Chapter 11
SPECIAL PLAN ELEMENTS

Introduction

There are a number of special plan elements referred to in earlier chapters which are routinely included in projects or constructed as individual projects to improve safety, traffic flow, the environment, and usage by pedestrians and bicyclists. Several of these special plan elements are designed by other bureaus in the NHDOT, however, most are coordinated by the Bureau of Highway Design if we are the Lead Bureau.

The item numbers used for some of these special plan elements may be found in Appendix 13-1, Item Description Master File, but not in all cases. As existing products are upgraded and new technology evolves, Supplemental Specifications and/or Special Provisions must be included in the Proposal to reflect the current requirements. Normally, this information is written by the Specifications Engineer or the Consultant responsible for the design.

In most cases, a Generic or Performance Spec. is written that describes the criteria for acceptance of a particular product. Sometimes, specific product name by Manufacturer is noted along with the words "or approved equal". However, in some cases there may not be any known equal, in which case, a Proprietary Item is used, i.e., that which is protected by patent rights. The NHDOT normally does not promote use of Proprietary Products unless there is no other feasible alternative because it may limit competitive bidding

Safety

Vehicular barriers and impact attenuators, i.e., crash cushions, help the driver maintain control of the vehicle and lessen the severity if an accident occurs. Projects under design should incorporate safety features as part of the normal design process. Existing highways may require upgrading safety features by special safety projects.

Barriers

Guardrail, concrete safety shapes, median dividers of several types, and impact attenuators are all considered as barriers. All perform the function of visual warning and physical containment. The objective is to slow or safely stop an errant vehicle without injuring the passengers or involving other traffic. The primary purpose of all roadside barriers is to prevent a vehicle from leaving the roadway and striking a fixed object or terrain feature that would have more severe results than striking the barrier itself. All barrier systems proposed should be carefully considered since the barriers themselves may constitute a hazard.

Refer to the *Roadside Design Guide* (30) for additional information and specific design procedures involving roadside barriers and application of the *Clear Zone* concept. Before a

final determination of beginning and ending points for a specific problem area is established. review the adjoining areas to ensure that short gaps, i.e., 75 to 100 m, between barrier installation are not created.

Traditionally, most roadside barriers were designed with the intent to contain and redirect passenger vehicles weighing up to 2000 kg, traveling at speeds of up to 110 km/h and impacting the barrier at shallow angles (less than 25 degrees). These criteria resulted in the development of a barrier appropriate for cars but not necessarily for larger vehicles with a higher center of mass. To accommodate a wider range of vehicles, new crash test criteria was derived as stated in the *National Cooperative Highway Research Program (NCHRP) Report 350---Recommended Procedures for the Safety Performance Evaluation of Highway Features* (10). These performance standards require that all new safety hardware be tested with a full size 3/4 ton pickup as the standard test vehicle in place of the 2000 kg passenger car to reflect the fact that almost one-quarter of the passenger vehicles on US roads are in the "light truck" category. *NCHRP 350* also defines other supplemental test vehicles including a mini-compact passenger car (700 kg), a single-unit cargo truck (8000 kg) and a tractor-trailer vehicle (36 000 kg) to provide the basis for optional testing to meet higher performance levels.

The features covered by these procedures include:

- Longitudinal barriers such as bridge rail, guardrail, median barrier, transitions, and terminals;
- Impact attenuators;
- Breakaway or yielding supports for signs and luminaires;
- Breakaway utility poles;
- Truck-mounted attenuators; and,
- Work zone traffic control devices.

Guardrail

Guardrail is used on embankments, in medians and to protect vehicles from obstructions within the clear zone. The face of guardrail is commonly set at the edge of shoulder, i.e., edge of pavement; however, when space is available, an additional 0.6 m (paved) offset is sometimes preferred, as on high speed facilities.

Side slopes on embankments should provide reasonable opportunity for recovery of an errant vehicle. There may be instances, however, where construction of 4H:1V or flatter slopes is not feasible or practical. This situation may require guardrail. Barrier warrants are based on the premise that a traffic barrier should be installed only if it reduces the severity of potential accidents.

New Hampshire's typical warrant for guardrail, under rural conditions, is on any slope steeper than 4:1; however, embankment heights of approximately 1.5 m or less at slopes steeper than 4:1 may not necessarily require guardrail, especially if the area at the toe of the slope appears to be reasonably safe, i.e., no trees or water . The 4:1 typical warrant for

guardrail is conservative criteria that NHDOT has adopted as compared to the information shown in Figure 5.1 of the *Roadside Design Guide* (30). The "length of need" is determined by the procedures as outlined in the *Roadside Design Guide* (30).

All guardrail installations must end safely using an appropriate guardrail terminal (end treatment). The standard choices for terminals include the Eccentric Loader Terminal unit type ELT, the Modified Eccentric Loader Terminal unit type MELT, the terminal section type E-1, and the terminal unit type G-2. (See Chapter 8 of the *Roadside Design Guide* (30) for a more comprehensive explanation of guardrail end treatments, some of which are proprietary). The MELT, ELT, E-1 and G-2 terminals are not proprietary. Keep in mind that the MELT terminal unit is intended to be used only on non-NHS / low speed roadways, i.e., roadways with posted speeds of 40 mph or less. The terminal sections, along with the "length of need" of guardrail in advance of the hazard, are always placed completely beyond the "warrant area".

In urban conditions and other special locations, barrier warrants may need to be evaluated on an individual basis. Carefully consider any variation from the typical treatment and review it with your supervisor.

There are times when barrier may be required to protect vehicles from areas containing water or other hazards even though the sideslope is 4:1 or flatter. These and other roadside conditions involving consideration of, or requirements for, shielding are addressed in Table 5.1 of the *Roadside Design Guide* (30).

The standard types of guardrail and guardrail terminals approved for use by NHDOT along with details and appurtenant hardware are shown in the Standard Plans or Special Details. The type of guardrail and guardrail terminal will be specified on the plan.

Guardrail may be used as median barrier or as an intermittent barrier in wide medians to keep vehicles from striking bridge piers or other median hazards. Beam guardrail is normally used unless otherwise directed. In areas where deflection offset is limited, thrie beam guardrail may be required. See Chapter 5 of the *Roadside Design Guide* (30) for dynamic lateral deflection of the different versions of guardrail. For the strong (wood) post W-beam guardrail typically used in New Hampshire, the lateral deflection commonly is assumed as 1.8 m, whereas, thrie beam deflection is assumed as 0.6 m. Deflection is more critically evaluated where guardrail is used to protect vehicles from bridge piers, abutments or similar hazards. In this case, a truck (with higher center of gravity) impacting the barrier may begin to overturn, at which point, the cargo box may hit the pier/abutment.

There are instances where tapering or flaring the approach end of guardrail will enhance safety. A roadside barrier is considered flared when it is not parallel to the edge of the traveled way. Flare is normally used to locate the barrier terminal farther from the roadway, to minimize the driver's reaction to a hazard near the roadway by gradually introducing a parallel barrier installation, to transition a roadside barrier to a hazard nearer the roadway such as a bridge parapet or railing, or to reduce the length of need.

Reducing the length of need is the most common reason to flare guardrail, however, the designer should be aware that there are disadvantages to flaring barrier, i.e., the greater the flare rate, the greater the impact angle. As the angle of impact increases, the severity of the

accident increases, particularly for rigid and semi-rigid barrier systems. Another disadvantage is the increased likelihood that a vehicle will be redirected back into or across the roadway following an impact. This situation is especially undesirable on two-way roadways where the impacting vehicle could be redirected into oncoming traffic. Field conditions sometimes dictate the need for flared installations on two-way roadways. however, a flared installation solely for the purpose of reducing the length of rail is not recommended.

Flared rail may also present a vaulting potential when used along the outside of a superelevated horizontal curve. To avoid this potential from occurring, do not design flared installations on the outside of horizontal curves unless the curvature is so flat that superelevation in not required, i.e., the cross slope should be at or near normal crown to consider using flared rail. As always, each guardrail installation must be designed on an individual basis using good engineering judgment. The maximum recommended flare rates are a function of highway design speed and barrier type. See the *Roadside Design Guide* (30) for further specific information.

Wood is New Hampshire's standard guardrail post material. Recommendations to use steel posts (for permanent installations) must be approved by the Assistant Commissioner. In the case of temporary traffic control barrier (Item 606.95), the selection of the type of barrier is the contractor's option. If guardrail is chosen as the type to be used, then the choice of steel posts (in this temporary application) is the contractor's option.

Galvanized beam guardrail is most commonly used in New Hampshire. There are certain situations, however, where it may be more appropriate to use weathering steel (a.k.a. Cor-10 or "rusty rail"). Such areas may include historic or other environmentally sensitive areas where conventional galvanized guardrail may appear objectionable. The Commissioner's Office should be consulted when weathering steel is being considered.

Concrete Barrier

Concrete safety shapes are commonly used in narrow medians, as temporary traffic control devices, as half-sections in front of bridge piers, and in other areas, if appropriate. The purpose of the shape is to deflect vehicles from a possible head-on collision with a fixed object or other vehicle, back to the traveled way. Experience has shown that fatalities are dramatically reduced when a safety shape is used to prevent accidental cross-over to opposing traffic lanes. Typical concrete safety shapes used in New Hampshire include either the "F-Shape" barrier (used primarily for permanent installations) or the "Jersey-Shape" portable concrete barrier (for temporary use in work zones). Standard Plan GR-4 illustrates the "F-Shape" barrier. The "Jersey -Shape" is a Special Detail.

On existing divided highways having an uncurbed median width of less than 12 m and a design speed of 80 km/h or more, a median barrier should be considered. These criteria are not meant as a guide for designing widths. Design median widths are discussed in chapter 3. For all divided highways regardless of median width, the median roadside within the clear zone must be examined for barrier needs because of embankment steepness, non-traversable hazard, or fixed object.

On existing divided highways where a hazardous area has been identified within the clear zone, median barrier should be considered regardless of median width.

The beginning or ending point of a median barrier will normally occur where there is a transition into a narrower or wider median, respectively. When this occurs, the barrier should extend sufficiently into the approach section and consideration should be given to the use of guardrail as a method of transitioning the concrete barrier to a safe end treatment without the need of providing an unnecessarily wide median area to taper the concrete barrier outside the clear zone, or, to use an impact attenuator as discussed below.

Impact Attenuators

Economic considerations, space limitations, and other factors make it impossible to construct highways completely free of roadside hazards. This is particularly true of freeways and expressways in urban and suburban areas.

Although most roadside hazards can be adequately shielded with guardrail or other forms of longitudinal barrier placed along the roadside, there are certain hazards that can be shielded by special barriers called impact attenuators placed at the hazard site.

Attenuator systems or crash cushions are designed to reduce the intensity of head-on impacts. However, angular impacts are also possible; therefore, attenuator systems must be capable of shielding the hazard from angular impacts as well. Impact attenuators, like longitudinal barrier systems, must be designed to either redirect or safely cushion angular impacts up to 25 degrees.

To shield a hazard that is located in such a position that it is likely to be impacted head-on, these special barriers must satisfactorily cushion the impact and safely stop or redirect an errant vehicle before it reaches the hazard.

Impact attenuators, like other barrier systems, are costly, must be maintained, and can be hazards in themselves. Therefore, emphasis is placed on using them only after careful consideration of both safety and economic aspects.

Some highway features which may qualify for installation of impact attenuators are:

- Exit gores and diverges with insufficient recovery area or which contain fixed obstacles; and,
- Bridge piers, railings, abutments and other hazards within the clear zone.

To be acceptable, impact attenuators must be able to withstand severe impacts from vehicles traveling at highway speeds. They must also be capable of decelerating and safely stopping most impacting vehicles in a relatively short distance without exceeding a deceleration greater than human tolerance. Acceptable criteria for design of crash cushions are found in the *Roadside Design Guide* (30), *NCHRP Report 350* (10) and in manufacturers' design criteria.

An appropriate attenuation system for a given site is selected after considering the following:

- Type and width of hazard;

- Space available for installation of the system;
- Cost of installation and maintenance; and,
- Ease or difficulty of accessing and restoring the system after impact.

Consult the *Roadside Design Guide* (30) before recommending the type of cushion for a particular location. The actual selection of the type of attenuator as a bid item should be carefully considered and reviewed for approval. Since most impact attenuators are proprietary, a "performance specification" is usually written by the Bureau's Specifications Engineer that identifies the criteria that must be achieved for the product to be acceptable. This practice promotes competitive bidding while satisfying the safety requirements of the design.

In urban areas, the potential for vandalism should also be considered.

Glare Screens

Glare screens are a type of barrier used for shielding headlight beams from opposing traffic. Usually the problem exists on high-speed, high-volume, non-lighted divided highways with narrow medians.

The magnitude and severity of headlight glare depends on a variety of factors including:

- Type of headlight system, which includes the headlight configuration, height of beam, and output intensity;
- Roadway features, which include the roadway alignment, geometrics, and pavement reflectance (wet pavement reflects more glare); and,
- Human variables, which include driver's age, visual ability, and state of fatigue.

The decision to install a glare screen requires careful consideration. There are combinations of features and situations to which glare screens may be a solution.

To be effective, glare screens should block out all glare from headlight beams of vehicles in opposing traffic lanes. In order to accomplish this ideally, the upper and lower edges of the screen should be set to prevent light from the largest design vehicle from shining over the screen, and conversely, the lower edge must be low enough to prevent light from the lowest design vehicle from shining under the screen. The screen should also block out all light up to an angle of 20 degrees in relation to the centerline of the highway.

Suggested mounting heights and additional information on glare screen applications are found in the (somewhat dated) *Glare Screen Guidelines, NCHRP Synthesis 66* (31).

Use of glare screens atop the current standard 1070 mm "F-Shape" barrier is not as commonly required as with the former standard (permanent) "Jersey-Shape" barrier which is 810 mm high.

Traffic Operations

Traffic flow is improved through the use of signs, signals, pavement markings and street lighting. These facilities, with the exception of street lighting, are designed cooperatively by the Bureau of Traffic and the Bureau of Highway Design. If consultants prepare the plans, either the consultant will provide the design of the signs, signals and pavement markings and Traffic will review it along with Design staff; or, the consultant will provide a base plan to Traffic who will provide the design to the consultant who will then draft the information onto the plans.

The stipulations of the Traffic Control Plan (TCP), detours and construction signing are components of the plan designed to promote safe travel while the project is being constructed (see the sample TCP, Appendix 13-6). The permanent signs, signals, and pavement markings and other devices installed as part of the contract or by the Bureau of Traffic, will provide safe traffic control after the project is completed.

Lighting

Lighting design is normally provided by the Design Services Section but, in some cases, if a consultant is involved, the consultant may design the lighting and Design Services will review it before it is included on the final plans. Early in project plan development, a set of plans and cross sections should be furnished to Design Services to determine the needs for street lighting and to conceptualize the preliminary lighting layout. When roadway (and bridge) plans have progressed to near PPS&E stage, the lighting design is finalized and coordinated with the utility pole relocation needs and signal work, if involved. The information is then added to the roadway plans. Lighting quantities,e.g., conduit, pull boxes, and concrete light pole bases are computed by the highway (or bridge) designer or the consultant.

Normally, street lighting is arranged for under a Force Account Agreement between the electric utility involved and the State. (Include this as a line entry in the Estimate.) The roadway/bridge contractor usually installs the light pole bases, conduit and pull boxes as part of the roadway/bridge project. The electric company erects the light poles, mast arms, luminaires, installs the wiring, and energizes the lights under the Force Account Agreement.

If the lighting plan is to be a separate contract, the Design Services Section will initiate the proposal documents and coordinate with the Contracts and Specifications Engineer for advertising. See Chapter 9, "Utilities", for the procedure flow diagram, and design references (21) and (32).

The primary objective of street lighting is to increase highway safety. Lighting enables the driver to determine the geometry and condition of the roadway at extended distances, thereby simplifying the task of driving. This, in turn, increases driver comfort level and reduces driver fatigue.

When future street lighting is being considered through a project area, it may be beneficial to install the conduit and pull boxes as part of the project thereby avoiding the future expense of disturbing the pavement, curbing and other features of the new construction.

Lighting design must also incorporate safety considerations within the system itself. For instance, the placement of (aluminum) lighting standards (light poles) should not constitute a hazard to errant vehicles. The use of breakaway connections between the light pole and the base generally will suffice to ensure a safe design.

High-mast lighting has its advantages, particularly in urban interchange and surrounding areas. The concept is to elevate the light source high enough and make it sufficiently bright in order to replace many other lights mounted at conventional heights. The use of one (1) high-mast light pole commonly replaces up to eight (8) to ten (10) conventional light poles. Not only is it economically justified, but it improves the lighting to the overall interchange area. The use of high pressure sodium instead of mercury vapor lighting also provides the additional benefit of reduced energy consumption for a comparable level of lighting. Different light sources or types of luminaires should not be mixed in a common area since it may be distracting to the driver and may create an irregular light pattern. A high-mast light is a massive structure and consequently is always placed well off the roadway and beyond the clear zone.

Lighting should provide the intended benefits while not creating adverse effects, e.g., to the environment. Lighting is an advantage to the driver in rural areas but "spill-over" light can have undesirable environmental effects in terms of "light pollution". Urban street lighting is generally desirable for both pedestrian and vehicular movements, but there may be instances where excessive light adversely affects the living environment.

Signs

Permanent signing, and pavement marking designs are normally prepared by the Bureau of Traffic to be included into the project plans. Quantities for roadside and barrier delineators are estimated by the designer according to guidelines in the Standard Plans. (See Chapter 8 for additional information regarding calculating these quantities.)

The signs to be erected and pavement markings to be applied are shown on the plans whether the work is performed by the contractor as part of the project or by the Bureau of Traffic as Force Account Work. (Include the Force Account Work by Traffic as a line entry in the Estimate.)

Early coordination with Traffic is essential to avoid delays in obtaining information, particularly where overhead signs or other special designs are required that may affect others, e.g., Bridge Design is involved for overhead sign structure and foundation design and Materials and Research to provide subsurface information for the foundations.

In addition to coordination responsibility, the designer should check sign locations for interference with other highway features, for vehicular safety, and for right-of-way implications. All signing installation, permanent or temporary, must comply with the *Manual on Uniform Traffic Control Devices (MUTCD)* (5).

Signals

Traffic signal design is normally provided by the Bureau of Traffic (or a consultant) and included in the final plans by the Bureau of Highway Design (or directly by the consultant). Shop drawing review and final installation inspection is also performed by Traffic.

Coordination with the Bureau of Highway Design is maintained throughout design and particularly when assembling the plans with other elements for final review. As part of the request for the Geotechnical Report, the preliminary signal pole locations are identified on the plans and forwarded to Materials and Research to determine the type of signal foundation(s) to be used and whether there should be any deviation from standard practice when installing the foundation(s).

The highway designer should be concerned with the visibility and placement of the signal heads as well as the signal pole(s) and mast arm(s). For example, the signal heads should "line up" with the center of the traffic lane they control, be properly located longitudinally from the stop bar, and not be obstructed by utility wires. Signal poles and controllers must be located preferably within the right-of-way or, as a minimum, within a permanent easement. To minimize the required length of mast arms, signal poles are often intentionally placed within the clear zone without barrier protection.

The signal mast arms have a length limit beyond which a different size foundation is required. Adding the weight of street lighting to a signal pole may also require changes to the foundation. For additional information regarding specific design elements and limiting criteria, see the Traffic Signal Mast Arm Foundation Standards. If the design exceeds the criteria included in the these Standards, Bridge Design should be consulted for modifications that may be required.

The preparation of Traffic Signal Plans is preceded by a capacity analysis (Chapter 5, "Geometrics") and an examination of the qualifying warrants described in the *MUTCD* (5). The decision to install a signal is based upon warrants. The design of the intersection geometrics is based upon the capacity analysis. The intersection geometrics and the signal layout must be complimentary. It is essential that they be designed together although separate plan elements will be assembled in the contract plans. In some cases, conduit and pull boxes may be installed at intersections for future signal installation, as with lighting, to avoid the future expense of disturbing pavement, curbing and other features of the new construction.

Maintenance of Traffic

Traffic Control Plan

The written Traffic Control Plan (TCP), prepared by the Designer, is included in the Proposal and describes the manner in which traffic will be maintained through the project and specifics about control of the traffic operation. This document compliments Section 619 of the Standard Specifications titled Maintenance of Traffic.

It is important that a conceptual TCP is developed early enough in the design stage to identify ancillary issues that may require follow-up. For example, the need for a temporary detour (roadway and bridge) or temporary widening(s) that may require additional right-of-way easements should be identified at the Preliminary Design stage, especially if a Public Hearing is required, in which case, the easements must be shown on the Public Hearing plan. Temporary drainage that may involve information necessary to be shown on the Wetlands

Permit application, temporary lighting that may involve a utility agreement, and, coordination with the communities involved if it's necessary to detour traffic over local roads should all be identified at the Slope and Drainage stage to allow enough time for coordination with those that may be involved. This last example may involve localized roadway improvements to allow for truck turns at intersections or to overlay the detour route to prepare it before its use or repair it afterward.

Sometimes, the contractor will request a "Variation of the TCP". All such requests are submitted in writing and are reviewed by the District Construction Engineer. When a significant variation of the TCP is requested, the designer may be contacted for input, and at times, the TCP Committee (composed of a representative from Construction, Highway Design, and Traffic) may convene to review the request.

Construction Signs

Traffic flow is maintained through the construction project by using traffic control devices including construction signs mounted "permanently" on posts, and operational controls such as construction signs mounted temporarily on easels, as well as cones, drums and barricades used for daily construction activities, all of which are placed according to Part 6 of the *MUTCD* (5) and/ or the "Work Zone Traffic Control Standard Plans" (TC series) attached to the plans.

The designer will request the list of Construction Signs and Warning Devices from the Bureau of Traffic along with an estimated cost. This recommended "Construction Sign Package" is reviewed by Highway Design and Construction. Changes are made, if necessary, and the cost is revised accordingly. Keep in mind that Traffic estimates the cost of new traffic control devices. Most contractors own these devices and use them from project to project. Rarely does the bid item for 619.1---Maintenance of Traffic reflect the cost of new traffic control devices.

The contractor is responsible for traffic control throughout the construction project. This includes complying with the requirements of the *MUTCD* (5) and using flaggers and uniformed officers appropriately.

Haul Roads

Haul road designations are used where large amounts of material are trucked to the project. The purpose is to limit material haulers to using roads and bridges that can sustain the heavy loads. Haul roads to be designated on a project should be described in the Prosecution of Work or shown on the plans. As with the conceptual level TCP, the requirement for, and location of, haul roads are necessary to identify because of the ancillary issues that may require follow-up.

Detours

Short by-pass detours are set up using existing or modified facilities to route traffic around the construction site. Traffic and Construction will cooperate with Highway Design to establish the by-pass arrangements. Sometimes, temporary bridges or existing bridges must be used, in which case Bridge Design must be consulted.

If major detours are a part of the project, conceptual detour plans should be developed at the preliminary design stage.

Roadside Improvements

Roadside improvements, generally treated as special plan elements, include:

- Landscaping and wetland mitigation areas;
- Rest areas, scenic overlooks, safety inspection areas, truck weigh stations;
- Pedestrian and bicycle facilities; and,
- Commuter parking lots, a.k.a., "Park & Rides".

Landscaping, scenic overlooks and similar plan elements are developed by the Roadside Development Section of the Bureau of Highway Design or by consultant.

Landscaping

Most projects will need both temporary and permanent erosion control measures, but the beautification work needed to create a more aesthetically pleasing and environmentally sensitive project is performed when the construction work is nearing completion. Before any special landscaping is included in a project or proposed as a separate project, the concept should be reviewed with the Commissioner's Office.

In all cases, the designer should attempt to preserve natural beauty and consult with the Roadside Development Section regarding ways to minimize detrimental impacts to trees and shrubs within and adjacent to the work area. Again, early coordination is important to ensure the desired final product.

If a separate landscaping project is anticipated, a set of reproducible mylars of the plan sheets should be made about the time that right-of-way plans are developed. These sheets can be updated later, if necessary, but they provide a good base plan for landscaping design without the clutter of construction notes or right-of-way (boxed) information.

Wetland Mitigation Areas

Grading for highway projects may affect or "impact" areas that have been classified as "wetlands". A wetland must meet certain established environmental criteria. The Environmental Coordinator will provide "delineated wetland" boundaries to be shown on the construction and right-of-way plans.

The total wetland area impacted by the project is presented as part of the Natural Resource Agencies Meeting. As part of this process, it is decided whether it will be necessary to "mitigate" for damages to these wetland areas caused by the project.

Mitigation can be accomplished in several ways, e.g., by creating new wetlands, expanding existing wetland areas, "enhancing" or increasing the ecological value of an existing wetland,

or by purchasing a Conservation Easement to protect a wetland or upland area from future development.

Providing the design to develop wetlands involves the Environmental Coordinator, Roadside Development and, possibly, a consultant. The work will either be included in the construction project or advertised as a separate project. Sometimes, a single wetland mitigation project may replace wetland areas impacted by several construction projects.

Rest Areas

Rest Areas, including those described as Welcome Centers and Tourist Information Centers, along with scenic overlooks are functional and desirable elements of the complete highway system. A rest area, in the general sense, is a roadside area, with parking facilities separated from the roadway, usually providing toilet facilities and some with vending machines and staff to answer questions. These facilities serve the purpose of making the motorist physically more comfortable and mentally more alert.

Rest Areas located in New Hampshire near adjoining State borders are called "Welcome Centers". Rest Areas open year round are called "Tourist Information Centers", whereas those only open seasonally remain described as "Rest Areas".

Scenic overlooks are, to a certain extent, similar to Rest Areas in that they provide the motorist the opportunity to pull off the roadway, stop and "stretch" for a while at the same time enjoying a fabulous view of the country side.

Safety Inspection Areas and Truck Weigh Stations

Safety inspection areas and truck weigh stations are both intended to provide the facility for the Department of Safety to monitor trucks, i.e., to conduct safety inspections on trucks and to discourage overweight trucks from using New Hampshire's roadways.

These facilities may be designed as separate projects or included as part of a highway project. The area provided must be large enough to accommodate truck movement and parking within, as well as providing entering and exiting pavement tapers that follow standard geometric deceleration and acceleration criteria compatible with the design speed of the road.

Pedestrian, Bicycle, and Non-Highway User Facilities

Certain projects may include or specifically be intended to provide a pedestrian and bicycle path. The specific projects are normally part of the Transportation Enhancement (TE) Program. The goal of constructing these facilities is to encourage alternative modes of transportation and reduce the number of vehicles on the road, i.e., motorists would choose to either walk or bicycle to their destination.

The design, construction, or alteration of facilities for pedestrians should be compatible with the Americans with Disabilities Act (ADA) by complying with the criteria provided in either of two (2) standards:

- *Uniform Federal Accessibility Standards (UFAS)* (17),or

- *Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)* (38).

Note: A Public entity is entitled to choose to comply with either ADAAG or UFAS. The NHDOT has chosen to comply with ADAAG.

Approved criteria for pedestrian facilities can be found in the *Manual for Planning Pedestrian Facilities, FHWA, 1974* (39).

Bikeway construction projects may involve shared facilities, separate bike paths or marked routes which incorporate both concepts.

Bike paths are generally multi-purpose, however, the daily good-weather commuting distance is limited to about 10 km, one-way, according to the FHWA publication, *Safety Design and Operational Practices for Streets and Highways* (21). Bikeways provide safety for the cyclist and better traffic flow for the motorist.

The NHDOT report titled *New Hampshire Statewide Bicycle and Pedestrian Plan* (11) is the approved reference for planning bicycle routes in the State. Additional bikeway planning and design information can be found in the *Guide for the Development of Bicycle Facilities* (9) and *Selecting Roadway Design Treatments to Accommodate Bicycles* (40).

Pedestrian and bicycle facilities may be used in the winter by cross-country skiers and sometimes snowmobilers. For this reason, a facility constructed with a roadway underpass may also need to be large enough for a cross-country trail or snowmobile trail groomer. If the trails aren't groomed, the width is determined on the basis of accommodating two (2) snowmobiles (one in each direction). Coordination with the local public officials will usually identify whether the trails are groomed. There are also many miles of specific snowmobile trails throughout New Hampshire and, because of this, there are instances where specific "snowmobile underpasses" are constructed. In certain bridge crossing areas, consideration should be given to snowmobilers if a known snowmobile system exists.

Commuter Parking Lots

Commuter parking lots or "Park & Rides" are constructed to reduce the number of passenger vehicles on the road by encouraging motorists to share rides or to use public transportation. These Park & Rides are usually initiated by the Office of the Car Pool Coordinator in the Bureau of Rail & Transit or by a community applying for Congestion Mitigation and Air Quality (CMAQ) funding.

The Park & Rides are designed on an individual basis, depending upon the land available, the estimated number of vehicle spaces needed and future expansion needs. Most Park & Rides have telephone service and lighting. The larger Park & Rides may have a shelter or possibly a bus terminal. Refer to Chapter 5, "Geometrics", and to Appendix 5-2 for additional information and parking layout diagrams.

Environmental Elements

The most obvious and objectionable by-products of highway improvements are noise and erosion; however, these effects can be minimized through responsible design practices.

Controlling dust during construction is also important and can be regulated by provisions included in the contract. Post construction effects on air quality are not within the control of the designer but are considered an environmental matter to be resolved before programming the project.

In this chapter, noise barriers and erosion control measures are identified as plan elements.

Noise Barriers

The NHDOT *Policy and Procedural Guidelines for the Assessment and Abatement of Highway Traffic Noise for Type I Highway Projects* (41) should be referred to in determining the need for noise barriers. The location and conceptual design of proposed noise barriers must be identified in the preliminary design stage to ensure that adequate right-of-way exists or is acquired to construct and maintain the barrier. Coordination with the Bureau of Environment is required to determine where noise barriers are warranted. Always discuss this issue as early as possible with the Commissioner's Office whenever noise barriers are being considered.

Barriers may take the form of earth berms or walls of various types. Methods of noise attenuation are listed in references (33) and (34).

Erosion Control

Erosion control measures are usually designed into the project to provide protection against temporary or permanent erosion. Drainage systems, ditches, channels, and slopes are designed to minimize the effects of erosion and are protected with combinations of materials and vegetation. The *Manual on Drainage Design for Highways* (13) and Chapter 6, "Drainage", deal with erosion control.

Erosion control during the vulnerable construction stage is the responsibility of the contractor. Section 107 of the Standard Specifications titled "Legal Relations and Responsibility to Public", states the general rules that the contractor must follow. Supplemental Specifications and Special Attentions in the Proposal also direct the contractor regarding erosion control. Most projects that contain earthwork require the contractor to be responsible for the design and implementation of an Erosion Control Plan and monitoring of this Plan by qualified individual(s) as bid items of the contract. If monitoring of the Erosion Control Plan is expected to be minimal, include it as part of he Plan itself as a single bid item.