PROJECT COMMITMENTS

T.I.P. No. R-2248 G
I-485/ Charlotte Outer Loop
Paving of existing ramps at Oakdale Road (SR 2042) and
construction of roundabouts at ramp termini and at the intersection
of Oakdale Road and Mt Holly- Huntersville Road
Mecklenburg County
State Project No. 34410.1.S27

COMMITMENTS FROM PROJECT DEVELOPMENT AND DESIGN

Division 10 Construction Unit

Due to the hydrology present in the northern project area draining into a Critical Water Supply Watershed, this project will be subject to "NCDOT's Design Standards for Sensitive Waters."

North Carolina Department of Transportation
PROJECT ENVIRONMENTAL CONSULTATION FORM
I.D. NO R-2248G
January 25, 2015

I. GENERAL INFORMATION

a.	Consultation Phase:	Construction Consultation (Memo to File) Zahid Baloch, P.E Project Planning Engineer Project Development and Environmental Analysis Unit	
b.	Project Description	Section G, I-485 Interchange with SR 2042 (Oakdale Road) Ramp pavement and improvements to Oakdale Road and Mt. Holly-Huntersville Road Intersection, Charlotte, Mecklenburg County.	
c.	State Project: Federal Project:	34410.1.S27 N/A (This part of the project is state funded)	
d.	Document Type:	Final Environmental Impact Statement (EIS)	01-29-1992 Date
		Record of Decision (ROD)	10-15-1992 Date

II. CONCLUSIONS

The above environmental document (Record of Decision) was re-evaluated in 2009 as required by the Code of Federal Regulations (CFR) Title 23, Part 771. It was determined that the current proposed action is essentially the same as the original proposed action. Proposed changes, if any, are noted below in Section III. It has been determined that anticipated social, economic, and environmental impacts were accurately described in the above referenced document(s) unless noted otherwise herein. Therefore, the original Administration Action remains valid.

A circumferential freeway (the Outer Loop or I-485) around the city of Charlotte first gained local government support in 1977 with the adoption of the Charlotte-Mecklenburg Thoroughfare Plan. To meet the requirements of the National Environmental Policy Act (NEPA), an Environmental Impact Statement (EIS) was prepared and the Final EIS was approved in January 1992. Since the completion of the Record of Decision (ROD) in October 1992, the design and construction of various segments have taken place. Construction on the final 5.1-mile section of I-485 (R-2248E) to complete the Outer Loop around Charlotte is being conducted through the design-build process. This final section runs from west of NC 115 to west of I-85.

During the construction of this portion of I-485, it was requested by the City of Charlotte to delay the paving of Oakdale Road (SR 2042) interchange ramps. The reason behind this decision was to discourage the potential for change of land use in the form of uncontrolled sprawl, resulting in congested interchange and eventually deteriorating freeway operations. Now that

the City of Charlotte has better control on growth patterns, the project is ready to move forward with opening the interchange by paving the ramps. Also, instead of standard intersections at the interchange, roundabouts will be provided at the intersections for better traffic movement. This project also includes improvements to the intersection of Oakdale Road and Mt. Holly-Huntersville Road by providing a roundabout to improve traffic flow and improve safety.

III. CHANGES IN PROPOSED ACTION AND ENVIRONMENTAL CONSEQUENCES

The interchange ramps will be paved as originally planned in EIS, however instead of standard intersections, new roundabouts will be constructed at both ramp terminals of the interchange. Also, the intersection of Oakdale Road and Mt. Holly-Huntersville Road will be improved by providing new roundabout. All three roundabouts will be constructed within existing right of way but may require some right of way or construction easement.

Since Right of Way Consultation, some minor improvements to the design were included. Curb and gutter around the roundabouts was added. Also, curb and sidewalk was extended to the limits of the Control of Access (CA) at the interchange, and extended to the project limits approximately 75 feet to the CA along Oakdale road per Division's request. Also there are some changes to Public Utility Easements (PUEs) requested on January 13, 2015 for plan sheet 4. The PUEs impacts parcels 2, 3 and 6 and these changes are shown in the attached maps.

In order to evaluate the traffic flow impacts of converting the existing grade separation to a diamond interchange, intersection traffic volumes using the Traffic forecast for 2015 and 2035 dated January 2014 were used. Oakdale Road is a three (3) lane roadway (middle lane is Two-Way Left-Turn Lane) TWLTL with a 2012 AADT of 5,100 vehicles per day. Capacity analysis were performed for the base year (2015) and the design year (2035) peak hour using SIDRA traffic analysis software, version 5. (Please see the attached December 12, 2013 Memo for details.)

Roundabout Intersections Analysis Results

The following three intersections were analyzed for base year 2015 and design year 2035:

1. The I-485 Eastbound (EB) Ramps and SR 2042 (Oakdale Rd.) Interchange Intersection
2. The I-485 Westbound (WB) Ramps and SR 2042 (Oakdale Rd.) Interchange Intersection
3. SR 2042 (Oakdale Road) and SR 2004 (Mt. Holly Rd. / Huntersville Rd.) Stop-Controlled Intersection

Base Year (2015)/Design Year (2035) No-Build/Build Analysis

1. The I-485 Eastbound (EB) Ramps and SR 2042 (Oakdale Rd.) Interchange Intersection

A single lane roundabout was analyzed for this intersection. Based on 2013 base year capacity analysis results, this single lane roundabout configuration should work acceptably during the base year 2015. During the design year (2035), an exclusive northbound right-turn lane with 200' storage plus taper should be added. (Please see the attached December 12, 2013 Memo.)

The results of the base year (2015) and Design year (2035) peak hour analysis are shown in the following table.

Table 1: I-485 Eastbound Ramps and SR 2042 (Oakdale Road) Base Year (2015) and Design Year (2035) Peak Hour Analysis

Peak Hour Intersection Analysis Comparisons	2015 No Build/Build Single Lane Roundabout		2035 No Build /Build Single Lane Roundabout★	
	AM	PM	AM	PM
Overall Intersection LOS	A	A	A	A
Worst Movement LOS	A	B	B	B
Worst Movement v/c Ratio	0.47	0.74	0.42	0.61
Worst Movement Max. Queuing	100’	274’ (NB)	100’	182’ (NB)

★ Single lane Roundabout with slip lane

2. The I-485 Westbound (WB) Ramps and SR 2042 (Oakdale Rd.) interchange Intersection

A single lane roundabout was analyzed for this intersection. Based on 2013 base year capacity analysis results, this single lane roundabout configuration should work acceptably during the base year 2015. During the design year (2035), an exclusive southbound right-turn lane with 150’ storage plus taper should be added.

The results of the base year (2015) and Design year (2035) peak hour analysis are shown in the following table.

Table 2: I-485 Westbound Ramps and SR 2042 (Oakdale Road) Base Year (2015) and Design Year (2035) Peak Hour Analysis

Peak Hour Intersection Analysis Comparisons	2015 No Build /Build Single Lane Roundabout		2035 No Build /Build Single Lane Roundabout★	
	AM	PM	AM	PM
Overall Intersection LOS	A	A	A	A
Worst Movement Delay (Sec.)	A	A	B	B
Worst Movement v/c Ratio	0.79	0.50	0.78	0.79
Worst Movement Max. Queuing	338’ (SB)	117’	327’ (SB)	339’ (off-ramp)

★ Single lane Roundabout with slip lane

3. SR 2042 (Oakdale Rd.) and SR 2004 (Mt. Holly/Huntersville Rd.) Intersection

A single lane roundabout with a northbound exclusive right-turn lane (200’) was analyzed for this intersection. Based on 2012 base year capacity analysis results, this single lane roundabout configuration should work acceptably during the 2015 base year.
The results of the base year (2015) and Design year (2035) peak hour analysis are shown in the following table.

Table 3: SR 2042 (Oakdale Road) and SR 2004 (Mt. Huntersville Road) Base Year (2015) and Design Year (2035) Peak Hour Analysis

Peak Hour Intersection Analysis Comparisons	2015 No Build /Build Single Lane Roundabout★		2035 No Build /Build Single Lane Roundabout★	
	AM	PM	AM	PM
Overall Intersection LOS	A	A	A	A
Worst Movement Delay (Sec.)	B	B	A	B
Worst Movement v/c Ratio	0.79	0.70	0.65	0.61
Worst Movement Max. Queuing	371' (WB)	251' (EB)	207' (EB)	178' (NB)

★ Single lane Roundabout with slip lane

During the design year (2035), a single lane roundabout with lanes (225' EB right-turn, 200' NB Right-turn, and 200' WB left-turn lanes) was analyzed for this intersection. Based on the capacity analysis results, this single lane roundabout will work acceptably during the 2035 design year.

Interchange Analysis including Mainline

Capacity analysis utilizes Highway Capacity Manual (HCM) 2010 procedures to evaluate the effect of adding an interchange at I-485 and SR 2042 (Oakdale Road) Figure 1 in attached (R-2248G Highway Capacity Analysis Memorandum dated January 8, 2014) shows the location of the proposed interchange. The evaluation analyzes the 2015 No Build, 2015 Build, 2035 No Build, and 2035 Build scenarios. The 2015 No Build scenario includes two separate conditions, one with STIP R-2248E and one without STIP R-2248E. Both conditions are included in this analysis. (See details January 8, 2014 Capacity Analysis Memorandum done by Hatch Mott MacDonald)

The analyses used the traffic forecast prepared for R-2248G dated December 17, 2013. The AM and PM peak hour volumes for the four scenarios are presented in Figure 2 through Figure 6 in attached (R-2248G Highway Capacity Analysis Memorandum dated January 8, 2014). The No Build analysis was based upon existing laneage (no interchange) as shown on aerial photography. The Build analysis laneage was based on a plan sheet and supplemental information provided by the NCDOT Roadway Design Project Engineer and aerial photography of the existing ramp stub-outs. The purpose of this analysis is to compare the No Build conditions to the Build conditions in years 2015 and 2035.

No Build Scenarios

In the 2015 and 2035 No Build scenarios, I-485 consists of a six-lane freeway, with three lanes in each direction. Existing Oakdale Road is grade separated with I-485. The four ramp stub-outs for the R-2248G project are in place along I-485. The free flow speed was estimated, using HCM 2010 methodologies, to be 73.1 miles per hour for the No Build conditions. The terrain is assumed to be rolling and the percentage of trucks and recreational vehicles was taken from the R-2248G traffic forecast. Given there is no interchange at this location currently, the No Build analyses consisted of basic freeway analyses only.

Build Scenarios

In the 2015 and 2035 Build scenarios, I-485 consists of a six-lane freeway, with three lanes in each direction. STIP R-2248G proposes to convert the existing Oakdale Road grade separation with I-485 to a standard diamond interchange. For the purposes of this analysis, existing aerial photography along with design information provided by the NCDOT Roadway Design Project Engineer were both used.

For the ramp analyses, on I-485 eastbound, the diverge was analyzed with a 250-foot deceleration length and the merge was analyzed with a 900-foot acceleration length (including taper distance). In the I-485 westbound direction, the diverge was analyzed with a 250-foot deceleration length and the merge was analyzed with a 900-foot acceleration length (including the taper distance).
For the basic freeway segment analyses, the free flow speed was estimated using a base free flow speed of 75.4 miles per hour and HCM 2010 methodologies. The terrain is assumed to be rolling and the percentage of trucks and recreational vehicles was taken from the R-2248G traffic forecast. The provided traffic forecast did not include adjacent interchanges; therefore, for the Build analyses, the adjacent interchange ramps at NC 24 (WT Harris Boulevard) and NC 16 (Brookshire Boulevard) were not included in this analysis. The distance between the proposed ramps at the Oakdale Road interchange and the existing ramps at NC 24 is approximately 2.30 miles while the distance to the NC 16 ramps is approximately one mile. However, the analysis included the effects of the adjacent ramps at the proposed SR 2042 (Oakdale Road) interchange itself.

Analysis Results

Tables 4 and 5 provide the Highway Capacity Software analyses results and those results are discussed after the respective tables.

Table 4: 2015 No Build and Build Level of Service /Density (pc/mi/ln)

Segment	Segment Type	2015 No Build W/O R-2248E		2015 No Build with R-2248E		2015 Built	
		AM	PM	AM	PM	AM	PM
I-485 Eastbound at Oakdale Road Overpass	Freeway	B/11.2	B/13.7	B/14.7	C/18.3	N/A	N/A
I-485 Westbound at Oakdale Road Overpass	Freeway	B/13.7	B/11.2	C/18.3	B/14.7	N/A	N/A
I-485 Eastbound Before Oakdale Road Diverge	Freeway*	B/11.2	B/13.7	B/14.7	C/18.3	B/17.5	C/20.8
I-485 Eastbound to Oakdale Road	Diverge	N/A	N/A	N/A	N/A	C/22.7	C/26.7
I-485 Eastbound Between Oakdale Road Ramps	Freeway*	B/11.2	B/13.7	B/14.7	C/18.3	B/15.6	C/19.1
I-485 Eastbound from Oakdale Road	Merge	N/A	N/A	N/A	N/A	B/19.1	C/21.7
I-485 Eastbound After Oakdale Road Merge	Freeway*	B/11.2	B/13.7	B/14.7	C/18.3	B/17.4	C/21.3
I-485 Westbound Before Oakdale Road Diverge	Freeway*	B/11.2	B/13.7	B/14.7	C/18.3	C/21.3	B/17.4
I-485 Westbound to Oakdale Road	Diverge	N/A	N/A	N/A	N/A	C/27.3	C/23.5
I-485 Westbound Between Oakdale Road Ramps	Freeway*	B/11.2	B/13.7	B/14.7	C/18.3	C/19.1	B/15.6
I-485 Westbound from Oakdale Road	Merge	N/A	N/A	N/A	N/A	C/21.0	B/17.0
I-485 Westbound After Oakdale Road Merge	Freeway*	B/11.2	B/13.2	B/14.7	C/18.3	C/19.8	B/15.7

* No Build level of service and delay is for segment at Oakdale Road Overpass and listed here for comparison purposes

As shown in Table 4, all existing movements and proposed interchange movements operate at LOS C or better in 2015. Based on this information, congestion is not anticipated at the proposed interchange in 2015.

Table 5: 2035 No Build and Build Level of Service /Density (pc/mi/ln)

Segment	Segment Type	2035 No Build		2035 Built	
		AM	PM	AM	PM
I-485 Eastbound at Oakdale Road Overpass	Freeway	C/22.6	D/30.3	N/A	N/A
I-485 Westbound at Oakdale Road Overpass	Freeway	D/30.3	C/22.6	N/A	N/A
I-485 Eastbound Before Oakdale Road Diverge	Freeway*	C/22.6	D/30.3	C/23.4	D/31.4
I-485 Eastbound to Oakdale Road	Diverge	N/A	N/A	D/28.7	D/33.7
I-485 Eastbound Between Oakdale Road Ramps	Freeway*	C/22.6	D/30.3	C/21.7	D/28.2
I-485 Eastbound from Oakdale Road	Merge	N/A	N/A	C/26.8	D/32.0
I-485 Eastbound After Oakdale Road Merge	Freeway*	C/22.6	D/30.3	D/26.5	E/35.2
I-485 Westbound Before Oakdale Road Diverge	Freeway*	C/22.65	D/30.3	E/35.2	D/26.5
I-485 Westbound to Oakdale Road	Diverge	N/A	N/A	E/35.9	D/31.6
I-485 Westbound Between Oakdale Road Ramps	Freeway*	C/22.6	D/30.3	D/28.2	C/21.7
I-485 Westbound from Oakdale Road	Merge	N/A	N/A	D/28.8	C/23.1
I-485 Westbound After Oakdale Road Merge	Freeway*	C/22.6	D/30.3	D/30.7	C/22.4

* No Build level of service and delay is for segment at Oakdale Road Overpass and listed here for comparison purposes

As shown in Table 5, without the proposed interchange, I-485 is anticipated to operate at LOS D or better in the 2035 design year. For the Build conditions, three locations operate at LOS E in the design year. The freeway segments of I-485 eastbound and I-485 westbound west of the proposed interchange are anticipated to operate at LOS E as is the I-485 westbound diverges to Oakdale Road. Based on this information, congestion is anticipated along I-485 in the area of the interchange in the design year; however, it should be noted that the greatest density is 35.9 passenger cars per mile per lane (pc/mi/ln) which is only 0.9 pc/mi/ln outside the threshold for LOS D.

Summary on LOS

Based on the capacity analysis results, all single lane roundabouts will work acceptably during the base year 2015. Some exclusive turn lanes will be needed to accommodate 2035 design year traffic. (See attached December 12, 2013 analysis.)

As far as the proposed interchange mainline and ramps are concerned, the worst levels of operations in the area of Oakdale Road will degrade from LOS D to LOS E. However, it should be noted that the density exceeds the LOS D threshold by 0.9 pc/mi/ln or less in each instance and that the effect of the adjacent interchanges were not accounted for in the analyses. These results were shared with FHWA Congestion Management in detail via email on February 18, 2014 (see Appendix C). FHWA concurred with the findings and had no further comments.

Environmental Impacts

Water resources and list of federally protected species for Mecklenburg County remain unchanged from the above referenced Right of Way Consultation.

A US Fish and Wildlife Service proposal for listing the Northern Long-eared Bat (Myotis septentrionalis) as an endangered species was published in the Federal Register in October 2013. The listing will become effective on or before April, 2015. NCDOT is working closely with

the USFWS to understand how this proposed listing may impact NCDOT projects. NCDOT will continue to coordinate appropriately with USFWS to determine if this project will incur potential effects to the Northern long eared bat, and how to address these potential effects, if necessary.

There are two drainage areas for this project. Mt. Holly – Huntersville Road serves as the dividing line between these two drainages. Water draining to the north of Mt. Holly – Huntersville Road drains to Mountain Island Lake, classified as a WS-IV and B, Critical Area, while drainage to the south flows to Long Creek, classified as WS-IV and 303 (d)(on the 2012 list) for copper.

Due to the Critical Area designation of the project, this project will require Design Standards for Sensitive Waters.

Protected Species

The United States Fish and Wildlife (USFWS) lists four federally protected (endangered) species for Mecklenburg County (Table 6).

Table 6. Federally protected species listed for Mecklenburg County

Scientific Name	Common Name	Habitat Present	Biological Conclusion
Echinacea laevigata	Smooth coneflower	Yes	No Effect
Helianthus schweinitzii	Schweinitz's sunflower	Yes	No Effect
Lasmigona decorata	Carolina heelsplitter	No	No Effect
Rhus michauxii	Michaux's sumac	Yes	No Effect

NCDOT biologists surveyed the project area on October 2, 2013. Suitable habitat is present for the three plants listed for Mecklenburg County. No specimens were located. A review of NCNHP records on October 4, 2013, indicates no known occurrences of listed species within 1.0 mile of the study area.

IV. LIST OF ENVIRONMENTAL COMMITMENTS

Due to the project draining to an area designated as "Critical Area", this project will be subject to "NCDOT's Design Standards for Sensitive Waters."

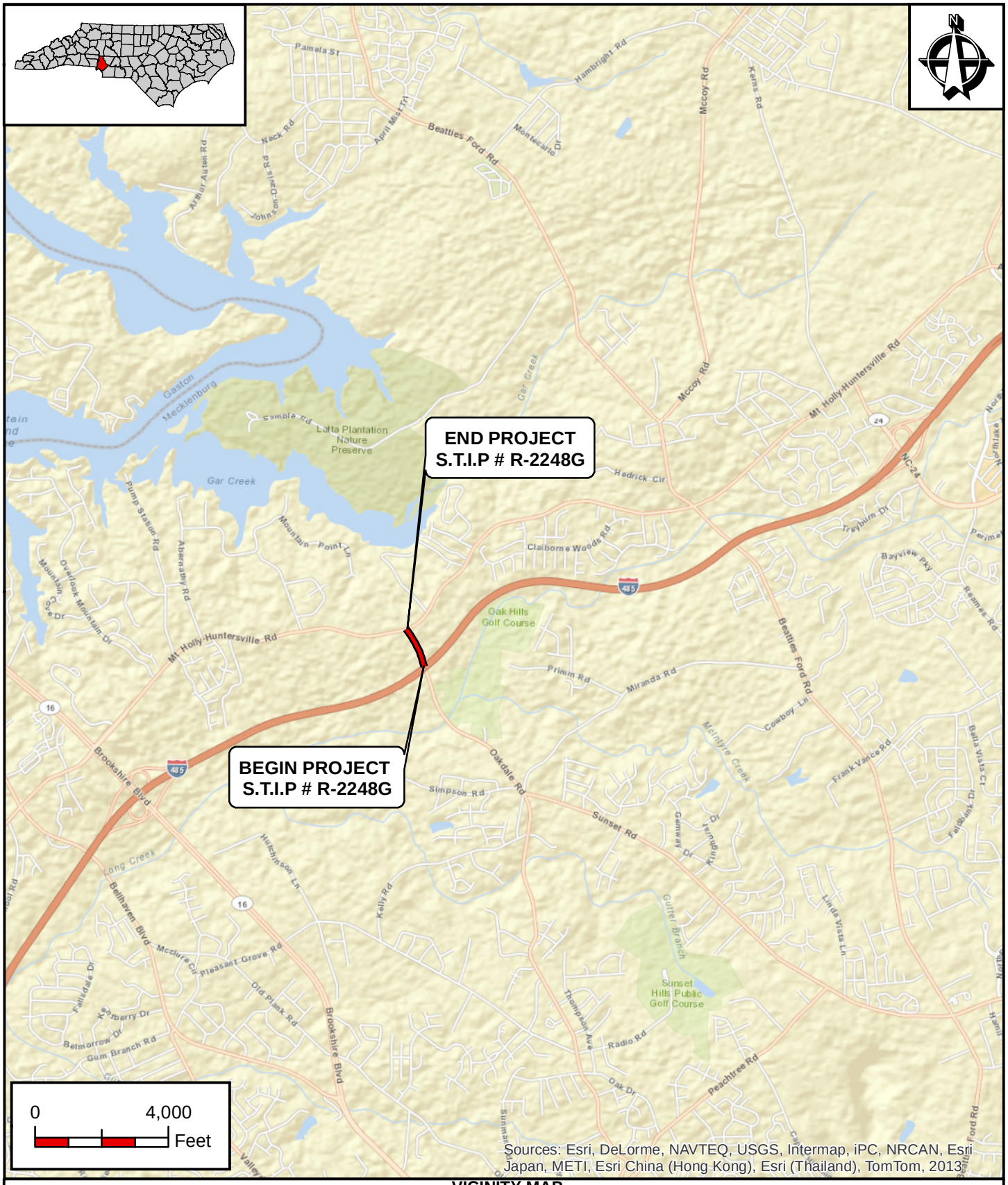
V. COORDINATION

Project Development and Environmental Analysis Unit personnel have discussed current project proposals with others as follows:

Design Engineer:	Kanchana Noland	01/20/2015 Date
Permits Section:	Michael Turchy	12/11/2014 Date
Hydraulic Section:	Stephen Morgan	12/04/2014 Date

Appendix A

Figures



VICINITY MAP
I - 485 INTERCHANGE WITH SR 2042 (OAKDALE ROAD) RAMP PAVEMENT AND IMPROVEMENTS TO OAKDALE ROAD AND MR. HOLLY-HUNTERVILLE ROAD INTERSECTION
MECKLENBURG COUNTY
TIP PROJECT R - 2248 G

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS UNIT

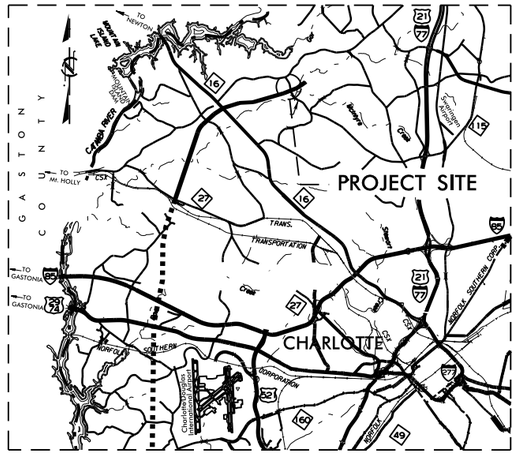
County:	Mecklenburg
Div: 10	TIP# R-2248G
WBS:	34410.1.S27
Date:	December 2013

Figure 1

09/08/99

TIP PROJECT: R-2248G

See Sheet 1-A For Index of Sheets



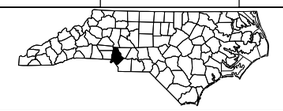
VICINITY MAP

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

MECKLENBURG COUNTY

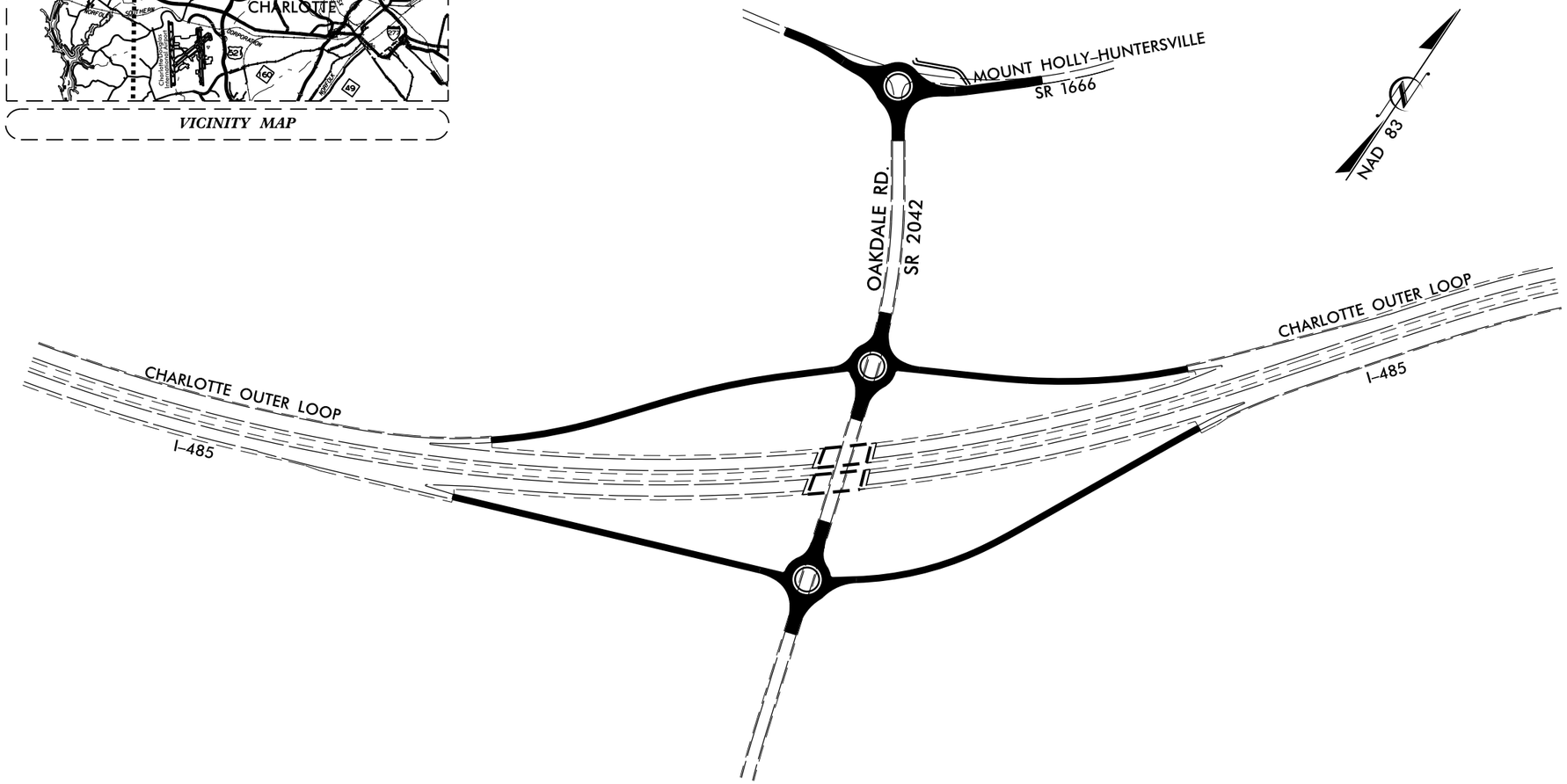
STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	R-2248G	1	

STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION
34410.1.S27		PE



LOCATION: I-485 CHARLOTTE OUTER LOOP INTERCHANGE WITH SR 2042 (OAKDALE INTERCHANGE)

TYPE OF WORK: GRADING, DRAINAGE AND PAVING



INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

CONTRACT:

GRAPHIC SCALES

PLANS

PROFILE (HORIZONTAL)

PROFILE (VERTICAL)

DESIGN DATA

ADT =
ADT =
DHV = %
D = %
T = % *
V = MPH
* TTST = DUAL
FUNC CLASS =

TIER

PROJECT LENGTH

Prepared In the Office of:
DIVISION OF HIGHWAYS
1000 Birch Ridge Dr., Raleigh NC, 27610

2012 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE:
AUGUST 15, 2014

LETTING DATE:
JUNE 16, 2015

G. E. BREW, PE
PROJECT ENGINEER

I. T. YOUNIS
PROJECT DESIGN ENGINEER

HYDRAULICS ENGINEER

P.E.
SIGNATURE:

ROADWAY DESIGN ENGINEER

P.E.
SIGNATURE:

DIVISION OF HIGHWAYS

STAE OF NORTH CAROLINA

30-AUG-2013 16:06
R:\Roadway\Proj\R2248G_Rdy_tsh.dgn
$$$$USERNAME$$$$

5/14/99

NEEDED DATA

1) FURNISH PLAN SHEETS IN ENGLISH UNITS AT A SCALE OF 1"=50'.
2) SURVEY LIMITS TO BE TAKEN AT THE DISTANCE SHOWN BELOW FROM THE EXISTING CENTER LINE.
3) LEVELS ON EXISTING PAVEMENT.
4) COMPLETE TOPOGRAPHIC MAPPING.
5) PROFILE ALONG EXISTING CENTER LINE.

PROJECT REFERENCE NO.	SHEET NO.
R-2248G	SUR

100 0 200

NAD 83

BEGIN SURVEY APPROX. 460' FROM THE INTERSECTION OF MT HOLLY HILL RD AND OAKDALE RD

END SURVEY APPROX. 630' FROM THE INTERSECTION OF MT HOLLY HILL RD AND OAKDALE RD

BEGIN SURVEY -RPA- GORE AREA

BEGIN SURVEY -RPB- GORE AREA

BEGIN SURVEY -RPC- GORE AREA

BEGIN SURVEY -RPD- GORE AREA

END SURVEY APPROX. 300' FROM THE INTERSECTION OF RPC AND RPD

SURVEY LIMITS

100'

50'

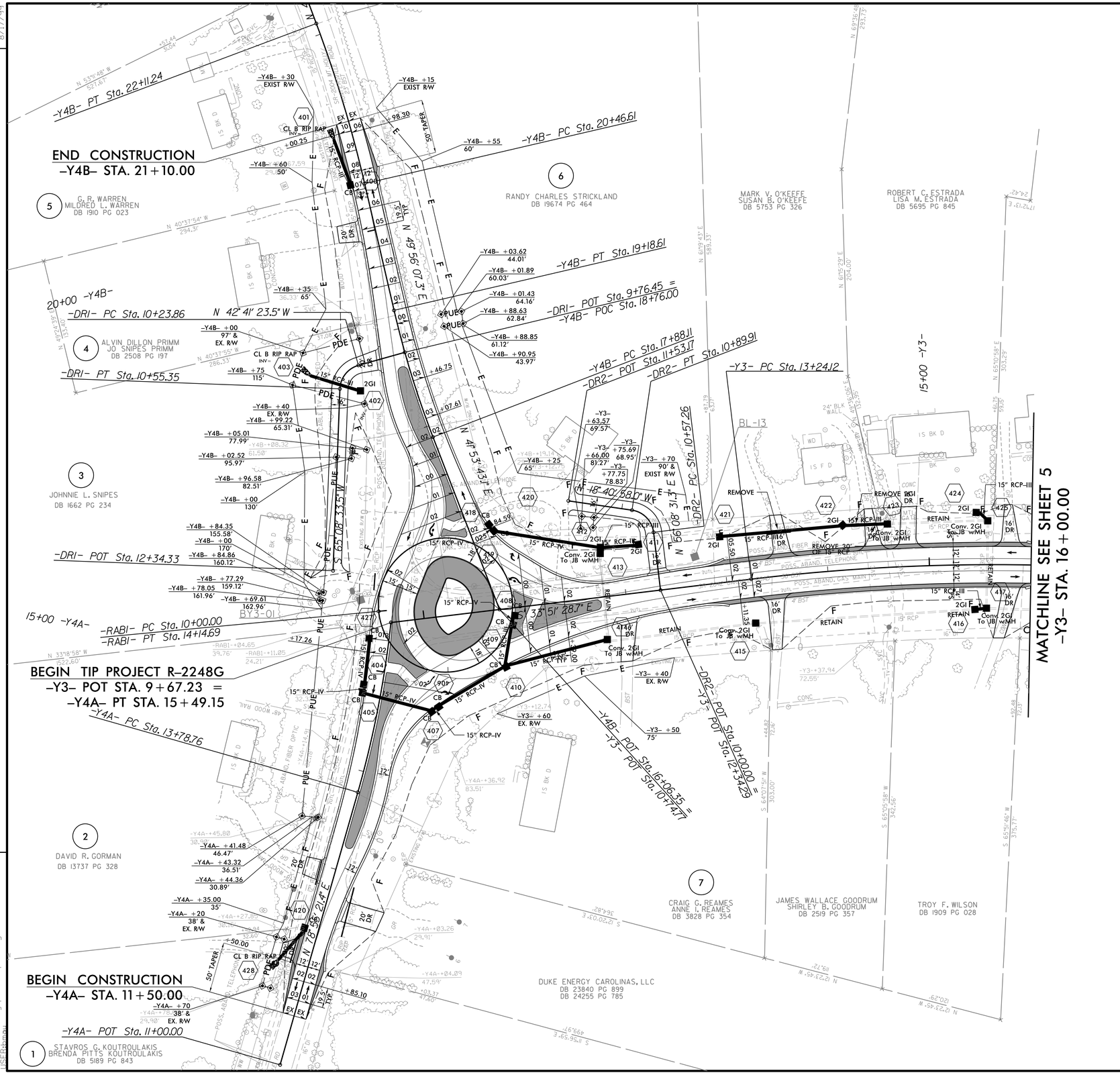
I:\Projects\2248G\Survey\R2248G_Survey.dgn

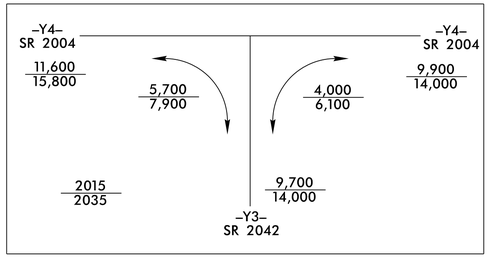
WETHERILL ENGINEERING
559 Jones Franklin Rd. Suite 164
Raleigh, N.C. 27606
License No. F-0377
Bus: 919 851 8077
Fax: 919 851 8107
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

PROJECT REFERENCE NO.	SHEET NO.
R-2248G	4
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NAD 83/2011





-RAB1- CURVE DATA	
PI Sta 10+00.00 △ = 360° 00' 00.0" (LT) D = 00° 00' 00.0" L = 414.69' T = 0.00' R = 66.00' SE = 0.02	
-Y3- CURVE DATA	**-Y4A- CURVE DATA**
PI Sta 16+26.38 △ = 17° 11' 18.0" (RT) D = 2° 51' 53.2" L = 599.99' T = 302.26' R = 2,000.00' SE = SEE PLANS DS = 50 MPH	PI Sta 14+64.16 △ = 9° 45' 44.3" (LT) D = 5° 43' 46.5" L = 170.38' T = 85.40' R = 1,000.00' SE = SEE PLANS DS = 20 MPH
-Y4B- CURVE DATA	
PI Sta 18+53.47 △ = 8° 02' 24.2" (RT) D = 6° 09' 39.0" L = 130.50' T = 65.36' R = 930.00' SE = SEE PLANS DS = 35 MPH	PI Sta 21+29.04 △ = 7° 29' 09.8" (LT) D = 4° 32' 50.2" L = 164.63' T = 82.43' R = 1,260.00' SE = SEE PLANS DS = 35 MPH
-DR1- CURVE DATA	**-DR2- CURVE DATA**
PI Sta 10+42.08 △ = 72° 10' 03.0" (LT) D = 229° 10' 59.2" L = 31.49' T = 18.22' R = 25.00' SE = NC	PI Sta 10+76.39 △ = 74° 49' 29.4" (LT) D = 229° 10' 59.2" L = 32.65' T = 19.12' R = 25.00' SE = NC

SEE SHEET 8 FOR -Y3- PROFILE
SEE SHEET 9 FOR -Y4A- & -Y4B- PROFILES
SEE SHEET 12 FOR -RAB1- PROFILE
SEE SHEET 12 FOR -DR1- & -DR2- PROFILE
SEE SHEET 2B-1 FOR ROUNDABOUT DETAIL

REVISIONS
R/W REVISION - 1/16/2014 - ADDED PERMANENT UTILITY EASEMENTS (PUE) TO PARCEL NOS. 2, 3 & 6. BAM

8/17/99

1/15/2015
R2248G_rdy_psh_04_plan.dgn
USER:bmay

PI Sta 16+26.38 Δ = 117° 11' 18.0" (RT) D = 2° 51' 53.2" L = 599.99' T = 302.26' R = 2,000.00' SE = SEE PLANS	PI Sta 945+27.10 Δ = 37° 00' 51.6" (LT) D = 0° 59' 52.6" L = 3,709.11' T = 1,921.86' R = 5,741.46' SE = EXIST.	PI Sta 23+50.01 Δ = 41° 14' 23.7" (RT) D = 39° 14' 37.3" L = 105.09' T = 54.94' R = 146.00' SE = SEE PLANS DS = 15 MPH	PI STA 23+25.77 Δ = 7° 09' 08.2" (RT) D = 2° 29' 28.0" L = 287.11' T = 143.74' R = 2,300.00' SE = 0.05 DS = 50 MPH	PI Sta 26+39.63 Δ = 14° 23' 16.8" (LT) D = 14° 19' 26.2" L = 100.45' T = 50.49' R = 400.00' SE = SEE PLANS DS = 15 MPH	PI Sta 24+34.16 Δ = 43° 47' 12.4" (RT) D = 39° 14' 37.3" L = 111.58' T = 58.67' R = 146.00' SE = SEE PLANS DS = 15 MPH	PI STA 23+59.34 Δ = 15° 07' 55.5" (RT) D = 5° 43' 46.5" L = 264.10' T = 132.83' R = 1,000.00' SE = 0.07 DS = 45 MPH
PI Sta 10+00.00 Δ = 360° 00' 00.0" (LT) D = 00° 00' 00.0" L = 502.65' T = 0.00' R = 80.00' SE = 0.02	PI Sta 10+00.00 Δ = 360° 00' 00.0" (LT) D = 00° 00' 00.0" L = 502.65' T = 0.00' R = 80.00' SE = 0.02					

WETHERILL ENGINEERING
559 Jones Franklin Rd. Suite 164
Raleigh, N.C. 27606
License No. F-0377
Bus: 919 851 8077
Fax: 919 851 8107
TRANSPORTATION PLANNING/DESIGN - BRIDGE/STRUCTURE DESIGN
CIVIL/SITE DESIGN - GIS/GPS - CONSTRUCTION OBSERVATION

PROJECT REFERENCE NO.	SHEET NO.
R-2248G	5
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

8/17/99

REVISIONS

NAD 83/2011

MATCHLINE SEE SHEET 6
-RPA- STA. 22+00.00

MATCHLINE SEE SHEET 6
-RPD- STA. 23+00.00

MATCHLINE SEE SHEET 4
-Y3- STA. 16+00.00

MATCHLINE SEE SHEET 7
-RPB- STA. 23+00.00

MATCHLINE SEE SHEET 7
-RPC- STA. 23+00.00

END TIP PROJECT R-2248G
-Y3- STA. 29+75.00

-RPA- PC Sta. 22+95.08
-RPA- PT Sta. 24+00.16
-RAB2- PC Sta. 10+00.00
-RAB2- PT Sta. 15+02.65
-Y3- PT Sta. 19+24.10
-RPB- PRC Sta. 26+89.58
-RPB- PC Sta. 25+89.14
-RPB- PT Sta. 24+69.14
-RPD- PT Sta. 24+90.62
-RPD- POT Sta. 27+23.25
-RAB3- PC Sta. 10+00.00
-RAB3- PT Sta. 15+02.65
-RPC- PT Sta. 24+87.06
-RPC- PC Sta. 23+75.49
-Y3- POT Sta. 30+00.00

-Y3- S 16° 40' 10.7" E

-RPA- S 53° 37' 43.8" W

-RPC- S 5° 47' 22.36" W

N 49° 01' 41.0" E

N 59° 44' 49" E

955+00 -L-

960+00 -L-

-L- 20+00

25+00 -RPD-

25+00 -RPB-

EUGENE DAVIS BIRMINGHAM REVOCABLE TRUST
DB 15294 PG 345

BOYCE D. NIXON
GRACE K. NIXON
DB 4458 PG 603

STEPHEN W. McCLURE
WILLIAM R. McCLURE
DB 27573 PG 614

DON DAVIES ROBINSON
RONALD ALLEN ROBINSON
DB 2782 PG 471

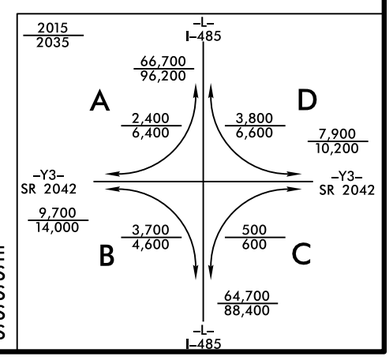
MIDNIGHT NIXON, LLC
DB 24520 PG 100
DB 25605 PG 171

DUKE ENERGY CAROLINAS, LLC
DB 23840 PG 899
DB 24255 PG 785

NCDOT
DB 12654 PG 472

SR-2042 OAKDALE ROAD

SEE SHEET 8 FOR -Y3- PROFILE
SEE SHEET 10 FOR -RPA- & -RPB- PROFILES
SEE SHEET 11 FOR -RPC- & -RPD- PROFILES
SEE SHEET 12 FOR -RAB2- & -RAB3- PROFILES
SEE SHEETS 2B-2 & 2B-3 FOR ROUNDABOUT DETAILS



20-JAN-2015 16:58
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$$$$USERNAME$$$$

Appendix B

1: Water Resources and protected spices update, dated December 11, 2014
2: Traffic Forecast for R-2248G, dated December 17, 2013
3: R-2248G Highway Capacity Analysis, dated January 8, 2013

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

PAT L. MCCRORY
GOVERNOR

ANTHONY J. TATA
SECRETARY

December 11, 2014

MEMORANDUM TO: Zahid Baloch, Project Development Engineer
Project Development Section

FROM: Michael Turchy, Environmental Coordinator
Natural Environment Section

SUBJECT: Water resources and protected species update for a Federal Highway Administration (FHWA) **Construction Consultation** for the proposed ramp creation on I-485 at Oakdale Road and improvements extending to Mt. Holly – Huntersville Road in Mecklenburg County, TIP R-2248 G.

REFERENCE: Environmental Review for a Federal Highways Right of Way Consultation Dated October 9, 2013.

Right of Way Consultation dated March 4, 2014

Water Resources & Federally Protected Species

Water resources, and list of Federally protected species for Mecklenburg County remain unchanged from the above referenced Right of Way Consultation.

A US Fish and Wildlife Service proposal for listing the Northern Long-eared Bat (*Myotis septentrionalis*) as an Endangered species was published in the Federal Register in October 2013. The listing will become effective on or before April, 2015. NCDOT is working closely with the USFWS to understand how this proposed listing may impact NCDOT projects. NCDOT will continue to coordinate appropriately with USFWS to determine if this project will incur potential effects to the Northern long-eared bat, and how to address these potential effects, if necessary.

Project Commitments

The greensheet found in the Right of Way Consultation remains accurate.

cc: R-2248 G file

MAILING ADDRESS:
NC DEPARTMENT OF TRANSPORTATION
PROJECT DEVELOPMENT & ENVIRONMENTAL ANALYSIS UNIT
1598 MAIL SERVICE CENTER
RALEIGH NC 27699-1598

TELEPHONE: 919-707-6000
FAX: 919-212-5785

WEBSITE:NCDOT.GOV

LOCATION:
CENTURY CENTER, BUILDING B
1020 BIRCH RIDGE DRIVE
RALEIGH NC 27610

5/14/99

NEEDED DATA

1) FURNISH PLAN SHEETS IN ENGLISH UNITS AT A SCALE OF 1"=50'.
2) SURVEY LIMITS TO BE TAKEN AT THE DISTANCE SHOWN BELOW FROM THE EXISTING CENTER LINE.
3) LEVELS ON EXISTING PAVEMENT.
4) COMPLETE TOPOGRAPHIC MAPPING.
5) PROFILE ALONG EXISTING CENTER LINE.

PROJECT REFERENCE NO.	SHEET NO.
R-2248G	SUR

100 0 200

NAD 83

BEGIN SURVEY APPROX. 460' FROM THE INTERSECTION OF MT HOLLY HILL RD AND OAKDALE RD

END SURVEY APPROX. 630' FROM THE INTERSECTION OF MT HOLLY HILL RD AND OAKDALE RD

BEGIN SURVEY -RPA- GORE AREA

BEGIN SURVEY -RPB- GORE AREA

BEGIN SURVEY -RPC- GORE AREA

BEGIN SURVEY -RPD- GORE AREA

END SURVEY APPROX. 300' FROM THE INTERSECTION OF RPC AND RPD

SURVEY LIMITS

100'

50'

I:\Projects\2248G\Survey\R2248G_Survey.dgn

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
1554 MAIL SERVICE CENTER, RALEIGH, N.C. 27699-1554

PAT MCCRORY
GOVERNOR

ANTHONY J. TATA
SECRETARY

December 17, 2013

MEMORANDUM TO: Zahid Baloch, P.E.
Project Development – West Region
Project Development & Environmental Analysis Unit

FROM: Paul S. Schroeder, PhD, PE
Western Traffic Forecasting Group
Transportation Planning Branch

SUBJECT: Traffic Forecast for R-2248G
Mecklenburg County
I-485 & SR 2042 Interchange

Please find attached the 2013/2015/2035 traffic forecast for R-2248G in Mecklenburg County. The project is located north of the City of Charlotte and concerns the proposed I-485 & SR 2042 (Oakdale Road) interchange.

Project R-2248G is located within the Charlotte Regional Transportation Planning Organization (CRTPO) area. It is included within the 2035 Long Range Transportation Plans (LRTP) of the CRTPO.

While there is some evidence that a previous forecast for R-2248G was developed, a complete forecast could not be found. Therefore, it is assumed that this is the initial forecast for R-2248G.

The following individuals were consulted during the development of this forecast update:

- CRTPO Project Manager, Stuart Basham
- Charlotte DOT (CDOT) Transportation Planner, Tim Gibbs
- CDOT Modeling Manager, Anna Gallup, PE
- NCDOT Division 10 District 2 Senior Field Services Engineer, Wendy Taylor, PE
- NCDOT CRTPO Coordinator, Anil Panicker

R-2248G is scheduled for completion in 2015. A related project R-2248E concerns the construction of the proposed I-485 section from I-85 to NC 115. This will complete the I-485 Loop and is expected to substantially affect traffic volumes along I-485, including within the R-2248G project area. Accordingly, the following scenarios are provided:

- R-2248G 2013 No Build
- R-2248G 2015 No Build

MAILING ADDRESS:
NC DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING BRANCH
1554 MAIL SERVICE CENTER
RALEIGH NC 27699-1554

NCDOT TPB
TRANSPORTATION PLANNING BRANCH
http://ncdot.org/doh/preconstruct/tpb/

LOCATION:
TRANSPORTATION BUILDING
1 SOUTH WILMINGTON STREET
RALEIGH, NC 27601
Phone: 919-707-0900
Fax: 919-733-9794

- R-2248G 2015 No Build (without R-2248E in place)
- R-2248G 2015 Build (with R-2248E in place)
- R-2248G 2035 No Build (with R-2248E in place)
- R-2248G 2015 Build (with R-2248E in place)

The No Build and Build scenarios refer to the construction of the I-485 & SR 2042 (Oakdale Road) interchange.

Certain Assumptions were made during the development of this forecast.

Fiscal Constraint:
Within an MPO area, future year forecasts assume construction of projects listed within an MPO's Long Range Transportation Plan (LRTP). This forecast is consistent with the CRTPO current LRTP which was adopted on May 3, 2010 (amended September 2012).

Development Activity:
There are currently no specific plans for any substantial development near the forecast area.

Forecast Methodology:

The 2013 estimates were based upon 2013 traffic counts and historic AADT trends.

The 2015 and 2035 forecasts were developed primarily based upon travel demand predictions of the Metrolina Regional Model (MRM), Version MRM 11v1.0, adopted January 2012.

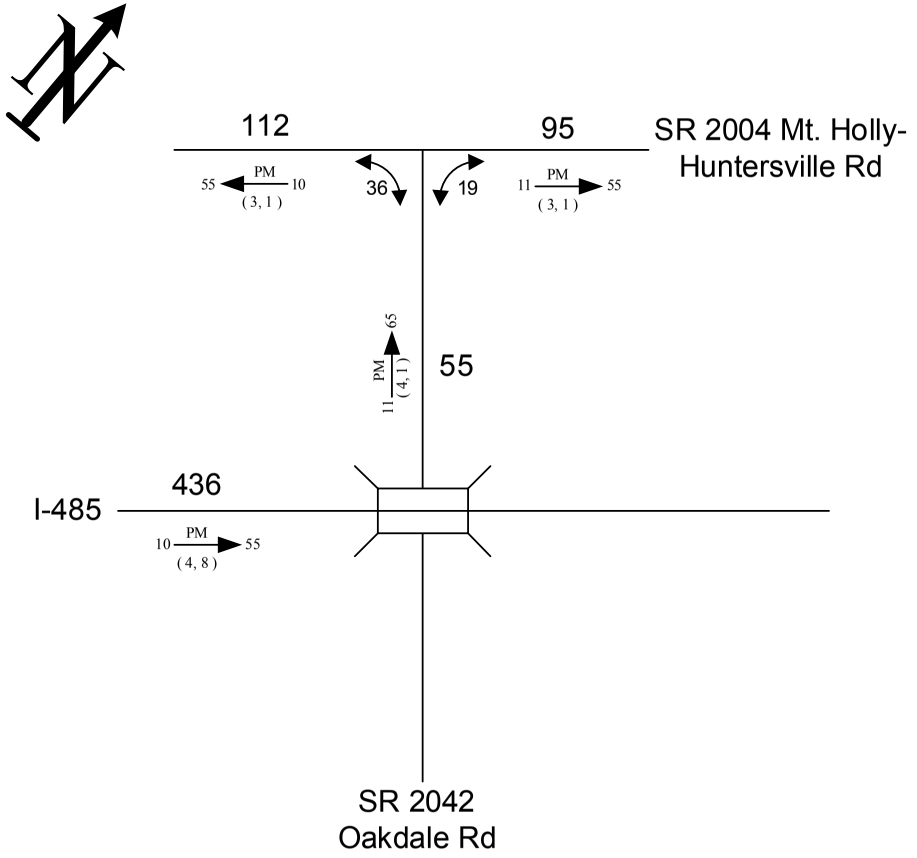
The use of straight-line interpolation to estimate AADT for years between 2013 and 2015 (without R-2248E in place), between 2015 and 2035, and straight-line extrapolation to estimate AADT for up to 2 years beyond 2035, is acceptable. However, any interpolation or extrapolation must be conducted within the same scenario, i.e. either No Build or Build.

If it is determined that any of these assumptions have become inconsistent with the project and surrounding area activity, please request updated projections at this location.

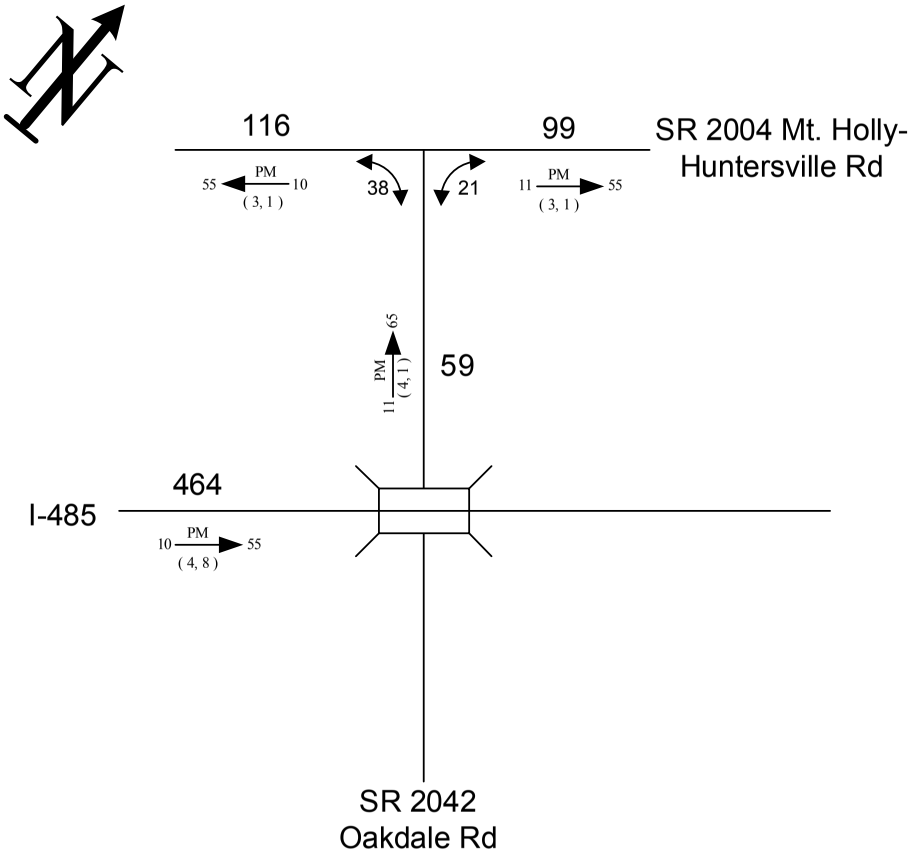
For future reference, this forecast will be saved in Project Store in the LongRangePlanning\ Traffic Forecasts folder, under project R2248G.

If we can be of any further assistance please do not hesitate to contact me at 707-0983, email: pschroeder@ncdot.gov or Michael Orr at 707-0982, email: mlorr@ncdot.gov.

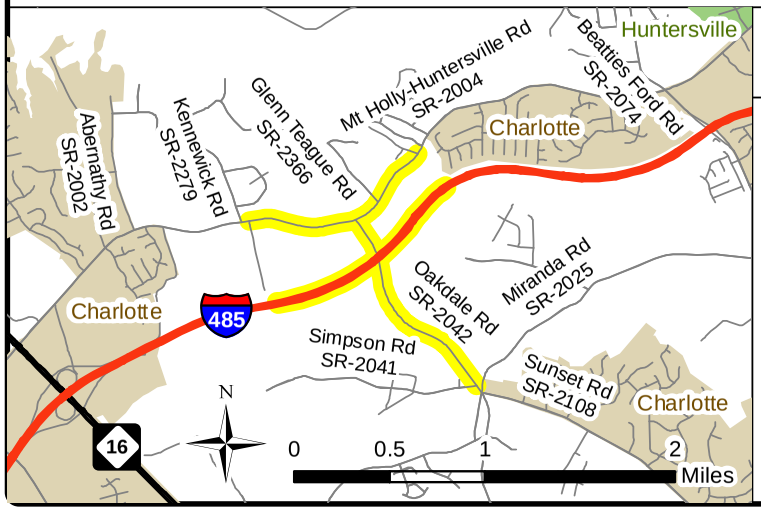
cc (with Attachments):
Jay Bennett, PE, Highway Design Branch
Jamal Alavi, PE, Transportation Planning Branch
Deborah Hutchings, PE, Transportation Planning Branch
James Dunlop, PE, Congestion Management Section
Don Chen, PE, Pavement Management
Robert Cook, CRTPO Coordinator
Louis Mitchell, PE, Division 10 Engineer
File Copy: R-2248G Mecklenburg County



2013 No Build Estimated AADT (without R-2248E in Place)



2015 No Build Estimated AADT (without R-2248E in Place)



2013/2015 AVERAGE ANNUAL DAILY TRAFFIC

No Build / No Build
SHEET 1 OF 1

LEGEND

###	No. of Vehicles Per Day in 100s
1-	Less than 50 vpd
X	Movement Prohibited
K PM (d, t) D	
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d, t)	Duals, TT-STs (%)

TIP: R-2248G **WBS:** 34410.1.S27

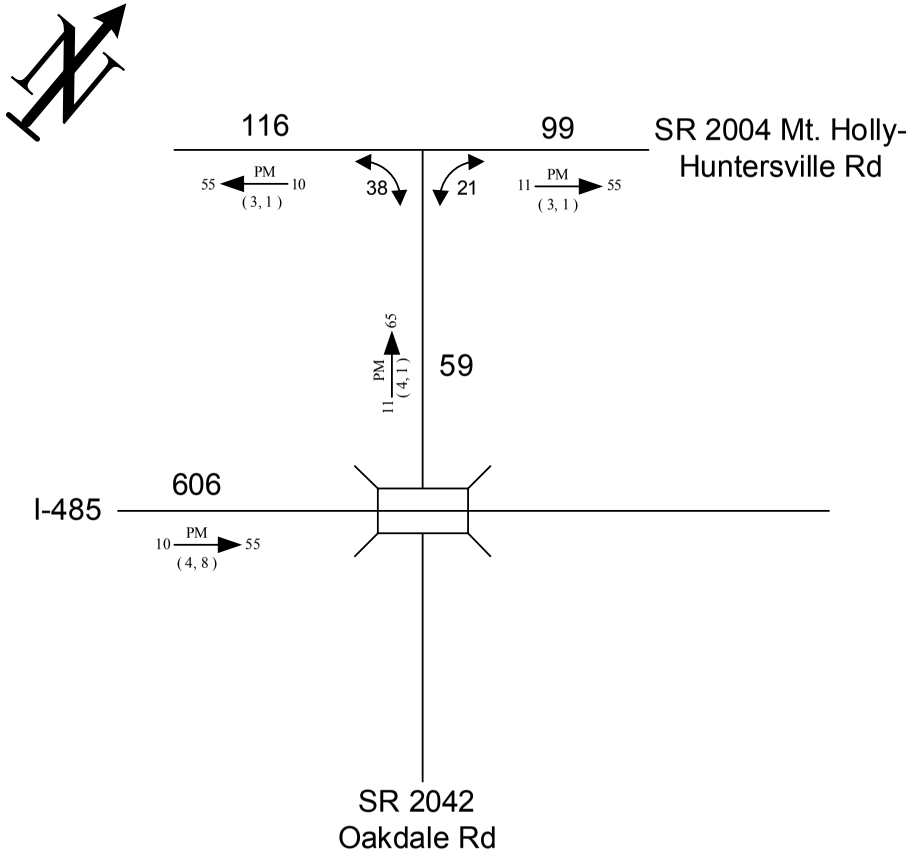
COUNTY: Mecklenburg **DIVISION:** 10

DATE: December 17, 2013

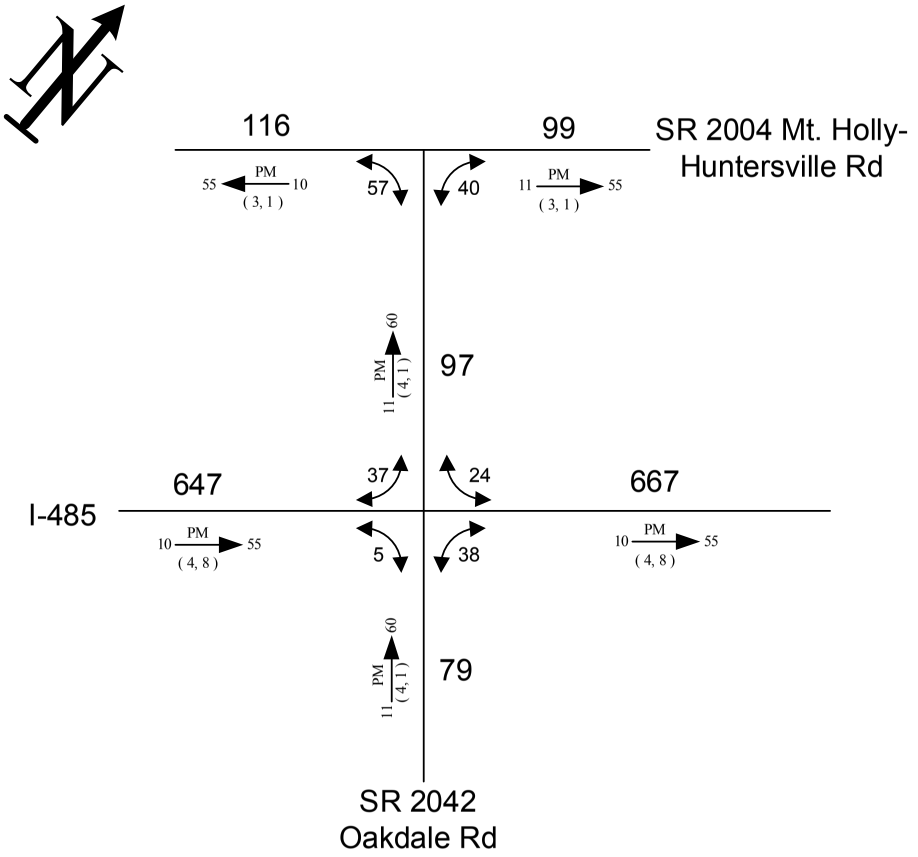
PREPARED BY: Paul Schroeder, PhD PE

LOCATION: I-485 Charlotte Outer Loop

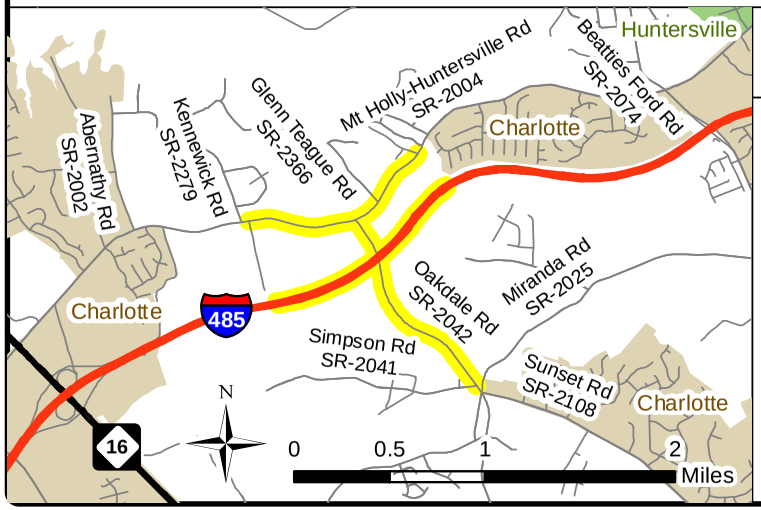
PROJECT: Construct I-485 & SR 2042 (Oakdale Rd) Interchange



2015 No Build Estimated AADT (with R-2248E in Place)



2015 Build Estimated AADT (with R-2248E in Place)



2015/2015 AVERAGE ANNUAL DAILY TRAFFIC

No Build / Build
SHEET 1 OF 1

LEGEND

###	No. of Vehicles Per Day in 100s
1-	Less than 50 vpd
X	Movement Prohibited
K PM (d, t) D	
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d, t)	Duals, TT-STs (%)

TIP: R-2248G **WBS:** 34410.1.S27

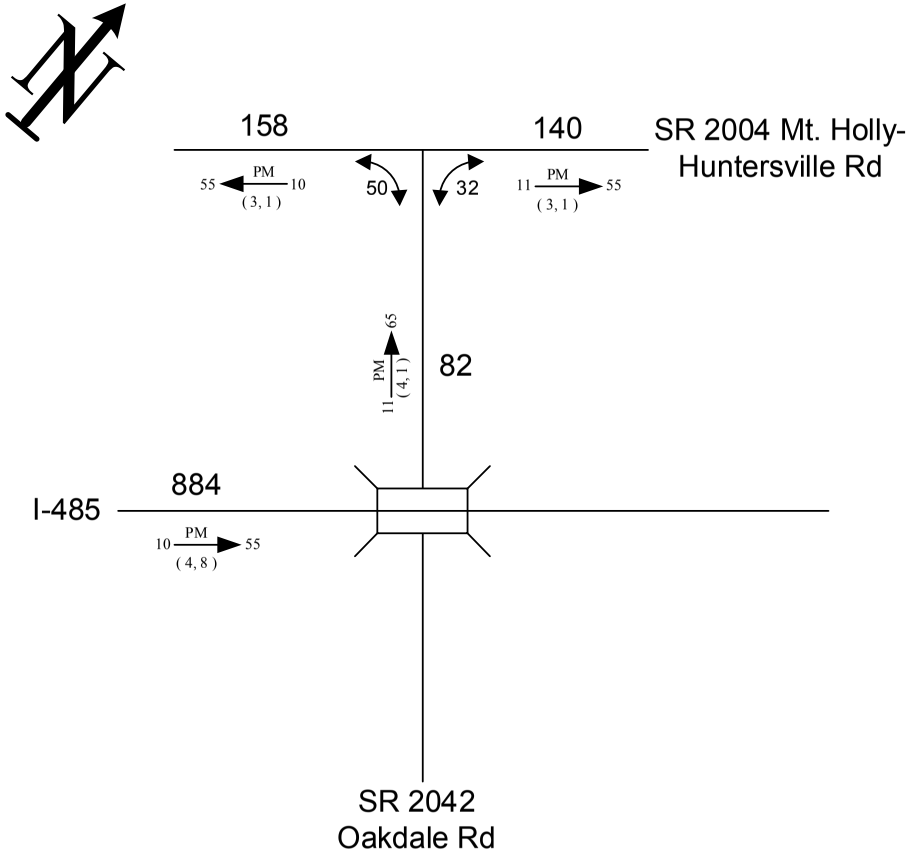
COUNTY: Mecklenburg **DIVISION:** 10

DATE: December 17, 2013

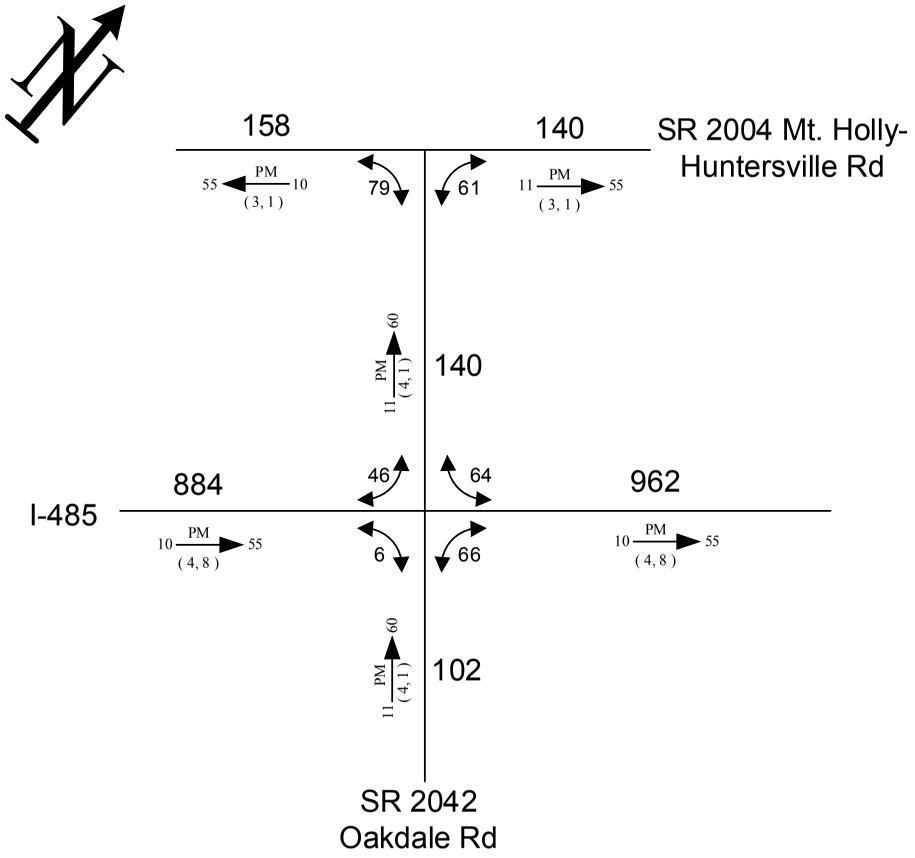
PREPARED BY: Paul Schroeder, PhD PE

LOCATION: I-485 Charlotte Outer Loop

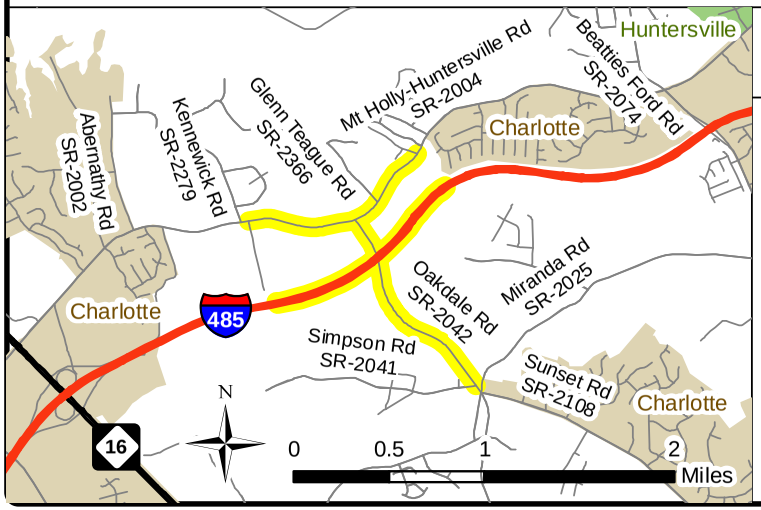
PROJECT: Construct I-485 & SR 2042 (Oakdale Rd) Interchange



2035 No Build Estimated AADT (with R-2248E in Place)



2035 Build Estimated AADT (with R-2248E in Place)



2035/2035 AVERAGE ANNUAL DAILY TRAFFIC

No Build / Build
SHEET 1 OF 1

LEGEND

###	No. of Vehicles Per Day in 100s
1-	Less than 50 vpd
X	Movement Prohibited
K PM (d, t) → D	
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d, t)	Duals, TT-STs (%)

TIP: R-2248G **WBS:** 34410.1.S27

COUNTY: Mecklenburg **DIVISION:** 10

DATE: December 17, 2013

PREPARED BY: Paul Schroeder, PhD PE

LOCATION: I-485 Charlotte Outer Loop

PROJECT: Construct I-485 & SR 2042 (Oakdale Rd) Interchange

Hatch Mott MacDonald

January 8, 2014

To: **Jim Dunlop, PE**
Congestion Management Regional Engineer
NCDOT
1561 Mail Service Center
Raleigh, NC 27699-1561

Subject: **R-2248G Highway Capacity Analysis Memorandum**

From: **Nathan Phillips, PE**
Senior Transportation Engineer
Hatch Mott MacDonald (License No. F-0669)
7621 Purfoy Road
Fuquay-Varina, NC 27256

As requested, Hatch Mott MacDonald I&E, LLC (HMM) has developed an analysis utilizing Highway Capacity Manual (HCM) 2010 procedures to evaluate the effect of adding an interchange at I-485 and SR 2042 (Oakdale Road) as part of STIP R-2248G. ***Figure 1*** shows the location of the proposed interchange. The evaluation analyzes the 2015 No Build, 2015 Build, 2035 No Build, and 2035 Build scenarios. The 2015 No Build scenario includes two separate conditions, one with STIP R-2248E and one without STIP R-2248E. Both conditions are included in this analysis and memorandum.

The analyses used the traffic forecast prepared for R-2248G dated December 17, 2013. The AM and PM peak hour volumes for the four scenarios are presented in ***Figure 2*** through ***Figure 6***. The No Build analysis was based upon existing laneage (no interchange) as shown on aerial photography. The Build analysis laneage was based on a plan sheet and supplemental information provided by the NCDOT Roadway Design Project Engineer and aerial photography of the existing ramp stub-outs. The purpose of this technical memorandum is to compare the No Build conditions to the Build conditions in years 2015 and 2035.

No Build Scenarios

In the 2015 and 2035 No Build scenarios, I-485 consists of a six-lane freeway, with three lanes in each direction. Existing Oakdale Road is grade separated with I-485. The four ramp stub-outs for the R-2248G project are in place along I-485. The free flow speed was estimated, using HCM 2010 methodologies, to be 73.1 miles per hour for the No Build conditions. The terrain is assumed to be rolling and the percentage of trucks and recreational vehicles was taken from the R-2248G traffic forecast. Given there is no interchange at this location currently, the No Build analyses consisted of basic freeway analyses only.

Build Scenarios

In the 2015 and 2035 Build scenarios, I-485 consists of a six-lane freeway, with three lanes in each direction. STIP R-2248G proposes to convert the existing Oakdale Road grade separation with I-485 to a standard diamond interchange. For the purposes of this analysis, existing aerial photography along with design information provided by the NCDOT Roadway Design Project Engineer were both used.

For the ramp analyses, on I-485 eastbound, the diverge was analyzed with a 250-foot deceleration length and the merge was analyzed with a 900-foot acceleration length (including taper distance). In the I-485 westbound direction, the diverge was analyzed with a 250-foot deceleration length and the merge was analyzed with a 900-foot acceleration length (including the taper distance).

For the basic freeway segment analyses, the free flow speed was estimated using a base free flow speed of 75.4 miles per hour and HCM 2010 methodologies. The terrain is assumed to be rolling and the percentage of trucks and recreational vehicles was taken from the R-2248G traffic forecast. The provided traffic forecast did not include adjacent interchanges; therefore, for the Build analyses, the adjacent interchange ramps at NC 24 (WT Harris Boulevard) and NC 16 (Brookshire Boulevard) were not included in this analysis. The distance between the proposed ramps at the Oakdale Road interchange and the existing ramps at NC 24 is approximately 2.30 miles while the distance to the NC 16 ramps is approximately one mile. However, the analysis included the effects of the adjacent ramps at the proposed SR 2042 (Oakdale Road) interchange itself.

Analysis Results

Tables 1 and ***2*** provide the Highway Capacity Software analyses results and those results are discussed after the respective tables. The Highway Capacity Software analyses are located after the figures.

Table 1: 2015 No Build and Build Level of Service/Density (pc/mi/ln)

Segment	*Segment Type*	*2015 No Build w/o R-2248E*		*2015 No Build With R-2248E*		*2015 Build*	
		AM	*PM*	*AM*	*PM*	*AM*	*PM*
I-485 Eastbound at Oakdale Road Overpass	Freeway	B/11.2	B/13.7	B/14.7	C/18.3	N/A	N/A
I-485 Westbound at Oakdale Road Overpass	Freeway	B/13.7	B/11.2	C/18.3	B/14.7	N/A	N/A
I-485 Eastbound Before Oakdale Road Diverge	Freeway*	B/11.2	B/13.7	B/14.7	C/18.3	B/17.5	C/20.8
I-485 Eastbound to Oakdale Road	Diverge	N/A	N/A	N/A	N/A	C/22.7	C/26.7
I-485 Eastbound Between Oakdale Road Ramps	Freeway*	B/11.2	B/13.7	B/14.7	C/18.3	B/15.6	C/19.1
I-485 Eastbound from Oakdale Road	Merge	N/A	N/A	N/A	N/A	B/19.1	C/21.7
I-485 Eastbound After Oakdale Road Merge	Freeway*	B/11.2	B/13.7	B/14.7	C/18.3	B/17.4	C/21.3
I-485 Westbound Before Oakdale Road Diverge	Freeway*	B/11.2	B/13.7	B/14.7	C/18.3	C/21.3	B/17.4
I-485 Westbound to Oakdale Road	Diverge	N/A	N/A	N/A	N/A	C/27.3	C/23.5
I-485 Westbound Between Oakdale Road Ramps	Freeway*	B/11.2	B/13.7	B/14.7	C/18.3	C/19.1	B/15.6
I-485 Westbound from Oakdale Road	Merge	N/A	N/A	N/A	N/A	C/21.0	B/17.0
I-485 Westbound After Oakdale Road Merge	Freeway*	B/11.2	B/13.7	B/14.7	C/18.3	C/19.8	B/15.7

*No Build level of service and delay is for segment at Oakdale Road Overpass and listed here for comparison purposes

As shown in ***Table 1***, all existing movements and proposed interchange movements operate at LOS C or better in 2015. Based on this information, congestion is not anticipated at the proposed interchange in 2015.

Table 2: 2035 No Build and Build Level of Service/Density (pc/mi/ln)

Segment	Segment Type	2035 No Build		2035 Build	
		AM	PM	AM	PM
I-485 Eastbound at Oakdale Road Overpass	Freeway	C/22.6	D/30.3	N/A	N/A
I-485 Westbound at Oakdale Road Overpass	Freeway	D/30.3	C/22.6	N/A	N/A
I-485 Eastbound Before Oakdale Road Diverge	Freeway*	C/22.6	D/30.3	C/23.4	D/31.4
I-485 Eastbound to Oakdale Road	Diverge	N/A	N/A	D/28.7	D/33.7
I-485 Eastbound Between Oakdale Road Ramps	Freeway*	C/22.6	D/30.3	C/21.7	D/28.2
I-485 Eastbound from Oakdale Road	Merge	N/A	N/A	C/26.8	D/32.0
I-485 Eastbound After Oakdale Road Merge	Freeway*	C/22.6	D/30.3	D/26.5	**E/35.2**
I-485 Westbound Before Oakdale Road Diverge	Freeway*	C/22.6	D/30.3	**E/35.2**	D/26.5
I-485 Westbound to Oakdale Road	Diverge	N/A	N/A	**E/35.9**	D/31.6
I-485 Westbound Between Oakdale Road Ramps	Freeway*	C/22.6	D/30.3	D/28.2	C/21.7
I-485 Westbound from Oakdale Road	Merge	N/A	N/A	D/28.8	C/23.1
I-485 Westbound After Oakdale Road Merge	Freeway*	C/22.6	D/30.3	D/30.7	C/22.4

*No Build level of service and delay is for segment at Oakdale Road Overpass and listed here for comparison purposes

As shown in ***Table 2***, without the proposed interchange, I-485 is anticipated to operate at LOS D or better in the 2035 design year. For the Build conditions, three locations operate at **LOS E** in the design year. The freeway segments of I-485 eastbound and I-485 westbound west of the proposed interchange are anticipated to operate at **LOS E** as is the I-485 westbound diverge to Oakdale Road. Based on this information, congestion is anticipated along I-485 in the area of the interchange in the design year; however, it should be noted that the greatest density is 35.9 passenger cars per mile per lane (pc/mi/ln) which is only 0.9 pc/mi/ln outside the threshold for LOS D.

Summary

With the proposed interchange, the worst levels of operations in the area of Oakdale Road will degrade from LOS D to **LOS E.** However, it should be noted that the density exceeds the LOS

D threshold by 0.9 pc/mi/ln or less in each instance and that the effect of the adjacent interchanges were not accounted for in the analyses.

Attachments

Cc with Attachments:
File

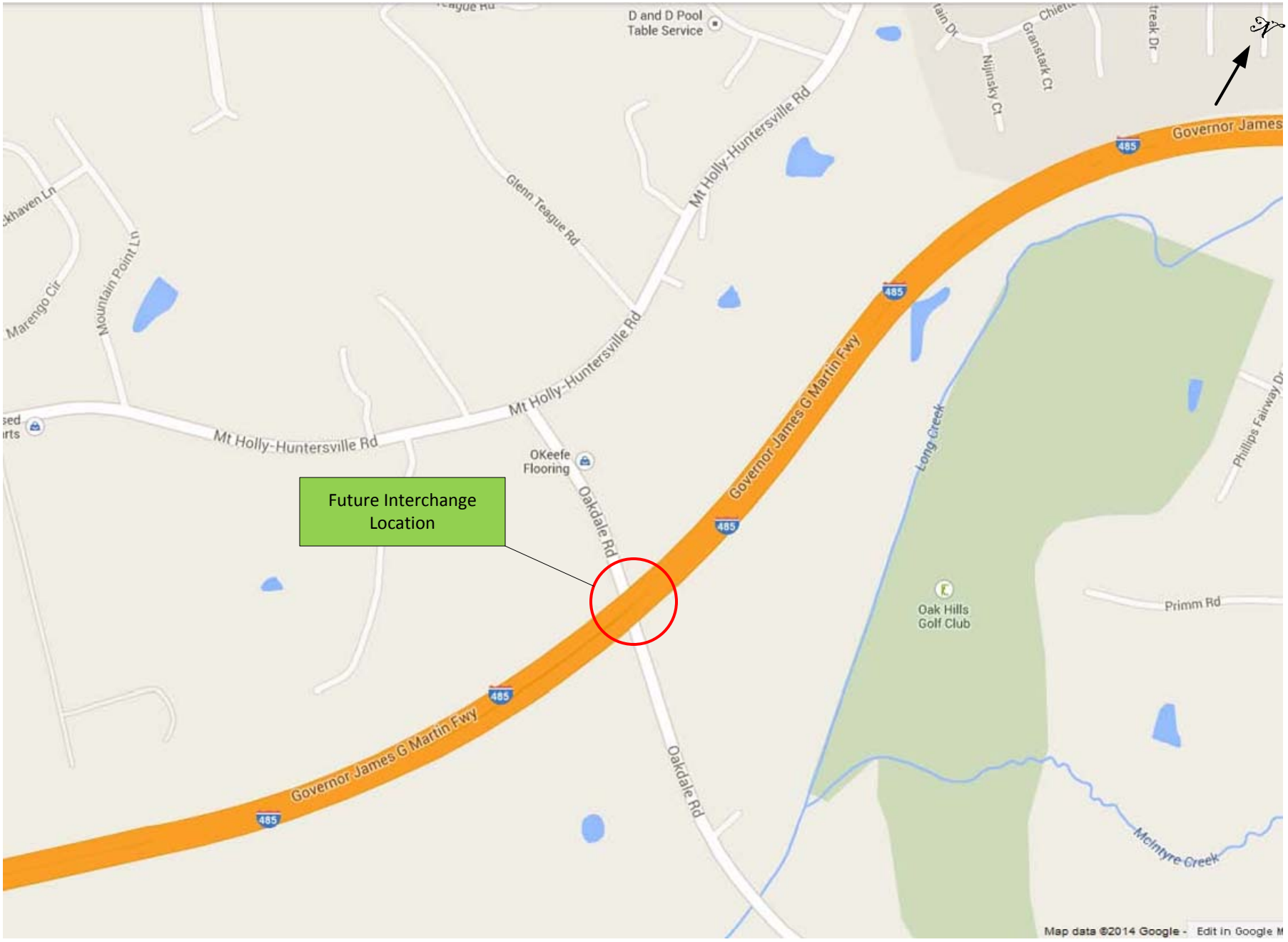


FIGURE 1	DATE: JANUARY 2014 SCALE: NOT TO SCALE	R-2248G I-485 and SR 2042 (Oakdale Road) Study Area	Hatch Mott MacDonald

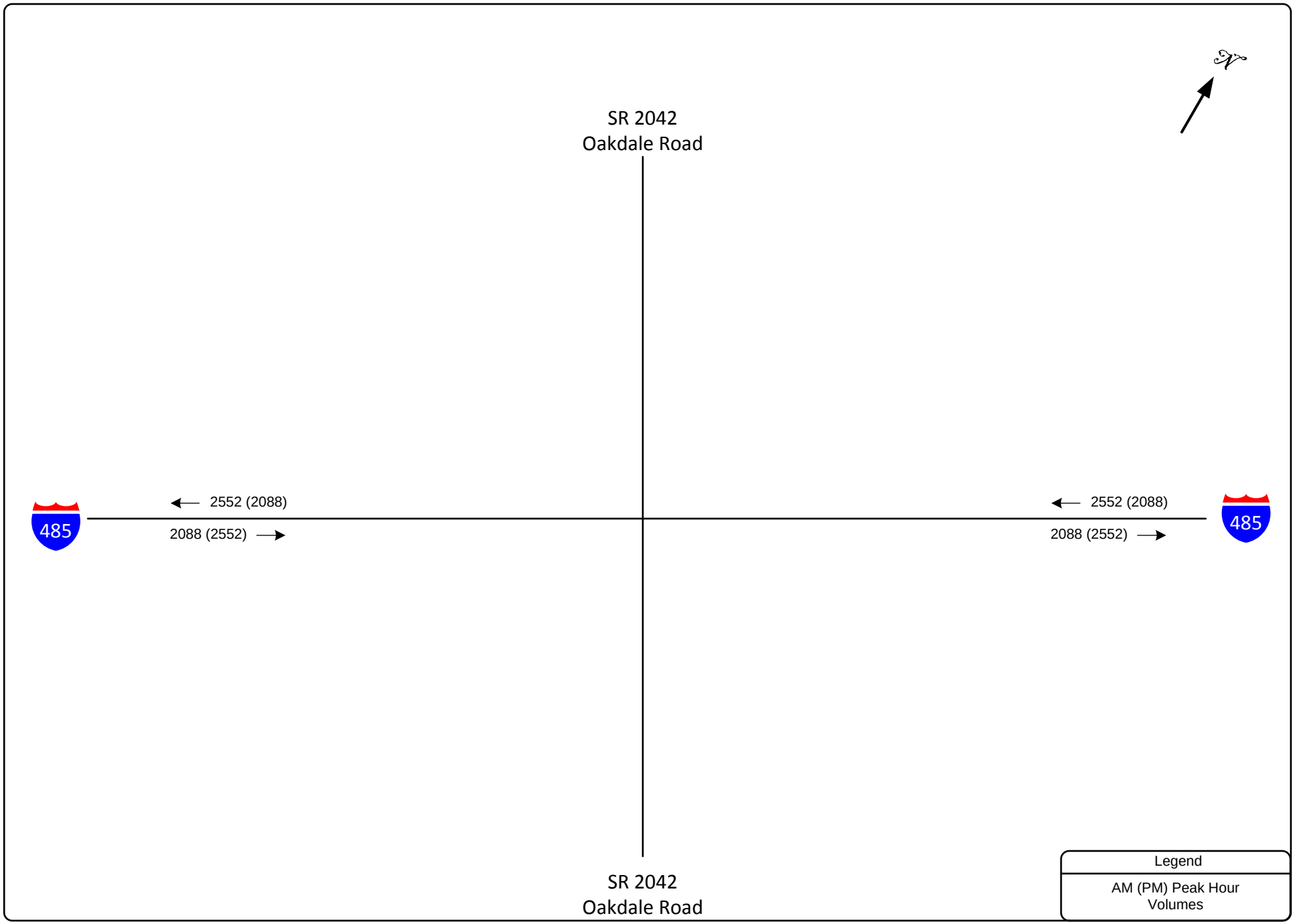


FIGURE 2

DATE: JANUARY 2014

SCALE: NOT TO SCALE

R-2248G
I-485 and SR 2042 (Oakdale Road)
2015 No Build Volumes without R-2248E

Hatch Mott MacDonald

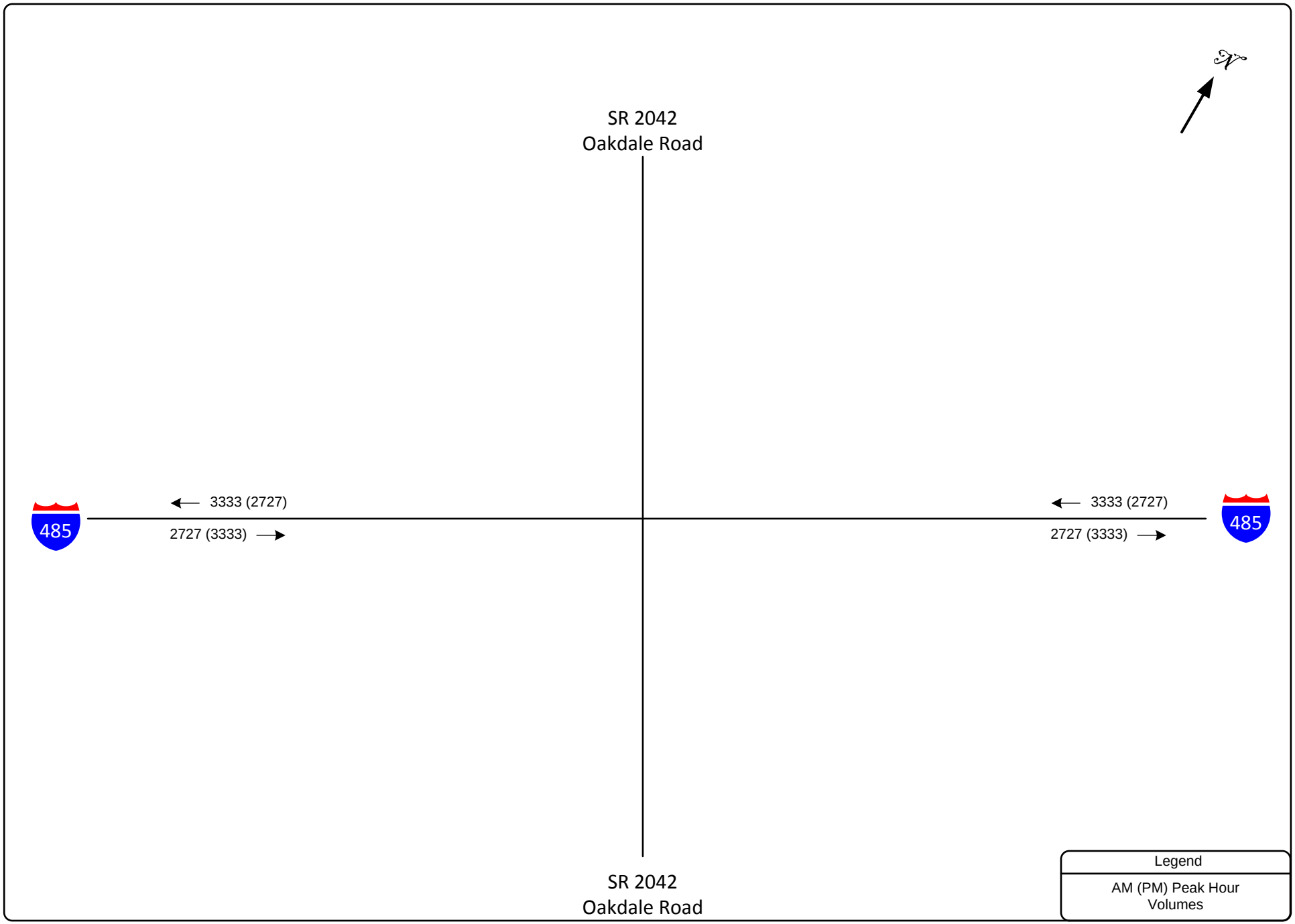


FIGURE 3

DATE: JANUARY 2014

SCALE: NOT TO SCALE

R-2248G
I-485 and SR 2042 (Oakdale Road)
2015 No Build Volumes with R-2248E

Hatch Mott MacDonald

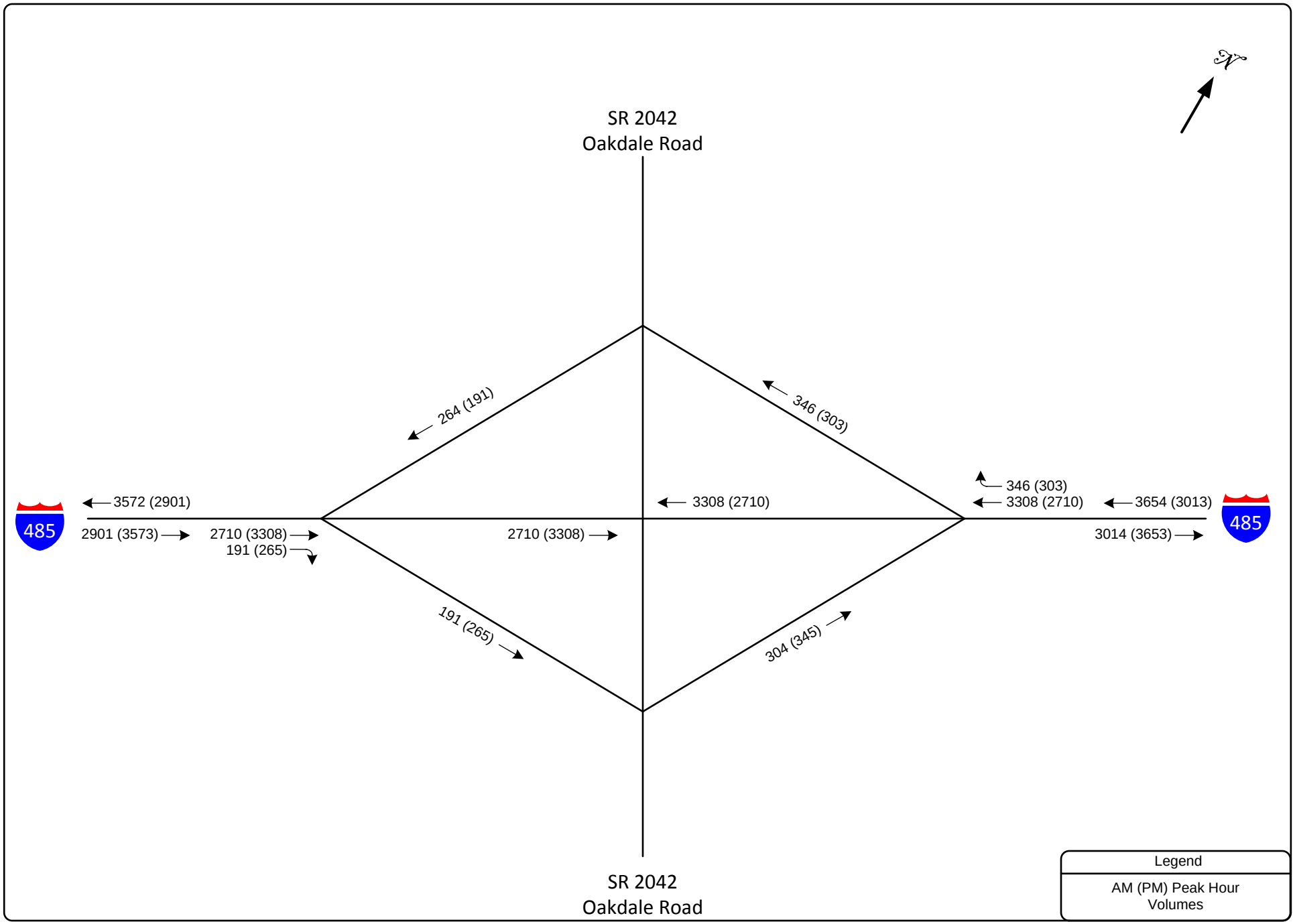


FIGURE 4	DATE: JANUARY 2014 SCALE: NOT TO SCALE	R-2248G I-485 and SR 2042 (Oakdale Road) 2015 Build Volumes	Hatch Mott MacDonald

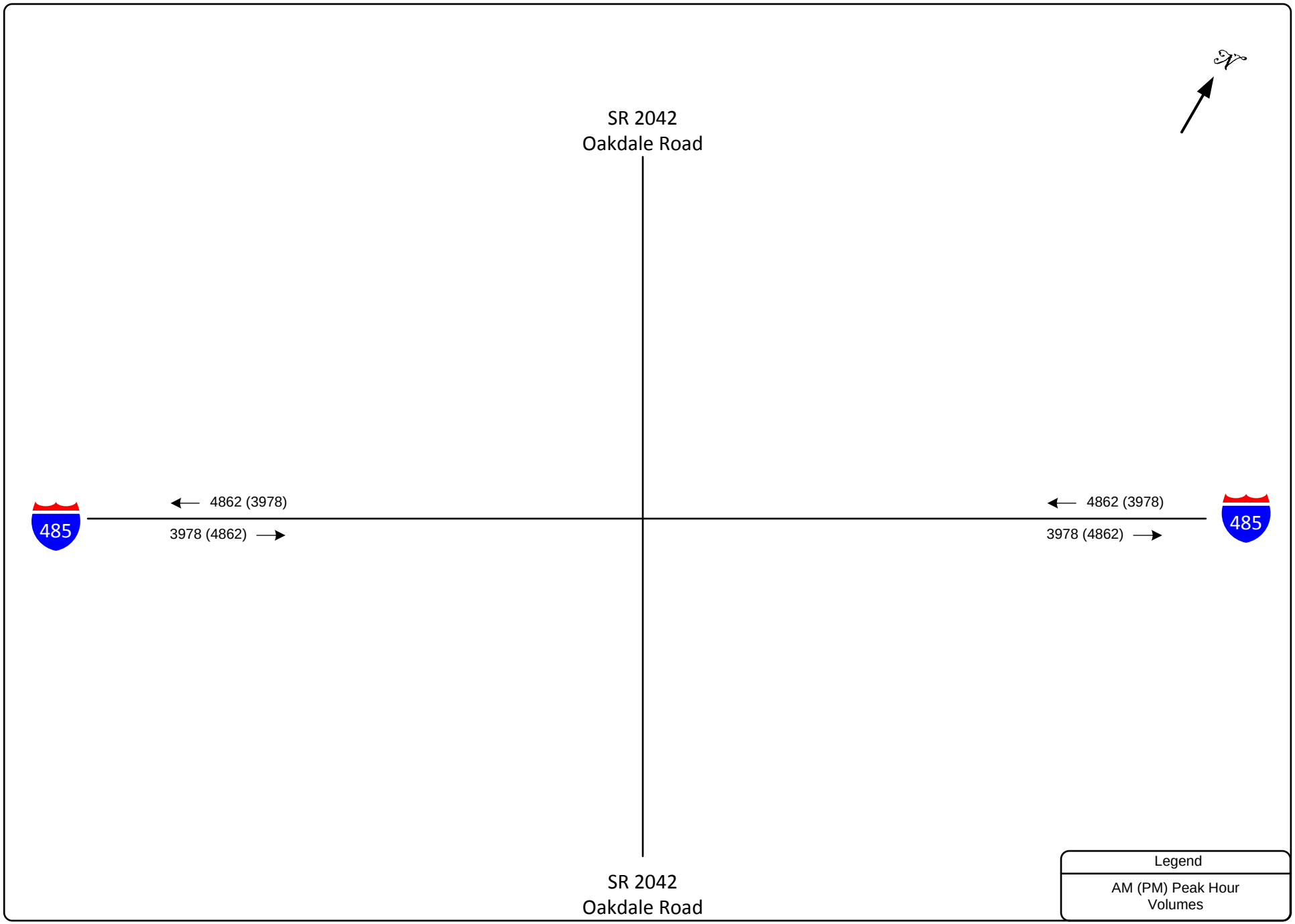


FIGURE 5

DATE: JANUARY 2014

SCALE: NOT TO SCALE

R-2248G
I-485 and SR 2042 (Oakdale Road)
2035 No Build Volumes

Hatch Mott MacDonald

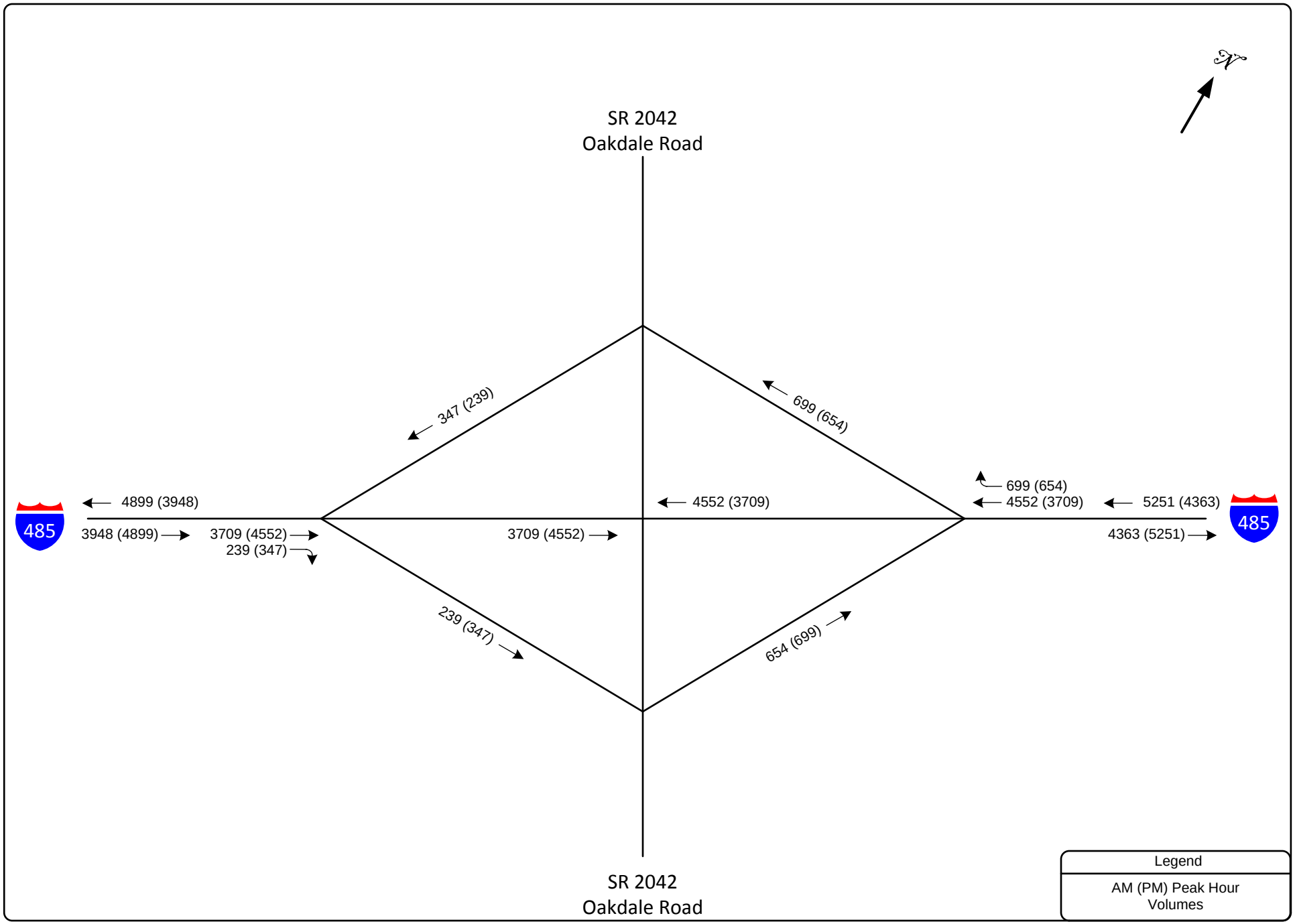


FIGURE 6

DATE: JANUARY 2014

SCALE: NOT TO SCALE

R-2248G
I-485 and SR 2042 (Oakdale Road)
2035 Build Volumes

Hatch Mott MacDonald

HCS Analysis

2015 No Build without R-2248E

BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*NKP*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*AM No Build w/o R-2248E*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2015*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*2088*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.67*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.3*	mph
FFS	*73.1*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*843*	pc/h/ln
S	*75.0*	mph
D = v_p / S	*11.2*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*NKP*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*PM No Build without R-2248E*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2015*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*2552*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.67*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.3*	mph
FFS	*73.1*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1030*	pc/h/ln
S	*75.0*	mph
D = v_p / S	*13.7*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*NKP*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*AM No Build w/o R-2248E*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2015*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*2552*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.83*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.8*	mph
FFS	*72.6*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1030*	pc/h/ln
S	*75.0*	mph
D = v_p / S	*13.7*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*NKP*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*PM No Build w/o R-2248E*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2015*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*2088*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.83*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.8*	mph
FFS	*72.6*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*843*	pc/h/ln
S	*75.0*	mph
D = v_p / S	*11.2*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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2015 No Build with R-2248E

2015 Build

BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*AM No Build w/ R-2248E*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2015*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*2727*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.67*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.3*	mph
FFS	*73.1*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1101*	pc/h/ln
S	*74.9*	mph
D = v_p / S	*14.7*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*PM No Build with R-2248E*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2015*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*3333*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*		E_R	*2.0*
E_T	*2.5*		$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.67*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.3*	mph
FFS	*73.1*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1346*	pc/h/ln
S	*73.7*	mph
D = v_p / S	*18.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*AM No Build w/ R-2248E*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2015*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*3333*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.83*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.8*	mph
FFS	*72.6*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1346*	pc/h/ln
S	*73.7*	mph
D = v_p / S	*18.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*PM No Build w/ R-2248E*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2015*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*2727*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.83*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.8*	mph
FFS	*72.6*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1101*	pc/h/ln
S	*74.9*	mph
D = v_p / S	*14.7*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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2035 No Build

BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*PM No Build*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*4862*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.67*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.3*	mph
FFS	*73.1*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1963*	pc/h/ln
S	*64.7*	mph
D = v_p / S	*30.3*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*AM No Build*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*3978*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.67*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.3*	mph
FFS	*73.1*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1606*	pc/h/ln
S	*70.9*	mph
D = v_p / S	*22.6*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*AM No Build*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*4862*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.83*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.8*	mph
FFS	*72.6*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1963*	pc/h/ln
S	*64.7*	mph
D = v_p / S	*30.3*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/18/2013*
Analysis Time Period	*PM No Build*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*NC 16 to Beatties Ford Road*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*3978*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.83*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.8*	mph
FFS	*72.6*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1606*	pc/h/ln
S	*70.9*	mph
D = v_p / S	*22.6*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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2035 Build

BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*AM Build*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*Before Oakdale off-ramp*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*3948*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*1.00*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*3.2*	mph
FFS	*72.2*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1594*	pc/h/ln
S	*68.2*	mph
D = v_p / S	*23.4*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*PM Build*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*Before Oakdale off-ramp*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*4899*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*1.00*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*3.2*	mph
FFS	*72.2*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1978*	pc/h/ln
S	*63.0*	mph
D = v_p / S	*31.4*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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HCS 2010: Freeway Merge and Diverge Segments Release 6.50

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Millen
Agency/Co.:	HMM
Date performed:	12/19/2013
Analysis time period:	AM Build
Freeway/Dir of Travel:	I-485 Eastbound
Junction:	Diverge to Oakdale Road
Jurisdiction:	Mecklenburg County, NC
Analysis Year:	2035
Description:	R-2248G - Oakdale Road Interchange Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3948	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	239	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3948	239		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1097	66		v
Trucks and buses	6	3		%
Recreational vehicles	0	0		%
Terrain type:	Rolling	Rolling		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	2.5	2.5		
Recreational vehicle PCE, ER	2.0	2.0		

Heavy vehicle adjustment, fHV	0.917	0.957	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	4781	278	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.628 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3104 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4781	7200	No
$v_{FO} = v_F - v_R$	4503	7200	No
v_R	278	2100	No
v_3 or v_{av34}	1677 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 3104 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3104	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_R - 0.009 L_D$ = 28.7 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.323

Space mean speed in ramp influence area, S_R = 61.0 mph

Space mean speed in outer lanes, S_0 = 74.1 mph

Space mean speed for all vehicles, S = 65.0 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Millen
Agency/Co.:	HMM
Date performed:	12/19/2013
Analysis time period:	PM Build
Freeway/Dir of Travel:	I-485 Eastbound
Junction:	Diverge to Oakdale Road
Jurisdiction:	Mecklenburg County, NC
Analysis Year:	2035
Description:	R-2248G - Oakdale Road Interchange Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4899	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	347	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4899	347		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1361	96		v
Trucks and buses	6	3		%
Recreational vehicles	0	0		%
Terrain type:	Rolling	Rolling		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	2.5	2.5		
Recreational vehicle PCE, ER	2.0	2.0		

Heavy vehicle adjustment, fHV	0.917	0.957	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	5933	403	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.593 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3683 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5933	7200	No
$v_{FO} = v_F - v_R$	5530	7200	No
v_R	403	2100	No
v_3 or v_{av34}	2250 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 3683 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3683	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086\, v_R - 0.009\, L_{12}$ = 33.7 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.334

Space mean speed in ramp influence area, S_R = 60.6 mph

Space mean speed in outer lanes, S_0 = 71.9 mph

Space mean speed for all vehicles, S = 64.5 mph

BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*AM Build*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*Between Oakdale ramps*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*3709*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*1.00*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*3.2*	mph
FFS	*72.2*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1497*	pc/h/ln
S	*69.0*	mph
D = v_p / S	*21.7*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*PM Build*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*Between Oakdale ramps*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*4552*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*1.00*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*3.2*	mph
FFS	*72.2*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1838*	pc/h/ln
S	*65.3*	mph
D = v_p / S	*28.2*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Millen
Agency/Co.:	HMM
Date performed:	12/19/2013
Analysis time period:	AM Build
Freeway/Dir of Travel:	I-485 Eastbound
Junction:	Merge from Oakdale Road
Jurisdiction:	Mecklenburg County, NC
Analysis Year:	2035
Description:	R-2248G - Oakdale Road Interchange Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3709	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	654	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	239	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3709	654	239	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1030	182	66	v
Trucks and buses	6	6	3	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

Heavy vehicle adjustment, fHV	0.917	0.917	0.957	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4492	792	278	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1481.78 (Equation 13-6 or 13-7)

P_{FM} = 0.603 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2707 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5284	7200	No
v_3 or v_{av34}	1785 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 2707 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3499	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 26.8 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.369	
Space mean speed in ramp influence area,	S_R = 59.7	mph
Space mean speed in outer lanes,	S_0 = 65.4	mph
Space mean speed for all vehicles,	S = 61.5	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Millen
Agency/Co.:	HMM
Date performed:	12/19/2013
Analysis time period:	PM Build
Freeway/Dir of Travel:	I-485 Eastbound
Junction:	Merge from Oakdale Road
Jurisdiction:	Mecklenburg County, NC
Analysis Year:	2035
Description:	R-2248G - Oakdale Road Interchange Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4552	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	699	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	347	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2950	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4552	699	347	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1264	194	96	v
Trucks and buses	6	6	3	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

Heavy vehicle adjustment, fHV	0.917	0.917	0.957	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5513	847	403	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1712.04 (Equation 13-6 or 13-7)

P_{FM} = 0.603 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3323 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	6360	7200	No
v_3 or v_{av34}	2190 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 Yes

If yes, v_{12A} = 3323 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{12A}	4170	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 32.0 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.492	
Space mean speed in ramp influence area,	S_R = 56.2	mph
Space mean speed in outer lanes,	S_0 = 63.9	mph
Space mean speed for all vehicles,	S = 58.6	mph

BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*AM Build*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*After Oakdale on-ramp*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*4363*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*1.17*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*3.7*	mph
FFS	*71.7*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1761*	pc/h/ln
S	*66.3*	mph
D = v_p / S	*26.5*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*PM Build*

Site Information

Highway/Direction of Travel	*I-485 Eastbound*
From/To	*After Oakdale on-ramp*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*5251*	veh/h	Peak-Hour Factor, PHF	*0.90*	
AADT		veh/day	%Trucks and Buses, P_T	*6*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*	
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*	

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*1.17*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*3.7*	mph
FFS	*71.7*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2120*	pc/h/ln
S	*60.2*	mph
D = v_p / S	*35.2*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*AM Build*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*Before Oakdale off-ramp*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*5251*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*1.17*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*3.7*	mph
FFS	*71.7*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2120*	pc/h/ln
S	*60.2*	mph
D = v_p / S	*35.2*	pc/mi/ln
LOS	*E*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*PM Build*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*Before Oakdale off-ramp*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*4363*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*1.17*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*3.7*	mph
FFS	*71.7*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1761*	pc/h/ln
S	*66.3*	mph
D = v_p / S	*26.5*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Millen
Agency/Co.:	HMM
Date performed:	12/19/2013
Analysis time period:	AM Build
Freeway/Dir of Travel:	I-485 Westbound
Junction:	Diverge to Oakdale Road
Jurisdiction:	Mecklenburg County, NC
Analysis Year:	2035
Description:	R-2248G - Oakdale Road Interchange Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	5251	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	699	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5251	699		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1459	194		v
Trucks and buses	6	3		%
Recreational vehicles	0	0		%
Terrain type:	Rolling	Rolling		
Grade	0.00 %	0.00 %		%
Length	0.00 mi	0.00 mi		mi
Trucks and buses PCE, ET	2.5	2.5		
Recreational vehicle PCE, ER	2.0	2.0		

Heavy vehicle adjustment, fHV	0.917	0.957	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	6360	812	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.564 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3939 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6360	7200	No
$v_{FO} = v_F - v_R$	5548	7200	No
v_R	812	2100	No
v_3 or v_{av34}	2421 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 3939 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3939	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 35.9 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.371

Space mean speed in ramp influence area, S_R = 59.6 mph

Space mean speed in outer lanes, S_0 = 71.2 mph

Space mean speed for all vehicles, S = 63.6 mph

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	Millen
Agency/Co.:	HMM
Date performed:	12/19/2013
Analysis time period:	PM Build
Freeway/Dir of Travel:	I-485 Westbound
Junction:	Diverge to Oakdale Road
Jurisdiction:	Mecklenburg County, NC
Analysis Year:	2035
Description:	R-2248G - Oakdale Road Interchange Analysis

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4363	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	45.0	mph
Volume on ramp	654	vph
Length of first accel/decel lane	250	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

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

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4363	654		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1212	182		v
Trucks and buses	6	3		%
Recreational vehicles	0	0		%
Terrain type:	Rolling	Rolling		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	2.5	2.5		
Recreational vehicle PCE, ER	2.0	2.0		

Heavy vehicle adjustment, fHV	0.917	0.957	
Driver population factor, fP	1.00	1.00	
Flow rate, vp	5284	759	pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 0.593 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3442 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5284	7200	No
$v_{FO} = v_F - v_R$	4525	7200	No
v_R	759	2100	No
v_3 or v_{av34}	1842 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 3442 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3442	4400	No

Level of Service Determination (if not F)

Density, $D = 4.252 + 0.0086 v_R - 0.009 L_{12}$ = 31.6 pc/mi/ln

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

Speed Estimation

Intermediate speed variable, D_S = 0.366

Space mean speed in ramp influence area, S_R = 59.7 mph

Space mean speed in outer lanes, S_0 = 73.5 mph

Space mean speed for all vehicles, S = 63.9 mph

BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*AM Build*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*Between Oakdale ramps*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*4552*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*1.17*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*3.7*	mph
FFS	*71.7*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1838*	pc/h/ln
S	*65.3*	mph
D = v_p / S	*28.2*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*PM Build*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*Between Oakdale ramps*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*3709*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*1.17*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*3.7*	mph
FFS	*71.7*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1497*	pc/h/ln
S	*69.0*	mph
D = v_p / S	*21.7*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Millen
Agency/Co.:	HMM
Date performed:	12/19/2013
Analysis time period:	AM Build
Freeway/Dir of Travel:	I-485 Westbound
Junction:	Merge from Oakdale Road
Jurisdiction:	Mecklenburg County, NC
Analysis Year:	2035
Description:	R-2248G - Oakdale Road Interchange Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	4552	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	347	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	699	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2900	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4552	347	699	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1264	96	194	v
Trucks and buses	6	6	3	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

Heavy vehicle adjustment, fHV	0.917	0.917	0.957	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5513	420	812	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1620.66 (Equation 13-6 or 13-7)

P_{FM} = 0.603 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 3323 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5933	7200	No
v_3 or v_{av34}	2190 pc/h	(Equation 13-14 or 13-17)	

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 3323 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3743	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 28.8 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.405	
Space mean speed in ramp influence area,	S_R = 58.7	mph
Space mean speed in outer lanes,	S_0 = 63.9	mph
Space mean speed for all vehicles,	S = 60.5	mph

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	Millen
Agency/Co.:	HMM
Date performed:	12/19/2013
Analysis time period:	PM Build
Freeway/Dir of Travel:	I-485 Westbound
Junction:	Merge from Oakdale Road
Jurisdiction:	Mecklenburg County, NC
Analysis Year:	2035
Description:	R-2248G - Oakdale Road Interchange Analysis

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	70.0	mph
Volume on freeway	3709	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	45.0	mph
Volume on ramp	239	vph
Length of first accel/decel lane	900	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	654	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	Off	
Distance to adjacent Ramp	2900	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3709	239	654	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1030	66	182	v
Trucks and buses	6	6	3	%
Recreational vehicles	0	0	0	%
Terrain type:	Rolling	Rolling	Rolling	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	2.5	2.5	2.5	
Recreational vehicle PCE, ER	2.0	2.0	2.0	

Heavy vehicle adjustment, fHV	0.917	0.917	0.957	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	4492	289	759	pcph

Estimation of V12 Merge Areas

L_{EQ} = 1374.13 (Equation 13-6 or 13-7)

P_{FM} = 0.603 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2707 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4781	7200	No
v_3 or v_{av34}	1785 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34}	> 2700 pc/h?	No	
Is v_3 or v_{av34}	> 1.5 v_{12} /2	No	

If yes, v_{12A} = 2707 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2996	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 23.1 pc/mi/ln

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

Speed Estimation

Intermediate speed variable,	M_S = 0.318	
Space mean speed in ramp influence area,	S_R = 61.1	mph
Space mean speed in outer lanes,	S_0 = 65.4	mph
Space mean speed for all vehicles,	S = 62.6	mph

BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*AM Build*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*After Oakdale on-ramp*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*4899*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.83*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.8*	mph
FFS	*72.6*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1978*	pc/h/ln
S	*64.4*	mph
D = v_p / S	*30.7*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information

Analyst	*Millen*
Agency or Company	*HMM*
Date Performed	*12/19/2013*
Analysis Time Period	*PM Build*

Site Information

Highway/Direction of Travel	*I-485 Westbound*
From/To	*After Oakdale on-ramp*
Jurisdiction	*Mecklenburg County, NC*
Analysis Year	*2035*

Project Description *R-2248G - Oakdale Road Interchange Analysis*

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

Flow Inputs

Volume, V	*3948*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs

Lane Width	*12.0*	ft
Rt-Side Lat. Clearance	*6.0*	ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD	*0.83*	ramps/mi
FFS (measured)		mph
Base free-flow Speed, BFFS	*75.4*	mph

Calc Speed Adj and FFS

f_{LW}	*0.0*	mph
f_{LC}	*0.0*	mph
TRD Adjustment	*2.8*	mph
FFS	*72.6*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1594*	pc/h/ln
S	*71.1*	mph
D = v_p / S	*22.4*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

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

Glossary

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

Factor Location

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

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STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

PAT MCCRORY
GOVERNOR

ANTHONY J. TATA
SECRETARY

December 12, 2013

TIP Project: R-2248G
Division: 10
County: Mecklenburg
Description: I-485 Charlotte Outer Loop Interchange with SR 2042 (Oakdale Road)

MEMORANDUM

Document Sent Electronically

To: Zahid M. Baloch, P.E., Project Development Engineer
Project Development – Western Region/Turnpike

From: Mohammad S. Islam, P.E., Project Design Engineer
Congestion Management Section

Subject: I-485 Interchange with SR 2042 (Oakdale Road) Corridor Roundabout Analysis

As requested, the Congestion Management Section has completed a draft review of the subject interchange and intersection. In order to evaluate the traffic flow impacts of converting the existing grade separation to a diamond interchange, we calculated intersection traffic volumes using the DRAFT Traffic forecast for 2015 and 2035 dated January 2014. Oakdale Road is a three (3) lane roadway (middle lane TWLTL) with a 2012 AADT of 5,100 vehicles per day. We performed capacity analysis for the base year (2015) and the design year (2035) peak hour using SIDRA traffic analysis software, version 5.

The following three intersections were analyzed for base year 2015 and design year 2035:

1. The I-485 Eastbound (EB) Ramps and SR 2042 (Oakdale Rd.) Interchange Intersection
2. The I-485 Westbound (WB) Ramps and SR 2042 (Oakdale Rd.) Interchange Intersection
3. SR 2042 (Oakdale Road) and SR 2004 (Mt. Holly Rd. / Huntersville Rd.) Stop-Controlled Intersection

Our analysis results and sample geometrical figures are attached with this letter.

Base Year (2015)/Design Year (2035) No-Build/Build Analysis

1. The I-485 Eastbound (EB) Ramps and SR 2042 (Oakdale Rd.) Interchange Intersection
A single lane roundabout was analyzed for this intersection. Based on 2012 base year capacity analysis results, this single lane roundabout configuration should work acceptably during the base year 2015. During the design year (2035), an exclusive northbound right-turn lane with 200' storage plus taper should be added.

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1561 MAIL SERVICE CENTER
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WEBSITE: WWW.NCDOT.ORG

LOCATION:
750 NORTH GREENFIELD PARKWAY
GARNER NC 27529

2. The I-485 Westbound (WB) Ramps and SR 2042 (Oakdale Rd.) interchange Intersection
A single lane roundabout was analyzed for this intersection. Based on 2012 base year capacity analysis results, this single lane roundabout configuration should work acceptably during the base year 2015. During the design year (2035), an exclusive southbound right-turn lane with 150' storage plus taper should be added.

3. SR 2042 (Oakdale Rd.) and SR 2004 (Mt. Holly/Huntersville Rd.) Intersection
A single lane roundabout with a northbound exclusive right-turn lane (200') was analyzed for this intersection. Based on 2012 base year capacity analysis results, this single lane roundabout configuration should work acceptably during the base year 2015.

During the design year (2035), a single lane roundabout with lanes (225' EB right-turn, 200' NB Right-turn, and 200' WB left-turn lanes) was analyzed for this intersection. Based on capacity analysis results, this single lane roundabout configuration works acceptably during the design year 2035.

Based on our analysis, we have the following recommendations for design and these recommendations should be installed during the construction of this TIP project:

1. The I-485 Eastbound (EB) Ramps and SR 2042 (Oakdale Rd.) Interchange Intersection
- A single lane roundabout with an exclusive NB right-turn lane with 200' storage with appropriate taper.

2. The I-485 Westbound (WB) Ramps and SR 2042 (Oakdale Rd.) Interchange Intersection
- A single lane roundabout with an exclusive SB right-turn lane with 150' storage with appropriate taper.

3. SR 2042 (Oakdale Rd.) and SR 2004 (Mt. Holly/Huntersville Rd.) Intersection
- A single lane roundabout with exclusive lanes (225' EB right-turn, 200' NB Right-turn, and 150' WB left-turn lanes with appropriate taper).

A final memo will be issued once the traffic forecast has been finalized. Congestion Management Section is also reviewing freeway operations on I-485 with the proposed interchange, and will issue a separate review memo shortly.

If you have questions regarding this analysis, or if further analysis is requested, please contact me or Congestion Management Engineer James H. Dunlop, P.E., at (919) 773-2800.

MSI/

Attachments

cc: G. E. Brew, P.E. (Attn. I. T. Younis)
J. S. Cole, P.E. (Attn. S. M. Epperson, P.E.)
J. K. Lacy, P.E., CPM
D.D. Galloway, P.E.
M. P. Butler, P.E.
J. H. Dunlop, P.E.
M. P. Reese, P.E.

December 12, 2013

R-2248G

NCDOT-Congestion Management Section

1. **I-485 Eastbound (EB) Ramps and SR 2042 (Oakdale Road) Interchange Intersection**
The results of the base year (2015) and Design year (2035) peak hour analysis are shown in the following table:

Peak Hour Intersection Analysis Comparisons	2015 NB/Build Single Lane Roundabout		2035 NB/Build Single Lane Roundabout★	
	AM	PM	AM	PM
Overall Intersection LOS	A	A	A	A
Worst Movement LOS	A	B	B	B
Worst Movement v/c Ratio	0.47	0.74	0.42	0.61
Worst Movement Max. Queuing	100'	274' (NB)	100'	182' (NB)

★ Single lane Roundabout with slip lane

2. **I-485 Westbound (WB) Ramps and SR 2042 (Oakdale Road) Interchange Intersection**
The results of the base year (2015) and Design year (2035) peak hour analysis are shown in the following table:

Peak Hour Intersection Analysis Comparisons	2015 NB/Build Single Lane Roundabout		2035 NB/Build Single Lane Roundabout★	
	AM	PM	AM	PM
Overall Intersection LOS	A	A	A	A
Worst Movement Delay (Sec.)	A	A	B	B
Worst Movement v/c Ratio	0.79	0.50	0.78	0.79
Worst Movement Max. Queuing	338' (SB)	117'	327' (SB)	339' (off-ramp)

★ Single lane Roundabout with slip lane

3. **SR 2042 (Oakdale Road) and SR 2004 (Mt. Holly-Huntersville Road) Intersection**
The results of the base year (2015) and Design year (2035) peak hour analysis are shown in the following table:

Peak Hour Intersection Analysis Comparisons	2015 NB/Build Single Lane Roundabout★		2035 NB/Build Single Lane Roundabout★	
	AM	PM	AM	PM
Overall Intersection LOS	A	A	A	A
Worst Movement Delay (Sec.)	B	B	A	B
Worst Movement v/c Ratio	0.79	0.70	0.65	0.61
Worst Movement Max. Queuing	371' (WB)	251' (EB)	207' (EB)	178' (NB)

★ Single lane Roundabout with slip lane

TIP R-2248G (2015 No-Build/Build)

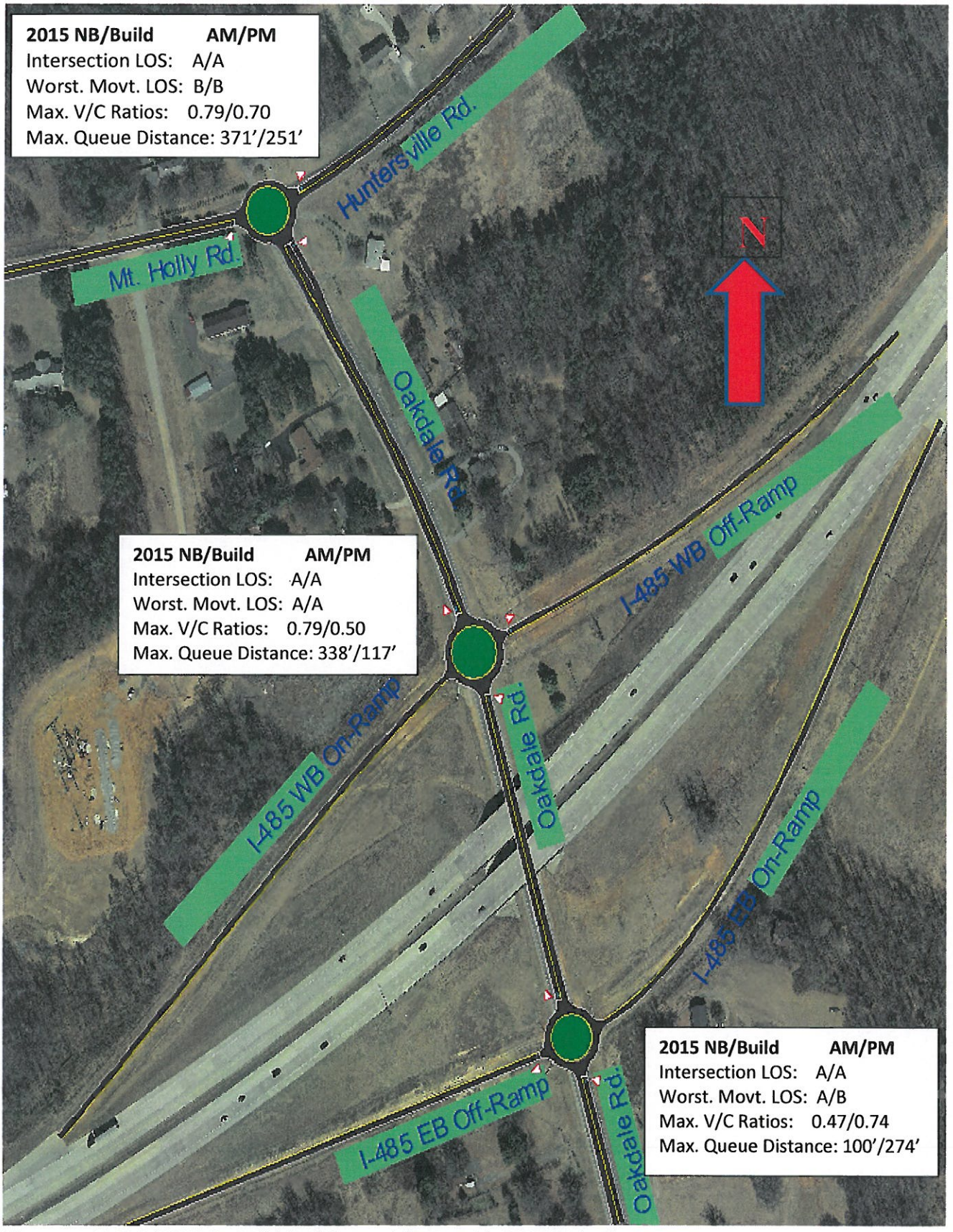

Figure: R-2248G (2015 No-Build/Build) roundabouts with R-2248E in place

TIP R-2248G (2035 No-Build/Build)

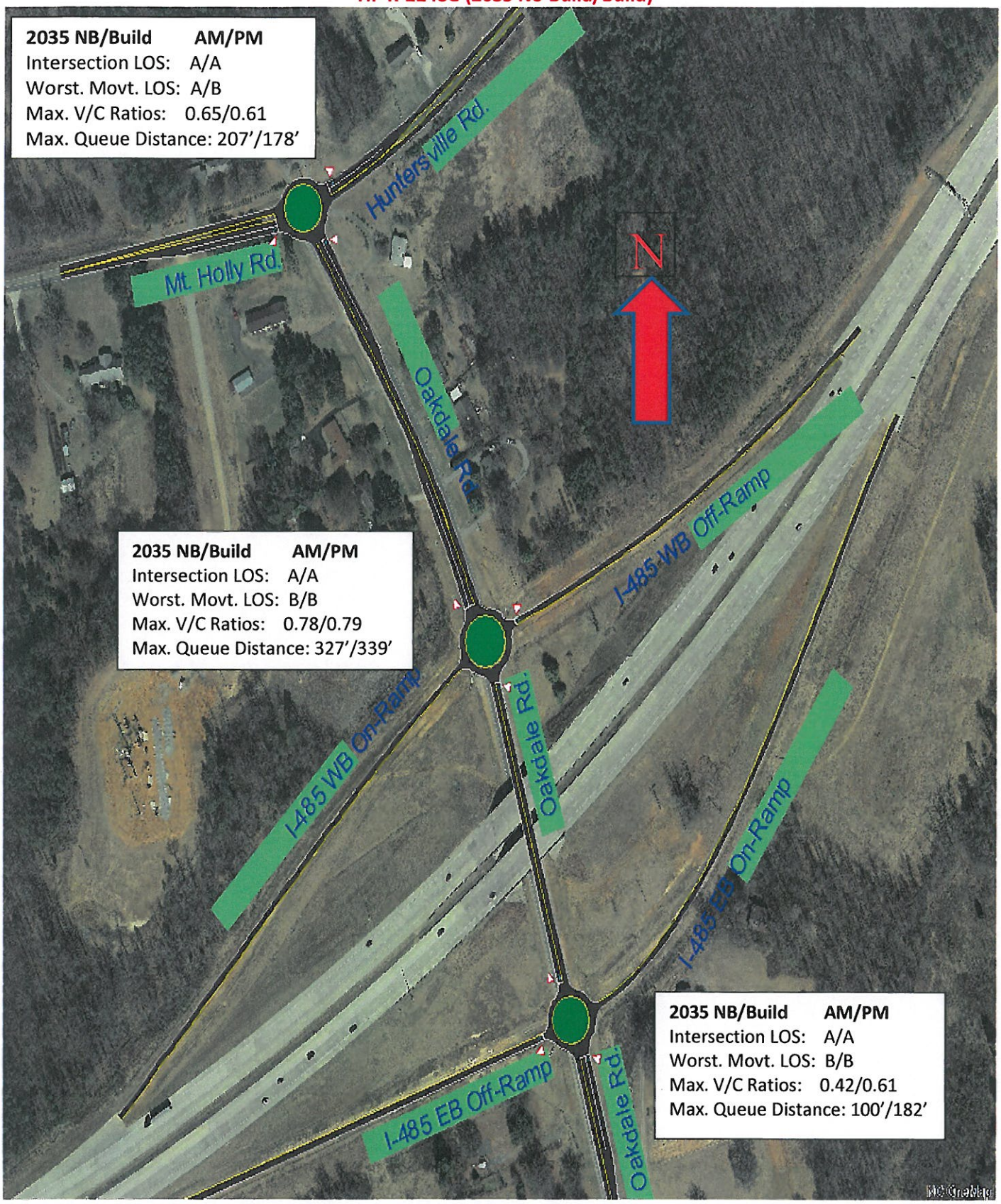

Figure: R-2248G (2035 No-Build/Build) roundabouts with R-2248E in place

Appendix C

Correspondence

Baloch, Zahid M

From: Turchy, Michael A
Sent: Thursday, December 11, 2014 4:33 PM
To: Baloch, Zahid M
Subject: RE: Construction Consultation For R-2248 G Project
Attachments: R-2248 G Const Memo 2014-12-11.pdf

Sure, no problem – Construction Consultation memo attached.
Let me know if you have any questions or need anything else.
Thanks,
Michael

From: Baloch, Zahid M
Sent: Wednesday, December 10, 2014 4:08 PM
To: Turchy, Michael A; Dagnino, Carla S
Subject: RE: Construction Consultation For R-2248 G Project

Michael, Could you please provide me Construction Consultation memo for our files. Thanks for your help.
I Hope things are fine at home front. Thanks

Zahid Baloch, P.E.
Project Planning Engineer
Project Development & Environmental Analysis Unit
NC Department of Transportation
Office 919-707-6012

From: Turchy, Michael A
Sent: Thursday, December 04, 2014 12:45 AM
To: Dagnino, Carla S; Baloch, Zahid M
Subject: RE: Construction Consultation For R-2248 G Project

Hi Zahid-
The March 4, 2014 ROW Memo remains accurate for this project. However, if you need an official memo stating it is for a Construction Consultation, just let me know and I can supply that.

Baloch, Zahid M

From: Morgan, Stephen R
Sent: Thursday, December 04, 2014 11:11 AM
To: Baloch, Zahid M
Cc: Conforti, John G; Dagnino, Carla S; Turchy, Michael A; Allen, Raymond S; Brew, Gregory E; Younis, Imad T; Zerman, William S; Hefner, Karen
Subject: RE: Construction Consultation For R-2248 G Project

Zahid,

We have no significant changes from Hydro.

Stephen R. Morgan PE
NCDOT Hydraulics Unit
Project Manager
Design Support Group
Phone (919) 707-6739
Fax (919) 250-4108

From: Baloch, Zahid M
Sent: Wednesday, December 03, 2014 10:20 AM
To: Dagnino, Carla S; Turchy, Michael A; Morgan, Stephen R; Allen, Raymond S; Brew, Gregory E; Younis, Imad T
Cc: Conforti, John G
Subject: Construction Consultation For R-2248 G Project

Hi, It is time to complete the Construction Consultation and I just want to make sure that nothing major has been changed since we did the ROW (Momo to File) document on September 22, 2013. If you need any additional information please let me know. Thanks

Zahid Baloch, P.E.
Project Planning Engineer
Project Development & Environmental Analysis Unit
NC Department of Transportation
Office 919-707-6012

Thanks,
Michael

From: Dagnino, Carla S
Sent: Wednesday, December 03, 2014 3:17 PM
To: Baloch, Zahid M
Cc: Turchy, Michael A
Subject: RE: Construction Consultation For R-2248 G Project

Hi Zahid,
Michael submitted a ROW consultation memo to you on October 9th, 2013. This is after the September 22, 2013 memo to file you mentioned below. When I looked on the server, I saw the March 4, 2014 ROW memo to file and that memo incorporated the information that Michael had on his consultation response (Oct. 9, 2013).
I think all should be OK for the construction consultation, although Michael will be able to confirm that. He will be in the office on Monday.
Thanks.
Carla

From: Baloch, Zahid M
Sent: Wednesday, December 03, 2014 10:20 AM
To: Dagnino, Carla S; Turchy, Michael A; Morgan, Stephen R; Allen, Raymond S; Brew, Gregory E; Younis, Imad T
Cc: Conforti, John G
Subject: Construction Consultation For R-2248 G Project

Hi, It is time to complete the Construction Consultation and I just want to make sure that nothing major has been changed since we did the ROW (Momo to File) document on September 22, 2013. If you need any additional information please let me know. Thanks

Zahid Baloch, P.E.
Project Planning Engineer
Project Development & Environmental Analysis Unit
NC Department of Transportation
Office 919-707-6012

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Baloch, Zahid M

From: Kretchman, Douglas W
Sent: Tuesday, January 20, 2015 5:26 PM
To: Baloch, Zahid M
Cc: Noland, Kanchana V
Subject: RE: R-2248 G ((I-485 and Oakdale Road) Interchange Construction Consultation Draft, Mecklenburg County
Attachments: R2248G_rdy_psh_04_plan.pdf; R2248G_rdy_psh_05_plan.pdf

Zahid,

We have had two changes to the plans. First, the project limits were extended approximately 75' on Oakdale instead of the original 50'. This was to allow the sidewalk to run the entire length of the C/A limits.

Second, we received a request for PUEs on January 13 for plan sheet 4. The PUEs impact parcels 2, 3, and 6. This has been processed.

Again, these are minor changes, but I wanted to give you the latest revised plan updates.

The changes are shown in the attached PDFs.

Thanks,

Douglas W. Kretchman, PE

Assistant Project Design Engineer
NC Dept. of Transportation
Phone: 919-707-6273

From: Baloch, Zahid M
Sent: Wednesday, January 07, 2015 10:18 AM
To: Brew, Gregory E; Turchy, Michael A; Dagnino, Carla S; Dunlop, James H; Reese, Michael P; Kretchman, Douglas W; Noland, Kanchana V; Michael.Batuzich@dot.gov; Morgan, Stephen R; Allen, Raymond S; Conforti, John G; Harris, Jennifer; Marshall, Harrison
Cc: Baloch, Zahid M
Subject: R-2248 G ((I-485 and Oakdale Road) Interchange Construction Consultation Draft, Mecklenburg County

Hi, Hope all had a great holidays and New Year. Please see the attached Draft R-2248 G Construction Consultation for your review and comments. Just want to let you know this project is State Funded. Please complete your review by January 21, 2015, so I can finalize the document. If you need any additional information please let me know. As always thanks for your help.

Zahid Baloch, P.E.
Project Planning Engineer
Project Development & Environmental Analysis Unit
NC Department of Transportation
Office 919-707-6012

From: Baloch, Zahid M
Sent: Wednesday, December 03, 2014 10:35 AM
To: Moore, Brenda L; Noland, Kanchana V
Subject: FW: Construction Consultation For R-2248 G Project

Hi, It is time to complete the Construction Consultation and I just want to make sure that nothing major has been changed since we did the ROW (Momo to File) document on September 22, 2013. If you need any additional information please let me know. Thanks

Zahid Baloch, P.E.
Project Planning Engineer
Project Development & Environmental Analysis Unit
NC Department of Transportation
Office 919-707-6012

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Baloch, Zahid M

From: Islam, Mohammad S
Sent: Friday, January 09, 2015 2:37 PM
To: Baloch, Zahid M; Brew, Gregory E; Turchy, Michael A; Dagnino, Carla S; Dunlop, James H; Reese, Michael P; Kretchman, Douglas W; Noland, Kanchana V; Michael.Batuzich@dot.gov; Morgan, Stephen R; Allen, Raymond S; Conforti, John G; Harris, Jennifer; Marshall, Harrison
Subject: RE: R-2248 G ((I-485 and Oakdale Road) Interchange Construction Consultation Draft, Mecklenburg County

Zahid,
As requested, Congestion Management Section has reviewed the "R-2248G Construction Consultation Draft Report" dated on January 5, 2015. Based on our review, the draft traffic forecast from the memo should be replaced with new forecast, released on December 17, 2013. We have no other comments at this time.

If you have any questions or if we could be of further assistance, please contact me or Michael P. Reese, P.E.

Thanks!

Mohammad S. Islam, PE
Project Design Engineer
NCDOT-Transportation Mobility and Safety Division
1561 Mail Service Center
Raleigh, North Carolina 27699-1561
(919) 773-2800
msislam@ncdot.gov
http://www.ncdot.org/doh/preconstruct/traffic/congestion/CM/default.html

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From: Baloch, Zahid M
Sent: Wednesday, January 07, 2015 10:18 AM
To: Brew, Gregory E; Turchy, Michael A; Dagnino, Carla S; Dunlop, James H; Reese, Michael P; Kretchman, Douglas W; Noland, Kanchana V; Michael.Batuzich@dot.gov; Morgan, Stephen R; Allen, Raymond S; Conforti, John G; Harris, Jennifer; Marshall, Harrison
Cc: Baloch, Zahid M
Subject: R-2248 G ((I-485 and Oakdale Road) Interchange Construction Consultation Draft, Mecklenburg County

Hi, Hope all had a great holidays and New Year. Please see the attached Draft R-2248 G Construction Consultation for your review and comments. Just want to let you know this project is State Funded. Please complete your review by January 21, 2015, so I can finalize the document. If you need any additional information please let me know. As always thanks for your help.

Zahid Baloch, P.E.
Project Planning Engineer
Project Development & Environmental Analysis Unit
NC Department of Transportation
Office 919-707-6012

Thanks,
Michael

From: Dagnino, Carla S
Sent: Wednesday, December 03, 2014 3:17 PM
To: Baloch, Zahid M
Cc: Turchy, Michael A
Subject: RE: Construction Consultation For R-2248 G Project

Hi Zahid,
Michael submitted a ROW consultation memo to you on October 9th, 2013. This is after the September 22, 2013 memo to file you mentioned below. When I looked on the server, I saw the March 4, 2014 ROW memo to file and that memo incorporated the information that Michael had on his consultation response (Oct. 9, 2013).
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Thanks.
Carla

From: Baloch, Zahid M
Sent: Wednesday, December 03, 2014 10:20 AM
To: Dagnino, Carla S; Turchy, Michael A; Morgan, Stephen R; Allen, Raymond S; Brew, Gregory E; Younis, Imad T
Cc: Conforti, John G
Subject: Construction Consultation For R-2248 G Project

Hi, It is time to complete the Construction Consultation and I just want to make sure that nothing major has been changed since we did the ROW (Momo to File) document on September 22, 2013. If you need any additional information please let me know. Thanks

Zahid Baloch, P.E.
Project Planning Engineer
Project Development & Environmental Analysis Unit
NC Department of Transportation
Office 919-707-6012

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Baloch, Zahid M

From: Kretchman, Douglas W
Sent: Monday, December 29, 2014 11:36 AM
To: Baloch, Zahid M
Cc: Noland, Kanchana V
Subject: RE: Construction Consultation For R-2248 G Project
Attachments: 2014.12.23.R2248G_007.pdf; 2014.12.23.R2248G_008.pdf

Zahid,

I have attached a PDF of the current design for R-2248G. It is our opinion that there have be no ***major*** changes since the ROW document.

Notable changes include the addition of curb & gutter around the roundabouts and adjusting the roundabout designs. We also included curb and sidewalk extended to the limits of the CA at the interchange, and extended the project limits approximately 50' to the CA along Oakdale road per Division's request.

Let us know if you need anything additional, and sorry for the delay on the response.

Thanks,

Douglas W. Kretchman, PE

Assistant Project Design Engineer
NC Dept. of Transportation
Phone: 919-707-6273

From: Noland, Kanchana V
Sent: Wednesday, December 03, 2014 11:01 AM
To: Kretchman, Douglas W
Subject: FW: Construction Consultation For R-2248 G Project

Doug,

Please coordinate with Zahid.

Thanks,
Kanchana

Baloch, Zahid M

From: Islam, Mohammad S
Sent: Tuesday, February 18, 2014 9:56 AM
To: Baloch, Zahid M
Cc: Reese, Michael P
Subject: FW: R-2248G: IJR needed? (I-485 at Oakdale Rd in Charlotte)

From: "Jgeigle@dot.gov" <Jgeigle@dot.gov>
Date: Tue, Feb 18, 2014 08:12
Subject: R-2248G: IJR needed? (I-485 at Oakdale Rd in Charlotte)
To: "Reese, Michael P" <mikereese@ncdot.gov>

Mike,

The information you provided is sufficient and FHWA HQ concurrence is not needed in this instance.

Joe

Joseph Geigle, P.E.
Congestion Management & ITS Engineer
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, NC 27601
(919) 747-7007

"Leave all the afternoon for exercise and recreation, which are as necessary as reading. I will rather say more necessary because health is worth more than learning."

- Thomas Jefferson

***** Please consider the environment before printing this e-mail. *****

From: Reese, Michael P [mailto:mikereese@ncdot.gov]
Sent: Monday, February 17, 2014 3:54 PM
To: Geigle, Joseph (FHWA)
Cc: Baloch, Zahid M; Dunlop, James H; Islam, Mohammad S
Subject: RE: R-2248G: IJR needed? (I-485 at Oakdale Rd in Charlotte)

Joe, per our recent conversation, stating our data on this matter below for appropriate forwarding as you see fit. Please let me know if you need any additional information, and please advise if we get concurrence from HQ so we can advise appropriate NCDOT authorities. –Mike

---

During the planning stages of I-485, the City of Charlotte asked for four interchanges (West Boulevard, NC 51 in Mint Hill, Weddington Road, and Oakdale) to be delayed. This allowed the City/County to better manage the land development "rush" that typically follows a beltway project such as I-485. While the land uses were included in the original (and most recent) traffic forecasts, this decision allowed them to better direct growth towards areas that already had sufficient infrastructure. Since the original construction of I-485, two of these interchanges, West Boulevard and NC 51, have been completed. Besides the subject interchange, the Department and City are in the initial stages of re-starting the Weddington Road interchange project.

This section of I-485 was STIP project R-2248B during the Planning and Environmental stage of the project. The EIS was signed and approved by FHWA on January 29, 1992. The original R-2248B was from NC 27 to beyond I-85 (approx. 16 miles; the entire remaining northern portion of I-485). As this project proceeded into design and construction phases, R-2248B was subdivided into R-2248C (construction completed in 2007), R-2248D (construction completed in 2009), and R-2248E (currently under construction). The section including the subject interchange was R-2248C, and when the decision was made NOT to construct the Oakdale interchange at that time, the Oakdale Interchange became R-2248G (currently in the planning phase). Since, and today, the Oakdale interchange has continued to be shown in the Long Range Transportation Plan (http://crtpo.org/PDFs/2035_LRTP/Document/Maps/25Figure11-1Thoroughfare.pdf).

The traffic forecast used for the R-2248B EIS predicted a 2010 design year AADT of 24,000 on I-485. It also had about the same AADT (23,800) on Mount Holly-Huntersville Road, which parallels I-485 in this area. The current (2012) AADT on I-485 is 39,000vpd, with about 10,000 AADT on Mount Holly-Huntersville. So while the original traffic forecast was on target regarding the total trips in the basic corridor, it underestimated the benefits of a 65 MPH free-flow facility compared to a two-lane 45 MPH roadway. The 2035 design year forecast (R-2248G) predicts I-485 traffic at about 96,000 AADT near the interchange, and 15,800 AADT on Mount Holly-Huntersville.

The EIS also indicated that Oakdale Road would carry an AADT of 18,000 in 2010 near the interchange. The current 2012 AADT on Oakdale Road is much less (5,100) without the interchange, but the R-2248G forecast predicts an AADT of 14,000 in 2035.

Even with the expected significant volume increase on I-485 beyond the original EIS, the current R-2248G capacity analysis indicates the interstate segments and points will operate at LOS E or better in the 2035 design year. According to the "R-2248G Analysis Memo" sealed January 8, 2014, only three segments/points are expected to exceed LOS D in the 2035 Build scenario, and those three elements exceed the LOS D threshold by less than 1 passenger car per mile per lane.

If any questions or if further clarification is needed, please advise.

Mike Reese, P.E.
Western Region Project Engineer
NCDOT Congestion Management
Phone: 919-773-2800

17 Feb 2014

From: Jgeigle@dot.gov [mailto:Jgeigle@dot.gov]
Sent: Monday, January 27, 2014 3:35 PM
To: Reese, Michael P
Subject: FW: IJR needed?

FYI

Joseph Geigle, P.E.
Congestion Management & ITS Engineer
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, NC 27601
(919) 747-7007

"Leave all the afternoon for exercise and recreation, which are as necessary as reading. I will rather say more necessary because health is worth more than learning."

- Thomas Jefferson