

2.0 Vermont's Highway System – Current Profile

This section presents information about the Vermont highway system and the activities it serves. Information is organized into three sections. Section 2.1 provides a profile of extent, characteristics, and condition of the system. Section 2.2 presents operational and usage characteristics. Finally, Section 2.3 focuses on activities served by the highway system as well as its connections with other modes.

The information presented here provided a solid baseline for understanding of existing conditions and development of a performance-based policy framework to guide future investment in the highway system.

■ 2.1 Highway System Inventory and Condition

Extent and Classification of the Road Network

The State of Vermont has over 14,000 miles of public roads. Roughly 19 percent or 2,704 miles are on the state-owned highway system; the remainder is owned by cities and towns. Vermont has 703 miles on the designated National Highway System (NHS). The Vermont NHS system includes 320 Interstate system miles.

Vermont's highway system is predominantly rural – only 22 percent of Interstate and 15 percent of NHS miles are classified as urban. Table 2.1 shows a detailed breakdown of the road network by functional classification and roadway type. State and town highways in Vermont are classified by roadway type as follows:

- **State Highways** – These are highways maintained exclusively by the Agency of Transportation.
- **Class 1 Town Highways** – These are town-maintained highways which form the extension of a state highway route and which carry a state highway route number.
- **Class 2 Town Highways** – These are town-maintained highways selected as the most important highways in each town (in addition to Class 1 highways).
- **Class 3 Town Highways** – These are other town-maintained highways negotiable under normal conditions all seasons of the year by a standard manufactured passenger car.

Table 2.1 Vermont’s Total Public Road Mileage

Functional Classification	State	Class 1 Town	Class 2 Town	Class 3 Town	Other Roads	Total	Percent
Interstate	320	-	-	-		320	2.2%
Principal Arterial	382	43	10	-		435	3.0%
Minor Arterial	770	54	60	-		884	6.2%
Major Collector	1,145	38	827	-		2,010	14.1%
Urban Collector	5	-	116	90		211	1.5%
Minor Collector/Local	10	-	1,697	8,402		10,109	70.7%
Military Reservation	-	-	-	-	24	24	0.2%
State Forest Highway	-	-	-	-	212	212	1.5%
National Forest Dev.	-	-	-	-	86	86	0.6%
Totals	2,632	135	2,710	8,492	322	14,291	100%
Percent	18.4%	0.9%	19.0%	59.4%	2.3%	100%	

Source: VTrans Program Development Division, January 1, 2002.

Pavement Characteristics and Condition

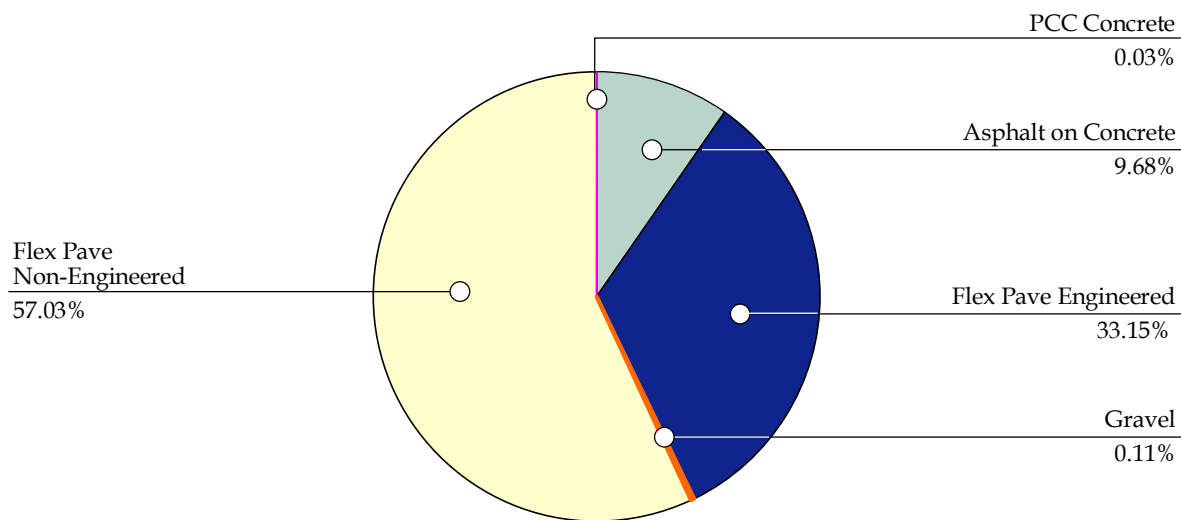
Pavement Type

Figure 2.1 shows the types of pavements on state and Class 1 town highways. Flexible (asphalt) pavement is the predominant type, accounting for 90 percent of the lane-miles. However, only 33 percent of the lane-miles have “engineered” flexible pavements, which means that the type and placement of fill underneath the surface is known and was designed to meet engineering specifications or criteria. Little is known about the subsurface characteristics for the 57 percent of lane-miles with “non-engineered” flexible pavements, which makes their future performance more uncertain. Ten percent of the lane-miles are composite – with an asphalt overlay on top of Portland cement concrete (PCC).

Pavement Condition

Pavement condition on State and Class 1 town highways are surveyed regularly with a specially equipped vehicle that measures rutting, cracking and roughness. This information is summarized into a condition index that ranges from zero to 100; where 100 represents perfect pavement conditions. As shown in Table 2.2 and Figure 2.2, the Interstate system is in relatively good shape, with 93 percent of the lane-miles in good or fair condition (condition index 65 or over). In contrast, 60 percent of the lane-miles in the non-Interstate portion of the State Highway System (SHS) are in good or fair condition.

Figure 2.1 Pavement Type - Lane-Miles Distribution
State and Class 1 Town Highways



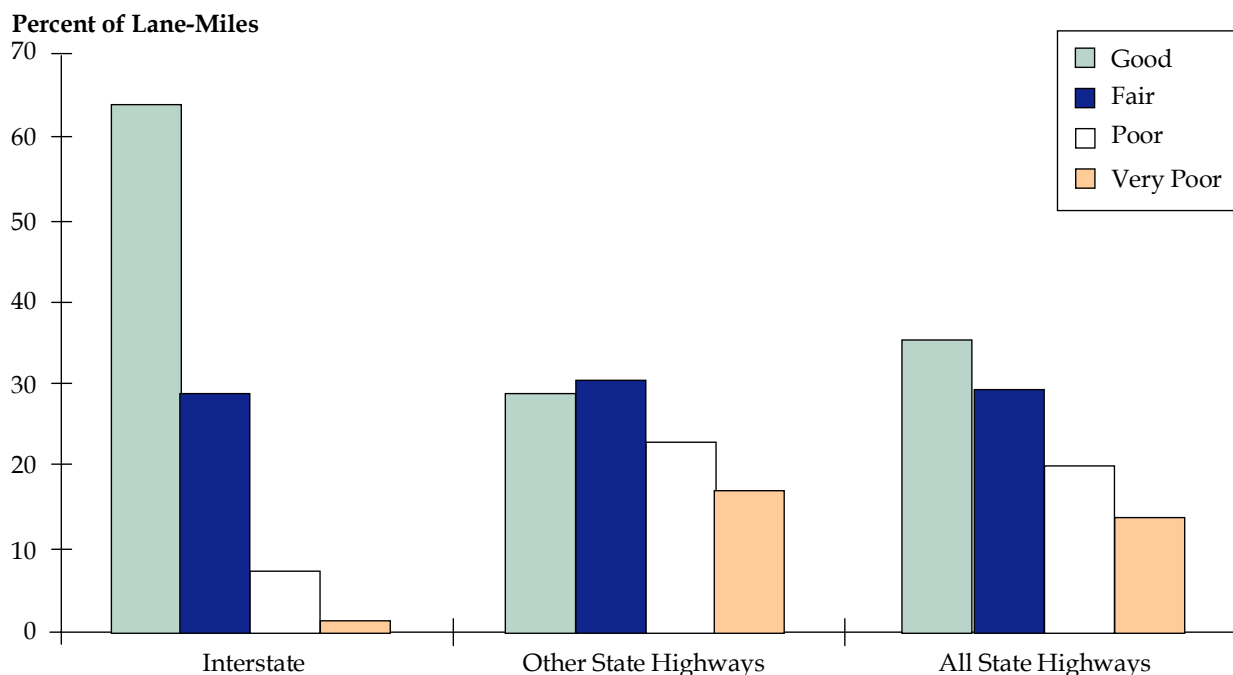
Source: VTrans Pavement Management Section, November 2002.

Table 2.2 Pavement Condition of State Highway Lane-Miles
 2002

	Good (80 to 100)	Fair (65 to 79)	Poor (40 to 64)	Very Poor (Less than 40)
Interstate	64%	29%	7%	1%
Other State Highways	29%	31%	23%	17%
Total (All State)	36%	30%	20%	14%

Source: VTrans Pavement Management Section, November 2002.

Figure 2.2 Percent of Lane-Miles by Pavement Condition



Bridge Inventory

The State of Vermont has 2,659 publicly owned and five privately owned highway bridges over 20 feet in length (also known as “long structures”).^{1,2} Forty percent of these bridges are owned and maintained by the State (see Table 2.3). The state-owned bridges tend to be much larger than the local bridges – state-owned bridges account for over 70 percent of the bridge deck area statewide.

¹ The National Bridge Inspection Standards (NBIS) in 23 CFR 650.3 define bridges as structures over 20 feet (6.1 meters) in length. There are an additional 1,306 “short structures” (between six and 20 feet long) on the Vermont SHS.

² Highway bridges are defined as bridges carrying highways (NBI item 42A = 1, 4 or 5).

Table 2.3 Highway Bridges by Owner

Ownership	Number (Percent) of Highway Bridges	Deck Area in m² (Percent)
State	1,072 (40%)	554,856 (71%)
Town	1,507 (57%)	193,738 (25%)
City	80 (3%)	31,870 (4%)
Private/Railroad	5 (0%)	370 (0%)
Total	2,664 (100%)	780,834 (100%)

Source: VTrans Pontis database, November 2002.

Figure 2.3 provides a breakdown of bridges both by ownership and by the different portions of Vermont's Road Network. The SHS includes a total of 1,075 bridges - with 47 percent of the SHS bridges on the truck network. Most of Vermont's state-owned bridges are located on the SHS; however, the SHS includes roughly 60 local or privately owned bridges and about the same number of state-owned bridges are located off of the SHS.

The designated Commercial Vehicle Network (which includes all of the National Highway System as well as other major truck routes - see Figure 2.9) has 504 bridges, 96 percent of which are owned by the State. The remaining portion of the SHS off of the Truck Network has 571 bridges, 93 percent of which are state-owned. The 1,589 long highway structures off of the SHS are primarily owned by cities and towns - only four percent of these structures are owned by the State.

Figure 2.3 Bridges by Ownership and Highway System

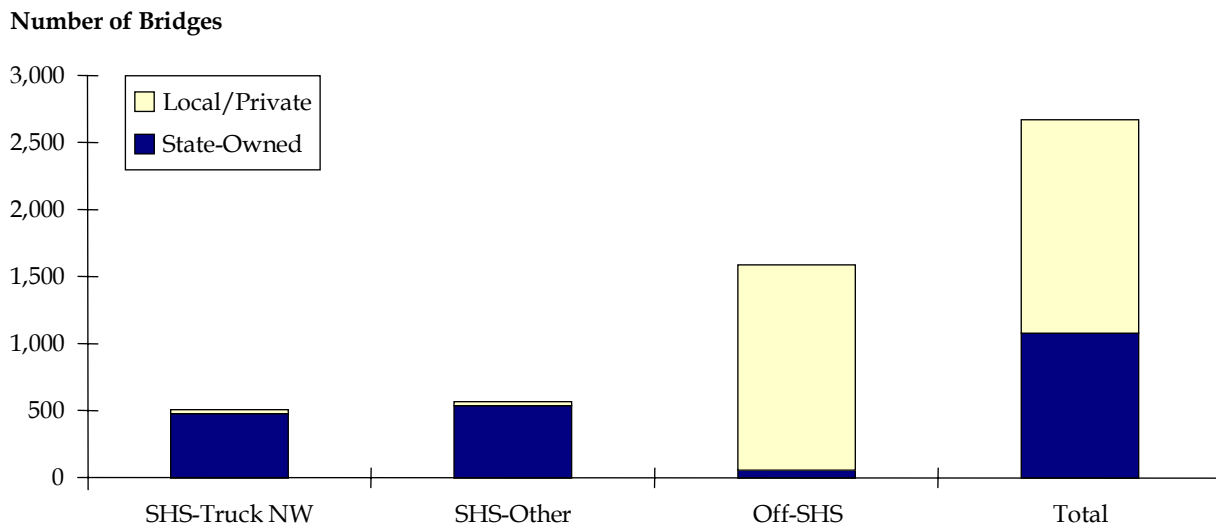


Figure 2.4 shows the breakdown of bridge deck area by ownership and highway system, indicating that while the SHS accounts for 40 percent of the highway bridges statewide, it includes over 70 percent of the bridge deck area in the State.

Figure 2.4 Bridge Deck Area by Ownership and Highway System

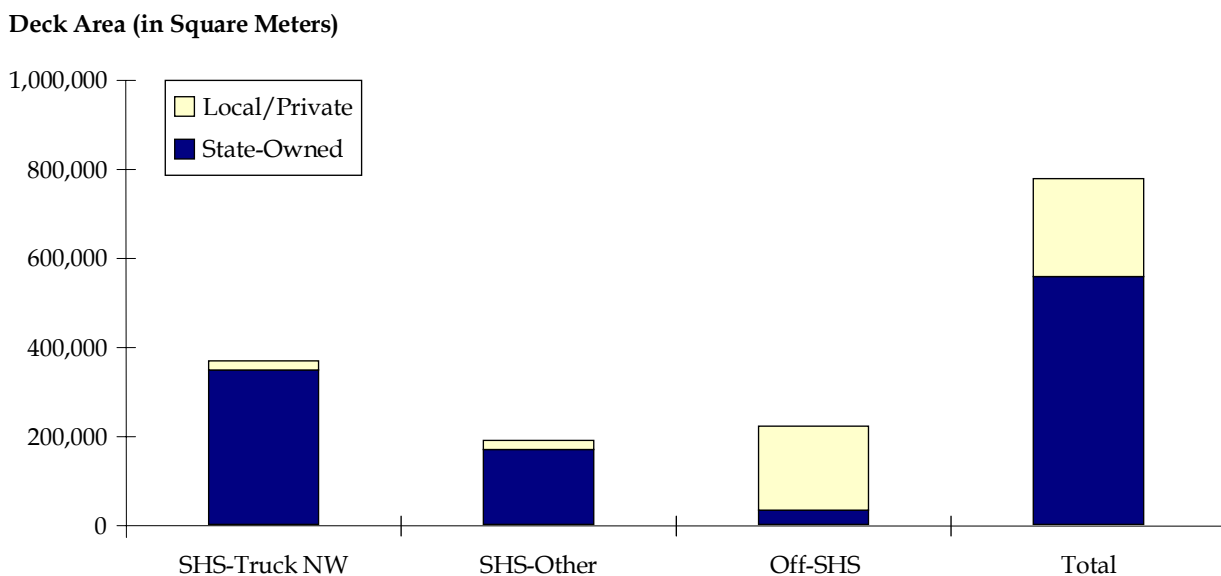


Table 2.4 shows a breakdown of bridges and bridge deck area by functional classification. Three hundred fourteen bridges accounting for 31 percent of the bridge deck area

statewide are on the Interstate system; 454 bridges (accounting for 43 percent of the bridge deck area statewide) are on the NHS.

Table 2.4 Highway Bridges by Functional Classification

Functional Class	Bridges (Percent)	Deck Area in m ² (Percent)
Interstate	314 (12%)	240,236 (31%)
Principal Arterial	165 (6%)	114,603 (15%)
Minor Arterial	187 (11%)	108,817 (14%)
Major Collector	519 (19%)	137,246 (8%)
Urban Collector	41 (2%)	13,251 (2%)
Minor Collector/Local	1,338 (50%)	166,683 (21%)
Total	2,664 (100%)	780,834 (100%)

Source: VTrans Pontis database, November 2002.

Bridge Characteristics and Condition

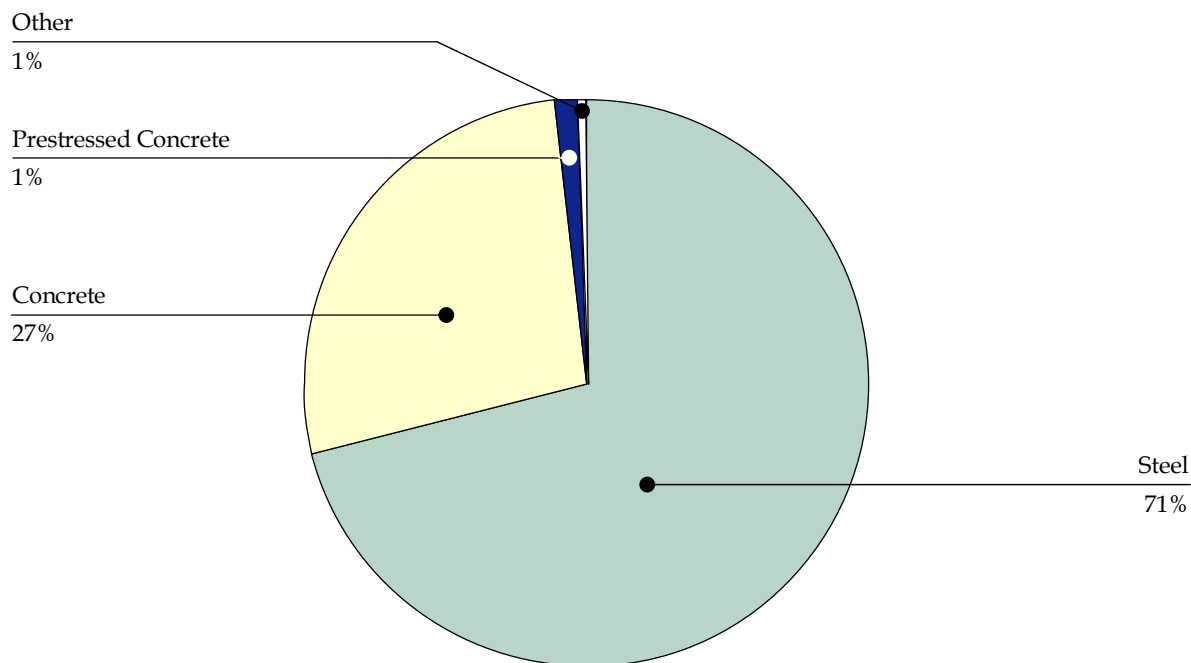
This section presents more detailed information about bridges located on the SHS.

Materials

Over 70 percent of the Vermont SHS bridges are classified as steel structures; an additional 27 percent are classified as concrete structures³. Figure 2.5 shows the proportional distribution of SHS bridges by material type.

³ This classification is based on the value of NBI Item 43A – Structure Type, Main Span - kind of material and/or design. These materials refer to the superstructure; so a steel structure can have a concrete deck.

Figure 2.5 SHS Bridge Type Distribution



Source: VTrans Pontis database, November 2002.

Age

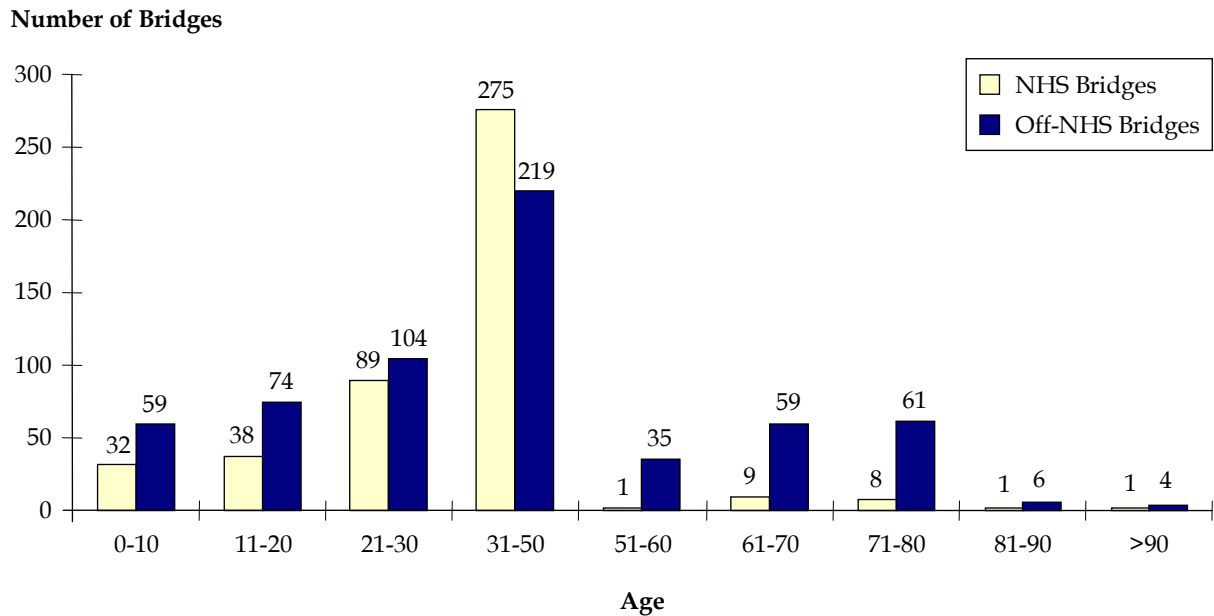
Figure 2.6 provides an overview of the age distribution for Vermont SHS bridges⁴. A total of 81 SHS bridges are over 70 years old, which means they are nearing (or have exceeded) the typical life of 75 to 80 years⁵. Ten of the bridges in this category are on the NHS. While the NHS has relatively few bridges that are very old, 61 percent of NHS bridges currently are 31 to 50 years old, reflecting the Interstate construction period between 1958 and 1971. In contrast, the age distribution for non-NHS bridges is much more spread out. Overall, roughly 63 percent of the SHS bridge inventory is over 30 years old.

The large cohort of bridges in the 30- to 50-year range is significant because it is at this stage of a bridge’s life span that substantial maintenance or rehabilitation is typically required to preserve its structural integrity.

⁴ Age is based on either NBI item 27 (Year built) or item 106 (Year last reconstructed), whichever is more recent.

⁵ A recent NCHRP project on bridge life-cycle cost analysis acknowledged the wide variation in actual service lives, but stated that “Current bridge management practice sets service life in the range of 75 to 100 years for most a bridge’s sub- and superstructure, and the current AASHTO Design Code sets a design life of 75 years.” [NCHRP Report 483, “Bridge Life-Cycle Cost Analysis,” prepared by Hugh Hawk, National Engineering Technology Corporation, 2003].

Figure 2.6 SHS Bridge Age Distribution



Source: VTrans Pontis database, November 2002.

Bridge Condition

Bridge condition is tracked via detailed inspections of each bridge on a two-year cycle. Two key performance measures – deficiency status and sufficiency rating – are derived from inspection data that are reported to FHWA and are used to establish eligibility for Federal bridge funding.⁶ Two additional measures – number of restricted bridges and the Health Index – also are tracked by the Bridge Section.

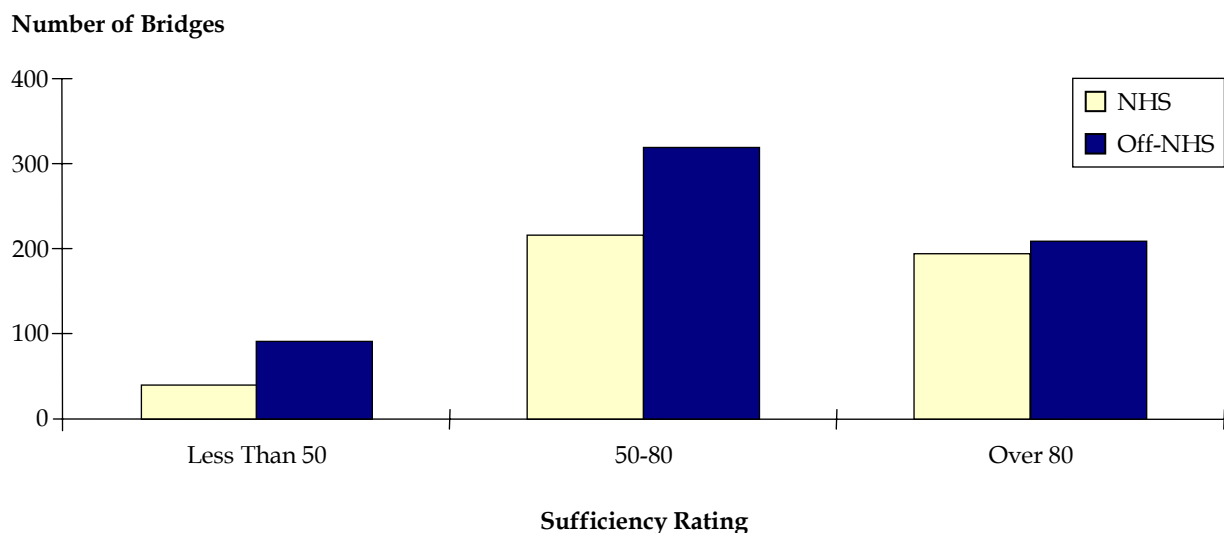
Structurally Deficient Bridges – Bridges are classified as structurally deficient if they have a poor condition rating for one of their major structural components (deck, superstructure, substructure, culvert) or if the structure’s appraisal rating and waterway adequacy (where appropriate) is poor. Seventeen percent of Vermont’s SHS bridges (188 of 1,075) are classified as structurally deficient⁷. This is slightly higher than the national average of 14 percent.

⁶ A structurally deficient or functionally obsolete bridge with a sufficiency rating less than 50 is eligible for Federal bridge replacement funding. A structurally deficient or functionally obsolete bridge with a sufficiency rating of 80 or less is eligible for Federal bridge rehabilitation funding.

⁷ This figure includes 14 locally-owned bridges on the SHS.

Sufficiency Rating – The Federal bridge sufficiency rating is a number from zero to 100 indicating the sufficiency of a bridge to remain in service. It is based on structural adequacy and safety, serviceability and functional obsolescence, and essentiality for public use. The sufficiency rating distribution for Vermont SHS bridges is shown in Figure 2.7.

Figure 2.7 SHS Bridge Sufficiency Rating Distribution



Source: VTrans Pontis database, November 2002.

The ranges in sufficiency ratings shown are those commonly used because of their relation to Federal bridge funding eligibility.⁸ Roughly 12 percent of the SHS bridges have a sufficiency rating less than 50, which makes them eligible for Federal bridge replacement or rehabilitation funds. One-half of the SHS bridges have sufficiency ratings in the 50 to 80 range, which means that they are eligible for Federal bridge rehabilitation funds. Bridges on the NHS tend to be in better condition than those not on the NHS; 43 percent of NHS bridges have a sufficiency rating of at least 80, compared to 38 percent of non-NHS SHS bridges.

Restricted Bridges – The performance measure proposed for Vermont’s bridges includes an indication of the number of restricted bridges. The term restricted is defined as an impediment to the free flow of all vehicles meeting Motor Carrier Safety Regulations in Vermont. The types of restrictions will include a load capacity limitation of a structure, overpass height restrictions and bridge width due to a one-lane bridge. Items that reflect the condition of a structure but do not provide an obvious impediment to the free flow of traffic, such as tem-

⁸ Note that other sources of Federal, state, and local funding for bridge projects are available that do not use sufficiency rating to establish eligibility.

porary shoring, temporary bridges, deteriorated steel and concrete are not included. Currently, there are six restricted bridges on Vermont's SHS.⁹

Health Index – The health index is a number between zero and 100, used by the Agency's Bridge Management System Pontis, to define the overall condition or "remaining value" of a bridge. The health index is a useful metric for tracking the average condition of the entire network of bridges in Vermont over time. The value of the health index for a bridge is derived by comparing the current dollar value of a bridge to the replacement value of that bridge. A new bridge would have a health index of 100. The assessment of the current value is based on a detailed field inspection of the bridge by trained bridge inspectors. The inspection determines the remaining value of each major component of a bridge like the deck, superstructure, substructure, bearings, and paint system. The replacement value is determined by tracking cost data collected from actual bridge replacement projects.

The current average health index across all SHS structures¹⁰ is 87. The average health index is higher for structures on higher functional classes – 91 for Interstate System bridges, 89 on Non-Interstate NHS system bridges, and 85 on other SHS bridges.

Roadway Features

While investments in pavements and bridges account for a substantial share of the highway system investment needs, features such as signs, lights, guardrails, ditches, and turf areas are important elements of the highway system and require ongoing maintenance in order to provide for safe and efficient operations. Table 2.5 provides an inventory of SHS roadway features from the Maintenance Activity Tracking System (MATS).

⁹ One of the restricted bridges is a floating bridge which will always be restricted. VTrans Bridge Section, December 2000.

¹⁰ Structures over 20-feet long.

Table 2.5 Roadway Features Inventory

Item	Unity of Measure	Quantity	Quantity per State Highway Mile¹
Traffic Signs	Each	64,873	24.0
Travel Directional Signs	Each	404	0.1
Paved Shoulders	Mile	4,329	1.6
Gravel Shoulders	Mile	3,075	1.1
Signals	Each	235	0.1
Fence	Mile	1,314	0.5
Roadway Lights	Each	981	0.4
Delineators/Mile Marker Plaques	Each	64,077	23.7
Guardrail	Linear Foot	5,608,792	2,074.3
Ditches	Mile	3,228	1.2
Culverts (six feet or less in diameter)	Each	40,192	14.9
Mowable Roadside Area	Acre	11,172	4.1

¹ This column divides each quantity by 2,704 – the total number of state highway miles.

Source: VTrans Operations Division, November 2002.