

DRAFT

TRAFFIC IMPACT STUDY GUIDELINES

**Vermont Agency of Transportation
Policy and Planning Division
Traffic Research Unit**

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**Vermont Agency of Transportation
Traffic Research Unit
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Introduction

Introduction

A Traffic Impact Study is an evaluation of the congestion and safety effects of a particular development on its surrounding and supporting transportation infrastructure. It is performed to ascertain if a development will have an adverse impact on its surrounding and supporting transportation infrastructure and, if so, how that impact can be ameliorated. The current Agency practice is one of not participating in the costs for any mitigation measures.

The Traffic Research Unit of the Vermont Agency of Transportation (VTrans) is charged with the review of Traffic Impact Studies for proposed development in the State of Vermont. This document is provided as a guideline for Traffic Engineers preparing Traffic Impact Studies to address the traffic impacts that development projects have on the ability of the transportation infrastructure to handle those projects' demands. It is also provided as a reference for the Traffic Research Unit and other professional(s) reviewing such analyses. Special conditions requiring the attention of those preparing Traffic Impact Studies are shown in *bold italics*.

The information contained herein is meant to serve as a guide in the development of Traffic Impact Studies. It should not be construed as all inclusive regarding every conceivable situation or technical application. It does not preclude the requesting of additional supporting information. It is assumed and expected that those performing these types of analyses are educated in and experienced with the literature and methodologies referenced and will exercise good engineering judgment in reaching meaningful and reasonable conclusions.

In addition to this guideline, it is recommended that Traffic Engineers preparing Traffic Impact Studies also consult the Institute of Transportation Engineer's Proposed Recommended Practice *Transportation Impact Analysis for Site Development* (ITE, 2006). The discussions of many aspects of preparing Traffic Impact Studies, especially those labeled "Caution" and "Guidance," within the Proposed Recommended Practice are excellent.

Occasionally, consulting engineers engaged in preparing Traffic Impact Studies wish to depart from the standards set forth in these Traffic Impact Study Evaluation guidelines. Such departures should be discussed beforehand with the Traffic Research Unit and be documented thoroughly in the Traffic Impact Study, including appropriate data collected.

Introduction

Initiating Traffic Impact Studies

Data collected by the Institute of Transportation Engineers (ITE) indicate that Traffic Impact Studies, as currently required by jurisdictions throughout the country, commonly use the following variables (among others) to determine when generated trips trigger a requirement for a traffic impact analysis:

- Specified number of peak hour trips.
- Specified number of daily trips.
- Specified number of dwelling units or square footage.

There is little consistency in specific threshold quantities among various states' guidelines for the first three criteria.

The Agency's review staff exercise the discretion to determine the most appropriate variable(s).

Vermont Agency of Transportation (VTrans) general guideline

This general guideline states that a traffic impact study should be considered when the proposed development generates 75 or more peak hour trips directly accessing the State Highway System¹. However, there are situations where VTrans may set a higher or lower threshold depending on such factors as directional distribution, peak hour of the generator or existing traffic conditions. In addition, VTrans normally expects that the geographic scope of the study includes those intersections or highway segments receiving 75 or more project generated peak hour trips, those intersections or highway segments that may **fail**² as a result of the development and the immediate access points.

Refer to Table 1 on the following page for a list of types of development and the sizes required to generate the threshold number of 75 peak hour trips. Table 1 is for illustrative purposes only. It does not preclude requiring Traffic Impact Studies for other uses.

Furthermore, VTrans may request a Traffic Impact Study in additional instances, such as:

- When a development occurs in a **sensitive**³ area.
- When financial assessments are required and the extent of impact must be determined.

¹ This could be A.M. or P.M. trips depending upon use. The specific number of trips (75) is based on 19 V.S.A. Ch. 11 § 1111.

² In general, those intersections or highway segments experiencing LOS "F."

³ The term "sensitive" refers to safety, traffic congestion, the environment, historical areas, development pressure or any other, similar "sensitivity."

Introduction

Sources available to VTrans of projects potentially needing Traffic Impact Studies

Developments requiring a traffic Impact study come to the attention of the Traffic Research Unit from several different sources:

- Applications for Access Permits in accordance with 19 VSA Chapter 11 § 1111
- Act 250 Weekly Agenda of recent applications for an Act 250 permit.
- Local Municipalities
- Regional Planning Commissions

Traffic Impact Study Request Protocol

Whenever it is determined that a project requires a Traffic Impact Study, such a study will be requested directly from the applicant or through Act 250.

Introduction

Table 1
Development Review Thresholds At A Glance
(Thresholds based on 75 Weekday PM Peak hour trips)

Type	ITE LUC *	Use	Variable 1		Variable 2	
Retail	815	Discount Store	18,000	sq ft		
	820	Shopping Center	20,000	sq ft		
	845	Gas Station w/convenience store	700	sq ft	6	pumps
	850	Supermarket	7,000	sq ft		
	853	Convenience Market w/gas pumps	1,200	sq ft	4	pumps
	880/881	Pharmacy	8,500	sq ft		
	911/912	Bank	1,700	sq ft		
Restaurant	832	High Turnover Restaurant	7,000	sq ft	180	seats
	833/834	Fast food	2,600	sq ft	80	seats
Housing	210	Single Unit Houses	65	units		
	220	Apartment	120	units		
	230	Condominium/Townhouse	140	units		
	240	Mobile Home Park	130	units		
	251	Senior Adult Housing	290	units		
	260	Recreational Homes	290	units		
	270	PUD (mixed residential)	90	units		
	310	Hotel	120	rooms		
	320	Motel	130	rooms		
	330	Resort Hotel	150	rooms		
Business	130	Industrial Park	80,000	sq ft	7	acres
	140	Manufacturing	100,000	sq ft	200	employees
	710	Office	50,000	sq ft	160	employees
	770	Business Park (office/small bus.)	60,000	sq ft	100	employees

* Institute of Transportation Engineers (ITE) Land Use Code (LUC)
 Dual codes designate with and without drive through – Trip Generation threshold not significantly different.

Traffic Impact Study Elements: Checklist

The following elements are to be addressed in evaluating traffic related impacts. The degree of emphasis placed on each item may vary from project to project depending on the project scope.

I. EXISTING CONDITIONS DATA AND ANALYSIS

- A. Geometrics**
- B. Speed Limit**
- C. Sight Distance**
- D. Crash Data**
- E. Other Planned Developments and Highway Improvements**
- F. Public Transportation⁵ Service**
- G. Pedestrian and Bicycle Facilities**

II. PROJECT PARAMETERS

- A. General Description**
- B. Site Plan/Layout/Circulation Plan**
- C. Project Generated Traffic**
- D. Parking Demands**
- E. Planned Phasing**
- F. Proposed Public Transportation Service**
- G. Proposed Pedestrian and Bicycle Facilities**

⁵ Public Transportation refers to the transportation of persons, including groups of the general public with special needs, by all means available to the general public (24 V.S.A., Ch. 126, § 5081). Within the context of this document public transportation services refer to fixed and deviated fixed routes only.

Traffic Impact Study Elements: Checklist

III. TRAFFIC PROJECTIONS FOR ACCESS (ES) AND OTHER STUDY INTERSECTIONS AND HIGHWAY SECTIONS

A. Traffic Data Types

Traffic projections should include the following types of data:

1. Annual Average Daily Traffic (AADT)
2. Design Hour Volume (DHV)
3. Design Hour Turning Movements
4. Directional Distribution. (%D)
5. Percent Trucks (%T)

B. Growth Factors

C. Traffic Projection Scenarios

1. Construction Year No-Build
2. Planning Year No-Build (generally five (5) years after the construction year).
3. Construction Year Build (Construction Year No-Build plus project generated traffic).
4. Planning Year build (Planning Year No-Build plus project generated traffic).

D. Modal Split Analysis for Major Developments

E. Traffic Counts and Calculations in the Traffic Impact Study

IV. CAPACITY AND WARRANT ANALYSES

A. Capacity and Level of Service Analyses for:

1. Construction year build scenario
2. Construction year no-build scenario
3. Planning year build scenario
4. Planning year no-build scenario

B. Geometric features:

1. Immediate access design
2. Left and/or Right turn lane(s)
3. Exiting acceleration lane
4. Associated signing
5. Sight Distance improvement, etc
6. Sidewalks, crosswalks, bicycle lanes, shared use paths, or other facilities for non-motorized transportation

C. Traffic signal warrants analysis or need for modification to existing system(s) including the effect on pedestrian phasing, if present.

D. Consideration of Bicycle and Pedestrian Access and Safety

Traffic Impact Study Elements: Checklist

V. Safety Analyses

A. High Crash Locations

B. Sight Distance

VI. Summary of Findings and Recommendations for Mitigation of Impacts

A. Geometric improvements

B. Signal installation or re-timing

C. Access Management

D. Transportation Demand Management (vanpools, ridesharing, flextime, etc.)

E. Public transportation service, pedestrian and bicycle facilities

F. Monitoring conditions

Traffic Impact Study Elements: Details

I. EXISTING CONDITIONS DATA AND ANALYSIS

The intent of this study element is to provide a clear picture of the existing conditions of the transportation network in the vicinity of the proposed project. Refer to Appendixes A and B for available data resources.

A. Geometrics

The geometric configuration for each approach and each direction of an intersection at the point(s) of proposed access, and at each intersection affected by the proposed project should be addressed in terms of:

1. Traffic lanes including number of lanes, lane width, and lane usage (i.e.: identify through lanes, auxiliary lanes, shoulders/curbing, parking/type, etc.)
2. Gradient of the roadway and approaches.
3. Operating issues including nearby intersecting roads and drives with associated features.
4. Traffic control devices including signalization, signing & pavement markings that might affect or be affected by the project.
5. Feature Inventory including sidewalks, crosswalks, bicycle lanes and shared use paths, where applicable.
6. Bus stops and/or shelters

B. Speed Limit

Provide the speed limit, as well as operating or other appropriate measures of speed identified for use in various analyses for the highway being accessed and for all intersecting roadways, drives and streets.

C. Sight Distance

In order to identify potential safety concerns, sight distance should be addressed in terms of:

1. Stopping sight distance, i.e., ability of driver on the main highway to see an object on the roadway directly in front of them.
2. Corner sight distance, i.e., ability of drivers on the access or on cross roads to see vehicles approaching from either direction on the main highway.

D. Crash Data

1. Crash data should include the following:
 - a. Crash analysis for the point of access and along the highway system as appropriate, in order to identify existing areas of high crash incidence and patterns that might be affected by the project.

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- b. Generally, the most recent five year history of crash data, derived from police reported crashes, should be used to provide as statistically reliable a representation as possible of current conditions.
 - c. Crashes involving pedestrians and bicyclists should be included.
 - d. Crash rates should be presented as follows:
 - i. For sections, number of crashes per million vehicle miles of travel (Acc/MVM)
 - ii. For intersections, number of crashes per total number (million) of entering vehicles (Acc/MV)
2. Summary crash listings are available on the VTrans website for the following locations:
 - a. Highways on the state system
 - b. Class 1 town highways through various village and/or urban areas
 - c. Federal Aid Urban (FAU) highways
 - d. Town Highway Major Collectors
 3. More abbreviated listings for crashes on all other facilities, as well as average summary statistics for various highway classes, are available from the VTrans Highway Research Section.
 4. The current policy for including crash records in VTrans listings is crashes involving personal injury or fatality.

E. Other Planned Developments and Highway Improvements

Other pending or planned improvements to the highway(s) under consideration should be addressed in terms of effect on the project or the impact of the project on such improvements. These may include projects on the Agency of Transportation's "Construction Program" or improvements as a result of other developments in the area.

The number of trips generated by other permitted developments should be included in the various analyses.

F. Public Transportation Service

Provide information on existing and planned public transportation routes and schedules as well as bus stop locations that could serve the proposed development. This information may be obtained from the local Public Transportation provider or from VTrans Public Transit Section. The term "planned" in this context refers to new routes, expanded routes or both that are linked to a reasonably foreseeable funding program (e.g., Private funds, New Starts, JARC etc.). If no services exist, this should be so noted.

G. Bicycle and Pedestrian Facilities

Provide information on existing and committed bicycle and pedestrian facilities in the area. This information may be obtained from the local municipality or from the VTrans Bicycle

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and Pedestrian Program. The term "committed" in this context refers to facilities for which funding exists. If no such facilities exist, this should be so noted.

Traffic Impact Study Elements: Details

II. PROJECT PARAMETERS

The intent of this study element is to provide a clear picture of the proposed development and its impact on the surrounding transportation network.

A. General Description

A general description of the project, including discussion of construction constraints or other elements affecting site layout, aids in understanding specific features not readily apparent.

B. Site Plan/Layout/Circulation Plan

Plans or layouts of the development site, preferably to scale, showing its relationship to the adjacent transportation network and other pertinent physical features, including bicycle and pedestrian facilities, should be provided. Provision for public transportation should be noted, as well as access and circulation.

C. Project Generated Traffic

1. Trip Generation generally involves using estimated trip rates based on known relationships obtained from various studies around the country. ITE maintains a fairly extensive database of trip rates for various types of developments. These trip rates represent the number of trip ends (essentially this is the number of vehicles entering and exiting a site during a given time period) generated based on an independent unit of land use or activity such as:
 - a. Acreage for large industrial/commercial sites
 - b. Square footage for well defined industrial/commercial and retail types of land use
 - c. Number of employees for employment in general
 - d. The number of occupied/units for various types of residential housing or lodging
 - e. Others as correlation indicates appropriate
2. The number of vehicle trips generated as a result of summing the product of the trip rate times the magnitude of development for each land use represents the total number of trips directly accessing the site. Of this total, especially in the case of retail establishments (shopping centers, etc.), there are three distinct types of trips; "New," "Pass-by" and "Diverted Link."
 - a. New Trips (Or Primary Trips)
New Trips are those that would not be made at all if not for the development. They may account for only a minor portion of the total number of trips.
 - b. Pass-by Trips
Pass-by trips, on the other hand, may account for the majority of the total number of trips and represent those that presently use highways that pass by the site and thus would not affect background traffic volumes, except to create turning movements to and from the site at points of immediate access.

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c. Diverted Link Trips

The remaining diverted link trips are those made as a result of attracting trips away from other similar land uses in the region and, as these may be a significant portion of the total number of trips, they can result in decreased traffic volumes on highways removed from the immediate area. ITE's Trip Generation Handbook contains a detailed section on pass-by and diverted link trips.

3. Local Trip Generation Rates

The use of local Trip Generation rates is preferable to using ITE Trip Generation rates or equations, but only where sufficient data has been collected at specific sites to insure statistical reliability. When it is desired to use local rates, a preliminary discussion with the reviewer at VTrans is quite helpful in reducing review times. The consultant should be prepared to present the complete data on which the use of local Trip Generation rates is based.

4. Traffic Distribution Methods

Methodologies used to distribute and assign the generated traffic may be as straight forward as basing directional splits on patterns of nearby similar generators or existing background traffic patterns or as complex as applying more sophisticated distribution using the Gravity Model in conjunction with "Shortest Path" or "User Equilibrium Assignment" models for large more complex projects, which often involve the use of computer program developed for these purposes.

For ***large developments*** where public transportation service either exists or could be made available and where there is a co-operative and comprehensive transportation planning process as well as appropriate modeling tools, a modal split analysis should be undertaken to estimate the percent of trips that could potentially be diverted to public transportation. Bicycle and pedestrian generated trips should also be estimated using appropriate methodology⁶. Such an analysis should be realistic in its projections and preferably should be compared to services at similar developments in the area.

D. Parking Demands

1. The number of parking spaces generally depends on peak traffic generation and turn-over rate of the land use being served. Adequate parking is necessary to ensure that the public highway is not affected by overflow parking needs during peak demand periods.

⁶ FHWA Guidebook on Methods to Estimate Non-Motorized Travel: Supporting Documentation (FHWA-RD-98-166) and Overview of Methods (FHWA-RD-98-165), July 1999.

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2. The Agency of Natural Resources (ANR) presently uses the number of parking spaces as a mechanism for requiring submittal of an Air Quality Permit and should be contacted for specific criteria in this regard.
3. The Traffic Impact Study should include:
 - a. Anticipated parking demands, including bicycle parking, as estimated under section C.4, above.
 - b. A plan or layout of the site identifying parking areas in respect to internal circulation patterns and access to the highway/street system.

E. Planned Phasing

1. Any planned phasing of a development should be clearly identified.
2. If the Traffic Impact Study does not clearly identify the development phases, or the project is planned as one unit, then impacts at full build-out should be addressed.
3. Otherwise, as each lot or other unit in a development is proposed, an updated traffic study is required to address and include cumulative impacts of the development up to that point, including the element(s) being added.

For further discussion on this topic see Appendix D.

F. Proposed Public Transportation Service

In cases where the proposed development will be served by an existing, expanded or a new public transportation route, the site layout should be designed to accommodate buses entering, transiting and exiting the site. In addition, the proposed new or expanded route should be noted as well as bus stop locations.

G. Proposed Pedestrian and Bicycle Facilities

If it is proposed that the development be connected to planned or committed pedestrian or bicycle facilities, that the details of such connections should be shown.

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III. TRAFFIC PROJECTIONS FOR ACCESS (ES) AND OTHER STUDY INTERSECTIONS AND HIGHWAY SECTIONS

The intent of this study element is to provide a clear picture of current and projected traffic volumes on the nearby transportation network. Refer to Appendix F for an example table of traffic volumes.

A. Data Types

1. Annual Average Daily Traffic (AADT)

The AADT is a fundamental statistic for developing the Traffic Impact Study. The VTrans Traffic Research Unit annually estimates the AADT on each segment of state highway in the State of Vermont and on some local roads. These estimates are available in the VTrans Route Log AADT, which are separately published for Major Collector, Federal Aid Urban Streets and States Highways. These may be found on the VTrans website at the following URL:

<http://www.aot.state.vt.us/Planning/Documents/TrafResearch/Publications/pub.htm>

Approximately one-third of the AADTs are estimated from actual counts. These are identified with an "A" beside the AADT listed in the Route Log. The rest are estimated based on either growth factors or on nearby Turning Movement Counts (TMC) and are identified with an "E" beside the AADT listed in the Route Log. They are sufficiently accurate for estimating annual Vehicle Miles of Travel (VMT) for the Highway Performance Monitoring System (HPMS) but they are not sufficiently accurate for estimating DHVs for Traffic Impact Studies.

Based on the above discussion, *it is therefore recommended that consultants performing Traffic Impact Studies on segments of road for which AADTs are not based on actual recent Automatic Traffic Recorder (ATR) counts perform their own ATR counts or be prepared to demonstrate and document a procedure for accurately estimating the AADT.* Standards for performing and reporting ATR counts are in "Vermont Traffic Monitoring Standards for Contractual Agreements," found on the VTrans website at the following URL:

<http://www.aot.state.vt.us/Planning/Documents/TrafResearch/Publications/trafficstandards.pdf>

If an AADT is to be estimated from an ATR count, then appropriate seasonal factors have to be applied. These are contained in the VTrans Traffic Research Unit Publication "Continuous Traffic Counter (CTC) Grouping Study and Regression Analysis Based on 200x Traffic Data" (aka the "Red Book."). The Red Book may be found on the VTrans website at the following URL:

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<http://www.aot.state.vt.us/Planning/Documents/TrafResearch/Publications/2005RedbookText.pdf>

Where recent high growth or alterations to the highway system/circulation pattern have occurred, traffic surveys should be performed by the applicant to address prevailing conditions.

2. Design Hourly Volume (DHV)

The DHV is generally the 30th highest hourly volume during the year. It is value that, in conjunction with Turning Movement Counts, roadway classification and roadway geometry is used to develop a traffic distribution pattern for existing and future scenarios; and in turn estimate the Level of Service (LOS) of a project site.

Since it is impractical to design a highway for the highest volume encountered during the year, Highway Engineers have sought a compromise between capacity and cost. Thus, a highway is designed for the 30th highest hourly volume of the year, commonly known as the "Design Hour Volume" (DHV). Several techniques have been developed for estimating the DHV.

a. Use of "k" Factor

The most commonly used is to develop a "k" factor based on the ratio of the DHV to the AADT.

b. Equations relating DHV to AADT

Another technique is to development equations relating DHV to AADT. These equations have been simplified by the VTrans Traffic Research Unit displayed in a set of tables in the back of the Red Book.

c. VTrans "Alternative DHV Determination Method" by Poll Group

VTrans Traffic Research Unit has also developed "k" factors and equations and combined them in a publication entitled: "DHV Determination" included at the end of the Red Book. This is VTrans Traffic Research Unit preferred method.

d. CTC Method

Many consultants preparing Traffic Impact Studies prefer to use the so-called "CTC method" of calculating DHVs. This technique relies on comparing the peak hour in which a manual turning movement count is conducted to the 30th highest hour at a "nearby" or "representative" Continuous Traffic Counter (CTC). This method suffers from two drawbacks, detailed as follows:

i. Selecting an appropriate CTC:

If a proposed development is quite close to a CTC Station, then it makes sense to use the CTC method, e.g., Green Mountain Plaza in Rutland and VTrans R022 CTC Station on US 7. However, the further away a proposed development is

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from a CTC site, the less applicable that CTC Station becomes as appropriate for calculating DHVs. It is especially difficult to evaluate the appropriateness of a CTC Station when that station is not in the vicinity of the proposed development or when the traffic from many existing intersections between the CTC and the development access "dilute" the CTC's relevance. VTrans Traffic Research Unit is hesitant to describe a distant CTC Station as "representative" of a particular site.

ii. Data problems at the CTC used

On those occasions when it is necessary for Agency staff to supplement erroneous data, these estimates are noted.

Any proposed use of the "CTC Method" should be checked with the VTrans Traffic Research Unit.

In areas which experience unusual or highly seasonal fluctuation in traffic flow, the 30th highest hour may not be the most appropriate design hour, as economy and local sentiment may dictate the acceptance of lower levels of service. If the traffic impacts of the proposed development will typically occur during a time that does not coincide with the 30th highest hour, the consultant should discuss the issue with the Agency of Transportation to develop an alternate design hour. ***The consultant should be prepared to support their choice of another design hour either by reference to the transportation literature or by their own original research.***

3. Design Hour Turning Movements

Turning movements to be used in LOS analyses should be adjusted to match the Design Hour Volume on the appropriate approach. If more than one approach has a calculated DHV, then the Design Hour Turning Movements can be adjusted to meet the DHVs using Kruihof's algorithm⁷. The Fratar method and least squares approaches can also be applied in these cases.

4. Directional Distribution (%D)

The %D represents the variation of traffic pattern with time. It helps to determine the most representative peak hour, i.e., AM or PM. It is normally used in geometric and LOS analyses and it is an important factor in selecting the proper signalization timing patterns throughout the day in location where pre-set timed signalizations are still in use.

⁷ Schaefer, Mark C., "Estimation of Intersection Turning Movements from Approach Counts," ITE JOURNAL, Vol. 58, #10, October, 1988, pp 41-46

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5. Truck Traffic (%T)

The %T is an important parameter that can be used to translate the number of trucks into an equivalent number of passenger cars as a means to simplify the LOS analysis. A design truck's weight and required turning radius are determining factors in the structural and geometric design of roadways.

B. Growth Factors

Growth factors from regression analysis are grouped by Highway type in the Red Book. They can also be derived for individual CTC Stations. Which approach to use depends upon how close a proposed development is to a given CTC station. The same problems described above with regard to DHV calculations also occur here in selecting growth factors. In the Traffic Impact Study itself, the growth assumptions should be clearly described and growth factors clearly indicated.

C. Traffic Projection Scenarios

1. Construction Year No-Build

The Traffic Impact Study should establish a baseline traffic data representing existing highway conditions for the year the development/phases are to be constructed/commence operation.

The developer is responsible for acquiring any additional data deemed necessary for proper coverage and analysis. ***Additional data include vehicle trips from any developments in the study area that have previously been permitted but not yet built.*** These vehicle trip estimates and their distributions can normally be obtained from traffic studies that have already been prepared for those developments.

2. Planning Year No-Build

The Traffic Impact Study should include a No-Build planning projection of the baseline traffic at least five (5) years from the construction year. This may be extended for phased developments.

This is important because:

- a. It provides a reference to determine how this site's traffic, or any nearby site affected by the proposed development, will impact the overall traffic conditions in the future without the proposed development.
- b. It helps in determining the additional improvements that this site, or any nearby site affected by the proposed development, will need in the future to provide sufficient site access and capacity for passing traffic without the proposed development

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- c. It is used to ensure that the present system, as well as any improvements, are not obsolete as soon as or shortly after the development is in place and to include those improvements that nearby sites would have already needed in the future regardless of the proposed development.
- d. In addition, this type of analysis allows the developer to follow the project or site as it matures, not in regard to any planned phasing, but as related to establishing full development of a site's potential as in the case of lots in an industrial/commercial park, stores/shops in a shopping mall, building of houses in a subdivision, etc.

3. Construction Year Build

The Traffic Impact Study should include a Construction Year Build projection combining traffic from the Construction Year No-Build projection and the project generated traffic.

4. Planning Year Build

The Traffic Impact Study should include a Planning Year Build projection combining traffic from the Planning Year No-Build projection and the project generated traffic.

D. Modal Split Analysis

A Modal Split Analysis should only be conducted for ***major developments***⁸ in areas of the state where a computerized Travel Demand Model based on a computerized network exists or could be developed.

E. Traffic Counts and Calculations in the Traffic Impact Study

To hasten the Traffic Impact Study review process, the following items should be included in the study:

1. Counts done by the consultant should be included in the study, unadjusted. The counts should be labeled with the date they were done, and the count location.
2. Data calculations should be clearly documented in the study, e.g., derivation of DHV and growth factors.

⁸ The parameters for a major development have yet to be developed, but a paradigm example would be a Wal*Mart.

Traffic Impact Study Elements: Details

IV. CAPACITY AND WARRANT ANALYSES

The intent of this study element is to provide commonly understood analyses of the impact of development traffic on the transportation system. Also, if the transportation system is shown to be inadequate in light of the proposed development, then proposed mitigation measures need to be addressed.

A. Capacity and Level of Service (LOS) analyses should be performed for intersections and highway sections being studied to address the construction and planning years for the no-build and build traffic scenarios. If mitigation is shown to be necessary, the additional LOS analyses are needed to show the results with proposed mitigation. When a Traffic Impact Study is submitted for review, the particular software package, with version, used to calculate LOS needs to be clearly indicated.

VTrans has a Policy on Level of Service, as follows:

It is the agency's policy to design its highways and to require others accessing its facilities to effect improvements that will maintain a LOS "C" for the prescribed design period. In interpreting this policy, LOS refers to the overall LOS for the particular facility as defined in the latest HCM. LOS is defined as a quality measure for various highway facilities, including freeways, two-lane rural highways, signalized and unsignalized intersections.

For further discussion, see the proposed VTrans Level of Service policy in Appendix E.

B. Geometric features

In addition to level of service analyses, left and right-turn lane warrants should be checked for unsignalized intersections as well as the need for exiting acceleration lanes.

Storage lengths for any additional lanes should be addressed. Storage lengths of existing lanes should also be checked, as many Level of Service and Capacity software packages automatically assume adequate storage length.

New accesses and changes in access onto State Highways must be approved by the VTrans Utilities and Permits Unit. Refer to Appendix A for links to VTrans access management publications.

C. Signalization Warrant

If the installation of signals is proposed, a signal warrant analysis should be performed in accordance with the latest Manual on Uniform Traffic Control Devices (MUTCD). If a signal is warranted, an assessment of the need for and design of pedestrian phases should be included. Pedestrian phases would normally be included only if pedestrian facilities lead up to the leg of the intersection on which the pedestrian phase would be provided.

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If a traffic signal is found to be warranted at any intersection analyzed, including the site driveway intersection, and the developer proposes to install a traffic signal, then VTrans' Traffic Research Unit strongly recommends that a roundabout also be analyzed for installation at the same locations. A full life-cycle cost analysis should be undertaken to compare life-cycle costs of both a traffic signal and a roundabout installation. VTrans is in the process of developing relevant parameter values.

This requirement was imposed on VTrans by the Vermont legislature in Act 141, section 37, 2001-2002 session. See the relevant language in Appendix G.

D. Consideration of Bicycle and Pedestrian Access and Safety

If there are existing bicycle and/or pedestrian facilities in the area to be impacted by a proposed development, assessment should be included of how these facilities may be impacted. For example, if there are bicycle lanes on the roadway and a turn lane is needed to mitigate traffic impacts, provision must be made for continuity of the bicycle lane. Infrastructure changes proposed to mitigate traffic impacts should not result in the degradation of bicycle or pedestrian access or safety.

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V. Safety Analyses

A. High Crash Locations

If a highway segment or intersection is identified as a High Crash Location (HCL), then the crashes contributing to the HCL need to be analyzed and collision diagram prepared that identifies, to the extent possible, the causes of the crashes. If a highway geometric or traffic operation condition is found to be contributing to the identified crashes, then recommendations to ameliorate those conditions should be prepared and included in the Traffic Impact Study.

B. Sight Distance

Sight distances described in Section I.C, above, need to be compared to applicable sight distance standards. If a deficiency exists, recommendations to ameliorate the deficiency need to be incorporated into the Traffic Impact Study.

Traffic Impact Study Elements: Details

VI. SUMMARY OF FINDINGS AND RECOMMENDATIONS FOR MITIGATION OF IMPACTS

The Traffic Impact Study should include a summary of findings and recommendations, including the following:

A. Recommended geometric improvements

These would include left-turn and right-turn lanes.

B. Signal installation or re-timing recommendations (including roundabouts)

C. Recommended access management improvements

In recommending access management improvements, the developer should consider combining accesses, access spacing, corner clearance, access via Town Highways, one-way entrances and exits, etc. Developers should also consider any possible interconnection between their development and neighboring land uses. For example, residents of a housing development which abuts a proposed commercial activity ideally should not have to get into their cars, work their way from local streets to arterial highways and then enter the commercial activity. Preferably, there would be some sort of direct connection between the two land use activities. However, such interconnections depend on local planning and VTrans recognizes that they may not always be feasible for existing developments.

D. Recommended Transportation Demand Management (TDM) measures

TDM measures should also be considered. TDM measures include flexible work hours or adjusting shift schedules to avoid peak hours of the adjacent roadway, promoting ridesharing or vanpooling and promoting alternate modes of travel to include bicycle, pedestrian and public transportation.

E. Recommended Public Transportation, pedestrian and bicycle facilities

Developers can mitigate impacts through the appropriate use of public transportation services as well as bicycle and pedestrian facilities. Estimates of the number (or percent) of trips mitigated by use of public transportation, bike and pedestrian facilities should be realistic and based on local/regional observations or comparable data from similar regions around the country.

F. Monitoring Conditions

It frequently occurs that a particular improvement is not warranted in the opening year of a development, but is warranted in the future year. Because the future year analyses are based on a number of conservative assumptions, they represent a "worst case" scenario, and may not be entirely indicative of what will occur in five years. In these instances, a monitoring condition may be imposed. This requires that the developer conduct traffic counts before a development opens, at opening, and five years after opening. If an improvement is warranted by reason of the monitoring counts, then the developer is required to pay for it. If several developers contribute to traffic causing the failure, then all have to contribute to fixing the problem. As presently constituted, this would have to be adjudicated locally or through Act 250.

Traffic Impact Study Elements: Details

Recently, because of the uncertainties in traffic projections, we have been recommending to all the local Act 250 commissions that they retain jurisdiction for five years and impose monitoring conditions, as described below, on developers.

Typical Monitoring Conditions:

1. Six months to one year and five years after the development is fully constructed and occupied, a traffic monitoring study will be conducted by the developer to ascertain if excessive congestion has occurred at the intersections included in the study. The monitoring study will include conducting turning movement counts at these intersections and analyzing the results for turn-lane warrants, Level-of-Service, delay and queue lengths.
2. Additionally, crash records will be examined to ascertain if highway safety in the study area is negatively impacted. This will be done one year and five years after the development is fully constructed at the same time the above-referenced counts are undertaken.
3. If congestion or safety problems are identified, then results of the above studies are to be submitted to the Act 250 Commission for further adjudication. The developer must contribute to the amelioration measures acceptable to VTrans and the city or town, as appropriate.

Appendix

APPENDIX A: Agency of Transportation Resources

Available from Traffic Research:

- Automatic Traffic Recorder Counts
- Turning Movement Counts
- Continuous Traffic Counts*
 - Monthly Hourly Reports
 - 200 High Hour Report
 - 30th Highest Hour
- WIM Data (Weigh in Motion)
- Route Logs AADT publications*
- CTC Grouping Study and Regression Analysis (“Red Book”)*
- Turning Movement Count Database (an index to completed counts – not actual count data)*
- Guidelines for Traffic Engineering Issues

*Obtain on the web at:

<http://www.aot.state.vt.us/Planning/Documents/TrafResearch/Publications/pub.htm>

Available from Mapping and GIS

- Town Maps
Obtain on the web at:
http://www.aot.state.vt.us/Planning/MapGIS/Town_Maps1.htm

Available from Highway Research

- Crash Data
Obtain on the web at:
<http://www.aot.state.vt.us/techservices/Documents/HighResearch/Publications/pub.htm>
For most current data, E-mail request to: AOT-crashrequest@state.vt.us

Available from Permits and Utilities

- Vermont Access Management website at:
<http://www.vtaccessmanagement.info/>
- Access Management Program Guidelines
Obtain on the web at:
<http://www.vtaccessmanagement.info/Documents/AccManProgGuidelinesRev072205.pdf>

Public Transportation – 802-828-2828

Bicycle and Pedestrian Program – 802-828-5799

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Traffic Impact Study Guidelines

Appendix

APPENDIX B: Other Resources

- "A Policy on Geometric Design of Highways and Streets" (AASHTO, 2001).
- Traffic Signal Information on State Routes (Traffic Design Section)
- "Highway Capacity Manual". (TRB Report 209- 2000 Edition)
- "Manual on Uniform Traffic Control Devices" (MUTCD - 2000 Edition)
- ITE Publications:
 - Traffic Engineering Handbook
 - Trip Generation, 7th Edition, 2003
 - Trip Generation Handbook, 2001
 - Parking Generation, 2003
 - Transportation Impact Analysis for Site Development (A Proposed Recommended Practice – 2006)
 - Design and Safety of Pedestrian Facilities, 1998
- VAOT Standard Sheets
 - A-76
 - B-13
 - B-71
- Vermont Pedestrian and Bicycle Facility and Design Manual (December 2002)

Appendix

APPENDIX C: Applicable Statutes/Policies

Statutes

- 19 V.S.A. Section 1111 (Access Permits)
- 23 V.S.A. Section 1025 (Standards for traffic control signs, signals and markings)
- 24 V.S.A., Ch. 126, § 5081 (Public Transportation)

Policies

- VAOT Level of Service Policy
- VAOT Traffic Signal Installation Policy

Appendix

APPENDIX D: Large, Long-term, Multi-use developments

Occasionally, extensive developments, such as ski areas, industrial parks and combined housing developments and shopping centers are proposed. Typically, such developments are completed in phases with different levels of mitigation required in each phase. A frequent question that arises is what form Traffic Impact Studies for such developments should take place, especially how the timing for future impacts should be structured. For large developments that are expected to open all at once, such as a supermarket or a discount store, traffic impacts are analyzed in the year the development opens and five years later in the future. But this sort of scenario is hard to fit to a development that is expected to open in several phases over a number of years.

Overall, VTrans Traffic Research Unit would like to know what traffic mitigation measure will be necessary when the development is fully built out. This would imply a traffic analysis at full build-out plus five years even if that's twenty-five years in the future. However, a lot can change in twenty-five years. Therefore, VTrans Traffic Research Unit should have Traffic Impact Studies at regular intervals during the life of a large, long-term, multi-use, multi-phase development. VTrans Traffic Research Unit, the developer, and consultants, should be involved in making the determination of the extent and frequency of Traffic Impact Studies.

Another problem with large, long-term, multi-use, multi-phase developments is that they may have longer-term and greater ranging effects than VTrans Traffic Research Unit normally expects and for which there exists the analysis tools. Normally, VTrans Traffic Research Unit would expect developers to pay for left- and right-turn lanes and traffic signals at their access intersections and nearby affected intersections. However, if several such developments occur in close proximity, larger and much more expensive mitigation measure may be needed, such as road widening or interstate bridge replacement. In such an instance, if several developments contribute to the need, they should share the cost equitably. As development review is currently constituted in Vermont, such cost sharing arrangements would have to be enacted through Act 250.

Another issue that arises in these instances is insuring there are sufficient funds to pay for the mitigation when it is needed, if it is needed. If one developer is going to be available for the long term, as is the case for a shopping center or ski area, then it is only necessary to require that developer to pay for the mitigation when it is needed. Usually some sort of sinking fund or escrow account will suffice. However, in an instance where the original developer sells lots for individual development, as in an industrial park, and when all lots are sold that developer is no longer available, the ultimate responsibility for paying for mitigation is much less clear. In such an instance, all lot owners should be responsible for paying for mitigation in some equitable manner, and this should be known to individual lot developers when they buy their lots. Admittedly, this is more a legal issue than a traffic issue; nevertheless, the Traffic Impact Study should address it in some manner.

Appendix

APPENDIX E: Level of Service Policy

(Proposed)
VERMONT AGENCY OF TRANSPORTATION (VTrans)
HIGHWAY DESIGN “LEVEL OF SERVICE” POLICY

Purpose:

The purpose of this policy is to establish a **highway design performance measure** which addresses mobility and capacity issues on Vermont roadways. The measure selected is the **Level of Service (LOS)** of a facility as defined in the latest version of the Highway Capacity Manual (HCM), also known as Transportation Research Board Special Report 209. This policy applies to all roadway facilities.

Please note that the agency has also developed performance measures and targets that address mobility at a corridor level for planning purposes. These measures are defined in the agency’s Highway System Policy Plan and include intercity travel times and volume to capacity (v/c) ratios for different land uses.

Policy:

All Facilities:

It is the agency’s policy to design its highways and to require others accessing its facilities to effect improvements that will maintain a LOS “C” for the prescribed design period. In interpreting this policy, LOS refers to the overall LOS for the particular facility as defined in the latest HCM. LOS is defined as a quality measure for various highway facilities, including freeways, two-lane rural highways, signalized and unsignalized intersections.

Reduced LOS criteria may be acceptable, when approved by the Secretary of Transportation or designee on a case-by-case basis, especially within densely settled areas. Such determination should take into consideration, at a minimum, the following:

- Current and future traffic volumes
- The delay incurred by the traveling public
- The volume to capacity (v/c) ratio
- Facility safety (crash rates)

Appendix

- The negative impacts (cultural, environmental, etc.) which may result to the surrounding area, because of improvements required to achieve a Level of Service “C” for the facility

In extreme circumstances, where the existing LOS is “F” and where the necessary geometric improvements are not feasible, LOS “F” may be acceptable, as long as improvements over existing conditions regarding safety and mobility of the traveling public can be demonstrated. Strategies effecting such improvements should include traditional traffic engineering approaches such as installation of traffic and pedestrian signals, adjustment to signal phasings and timings, modification to existing lane configurations, pedestrian crossings etc., in conjunction - where appropriate - with Transportation Demand Management (TDM) strategies. Examples of possible alternative strategies or improvements are listed in the *Transportation Demand Management Strategies* attachment. The attached list is not intended to be all inclusive and is provided for information purposes only.

Town and Regional officials should be consulted on any mitigation strategies proposed for projects under their jurisdiction or in their geographic area.

Two-Way Stop Controlled Intersections:

For two-way stop controlled intersections, the HCM does not define a procedure for obtaining an overall LOS or a LOS for major street approaches. Therefore, VTrans LOS Policy for two-way stop controlled intersections is to maintain a LOS “D”, for side roads with volumes exceeding 100 vehicles/hour for a single lane approach, or 150 vehicles/hour for a two lane approach. VTrans' main concern at unsignalized two-way stop controlled intersections is to minimize safety problems caused by vehicle operators exiting the stop-controlled side streets by accepting unsafe gaps in the major street through traffic.

This policy supersedes the policy dated July 25, 1996

EFFECTIVE DATE: _____

APPROVED: _____

DATE: _____

Neale Lunderville

Appendix

Secretary of Transportation

Attachment

Vermont Agency of Transportation

Highway Design “Level of Service” Policy

Transportation Demand Management (TDM) Strategies

<u>Strategy Type</u>	<u>Employer/Developer Provides</u>
1. Carpools/Vanpools	Preferential Parking Ride Matching onsite Financial Incentive Guaranteed Ride Home
2. Transit	Subsidized Passes Shuttle from Park & Ride lot or Transit Station Guaranteed Ride Home
3. Work Place	Showers and Bicycle Lockers Alternative Work Schedules Telecommuting Charging for Parking On-site Informational Programs
4. Infrastructure Investments Contributions to:	Park & Ride lots Bus Shelters Sidewalks Bicycle Lanes & Parking Shared Use Paths

NOTE: THIS LISTING IS NOT CONSIDERED TO BE ALL INCLUSIVE NOR IS ANY ONE EMPLOYER/DEVELOPER EXPECTED TO IMPLEMENT ALL STRATEGIES.

Appendix

APPENDIX F: Example Table of Traffic Volumes

Number	Route		AADT (1)	Year	Growth Factor (2)	How Obtained (3)	DHV (4)	How Obtained
	Segment							
	From	To						
U.S. 7	U.S. 4	TH 36	23,000	2004	Start	CTC R022	2290	200 HH (5)
U.S. 7	U.S. 4	TH 36	23,200	2006	1.01	CTC R022 Growth	2320	k Factor
U.S. 7	U.S. 4	TH 36	24,200	2011	1.05	Urban – Red Book	2420	k Factor

Notes:

- 1) Rounded to nearest 100
- 2) Actual factor from start year to designated year
- 3) Short reference – can be expanded in text of report
- 4) Rounded to nearest 10
- 5) 200 high hour report

Appendix

APPENDIX G: Roundabout Legislation

Sec. 37. LEGISLATIVE SUPPORT FOR ROUNDABOUTS

The general assembly finds that the installation of roundabouts at dangerous intersections in the state has been cost-efficient, and has enhanced the safe operation of vehicles at these locations. The agency of transportation is directed to carefully examine and pursue the opportunities for construction of roundabouts at intersections determined to pose safety hazards for motorists.

Appendix

APPENDIX H: Checklist for Bicycle and Pedestrian Considerations

1. Is the proposed development on a highway that limits access by bicyclists and pedestrians?

If YES, STOP – no further information on bicycle and pedestrian accommodation is needed.

If NO – Continue to other items on this checklist.

2. What existing bicycle and/or pedestrian facilities are located in the affected highway corridor:
 - Sidewalks
 - Crosswalks
 - Bicycle lanes (identified with specific signs and pavement markings)
 - Shared use path (note: paths may be outside the highway Right of Way)
3. Does the developer's site plan show continuity of bicycle and/or pedestrian facilities? E.g. if sidewalks on one or both sides of the parcel being developed, are connecting sidewalks being provided on the parcel proposed for development?
4. Are there provisions for bicyclists and pedestrians to safely access the development from the street? (note: this question may be relevant even if on a limited access highway IF served by public transit)
5. Do proposed traffic improvements (signals, turn lanes, etc.) maintain safe bicyclist/pedestrian access?
6. Are pedestrian phases included in any signal upgrades/installations?
7. If bicycle and/or pedestrian trips are being used to offset proposed vehicle trips or as a TDM measure, is the rationale for the number of trips reasonable?