CHILLICOTHE COUNTY
METROPOLITAN PLANNING ORGANIZATION

TRANSPORTATION PLAN

Adopted 8/17/87
This Chittenden County Metropolitan Planning Organization Transportation Plan provides goals and policies for the use of transportation resources, particularly highways and public transportation.

This Transportation Plan serves as a flexible tool to ensure the development and maintenance of balanced, efficient transportation systems that complement regional land use and economic development. To accomplish this, the plan incorporates goals and policies that provide decision makers with the guidelines necessary to evaluate transportation issues and make informed decisions. This Plan establishes the technical procedures and standards necessary for the development of recommended transportation planning projects and improvements on a continuing basis. It is important to note, however, that standards should be based on engineering analysis, community values and economic resources.

Transportation refers to methods of conveying people and goods, and transportation systems include the pathways as well as the conveyances that move along them. The map on page presents the regional transportation system. Modes of transportation include private vehicle, walking, transit, paratransit, air, rail and water travel, bicycle and goods shipment. A transportation plan considers all these elements to assure people reasonable access to a safe system to go to work, to shop, to perform personal business and to participate in social activities as well as fostering economic development.

The following transportation goals are adopted:

1. To create and support a balanced, safe, humane and cost-effective transportation system.

2. To provide people with reasonable access to transportation services.

3. To adopt and apply transportation standards for use in analyzing the performance of the transportation system.

4. To maximize benefits to the region within the constraints of limited resources.

5. To complement and support land use and economic opportunities, both present and future. Appropriate transportation facilities should be provided in a timely fashion in growth areas as defined in the regional plan.

6. To recognize and support the relationship between transportation systems and economic development and encourages private sector participation in the
provision, financing and planning of these transportation systems.

7. To ensure a high degree of regional and local responsibility and authority in project development, design and implementation.

To further these goals, the following policies are adopted:

1. To maintain and update a regional transportation system that reflects this plan's goals.

2. To urge local officials throughout the region to develop the transportation elements of their local comprehensive plans, incorporating the objectives, standards and guidelines set out in this plan. Exceptions to these objectives should only be made when it can be demonstrated that greater public good is served by the exception.

3. To encourage coordination between the public and private sector in transportation planning and implementation.

The above goals and policies reflect the intention to create an ongoing planning process that will provide basic mobility for people. Achieving this will require the cooperation of the private sector as well as the traditional public sector entities such as the Vermont Agency of Transportation (VAT), federal transportation agencies, regional commissions, authorities and local governments. A high degree of cooperation is essential in order to efficiently program funds to address the region’s existing and future transportation deficiencies. The Metropolitan Planning Organization (MPO) was created to aid in this process. With representation from local and state government the MPO is emerging as an important decision-making forum for regional transportation planning and should not be bypassed by federal, state or local governments when dealing with public sector transportation funds.

1. **HIGHWAY**

The development and maintenance of an efficient and safe highway network is an essential goal of the transportation plan. Such a network contributes to continued regional economic growth, provides for reasonable travel times, contributes to safe travel in our communities and allows for more effective coordination of transportation planning with regional and local growth management programs.

The following highway goals are adopted:

1. To achieve a high quality road network by increasing capacity on roads where present capacity is insufficient
or where significant increases in traffic volumes are forecast.

2. To integrate short-term and long-term highway improvements within existing communities with a minimum disruption to neighborhoods and the natural environment.

3. To integrate regional public transportation and inter-modal goals that achieve a flexible and responsive transportation plan.

4. To cause the provision, and/or extension, of highway facilities in growth areas as defined in the regional plan.

5. To develop mechanisms, procedures and incentives that provide for Private Sector Involvement (PSI) in financing highway improvements.

6. To use appropriate land use development and review policies to control and stage growth so that the highway system can accommodate additional travel demand while maintaining reasonable levels of traffic service.

7. To ensure that highway trust fund resources are expended exclusively for transportation programs.

To further these goals, the following policies are adopted:

1. To reduce peak period vehicle delay.

2. To increase the vehicle miles of travel that occur at acceptable levels of service.

3. To create and maintain a highway network that minimizes fuel consumption and maintains acceptable regional air quality.

4. To use the Transportation Improvement Program (TIP) to program and stage regional highway improvements.

5. To adopt and consistently apply standard procedures for evaluating the traffic impact of proposed major development.

6. To strengthen local ordinances by using standard access management strategies.

7. To strengthen local regulations by using road design and construction standards which correspond to functional classifications, so that a road classified to a particular functional class is built to the proper minimum standard.
8. To reduce accident rates - fatalities, injuries and property damage.

9. To increase Private Sector Involvement (PSI) in financing highway improvements.

10. To encourage and direct through traffic to use appropriate non-local routes.

11. To revise state aid to town highways by using traffic volumes and/or lane miles as the basis for payment.

12. To use the latest edition of Trip Generation (an informational report) by the Institute of Transportation Engineers as a regional standard.

13. To encourage "streetscape design concepts" be provided in our road and highway improvements.

The regional highway system has undergone several comprehensive evaluations, beginning in 1965 with the Greater Burlington Urban Area Highway Plan. This document, prepared by the Vermont Department of Highways, analyzed traffic operations in the greater Burlington area and developed a long-range plan for the area's arterials. Using detailed travel information - traffic volumes and variations in flow, origin-destination surveys and traffic forecasts - the report developed specific recommendations for arterial and collector streets, accompanied by cost estimates, and in some cases typical sections and proposed alignments. One of the study's recommendations called for a limited access Essex Junction beltline, which would extend from the western limits of the Village, approximately from the intersection of VT 15 and Susie Wilson Road, then four miles east around the north of the Village, to an intersection with VT 2A. Other recommendations included "beltlines" which would improve access to Burlington, one-way pairs for streets in downtown Burlington, as well as parking and traffic operation programs.

The next major study occurred in 1971 with the TOPICS study for Burlington. Concentrating on intersections, the report recommended a program of low cost projects to improve traffic operations. This was followed by the Greater Burlington Federal-Aid Urban Area Transportation Study in 1976, which was a comprehensive inventory and evaluation of the region's urban transportation system. This CCRPC report also presented recommendations for developing a balanced transportation system that would meet future travel demand.

Each of the above reports described existing conditions, identified deficiencies and recommended a package of improvements. An updated evaluation of this region's highway system was prepared for this plan in order to develop project recommendations. One useful source of existing travel characteristics is the 1980 U.S. Census urbanized area
tabulations. Information such as autos per household, percent of workers by means of transportation to work and average travel time to work provides a useful picture of the urbanized area's travel characteristics. Material from the 1980 U.S. Census will be presented in the Appendix.

A general source of travel information worth noting is the 1983-1984 Nationwide Personal Transportation Study. (Summary of Travel Trends, U.S.DOT, November 1985) This study contains national data on the nature and characteristics of travel. Key conclusions of this survey are:

- Over time, households are owning more vehicles, with more individuals having a vehicle at their personal disposal.

- The number of household vehicles is increasing at a faster rate than household trips, and both of these are increasing faster than Vehicle Miles of Travel (VMT). This indicates that people own more vehicles, but are driving each of them less.

- Although average annual vehicle miles of travel per household has decreased slightly over time, travel for shopping and for other family or personal business has increased. One possible reason is the growth of two income families resulting in increases in disposable income to purchase goods and services.

- Since 1977 average vehicle occupancy has decreased slightly. Social and recreational trips continue to have the highest occupancy rate, since people often take such trips in groups, while home to work trips have had the lowest occupancy rate of the trip purposes shown.

- The average travel time to work has decreased slightly, while the average commute distance is the same as 1969. This may be partially due to the relocation of jobs to suburban and exurban areas.

To some extent, the national indicators are applicable to Chittenden County. Household size has declined, job opportunities outside of the Burlington Central Business District (CBD) have increased and volumes at continuous count stations are increasing, which suggests total VMT is also growing.

At the regional level, travel has been increasing on the area's roads. Trends at the AOT's Chittenden County continuous count stations were examined and bear this out. These trends will be presented in the Appendix. At a sub-regional scale, level of service estimates for current and future conditions were performed at critical intersections. The results will be shown in the Appendix.
Although traffic congestion problems are worse in large cities, the perception of traffic problems appears to transcend city size, and support for improved transportation in small and medium sized communities is also strong. Congestion reflects a condition in which the number of vehicles attempting to use a roadway at any given time exceeds the ability of the roadway to carry the load at generally acceptable service levels. The term "acceptable service levels" is significant; service levels A to F are qualitative and are linked to quantitative measures such as speed, density and delay. However, to some extent congestion is a relative matter, and while absolute congestion is certainly less in a smaller urban area, the perception of the problem, and the eagerness to do something about it may well be equal to that of larger areas.

The strategies and projects presented in the following pages are designed to address highway problems in a reasonable fashion. Moreover, the long-range recommendations will serve as a resource for project programming decisions and documents such as the MPO's Transportation Improvement Program and the Agency of Transportation's Five Year Program, both of which are annually updated. The Appendix contains documentation for the policies and recommendations presented in the plan. For example, traffic volumes, guidelines for highway standards and traffic impact estimation procedures are presented in the Appendix. Specific project recommendations are presented in the Appendix.

CHITTENDEN COUNTY CIRCUMFERENTIAL HIGHWAY (CCCH)

The need for a new Chittenden County regional highway was identified in the late 1950s. Transportation studies, conducted in the 1960s and 1970s, documented the need for a new highway. CCRPC developed a Vermont Demonstration project called the Circumferential Road in April 1981. The project suggested that through the application of private sector expertise and local decision making, highways can be constructed with substantially greater cost-effectiveness and in a significantly shorter time period. The project will also establish that an investment in integrating highway construction with mass transit and paratransit will be beneficial to the communities and the users. The method and techniques to be developed tested and demonstrated include: integration of highway construction and transit activities; selection of design standards; control of access by contract with local governments; waiver of federal Environmental Impact Statement requirements for state environmental controls; restriction of highway use to high occupancy vehicles during peak period use; construction of fringe parking areas and coordination of associated bus service; advancement of right-of-way acquisition and relocation activities; bicycle integration; utilization of fast track (concurrent scheduling) construction; establishment of ridesharing programs supported and coordinated by employers; development of responsive and timely citizen participation opportunities; consideration of design build techniques; and development of private sector interface with the
Vermont Agency of Transportation (VACT) and the Federal Highway Administration (FHWA). The funding for construction was obtained through the 1982 Surface Transportation Assistance Act. The Chittenden County Circumferential Highway Environmental Impact Statement was published in the summer of 1986. This document describes the proposed action, major alternatives evaluated, and analysis of impacts in seven areas.

The proposed action is construction of a new limited access facility from I-89 in Williston to Route 127 in Colchester, a distance of 16 miles. Because of funding constraints, proposed initial construction is for two lanes on a four lane right-of-way, with construction of the additional lanes at a later time. The construction of the C.C.C.H. is intended to mitigate existing and future traffic congestion at locations throughout the study area, decrease accidents, and improve travel times and levels of service. The following policies should be observed as this project nears implementation:

- An effective access control policy that strictly regulates location and spacing of access points should be adopted. A proposed approach will be presented in the Appendix.

- Sufficient right-of-way should be obtained to allow for cost-effective expansion on intersections at a later date. This will also provide flexibility in locating park-n-ride lots if and when demand warrants. A detailed discussion of this issue will be presented in the Appendix.

- A comprehensive approach to land use planning within the impact area of the highway is essential. The Appendix will present details on ways to control strip development adjacent to the highway, limit access, and encourage compact, mixed use and development using various zoning and site planning techniques.

BURLINGTON SOUTHERN CONNECTOR & SOUTH BURLINGTON EXTENSION

The Burlington Southern Connector and the South Burlington Connector are two new facilities that, when completed, will enhance access to Burlington as well as improve travel conditions in South Burlington's US 7 corridor. Both of these projects constitute long-planned, important additions to the Region's highway network. This plan reaffirms the support for the two projects and urges that construction begin as soon as possible.
2. PUBLIC TRANSPORTATION

Public transportation is a key element of this region's transportation system and includes all modes and forms of transportation available to the public. Each of these elements plays an important and distinct role in assuring adequate transportation services to the residents of the region.

The following public transportation goals are adopted:

1. To provide safe, reliable, humane, cost-efficient and fiscally responsible public transportation that meets the needs of the public.

2. To provide basic mobility for those without alternative means of transportation including, but not limited to, the poor, the elderly, the young and the disabled.

3. To expand public transportation to presently unserved areas that can sustain it through the appropriate choice of a cost-effective mode.

4. To support the integration of transit considerations within the regional and local land use plans and planning process to:

   - encourage beneficial land use and growth patterns
   - increase the efficiency of transit and other transportation resources

5. To complement the regional intermodal and modal goals to achieve a flexible and responsive transportation plan and complements the existing transportation system.

6. To encourage public/private sector participation in the planning and provision and support of services.

To further these goals, the following policies are adopted:

1. To improve Chittenden County Transportation Authority (CCTA) reliability, equipment, facilities and schedules.

2. To maintain and/or implement standards to assure cost-efficiency.

3. To maintain CCTA accessibility for the elderly and disabled while increasing other transportation options for this group.

4. To increase the use of paratransit and ridesharing programs.
5. To increase transportation options to the residents of rural areas through the use of public carriers, ridesharing and outreach programs and the coordination of existing services.

6. To increase private sector involvement in the planning and provision of public transportation.

Public transportation benefits a region in two major ways. It provides mobility for those who have no other means and it can help alleviate peak hour road and parking congestion, thus making more efficient use of limited transportation resources. By providing transportation to the transit dependent, public transportation increases the available labor pool, strengthening the region's economic development potential.

According to the 1980 Census, 10.7% of the households in Chittenden County have no car and another 42% have only one. As the number of families with more than one wage earner increases, the pool of transit dependent workers will also increase. And according to a 1985 CCRPC study about 75% of the elderly and disabled have no car and must rely on other forms of transportation. Therefore, public transportation is important to large numbers of people in the region.

And as peak hour road congestion in this region's core increases and parking becomes more expensive to provide, public transportation becomes an important option to municipalities facing costly infrastructure expenditures. Transit may offer a less expensive solution to road congestion than would new road construction. It is true, however, that commuters exhibit a strong preference for private automobile use. Therefore, any decision to rely on public transportation must be coupled with enhanced transit services and policies that discourage low occupancy automobile travel.

Chittenden County Transportation Authority (CCTA) provides fixed route bus service in Burlington, South Burlington, Essex, Winooski and Shelburne. Special Services Transportation Agency (SSTA) assists the elderly and disabled meet their transportation needs. Various private providers also offer transportation services in the region. The Appendix will discuss these services in depth.

PUBLIC TRANSPORTATION ISSUES IN CHITTENDEN COUNTY

Unlike highways standards, public transportation standards are often the result of social policy and fiscal realities. It is important that standards reflect social policy and that the effects of these policies and standards be clearly understood. As with highways, transit can be subject to capacity and Level Of Service (LOS) standards. The TRB Highway Capacity Manual, however, states "The concept of level of service for transit is
far more complex than for highways. It includes such factors as coverage of major residential and activity areas, comfort, speed and reliability. Convenient schedules comfortable vehicles and frequent fast and reliable service contribute to LOS."
Engineering and planning standards and guidelines do exist for transit. These standards must further policy and increase the level of productivity and efficiency.

-Role of CCTA in public transportation.

CCTA has a mandate to provide and coordinate public transportation services throughout the county. It presently provides fixed route bus service in its five member communities. Declining ridership and increasing cost suggest it needs to investigate ways it may better respond to public demand and improve existing services within limited resources.

-Elderly and disabled transportation.

Because they may not be able to use standard transportation or drive, the elderly and disabled have special transportation needs. CCTA offers lift-equipped service on its fixed route service, however, it is used only minimally in part because many handicapped people need door to door service. Special Services Transportation Agency (SSTA) subsidizes door to door taxi and van service for the elderly and disabled. This service receives no federal funding and is supported by local municipal contributions. The demand for this service severely limits the amount of subsidy each participant receives. And in the rural areas, the elderly and disabled must depend on limited social services or friends and relatives. Providing adequate services for this group must remain a priority.

-Lack of rural transportation services.

Rural areas have no public transportation. Like the elderly and disabled, those rural people without cars must depend on friends and relatives. Lack of transportation can contribute to unemployment and other social problems. While fixed route bus service would be inappropriate in rural areas, other options exist including paratransit and ridesharing programs.

-Funding for public transportation.

Presently, the Urban Mass Transportation Administration (UMTA) funds about 40% of CCTA's operating expenses and 80% of its capital costs. This federal subsidy for operating expenses has been declining and will no doubt continue to, thus causing a greater burden to fall on local and state government and users. CCTA officials believe they cannot raise fares further nor can they make substantial cuts in service. It may, however, be possible to increase productivity and maintain expense levels. In the meantime, additional funding sources must be located.
This year the State has allocated dollars for a state transit contingency fund to cover the shortfall in federal subsidy. This line item is allocated on a yearly basis and makes no provision for formula distribution of funds, nor new start-ups. The Vermont Agency of Transportation (VAOT), working with CCRPC is presently exploring ways to further participate in public transportation and should be encouraged to do so. State and federal funding should be used to provide services to the rural areas, the elderly and disabled as well as CCTA service area.

The private sector offers another source of funding for public transportation. In larger urban areas, it is not uncommon for a developer or business to contribute to the costs of constructing a public transportation facility. The benefits to the private sector in these areas is clearer than it would be in the CCTA service area. But as congestion and parking expenses increase, the benefits may become more obvious. The idea of traffic impact fees is currently gaining popularity in some areas. If implemented some of those revenues could be used for public transportation services.

RECOMMENDATIONS

This plan recommends that CCMPO continue to provide transit planning expertise to the Chittenden County Transportation Authority (CCTA), other municipalities interested in traditional transit or other paratransit opportunities, private providers and local and state planners in an effort to integrate transit components into their transportation plans.

Specific recommendations include:

- CCMPO should continue to assist CCTA in improving service delivery, reliability, productivity and general efficiency of operations and continue to pursue and provide UMTA Transit Technical Studies to promote and develop a public transportation system in Chittenden County that is responsive to the needs of our citizens.

- CCMPO should continue to review its transportation plan and its transit component to ensure it is consistent with the needs of the public.

- CCMPO should study methods, including regulatory changes, to enhance private sector participation in public transportation.

- CCMPO should work with social service providers and special service providers to enhance opportunities for and coordination of services for the transit dependent.

- CCMPO should work with local officials and planners to implement ways for improved economic development and
efficient use of transportation resources through the use of public transportation including regulatory changes that will encourage the use of public transportation.

- The State of Vermont should address the issue of declining federal operating subsidies and provide support for public transportation.

- CCTA should develop and implement standards against which to evaluate its effectiveness and efficiency and implement programs to reverse its falling ridership.

- CCMPO should work with CCTA, local municipalities and the private sector to enhance public transportation options to presently unserved areas.

3. **RAIL IMPROVEMENTS**

This component identifies goals, policies and recommendations for regional rail improvement.

The following rail goals are adopted:

1. To assure safe reliable efficient intra and interstate passenger and freight service.

2. To foster economic development and support existing industry.

3. To encourage efficient use of transportation resources.

To further these goals, the following policies are adopted:

1. To reduce grade crossing hazards.

2. To maintain adequate freight handling capabilities and improve facilities on Vermont Railway (VTR) and Central Vermont Railway (CV).

3. To maintain existing and when and where practical re-establish passenger service.

4. To encourage continued state support of existing rail services.

5. To increase commercial and passenger use of existing services.

6. To maintain existing interstate gateways.

7. To provide economic development opportunities on railway property or adjacent thereto.
Rail services are an integral part of the regional, intrastate and interstate transportation system. They provide economical freight shipment for bulk commodities, and in doing so lessen stress and congestion on the existing highway network. Passenger rail competes with other forms of passenger transportation, benefiting the consumer through increased options and competitive pricing. In some instances rail can provide efficient commuter transportation. The State of Vermont can play an important role in stimulating use of rail by actively seeking to locate industry along railroads. Innovative rail services can also make rail a more efficient shipper of goods. One such idea is railroad parks in which shippers may store or park commodities that have been shipped by rail.

Chittenden County is served by two freight rail services, Vermont Railway (VTR) and Central Vermont Railroad (CV) and the only existing passenger rail service in the state, Amtrak's Montrealer. The Appendix taken from the Vermont State Rail Plan 1984 update will outline these services.

Unlike highways, most railroads are owned and maintained by the private sector. Federal funding is minimal. The Federal Railroad Administration (FRA) does offer limited funds for specific capital projects and rail planning through the Local Rail Services Assistance (LRSA) program. New regulations replace state entitlement grants with discretionary funding, forcing Vermont to compete with projects from throughout the country for about $10 million in funding. Vermont AOT officials believe this may inhibit the development of innovative projects in Vermont.

In Vermont, however, the State owns 300 miles (of the total 746 miles) of track in the state including the 120 miles leased by VTR. In the past some concern has existed about the State's failure to use VTR's track rental fees to upgrade this facility. In the past several years the State has embarked on track rehabilitational and renewal projects for VTR and has made other improvements. The Appendix will outline the State's 5 year plan for improvements on VTR.

Two interstate gateways (the Clarendon and Pittsford Railroad (C&P) at Whitehall, New York and the Hoosick Branch of the Boston & Maine Railroad (B&M)) connect VTR with the national rail network. This latter branch is the principal route by which freight moves to and from southeastern Vermont and is considered an important gateway. The five mile segment between North Hoosick and the Vermont/New York State boundary is owned by the B&M and has been designated for abandonment or discontinuance within the next several years. A labor strike on the Guilford line has shut down this gateway and service may not resume after the strike. The Rutland Branch of the C&P is also an important gateway. In addition to connecting two in-state rail lines, the Rutland Branch is also the route by which a considerable amount of oil and gasoline is delivered to Burlington, Vermont. Both
these gateways are important to rail services in Vermont, and
should be maintained.

Regularly scheduled rail passenger service is provided
within Vermont by the National Railroad Passenger Service Corp.
(AMTRAK) with their Montrealer.

As the following table indicates, service has fallen off
considerably over the past several years, due in great part to
competition from the discount airlines. The Montrealer has,
however, experienced a 6% increase in ridership over the last
year.

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Nonetheless, the future of the Montrealer is uncertain.
Amtrak lost 10% of its federal subsidy this year and under
Graeme-Rudman may experience more substantial cuts in the next
several years. The present administration recommends that it
receive no federal funding. And even with the existing subsidy,
Amtrak Montrealer fares are not competitive with the discount
airlines. Amtrak costs remain artificially high because it must
deal with union rates that inflate expenses, while not enhancing
efficiency.

New York DOT, Vermont AOT and Le Ministire des Transports au
Quebec have just completed a pre-feasibility study on a very high
speed passenger rail that would connect Montreal and New York
City. It would take about 3 hours, therefore, competing with
airline services. This rail service would stop in the Rutland
area and Burlington. The pre-feasibility study suggests that
ridership revenues would cover operating costs, but would not
cover the $1.2 billion in construction costs. The report
maintains that the construction of the project would have
substantial economic development effects and that the benefits of
the project would exceed the costs. While this assumption as
well as others remains untested, this project merits further
study.

**RECOMMENDATIONS**

- Chittenden County Metropolitan Planning Organization
urges the Congress to continue to appropriate funds for
the Local Rail Services Assistance Program. The loss of
these funds without replacement would seriously limit...
economic viability of affected localities and the structural integrity of the streets, highways and bridges in those areas which would lose rail services.

- CCMPO continues to recommend that the two ports of entry to Vermont Railway from New York be maintained so that viable rail service can continue to be provided along the western side of Vermont. We urge the State of Vermont and Vermont Railway to maintain these ports of entry including not allowing the White Creek Branch (Hoosick) of the B&M Railroad to be abandoned.

- CCMPO recommends that the State Rail Plan incorporate a provision for railroad parks in its plan.

- CCMPO urges the State Agency of Transportation to work with the State Economic Development Agency to locate industry along existing railroads.

- CCMPO believes the very high speed rail proposal deserves further study and will explore its proposed costs and benefits and impact on the region.

4. AIR TRAVEL IMPROVEMENTS

This component outlines goals and policies which serve as guidelines to improve air transportation services in the Region.

The following air transportation goals are adopted:

1. To assure the availability of safe and adequate scheduled airline passenger, general aviation and air freight service.

2. To foster economic development in the region and throughout the state.

3. To assure that the quality of life in neighboring communities is not unduly disturbed by airport activities.

To further these goals, the following policies are adopted:

1. To increase parking and landside facilities in accordance with present and anticipated needs.

2. To maintain or increase the number and quality of air service providers.

3. To minimize disturbances and safety hazards to adjacent communities.
4. To increase Burlington International Airport fiscal autonomy, while maintaining government oversight.

5. To maintain or enhance present level of accessibility to the air carrier airport by means of an adequate transportation system which provides a reasonable travel time.

6. To obtain required land and/or easements, while minimizing residential dislocation.

Burlington International Airport (BIA), owned by the City of Burlington and located in the City of South Burlington, is the only provider of air services in the region, the major provider in State and the 3rd busiest airport in New England. The facility is also used by the Vermont Air National Guard. In 1982 deregulation of the air carrier industry threatened BIA with the loss of major airline service. Today, however, nine commercial airliners serve the airport. Enplanements doubled between 1982 and 1984 (452,000). People Express Airlines carried nearly half of these outbound travelers in 1984. While People Express service from Montreal has reduced 1985 enplanements to 442,000, the overall future of the airport seems promising and it is likely that enplanements will continue to increase at a rate of about 5-6% a year. BIA must therefore plan for continued growth by providing adequate air and landside facilities.

The growth of the region and its airport has caused adjacent residents to become increasingly concerned about noise and other negative effects on the community. This, coupled with limited land for airport expansion, has led to a proposal that the airport be relocated to a more rural area. The Vermont Air National Guard recently replaced their F-4 fighters with quieter F-16 aircraft, thus relieving some of the noise problem. Relocation of the airport, however, may be quite costly both in dollars and lost economic development benefit. Within the next few years, this issue should be fully studied and recommendations made.

In 1983 the City of Burlington decided it would transfer airport revenues into the General Fund. The State opposed this transfer, maintaining the City had signed assurances with both the airlines and the Federal Aviation Administration (FAA) stating that all airport revenues would be used at the airport. The FAA supported the State's position. In response to this position, the City suggested it might wish to sell the airport to a regional authority. A state study group authorized by the Governor, a City of Burlington study group and CCRPC all investigated possible future options for BIA. The CCRPC and State studies both determined that there was no compelling reason to establish a regional authority and that Burlington should retain ownership. The CCRPC study maintained that BIA should have increased financial autonomy, while the City should retain
oversight. CCRPC outlined specific proposals which are included in the recommendations section.

RECOMMENDATIONS

- BIA should develop a capital fund for future development.
- BIA should continue to upgrade its landside facilities and increase its parking as needed.
- BIA should continue its efforts to minimize airplane noise pollution and disturbance for adjacent residential communities.
- CCMPO should undertake before the next update of its transportation plan, a study of the effects of relocating BIA.
- The City of Burlington should take appropriate steps to change the City Charter, Chapter 3 to provide and establish,
  a. Burlington International Airport funds as separate from the City General Fund—so called enterprise funds;
  b. Burlington International Airport should establish annually its operating budget based on airport revenues;
  c. Burlington International Airport to operate and handle its own revenues;
  d. Burlington International Airport is granted authority to contract for services, and as appropriate, on a bid basis.
- CCMPO should cooperate with appropriate groups in determining the effects of increased airport growth on the transportation network to the airport and should develop ways to get people out of low occupancy vehicles to minimize congestion and parking needs.

5. BICYCLES

This component of the transportation plan presents goals and policies for the planning of bicycle facilities. These facilities must be designed to accommodate recreational use and to encourage commuter use.

The following bicycle goals are adopted:

1. To accommodate the demand for and to help assure greater mobility and safety of the bicyclist both for commuting and recreation.
2. To provide a system of bikeways which will connect activity centers using safe and direct routes.

To further these goals, the following policies are adopted:

1. To increase coordination between municipalities in planning bikeways.

2. To increase bikeway options.

3. To increase bicycle safety.

4. To provide a standard ordinance for the planning, coordination and design of bicycle facilities.

5. To provide for bicycles within new highway design and construction when and where economically feasible.

6. To give priority to the construction of bikeways which can serve a variety of trip purposes: commuting, recreation, personal business and shopping.

RECOMMENDATIONS

CCMPO, through CCRPC, should coordinate efforts for the development of a regional bikeway system connecting communities. Further, CCMPO should assist in the design and implementation of bikeways in any new highway construction and reconstruction, where economically feasible. This is essential since bicyclists are more sensitive than motorists to street surface irregularities. Thus, depressions and bumps should be held to a minimum. Adequate conditions for bicycle use include proper curb and gutters as well as bicycle-safe sewer grates.

Bicycle facilities are usually classified into three classes. Class I bikeways are completely separated from vehicular traffic and are contained within an independent right-of-way. With this type of facility, conflicts with motor vehicles are eliminated except at major intersections. Often, utility rights-of-way can be used for Class I bikeways. Another option is the Class II bikeway, which establishes bicycle lanes within the roadway directly adjacent to the outside motor vehicle lane, or on the shoulder. These lanes are designated by signs and pavement markings. A bike route is a Class III bikeway which is a road signed for bicycling and no portion of the road is set aside for the exclusive use of bicycles. Thus, cars and bikes share the road.

The basic dimensions and standards to be used in the physical planning of bicycle facilities will be presented in the Appendix. In all cases, bicycle-use related signs, pavement markings and signals should conform to the Manual On Uniform Traffic Control Devices.
6. **PEDESTRIAN IMPROVEMENTS**

This component of the transportation plan addresses the need to plan and design sidewalks and trails for use by pedestrians. These facilities are used for a wide range of purposes: shopping, walking to work or bus stops and recreation. In some instances, it may be possible and desirable to construct hike/bike trails which allow for mixed pedestrian and bicycle use.

The following pedestrian goals are adopted:

1. To provide for safe facilities in areas of high pedestrian concentration.

2. To incorporate pedestrian facilities into the land development design and review process.

To further these goals, the following policies are adopted:

1. To connect major activity centers with sidewalks.

2. To encourage pedestrian use of existing facilities by eliminating barriers that impede movement.

3. To provide sidewalk design that includes features which enhance use by mobility impaired individuals.

4. To encourage innovative design concepts in providing sidewalks.

The planning and provision of pedestrian facilities is an important element of the region's transportation system. Sidewalks are standard features of central business district streets, but the need for sidewalks or pedestrian paths in suburban and rural areas is often equally important. This is particularly true where the development pattern includes schools, neighborhood or village retail centers, and employment centers, which result in pedestrian concentrations along roads, some of which may carry low traffic volumes. The justification for constructing sidewalks is principally determined by the volumes (existing or anticipated) of vehicles and pedestrians, relative timing, and the speed of the vehicles. Traffic volume - pedestrian warrants for sidewalks along highways have not been established. There are guidelines, however, that can be used to evaluate the need for sidewalks. A general framework and procedures for the analysis of pedestrian facilities has been developed which permits an evaluation of pedestrian flow. (Highway Capacity Manual, SR209, Chapter 13, Pedestrians, Transportation Research Board, 1985.) In addition, safety research has yielded important information regarding ways to reduce pedestrian-traffic hazards. Once the decision is made to
build a pedestrian facility - sidewalk, trail, crossing structure - design and construction standards are readily available.

As a general rule, sidewalks should be considered in the design of new major streets, or the improvement of existing ones. If directly abutted by residential development fronting on both sides of a collector or higher classification street, walks should go on both sides. On streets leading to schools or libraries, walks should be used on at least one, and often both, sides. Factors such as vehicular and pedestrian volumes, distance from the school, availability of alternate routes, terrain along the route, and type of adjacent development should be used to evaluate proposed locations.

The primary design considerations are width, placement in the right-of-way, relationship to the traveled way, grades, and treatment at driveway and street intersections.

The width should be related to the street type and frequency of use. In older commercial areas, the sidewalk should extend from the property line to the curb line covering the entire border area. In newer commercial areas, with front parking lots and setback buildings, there may be no need for paving more than a conventional walk of $\frac{4}{10}$ to 6 foot width. This is particularly true where curb parking is prohibited and most passenger pickup and dropoff occurs in the parking lots.

In other areas, a minimum width of 4 or 5 feet desirable, should be provided. The "desirable" width permits two adults to walk side by side or two adults to pass without difficulty. A 6-foot wide walk, should be provided along streets with frequent pedestrian travel, such as those in the vicinity of school campuses, parking facilities, and transportation terminals. Curb ramps are being provided in many areas as mandated by Federal or State government regulations.

7. **WATER TRANSPORT IMPROVEMENTS**

This component of the transportation section outlines waterway policies, stressing the recreational as well as transportation and commercial aspects of Lake Champlain.

The following water goals are adopted:

1. To provide port and navigational facilities which support transportation activities and recreational uses as appropriate.

2. To provide adequate basin and harbor refuge for pleasure boats.
3. To provide improved navigational training programs, public safety awareness and rescue facilities, in cooperation with the Coast Guard.

4. To encourage commercial and commuter travel activities on Lake Champlain.

To further these goals, the following policies are adopted:

1. To provide adequate breakwater facilities and maintenance programs.

2. To provide and maintain recreational, non-motorized boat access to the Winooski River, as appropriate.

3. To provide pleasure craft marinas where they are not a degradation of the environment.

4. To improve knowledge of and access to the ferry crossing areas.

This region profits from its proximity to Lake Champlain and its tributaries because of its potential for both recreational and commercial activities as well as its natural beauty. Over the past several years boating and sports use of the Lake has increased substantially. While it is not presently used as a shipping route, Lake Champlain connects by canal to the Hudson River and to the St. Lawrence Seaway; and, as a result has access to the Great Lakes and the Atlantic Ocean. Further, Lake Champlain Ferries transports people across the Lake at Burlington, Charlotte and Grand Isle. While the Charlotte and Burlington lines carry mostly pleasure riders, the Grand Isle route mostly transports commuters.

Lake Champlain is certainly large enough to sustain a wide variety of activities. In fact, the potential for increased commercial use of the Lake should be explored. The commuter aspects of the Charlotte Ferry could be enhanced by improved access to the Northway on the New York side. And ways to develop additional pleasure boat storage should be implemented. However, these uses need to be coordinated. The Lake Champlain ferry service has difficulty docking because of boats moored at Charlotte and windsurfers in Burlington Harbor. Safety measures to alleviate this problem should be explored. Moreover, efforts should be made to preserve the Lake's value as a natural resource.

8. PARKING IMPROVEMENTS

This component of the transportation plan addresses the need to provide adequate parking facilities. As the Region grows, the need to carefully design, locate and operate parking facilities increases. This suggests parking be viewed as an integral part
of the transportation system, and that appropriate management strategies and standards be used to guide the development of parking facilities.

The following parking goals are adopted:

1. To encourage efficient use of parking resources.

2. To integrate parking system management strategies with the overall transportation planning process.

To further these goals, the following policies are adopted:

1. To develop a continuing process for evaluating parking demand, selecting locations for new or expanded parking facilities.

2. To develop parking standards for use throughout this Region.

Provision of parking facilities is a private as well as a public responsibility. In the Burlington CBD, CCMPO recommends a parking system management program to efficiently use parking resources. Outside of the CBD off street parking requirements should be established that will result in provision of adequate spaces. The standards will be presented in the Appendix should be used as Regional guidelines. These standards present information on the amount of accessory off-street parking typically necessary for a particular land use.

9. TRANSPORTATION SYSTEMS MANAGEMENT

Transportation Systems Management (TSM) emphasizes the coordinated and efficient management of the existing transportation system using low cost, quick turn around techniques. The basic objective is to squeeze more productivity from existing transportation facilities, rather than create new highway or transit systems. TSM embraces traditional traffic engineering measures, as well as exclusive bus lanes, parking management, ridesharing, paratransit, and work schedule changes to reduce peak transportation demand. Accordingly, the following TSM goals are adopted:

1. To make efficient use of existing transportation facilities.

2. To foster the use of an intermodal approach for meeting mobility goals.

3. To identify and pursue appropriate, low cost physical, operational, managerial and regulatory measures for improving regional mobility.
To further these goals, the following policies are adopted:

1. To develop a process for screening and implementing TSM actions.

2. To develop an approach for Private Sector Involvement (PSI) in identifying and financing TSM measures.

3. To develop measures of effectiveness for evaluating anticipated benefits of alternate TSM projects.

Many of the low cost physical and operational TSM improvements have been the focus of other programs such as the Traffic Operations Program to Increase Capacity and Safety (TOPICS), Transit Development Planning (TDP's) and High Hazard Locations. What is new about TSM is the emphasis on coordination. The TSM concept continues to evolve, and current applications in small to medium urban areas appear to emphasize traffic engineering measures, followed by transit measures.

The following actions are examples of TSM actions which may be appropriate for this region:

1. Upgrade and coordinate traffic signals.
2. Optimize signal phasing and timing.
3. Provide new turn lanes at intersections through parking removal, restriping and/or pavement widening.
4. Prohibit left turns during peak periods.
5. Restrict on-street parking during peak periods.
6. Provision of commuter parking lots.
7. Control of access on arterials.
8. Use of one-way pairs.
9. Flexible work hours.
10. Relocate bus stops.

A comprehensive discussion of strategies and actions is presented in Simplified Procedures for Evaluating Low-Cost TSM Projects, NCHRP 263, 1983. This publication provides a practical framework for TSM planning.
COLLECTOR STREETS IN BURLINGTON (NOT ShOWN)

BECAUSE OF SCALE:
S. PROSPECT, FROM PEARL TO MAIN
NORTH STREET, FROM NORTH AVE. TO N. WILARD
ST. PAUL., FROM MAIN TO S. WINOOSKI
INDUSTRIAL DRIVE

ALL UNDESIGNATED ROADS/STREETS ARE LOCAL.

EXISTING TRANSPORTATION SYSTEM
TRANSPORTATION PLAN TECHNICAL APPENDIX
# TABLE 1

**HIGHWAY**

**-BURLINGTON URBANIZED AREA (1980)-**

Per Capita Vehicles Available

<table>
<thead>
<tr>
<th>SMSA Population</th>
<th>Total Population</th>
<th>Total No. Households</th>
<th>Vehicles Per Household</th>
<th>Person Per Vehicle</th>
<th>Workers Per Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>114,018</td>
<td>76,656</td>
<td>26,073</td>
<td>1.4</td>
<td>2.1</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Percent of Workers Making Work Trips By:

<table>
<thead>
<tr>
<th>Total Auto</th>
<th>Rail</th>
<th>Bus</th>
<th>Truck or Van</th>
<th>Other</th>
<th>Carpool Auto</th>
<th>Carpool Truck or Van</th>
</tr>
</thead>
<tbody>
<tr>
<td>70.8</td>
<td>u/a</td>
<td>4.6</td>
<td>7.4</td>
<td>17.2</td>
<td>21.0</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Travel Time To Work (Minutes) by % of Workers Who Didn't Work at Home

<table>
<thead>
<tr>
<th>Less Than 10 Minutes</th>
<th>10-19 Minutes</th>
<th>20-29 Minutes</th>
<th>30-44 Minutes</th>
<th>45+ Minutes</th>
<th>Mean</th>
<th>45+</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.7%</td>
<td>46%</td>
<td>18.8%</td>
<td>8.3%</td>
<td>3.3%</td>
<td>16</td>
<td>64</td>
</tr>
</tbody>
</table>
TABLE 2  
AADT at Continuous Count Stations  
1965-1985

<table>
<thead>
<tr>
<th>Location</th>
<th>Station #</th>
<th>Year</th>
<th>Annual Average Daily Traffic</th>
<th>Percent Change from Previous Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>So. Burl.</td>
<td>D91</td>
<td>1965</td>
<td>9,281</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1975</td>
<td>17,508</td>
<td>+89%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1985</td>
<td>31,728</td>
<td>+81%</td>
</tr>
<tr>
<td>I-89</td>
<td>D99</td>
<td>1965</td>
<td>n/a</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1975</td>
<td>17,038</td>
<td>+78%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1985</td>
<td>30,362</td>
<td>+78%</td>
</tr>
<tr>
<td>So. Burl.</td>
<td>D2</td>
<td>1965</td>
<td>6,949</td>
<td>-</td>
</tr>
<tr>
<td>I-189</td>
<td></td>
<td>1975</td>
<td>10,408</td>
<td>+50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1985</td>
<td>15,319</td>
<td>+47%</td>
</tr>
<tr>
<td>Shelburne</td>
<td>D2</td>
<td>1965</td>
<td>6,949</td>
<td>-</td>
</tr>
<tr>
<td>US 7</td>
<td></td>
<td>1975</td>
<td>10,408</td>
<td>+50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1985</td>
<td>15,319</td>
<td>+47%</td>
</tr>
<tr>
<td>Burlington</td>
<td>D1</td>
<td>1965</td>
<td>n/a</td>
<td>-</td>
</tr>
<tr>
<td>VT 127</td>
<td></td>
<td>1975</td>
<td>10,337</td>
<td>+29%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1985</td>
<td>13,302</td>
<td>+29%</td>
</tr>
<tr>
<td>Colchester</td>
<td>D40</td>
<td>1965</td>
<td>2,557</td>
<td>-</td>
</tr>
<tr>
<td>US 7</td>
<td></td>
<td>1975</td>
<td>5,107</td>
<td>+99%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1985</td>
<td>8,804</td>
<td>+72%</td>
</tr>
<tr>
<td>Colchester</td>
<td>D92</td>
<td>1965</td>
<td>4,427</td>
<td>-</td>
</tr>
<tr>
<td>I-89</td>
<td></td>
<td>1975</td>
<td>8,842</td>
<td>+99%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1985</td>
<td>15,109</td>
<td>+71%</td>
</tr>
</tbody>
</table>

At a sub-regional scale, existing and future levels of service were estimated for a set of intersections. Table 3, Intersection Level of Service, presents this information for 13 intersections.
### TABLE 3
INTERSECTION LEVEL OF SERVICE

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Location</th>
<th>P M Peak Level of Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Shelburne Road/</td>
<td>So. Burlington</td>
<td>B</td>
</tr>
<tr>
<td>2. Shelburne Road/</td>
<td>So. Burlington</td>
<td>D</td>
</tr>
<tr>
<td>3. Shelburne Road/</td>
<td>So. Burlington</td>
<td>D</td>
</tr>
<tr>
<td>4. Main Street/</td>
<td>Burlington</td>
<td>E</td>
</tr>
<tr>
<td>5. College Street/</td>
<td>Burlington</td>
<td>E</td>
</tr>
<tr>
<td>6. Pearl Street/</td>
<td>Burlington</td>
<td>C</td>
</tr>
<tr>
<td>7. Colchester Avenue/</td>
<td>Burlington</td>
<td>C</td>
</tr>
<tr>
<td>8. Main Street/</td>
<td>Burlington</td>
<td>B</td>
</tr>
<tr>
<td>9. Dorset Street/</td>
<td>So. Burlington</td>
<td>E</td>
</tr>
<tr>
<td>11. US 2/VT 2A</td>
<td>Williston</td>
<td>A</td>
</tr>
<tr>
<td>12. VT 116/Kennedy Dr.</td>
<td>So. Burlington</td>
<td>B</td>
</tr>
</tbody>
</table>

* without improvement
ACCESS MANAGEMENT

Major arterials are intended to provide both traffic service and land access, and, to a certain extent, these are conflicting functions. If arterials are to continue providing safe, adequate levels of service, while allowing reasonable access to properties, effective access control strategies are required. This is particularly important when considering the long term effect of realigned and widened roads. Realignments and widenings can create numerous small parcels of land, each of which can potentially request access to a road. Moreover, a widened road will often attract additional development pressures because of the comparatively good access the improved roadway provides. The disadvantages of this are clear. An excessive number of entrances and exits creates a decline in the operating and safety characteristics of a road as traffic slows to accommodate vehicles making turns onto or off of the road. The result can be that an improved road rapidly deteriorates in service quality, and the large public investment in the road is, in part, squandered. Often, this process is gradual, with each new access point and degrading traffic service a small amount. At some point, the cumulative effect becomes apparent, with travel time and safety all unsatisfactory. Safety is also an important purpose of access control. Arterials exhibit a definite increase in accident rates with increasing numbers of intersections and commercial driveways per mile.

Consequently, in order to limit the number and location of separate and exclusive access points to significant roads, certain arterials should receive special access treatment. Roads with at least one of the following characteristics are deemed appropriate for such treatment:

- Arterials with traffic counts exceeding 3,000 vehicles per day, abutting substantial amounts of zoned but vacant land.
- Arterials proposed for realignment and/or widening, with traffic counts exceeding 5,000 vehicles per day.
- Three thousand feet along arterials intersecting a major employment center.

Future connections to these arterials should be accomplished in accordance with local zoning ordinances and accepted access management techniques.

These techniques include the use of service drives, consolidation of entrances and exits, minimization of the frequency of conflict points, and construction of auxiliary lanes. Any access management effort should include evaluations of engineering feasibility, operational effectiveness and economic viability, in order to accomplish the following:
- limit the number of conflict points by modifying the operations of driveways and by installing regulatory and directional signs;

- separate basic conflict areas by consolidating access for adjacent properties;

- remove turning volumes or queues from sections of through lanes; and

- improve substandard driveways to allow for safer, more efficient entry and exit of vehicles.

A comprehensive approach to access control will help preserve the traffic service function of arterials.
HIGHWAY RECOMMENDATIONS

Using the framework of the goals and objectives presented earlier in this section, recommendations were developed for specific projects. These recommendations are grouped according to funding program categories used by the state transportation agency, except for a unique demonstration project, the Chittenden County Circumferential Highway. This section then concludes with general recommendations concerning design standards.
The apparent need for a new Chittenden County regional highway was identified in the late 1950s. Transportation studies, conducted in the 1960s and 1970s, documented the need for a new highway, with funding for construction obtained through the 1982 Surface Transportation Assistance Act. Consequently, detailed planning studies began in earnest, resulting in the release of the Chittenden County Circumferential Highway Draft EIS in August 1985. This document describes the proposed action, major alternatives evaluated, and analysis of impacts in seven areas. Each of these items is briefly discussed below.

The proposed action is construction of a new four lane limited access facility from I-89 in Williston to Route 127 in Colchester, a distance of 16 miles. Because of funding constraints, proposed initial construction is for two lanes on a four lane right-of-way, with construction of the additional lanes at a later time. The construction of the C.C.C.H. is intended to mitigate existing and future traffic congestion at locations throughout the study area, decrease accidents, and improve travel times and levels of service.

The Final EIS evaluated the following alternatives:

- No Build. This involves maintenance of existing roads and no increases in highway capacity.

- Alternative Modes of Transportation. This option would attempt to satisfy regional travel demand through the use of express bus service, ridesharing and commuter parking facilities, with intensive marketing of this package.

- Rebuild Existing Roadways. This alternative consists of upgrading existing roads in the study area. These roads would include: Prim Road, Lake Shore Drive, Blakely Road, Severance Road, Susie Wilson Road and Route 2A.

- Build Alternatives. Three build alignments were evaluated. Of these three, the "yellow-blue-yellow" alternative is recommended as the preferred action on the basis of a comprehensive analysis. It appears the no build alternative will not reduce traffic congestion, the alternative modes option will reduce congestion only slightly, and the rebuild existing would reduce congestion for a limited time. The preferred build alternative is recommended because it appears to avoid sensitive environmental areas, has a large degree of community acceptance, and provides the most transportation benefits of all the build alternatives. The preferred alignment is shown on the map on page 32; the estimated construction cost is $82 million.
Construction of the "yellow-blue-yellow" line is likely to result in significant impacts in seven areas: transportation, agriculture, land use, parklands, stream crossings, air quality and archaeology.

A discussion of several issues concerning the highway is presented below.

Access management, reservation of right-of-way and land use impacts are three key issues requiring attention. A cohesive access management strategy is necessary to preserve the level of service that will be provided by the highway. Reservation of additional right-of-way for various purposes will help to ensure that the region's transportation system is flexible enough to respond to additional travel demands. And a careful evaluation of land use policies within the highway corridor is essential if the four towns are to have the ability to affect the timing, location and intensity of development at interchanges and intersections. Each of these three issues is discussed in detail below.

1. Access Management

The Circumferential Highway is to be constructed as a 16 mile limited access highway, with four grade-separated interchanges and several at-grade intersections. By limiting access to these well-designed locations, the highway provides reduced access to abutting properties in order to function as a major arterial providing a high degree of traffic service. The advantages to this approach are clear. An excessive number of entrances and exits creates a decline in the operating and safety characteristics of a road as traffic slows to accommodate vehicles making turns onto or off of the road. The result can be that a new highway soon deteriorates in service quality, and the large public investment in the road is, in part, squandered.

Safety is also an important purpose of access control. Arterials exhibit a definite increase in accident rates as the number of intersections and driveways increase. If the Circumferential Highway is to continue to provide a high level of service, an effective access control policy should be followed. This policy would be used to evaluate any proposed connections, and would include strict design standards regulating the spacing of access points, limiting crossovers, requiring acceleration/deceleration lanes and channelization of intersections. This type of comprehensive approach to access control is essential if a high level of traffic service is to be preserved.
ii. Reservation of Right-of-Way

The Circumferential Highway has been designed to provide a good level of service through the design year of 2004. This capacity notwithstanding, it seems prudent to build a certain amount of flexibility into the design of the highway. In part, this can be done by reserving or purchasing a sufficient amount of additional right-of-way for two purposes. First, it may be desirable to locate commuter parking facilities at strategic locations along the highway. Such facilities would support any future ridesharing and/or express bus programs. If a careful analysis of the need for and cost of providing such services resulted in a decision to fund a program, then locations for commuter parking facilities would have to be identified. Reservations of right-of-way at various locations would ensure availability of land at a reasonable cost.

A second area for reservation of additional right-of-way might be at locations currently planned as at-grade intersections. The design of these intersections presently incorporates channelization for turning lanes and deceleration lanes. Such a design should provide good levels of intersection service. In the event that additional capacity is needed at the at-grade intersections, it is desirable to have sufficient right-of-way for construction of additional lanes or for expansion to a grade separation.

The likelihood of needing right-of-way for the above purposes is difficult to estimate, but the energy crisis of past years, and continued transportation funding uncertainties suggest that incorporating flexibility into the design of this regional highway may have considerable merit.

iii. Land Use

Although not specifically intended as a tool for economic development, the Circumferential Highway is likely to influence development and land use patterns to some degree. It may affect the density, location and sequence of regional development, and thus have a significant impact on the form and content of the community.

Potential adverse impacts of highway construction can be diminished or even eliminated through careful application of land use controls, incentives and design concepts, supplemented by good access management strategies.

Traffic service and land access are necessary but conflicting functions of a highway system. This conflict often appears in areas adjacent to interchanges and intersections of major arterials, and is often called "strip commercial development." Good access may encourage development, but this development generates additional traffic that affects the highway's level of service. Moreover, increased access adds
conflict points, which contributes to higher accident rates and jeopardizes the functional integrity of the road. Often, the process of diminished traffic service occurs in an incremental fashion, with each new access point degrading the traffic service a small or moderate amount. At some point, the cumulative effect becomes apparent when travel time, capacity and safety become unsatisfactory.

One way to avoid this at the Circumferential Highway's interchanges and intersections is to provide opportunities for compact, modal development, with plans and regulations that treat the interchange's area of influence as a whole. This approach helps to prevent fragmented development by using various site designs and access control strategies to help manage growth in the proximity of the Circumferential Highway.

With regard to site design, a key to the approach is clustering development - retail, office, perhaps residential - on large sites at moderate densities. The various land uses can then be grouped around shared parking, with adequate landscaping, screening and buffering. The retention of mature vegetation, along with the planting of shrubs and trees can provide aesthetic and noise reduction benefits to the area around the development node. Site design should also result in an adequate internal circulation plan that will minimize queuing onto the road.

In terms of access control, combining several generators on one site makes it possible to consolidate access points, and these access points could be located far enough from intersections so as not to affect intersection safety and operation. Actual driveway location and design would be determined by the volume of type of traffic using the site. For example, AM and PM peak hour volumes can be estimated based on floor area, and driveway turning volumes can then be derived, which then help determine driveway design and location. In any case, a minimum distance from intersecting streets should be established within which driveways will not be permitted.

An additional control technique is the use of setbacks, so that sufficient right-of-way is available for the development of frontage roads. Fully developed frontage roads effectively control access, as illustrated in the schematic on the following page.

One way of managing development at the highway nodes would be the adoption of special overlay zoning districts for parcels adjacent to the Circumferential Highway's interchanges and intersections. The provisions of the overlay zoning would regulate the timing intensity and design of land development using a variety of growth management techniques, including those discussed above. By adopting such zoning, local planners and elected officials would have the tools to influence the form and character of growth in their communities.
DEVELOPMENT OF FRONTAGE ROAD
AND COMMERCIAL ENTRANCES
SHOWING CONTROL OF ACCESS TO MAJOR HIGHWAY

STAGE I - ROADSIDE UNDEVELOPED

STAGE II - ROADSIDE PARTIALLY DEVELOPED

STAGE III - ROADSIDE DEVELOPED WITH CONTINUOUS FRONTAGE ROAD
Although the interstate system in Vermont is complete, there are several types of projects that would be funded from this category. These include reconstruction, resurfacing, restoration or rehabilitation of existing facilities, as well as construction of expanded and new interchanges. Specific projects are presented below, not necessarily in priority order.


2. Rehabilitation of bridge 70 N & S on I-89 over the Winooski River, in South Burlington-Winooski. Rehabilitation is expected in 1986 at an estimated cost of $1,500,000.

3. Improvements to interchange #13 on I-89 in South Burlington. $100,000 for preliminary engineering has been allocated for 1986. This improvement received a comprehensive analysis which examined current and future traffic operations, alternative designs as well as costs and benefits.

4. Construction of a new interchange on I-89 in the Town of Colchester for the Circumferential Highway. Funds for preliminary engineering and right-of-way have been programmed, with construction anticipated in 1989 at an estimated cost of $6,000,000.

5. Construction of a new interchange in the Town of Williston for the Circumferential Highway. Funds for preliminary engineering and right-of-way have been programmed, with construction anticipated in 1990 at an estimated cost of $6,600,000.

6. Construction of a new I-89 interchange in Milton at Mayo Road. Preliminary results from a comprehensive travel and cost-benefit analysis indicate construction of an interchange is not warranted at this time. A subsequent analysis, within five years, should be conducted to re-examine the need for an interchange at this location.
1. Widening of US 7 from the LaPlatte River in Shelburne extending north 3.30 miles, ending 0.95 mile north of the Shelburne-South Burlington boundary. Construction is anticipated in 1988 at an estimated cost of $11,685,700.

2. Reconstruction of VT 15, beginning 0.4 miles east of 5 Corners and ending at the intersection with VT 128 in Essex Center. The design of this project is contingent on the final alignment of the Chittenden County Circumferential Highway. Additional improvements to VT 15 are recommended in Jericho and Westford.

3. Improvements to VT 116 in Hinesburg, beginning 0.10 mile south of TH 1 (Silver Street) and extending to the north 1.40 miles.

4. Reconstruction of US 7 in Colchester (including the intersection with TH 7 and TH 9). An allocation of $229,700 in construction funds has been programmed for 1986; this project, however, is on hold pending a final location of the Circumferential Highway.

5. Reconstruction of VT 2A in Colchester, from the Essex Town line to the intersection of US 7. Preliminary engineering and right-of-way funds have been programmed for 1986 and 1988, respectively, with construction anticipated in 1990 at an estimated cost of $1,030,400. This project is contingent on selection of the final design of the Circumferential Highway.

6. Pearl Street (VT 15) from 5 Corners to the fairgrounds should be upgraded to provide additional capacity and improved traffic operations. This project should include widening, consolidation of commercial driveways and underground relocation of utilities.

7. VT 15, from milemarker 0.00 to 1.60. This project begins at the Winooski-Colchester town line and extends 2.910 miles. Preliminary engineering funds of $102,000 have been programmed for 1990, at which time the scope of improvements will be defined. This project and #6 (Pearl Street) should be evaluated using a comprehensive, systems approach for the VT 15 corridor.
Several urban system projects are recommended in this plan. Some are new facilities that, when completed, will create additional routes as well as add capacity. Other projects involve widening on existing alignments. Some progress has been made in implementing recommendations made in the previous regional plan. The Northern Connector, for example, was completed in the fall of 1985 and opened to traffic in November 1985. Completion of the following projects will further enhance mobility for the region's travelers.

1. The Southern Connector is a new facility that will begin approximately at the I-189/US 7 interchange, extending northwest approximately 4500 feet, then extending north and terminating at the intersection of King and Battery Streets. This project is to be completed in phases at an estimated construction cost of $25,000,000. When completed, this facility will improve access to the Burlington CBD and make a positive contribution to the region's transportation system.

2. A South Burlington connector is a proposed new facility located in the City of South Burlington. It would begin at the Southern Connector/I-189 interchange and extend south to the Bartletts Bay/Green Mountain Drive intersection at US 7. Although a bond for the local share of this project was defeated in 198_, there is still a need to improve travel conditions in the corridor. A Shelburne Road Corridor Study is being conducted that will evaluate the need for this facility.

3. Dorset Street in South Burlington is proposed for widening from Williston Road to Kennedy Drive. The road is to be upgraded to a four lane divided facility, with channelized intersections. Construction is anticipated in 1987 or 1988 at an estimated cost of $2,595,000.

4. Williston Road is recommended and programmed for widening from East Terrace Street in Burlington to the US 2/I-89 interchange (#14) in South Burlington. Construction is expected in 1986 at an estimated cost of $450,000.

5. Additional improvements to Williston Road are recommended between Dorset Street and Hinesburg Road (VT 116) and from Millham Court to the Griswold Industrial Park. Funds have been programmed for these projects.

6. Main Street (US 2) in Burlington is recommended for upgrading. This improvement is particularly important given the widening of US 2 to the east (refer to project #4). Preliminary engineering is scheduled to begin in 1990, with an allocation of $35,000. Acceleration of this project is
desirable in order to provide continuity of cross section on US 2.

7. Main Street (US 7) in Winooski is recommended for reconstruction. Construction is anticipated in 1987 at a cost of $2,078,000.

8. Riverside Avenue (US 2 & 7) in Burlington is recommended for reconstruction and realignment. It is imperative that this road receive structural and drainage improvements. There is also an opportunity for private as well as public financing of this improvement.

9. Kimball Avenue extension...

10. Other candidate projects (TIP; comprehensive plans.)
As key links in the road network, it is essential that the region's bridges be maintained in satisfactory condition. Several of the bridges recommended for replacement or rehabilitation in the previous regional plan are now programmed. These include bridge #8 on 2A between Williston and Essex Junction (Powerhouse Bridge), which will be replaced in 1986 at an estimated cost of $2,269,000; bridge #162 on US 7 over the Lamoille River in Milton is scheduled for rehabilitation in 1987 at an estimated cost of $240,000; and bridges #14 and 15 over Allen and Muddy Brooks, respectively are to be upgraded in the next several years at an estimated cost of $120,000 for Allen Brook and $90,000 for Muddy Brook. Table 4, Bridge Ratings for the Chittenden County Urbanized Area, displays sufficiency ratings.

There is a need, however, to upgrade the following structures:

1. The North Williston Road bridge over the Winooski River between Williston and Essex. This bridge has a sufficiency rating of 42.5, which indicates a need for replacement.

2. The Falls Road bridge, a 58 foot span over the LaPlatte River in Shelburne is recommended for widening.

Programming of additional bridge rehabilitation or replacement should use sufficiency ratings as a useful guide for establishing priorities.
### TABLE 4
BRIDGE RATINGs FOR THE
CHITTENDEN COUNTY URBANIZED AREA

TOWN HIGHWAY BRIDGES
THAT QUALIFY FOR REPLACEMENT OR REHABILITATION*

<table>
<thead>
<tr>
<th>CLASS</th>
<th>ROAD</th>
<th>BRIDGE</th>
<th>TOWN/CITY</th>
<th>REPLACE</th>
<th>REHAB.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>7</td>
<td>2</td>
<td>Burlington</td>
<td>45.2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>35</td>
<td>11</td>
<td>Colchester</td>
<td>16.7</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>14</td>
<td>Colchester</td>
<td></td>
<td>59.5</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>8</td>
<td>Essex</td>
<td>42.5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>44</td>
<td>19</td>
<td>Essex</td>
<td></td>
<td>74.0</td>
</tr>
<tr>
<td>3</td>
<td>23</td>
<td>20</td>
<td>Essex</td>
<td></td>
<td>14.8</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>15</td>
<td>Shelburne</td>
<td>43.7</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>14</td>
<td>Williston</td>
<td>40.9</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>15</td>
<td>Williston</td>
<td>33.0</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>40</td>
<td>18</td>
<td>Milton</td>
<td>26.2</td>
<td></td>
</tr>
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</table>

FEDERAL AID SYSTEM BRIDGES
THAT QUALIFY FOR REPLACEMENT OR REHABILITATION*

<table>
<thead>
<tr>
<th>ROUTE</th>
<th>BRIDGE</th>
<th>DIST</th>
<th>TOWN/CITY</th>
<th>REPLACE</th>
<th>REHAB.</th>
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<tr>
<td>2A</td>
<td>8</td>
<td>5</td>
<td>Williston</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>3</td>
<td>5</td>
<td>Essex</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>FAS 210</td>
<td>6</td>
<td>5</td>
<td>Shelburne</td>
<td>47.4</td>
<td></td>
</tr>
<tr>
<td>Shunpike Rd</td>
<td>16</td>
<td>5</td>
<td>So. Burlington</td>
<td>21.0</td>
<td></td>
</tr>
<tr>
<td>Industrial Avenue</td>
<td>17</td>
<td>5</td>
<td>Williston</td>
<td>54.5</td>
<td></td>
</tr>
<tr>
<td>Airport Pkwy/ Lime Kiln Rd.</td>
<td></td>
<td></td>
<td>So. Burlington/ Milton</td>
<td>70.2</td>
<td>20.4</td>
</tr>
<tr>
<td>US 7</td>
<td>162</td>
<td>8</td>
<td>Milton</td>
<td>20.4</td>
<td></td>
</tr>
</tbody>
</table>

*As of 5/21/85
RAIL CROSSING IMPROVEMENTS

1. Flynn Avenue in Burlington.
2. TH 6 in Colchester.
3. South Summit in Essex Junction
4. Lakeside Avenue in Burlington.
<table>
<thead>
<tr>
<th>DESIGN ELEMENT</th>
<th>INTERSTATE</th>
<th>FREEWAY/EXPRESSWAY/PARKWAY</th>
<th>OTHER PRINCIPAL ARTERIAL</th>
<th>MINOR ARTERIAL</th>
<th>COLLECTOR</th>
<th>LOCAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>70</td>
<td>60-65</td>
<td>50-60</td>
<td>40-50</td>
<td>30</td>
<td>30 mph</td>
</tr>
<tr>
<td>Maximum grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- flat</td>
<td>3%</td>
<td>3%</td>
<td>4-3%</td>
<td>7-4%</td>
<td>Rural</td>
<td>7%</td>
</tr>
<tr>
<td>- rolling</td>
<td>4%</td>
<td>4%</td>
<td>5-4%</td>
<td>8-5%</td>
<td>Urban</td>
<td>9%</td>
</tr>
<tr>
<td>- mountainous</td>
<td>5%</td>
<td>6%</td>
<td>7-6%</td>
<td>10-7%</td>
<td></td>
<td>9%</td>
</tr>
<tr>
<td>Stopping Sight Distances</td>
<td>625-850 ft.</td>
<td>525-725 ft.</td>
<td>400-650 ft.</td>
<td>275-475 ft.</td>
<td>200 ft.</td>
<td>200 ft.</td>
</tr>
<tr>
<td>Access Control</td>
<td>Full</td>
<td>Full</td>
<td>Partial</td>
<td>Partial</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Right-of-Way</td>
<td>150-300 ft.</td>
<td>100-160 ft.</td>
<td>90-110 ft.</td>
<td>60-90 ft.</td>
<td>50-60 ft.</td>
<td>40-50 ft.</td>
</tr>
<tr>
<td>Shoulder Width</td>
<td>10 ft.</td>
<td>10 ft.</td>
<td>8-10 ft.</td>
<td>4-10 ft.</td>
<td>4-8 ft.</td>
<td>2-8 ft.</td>
</tr>
<tr>
<td>Lane Width</td>
<td>12 ft.</td>
<td>12 ft.</td>
<td>12 ft.</td>
<td>10-12 ft.</td>
<td>10-12 ft.</td>
<td>7-12 ft.</td>
</tr>
<tr>
<td>Number of Lanes</td>
<td>as needed</td>
<td>2-4</td>
<td>2-4</td>
<td>2-4</td>
<td>2-4</td>
<td>2</td>
</tr>
<tr>
<td>Vertical clearance</td>
<td>16.5 ft.</td>
<td>16.5 ft.</td>
<td>14.5 ft.</td>
<td>14.5 ft.</td>
<td>14.5 ft.</td>
<td></td>
</tr>
<tr>
<td>Sidewalk</td>
<td>None</td>
<td>In urban/village areas</td>
<td>In urban/village areas</td>
<td>As needed</td>
<td>As needed</td>
<td></td>
</tr>
<tr>
<td>Interchange/Intersection</td>
<td>Grade Separated</td>
<td>Grade separated; some at-grade, channelization; grade separated as needed.</td>
<td>At grade; channelization; grade separated as needed.</td>
<td>At-grade, w/channelized intersections.</td>
<td>At-grade</td>
<td></td>
</tr>
<tr>
<td>Maximum Curvature</td>
<td>$E_{max}=0.08$</td>
<td>$4.75-3.75$</td>
<td>$7.5-4.75$</td>
<td>$12.25-7.5$</td>
<td>$22.75$</td>
<td>$22.75$</td>
</tr>
<tr>
<td>Minimum Radius</td>
<td>$E_{max}=0.08$</td>
<td>$1,206-1,528$</td>
<td>$764-1,206$</td>
<td>$468-764$</td>
<td>$252$</td>
<td>$252$</td>
</tr>
<tr>
<td>DESIGN ELEMENT</td>
<td>INTERSTATE</td>
<td>FREEWAY/EXPRESSWAY/PARKWAY</td>
<td>OTHER PRINCIPAL ARTERIAL</td>
<td>MINOR ARTERIAL</td>
<td>COLLECTOR</td>
<td>LOCAL</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------</td>
<td>----------------------------</td>
<td>--------------------------</td>
<td>----------------</td>
<td>-----------</td>
<td>-------</td>
</tr>
<tr>
<td>Bus Turnouts</td>
<td>None</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Minimum Design Loading</td>
<td>HS 20</td>
<td>HS 20</td>
<td>HS 20</td>
<td>HS 20</td>
<td>HS 20</td>
<td>HS 20</td>
</tr>
<tr>
<td>Parking</td>
<td>NO</td>
<td>No</td>
<td>Restricted</td>
<td>Restricted</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Reverse Flow/Bus-Carpool Lanes</td>
<td>As needed</td>
<td>As needed</td>
<td>As needed</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
PUBLIC TRANSPORTATION DISCUSSION

Public transportation benefits a region in two major ways. It provides mobility for those who have no other means and it can help alleviate peak hour road and parking congestion, thus making more efficient use of limited transportation resources. By providing transportation to the transit dependent, public transportation increases the available labor pool, strengthening the region's economic development potential.

According to the 1980 Census, 10.7% of the households in Chittenden County have no car and another 42% have only one. As more families have more than one wage earner, the pool of transit dependent workers is increasing. According to a 1985 CCRPC study about 25% of the elderly and disabled have no car and must rely on other forms of transportation. Therefore, public transportation is important to large numbers of people in the region.

As peak hour road congestion in this region's core increases and parking becomes more expensive to provide, public transportation becomes an increasingly important option to municipalities facing costly infrastructure decisions. Transit may offer a less expensive solution to road congestion than would new road construction. It is true, however, that commuters exhibit a strong preference for private automobile use. Therefore, any decision to rely on public transportation must be coupled with enhanced transit services and policies that discourage the use of low occupancy automobiles.

PUBLIC TRANSPORTATION IN CHITTENDEN COUNTY

Chittenden County Transportation Authority (CCTA) is the major provider of public transportation in Chittenden County. Serving the communities of Burlington, Essex, Shelburne, South Burlington and Winooski, CCTA operates 23 buses on nine fixed routes. The buses run between about 6:00a.m. and 9:00p.m. Monday through Saturday on most routes and connect all major activity centers in the service area.

A legislatively enabled transportation authority, CCTA has the power to provide, coordinate or administer transportation services in any member community in Chittenden County and levy taxes from those communities. Figures from the 1980 Census suggest that about 5% of workers in the member communities commute on public transportation and according to CCRPC surveys, about 50% of all riders use the bus to commute to work. Another 8% use the bus to go shopping, while 18% of all riders go to school or college on the bus. Because Burlington does not have a school bus system, CCTA plays a major role in transporting students in this city to school. About 70% of CCTA riders do not have a car available, 5% have a disability that limits mobility and 8% are 60 years of age or older.
During FY85 CCTA provided over 1.6 million rides. Ridership, however, has been declining for the past several years and FY86 ridership was about 13% less than it was in FY83. This coupled with a significant increase in the number of employed people in the county suggests a serious decline in bus use. This loss is due in part to fare increases and service cuts, but ridership per mile has also been declining. Declining ridership may be caused by the rising affluence of the region and changing demographic patterns. While CCRPC surveys indicate that 90% of passengers rate service as good or very good, some evidence suggests that a lack of on-time reliability, a poor image and lack of support from the business community may contribute to declining ridership. CCTA has begun to analyze this loss and investigate the need to investigate other kinds of service.

In FY86 CCTA's operating budget was about $1.7 million. About 43% of this came from passenger and operating revenues, 38% from the local communities and 17% from the federal Urban Mass Transportation Administration (UMTA) and state subsidies. In FY86 CCTA received a total of $515,000 from UMTA for capital and operating but could only use 40% of this for operating expenses. Because CCTA is in a "newly urbanized area", it must use a smaller percentage of its total grant on operating expenses than areas that were designated urban areas before 1980 and is thus penalized. The percentage of operating expenses covered by passenger revenues has been declining (although it remains higher than many similar systems), while the communities must increase their subsidy. In fiscal year 1987 the State began to provide funds for public transportation.

CCTA maintains a fleet of 29 buses. Table 5 lists fleet characteristics and Table 6 lists the fleet replacement schedule. CCTA plans to replace several buses within the next several years. UMTA provides 80% of the funding for capital acquisitions. The remaining 20% must come from local sources. In past years, member communities have covered this cost through bond issuance. Presently, 13 buses are lift-equipped, this enabling the wheelchair bound to use the service. Of these lifts, 10 are subject to frequent malfunctions making the service unreliable. CCTA hopes to replace 4 of these lifts with more maintenance free equipment. Each of these new lifts will cost about $10,000, but will save more than that in maintenance costs.
TABLE 5

CCTA FLEET CHARACTERISTICS

<table>
<thead>
<tr>
<th>VEH #</th>
<th>Year of Manufacture</th>
<th>Total Miles thru June '85</th>
<th>Seating Capacity</th>
<th>Lift Equipped</th>
<th>Kneeling Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>310</td>
<td>1981</td>
<td>144,775</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>311</td>
<td>1981</td>
<td>133,091</td>
<td>47</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>312</td>
<td>1981</td>
<td>160,161</td>
<td>47</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>313</td>
<td>1981</td>
<td>137,731</td>
<td>47</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>314</td>
<td>1981</td>
<td>143,612</td>
<td>47</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>315</td>
<td>1981</td>
<td>154,261</td>
<td>47</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>316</td>
<td>1981</td>
<td>160,361</td>
<td>47</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>317</td>
<td>1981</td>
<td>155,756</td>
<td>47</td>
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<tr>
<td>318</td>
<td>1981</td>
<td>144,883</td>
<td>47</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>1979</td>
<td>228,233</td>
<td>37</td>
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<tr>
<td>301</td>
<td>1979</td>
<td>251,261</td>
<td>37</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>302</td>
<td>1979</td>
<td>237,207</td>
<td>37</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>303</td>
<td>1979</td>
<td>232,051</td>
<td>37</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>304</td>
<td>1979</td>
<td>264,266</td>
<td>37</td>
<td>X</td>
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<td>305</td>
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<td>250,292</td>
<td>37</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>306</td>
<td>1979</td>
<td>227,917</td>
<td>47</td>
<td></td>
<td></td>
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<tr>
<td>307</td>
<td>1979</td>
<td>243,728</td>
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<td>308</td>
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<td>230,844</td>
<td>47</td>
<td>X</td>
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</tr>
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<td>309</td>
<td>1979</td>
<td>246,202</td>
<td>47</td>
<td>X</td>
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</tr>
<tr>
<td>120</td>
<td>1984*</td>
<td>16,564**</td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>122</td>
<td>1984*</td>
<td>9,407**</td>
<td>29</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>124</td>
<td>1984*</td>
<td>15,669**</td>
<td>29</td>
<td>X</td>
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</tr>
<tr>
<td>126</td>
<td>1984*</td>
<td>20,558**</td>
<td>29</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>132</td>
<td>1974</td>
<td>326,127</td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>134</td>
<td>1974</td>
<td>311,089</td>
<td>33</td>
<td></td>
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<td>282,922</td>
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<td>326,176</td>
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<tr>
<td>146</td>
<td>1974</td>
<td>303,679</td>
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</tr>
<tr>
<td>200</td>
<td>1975</td>
<td>40,605</td>
<td>15</td>
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</tr>
<tr>
<td>202</td>
<td>1975</td>
<td>103,961</td>
<td>15</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

* Year of remanufacture
**Mileage since remanufacture
<table>
<thead>
<tr>
<th>YEAR</th>
<th>1992</th>
<th>1993</th>
<th>FY94</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>9 FIX</td>
<td>9 FIX</td>
<td>9 FIX</td>
</tr>
<tr>
<td>1990</td>
<td>9 FIX</td>
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<td>1993</td>
<td>9 FIX</td>
<td>9 FIX</td>
<td>9 FIX</td>
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<tr>
<td>1994</td>
<td>9 FIX</td>
<td>9 FIX</td>
<td>9 FIX</td>
</tr>
</tbody>
</table>

**Fleet Replacement Schedule**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>1992</th>
<th>1993</th>
<th>FY94</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>10 RTS</td>
<td>10 RTS</td>
<td>10 RTS</td>
</tr>
<tr>
<td>1990</td>
<td>10 RTS</td>
<td>10 RTS</td>
<td>10 RTS</td>
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<td>1991</td>
<td>10 RTS</td>
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<td>1992</td>
<td>10 RTS</td>
<td>10 RTS</td>
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<tr>
<td>1993</td>
<td>10 RTS</td>
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</tr>
<tr>
<td>1994</td>
<td>10 RTS</td>
<td>10 RTS</td>
<td>10 RTS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR</th>
<th>1992</th>
<th>1993</th>
<th>FY94</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>6 GMC</td>
<td>6 GMC</td>
<td>6 GMC</td>
</tr>
<tr>
<td>1990</td>
<td>6 GMC</td>
<td>6 GMC</td>
<td>6 GMC</td>
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<tr>
<td>1991</td>
<td>6 GMC</td>
<td>6 GMC</td>
<td>6 GMC</td>
</tr>
<tr>
<td>1992</td>
<td>6 GMC</td>
<td>6 GMC</td>
<td>6 GMC</td>
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<tr>
<td>1993</td>
<td>6 GMC</td>
<td>6 GMC</td>
<td>6 GMC</td>
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<tr>
<td>1994</td>
<td>6 GMC</td>
<td>6 GMC</td>
<td>6 GMC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR</th>
<th>1992</th>
<th>1993</th>
<th>FY94</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>3 Twins</td>
<td>3 Twins</td>
<td>3 Twins</td>
</tr>
<tr>
<td>1990</td>
<td>3 Twins</td>
<td>3 Twins</td>
<td>3 Twins</td>
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<tr>
<td>1991</td>
<td>3 Twins</td>
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<td>3 Twins</td>
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<tr>
<td>1992</td>
<td>3 Twins</td>
<td>3 Twins</td>
<td>3 Twins</td>
</tr>
<tr>
<td>1993</td>
<td>3 Twins</td>
<td>3 Twins</td>
<td>3 Twins</td>
</tr>
<tr>
<td>1994</td>
<td>3 Twins</td>
<td>3 Twins</td>
<td>3 Twins</td>
</tr>
</tbody>
</table>

**Note:** A year in which buses become 12 years old

**Grant Purchase Years:**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>1992</th>
<th>1993</th>
<th>FY94</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>26</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>1990</td>
<td>27</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>1991</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>1992</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>1993</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>1994</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
</tbody>
</table>
SERVICES FOR THE EDLERLY AND DISABLED

As mentioned above, CCTA provides lifts on its regular vehicles for the elderly and disabled. But these lifts are infrequently used (less than 20 times a month on all routes), thus making this a capital intensive service. Wheelchair bound and other disabled people find it difficult to get to bus stops, especially in winter. Representatives of the disabled community maintain that lift use would be greater if the equipment were more reliable. It is impossible to determine the value of the lifts. It is, however, important that CCTA maintain lifts on some of its buses so that the disabled have the option to use this public transportation. But because of its limited use, CCTA should not strive for a 100% lift-equipped fleet.

Special Services Transportation Agency (SSTA) offers coupons to elderly and disabled people to defray the cost of taxi service and lease a lift-equipped van to a local cab company so that wheelchair bound people may have access to the service. SSTA serves people in the communities of Burlington, South Burlington, Colchester and Essex and receives funding from these communities. It receives no federal operating subsidies, although it has purchased three lift-equipped vans with the use of federal funds. SSTA is a United Way organization, receiving about $24,000 a year from them.

Ridership in this program has increased substantially over the past year and SSTA now serves about 300 individuals. By assisting the elderly and disabled to obtain door to door general transportation service at affordable rates, SSTA meets a need that would otherwise go unmet.

Both the Town and Village of Essex operate vans for the elderly inside their jurisdictions. This service is free of charge. Both the Town and the Village have requested and should receive new vans from UMTA through CCTA. They are presently exploring ways to coordinate their services to enhance efficiency.

Various social service organizations provide transportation or user side subsidies to help defray transportation costs for members of special needs groups. These services, however, are usually program or purpose specific and no program may exist to meet the general transportation needs of some elderly or disabled people in the area. Moreover, while there are numerous programs, little or no coordination exists among them.

PRIVATE PROVIDERS

Vermont Transit provides scheduled intercity service between the Greater Burlington Urban area and points in Vermont and neighboring states. It also provides charter service as do several small transportation companies in the area.
Several taxi companies provide exclusive ride service in Burlington and neighboring communities. The City of Burlington sets fare rates within city limits thus restricting the types of services these companies can provide. CCRPC is working with the City of Burlington ordinance committee to rewrite the taxicab ordinance to increase the range of services cab companies can provide. Some taxi companies are incorporating as transportation companies so that they may meet a variety of needs.
RAIL

Burlington-Bennington:

Vermont Railway, Inc.

This line is owned by the State of Vermont and is leased to, and operated by, the Vermont Railway (VTR). From a planning perspective, this line consists of two principal elements - a North Segment running from Burlington to Rutland, and a South Segment which runs from Rutland to Bennington.

North Segment: This segment extends from Burlington to Rutland a distance of 68 track miles. The segment is serviced each way, Monday through Friday. The maximum operating speed is 40 MPH.

The condition of this segment is generally good for FRA Track Class III operations, although rail wear is becoming a problem in some areas. Five bridges on this segment restrict the speed of trains with cars over 125 gross tons; bridges 205, 229, 233, 239 and 243.

Recent traffic history for the North Segment is as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Carloads</th>
<th>Freight Tons</th>
<th>Principal Commodities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>Forwarded</td>
<td>273</td>
<td>10,669</td>
</tr>
<tr>
<td></td>
<td>Received</td>
<td>4,545</td>
<td>326,299</td>
</tr>
<tr>
<td></td>
<td>Overhead</td>
<td>482</td>
<td>40,375</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>5,300</td>
<td>377,343</td>
</tr>
</tbody>
</table>

Waste paper, ground limestone, limestone slurry, scrap steel, aluminum "scrap", piggyback "freight of all kinds", synthetic fiber, lumber.

Coal, lumber, grain, steel, road salt, beer & wine, food products, synthetic plastics, appliances, LP gas, agricultural fertilizers, furniture, gasoline, fuel oil, kerosene 40,000,000 gallons annually.
### 1983

<table>
<thead>
<tr>
<th></th>
<th>Carloads</th>
<th>Freight Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forwarded</td>
<td>1,367</td>
<td>117,335</td>
</tr>
<tr>
<td>Received</td>
<td>3,927</td>
<td>291,020</td>
</tr>
<tr>
<td>Overhead</td>
<td>713</td>
<td>53,755</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,007</td>
<td>462,110</td>
</tr>
</tbody>
</table>

**Principal Commodities**
- Same as above.

**South Segment:** This segment extends from Rutland to No. Bennington, a distance of 52 track miles and on the Bennington Branch for 4 miles. The segment is serviced Monday, Wednesday and Friday each way. The speed limit varies from 25 - 40 MPH.

The condition of this line is adequate for present operations and tonnages. One bridge on this segment (#63) and one on the Bennington Branch (#56) have restricted train speed due to condition. VTR anticipates the need for extensive tie renewal in the near future.

Recent traffic history on the South Segment is as follows:

### 1982

<table>
<thead>
<tr>
<th></th>
<th>Carloads</th>
<th>Freight Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forwarded</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Received</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overhead</td>
<td>67</td>
<td>6,590</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>634</td>
<td>38,594</td>
</tr>
</tbody>
</table>

**Principal Commodities**
- Lumber, wrapping paper, wood dowels, scrap lead dross, concrete blocks, scrap steel.
- Grain, lumber, sulfuric acid, auto battery parts, road salt, agricultural fertilizers, coal, LP gas, synthetic plastic pellets.

### 1983

<table>
<thead>
<tr>
<th></th>
<th>Carloads</th>
<th>Freight Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forwarded</td>
<td>28</td>
<td>980</td>
</tr>
<tr>
<td>Received</td>
<td>363</td>
<td>18,596</td>
</tr>
<tr>
<td>Overhead</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>391</td>
<td>19,576</td>
</tr>
</tbody>
</table>

**Principal Commodities**
- Same as above.

- Same as above.
Winooski Branch:

Central Vermont Railway, Inc.

The Winooski Branch is owned and operated by the Central Vermont Railway (CV). The line extends from the CV mainline in Essex Junction, Vermont to the Vermont Railway's mainline in Burlington, Vermont, a distance of eight (8.0) miles.

Service on this line is provided six days per week between Essex Junction and Burlington. The line is in good condition for Track Class II and has an operating speed limit of 25 MPH.

The Burlington Electric Dept. power generating plant, located on this branch, utilizes wood chips as fuel. The Vermont Public Service Board order, concerning this project, requires that no less than 75% of the fuel consumed by the plant be supplied by rail to limit traffic congestion by trucks.

Recent traffic history is as follows:

<table>
<thead>
<tr>
<th></th>
<th>1982 Carloads</th>
<th>1983 Carloads</th>
<th>Freight Tons</th>
<th>Principal Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forwarded</td>
<td>5</td>
<td>0</td>
<td>187</td>
<td>Grain, coal, building products</td>
</tr>
<tr>
<td>Received</td>
<td>857</td>
<td>857</td>
<td>32,124</td>
<td>Same as above.</td>
</tr>
<tr>
<td>Overhead</td>
<td>307</td>
<td>886</td>
<td>11,508</td>
<td>Same as above.</td>
</tr>
<tr>
<td>Total</td>
<td>1,169</td>
<td>1,743</td>
<td>43,819</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Principal Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain, coal, building products</td>
</tr>
<tr>
<td>Same as above.</td>
</tr>
<tr>
<td>Same as above.</td>
</tr>
</tbody>
</table>
Central Vermont Railway:

Swanton, Roxbury, Windsor & Palmer Subdivisions

The Central Vermont Railway, Inc. (CV) is a wholly owned subsidiary of the Grand Trunk Corporation, operating 377 miles of I.C.C. Class II railroad in the States of New York, Vermont, New Hampshire, Massachusetts and Connecticut plus the Province of Quebec. The CV owns and operates 158 miles of these subdivisions in Vermont. The CV handles U.S. bound eastern Canadian traffic from CV's eastern lines to the U.S. rail system south of New England.

An intermodal service (TOFC) was established by CV in 1978 to compete for traffic between eastern Canada and southern New England. This service ran between St. Albans, Vermont and Palmer, Massachusetts. "This service was discontinued in 1984 and reestablishment of this service is contemplated in the near future. At the time of this writing, (Oct. 1984), a contract is nearly complete for handling trailers at both ends of this service."

This line combined with Boston and Maine owned line in Vermont and New Hampshire make up Amtrak's "Montrealer" route through Vermont to Montreal.

Freight service is provided daily between St. Albans, Vermont and White River Junction (Hartford) Vermont where traffic is exchanged with B&M for operations between White River Junction and Brattleboro, Vermont. At Brattleboro CV's southern division continues freight service to New London, Connecticut.

These subdivisions are maintained in FRA Class III condition with a 40 MPH freight speed, and an allowable passenger train speed of 59 MPH. Present operating freight speed is 40 MPH generally and passenger train (AMTRAK) speed is 59 MPH.

Recent traffic data on this line is as follows:

<table>
<thead>
<tr>
<th></th>
<th>Carloads</th>
<th>Freight Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forwarded</td>
<td>1,492</td>
<td>33,644</td>
</tr>
<tr>
<td>Received</td>
<td>3,599</td>
<td>77,947</td>
</tr>
<tr>
<td>Overhead</td>
<td>22,484</td>
<td>2,050,403</td>
</tr>
<tr>
<td>TOTAL</td>
<td>27,575</td>
<td>2,161,994</td>
</tr>
</tbody>
</table>

Principal Commodities
Lumber, paper products, grain, salt, cement and petroleum.

Per conversation, Central Vermont Railway, James Fitzgerald, Clerk of Corp., Oct. 15, 1984
Funding for Capital Improvements and Rehabilitation

Unlike highways, railroads are owned and maintained for the most part by the private sector. Federal funding is minimal. The Federal Railroad Administration (FRA) does offer limited funds for specific capital projects and rail planning through the Local Rail Services Assistance (LSRA) program. New regulations replace state entitlement grants with discretionary funding, forcing Vermont to compete with projects from throughout the country for about $10 million in funding. State AOT officials believe this may inhibit the development of innovative projects in Vermont.

In Vermont, the State owns 300 miles (of the total 746 miles of track in the state) including the 120 miles leased by VTR. In the past some concern has existed about the State's failure to use VTR's track rental fees to upgrade this facility. In the past several years the State has embarked on track rehabilitational and renewal projects for VTR and has made other improvements. Table 7 outlines the State's 5 year plan for improvements on VTR.
TABLE 7

STATE CAPITAL CONSTRUCTION PROGRAM FOR VERMONT RAILWAY

<table>
<thead>
<tr>
<th>Fiscal Year 1986</th>
<th>July 1, 1985 - June 30, 1986</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Haven-Rail</td>
<td>$425,700</td>
</tr>
<tr>
<td>(M.P. 93.33-96.83)</td>
<td>$129,700</td>
</tr>
<tr>
<td>North Ferrisburg-Rail</td>
<td>$158,000</td>
</tr>
<tr>
<td>(M.P. 105.11-106.00)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fiscal Year 1987</th>
<th>July 1, 1986 - June 30, 1987</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shelburne - Rail</td>
<td>$180,000</td>
</tr>
<tr>
<td>(M.P. 115.53-117.25)</td>
<td>-0-</td>
</tr>
<tr>
<td>Charlotte - Rail</td>
<td>$69,000</td>
</tr>
<tr>
<td>(M.P. 109.47-110.00)</td>
<td>-0-</td>
</tr>
<tr>
<td>Ferrisburg - Rail</td>
<td>$82,000</td>
</tr>
<tr>
<td>(M.P. 102.000-102.84)</td>
<td>-0-</td>
</tr>
</tbody>
</table>

| Vermont Railway, Inc./ |
|------------------------|-----------------|-------------------------------|
| Clarendon Pittsford Railroad | $140,000 | -0- | $140,000 | -0- |
| Connection of two railroads at Center Rutland (ROW & PE costs) |

| Vermont Railway, Inc. |
|-----------------------|-----------------|-------------------------------|
| Rail & OTH - Brandon | $210,000 | -0- | $163,000 | $47,700 |
| (M.P. 68.50-70.09)    |

<table>
<thead>
<tr>
<th>Fiscal Year 1989</th>
<th>July 1, 1988 - June 30, 1989</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middlebury-Rail replace.</td>
<td>$257,600</td>
</tr>
<tr>
<td>(M.P. 84.58-87.02)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fiscal Year 1990</th>
<th>July 1, 1989 - June 30, 1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferrisburg</td>
<td>$146,000</td>
</tr>
<tr>
<td>(M.P. 103.92-105.11)</td>
<td></td>
</tr>
<tr>
<td>Ferrisburg/Charlotte</td>
<td>$136,500</td>
</tr>
</tbody>
</table>
INTERSTATE VTR GATEWAYS

An interstate gateway connects Vermont rail services with the national rail network. The Clarendon and Pittsford Railroad at Whitehall, New York and the Hoosick Branch of the Boston & Maine Railroad are the gateways for VTR. This latter branch is the principal route by which freight moves to and from southeastern Vermont and is considered an important gateway. The five mile segment between North Hoosick and the Vermont/New York State boundary is owned by the B&M and has been designated for abandonment or discontinuance within the next several years. A labor strike on the Guilford line has shut down this gateway and service may not resume after the strike. The Rutland Branch of the C&P is also an important gateway. In addition to connecting two in-state rail lines, the Rutland Branch is also the route by which a considerable amount of oil and gasoline is delivered to Burlington, Vermont. Both these gateways are important to rail services in Vermont, and should be maintained.

PASSENGER SERVICES

AMTRAK

Regularly scheduled rail passenger service is provided within Vermont by the National Railroad Passenger Service Corp. (AMTRAK) with their Montrealer. The Montrealer is a daily train running between Washington, D. C. and Montreal, Quebec, via New York City. The Montrealer travels over interstate track within Vermont from the Vermont/Massachusetts state boundary in Vernon to White River Junction; from White River Junction to Essex Junction; and from Essex Junction to the International Boundary in Alburg, Vermont. The stations in Vermont serviced by the Montrealer are located in Brattleboro, Bellows Falls, White River Junction, Montpelier Junction, Waterbury, Essex Junction and St. Albans.

Recent passenger on/off history for Amtrak services in Vermont is as follows:

While service has fallen off considerably over the past several years, due in great part to competition from the discount airlines, the Montrealer has experienced a 6% increase in ridership over last year.

RAIL–HIGHWAY CROSSING IMPROVEMENT PROGRAM

Federal highway funds are specifically earmarked to pay for 90% of grade crossing safety projects. There are 594 at grade rail-highway crossings in Vermont, 77 of which have been improved by the installation of railroad warning signals and 94 by surface improvements.

Railroads, the State, municipalities or individuals may request a specific crossing be upgraded. The State AOT notes
that requests for projects currently on file for exceed the Agency's funding capabilities.

Table 8 lists projects in Chittenden County on the Rail Highway Crossing Program and their status (as of December 1984).
<table>
<thead>
<tr>
<th>Municipality</th>
<th>RR</th>
<th>Route</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richmond</td>
<td>CV</td>
<td></td>
<td>New RR signals and gates</td>
<td>completed 1980</td>
</tr>
<tr>
<td>Burlington</td>
<td>VTR</td>
<td>Flynn Ave.</td>
<td>Upgrade signals &amp; reconstruct rail/hwy.crossing</td>
<td>completed 1983</td>
</tr>
<tr>
<td>Winooski</td>
<td>CV</td>
<td>VT 15</td>
<td>Upgrade signals &amp; reconstruct rail/hwy.crossing</td>
<td>completed 1981</td>
</tr>
<tr>
<td>Colchester</td>
<td>CV</td>
<td>TH 6</td>
<td>Install signals &amp; reconstruct rail/hwy.crossing</td>
<td>completed 1983</td>
</tr>
<tr>
<td>Essex Junction</td>
<td>CV</td>
<td>S.Summit</td>
<td>Install signals &amp; reconstruct rail/hwy.crossing</td>
<td>completed 1984</td>
</tr>
<tr>
<td>Essex</td>
<td>CV</td>
<td>TH 20</td>
<td>Install signals &amp; reconstruct rail/hwy.crossing</td>
<td>completed 1984</td>
</tr>
<tr>
<td>Milton</td>
<td>CV</td>
<td>TH 31</td>
<td>Install signals with gates &amp; reconstruct rail-highway crossing</td>
<td></td>
</tr>
<tr>
<td>Winooski</td>
<td>CV</td>
<td>Barlow Street</td>
<td>Install signals with gates &amp; reconstruct rail-highway crossing</td>
<td></td>
</tr>
<tr>
<td>Shelburne</td>
<td>VTR</td>
<td>TH 1</td>
<td>Install signals &amp; reconstruct rail-highway crossing</td>
<td></td>
</tr>
<tr>
<td>Colchester</td>
<td>CV</td>
<td>TH 5</td>
<td>Reconstruct rail-highway crossing/ install RR warning signals.</td>
<td></td>
</tr>
</tbody>
</table>
DISCUSSION

Owned by the City of Burlington, and located in the City of South Burlington, Burlington International Airport (BIA) is the only provider of air services in the region, the major provider in State and the 3rd busiest airport in New England. In 1982 deregulation of the air carrier industry threatened BIA with the loss of major airline service. Today, however, nine commercial air carriers serve the airport. Enplanements doubled between 1982 and 1984 (452,000). People Express Airlines carried nearly half of these outbound travelers in 1984. While People Express service from Montreal has decreased 1985 enplanements to 442,000, the overall future of the airport seems promising and it is likely that enplanements will continue to increase at a rate of about 5-6% a year.

In fact, the BIA Master Plan written in 1983 had to be updated to account for the increased enplanement. The January 1985 update, however, continues to somewhat underestimate enplanements.

But while BIA, City of Burlington and regional planners and officials must be prepared to deal with continued growth at the airport, the January 1985 BIA terminal area update final report states:

[The rapid changes in the airline industry resulting from deregulation and other factors make it difficult to predict with certainty whether...services will remain at the airport.

People Express accounts for nearly half of all enplanements. According to the Update, it is unlikely, however, that People Express will leave BIA, in part because BIA offers operational advantages as a terminal point on its routes.

Nonetheless, the realities of deregulation suggest that BIA must continue to create a positive environment for air carriers, maintain its air facilities and upgrade its landside facilities. BIA is presently considering a compensatory lease arrangement in which airlines and concessionaires pay fees based on allotted costs of operating the airport and in turn have a say in what expenses the airport incurs. If BIA does undertake this system, it should include costs for capital fund. This fund might include the costs for possible increased congestion on the transportation network leading to the airport.

In any case, BIA is planning for continued growth and facility maintenance. Last year BIA completed a runway resurfacing project. It is presently expanding terminal facilities with funds from a G.O. bond issue approved by Burlington voters. It has been suggested that because of a
limited bond issue the facility will not meet airport needs and will shortly become overcrowded.

Parking remains a problem. Although space has been doubled over the past several years, the BIA Update suggests it will need twice as many spaces by the year 2000. Land upon which to expand remains a problem and parking may have to be elevated or underground.

Although an analysis performed by Trans/Op, Inc. in July 1984 indicates that no major rework of either the entrance or exit will be required in the immediate future, airport growth will generate traffic on the roadways leading to the airport. It may become important to investigate the magnitude of this congestion and determine methods for financing any necessary improvements.

RELOCATION OF THE AIRPORT

As the airport grows, adjacent residents become increasingly concerned about noise and other negative effects on the community. This coupled with limited land on which to expand has led to a proposal that the airport be relocated to a more rural area. Relocation of the airport, however, may be quite costly both in dollars and lost economic development benefit. Within the next 10 years, this issue should be fully studied and recommendations made.
BICYCLES

Design standards for the construction of new bicycle facilities should generally conform to AASHTO recommendations. The publication, "Guide for Development of New Bicycle Facilities" published in 1981 by AASHTO presents guidelines that are valuable in achieving good design which is responsive to the safety and travel needs of both bicyclists and other highway users.

Among the factors that should be considered when designing and locating a bicycle facility are:

- **Barriers** - Physical barriers including topographical features and freeways.

- **Accidents** - Reduction or prevention of bicycle accidents is of high priority.

- **Security** - The potential for criminal acts against bicyclists is important.

- **Maintenance and Pavement Quality** - Bikeways should be free of bumps and debris. Utility covers and drainage grates should be at grade and, if possible, outside bicycle travel lanes.

- **Intersections** - A high proportion of bicycle accidents occur at intersections. Every effort should be made to ensure that bicycle facilities are adequately signed at intersections.

- **Traffic Control Devices** - All bicycle-use related signs, pavement markings and signals should be designed, placed and maintained in conformance with the Manual on Uniform Traffic Control Devices (MUTCD). Part IX of the MUTCD provides detailed information on this topic.

Width requirements for bicycle facilities vary according to several factors, including traffic volumes and speeds, presence of parking, available right-of-way, and amount of heavy vehicles. Three typical sections are shown on Figure 3.

Other issues that need to be considered include provision of secure bicycle parking facilities, maintenance of facilities and legal aspects.
(a) CURBED STREET WITH PARKING

(b) CURBED STREET WITHOUT PARKING

(c) STREET OR HIGHWAY WITHOUT CURB OR GUTTER

(Not to Scale)

(Metric Conversion: 1 Ft. = 0.3m.)

FIGURE 3  Typical Bicycle Lane Cross Sections
PARKING

Several sources of parking standards are currently available. "Zoning, Parking and Traffic" published by the Eno Foundation presents suggested off-street parking requirements. Although the information is dated, it serves as a valuable resource. A Highway Research Board publication "Parking Principles" (Special Report 125) provides a comprehensive discussion of parking characteristics, programs, studies, location, design and standards. A recent report, "Parking Generation" published by ITE (Institute of Transportation Engineers) provides guidance on parking generation rates for various land uses and building types. The report summarizes data collected in over 750 field studies, and includes information on weekday peak parking rates and range of parking rates.

All of the above reports are available for review at CCRPC offices. Additional information on parking lot landscaping, parking for institutions and special events, and parking demand at regional shopping centers is also available at CCRPC. Sample ordinances from various local governments are also on file.

In 1987, CCRPC will conduct a comprehensive review of regional parking generation rates and off-street parking requirements. This information will be distributed to member towns and cities.

TRAFFIC IMPACT METHODOLOGY

INTRODUCTION

As a result of the growing concern about the traffic impacts of private development, many local governments are requiring site access studies to estimate the effect of land development on the local, and in some cases regional, transportation system. In many instances these studies provide the basis for negotiating the timing, location and financing of traffic mitigation measures. This section is intended to inform local governments and staff of the basic methodology that comprises a technically sound impact study.

There are four primary reasons why a local government may request a traffic evaluation.

1) To allow all involved agencies to determine whether the road network will be able to accommodate the additional traffic at a reasonable level of service;

2) To enable those commissions and agencies with regulatory responsibilities to evaluate transportation impacts before issuing permits;
3) To enable the driveway permit agency to check access
design. This includes location, width, radii, allowable
movements and estimated turning volumes during one or
more critical design hours;

4) To provide the information needed to develop a fair and
equitable determination of cost sharing between the
developer(s) and public agencies for any needed
improvements.

The balance of this discussion presents general guidelines
for the basic traffic impact study process. The content of a
particular study, however, will vary to satisfy specific local
regulations and to address the elements of a specific site
development plan.

Initially, the applicant and staff need to establish the
study ground rules, adequacy of traffic data and confirm the
development program. Ground rules need to be agreed upon for the
following items:

1) which intersections are to be included in the traffic
impact analysis;
2) adequacy of available turning movement counts and need
for additional data;
3) period of analysis (A.M. or P.M. or both);
4) trip generation rates, especially for commercial
development;
5) directional distribution of site-generated and platted
traffic;
6) mode split assumptions;
7) programmed projects to be considered in the analysis,
along with techniques for estimating traffic diversion to
major new programmed facilities;
8) link adequacy and trends in traffic growth;
9) feasible range of traffic engineering improvements
associated with implementing the development; and
10) Assumptions regarding capture rates from pass by
traffic.

Guidelines regarding sources and adequacy of traffic data
are presented below:

1. Traffic volume data (turning movements and links) are
available from the Chittenden County Regional Planning
Commission, the Vermont Agency of Transportation and, in
some cases, units of local government;

2. Data should be adjusted to the current year using
accepted adjustment methods or new counts should be made
by the applicant if, in the opinion of staff, traffic
volumes have changed due to some alteration in the
traffic pattern, such as the completion of a development.
project or opening of a new transportation facility after
the count was made;

3. If turning movement data are older than three years, or
if there are locations for which data are non-existent,
data should be acquired by the applicants using their own
resources;

4. Intersection traffic counts conducted by the applicant
must be manual turning movement counts over the periods
of 7-9 A.M. and 4-6 P.M. so as to allow selection of the
peak hour within the nearest thirty minutes (e.g.
4:00-5:00, 4:30-5:30; or 5:00-6:00). Inclusion of all
7-9 A.M. and 4-6 P.M. turning movement data is required
to be submitted as part of the applicant's traffic impact
analysis.

5. If the applicant intends to present design hourly volumes
(DHV) for existing and future conditions, the derivation
of these volumes should be clearly documented.

Specifics of the development program include:

1. Proposed land use(s) and density;

2. Current zoning category and allowable yield;

3. Year of project build-out and staging plan, if any;

4. Site access constraints and opportunities (e.g.
   right-of-way, easements, sight distance);

5. Site plans showing dimensions and locations of buildings,
   access points, and internal circulation.

Once these basic land development parameters are
established, the analysis should continue in the following
sequence:

1) Trip Generation: Once land uses have been determined,
it is possible to estimate the number of trips that will be
generated by the development. Trip generation rates have been
collected for various land uses. The rates are a function of
character (type of land use), intensity (number of dwelling
units, amount of gross floor area, number of restaurant seats)
and location. Other factors, such as proximity of public
transportation, availability of a ridesharing program, or a mixed
use development which encourages walk trips will affect rates.
In these cases, appropriate adjustments should be considered on a
case by case basis. Standard trip rate references include:

- The Institute of Transportation Engineers (ITE) "Trip
  Generation-An Informational Report." This document is
  periodically updated; the latest edition should be used;

Federal Highway Administration (FHWA), "Development and Application of Trip Generation Rates," 1985. This report presents an overview of the data sources on trip generation rates. Updated trip generation rates are presented along with factors for adjusting trip rates due to variations in residential characteristics.

If local data or special ITE, or transportation agency studies are available, they could be used if local staff consider them more accurate. All of the above reports are available for review at Chittenden County Regional Planning Commission (CCRPC).

Special concerns regarding existing trip generation data include:

a. Trip rates may be based on a limited number of studies;
b. Variability among trip generation rate sources and geographic locations as well as differences between these rates and other national data sources, such as the 1983-1984 Nationwide Personal Transportation Study (NPTS);
c. Lack of detailed guidelines on the use of existing trip generation rate data;
d. The effect of socio-economic variables on residential trip generation rates;
e. Reduced external trips generated by multi-use centers (i.e. a percentage of the trips generated by a multi-use center are internal and remain on site);
f. Capture rates for "passer-by" traffic (i.e. trips attracted to the development from traffic normally passing-by the site).

Nonetheless, the ITE Informational Report (latest edition) remains the standard reference on this topic, and use of alternate rates should be well documented.

2. Trip Distribution: The directional distribution of the generated trips entering and leaving the proposed subdivision via all access points must be justified by the relative locations of other traffic generators (i.e., employment centers, commercial centers, regional or area shopping centers, transportation terminals, etc., and/or the trip table information provided by CCRPC staff). These same factors or other factors provided by staff shall be applied to the development under study as well as to other "nearby" subdivision plans in their analyses.

3. Directional Split: Trips generated by residential uses should be assumed to have 60-70 percent leaving and 30-40 percent
entering the proposed subdivision during the morning peak and 60-70 percent entering and 30-40 percent leaving the proposed subdivision in the evening peak. The split for traffic associated with other land uses is to be derived from ITE published information or other accepted studies, as determined by staff and the applicant.

4. Trip Assignment: The distribution factors shall be applied to the generated trips and the resulting traffic volumes assigned to the road network providing access to the proposed subdivision plus existing and "nearby" future traffic to determine the impact on the adequacy of the transportation facilities. The assignment is to be extended to the nearest major intersection, or intersections, as determined by staff and can include an evaluation of the impact of generated traffic on existing links.

5. Capacity Analysis: At the identified major intersection(s) the existing and estimated future traffic must be compared to the adequacy of the intersection(s). This can be accomplished using the procedures contained in Chapters 9 (Signalized Intersections) and 10 (Unsignalized Intersections) of the 1985 Highway Capacity Manual. Link volume analysis should also be done in accordance with the 1985 Highway Capacity Manual. The analysis should be done for both the AM and the PM peak hours. All worksheets or printouts should be included in the report. These worksheets should display all inputs used in the analysis: turning movements, cycle length, signal phasing and geometry, as well as adjustment factors.

This step will yield peak hour level of service estimates that indicate how well an intersection is currently operating and how well an intersection can accommodate a given future volume of traffic. For signalized intersections, at Level of Service (LOS) A, drivers experience little or no delay (less than 5.0 seconds per vehicle). At LOS B, delay is in the 5.1 to 15.0 seconds per vehicle range. Higher delays (15.1 to 25.0) occur at LOS C, possibly accompanied by cycle failures. At LOS D, the level of congestion becomes more pronounced, with delay of 25.1 to 40.0 seconds per vehicle. The limit of acceptable delay is considered to be LOS E, with delay of 40.1 to 60.0 seconds. LOS F describes delay in excess of 60 seconds per vehicle; this level is considered unacceptable to most drivers.

Many local and state agencies use the level of service hierarchy for design and regulatory purposes. Selection of the appropriate level as a standard is dependent on a variety of factors and is best determined at the regional and local level.

6. Develop Solutions and Implement Project: Once level of service estimates have been prepared, it is possible to begin an assessment of what changes, if any, are needed in either the transportation system or the land development plan. Typical changes include:
- widening intersection approaches;
- signal timing or phasing changes;
- channelization modifications;
- modification, relocation or reduction of access points;
- a Transportation Systems Management (TSM) program to reduce site generated peak hour traffic;
- changes in the development plan to a lower density or different mix of uses that will reduce trip generation or modify trip distribution.

After selecting one or more changes it is necessary to re-estimate the level of service calculations in order to evaluate the effect of each change. This often leads to the selection of a preferred solution that can be documented and presented for local review.

If the solution is acceptable to local officials, and funding arrangements have been successfully negotiated, the necessary plans, specifications and bids are prepared. It is important to coordinate private site related improvements with publicly funded projects or existing operational and roadway features. Facilities built by the private sector should be built to the appropriate state or local standard.
REPORT FORMAT

In an effort to standardize what information is to be submitted as part of a traffic analysis, the following items should be provided before an analysis is considered complete:

1. A site or area map showing existing roads in the area.

2. The location on the site map of "programmed" highway improvements, if any, that are in the Transportation Improvement Program (TIP) or the Agency's Five Year Program which would affect traffic at the critical intersection(s) to be studied provided that they are scheduled for at least 50 percent of their construction costs to be expended within the program period of the adopted TIP or Five Year Program.

3. Existing A.M. and P.M. peak traffic count summaries for all "nearby" critical intersections.

4. "Nearby" approved developments that would affect traffic at the critical intersection(s), with their location shown on the area map.

5. A table giving A.M. and P.M. peak hour traffic generated by all "nearby" approved but unbuilt developments showing the generation rate for each type of subdivision.

6. A.M. and P.M. peak hour traffic generated by the proposed development proportioned to the traffic entering and leaving the site.

7. Trip distribution pattern, in percent, for the "nearby" approved developments during the A.M. and P.M. peak hour, with the pattern being shown on an area map.

8. Trip distribution pattern, in percent, for the proposed development during the A.M. and P.M. peak hours, with the pattern being shown on an area map.

9. Maps which show separately and in combination:

   (a) Existing A.M. and P.M. traffic volumes assigned to the affected highway system.

   (b) Projected A.M. and P.M. traffic volumes assigned to the affected highway system and for all "nearby" approved developments.

   (c) Projected A.M. and P.M. traffic volumes assigned to the affected highway system for the proposed development.
10. Any study performed to help determine how to assign recorded or proposed development traffic, such as a license plate study or special turning movement counts, should also be supplied.

11. Copies of all capacity analyses, showing inputs, assumptions and calculations for each approach.

12. A listing of all transportation improvements, if any, that the developer agrees to provide.

PHYSICAL, ENVIRONMENTAL AND OTHER IMPACTS

This report focuses on estimating and evaluating the traffic operations impact of proposed development. Other related impacts may be identified in the course of reviewing a specific proposed development. These include: effects of heavy vehicles, noise and air quality impacts, safety issues, adequacy of parking, and driveway design and location. Each of these items is briefly discussed below.

Adding a large number of heavy vehicles to a local or regional road network will generally have impacts in at least the following areas:

- Roadway or intersection capacity
- Pavement design and stress
- Noise

Heavy vehicles are larger than passenger cars and, therefore, occupy more roadway space than cars; moreover, heavy vehicles have poorer operating capabilities than cars, particularly with respect to acceleration, deceleration and the ability to maintain speed on upgrades. The latter impact is most critical. When doing a capacity analysis, adjustment factors are used to reflect the proportion of trucks, recreational vehicles and buses in the traffic stream. With respect to pavement, it is important to estimate axle and total weight, which can then be used for design and policy decisions. Areas of concern include the effect of additional loads on pavement life as well as construction and maintenance cost responsibility.

Trucks can be major contributors to roadway traffic noise. Diesel trucks are inherently more noisy than cars, producing a noise level about 15 decibels (dBA) higher in each type of vehicle operating condition. The noise source for large diesel trucks is a composite of contributions from the engine and exhaust system and the tire-roadway interaction, with the engine noise dominating at low speeds and tire-roadway interaction dominating at high speeds. Once a noise problem is identified, several control techniques may be considered. Pathway controls include roadside barriers that shield or separate the noise receiver from the noise source. Site planning techniques can be used to position sensitive uses farthest from the noise source,
reduce the exposed surface of buildings, and place intervening structures as barriers. Architectural and administrative controls can also mitigate noise impacts. Comparative noise levels are presented in Table 9.

**TABLE 9**

**COMPARATIVE NOISE LEVELS**

Typical decibel (dBA) values encountered in daily life and industry.

- Rustling leaves: 20 dBA
- Soft whispers at 5 feet: 34
- Window air conditioner: 55
- Conversational speech: 60
- Busy restaurant: 65
- Vacuum cleaner at 10 feet: 69
- Ringing alarm clock: 80

Over 85 dBA, beginning of hearing damage if prolonged.

- Printing press plant: 86
- Heavy city traffic: 92
- Heavy diesel vehicle at 25 feet: 92
- Home lawn mower: 98
- Air hammer: 107
- Jet airliner 500 feet overhead: 115

**Source:** Impact of Noise on People, FAA, U.S. DOT May, 1977.

The effect of vehicle emissions on air quality is a complex relationship. Season, time of day, atmospheric conditions, travel speeds, percentage of cold starts, all have a relationship to air pollution. Models are used to estimate future emissions; the output of these models is highly dependent on various assumptions. National air quality standards are shown on Table 10.

Safety, adequacy of parking and driveway design and location are all elements of site planning and access that must be considered on a case by case basis. The CCRPC has information on high accident locations as compiled by the VAOT. Model parking standards and generation rates are also available at CCRPC. Site access, both location and design, must be carefully evaluated for operational and safety reasons. Sight distance, auxiliary lanes for deceleration, and spacing of driveways are design elements that need evaluation.
### TABLE 10
NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)*

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Averaging** Time</th>
<th>Primary** Standard</th>
<th>Secondary*** Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur Dioxide</td>
<td>Annual Average</td>
<td>0.03 ppm</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>24 hr.</td>
<td>0.14 ppm</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>3 hr.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspended Particulate Matter</td>
<td>Annual Geometric Mean</td>
<td>75 ug/m</td>
<td>60 ug/m</td>
</tr>
<tr>
<td></td>
<td>24 hr.</td>
<td>260 ug/m</td>
<td>150 ug/m</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>8 hr.</td>
<td>9 ppm</td>
<td>Same</td>
</tr>
<tr>
<td></td>
<td>1 hr.</td>
<td>35 ppm</td>
<td>Same</td>
</tr>
<tr>
<td>Nitrogen Dioxide</td>
<td>Annual Average</td>
<td>0.05 ppm</td>
<td>Same</td>
</tr>
<tr>
<td>Ozone</td>
<td>1 hr.</td>
<td>0.12 ppm</td>
<td>Same</td>
</tr>
<tr>
<td>Lead</td>
<td>1 Month Average</td>
<td>1.5 ug/m</td>
<td>Same</td>
</tr>
</tbody>
</table>

*Standards based on other than annual average or annual geometric mean are not to be exceeded more than once per year.

**Primary standards - set to protect human health.

***Secondary standards - set to protect public welfare.

ug/m = microgram per cubic meter
ppm = parts per million.


### CONCLUSION

The traffic impact estimation process is a widely used tool for resolving transportation and land use issues. With growing emphasis on innovative approaches to financing transportation improvements, traffic impact analysis has emerged as an important tool in growth management. This places considerable responsibility on the developer as well as the agency or individuals responsible for technical review and negotiation of
improvements. Moreover, the technical process must be understood by citizens, planning commissioners, and elected officials, so that they can make informed decisions. Accordingly, this section is designed to be an introduction to basic traffic impact analysis procedures. As such, it offers guidelines that will help ensure an analysis is technically sufficient to provide meaningful results. Each impact study, however, must be tailored to the unique conditions of a site. A bibliography is included following this section for readers needing detailed source material. Items #3, 6, 7 & 8 contain examples of basic and complex traffic impact studies. All publications in the bibliography are available for review at Chittenden County Regional Planning Commission (CCRPC) offices, and staff is available both to answer specific questions not addressed in this section, and to assist member communities in the review of traffic impact reports.
BIBLIOGRAPHY


GLOSSARY OF TERMS

Access Time - The total time from origin or destination to the primary mode of travel. May include walking time, waiting time, time in another type of vehicle, or terminal time.

All-or-Nothing Assignment - The process of allocating the total number of trips between each pair of analysis areas to the path or route with the minimum travel time.

Average Daily Traffic (ADT) - The average number of vehicles passing a specified point during a 24-hr. period. Some examples are as follows:
  Annual Average Daily Traffic (AADT) - Denotes daily traffic averaged over one calendar year.
  Annual Average Weekday (AAWD) - Denotes that the specified period includes only weekdays, Monday through Friday.

Calibration - The procedure used to adjust travel models to simulate base-year travel.

Capacity - The maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic and control conditions.

Capacity Restraint - The process by which the assigned volume on a link is compared with the practical capacity of that link and the speed of the link adjusted to reflect the relationship between speed, volume, and capacity. The procedure is iterative until a realistic balance is achieved.

Capture Rates for Pass-by Traffic - Proportion of trips attracted to the development from traffic normally passing-by the site.

"Committed" Development - New land use projects for which site location, type and density are firmly established for construction.

Committed Roadway/Traffic Operational Improvements - New roadway or traffic operational improvements for which plans are firmly established, and funded, for construction.

Cycle Length - The time required for one complete sequence of traffic signal indications.

Green Ratio - The ratio of effective green time to the cycle length; given the symbol g/c.
Gravity Model - A trip distribution technique. The gravity model is based on the hypothesis that the number of trips between two areas is directly related to the amount of activity in an area and inversely related to the spatial separation between the areas, represented as a function of travel time.

"Internal" Trips - Site generated trips which occur between two or more land uses located on the subject site with both trip ends on-site.

Level of Service (LOS) - A set of qualitative and quantitative criteria that describes the degree to which an intersection, roadway, weaving section or ramp efficiently serves peak hour and/or daily traffic.

Mode Split - The percentage split of site generated trips which use various modes of travel to access a site, i.e. auto, bus, subway, walk, bicycle.

"Off-Site" Access - The road network beyond the site's boundary which provides vehicular site access.

"On-Site" Circulation - Vehicular network which primarily accommodates site generated traffic within the site boundary and includes not only roadways, but parking lots, decks and garage travelways.

Pavement Structure - The combination of sub base, base course and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

Peak Hour - The hour during which the maximum amount of traffic occurs.

Peak Hour Factor - The ratio of total hourly volume to the maximum 15-minute rate of flow within the hour. That is,

 hourly volume
Peak Hour Factor = (4)x(volume during peak 15 min.
of peak hour.)

Sight Distance - The length of roadway ahead visible to the driver. The minimum sight distance available on a road should be sufficiently long to allow a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path.

Special Generator - A land-use activity that generates a high volume of traffic, such as a shopping center, an airport, or a university.

Traffic Assignment - The process of determining route or routes of travel and allocating the zone-to-zone trips to these routes.
Trip - A single or one-direction vehicular trip with either the origin (outbound) or destination (inbound) or both inside the study area. Each trip has two trip ends.

Trip Distribution - The process by which trips originating in one portion of the study area are distributed to the other portions of the study area.

Trip End - A trip origin or a trip destination. Trip ends for a location are the summation of origins and destinations. A trip has two ends, the origin and the destination. A site which has over some period of time, 2,000 trips entering and 1,800 trips leaving, has 3,800 trip ends associated with it. The 3,800 total trips to and from the site represent a total of 7,600 trip trip ends. Of these, 3,800 occur at locations other than the site in question.

Trip Generation - Estimating the number of vehicle trips which may be generated by a specific building or land use.

"VMT - Vehicle-miles of travel" is generally used as an areawide measure. May be calculated by summing data on a link basis or by multiplying average trip length (in miles) times the total number of vehicle trips.