

# NCDOT Express Design Traffic Evaluation Guidance

Version 2.0

Feasibility Studies Unit  
Transportation Planning Division  
Congestion Management Section

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Prepared for:

NCDOT

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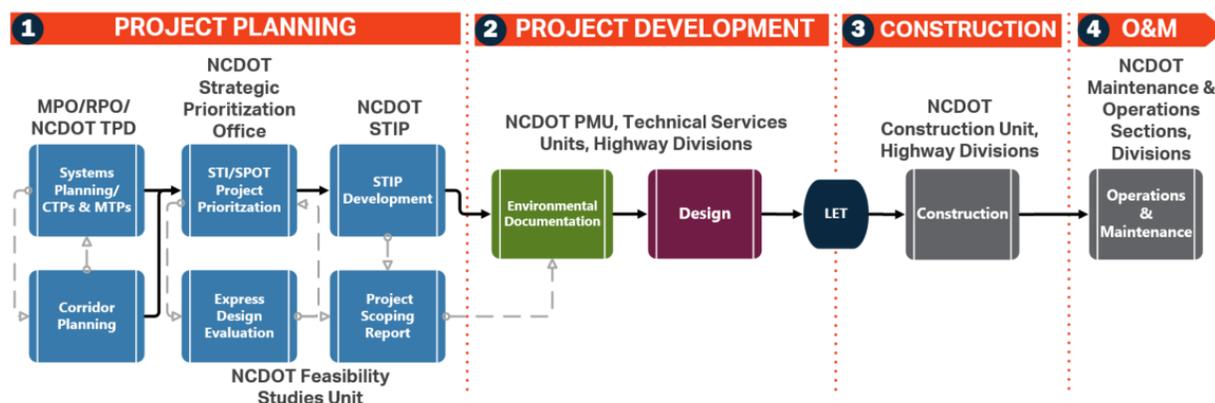
# I. Introduction

The North Carolina Department of Transportation’s (NCDOT) Feasibility Studies Unit (FSU) is responsible for investigating candidate State Transportation Improvement Program (STIP) projects requested by the public, local government, and/or NCDOT Board of Transportation Members. Feasibility studies (*now referred to as the **Project Scoping Process***) are conducted as part of the initial step known as Stage 1 Project Initiation in the Project Delivery Network (PDN). The PDN outlines the stages, activities, tasks, deliverables, and references to accomplish the goals of the Project Scoping Process. Throughout this guide, references to the PDN sections are noted by an activity identifier (example 1TP1). The purpose of the Project Scoping Process is to describe the proposed project, estimate preliminary costs, and identify any potential problems that may require consideration in the project development phase.

## PURPOSE OF EDTE

- ❖ The purpose of the EDTE is to evaluate and develop cost effective designs during the development of the Express Design (Stage 1 of PDN).
- ❖ Provide designs that meet project needs and minimize expansion of scope of project during Stage 2 (Alignment Defined)

## NCDOT Existing Process



This guidance document provides instructions for NCDOT staff and NCDOT consultants to complete the traffic related aspects of the Project Scoping Process. The **Project Scoping Process** will be completed in two phases – the **Express Design Evaluation** and **Project Scoping Report**.

The **Express Design Evaluation** will investigate conceptual design option(s) and prepare costs needed for the project to go through the prioritization process (SPOT), in accordance with the Strategic Transportation Investments Law (STI), and potentially be included in the STIP. When or if the project moves forward after SPOT, the **Project Scoping Report (PSR)** will be initiated. The PSR will provide project background, more detailed environmental screening data, and documentation for NCDOT management to use in determining how the project will proceed into the project development phase.

The **Express Design Traffic Evaluation (EDTE)** will also be developed in two phases – the **Express Design Traffic Volumes (EDTV)** and the **Express Design Traffic Analysis (EDTA)**.



### Why is the EDTE Important?

- Evaluates whether the proposed design will operate at a level consistent with the project goals.
- Reduces likelihood of cost escalation during project development due to expansion of project scope. Produces greater certainty in project costs during Prioritization and Programming.
- Screen or eliminate design alternatives during the Express Design phase, creating cost and time savings during Stage 2. Identifies projects that are over or under designed early in the process.

The Express Design Traffic Volume (EDTV) task includes the development of the volume data required to complete the Express Design Traffic Analysis (EDTA) and will include estimates of the current traffic volumes and design year traffic volumes for the proposed project. The EDTV will include estimates of the Average Annual Daily Traffic (AADT) and peak hour traffic volumes for the project study area. The deliverable for the process includes the development of the EDTV Report.

The Express Design Traffic Analysis (EDTA) task includes the evaluation of the traffic operations for the proposed project at a level commensurate with the complexity of the project. The EDTA will typically include an evaluation of the Base Year and Design Year No-Build conditions and an analysis of the Design Year Build scenario for each Alternative. The deliverable for the process includes the EDTA Report.

All components of the EDTV and EDTA will be uploaded through the ATLAS Workbench (Workbench) to the NCDOT Connect Scoping Team Site (Scoping Site, for Express Design Evaluation) or NCDOT Connect Preconstruction Team Site (Preconstruction Site, for Project Scoping). The Workbench is the platform to upload the final version of all the deliverables for the Project Scoping Process. Information uploaded to the Workbench will be integrated and automatically placed in the correct location on the Scoping or Preconstruction Site with the correct naming convention. See Appendix A1 for Scoping Site and Workbench upload instructions.

Updates to this process guidance will periodically be completed as needed. For questions on this guidance, or to provide suggested improvements, please contact (as of March 2023):

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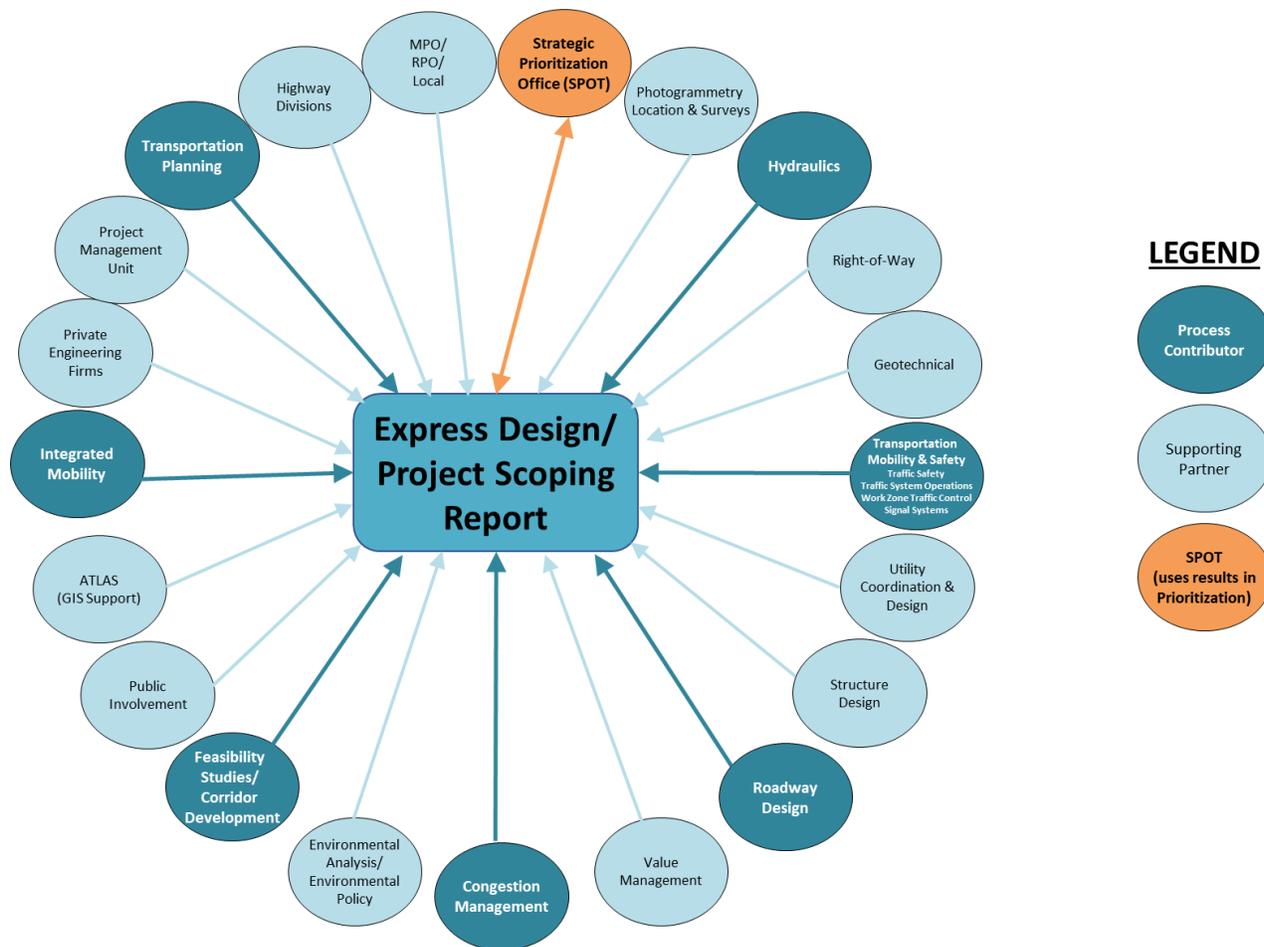
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## 2. Express Design Traffic Evaluation Overview

### 2.1 Express Design/Project Scoping Report Overview

The overall Express Design/Project Scoping Report (ED/PSR) process includes the integration of a multi-disciplined team to develop the designs and documentation. The ED/PSR process is managed and implemented by the Feasibility Study Unit (FSU) with support from numerous NCDOT and external partners. The partners include both Process Contributors and Supporting Partners.



The development of the technical aspects of the ED/PSR are typically done by a comprehensive team made up of individuals with expertise in each technical area. The ED/PSR Team is managed by the FSU Project Manager and is responsible for the delivery of all aspects of the ED/PSR.

*Process Contributors* are NCDOT Units that provide support and technical expertise throughout the process. The Process Contributors are responsible for the development of procedures and guidelines on how the technical aspects of the ED/PSR process are to be completed. Process Contributors also may be called upon to provide their expertise in individual areas and make recommendations to guide the development of the ED/PSR. Process Contributors also may provide technical reviews of the elements of the ED/PSR process that fall within their purview. Process Contributors typically do not develop the technical aspects of individual ED/PSRs but provide support and review to ensure they meet the goals of the project and adhere to the procedures and guidelines.



*Supporting Partners* provide guidance and insight into individual projects and guide the development of the studies or provide a support service that enables the more efficient development of the studies. Highway Divisions, MPOs, RPOs and Local agency staff provide support and guidance on the goals of the project and share local knowledge and project specific information to the ED/PSR Team. NCDOT Business Units (Photogrammetry, Location & Surveys, Right-of-Way, Geotechnical, Utility Coordination & Design, Environmental Analysis, Structure Design) provide support by assisting with discipline specific items and provide access to available data relating to each discipline.

The Project Management Unit, Value Management Unit, Environmental Policy Unit, Public Involvement and ATLAS (GIS Support) assist the ED/PSR Team by providing resources and utilities to allow for the preservation and transfer of information to later stages in the IPD process and prepare the project to advance seamlessly into Stage 2 of the PDN Process.

## 2.2 Express Design Traffic Evaluation Process Roles and Responsibilities

The following entities are instrumental in the delivery of the Express Design Traffic Evaluation (EDTE) portion of the overall ED/PSR process. Each Process Contributor serves a vital role in the delivery of the EDTE and have defined roles and responsibilities.

### Feasibility Study Unit

FSU serve as the primary *Process Contributor* and provide the overall management structure for the ED/PSR process and responsible for the delivery of ED/PSR deliverables. Their role in the implementation of the EDTE process includes the following tasks:

- Assemble Comprehensive Project Teams to develop the Express Design and Project Scoping Reports
- Serve as NCDOT Project Managers overseeing the work of the ED/PSR Teams including the development of the EDTE
- Identify Projects that need an EDTE
- Develop the Scope for the EDTE
- Coordinate Review of EDTE deliverables

FSU's primary role is to implement the EDTE process as a part of the overall ED/PSR delivery process. Therefore, their responsibility is to assemble the project team, develop the scope for the studies and coordinate the delivery of the EDTE in coordination with the design development process. For some projects that have previously developed designs, the project may have transitioned to either the Project Management Unit (PMU) or to the Division staff. For these projects the PMU or Division Project Manager will serve the same roles as the FSU Project Manager described above.

### Transportation Planning Division (TPD)

TPD serves as a *Process Contributor* and support the development of the Express Design Traffic Volume (EDTV) phase of the overall EDTE Process. Their role in the implementation of the EDTE process includes the following tasks:



- Develop and maintain the Express Design Traffic Volume (EDTV) Development Procedure and Guidelines
- Provide and maintain the EDTV portions of the *EDTE Tool* that is utilized to develop the EDTV
- Provide technical expertise and local knowledge upon request for the development of EDTVs for specific projects
- Provide travel demand model data for all standard travel demand models
- Run travel demand models for scenarios that are not included in the standard travel demand model deliverables
- Provide reviews of EDTVs developed by the ED/PSR Teams

TPD's primary role is to provide technical oversight and assistance to the ED/PSR Teams developing the EDTV Reports. TPD is responsible for developing the overall procedure for developing EDTVs and providing the technical resources (EDTE Tool, travel demand model data) required to implement the procedure. TPD is also responsible for providing their technical expertise during the EDTV review process.

Additionally, TPD may also contribute through the development of EDTV Reports for select projects. The preferred method of delivery is to maintain the development of the entire EDTE by the ED/PSR Team; however, on occasion the EDTV task may be split out as a stand-alone deliverable that will be developed by TPD or their Supporting Partners.

### **Congestion Management Section (CMS)**

CMS serves as a *Process Contributor* and supports the development of the Express Design Traffic Analysis (EDTA) phase of the overall EDTE Process. Their role in the implementation of the EDTE process includes the following tasks:

- Develop and maintain the Express Design Traffic Analysis (EDTA) Development Procedure and Guidelines
- Provide and maintain EDTA Templates and Utilities that are utilized to develop the EDTA
- Provide technical expertise upon request for the development of designs or analysis techniques for specific projects
- Provide digital files for any previous developed studies in the vicinity of the project
- Provide reviews of EDTAs developed by the ED/PSR Teams

CMS's primary role is to provide technical oversight and assistance to the ED/PSR Teams developing the EDTA Reports. CMS is responsible for developing the overall procedure for developing EDTAs and providing the technical resources (software specific guidelines, templates) required to implement the procedure. CMS is also responsible for providing their technical expertise during the EDTV review process.

Additionally, CMS may also contribute through the development of EDTA Reports for select projects. The preferred method of delivery is to maintain the development of the entire EDTE by the ED/PSR Team;



however, on occasion the EDTA task may be split out as a stand-alone deliverable that will be developed by CMS or their Supporting Partners.

### **Professional Engineering Firm (PEF)**

PEFs serve an important role as *Support Partner* in the implementation of the EDTE and ED/PSR processes. Their role in the implementation of the EDTE Process includes the following tasks:

- Develop EDTE Reports and EDTA Reports in accordance with the EDTE procedures for assigned projects as part of an ED/PSR Team
- Coordinate with other Support Partners (SPOT, Project Management Unit, Highway Divisions, MPOs, RPOs and Local Governments) throughout the development of the EDTE and ED/PSR.

PEFs are the primary developers of the technical studies that are developed in the ED/PSR process. Individual PEFs or a team of PEFs are assembled for each project and work collaboratively on all aspects of the ED/PSR.

### **EDTE Program Manager/General Engineering Services Consultant**

The EDTE Program Manager (or General Services Engineering Consultant (GESC)) is a PEF that acts as a *Support Partner* providing both technical and support services to any of the above listed groups. The EDTE Program Manager also serves as an extension of the NCDOT staff to provide assistance in delivering the EDTE Program. Due to the staff resources limitations and the range of responsibilities each unit has, the EDTE Program Manager may be delegated the responsibilities for individual tasks to deliver aspects of the EDTE Process under the direction and supervision of the NCDOT Unit. The EDTE Program Manager has the following responsibilities during the development of the EDTE Process:

- Identify Projects that need an EDTE (if delegated by FSU)
- Develop the Scope for the EDTE (if delegated by FSU)
- Provide reviews of EDTVs developed by the ED/PSR Teams (if delegated by TPD)
- Provide reviews of EDTAs developed by the ED/PSR Teams (if delegated by CMS)

## **2.3 Express Design Traffic Evaluation Delivery Process**

The EDTE process was originally developed in 2021 and was included in a Pilot Study throughout 2022; therefore, it is a recent addition to the ED/PSR process as of 2023. There are a substantial number of projects with either Express Designs or both Express Designs and Project Scoping Reports that are already complete that have not include any traffic analysis. Due to this, the implementation of the EDTE process is dependent on the current status of the project in the ED/PSR process and its current funding status. Therefore, the following delivery methods were developed:

- EDTE for Existing Projects with Express Design Complete
- EDTE for New Projects without Express Design Complete

### **EDTE for Existing Projects with Express Design Complete**

The process for developing an EDTE when the project already has an Express Design includes preparing the analysis for the proposed design alternatives. The preferred method for delivering this type of project is to have a single PEF Team develop the full EDTE including both the EDTV and EDTE. Allowing



one PEF Team to develop the full EDTE allows for data gathered during scoping of the analysis to be utilized for both the EDTV and EDTA. Additionally, this process reduces the coordination effort and minimizes questions during the analysis phase as the same group is responsible for the development of the deliverables.

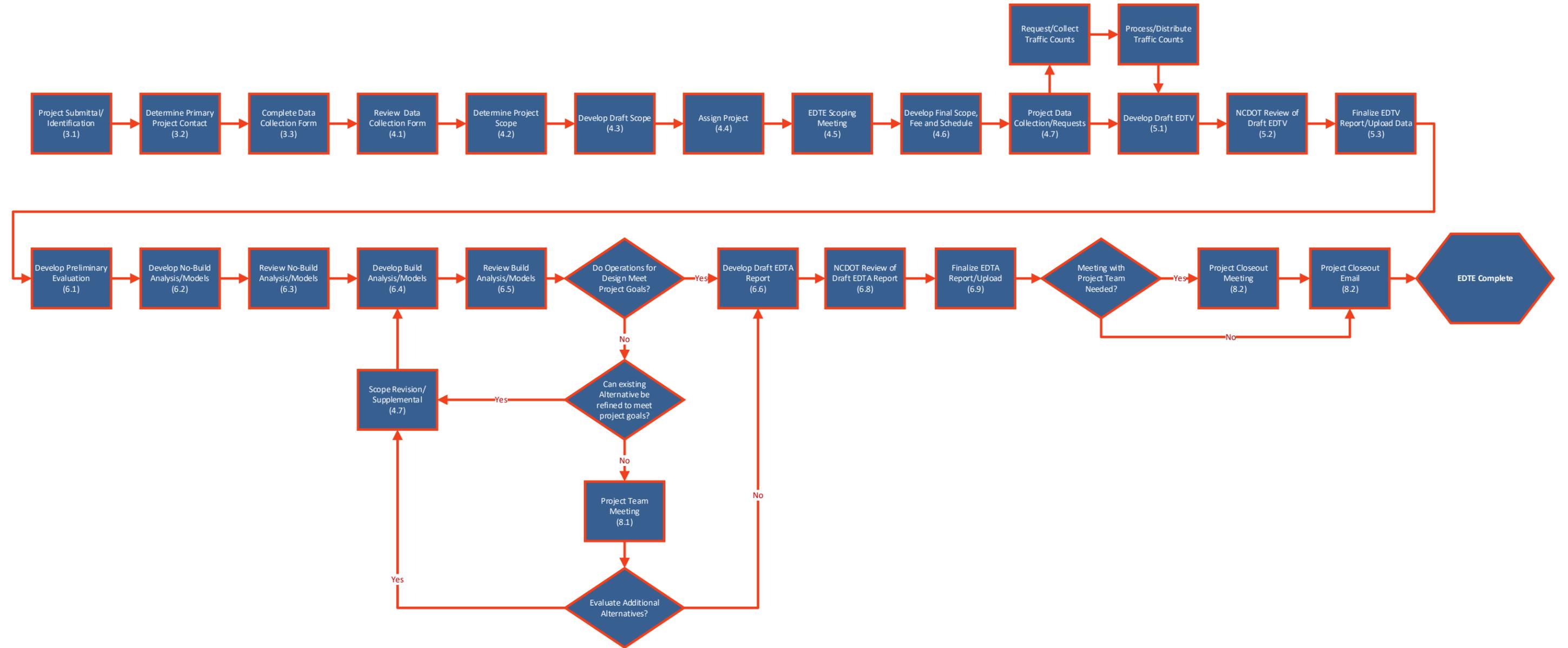
It is preferable to allow the PEF that developed the design to develop the EDTE if they meet the prequalification for the level of analysis and have the availability to complete the study. However, because the design has already been developed the level of coordination with the design team is relatively minimal; therefore, assigning the EDTE to a PEF who did not participate in the design development is acceptable. This approach will be used extensively due to the large number of projects in the project development pipeline that have an Express Design but have not had any detailed traffic analysis. As more EDTEs are completed and the process is implemented from the inception of the ED/PSR process this delivery method will be greatly reduced.

### **EDTE for New Projects without Express Design Complete**

The process for developing the EDTE for projects that are just starting out in the ED/PSR process relies heavily on utilizing a comprehensive project team that understands the project specific dynamics and challenges. Each PEF Team should have either prequalified staff or a separate EDTE PEF will be assigned to assist the Design PEF Team in the development of the EDTE. Involving the staff that are responsible for the EDTE in the project from the scoping meeting through its completion allows for a better collaboration throughout the project development process. Including the traffic staff at all stakeholder meetings provides valuable insight to the study area and potential future development that is critical in determining the future year traffic volumes. This method should be utilized to the greatest extent possible for all new projects that do not yet have an Express Design.



## EXPRESS DESIGN TRAFFIC EVALUATION (EDTE) PROCESS FLOWCHART





## 3. Express Design Traffic Evaluation Data Collection/Initiation

The Express Design traffic evaluation begins with developing a thorough understanding of the proposed project and determining the appropriate methodology for completing the analysis.

### 3.1 Project Submittal/Identification

The first step in the process begins once a proposed project is submitted to the FSU Project Manager or when an existing project that does not have a current traffic evaluation is identified. Once the project is submitted or identified the scoping of the Project Scoping Process begins and the scope of the traffic evaluation is determined.

### 3.2 Determination of Primary Project Contact

The second step in the process is to determine who will be the Primary Project Contact. The Primary Project Contact will be the NCDOT staff member who is responsible for coordinating the individual studies that are utilized in the ED/PSR process. Typically, the Primary Project Contact will be the NCDOT FSU Project Manager for ongoing projects that are in the ED/PSR Phase. The Primary Project Contact may also be the PMU Project Manager or Division Project Manager for projects that are already in Stage 2.

### 3.3 Data Collection Form

The next step is for the Primary Project Contact to complete the EDTE Data Collection Form. There are two separate versions of the Data Collection Form depending on the delivery method:

- EDTE Data Collection Form for Existing Projects with Express Design Complete
- EDTE Data Collection Form for New Projects without Express Design Complete

The EDTE Data Collection form is utilized in the development of the EDTE Scope. The following graphics show each of the EDTE Data Collection Forms and detailed Instructions are included in Appendix A:

#### RESOURCES

- ❖ [Express Design Traffic Evaluation Data Collection Form \(Appendix A1\)](#)



EXPRESS DESIGN TRAFFIC EVALUATION (EDTE) DATA COLLECTION FORM - PROJECT WITH PREVIOUSLY DEVELOPED DESIGN				
TIP No.		Previous Traffic Forecast Completed	{Yes/No}	{Insert Link}
SPOT ID		Does Area Require Seasonal Analysis	{Yes/No}	
SPOT Data Sheet <a href="#">click for link</a>	{Insert Link}	Previous Traffic Analysis Completed	{Yes/No}	{Insert Link}
County #1		Design Included in STIP Cost Estimate		{Insert Alternative Name/Description}
County #2		Cost Estimate Alternative Design (PDF Format)		{Insert Link}
Division #1		Cost Estimate Alternative Design (DGN Format)		{Insert Link}
Division #2		DGN File in Correct Global Origin/Units	{Yes/No}	
MPO/RPO #1 <a href="#">click for link</a>		Additional Alternative Under Consideration #1	{Yes/No}	{Insert Alternative Name/Description}
MPO/RPO #2		Cost Estimate Alternative Design (PDF Format)		{Insert Link}
Project Description		Cost Estimate Alternative Design (DGN Format)		{Insert Link}
SPOT Specific Improvement Type		DGN File in Correct Global Origin/Units	{Yes/No}	
Urbanized Area <a href="#">click for link</a>	{Yes/No}	Additional Alternative Under Consideration #2	{Yes/No}	{Insert Alternative Name/Description}
Travel Demand Model Coverage	{Insert Travel Demand Model}	Cost Estimate Alternative Design (PDF Format)		{Insert Link}
Current Status	{Insert Express Design or Preconstruction}	Cost Estimate Alternative Design (DGN Format)		{Insert Link}
Current NCDOT Project Manager		DGN File in Correct Global Origin/Units	{Yes/No}	
Current Primary Division Contact		Additional Alternative Under Consideration #3	{Yes/No}	{Insert Alternative Name/Description}
Current R/W Date		Cost Estimate Alternative Design (PDF Format)		{Insert Link}
Current Construction Date		Cost Estimate Alternative Design (DGN Format)		{Insert Link}
Scoping Connect Site	{Yes/No}	DGN File in Correct Global Origin/Units	{Yes/No}	
Scoping Connect Site Link	{Insert Link}	Analysis of Additional/New Alternatives Needed		{Insert Alternative Name/Description}
Express Design FSU/CDE Manager		Any change in Vision/Purpose/Need of Project		
Express Design PEF (or In-house)				
Preconstruction Managed by	{Insert Division or Central}			
Preconstruction Site	{Yes/No}			
Preconstruction Connect Site Link	{Insert Link}			
Preconstruction Project Manager				
Preconstruction PEF				

EXPRESS DESIGN TRAFFIC EVALUATION (EDTE) DATA COLLECTION FORM - NEW PROJECT WITHOUT PREVIOUSLY DEVELOPED DESIGN				
TIP No.		Previous Traffic Forecast Completed	{Yes/No}	{Insert Link}
SPOT ID		Does Area Require Seasonal Analysis	{Yes/No}	
SPOT Data Sheet <a href="#">click for link</a>	{Insert Link}	Previous Traffic Analysis Completed	{Yes/No}	{Insert Link}
County #1		Alternative Under Consideration #1		{Insert Alternative Name/Number}
County #2		Proposed Typical Section <a href="#">click for link</a>		{Insert Typ Section # or N/A}
Division #1		Alternative #1 Description		{Insert Description}
Division #2		Alternative Under Consideration #2		{Insert Alternative Name/Number}
MPO/RPO #1 <a href="#">click for link</a>		Proposed Typical Section <a href="#">click for link</a>		{Insert Typ Section # or N/A}
MPO/RPO #2		Alternative #2 Description		{Insert Description}
Project Description		Alternative Under Consideration #3		{Insert Alternative Name/Number}
SPOT Specific Improvement Type		Proposed Typical Section <a href="#">click for link</a>		{Insert Typ Section # or N/A}
Urbanized Area <a href="#">click for link</a>	{Yes/No}	Alternative #3 Description		{Insert Description}
Travel Demand Model Coverage	{Insert Travel Demand Model}	Alternative Under Consideration #4		{Insert Alternative Name/Number}
Current Status	{Insert Express Design or Preconstruction}	Proposed Typical Section <a href="#">click for link</a>		{Insert Typ Section # or N/A}
Current NCDOT Project Manager		Alternative #4 Description		{Insert Description}
Current Primary Division Contact		Analysis of Additional/New Alternatives Needed		{Insert Alternative Name/Description}
Current R/W Date	unfunded	Any change in Vision/Purpose/Need of Project		
Current Construction Date	unfunded			
Scoping Connect Site	{Yes/No}			
Scoping Connect Site Link	{Insert Link}			
Express Design FSU/CDE Manager				
Express Design PEF (or In-house)				
Preconstruction Managed by	{Insert Division or Central}			
Preconstruction Site	{Yes/No}			
Preconstruction Connect Site Link	{Insert Link}			
Preconstruction Project Manager				
Preconstruction PEF				

The following elements are included on both versions of the EDTE Data Collection Form:

- Project Data
  - STIP Number
  - SPOT ID
  - Link to SPOT Data Sheet (for projects that were scored in P5 or P6)
  - County
  - Division
  - MPO/RPO
  - Project Description
  - SPOT Specific Improvement Type
  - Urbanized Area
  - Travel Demand Model Coverage
- Project Status and Contacts
  - Current Status (Express Design or Preconstruction)
  - Current NCDOT Project Manager



- Current Primary Division Contact
- Current R/W Data
- Current Construction Date
- Express Design Project Information
  - Scoping Connect Site
  - Scoping Connect Site Link
  - Express Design FSU/CDU Manager
  - Express Design PEF (or In-house)
- Preconstruction Project Information
  - Preconstruction Managed by
  - Preconstruction Site
  - Preconstruction Connect Site Link
  - Preconstruction Project Manager
  - Preconstruction PEF
- Traffic Forecast/Analysis Information
  - Previous Traffic Forecast Completed
  - Does Area Require Seasonal Analysis
  - Short-term or Long-term Solution
  - Previous Traffic Analysis Completed

For projects that have previously developed Express Designs, the *EDTE Data Collection Form for Existing Projects with Express Design Complete* is utilized. The following elements are required for each design alternative for projects with previously developed designs:

- Identification of the design alternative that is currently the basis for STIP Cost Estimate
- Design Alternative ID/Number and description
- Design Alternative Plan Sheet/Roll Plot (PDF Format)
- Design Alternative Design File (DGN Format)
- Confirmation that the design files is in the correct Global Origin/ Working Units
- Any change in Vision/Purpose/Need of Project

For projects that do not have a previously developed Express Designs, the *EDTE Data Collection Form for New Projects without Express Design Complete* is utilized. The following elements are required for each design alternative for newly identified projects:

- Design Alternative ID/Number and description
- Proposed Typical Section (from Highway Typical Sections for Use In SPOT On!ine)
- Description of Design Alternative
- Vision/Purpose/Need of Project

Once the appropriate EDTE Data Collection form has been completed it is returned to the NCDOT FSU Project Manager (or their designee) for the development of the EDTE Scope.



## 4. Express Design Traffic Evaluation Scoping

The Express Design traffic evaluation proceeds with developing a thorough understanding of the proposed project based on the information included on the Data Collection Form and determining the appropriate methodology for completing the analysis.

### 4.1 Review Data Collection Form

The first step in the scoping process begins with a review of the Data Collection Form completed in Section 3.3. Once the Data Collection Form is reviewed and approved the scoping process begins.

### 4.2 Determine Project Scope

The project scoping step is typically completed by the Primary Project Contact (or their designee). The major part of this step is determining the detailed methodology for completing the traffic evaluation, including each of the elements included in the following sections:

#### **Determine Study Area**

The first step in scoping the traffic evaluation is to determine the study area for the proposed project. The study area for the traffic evaluation may be slightly different than the overall project study area and is focused primarily on determining which locations are critical to determining the design of the proposed project. The Express Design study area may be smaller than the study area that is needed in Stage 2 of the PDN during the development of the traffic capacity analysis (2TM1) for the environmental documentation.

Generally, the study area should encompass the full limits of the project and include all intersection/interchanges where the current side street volume exceeds 3,000 vehicles per day for roadways with mainline volumes exceeding 10,000 AADT and 15% of AADT for roadways with of 10,000 AADT or less. Additional intersections may be evaluated on a case-by-case basis and included in the study based on the judgement of the scope developer. Typically, the study area is not extended to include adjacent intersections/interchanges outside the limits of the project unless it is determined that they are critical to the operations of the project and warrant inclusion.

#### **Determine Design Year**

The next step is to determine the design year for the analysis. Consideration should be given to both the likely schedule for constructing the project and identified purpose of the proposed project. Short-term or interim projects that are designed to provide temporary relief should generally include a design year 10-15 years beyond the likely construction date. Long-term solutions that are meant to address the congestion for a longer period should generally include a design year 20 years beyond the likely construction date. The design year should be rounded up to the next 5-year increment.

#### **Determine Study Alternatives**

The next step is to determine which alternatives will be evaluated in the study. The determination of study alternatives should balance the cost and level of effort to develop the analysis of the alternatives with the need to consider a range of alternatives in the project development process.

The determination of alternatives should consider a two-tiered approach that reduces the number of alternatives that are included in the full traffic analysis. The first tier of analysis should utilize high-level analysis techniques, such as critical lane analysis methods, FHWA's Capacity Analysis for Planning of



Junctions (CAP-X) or NCDOT’s ARterial eVALuation Computational Engine (ARTVAL) to reduce the number of alternatives down to one or two, if possible. Tier two of the evaluation will include a more in-depth analysis of the alternatives identified in Tier 1 with detailed measures of effectiveness (MOE’s) and should generally be limited to no more than two or three alternatives, if possible.

This step should also determine the recommended sequencing of the analysis. Three potential approaches can be implemented in the traffic evaluation: design-led, traffic-led and collaborative. In the design-led evaluation the Express Design is provided, and the analysis is completed based on the design. If any aspect of the design does not operate acceptably then the traffic analyst should discuss them with the designer and provide a list of recommended design revisions to the designer once the revisions are agreed to and the analysis is completed. In the traffic-led evaluation the traffic analyst determines what is needed for the project to operate at an acceptable level and discusses the proposed design with the designer. Once the traffic-led analysis is finalized it is provided to the designer to implement in the Express Design plans. The collaborative evaluation includes the designer and traffic analyst working collaboratively and may include the designer developing design concepts for the traffic analysis. Once the final alternatives are developed collaboratively the analysis is finalized.

At a minimum the analysis should include the design that is being utilized for evaluation/programming purposes in SPOT and/or the STIP. Additionally, it should include the design alternative analyzed in the previous round of SPOT Prioritization if it is different than the alternative being used for programming. If the Express Design and Project Scoping Report have already been completed, then the analysis should include the design without any substantial modifications. If during the development of the analysis, additional variations of an alternative are needed to meet the project goals then they can be added and labeled with ascending letters appended to the original alternative. For example, design variations of Alternative 1 would be labeled Alternative 1A, Alternative 1B, etc. Analysts should consult the latest version of the Safest Feasible Intersection Design (SAFID) charts which are included in the “Selecting Optimum Intersection and Interchange Alternatives” guidance document posted on the NCDOT website. In fact, the intersection alternative which the available research shows to be the safest, as provided in the SAFID charts, should always be considered.

### Determine Level of Analysis/Software

The next step is to determine the Level of Analysis required. Determination of the Level of Analysis for projects is done by the NCDOT – Congestion Management Section. The level of analysis is based on the complexity of the project and how the project will be scored in the Prioritization Process (See 1SP1 for related information). The following are the levels of traffic operations:

- Level 0 – Low traffic volume locations where traffic operations are not critical to the design or analysis of the project. No detailed traffic analysis is required.
- Level 1 - Level 1 analysis involves basic traffic operations that can be reviewed by use of macroscopic analysis tools where the design may not be critical in all locations. This type of analysis is typically done for projects that are identified in the Prioritization Process as corridor type projects.
- Level 2 - Level 2 analysis involves more complex traffic operations that can be best evaluated by use of microscopic analysis tools. This type of analysis is typically done for projects that are developed by the Congestion Management Team in the Prioritization Process.

## RESOURCES

❖ Traffic Analysis Level  
Prequalification and Work  
Codes (Appendix B1)



- Level 3 – Level 3 analysis involves the highest complexity for traffic operations. These projects require evaluation by use of advanced methodology involving microscopic analysis tools. Typical projects may include (but are not limited to): Complex freeway system interchanges, new alignment projects (both freeway and arterial) that involve potential multiple travel routing, and multi-modal projects.

Additional information on the Level of Analysis and Prequalification requirements is included in Appendix B1. **Table 1** provides general guidance on the appropriate Levels of Analysis for each Specific Improvement Type (SIT) from the Prioritization Process:

**Table 1: Level of Analysis Guidance**

Prioritization Specific Improvement Type	Level 0	Level 1	Level 2	Level 3
1 - Widen Existing Roadway		X		
2 - Upgrade Arterial to Freeway/Expressway		X		
3 - Upgrade Expressway to Freeway	X	X		
4 - Upgrade Arterial to Reduced Conflict Intersection (RCI) Corridor			X	
5 - Construct Roadway on New Location		X		X
6 - Widen Existing Roadway and Construct Part on New Location		X		X
7 - Upgrade At-grade Intersection to Interchange or Grade Separation			X	
8 - Improve Interchange			X	X
9 - Convert Grade Separation to Interchange		X	X	
10 - Improve Intersection			X	
11 - Access Management	X	X		
12 - Ramp Metering	X	X	X	
13 - Citywide Signal System	X			
14 - Closed Loop Signal System	X			
15 - Install Cameras and DMS	X			
16 - Modernize Roadway	X	X		
17 - Upgrade Freeway to Interstate Standards	X	X		
18 - Widen Existing Local (Non-State) Roadway		X		
19 - Improve Intersection on Local (Non-State) Roadway			X	
20 - Convert Grade Separation to Interchange to Relieve Existing Congested Interchange			X	
21 - Realign Multiple Intersections			X	
22 - Construct Auxiliary Lanes or Other Operational Improvements			X	
23 - Construct Grade Separation at Highway / Railroad Crossing		X		
24 - Implement Road Diet to Improve Safety	X	X		
25 - Improve Multiple Intersections along Corridor		X		

Based on an understanding of the project goals, the Congestion Management Section and Feasibility Study Unit will determine the Level of Analysis and select the software that will be utilized for the analysis.

Based on the level of analysis, the next step is to select the software that will be utilized for the evaluation. Simplified spreadsheet analysis to implement critical lane volume analysis procedures may be utilized for Levels 1, 2 and 3 to reduce the number of alternatives. For Level 1 the evaluation of detailed alternatives is typically done utilizing Synchro, HCS or Sidra. Level 2 and 3 analyses are typically done utilizing TransModeler.



## Determine Volume Development Deliverable

The next step in the scoping process once the Analysis Level and Software are decided is to determine the volume development deliverable. Level 1 projects typically require the development of turning movements volumes for each intersection/interchange included in the study. Level 2 or 3 projects typically require the development of origin-destination (O-D) matrices for the analysis study area.

## Determine if SPOT Travel Time Savings are Required

The last step in the scoping process is to determine if a Travel Time Savings analysis is needed, because to develop a project score in Prioritization a travel time savings estimate is required. An estimate of the travel time savings will allow the project submitter to make a more informed decision on the viability of a project for Prioritization. The only projects that will include a Travel Time Savings analysis will be those that are analyzed by the Congestion Management Team (CMT) in SPOT. The following SPOT SIT codes are candidates for developing a Travel Time Savings analysis:

- 4 - Upgrade Arterial to Reduced Conflict Intersection (RCI) Corridor
- 7 - Upgrade At-grade Intersection to Interchange or Grade Separation
- 8 - Improve Interchange
- 9 - Convert Grade Separation to Interchange
- 10 - Improve Intersection
- 19 - Improve Intersection on Local (Non-State) Roadway
- 20 - Convert Grade Separation to Interchange to Relieve Existing Congested Interchange
- 21 - Realign Multiple Intersections
- 22 - Construct Auxiliary Lanes or Other Operational Improvements

## 4.3 Develop Draft Scope

Once the details of the scope are determined and the available project information is collected the initial EDTE Scope (utilizing the EDTE Scoping Template) can be prepared by the NCDOT Project Manager (or their designee). The EDTE Scoping Template and detailed Instructions are included in Appendix B2:

### RESOURCES

❖ **Scope Development Procedure (Appendix B2)**

## 4.4 Project Assignment

Once the project information and Draft Scope have been assembled the Express Design Traffic Evaluation will be assigned to a Private Engineering Firm or NCDOT in-house unit for completion. The assignment of the project requires that the entity completing the analysis be prequalified for the level of analysis determined in Section 4.2.

## 4.5 EDTE Scoping Meeting

The next step is to hold the EDTE Scoping Meeting. The EDTE Scoping Meeting is setup by the Primary Project Contact and should include the following individuals (if applicable):

- Primary Project Contact



- Division Staff (as designated in Contact List)
- FSU Project Manager
- PMU Project Manager
- Congestion Management Project Engineer
- EDTE PEF
- EDTE Review PEF
- EDTE Program Manager

The Scoping Meeting is typically done virtually through Microsoft Teams and should be recorded and uploaded to the Project Scope folder on SharePoint. The goal of the Scoping Meeting is to discuss the project, alternatives to be analyzed and review the Scoping Template.

## 4.6 Develop Final Scope, Budget and Schedule

The step following the scoping meeting is to develop the final scope, budget and schedule. Following the scoping meeting the EDTE PEF (or in-house engineer for in-house projects) will review and refine the EDTE Scoping Template based on the decisions made in the meeting. Once the scope has been approved the template will determine the number of mandays required for the analysis. The EDTE tool (Scope Fee Input Tab) is then used to convert the mandays into the project budget based on the standard classifications for Congestion Management.

The project schedule also must be established and is based on the magnitude of the study. The following are typical schedules for small and large projects:

- Small projects (less than 15 mandays):
  - EDTV complete 3 weeks from the date the count data is received
  - EDTA complete 10 weeks from the date the count data is received
  - SPOT TTS complete 12 weeks from the date the count data is received
- Large projects (15 or more mandays):
  - EDTV complete 4 weeks from the date the count data is received
  - EDTA complete 14 weeks from the date the count data is received
  - SPOT TTS complete 16 weeks from the date the count data is received

## 4.7 Project Data Collection/Requests

The final step of the scoping procedure is to complete the project data collection and determine if existing data is available for the analysis or if not, to request the required data. This step is different than the initial data collection step for scoping included in Section 3 and is focused on the data needed for the actual study. The NCDOT Project Manager will review available databases to determine if existing traffic count data is available and appropriate for the analysis, if any design data are available and if previously developed models are available. If there are not adequate turning movement count data available, the locations that will require new counts will be identified by the NCDOT Project Manager and provided to the analyst. Following the scoping of the project (Section 4.6) either the EDTE Program Manager or EDTE PEF will request the required turning movement counts through the Transportation Mobility & Safety Division Traffic Count Request website (<https://connect.ncdot.gov/site/Traffic-Requests/>).



Additionally, the traffic analyst assigned to the project will collect readily available data, including GIS data layers, local plans, and project history. Data collected may include, but is not limited to, the information noted in **Table 2**.

**Table 2: Project Data**

Provided By NCDOT*	Download From NCDOT	From Publicly Available Sources and ATLAS
Turning Movement Count Data	Express Design Traffic Evaluation Templates	NCDOT AADT Map Data
List of locations that require new turning movement counts	Travel Demand Model Data	NCDOT Functional Classification Web Map
Proposed Design Alternatives (Microstation design files)	Default TransModeler Project File	NCDOT State Maintained Roadways Web Map
Previously developed Models or Analysis Files		NCDOT Smoothed Urban Boundary GIS Data

\*Data will be provided as available and as applicable to the project.

## 4.8 Scope Revisions

During the development of the EDTE it is possible that the scope of the study may change. If an out-of-scope item is identified the PEF developing the EDTE should contact NCDOT Project Manager (or the EDTE Program Manager) to discuss revising the scope. It is common for the scope to change to add additional alternatives or variations of the existing alternatives to improve traffic operations.

If a scope revision is required, then the NCDOT Project Manager (or EDTE Program Manager) will develop the initial supplemental scope and provide it to the EDTE PEF for review. The EDTE PEF will review the scope and if any changes are needed, they should be discussed with the NCDOT Project Manager (or EDTE Program Manager). Once all concerns are resolved the final scope template should be approved by the EDTE PEF and NCDOT Project Manager (or EDTE Program Manager) and uploaded to the Scoping folder of the EDTE SharePoint site. Once the scope has been approved the template will determine the number of mandays required for the analysis. The EDTE tool (Scope Fee Input Tab) is then used to convert the mandays into the project budget based on the standard classifications for Congestion Management.

The project schedule also must be adjusted and is based on the magnitude of the study. The following are typical schedules for small and large project supplemental scopes:

- Small projects (less than 15 mandays):
  - EDTV complete 1 week from the date the supplemental scope is approved
  - EDTA complete 3 weeks from the date the supplemental scope is approved
  - SPOT TTS complete 5 weeks from the date the supplemental scope is approved
- Large Projects (15 or more mandays):
  - EDTV complete 2 weeks from the date the supplemental scope is approved
  - EDTA complete 4 weeks from the date the supplemental scope is approved
  - SPOT TTS complete 6 weeks from the date the supplemental scope is approved



## 5. Express Design Traffic Volumes (EDTV)

The first phase of the Express Design Traffic Evaluation is to develop the Express Design Traffic Volumes (EDTV) that will be used in the traffic analysis. The EDTV deliverable will vary slightly depending on the proposed project and the Level of Analysis determined during scoping. **Table 3** includes a summary of the information that is to be included in the EDTV Report.

**Table 3: Express Design Traffic Volume Deliverable Contents**

Prioritization Specific Improvement Type	Level 0	Level 1	Level 2	Level 3
EDTV Report Cover Page	X	X	X	X
Average Annual Daily Traffic (AADT) Figure	X	X	X	X
AADT Link Volumes	X	X	X	X
Design Data		X	X	X
Turning Movement Volumes Figure		X	X	X
Origin-Destination Matrices			X	X
Travel Time Savings Summary			X <sup>1</sup>	X <sup>1</sup>
Individual Intersection Data Sheets		X	X	X

Note 1: Need for Travel Time Savings Summary will be determined on a project-by-project basis

### 5.1 Develop Draft Express Design Traffic Volume (EDTV) Report

The development of the Draft EDTV Report includes developing the traffic volumes for the Base Year and Design Year analysis. The two primary inputs into the process to develop the Base Year volumes are the Average Annual Daily Traffic (AADT) volume and the data from a turning movement count (TMC). For the development of the Future Year volumes, engineering judgement is relied upon to determine a compound annual growth rate (CAGR) based historical growth rates and travel demand model data.

#### RESOURCES

- ❖ Express Design Traffic Volume Tool (Appendix B)
- ❖ Express Design Traffic Volume GIS Data (Appendix B I I)

The EDTV Report is generated by utilizing the Express Design Traffic Evaluation Tool (EDTE Tool). The detailed procedure for implementing the EDTE Tool are included in Appendix B.

The AADT data is typically taken for each intersection approach from the NCDOT AADT Web Map for the latest available year. For approaches that do not have any AADT data the selected AADT is based on proportioning the TMC data based on a known AADT volume. If there are no AADT volumes in the vicinity of the intersection, then conversion of the count data to AADT or engineering judgment are generally used.

The TMC data is used to convert the AADT volumes into peak hour turning movement volumes. The TMC data is also utilized to determine the Design Hour Value (known as the K-value) and Directional Distribution (D-value). The AADT, K-value and D-value are combined to determine the entry and exit volumes for each intersection approach. The turning percentages from the TMC are then utilized to distribute the entry and exit volumes and then balanced utilizing iterative proportional fitting (IPF) to generate intersection turning movement volumes.



The development of origin-destination (O-D) matrices are required for projects with a Level of Analysis of 2 or 3 due to the use of simulation-based software. There are three approaches to developing the O-D matrices: one method for single intersection projects, one method for projects that make up a single continuous corridor, and a third for those that are for larger networks that are not a single corridor. For single intersection projects the development of the O-D matrix is simply the conversion of the turning movement volumes into O-D format. For corridor projects the development of the O-D matrices is automated in the EDTV Tool by using the proportion of all the upstream or downstream movements that enter or exit the corridor to divide each entry or exit volume into the network. For larger networks, the use of alternative techniques included in the *Origin-Destination Matrix Volume Development Techniques for the North Carolina Department of Transportation* ([Link](#)) are utilized.

The development of the Future Year volumes is based on the selection of a CAGR for each approach that is used to calculate the Future Year AADT volume. Once the Future Year AADT is determined, a similar process is used to convert the daily volumes to peak hour volumes and O-D matrices.

Each of the items included in [Table 3](#) are then combined into a single Draft EDTV Report and submitted along with the EDTE Tool to NCDOT (or their designee) for review.

## 5.2 NCDOT Review of Draft EDTV Report

The Draft EDTV Report and EDTE Tool are submitted to the NCDOT Transportation Planning Division (TPD) by the traffic analyst for review. The NCDOT TPD Engineer (or their designee, including an *EDTE Program Manager/General Engineering Services Consultant*) will then review the technical aspects of the Report and the assumptions utilized to determine the growth rates for the future year traffic volumes. Written comments based on the review will be provided to the traffic analyst for consideration and incorporation into the Final EDTV Report.

## 5.3 Finalize EDTV Report/Upload Data

Once the comments have been received by the traffic analyst the EDTE Tool and Report will be updated. Any comments requiring additional coordination or discussion can occur between NCDOT and the analyst. Once all comments are resolved the Final EDTV Report is completed and uploaded to the Scoping (or Preconstruction) Connect site (see Appendix E2/E3) with notification being provided to the NCDOT FSU Project Manager. The EDTV Report submittal includes the following:

- Express Design Traffic Volumes Report
- Express Design Traffic Evaluation Tool
- Archive of Turning Movement Counts utilized in EDTV development



## 6. Express Design Traffic Analysis (EDTA)

The second phase of the Express Design Traffic Evaluation is to develop the Express Design Traffic Analysis (EDTA) that will be utilized to assess the traffic operations of the No-Build and Build scenarios for the proposed project. The EDTA process may include two separate phases, a preliminary phase that utilizes high level tools to screen potential alternatives and a second phase that includes a more detailed evaluation of the alternatives, including more advanced measures of effectiveness (MOEs). **Table 4** includes a list of the measures of effectiveness that are typically included in the EDTA. Note that all the measures shown in Table 4 are for the peak hour.

**Table 4: Express Design Traffic Analysis Measures of Effectiveness**

Measure of Effectiveness	Level 0	Level 1	Level 2	Level 3
Stage 1 – Preliminary Evaluation				
Volume to Capacity (V/C) Ratio	X	X	X	X
Stage 2 – Detailed Evaluation				
Interrupted Flow: Overall Level of Service		X	X	X
Interrupted Flow: Lane Group Level of Service		X	X	X
Interrupted Flow: 95 <sup>th</sup> percentile Queue Length		X	X	X
Interrupted Flow: Queue Spillback Rate			X	X
Interrupted Flow: Maximum Queue Length (Approach)			X	X
Freeway: Level of Service		X	X	X
Freeway: Density		X	X	X
Freeway: Speed Heat Map			X	X
Travel Time Savings			X <sup>1</sup>	X <sup>1</sup>

Note 1: Need for Travel Time Savings Summary will be determined on a project-by-project basis

### 6.1 Develop Preliminary Evaluation

The first step in the EDTA Process is to develop the preliminary evaluation of alternatives. The preliminary evaluation includes a high-level analysis of the potential alternatives with the goal of reducing the number of alternatives down to one or two alternatives to carry forward into the detailed analysis. The preliminary evaluation should be done for all projects in the EDTE for *New Projects without Express Design Complete* category or if additional alternatives are being considered for a project in the *EDTE for Existing Projects with Express Design Complete* category. The preliminary evaluation may include analysis using one or more of the following methods:

- Critical Lane analysis spreadsheets
- FHWA Capacity Analysis for Planning of Junctions (CAP-X)
- NCDOT ARterial eVALuation Computational Engine (ARTVAL)
- NCDOT NCLOS – Level of Service for Highways

Following the development of the preliminary evaluation the results and recommendations on which alternatives to carry forward to the detailed analysis should be provided to the Congestion Management Section Project Engineer, Feasibility Study Unit Project Manager, Division staff and the roadway design team for review and concurrence on the recommendations. The preliminary evaluation analysis, recommendations and conclusions should be included in the EDTA Report.



## 6.2 Develop No-Build Analysis/Models

The next step in the development of the EDTA is to begin the Detailed Analysis and prepare an evaluation of the No-Build scenario for the Base Year and Future Year scenarios. The Base Year No-Build analysis will be developed based on the existing configuration in place at the time of the analysis while the Future Year analysis will assume any fiscally constrained projects, besides the proposed project are in place.

Depending on the selected software and complexity of the project, the information required for submittal of the No-Build analysis will vary. For macroscopic software packages (HCS, FREEVAL, Synchro and Sidra) the analysis may include the development of the full analysis including the MOEs included in [Table 4](#). For microscopic simulation projects (TransModeler) the analysis at this stage will typically only include the development of the No-Build model to the point that it is ready to run the MOEs. MOEs for simulation-based projects will typically be run after the model has been reviewed to minimize the level of effort associated with re-running the outputs multiple times.

## 6.3 NCDOT Review of No-Build Analysis/Model

The No-Build Analysis or models are submitted to the NCDOT Congestion Management Section (CMS) by the traffic analyst for review. The NCDOT CMS Engineer (or their designee, including an *EDTE Program Manager/General Engineering Services Consultant*) will then review the technical aspects of the analysis/model. Written comments based on the review will be provided to the traffic analyst for consideration and incorporation into the Final EDTA Report. If additional reviews are required, they will occur until all comments have been resolved. For simulation-based projects once the model has been approved the MOEs should be developed based on the MOEs included in [Table 4](#).

## 6.4 Develop Build Analysis/Models

The next step once the No-Build Analysis has been completed is to develop the Future Year Build Analysis. Like the procedure for the No-Build analysis, the information required for submittal of the Build analysis will vary. For macroscopic software packages (HCS, FREEVAL, Synchro and Sidra) the analysis may include the development of the full analysis including the MOEs included in [Table 4](#). For microscopic simulation projects (TransModeler) the analysis at this stage will typically only include the development of the Build model to the point that it is ready to run the MOEs. MOEs for simulation-based projects will typically be run after the model has been reviewed to minimize the level of effort associated with re-running the outputs multiple times.

If the Build analysis shows that the recommended alternatives or improvements are either not warranted or are not adequate to address the future year traffic demands the traffic analyst should work with the Project Submitter, FSU Project Manager and/or the Roadway Designer to determine if the proposed alternatives or design should be revisited or modified (See Section 8.1). If the design is modified, then the Build analysis should be updated based on these recommendations and the decisions documented in a short memorandum that will be included in the EDTA.

## 6.5 NCDOT Review of Build Analysis/Model

The Build Analysis or models are submitted to the NCDOT Congestion Management Section (CMS) by the traffic analyst for review. The NCDOT CMS Engineer (or their designee, including an *EDTE Program Manager/General Engineering Services Consultant*) will then review the technical aspects of the analysis/model. Written comments based on the review will be provided to the traffic analyst for



consideration and incorporation into the Final EDTA Report. If additional reviews are required, then they will occur until all comments have been resolved. For simulation-based projects once the model has been approved the MOEs should be developed based on those included in [Table 4](#).

## 6.6 Develop Draft Express Design Traffic Analysis (EDTA) Report

The next step in completing the traffic evaluation is to develop the EDTA Report. The goal of the EDTA Report is to provide adequate documentation of the evaluation of alternatives and the MOEs for each alternative. The report should be as streamlined as possible and include the following information:

- EDTA Report Cover
- Analysis Summary – 1-2 pages of summary information of the results of the analysis
- Preliminary Evaluation Summary
- Recommended Laneage Figures for Each Alternative
- Measures of Effectiveness Tables for Base Year No-Build, Future Year No-Build, and Future Year Build for each Alternative

## 6.7 Coordinate with Submitter/Designer

For projects included in the *New Projects without Express Design Complete* category, following the completion of the No-Build and Build analyses the traffic analyst will coordinate the preliminary results of the analysis with the Project Submitter and Roadway Designer. The traffic analyst should provide the Draft EDTA Report to the Project Submitter and Roadway Designer for a review that runs concurrently with the Congestion Management Section Review (Section 6.8) with the review time not to exceed 1 week.

For projects included in the *EDTE for Existing Projects with Express Design Complete* category the coordination will occur only if the project is under- or over-designed.

## 6.8 NCDOT Review of Draft EDTA Report

The Draft EDTA Report is submitted to the NCDOT Congestion Management Section (CMS) by the traffic analyst for review at the same time as the coordination with the submitter/designers is occurring. The NCDOT CMS Engineer (or their designee, including an *EDTE Program Manager/General Engineering Services Consultant*) will then review the EDTA Report. Written comments based on the review will be provided to the traffic analyst for consideration and incorporation into the Final EDTA Report. If additional reviews are required, then they will occur until all comments have been resolved.

## 6.9 Finalize EDTA Report/Upload Data/Closeout Meeting

Once all comments are resolved, the Final EDTA Report is completed and uploaded to the Scoping (or Preconstruction) Connect site (see Appendix E2/E3). For projects where design revisions are recommended, or the project doesn't meet the project goals then a Project Closeout Meeting should be held (Section 8.2). For projects that are adequately designed then a Project Complete email (See Section 8.3) should be sent. Notification of the completion of the EDTE should be provided to the following individuals:

- NCDOT Primary Project Contact
- NCDOT FSU Project Manager (if not Primary Project Contact)
- NCDOT FSU Manager
- NCDOT Congestion Management Section Regional Engineer



- NCDOT TPD Forecast Engineer ([trafficforecast@ncdot.gov](mailto:trafficforecast@ncdot.gov))
- NCDOT PMU Regional Team Lead
- NCDOT Division Contacts (based on *Express Design Division Contacts List*)
- Express Design/Project Scoping Report PEF
- EDTE PEF and Program Manager/General Engineering Services Consultant (if applicable)

The EDTA Report submittal includes the following:

- Express Design Traffic Analysis Report
- Digital archive of all files included in analysis, including:
  - Design Files
  - Background data (signal plans, adjacent projects, etc.)
  - EDTA software files (HCS/FREEVAL/Synchro/Sidra/TransModeler)
  - EDTA MOE spreadsheets and figures in native digital format
  - EDTA Report in Word format



At this point, the Scoping Site, Preconstruction Site, and **ATLAS Workbench** should contain the complete record of all deliverables prepared throughout the Express Design Traffic Evaluation process.



## 7. SPOT Travel Time Savings (TTS) Analysis

In addition to the creation of the EDTE, the procedure can be utilized to determine the travel time savings for use in Prioritization. The development of the SPOT TTS can occur at the same time that the EDTE is developed.

### 7.1 Review Data Collection Form

The first step in the SPOT TTS scoping process begins with a review of the Data Collection Form completed in Section 3.3. Once the Data Collection Form is reviewed and approved the scoping process begins.

### 7.2 Determine Project Scope

The project scoping step is typically completed by the Primary Project Contact (or their designee) and includes determining the detailed methodology for completing the traffic evaluation, including each of the elements included in the following sections:

### 7.3 Develop Draft SPOT Volume Report

The development of the Draft SPOT Volume Report includes developing the traffic volumes for the base year and future year analysis. The two primary inputs into the process to develop the base year volumes are the average annual daily traffic (AADT) volume and the data from a turning movement count (TMC). For the development of the future year volumes, compound annual growth rate (CAGR) derived from the North Carolina Statewide Model (NCSTM) are used.

The SPOT Volume Report is generated by utilizing the SPOT Tabs included in the Express Design Traffic Evaluation Tool (EDTE Tool).

The AADT data is typically taken for each intersection approach from the NCDOT AADT web map for the latest available year. For approaches that do not have any AADT data the selected AADT is based on proportioning the TMC data based on a known AADT volume.

The TMC data is used to convert the AADT volumes into peak hour turning movement volumes. The TMC data is also utilized to determine the Design Hour Value (known as the K-value) and Directional Distribution (D-value). The AADT, K-value and D-value are combined to determine the entry and exit volumes for each intersection approach. The turning percentages from the TMC are then utilized to distribute the entry and exit volumes and then balanced utilizing iterative proportional fitting (IPF) to generate intersection turning movement volumes. The development of origin-destination (O-D) matrices is required for SPOT analysis and is based on the same methods as the EDTE O-D development process.

The development of the future year volumes is based on the selection of a CAGR for each approach that is derived from the NCSTM and is used to calculate the future year AADT volume. Once the future year AADT is determined, a similar process is used to convert the daily volumes to peak hour volumes and O-D matrices.

#### RESOURCES

- ❖ Express Design Traffic Volume Tool (Appendix B)
- ❖ Express Design Traffic Volume GIS Data (Appendix B I I)



The AADT Figure, O-D Matrices and the Individual Intersection Data Sheets are then combined into a single Draft SPOT Volume Report and submitted along with the EDTE Tool to NCDOT (or their designee) for review.

## 7.4 NCDOT Review of Draft SPOT Volume Report

The Draft SPOT Volume Report and EDTE Tool are submitted to the NCDOT Transportation Planning Division (TPD) by the traffic analyst for review. The NCDOT TPD Engineer (or their designee, including an *EDTE Program Manager/General Engineering Services Consultant*) will then review the technical aspects of the report and the assumptions utilized to determine the growth rates for the future year traffic volumes. Written comments based on the review will be provided to the traffic analyst for consideration and incorporation into the Final SPOT Volume Report.

## 7.5 Finalize SPOT Volume Report

Once the comments have been received by the traffic analyst the EDTE Tool and Report will be updated. Any comments requiring additional coordination or discussion can occur between NCDOT and the analyst. Once all comments are resolved the Final SPOT Volume Report is completed and uploaded to the EDTE Analysis site.

## 7.6 Develop No-Build Analysis/Models

The next step in the development of the SPOT Analysis is to prepare an evaluation of the No-Build scenario for the Base Year and Future Year scenarios. The No-Build analysis will be developed based on the No-Build model described in Section 6.2. The only difference between the EDTE and the SPOT analysis will be the OD volumes and the optimization of signals.

## 7.7 NCDOT Review of No-Build Analysis/Model

The No-Build Analysis or models are submitted to the NCDOT Congestion Management Section (CMS) by the traffic analyst for review. The NCDOT CMS Engineer (or their designee, including an *EDTE Program Manager/General Engineering Services Consultant*) will then review the technical aspects of the analysis/model. Written comments based on the review will be provided to the traffic analyst for consideration and incorporation into the Final model. If additional reviews are required, they will occur until all comments have been resolved.

## 7.8 Develop Build Analysis/Models

The next step once the No-Build Analysis has been completed is to develop the Base Year and Future Year Build Analysis. The Build analysis will be developed based on the Build model described in Section 6.4. The only difference between the EDTE and the SPOT analysis will be the OD volumes and the optimization of signals.

## 7.9 NCDOT Review of Build Analysis/Model

The Build Analysis or models are submitted to the NCDOT Congestion Management Section (CMS) by the traffic analyst for review. The NCDOT CMS Engineer (or their designee, including an *EDTE Program Manager/General Engineering Services Consultant*) will then review the technical aspects of the analysis/model. Written comments based on the review will be provided to the traffic analyst for



consideration and incorporation into the Final EDTA Report. If additional reviews are required, they will occur until all comments have been resolved.

## 7.10 Develop Draft Travel Time Savings (TTS) Report

The next step in completing the traffic evaluation is to run the models using the SPOT Output macro in TransModeler and develop the SPOT Travel Time Saving (TTS) Report. The goal of the SPOT TTS Report is to show the travel time savings and travel time savings per vehicle results and provide graphics of the existing and proposed design. The report should be as streamlined as possible and include the following information:

- EDTA Report Cover
- Existing Conditions Figure
- Proposed Build Figure for each alternative

## 7.11 NCDOT Review of Draft TTS Report

The Draft TTS Report is submitted to the NCDOT Congestion Management Section (CMS) by the traffic analyst for review at the same time as the coordination with the submitter/designers is occurring. The NCDOT CMS Engineer (or their designee, including an *EDTE Program Manager/General Engineering Services Consultant*) will then review the EDTA Report. Written comments based on the review will be provided to the traffic analyst for consideration and incorporation into the Final TTS Report. If additional reviews are required, they will occur until all comments have been resolved.

## 7.12 Finalize TTS Report

Once all comments are resolved, the Final TTS Report is completed and uploaded to the Scoping (or Preconstruction) Connect site (see Appendix E2/E3).



## 8. EDTE Coordination and Completion

The final phase of the Express Design Traffic Evaluation is to coordinate the results of the study with the Project Team and close out the EDTE Process. Additionally, if during the development of the EDTE questions or concerns arise they should be coordinated through the Primary Project Contact.

### 8.1 Interim Coordination and Meetings

During the development of the study, it may be necessary to hold a meeting or coordinate with the Project Team. If the EDTE PEF feels as though additional coordination is needed, they should discuss their concerns with the NCDOT Project Manager (or EDTE Program Manager) to determine the best method of coordination.

If during the development of the analysis, additional variations of an alternative are needed to meet the project goals or substantially improve operations then they could be added (through a supplemental scope (Section 4.8)) and labeled with ascending letters appended to the original alternative. For example, design variations of Alternative 1 would be labeled Alternative 1A, Alternative 1B, etc. The addition of a variation on an Alternative typically does not require additional coordination; however, on a case-by-case basis it may be needed at the discretion of the NCDOT Project Manager (or EDTE Program Manager)

For projects where the proposed design alternatives or minor variations (described above) do not appear to meet the project goals, additional coordination is needed with the Project Team. If the project is under designed, then the Project Team must decide the following:

- Should additional alternatives be developed for the proposed project to help align with the project goals?
- Should the project's goals be modified to a level that is commensurate with the project budget?
- Should the Purpose and Need for the project be modified?
- Should the scope of the project be reviewed and/or modified?

If additional coordination is warranted due to a project being under designed, then the NCDOT Project Manager (or EDTE Project Manager) will contact the Primary Project Contact. For email-based coordination, the NCDOT Project Manager (or EDTE Project Manager) will send an email to the Primary Project Contact and the members of the Project Team seeking input and the coordination will be done through email. If a Coordination Meeting is needed, then the NCDOT Project Manager (or EDTE Project Manager) will send an email to the Primary Project Contact requesting that the Primary Project Contact setup a meeting with the Project Team. The email to the Primary Project Contact should include a list of the items that need to be discussed with the Project Team. The Project Team should include the following individuals (if applicable):

- Primary Project Contact
- Division Staff (as designated in Contact List)
- FSU Project Manager
- PMU Project Manager
- FSU or PMU Design PEF
- Congestion Management Project Engineer
- EDTE PEF



- EDTE Review PEF
- EDTE Program Manager

## 8.2 Project Closeout Meeting

Once the EDTE has been completed the project findings are reviewed by the NCDOT Project Manager (or EDTE Program Manager) to determine the following:

- Classify each Alternative as either over designed, adequately designed or under designed
- Determine if there are recommended design revisions that should be made to the design and cost estimate because of the EDTE
- Determine if additional traffic analysis is recommended

Based on the answers to the list above, it can be determined whether or not a Project Closeout Meeting is necessary. If the alternatives are adequately designed and there were no issues encountered in the development of the EDTE, then a Project Closeout Meeting is not likely needed and the next step is to send the Project Completion Email (Section 8.3). For projects where a Closeout Meeting is needed, the NCDOT Project Manager (or EDTE Project Manager) will send an email (see Template in Appendix F2) to the Primary Project Contact requesting that the Primary Project Contact setup the Project Closeout Meeting with the Project Team. The email to the Primary Project Contact should include links to the Final EDTV Report and EDTA Reports on the Scoping or Preconstruction SharePoint site. The Project Team should include the following individuals (if applicable):

- Primary Project Contact
- Division Staff (as designated in Contact List)
- FSU Project Manager
- PMU Project Manager
- FSU or PMU Design PEF
- Congestion Management Project Engineer
- EDTE PEF
- EDTE Review PEF
- EDTE Program Manager

The Project Closeout Meeting is typically done virtually through Microsoft Teams and should be recorded and uploaded to the Project Closeout folder on SharePoint. The EDTE PEF will be responsible for leading the meeting and developing comprehensive meeting minutes detailing the discussion, decisions and action items from the meeting. The meeting minutes shall be distributed to all individuals invited to the meeting within three (3) business days of the meeting. Following a one (1) week review the meeting minutes should be revised (if needed) and distributed to all invitees and uploaded to the Project Closeout folder on SharePoint.

## 8.3 Project Completion Email

Once the EDTE has been completed and the Project Closeout Meeting (if necessary) has been held the final step in the EDTE Process is for the NCDOT CMS Engineer (or their designee, including an *EDTE Program Manager/General Engineering Services Consultant*) to send the Express Design Traffic Evaluation Complete email to the entire Project Team (based on the template in Appendix F3) summarizing the findings of the EDTE study.



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# Appendix A: Express Design Traffic Evaluation Data Collection Templates

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## APPENDIX A I EDTE DATA COLLECTION FORM INSTRUCTIONS

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The following information should be input into the PROJECT DATA section:

- STIP No. – Insert the project number from the State Transportation Improvement Program (STIP). If the project does not have STIP number then insert N/A in the data field.
- SPOT ID – Insert the SPOT Identification number (Typically H#####) for the project from the NCDOT Prioritization process. If the project does not have a SPOT ID then insert N/A in the data field.
- Link to SPOT Data Sheet (for projects that were scored in P5 or P6) – Insert a link to the SPOT Data Sheet. SPOT P5 Data Sheets are available at: [P5 Data Sheets](#) and SPOT P6 are available at: [P6 Data Sheets](#)
- County #1/County #2 – Insert the county in which the project is located. For projects that are in multiple counties then County #2 should also be added.
- Division #1/Division #2 – Insert the division in which the project is located. For projects that are in multiple divisions then Division #2 should also be added. Link to: [NCDOT Division Map](#)
- MPO/RPO #1 / MPO/RPO#2 – Insert the MPO/RPO in which the project is located. For projects that are in multiple MPO/RPOs then MPO/RPO #2 should also be added. Link to: [MPO/RPO Map](#)
- Project Description (Location/Type) – The project description should (as succinctly as possible) define the subject roadway and begin and end roadways for corridor projects or the intersecting roadways for intersection projects [Examples: I-40 from NC 147 to I-540 (for corridors) or Main Street at Park Avenue (for intersections/interchanges)] and a brief description of the proposed improvements for the project [Examples: Widening to 6-lane Arterial -or- Conversion to 4-lane RCI Corridor -or- Access Management -or- Intersection Improvement -or- Interchange Improvements].
- SPOT Specific Improvement Type (SIT Code) – The Projects SIT Code, used to score the project in the Prioritization process should be added. If the SIT Code is not known the coordination with the SPOT office is required to determine the proper category:
  - 1 – Widen Existing Roadway (segment) – Adding new through travel lanes to the roadway
  - 2 – Upgrade Arterial to Freeway/Expressway (segment) – Improving a signalized arterial to a signal-free freeway or expressway
  - 3 – Upgrade Expressway to Freeway (segment) – Improving an expressway (signal-free facility that has at-grade access) to a full control of access freeway



- 4 – Upgrade Arterial to Superstreet (segment) – Improving two or more intersections along a signalized arterial to a superstreet design.
- 5 – Construct Roadway on New Location (segment) – Constructing a new roadway on a new alignment
- 6 – Widen Existing Roadway and Construct Part on New Location (segment) – Adding new travel lanes to the roadway and constructing a new roadway on a new alignment
- 7 – Upgrade At-grade Intersection to Interchange or Grade Separation (point) – Converting a signalized intersection to an interchange or grade separation
- 8 – Improve Interchange (point) – Improving traffic flow at an existing interchange by changing the ramp configuration or type of interchange
- 9 – Convert Grade Separation to Interchange (point) – Providing access from/to a freeway/expressway at an existing grade separation primarily for land access
- 10 – Improve Intersection (point) – Improving traffic flow at an existing intersection by changing intersection type (i.e., roundabout) and/or adding turn lanes
- 11 – Access Management (segment) – Enhancing the capacity and safety of the roadway by installing a median, consolidating driveways, etc.
- 12 – Ramp Metering (segment) – Installing ramp meters at interchanges along a freeway
- 13 – Citywide Signal System (segment) – Installing a citywide signal system
- 14 – Closed Loop Signal System (segments) – Installing a closed loop signal system along a single corridor
- 15 – Install Cameras and DMS (segment) – Installing traffic cameras and dynamic message signs along a roadway corridor
- 16 – Modernize Roadway (segment) – Improving a roadway to current design standards primarily by increasing the lane and/or shoulder width. Could also include improving the horizontal or vertical geometry. Could also include adding turn lanes at intersections to help improve mobility on the through route.
- 17 – Upgrade Freeway to Interstate Standards (segment) – Improving an existing freeway to interstate design standards primarily by increasing shoulder width and/or bridge clearances.
- 18 – Widen Existing or Construct New Local (Non-State) Roadway (segment) – Widening roadway or construct a local roadway that is not on the state highway system
- 19 – Improve Intersection on Local (Non-State) Roadway (segment) – Improving an intersection of two or more local roadways that are not on the state highway system
- 20 – Convert Grade Separation to Interchange to Relieve Existing Congested Interchange (point) – Providing access from/to a freeway/expressway at an existing grade separation primarily in order to relieve a nearby congested interchange
- 21 – Realign Multiple Intersections (point) – Improving the geometric configuration at a single location of nearby offset intersections to enhance traffic flow
- 22 – Construct Auxiliary Lanes or Other Operational Improvements (segment) – Constructing one or more auxiliary lanes between interchange ramps along freeways or expressways



- 23 – Improve Highway / Railroad Crossing (point) – Improving existing highway and railroad crossing intersections primarily by constructing grade separations separating the two modes
- 24 – Implement Road Diet to Improve Safety (segment) – Enhancing the safety of a roadway by reducing the lanes within the cross-section
- 25 – Improve Multiple Intersections along Corridor (segment) – Enhancement of multiple intersections along a single corridor
- 26 – Upgrade Roadway (segment) – Collection of roadway improvements using mobility default criteria and weights
- Urbanized Area (Urban/Rural) – Insert whether the project location is located within an urban or rural area based on the smoothed boundaries for the 2010 Census urban areas. For projects that are partially within both urban and rural areas the Area Type should be selected based on which designation represents the majority of the project study area. Link to: [NCDOT Urbanized Boundary Map](#)
- Travel Demand Model Coverage – Insert whether the project location is located within the limits of a Travel Demand Model. All locations in the state are included in the North Carolina Statewide Travel Demand Model (NCSTM); therefore, this does not need to be included. However, if multiple models are available for a project all models should be included in the data collection form. Link to: [NCDOT Travel Demand Model Coverage Map](#)

The following information should be input into the PROJECT STATUS AND CONTACTS section:

- Current Status (Express Design or Preconstruction) – Insert the current status of the project, either it is in the Express Design phase or the Preconstruction phase.
- Current NCDOT Project Manager – Insert the name of the current NCDOT Project Manager. This will be the FSU Project Manager for projects in the Express Design phase or the Project Management Unit or Division Project Manager for projects in the Preconstruction Phase.
- Current Primary Division Contact – Insert the name of the Primary Division Contact. This individual should be the person who will be contacted at the Division to discuss the proposed project.
- Current R/W Date – Insert the R/W date (year) from the current STIP. For multi-section projects include the most recent date.
- Current Construction Date – Insert the construction date (year) from the current STIP. For multi-section projects include the most recent date.

The following information should be input into the EXPRESS DESIGN PROJECT INFORMATION section:

- Scoping Connect Site – Insert Yes for projects that have a Scoping Connect Site and No if a site is not available.
- Scoping Connect Site Link – Insert a link to the Scoping Connect Site for the proposed project.
- Express Design FSU Manager – Insert the name of the current NCDOT Project Manager from the Feasibility Study Unit.



- Express Design PEF (or In-house) – Insert the name of the PEF assigned to the project. For in-house studies include the name of the Project Engineer.

The following information should be input into the PRECONSTRUCTION PROJECT INFORMATION section:

- Preconstruction Managed by – Insert Central if the project is being managed by the Project Management Unit or Division if it is being managed at the Division level.
- Preconstruction Connect Site – Insert Yes for projects that have a Preconstruction Connect site and No if a site is not available.
- Preconstruction Connect Site Link – Insert a link to the Preconstruction Connect site for the proposed project.
- Preconstruction Project Manager – Insert the name of the current NCDOT Project Manager from the Project Management Unit or Division.
- Preconstruction PEF – Insert the name of the PEF assigned to the project. For in-house studies include the name of the Project Engineer.

The following information should be input into the TRAFFIC FORECAST/ANALYSIS INFORMATION section:

- Previous Traffic Forecast Completed – Insert Yes if a previous forecast is available or No if one is not available. For projects with a traffic forecast, a link to the forecast should be inserted into the form. Link to: [Traffic Forecast Archive](#)
- Seasonal Analysis Requirement – For projects where seasonal variation of traffic volumes is a key component of the design, insert Yes. For projects where the design will be developed based on the Average Annual Daily Traffic, (AADT) insert No.
- Short-term or Long-term Solution – For projects where the proposed design is intended to serve a long-term need, the analysis will be performed for a design year that is at least 20-years in the future. For projects that are to address a short-term need and are only intended to provide short-term benefits, a design year less than 20-years will be utilized. For projects submitted in P6 or later, this information can be found on the PX.0 Identified Needs & Proposed Solution for Prioritization form included in the SPOT Data Sheet.
- Previous Traffic Analysis Completed – Insert Yes if a previous traffic capacity analysis is available or No if one is not available. For projects with a traffic analysis available, a link to the analysis on either the Scoping or Preconstruction site should be inserted into the form.

For projects that have previously developed Express Designs, the *EDTE Data Collection Form for Existing Projects with Express Design Complete* is utilized. The following information should be input into the ALTERNATIVES INFORMATION section:

- Identification of the design alternative that is currently the basis for STIP Cost Estimate – Insert the Alternative ID/Name of the Alternative that is currently included in the STIP. If the project is not currently included in the STIP, the Alternative that is being used for scoring SPOT Prioritization should be included.



- Design Alternative ID/Number and Description – Insert the Alternative ID/Name for each additional alternative that is currently being considered for the proposed project. Provide a general description of the alternative so that it can be differentiated from the other alternatives.
- Design Alternative Plan Sheet/Roll Plot (PDF Format) – Insert a link to either the roll plot or plan sheet in Adobe Acrobat format for each alternative.
- Design Alternative Design File (DGN Format) – Insert a link to the MicroStation design (.dsn) file for each alternative.
- Confirmation that the design files are in the correct Global Origin/ Working Units – The designs are typically imported into the traffic analysis software; therefore, they must be in the NCDOT standard Global Origin and Working Units. To verify that the design is in the correct location, it should be exported to a Google Earth KMZ file (>File>Export>Google Earth) and confirmed that the design opens in the proper location. If the design files do not open in the correct location, this form will be returned until the designs are corrected.
- Any change in Vision/Purpose/Need of Project – It is possible that the vision for a project or the purpose and need may change as a project evolves and moves through the project development process. If there any changes to the vision of a project, they should be included in this section of the form.

For projects that do not have a previously developed Express Designs, the *EDTE Data Collection Form for New Projects without Express Design Complete* is utilized. The following information should be input into the ALTERNATIVES INFORMATION section:

- Design Alternative ID/Number and description – Insert the Alternative ID/Name for each alternative that is currently being considered for the proposed project. Provide a general description of the alternative so that it can be differentiated from the other alternatives.
- Proposed Typical Section (from Highway Typical Sections for Use In SPOT On!ine) – For corridor projects insert the proposed typical section for each alternative. For non-corridor projects, insert N/A. Link to: [Highway Typical Sections for Use In SPOT On!ine](#)
- Description of Design Alternative – Insert a more in-depth description of the design alternative that is adequate to develop the scope for the traffic analysis including intersection configurations and level of access control.
- Vision/Purpose/Need of Project – Insert a summary of the Vision or Purpose and Need for the proposed project. For projects that were scored in P5 or P6, this should be available from the SPOT Data Sheet.



# Appendix B: Express Design Traffic Evaluation Scope Development

## APPENDIX B I TRAFFIC ANALYSIS LEVEL PREQUALIFICATION AND WORK CODES

The EDTE PEF must be prequalified in the appropriate work code. Prequalification is by individual and is summarized by firm. For a current list of prequalified firms select the link by level in “Disciplines” below:

Disciplines	<a href="#">Capacity Analysis; Level 1</a>	<a href="#">Capacity Analysis; Level 2</a>	<a href="#">Capacity Analysis; Level 3</a>
<b>Discipline Code</b>	26	27	28
<b>Description Of Work</b>	<p>Traffic Analysis – Basic (Level 1 projects) –</p> <p>Level 1 analysis involves basic traffic operations that can be reviewed by use of macroscopic analysis tools.</p> <p>Typical projects include: simple intersection operation (unsignalized, signalized, roundabouts), basic corridor analysis, and freeway operations (including merge, diverge, weave) that are mostly under capacity.</p> <p>Traffic Analysis Software typically used for this analysis include: Synchro, HCS, SIDRA.</p>	<p>Traffic Analysis – Intermediate (Level 2 projects) –</p> <p>Level 2 analysis involves more complex traffic operations that can be best evaluated reviewed by use of microscopic analysis tools.</p> <p>Typical projects may include: freeway operations near or above capacity, innovative intersections and corridors that include designs such as (but are not limited to) Reduced Conflict Intersections, Continuous Flow Intersections, Diverging Diamond Interchanges.</p> <p>Traffic Analysis Software typically used for this analysis is TransModeler.</p>	<p>Traffic Analysis – Advanced (Level 3 projects) –</p> <p>Level 3 analysis involves the highest complex traffic operations. These projects require evaluation by use of advanced methodology involving microscopic analysis tools.</p> <p>Typical projects may include (but are not limited to): Complex freeway system interchanges, new alignment projects (both freeway and arterial) that involve potential multiple travel routing, and multi-modal projects.</p> <p>Traffic Analysis Software typically used for this analysis is TransModeler.</p>
<b>Key Personnel</b>	Project Engineer	Project Engineer	Project Engineer
<b>Employee Registration</b>	NC P.E.	NC P.E.	NC P.E.



<p><b>Additional Requirements</b></p>	<p>Must have at least one (1) key person per role. Analysis methodology should follow Highway Capacity Manual (Sixth Edition) procedures, primarily found in Volume 3, Interrupted Flow or Volume 2, Uninterrupted Flow. This analysis is primarily macroscopic, although simpler microscopic procedures may be used. Adherence to procedures in the NCDOT Congestion Management Capacity Analysis Guidelines is required.</p> <p>Must submit examples of DOT or similar work completed within the last five (5) years and sealed by each engineer; electronic submittals only. If the work was performed for or submitted to the Transportation Mobility and Safety Division, only a reference to the work is necessary. If previously prequalified in this discipline, no examples are required unless requested by the reviewing Unit. Examples should include: project lists and descriptions including names and current contact information of clients and owners, resumes, references, certificates, experience descriptions and details, etc. If a firm has previously completed work for the NCDOT, this will also be considered for prequalification.</p> <p>Prequalification for this discipline will require demonstrated proficiency with basic traffic operations and analysis methods, including HCM procedures used in traffic analysis software such as HCS, Synchro, and Sidra.</p>	<p>Must have at least one (1) key person per role. Prequalification for this discipline will require prequalification for discipline 26 (Level 1) and also proficiency with advanced traffic simulation software. NCDOT projects will involve the use of TransModeler, proficiency with other software such as (but not limited to) Paramics, TSIS-CORSIM and VISSIM will be considered for eligibility for prequalification for this discipline. Because of its limitations for use for uninterrupted flow, the Synchro/SimTraffic software package is not included for qualification in this category.</p> <p>Must submit examples of DOT or similar work completed within the last five (5) years and sealed by each engineer; electronic submittals only. If the work was performed for or submitted to the Transportation Mobility and Safety Division, only a reference to the work is necessary. If previously prequalified in this discipline, no examples are required unless requested by the reviewing Unit. Examples should include: project lists and descriptions including names and current contact information of clients and owners, resumes, references, certificates, experience descriptions and details, etc. If a firm has previously completed work for the NCDOT, this will also be considered for prequalification.</p>	<p>Must have at least one (1) key person per role. Prequalification for this discipline will require prequalification for discipline 26 (Level 1) and discipline 27 (Level 2) plus demonstrated advanced proficiency with traffic simulation software. Methodology includes advanced network modeling, Dynamic Traffic Assignment and Origin-Destination Matrix Estimation (ODME.)</p> <p>While most NCDOT projects will involve the use of TransModeler, and prequalification will be based primarily on that software package, proficiency with other software such as (but not limited to) Paramics and VISSIM may be considered for eligibility for prequalification for this discipline.</p> <p>Must submit examples of DOT or similar work completed within the last five (5) years and sealed by each engineer; electronic submittals only. If the work was performed for or submitted to the Transportation Mobility and Safety Division, only a reference to the work is necessary. If previously prequalified in this discipline, no examples are required unless requested by the reviewing Unit. Examples should include: project lists and descriptions including names and current contact information of clients and owners, resumes, references, certificates, experience descriptions and details, etc. If a firm has previously completed work for the NCDOT, this will also be considered for prequalification.</p>
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## APPENDIX B2 SCOPE AND MANDAY DEVELOPMENT PROCEDURE

The Scope and Manday development process includes the attributes of the project that define how the study will be accomplished and determine the mandays for completing the study. The following sections include instructions on how the Scope and Manday Template should be completed.

### Project Data

The PROJECT DATA portion of the template is shown below:

STIP No.		TIP No.		SPOT ID:		SPOT ID		Location		Project		WBS No.		34263.1.1		County		DIVISION Choose County #1	
Recommended Traffic Level:				PREPARED BY:				EDTV/SPOT Volumes Prepared By				EDTE BASE YEAR				2019			
Recommended Analysis Software				EDTE Scoping Date				SPOT BASE YEAR				2019				2045			
				SPOT ANALYSIS Yes				SPOT FUTURE YEAR				2019				2029			

This portion includes the Scope Template includes the information taken from the PROJECT DATA TAB in the EDTE Tool and are detailed in APPENDIX C. The following fields are required to be completed on the PROJECT DATA TAB:

- Location
- Project
- STIP No.
- SPOT ID
- WBS No.
- County
- Division
- Recommended Level of Analysis
- Prepared By
- EDTE Scoping Date:
- EDTE Base Year/Future Year
- SPOT Base Year/Future Year

The only item that is not entered on the PROJECT DATA TAB is the SPOT ANALYSIS (Yes/No). The determination of whether or not to include the SPOT Analysis is based on the SPOT Specific Improvement Type (SIT) Code. The following SIT Codes should include a SPOT Analysis:

- 4 – Upgrade Arterial to RCI Corridor
- 7 – Upgrade At-grade Intersection to Interchange or Grade Separation
- 8 – Improve Interchange
- 10 – Improve Intersection
- 19 – Improve Intersection on Local (Non-State) Roadway
- 20 – Convert Grade Separation to Interchange to Relieve Existing Congested Interchange (note the study area will be different as SPOT analyzes the existing congested interchange for TTS)
- 21 – Realign Multiple Intersections
- 22 – Construct Auxiliary Lanes or Other Operational Improvements



## Alternatives, Study Intersections and Measures of Effectiveness

The next portion of the scope template includes a listing of the Alternatives and intersections that are included in the study. Additionally, the Measures of Effectiveness are also defined in this portion of the template.

Alternative	Alternative Name	Alternative Description					
Alternative 1							

Traffic Count Data								
Int ID	Intersection	Measures of Effectiveness	EDTE	SPOT	Scenarios Analyzed	EDTE	SPOT	
1	A Street @ B Street	Volume to Capacity Ratio (v/c)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1	2019 Base Year No-Build	<input checked="" type="checkbox"/>	
2	A Street @ B Street				2	2019 Base Year Build	<input checked="" type="checkbox"/>	
3	A Street @ B Street	Intersection Delay/LOS (Overall)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	3	2045 Future Year No-Build	<input checked="" type="checkbox"/>	
4	A Street @ B Street	Intersection Delay/LOS (Lane Group)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				
5	A Street @ B Street	Intersection Queue Length (95th %)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				
6	A Street @ B Street	Intersection Queue Length (max)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				
7	A Street @ B Street	Freeway Density/LOS (Overall)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				
8	A Street @ B Street	Freeway Speed (Heat Map)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	S1	2019 Base Year No-Build		<input checked="" type="checkbox"/>
9	A Street @ B Street	Travel Time Savings (10-year)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	S2	2019 Base Year Build		<input checked="" type="checkbox"/>
10	A Street @ B Street				S3	2045 Future Year No-Build		<input checked="" type="checkbox"/>

A maximum of 4 alternatives can be included on the scope sheet and include the Alternative Number, Alternative name and Alternative Description. If additional alternatives are required, then additional lines should be added beneath the existing table. However, note that the remainder of the sheet is based on only 4 alternatives; therefore, quantities for alternatives greater than 4 should be added together and included for Alternative 4. Once the Alternative Number and Alternative Description are both added the Alternative will automatically be added to the list as a Future Year Build alternative in the SCENARIOS ANALYZED section of the Template.

The TRAFFIC COUNT DATA section includes a listing of the intersection that will be included in the analysis. Each intersection should be listed under the INTERSECTION heading. If less than the total number of intersections (10 above but varies depending on the spreadsheet) are needed, then the number and A Street @ B Street should be deleted. The numbers under intersection ID are used to populate the number of intersections in the VOLUME DEVELOPMENT portion of the template.

The MEASURES OF EFFECTIVENESS section includes checkboxes for the various MOEs that will be developed for the study. The appropriate dropdown should be selected from the menu (with Q =  and R = ) for each MOE. The following are the standard MOEs that are typically used in a study:

MOE	Critical Lane	Level 1 EDTE	Level 2 EDTE	SPOT
Volume to Capacity Ratio (v/c)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Intersection Delay/LOS (Overall)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Intersection Delay/LOS (Lane Group)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Intersection Queue Length (95 <sup>th</sup> %)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Intersection Queue Length (max)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Freeway Density/LOS (Overall)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Freeway Speed (Heat Map)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Travel Time Savings (10-year)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

The final portion of this section is to list the scenarios that will be analyzed for both the EDTE and SPOT analysis (if applicable). The default form includes entries for Base Year No-Build (1,S1), Base Year Build (2,S2) and Future Year No-Build (3,S3). The scenario ID is used in the STUDY ELEMENTS portion of the



template. The Future Year Build scenarios (4-7,S4-S7) are auto populated once the Alternatives are added in the ALTERNATIVES section. The appropriate dropdown should be selected from the menu (with Q =  and R = ) for each

The following are the standard MOEs that are typically used in a study:

MOE	EDTE	SPOT
Base Year No-Build	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Base Year Build (Each Alternative)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Future Year No-Build	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Future Year Build (Each Alternative)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

The SPOT Scenarios will remain  unless both the SPOT Analysis (in PROJECT DATA Section) is set to Yes and the Recommended Traffic Level (in PROJECT DATA Section) is set to Level 2.

### Coordination and Management

The Coordination and Management Section defines the duration of the study, the number of meetings assumed and the experience level of the PEF completing the study.

Coordination and Management			PEF Experience Level
Study Duration	3 months	3 months for small/4 months for large projects	Experienced
Meetings	0	Assume virtual meeting w/ 2 attendees	

Under the COORDINATION and MANAGEMENT portion of the scope template includes the number of months to complete the study based on the number of mandays. The default is three (3) months for a small project (less than 15 mandays) and four (4) months for a large project (15 or greater mandays). Additionally, the number of meetings should be included and does not include the scoping meeting. It is assumed that each meeting will include two (2) attendees from the PEF and will be virtual. The PEF will also be responsible for producing meeting minutes of the meeting.

The PEF EXPERIENCE LEVEL includes a drop-down menu to select if the PEF has done less and or more than three (3) projects in the EDTE Process. PEFs are provided with a 30% increase in the number of mandays for the analysis portion of the scope for their first three (3) EDTE projects. If the PEF has completed less than three (3) projects then the Project 1, Project 2 or Project 3 should be selected based on the appropriate number of projects.

### Volume Development

The VOLUME DEVELOPMENT Section defines the attributes of the development of the EDTV and SPOT Volumes (if applicable).

VOLUME DEVELOPMENT			
Volume Development	EDTE Volumes	SPOT Volumes	AADT Volumes /
Number of Intersections	10	0	Developed By:
Intersections (Existing Counts)	10		OD Matrix Basis
Intersections (New Counts)	0		Seasonal Factor
<b>Travel Demand Models</b>		New Runs?	AAWT Factor
NCSTM	<input checked="" type="checkbox"/>	No	U-turn Forecast
Regional Model	<input checked="" type="checkbox"/>	No	Constrained Matrix
			Additional Scenarios
			Add # of Additional Scenarios for variations in number of lanes

The primary input for Volume Development is the number of intersections included in the study. The NUMBER OF INTERSECTIONS input is populated by the number of intersections listed in the ALTERNATIVES, STUDY INTERSECTIONS AND MEASURES OF EFFECTIVENESS section. The number of Intersections for (EXISTING COUNTS) and (NEW COUNTS) should total the NUMBER OF INTERSECTIONS value. The difference between (EXISTING) and (NEW) is that if they are listed as (NEW) the PEF is



responsible for ordering and processing the count data while (EXISTING) counts are provide in processed form to the PEF.

The TRAVEL DEMAND MODELS Section includes the travel demand models that will be utilized in determining the growth rates for the study. The NCSTM is always selected () and if the project is located in a location with a travel demand model based on the NCDOT Travel Demand Model Coverage Map ([Link](#)) then the Regional Model box is checked (). The name of the Regional Model should also be entered. The NCSTM and Regional Travel Demand Model should be reviewed to determine if the proposed project is adequately modeled in the existing model data sets. If it is not properly modeled, then additional model runs will be needed. The model runs are typically done by NCDOT; however, in some instances the PEF will develop the model runs. If the PEF will be developing the model runs, then the drop-down box under NEW RUNS? should be utilized to select the number of new model runs needed. If NCDOT will be performing the model run, then the field should still be set to NO.

The VOLUME DELIVERABLE is auto populated based on the LEVEL OF ANALYSIS from the PROJECT DATA section and is AADT Volumes / Peak Hour Volumes for Level 1 and AADT Volumes / O-D Matrices for Level 2 Projects.

The Advanced Volume Development portion of the template includes the following items with the variable and who the product will be DEVELOPED BY:

- O-D MATRIX BASIS: For Level 1 Projects N/A should be selected. For Level 2 Projects the default is to use PROPORTIONAL if it is a continuous corridor. If it is a network or has non-corridor intersections included, then STREETLIGHT should be selected.
- SEASONAL FACTOR: If the project is in a location that includes substantial seasonal variation, then seasonal factors can be developed utilizing StreetLight Data. The options are NO, 5<sup>TH</sup> HIGHEST DAY, 30<sup>TH</sup> HIGHEST DAY AND 50<sup>TH</sup> HIGHEST DAY.
- AAWT FACTOR: If the project is in a location where weekday traffic is the primary design volume then AAWT factors can be applied. The options are YES or NO.
- U-TURN FORECAST: For projects that are adding medians to existing undivided sections with no access control then U-turn forecasts may be helpful in determining the increased number of U-turns once the access management is installed. The input is the number of intersection where U-turn forecasts are needed.
- CONSTRAINED MATRIX: Constrained matrices are used on a case-by-case basis when the project includes a volume on an adjacent roadway that is being modeled but is not part of the proposed project. The options are YES or NO.
- ADDITIONAL SCENARIOS: If additional volume scenarios are needed, such as for analyzing a four-lane and six-lane option then they should be included in this section. The primary change is in the growth rates selected for each link. The input is the number of additional scenarios needing volumes.

The DEVELOPED BY selections can be the PEF, the Project Manager or NCDOT with mandays only being added to the estimate if PEF is selected.

## Study Elements

The Study Elements portion of the scope defines the analysis tasks for the traffic analysis and is broken into Critical Lane Analysis, Level 1 and Level 2 sections. The default file shows the cells shaded gray; however, once the RECOMMENDED TRAFFIC LEVEL (in PROJECT DATA section) is selected, it will use the /  for each scenario listed in the SCENARIOS ANALYZED (in ALTERNATIVES, STUDY INTERSECTIONS



AND MEASURES OF EFFECTIVENESS section) to turn the appropriate columns yellow. The Scenario number listed for each column corresponds to the Scenario listing in SCENARIOS ANALYZED section.

STUDY ELEMENTS								
Task	Unit	Critical Lane Analysis						
		Scenario						
		1	2	3	4			
CAP-X Analysis	per intersection							
Critical Lane Analysis (spreadsheet)	per intersection							

The Critical Lane Analysis portion of the template includes utilizing either the FHWA Capacity Analysis for Planning of Junctions (Cap-X) Tool or a customized spreadsheet (currently under development) to evaluate intersection alternative designs at a high level. The number of intersections that will be included in the critical lane analysis for each scenario should be input into the appropriate columns.

Level 1 Analysis (Synchro/Sidra)									
Task	Unit	Scenario							
		Prev. Dev.	1	2	3	4			
Likelihood of Design Iteration	Low/Med/High					Low	Low	Low	Low
Synchro: Unsignalized Intersection (Basic)	per intersection								
Synchro: Unsignalized Intersection (Complex)	per intersection								
Synchro: Signalized Intersection (Standard)	per intersection								
Synchro: Signalized Intersection (Unconventional)	per intersection								
Synchro/Sidra: Single Lane Roundabout	per intersection								
Sidra: Multilane Roundabout	per intersection								
FREEVAL/HCS Freeway Facility Volume Redistributic	per intersection								
FREEVAL: Freeway Segment	per Segment								
HCS Freeway Facilities: Freeway Segment	per Segment								
FREEVAL/HCS MOE Table	per Segment								
Volume Redistribution/Re-Routing	per intersection								
Synchro/Sidra: MOE Table	per intersection		0	0	0	0	0	0	0

The Level 1 Analysis portion of the template includes inputs for analysis completed using Synchro, Sidra, FREEVAL and HCS. The number of intersections or segments that will be included in the Level 1 analysis for each scenario should be input into the appropriate columns. The analysis of Future Year Build scenarios may include an increased likelihood of requiring design iterations in order to achieve acceptable operations. Therefore, the Likelihood of Design Iterations line item allows for the selection of Low, Medium (15% increase in level of effort) and High (30% increase) for each scenario. The spreadsheet is setup such that the total number of intersections/segments is entered into the appropriate line. If there is a previously developed network, it should be listed under the Previously Developed column and the corresponding scenarios should be input as being 50% of the total. For example, if a 6 intersection Base Year No-Build network exists the number of intersections input for Scenario 1 should be (6 intersections \* 50% =) 3 intersections.

Level 2 Analysis (TransModeler)														
Task	Unit	Scenario												
		Prev. Dev.	1	2	3	4								
Level of Complexity	Low/Med/High		Low											
Likelihood of Design Iteration	Low/Med/High				Low									
Merge Existing Model	per model													
Freeway Coding	per mile													
Arterial/Collector/Local Coding	per mile													
System Interchange (Standard)	per interchange													
System Interchange (Complex)	per interchange													
Service Interchange (Standard)*	per interchange													
Service Interchange (DDI)**	per interchange													
Unsignalized Intersection	per intersection													
Unsignalized RC	per intersection													
Roundabout (single lane)	per intersection													
Roundabout (multi-lane)	per intersection													
Signalized Intersection (Simple)	per intersection													
Signalized Intersection (Complex)	per intersection													
Signalized Intersection (Unconventional)	per intersection													
Signalized Intersection (RCI)**	per intersection													
Add O-D Matrix/Vehicle Composition	per scenario													
Run Dynamic Traffic Assignment	per scenario													
Optimize Coord. Signal Timings and Offsets	per corridor													
Optimize Signal Timings (isolated intersection)	per intersection													
Run Model/Extract Outputs	per scenario													
MOE Table: Intersection	per intersection													
MOE Table: Freeway LOS	per analysis point													
MOE Table: Freeway Heat Map	per corridor													
MOE Data: Travel Time Savings	per alternative													

\* - does not include coding the signals  
\*\* - includes the main intersection and two u-turn intersections

Previously Developed Models



The Level 2 Analysis portion of the template includes inputs for analysis completed in TransModeler. The analysis of Future Year Build scenarios may include an increased likelihood of requiring design iterations in order to achieve acceptable operations. Therefore, the Likelihood of Design Iterations line item allows for the selection of Low, Medium (15% increase in level of effort) and High (30% increase) for each scenario. The Level 2 analysis also includes a Level of Complexity parameter that operates in a similar manner with Low, Medium (15% increase in level of effort) and High (30% increase) for each scenario. The vast majority of projects should fall into the Low category with a small majority being considered to be medium complexity and a very small number being high complexity.

In the event that there is a previously developed network, it should be listed under the Previously Developed column. The input of the attributes for Level 2 is slightly different than for Level 1 and includes additional attributes required to develop the model network. The network attributes are only included the first time they are needed, and subsequent Scenarios only include those elements that are modified from one of the previous scenarios.

Level 2 projects also may include the development of a SPOT Travel Time Savings analysis. If the SPOT ANALYSIS (Yes/No) is set to Yes (In PROJECT DATA section) and the Scenarios are set to  under SPOT Scenarios (in ALTERNATIVES, STUDY INTERSECTIONS AND MEASURES OF EFFECTIVENESS section) then the SPOT Columns will allow for the input of attributes for the SPOT TTS analysis. The SPOT analysis typically only requires that the final EDTE models be updated with the SPOT O-D matrices, re-optimization of signals and running the TTS output.

### **Fiscally Constrained Projects and Total Mandays**

The final step is to review the appropriate plans to determine if there are any fiscally constrained projects that intersect or overlap the proposed project study area. For MPO areas, the Metropolitan Transportation Plan will determine fiscal contract while RPO areas require the project to have construction funding in the current STIP. Any fiscally constrained project should be listed in the OTHER FISCALLY CONSTRAINED PROJECTS IN STUDY AREA section.

<i>Other Fiscally Constrained Projects in Study Area</i>	
TOTAL MANDAYS	6.88

Once all of the attributes have been input into the Scoping Template it will calculate the number of Mandays for the analysis and include it in the bottom right corner of the form.



# Appendix C: Express Design Traffic Volumes (EDTV) Tool Procedures

The Express Design Traffic Volumes Tool (EDTV Tool) is a spreadsheet utility used to develop the volumes as part of the Express Design Traffic Evaluation process and is included as part of the overall Express Design Traffic Evaluation Tool (EDTE Tool). There are three separate spreadsheets that provide very similar functionality that allow for the development of volumes for projects of varying sizes:

- Express Design Traffic Evaluation Tool\_vX.X\_01 – This version should be used for single intersection projects
- Express Design Traffic Evaluation Tool\_vX.X\_10 – This version should be used for projects with 2-10 intersections
- Express Design Traffic Evaluation Tool\_vX.X\_25 – This version should be used for projects with 11-25 intersections

For any project greater than 25 intersections multiple versions of the tool will be required with advanced techniques being utilized for the development of O-D data, if needed. The following sections provide detailed guidance on how to complete each portion of the EDTV Tool.

## APPENDIX C I PROJECT DATA TAB

The PROJECT DATA TAB includes the information about the projects and defines the default values and parameters utilized in the EDTV process. The inputs into this tab are used throughout the spreadsheet and the data fields shaded in yellow should be completed fully for all projects.

SPOT/EXPRESS DESIGN TRAFFIC EVALUATION (EDTE) TOOL					
PROJECT INPUTS		STATUS		DEFAULT VALUES	
TIP No.				K-value Round	Round Up
WBS No.	34263.1.1			K-value Increment	0.5
SPOT ID				D-value Round	Round Up
EDTE Scoping Date				D-value Increment	2.5
SPOT Date			Draft	Capacity Adjustment (Rolling)	0.95
EDTV Date			Draft	Capacity Adjustment (Mountainous)	0.90
EDTA Date			Draft	v/c at Capacity	0.85
EDTV/SPOT Volumes Prepared By				K-value Over Capacity Increase #1 K-value Delta	0.01
EDTA/SPOT TTS Prepared By				K-value Over Capacity Increase #2 v/c Delta	0.35
Location				K-value Capacity Increase #2 v/c Threshold	1.20
Project				K-value Capacity Increase #2 K-value Delta	0.02
Is this a single corridor?	No			Count Year to Base Year Growth Rate	1.5%
Corridor Direction				Minimum Volume for AADT=100	25
County #1				AM K/D Source	AM Peak
County #2				PM K/D Source	PM Peak (Overall)
Division #1	Choose County #1				
Division #2	Choose County #2				
Terrain	Choose County #1				
County (Label)	0				
Division (Label)	Choose County #1				
Area Type (Click for Link)					
EDTE Base Year/Scenario	2019	Base Year (Existing)		SPOT Base Year	2019
EDTE Future Year/Scenario	2045	Future Year Build		SPOT Future Year	2029
Model #1	North Carolina Statewide Model (NCSTM)	Gen 4.5		Recommended Traffic Analysis Level	
Model #1 Base Year	2017			Recommended Software 1	
Model #1 Interim (SPOT) Year	2030			Recommended Software 2	
Model #1 Future Year	2045			Recommended Software 3	
Model #2	{Insert Regional Model Name}	{Insert Version}			
Model #2 Base Year					
Model #2 Future Year					
AADT Data Source				Version	3.11(01)
O-D Matrix Source				Last Updated	2/13/2023



The following information should be input into the PROJECT DATA TAB:

- TIP No. – Insert the project number from the State Transportation Improvement Program (STIP). If the project does not have STIP number then insert N/A in the data field.
- WBS No. – Insert the Work Breakdown Structure (WBS) number for the proposed project. The WBS number should be available from the NCDOT FSU Project Manager.
- SPOT ID – Insert the Identification number (Typically H#####) for the project from the NCDOT Prioritization Process. If the project does not have a SPOT ID then insert N/A in the data field.
- EDTE Scoping Date – Insert the Date that the EDTE Scope was finalized.
- SPOT Date/Status – Insert the Date that the SPOT TTS Report was finalized. If the Report is in Draft format, then include the date of submittal for the Draft EDTV in the data field. Under the Status column maintain the project in Draft format until approved and then update to Final.
- EDTV Date/Status – Insert the Date that the EDTV Report was finalized. If the Report is in Draft format, then include the date of submittal for the Draft EDTV in the data field. Under the Status column maintain the project in Draft format until approved and then update to Final.
- EDTA Date – Insert the Date that the EDTA Report was finalized. If the Report is in Draft format, then include the date of submittal for the Draft EDTA in the data field. Under the Status column maintain the project in Draft format until approved and then update to Final.
- EDTV/SPOT Volumes Prepared By – Insert the entity responsible for developing the EDTV and/or SPOT Volumes (either the name of the Private Engineering Firm or the NCDOT Unit).
- EDTA/SPOT TTS Prepared By – Insert the entity responsible for developing the EDTA and/or SPOT TTS (either the name of the Private Engineering Firm or the NCDOT Unit).
- Location – The project locations should (as succinctly as possible) define the subject roadway and begin and end roadways for corridor projects or the intersecting roadways for intersection projects. [Examples: I-40 from NC 147 to I-540 (for corridors) or Main Street at Park Avenue (for intersections/interchanges)].
- Project – The Project field should include a brief description of the proposed improvements for the project. [Examples: Widening to 6-lane Arterial -or- Conversion to 4-lane RCI Corridor -or- Access Management -or- Intersection Improvement -or- Interchange Improvements].
- Is this a Single Corridor? (Yes/No) – {Applies only to 10 and 25-intersection versions} Select YES if the project is a single corridor with no substantial breaks (which would typically be represented by a break line in a traffic forecast) that would affect traffic volume along the corridor. If YES is selected, then the tool is used to develop the balanced turning movement volumes and the proportion-based O-D matrices automatically. If NO is selected, then balanced turning movement volumes are not available and advanced O-D techniques are required to develop O-D volumes. If the proposed project study area includes a network or intersections adjacent to the corridor, then NO should be selected.
- Corridor Direction – (West to East/South to North/East to West/North to South) This field is used to set the direction for projects that have YES selected in the 'Is this a Single Corridor?'. This is used in the corridor balancing and proportion-based O-D development process to properly orient the corridor. West to East should typically be used for East/West corridors and South to North should typically be used for North/South



corridors. The orientation of the Turning Movement Counts (TMC) should be oriented with Nodes 2 and 4 representing the East and West legs of the intersection and Nodes 1 and 3 representing the North and South legs of the intersection. The direction should be based on the predominant direction of the corridor and the analyst should ensure that the orientation of the TMC data is such that it creates a single corridor.

- County #1/County #2 – Insert the County in which the project is located. For projects that are located in multiple counties then County #2 should also be added.
- Division #1/Division #2 – Auto populated based on County #1 and County #2.
- Terrain – (Level/Rolling/Mountainous) Default terrain auto populated based on Division but can be overwritten to better represented the actual terrain in the project study area. The terrain is utilized in determining the capacity of a roadway as the capacity of a roadway is affected by the terrain.
- County (Label)/Division (Label) – Auto populated based on County and Division inputs.
- Area Type (Urban/Rural) – Insert whether the project location is located within an urban or rural area based on the smoothed boundaries for the 2010 Census urban areas in North Carolina GIS data ([https://xfer.services.ncdot.gov/gisdot/DistDOTData-Current/State/shpe/Smooth\\_Boundary.zip](https://xfer.services.ncdot.gov/gisdot/DistDOTData-Current/State/shpe/Smooth_Boundary.zip)). For projects that are partially within both urban and rural areas the Area Type should be selected based on which designation represents the majority of the project study area.
- EDTE Base Year/Scenario – Insert the Base Year for the EDTE traffic volumes and analysis. The Base Year is typically the year when the most recent AADT data is available for the roadways within the study area. The Scenario defaults to 'Base Year (Existing)' and typically won't need to be updated. If a base year Build scenario is needed this may be updated to reference a Build scenario.
- EDTE Future Year/Scenario – Insert the EDTE Design Year for the traffic volumes and analysis. The Design Year is determined during the scoping of the project (Section 0) and is based on whether the improvement is an Interim or Long-term improvement project. Short-term or interim projects that are designed to provide temporary relief should generally include a design year 10 years beyond the likely construction date. Long-term solutions that are meant to address the congestion of a longer period of time should generally include a design year 20 years beyond the likely construction date. The design year should be rounded up to the next 5-year increment. The Scenario defaults to 'Future Year Build' and typically won't need to be updated. If Build scenarios exist that have different volumes, then the use of multiple spreadsheets is required. Typically, the Future Year Build volumes are used for the Future Year No-Build as well to reduce the level of effort. If a separate and distinct Future Year No-Build scenario is needed, then the field can be updated.
- SPOT Base Year – Insert the Base Year for the SPOT traffic volumes and analysis. The Base Year is typically the year when the most recent AADT data is available for the roadways within the study area or as determined by the SPOT Workgroup.
- SPOT Future Year – Insert the SPOT Future Year for the traffic volumes and analysis. The Future Year is typically 10 years from the SPOT Base Year.
- Model #1/Model #2 & Version – The process allows two travel demand model data sets to be included in the INDIVIDUAL INTERSECTION DATA TABs. The Title of each Travel Demand Model and the model version should be included in the appropriate data fields.
- Model #1/#2 Base Year/Interim (SPOT) Year/Future Year – The Base Year, Interim Year (typically used for SPOT with NCSTM) and Future Year for Model #1 and #2 should be



added to the appropriate data fields. These dates are used to determine the Compound Annual Growth Rate for the model data.

- AADT Data Source – (20XX NCDOT AADT Web Map, Traffic Count Conversion to AADT, Previous Forecast/Estimate, Engineering Judgment) Add the source that was relied upon to determine the AADT data. If multiple techniques are utilized, then include the predominant method and note any additional sources in the INDIVIDUAL INTERSECTION DATA TABs.
- O-D Matrix Source – Select the method that will be used for the O-D Matrix development. PROPORTIONAL is typically used for corridor projects and STREETLIGHT DATA is typically used for network or non-corridor projects.
- Recommended Traffic Analysis Level – Select the Traffic Analysis Level determined during scoping (Section 0).
- Recommended Software #1/#2/#3 (None, Critical Lane Analysis, HCS, FREEVAL, Synchro, Sidra, TransModeler, Vissim, Other) – Select up to three software packages determined during scoping (Section 0).

The following default values are also included in the PROJECT DATA TAB and should not be modified without approval from the NCDOT Congestion Management Section Engineer.

- K-Value Round/D-Value Round (Round/Round Up) – This value determines if the K-value and D-value calculated from the turning movement count is simply rounded or rounded up to the next increment.
- K-value Increment (0.5,1.0) – This value determines if the K-value (once rounded) is calculated to a 0.5% or 1% increment.
- D-value Increment (2.5,5.0) – This value determines if the D-value (once rounded) is calculated to a 2.5% or 5% increment.
- Capacity Adjustment (Rolling/Mountainous) – This value adjusts the “v/c at Capacity (Level)” value to account for the effect of terrain on overall capacity. The default for Rolling is to use 95% (0.95) of the Level terrain capacity as the capacity for Rolling. The default for Mountainous is to use 90% (0.90) of the Level terrain capacity as the capacity for Mountainous terrain. The assumption is based on the effect of terrain and greater geometric constraints on capacity in steeper terrain.
- v/c at Capacity (Level) – This value is utilized to determine when a facility is considered to be over capacity for roadways on level terrain. Because NCDOT prefers to design to LOS D or better, the default value is set to 0.85 (85% of capacity).
- K-value Over Capacity Increase #1 K-value Delta – This value determines the increase in the k-value (in decimal format (ie; 0.010 is a 1% increase in the K-value) if the v/c at Capacity is exceeded.
- K-value Over Capacity Increase #2 v/c Delta (0.05 to 0.75 in increments of .05) – this is the increase over the v/c at Capacity where an even higher k-value is utilized. The assumption here is that if a roadway is substantially over capacity, then it is more likely that the demand is being reduced by traffic using shoulder hours or alternative routes and that the actual demand would be higher than what is being collected in the count.
- K-value Capacity Increase #2 v/c Threshold – This is the threshold where the additional increase is added. It is the sum of the v/c at Capacity and the K-value Over Capacity Increase #2 v/c Delta.
- K-value Capacity Increase #2 K-value Delta (0.000, 0.005, 0.010, 0.015, 0.020, 0.025, 0.030) – This value determines the increase in the K-value (in decimal format (ie; 0.010 is a 1%



increase in the k-value) if the v/c Threshold #2 is exceeded and is typically higher than the Increase #1 K-value Delta.

- Count Year to Base Year Growth Rate – The ‘INDIVIDUAL INTERSECTION DATA TABS’ include the calculation of the AADT based on the TMC data, ATR Category (with associated Seasonal Factor) and 13-to-24-hour conversion factor. Because the AADT data is typically derived from the AADT Web Map data the age of the count is not as important under this process and counts up to five years old are commonly used. In the event that the traffic analyst wanted to review what the estimated AADT would be in the base year the count derived AADT for a past year is grown based on this growth rate to the Base Year.
- Minimum Volume for AADT=100 – This value determines when a turning movement derived AADT value with a value less than 100 is rounded up to 100.
- AM K/D Source/PM K/D Source (AM Peak, Opposite of PM Peak, Any 1-hour increment from count) – This determines what portion of the TMC is utilized to determine the K-value and D-value. Some older forecasts did not include AM design data and using the opposite of PM category will use the PM peak K-value and D-value with the reverse direction for D for the AM Peak. Additionally, the analysis can be run for a particular period of time by setting the Source to a specific hour.

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## C2 EDTV/SPOT VOLUME COVER TAB

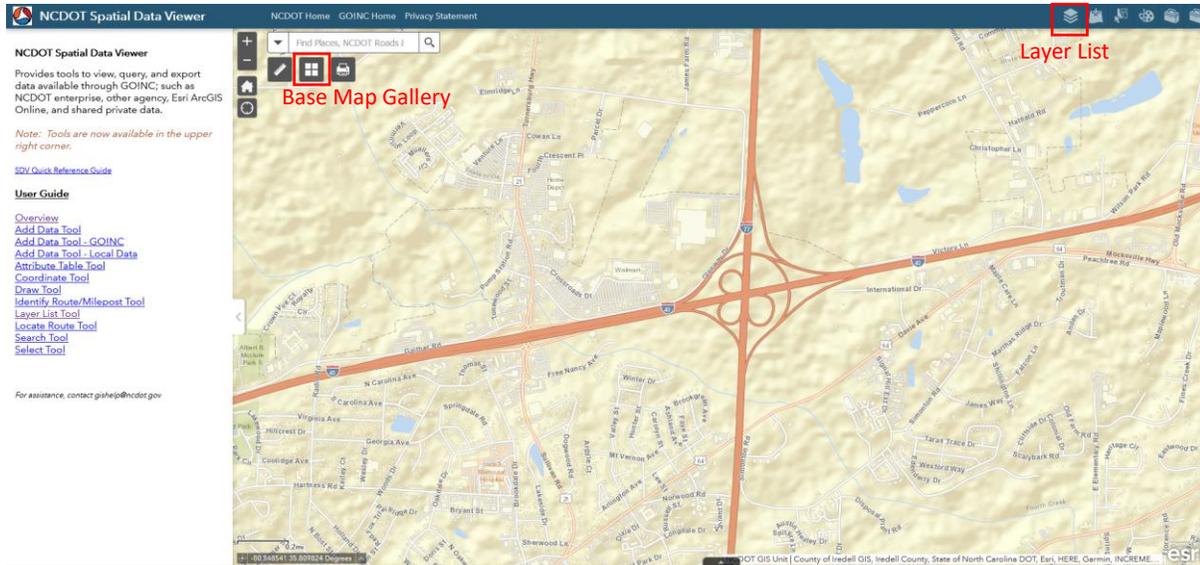
---

The EDTV COVER TAB includes the template for the cover for the Express Design Traffic Volumes Report cover. The SPOT VOLUME COVER TAB includes the template for the cover for the SPOT Volume Report cover. Nearly all of the data is referenced in from the PROJECT DATA TAB and typically should not need to be revised or updated.

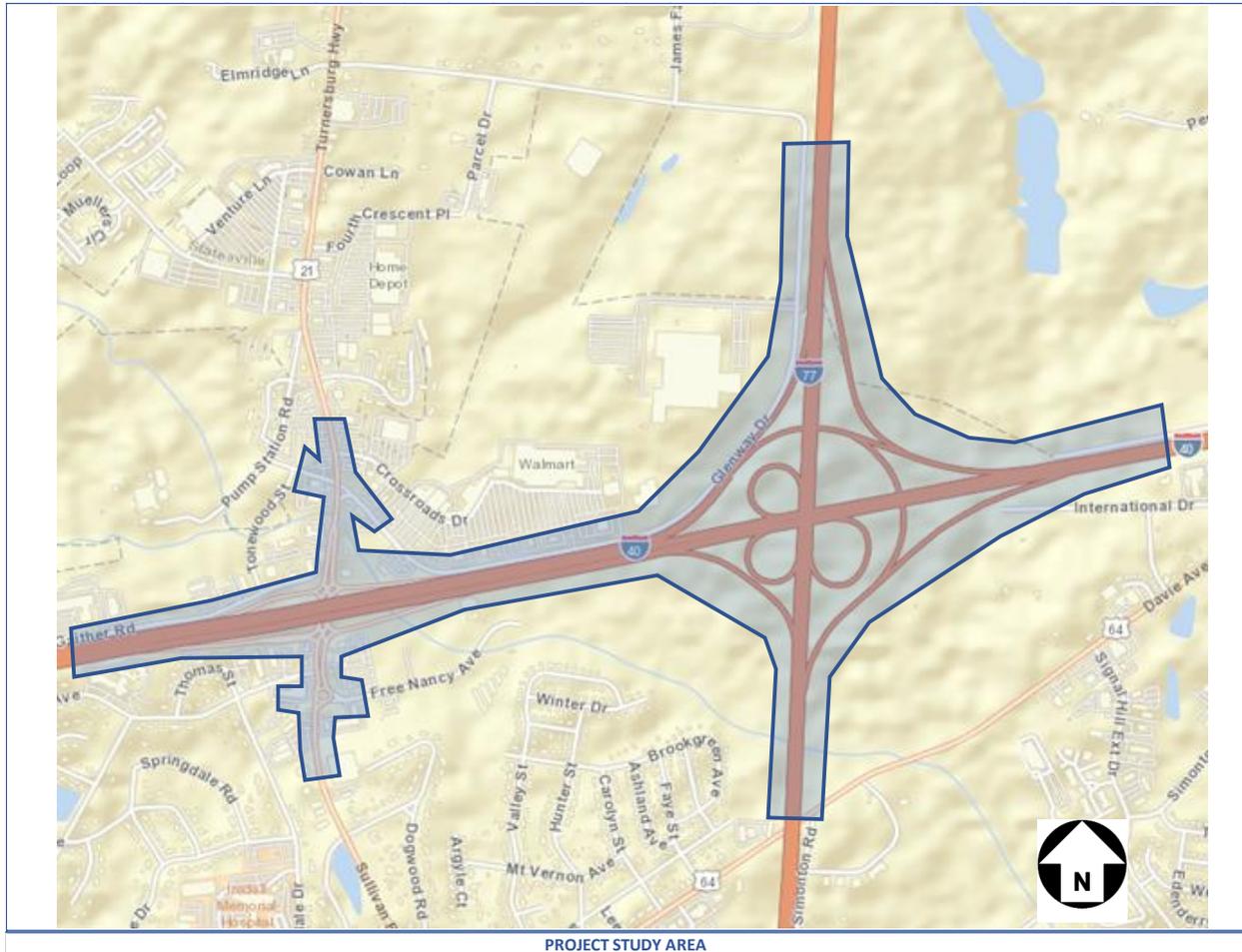
The EDTV Report Cover includes a Project Study Area box that needs to be completed by the traffic analyst. The background image should show the entire study area at a scale that provides adequate detail to understand the location of the project. The background image is typically taken as a screenshot from the NCDOT GIS Spatial Data Viewer (SDV) web map:

(<https://ncdot.maps.arcgis.com/apps/webappviewer/index.html?id=bcbb2529c6174b22a14b29e63614fef4>)

The Study Area map image should utilize the Base Map Gallery  to select the most appropriate Base Map layer (the Streets and Navigation backgrounds tend to work best for most projects. The GIS layers  should also be turned on or off to provide the best available map.



The study area image should then be cropped to fit the box in the Report Cover template. A semi-transparent shape should also be added to show the project study area for the project that bulbs out around the side streets or interchanges that are included in the analysis. Typically, the shading is set at 75% transparency and the outline of the shape is set to a line width of 3 pt. Additionally, the North Arrow must be included and should be properly oriented in the north direction if the background image is rotated. An example of the Project Study Area is shown below:



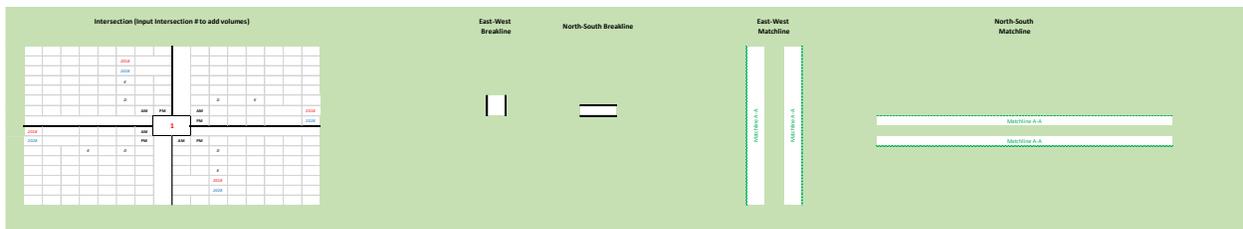
PROJECT STUDY AREA

The Report Cover also includes a REPORT STATUS data field that should remain Draft until it has been finalized and then set to Final in the PROJECT DATA Tab.

### C3 AADT FIGURE TAB (EDTE/SPOT)

The AADT Figure (EDTE) Tab is used to develop a summary of the AADT data developed as part of the EDTV process. A second version of the figure, AADT FIGURE (SPOT) is also available and has the same information for the SPOT volume development. The AADT Figure includes a border and title block that include data referenced from the PROJECT DATA TAB.

The AADT Figure provides the ability to show the AADT and Design Data for a 4 by 4 grid and includes copying the elements from the Input Template shown in green at the top of the page.





The Input Template includes an intersection template that will display the data for each intersection by inputting the intersection number into the box in the center of the intersection. The input will extract the data from a database based on the Intersection ID from the INDIVIDUAL INTERSECTION INPUT TAB.

The AADT Network is created by copying and pasting the templates into the figure and updating the intersection numbers based on the actual network configuration. The first intersection should be inserted at the yellow shaded block **Paste First Intersection Here**. Between each intersection the East-West or North-South Breakline should be copied and pasted into the figure. At the edge of the figure if the network continues then the East-West and North-South Matchlines should be copied, pasted and modified to represent the network. The North Arrow on the figure should also be rotated, as needed to reflect the approximate north direction.

---

## **C4 TMV FIGURE (BASE YEAR/FUTURE YEAR)(EDTE/SPOT) TAB**

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The Turning Movement Volume Figure includes a total of four separate tabs, one for the EDTE Base Year, one for the EDTE Future Year, one for the SPOT Base Year and one for the SPOT Future Year. The TMV Figure works in the same way as the AADT Figure and includes copying and pasting the template data into the figure sheet. The only substantive difference is that the TMV figures include a template for an East-West Connection and North-South Connection that includes the volume balancing between intersections.

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## **C5 OD MATRIX FIGURE TAB (EDTE/SPOT)**

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The OD MATRIX FIGURE TAB is setup to provide the Origin-Destination Matrices for corridor projects and has separate figures for EDTE and SPOT. The top section provides a stick figure of the network for the corridor based on the information included in the Individual Intersection Data Tabs. The networks have been automated to the extent possible and may require some manual changes to fully represent the network. The North Arrow should be rotated to approximate the North direction for the corridor.

To the right of the O-D Figure is a copy of the O-D matrix sized to either the 10-intersection or 25-intersection sheet. For networks with less than the 10/25 intersections the last row and column include the last external node and are renumbered based on the last node used. The O-D matrices can be consolidated by deleting rows and columns to only include the nodes that are included in the network. Once the O-D matrices have been reduced the matrices should be cut and pasted into the bottom portion of the O-D Figure for printing.

If the project is not a corridor project and includes an overall network then the OD Matrix Figure should be developed manually to present the information based on the results of utilizing the OD\_MATRIX\_ITERATION Tabs.

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## **C6 SPOT TRAVEL TIME SAVINGS REPORT TAB**

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The SPOT TTS COVER Tab includes a summary of the data utilized to calculate Travel Time Savings between the Base Year and Future Year. The TTS Summary is typically used in the NCDOT Prioritization Process.

The SPOT TTS cover includes data linked to the PROJECT DATA TAB and the INDIVIDUAL INTERSECTION DATA TABS with most of the data is prepopulated based on data in other Tabs of the EDTV Tool. The Cover Sheet includes a listing of all of the links within the network and the analyst must select which of the links are "External" links (those that begin or end at the edge of the network) as these are needed to



determine the volume for the “Travel Time Savings Per vehicle” output. Additionally, a description of the proposed design should be included on the bottom portion of the form.

The TTS Report cover also includes the template for the TransModeler output for both the primary analyst and the review firm. The calculation of the travel time savings and travel time savings per vehicle is generated automatically by the spreadsheet.

## C7 INDIVIDUAL INTERSECTION DATA TABS

The Individual Intersection Data Tabs are included in the EDTV Tool and are numbered starting with 01 through the maximum number in each version of the spreadsheet. The EDTV Tool includes both inputs for EDTE (shaded in blue) and SPOT (shaded in green) with the data that needs to be input by the analyst in yellow.

There are four different areas included on the Intersection Data sheets:

- Input Data
- Growth Rate Data
- Turning Movement Percentage and Volume Development Notes
- Turning Movement Count Data

The Input Data includes the following data and requires the data cells shaded in yellow to be completed.

INPUT DATA													
INTERSECTION DATA			EDTE ANALYSIS YEARS				COUNT DATA				Area Type		
Intersection ID	01		Base Year	2019		Start Date/Time	1/1/2019 6:00 AM		0				
County	00		Future Year	2045		Count ID	19-00000		AM K/D Source				
Description	Street A @ Street B						Count Collected By:	Insert Count Firm		AM Peak			
APPROACH ATTRIBUTES											PM Peak (Overall)		
Approach	Road Name	AADT LocationID	ATR Group	Route Type	No. of Lanes	Facility Type	Functional Class	Capacity	13/24 Factor	Seasonal Adj. Factor	Socioeconomic		
North Leg	Street A							#N/A	#N/A	#VALUE!	County	0.00%	
East Leg	Street B							#N/A	#N/A	#VALUE!	OSBM	#N/A	
South Leg	Street C							#N/A	#N/A	#VALUE!	NCSTM (Pop)	#N/A	
West Leg	Street D							#N/A	#N/A	#VALUE!	NCSTM (Emp)	#N/A	
COUNT DATA											SPOT Base Year		
Approach	Road Name	% Duals	% TTST/TWIN	K (AM)	D (AM) INBOUND	AM PEAK DIRECTION	K (PM)	D (PM) INBOUND	PM PEAK DIRECTION	2019			
North Leg	Street A			#N/A	0.0%	OUTBOUND	#N/A	0.0%	OUTBOUND	0			
East Leg	Street B			#N/A	0.0%	OUTBOUND	#N/A	0.0%	OUTBOUND	0			
South Leg	Street C			#N/A	0.0%	OUTBOUND	#N/A	0.0%	OUTBOUND	0			
West Leg	Street D			#N/A	0.0%	OUTBOUND	#N/A	0.0%	OUTBOUND	0			
AADT DATA											SPOT Future Year		
Approach	Road Name	Station AADT	AADT Year	AADT Source	Use Proportions	Selected 2019 AADT	Growth Source	Annual Growth %	2045 AADT	2019 V/C Ratio	2029		
North Leg	Street A				No	0	Eng. Judg.	0.0%	0	#N/A	SPOT Station AADT	SPOT AADT Source	2019 AADT
East Leg	Street B				No	0	Eng. Judg.	0.0%	0	#N/A			0
South Leg	Street C				No	0	Eng. Judg.	0.0%	0	#N/A			0
West Leg	Street D				No	0	Eng. Judg.	0.0%	0	#N/A			0

- Intersection ID: This should generally not be updated; however, if there is a need to update the ID then it can be modified.
- County: Auto populated from PROJECT DATA TAB
- Description: Provide a succinct description of the intersection that includes all roadways included in the intersection. The use of the roadway name only for SR routes is acceptable in order to keep the description short enough as it is shown on the EDTV cover page.
- EDTE Analysis Years (Base Year/Future Year): Auto populated from PROJECT DATA TAB
- Start Date/Time: Insert the date of the count, for counts that span multiple days then the date that a majority of the count was collected should be used. The standard time for starting 13-hour counts is 6:00 AM.



- Count ID: Insert the count ID or designation provided in the count file.
- Count Collected By: Insert the entity (Consultant, NCDOT or other agency) that collected the count data.
- Area Type (Urban/Rural): Auto populated from PROJECT DATA TAB
- AM K/D Source/PM K/D Source: Auto populated from PROJECT DATA TAB. Typically not adjusted; however, the data could be adjusted to reflect the overall peak for the network instead of just the intersection.
- North/East/South/West Leg Name: Provide the roadway name for each approach. If there is not an approach for a leg then enter "No Approach" for the name.
- AADT\_LOCATIONID: This data field is input based on the location\_ID for each AADT count station included in the NCDOT AADT Web Map ([Link to AADT Map](#))
- ATR Group (1-7,11-14): Insert the ATR Group based on the NCDOT TSG ATR Groups which are available for most roadways in the NCDOT AADT Web Map. If the ATR Code is not included in the Web Map, then engineering judgement should be utilized to determine the most applicable ATR Group. A description of the ATR Groups is available by hovering over the ATR Group cell. If the LOCATION\_ID is input, then the ATR group will auto populate.
- Route Type (Interstate, US, NC, SR, Local): Insert the Route Type based on the designation of the roadway. If the LOCATION\_ID is input, then the Route Type will auto populate.
- No. of Lanes (2,4,6,8,10): Choose the total number of lanes on the intersection leg from the drop-down list. The number chosen should be the number of continuous through lanes over a reasonable distance on the approach and departure to the intersection. The selected number of lanes should be reflective of the likely capacity of the roadway. For approaches with a different number of lanes in each direction multiply the lower number of lanes by two to determine the number of lanes to be input. For example, if the approach has two lanes in one direction and one lane in the opposite direction it would be coded as a two-lane roadway. For roadways that require judgment please add a note in the Traffic Volume Development Notes section about why the selected value was made.
- Facility Type (Freeway, Arterial, Multilane, Two-Lane, Superstreet): Choose the proper facility type from the drop-down list. These facility types are based on HCM methodology for analyzing interrupted and uninterrupted flow. The following table should be utilized to determine the facility type:

Facility Type	Urban Area	Rural Area
<b>Two-Lane</b>	Not Applicable. All two-lane roads in urban areas are classified as Arterials	Two-lane roadway where the subject roadway is not stop-controlled or signal-controlled and has no interrupted flow conditions within 2 miles of the intersection
<b>Multilane</b>	Four or more lane facility where the subject roadway is not stop-controlled or signal-controlled and has no interrupted flow conditions within 2 miles of the intersection	
<b>Freeway</b>	Controlled access facility with interchanges	
<b>Arterial</b>	Facility where the subject roadway is stop-controlled, signal-controlled or has interrupted flow conditions within 2 miles of the intersection	
<b>RCI Corridor</b>	Existing facility that includes multiple RCIs along a corridor such that the capacity of the facility is defined by the RCI concept	



- Functional Classification: Choose the proper roadway classification from the drop-down list based on the NCDOT functional roadway classification ([Link to Functional Classification Webmap](#)) with the following legend:

NCDOT Functional Class

Functional Class

- Interstate
- Other Freeway
- Other Principal Arterial
- Minor Arterial
- Major Collector
- Minor Collector
- Local

Classification sub-types are combined for the EDTV volume development process. “Other Principal Arterial” and “Minor Arterial” are both coded as “Arterial,” for example.

- Capacity: The capacity of the approach roadway is auto populated and is determined by the number of lanes and classification and is based on the capacities utilized in the Prioritization Process.
- 13/24 Factor: Auto populated factor to convert 13-hour TMC to 24-hour count. Factors are based on Route Type and factors developed by NCDOT Traffic Survey Unit.
- Seasonal Adjustment Factor: Auto populated based on count date and ATR Group.
- Socioeconomic: Auto populated data based on county including compound annual growth rate (CAGR) of the OSBM population projection and the population and employment projection from the NCSTM. The average NCSTM growth rate by facility type for the county from the NCSTM is also included.
- % Duals/% TTST/TWIN: Auto calculated based on the turning movement count data.
- K-Factor (AM/PM): Auto calculated K-factor, rounded based on the setting on the PROJECT DATA Tab. The K-factor will be modified based on the v/c ratio based on thresholds and values on the PROJECT DATA Tab.
- D-Factor (AM/PM)(INBOUND): Auto calculated D-factor percentage, rounded based on the setting on the PROJECT DATA Tab. The D-factor is the directional percentage INTO the intersection.
- AM/PM Peak Direction: Auto calculated direction of the peak volume in the AM and PM peak hours. If the D-Factor is less than 50% the peak direction is OUTBOUND (AWAY from the intersection) and if it is 50% or more the direction is INBOUND (INTO the intersection).
- Station AADT: AADT for count station from AADT webmap. Auto populated based on AADT INTERSECTION ID field
- AADT Year: Latest year of AADT count data from AADT webmap. Auto populated based on AADT INTERSECTION ID field
- Source – The appropriate AADT Source Code, A through F, is chosen from the drop-down list.
  - Source Code A – For AADT count locations from NCDOT count maps directly at the intersection (i.e., very close to the intersection with little to no intervening driveway activity).
  - Source Code B – For AADT count locations from NCDOT count maps at adjacent locations. These locations can be somewhat further away from the intersection with only minor driveways or a minor roadway between the count and intersection. If it is believed that the total volumes of all intersecting roadways between the AADT and the intersection to be less than 30-40% of the AADT value, then the AADT count may



- be used. The count should not be used if there are roadways or development access between the locations that may substantially alter volumes.
- Source Code C – For corridor projects the availability of AADT stations for all links is unlikely. Therefore, if the AADT from an adjacent intersection is reliable then it can be carried over to the subject intersection for the common leg.
  - Source Code D – If there is no AADT count available on an intersection leg, one can be estimated from turning movement data and AADT data on the other legs. The proportions of turn movements and AADT on known approaches are used to estimate the AADT on unknown approaches.
  - Source Code E – The use of an AADT volume calculated based on the conversion of the TMC data to an AADT volume can be utilized if there are no reasonable AADT counts in the vicinity of the project. The spreadsheet determines the AADT by utilizing the 13-hour TMC and applying the 13-to-24-hour factor and the Seasonal Factor (derived from the Date of the count and the ATR Code).
  - Source Code F – Engineering judgment is used if no count data is available at all, or if the analyst believes the AADT from other sources to be inappropriate (in such cases, an explanation should be given in the Traffic Volume Development Notes section of the sheet).
  - Source Code G – Used for AADT chosen using any other method. Include an explanation in the Traffic Volume Development Notes section of the sheet.
- Use Proportions: For intersections that include a source D leg, the volumes are developed based on proportions from known AADTs on other legs of the intersection. This column can set whether a known AADT volume (Source A, B or C) is used in the proportioning calculation or not. This can be used to test how a known AADT affects the proportioning of the unknown legs and should only be used in the final volumes with approval from NCDOT TPD (or their designee).
  - Selected 20XX AADT: This field is auto populated for Source A and B and auto calculated for Source D and E. For Source C and F the AADT volume is entered directly into the cell. The use of Engineering Judgement is permitted and generally priority should be given based on alphabetic order with a Source A being given the highest consideration.
  - Growth Source: The growth source for the development of the future year AADT is typically based on Engineering Judgment. Alternatively, the NCSTM growth rate or the VMT Growth Rate based on the NCSTM can also be used in rare circumstances. If a different method is used the OTHER should be selected and a note added in the VOLUME DEVELOPMENT NOTES section.
  - Annual Growth Percentage: growth rate linked to the EDTE SELECTED column in GROWTH RATE section.
  - Future Year (20XX) AADT: Auto calculated based on the Base Year AADT, EDTE Selected Growth Rate and the number of years between Base Year and Future Year. The final volume is rounded up to the nearest 100.
  - Base Year v/c Ratio: Auto calculated as the Base Year AADT divided by the Capacity
  - SPOT Station AADT: Auto populated based on if the AADT Year is 2018 or 2019 (current Base Years for SPOT P7) If they are for 2018 or 2019 then the AADT will be displayed.



- SPOT AADT Source: The SPOT AADT source is similar to the EDTE AADT Source however, there is not any flexibility, and the source priority is set with A being the highest priority followed by B. Source C can be carried over from an adjacent intersection and utilized in SPOT to have adequate locations on corridor projects so that Source D proportioning can occur. Source E and F are only allowed under very rare circumstances when no AADT data is available. Source G is typically only used if the AADTs are averaged when volumes from two directions meet.
- SPOT Base Year AADT: Typically, auto calculated based on the SPOT AADT Source with only very rare instances where the volume is manually coded in for Source G.

The Growth Rate Data includes the following data and requires the data cells shaded in yellow to be completed.

Scenario	Model					Model			Previous Forecast			Historic Rates		EDTE Selected	SPOT Growth Source	SPOT Annual Growth %	2029 AADT		
	North Carolina Statewide Model (NCSTM)					(Insert Regional Model Name)			(Insert STIP/Year)			1999-2019	2009-2019						
	Base Yr	SPOT YR	Future Yr	2017-2030	2017-2045	Base Yr	Future Yr	-	Base Year	Future Year	-	CAGR	CAGR						
Year	2017	2030	2045	CAGR	CAGR			CAGR			CAGR			CAGR	CAGR				
Node 1														#N/A	#N/A	0.0%	VMT (NCSTM)	0.0%	0
Node 2														#N/A	#N/A	0.0%	VMT (NCSTM)	0.0%	0
Node 3														#N/A	#N/A	0.0%	VMT (NCSTM)	0.0%	0
Node 4														#N/A	#N/A	0.0%	VMT (NCSTM)	0.0%	0

- Model Base/SPOT/Future Year Volume: Input the model volume for each link for each of the analysis years. Leave blank if no value is available.
- Model CAGR: Auto calculated based on the model volumes and the number of years between model years.
- Previous Forecast AADT: Input the Forecast STIP Number and Date and enter the Base Year and Future Year. Next add the traffic forecast volumes for each link for each horizon year.
- Previous Forecast CAGR: Auto calculated based on the forecast volumes and the number of years between forecast years.
- Historic rates (10-year/20-year): Auto populated with historic 10-year and 20-year growth rates based on the AADT\_LOCATIONID
- EDTE SELECTED: Selected compound annual growth rate (CAGR) for growth from base year to future year based on available growth data and method included in GROWTH SOURCE column.
- SPOT Growth Source: Auto populated based on whether the NCSTM volumes are greater than zero. If NCSTM is greater than 0 then NCSTM CAGR is used. If the link is not in the NCSTM then the cell will read VMT(NCSTM).
- SPOT Annual Growth %: Auto populated based on the NCSTM CAGR for links in the NCSTM and the VMT (NCSTM) based on the county and Facility Type.
- SPOT Future Year (20XX) AADT: Auto calculated based on the SPOT Base Year AADT, SPOT Annual Growth Percentage and the number of years between Base Year and Future Year. The final volume is rounded up to the nearest 100.

The Turning Movement Percentage and Volume Development Notes include the following data and require the data cells shaded in yellow to be completed.



2019 Turning Percentage				2045 Turning Percentage				AADT Source	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		A - NCDOT AADT Map at Intersection	
←	↓	→		←	↓	→		B - NCDOT AADT Map - Adjacent Segment	
#DIV/0!	↑		#DIV/0!	#DIV/0!	↑		#DIV/0!	C - AADT Carryover from Adjacent Intersection	
#DIV/0!	→	AM	←	#DIV/0!	→	AM	←	D - Based on Traffic Count Proportions	
#DIV/0!	↓		#DIV/0!	#DIV/0!	↓		#DIV/0!	E - Based on Calculated AADT	
←	↑	→		←	↑	→		F - Based on Engineering Judgment - See Notes	
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		G - Other - See Notes	
#DIV/0!	↓	→		#DIV/0!	↓	→			
#DIV/0!	↑		#DIV/0!	#DIV/0!	↑		#DIV/0!		
#DIV/0!	→	PM	←	#DIV/0!	→	PM	←		
#DIV/0!	↓		#DIV/0!	#DIV/0!	↓		#DIV/0!		
←	↑	→		←	↑	→			
#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!			

Volume Development Notes

- Base Year/Future Year Turning Percentages: The turning percentages are auto calculated based on the turning movement counts and displayed for the AM and PM peak periods. The individual percentages can be revised based on engineering judgment with a note added in the Volume Development Notes section. If a volume is modified, then the percentages will become shaded in yellow with red text.
- Volume Development Notes: The Volume Development Notes section should be used to provide explanations, background, and calculations to support the decisions made in developing the information included in the Individual Intersection Data Sheet.

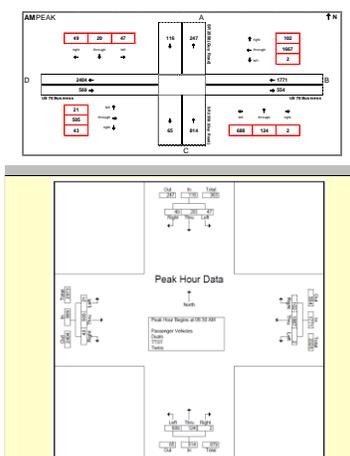
The Turning Movement Count Data portion includes the following data and requires the data cells shaded in yellow to be completed.

- Turning Movement Counts by FHWA Class – The turning movement data should be copied into the sheet for each set of vehicle classes
  - Passenger Cars (Class 1-3)
  - Duals (Class 4-7)
  - TTST (Class 8-10)
  - TWIN (Class 11-13)

Passenger Cars (Class 1-3)													Duals (Class 4-7)													TTST (Class 8-10)													TWIN (Class 11-13)												
Year	Approach			Departure			Approach			Departure			Approach			Departure			Approach			Departure			Approach			Departure																							
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right																								
2019																																																			
2020																																																			
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- Screen Captures of the AM, PM and 13-hour Count Summaries – The Peak Hour and 13-Hour figures included in the TMC count report should be copied and pasted into the sheet so that the peak hour determined from the count data can be verified against the figures. Some TMC counts include mid-day peaks or different time frames for the AM and PM peak periods. Other counts are complex counts that are combined to make a single intersection and do not have the corresponding figures. If the figure in the report does not match the calculated data or is for a combined count, then do not add a screen capture but include a note that explains why the figure is not included.



## C8 OD MATRIX PROP (BASE YEAR/FUTURE YEAR)(EDTE/SPOT) TAB

The OD Matrix Proportion series of tabs allows for the development of an O-D matrix for corridor projects. The Matrix Proportion tool is based on the methodology included in Method 1: Turn Proportions of the *Origin-Destination Matrix Volume Development Techniques for the North Carolina Department of Transportation Procedure*. No inputs are needed as it uses the existing TMV Data to develop the OD matrices.

## C9 OD\_MATRIX\_ITER (BASE/FUTURE YEAR)(AM/PM) (EDTE/SPOT) TAB

The Matrix Iteration series of tabs allows for the development of an O-D matrix from a seed matrix (such as from StreetLight Data or a travel demand model) and is setup to accommodate non-corridor projects. The Matrix Iteration tool includes the following set of inputs:

- OD\_MATRIX\_ENTRY-EXIT VOL
- OD\_MATRIX\_ITERATION (BY\_AM)
- OD\_MATRIX\_ITERATION (BY\_PM)
- OD\_MATRIX\_ITERATION (FY\_AM)
- OD\_MATRIX\_ITERATION (FY\_PM)
- OD\_MATRIX\_CopyPaste(EDTE)
- OD\_MATRIX\_ENTRY-EXIT VOL (SPOT)
- OD\_MATRIX\_ITERATION (BY\_AM) (SPOT)
- OD\_MATRIX\_ITERATION (BY\_PM) (SPOT)
- OD\_MATRIX\_ITERATION (FY\_AM) (SPOT)
- OD\_MATRIX\_ITERATION (FY\_PM) (SPOT)
- OD\_MATRIX\_CopyPaste(SPOT)



The OD\_MATRIX\_ENTRY-EXIT VOL tab utilizes the information from the INDIVIDUAL INTERSECTION DATA SHEETS (AADT, K and D) to develop Target Link Volumes for each entry and exit link in the network and requires the analyst to map the external nodes to the listing of Links in ID Column.

The OD\_MATRIX\_ITERATION (BY) Tab references in the Entry and Exit Volumes as Target Volumes and utilizes a Seed Matrix (Input Matrix) as inputs to an Iterative Proportional Fitting (IPF) routine that generates the FINAL OUTPUT MATRIX. The final OD Matrices are then referenced into the CopyPaste tabs in order to copy them efficiently into TransModeler.

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## **C10 AADT NETWORK (EDTE/SPOT) TAB**

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The AADT network tab works similarly to the AADT Figure and TMV Figures by using a template intersection to build the overall project network or corridor. The goal of the AADT network is to show both the proposed and selected AADT Source in a single graphic to allow the reviewer to see how the AADTs were developed for larger corridor or network projects.

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## **C11 SA FACTORS (SEASONAL ADJUSTMENT) TAB**

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The Seasonal Adjustment (SA) factors tab utilizes season StreetLight Data output to determine the seasonal factor for each day of the week for each month of the year. It also determines factors for the highest day of the year and the 5<sup>th</sup>, 30<sup>th</sup>, 50<sup>th</sup> and 100<sup>th</sup> highest days of the year.



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## Appendix D: Express Design Traffic Analysis (EDTA) Procedures

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The Express Design Traffic Analysis task will be completed utilizing a variety of software products, including:

- Critical Lane Analysis Spreadsheets
- FREEVAL
- Highway Capacity Software (HCS)
- Synchro
- Sidra
- TransModeler

The following sections include the guidelines for utilizing each software in the Express Design Traffic Analysis process.

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### APPENDIX D1 CRITICAL LANE ANALYSIS GUIDELINES

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To Be Developed in the Future

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### APPENDIX D2 FREEVAL GUIDELINES

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To Be Developed in the Future

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### APPENDIX D3 HIGHWAY CAPACITY SOFTWARE GUIDELINES

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To Be Developed in the Future

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### APPENDIX D4 SYNCHRO GUIDELINES

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#### D4.1 GENERAL PROJECT INFORMATION

Before addressing the specifics of Synchro analyses, some general information regarding analysis procedures is presented in this section. This information applies to Express Design Traffic Analysis (EDTA).

##### D4.1.1 GENERAL SYNCHRO INFORMATION/PROJECT SETUP

###### D4.1.1.1 FILE NAMING CONVENTIONS

The model files developed in Synchro will be utilized for future traffic analysis efforts and need to be developed in a manner that allows them to be easily followed for any future analyst who may need to work with the project. For the development of models, the naming conventions include the use of the Base Year (20XXBY) and Future Year (20XXFY). The following are the required naming conventions for each file:

- In general, each file includes the STIP number (if the project has a STIP ID) or the SPOT ID (as an H followed by a six-digit number value), followed by the scenario (NB for No-Build and B\_Alt\_X for each Build alternative), followed by the analysis year. See Table E1-1 for file naming conventions.



#### D4.1.1.2 BACKGROUND IMAGES FOR MODEL DEVELOPMENT

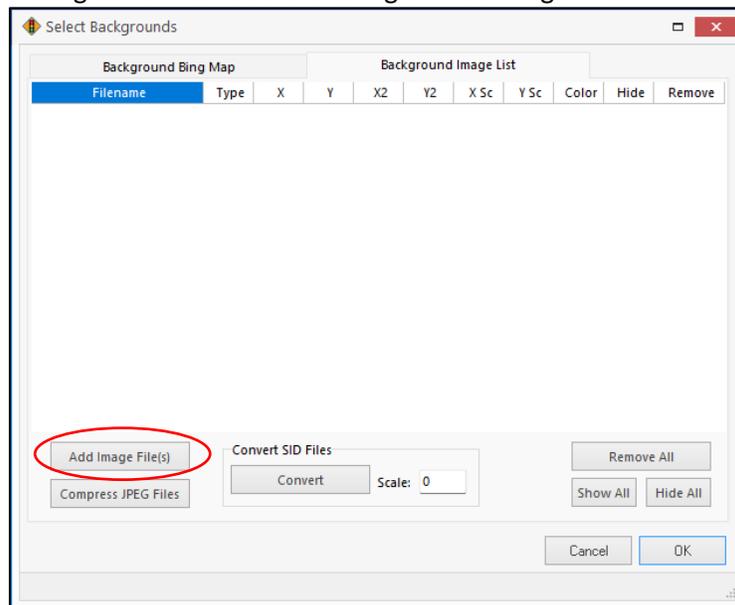
The development of models is typically done utilizing aerial imagery for existing conditions models and GIS shapefiles for proposed designs. The following file formats can be attached in Synchro: DXF, GIS, Bitmap, JPEG and Shapefile (\*.dxf, \*.bmp, \*.jpg, \*.jpeg and \*.shp).

There are several sources and methods for utilizing aerial imagery in Synchro, including:

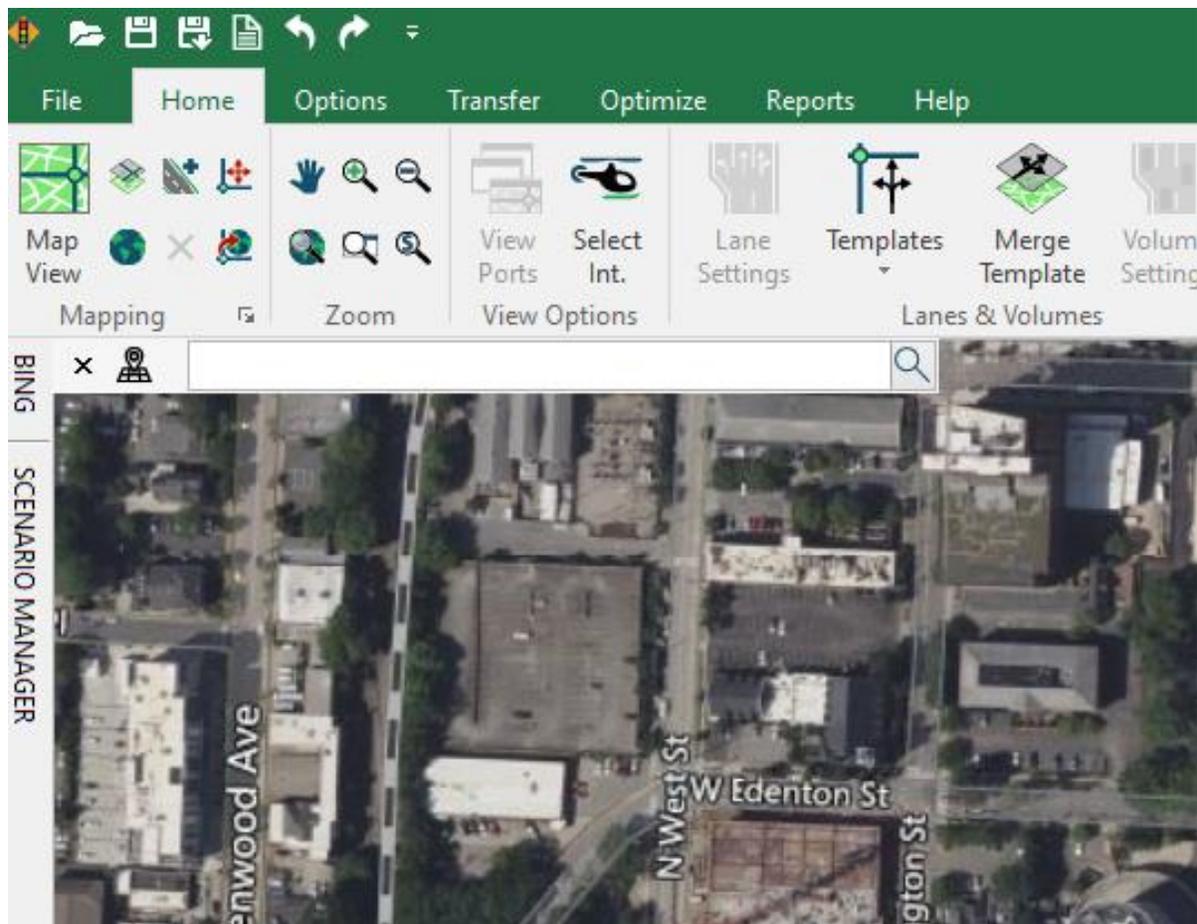
- NC OneMap → high resolution aerial imagery collected on a rotating basis every three years. The data can be downloaded and utilized at any time without a network connection. Once the files are downloaded, they can be stored locally on a computer or server and referenced into the model. Available at: [Link to NC OneMap Imagery](#)
- Bing Map Layer → Synchro 10 and newer versions include commercially available aerial imagery from Bing that can be accessed with a network connection.
- Project Specific Aerials → If project specific aerials are available in a standard imagery format, they shall be attached in a coordinately correct manner.

Multiple imagery sources should be reviewed to determine if there have been any changes to the study area. If there are no recent changes to the study area, then the most convenient imagery source can be used.

Background data files are attached to the model under the Select Background Tab. Aerial image files can be attached using the Background File List and clicking on Add Image Files.



Bing Maps is now typically used to create background images in Synchro. In Synchro 11, a background aerial is integrated into home screen when a file is created. An address or specific location can be searched for under the Bing tab on the left-hand side of the screen to locate the analysis area.



#### *D4.1.1.3      NODE NUMBERING*

Node numbering should be done in a consistent manner across all projects. The main corridor should be numbered starting in either the southern or western part of the corridor depending on the orientation of the project and increase in reasonable increments (1, 2, 3, 4... or 10, 20, 30, 40...). For projects where there is more than one major corridor, each corridor should be numbered in a similar manner with each corridor progressing with the next set of logical numbers.

#### *D4.1.1.4      CARDINAL DIRECTIONS*

Intersection approaches should only be coded by cardinal directions (north, south, east, and west) as other approach directions (northeast, southeast, northwest, and southwest) may prevent Synchro from discerning turn movements from through movements resulting in inaccurate capacity and queuing results.

To adjust directions, right click over the direction wanting to be changed and a drop-down list will appear, then select the correct cardinal direction for that approach. Note that that each leg may have to be manually adjusted to get all cardinal directions correct. The directions can be revised in any of the setting windows.

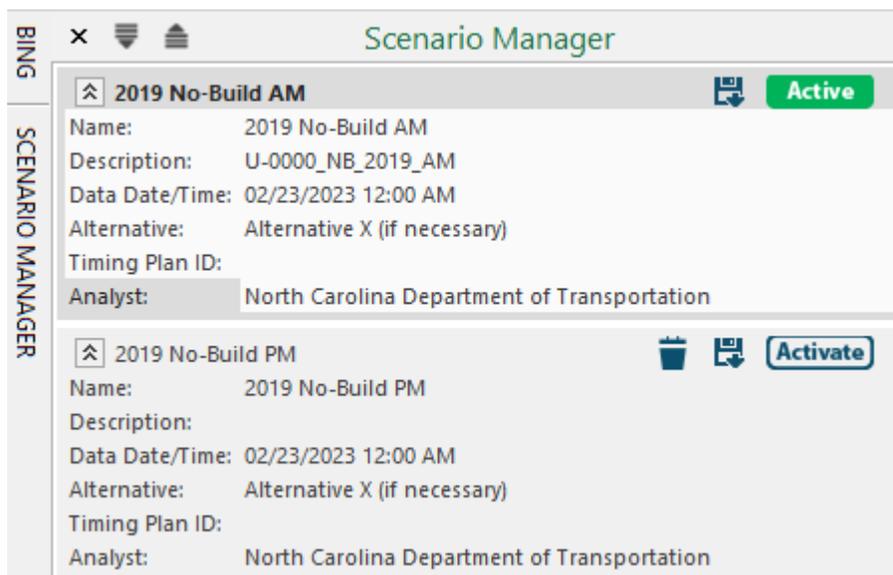
Cardinal directions may not be feasible for atypical intersections and alternative intersection designs such as diverging diamond interchanges and continuous flow Intersections. In the case of atypical intersections and alternative designs, the project analyst should use best judgment when coding approach directions.



#### D4.1.1.5 SCENARIO MANAGER

The Scenario Manager allows the user to track scenarios and enter project information which is shown on output reports. The Description should provide the STIP Number/SPOT ID and analysis period (year and time of day). The Alternative should be a description of the scenario being analyzed and the Analyst should provide the name of the firm performing the work. If helpful to the analyst, the Time and Timing Plan ID information may also be included. It is important to update this information for each Synchro file to avoid confusion when output is provided.

In Synchro 11, the Scenario Manager is integrated into home screen when a file is created on the left-hand side of the screen. Additionally, Synchro 11 allows multiple scenarios to be developed in the same file if the network is the same. This allows the analyst to have both the AM and PM peak hours in the same file.



## D4.2 VOLUME DEVELOPMENT AND INPUT

### D4.2.1 VOLUME DEVELOPMENT

The peak hour traffic volumes will be provided in the Express Design Traffic Volume (EDTV) report.

### D4.2.2 VOLUME SETTINGS

The volume settings tab is used to enter/edit traffic volumes and related information. Each Synchro file models hourly volumes for one design hour/peak period (ex. 7:00 – 8:00 AM or 5:00 – 6:00 PM). Note the absence of traffic volumes on some movements that are allowed at one or more intersections may cause Synchro to incorrectly calculate one or more movements as being prohibited. We recommend changing zero volume movements to four vehicles per hour.

#### D4.2.2.1 HEAVY VEHICLES

A default value of 2% should be used for the percentage of heavy vehicles.

#### D4.2.2.2 PEAK HOUR FACTOR

The peak hour factor accounts for the fluctuation in traffic arrivals during the peak hour and is used to convert the hourly traffic volume into the flow rate that represents the peak fifteen minutes. The analyst should use a peak hour factor of 0.90 unless approved by the NCDOT Congestion Management



Section. If a school is in the vicinity of the project, coordination with the Congestion Management Section (or their designee) is necessary due to the possible differences in the acceptable PHF.

## **D4.3 NETWORK CODING**

### **D4.3.1 LINK SPEED**

For arterials, collectors and local roadways, the link speed should be selected based on the posted speed limit of the facility. For roadways that do not have a posted speed limit, an appropriate speed limit should be selected and documented in the model documentation.

For freeway ramps, the default speed limit should be 45 mph. For freeway loops, the default speed limit should be 25 mph. For directional ramps, the speed limit should be 55 mph. If detailed design information is available, then deviation from the default speed is acceptable, if properly documented in the model documentation.

### **D4.3.2 LINK NAMES**

All roadway links should be named in order for the reviewer to identify which roadways are being analyzed. Link names are input in the Lane Settings tab and the names should be input on the link adjacent to the intersection, so they can be included on the headings of the output reports.

### **D4.3.3 LINK LENGTHS**

It is preferred that all links be a minimum of 100' to avoid simulation issues in SimTraffic. Additionally, all boundary nodes should extend a reasonable distance beyond the last intersection node (typically 1,000') to ensure adequate queuing can be calculated in SimTraffic.

### **D4.3.4 LANE WIDTH**

The coding of lane widths in Synchro shall utilize the default width of 12 feet for all lanes being coded.

### **D4.3.5 INTERSECTION CODING**

The coding of intersections in a consistent manner is a goal that will allow for the most reliable comparison of alternatives and allow for the re-use of model networks. The following sections include best practices that should be adhered to as much as possible when developing intersections within the model.

#### ***D4.3.5.1 CHANNELIZED MOVEMENTS***

Channelized right turn lanes shall be modeled as part of the same link as the through traffic and included in the main intersection node. The Highway Capacity Manual 2010 does not include any means of determining delay or Level of Service for yield movements; therefore, yield-controlled right turn movements shall be included in the signal operations as a permitted phase. For yield-controlled movements, Right Turn on Red (RTOR) may be used for the right turns to emulate the yield-controlled conditions during phases with conflicting movements. Overlap phasing should be used if the corresponding left turn has protected phasing.

Right turn channelization options are available under the Lane Settings tab including control type, curb radius and lane additions. These functions are used to visually match existing field conditions and control simulation operations.

For channelized free flow movements, the right turn can be removed from signal operations and set at free when a dedicated lane addition is included downstream.



#### *D4.3.5.2 CODING OF TURN LANES*

When coding turn lanes, the available storage is often a critical component of the analysis and should be modeled at a level that allows for the accurate analysis of the operations. The storage length of a turn lane should not include the taper length and should be measured from the stop bar to the beginning of the taper.

Synchro only allows one length to be entered for the storage length, which is usually an issue for dual turn lanes because they are often not the same length. In this situation, the average of the two turn lane lengths should be used.

It is important to note that if a turn lane does not include a storage length, it is assumed to be a full lane which will extend the length of the link. The storage length does not affect Synchro output results; however, it will have a considerable effect on any simulation results.

#### *D4.3.5.3 TAPER LENGTHS*

The default taper length in Synchro is 25 feet which allows a maximum of one queued vehicle to be stored in the taper. The taper length does not affect Synchro output results; however, it will have a considerable effect on any simulation results. All taper lengths in the model should be set to 100 feet, which allows additional vehicles to store in the taper.

#### *D4.3.5.4 ROUNDABOUTS*

Analysis for roundabouts has been updated in the HCM 6<sup>th</sup> Edition. These updates have increased the capacity of roundabouts when compared to the HCM 2010. It is acceptable for single lane roundabouts (without any bypass lanes) to use the HCM 6<sup>th</sup> Edition for reporting roundabout MOE's. The analyst shall include roundabouts in SimTraffic outputs as well. For dual lane roundabouts, it is recommended that Sidra Intersection be utilized for roundabout operations.

If a dual-lane roundabout is needed for the design year, consider construction as a single-lane roundabout designed for simple expansion to a dual-lane design. The interaction between the proposed roundabout and adjacent intersections should be considered. Roundabouts should not be constructed where queues from adjacent intersections restrict the flow of vehicles leaving the roundabout.

For single-lane roundabout analysis, use a minimum 120 feet for the roundabout inscribed diameter, with 16-foot lanes, and an 88 foot inside diameter. The speed of the roundabout should be restricted to a maximum of 25 mph.

### **D4.4 SIGNALIZED INTERSECTION CODING**

The coding of signalized intersections in Synchro requires a basic understanding of signal design and operations. Attempts have been made to simplify the coding of signalized intersections and the following section includes the default values and basic coding requirements for signalized intersections. More detailed coding of signalized intersections may be allowable on a project-by-project basis if they are warranted by the project scope or the nature of the improvement. Deviation from the default values shall be discussed with the NCDOT Congestion Management Section and documented in the model documentation, if approved. For additional guidance on the design of signalized intersections, please refer to the *NCDOT Traffic Management and Signal System Unit Design Manual* (<https://connect.ncdot.gov/resources/safety/its%20and%20signals%20resources/its%20and%20signals%20unit%20design%20manual.pdf>).



All existing signalized intersections in Synchro shall be coded as shown on a verified signal plan from the NCDOT or local municipality. If a signal plan is unavailable, phasing and timings should be obtained from a review of Google Streetview along with engineering judgment or by contacting the maintaining authority for verification. NCDOT signal plans can be found at <https://connect.ncdot.gov/site/tmsd/SignalPlans/Pages/default.aspx>.

#### D4.4.1 TIMING AND PHASING SETTINGS

The coding of signalized intersections is completed by utilizing the Timing and Phasing Settings tabs. The following sections include the process for coding signalized intersections in the model.

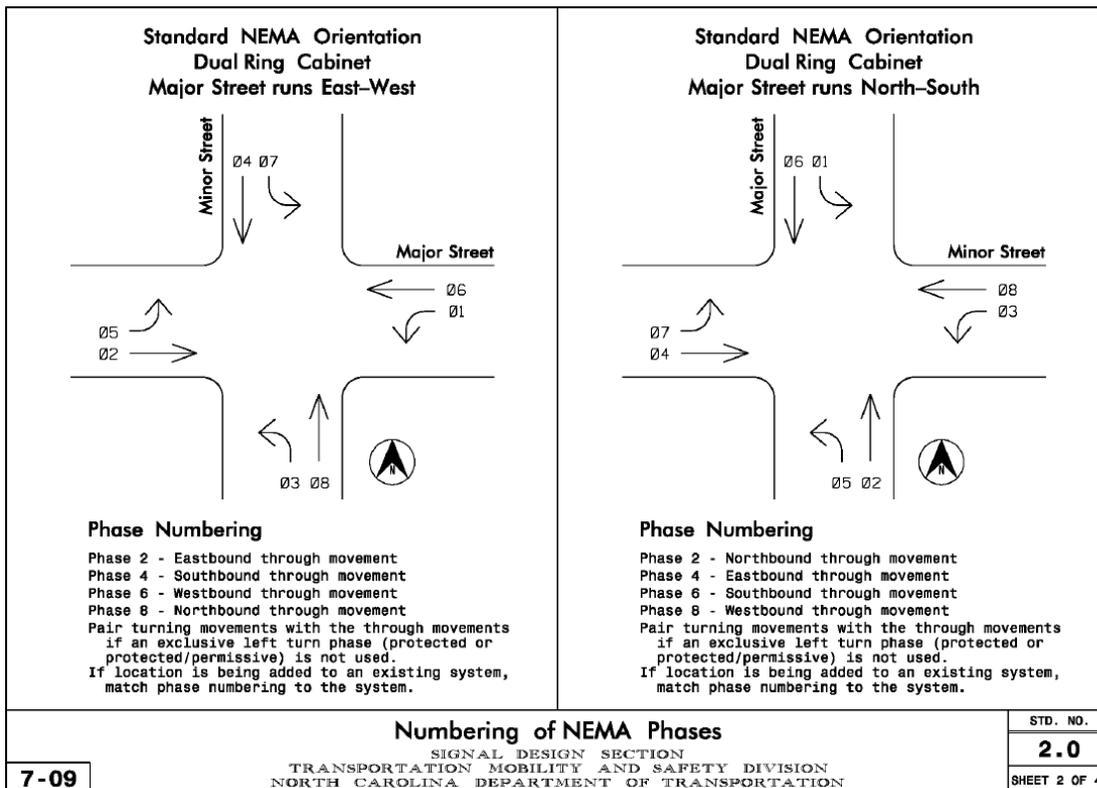
#### D4.4.2 CONTROL TYPE

The Control Type is a drop selection of intersection control with options such as pretimed, actuated uncoordinated, semi actuated uncoordinated and actuated coordinated. The signal plan should inform the analyst to whether the signal is actuated or semi actuated and coordinated or uncoordinated. For the purpose of analyses, it is acceptable (and recommended) to assume that signals are actuated coordinated unless specific information is available.

#### D4.4.3 PHASING SETTINGS

For any existing signals, the use of the Table of Operations and Phasing Diagram on the existing signal design plans should be utilized as a basis for determining the phasing for the signal. In the absence of an existing signal plan, engineering judgment and/or based on a review of Google Streetview should be utilized to determine the most appropriate phase settings.

The phase ID's shall be set based on the NEMA phase numbering system included in the following figure.



#### D4.4.4 DEFAULT TIMING SETTINGS



The default timing settings in Synchro are described along with guidance on how each parameter should be implemented beyond the default setting, in the following section.

- Coordinated Phases
  - Default = No
  - Shall be modified to yes for any coordinated phases, typically phases 2+6
- Coordination Referenced to
  - Default = Begin of Green
- Coordination Mode
  - Default = Fixed
- Yield Point
  - Default = Single
- Minimum Initial
  - Major Street based on the posted speed along the approach, with 50-55 mph = 14 seconds, 40-45 mph = 12 seconds and  $\leq 35$  mph = 10 seconds. Side Streets = 7 seconds. If a side street meets the criteria for using min recall, then the minimum green for the side street through movement should be based on the speed limit included for Major Streets.
- Yellow Time
  - Default = 5 seconds
- All Red Time
  - Default = 2 seconds
- Lost Time Adjust
  - Default = -2 seconds
- Recall Mode
  - Default = none
  - Min recall for minor street through movement phases if a majority of the traffic on the approach makes the through movement
  - Max recall for major street through movements

#### **D4.4.5 FLASHING YELLOW ARROW**

Flashing Yellow Arrows (FYA's) have become preferred to protected + permitted (pm+pt) signals for left turn traffic at signalized intersections. FYA's provide operational improvements and eliminate the "yellow trap" where drivers may make a left turn movement as their signal turn transitions to red assuming the opposite direction is transitioning to red at the same time.

Synchro does not provide a specific turn type for FYA's; however, Dallas Protected-Permitted (D.P+P) phasing can be utilized since phasing and operations are similar. Reviews have shown only minimal differences in total delay when comparing D.P+P to the traditional pm+pt phasing in Synchro. The primary difference in the timing settings is that the permitted phases selects the opposing through phase rather than the concurrent one, which matches controller settings. Dallas phasing should be used for existing conditions where a four-section head with a FYA has been installed. If a five-section "doghouse" signal head is used, then the traditional pm+pt phasing should be used.

Please note that when pm+pt or D.P+P are selected a Permitted Flashing Yellow checkbox appears in the timings settings window. This checkbox is only used if a simulation within SimTraffic is conducted. The Permitted Flashing Arrow checkbox does not affect the analysis results in Synchro.



#### **D4.4.6 ALLOW LEAD/LAG OPTIMIZE**

During signal optimization, Synchro can select the most efficient order of phases. If the allow lead/lag optimize box is checked, Synchro will optimize all combinations to choose the most efficient phase order (lead or lag). If this tool is utilized, the analyst should ensure to avoid the “yellow trap” scenario.

#### **D4.4.7 RIGHT TURN ON RED (RTOR)**

Right Turn on Red (RTOR) shall not be included in the model for modeling of signalized intersections in a future year analysis, except where explicitly allowed (see below). Because RTOR are not allowed for the future year, they should also not be modeled as part of the base year scenario in order to allow for a more reliable comparison of the results. RTOR can be found under the Lane Settings tab.

The use of RTOR is permitted when coding channelized right turns with yield-controlled movements that are being modeled as part of the signal. On a project by project basis the use of RTOR for signals that currently allow RTOR and are not modified as part of the build improvements may be allowed, if approved by the NCDOT Congestion Management Section.

#### **D4.4.8 RING AND BARRIER**

Once the phases for a traffic-actuated timing plan have been defined, a phase order and transition scheme with a ring-and-barrier table can be defined as well. The ring-and-barrier table is a common method for illustrating the phase transition logic for actuated controllers and is shown on the bottom of the Timing Settings window.

The block of phases between any two consecutive barriers is referred to as a barrier and the sequence of phases in a single row – which may span multiple barriers – is referred to as a ring. Dual ring, two-barrier designs are common; however, Synchro allows more complex designs with as many as 4 barriers and 4 rings and can be revised using the Ring and Barrier Designer tab on the main toolbar.

The ring and barrier for existing signals should be defined based on the Phase Diagram from the existing signal design plan. For modified or new signals, the ring and barrier table should be set up based on engineering judgment.

#### **D4.4.9 SIGNAL RECOMMENDATIONS**

Monitoring for signalization should be recommended when peak hour warrants are met. Poor LOS on a side street does not always result in a recommendation for signalization if v/c ratios and queuing are acceptable. The following list indicates when signals are less desirable:

- Strategic Highway Corridors
- In close proximity to other signals
- When the signal creates operational and queuing problems greater than it solves

When signals are warranted, every option to reduce phasing should be analyzed, especially on a Strategic Highway Corridor.

#### **D4.4.10 SIGNALIZED INTERSECTION BEST PRACTICES**

The phasing and timing settings for signalized intersections require the analyst to review the volumes and SimTraffic simulation to determine the most appropriate signal operations.

- Signal phasing should remain consistent for all time periods. As an example, if split phasing is used for the AM peak, it must be used for the PM peak. Changing the phasing sequence, such as



altering left turn phasing from leading left to lagging left, is dependent on the traffic signal controller equipment.

- Dual left turns should be used cautiously due to:
  - Turn Conflicts requiring split phasing
  - Protected Phasing (see signal plans)
  - Driveways in close proximity to the intersection on the receiving lanes can lead to erratic movements
  - Merges on the receiving lanes can create false capacity in the analysis
- Dual right turns with one lane sharing a through movement perform poorly in overlap and RTOR conditions.
- Through movements on highway ramps should not be combined with right turns for three phase signals or standard diamond configurations. The through movement should be shared with the left turn lanes.
- Protected-permitted phasing at an intersection in the base year should be changed to protected only phasing in the future year scenarios (NB and Build) if any part of the intersection has proposed design changes in the Build scenario.
- If a protected-permitted intersection is in the study area but outside the limits of the design, then the cross product should be applied to determine if protected phasing is necessary. If the cross-product condition is not met, then the signal should remain protected-permitted.

Number of Opposing Lanes (Through and Right)	Condition
1	Left turn Volume * Opposing Volume > 50,000
2	Left turn Volume * Opposing Volume > 90,000
3 or more	Left turn Volume * Opposing Volume > 110,000

- All signals with existing permitted phasing in the base year should be changed to protected phasing in the future year (NB and Build) if the cross-product rule is met. This applies to all intersections.
- Unsignalized intersections may be signalized in the future year No-Build if warranted. This should be applied on a case-by-case basis and approval should be requested from the Program Manager before any changes are made.
- Intersections with combination through/left turn lanes should have either permitted-only left turn treatment or split phase left turn treatment for that approach. This is not a recommended geometric configuration and should be avoided when possible if there is an opposing movement.
- Lane configuration for opposing side streets should match when possible to avoid driver confusion (for example: avoid a combination through/left turn and right turn lane on one approach opposite a combination through-right turn and left turn lane on the opposite approach).
- For analysis, generally use protected left turn treatment instead of permitted when:
  - Dual left turn lanes are present
  - Hourly volume exceeds 240 cars
  - Left turn lanes are crossing 3 or more opposing through lanes of traffic
  - When a condition is satisfied in the table below:



Number of Opposing Lanes (Through and Right)	Condition
1	Left turn Volume * Opposing Volume > 50,000
2	Left turn Volume * Opposing Volume > 90,000
3 or more	Left turn Volume * Opposing Volume > 110,000

- Use overlapping right turn phasing where appropriate. Use of a shared through-right turn lane limits the effectiveness of the right turn overlap, especially where volumes require dual right turns.
- Cycle lengths for individual intersections in coordinated systems should be equal. Double or half cycles can be used if the minimum cycle lengths, defined below, are accommodated.
- It should not be the intent at the planning stage of a project to fully design and optimize a coordinated traffic signal system.
- Generally, the minimum cycle lengths are shown in the table below. Deviation from these minimum values is acceptable if justified in the model documentation.

Number of Phases	Minimum Cycle Length
2	60 seconds
3	90 seconds
4 or more	120 seconds

- Generally, the maximum cycle length should not exceed 180; however, cycle lengths up to 240 seconds are acceptable if justified in the model documentation.

#### D4.4.11 SIGNAL OPTIMIZATION

The optimization of signalized intersections is vital to accurately modeling the traffic operations of both isolated signals and coordinated corridors. The optimization of signals in Synchro is completed in two different manners depending on the number of signals being analyzed, with isolated signals (those that are not coordinated with other signals in a signal system) and multi-signal corridors (those that are coordinated as part of a signal system) being optimized with separate methods.

The following are recommendations for signal timing and apply to all signalized intersections.

- Generally, the minimum cycle length for a two-phase signal should be 60 seconds, with three to six phase signals having a minimum cycle length of 90 seconds, and seven or more phases having a minimum cycle length of 120 seconds. Deviation from these minimum values is acceptable if justified in the model documentation.
- Generally, the maximum cycle length should not exceed 180; however, cycle lengths up to 240 seconds are acceptable if justified in the model documentation.
- Overall cycle lengths should be rounded to the nearest 10 second increment and individual splits should be rounded to the nearest whole second.

##### D4.4.11.1 ISOLATED SIGNAL OPTIMIZATION

If the signal is an isolated signal (not coordinated with another signal) click on the signal to be optimized and use the Intersection signal feature under the Optimize Tab to optimize either the intersection splits or cycle length.



The Splits command will select the optimal split for each phase based on each lane groups volume divided by its adjusted saturation flow rate. This is a good exercise when looking to have a good and quick indication how certain laneages or cycle lengths will work for any given volume. If two or more lane groups move concurrently, the highest volume to saturation flow rate will be used to set the phase time.

The Cycle Length command will set the intersection to its natural cycle length. It is worth noting that in certain instances longer cycle lengths will provide better performance measures. When optimizing, Synchro tries to determine the shortest cycle length with acceptable performance.

#### *D4.4.11.2 MULTI-SIGNAL CORRIDOR OPTIMIZATION*

To optimize the cycle length for multiple signalized intersections that are located along a corridor, the Network signal optimization tool shall be utilized. This tool allows the analyst to optimize the cycle length for the entire network or a corridor by selecting a specific zone.

The following are recommendations for optimizing cycle lengths using the Network Cycle Length command box.

- Allow Uncoordinated = Never
- Allow Half Cycle Length = Checked
- Preserve Files for Each Cycle Length = Unchecked unless a specific need is identified
- Optimize Phase Sequence = Checked
- Offset Optimization = Extensive
- Weighting = No Weighting
- Scope = Set to Zone if the analyst is performing optimization of a specific corridor and that zone should then be selected in the drop down. If the entire network is to be optimized, the analyst should select Entire Network.
- Write Timing File = Unchecked, unless a specific need is identified

When performing the optimization, the analyst can choose between Manual or Automatic to run the optimization. The analyst should choose Automatic to let Synchro chose the best timings combination. If the analyst uses the Manual option, they must justify that in the traffic report and provide detail on the steps taken to choose the timing data used in the Synchro file.

#### *D4.4.11.3 BEST PRACTICES FOR SIGNAL OPTIMIZATION*

The optimization of signalized intersections requires experience in traffic operations and basic knowledge of signal design; however, the optimization methods in Synchro should be considered a tool that assists the analyst in developing the signal timing and offsets for a given project; therefore, fine tuning may be required following the completion of the optimization task in Synchro.

The coordination of grids and other networks where major corridors intersect may require optimizing both the east-west and north-south routes separately. The best way to coordinate this type of system is to first optimize the major route that includes the coordinated phases, then each perpendicular route should be reviewed and the cycle length set to the same (or a compatible variation of the) major corridor cycle length with each signal's splits being optimized individually.

Optimization of Superstreet corridors should be done individually for each direction of travel along the corridor.



## **D4.5 SIMTRAFFIC SIMULATION**

SimTraffic should only be run as an auditing tool to visualize overall network operations. Any significant queuing, starvation, spillback, or gridlock should be addressed.

## **D4.6 ERROR CHECKING AND QUALITY CONTROL**

### **D4.6.1 NETWORK ERROR CHECK**

Following the development of the model and prior to running any output or submitting for review, the analyst should utilize the Error Check tool under the options tab to review the model coding. It is possible, that the error check will identify items that are not actually errors or will not influence model results.

### **D4.6.2 QUALITY CONTROL**

Quality Control of the model shall also be performed on all models prior to submittal to NCDOT. A detailed review of the model for quality control should be done by an individual with a thorough understanding of Synchro and these Guidelines. A second, independent review of the model by an individual who has expertise in traffic operations but was not involved in the development of the model is also recommended prior to running any outputs.

## **D4.7 MEASURES OF EFFECTIVENESS**

### **D4.7.1 SIGNALIZED INTERSECTIONS**

The control delay (shown in the Synchro Timing Settings Window) by intersection and control delay by lane group and their corresponding LOS shall be reported for the overall intersection and each individual lane group.

For approach based and intersection wide assessments, LOS is defined solely by control delay with LOS D or better typically being considered acceptable; however, there may be individual movements (lane groups) where the v/c ratio is greater than one. If this occurs, the movement is considered LOS F, even if the control delay is below the LOS F threshold. Further evaluation is needed at these locations and additional improvements may be necessary to achieve acceptable operations.

### **D4.7.2 QUEUE LENGTHS**

The reporting of queue length shall be done utilizing the Synchro 95<sup>th</sup> percentile queue length. For the analysis of Build designs, the length of turn bays should generally accommodate the 95<sup>th</sup> percentile queue length from Synchro. Storage recommendations for queue lengths should be rounded up to the nearest 25 feet with a minimum of 100 feet for both right turn and left turn lanes.

For Synchro 95<sup>th</sup> percentile queue lengths, any movement that is flagged (~, #, or m) should be reviewed in further detail and more reliance should be placed on SimTraffic outputs. A ~ indicates that the volume exceeds capacity and the queue length could be much longer than reported. A # indicates that compound queuing may occur over multiple cycles and exceed the reported 95<sup>th</sup> percentile queue length. If the v/c ratio for the movement is less than one, then the reported queue length may be acceptable for design of storage bays. The m indicates traffic is being metered from upstream and could also indicate a volume or signal coding issue.

Queue lengths for through lanes should also be reviewed to ensure that they don't extend beyond the taper of the adjacent turn lanes. If this occurs, engineering judgment should be used to adjust storage lengths accordingly.



**Sample MOE Table**

Intersection No.	Intersection	Approach	Lane Group	Delay (sec)		LOS		95th % Queue	
				AM	PM	AM	PM	AM	PM
1	Lake Boone Trl at Wycliff Rd	<b>Overall</b>		<b>16.6</b>	<b>15.1</b>	<b>B</b>	<b>B</b>		
		Lake Boone Trl Eastbound	LT	40.3	8.8	D	A	#242	38
			TH	2.7	10.4	A	B	52	165
		Lake Boone Trl Westbound	TH	15.3	9.6	B	A	376	156
			RT	11.7	8.8	B	A	m202	60
		Wycliff Rd Southbound	LT	44.4	38.1	D	D	84	#313
RT	24.4		21.2	C	C	122	187		

#### D4.7.3 UNSIGNALIZED INTERSECTIONS (STOP OR YIELD CONTROLLED)

The Control Delay by Lane Group (results shown under the HCM 6th Edition Tab) and their corresponding LOS shall be reported for any individual lane group that has a conflicting movement.

Note there is not an overall LOS for unsignalized intersections in the HCM methodology; therefore, overall Intersection Control Delay or LOS shall not be reported for unsignalized intersections. There is currently no methodology for determining the control delay or LOS for yield-controlled movements (with the exception of roundabouts); therefore, for those in close proximity to signals, they shall be modeled as part of the signal (as noted in the **Intersection Coding** section). For yield-controlled intersections that are not near a signalized intersection, Queue Length shall be reported for each yield-controlled approach with a note that delay and LOS are not reported for yield controlled intersections.

The analyst should review level of service and queuing outputs to determine if turn lanes are required at unsignalized intersections.

Unsignalized Intersections									
Intersection No.	Intersection	Approach	Lane Group	Delay (sec)		LOS		95th % Queue	
				AM	PM	AM	PM	AM	PM
2	Lake Boone Trl at Shopping Center Dwy/Myron Dr	Lake Boone Trl Westbound	LT	10.4	18.3	B	C	16	5
		Myron Dr Northbound	RT	10.5	12.2	B	B	6	23
		Shopping Center Dwy Southbound	RT	18.3	11.9	C	B	57	11

#### D4.7.4 ROUNDABOUTS

The HCM 6<sup>th</sup> Edition detailed report should be used for the approach/lane group LOS and delay which should be documented in the traffic technical memorandum. Queue lengths and v/c ratios should be documented and any movement with a v/c ratio greater than 0.85 should be considered for additional improvements.

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### APPENDIX D5 SIDRA GUIDELINES

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To Be Developed in the Future

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### APPENDIX D6 TRANSMODELER GUIDELINES

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The TransModeler Guidelines for EDTE analysis are generally the same as those used in Prioritization. However, there are a few differences in the process of evaluation between EDTE and SPOT Prioritization. Guidelines that are specific to the EDTE Process are shown in blue, while guidelines specific to SPOT Prioritization are shown in green.

## D6.1 TRANSMODELER DEFAULT PARAMETERS

The default parameters in TransModeler that are to be utilized for the Express Design traffic analyses include the following:

- Project Settings
- Local Loading Parameters/Vehicle Fleet
- Desired Speed Distributions
- Road Class Definitions

A default TransModeler simulation database file was developed that includes the parameters described below.

### D6.1.1 PROJECT SETTINGS

The Project Settings (>Project>Settings) include many of the settings used by TransModeler to configure and run the simulations. In general, many of the default values will be utilized. For purposes of this analysis, the AM peak period will run from 07:45 to 09:00 and the PM peak period will run from 16:45 to 18:00. The simulations will be run from an empty initial state with a 15-minute warm-up period. The “Project and Model Parameters” box should be checked on the Setup tab and the “Model Parameters” on the Parameters tab should reference the NCDOT\_Default\_Parameters\_SPOT\_P7.xml file. The “Output” tab on the project settings dialog box for EDTE should have the following outputs selected:

- Trip Statistics
- Flow & Travel Time (for freeway projects only)
- Delay (with intersection selection set)
- Lane Queue (with intersection selection set)
- Spillback Queue (with intersection selection set)
- Point Sensor Data (for freeway projects only)

The “Output” tab on the project settings dialog box for SPOT should have the following outputs selected:

- Trip Statistics

### D6.1.2 LOCAL LOADING PARAMETERS/VEHICLE FLEET

The distribution of vehicles that is included in the simulation is an important aspect of the analysis. The loading of vehicles based on the facility type in TransModeler will require the use of the local loading parameters. The default TransModeler file includes the distributions, which can be applied under >Demand>Local Loading Parameters>Apply Distributions and requires a new field to be developed in the Node or Centroid layer to assign each of the distributions to the origin points of the model. Please make sure the local loading parameters for Vehicle Classification are applied to the node or centroid layers.

The local loading parameter for each node is to be selected based on the Smooth Urban Boundary shape file (SmoothedUrbanBoundary.shp).

### D6.1.3 DESIRED SPEED DISTRIBUTIONS



The desired speed distributions in TransModeler reflect the reality that not all vehicles travel at the same speed. Therefore, a distribution of speeds is used that reflect the generalized driving conditions across the State. The desired speed distributions that shall be used are included in the default parameters file.

#### **D6.1.4 ROAD CLASS DEFINITIONS**

Each link in TransModeler is to be assigned a road class that distinguishes different types of facilities by basic traffic flow parameters. For this analysis, a new set of road classes has been developed based on the FHWA functional classification of the facility and speed limit. The default file includes the road classes utilized in the analysis along with the desired speed distribution chosen for each road class.

There may be rare instances where there is not a matching facility and speed to what actually exists in the field. In those cases, the modeler may create a new category based on the closest available configuration. For example, if there were a 20 mph arterial in the field, the analyst should create a new facility for a 20 mph arterial based on the 25 mph facility with only the speed changed. The analyst should make the NCDOT Congestion Management Engineer or the designated Program Manager aware of this upon their submittal.

#### **D6.2 TRANSMODELER MODEL DEVELOPMENT**

The models are to be developed based on a consistent methodology. The following sections provide guidance on how the models are to be developed. If there is a situation where the default parameters are not adequate, then the NCDOT Congestion Management Engineer or the designated Program Manager shall be contacted prior to changing any settings. Deviations from the standard settings may be granted on a case-by-case basis if it is deemed necessary to provide reliable results.

The development of models is typically done utilizing aerial imagery for existing conditions models and Google Earth (\*.kmz) for proposed designs.

There are several sources and methods for utilizing aerial imagery in TransModeler, including:

- NC OneMap - high resolution aerial imagery collected on a rotating basis every three years. WebMap layers are available to display the imagery through a network connection without downloading.
- Google Satellite Layer - TransModeler includes commercially available aerial imagery from Google that can be accessed with a network connection.
- Project Specific Aerials or NC OneMap Downloads - If project specific aerials or downloads from NC OneMap are available in a standard imagery format, they shall be attached in a coordinate correct manner.

Multiple imagery sources should be reviewed to determine if there have been any changes to the study area. If there are no recent changes to the study area, then the most convenient imagery source can be used. There can be slight differences in the projection of the aerial imagery, therefore, If the existing model was developed using one of the methods above it should be maintained when updating the model unless the difference are negligible (less than 5 feet difference).

The aerial photography source should be noted when the model is submitted for review. The following minimum lengths should be adhered to in developing the models, with the minimum length being measured from the entry node to the first major node (intersection or ramp junction) within the network:



- Local: 0.2 miles
- Collector: 0.3 miles
- Arterial: 0.3 miles
- Freeway: 0.5 miles (from merge or diverge point)
- Auxiliary Lane Projects: 0.25 miles beyond merge or diverge

The tolerance for these distances is +/- 0.02 of a mile. All external nodes must be the same between the No-Build and Build models with the nodes having a tolerance of +/- 5 feet.

### **D6.2.1 TRANSMODELER FILE NAMING CONVENTIONS**

The model files developed in TransModeler will be utilized for future traffic analysis efforts and need to be developed in a manner that allows them to be easily followed for any future analyst who may need to work with the project. For the development of models, the naming conventions include the use of the Base Year (20XXBY) and Future Year (20XXFY). The following are the required naming conventions for each file:

- In general, each file includes the STIP number (if the project has a STIP ID) or the SPOT ID (as an H followed by a six-digit number value), followed by the scenario (NB for No-Build and B\_Alt\_X for each Build alternative), followed by the analysis year. Additional information for some elements, such as the peak period (AM or PM), may also be added to the file name.
- The directory structure was developed such that the overall STIP number or SPOT ID (with H and six digits) simulation file (.smp) is in the root directory with the support files in individual folders. Both the base year and future year analyses are included in the same simulation file (named with the \_2019 nomenclature) with the project settings being set for each analysis year.
- The output is to be stored in a folder titled "Output," with subfolders for each of the scenarios analyzed for that model.
- The NCDOT SPOT Parameters file is stored in Parameters directory for each of the models

TransModeler models are to be transmitted by utilizing the project archive function in TransModeler (>File >Archive >Archive Project) and the zip file is to be named based on the file naming conventions in Table E1-1.

### **D6.2.2 NODE NUMBERING AND VEHICLE CLASS INPUT**

The nodes in the TransModeler model are to match the nodes in the O-D matrix in the EDTV report for each project. The nodes can be re-numbered by adding a field into the Nodes database with the new IDs input into the new field. The database can then be exported by setting Links as the active layer then using the >Tools>Export function and setting the Node ID Field to the new ID field.

Once the nodes are renumbered to match the O-D matrix, each entry node or centroid connector will be coded with the local loading parameters based on the functional classification and area type. Note that the O-D IDs must match the IDs in the O-D Matrix figure in the EDTV or SVR.

### **D6.2.3 MATRIX DEVELOPMENT**

The matrices for each of the scenarios are defined in TransModeler for each scenario. Two matrices are required for each peak period being modeled. The first matrix is a warmup matrix to input vehicles into



the network prior to collecting output results. The warmup matrix includes a time interval of 15-minutes beginning prior to the peak period, with a matrix unit of hourly rate (set on the Options tab), a time distribution of “constant over time”, generated headway departures by O-D and a random (uniform) departure headway distribution. The volumes for the warmup matrix are to be the same volumes as the peak period matrix but include a unit scaling factor of 0.80. The peak period matrix is to be simulated for one-hour and includes a matrix unit of hourly rate, a time distribution of “curve-based”, generated headway departures by O-D and a random (uniform) departure headway distribution. The curve-based time distributions are to be input to emulate a peak hour factor of 0.90 as included in the following table:

**Curve Based Time Distribution**

AM Peak Period	PM Peak Period	Percentage
8:00-8:15	17:00-17:15	25.0%
8:15-8:30	17:15-17:30	27.8%
8:30-8:45	17:30-17:45	25.0%
8:45-9:00	17:45-18:00	22.2%

#### **D6.2.4 CODING FREEWAY FACILITIES**

The coding of freeway facilities includes utilizing the proper road class in TransModeler. If the proposed project includes upgrading the overall facility to a freeway, then the mainline links are to be coded as freeway links with an appropriate speed limit for the Build scenarios. For projects that include constructing grade separations or interchanges along arterials that are not expected to be fully controlled access, the road class should remain an arterial or collector for the Build scenario. The definition of the Local Loading Parameters for the vehicle fleet shall remain the same for both the No-Build and Build scenarios with the classification being based on the No-Build condition.

Freeways should be coded as one-way facilities; however, if an existing model is being used with updated volumes that has the freeway coded as two-way facility it does not have to be modified to a one-way facility.

The merging of interchange on-ramps include the coding of lane connectivity bias for the lane connectors at the merge point where the acceleration lane ends. The lane connectors for the continuous through lane maintain a connectivity bias of 1.0 while the acceleration lane merge connectors have a connectivity bias of 0.6 for urban areas and 1.0 for rural areas. For multi-lane ramps that drop a lane before entering the freeway, the same method should be used for lane drops with a connectivity bias of 0.6 for urban areas and 1.0 for rural areas. This approach also applies to ramps onto arterials in urban areas where arterials also have interchanges.

For freeway merges and diverges, the guidance included in the *NCDOT Congestion Management Simulation Guidelines- TransModeler* should be used. The models are to be coded such that the lane connectors from the combined link begin (diverge) or end (merge) at the point where the pavement markings on the ramp and freeway intersect. Merge/diverge points that are modeled greater than 25 feet away from where the pavement markings on the ramp and freeway intersect will require revision. For tapered entrances, the combined freeway/acceleration segment should begin where the ramp pavement marking is 4 feet from the mainline through lanes and should end when the width of the acceleration lane drops below 8 feet.



When coding a tapered exit on the freeway, include a deceleration lane that starts where the taper is 8 feet wide, meaning the head of the lane connector arrow should be where the taper is 8 feet wide (yellow arrow below).



When coding a tapered exit on the freeway, after including a deceleration lane that starts where the taper is 8 feet wide, the ramp should diverge from the freeway where the edge of travel lines diverge, meaning that the tail of the lane connector arrows should start at this location (red arrow).



For lane drops, the 8 feet is measured at the beginning (tail) of the lane connector arrow and a lane addition is measured at the end (tip/head) of the arrow. The area covered by two lane connectors is treated as one lane, so the lanes start at the head of the lane connector arrow and drop at the tail of the lane connector arrow. For freeway merges and diverges, lane connectors follow the Simulation Analysis Guidelines Freeway Coding Best Practices. There is no difference for freeway lane drops vs arterial lane drops.

Data point sensors will need to be added to the freeway facilities to collect speed data MOEs. This can be done by using transit routes to place evenly spaced sensors along the length of the freeway. To do this add a transit system (>Route Systems>New Route System) with the default settings. (It is recommended to save the route system in its own folder to keep the folder structure clean; however, it will be removed from the model once the sensors are placed.) Using the Route System Editor (>Route Systems> Route System Editor) add a new route along the full length of each direction of the freeway,



naming each route for the freeway and direction (i.e.: I-85 SB). Add sensors to each route (>Route Systems>Add Sensors on a Route) every 200 feet. The sensors should have a detection zone of 6 feet, be link-wide, and be Point Data collection. Once the sensors have been added be sure to save your project so that the selection sets TransModeler created with the sensors are saved. (Those selection sets will be used to extract the point sensor data after the simulations have been run.) After the sensors have been setup, remove the transit routes from the network by dropping the Route System, Route Stops and Physical Stops layers from the layer manager and unchecking the Transit box on the Setup tab of the project settings.

## D6.2.5 SIGNALIZED INTERSECTION CODING

The process of coding the signalized intersections for Express Design traffic analysis is based on trying to provide results that are reliable but do not require extensive input and optimization by the analyst. Therefore, the following parameters are to be utilized to the greatest extent possible:

- Traffic Actuated controllers shall be utilized for all signalized intersections. All signals should also be set to coordinated with Phases 2+6 being set as the coordinated phases.
- The phasing plan from the NCDOT signal plans is to be used as the basis for the phasing of each signalized intersection. The signal plans should be submitted with the TransModeler models, and all plans should be combined into one file named after the STIP number or SPOT project number, if it has no STIP ID.
- Right turn on red (RTOR) is to be disabled for all movements, unless warranted by unusual circumstances.
- The Phase Transitions are to be set to ring and barrier table and the Main Approach (Phase 2) is to be set to be the major roadway approach in the northbound or eastbound direction, or as defined in the NCDOT signal plan. If a corridor project includes multiple signals that have variations in the direction of Phases 2+6, please coordinate with the NCDOT Congestion Management Engineer or designated Program Manager to determine how to code and coordinate the signals.
- Standard NEMA phase numbering is to be utilized for all signals. Protected plus permitted phases are to be included in the Base Year analysis if they are included in the signal plan.
- Protected-permitted phasing at an intersection in the base year should be changed to protected only phasing in the future year scenarios (NB and Build) if any part of the intersection has proposed design changes in the Build scenario.
- If a protected-permitted intersection is in the study area but outside the limits of the design, then the cross product should be applied to determine if protected phasing is necessary. If the cross-product condition is not met, then the signal should remain protected-permitted.

Number of Opposing Lanes (Through and Right)	Condition
1	Left turn Volume * Opposing Volume > 50,000
2	Left turn Volume * Opposing Volume > 90,000
3 or more	Left turn Volume * Opposing Volume > 110,000



- All signals with existing permitted phasing in the base year should be changed to protected phasing in the future year (NB and Build) if the cross-product rule is met. This applies to all intersections.
- Unsignalized intersections may be signalized in the future year No-Build if warranted. This should be applied on a case-by-case basis and approval should be requested from the Program Manager before any changes are made.
- Coordination of the 2+6 phases is to be used for multiple intersection projects. For all signals, the major street through movements (2+6) are to be set to max recall with the minor street through movements (4+8) set to min recall if they include a through movement that carries the highest volume of traffic for the approach for at least one of the peak hours and no recall if they do not. If Phases 4+8 run concurrently, then both Phase 4 and Phase 8 should be set to min recall if either phase meets the threshold. Left turn phases are to have their recall mode set to none.
- Simultaneous gap out is set to yes for all phases
- The minimum green should be based on NCDOT guidance using the following: 50-55 mph (14 sec), 40-45 mph (12 sec),  $\leq 35$  mph (10 sec) and side streets/lefts (7 sec). If a side street meets the criteria for using min recall, then the minimum green for the side street through movement should be based on the speed limit.
- Extension is to be set to 6 seconds for side street through movements if the through movement carried the highest volume on the approach for at least one of the peak hours, and 3 seconds for low volume minor movements and left turns
- Yellow Change Interval is to be set to 5 seconds, Red Clearance is to be set to 2 seconds, and Lost Time is to be set to 5 seconds
- Initially, the maximum green should be set to the value included in the signal plans but will be updated during optimization.
- Added Initial should be set at 2 seconds.
- Max Initial should be set at 15 seconds to start with and adjusted when needed so that it is not greater than the Split – Yellow & Red Clearance.
- Time before reduction should be set at 15 seconds.
- Reduce by/Every should be set at 0.5 seconds/5 seconds.
- Min Gap should be set at 3 seconds.
- The split timings and maximum split timings should be input initially as the maximum green + Yellow + Red Clearance Time.
- Optimization Min Green should be set to 7 seconds and modified to match the Min Green defined above.
- The TransModeler Default Detector Template (located as the second tab on the Intersection Toolbox Configuration dialog box) are to include all detectors being set to presence and are to be setup as follows and utilized for placing the detectors in the models:
  - 6-foot by 40-foot sensor for all exclusive left, through/shared and exclusive right turn movements, located at the stop bar and set to both call and extend the phase with a sensor type of presence



- 6-foot by 6-foot sensor for all through/shared movements located 300 feet upstream of the stop bar and set to both call and extend the phase with a sensor type of presence
- Once the sensors are added (using the Add and Assign Detectors tool) the analyst should remove (using the “Delete a Sensor Station” tool on the Roadway Editor toolbox) the following detectors:
  - Major street (phases 2+6) through and shared through/right 6-foot by 40-foot sensors at the stop bar.
  - Minor street (phases 4+8) through and shared through/right 6-foot by 6-foot sensors located 300 feet upstream of stop bar.
- Detectors placed more than 5 feet from the 300-foot location (<295’ or >305’) will require revision.
- The assignment of detectors is to be done using the Add and Assign Detectors. The detectors settings should not be modified from those assigned even if the signal plan includes different settings without approval of the NCDOT Congestion Management Engineer or designated Program Manager. (i.e. Overlapped right turns should not have detectors calling the left turn.)
- The ring and barrier table is to be setup based on the signal plans for the intersection.
- Separate signal plans are to be established for both the AM and PM peak periods with the start times being set to 0:00 for AM peak and 12:00 for PM peak.
- Overlap phases are to be coded as protected – not as overlap phases.
- Coordinate Beginning of Green
- Use “by phase” for coordinated yield point.
- If the “based on” box is checked, TM will not optimize phase order. The “based on” box should only be checked if you are not optimizing phase order or using it to get the inputs that do not change into the timing plan but remove for optimization.
- If you have a signal leg with no volumes, the minimum green with min recall are to be used for that leg.
- For flashing yellow arrow running protected + permitted, the permitted left turn should be coded as a permitted green with the opposing through movement.

#### **D6.2.6 SIGNAL OPTIMIZATION**

The optimization of signals in TransModeler is to be completed in two different manners depending on the number of signals being analyzed. If the signal is an isolated signal, (not coordinated with another signal) then the Optimize Signal Timings feature under the Phase Tab of the Intersection Control Editor shall be utilized with Webster’s Method selected and the minimum and maximum cycle lengths set based on the NCDOT guidelines {60 second (2 phase), 90 second (3 phase) and 120 second (4 or more phases) cycle lengths as a minimum and a 180 second cycle length as a maximum}. The number of phases is based on the signal plans phasing diagram number of phases, not the number of phases that are running in the model. The optimization is to be based off of the turning movement volumes provided in the EDTV report. The turning movement volumes are to be input into a single turning movement file (\_TMC.bin) for each of the scenarios. There is no need to code warm-up period turning movement volumes as they are not utilized.

For projects with multiple signalized intersections, the simulation-based signal optimization tool in TransModeler is to be utilized. Once the multi-signal corridor is selected the optimization shall be



completed by setting a warmup period of 5 minutes and evaluation start and finish time for 8:00-8:50 for the AM peak and 17:00-17:50 for the PM peak. The cycle length is to be optimized with the minimum and maximum cycle lengths set based on the NCDOT guidelines, using the following MOE weighting Control delay=1, Queue Length=0.5, Arrival on Green=5 and Stops=0.25. The default settings for Offset optimization shall also be utilized (Stage 1 – step size=5 seconds, number of steps=6, number of iterations=3 and Stage II – step size=1 second, number of steps=5, number of iterations=6). For corridors along one-way links, the optimization should be done to match the peak directions for each scenario being optimized. For corridors with two-way links the optimization should optimize signal timings for Both Directions.

The optimized cycle length should be rounded to the nearest 10 seconds and splits rounded to the nearest 1 second. For intersections where it was obvious that the phasing should be modified based on the O-D volumes, the analyst may make modifications if approved by the Congestion Management Section Engineer (or their designee). For the Future Year No-Build and Build scenarios, engineering judgment should be utilized to determine the most likely phasing plan based on the O-D volumes.

The optimization of signals in TransModeler should be utilized as a starting point, and the signals can be tweaked to improve the operations and make sure the corridors are operating realistically. Timings should be modified to avoid queuing beyond the limits of the network while other movements are operating acceptably.

The optimization of signals in TransModeler should be used without modification unless there are approaches to the network that are queuing beyond the limits of the network while other movements are operating acceptably. If this scenario occurs the analyst may tweak the signal timings to improve the operations, but this must be noted in the submittal to the Program Manager for review.

#### **D6.2.7 RUN CONTROLS AND OUTPUT**

Each scenario will be simulated for 1 hour and 15-minutes (including warm-up period) with the AM peak running from 07:45 to 09:00 and the PM peak running from 16:45 to 18:00. The models will be run for 10 separate random seeds (RS #5, 10, 15, 20, 25, 30, 35, 40, 45 and 50). Outputs will be extracted for a 1-hour period for both the AM and PM peak simulations.

The output for each model run will include the following:

- Network MOEs
  - Vehicle Hours Traveled (VHT)
- Intersection MOEs
  - Delay and LOS by Intersection for signalized intersections
  - Delay and LOS by Lane Group for signalized and stop-controlled intersections
  - 95<sup>th</sup> percentile Queue Length by Lane Group for all intersections
  - Maximum Spillback Queue by Approach for all intersections
- Freeway MOEs
  - Density and LOS by analysis segment
- Point Sensor Data
  - Freeway Speed Heat Maps

The VHT outputs will be run using the SPOT macro. The intersection and freeway MOEs will be run using the NCTransModelerHelper macro and will utilize the NCDOT TransModeler MOE Spreadsheet provided in the NCDOT Traffic Engineering Suite ([Available here and provides instructional videos](#)). The point



sensor data will be extracted using the Output Manager and will be extracted for 5 min intervals for each selection set (each direction of the freeway).

The NCTransModelerHelper macro resource will produce intersection MOEs that will automatically populate the MOE spreadsheet with intersection and approach names. Therefore, all links shall be named before running the models for outputs. The macro, "First," in the helper resource will create new fields in the Nodes layer to label the major and minor road of each intersection, which will be used to name each intersection in the MOE tables. This macro will also create the Sort Order field that will be used to determine the order of the intersections in MOE table.

### **D6.3 ADDITIONAL CODING GUIDANCE**

The following additional items shall be adhered to in the development of the models:

- If designs are available, the models should be coded based on those designs. If changes need to be made to accommodate the traffic, the analyst should coordinate with the design firm and the NCDOT Congestion Management Engineer or designated Program Manager.
- All lane widths are coded as 12 feet.
- School speed limits should not be modeled.
- When coding a CFI, the speeds do not need to be adjusted for turn lanes. They will stay the same speed as the link from which they originate.
- When coding quadrant facilities, the default quadrant speed limit should be 35 mph.
- When a lane is added or dropped, it should be coded such that the link (or segment) begins/ends where the lane reaches approximately eight feet in width with the remainder length being coded as a taper. The lanes should be modeled such that they represent the storage available and do not necessarily have to match the pavement in the aerial photography. Tapers that begin or end where the lane width is greater than 10 feet or less than 6 feet will require revision.
- For two-lane roads widened to four-lane roads for superstreets, there has been discussion if and where to taper back down to a two-lane facility after the U-turn. Until further notice, the facilities should be tapered back to existing conditions approximately 600 feet beyond the U-turn.
- For intersections that are converted to interchanges, assume the link entry distance is added for new interchanges. Only upgrade the facility to a freeway if that facility is planned to be converted to a freeway. Assume 1,600 feet for the ramp distance and add 0.5 miles for entry distance for total of 0.8 miles on each side of intersection. We do not modify the percent trucks between the Build and No-Build scenarios (local loading parameters).
- For one lane approaches wide enough for two-lanes, only use what laneage is striped when coding that approach.
- Be sure and check that lane alignments are correctly assigned for movements, including lane additions.
- When coding intersections, lane connectors for each movement should be coded to connect to all receiving lanes that are likely to be utilized under real world conditions. For example,



connect U-turns to all receiving lanes but for diamond interchanges, do not connect the through lane from the off-ramp to the on-ramp.

- All newly coded arterial corridors should be coded as two-way links unless approved by NCDOT Congestion Management Engineer or designated Program Manager. Note, when superstreet corridors are included in the build design, the Build links should be separated into one-way links.
- Where there is a change in the number of lanes due to a facility that is not being modeled, the analyst should review the volumes and determine the most appropriate way to model the change. If the volume in the lane that is being dropped is substantial enough to cause unrealistic operations, then it should be extended or carried to the end of the network such that it produces realistic operations.
- The length of lane connectors should be minimized to the greatest extent possible; however, they should still allow for the smooth flow of traffic within the simulation. While there are no firm requirements, it is recommended that lane connectors connecting segments with the same number of lanes be about five feet in length, while those connecting an unequal number of lanes (lane drop/lane add) be approximately 25 feet in length, with slightly longer lengths (up to 40 feet) on freeways. The lane connector lengths should be consistent throughout the development of the models.
- When coding intersections, the coding of turn lanes should generally match the existing geometry and paint striping, including the addition of a lane prohibition (shown as a solid white line) between the through lanes and the turn lane.
- For the modeling of existing intersections that have stop bars that are staggered along an approach, the end of the link should be coded at the stop bar that is located furthest from the center of the intersection. The Drag Stop Bar tool should then be used to move the stop bars forward to the location of the stop bar for each lane that extends beyond the end of the link. However, for signalized intersections, if the difference between the stop bars exceeds 15 feet, then only place the end of the link 15 feet from the stop bar for the through movements as we want to avoid vehicles stopping between the end of the link and stop bar that are not triggering the detector. The link can also have a bend added and be rotated; however, caution should be used when doing this as it can result in odd lane connector paths through the intersection. If an intersection does not have stop bars, they should be placed at a location that as close to the intersection as would be reasonable. Also, the length of lane connectors should be minimized at intersections and the outbound link of an intersection does not have to start at the same location as the inbound link if the facility is divided.
- Channelized right turn lanes at signals shall be modeled as part of the same link as the through traffic and included in the main intersection node unless there is a lane addition on the receiving approach. This requirement includes yield controlled movements that do not result in a lane addition downstream. For yield controlled movements, Right Turn on Red (RTOR) should be used for the right turns to emulate the yield controlled conditions for all phases; however, if there is a protected left turn phase for the corresponding movement the right turn phase is to be coded as a protected green phase.
  - For unsignalized intersections, the yield movements may be modeled as they operate in the field.
- If there is a stop sign controlled approach at a signalized intersection, this leg should be modeled as a flashing red arrow. For isolated signals using Webster's Equation for optimization



the approach should be temporarily set to permitted green during optimization and then reverted back to a stop sign.

- Yield points should be set 1 to 5 feet from the stop bar for permitted lefts.
- The modeling of offset left turns (those with the left turn separated from the adjacent through lanes to improve sight distance at the intersection) should be treated in a similar manner and modeled as part of the same link as the adjacent through lanes. If the offset left turn is more than 16 feet away from the nearest through lane, then the analyst may choose to create a separate link for the left turn lane, if they feel it will produce more realistic operations.
- If a roadway has a median width greater than 50 feet, unsignalized intersections should be modeled as a two-stage crossing with nodes being located on each side of the median and a separate link representing the median refuge area between them. If the median is 24-50 feet in width the intersection should be coded in the same manner; however, the intersections should be coded with a minimum link length of 48 feet by moving the intersection nodes out slightly to accommodate truck storage within the median link. For median widths less than 24 feet, it should be coded as a single intersection node and vehicles must clear both directions of traffic in a single movement to make a left turn. If a median width is expanded for intersections with 24-50 foot widths in the No-Build scenario it should be brought back to the original width if the proposed project removes the unsignalized narrow median concept (such as with a signal, roundabout, superstreet, etc.).
- For superstreet intersections where no designs have been completed, the analyst shall review the proposed volumes and develop the design to appropriately accommodate the traffic volumes. The following should be included for superstreet designs:
  - The U-turn lanes should be coded approximately 800 feet from the main intersection (unless directed otherwise by the NCDOT Congestion Management Engineer or designated Program Manager) with deceleration lengths long enough to provide transition from mainline speeds onto the U-turn lanes. The combined link (mainline and deceleration lane) should continue until approximately 100 feet upstream of the U-turn location before separating into separate links.
  - Likewise, direct left turns at the main intersection should be designed to provide adequate transitions and the combined segment should continue until approximately 150 feet upstream of the left turn movement before splitting.
  - For heavy right turn movements from a side street, consideration should be given to extending the U-turn lanes back to the main intersection and having traffic load directly to the U-turn lanes(s). This greatly improves the capacity of the side street traffic for heavy re-directed left turn movements
  - Both the No-Build and Build networks should have the limits on the superstreet corridor extended an additional 0.15 mile past the required distance discussed in Section 0
- For proposed roundabouts where no designs have been completed, any movements requiring slip lanes should first be modeled as an additional lane within the roundabout. If the operations of this configuration are not adequate, please coordinate with the NCDOT Congestion Management Engineer or designated Program Manager to determine if modeling separated slip lanes is appropriate. In general, the inscribed diameter for single lane roundabouts should be 120 feet and multi-lane roundabouts should be 150 feet unless modified during scoping or



through coordination with the NCDOT Congestion Management Engineer or designated Program Manager.

- Mini roundabouts will be modeled as a typical one-lane roundabout with an 80-foot inscribed diameter unless there are issues with trucks traversing the roundabouts as they would a typical roundabout.
- For DDI signal timing, the clearance time for the short segments between the main intersection and the ramp signal should be added to the red clearance time for mainline phases. For example, if based on the simulation, 4 seconds of clearance is needed, the red clearance time should be 6 seconds for the through phases at the cross over intersection (4 second clearance + 2 second all-red). DDI should also have max recall set only for the peak direction. (Setting both directions with max recall essentially creates a pretimed signal.)

ID	2	4	6	7
Min Green	12	7	12	7
Max Green				
Yellow	5	5	5	5
Red Clearance	6	2	6	2
Lost Time	5	5	5	5
Recall Mode	Max	None	None	None
Detectors	9,10; 9,10	2,1; 2,1	14,13,28; 14,13,28	15; 15
Memory Mode		NL	NL	NL
Extension		3	3	3
Simultaneous Gap O...	Yes	Yes	Yes	Yes
Added Initial		2	2	2
Max Initial		15	15	15
Time before Reducti...				
Reduce by / Every				
Min Gap		3	3	3

## D6.4 RAMP METERING PARAMETERS AND SETUP

### Ramp Meter Setup –>

- Freeway sensors placed 400' upstream of gore<sup>1</sup>
- Ramp meter placed 350' upstream of gore<sup>2</sup>
- Check-in detector placed 3' upstream of ramp meter<sup>1</sup>
- Check-out detector placed 10' downstream of ramp meter<sup>2</sup>
- Queue detector placed at a minimum of 300' from ramp meter. Queue detector should be located based on the volumes in order to maximize operations. <sup>2,3</sup>
- Control type – Local feedback, closed loop
  - Target Occupancy set at 60%
  - Release set as single
- Acceleration lane extended to meet minimum requirements<sup>1</sup>
  - 1620' for 70 mph design speed (from meter to lane drop)
  - 1790' for 75 mph design speed (from meter to lane drop)
- Lane connectivity bias at acceleration lane drop set at 0.8<sup>3</sup>
- If the ramp has a lane drop on it, the lane connectivity bias for the lane drop set at 0.8<sup>3</sup>

### Parameters-> Traffic Control Defaults-><sup>3</sup>



- Update step size – 30 sec
- Minimum red time – 1.5 sec
- Queue occupancy – 25%
- Minimum single vehicle metering rate – 1200 vph
- Maximum single vehicle metering rate – 1800 vph
- Demand red – 2.0 secs for 2-lane ramp/1.0 sec for 1-lane ramp

<sup>1</sup>Parameters based on *M-0446 Ramp Metering Feasibility Study for Durham and Wake Counties – Typical Design Criteria* (Atkins, March 2013).

<sup>2</sup>Parameters developed with the Typical Design Criteria as a starting point, then adjusted based on the operations during the simulation.

<sup>3</sup>Parameters based on guidance from Caliper.

## **D6.5 SUMMARY REPORT**

### **D6.5.1 SUMMARY AND MOE TABLES**

The summary should include a description of all build alternatives analyzed and operations notes for each alternative. The intersection and freeway MOE tables should be reported for the base year no-build, future year no-build and future year build alternatives.

The intersection and freeway outputs (automatically created by the helper macro) shall be copied into the MOE spreadsheet on the appropriate tab. The table on the Delay\_LOS tab should be cleaned up so that empty rows are hidden (not deleted).

Freeway speed heat maps should also be included with the summary report. Freeway point sensor data shall be copied into the heat map spreadsheet in the appropriate tab. The scale of the speeds should be adjusted so that speed limit is the high value and the low value is based on operations of the facility.

### **D6.5.2 TRAVEL TIME SAVINGS SUMMARY SHEETS**

The VHT output shall be copied to the TTS Summary sheet. The output will be run by the Program Manager as a check and any discrepancies greater than one percent will require re-running the models until the results are replicated between the analyst and the Program Manager. The level of detail in the No-Build and Build images should be at a level that the difference between the No-Build and Build design are readily discernable. Use of insets and blow-ups of portions of the network are encouraged. When developing the images please remove all labels, selections sets, and highlighting from the model as they frequently obstruct the details that differentiate the alternatives.

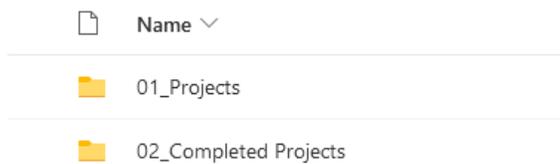


# Appendix E: Express Design Traffic Evaluation (EDTE) Data Management Procedures

## APPENDIX E I EDTE SHAREPOINT FOLDER STRUCTURE/FILE NAMING PROCEDURES

The EDTE SharePoint Site ([Link to EDTE SharePoint](#)) is used during the development of an EDTE and the final deliverables are then copied to the Express Design or Preconstruction SharePoint site. The EDTE SharePoint site requires each user to request access to the site. To request access the user can select the link on the left side of the main Express Design SharePoint site or through the following [Link to Request Access to EDTE Site](#). Once the online form is completed it typically takes one business day for NCDOT staff to be approved and three business days for PEFs to be approved and added to the site. An email will be sent with an invitation to the site.

On the EDTE Site each PEF will have two folders:



Active projects will utilize the 01\_Projects folder and once a project has been completed it is moved to 02\_Completed Projects folder. Each Project folder has a 01\_Draft and 02\_Final folder with the following folder structure:

00_EDTE Tool	00_EDTE Tool – The EDTE Tool folder includes the EDTE Tool (in Excel format) that is used throughout the development of the EDTE and SPOT procedures. The EDTE Tool should not be included in the individual folders used throughout the analysis.
01_EDTE Scoping	01_Scoping – The scoping folder includes the final scoping document and video of the scoping meeting. The final scope should be a .pdf of the Scoping Template.
02_Counts	02_Counts – The counts folder includes individual folders for each count location that match the count tab in the EDTE tool. The counts will typically include a .pdf of the count data and an Excel file. If an existing traffic forecast is available, it will be included in the 00_Traffic Forecast folder. If a project specific travel demand model run is required, then it will be added into the 00_TDM folder. Any StreetLight Data used for advanced volume development is included in the 00_StreetLight folder.
03_EDTV	03_EDTV – The EDTV folder includes the Final EDTV document in .pdf format.
04_Design	04_Design – The Design folder includes any design data available for the project and should include the design in .pdf format, MicroStation (.dgn) format and Google Earth (.kmz) format.
05_Signal Plans	05_Signal Plans – The Signal Plans folder includes any existing signal plans or plans for committed or proposed projects. Only the general signal plan sheet is needed, and the electrical drawings should not be uploaded to the site.
06_EDTE Analysis Files	06_Analysis Files – The Analysis Files folder includes all of the digital files used to complete the analysis and typically includes the Synchro file or TransModeler archive file. Do not include SimTraffic history files or non-archived TransModeler files in this folder.
07_MOE Files	
08_Documentation	
09_EDTA	
10_EDTE Deliverables	
11_SPOT Scoping	
12_SVR	
13_STTS Analysis Files	
14_STTS Report	
15_SPOT Deliverables	



07\_MOE Files – The MOE Files folder includes the digital files (typically in Excel) of the Measures of Effectiveness that are used in the analysis.

08\_Documentation – The Documentation folder includes the digital files (typically in Word) utilized to develop the report documentation.

09\_EDTA – The EDTA folder includes the Final EDTA Report in .pdf format and is sealed by the Engineer of Record for the project.

10\_EDTE Deliverables – The EDTE Deliverables folder includes a .zip file of folders 00 through 09 except for the Scoping Meeting Video or any other videos.

11\_SPOT Scoping – The SPOT scoping folder includes the final scoping document and video of the scoping meeting. The final scope should be a pdf of the Scoping Template.

12\_SVR – The SVR folder includes the Final SPOT Volume Report document in .pdf format.

13\_STTS Analysis Files – The Analysis Files folder includes the TransModeler archive files. Do not include non-archived TransModeler files in this folder.

14\_STTS Report – The EDTA folder includes the Final SPOT TTS Report in .pdf format and is not required to be sealed.

15\_SPOT Deliverables – The SPOT Deliverables folder includes a .zip file of folders 00 and 11 through 14 except for the Scoping Meeting Video or any other videos.

Once the project is completed the following information is uploaded to the Express Design and/or Preconstruction Site:

- For EDTE
  - Express Design Traffic Volume (EDTV) Report
  - Express Design Traffic Analysis (EDTA) Report
  - Digital Archive of Project Files (Folders 00-09)
- For SPOT
  - SPOT Volume Report (SVR)
  - SPOT TTS Report
  - Digital Archive of Project Files (Folders 00, 11-14)

The file naming procedure is essential to keeping the files well organized and being able to identify and find files easily. Table E1-1 includes the file naming conventions that should be used for all files on the EDTE SharePoint site.



**Table E1-1: File Naming Conventions**

File Naming Convention	Typical Extension	Description
<b>00_EDTE Tool</b>		
STIP_SPOT - EDTE Tool	.xlsx, .xlsb	EDTE Tool Spreadsheet
<b>01_EDTE Scoping_Coordination</b>		
STIP_SPOT - EDTE Scoping Workday Estimate	.pdf	Scoping Cost Estimate Sheet
STIP_SPOT - EDTE Scoping Meeting mm-dd-yyyy	.mp4	Scoping Meeting Video
<b>02_Counts</b>		
STIP_SPOT_##	.xls	TMC Count (## = intersection)
<b>03_EDTV</b>		
STIP_SPOT - EDTV Report - mm-dd-yyyy	.pdf	EDTV Report
<b>04_Design</b>		
<i>Separate folder for each Alternative that matches naming convention in scope</i>		
<b>05_Signal Plans</b>		
STIP_SPOT - Signal Plans	.pdf	Signal Plans in combined single PDF in order of Intersection ID
<b>06_EDTE Analysis Files</b>		
STIP_SPOT_Scenario_Analysis Year_Alternative (if Build)	.syn, .zip, .sip9	Software Analysis Files (include date in filename during Draft stage)
<b>07_MOE Files</b>		
STIP_SPOT_Scenario_Analysis Year_Alternative (if Build)_MOE Type	.xlsx	MOE Output Files MOE Type: Int=Intersection; Fwy=Freeway; Speed=Speed Heat Map
<b>08_Documentation</b>		
STIP_SPOT_EDTA Report	.docx	EDTA Report document
<b>09_EDTA</b>		
STIP_SPOT - EDTA Report - mm-dd-yyyy	.pdf	EDTA Report
<b>10_EDTE Deliverables</b>		
STIP_SPOT - EDTE Digital Files	.zip	EDTE Digital Files (Folders 0-9 except for videos)
STIP_SPOT - EDTV Report - mm-dd-yyyy	.pdf	EDTV Report
STIP_SPOT - EDTA Report - mm-dd-yyyy	.pdf	EDTA Report
<b>11_SPOT Scoping_Coordination</b>		
STIP_SPOT - SPOT Scoping Cost Estimate	.pdf	Scoping Cost Estimate Sheet
STIP_SPOT - SPOT Scoping Meeting	.mp4	Scoping Meeting Video
<b>12_SVR</b>		
STIP_SPOT - SPOT Volume Report - mm-dd-yyyy	.pdf	SPOT Volume Report
<b>13_STTS Analysis Files</b>		
STIP_SPOT_Scenario_Analysis Year_Alternative (if Build)	.zip	Software Analysis Files (include date in filename during Draft stage)
<b>14_STTS Report</b>		
STIP_SPOT - SPOT TTS Report - mm-dd-yyyy	.pdf	SPOT Travel Time Savings Report
<b>15_SPOT Deliverables</b>		
STIP_SPOT - SPOT Digital Files	.zip	SPOT Digital Files (Folders 0, 11-14 except for videos)
STIP_SPOT - SPOT Volume Report - mm-dd-yyyy	.pdf	SPOT Volume Report
STIP_SPOT - SPOT TTS Report - mm-dd-yyyy	.pdf	SPOT Travel Time Savings Report



## APPENDIX E2 EXPRESS DESIGN SHAREPOINT UPLOAD INSTRUCTIONS

The EDTE Deliverables should be uploaded to both the Express Design SharePoint and Preconstruction SharePoint sites if they both exist.

1. Go to the NCDOT Connect Scoping Site: <https://connect.ncdot.gov/site/scoping/default.aspx>
2. Select the Division of the project and then find the project in the list and click on link. The search bar at the top doesn't seem to have all the projects, so you will need to scroll down to find your project from the list.

Conceptual Express Design content for NCDOT projects in early stages. Older Scoping content is also located on this site. Going forward, projects can use the Project Scoping library in Preconstruction.

**Find a Project**

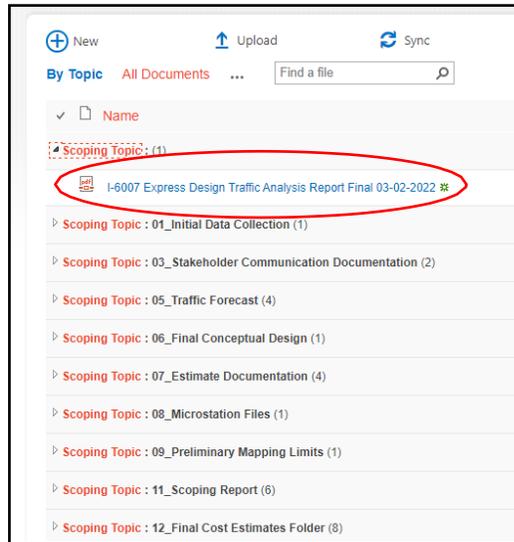
**Project Libraries**

Active Inactive Completed

Please click on the Division tabs below to view the projects.

Project Sites	H000099 H000099: 2021 STIP Costs Update Exercise
	B141188 EB-5718: Western Boulevard Bike/Pedestrian Tunnel
Division 01	ECM: April Subsite Test
Division 02	H090154 R-2587: US 158
Division 03	H090195D R-2814D: SR 1103 (FLAT ROCK CHURCH ROAD / CLIFTON POND ROAD) TO SR 1700 (FOX PARK ROAD) SOUTH OF LOUISBURG
Division 04	H090247 R-3608: US 401/NC 39
Division 05	H090368B U-6067: I-40/US 15-501 Interchange Improvements
Division 06	H090373BB U-2901B: NC 55 (Williams Street)
Division 07	H090377 U-2918: Widen Westgate Road
Division 08	H090575A: NC 54 Superstreet Part A
Division 09	H090575B: NC 54 Superstreet
Division 10	H090577 U-5891: NC 50 Widening to Multi-Lanes
Division 11	H090908 U-5889: SR 1115 (Avent Ferry Road)
Division 12	H110996: NC 98 Upgrade
Division 13	H110997 U-5934: Widen NC 147
Division 14	H110998 I-5704: I-40/US 64
	H111011: NC 751 (Hope Valley Road)
	H111012: NC55 new interchange
	H111013B I-5702B: I-40 Managed Lanes
	H111019 S05002: Widen NC 50
	H111019A: NC 50
	H111019B: NC 50
	H111022C U-6066: US 1
	H111053 U-6024: US 401/NC 39

3. Drag and drop the files and they will automatically upload. The uploaded files will show up at the top of the list with a green asterisk.



- Click on the uploaded file and then the 3 dots to the right. A menu will open, then click on the 3 dots that says More Actions. A drop down will appear and click on Properties.



- Click the drop down under Scoping Topic and select 05\_Traffic. The file will now show up in that folder. Please note that 05\_Traffic may not show up on the project home page initially; however, once you select it under Scoping topic, the folder will be created and include the uploaded file.

## APPENDIX E3 PRECONSTRUCTION SHAREPOINT UPLOAD INSTRUCTIONS

The EDTE Deliverables should be uploaded to both the Express Design SharePoint and Preconstruction SharePoint sites if they both exist.

- Go to the NCDOT Connect Preconstruction Site:  
<https://connect.ncdot.gov/site/preconstruction/Pages/Default.aspx>
- Select the Division of the project and then find the project in the list and click on link. The search bar at the top doesn't seem to have all the projects, so you will need to scroll down to find your project from the list.



Conceptual Express Design content for NCDOT projects in early stages. Older Scoping content is also located on this site. Going forward, projects can use the Project Scoping library in Preconstruction.

**Find a Project**

**Project Libraries**

**Active** [Inactive](#) [Completed](#)

Please click on the Division tabs below to view the projects.

Project Sites	H00099 H00099: 2021 STIP Costs Update Exercise
Division 01	B141108 EB-5718: Western Boulevard Bike/Pedestrian Tunnel
Division 02	ECM: April Subsite Test
Division 03	H090154 R-2587: US 158
Division 04	H090195D R-2814D: SR 1103 (FLAT ROCK CHURCH ROAD / CLIFTON POND ROAD) TO SR 1700 (FOX PARK ROAD) SOUTH OF LOUISBURG
<b>Division 05</b>	H090247 R-3608: US 401/NC 39
Division 06	H090366B U-6067: I-40/US 15-501 Interchange Improvements
Division 07	H090373BB U-2901B: NC 55 (Williams Street)
Division 08	H090377 U-2918: Widen Westgate Road
Division 09	H090575A: NC 54 Superstreet Part A
Division 10	H090575B: NC 54 Superstreet
Division 11	H090577 U-5891: NC 50 Widening to Multi-Lanes
Division 12	H090908 U-5889: SR 1115 (Avent Ferry Road)
Division 13	H110996: NC 98 Upgrade
Division 14	H110997 U-5934: Widen NC 147
	H110998 I-5704: I-40/US 64
	H111011: NC 751 (Hope Valley Road)
	H111012: NC55 new interchange
	H111013B I-5702B: I-40 Managed Lanes
	H111019 S05002: Widen NC 50
	H111019A: NC 50
	H111019B: NC 50
	H111022C U-6066: US 1
	H111053 U-6024: US 401/NC 39

3. Click on Disciplines and select Congestion Management:

**Preconstruction Home**

**Precon Dashboard**

**Project Site**

- Change Report
- Recently Modified
- Key Documents
- Project Contacts
- Email Project Contacts
- Project Info U-5940
- Project Structures

**Project Management**

- Project Schedule

**Precon Tools**

- Pay Items & Quantities
- Project Commitments
- Submittal Tracker
- Avoidance and Minimization Tracker

**Processing Requests**

- Grant Consulting Firm Access
- Grant Municipality Access
- Lock/Unlock Projects

**NOTICE:** All libraries will be locked approximately 7 weeks prior to letting to ensure there are no changes during plan checking and finalization. Please make sure everything is uploaded and marked before locking. This includes final sealed plans, final sealed special provisions, labeling key documents, etc. For any changes or additions needed after this date, please contact the Contract Office for central let projects [finalplans@ncdot.gov](mailto:finalplans@ncdot.gov), or the Division PM for division let projects.

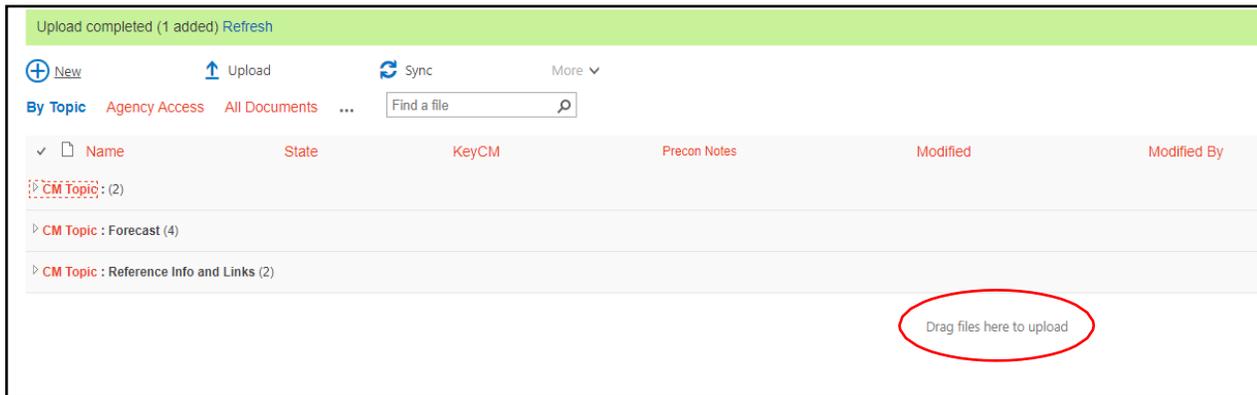
**General**

**Disciplines**

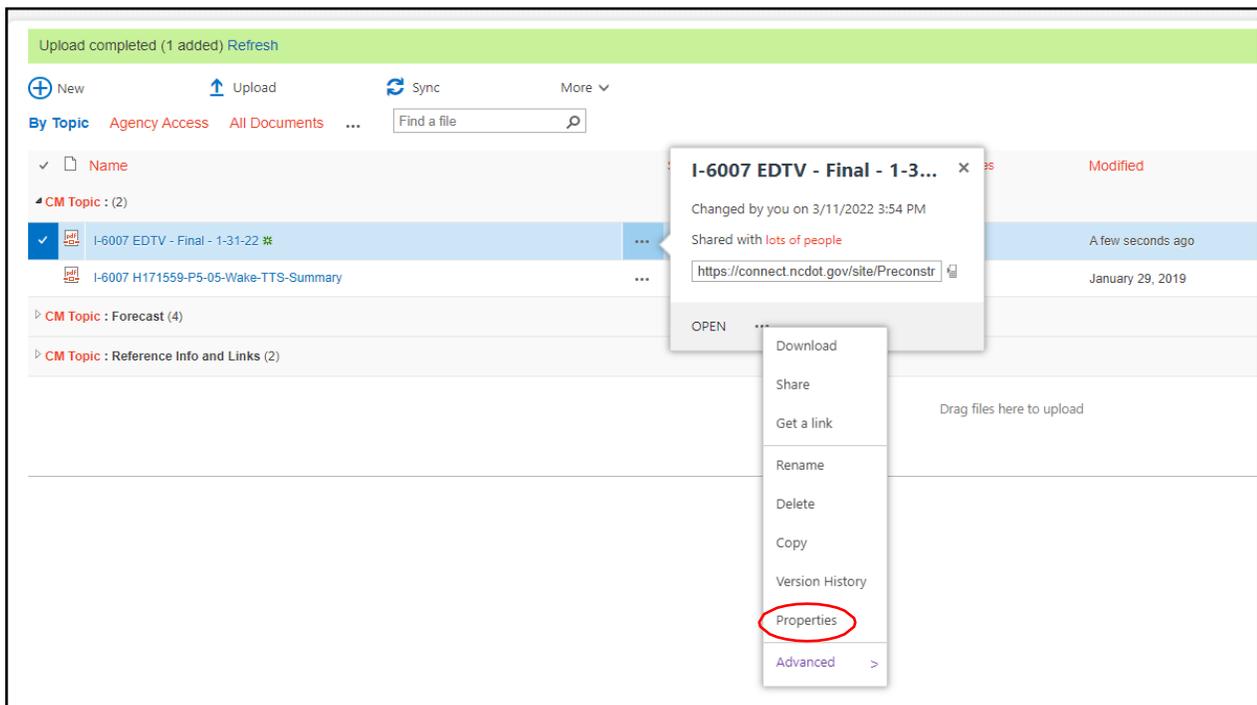
- ATLAS Deliverables (1)
- Congestion Management (1)**
- Erosion Control (0)
- Geoenvironmental (1)
- Geotechnical (0)
- Human Environment (2)
- Hydraulics (1)
- Intelligent Traffic Systems and Signals (0)
- Location and Surveys (4)
- Natural Environment (4)
- Project Management (2)
- Project Scoping (0)
- Rail (0)
- Right of Way (2)
- Roadway Design (7)
- Signaling and Delineation (0)
- Structures Design (0)
- Traffic Safety (0)
- Traffic Systems Operations (0)
- Utilities (0)
- Value Management (0)
- Work Zone Traffic Control (0)



4. Drag and drop the files and they will automatically upload. The uploaded file will show up at the top of the list with a green asterisk.



5. Click on the uploaded file and then the 3 dots to the right. A menu will open, then click on the 3 dots that says More Actions. A drop down will appear and click on Properties.



6. Fill in the requested information for Title and for CM Topic, select Studies. The other information can be left blank. Hit save and the file will now be in the Studies folder.



Content Type    
Create a new Congestion Management Document

Name \* .pdf

Title

CM Topic    
Folder-like grouping to organize working files

State

KeyCM    
Use this to identify key project documents for later reference. Not all choices will be used in every project. Leave blank if this is not a key document.

Agency Access    
Choose Yes for Agency Access ONLY if this document is in a final form and should be copied to the External Collaboration library where external agencies and planning organizations can access. Any updates to the document should be made in the discipline library which will then be synched with the External Collaboration library.

Precon Notes

Version: 0.1  
Created at 11/18/2021 8:59 AM by



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# Appendix F Express Design Traffic Evaluation (EDTE) Closeout Procedures

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## APPENDIX F1 EXPRESS DESIGN CONTACT LIST

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*The Express Design Contact List is located in the Help Section of the Scoping Connect site([Link to Express Design Contact List](#)).*

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## APPENDIX F2 EDTE CLOSEOUT MEETING REQUEST EMAIL TEMPLATE

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### EMAIL SUBJECT LINE: STIP ID (SPOT ID) – County - Express Design Traffic Evaluation (EDTE) Closeout Meeting Request

The NCDOT Feasibility Study Unit has developed a process for estimating future traffic volumes and analyzing the design year traffic operations for Express Design Projects. This process, known as the Express Design Traffic Evaluation (EDTE), is being implemented to determine if the proposed design will operate acceptably based on the project’s goals and the stated need for the project. The Express Design Traffic Evaluation (EDTE) is developed in two phases – the Express Design Traffic Volumes (EDTV) and the Express Design Traffic Analysis (EDTA).

The Express Design Traffic Volume (EDTV) task includes the development of the volume data required to complete the Express Design Traffic Analysis (EDTA) and includes estimates of the current traffic volumes and design year traffic volumes for the proposed project. The EDTV includes estimates of the Average Annual Daily Traffic (AADT) and peak hour traffic volumes for the project study area. The deliverable for the process includes the development of the EDTV Report.

The Express Design Traffic Analysis (EDTA) task includes the evaluation of the traffic operations for the proposed project at a level commensurate with the complexity of the project. The EDTA typically includes an evaluation of the Base Year and Design Year No-Build conditions and an analysis of the Design Year Build scenario for each Alternative. The deliverable for the process includes the EDTA Report.

For more information on the EDTE Process a video of the 6/1/22 presentation is available at:

 [Express Design Traffic Evaluation Process – Recording 6/1/22](#)

---

An EDTE has been prepared for the subject project and is available at the following links:

EDTV Report: *{insert link}*

EDTA Report: *{insert link}*

Based on the results of the EDTE:

- A Project Team meeting is recommended to discuss the results and determine next steps (1)

(1) The following individuals from the EDTE development team should be invited to the meeting:

*{Always include the following individuals}*

- a. Elise Groundwater (Congestion Management) – [ekgroundwater@ncdot.gov](mailto:ekgroundwater@ncdot.gov)
- b. Peter Trencansky (Patriot Transportation) – [peter@pt-engineering.net](mailto:peter@pt-engineering.net) *(include as optional)*



- c. Heath Gore (Patriot Transportation) – [heath@pt-engineering.net](mailto:heath@pt-engineering.net)  
*{Always include the Review PEF for the project and delete the remaining names}*
- d. Mark Freeman (Three Oaks Engineering) - [mark.freeman@threeoaksengineering.com](mailto:mark.freeman@threeoaksengineering.com)
- e. Regina Bowman (RS&H) - [regina.bowman@rsandh.com](mailto:regina.bowman@rsandh.com)
- f. Travis Braswell (Mott MacDonald) - [robert.braswell@mottmac.com](mailto:robert.braswell@mottmac.com)  
*{Always include the EDTE PEF for the project and delete the remaining names}*
- g. Mark Freeman (Three Oaks Engineering) - [mark.freeman@threeoaksengineering.com](mailto:mark.freeman@threeoaksengineering.com)
- h. Regina Bowman (RS&H) - [regina.bowman@rsandh.com](mailto:regina.bowman@rsandh.com)
- i. Travis Braswell (Mott MacDonald) - [robert.braswell@mottmac.com](mailto:robert.braswell@mottmac.com)
- j. Gavin Teng (Accelerate Engineering) - [Gavin.Teng@Accelerateeng.com](mailto:Gavin.Teng@Accelerateeng.com)
- k. Austin Bell (AECOM) - [Austin.bell@aecom.com](mailto:Austin.bell@aecom.com)
- l. Jonathan Reid (Arcadis) - [Jonathan.Reid@arcadis.com](mailto:Jonathan.Reid@arcadis.com)
- m. James Parkhill (Atkins) - [james.parkhill@atkinsglobal.com](mailto:james.parkhill@atkinsglobal.com)
- n. Steve Epley (Davenport Engineering) - [sepley@davenportworld.com](mailto:sepley@davenportworld.com)
- o. Todd Brooks (Dewberry) - [tbrooks@dewberry.com](mailto:tbrooks@dewberry.com)
- p. Andrew Ritter (HDR) - [andrew.ritter@hdrinc.com](mailto:andrew.ritter@hdrinc.com)
- q. Andrew Bell (HNTB) - [aabell@HNTB.com](mailto:aabell@HNTB.com)
- r. Kevin Baumann (Kimley Horn) - [kevin.baumann@kimley-horn.com](mailto:kevin.baumann@kimley-horn.com)
- s. Zach Bugg (Kittelson & Associates) - [zbugg@kittelson.com](mailto:zbugg@kittelson.com)
- t. Kyle Roberts (Mead and Hunt) - [Kyle.Roberts@meadhunt.com](mailto:Kyle.Roberts@meadhunt.com)
- u. Kelly Cory (Michael Baker International) - [KMCory@mbakerintl.com](mailto:KMCory@mbakerintl.com)
- v. BenJetta Johnson (NV5) - [BenJetta.Johnson@NV5.com](mailto:BenJetta.Johnson@NV5.com)
- w. Jessica McClure (Ramey Kemp & Associates) - [jmclclure@rameykemp.com](mailto:jmclclure@rameykemp.com)
- x. Shreyas Bharadwaj (RK&K) - [sbharadwaj@rkk.com](mailto:sbharadwaj@rkk.com)
- y. Kellie Reep (Stantec) - [Kellie.Reep@stantec.com](mailto:Kellie.Reep@stantec.com)
- z. Trent Moody (STV) - [Trent.Moody@stvinc.com](mailto:Trent.Moody@stvinc.com)
- aa. Andrew Topp (VHB) - [atopp@vhb.com](mailto:atopp@vhb.com)
- bb. Sravya Suryadevara (WSP) - [Sravya.suryadevara@wsp.com](mailto:Sravya.suryadevara@wsp.com)

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## APPENDIX F3 EDTE COMPLETE EMAIL TEMPLATE

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### EMAIL SUBJECT LINE: STIP ID (SPOT ID) – County - Express Design Traffic Evaluation (EDTE) Complete

The NCDOT Feasibility Study Unit has developed a process for estimating future traffic volumes and analyzing the design year traffic operations for Express Design Projects. This process, known as the Express Design Traffic Evaluation (EDTE), is being implemented to determine if the proposed design will operate acceptably based on the project’s goals and the stated need for the project. The Express Design Traffic Evaluation (EDTE) is developed in two phases – the Express Design Traffic Volumes (EDTV) and the Express Design Traffic Analysis (EDTA).

The Express Design Traffic Volume (EDTV) task includes the development of the volume data required to complete the Express Design Traffic Analysis (EDTA) and includes estimates of the current traffic volumes and design year traffic volumes for the proposed project. The EDTV includes estimates of the Average Annual Daily Traffic (AADT) and peak hour traffic volumes for the project study area. The deliverable for the process includes the development of the EDTV Report.

The Express Design Traffic Analysis (EDTA) task includes the evaluation of the traffic operations for the proposed project at a level commensurate with the complexity of the project. The EDTA typically includes an evaluation of



the Base Year and Design Year No-Build conditions and an analysis of the Design Year Build scenario for each Alternative. The deliverable for the process includes the EDTA Report.

For more information on the EDTE Process a video of the 6/1/22 presentation is available at:

[Express Design Traffic Evaluation Process – Recording 6/1/22](#)

---

An EDTE has been prepared for the subject project and is available at the following links:

EDTV Report: *{insert link}*

EDTA Report: *{insert link}*

The current status of each of the Alternatives include in the EDTE for the subject project is as follows:

*{Delete checkbox that doesn't apply for each check box below an if the blank box is selected then remove the line for "List of Alternatives"}*

The results of the EDTE have concluded that:

- The project is over designed and the potential exists to reduce project costs for the following alternatives:
  - ✧ List Alternative(s)
- The project is adequately designed and operates at a level consistent with project goals
  - ✧ List Alternative(s)
- The project is under designed and does not operate at a level consistent with project goals
  - ✧ List Alternative(s)

*{The text and bullets below should be removed if the project is over designed or adequately designed.}*

Based on the project being under designed:

- The EDTE includes design recommendations that should be added to the proposed design, if feasible
- A Project Team meeting is recommended to discuss the results and determine next steps (1)
- Additional Traffic Analysis is recommended

Based on the findings and ongoing coordination the current status of the EDTE is as follows:

- The Express Design Traffic Evaluation is complete (2)

(1) The following individuals from the EDTE development team should be invited to the meeting:

*{Always include the following individuals}*

- a. Elise Groundwater (Congestion Management) – [ekgroundwater@ncdot.gov](mailto:ekgroundwater@ncdot.gov)
- b. Peter Trencansky (Patriot Transportation) – [peter@pt-engineering.net](mailto:peter@pt-engineering.net) *(include as optional)*
- c. Heath Gore (Patriot Transportation) – [heath@pt-engineering.net](mailto:heath@pt-engineering.net)

*{Always include the Review PEF for the project and delete the remaining names}*

- d. Mark Freeman (Three Oaks Engineering) - [mark.freeman@threeoaksengineering.com](mailto:mark.freeman@threeoaksengineering.com)



- e. Regina Bowman (RS&H) - [regina.bowman@rsandh.com](mailto:regina.bowman@rsandh.com)
- f. Travis Braswell (Mott MacDonald) - [robert.braswell@mottmac.com](mailto:robert.braswell@mottmac.com)  
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- i. Travis Braswell (Mott MacDonald) - [robert.braswell@mottmac.com](mailto:robert.braswell@mottmac.com)
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(2) If any of the recipients of this email feel that additional discussions or analysis are needed, please respond to this email with a request for a meeting to discuss the need additional analysis.