HIGHWAY SYSTEM CHARACTERISTICS AND USAGE

Roadway Functional Classification

The road network in the region consists of highways classified as interstate highway and expressways, principal arterials; minor arterials; major collectors; minor collectors; and local streets, as shown in **Figure 12** . The classification system is organized as a hierarchy of facilities, based on the degree to which the roadway facility serves mobility and access to adjacent land uses. Interstate highways and expressways, at the top of the hierarchy, are devoted exclusively to mobility, with very limited access to adjacent land. Arterials and Collectors provide both mobility and access. The local road system is devoted exclusively to providing local access, with limited capacity and relatively slow speeds.

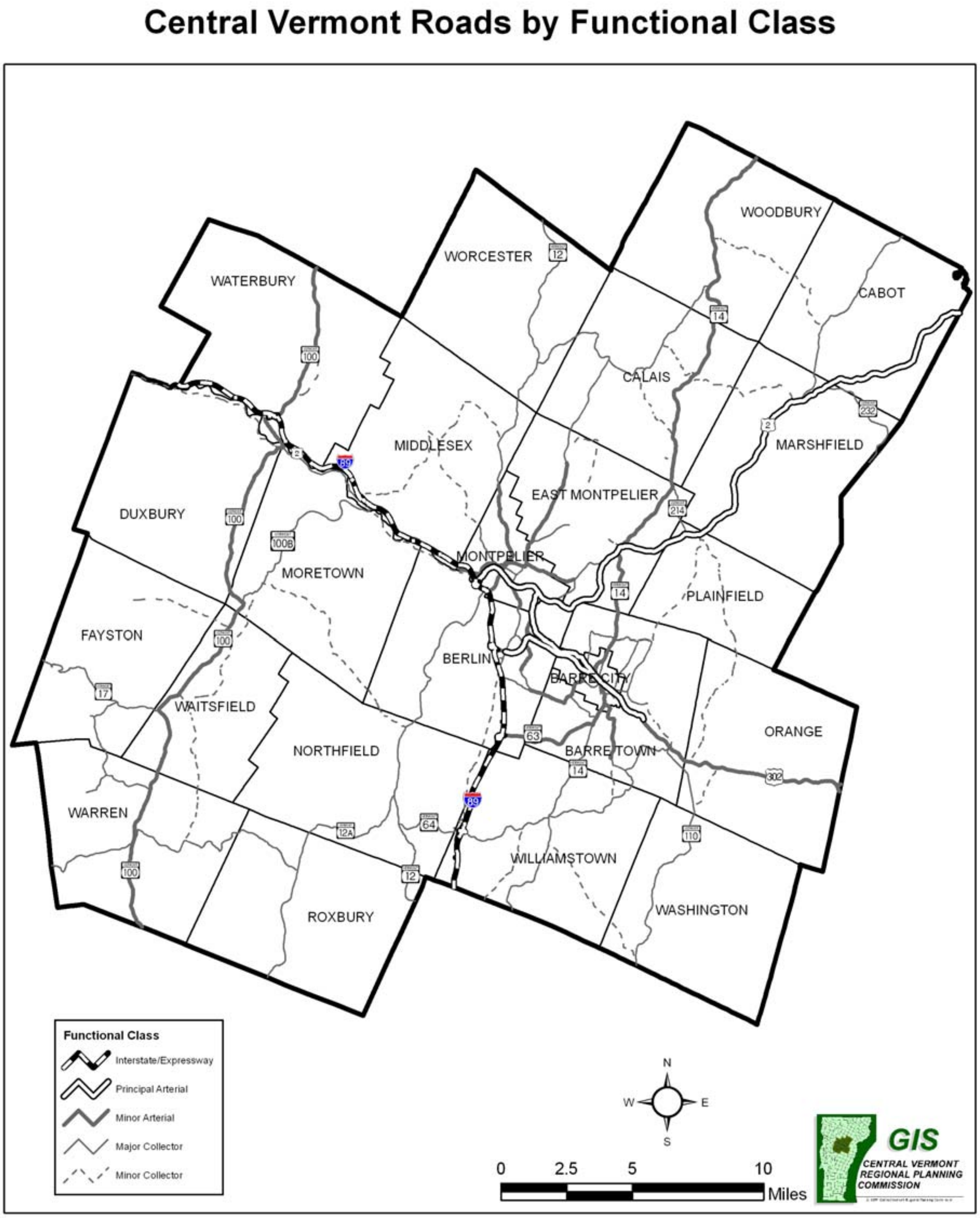
Interstate Highway and Expressway System -- The interstate highway system primarily serves statewide and interstate travel on facilities designed to federal interstate highway standards. Other freeways and expressways serve a similar function but are not designed to interstate highway standards. **I-89** is the region's only interstate highway. Two other roadways in the region (**Montpelier State Highway** in Montpelier and **Route 62** in Berlin and Barre City) are classified as other freeways and expressways due in part to their direct connection with I-89.

Principal Arterial System -- In every Vermont region there exists a system of streets which can be identified as unusually significant to the region in which it serves. These principal arterials carry the major portion of trips entering the region as well as the majority of through movements desiring to bypass the central commercial areas of the region. In addition, the principal arterial system carries significant intra-regional travel (such as between the Montpelier and Barre City commercial districts) and between these business districts and major urban areas outside the region. This system stresses mobility of vehicles over access to abutting land. The region's principal arterial system consists of:

- **Route 2** from the Washington County line in Cabot, through Marshfield, Plainfield, East Montpelier, and into Montpelier to the Montpelier State Highway/Bailey Avenue intersection;
- **Route 302** from Barre Town, through Barre City and Berlin, to its terminus at Route 2 in Montpelier; and
- **Route 14** from the Barre Town/East Montpelier line to its westerly intersection with Route 302 in Barre City.

Minor Arterial System -- The minor arterial system interconnects with and augments the principal arterial system and provides service to trips of moderate length. The minor arterial system places more emphasis on land access than the principal arterial system as well as achieving an acceptable level of mobility. The minor arterial system also serves as a primary connection between the state's counties. Minor Arterials are shown in **Figure 12**.

Figure 12


Central Vermont Roads by Functional Class
WOODBURY
WORCESTER
WATERBURY
CABOT
CALAIS
MIDDLESEX
MARSHFIELD
DUXBURY
EAST MONTPELIER
MONTPELIER
MORETOWN
PLAINFIELD
FAYSTON
BERLIN
BARRE CITY
WAITSFIELD
ORANGE
NORTHFIELD
BARRE TOWN
WARREN
WILLIAMSTOWN
WASHINGTON
ROXBURY
Functional Class
Interstate/Expressway
Principal Arterial
Minor Arterial
Major Collector
Minor Collector
N
W
E
S
0
2.5
5
10
Miles
GIS
CENTRAL VERMONT REGIONAL PLANNING COMMISSION

Major Collector System -- The major collector street system balances land access service and traffic circulation within residential neighborhoods, commercial, and industrial areas. It differs from the arterial system in that facilities on the collector system may penetrate residential neighborhoods, distributing trips from the arterial system through the area to the ultimate destination. A primary function of the major collector system is to serve intra-county trips. Major Collectors are shown in **Figure 12**.

Minor Collector System -- The minor collector street system provides service to smaller communities in rural areas of the region and is spaced to collect traffic from local roads to the major collector system. Within the urban sectors of the region, a primary function of the minor collector system is to serve intra-town trips. Minor Collectors are shown in **Figure 12**.

National Highway System

The National Highway System (NHS) is part of the National Intermodal Transportation System which consists of Interstate and Defense Highways and principal arterial roads essential for interstate and regional commerce, travel, national defense, intermodal transfer facilities, international commerce and border crossings. Federal law (the Intermodal Surface Transportation Efficiency Act (ISTEA), the Transportation Efficiency Act for the 21st Century (TEA-21), the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), and Moving Ahead for Progress in the 21st Century Act (MAP – 21)) established the development of a National Intermodal Transportation System that is economically efficient and environmentally sound, providing the foundation for the Nation to compete in the global economy, and to move people and goods in an energy efficient manner. In addition, this system intends to provide improved access to ports and airports, the Nation's link to international commerce.

Within the Central Vermont Region, the roadway sections included on the NHS are I-89 (throughout the region), Route 2 from the Washington County line in Cabot into Montpelier to its intersection with Montpelier State Highway and Bailey Avenue, and Montpelier State Highway from Route 2 to its interchange with I-89.

Town Road Importance

To help prioritize culvert inventories, VTrans asked each Regional Planning Commission to identify town roads by three categories of importance. High Importance are roads that already have some kind of classification, Minor Arterials, Major & Minor Collectors, and Class 2 Town Highways. Medium Importance are roads that can be used as bypasses of the State System, connectors between State Highways, and feeder roads from developed areas in towns. Another purpose for this designation is that it can be used in the Project Review Process. See Figure 13.

Vermont Byways Program http://www.vermont-byways.us/

The Vermont Byways Program was created to recognize and promote the state's most unusual roadways. The ultimate objective of this program is to identify those roadways that exhibit such exceptional scenic, cultural, historic, natural, recreational, or archaeological resources that these roads should be both managed and promoted in special ways. The program is designed to encourage the creation of public/private partnerships along these special roads and to allow those partnerships to define the ways in which those roads should be promoted and managed.

The Program provides protection for owners of private property in that (1) existing land use regulations need not be modified, (2) the Program does not have powers of zoning or condemnation, (3) residents in or along a corridor are not required to participate, (4) the Program is intended to promote economic growth and development in a balanced manner, and (5) the Program and/or data collected as part of the Program are not intended to be used in an Act 250 hearing, nor would it preclude any land development otherwise permitted by existing zoning. The Central Vermont Regional Planning Commission also recognizes that designation as a Byway should not have special influence in the regulatory review process.

There are three primary benefits that can be derived from a byway designation. The first is the additional tourists who will travel along roadways that are designated as scenic on state tourism maps. For communities wishing to strengthen their tourist economies, the byways program offers a strong tool to achieve that objective.

A second benefit that can be derived from the byways programs is the protection and management of roads that have unusual qualities. For communities that feel that some of their narrow, winding, historic road layouts are essential to the character of their community, a byway designation would give towns the option to develop roadway maintenance standards to prevent the roadway's character from being damaged or destroyed by inappropriate highway improvements.

The final potential benefit that some communities may seek is the careful identification and assessment of how the special resources lying within a roadway corridor should be managed. Whether it be the protection of special archaeological or historic resources , the management of sensitive ecosystems along the corridor, or the use of land use regulations to manage growth and development, communities can use the byways program to achieve these types of results.

The following US and State Highways have been designated a Vermont Byway:

Mad River Byway

Middlesex Village (Route 2); Moretown (Route 100B); Waitsfield, Warren, Granville Gulf Reservation (Route 100); Fayston, and Buels Gore to the top of the Appalachian Gap (Route 17).

Green Mountain Byway

US 2 in Waterbury Village and Route 100 from Waterbury Village to the Stowe/Morrisville Town Line.

It is recommended that any road that exhibits the intrinsic qualities, should consider byway planning.
It is recommended that the scenic and rural views from the Interstate is protected.
It is also recommend that the State reinstate the Byway Program.

Figure 13

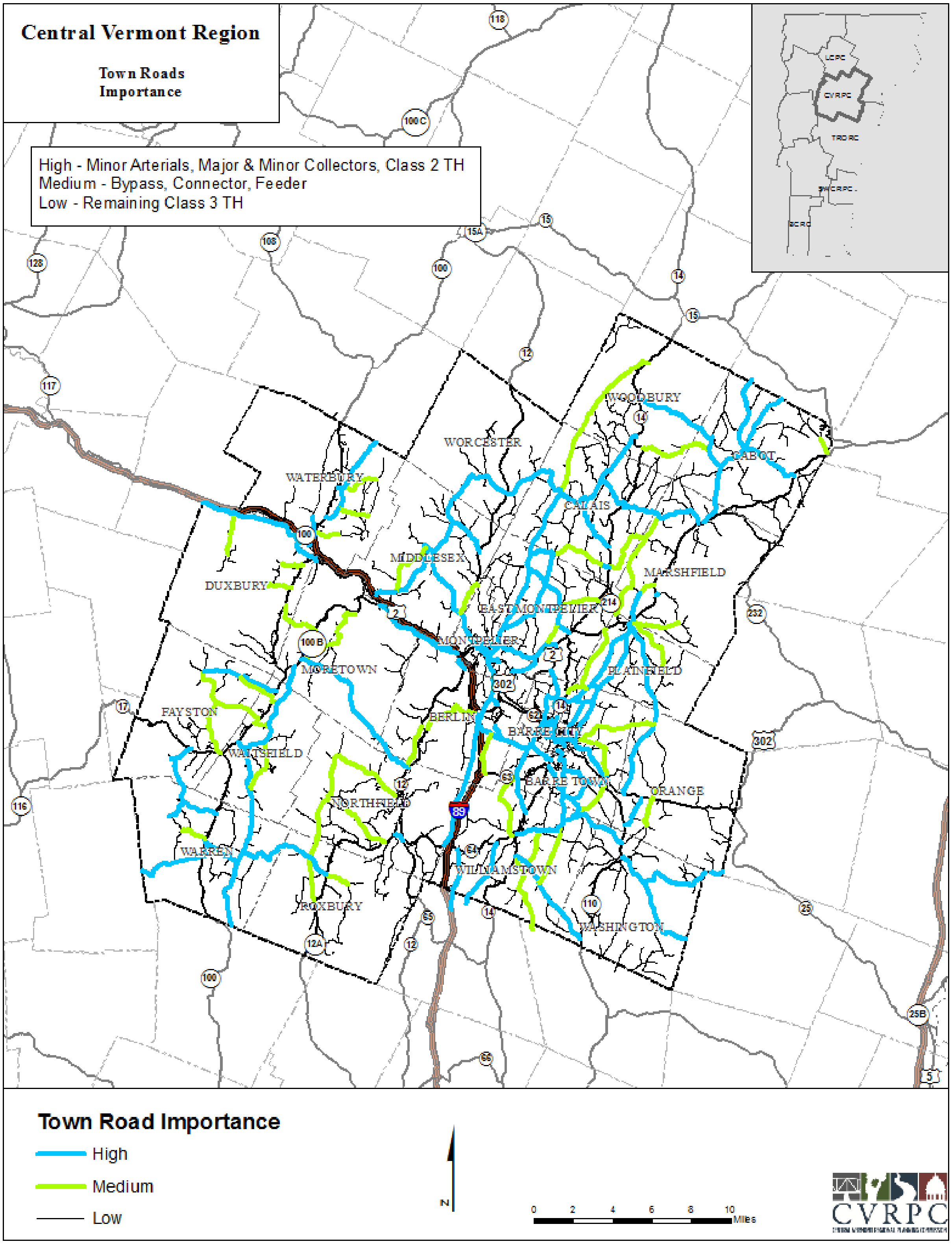
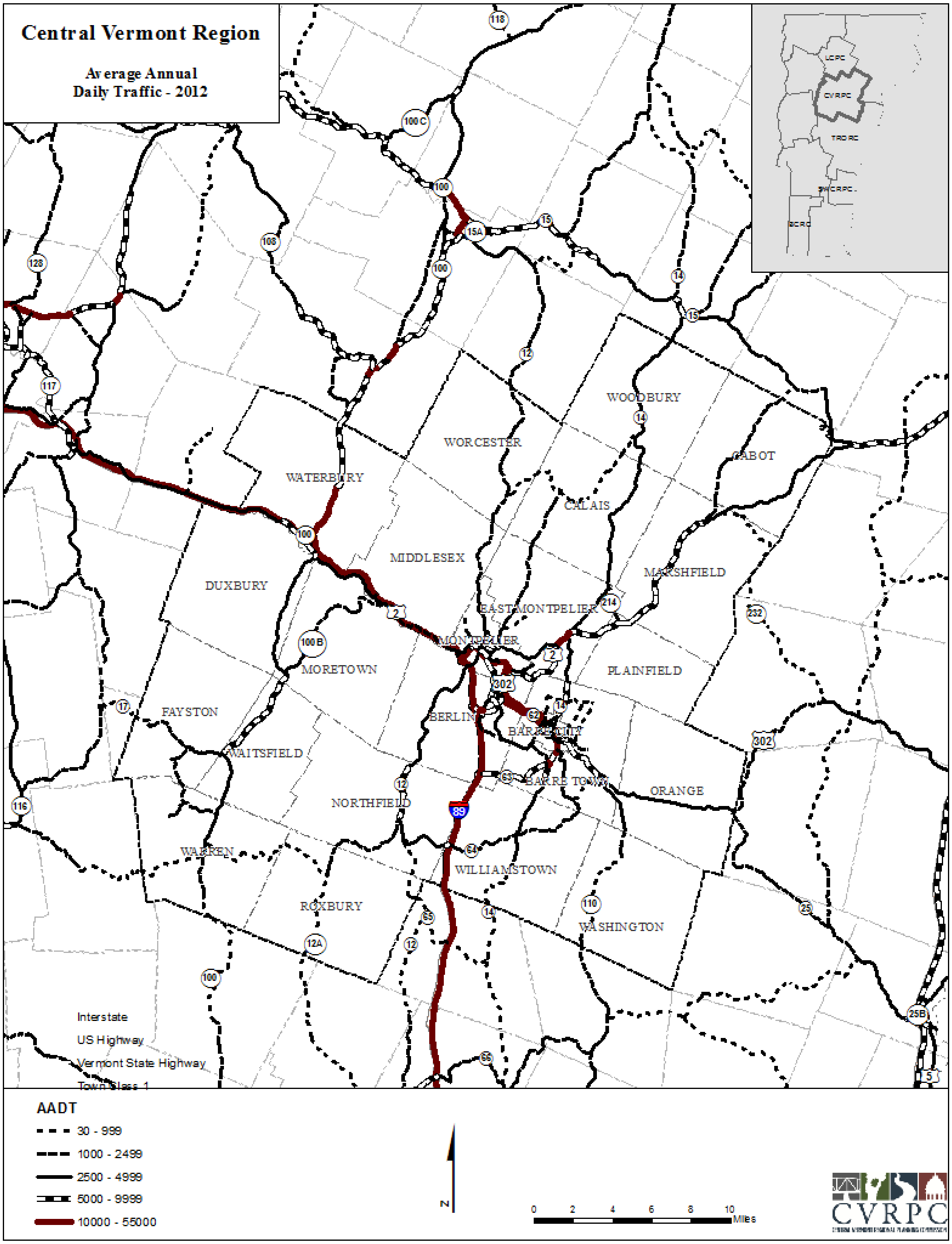

Central Vermont Region
Town Roads Importance
High - Minor Arterials, Major & Minor Collectors, Class 2 TH
Medium - Bypass, Connector, Feeder
Low - Remaining Class 3 TH
WOODBURY
CABOT
WORCESTER
WATERBURY
CALAIS
MIDDLESEX
DUXBURY
MARSHFIELD
EAST MONTPELIER
MONTPELIER
MORETOWN
PLAINFIELD
FAYSTON
BERLIN
BARRE CITY
WAITSFIELD
BARRE TOWN
ORANGE
NORTHFIELD
WARREN
WILLIAMSTOWN
ROXBURY
WASHINGTON
Town Road Importance
High
Medium
Low
N
0 2 4 6 8 10 Miles
CVRPC

Figure 14



Average annual daily traffic (AADT) volumes for all state highways and several other major roadways in the region are shown in **Figure 14**. These AADT values are for the year 2012 and are based on automatic traffic recorder counts taken by VTrans. Year 2012 AADT for major road segments can be

found at http://vtransplanning.vermont.gov/research/traffic/publications
The highest traffic volumes in the Region are found on I-89, which carries approximately 25,700 vehicles per day between Berlin and Waterbury. Excluding the Interstate, the highest traffic volumes in the Region are found in the Montpelier, Barre, and Berlin area and in the Route 100 Corridor north of I-89. The fact that these areas have the highest traffic volumes is consistent with the role they serve as employment centers in the Region, as well as being located at the cross roads of major highways. Traffic volumes along the major state highways in these areas generally range between 10,000 and 16,000 vehicles per day. Traffic volumes decrease as the state highways reach out into the surrounding communities dropping to between1,000 and 10,000 vehicle per day.

Historical Trends

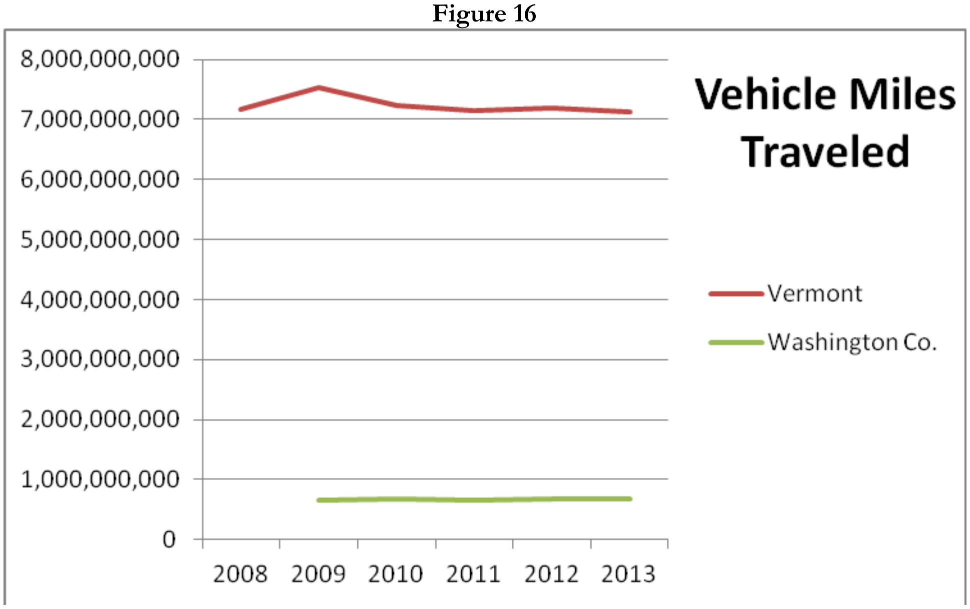
For over forty years the VMT showed very steady growth with the exception of the 1974 energy crisis. More recent VMT data (2003-2005) showed a significant decline, which relates to the sharp spike in fuel prices. Even more recent VMT data has shown no significant growth in Table 17 and Figure 16

Table 17

Vehicle Miles Traveled

Year	Vermont	Washington Co.
2008	7,176,200,000	
2009	7,537,028,000	663,820,000
2010	7,243,500,000	670,800,000
2011	7,141,039,000	667,000,000
2012	7,195,900,000	679,000,000
2013	7,117,900,000	669,500,000

Figure 16



HIGHWAY SYSTEM PERFORMANCE

- This section of the plan uses congestion, safety, and physical condition performance measures to identify existing and future deficiencies. A variety of methods are used to identify and quantify these deficiencies, including capacity analysis of both intersections and road segments; safety analysis using accident data; VTrans bridge sufficiency ratings, and VTrans pavement condition ratings.

Congestion

Congestion has been estimated for major intersections that have under gone recent engineering studies. Level of service (LOS) is the standard measure used to quantify the operational performance of highway facilities as perceived by the user. The grades A, B, C, D, E and F are the six possible LOS ratings where "A" indicates excellent conditions with free flow, "E" indicates intolerable conditions with unstable flow, and "F" indicates that demand exceeds capacity. **Table 20** summarizes the differences between the LOS ratings.

There is almost universal agreement that levels of service A, B and C are acceptable and LOS F is not. Because Level of Service ratings attempt to measure how well a facility is operating as perceived by the driver, the acceptability of LOS D varies by the location of the facility and the policies of state department of transportation's, and other municipal and regional organizations involved in transportation planning. On rural highway facilities where speeds are often higher and drivers expect a higher level of mobility, LOS D may not be acceptable. On the other hand, in urban areas and activity centers where drivers expect and are accustomed to greater delays, an LOS D is often considered acceptable and is often wide spread. In some cases, LOS E may be acceptable in urban areas and activity centers

Table 20. Qualitative Description of Level of Service

Level of Service	Traffic Operations
LOS A	Free flow conditions, vehicles are completely unimpeded, and minimal delay at intersections
LOS B	The ability to maneuver in a traffic stream is only slightly restricted and there are insignificant delays at intersections.
LOS C	Traffic flow is stable but the ability to maneuver and change lanes is more restricted than LOS B. Vehicles begin to back-up at intersections.
LOS D	A small increase in traffic may cause substantial increases in delay at intersections and decreases of travel speeds on road segments.
LOS E	Significant delays at intersections with road segment travel speeds at approximately 1/3 of the posted speed.
LOS F	Extremely slow travel speeds, high delays, and extensive vehicle back-ups at intersections

For the Central Vermont Region, LOS D is considered the extreme and should only be accepted for long-term planning purposes within the more urban, built-up sectors of the region (for example: Montpelier, Barre City, Northeast Berlin, South Barre, Waterbury Village, Northfield Village, and Waitsfield). Throughout most of the region, LOS C will be taken as the preferred condition and the threshold to be used in identifying potential problem locations.

Capacity Analysis - Level of Service

As stated in the 2000 Highway Capacity Manual, "the concept of *levels of service* uses qualitative measures that characterize operational conditions within a traffic stream and their perception by motorists and passengers. The descriptions of individual levels of service characterize these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience.

State highways carry not only locally-generated traffic, but also traffic originating from intersecting corridors, and from external through traffic. The land use and development patterns of the neighboring communities contribute to the levels of demand and congestion along these routes, not just those located where the congestion occurs. The demand created by these communities has produced a need for capacity improvements as described below in the corridor recommendations. Sustainable land use development and transportation facility improvements need to be balanced.

Congestion Management Strategies

Strategies designed to address congestion can be placed into demand and supply management categories. Demand management strategies attempt to reduce congestion by changing demand for single occupant vehicles by shifting travel to off-peak periods or to other modes. Supply management strategies are designed to address congestion through operational and physical changes to the transportation system's infrastructure.

Demand Management Strategies

- Land Use Policies and Regulations. Land use polices that encourage concentrated, mixed-use development patterns that are served by transit and a network of local streets, sidewalks, and bike paths could reduce the number and the length of vehicle trips helping to reduce congestion.
- Transportation Demand Management Programs. A variety of TDM programs are appropriate for the Central Vermont Region and are discussed in a later section.
- Increase Transit Ridership. Shifting travel from single occupant vehicles to transit may help reduce some congestion.
- Increase Use of Bicycle and Pedestrian Facilities. Shifting travel from single occupant vehicles to bicycle and pedestrian travel may help reduce some congestion.
- Improving Intermodal Connections. TDM programs, transit service, intercept parking lots, and bicycle and pedestrian networks will be most effective at reducing congestion if they are fully integrated.

Supply Side Congestion Management Strategies

- Optimizing Isolated Intersection Signal Timings. Retimed traffic signals, with no changes in hardware, generally reduce travel time by 12%. When new hardware is installed that allows for a wider variety of phasing plans, travel times may be reduced by as much as 25%[1].
- Coordinating Traffic Signals Along Arterials. When traffic signals are spaced at less than ½ mile, coordination of the timing plans should be evaluated. Traffic signal coordination has the potential to reduce travel time by as much as 25%[2] for through traffic on the main arterial.

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1 "Improving Traffic Signal Operations A Primer"; US Department of Transportation Federal Highway Administration; 1995.

2 "Improving Traffic Signal Operations A Primer"; US Department of Transportation Federal Highway Administration;

Coordination also reduces the number of stops, which in turn, may result in less rear end collisions.

- Minor Intersection Geometric Improvements. Small, low cost modifications such as minor widening to accommodate left or right turn lanes.

- Intersection Turn Restrictions. Provide intersection turn restrictions, which could be limited to peak travel periods, to reduce conflicts and increase overall intersection performance.

- Reversible Lanes. In locations where there is a heavy percentage of in-bound traffic in the morning, and a heavy percentage of outbound traffic in the evening, lane designations at intersections could be changed to accommodate the changes in traffic flows.

- Access Management. Reduce delays to through traffic caused by turning vehicles and "side friction" from driveways. If access management is planned for and incorporated into new roads or reconstruction projects, the cost is low. The cost to implement access management techniques for existing arterials can be high if development is dense and roadway improvements are restricted by limited right-of-way.

- Incident Management, Detection, Response & Clearance. In Central Vermont, congestion may not appear to be a problem until an incident that creates a disruption in the traffic flow occurs. Examples include an accident, temporary closure for road construction, or bad weather, Traveler radio, traveler alert notification (via email, fax, etc), and general public outreach to enhance incident related information could help reduce delays cause by these disruptions.

- Addition of Truck Climbing Lanes and Shoulder Widening. For rural principal and minor arterials such as US 2, strategic placement of truck climbing lanes can help eliminate bottlenecks. Widening of shoulders also improves operations and safety.

- Major Intersection Capacity Modifications. When traffic signal optimization or minor lane changes are not effective at eliminating congestion, major intersection reconfiguration should be considered. The reconfiguration could include new turn lanes on most of the approaches or adding through lanes. Roundabouts should also be considered whenever major reconstruction of an intersection appears to be necessary.

- Add Capacity to Highway Segments. Increase road capacity by adding through lanes.

Safety Analysis

One of the key considerations in the assessment of the transportation system is its capability to provide safe travel for motorists, transit patrons, pedestrians, and bicyclists. A safe transportation system is expected by all users of the region's transportation system. At the individual level, this concern for transportation system safety has primarily to do with the costs associated with crashes (e.g., medical, auto repair, loss of time from work and possibly income). However, this concern over safety has region-wide implications as well. It has been estimated by the Federal Highway Administration that over half of all motorist delay in urban areas is a direct result of incidents. Some of these incidents consist of traffic flow during roadway maintenance or reconstruction or during special events, but the majority of incident delay derives fromcrashes. Therefore, any safety improvements will result not only in reduced medical, liability, and loss time costs, but also in improved mobility and potentially reduced air pollutant emissions in the region.

1995.

VTrans High Crash Locations

VTrans analyzes the number of crashes occurring along road segments and at intersections and compares the frequency and severity to statewide averages for similar facilities. The crashes included in these analyses involve injuries or fatalities, or result in at least $1,000 of property damage. Any intersection or road section (0.3 mile section) that 1) has at least 5 crashes over a 5-year period and 2) has an actual crash rate (number of crashes per million vehicles) that exceeds the state's critical crash rate3 is then classified as a High Crash Location.

VTrans summarizes the HCLs in its High Crash Location Report. The most current version is based on crashes which occurred between2008 and 2012. The report indicates that there are a total of HCLs in the Central Vermont region **(Figure 19)** inluding 9 intersections **(Table 25)** and road segments **(Table 26)**.

3 The critical crash rate is based on the average crash rates of similar roadways in the state and is related to the functional class of the highway and whether it is located in an urban or rural area.

Figure 19. High Crash Locations

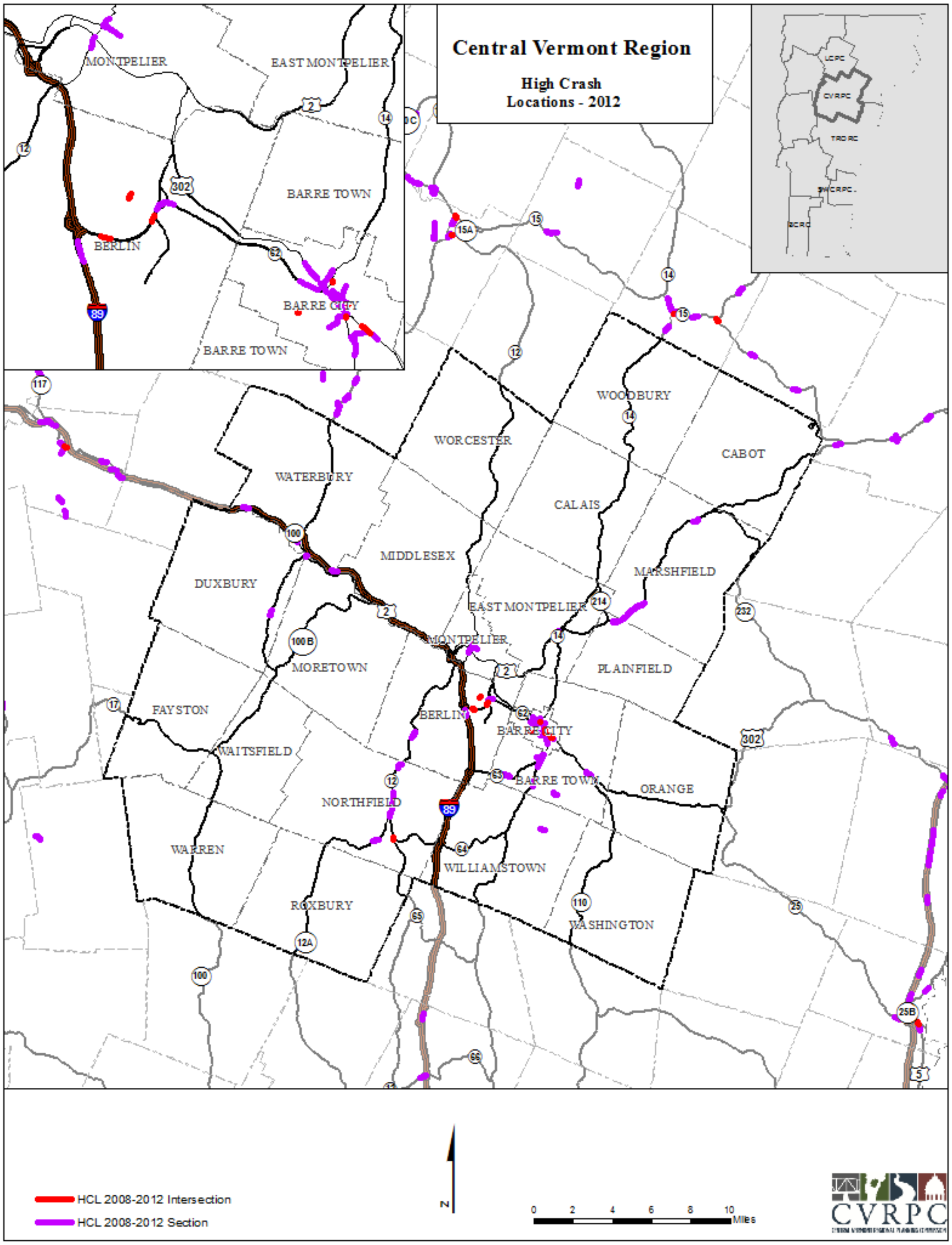


Table 25. Intersection High Crash Locations in Central Vermont

State Rank	Route	System	Town	Mileage	ADT	Crashes	Fatalities	Injuries	PDO Crashes	Critical Rate	Actual Rate	Actual/Critical Ratio	Severity Index ($/Accident/1.)
15	SUMMER ST., ELM ST., FRANKLIN ST.	Urban Collector (u)	Barre City	0.420 - 0.430	8050	26	0	5	23	1	2	1.85	$21,373
20	VT-12, VT-64	Major Collector (r)	Northfield	1.980 - 2.080	4638	13	0	6	8	0.9	2	1.727	$37,877
23	VT-62, BERLIN STATE HIGHWAY, FISHER RD.	Freeway/Expressway (u)/Minor Arterial (u)	Berlin	1.300 - 1.400	20154	62	0	17	50	1	2	1.712	$26,426
44	FAS 0201, <S6206>, TOWN ROAD 0019	Major Collector (r)	Berlin	1.050 - 1.150	4150	10	0	7	7	0.9	1	1.444	$55,370
86	VT-14, SEMINARY ST.	Minor Arterial (u)/Urban Collector (u)	Barre City	1.330 - 1.350	5405	14	0	4	10	1.2	1	1.18	$26,414
105	VT-62, FAS 0201	Minor Arterial (r)/Major Collector (r)	Berlin	0.400 - 0.560	15965	29	0	8	24	0.9	1	1.091	$26,731
113	VT-14, PROSPECT ST.	Minor Arterial (u)/Urban Collector (u)	Barre City	1.120 - 1.140	12600	25	0	2	23	1	1	1.076	$13,804
127	PROSPECT ST., BERLIN ST.	Minor Arterial (u)/Urban Collector (u)	Barre City	0.530 - 0.550	2650	7	0	3	5	1.4	1	1.016	$36,443
130	US-302, VT-110, TOWN ROAD 0030	Minor Arterial (r)/Major Collector (r)	Barre Town	2.470 - 2.630	7136	14	0	2	12	1.1	1	1.005	$17,657

Note: /1--Average Cost per fatality, injury or PDO is based on 2010 National Safety Council Estimates: Fatality $1,410,000; Injury $70,200; Property Damage Only $8,900
/2--Routes are logged from south to north and from west to east.

Table 26. Segment High Crash Locations

State Rank	Route	System	Town	Mileage	ADT	Crashes	Fatalities	Injuries	PDO Crashes	Critical Rate	Actual Rate	Actual/Critical Ratio	Severity Index ($/Accident/1.)
4	VT-63	Minor Arterial (r)	Barre Town	0.809 - 1.109	5154	30	0	19	18	2.6	11	4.134	$49,800
13	VT-14	Major Collector (r)	Barre Town	1.524 - 1.824	8280	33	0	7	27	2.4	7	3.032	$22,173
44	VT-12	Major Collector (r)	Northfield	4.153 - 4.453	5609	19	0	7	13	2.6	6	2.35	$31,953
53	FAS 0205	Major Collector (r)	Williamstown	1.900 - 2.200	1000	5	0	2	3	4.1	9	2.239	$33,420
66	SUMMER ST.	Urban Collector (u)	Barre City	0.100 - 0.400	4990	36	0	3	34	6.2	13	2.115	$14,256
87	US-302	Principal Arterial (u)	Barre City	1.869 - 2.169	14960	109	0	12	99	6.8	13	1.96	$15,812
149	PROSPECT ST.	Urban Collector (u)	Barre City	1.100 - 1.400	2090	15	0	2	13	7.6	13	1.732	$17,073
180	EAST STATE ST.	Urban Collector (u)	Montpelier	0.000 - 0.300	2253	15	0	4	11	7.4	12	1.636	$25,247
199	VT-62	Freeway/Expressway (u)	Barre City	1.166 - 1.466	9540	19	0	4	16	2.3	4	1.59	$22,274
215	VT-12	Minor Arterial (u)	Montpelier	0.801 - 1.101	5524	29	0	5	25	6.2	10	1.548	$19,776
216	VT-14	Minor Arterial (u)	Barre City	0.505 - 0.805	11570	53	0	11	45	5.4	8	1.545	$22,126
246	VT-12A	Major Collector (r)	Northfield	2.833 - 3.133	2243	6	0	0	6	3.3	5	1.471	$8,900
289	I-89	Interstate, Rural (r)	Berlin	49.80 - 50.100	16100	13	0	4	10	1.1	1	1.375	$28,446
300	HILL ST.	Urban Collector (u)	Barre City	0.000 - 0.300	3103	16	0	7	12	6.9	9	1.365	$37,388
316	VT-62	Freeway/Expressway (u)	Berlin	1.500 - 1.800	11835	19	0	4	15	2.2	3	1.344	$21,805
327	US-302	Minor Arterial (r)	Barre Town	1.807 - 2.107	6200	11	0	7	6	2.5	3	1.318	$49,527
354	FAS 0205	Major Collector (r)	Barre Town	1.140 - 1.440	2120	5	0	2	3	3.4	4	1.278	$33,420
358	MERCHANT ST.	Urban Collector (u)	Barre City	0.000 - 0.300	2339	12	0	2	10	7.4	9	1.272	$19,117
363	US-302	Principal Arterial (u)	Barre City	1.169 - 1.469	11220	55	0	11	44	7.1	9	1.265	$21,160
367	BROOK ST.	Urban Collector (u)	Barre City	0.000 - 0.300	1160	7	0	2	6	8.8	11	1.258	$27,686
370	US-302	Principal Arterial (u)	Barre City	1.569 - 1.869	14759	69	0	6	63	6.8	9	1.255	$14,230
398	VT-100	Minor Arterial (r)	Duxbury	2.547 - 2.847	3800	7	0	3	4	2.8	3	1.212	$35,171
413	US-2	Minor Arterial (r)	Waterbury	3.905 - 4.205	10550	15	0	2	13	2.2	3	1.195	$17,073
433	FAS 0214	Major Collector (r)	Barre Town	0.000 - 0.300	2400	5	0	0	5	3.3	4	1.166	$8,900
450	VT-100	Minor Arterial (r)	Moretown, Waterbury	1.163 - 0.236	4100	7	0	3	5	2.7	3	1.145	$36,443
491	VT-12	Major Collector (r)	Northfield	3.153 - 3.453	5673	9	0	0	9	2.6	3	1.104	$8,900
495	VT-12	Major Collector (r)	Northfield	3.553 - 3.853	5700	9	0	2	7	2.6	3	1.1	$22,522
496	VT-12	Major Collector (r)	Northfield	3.853 - 4.153	5700	9	0	0	9	2.6	3	1.1	$8,900
504	US-2	Principal Arterial (r)	Plainfield, Marshfield	1.420 - 0.234	7000	8	0	6	3	1.9	2	1.092	$55,988
505	US-302	Principal Arterial (u)	Barre City	2.469 - 2.769	8079	36	0	3	33	7.5	8	1.092	$14,008
513	US-2	Principal Arterial (r)	Plainfield	1.020 - 1.320	7091	8	1	7	5	1.9	2	1.082	$243,238
529	US-2	Principal Arterial (r)	East Montpelier	2.644 - 2.944	12233	12	0	9	9	1.7	2	1.071	$59,325
544	VT-12	Major Collector (r)	Northfield	5.753 - 6.053	4291	7	0	4	5	2.8	3	1.059	$46,471
548	VT-12	Major Collector (r)	Berlin	1.391 - 1.691	3500	6	0	1	5	3	3	1.057	$19,117
563	VT-14	Minor Arterial (u)	Barre Town	1.924 - 2.224	9404	30	0	9	22	5.6	6	1.039	$27,587
565	I-89	Interstate, Rural (r)	Waterbury	66.70 - 67.00	25500	14	2	6	9	1	1	1.038	$237,236
567	VT-14	Major Collector (r)	Barre Town	0.524 - 0.824	3600	6	0	1	5	2.9	3	1.035	$19,117
587	US-2	Principal Arterial (r)	Marshfield	6.734 - 7.034	4101	5	0	1	4	2.2	2	1.018	$21,160
599	I-89	Interstate, Rural (r)	Middlesex, Waterbury	60.80 - 61.10	24100	13	0	2	11	1	1	1.007	$18,331

The CVRPC High Crash Location report lists all locations where the actual rate to critical rate is 1.0 or greater. The critical rate is the rate which on average should be observed for a particular roadway under consideration. Therefore, a ratio of 2.0 would indicate a site has twice as many accidents as would be expected. These generally occur in urbanized areas and at intersections of major corridors. The Commission recommends these locations be investigated for feasible safety improvements. The Commission also recommends VTrans continue developing the Strategic Highway Safety Plan, and implement the Highway Safety Improvement Program, Road Safety Audit Reviews, and the High Risk Rural Road Program.

Access Management

An essential component of the management of the region's highway system is the complementary management of access along each highway corridor. How access management principles can and should be applied in the Central Vermont Region are described below.

Local and state management of access between arterial roads and adjacent property is primarily a land-use-oriented series of techniques that can, over time, help realize benefits in safety, mobility, accessibility to and from roadside businesses, neighborhood character, and visual quality. Access management measures control the interaction between a classified arterial and adjacent property by limiting and separating conflict points and by efficiently separating through-traffic from local traffic. By distinguishing between roads' functions of mobility and land access, access management is a key means of protecting the carrying capacity of an arterial while also reducing the potential for traffic accidents.

VTrans has developed access management guidelines to assist VTrans, zoning administrators and planning commissions in making permitting, planning, and development decisions based on design standards for different classifications of roadways or roadway segments. The Agency's classification system is based upon "critical attributes" of the roadway. Such attributes include the following examples: change in AADT (Average Annual Daily Traffic), change in functional classification (Major Collector, Minor Arterial, etc.), change in speed limit, number of accesses (i.e. curb cuts) per mile, current land use, current zoning, HCLs (High Crash Locations), number of lanes, whether or not there is a median, and finally, if there are any considerations or projects for future development. Following an analysis of attributes by regional planning commissions, roads, or segments thereof, may be placed into one of the six categories of access control **Figure 20**. Each category has specific design standards developed to ensure that the highway will continue to function at the level (category) assigned.

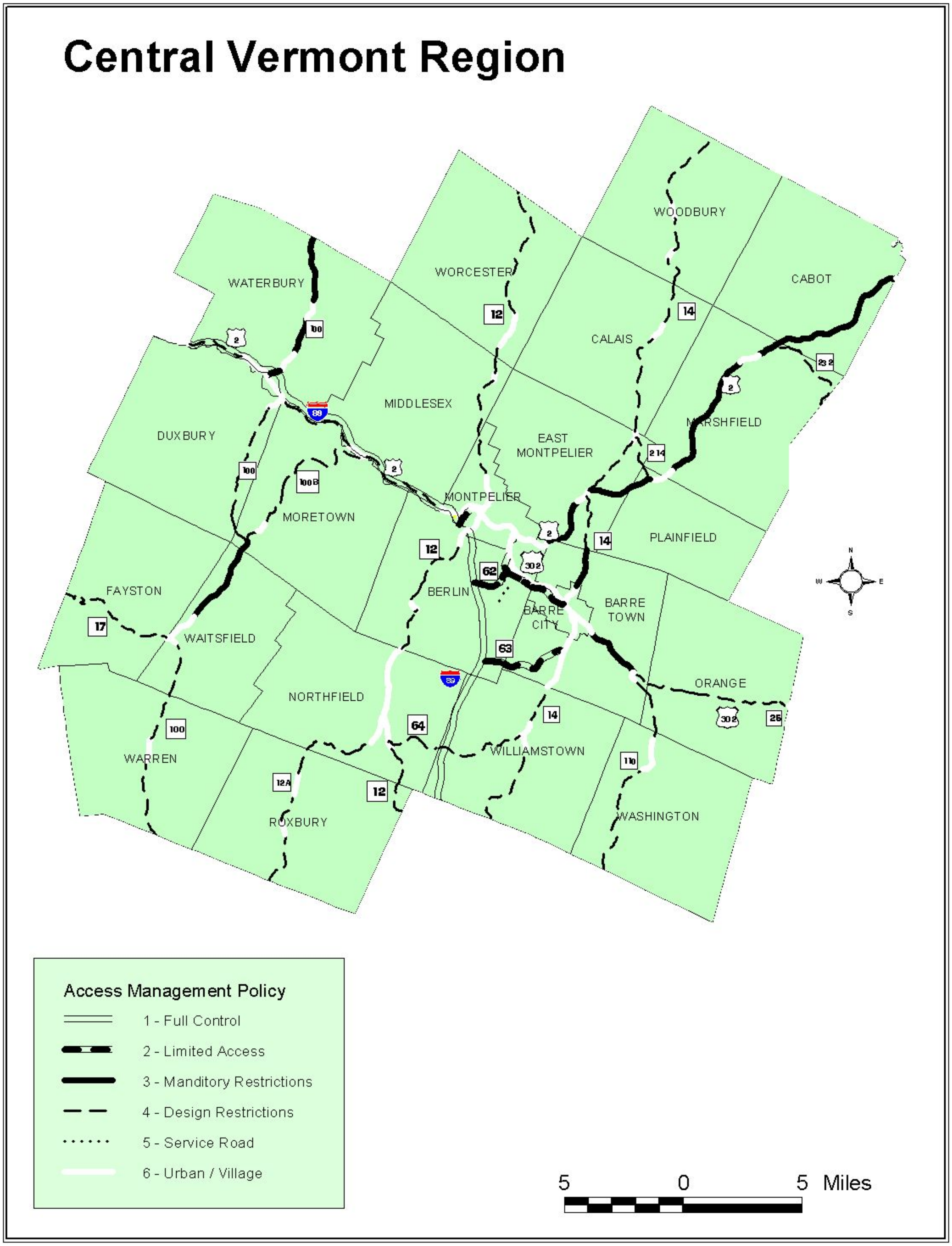
The following is a summary of the differences between the six categories along with the access management guidelines recommended by VTrans:

- **Category 1** highways are basically the Interstate, where high speed and high traffic volume capacity is needed. No access is allowed except at interchanges with public highways.
- **Category 2** highways are Other Principal Arterials and Limited Access Major Collectors such as Vermont Route 62 in Berlin and Vermont Route 63 in Berlin and Barre. These highways carry high volumes of traffic at medium to high rates of speed. Private access is generally not permitted unless access to the property was reserved when the limited access facility was established.
- **Category 3** highways are Principal Arterials, Minor Arterials, and Non-Limited Access Major Collectors on State Highway & Class 1 town Highways with a high traffic volume. Access is generally restricted if other reasonable access from a side street is available. Temporary access is allowed until side street access is available. Each parcel is limited to one access, and if a large parcel is subdivided each new parcel will use the existing access. Another important design feature of category 3 highways is the ¼ to ½ mile spacing of new streets.
- **Category 4** highways are Minor Collectors, Minor Arterials on State Highways or Class 1 town highways, and Non-Limited Access Major Collectors on State Highway & Class 1 Town Highways with a low traffic volume. Category 4 highways allow one access on State routes for

abutting parcels, and may allow additional access if the Agency determines that the additional access would not be detrimental to the safety and operation of the highway. Category 4 highways also require ½ to ¼ mile spacing of new public highway intersections.

- **Category 5** highways are highways that are designated as frontage or service roads. Direct property access is allowed, but signal spacing can be no less than 500 feet.
- **Category 6** highways are "urban" and village sections of highways. The restrictions on these highways are similar to Category 3 highways, where direct access to the highway can be denied and turning movements are restricted, requiring connection of future properties, and combining access points. However, one additional design feature requires access by a side street if access density is over 60 curb cuts per mile within a Category 6.

Figure 20



Central Vermont Region
WATERBURY
WORCESTER
WOODBURY
CABOT
CALAIS
MIDDLESEX
DUXBURY
EAST MONTPELIER
MARSHFIELD
MONTPELIER
MORETOWN
PLAINFIELD
FAYSTON
BERLIN
BARRE CITY
BARRE TOWN
WAITSFIELD
NORTHFIELD
ORANGE
WARREN
WILLIAMSTOWN
ROXBURY
WASHINGTON
Access Management Policy
1 - Full Control
2 - Limited Access
3 - Manditory Restrictions
4 - Design Restrictions
5 - Service Road
6 - Urban / Village
5
0
5 Miles

CVRPC has conducted a preliminary assessment/classification of roadways in Central Vermont, taking into account not only road attributes but local plans and zoning.

Some access management standards are more appropriate to residential development, some to nonresidential development, some equally to both. The following are some specific standards that are commonly addressed as part of an access management program:

- minimum sight distance at a driveway or street intersection
- maximum number of driveways per lot
- minimum distance between driveways
- minimum distance between a driveway and nearest street intersection
- mandatory access to a minor road, such as a frontage/service road or a common internal street
- mandatory location of access to corner lots
- mandatory shared driveways
- mandatory connections (immediate or future) to adjacent property
- minimum and maximum driveway width
- minimum driveway (throat) length
- corner turning radius
- left-turn or right-turn ingress lane
- driveway turnaround area (for small existing lots fronting the corridor)
- minimum or maximum on-site parking supply, shared-parking, and parking design
- minimum area and/or bays for loading and unloading
- landscaping and buffers to visually define and enhance access points

Specific actions could also include left-turn prohibitions, signalization, minor widening or realignment, median construction, and purchase of access rights.

Accessibility to and from roadside businesses is necessary for the economic vitality of many of the region's community centers. This access must however be balanced with the need for motorists, pedestrians, bicyclists, and other users of the roadway system to travel in safety and with sufficient mobility. Access to and from businesses as well as neighborhoods (especially difficult left turns), safety at specific intersections, excessive curb cuts, pedestrian facilities along the corridors, and visual quality of commercial strips are all important articulated concerns and could potentially be addressed by a corridor access management program.

On a regionwide scale, the Commission strongly encourages that VTRANS and each member jurisdiction adopt and adhere to consistent and comprehensive access management policies on their respective facilities. The VTRANS Long-Range Transportation Plan supports this need and also calls for local and regional measures to assist in the implementation of access management programs. VTRANS has adopted Access Management Guidelines which is used in the access permit process. Many of the standards would be adopted by the town's zoning regulations and site plan/subdivision regulation.

Traffic Calming

Physical traffic calming measures might be considered in cities, villages, and other growth areas in order to better control traffic speeds, improve pedestrian safety, and improve the overall environment. These measures could include speed humps or tables, chicanes, neck downs, narrow vehicle travel lanes, wider sidewalks, textured cross walks, pavement markings, medians, bulb- outs, roundabouts, gateways, plantings, and street furniture. VTrans has developed Traffic Calming

Standard Drawings in which construction details for these treatments have been based on Vermont conditions. All of these actions must be carried forward by the VTRANS and local officials, with proper concern and sensitivity for the needs and requirements of each individual community. VTrans has developed a draft "Traffic Calming Study and Approval Process for State Highways" that will help a community assess the problem, organize a steering committee, formulate a public participation process, create a traffic calming plan, and develop an implementation plan.

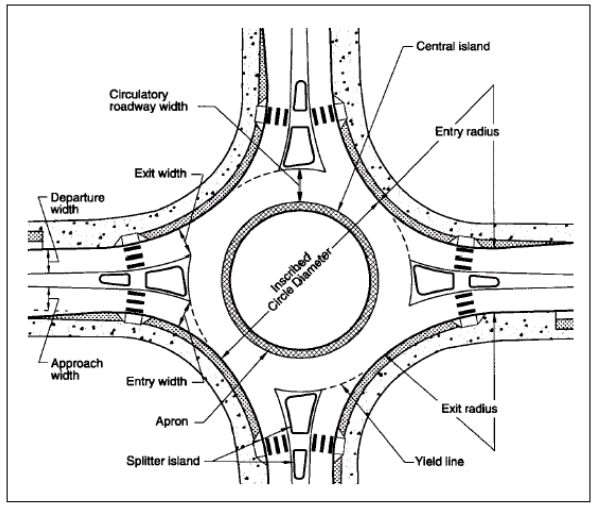
One form of traffic calming that has received a lot of attention lately is the modern roundabout, see **Figure 21**. It is a circular intersection design that, in certain circumstances, could be used instead of traffic signals. On appearance it resembles a traffic rotary, but is actually much smaller. Vehicles maneuver through it at very slow speeds, and entering vehicles must yield to vehicles in the circle. This creates a traffic control that is safer for vehicles and pedestrians, keeps vehicles moving efficiently, and can be landscaped to form an attractive gateway. There are three basic principles that distinguish a roundabout from a traffic circle:

Yield at Entry: At roundabouts the entering traffic yields the right-of-way to the circulating traffic. This yield-at-entry rule prevents traffic from locking-up and allows free flow movement;

Deflection: The entry and center island of a roundabout deflects entering traffic to slow traffic and reinforce the yielding process; and

Flare : The entry to a roundabout often flares out from one or two lanes to two or three lanes at the yield line to provide increased capacity.

Figure 21. Roundabout Design Features



Vermont Design Standards

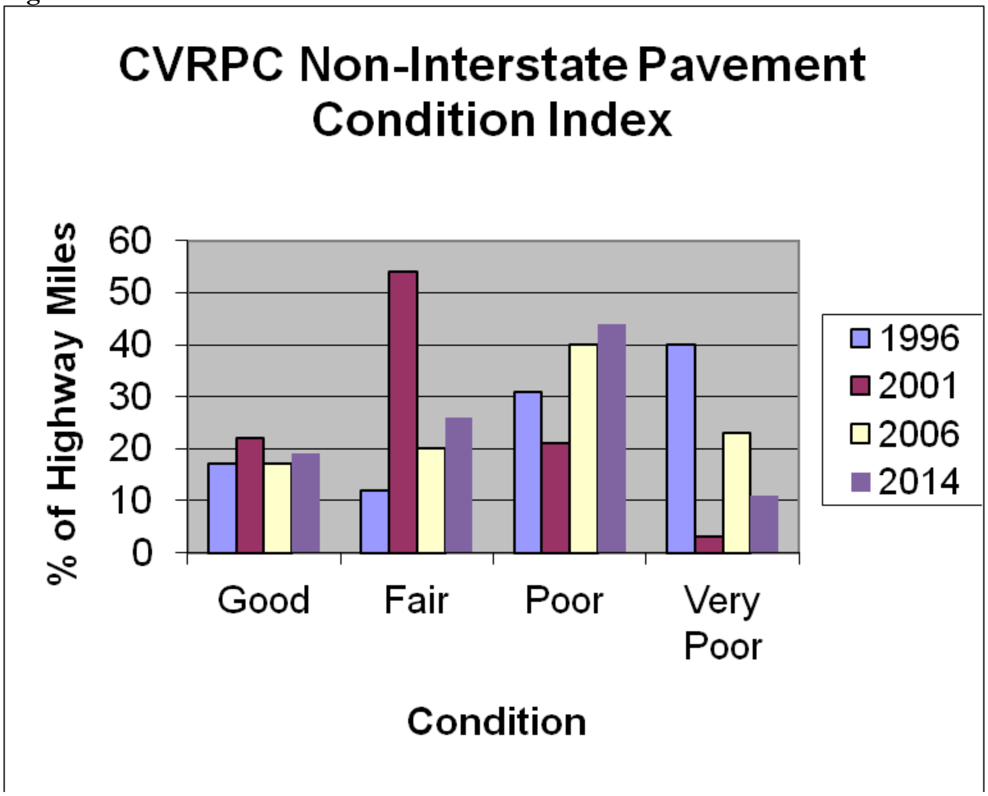
In 1996, VTrans adopted Vermont State Standards for the design of roads and bridges. These standards provide a clear direction for designers. They provide for access, mobility, and safety in transportation projects, while being sensitive to the social/environmental context of Vermont. The standards vary based on functional classification, traffic volume, and speed. Exceptions can be made in areas with historic/archaeological, natural, recreational, and scenic resources. Special considerations are also given in villages, cities, and economic areas. The region supported these standards, but recommend that the minimum combined single lane and shoulder width be 15 ft. where possible. The State Standards are currently being updated (2016). They weren't being followed in some cases, because they conflict with the Complete Streets Law. The 1996 Standards also didn't consider water quality, maintenance, villages, and other issues.

Vtrans has also expanded the types of bridge railings available in bridge design. Designers consider factors such as speed, and setting when making the selection. In areas with high speeds, very strong railings such as concrete and Box Beam are necessary. In lower speed village settings aesthetic aluminum, paneled concrete, or stone form lined concrete railings are an option. Historic lighting and other decorative features can be added.

Roadway Pavement Ratings

Figure 24, summarizes the miles of highway in the Region under these four condition categories for 1996, 2001, 2006, and 2014. To see the current map of pavement condition, go to:http://vtransparency.vermont.gov/

Figure 24.



VTrans goal for the percentage of roads in very poor condition is no more than 25%.

8

Pavement Management

Roadway maintenance continues to grow in importance as federal and state emphases shift toward maintaining existing roads instead of building new ones. VTRANS has developed and implemented a standardized method for evaluating, prioritizing, and allocating funds for these maintenance activities. VTRANS tests interstate roadways, state system roadways, Class I roadways and Class II roadways (that are on the federal aid system). When doing the testing, the data is taken every tenth of a mile. VTRANS tests each road for roughness, cracking, rutting, and texture, and uses these data to produce a Pavement Serviceability Rating for each section of the road from best to worst. This list is further modified with information from the Traffic & Safety Division on High Accident Locations. It is recommended that VTRANS make paving a priority and continue to maintain a favorable proportion of good to poor pavement conditions.

A pavement management system is an effective tool for maintaining local street networks as well. It can provide a method to organize, analyze, and prioritize an improvement strategy for both paved and gravel roads. The results of the system will allow town officials to compare strategies and select a road improvement that will yield the longest extended life and be most cost effective.

Similarly to the VTRANS process, all the roads in a town would be segmented (< 1 mile) and surveyed for surface distresses (paved roads - various types of cracking, potholes, drainage, roughness and rutting; gravel roads - cross section, drainage, corrugations, dust, potholes, ruts, and loose aggregate). Along with traffic volumes, the survey would be entered into a computerized data base.

Once the survey results are in the computer, the pavement management system can evaluate the severity of the problems for each segment and suggest a repair strategy (e.g. defer maintenance, routine maintenance, preventative maintenance, rehabilitate, or reconstruct). Then based on locally derived parameters, weights, and repair techniques, the pavement management system can present reports that can prioritize segments, display all repair options, repair options that provide the maximum duration, repair options that provide the best duration to cost ratio, repair options in a constrained budget, and estimates costs. Selectmen and road foremen can use this information to plan a improvement program for the current and future years. Barre City, Barre Town, Montpelier, East Montpelier, Waterbury, and Northfield have used pavement management surveys. A pavement management system program, with technical assistance, is available from CVRPC and the Vermont Local Roads Program.

Guardrails and Bridge Railing

In 1997, the legislature directed VTrans to study alternative guardrail types for performance, maintenance and life cycle information, and to include compatibility with aesthetics and non-motorized users. Three guardrail types were recommended as suitable for Vermont state highways; W-Beam, Box Beam, and Three Cable. Many factors are considered when selecting guardrail type such as; speed, volume, shoulder width, and deflection space available. The study recommends that areas identified as having significant foreground scenery and/or in a village setting, it is appropriate to use Box Beam or Three Cable. Regional Planning Commissions are to be consulted as to whether scenery and village settings are significant. If the highway is considered bicycle & pedestrian friendly (low volume ADT<2000 or wide shoulders >=3 ft.) wide posted W-Beam guardrails can be used. If the highway is not considered bicycle & pedestrian friendly, narrow posted W-Beam, Box Beam, or Three Cable is appropriate. Wood, stone, or weathering steel guardrails may be considered in special cases such as designated scenic highways, covered or historic bridges, historic areas, state/national forests, state/national wildlife areas, and state/national parks. The study concluded that a ten year trial period be established. Highways due for paving or maintenance projects will be considered for this trial.

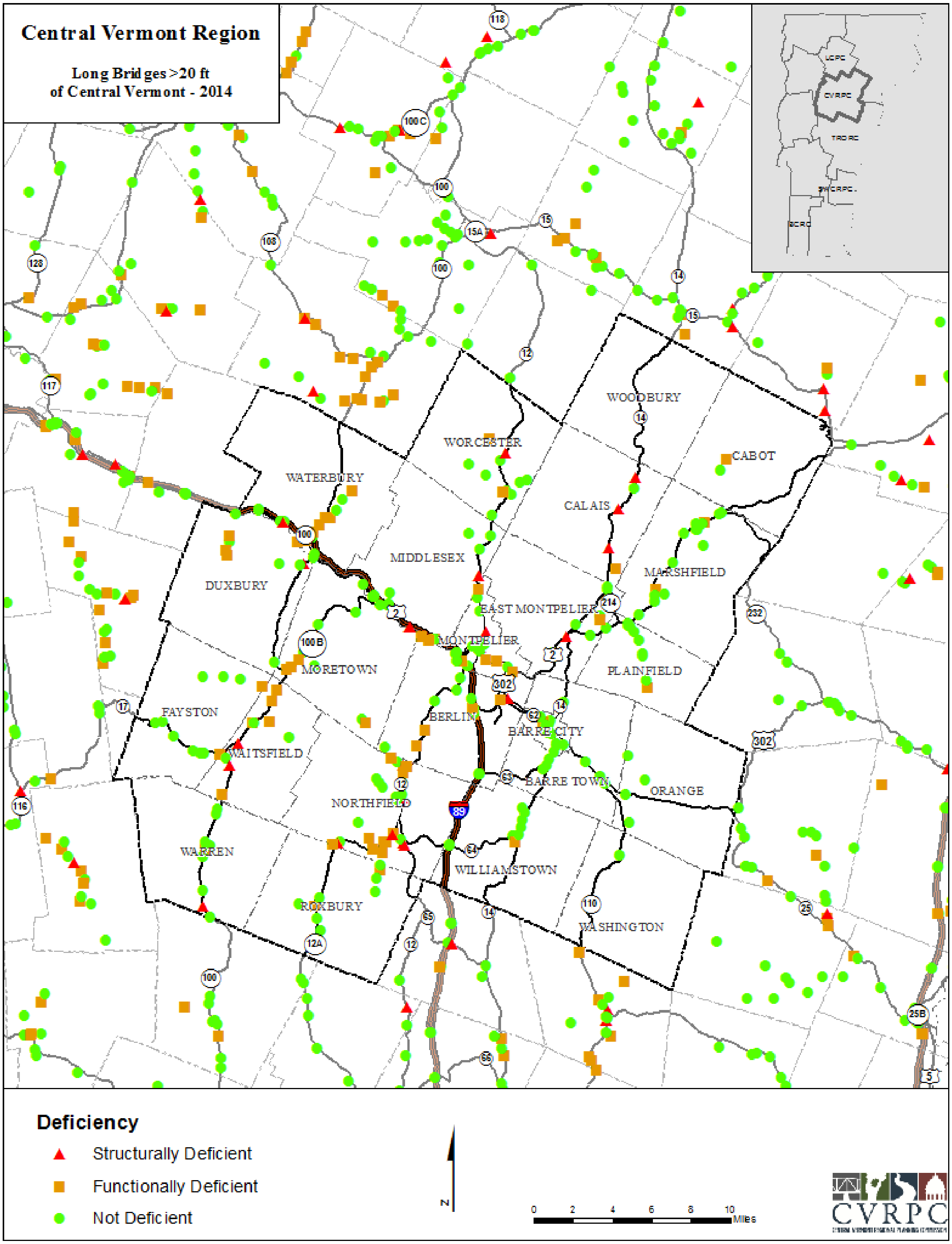
Bridges

There are a total of 250 individual bridges of lengths greater than 20 feet located within the Central Vermont region. Of these 250 bridges, 102 are State-owned and 148 are owned by the local town or city in which it is located. Of these 250 bridges, 12 are included on the National Register of Historic Places, one is eligible for inclusion on the Register, and 17 are considered possibly eligible for inclusion on the Register. In Central Vermont, 17 are historic truss bridges and 9 are covered bridges.

Bridge Sufficiency Ratings

VTrans rates bridges on both structural and functional standards. Bridges are rated from 0 to 100 under both categories. The evaluation of bridges by VTrans typically starts with the computation of a Federal Sufficiency Rating (FSR). The rating is based on three factors: (1) structural adequacy (i.e. deck, superstructure, and substructure); (2) a compared inventory rating (i.e. its standing truck load rating); and (3) serviceability and functional obsolescence (i.e. geometry, width of bridge compared with amount of traffic). Another element that is considered in the FSR is the length of detour and how much time it would take to travel the detour if the bridge were to be closed. All local and state highway system bridges with spans greater than twenty feet are inspected every one to two years (depending on condition). To view the bridge inpection reports, go to; http://vtransparency.vermont.gov/ The locations of bridges with spans greater than twenty feet are identified in **Figure 26**.

Figure 26


Central Vermont Region
Long Bridges >20 ft
of Central Vermont - 2014
WOODBURY
WORCESTER
CABOT
WATERBURY
CALAIS
MIDDLESEX
MARSHFIELD
DUXBURY
EAST MONTPELIER
MONTPELIER
MORETOWN
PLAINFIELD
FAYSTON
BERLIN
BARRE CITY
WAITSFIELD
BARRE TOWN
ORANGE
NORTHFIELD
WARREN
WILLIAMSTOWN
ROXBURY
WASHINGTON
Deficiency
Structurally Deficient
Functionally Deficient
Not Deficient
N
0 2 4 6 8 10 Miles
CVRPC

Historic Metal Truss Bridge Preservation Plan

In 1998, VTrans completed a comprehensive study of all the state and town owned truss bridges. The purpose of the study was to assess each bridge for structural condition, geometric dimensions, and historical significance. The study concluded that the state could not afford to save all the bridges. As a result, the Federal Highway Administration (FHWA), the Vermont Agency of Transportation. (VTrans), and the Vermont State Historic Preservation Office (VSHPO) agreed to categorize each bridge based on its characteristics. The categories range from rehabilitation at the existing site for highway use, to preserving the bridge for adaptive use (such as a bike path), or removal and possible destruction. Bridges in this last category are in bad condition and have little historic significance. It is the policy of the Region to encourage restoration or preservation of historic bridges. The Region acknowledges that towns may differ with the State's Preservation Plan.

The following truss bridges should be preserved for limited highway use.

Berlin, No. 27 * (Lovers Lane)
Berlin, No. 29 * (Three Mile Bridge Rd.)
Berlin, No. 67 s (Route 12)
Montpelier, No. 5 (Taylor St. to be rehabilitated in 2009)
Montpelier, No. 17 e (Granite St.)
Moretown, No. 41 (Bridge Rd.)
Moretown, No. 42* (near Town Hall)
Northfield, No. 65 (Rabbit Hollow Rd.)
Waterbury, No. 31 (Winooski Ave.)

* Recently rehabilitated
e Exceptional historic significance
s State-owned

The following truss bridges have been modified for continued limited or unlimited highway use. The trusses have been retained for their ascetic appearance, but no long support the modern deck.

Montpelier, No. 10 (School St.)
Montpelier, No. 11 (Langdon St.)

The following truss bridges should be preserved and adapted to alternative transportation use at their existing sites.

Moretown, No. 40 (Lovers Lane)
Northfield, No. 84 e (Vine St. Pedestrian Bridge)

c These projects involve the retention of an historic bridge in close proximity to a replacement bridge. There may be difficult and/or potentially irresolvable environmental issues

associated with these proposals.
e Exceptional historic significance

The following truss bridges, currently in storage , should be relocated and preserved for limited highway use or for alternative transportation use.

Berlin, No. 72 (formally Route 12, in storage)
Montpelier, No. 6 (formally Pioneer St., in storage)
Waitsfield, No. 22 (formally Butternut Hill Rd. in storage)

The following truss bridges will be documented and removed. Storage in anticipation of future loss of bridges in other categories is permissible but will not be required as part of any permit proceeding.

Barre City, No. 11 (Granite St.)

Maintaining the Existing System

The existing highway system is by far the most used and most costly aspect of our transportation system. Because of our low population densities and rural character, significant portions of the region are dependent on the automobile for work, shopping, and social trips. Our resident population and employment base has grown and spread throughout the region increasing the demand on the highway system. This demand along with increasing costs have caused the highway system to deteriorate faster than it can be maintained.

When considering improvement strategies, the two extremes are either (1) to defer and eventually rebuild, and (2) to provide preventive maintenance. The defer and rebuild strategy allows the transportation facility condition to deteriorate, for maybe twenty years, until reconstruction is necessary. Reconstruction involves building a new foundation, drainage, and surface for roads. Bridge reconstruction would involve building new deck and abutments.

The preventive maintenance strategy applies corrective measures more frequently thereby keeping the facility at a more constant level of condition. Preventive maintenance includes such items as overlay paving, crack sealing, drainage cleaning, and bridge painting. Over the life time of the facility, preventive maintenance costs can be as little as a third of reconstruction costs.

Rehabilitation lies between these two strategies in both costs and amount of work needed for the improvement. Rehabilitation usually addresses only part of the facility and can include structural paving, deck work, minor widening, and improving problem spots.

Clearly preventive maintenance is the most cost effective, and the Commission recommends and supports the Vermont Agency of Transportation attempts to emphasize this strategy. However, there is a significant number of roads and bridges that have deteriorated beyond maintenance. Which strategy is appropriate for any of our region's particular needs will have to be decided during scoping and project development. Current conditions, costs, life cycle factors, function within the highway system, and the corridor as a whole will have to be considered in developing an improvement program.