 1.00	\$	40,000.00
SPEC	RETAINING WALL UNDER STRUCTURE	1 EA	\$ 400,000.00	\$	400,000.00

			Subtotal	\$ :	3,210,000.00
614	MAINTAINING TRAFFIC	1 LS	\$ 35,000.00	\$	35,000.00
619	FIELD OFFICE, TYPE B	18 MN	\$ 2,000.00	\$	36,000.00
623	CONSTRUCTION LAYOUT STAKES	1 LS	\$ 25,000.00	\$	25,000.00
624	MOBILIZATION	1 LS	\$ 150,000.00	\$	150,000.00
			Subtotal	\$ :	3,456,000.00

#### Notes:

- 1 R/W and utilities are not included in this estimate. (New R/W not anticipated)
- 2 Existing pavement is assumed to be concrete and asphalt on concrete.
- 3 Pavement widening is assumed to be asphalt on concrete.
- 4 Construction assumed in 2018

		1							Г		_	
	Comments										TEMPORARY R/W & COST TO	CURE NOT CONSIDERED
	Cost to Cure		\$0									
	Sub-Total Cost	\$16,167	\$16,167	\$2,910	\$2,425	\$364	\$21,866	\$10,933	\$32,798			
	Relocation		\$0					ı				
CUY-271-9.9-10.5 HOCKING COUNTY, OHIO PRELIMINARY RIGHT OF WAY ESTIMATE - JUNE 19 2013 RAMP LONG TERM	Cost: Temporary	\$0	\$0									
	Cost: Fee Simple	\$16,167	\$16,167							Project Management	\$550	
	Labor	\$8,950					_	(%		Closings	\$400	
	Area: Temporary		Sub-Totals				<b>Estimated Cost</b>	Contingency (50%)	IOIAL COSI	Negotiation	\$1,100	
	Area: Fee Simple	080'0				1	Est	Ğ,	- 1.	Detailed Appraisal Review	\$2,000	
HC MINARY RIG	Area of Take (SF)	3200										
PRELI	Structure Impact	ON ON								Detailed Appraisal	\$4,500	
	TOTAL ACREAGE (ACRES)	5.480		.20	.50	025						able
	<b>Total</b> \$492,200	\$492,200		[(sub-total)x0.15]x1.20 [(sub-total)x0.10]x1.50 [(sub-total)x0.90]x0.025			Titles	\$400	s, where avail			
	Structure Value	\$0		-qns)]	-qns)]	t-dus)]			L	ollowing: cedures For	طر الا	IS parcel line⊱
	Land Value	\$492,200		sts		Costs	res.			ncludes the fc	Acquiring Rignts of way)	nated using G Ibstation
	Land Use	COMMERCIAL		Administrative Costs	Jury trial Costs	Incidental transfer Costs	All areas are in acres.			* Labor Cost Includes the following: (per ODOT Cost Estimating Procedures For	Acquillic	s: 1 Existing R/W estimated using GIS parcel lines, where available 2 New R/W along substation
	<u></u>											Notes:

 $\frac{\square}{n}$   $\frac{\square}{n}$   $\frac{\square}{n}$  Source: Data from CUY-271-9.9/10.5 Safety Study, July 25, 2014.

	Project Cost Estimate	st Estimate	
Project Name	CUY-271-9.9/10.5 SAFETY STUDY	Contact Email	
Project Description	IR-271-Cedar-Brainard Interchange - Safety Improvements Contact Phone		937-259-5000
Reference Number		Date Performed	7/3/2014
Analyst	MV	Analysis Year	2012
Agency/Company	LJB Inc		IR-271 NB Exit ramp to Cedar/Brainard

Engineering Design % Contingency %

Countermeasures	Construction Costs	Right of Way Costs	Engineering Design Costs	Contingency Amount	Total Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value
Site Characteristic Improvements (i.e. Lane widening)			\$0.00	\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Lighting)			\$0.00	\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)			\$0.00	\$0.00	\$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)			\$0.00	\$0.00	\$0.00		
CMF 1 - Change number of lanes on freeway exit ramp from 1 to 2 $$	\$3,456,000.00	\$32,798.00	\$348,879.80	\$1,221,079.30	\$5,058,757.10		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
			\$0.00	\$0.00	\$0.00		
Totals	\$3,456,000.00	\$32,798.00	\$348,879.80	\$1,221,079.30	\$5,058,757.10	\$0.00	\$0.00

\$6,454,974.06

Final construction cost should match the Project Cost Estimate

Final Costruction Cost: