NORTH CAROLINA
Department of Transportation

NCDOT Capacity Analysis Guidelines and Congestion Management Updates

NCSITE SimCap and Safety User Group Meeting
Charlotte, NC
September 29, 2022

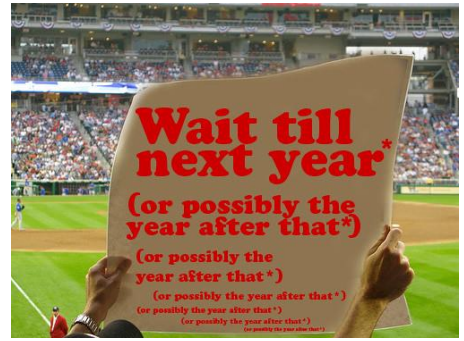
Michael P. Reese, PE, CPM
Congestion Management Section
Transportation Mobility and Safety Division

- **Congestion Management Section and Policy/Guidelines Updates**
- Capacity Analysis 101
- Capacity Analysis 201

Driveway Manual Policy

- GS-136-18 (5) and GS 163-93
- Adopted on July 10, 2003
- Granted the Board of Transportation the authority to make rules, regulations, and ordinances for use on the State highways; and **includes street and driveway access to State highways.**

http://www.ncleg.net/gascripts/statutes/statutelookup.pl?statute=136-18



http://connect.ncdot.gov/resources/safety/pages/congestion-management.aspx

Driveway Manual Policy

- DRAFT Driveway Manual anticipated to be released for stakeholder comments in 2023
- Driveway Manual will consist of four parts:
  - Board Policy
  - Legal Ordinances/ Requirements
  - Guidance (likely on CMS Website)
  - Interpretations and Applications (to be added over time)

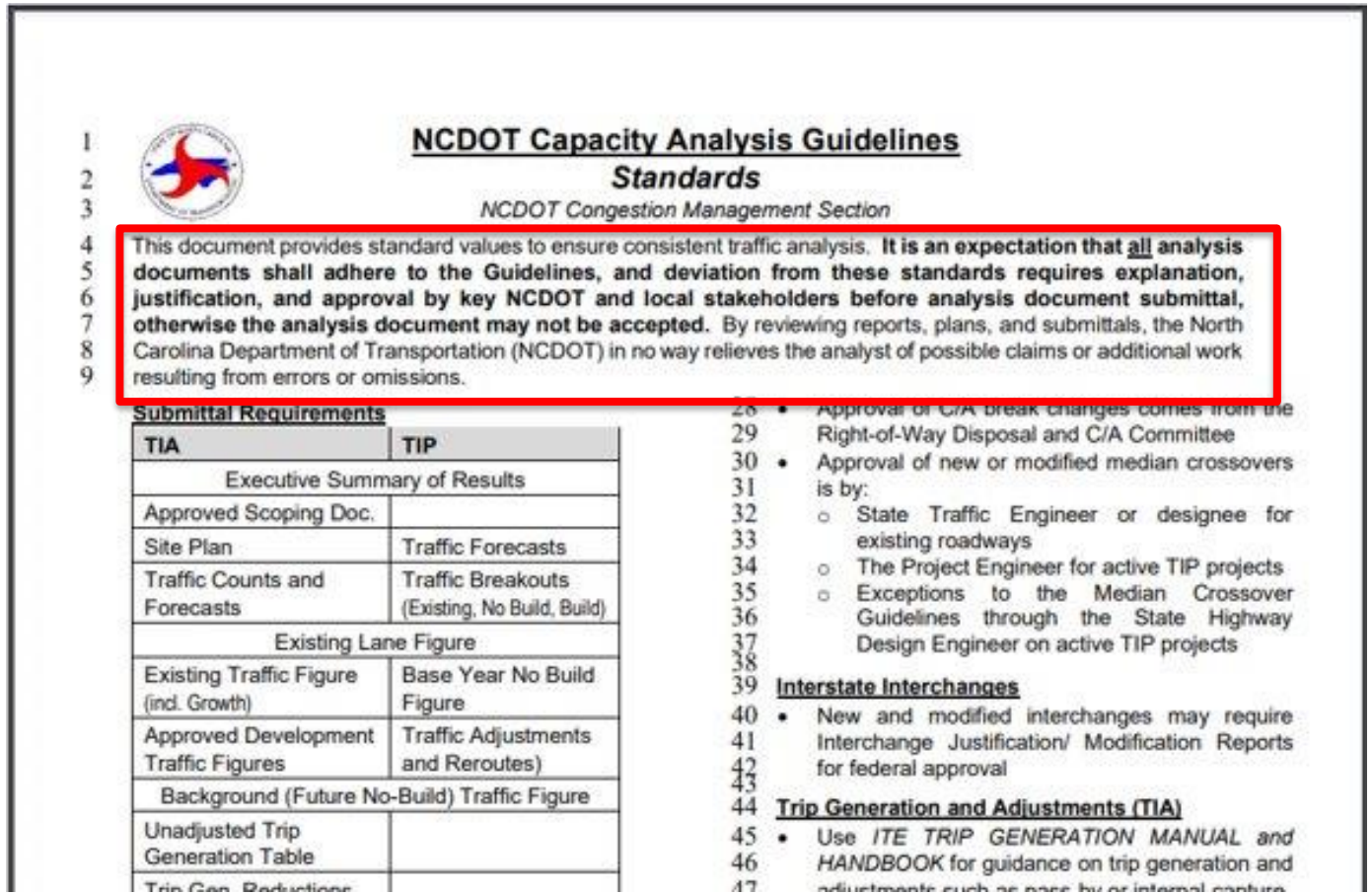
http://www.ncleg.net/gascripts/statutes/statutelookup.pl?statute=136-18

http://connect.ncdot.gov/resources/safety/pages/congestion-management.aspx

Draft New Analysis Guidelines - Standards

- New Guidelines now broken into *Standards* and *Best Practices*
- NCDOT Capacity Analysis Guidelines – Standards are now official and in effect (replaces 2015 Analysis Guidelines)

NCDOT 2022 Capacity Analysis Guidelines - Standards



NCDOT Capacity Analysis Guidelines

Standards

NCDOT Congestion Management Section

This document provides standard values to ensure consistent traffic analysis. **It is an expectation that all analysis documents shall adhere to the Guidelines, and deviation from these standards requires explanation, justification, and approval by key NCDOT and local stakeholders before analysis document submittal, otherwise the analysis document may not be accepted.** By reviewing reports, plans, and submittals, the North Carolina Department of Transportation (NCDOT) in no way relieves the analyst of possible claims or additional work resulting from errors or omissions.

Submittal Requirements

TIA	TIP
Executive Summary of Results	
Approved Scoping Doc.	
Site Plan	Traffic Forecasts
Traffic Counts and Forecasts	Traffic Breakouts (Existing, No Build, Build)
Existing Lane Figure	
Existing Traffic Figure (incl. Growth)	Base Year No Build Figure
Approved Development Traffic Figures	Traffic Adjustments and Reroutes)
Background (Future No-Build) Traffic Figure	
Unadjusted Trip Generation Table	
Trip Gen. Reductions	

- Approval of C/A break changes comes from the Right-of-Way Disposal and C/A Committee
- Approval of new or modified median crossovers is by:
  - State Traffic Engineer or designee for existing roadways
  - The Project Engineer for active TIP projects
  - Exceptions to the Median Crossover Guidelines through the State Highway Design Engineer on active TIP projects

Interstate Interchanges

- New and modified interchanges may require Interchange Justification/ Modification Reports for federal approval

Trip Generation and Adjustments (TIA)

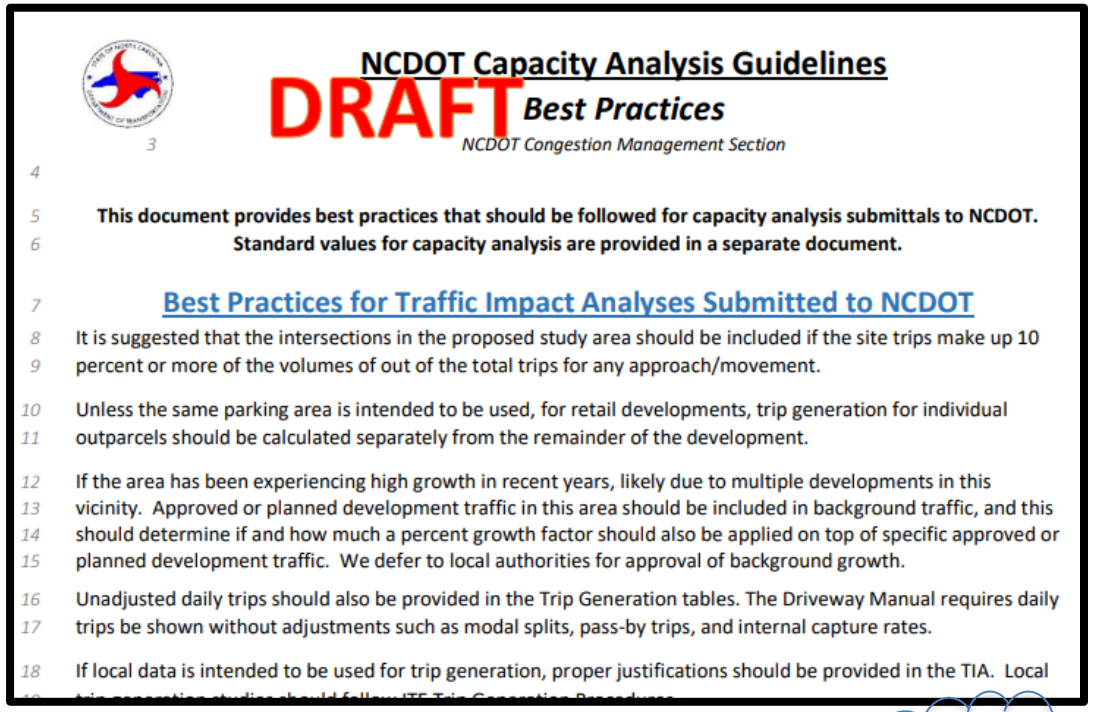
- Use *ITE TRIP GENERATION MANUAL and HANDBOOK* for guidance on trip generation and adjustments such as pass-by or internal capture

http://connect.ncdot.gov/resources/safety/pages/congestion-management.aspx

Draft New Analysis Guidelines – Best Practices

- New Guidelines now broken into *Standards* and *Best Practices*
- Draft *Best Practices* on CMS Website for comments will be revised **very** soon *(thank you to those who provided comments!)*
- Transition to using Draft *Best Practices* document
- More TIA Guidelines *Coming Soon…*

NCDOT DRAFT 2022 Capacity Analysis Guidelines - Best Practices



NCDOT Capacity Analysis Guidelines

DRAFT *Best Practices*

NCDOT Congestion Management Section

This document provides best practices that should be followed for capacity analysis submittals to NCDOT. Standard values for capacity analysis are provided in a separate document.

Best Practices for Traffic Impact Analyses Submitted to NCDOT

It is suggested that the intersections in the proposed study area should be included if the site trips make up 10 percent or more of the volumes of out of the total trips for any approach/movement.

Unless the same parking area is intended to be used, for retail developments, trip generation for individual outparcels should be calculated separately from the remainder of the development.

If the area has been experiencing high growth in recent years, likely due to multiple developments in this vicinity. Approved or planned development traffic in this area should be included in background traffic, and this should determine if and how much a percent growth factor should also be applied on top of specific approved or planned development traffic. We defer to local authorities for approval of background growth.

Unadjusted daily trips should also be provided in the Trip Generation tables. The Driveway Manual requires daily trips be shown without adjustments such as modal splits, pass-by trips, and internal capture rates.

If local data is intended to be used for trip generation, proper justifications should be provided in the TIA. Local

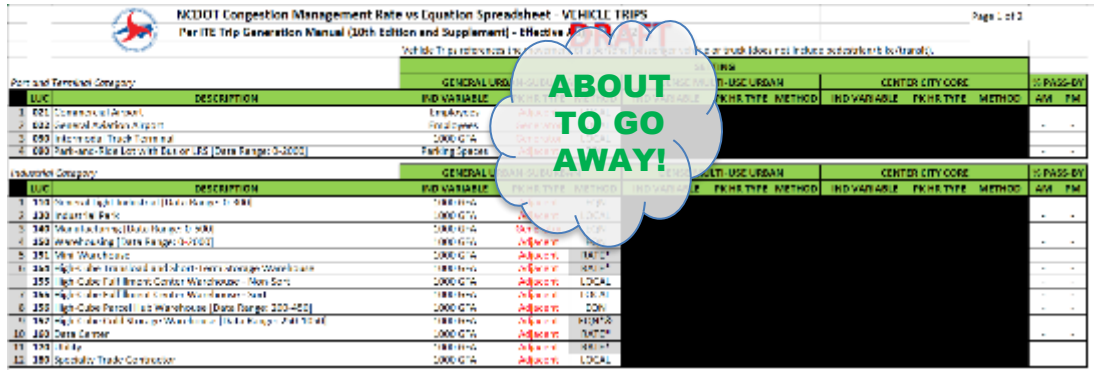
To be revised and reposted soon!

http://connect.ncdot.gov/resources/safety/pages/congestion-management.aspx

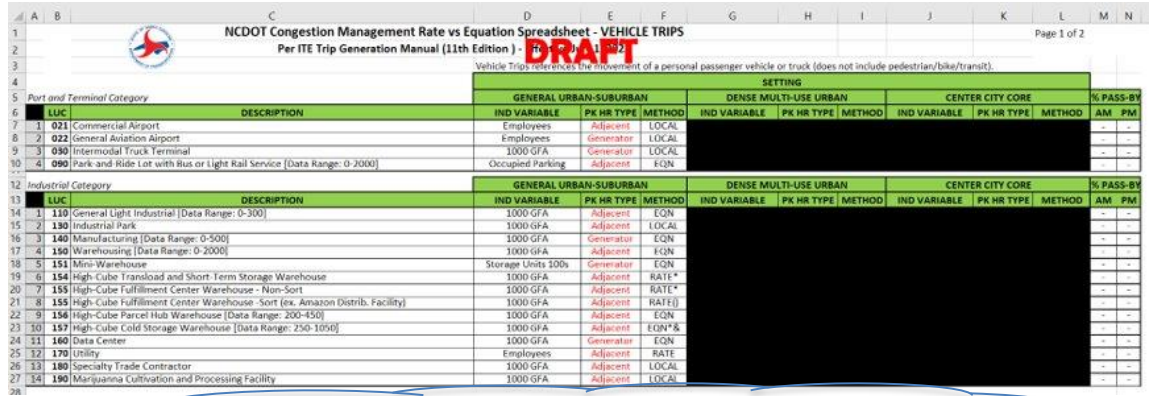
Draft New Trip Gen. Rate vs. Equation Spreadsheet

- New spreadsheet based on ITE Trip Gen. Manual Version 11 (more mode & setting data)
- Draft *V10+Supp* to be removed soon
- Draft *V11* Spreadsheet has been posted, but will be revised
- Trip Gen V11 <u>should</u> be used in TIAs now, required **<u>very</u>** soon

NCDOT 2022 Rate/Eqn Spreadsheet (TG V10+Supp)



NCDOT DRAFT 2022 Rate/Eqn Spreadsheet (TG V11)

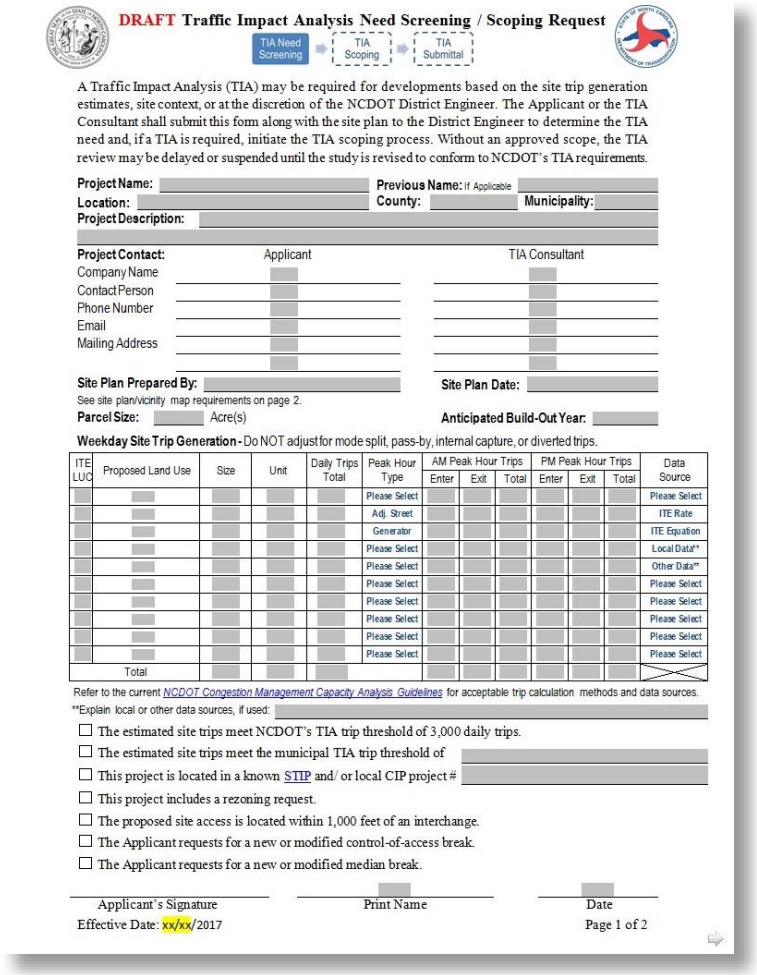


BEGIN REQUIRING V11 *<u>VERY</u> SOON!*

http://connect.ncdot.gov/resources/safety/pages/congestion-management.aspx

NCDOT TIA Scoping Checklists

TIA Need Screening



DRAFT Traffic Impact Analysis Need Screening / Scoping Request

TIA Need Screening → TIA Scoping → TIA Submittal

A Traffic Impact Analysis (TIA) may be required for developments based on the site trip generation estimates, site context, or at the discretion of the NCDOT District Engineer. The Applicant or the TIA Consultant shall submit this form along with the site plan to the District Engineer to determine the TIA need and, if a TIA is required, initiate the TIA scoping process. Without an approved scope, the TIA review may be delayed or suspended until the study is revised to conform to NCDOT's TIA requirements.

Project Name: **Previous Name:** If Applicable
Location: **County:** **Municipality:**
Project Description:

Project Contact:	Applicant	TIA Consultant
Company Name		
Contact Person		
Phone Number		
Email		
Mailing Address		

Site Plan Prepared By: **Site Plan Date:**
See site plan/vicinity map requirements on page 2.
Parcel Size: Acre(s) **Anticipated Build-Out Year:**

Weekday Site Trip Generation - Do NOT adjust for mode split, pass-by, internal capture, or diverted trips.

ITE LUC	Proposed Land Use	Size	Unit	Daily Trips Total	Peak Hour Type	AM Peak Hour Trips Enter	AM Peak Hour Trips Exit	AM Peak Hour Trips Total	PM Peak Hour Trips Enter	PM Peak Hour Trips Exit	PM Peak Hour Trips Total	Data Source
					Please Select							Please Select
					Adj. Street							ITE Rate
					Generator							ITE Equation
					Please Select							Local Data**
					Please Select							Other Data**
					Please Select							Please Select
					Please Select							Please Select
					Please Select							Please Select
					Please Select							Please Select
					Please Select							Please Select
Total												

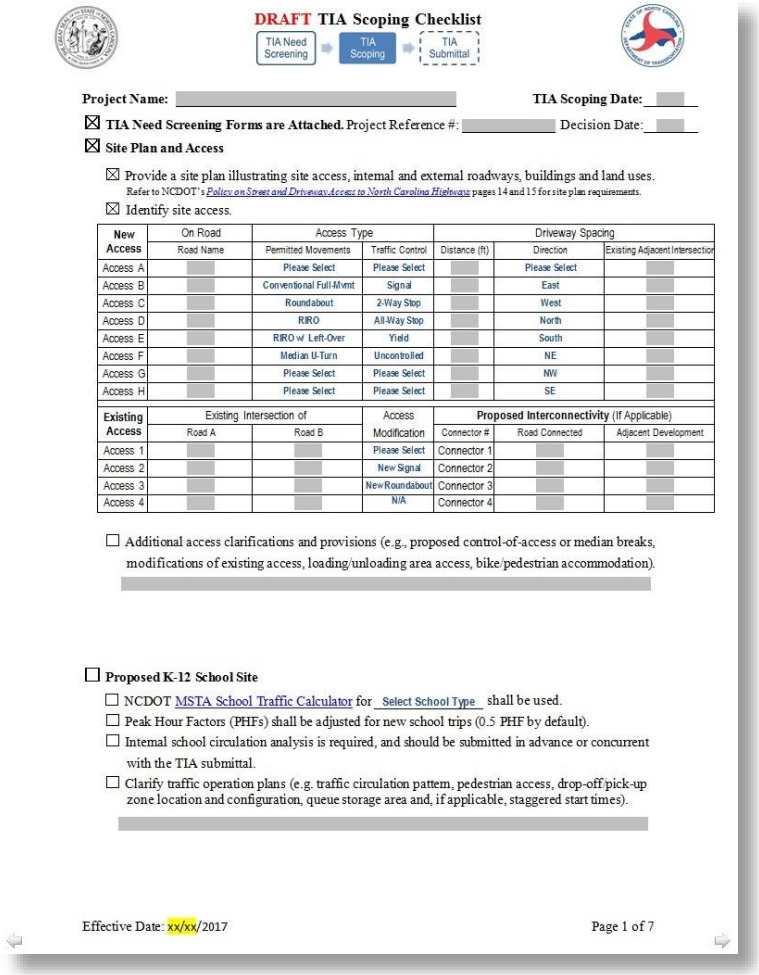
Refer to the current NCDOT Congestion Management Capacity Analysis Guidelines for acceptable trip calculation methods and data sources.
**Explain local or other data sources, if used:

- ☐ The estimated site trips meet NCDOT's TIA trip threshold of 3,000 daily trips.
- ☐ The estimated site trips meet the municipal TIA trip threshold of
- ☐ This project is located in a known STIP and/ or local CIP project #
- ☐ This project includes a rezoning request.
- ☐ The proposed site access is located within 1,000 feet of an interchange.
- ☐ The Applicant requests for a new or modified control-of-access break.
- ☐ The Applicant requests for a new or modified median break.

Applicant's Signature | Print Name | Date

Effective Date: xx/xx/2017 Page 1 of 2

TIA Scoping



DRAFT TIA Scoping Checklist

TIA Need Screening → TIA Scoping → TIA Submittal

Project Name: **TIA Scoping Date:**

☒ **TIA Need Screening Forms are Attached.** Project Reference #: Decision Date:

☒ **Site Plan and Access**

- ☒ Provide a site plan illustrating site access, internal and external roadways, buildings and land uses.
  Refer to NCDOT's Policy on Street and Driveway Access to North Carolina Highways pages 14 and 15 for site plan requirements.
- ☒ Identify site access.

New Access	On Road Road Name	Access Type Permitted Movements	Access Type Traffic Control	Driveway Spacing Distance (ft)	Driveway Spacing Direction	Driveway Spacing Existing Adjacent Intersection
Access A		Please Select	Please Select		Please Select	
Access B		Conventional Full-Mvmt	Signal		East	
Access C		Roundabout	2-Way Stop		West	
Access D		RIRO	All-Way Stop		North	
Access E		RIRO w/ Left-Over	Yield		South	
Access F		Median U-Turn	Uncontrolled		NE	
Access G		Please Select	Please Select		NW	
Access H		Please Select	Please Select		SE	

Existing Access	Existing Intersection of Road A	Existing Intersection of Road B	Access Modification	Proposed Interconnectivity (If Applicable) Connector #	Road Connected	Adjacent Development
Access 1			Please Select	Connector 1		
Access 2			New Signal	Connector 2		
Access 3			New Roundabout	Connector 3		
Access 4			N/A	Connector 4		

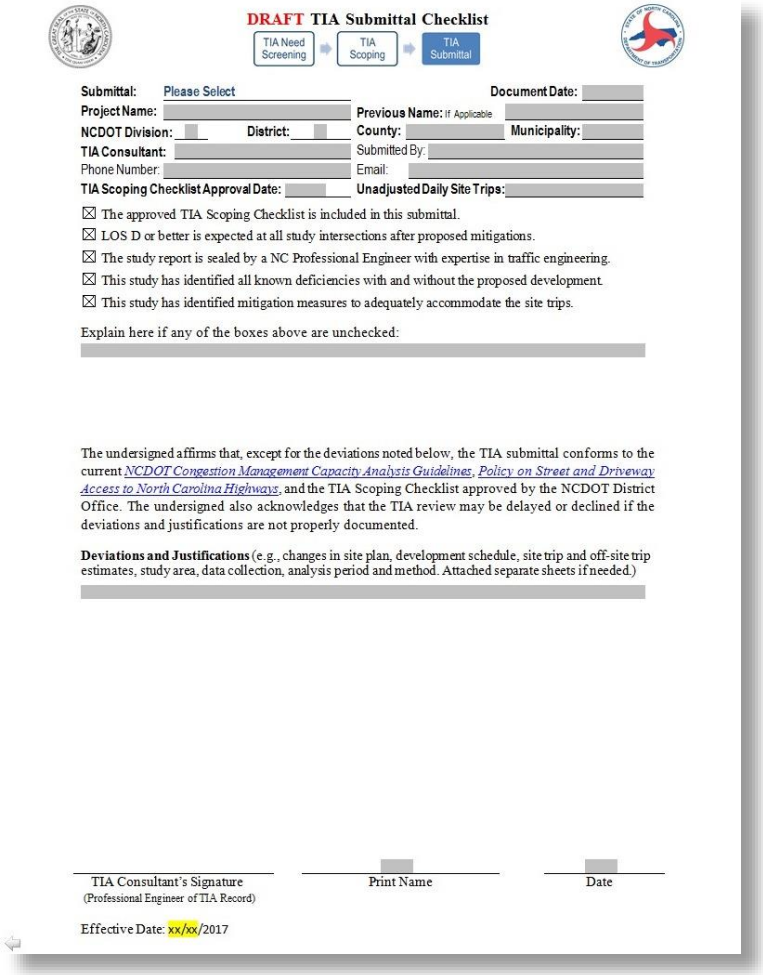
☐ Additional access clarifications and provisions (e.g., proposed control-of-access or median breaks, modifications of existing access, loading/unloading area access, bike/pedestrian accommodation).

☐ **Proposed K-12 School Site**

- ☐ NCDOT MSTA School Traffic Calculator for Select School Type shall be used.
- ☐ Peak Hour Factors (PHFs) shall be adjusted for new school trips (0.5 PHF by default).
- ☐ Internal school circulation analysis is required, and should be submitted in advance or concurrent with the TIA submittal.
- ☐ Clarify traffic operation plans (e.g. traffic circulation pattern, pedestrian access, drop-off/pick-up zone location and configuration, queue storage area and, if applicable, staggered start times).

Effective Date: xx/xx/2017 Page 1 of 7

TIA Submittal



DRAFT TIA Submittal Checklist

TIA Need Screening → TIA Scoping → TIA Submittal

Submittal: Please Select **Document Date:**
Project Name: **Previous Name:** If Applicable
NCDOT Division: **District:** **County:** **Municipality:**
TIA Consultant: Submitted By:
Phone Number: Email:
TIA Scoping Checklist Approval Date: **Unadjusted Daily Site Trips:**

- ☒ The approved TIA Scoping Checklist is included in this submittal.
- ☒ LOS D or better is expected at all study intersections after proposed mitigations.
- ☒ The study report is sealed by a NC Professional Engineer with expertise in traffic engineering.
- ☒ This study has identified all known deficiencies with and without the proposed development.
- ☒ This study has identified mitigation measures to adequately accommodate the site trips.

Explain here if any of the boxes above are unchecked:

The undersigned affirms that, except for the deviations noted below, the TIA submittal conforms to the current NCDOT Congestion Management Capacity Analysis Guidelines, Policy on Street and Driveway Access to North Carolina Highways, and the TIA Scoping Checklist approved by the NCDOT District Office. The undersigned also acknowledges that the TIA review may be delayed or declined if the deviations and justifications are not properly documented.

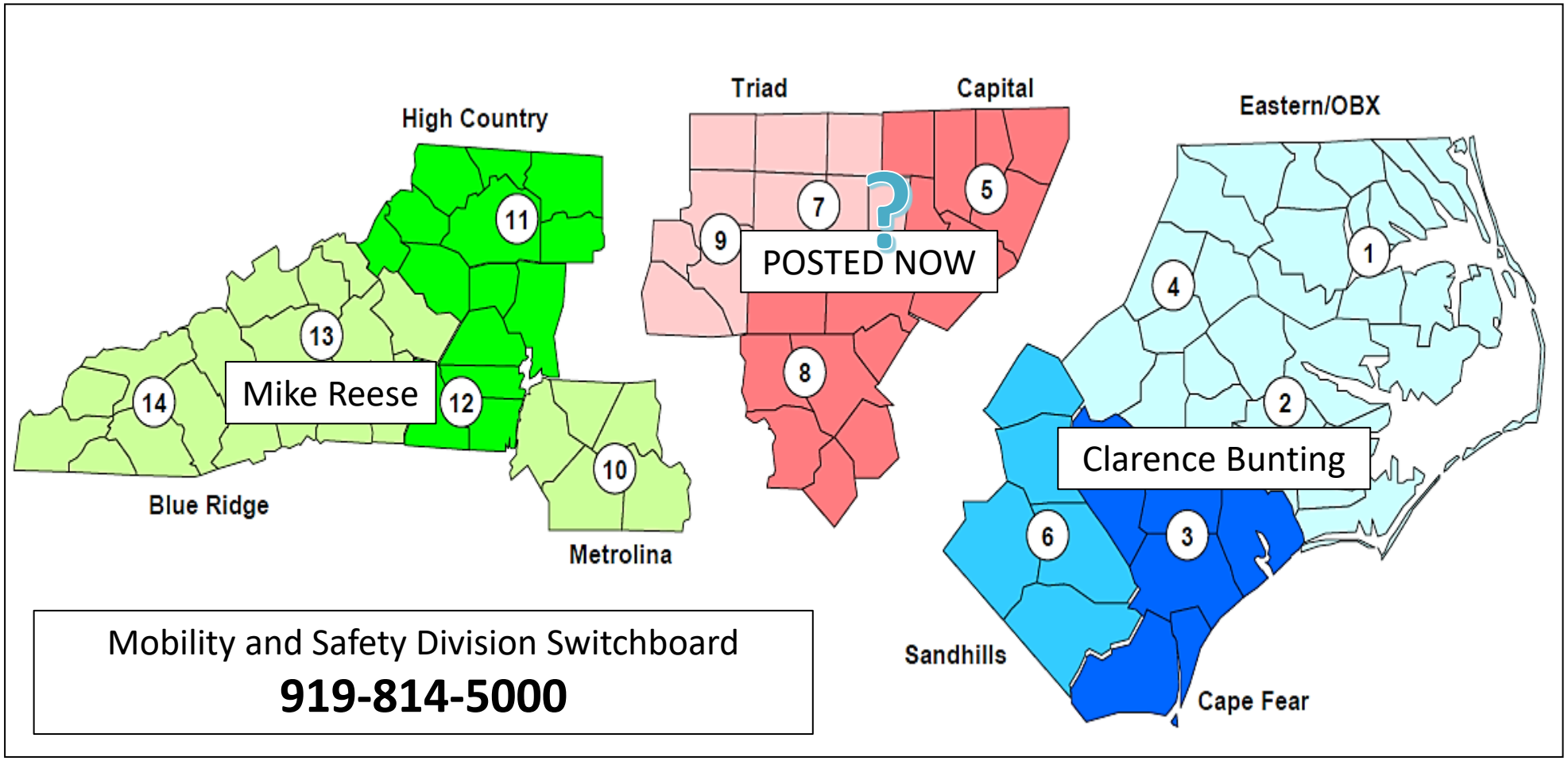
Deviations and Justifications (e.g., changes in site plan, development schedule, site trip and off-site trip estimates, study area, data collection, analysis period and method. Attached separate sheets if needed.)

TIA Consultant's Signature (Professional Engineer of TIA Record) | Print Name | Date

Effective Date: xx/xx/2017

http://connect.ncdot.gov/resources/safety/pages/congestion-management.aspx

Congestion Management Regions

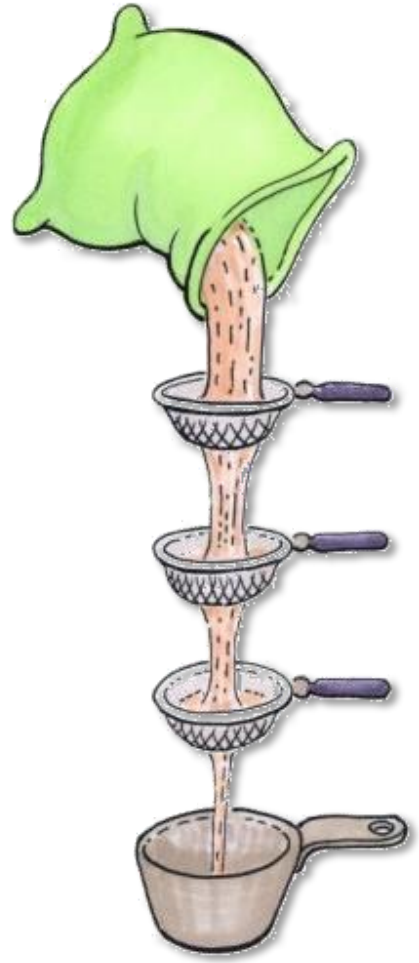


http://connect.ncdot.gov/resources/safety/pages/congestion-management.aspx

- Congestion Management Section and Policy/Guidelines Updates
- **Capacity Analysis 101**
- Capacity Analysis 201

Capacity Analysis Tool Selection Guidance

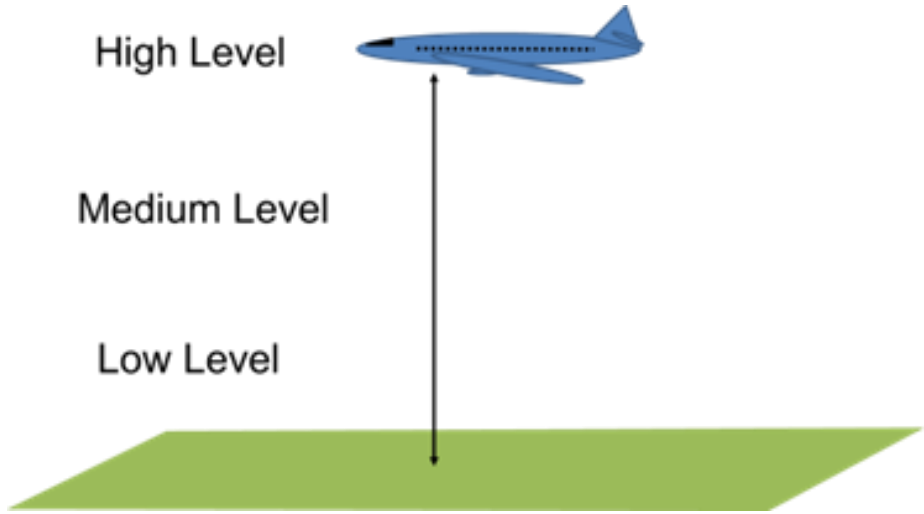
- Planning-level analysis
  - results provide estimates of expected performance and are useful in informing the initial feasibility and high-level design features.
- HCM analysis
  - balances operational detail with reasonable data input needs and analysis resource requirements.
  - may provide insight on additional geometric design and signal timing details
- Microsimulation analysis
  - allows for flexible customization and configuration of geometry, signal timing, and other operational parameters.
  - provides visualization of traffic patterns and roadway geometry



Slide Data Courtesy Kittelson & Associates, Inc.

Levels of Planning Analysis from HCM

- High level
  - Large analysis area
  - Low detail
- Medium level
  - Focus on a single roadway facility, segment, or intersection
  - Greater detail
- Low level
  - Highly focused and highly detailed



Slide Data Courtesy Kittelson & Associates, Inc.

Levels of Intersection Analysis

Planning-level Tools

e.g. CAP-X, Vjust, etc.

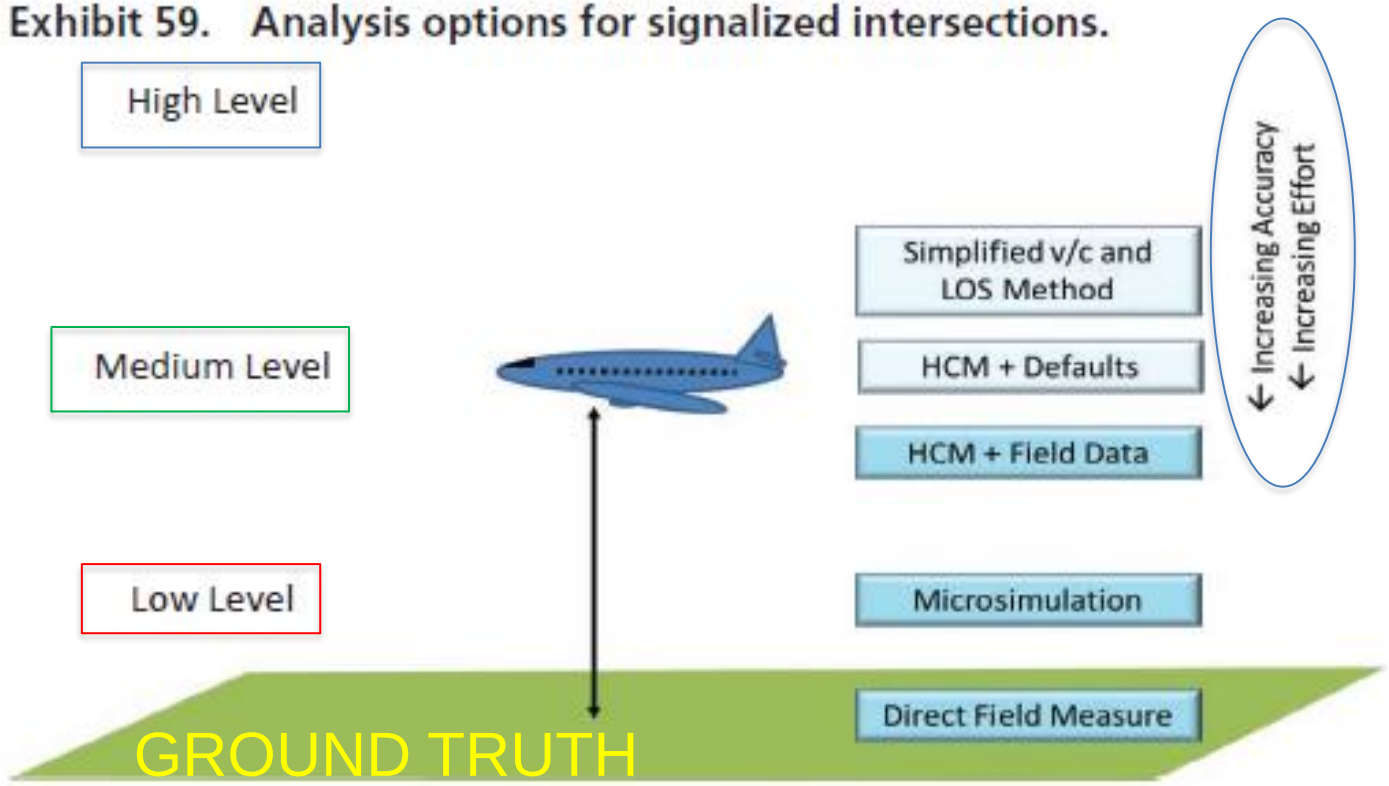
HCM Analysis Methods

e.g. HCM, HCS, Synchro, ARTVAL, Sidra, etc.

Microsimulation

e.g. TransModeler, VISSIM, SimTraffic, etc.

Exhibit 59. Analysis options for signalized intersections.



100 Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual

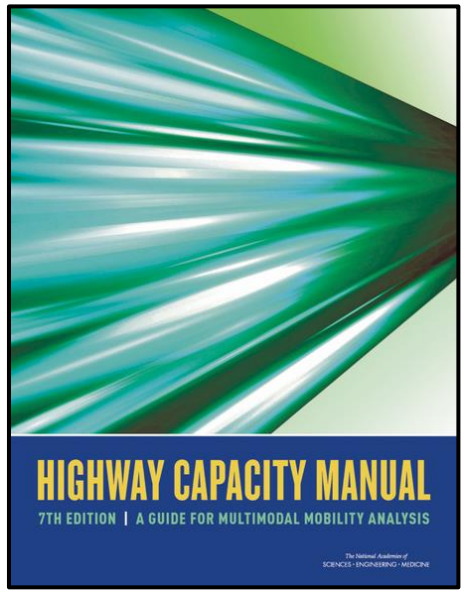
NCHRP Report 825

Slide Data Courtesy Kittelson & Associates, Inc.

Current CMS Capacity Analysis Tool Versions

As of Sept. 2022 – FOR UPDATES, EMAIL EKGROUNDWATER@NCDOT.GOV

Highway Capacity Manual



CAP-X / CAP-X NC

U.S.Department of Transportation
Federal Highway Administration

CAPX
Capacity Analysis for Planning of Junctions

Version 3.0
October 2018

Synchro plus SimTraffic

Caliper
TransModeler
Traffic Simulation Software

TransModeler

HCS™
Highway Capacity Software

Highway Capacity Software

SIDRA INTERSECTION 9
POWERFUL LANE-BASED NETWORK ANALYSIS

SIDRA

FREEVAL

Input freeway traffic, road geometry, signal control, and work zone information to generate travel time reliability and work zone analyses. Based on the Highway Capacity Manual (6th ed.)

freeval.org

FREEVAL-NC

ARTVAL

Input arterial road traffic, road geometry, signal control, and work zone information to generate travel time reliability and work zone analyses. Based on the Highway Capacity Manual (6th ed.).

artval.itredatalab.org

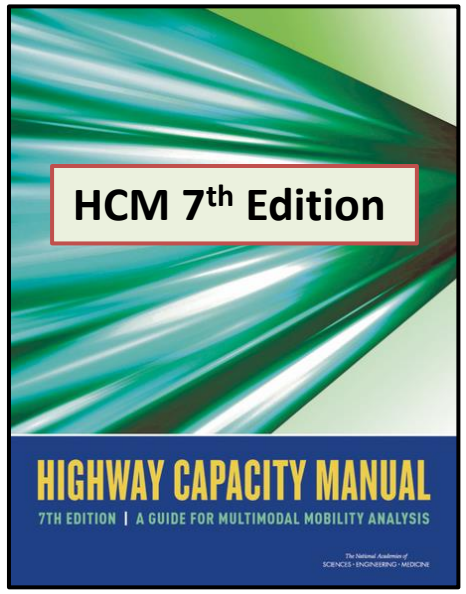
ARTVAL
COMING SOON!

http://connect.ncdot.gov/resources/safety/pages/congestion-management.aspx

Current CMS Capacity Analysis Tool Versions

As of Sept. 2022 – FOR UPDATES, EMAIL EKGROUNDWATER@NCDOT.GOV

Highway Capacity Manual



CAP-X / CAP-X NC

U.S.Department of Transportation
Federal Highway Administration

http://capxnc.itredatalab.org/

Alternative CMS Critical Lane Analysis tool under development

See CMS Website for Updates

Capacity Analysis for Planning of Junctions

Version 3.0
October 2018

Synchro plus SimTraffic

Synchro Version 10.3, Build 155, Revision 0

CMS *will not* get V. 11 until later in 2022

****SEND FILES In Version 10 FORMAT****

TransModeler 6.0 Build 8145

See CMS Website

TransModeler

HCS 2022 (Version 8.1)

HCS™
Highway Capacity Software

Highway Capacity Software

Sidra Intersection Version 9.0.3.9771

V.8 should no longer be accepted

SIDRA

FREEVAL

http://freeval.org/

zone analyses. Based on the Highway Capacity Manual (6th ed.)

freeval.org

FREEVAL-NC

ARTVAL

Input arterial road traffic, road geometry, signal control, and work zone information to generate travel time reliability and work zone analyses. Based on the Highway Capacity Manual (6th ed.).

artval.itredatalab.org

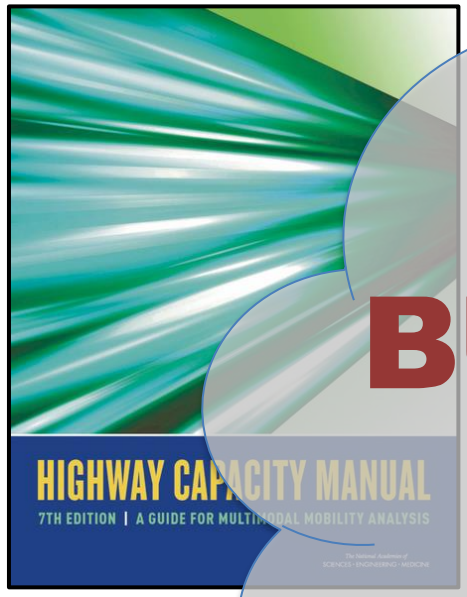
ARTVAL
COMING SOON!

http://connect.ncdot.gov/resources/safety/pages/congestion-management.aspx

Current CMS Capacity Analysis Tool Versions

As of Sept. 2022 – FOR UPDATES, EMAIL EKGROUNDWATER@NCDOT.GOV

Highway Capacity Manual



CAP-X / CAP-X NC

U.S. Department of Transportation
Federal Highway Administration

CAP-X

Capacity Analysis for Planning of Junction

Synchro plus SimTraffic

BUT WHAT ABOUT SAFETY??

Caliper
TransModeler
Traffic Simulation Software

TransModeler

HCS™
Highway Capacity Software

Highway Capacity Software

SIDRA INTERSECTION 9
POWERFUL LANE-BASED NETWORK ANALYSIS

SIDRA

FREEVAL

Input freeway traffic, road geometry, signal control, and work zone information to generate travel time reliability and work zone analyses. Based on the Highway Capacity Manual (6th ed.)

freeval.org

FREEVAL-NC

ARTVAL

Input arterial road traffic, road geometry, signal control, and work zone information to generate travel time reliability and work zone analyses. Based on the Highway Capacity Manual (6th ed.).

artval.ittedatalab.org

ARTVAL
COMING SOON!

http://connect.ncdot.gov/resources/safety/pages/congestion-management.aspx

Safest Feasible Intersection Design *(SaFID) for All Crashes based on CMFs*

				Minor street						
			Number through lanes:	2				4		6 or 8
Major street			Low AADT:	0	5,000	7,500	10,000	10,000	25,000 and above	Any
Number through lanes	Low AADT	High AADT	High AADT:	5,000	7,500	10,000	15,000	25,000		
2	0	7,500		**All-way stop**	**All-way stop**	n/a	n/a	n/a	n/a	n/a
	7,500	15,000		**One-lane roundabout**	**One-lane roundabout**	**One-lane roundabout**	**One-lane roundabout***	n/a	n/a	n/a
4	10,000	15,000		**Unsignalized RCI**	**Unsignalized RCI**	**Unsignalized RCI**	**Signalized RCI**	**Signalized RCI**	n/a	n/a
	15,000	20,000		**Unsignalized RCI**	**Unsignalized RCI**	**Signalized RCI**	**Signalized RCI**	**Signalized RCI**	n/a	n/a
	20,000	25,000		**Unsignalized RCI**	**Signalized RCI**	**Signalized RCI**	**Signalized RCI**	**Signalized RCI**	n/a	n/a
	25,000 and above			**Unsignalized RCI**	**Signalized RCI**	**Signalized RCI**	**Signalized RCI**	**Signalized RCI**	**Median u-turn**	n/a
6 or 8	Any			**Unsignalized RCI**	**Signalized RCI**	**Signalized RCI**	**Signalized RCI**	**Signalized RCI**	**Median u-turn**	**Median u-turn**

* One-lane roundabouts are generally feasible if the combined AADT is less than 25,000. If a one-lane roundabout is infeasible a signal is the safest feasible design.

https://connect.ncdot.gov/resources/safety/Teppl/TEPPL%20All%20Documents%20Library/C60_SaFID%20Chart.pdf

Pedestrian Optimum Feasible Intersection Design *(POFID)*

				Minor street						
			Number through lanes:	2				4		6 or 8
Major street			Low AADT:	0	5,000	7,500	10,000	10,000	25,000 and above	Any
Number through lanes	Low AADT	High AADT	High AADT:	5,000	7,500	10,000	15,000	25,000		
2	0	7,500		1) AWSC	2) AWSC	n/a	n/a	n/a	n/a	n/a
	7,500	15,000		3) Roundabout	4) Roundabout	5) Roundabout	6) Roundabout or signal	n/a	n/a	n/a
4	10,000	15,000		7) TWSC or signal	8) Bowtie or MUT	9) Bowtie or MUT	10) Bowtie or MUT	11) Bowtie or MUT	n/a	n/a
	15,000	20,000		12 TWSC or signal	13) Bowtie or MUT	14) Bowtie or MUT	15) Bowtie or MUT	16) Bowtie or MUT	n/a	n/a
	20,000	25,000		17) TWSC or signal	18) Bowtie or MUT	19) Bowtie or MUT	20) Bowtie or MUT	21) Bowtie or MUT	n/a	n/a
	25,000 and above			22) TWSC or signal	23) Bowtie or MUT	24) Bowtie or MUT	25) Bowtie or MUT	26) Bowtie or MUT	27) MUT	n/a
6 or 8	Any			28) TWSC or signal	29) Bowtie or MUT	30) Bowtie or MUT	31) Bowtie or MUT	32) Bowtie or MUT	33) MUT	34) MUT

https://connect.ncdot.gov/resources/safety/Teppl/TEPPL%20All%20Documents%20Library/POFID%20and%20BOFID%20ITEJ%20proofs.pdf

Bicycle Optimum Feasible Intersection Design *(BOFID)*

				Minor street						
			Number through lanes:	2				4		6 or 8
Major street			Low AADT:	0	5,000	7,500	10,000	10,000	25,000 and above	Any
Number through lanes	Low AADT	High AADT	High AADT:	5,000	7,500	10,000	15,000	25,000		
2	0	7,500		1) AWSC	2) AWSC	n/a	n/a	n/a	n/a	n/a
	7,500	15,000		3) Roundabout	4) Roundabout	5) Roundabout	6) Roundabout or signal	n/a	n/a	n/a
4	10,000	15,000		7) Unsignalized RCI or TWSC	8) Bowtie or MUT	9) Bowtie or MUT	10) Bowtie or MUT	11) Signalized RCI	n/a	n/a
	15,000	20,000		12) Unsignalized RCI or TWSC	13) Bowtie or MUT	14) Bowtie or MUT	15) Bowtie or MUT	16) Signalized RCI	n/a	n/a
	20,000	25,000		17) Unsignalized RCI or TWSC	18) Bowtie or MUT	19) Bowtie or MUT	20) Bowtie or MUT	21) Signalized RCI	n/a	n/a
	25,000 and above			22) Unsignalized RCI or TWSC	23) Bowtie or MUT	24) Bowtie or MUT	25) Bowtie or MUT	26) Signalized RCI	27) MUT	n/a
6 or 8	Any			28) Unsignalized RCI or TWSC	29) Signalized RCI	30) Signalized RCI	31) Signalized RCI	32) Signalized RCI	33) MUT	34) MUT

https://connect.ncdot.gov/resources/safety/Teppl/TEPPL%20All%20Documents%20Library/POFID%20and%20BOFID%20ITEJ%20proofs.pdf

- Congestion Management Section and Policy/Guidelines Updates
- Capacity Analysis 101
- **Capacity Analysis 201**

Top 10 Recent Traffic Impact Analysis Concerns…

1. **LACK OF MITIGATION (esp. queue spillback down ramps or across multiple nodes, inadequate queue reporting); RUN SIMULATION! ***

Making Recommendations from Synchro and SimTraffic

1. Verify volumes and adherence to NCDOT Capacity Analysis Guidelines and Driveway Manual Policy
2. Determine if degradation requires mitigation
3. Review 95th Queues in Synchro and Max Queues in SimTraffic, whichever is greater
4. 100’ min. turn bay length, 25’ increments
5. Iterate if needed
6. Include safety considerations!

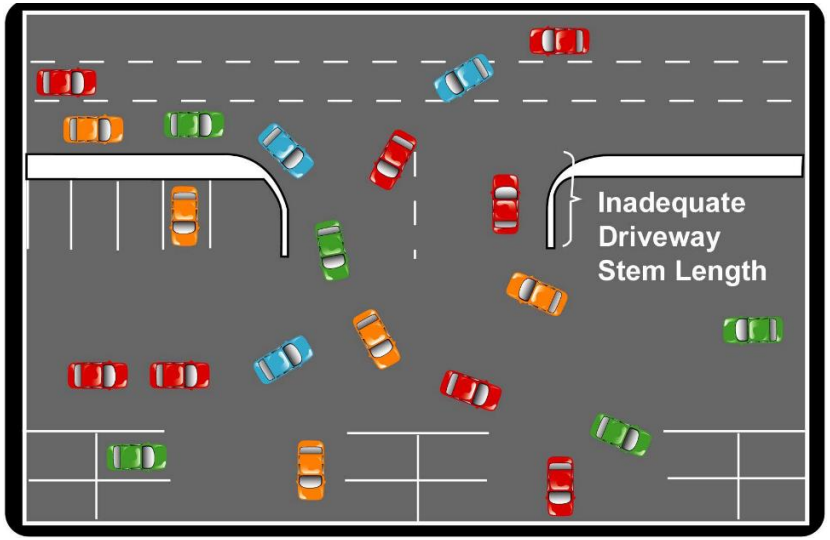
Top 10 Recent Traffic Impact Analysis Concerns…

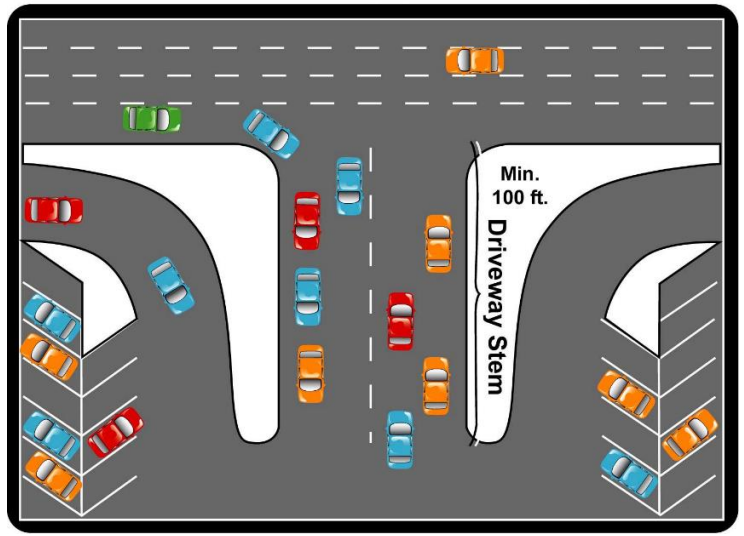
1. LACK OF MITIGATION (esp. queue spillback down ramps or across multiple nodes, inadequate queue reporting); RUN SIMULATION!
2. **Inadequate driveway stem (100' minimum; TIA should identify stem length)** *

Driveway Stem Length & Circulation

Appropriate internal circulation and adequate stem length are critical to safety and efficiency.

For any development with an internal roadway network, a required minimum storage of **100 feet** measured from near edge of the right of way **before any crossing or left-turning conflicts are allowed.**





Driveway Manual Page 34

Top 10 Recent Traffic Impact Analysis Concerns…

1. LACK OF MITIGATION (esp. queue spillback down ramps or across multiple nodes, inadequate queue reporting); RUN SIMULATION!
2. Inadequate driveway stem (100' minimum; TIA should identify stem length)
3. **Not justifying and no prior approval to Analysis Guidelines deviations** *

Follow NCDOT Capacity Analysis Guidelines

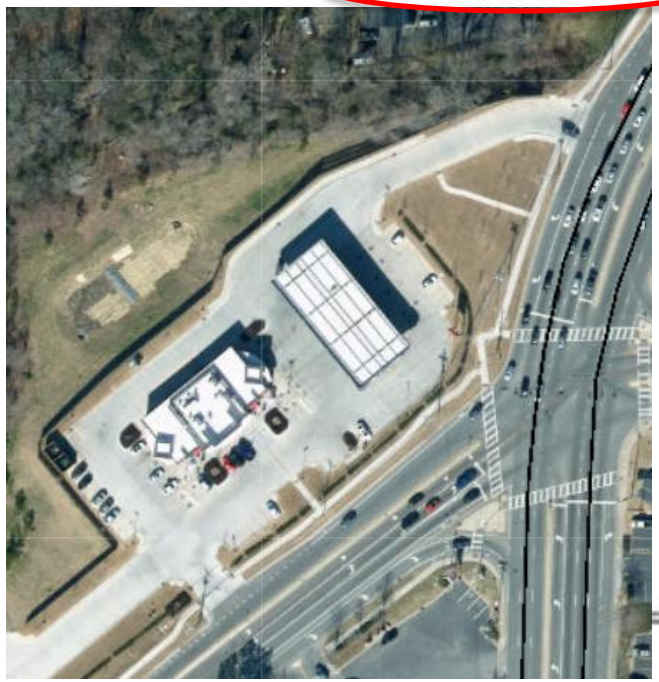
- Use NCDOT Capacity Analysis Guidelines Provided by Congestion Management, for example…
- Turn Lane Treatment
  - No protected-permitted lefts
  - Check if protected lefts should be analyzed
  - No right turns on red
- Recommended Timing Settings
  - Minimum initial green time, yellow time, all-red time, lost time adjustment, minimum split
- Minimum Cycle Length
  - Based on number of phases in the signal
- Use a Peak Hour Factor (phf) of 0.9 except for near schools where 0.5 to 0.75 is commonly used (check with MSTA or CMS)

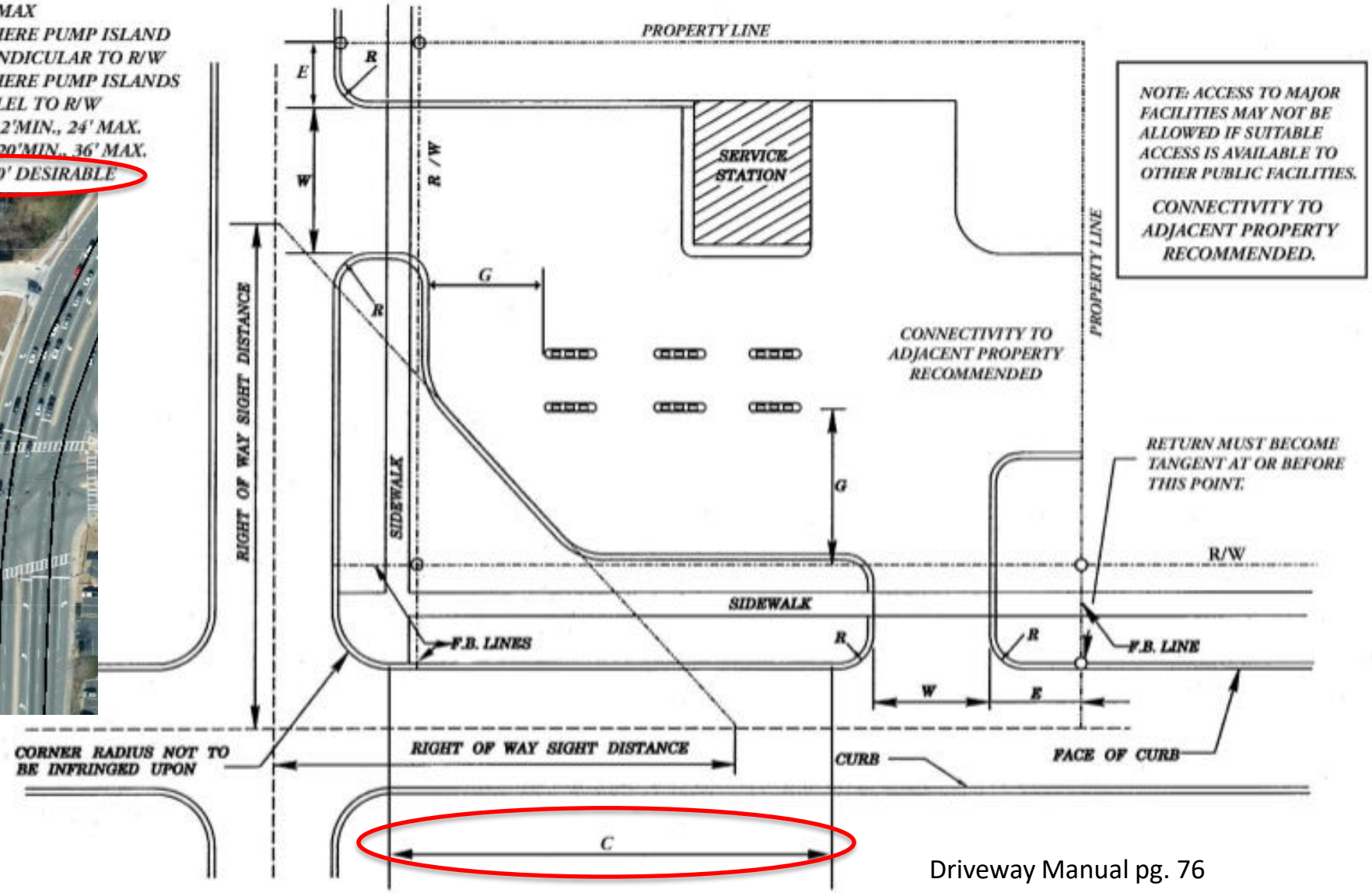
Top 10 Recent Traffic Impact Analysis Concerns…

1. LACK OF MITIGATION (esp. queue spillback down ramps or across multiple nodes, inadequate queue reporting); RUN SIMULATION!
2. Inadequate driveway stem (100' minimum; TIA should identify stem length)
3. Not justifying and no prior approval to Analysis Guidelines deviations
4. **Inadequate corner clearance (50' min/100’ preferred from ends of the radii)** *

Corner Clearance

E - 20' MIN.
R - 5' MIN., 30'MAX
G - 50' MIN WHERE PUMP ISLAND ARE PERPENDICULAR TO R/W
25' MIN WHERE PUMP ISLANDS ARE PARALLEL TO R/W
W - ONE WAY: 12'MIN., 24' MAX.
TWO WAY: 20'MIN., 36' MAX.
C - 50' MIN, 100' DESIRABLE



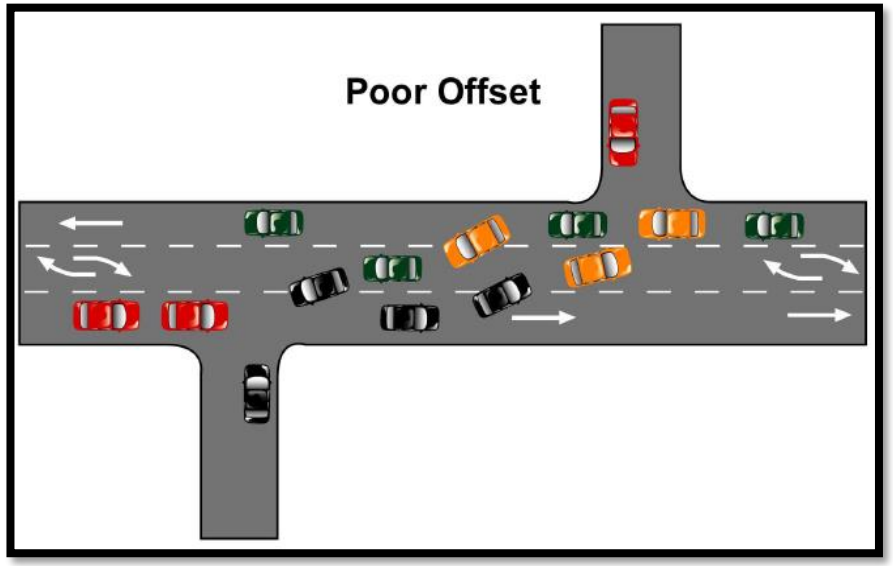


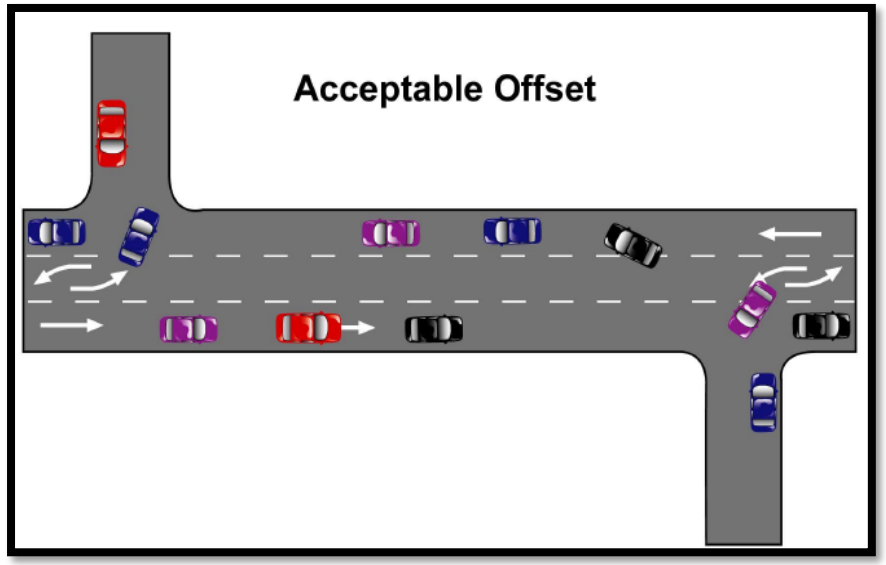
"At no time shall the corner clearance be less than 50 feet from the point of tangency of the radius curvature. "

Driveway Manual pg. 76

Driveway Separation Criteria

- Minimum **intersection corner clearance** of **100 feet** to the proposed driveway measured from the end of the radius.
- On most State maintained routes, the minimum distance between full-movement driveways into developments that generate **high traffic** volumes should be at least **600 feet**.
- State routes with **safety, congestion, or operational problems 1,000 feet** or more may be required.





Driveway Manual Pages 42,52

Top 10 Recent Traffic Impact Analysis Concerns…

1. LACK OF MITIGATION (esp. queue spillback down ramps or across multiple nodes, inadequate queue reporting); RUN SIMULATION!
2. Inadequate driveway stem (100' minimum; TIA should identify stem length)
3. Not justifying and no prior approval to Analysis Guidelines deviations
4. Inadequate corner clearance (50' min/100’ preferred from ends of the radii)
5. **Resubmittals restart the statutory timeframe clock! Piecemeals!!**

Top 10 Recent Traffic Impact Analysis Concerns…

1. LACK OF MITIGATION (esp. queue spillback down ramps or across multiple nodes, inadequate queue reporting); RUN SIMULATION!
2. Inadequate driveway stem (100' minimum; TIA should identify stem length)
3. Not justifying and no prior approval to Analysis Guidelines deviations
4. Inadequate corner clearance (50' min/100’ preferred from ends of the radii)
5. Resubmittals restart the statutory timeframe clock! Piecemeals!!
6. **No/Inadequate Maximum Walking Distance Figure/Internal Capture!** *

NCDOT Capacity Analysis Guidelines and CM Updates

Estimated Vehicle-Trips[3]		
Total	Entering	Exiting
190	32	158
1,176	582	594
327	176	151
0		
183	119	64
0		
0		
1,876	909	967

Land Use	Size	24 Hour Two-Way Volume	AM Pk Hour Enter	AM Pk Hour Exit	PM Pk Hour Enter	PM Pk Hour Exit
Shopping Center	100 Th.Sq.Ft. GLA	6791	94	60	312	324
Pharmacy / Drugstore with Drive-Thru	10 Th.Sq.Ft. GFA	882	15	11	52	52
Fast-Food Restaurant with Drive-Thru	7 Th.Sq.Ft. GFA	3473	176	169	123	114
High Turnover (Sit-Down) Restaurant	8 Th.Sq.Ft. GFA	1017	48	44	53	37
Drive-in Bank	5 Th.Sq.Ft. GFA	741	35	27	65	65
Convenience Market with Gasoline Pumps	16 Vehicle Fueling Positions	8682	133	133	153	153
General Office Building	100 Th.Sq.Ft. GFA	1334	165	23	32	158
Apartments	300 Dwelling Units	1942	30	121	119	64
Total Driveway Volume		24862	696	588	909	967

Table 5-P: Computations Summary

	Total	Entering	Exiting
All Person-Trips	2,063	1,000	1,063
Internal Capture Percentage	16%	17%	16%
External Vehicle-Trips[5]	1,567	756	811
External Transit-Trips[6]	0	0	0
External Non-Motorized Trips	0	0	0

NCHRP 684 Internal Trip Capture Estimation Tool

Project Name:	SimCap Acres Development	Organization:	Class
Project Location:	NCSU	Performed By:	I. B. Ingunear
Scenario Description:	Test	Date:	24-Sep-15
Analysis Year:	2015	Checked By:	
Analysis Period:	PM Street Peak Hour	Date:	

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*) ITE LUCs[1]	Quantity	Units	Estimated Vehicle-Trips[3] Total	Entering	Exiting
Office				190	32	158
Retail	820 et al	115KSF	16 VFP	1,176	582	594
Restaurant	932,934	15KSF	-	327	176	151
Cinema/Entertainment				0		
Residential	220	-	300 DU	183	119	64
Hotel				0		
All Other Land Uses[2]				0		
				1,876	909	967

Table 2-P: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips Veh. Occ.[4]	% Transit	% Non-Motorized	Exiting Trips Veh. Occ.[4]	% Transit	% Non-Motorized
Office	1.10	0%	0%	1.10	0%	0%
Retail	1.10	0%	0%	1.10	0%	0%
Restaurant	1.10	0%	0%	1.10	0%	0%
Cinema/Entertainment	1.10	0%	0%	1.10	0%	0%
Residential	1.10	0%	0%	1.10	0%	0%
Hotel	1.10	0%	0%	1.10	0%	0%
All Other Land Uses[2]	1.10	0%	0%	1.10	0%	0%

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From) \ Destination (To)	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		4000	4000		4000	
Retail					4000	
Restaurant					4000	
Cinema/Entertainment					4000	
Residential		4000	4000			
Hotel					4000	

Table 4-P: Internal Person-Trip Origin-Destination Matrix*

Origin (From) \ Destination (To)	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		3	0	0	0	0
Retail	11		56	0	17	0
Restaurant	5	68		0	3	0
Cinema/Entertainment	0	0	0		0	0
Residential	3	3	1	0		0
Hotel	0	0	0	0	0	

Table 5-P: Computations Summary

	Total	Entering	Exiting
All Person-Trips	2,063	1,000	1,063
Internal Capture Percentage	16%	17%	16%
External Vehicle-Trips[5]	1,567	756	811
External Transit-Trips[6]	0	0	0
External Non-Motorized Trips	0	0	0

Table 6-P: Internal Trip Capture Percentages by Land Use

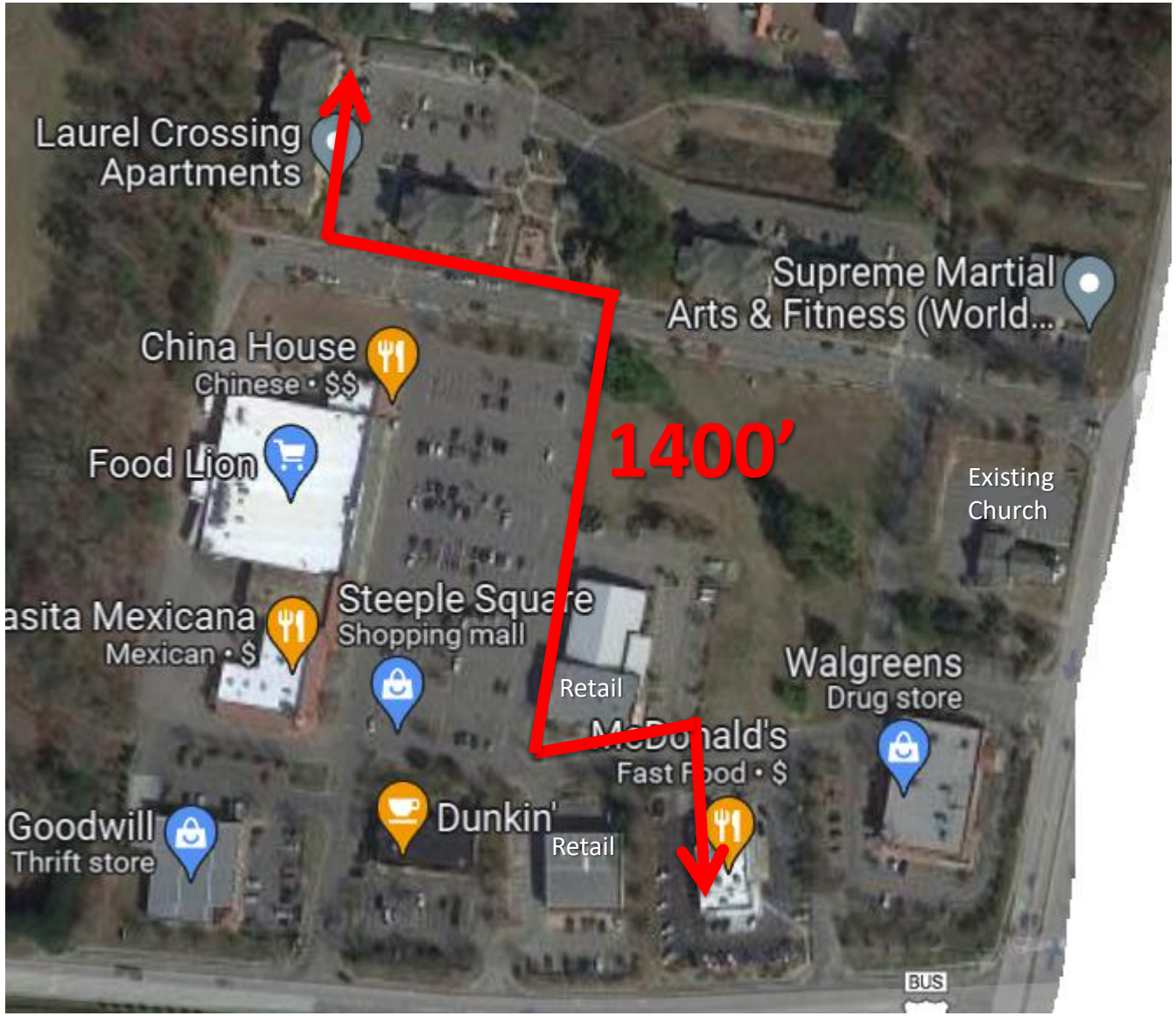
Land Use	Entering Trips	Exiting Trips
Office	54%	2%
Retail	12%	13%
Restaurant	29%	46%
Cinema/Entertainment	N/A	N/A
Residential	15%	10%
Hotel	N/A	N/A

[1]Land Use Codes (LUCs) from *Trip Generation Manual*, published by the Institute of Transportation Engineers.
[2]Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator.
[3]Enter trips assuming no transit or non-motorized trips (as assumed in ITE *Trip Generation Manual*).
[4]Enter vehicle occupancy assumed in Table 1-P vehicle trips. If vehicle occupancy changes for proposed mixed-use project, manual adjustments
[5]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P.
[6]Person-Trips
*Indicates computation that has been rounded to the nearest whole number.
Estimation Tool Developed by the Texas A&M Transportation Institute - Version 2013.1

Internal Capture Example

Take Note of Defaults in this table (1.1 Veh. Occ. And 0% transit/non-motorized)

Take Note of Default Walking Distances in this table (4000' OR calculated maximum walking distances btw. Given pair of land uses)



Walking Distance Figure Example

Consider Residential to Restaurant Walking Distance…

RULE: 4000' OR calculated maximum walking distances btw. given pair of land uses

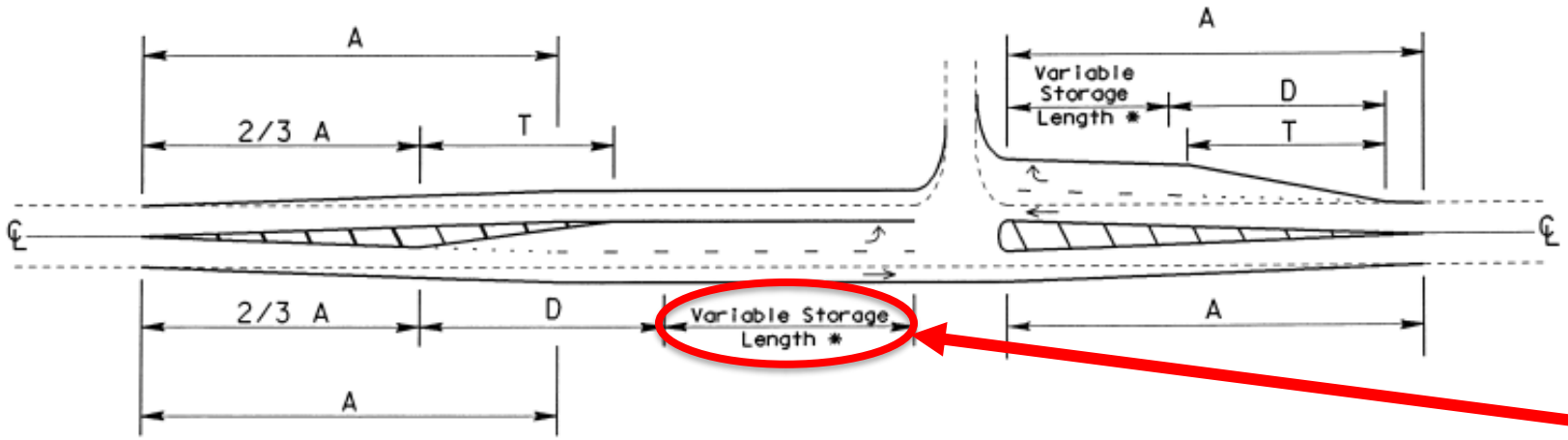
Top 10 Recent Traffic Impact Analysis Concerns…

1. LACK OF MITIGATION (esp. queue spillback down ramps or across multiple nodes, inadequate queue reporting); RUN SIMULATION!
2. Inadequate driveway stem (100' minimum; TIA should identify stem length)
3. Not justifying and no prior approval to Analysis Guidelines deviations
4. Inadequate corner clearance (50' min/100’ preferred from ends of the radii)
5. Resubmittals restart the statutory timeframe clock! Piecemeals!!
6. No/Inadequate Maximum Walking Distance Figure/Internal Capture!
7. **VSL in Driveway Manual (p. 78) is recommended storge from analysis (e.g. TIA) needs A & D values added to it!** *

NCDOT Capacity Analysis Guidelines and CM Updates

Recommended Treatment for Turn Lanes

Symmetrical Widening



Design Speed (mph)	Posted Speed (mph)	Minimum Deceleration Length (D)	Desirable Deceleration Length (D)	Bay Taper Length (T)	Approach / Departure Taper (A)
30	≤ 25	100′	150′	75′	$A = WS^2/60$ (IF $S \leq 40$ MPH) $A = WS$ (IF $S > 40$ MPH)
35	30	100′	150′	75′	
40	35	150′	200′	100′	S = Design Speed W = Width of Lateral Shift
45	40	150′	250′	100′	
50	45	150′	300′	100′	* Storage length for waiting vehicles should be calculated based on the latest version of the Highway Capacity Manual or Policy on Street and Driveway Access to North Carolina Highways.
55	50	200′	500′	150′	
60	55	250′	575′	200′	

Required storage from analysis (e.g., TIA)

Driveway Manual pg. 78

Top 10 Recent Traffic Impact Analysis Concerns…

1. LACK OF MITIGATION (esp. queue spillback down ramps or across multiple nodes, inadequate queue reporting); RUN SIMULATION!
2. Inadequate driveway stem (100' minimum; TIA should identify stem length)
3. Not justifying and no prior approval to Analysis Guidelines deviations
4. Inadequate corner clearance (50' min/100’ preferred from ends of the radii)
5. Resubmittals restart the statutory timeframe clock! Piecemeals!!
6. No/Inadequate Maximum Walking Distance Figure/Internal Capture!
7. VSL in Driveway Manual (p. 78) is recommended storge from analysis (e.g. TIA) needs A & D values added to it!
8. **Inappropriate breakdown of land uses or improper site plan (outparcels separately, roads separating sites, BEWARE of insufficient site plans!)**

Top 10 Recent Traffic Impact Analysis Concerns…

1. LACK OF MITIGATION (esp. queue spillback down ramps or across multiple nodes, inadequate queue reporting); RUN SIMULATION!
2. Inadequate driveway stem (100' minimum; TIA should identify stem length)
3. Not justifying and no prior approval to Analysis Guidelines deviations
4. Inadequate corner clearance (50' min/100’ preferred from ends of the radii)
5. Resubmittals restart the statutory timeframe clock! Piecemeals!!
6. No/Inadequate Maximum Walking Distance Figure/Internal Capture!
7. VSL in Driveway Manual (p. 78) is recommended storge from analysis (e.g. TIA) needs A & D values added to it!
8. Inappropriate breakdown of land uses or improper site plan (outparcels separately, roads separating sites)
9. **TIP design year analysis potentially needed** *

TIP Project Coordination

- Consider TIP project geometry
- Coordinate access points and construction with applicable personnel from Project Management Unit, Roadway Design, Division, etc.
  - Site plan overlay needed
- TIP design year analysis
  - Dependent on traffic forecast and zoning changes
- Use TIP volume projections
- Determine if TIA trips included in forecast

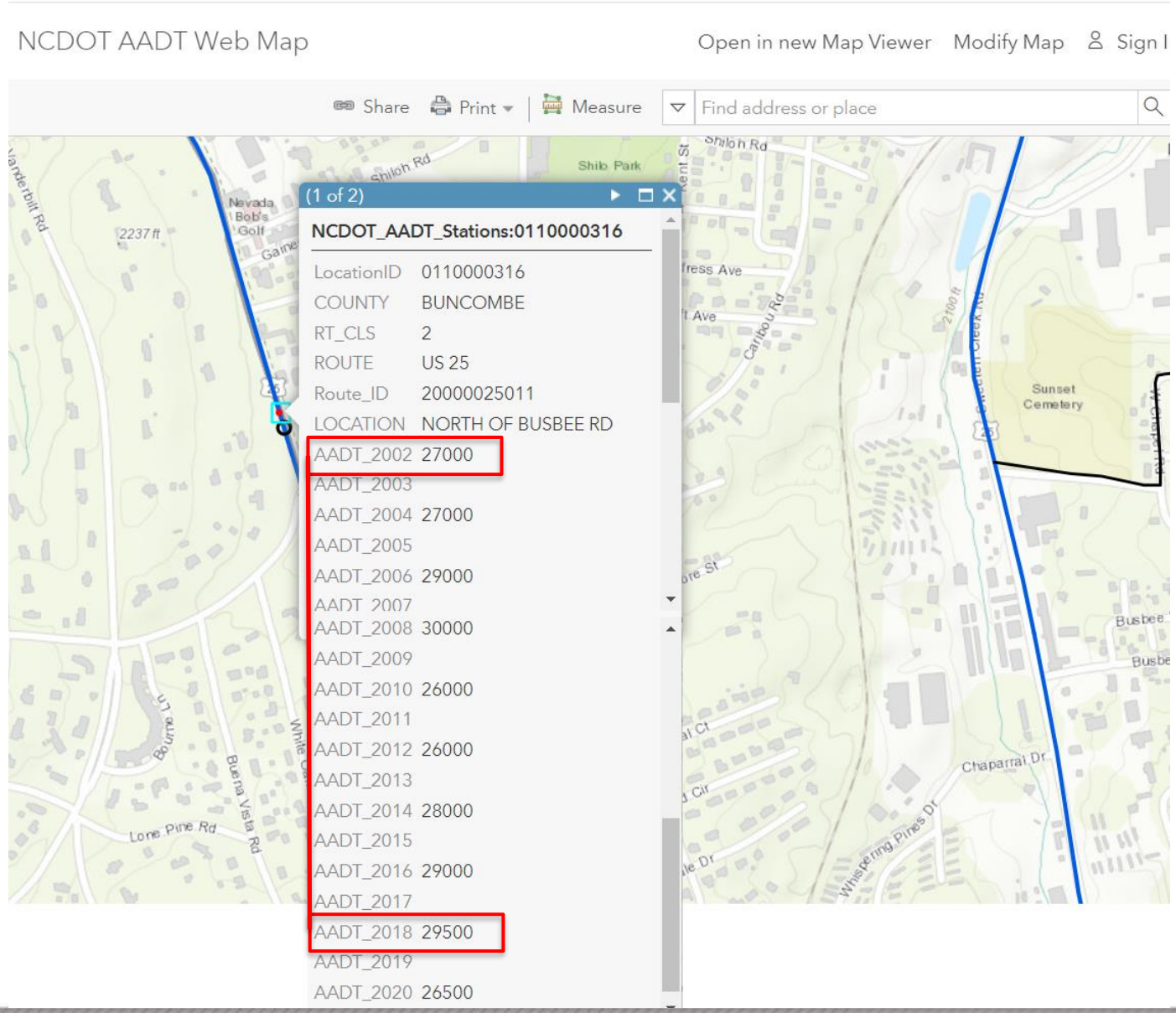
https://connect.ncdot.gov/projects/planning/pages/state-transportation-improvement-program.aspx

Driveway Manual Pages 6-8

Top 10 Recent Traffic Impact Analysis Concerns…

1. LACK OF MITIGATION (esp. queue spillback down ramps or across multiple nodes, inadequate queue reporting); RUN SIMULATION! *
2. Inadequate driveway stem (100' minimum; TIA should identify stem length)
3. Not justifying and no prior approval to Analysis Guidelines deviations *
4. Inadequate corner clearance (50' min/100’ preferred from ends of the radii)
5. Resubmittals restart the statutory timeframe clock! Piecemeals!!
6. No/Inadequate Maximum Walking Distance Figure/Internal Capture! *
7. VSL in Driveway Manual (p. 78) is recommended storge from analysis (e.g. TIA) needs A & D values added to it! *
8. Inappropriate breakdown of land uses or improper site plan (outparcels separately, roads separating sites)
9. TIP design year analysis potentially needed *
10. **Misapplying growth rate (take planned/ approved developments into account!) ***

Growth Rate Example



1. Use Maximum Number of Years Available (NOTE: Ignore 2020 data per CMS memo due to COVID)

2. Annual Growth Rate % Formula:

[(Latter Year AADT / Earlier Year AADT) ^ (1 / # of years)] - 1

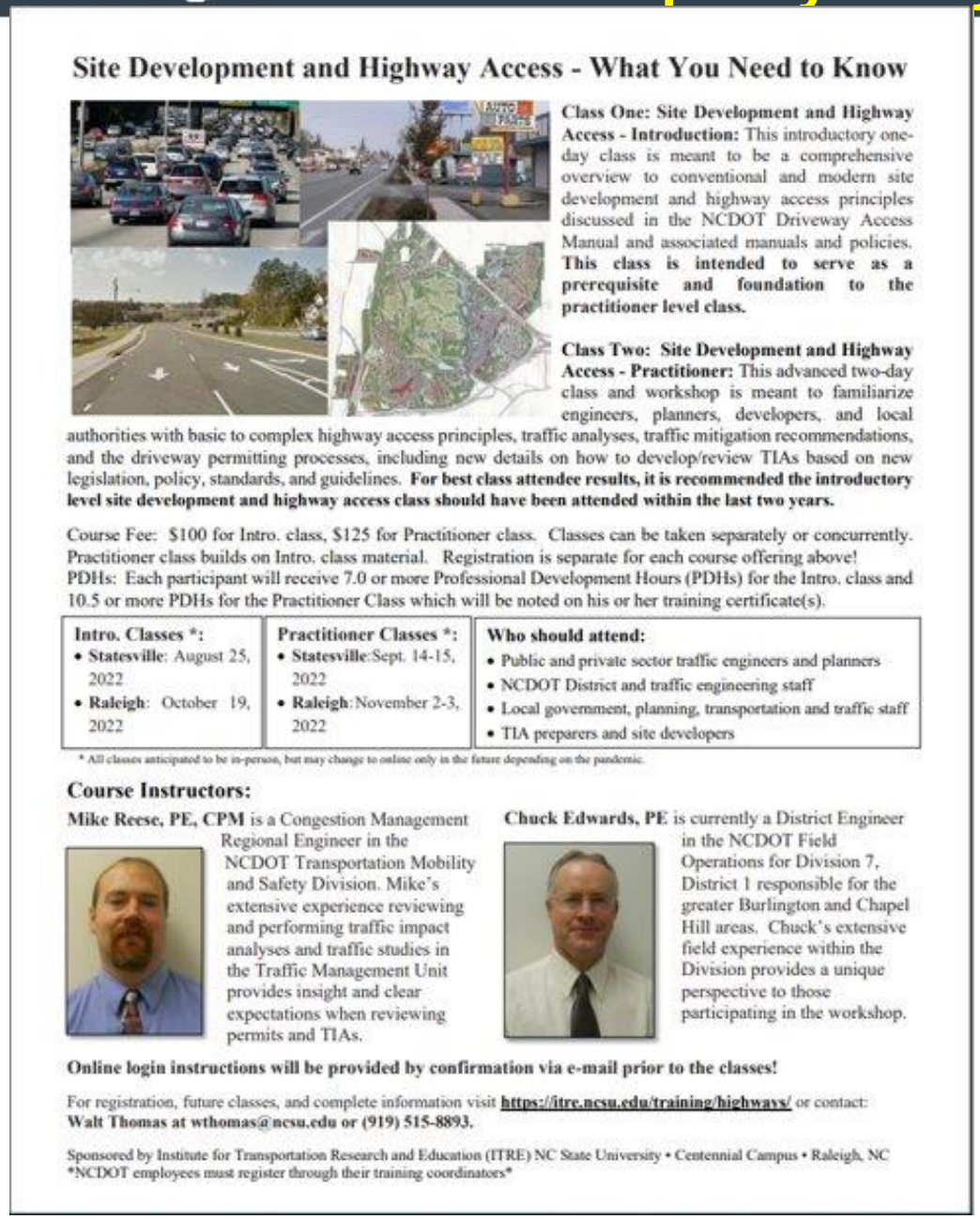
$[(29500/27000)^{(1/16)}] - 1$

$[(1.0926)^{(0.0625)}] - 1$

0.0055

0.55% Annual Growth Rate

Beware of 1 time jumps in AADT!



Site Development and Highway Access - What You Need to Know

Class One: Site Development and Highway Access - Introduction: This introductory one-day class is meant to be a comprehensive overview to conventional and modern site development and highway access principles discussed in the NCDOT Driveway Access Manual and associated manuals and policies. **This class is intended to serve as a prerequisite and foundation to the practitioner level class.**

Class Two: Site Development and Highway Access - Practitioner: This advanced two-day class and workshop is meant to familiarize engineers, planners, developers, and local authorities with basic to complex highway access principles, traffic analyses, traffic mitigation recommendations, and the driveway permitting processes, including new details on how to develop/review TIAs based on new legislation, policy, standards, and guidelines. **For best class attendee results, it is recommended the introductory level site development and highway access class should have been attended within the last two years.**

Course Fee: $100 for Intro. class, $125 for Practitioner class. Classes can be taken separately or concurrently. Practitioner class builds on Intro. class material. Registration is separate for each course offering above!
PDHs: Each participant will receive 7.0 or more Professional Development Hours (PDHs) for the Intro. class and 10.5 or more PDHs for the Practitioner Class which will be noted on his or her training certificate(s).

Intro. Classes *:	Practitioner Classes *:	Who should attend:
• **Statesville**: August 25, 2022 • **Raleigh**: October 19, 2022	• **Statesville**:Sept. 14-15, 2022 • **Raleigh**:November 2-3, 2022	• Public and private sector traffic engineers and planners • NCDOT District and traffic engineering staff • Local government, planning, transportation and traffic staff • TIA preparers and site developers

* All classes anticipated to be in-person, but may change to online only in the future depending on the pandemic.

Course Instructors:

Mike Reese, PE, CPM is a Congestion Management Regional Engineer in the NCDOT Transportation Mobility and Safety Division. Mike's extensive experience reviewing and performing traffic impact analyses and traffic studies in the Traffic Management Unit provides insight and clear expectations when reviewing permits and TIAs.

Chuck Edwards, PE is currently a District Engineer in the NCDOT Field Operations for Division 7, District 1 responsible for the greater Burlington and Chapel Hill areas. Chuck's extensive field experience within the Division provides a unique perspective to those participating in the workshop.

Online login instructions will be provided by confirmation via e-mail prior to the classes!

For registration, future classes, and complete information visit **https://itre.ncsu.edu/training/highways/** or contact: **Walt Thomas at wthomas@ncsu.edu or (919) 515-8893.**

Sponsored by Institute for Transportation Research and Education (ITRE) NC State University • Centennial Campus • Raleigh, NC
NCDOT employees must register through their training coordinators

NCSU Site Development and Highway Access Classes

- Co-Instructed by Mike Reese (Congestion Mgmt.) and Chuck Edwards (Graham District)
- Introductory (1 day) and Practitioner Level+Wkshp. (1.75 day) Classes
- Next classes:
  - Intro.: October 19 (Raleigh/ITRE)
  - Practitioner: November 2-3 (Ral/ITRE)
  - Additional classes across NC in 2023
- https://itre.ncsu.edu/training/highways

Questions?

Mike Reese, P.E., C.P.M.
mikereese@ncdot.gov

NCDOT Congestion Management Section