VIRGINIA DEPARTMENT OF TRANSPORTATION
ENVIRONMENTAL DIVISION
NEPA PROGRAM – LOCATION STUDIES

TRAFFIC ANALYSES TO SUPPORT NEPA STUDIES

CONSULTANT RESOURCE GUIDANCE DOCUMENT

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1.0 INTRODUCTION

Traffic forecasting and operational analysis plays an integral role in the overall transportation planning and design process. The traffic forecasting process allows planners, engineers and other transportation professionals to estimate the amount of traffic that will exist on our transportation system in the future. It further allows for the detailed assessment of specific project plans and designs, and their possible near-term and long-term impacts on traffic operations on existing and planned future roadway facilities. For any major federal action, such as the funding and approval of transportation projects, the National Environmental Policy Act (NEPA) of 1969 requires that proper consideration be given to the environment prior to the project advancing. Review for environmental impacts under NEPA occurs at the preliminary engineering phase. Upon completion of the NEPA review process, the Federal Highway Administration may approve a transportation improvement project to advance to more detailed phases of engineering design, right of way acquisition, and construction. For larger transportation projects, multiple alternatives are developed and compared in NEPA studies and traffic forecasting and analysis is a primary component of the alternatives' development and comparison.

1.1 Purpose

Since the environmental review process under NEPA typically occurs during the preliminary engineering phase of the project development process, the complexity and level of detailed traffic forecasting required for completing a NEPA analysis varies substantially from what may be required for more detailed engineering studies and design. FHWA's guidance regarding the level of traffic analysis necessary to support the environmental review process under NEPA is limited to air and noise analyses. FHWA does not prescribe the traffic modeling methodology for NEPA studies, so the purpose of this guidance document is to provide some background and information regarding the appropriate tools available and general process for conducting traffic forecasting to support NEPA analyses for the Virginia Department of Transportation (VDOT). This guidance document also identifies, at a rudimentary level, the processes and tools that should be considered for analyzing forecasted traffic results and predicting future operational conditions. It should be noted that for each individual traffic study prepared to support VDOT NEPA documents, the scope and methodology for traffic analyses are to be coordinated, reviewed and approved through VDOT's Transportation and Mobility Planning Division (TMPD) and VDOT's NEPA Program – Location Studies Section. Furthermore, FHWA has the opportunity to review the traffic analysis as part of their review and approval of the NEPA document. Depending on the project size, goals, objectives and measures for evaluating alternatives, the set of tools and analyses required may differ from those described herein.

2.0 TRAFFIC FORECASTING METHODOLOGY

Traffic forecasting is a multifaceted process, and the methods used vary significantly depending on factors such as the size of the project, the environment, and density of the study area. Transportation projects, requiring multi-alternative NEPA analyses, are often large, complex and costly- and local, regional, state and federal entities must be able to find project solutions that meet current transportation needs while also providing capacity and efficiency to allow for future growth in the demand on our transportation system. Planners and engineers apply forecasting techniques to projects of all sizes,

ranging from spot-improvements to the corridor level to regional and statewide transportation projects. Regional differences also play a key role in the forecasting process. Traffic patterns differ from dense urban centers to sparsely populated rural areas. VDOT works closely with local and regional partners (such as metropolitan planning organizations and planning district commissions) to identify the population, employment, land use(s), development patterns and other factors that impact traffic distribution and growth.

Depending on the project, the traffic analyses can entail any number of a wide variety of modeling and analysis types, including: travel demand modeling, operational analysis and simulation models. Currently VDOT uses:

- CUBE travel demand modeling software to maintain a statewide travel demand model, a super-regional model, and 10 metropolitan planning organization (MPO) travel demand models;
- Highway Capacity Software (HCS) to conduct capacity analysis on almost all capacity expansion projects;
- Synchro software to conduct operational analysis for intersections;
- CORSIM and VISSIM software to conduct microsimulation analysis for operational improvements;
- SIDRA for roundabout analysis;
- BPR and CAP-X spreadsheet models to analyze person throughput and hours of delay with the SMART SCALE statewide prioritization process pursuant to Code of Virginia 33.2-214.1; and
- ENTRADA spreadsheets to standardize the production of environmental traffic data required to support project-level noise analyses in order to identify the worst (loudest) hour of the day on roadway segments within the project study area.

2.1 Travel Demand Model Usage

For most multi-alternative NEPA analyses, VDOT uses regional travel demand models to assist in the development of traffic forecasts. A travel demand model is a tool used to support the transportation planning process. It is useful in developing traffic forecasts, testing alternative transportation scenarios, and evaluating transportation systems. A model is developed using demographic, survey, and transportation network data. Demographic and survey data are used to develop the mathematical equations necessary for modeling trip generation and distribution. Highway and transit data are used to develop the transportation network and transit system such as number of lanes, speed limit, road capacity, transit schedules and fares, etc.

When a travel demand model is needed for a study, the first step is to determine whether the project is located within a MPO coverage area or not. Often, an MPO will extend its modeling area outside its jurisdictional area to account for external travel influences. For example, the MWCOG model includes Warren and Clark Counties due to the travel behavior of the counties' residents influencing regional trip making within the MWCOG boundaries.

There are 15 MPOs within the Commonwealth of Virginia. In addition to the MPOs, there is a Tidewater super-regional model and Virginia Statewide Model for travel demand forecasting. The latest Information regarding specific software package used by each model should be obtained from the MPOs. The following are travel demand models maintained by MPOs or VDOT:

1. MWCOG*: http://www.mwcog.org/
2. Hampton Roads: http://www.hrtpo.org/
3. Richmond/ Tri-Cities Area: http://www.richmondregional.org/MPO/MPO.htm
4. George Washington Regional Commission: http://www.gwregion.org/
5. Roanoke Regional Commission: http://rvarc.org/transportation/mpo-urban-transportation/
6. Central Virginia Metropolitan Planning Organization (CVMPO): http://www.localgovernmentcouncil.org/about-cvmpo/calendar-cvmpo/89-events/236-mpo-central-virginia-metropolitan-planning-organization.html
7. Kingsport area MPO **: https://www.kingsporttn.gov/city-services/kmtpo/what-we-do/
8. Charlottesville-Albemarle Metropolitan Planning Organization (MPO): http://campo.tjpdc.org/
9. Bristol Metropolitan Planning Organization ** : http://www.bristoltn.org/136/Metropolitan-Planning-Organization
10. New River Valley Metropolitan Planning Organization (NRV-MPO): http://www.montgomerycountyva.gov/mpo
11. Winchester-Frederick County: http://winfredmpo.org/
12. Harrisonburg-Rockingham Metropolitan Planning Organization (HRMPO): http://www.hrvampo.org/about
13. West Piedmont Planning District Commission (PDC): http://www.wppdc.org/welcome-to-the-wppdc
14. Tidewater Super Model: http://www.vdot.virginia.gov/projects/vtm/vtm.asp
15. Staunton-Augusta-Waynesboro Metropolitan Planning Organization (SAWMPO) : http://www.sawmpo.org/about

* Northern Virginia Transportation Authority uses the MWCOG model as its base model. VDOT Northern Virginia District has developed a regional model for Northern Virginia based from the COG model.

** Both Bristol and Kingsport MPO are based in Tennessee and include portions of Virginia that influence travel patterns in their regions.

2.1.1 Four Step Travel Demand Modeling

VDOT's Virginia Transportation Modeling (VTM) Policies and Procedures Manual should guide the use of the travel demand models. It details the four-step travel demand modeling process and the process for model calibration.

2.1.2 Model Calibration and Refinement

Traffic models are calibrated and updated using the latest available estimates and assumptions for population, land use, travel, employment, congestion, and economic activity provided by local and regional partners. On a regional and sub-regional level, the travel demand model is calibrated against existing traffic counts. However, at a local level, the travel demand model can have errors on a link-by-link basis. Therefore, further adjustments or post processing of the model's daily outputs is required prior to its use in an analysis. Traffic forecasts typically need to be post-processed or refined using accepted national standard procedures such as those outlined in the Transportation Research Board's NCHRP Report 765 on Analytical Travel Forecasting Approaches for Project-Level Planning and Design. Information on Virginia's urban travel demand forecasting process is documented in the Virginia Transportation Modeling (VTM) Policies and Procedures Manual.

2.1.3 Post Process Results

Upon completion of travel demand modeling, the outputs should be post processed to develop traffic volumes for analysis of operations during peak periods and/or peak hours. Post processing of travel demand forecasts for traffic volumes should follow the guidelines prescribed in NCHRP Report 255 on Highway Traffic Data Urbanized Area Project Planning and Design, which has been subsequently updated by NCHRP Report 765.

3.0 TRAFFIC CAPCITY AND OPERATIONAL ANALYSES

A traffic analysis is often necessary to evaluate and compare alternatives considered in multi-alternative NEPA studies. Operational analyses should be performed using HCS for almost all analyses of roadway segments and ramp junctions. Synchro software is typically used for intersection analyses. The use of VISSIM microsimulation tools may be necessary on an individual study basis. The appropriate tools for developing operational analyses should be discussed, reviewed, and approved by TMPD and VDOT's NEPA Program – Location Studies Section.

3.1 Safety Analyses

Using data provided for the study area by VDOT, crash analyses may be necessary for individual NEPA studies. Crash analyses may apply to mainline roadway facilities, ramp junctions, and/or facilities adjacent to the individual study area. Crash data is generally analyzed based on location, type, severity, time, and day to identify existing crash patterns and safety concerns for a particular study. Computed crash rates should be compared with statewide rates for similar roadway types established and documented by VDOT.

Based on a review of historical crash experience, the methodologies presented in Highway Safety Manual (HSM) and/or the Interchange Safety Analysis Tool-Enhanced (ISATe) should be considered for use to predict crash rates under projected future conditions.

4.0 ENVIRONMENTAL TRAFFIC DATA

Environmental traffic data is a critical component necessary to facilitate the analyses of potential air and noise impacts associated with alternatives evaluated in NEPA studies. Traffic data for air quality analyses should include all roadways, interchange ramps, and/or connecting roadway facilities potentially impacted by the study alternatives where traffic data is developed. This traffic data should be developed for each analysis year, to be identified and/or agreed upon by VDOT, and the following list of post-processed traffic data should be considered for inclusion in the production of environmental traffic data. It should be noted that this is not an all-encompassing list and some studies may require less information, while others may necessitate additional detail.

- Average annual daily traffic (AADT), average annual truck traffic (AATT), and capacity-constrained peak-period volumes as well as operating, posted, and congested speeds for each link in the project area;
- Hourly traffic distribution (K-factor), hourly directional distributions, hourly distribution of percent trucks with two axles and six tires, and percent trucks with three or more axles;

- Directional volumes, including turning or ramp movements (vehicles/hour/link) for the mainline roadway, study interchanges, affected intersections, and parallel facilities;
- Signal timings (cycle lengths and phasing, approach splits), as well as level of service equivalencies based on control delay (includes intersection and approach delays and average queue lengths);
- Travel demand model outputs for all scenarios and years;
- GIS shapefiles with all roadway link identifiers and associated traffic data; and
- Lane configuration diagrams for each mainline roadway and intersection/interchange within the project corridor showing through and turn lanes.

Traffic data needed for noise analyses should be developed using the latest version of VDOT's ENTRADA tool. In addition to the data listed above, information about the corridor including facility geometry, access locations, and facility setting are needed inputs for the ENTRADA spreadsheets that should be developed for every roadway segment potentially impacted by the study alternatives where traffic data is developed

5.0 DOCUMENTATION AND TRAFFIC ANALYSIS PROCESSING

In order to support the traffic forecasting process and effectively document this effort to support NEPA analysis, a general outline and stepwise checklist is provided in **Appendix A**. This checklist defines the data and documentation expected to be provided to VDOT's TMPD for review and approval when conducting traffic analyses to support NEPA studies.

APPENDIX A. TRAFFIC ANALYSIS CHECKLIST

Metric	Analysis to be performed	VDOT Input to Support Analysis	Data to be provided to VDOT to support findings	Submitted to TMPD on:	TMPD Approval/Concurrence/Direction (include TMPD staff name, date, and specific direction)
Data Collection - Proposed Locations	Traffic classification counts, turning movements, continuous count stations, speed information and corridor level OD data collection if necessary(streetlight data)	Review and approval of proposed count and classification stations Provision of available data at existing continuous count stations	Scope of work should not prescribe specific locations that counts will occur. Scope should specify various locations that different counts will occur. Following NTP, VDOT will meet with the consultant to conduct a traffic kick off meeting. At that time, the consultant will present a map and supporting text to describe the specific locations where different counts will occur and how these locations relate to areas with continuous count stations. VDOT will approve/revise these locations with the consultant and give approval to move forward with the traffic data collection.		
Data Collection - Crash data	Collect/compare crash data within/outside the study area	Provision of readily available crash data	Collect, review, and compare any available crash data from VDOT/ MPO / Regional Transportation Commission / Localities		
Data Collection - Signal Timings	Analysis to determine if operational improvements will provide benefit	Provision of timing sheets / signal phasing			
Data Collection - Review and QC	Compile available data, and present it by relevance	VDOT review			
ADT/AWDT - Balancing	interchange ramp counts should be conducted simultaneously, where turning movements are unavailable, develop alternative methods such as FRATAR to	Any relevant available data; review of consultant products			

Metric	Analysis to be performed	VDOT Input to Support Analysis	Data to be provided to VDOT to support findings	Submitted to TMPD on:	TMPD Approval/Concurrence/Direction (include TMPD staff name, date, and specific direction)
	distribute traffic appropriately				
ADT/AWDT - Generate	48 hrs. tube counts or video count with seasonal factor from closest TMS continuous count station	VDOT TMS continuous count site data			
Closures - Major road/bridge closures in study area	Detailed discussion with VDOT should occur prior to initiating analysis	Any available traffic operations center data			
Consistency - comparing traffic count/peak hour factor data to published count data	refer to the previous studies	Relative previous traffic studies.	tech memo should address how current study relates to relevant previous studies		
Design Hour Volume - Generate	Detailed discussion with VDOT should occur prior to initiating analysis	closest VDOT TMS continue counts	tech memo on how and what K factor should be use,		
Environmental Traffic Data - ENTRADA	Develop environmental traffic data using ENTRADA spreadsheet tool, collect count data	Transmittal of most recent ENTRADA form	work sheets		
Environmental Traffic Data - Generate/post process	travel demand model+NCHRP255 or NCHRP765	travel demand model	work sheets, model output files, model network upon request		
Environmental Traffic Data - Methodology	volume, speed VC ratio, LOS	VDOT review	work sheets, model output files, model network upon request		

Metric	Analysis to be performed	VDOT Input to Support Analysis	Data to be provided to VDOT to support findings	Submitted to TMPD on:	TMPD Approval/Concurrence/Direction (include TMPD staff name, date, and specific direction)
Forecasts - Growth Rate	Detailed discussion with VDOT should occur prior to developing forecasts. Consultants should provide growth rate used, historical count information, model outputs and previous studies	previous studies, historical counts	tech memo on how and what GR should be use,		
Forecasts - Methodology	Consultants should present proposed methodology to VDOT prior to initiating forecasting	VDOT review	Technical memo		
Free flow speeds	Posted speed limit, field observation, data collection, Inrix data. Consultant should discuss proposed FFS with VDOT	Inrix data	Document in tech memo		
Heavy Vehicle Percentages	data collection	VDOT count information			
K-factors	percentile analysis	VDOT count information and previous studies	tech memo		
LOS - New/improved interchange analysis	HCS, VISSIM if required and appropriate	Travel demand model and any relevant current count data	outputs		
LOS - Outside of study area	HCS, Synchro	Travel demand model and any relevant current count data	outputs		

Metric	Analysis to be performed	VDOT Input to Support Analysis	Data to be provided to VDOT to support findings	Submitted to TMPD on:	TMPD Approval/Concurrence/Direction (include TMPD staff name, date, and specific direction)
LOS - Study area analysis	HCS, Synchro	Travel demand model and any relevant current count data	outputs		
Model - MPO/VDOT Regional Travel Demand Model		Transmittal of latest applicable regional demand model from MPO			
Model - Base year model development	traffic counts, Population, employment and land use data from MPO	TRAFFIC COUNTS	Documented version of MPO model, final validation loaded network		
Model - Input Parameters	depends on models	Virginia Travel Demand Modeling Policies and Procedures Manual	Technical memorandum		
Model - Network Review	speed, lanes, capacity, function classification,	Virginia Travel Demand Modeling Policies and Procedures Manual	At minimum, an email documenting review and any issues identified.		
Model - Screen/Cordon Line Analysis		Virginia Travel Demand Modeling Policies and Procedures Manual			
Model - Validation by consultant	RMSE by functional classification, study area validation	Virginia Travel Demand Modeling Policies and Procedures Manual	At minimum, an email documenting review and any issues identified.		
Model - Validation by VDOT	RMSE by functional classification, study area validation	Virginia Travel Demand Modeling Policies and Procedures Manual			
Peak Hour Factors	tube or turning movement counts	previous study (if available)	raw data sheet or electronic version		
Peak Hour	look up the area map				

Metric	Analysis to be performed	VDOT Input to Support Analysis	Data to be provided to VDOT to support findings	Submitted to TMPD on:	TMPD Approval/Concurrence/Direction (include TMPD staff name, date, and specific direction)
Volumes - Balancing	, start from the key locations				
Peak Hour Volumes - Generate	data collections	the closest count station information(if necessary)	Technical memorandum		
Review of CLRP projects	obtain the latest &greatest model from MPO	Verify LRTP Network with MPOs	At minimum, informal transmittal listing projects that are in the CLRP and comparing those that are in the model. Identify projects that are missing or projects that should be removed to avoid conflicts with the No Build analysis		
Terrain	data collection	state planning system			
Toll Diversion - Using proprietary/other method		review	Technical memorandum		
Toll Diversion - Using MPO/VDOT model		Available manuals or documentation of model development			
Tolling - New/changing toll conditions in study area	Detailed discussion with VDOT should occur prior to initiating analysis	review	tech memo		
Tolling - Toll rate assumptions required for model update	Consultant should discuss tolling assumptions with VDOT staff and consider previous relative analysis	Any guidance on upper and lower toll rates available			
Tolling - Toll rate assumptions when included in the model		Available manuals or documentation of model development			