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**Cape Cod Commission Guidelines for Transportation Impact Assessment**  
**Technical Bulletin 96-003**  
**Revised January 9, 2003**

- Part 1           DRI Overall Guidelines for Transportation Impact Assessment
- Part 2           Fair Share Overview and Methodology
- Part 3           Automobile Trip Reduction
- Part 4           Access Management
- Part 5           Functional Classification of Roads

This Technical Bulletin is intended for the use of planners and engineers in the preparation and review of traffic impact studies. Communities will also find these documents useful for local transportation planning.

Cape Cod Commission Guidelines for Transportation Impact Assessment  
Technical Bulletin 96-003

**Part 1 - Development of Regional Impact Overall Guidelines for  
Transportation Impact Assessment**

Revised January 9, 2003

The following guidelines were compiled as a representation of basic information to be included in traffic analysis sections of Development of Regional Impact (DRI) traffic assessments. Specific projects may warrant that additional information also be included. The primary intention of these guidelines is to ensure consistency among reports produced for review and that necessary information is developed in compliance with the Regional Policy Plan (RPP). The guidelines are outlined below. These guidelines are designed to be general and may be amended in the future as new research becomes available.

These guidelines are applicable to all projects to varying degrees. Not all of the guidelines must be fully addressed in a DRI traffic assessment for every project; however, any deviation from such should be justified and/or agreed to by the Cape Cod Commission (CCC).

A. Project Introduction

1. Proposal Description - A brief description of the proposed development and study area. The boundaries of this study area should be well defined and documented in the scope of the DRI traffic assessment but must include all Regional Roadway links and intersections where the development is expected to increase peak hour traffic. The total build-out of the development anticipated by the proponent must also be clearly stated.
2. Locus Map - to set context regionally
  - a. Site plotted centrally on United States Geographical Survey (USGS) map or similar Geographic Information System (GIS) map base;
  - b. Site plotted on State Highway Map or assessors map with locus defined; and,
  - c. Map showing proposed site in relation to existing passenger and freight facilities and lines including rail, bus, ferry, bicycling, and walking modes. Also, the map should include all sensitive receptors such as schools, hospitals, elderly housing, parks, etc. identified in the scope where appropriate.
3. Site Access and Context Map – A map at an appropriate scale showing site access as well as all properties and their accesses/driveways within 500 feet of the proposed development. The Map should also include any driveway interconnects to other properties as well as type and approximate size of nearby developments.
4. Site Plan - indicating proposed "footprint" of the project relative to other buildings on the site and showing all land owned by the proponent and all access to/from the site,

including bicycle, pedestrian, transit, and rail access where appropriate. A standard engineering scale should be used.

## B. Existing Conditions

1. Roadway Network - indicating jurisdictional responsibilities of each roadway link within the study area and indicating regional roadway links and intersections. (The road network should include all roads used to access the regional roadway network from the site, if applicable.)
2. Traffic Volumes - a Base Year traffic flow map should be developed covering the entire study area. The “Base Year” for all transportation review should be the year of the DRI application. Exceptions may be allowed by the CCC in unusual circumstances.

Peak Season average weekday volumes should be shown for 24 hours and the AM and PM peak hours in all cases. Saturday peak conditions should also be included for retail developments or other high weekend generators. Actual count volumes that are factored to base year levels should be no greater than two (2) years old and should include heavy vehicle counts. (Heavy vehicles are defined as any single or combination vehicle with more than two axles, 2-axle Recreational Vehicles, 2-axle box trucks, or buses.) Any adjustment factors or growth rates used should be cited and referenced. Actual traffic counts performed during April through November are preferred. Traffic studies based on counts conducted in December through March may be accepted at the discretion of the CCC, but require approval prior to submission.

Traffic volumes under average season conditions should also be included in the analyses. Adjustment factors used for non-peak traffic counts should be cited, referenced, and fully justified. The annual *Traffic Counting Report* published by the CCC provides seasonal variation factors.

3. Pedestrian and bicycle counts may be required for specific developments. Transit usage should also be quantified on a site-specific basis.
4. Air quality analysis may be required for specific developments.
5. Crash History and Analysis - a minimum of three (3) most recent years available to identify problem locations using state and local data. A written request should be made initially to the local police department and the Massachusetts Highway Department for crash records.

Analysis of crashes and the potential safety impacts of development and redevelopment must be included for all regional road links, at all intersections of regional roads, and at local road intersections with regional roads that are used by a project for access to the regional road network, where the project is expected to

increase traffic by 25 or more trips during the project's peak season peak hour. Locations with an average of three or more crashes per year or a higher than average crash rate, as compared to the latest three years of local, regional, or state data, shall require measures to mitigate potential safety impacts of the development and redevelopment to comply with Minimum Performance Standard 4.1.1.1. All measures to mitigate safety impacts must be consistent with Goal 4.1.3 and its supporting Minimum Performance Standards.

6. Capacity and Level of Service (LOS) Analysis – a Base Year capacity and level of service analysis shall be computed for the roadway network including site driveways, site access links and intersections (if appropriate), and all regional roadway elements (including links, intersections, U-Turns, rotaries, roundabouts, interchanges, bridges, etc.) LOS analysis shall include heavy vehicle percentages as measured and where appropriate. Performance indicators such as delay, travel time, v/c ratio, queue length, and traffic density, shall be documented in this section. A weave, merge, diverge and ramp road segment analysis shall be included where applicable. Also, departure lane merge capacity should be addressed as required and saturation flow rates adjusted accordingly. These analyses shall be performed using the most recent *Highway Capacity Manual*, and any updates published by the Transportation Research Board. If computer software is used for intersection analysis, the most recent version of Highway Capacity Software (HCS from the McTrans Center of the University of Florida, Gainesville) shall be used for analysis. Substitute software may also be used and will be considered for comparative analysis where applicable, such as SYNCHRO (from Trafficware of Albany, CA). SIDRA (from Akcelik & Associates of Melbourne, Australia) analysis is required for all analysis of rotaries and roundabouts.

LOS analysis shall be based on typical peak season worst case conditions as well as average season conditions. The CCC may also request examining a specific peak hour depending on the type of development and location. Generally, it is the hour during which the development has the greatest number of trips in and out (also called the “Peak of Generator”) which should be analyzed. Performance indicators such as volume to capacity ratio (v/c ratio), and delay should be reported regardless of value (e.g., v/c ratios greater than as well as less than 1.0, and seconds of delay greater than as well as less than 80 should be presented).

### C. Trip Generation

1. ITE Rates - the DRI traffic assessment should, as an initial analysis, use the unadjusted Institute of Traffic Engineers (ITE) rates for the particular land use code and be presented in this section of the report. The most recent edition of the *Trip Generation* manual published by ITE should be used for all land use codes. Trip generation should be developed using the "fitted curve" equations when statistically appropriate and used according to the methods outlined. Trip generation should be based on square footage in the case of most commercial development and on units in the case of most residential development. An alternative basis may be allowed by the

CCC where appropriate. For peak hour analyses, the “Peak of Generator” trip generation will be used.

2. Alternative Trip Generation - may be submitted and will be considered for comparative purposes where appropriate. Alternative Trip Generation may be accepted and/or recommended by the CCC. Any alternative trip generation should meet, at a minimum, the ITE guidelines for alternative studies as noted in the *ITE Trip Generation Handbook, October 1998* or its updates if published by ITE.
3. In some multi-use developments, land use interactions may reduce trip generation. The ITE method outlined in *ITE Trip Generation Handbook, October 1998* or its updates if published by ITE should be followed. All resulting reductions are to be documented.
4. In the case of developments within Growth/Activity Centers (See MPS 4.1.3.3), a 10% reduction of peak hour trip generation is allowed and for Growth Incentive Zones, a 25% reduction of peak hour trip generation is allowed for the purposes of analyzing peak hour impacts. However, neither are applicable to site driveways on regional roadways, or local roads used to access a development. These amounts should be outlined in a table. (Note that these reductions do not apply to trip reduction requirements as shown in Part 3 of these guidelines. See 7. below.)
5. An estimate of new heavy vehicle traffic to the site should also be included to assist in LOS analysis and trip reduction analysis under Build conditions.
6. The order in which the various adjustments to trip generation are to be computed is as follows:
  - a. Base trip generation from ITE (Weekday, AM peak hour of generator, PM peak hour of generator, Saturday, Saturday peak hour of generator);
  - b. Multi-use development interaction reduction (if applicable) based on ITE methodology;

After steps a. and b., the 25% weekday trip reduction requirement of Goal 4.1.2 is calculated.

- c. Reduction of Peak Hour trips by 25% for (required) trip reduction program / mitigation
- d. Reduction of Peak Hour trips by 10% if in a certified Growth / Activity Center and a reduction of 25% if in a certified Growth Incentive Zone.

For example, a large, multiuse development may generate 4250 weekday average trips and 450 Saturday peak hour trips (step a.). The ITE land-use interaction method may reduce this to 4000 weekday trips and 430 Saturday peak hour trips (step b). Then, the 25% weekday trip reduction requirement is 25% of 4000 or 1000 trips.

Next, the peak hour trips are reduced through trip reduction by 25% to 323 trips (step c.) The project is also in a certified Growth / Activity Center. The peak hour trips are reduced by another 10% to 290 peak hour trips. From this number, additional new trips / pass-by trips breakout as noted below may be applicable.

#### D. Trip Distribution

1. Distribution - all generated vehicle trips to/from the site through all access points are to be documented. The following trips should be considered for all developments:
  - a. Primary/Site - "one which the purpose of the trip is shopping and the trip pattern is generally home-to-shopping-to-home."
  - b. Pass-By/Site - "directly from the traffic stream passing the facility on the adjacent street system and does not require a diversion from another roadway."

The amount of "Pass-by" trips should be based on the most recent data from ITE, but should be no more than the amount allowed by MEPA or 25%, whichever is lower. Pass-By/Site trips credits may be allowed for the following land uses:

Retail, banks, supermarkets, hardware stores, convenience stores, fast-food and high-turnover restaurants, gas stations, building material stores (provided a majority of the business sales are to retail, not wholesale, customers), video rental stores, pharmacy / drug stores

No pass-by trip credit should be taken for the following uses:

Residential, medical and dental offices and clinics, hospitals, churches, schools, offices, libraries, industrial, manufacturing, warehousing, self-storage, automotive sales and services, theatres, golf courses and driving ranges, arenas, athletic facilities and fields, gyms, casinos, bowling alleys, and night clubs.

The CCC should be consulted if additional clarification is needed.

A development within 500 feet of a regional roadway/intersection with average daily traffic flows which will support the development may be able to take up to the maximum pass-by trip credit (see above guidelines) for regional roadway links and intersections beyond this regional roadway/intersection. All roads/intersections connecting from the development to this supporting roadway should consider all trip generation (i.e. no pass-by credit.) The key regional roadway access intersection analysis should consider additional turns created by pass-by traffic.

Developments not within 500 feet of a regional roadway capable of supporting the development will only be allowed pass-by trip credits limited to the adjacent street peak hour trips multiplied by the appropriate pass-by rate (see above guidelines.)

2. Trip generation summary – a graphical or tabular summary of trip distribution and trip generation outlining “new trips” to and from the proposed development should be submitted.

E. Future Conditions

1. Traffic Volumes - for the "no-build" and "build" scenarios should be graphically shown for the AM, PM, and if applicable, Saturday peak hour of generator peak season and average season. Future conditions should cover a five-year time horizon as a minimum. This five-year horizon should be from the “Base Year” as defined in section B-2.
  - a. A graphical summary should be submitted showing the five-year (from Base Year) “No Build” traffic volumes. Background baseline traffic growth should be included in future year background volumes. The traffic assignment for all other planned developments should be combined with future year background volumes to develop the "no-build" traffic volumes.
  - b. A graphical summary of project-generated new trips on regional roadway links and intersections after adjustments should be submitted which includes increased peak hour trip distribution to the last trip.
  - c. The traffic assignment for the proposed development should then be added to the “no-build” volumes to generate five-year "build" volumes.
2. Current Projects - table of DRI, local and/or MEPA projects, transit service, and infrastructure improvement projects within the study area covering at a minimum a five-year time horizon. Proponents should contact state agencies, the CCC, and local communities regarding the impact of other known projects in the affected study area to determine how to incorporate those impacts in the study.
3. Capacity Analysis and LOS Analysis - capacity and LOS under future conditions should be computed for no build and build, without and with mitigation measures in place, for peak and average season. The performance indicators as documented above in the Existing Conditions section of the report should again be computed and depicted in tabular form. The analysis must cover all regional roadway elements, site driveway intersections, and any intervening roadways between the development and the regional roadway access. Where applicable, heavy vehicle percentages are to be estimated from actual data and included in the LOS analysis.
4. Signal Warrant Analysis - using the most recent edition of *Manual on Uniform Traffic Control Devices Handbook*, Federal Highway Administration (FHWA). Locations to be analyzed include all unsignalized study area intersections.
5. Summary - tabular summary comparing level-of-service performance indicators for base-case, five-year "no-build", and five-year "build" scenarios.

## F. Mitigation Measures

All assessments should include but not be limited to the following:

1. Mitigation Actions - future year performance degradation must be fully mitigated to equivalent "no build" levels of performance indicators such as delay and v/c ratios. Improvements should address safety-related problems at high crash locations as identified in RPP Goal 4.1.1.
2. Additional Analysis - capacity analyses of all mitigation measures should be computed as outlined above. Impacts on wetlands, archaeological resources, right-of-way availability, historic resources, scenic resources, community character, etc., should also be examined for all mitigation proposed to determine the feasibility of implementation. Impacts of traffic mitigation on air quality may be necessary when required by MEPA or when the increase in raw trip generation is 3,000 or more daily vehicle trips. The most current emissions model should be used, if an analysis is required.
3. Optional Mitigation – under certain circumstances, it may possible to mitigate the impacts of development on parts of the Regional Roadway system which are impacted by fewer than 25 trips through a transit equivalency buyout. The applicant should discuss the possibility of using this buyout with the CCC before applying it. If approved for use by the CCC, the following procedure should be followed:
  - (a.) The applicant should choose a study area wide cutoff for actual peak hour mitigation by selecting a number of new peak hour trips of less than 25.
  - (b.) For all links inside the “cutoff”, a summation of the vehicle miles of travel (VMT) covered in the actual mitigation plan should be calculated by multiplying the number of peak hour peak season trips on each Regional Roadway link by the length of each link, and summing over the links inside the cutoff.
  - (c.) The overall VMT of the project should be calculated by multiplying the project’s new peak hour trips by the “analysis trip length” as defined in Part 3 of these guidelines.
  - (d.) The remaining VMT to be mitigated should be calculated by subtracting the result of (2.) from the result of (3.). This net VMT should be mitigated through a fee paid to CCC/Barnstable County based on the transit equivalency of this VMT as outlined in Part 3 of these guidelines. These funds will be expended by the CCC to improve transportation in the project’s study area and/or town(s) and/or according to MPS 4.1.3.4.
  - (e.) The applicant is still responsible for providing mitigation as directed by MPS 4.1.3.4 and other RPP requirements for all links and intersections inside the cutoff area.



4. Commitment - the report should clearly identify the individual costs of the proposed improvements. Conceptual improvement plans should be developed showing the recommended proposed improvements. The party agreeing to be responsible for the implementation of the proposed improvements should also be clearly identified. A mechanism by which these commitments will be executed and their intended duration should be indicated where applicable. Also, a schedule of when, in relation to any project phasing, particular improvements need to be implemented, should be outlined.
  5. On-Site Improvements - the proposed site layout in relation to the existing right-of-way should be clearly shown. Also, the following should be included:
    - a. Scaled plan showing existing and proposed layout lines, building and parking lot areas, driveways and land usage.
    - b. Proposed geometric changes and widening (driveways, storage lanes, and acceleration/deceleration lanes).
    - c. Construction Schedule - of proposed mitigation measures for construction traffic impacts, noise and dust pollution from construction equipment, and any capacity restraints on the existing network during construction.
  6. Off-Site Improvements - the proposed improvements in relation to the existing right-of-way should be clearly shown. Also, the following should be included:
    - a. Scaled plan showing existing and proposed layout lines;
    - b. Proposed geometric changes and widening (storage lanes, acceleration/deceleration lanes);
    - c. Proposed signalization and/or signal improvements including conceptual phasing and timing; and
    - d. Implementation Strategy and Construction Schedule - of proposed mitigation measures for construction traffic impacts, noise and dust pollution from construction equipment, and any capacity restraints on the existing network during construction.
  7. Fair Share Mitigation Analysis – include all proposed fair share analysis and commitment per Part 2 of the Technical Bulletin
- G. Trip Reduction Measures – Per Part 3 of the Technical Bulletin including Trip Reduction Plan, Trip Reduction Calculations, Land Donation Analysis, Transit Equivalency Calculations, etc.

## H. Other Analysis which Should Be Included:

- a. Stopping sight distance analyses / sight distance measurements - sight distance requirements according to the most recent *A Policy on Geometric Design of Highways and Streets* published by the American Association of State Highway and Transportation Officials (AASHTO) must be addressed. This includes Stopping Sight Distance at proposed site drives and affected area intersections. Include letter signed by a licensed professional engineer or licensed surveyor certifying sight distances.
- b. A parking analysis including the number of required spaces under town zoning and the number of proposed spaces. If any additional parking spaces above zoning are proposed, an analysis as to why the spaces are needed must be submitted for Commission review based on MPS 4.1.2.6. The analysis should be objective and consistent with ITE's Parking Generation or other such national studies based on actual parking accumulation.

## I. Appendix

The following list identifies data that should be included in each report. This list is to be consistently followed when displaying data and analyses:

1. Recorded traffic counts
  - a. Turning movement counts, including heavy vehicles
  - b. Directional volume counts
  - c. Existing AM/PM peak period and 24 hour traffic volumes including Peak Hour Factors by approach
  - d. Future year peak hour traffic volumes
  - e. Adjustment factors and sources
2. Preliminary sketches and layout plans
3. Capacity and LOS analysis data
  - a. Lane geometry
  - b. Assumed signal phasing and timing
  - c. Assumed saturation flow rates
  - d. All worksheets or computer outputs
4. ITE land use code sheets or other summary sheets showing trip generation calculations
5. ITE multi-use development trip reduction estimate sheets, if applicable
6. Signal warrant analysis sheets

## J. Analysis and Design Standards

The most recent editions of the following publications are applicable:

1. *Highway Capacity Manual*, Transportation Research Board.
2. *Trip Generation*, Institute of Transportation Engineers.
3. *Manual on Uniforms Traffic Control Devices Handbook and Massachusetts Amendments*.
4. *Massachusetts Highway Department Design Manual*.
5. *American Association of State Highway and Transportation Officials (AASHTO) Handbook*.
6. *Parking Generation*, Institute of Transportation Engineers.

Cape Cod Commission Guidelines for Traffic Impact Assessment  
Technical Bulletin 96-003

**Part 2 - Fair Share Overview and Methodology**  
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The Cape Cod Commission Regional Policy Plan (RPP), includes the following Minimum Performance Standard (MPS) regarding mitigation of transportation impacts:

**MPS 4.1.3.4** Developments of Regional Impact shall ... provide for full mitigation of project impacts on all regional road links, at all intersections of regional roads, and at local road intersections with regional roads that are used by the project for access to the regional road network... In lieu of mitigation of traffic impacts concurrent with project development, the Commission, at its discretion, may allow a fair-share payment of funds to Barnstable County...

Other MPS outline acceptable mitigation strategies. Please refer to Goal 4.1.3 of the RPP

**Introduction**

The provision for a payment of funds commensurate with project impacts in RPP Minimum Performance Standard 4.1.3.4 necessitates a reasonable and rational method for determining fair share financial contributions for traffic mitigation proposed by Development of Regional Impact (DRI) applicants.

The method outlined in this part of the Technical Bulletin is most likely to be used in the evaluation of automobile traffic impacts on intersection capacity.

The Commission may require improvements or a fair share financial contribution towards the cost of constructing capacity improvements to the regional roadway system and connectors necessitated by traffic attributable to the development of the project site. These improvements include mitigation strategies described under RPP Goal 4.1.3.

Improvements that benefit only the applicant shall be entirely the applicant's responsibility and are not considered in the fair share determination. Examples of this may include acceleration and deceleration lanes for site access points, left turn lanes which only provide access to the site, and traffic signals located at the applicant's driveway(s).

**Methodology**

Applicants are responsible for mitigation at each Study Area Location where, after adjustments, there is an increase in traffic during the project's peak hour as outlined in MPS 4.1.3.4.

Mitigation at each study area Location shall, at a minimum, be designed to add capacity sufficient to accommodate the background traffic anticipated under the analysis year determined for the project scope, as well as the applicant's DRI traffic while maintaining or improving

performance indicators (average delay, reserve capacity, volume/capacity [V/C ratio], etc., as appropriate). Such mitigation must be in accordance with the access requirements, standards, and policies of the appropriate state, regional, or local jurisdictions as determined by the Commission. Fair share contributions are at the discretion of the Commission. In addition, such mitigation shall be consistent with RPP Goal 4.1.3. Thus, proposed fair share contributions shall not be acceptable at locations where any of the following is true:

- The intersection or road link will operate at LOS E or F without actual improvements, due to the resulting safety hazards (MPS 4.1.1.1.);
- A safety deficiency exists under Base Year no-build conditions (MPS 4.1.1.1 and MPS 4.1.1.8);
- The “fair share” mitigation would degrade community character, scenic resources, and/or natural resources (MPS 4.1.3.13); and
- The “fair share” mitigation involving signalization, intersection widening, or road widening is in local or national historic districts (MPS 4.1.3.13).

The *Capacity Addition* created by mitigation is equal to the *Capacity With Mitigation* minus the *Capacity Without Mitigation*. *Capacity* means the maximum traffic volume possible with LOS E. When more than one measure of LOS is possible at a Location, such as the various movements at an unsignalized intersection, then the most sensitive measure, i.e., any one movement operating at LOS E/F, is the movement used to determine the capacity. Traffic volumes for all movements should be factored by a constant so that all movements will remain a fixed percentage of the total volume at the Location. The sum of the volumes of all movements is the Capacity for that scenario. Capacity Without Mitigation will be that of the given Location's existing geometric configuration under prevailing traffic conditions (such as peak hour factor, vehicle mix, and other assumptions consistent with the pattern of existing traffic and projected traffic growth) combined with DRI traffic (and then factored to meet the LOS E maximum volumes). Capacity With Mitigation will be that of the given Location's proposed (mitigated) configuration under prevailing traffic conditions, given the pattern of existing traffic and projected traffic growth combined with DRI traffic (and then factored to meet the LOS E maximum volumes.)

$$\text{Capacity Addition} = \text{Capacity With Mitigation} - \text{Capacity Without Mitigation}$$

The fair share proportion at a Location is equal to the DRI Traffic divided by the Capacity Addition, as reflected in the following formula:

$$\text{Fair Share Proportion} = \text{DRI Traffic} / \text{Capacity Addition}$$

The cost of mitigation at a Location is the public cost for the responsible agency(ies) to provide the mitigation. This includes the following Mitigation Elements:

1. Design of the mitigation;

2. Right-of-way appraisal and acquisition;
3. Construction of the mitigation;
4. Inspection and management of the construction; and
5. Environmental cleanup, permits, and mitigation.

Mitigation Cost = Sum of the above Mitigation Elements

The fair share at a Location is equal to the fair share proportion times the cost of the mitigation, as reflected in the following formula:

Fair Share = Fair Share Proportion x Mitigation Cost

The applicant's Fair Share Contribution at each location is equal to the Fair Share at each location less the estimated value of Mitigation Elements (item h. above) performed at the expense of the applicant for the specific location prior to the issuance of a certificate of compliance. The Fair Share Contribution should likewise be reduced by the amount, if any, which is assessed in other agencies' transportation impact fees and the transportation portion of municipalities' local impact fees which are directly related to the specific location.

Fair Share Contribution = Fair Share - (Performance of Mitigation Elements + Transportation Impact Fees)

The Fair Share Total Contribution is equal to the sum of the applicant's fair shares at all locations.

Fair Share Total Contribution = Sum of all Locations' Fair Share Contribution

For Locations which have been analyzed through a previous DRI review, and where such Locations were (1) identified for necessary improvements and (2) improvements are already constructed or construction is pending, subsequent DRIs impacting the Location may make a fair share contribution if the additional DRI traffic does not degrade LOS of the improved location beyond LOS D. In limited circumstances, the applicant may make use of Fair Share analyses created by previous DRIs, subject to CCC review. The Fair Share Process may be applied to subsequent DRIs in the same manner as stipulated above.

Cape Cod Commission Guidelines for Traffic Impact Assessment  
Technical Bulletin 96-003

**Part 3 - Automobile Trip Reduction**

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This part of the Traffic Impact Assessment Technical Bulletin describes approaches to meeting the goal of the Regional Policy Plan to reduce dependence on automobiles. In particular, it discusses approaches to meeting Minimum Performance Standards (MPS) under goal 4.1.2:

“To reduce and/or offset the expected increase in motor vehicular trips on public roadways and to reduce dependency on automobiles.”

**Background**

Providing alternative modes of transportation to reduce the region's dependence on the automobile is an important goal of the Regional Policy Plan. No less than 85% of the respondents to the 1995 Cape Cod Residents Survey wanted to encourage the provision of alternate modes of transportation. Reducing our dependence on the automobile is a significant challenge and an ambitious goal. Many of the goals and strategies of the Cape Cod Commission and the towns are to encourage alternatives to automobiles. To achieve these goals, the Regional Policy Plan requires Developments of Regional Impact to offset a minimum of 25% of their projected traffic volumes with alternatives to automobile travel (refer to MPS 4.1.2.1.). Possible strategies include carpooling programs, enhanced pedestrian and bicycle accessibility and transit.

**Methods and Strategies**

The first step in complying with RPP Goal 4.1.2 is to determine average traffic generated for that land use. Sources of this data typically include the Institute of Transportation Engineers (ITE) Trip Generation or may include observations of similar land uses. See Part 1 of these guidelines for additional requirements and multi-land use development adjustments. Also, heavy vehicle volumes should be estimated. Consistent with MPS 4.1.2.1, any vehicle with more than two axles shall be counted as the ratio of the number of vehicle axles to two. For example, a development expected to generate ten, 5 axle truck trips per day, shall subtract 10 ten trips from the estimated weekday traffic and add  $(10 * 5)/2 = 25$  trips to the weekday trip generation estimate. (This trip generation adjustment is for trip reduction purposes only and is not included in the peak hour analysis. Peak hour analysis should account directly for heavy vehicle traffic. See Part 1 of the Technical Bulletin for more information.)

The required trip reduction is 25% of the average daily traffic generated by that type of land use. MPS 4.1.2.2 requires trip reduction of only 12.5% of average weekday traffic for development within Growth Incentive Zones. For such developments, the full 25% peak hour trip reduction for purposes of peak hour traffic analysis is allowed when the 12.5% trip reduction is met.

Applicants may propose a combination of the strategies identified below to achieve the required trip reduction. In all cases, applicants are encouraged to identify and evaluate strategies that are

appropriate for their project. Sources of data should be identified and methods used should be justified.

- In-kind strategies are those that the applicant can and will implement as a condition of the project. These may include enhancing bicycle and pedestrian access to a project, implementing shuttle service to and from the project, and carpooling. The effectiveness of various strategies depends on the type of land use, proximity to existing transit corridors, walking and bicycling characteristics of the area and other factors.

Additional transportation demand management ideas include:

Support Measures	Transportation Services	Economic Incentives
Preferential parking for car/vanpoolers	Provide/subsidize vans for vanpoolers	Subsidize transit passes
On-site bicycle racks/lockers	Provide public transportation	Incentives and allowances for using alternate modes of transportation
Showers and changing facilities for bikers / joggers	“Guaranteed ride home” program (company car, rental car, cab, designated driver)	--
Arrange employee work hours to match transit schedules	Park & ride lots	--
Compressed work weeks		--
Flexible work hours for ridesharers		--
Transportation coordinator	--	--
Trip reduction monitoring program	--	--
Delivery services	--	--

- In addition, MPS 4.1.2.4 allows a portion of the trip reduction to be met through transit when a transit service is located immediately adjacent to a development. The trip reduction program should include securing (or maintaining) a bus stop and/or shelter at the location and employee / customer use incentives such as discount passes, posted schedules, etc. The credit for developments with adjacent year round service is 5% and with seasonal only service (running a minimum of eight weeks including July and August), 2.5% of the average daily traffic.
- A financial commitment to a strategy may also be used to comply with RPP Goal 4.1.2. For example, a project could participate in funding a project to initiate and operate variable message signs or information programs to reduce automobile travel on Cape Cod. The amount paid depends on the program cost and the expected traffic reduction. The principles of Part 2 - Fair Share should be followed.
- Donation and permanent conservation of land above other open space requirements capable of producing the number of trips to be reduced is allowable under the RPP. (MPS 4.1.2.7 a) At a minimum, the preservation of vacant developable land should meet the following requirements:



- The land should include the entirety of an individual, buildable lot;
  - The lot should be permanently protected through donation to a conservation entity such as a town conservation commission or an appropriate non-profit land trust, or through a MGL, Chapter 184, §§31-33 conservation restriction. The method of protection must extinguish future development potential, including prohibiting access to offsite development through the protected parcel;
  - The lot should have legal frontage;
  - The lot should meet the zoning requirements in effect including allowed use, minimum lot size, front, side, and rear setbacks, maximum building and lot coverage, maximum building height;
  - The theoretical use of the property should be allowed under zoning;
  - The theoretical use trip generation credit should be based on the same land use and trip generation values/formulas as the development trip generation; and,
  - In the case of commercial development, it is possible to conserve residentially zoned property provided it meets the requirements above. The trip generation credit would be for theoretical residential development, not commercial development on residentially zoned land.
- A monetary commitment to public transportation, based on the estimated cost of public transportation and the expected vehicle miles traveled by automobiles to and from the site, and the expected term of the project, for a period not less than 20 years. The use of standard values and cost estimates for the monetary commitment to public transportation should be used as identified below (See example estimation sheet at end of this section):

### TRIP LENGTH

(to be filled in on line 2. of the Transit Equivalency estimation sheet)

Project Use	Analysis Trip Length	Basis
Residential	4.64	Average Returning Home Trip Length
Retail	2.75	Average Shopping Trip Length
Medical / Dental / Hospital	4.82	Average Medical Dental Trip Length
Church	3.25	Average Religious Trip Length
School / College	4.98	Average School Trip Length
Office	6.19	Average Earn a Living General Cat. Trip Length
Library	3.44	Average Other Family / Personal Business Trip Length
Industrial	6.19	Average Earn a Living General Cat. Trip Length
Manufacturing	6.19	Average Earn a Living General Cat. Trip Length
Movie / Theater	5.7	Average Other Social / Recreational Trip Length
Restaurant	3.2	Average Out to Eat Trip Length
Hotel / Motel	4.07	Avg. of Out to Eat, Other Soc.& Rec., Shopping, and Return Home
(Private) Sports / Recreation (including golf, spectator, etc.)	5.7	Average Other Social and Recreational
Mini Warehouse / Self Storage	3.44	Average Other Family & Personal Business

Project Use	Analysis Trip Length	Basis
Automotive Sales / Service	3.44	Average Other Family & Personal Business
Bank	3.44	Average Other Family & Personal Business

Base: All lengths one-half 1995 National Transportation Survey for each category.  
Note: Table subject to update and changes as new information becomes available. New National Passenger Transportation Survey data is expected early 2003. Check with the CCC for latest values.

### TRANSIT COST

(to be filled in on line 5. of the Transit Equivalency estimation sheet)

Year of DRI Approval	Bus Cost
2002	\$50.06
2003	\$51.81
2004	\$53.63
2005	\$55.50
2006	\$57.45
2007	\$59.46

Table subject to update and changes as new information becomes available. Check with the CCC for latest values.  
Based on CCRTA data.

**Transit Costs** - Transit costs are tied to capital equipment and labor costs, which often rise faster than inflation. As of August, 2002, the CCC recommends 3.5% transit inflation rate on line 12 of the estimation sheet. Check with the CCC for changes.

**Escrow Interest** - Long term interest rates vary over time. As of August 2002, the CCC recommends 1.5% interest earned on escrow on line 13 of the worksheet. Check with the CCC for changes.

**Calculation of Factor** - The calculation to determine the factor on line 15 is as follows:

Define: Transit inflation rate = t (as a fraction)  
Interest earned on escrow = e (as a fraction)  
Years of Operation = m

Then the factor (line 15) is:

$$\{ [(1+t) / (1+e)]^m - 1 \} / \{ [(1+t) / (1+e)] - 1 \}$$

## **Plan Publication and Information**

Final trip reduction plans may be published by the CCC on its transportation website to inform the public of the plan. In addition, all plans should include a provision to post the following web address: [www.gocapecod.org/tdm](http://www.gocapecod.org/tdm) (or similar CCC address per CCC direction) in trip reduction literature, at ride matching boards, in employee trip reduction reminders, etc.

**Transit Equivalency:  
Example Calculation**

Line

1.	Identify number of trips	300 trips per day
2.	Identify average trip length (see Technical Memorandum)	4.64 mile(s)
3.	Determine 25% of total VMT	25% x 300 x 4.64 = 348 daily VMT

4.	Year of DRI Approval	2003
5.	Transit Cost	\$ 51.81 per hour
6.	Bus Capacity	30 seats
7.	Bus Operating Speed	20 mph
8.	Assume 100% Occupancy	

9.	Cost per passenger	\$51.81 ÷ 30 ÷ 20 = \$0.09 per mile
10.	Daily Cost	348 x \$0.09 = \$30.05 per day
11.	First Year Cost	365 x \$30.05 = \$10,968

<u>Analysis for One Time Payment</u>		
12.	Transit Inflation Rate	= 3.5%
13.	Interest Earned on Escrow*	= 1.5%
14.	Years of Operation	= 20
15.	Factor based on inflation, interest, & years of operation	= 24.2260
16.	20 years of operation, one time payment is	
	24.2260 x \$10,968 =	\$265,700

\*Consult CCC staff for current available rate

Cape Cod Commission Guidelines for Traffic Impact Assessment  
Technical Bulletin 96-003

**Part 4 - Access Management**

Revised January 9, 2003

In the past, traffic congestion was generally alleviated through roadway widening and new road construction, not by finding more efficient ways of using the existing roadway system. In the past, lack of access management and the proliferation of driveway access to major roadways resulted in the public funding the widening of roads, upgraded infrastructure, and the construction of new roads. Recently, this approach is becoming less feasible. Coordination of land use and transportation planning through access management can benefit all users of Cape Cod roadways and businesses along roadways that are experiencing deterioration in accessibility and safety.

Recent legislation encourages finding ways to more efficiently manage our current transportation system. Nationally, federal funding is being reduced for roadway system expansion through the Clean Air Act Amendments of 1990, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), and the Transportation Equity Act for the 21<sup>st</sup> Century of 1998 (TEA21). Regionally, Barnstable County's Regional Policy Plan echoes this direction through its goals and policies. Locally, each town's Local Comprehensive Plan provides a look into the future with these goals and policies in place.

This technical bulletin assists landowners and local officials in establishing the balance between land access and mobility for various types of roads. Towns may incorporate access management in their local comprehensive planning and in their local regulations through the regulatory powers of their local Planning and Zoning Boards.

**What Is Access Management?**

Access Management is a way to organize traffic movements to better use existing roadway capacity that results in continued economic viability of adjacent land development. Corridors where access management is employed can sustain a higher level of development. Access management is also a way to lengthen the useful life of roadways without adding traffic lanes. This is accomplished through controlling access location and spacing, prohibiting turn movements, provision of turn lanes, location of median barriers, and access geometry.

Every driveway creates the potential for accidents at "conflict points", where the paths of traffic traveling the roadway intersect with the paths of traffic turning into and out of driveways. Reducing the number of driveways and increasing the spacing between driveways and intersections separates these conflict areas. See Figures 1 through 3.

Appropriate driveway spacing simplifies the driving task by locating driveways along the roadway such that drivers can monitor one driveway at a time, rather than several simultaneously. Longer driveway spacing reduces the amount of information a driver must acquire, process, and react to, thus simplifying the driving task. Shorter driveway spacing

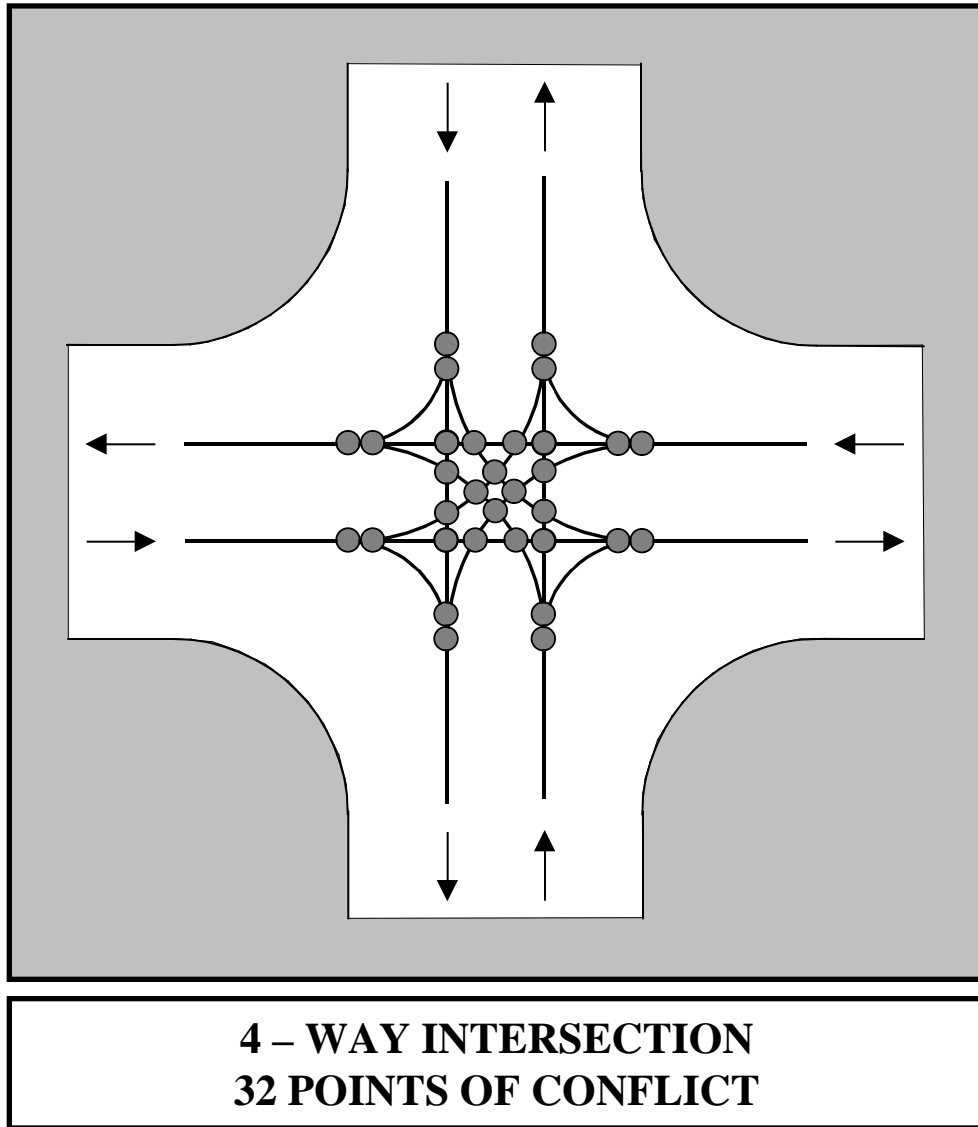


Figure 1  
*Access Management*

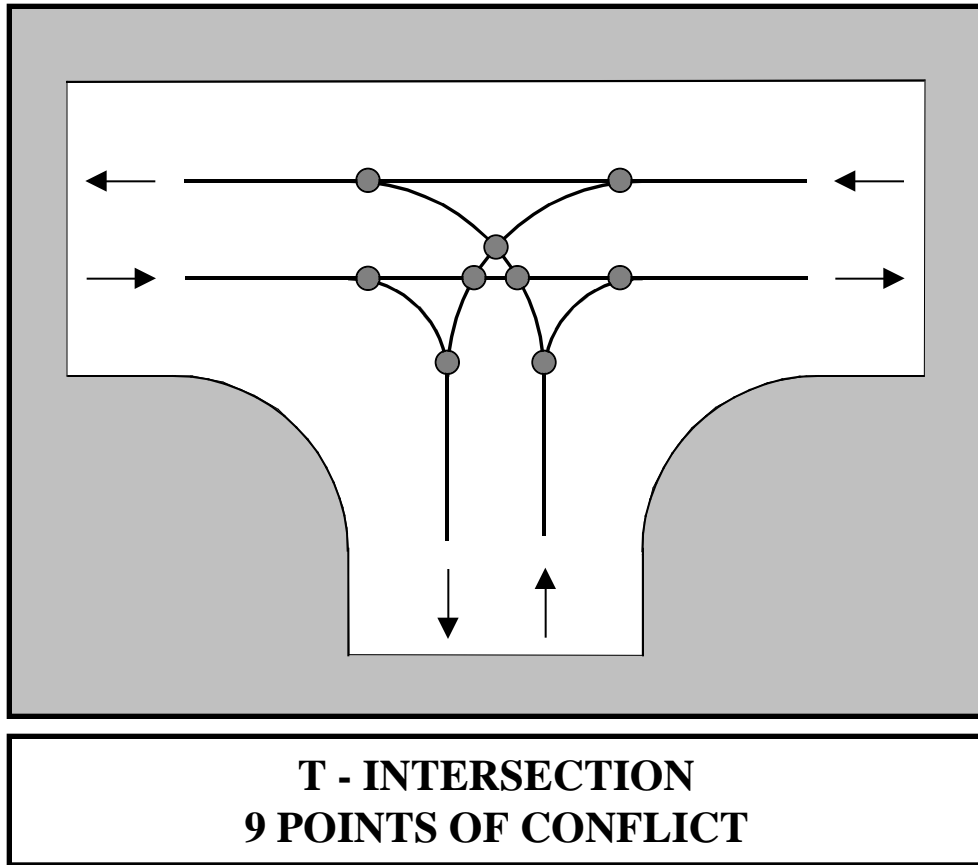
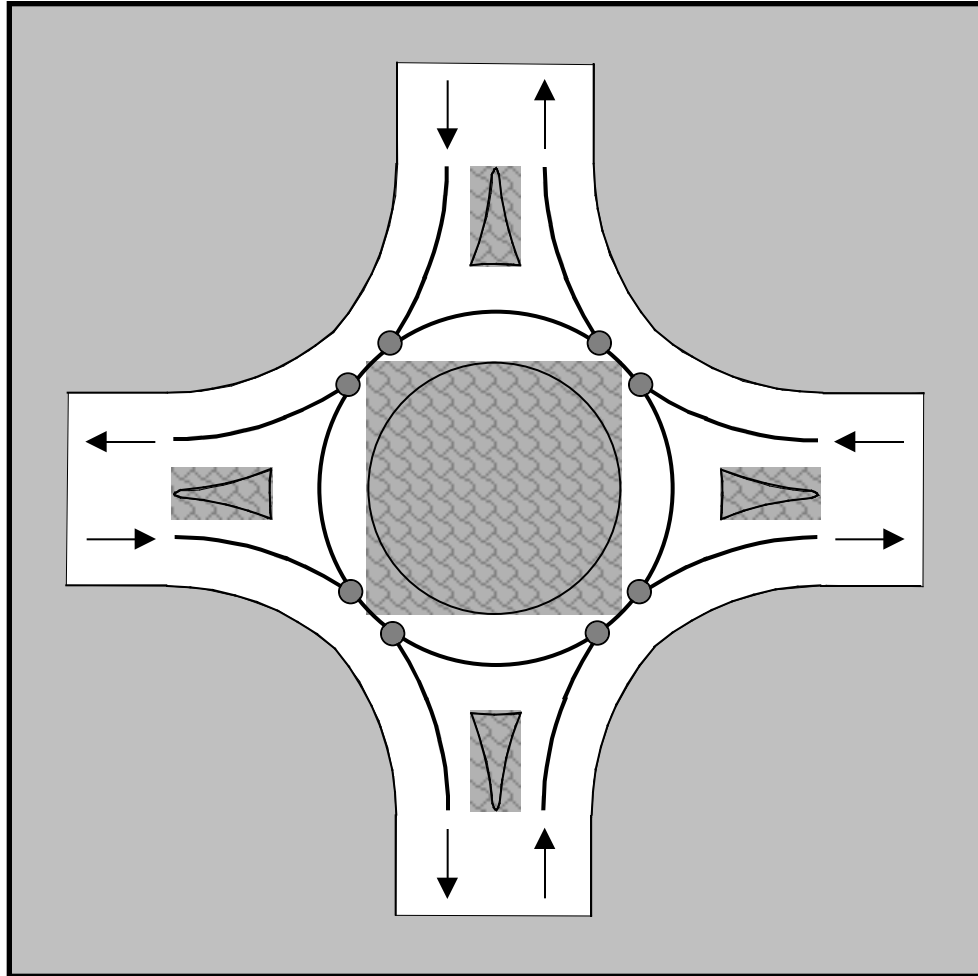


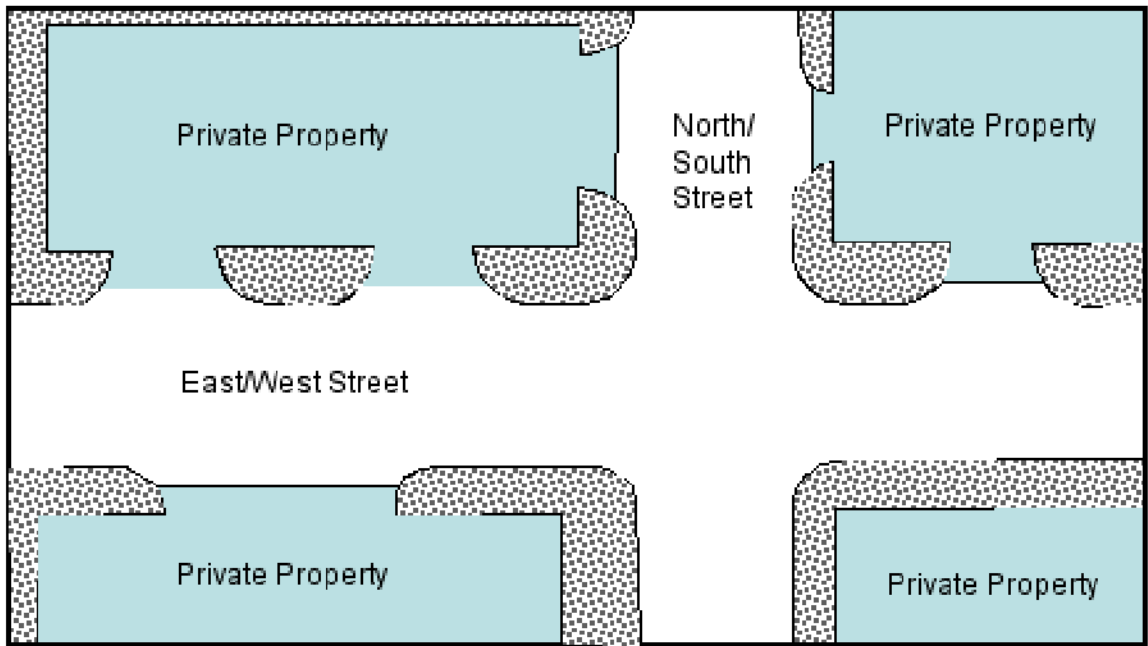
Figure 2  
*Access Management*



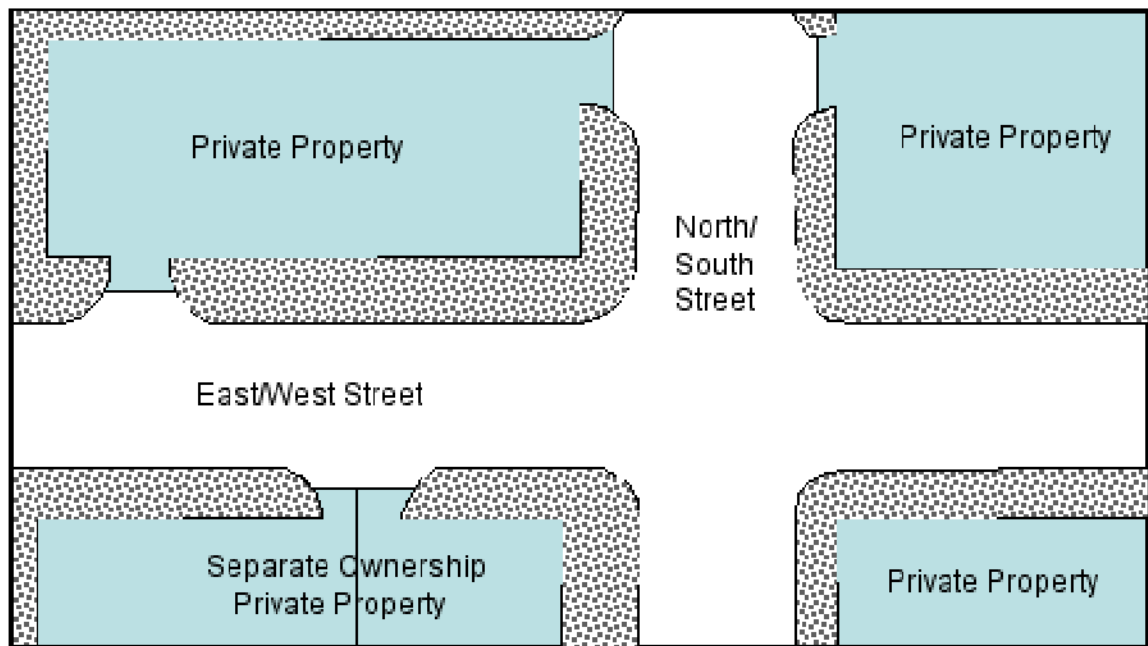
**ROUNDAABOUT  
8 POINTS OF CONFLICT**

Figure 3  
*Access Management*





**EXAMPLE OF POOR ACCESS MANAGEMENT**



**EXAMPLE OF BETTER ACCESS MANAGEMENT**

Figure 4  
*Access Management*

requires the driver to watch for traffic entering and exiting several driveway locations at once while maintaining control of his own vehicle. Figure 4 shows examples of poor and better access management.

### **Advantages of Access Management**

The economic viability of adjacent land development along a roadway experiencing traffic congestion and high accident rates will be impacted by further deterioration in traffic conditions. Without restrictions on access, traffic congestion will increase, lower travel speeds will result, and longer travel delays and higher accident rates will occur throughout the corridor.

With access management, a greater amount of development can be served by a roadway because a greater amount of traffic can be served with longer driveway spacing, better access location, coordinated traffic control and better driveway design. It is a valuable tool for preventing the loss of roadway capacity that often accompanies high traffic generating development. The loss of roadway capacity most often occurs along roadway corridors with numerous adjacent commercial developments such as Route 28 in Yarmouth, Route 6 in Eastham, and Route 6A in Orleans.

Access management applied to arterial roads can maintain the road's function within the overall transportation system to serve through traffic, resulting in higher accessibility in the region. Access management measures that separate turning vehicles from through vehicles create more efficient flow of traffic and minimize accidents.

Barnstable County's Regional Policy Plan recommends that each town identify areas in need of access management techniques to minimize accidents and relieve traffic congestion. A critical time to consider access changes occurs when new development is proposed and when adjacent roadway and intersection improvements are proposed.

This technical bulletin is intended to promote awareness of the impact of continued uncontrolled access and consideration of access management as a way for local authorities to deal with congestion. It also reviews some of the access management requirements of the Regional Policy Plan.

### **Access Management Techniques**

The most effective use of the following techniques is when new developments are being proposed, when redevelopment or change of use occurs, and when roadway and traffic control improvements are planned. Traffic impact studies provide an opportunity to address access management. Economic incentives may also be a feasible way to encourage access management for existing businesses.

### **Relating Roadway Function With Land Access And Mobility**

The relationship between mobility and land access for various classifications of roadways is shown in Figure 5. Higher mobility is characterized by higher speeds and uniform traffic flows

**PROPORTION OF FUNCTION BETWEEN ACCESS AND MOBILITY FOR VARIOUS ROADWAY CLASSIFICATIONS**

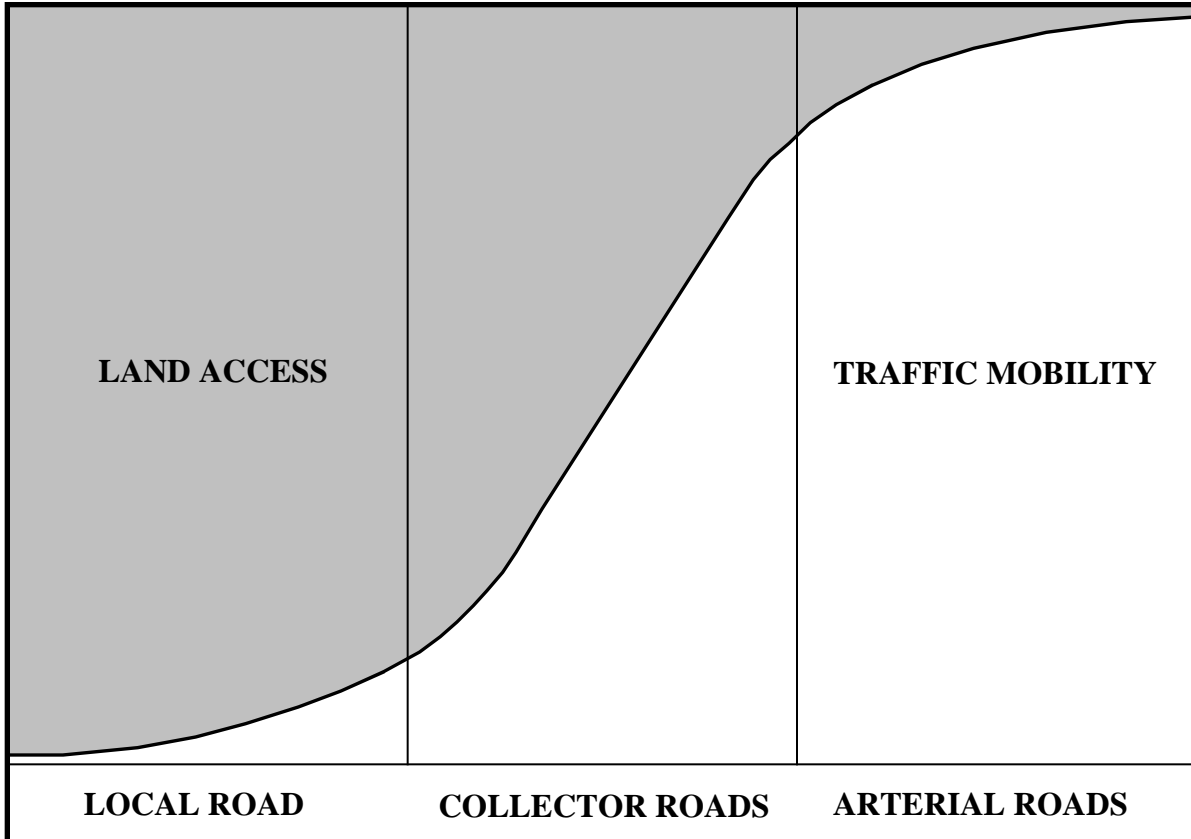


Figure 5  
*Access Management*

while land access requires low speeds and results in inconsistent flows. Roads serving high mobility traffic should have fewer driveways than roads serving land access.

### Location Of Intersecting Roadways

Providing desirable location and spacing of intersecting roadways can be achieved by establishing maximum intervals of local, collector and arterial roadways per mile. These measures can smooth traffic flow along the roadway.

### Location Of Access Driveways

The location of driveways directly affects the level of traffic congestion on the mainline roadway. The spacing of adjacent and opposing driveways and the spacing of driveways and intersections influence accident potential. Driveway design techniques that limit the types of conflicts, reduce the frequency of conflicts and/or reduce the area of conflict at driveways include:

- Limiting the number of driveways by developing appropriate driveway or intersection spacing requirements for various types of roadways.
- Relocating, closing, and prohibiting turn-movements with changes in traffic control or roadway cross-section.
- Providing access via existing secondary roads.
- Sharing access with existing driveways instead of creating a new driveway.
- Creating an internal roadway system that connects adjacent properties to eliminate short trips between adjacent properties and decrease traffic on arterial roadways with adjacent commercial development. This technique can also reduce the need for access along the mainline roadway.

### Driveway Design Of Higher Mobility Roads

Driveway design techniques that limit the deceleration requirements of drivers on desired high mobility roads are described below. These techniques are site specific and should be implemented where appropriate and consistent with the needs of the surrounding roadway system.

- Control parking along the roadway near the operational area of intersections and driveways to provide appropriate driveway turning speeds.
- Provide an ongoing “line of sight obstruction maintenance plan” to maintain safe intersection sight distances.
- Install visual cues like landscaped medians or sidewalks at driveway entrances to assist drivers who want to turn into a driveway.
- Install right-turn acceleration and deceleration lanes to reduce the need for speed changes in the through travel lanes.
- Provide an effective approach width of the driveway to minimize the difference between the entrance speed of drivers and the speed of through travelers on the roadway.
- Regulate the maximum width of driveways to minimize conflict areas.
- Locate driveways away from intersections to avoid queuing/turning conflicts and eliminate need for sudden stopping near intersections.

- Provide effective driveway depth and clearance, limiting parking near site entrances to avoid conflicts between vehicles entering / exiting a facility and vehicle performing parking maneuvers.

### Location Of Median Barriers On Higher Mobility Roads

Limiting or prohibiting certain turning maneuvers can be achieved through installation of median barriers that prohibit direct left-turn access onto the mainline and channelized median openings that prevent left-turn ingress/egress movements. Median barriers can be painted on asphalt, raised curb, depressed, landscaped, or guardrail safety types. The application of the types of median barriers can be established for various roadway classifications and desired degree of visual/physical enforcement. Minimum spacing and maximum number of median breaks per mile can be established to provide access to abutting properties and to maintain two-way progression. Minimum and desired median widths can also be established to ensure accommodation of left-turn lanes.

### **Requirements Of The 2002 Regional Policy Plan**

The Applicant should outline what steps were taken in the access design to meet the requirements of MPS 4.1.1.3. Applicants should show lower volume roadway analysis where applicable.

The Applicant should show pedestrian and bicycle access plans both to and across the proposed development to meet the requirements of MPS 4.1.1.6.

The Applicant should show how the site layout minimizes impacts on the adjacent road system and meets the requirements of MPS 4.1.1.6.

The Applicant should show the width of all driveways and/or curb-cut openings to serve development and redevelopment will not exceed MHD design standards to meet the requirements of MPS 4.1.1.9. As of August, 2002, this implies 12 feet for one-way driveways and 24 feet for two-way driveways. Larger driveways with more than a single lane will be reviewed on a case by case basis, but will generally follow the 12 foot per lane maximum.

## **Part 5 - Functional Classification of Roads**

Revised January 9, 2003

This part of the technical bulletin documents the characteristics of the functional classification system adopted by the Cape Cod Metropolitan Planning Organization (CCMPO) and describes what is defined as the Regional Roadway System for Developments of Regional Impact.

The concept of classifying roads by function is an important tool for planning the roadway system and understanding the roadway impacts of land development. The Cape Cod Metropolitan Planning Organization developed and adopted the functional classification system for Barnstable County roads. The CCMPO uses this system to seek federal and state funds for transportation related improvements and roadway maintenance needs. To assess regional transportation impacts of Developments of Regional Impact (DRI's), the Barnstable County Regional Policy Plan defines the Regional Roadway system as all roads classified within the adopted functional classification system at a higher level than those classified as local roads. The Regional Roadway System is shown by town in maps available through CCC staff.

Regional roadway elements include all intersections of two or more regional roadways and all regional roadway sections (links) between these intersections. Also included are regional roadway links which may access certain facilities (such as beaches), or cross county lines, and any other section of roadway designated higher than "local road". Also, the location where developments access local roadways is considered a regional intersection whether or not it is the intersection of two regional roadways. Also, the access points serve to segment the regional roadway link, forming links on both sides of each access point.

### **Functional Classification Of Roads As A System**

The roadway system in Barnstable County is constrained by the geography of the area. The functional roadway system adopted for Cape Cod can be described as a spinal system, with Route 6 providing movement from one end of the Cape to the other. Access to and from Route 6 is provided at regular intervals through interchanges with arterial roadways. Route 130 in Sandwich, Route 132 in Barnstable, Route 134 in Dennis, and Route 137 in Harwich are all examples of arterial roadways providing movement to Route 6.

The movement from local road to the major regional roads follows a hierarchy, where each type of roadway serves as a collecting function for the next higher roadway type. Intersections with the arterial roads provide points of distribution for major movements. Many of these intersections are signalized. The collector roads provide movement between an arterial road and all the local roads. Examples of collector roads include Queen Anne Road in Harwich and Strawberry Lane/White Rock Road in Yarmouth. Local roads serve destinations within the system with access to destinations within neighborhoods.

## Relationship Of Land Access And Traffic Mobility

The functional classification system can be viewed from the standpoint of land access and traffic mobility. Arterial roads provide a high degree of traffic mobility in the roadway system and local roads provide a high degree of land access. The proportion of function between access and mobility for various roadway classifications is shown in Figure 1. The degree of mobility is dictated by the ability to restrict access with adjacent land and control the location, spacing and type of traffic control with lower hierarchy roads.

## Functional System Characteristics

The general characteristics of each road classification are described in Table 1. Within Barnstable County, roads differ for rural and urban areas. The boundary between these areas is shown in the town maps and is defined as the New Federal-Aid Urban Area Boundary [23 USC 101 (a1)] approved by Federal Highway Administration Massachusetts Division Office, August 24, 1992, subject to any updates. Generally, in rural areas there are relatively more roads serving as collectors than in urban areas, where there are relatively more roads serving as arterial roadways.

**Table 1 - Functional Classification System**

<b>TYPICAL ROADWAY</b>	<b>TRIP-MAKING SERVICE-FUNCTION</b>	<b>ACCESS/ MOBILITY</b>	<b>SPEED LIMIT</b>	<b>MANAGEMENT TOOLS</b>
PRINCIPAL ARTERIAL	Provides high level of mobility within the regional and to other regions	Highest traffic mobility and highest land access control	45-65 mph	Access Management (Limited Access)
MINOR ARTERIAL / MAJOR COLLECTOR	Provides mobility within towns and between adjacent towns	Moderate mobility and managed access	30-60	Access Management
COLLECTOR	Provides mobility between neighborhoods and other local land uses	High land access and constrained mobility	30-60	Access Management
LOCAL	Provides mobility with similar land uses and within neighborhoods	Highest land access and constraint on mobility	20-30	Traffic Calming Strategies

## Corrections, Updates, And Changes

From time to time, corrections, updates, and changes are made in the classification of roadways and in roadways considered Regional Roadways. As such, staff may clarify Regional Roadways in projects per these corrections, updates, and changes.

**PROPORTION OF FUNCTION BETWEEN ACCESS AND MOBILITY FOR VARIOUS ROADWAY CLASSIFICATIONS**

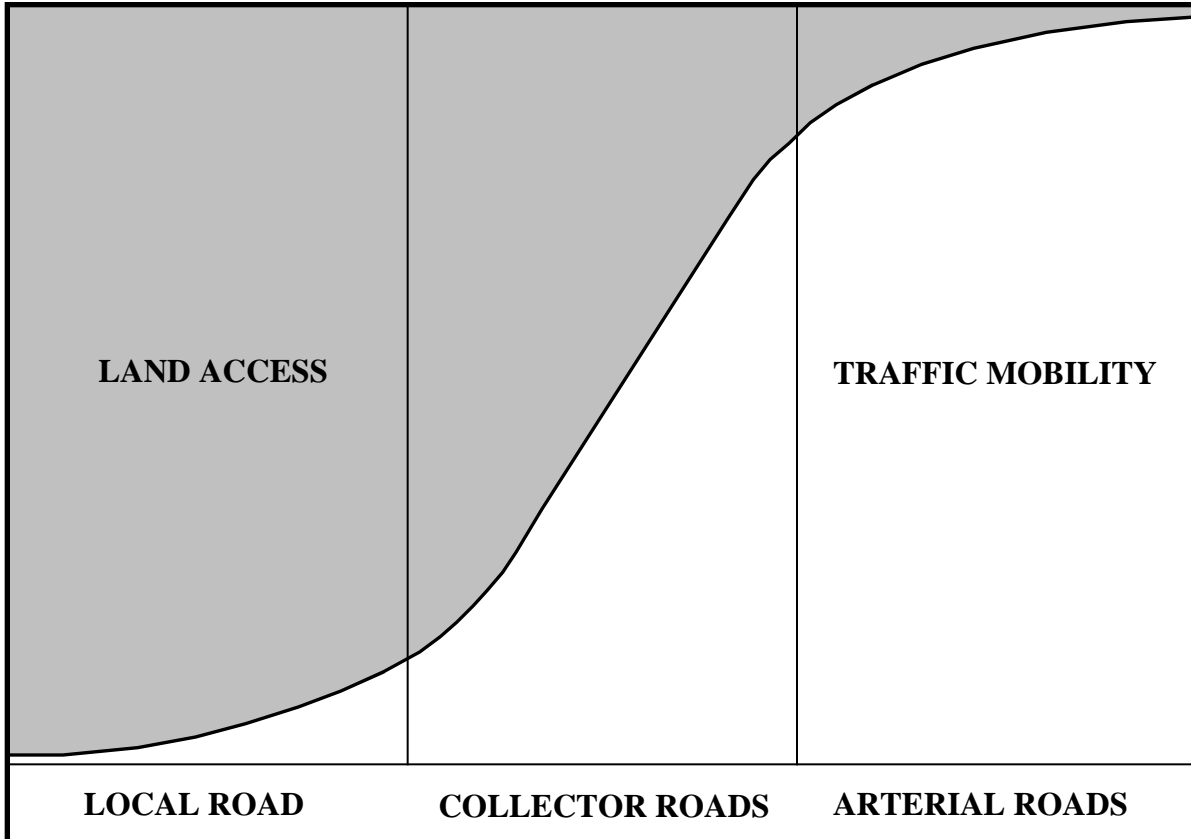


Figure 1  
*Functional Classification*