Washington State
Department of Transportation

TECHNICAL MANUAL

Maintenance Manual

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October 2010

Maintenance Operations

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Washington State
Department of Transportation

Executive Order

Number: E 1018.00

/s/ Douglas B. MacDonald
Secretary of Transportation

Date: September 26, 2001

Environmental Policy Statement

The Department of Transportation acknowledges the state's vital interests in protecting and preserving natural resources and other environmental assets, and its citizens' health and safety. These interests must be integrated with other vital interests, including the cost-effective delivery and operation of transportation systems and services that meet public needs.

The department shall conduct all its affairs in accordance with the dictates of sound environmental protection practices, including pollution prevention wherever reasonably possible. The department shall also avoid, minimize and appropriately mitigate adverse environmental impacts. These undertakings extend to the construction, maintenance and operation of its systems and facilities. Legal obligations in these matters are established by applicable laws and regulations; this Policy Statement is not intended to create further or additional legally enforceable requirements.

To support the performance of the department's responsibilities and undertakings, as Secretary of Transportation, I hereby commit the department:

- To implement and maintain an environmental management system that embraces all the department's program functions.
- To establish, maintain and make available to the public appropriate performance indicators of the department's exercise of its environmental stewardship, and to consistently review these indicators as a basis to improve the department's performance.
- To comply with all environmental laws and regulations applicable to our business and activities.
- To assure that employees of the department receive training appropriate to their functions concerning the department's environmental responsibilities.
- To communicate to contractors, designers, consultants and other participants in the department's work the management practices and compliance requirements established to further the aims of this Policy Statement.

- To encourage employees and all other citizens to communicate with the department about ways to increase the effectiveness of department practices supporting its mission of environmental stewardship.

- To make every reasonable effort to also protect the cultural and historic resources of the state.

Each employee of the department is charged to exercise his or her responsibility on behalf of the department to assure that the intentions of the Policy Statement are diligently carried out.

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Foreword

Reliable, well-maintained highway transportation facilities are essential to the well being of the state, its citizens, and its commerce. The Washington Department of Transportation's Maintenance and Operations personnel are essential to the state's transportation backbone – the state highway system. Public safety and the safety of our employees is a high priority and must be considered in every decision and activity affecting the highway facilities. The goal of Maintenance and Operations is to retain the highway system in a condition as near as possible to the condition of its initial construction or subsequent improvement. We all take pride in and strive for excellence in the maintenance and operations of our highway system.

/s/ Chris Christopher

Chris Christopher
State Maintenance Engineer

/s/ Gummada Murthy

Gummada Murthy
Director of Maintenance & Operations Division

Introduction

Purpose of this Manual

The purpose of this Maintenance Manual is to provide Maintenance personnel with guidance on how to conduct a wide variety of activities performed within the Maintenance Programs. The focus is on types of equipment, materials, techniques, and other information needed to properly carry out basic maintenance activities such as patching a pothole or removing snow from a roadway. Although this guidance does not establish absolute standards, it helps to promote uniform operating procedures and performance guidelines. Highway maintenance is carried out in a dynamic environment where varying factors can lead to different solutions to maintenance problems. Maintenance and Operations personnel need flexibility to match the appropriate solutions to different conditions. The Maintenance Manual is one of many resources that are available for trained maintenance personnel to utilize in applying their professional judgment to their daily work.

Performance Measurement

The extent to which maintenance activities are conducted is primarily determined by the level of funding provided each biennium by the Washington State Legislature. By placing their trust, in the form of a two hundred fifty million dollar appropriation per biennium, both the Legislature and the public are expecting the Departments Maintenance organizations to deliver their program in a timely and efficient manner. To better communicate the outcomes of the maintenance program, the Maintenance Accountability Program (MAP) has been developed and integrated into the Highway Maintenance Program. The MAP uses performance measures to communicate in easily understood terms the Level of Service (LOS) Maintenance delivers for various maintenance activities. A comprehensive MAP manual has been developed and is available for use by maintenance personnel. The MAP manual is available by visiting the Headquarters Maintenance organizations internet web site.

LOS is based on a letter-grade scale of “A” (highest level of funding) to “F” (lowest level of funding). The LOS for each activity is determined by conducting field condition assessments at highway locations randomly-selected throughout the state during the fall and spring of each year. The LOS targets, by MAP activity, are determined by statewide Maintenance staff utilizing both funding and Legislative guidance to provide the appropriate emphasis. The semi-annual surveys can be a valuable management tool for Maintenance Managers in allocating funds amongst various maintenance activities as well as adjusting their work schedules to achieve LOS targets.

Environmental Responsibilities

Just as we are entrusted with public monies to maintain the highway system, we are also entrusted with being good stewards of the public right-of-way associated with the highway system. As the population of Washington State continues to grow, the environmental value of the highway right-of-way and adjacent lands is also increasing. Whether the right-of-way or adjacent lands serve as habitat for burrowing owls, a conveyance for stormwater runoff into salmon-bearing streams, or as a haven for native plant species, it is reasonable to expect that the increasing environmental protection requirements will necessitate changes in how many maintenance activities are performed.

Many resources are available to assist maintenance personnel in conducting maintenance activities in compliance with environmental requirements. Several environmental guidance documents are available on the Headquarters Maintenance and Operations web site. Particularly applicable to specific maintenance activities is the WSDOT Maintenance Manual for Water Quality and Habitat Protection. This manual contains a number of best management practices that can be used for a variety of activities and/or conditions to ensure environmental compliance. Personnel are available in both the Headquarters Maintenance and Operations Office as well as Regional Environmental offices to assist in providing guidance on environmental issues. One of the most valued environmental resources that can be developed by maintenance personnel is a positive work relationship with local environmental regulators such as the Washington Department of Fish and Wildlife's Area Habitat Biologists. Such a positive work relationship will help maintenance personnel to not only deliver their program in a timely manner but to do so in conformance with environmental best practice methods.

Fiscal Management

Sound fiscal management is a key ingredient in delivering the maintenance program in an effective and efficient manner. Once the biennial budget is distributed to region maintenance organizations it is essential that the expenditure for various activities be accurately documented. This is accomplished through the Departments labor collection and voucher processing systems which not only provide an expenditure record for each maintenance activity, but also the detailed components that make up the cost, i.e., regular time, overtime, vendor services, materials, and equipment. By tracking the expenditure of activities Maintenance Managers are not only aware of the costs of doing business relative to targets but are better positioned to adjust their schedules to meet evolving problems and/or deliver their programs.

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General Responsibilities

This chapter provides guidance to reduce the vulnerability of the state transportation system from any emergency or disaster by:

1. Establishing capabilities for protecting the transportation system and employees from the effects of emergencies or disasters,
2. Responding efficiently to emergencies and disasters,
3. Assist in recovering in the aftermath of any emergency or disaster.

This chapter also incorporates some of the day-to-day operational procedures that are used in responding to incidents such as small spills, snow/ice removal, traffic accidents, emergencies, disaster events, and recovery efforts. The Washington State Department of Transportation (WSDOT) Disaster Plan and the *Emergency Relief Manual* (M 30-14) define the details of how the Department responds to these types of events and is included as an Appendix for reference purposes.

An emergency is defined as a situation involving natural phenomena, disasters, casualties, national defense or security measures, etc. and includes response activities that must be taken to prevent the imminent loss of human life or property.

WSDOT will perform the following functions in emergency situations:

- Determine usable portions of the state highway network. Coordinate and control emergency highway traffic regulations in conjunction with the Washington State Patrol.
- Notify your local Washington Department of Fish and Wildlife (WDFW) local habitat biologist that an emergency action needs to be taken and obtain the Hydraulic Project Approval (HPA) as soon as possible after taking the emergency action.
- Notify the "National Marine Fisheries Service and U.S. Fish and Wildlife Service" that maintenance is taking an emergency action that could result in an "after the fact" consultation under the endangered species act, if the emergency action involves threatened or endangered species' water bodies.
- Follow the memorandum of understanding on "Emergency Actions in Water Courses" with the Washington Department of Fish and Wildlife.
- Meet the conditions of the Washington Department of Fish and Wildlife (HPA) permit if applicable and possible.
- Reconstruct, repair and maintain state highways, bridges, and alternate routes. Coordinate the mobilization of personnel and equipment required for emergency engineering services.

- Maintain liaison with the Washington State Chapter of the Associated General Contractors of Washington and America, construction, and equipment rental companies.
- Provide initial damage assessment estimates on state and local facilities (both for federal aid eligible roads and non-federal aid eligible roads) and public/private airports as a member of the Preliminary Damage Assessment (PDA) Team.
- Participate on Damage Survey/Inspection Report Teams, conducting inspections of federal aid and non-federal aid system highway facilities damaged by a disaster.
- Coordinate all transportation related missions including, emergency air, marine and rail transportation of personnel and essential supplies.
- Conduct aerial reconnaissance and photographic missions.
- Provide public information support to the Office of the Governor and the Washington Emergency Operations Center during emergency response and recovery operations.

Regional Emergency Response Plans

Each Region shall develop and maintain an Emergency Response Plan that will establish day-to-day operational procedures to cope with routine spills, accidents, etc. Regions will also develop procedures to address their response capabilities for those events that are beyond the normal day-to-day operational mode. Each of these procedures shall clearly define employee roles and responsibilities.

WSDOT Disaster Plan

Concepts of Operations

Governments have the responsibility to make every effort to protect life and property during emergencies. When the emergency exceeds the capability of government to respond, assistance will be requested from the next higher level of government.

For example:

Local government may request state assistance and state government may request federal assistance. However, this plan heavily emphasizes the responsibility and capability of local governments to respond to and accomplish short-term recovery during emergencies/disasters.

The WSDOT Disaster Plan recognizes that emergency functions for groups and individuals should parallel normal day-to-day functions. When this is not possible, managers should attempt to maintain organizational continuity and assign familiar tasks to employees.

Organization and Assignment of Responsibilities

Service Centers and Regional Offices have emergency functions in addition to normal duties. Each Service Center and Regional Office establishes procedures for:

- Operations during emergencies.
- Emergency Personnel Roster.
- Compliance with WSDOT Responsibilities and Authorities.

Administration and Logistics

WSDOT acknowledges that in a time of crisis, some administrative procedures should be suspended, relaxed or made optional. However, it is desirable to foresee and plan for necessary changes in administrative procedures.

Documentation is critical for successful reimbursement of funds or to support liability issues. All actions taken, especially changes to established procedures, shall be documented. This is the responsibility of Maintenance Lead Technicians, Maintenance Supervisors and Superintendents. It is proper in these situations to use all tools that are available in order to provide a clear documentation trail.

Maintenance office staff are to be provided the documentation and then are tasked with filling out the proper records and forms to be forwarded to the Regional Maintenance administration.

Plan Development and Maintenance

The WSDOT Disaster Plan is the principal source of documented department emergency management activities. Most Service Centers and Regional Offices are responsible for developing or accomplishing tasks in some part of the plan. This may require simultaneous coordination with local, state and federal agencies. Overall, the Headquarters WSDOT Disaster Plan development, maintenance and coordination is the WSDOT Emergency Management Program Manager's responsibility in cooperation with Service Centers and Regional Offices.

Training and Exercises

WSDOT will periodically provide training and conduct exercises to test the WSDOT Disaster Plan and Procedures to assure maintenance of a readiness mode and reflection of current department operational practices.

Emergency Operating Procedures

General

There are many situations when transportation crews may be exposed to situations requiring emergency action. The most common emergency situations maintenance crews may encounter are vehicle accidents and hazardous material spills.

Hazardous materials are those substances which, when spilled, may make driving on the roadway unsafe, endanger the lives of people in the vicinity, or contaminate the environment. These materials may make the roadway surface slippery, impair visibility, or cause lane and road closures. Materials that may be dangerous in themselves include: explosives, flammables, corrosives, poisons, and radioactive materials. Other materials may not be hazardous but cause hazardous conditions such as fine powder-like materials which create visibility problems or bulky materials which cause lane closure.

WSDOT employees at the scene of an accident or spill will take emergency actions only as required to protect human life and property until the Washington State Patrol has control of the situation. The State Patrol has the responsibility for safety measures at an accident site and for coordination with Department of Ecology for the clean-up of spilled substances. The Washington State Patrol may request assistance from WSDOT for traffic control and to clean up an accident site. WSDOT employees must not attempt to clean up any hazardous material spills. In most cases WSDOT Maintenance employee's have not been trained and/or do not have the proper resources to clean up hazardous spills. Clean up is the responsibility of the owner or shipper of the cargo, if they can be identified. If the owner/generator is unknown, the Department of Ecology is responsible for the clean up. In general terms Ecology personnel only respond onsite to spills greater than 50 gallons of hazardous material.

Maintenance Field Personnel

Maintenance employees will take the following actions when encountering a hazardous condition:

- Advise the Area Maintenance Supervisor or Superintendent of the problem, and request aid from the Washington State Patrol.
- Take precautionary actions to protect themselves, maintenance crews, and the traveling public from any exposure.
- Provide traffic control, including closure of the highway if appropriate, to ensure that no one comes in contact with the hazardous material.
- Survey the situation and report the exact location, cause of the temporary closure, and extent of the closure to the Area or Regional Maintenance Office (or your Maintenance Supervisor or Lead Technician). Notification should also go to the TMC, Traffic Management Center, in each Region if they have one in Place.
- If the spilled substance is identified and is spreading toward water courses, additional traffic lanes, or likely to cause ground water damage, take appropriate action to absorb or confine the spill.

  Always use careful judgment and only take actions you know and understand are safe for you to do. Examples of commonly spilled materials include gas, oil and diesel.

- Never take action on an unknown substance or on a known substance that is extremely dangerous to life and property. Examples would include those products with greater harm than gas, oil and diesel. If employee's are not sure what the product is they are to stay clear of the area.
- Some accident scenes include human tissue and blood residues. Contact with these materials is to be avoided. Fire response should wash this residue from the highway or highway feature surfaces. The Washington State Patrol is the incident commander and should assure that the accident scene is ultimately safe.
- Stay on site to safeguard traffic until proper traffic control devices are installed and/or until relieved by your Maintenance Supervisor, Lead Technician, or a Washington State Patrol Trooper.
- Patrol for stranded motorists in isolated areas when traffic has been controlled and when applicable.

Maintenance Superintendent or Supervisor

- Coordinate personnel and equipment to close a highway or restrain traffic from entering a hazardous area.
- Make a complete report of the closure to the Regional Maintenance Engineer/ Manager and Traffic Control Center (TMC).
- Ensure the hazardous section of highway is being monitored, then patrol the area to make sure there are not stranded motorists.
- Provide detours around partial closures when safe to do so. Whenever possible, establish detours on existing state routes. Other local roads should only be used after surfaces, bridges, and overhead clearance restrictions have been reviewed and approved by the appropriate local jurisdiction. Detours will be signed and other traffic control devices (e.g., barricades and flashing lights) will be installed. Station flaggers at barricaded points when necessary.
- Arrange to advise the Regional Public Information Office so that announcements of the closure can be made on the WSDOT public service and communications networks.
- If a closure is requested by the Washington State Patrol, and the local Maintenance Superintendent is not available, contact the Regional Maintenance Manager or the Regional Administrator to advise of the request and provide recommendations concerning the need for the proposed temporary closure.
- Reopen the roadway when the physical blockage is eliminated or the hazardous conditions that caused the closure have abated.
- Advise the Area Maintenance Superintendent, Regional Maintenance Manager, or Regional Administrator of the reopening by the fastest means available.
- Arrange to relay notice of the reopening to the Regional Public Information Office to ensure that information on the public service and communications network is current.

Abandoned Cargo

- All cargo spilled on WSDOT property will be removed at the owner's expense if the owner can be identified. A determination that the cargo is hazardous material will necessitate the procedures outlined earlier. State law (RCW 4.24.512) dictates that the responsible party has the responsibility for clean up of hazardous materials.
- If the spilled material is hazardous, stay safely back from the hazard, establish traffic control, and call the Washington State Patrol who in turn will call the Department of Ecology Spill Response Team. The Department of Ecology is responsible for coordinating clean-up of hazardous materials. If dropped material is identified as hazardous but the container is not leaking or severely damaged, it can be removed to the edge of the shoulder to allow traffic flow if this action must be taken prior to Ecology's arrival at the scene. It should not be taken back to the maintenance facility.
- If dropped material is identified as non-hazardous and is reusable it should be returned to the maintenance facility. After a determination of ownership is made and if the commodity is not reclaimed within (30) days it becomes the property of the department and may be used for it's intended purpose, if appropriate.

Clearing the Highway

Open Road Policy

- The February 2002 WSP/WSDOT "Joint Operating Policy Statement" was developed to stress the importance of the Agencies' responsibility to do whatever is reasonable to reduce the delays associated with incidents and collisions. The open roads philosophy of this policy statement is that WSP and WSDOT shall open the roadway as soon as possible on an urgent basis.
- It is a goal of WSDOT to minimize traffic delays caused by vehicle accidents and incidents. WSDOT Maintenance personnel assisting at vehicle accidents will make every reasonable effort to clear the traveled way as quickly as possible.
- First priority -safety: It is the departments' obligation and responsibility to provide a safe environment for its employees and the public.
- Second priority- Minimizing traffic delay: Maintenance personnel responding to vehicle accidents which involve lane closures will consider every reasonable measure in coordination with WSP, to clear the lane as quickly as possible. At accident scenes which involve spilled or damaged cargo, the overriding strategy will be to minimize traffic delay. Salvage of the cargo will be secondary and at the convenience and

benefit of transportation movement. Criteria to be used in making "Open Road" decisions include:

- crime scene investigation
- traffic volume
- time of day

- Lowest priority- The potential salvage of the cargo should be the last consideration in decisions related to minimizing traffic delay.
- Bridges and other transportation structures closed due to structural damage require approval from the Bridge Preservation Engineer before opening.

General

Safe and effective traffic control is vital for the safety of the traveling public. It is also essential to protect construction, maintenance and utility workers whose work places them near high speed traffic. The traffic control guidelines in this manual provide the driving public positive and consistent guidance through work zones. These procedures will also reduce the risk to maintenance workers who are exposed to potential traffic hazards

The Secretary of Transportation has adopted the Manual on Uniform Traffic Control Devices (MUTCD) as the legal standard as required by RCW 47.36.030. **It is mandatory that traffic control measures on maintenance projects comply with the MUTCD requirements.** The MUTCD outlines basic principles and prescribes standards for the design, application, installation, and maintenance of traffic control devices. The MUTCD details requirements for color, size, shape, location and need for traffic control devices.

In some cases WSDOT has standards that exceed those in the MUTCD (e.g., see *Traffic Manual*, M 51-02, Chapter 5 and the *Work Zone Traffic Control Guidelines*, M 54-44). In such situations the most stringent standard is the legal standard you must follow. Learn those standards before you perform traffic control.

Consult the Regional Traffic Engineer when standard layouts are not applicable.

This chapter reflects the work and recommendations provided by the Work Zone Safety Task Force. The *Work Zone Traffic Control Guidelines* Book (M 54-44) incorporates the recommendations of the Work Zone Safety Task Force and the standards of the MUTCD, and is intended to be used as the companion resource to the guidance in this chapter.

The maintenance employee in charge at a work zone is responsible to see all standards are followed. This includes ensuring temporary signs, warning devices, and flag persons are placed appropriately to protect both motorists and workers. **Motorist and worker safety are of primary importance. Safety takes precedence over all efforts to maintain a highway or structure.**

Fundamental Principles

Principles to enhance motorist and worker safety in maintenance work areas:

- Develop a comprehensive traffic control strategy that can be implemented at the work site. Evaluation of the work operation, site, and traffic conditions should determine the traffic control measures to be utilized.

Refer to the *Work Zone Traffic Control Guidelines* Book, "checklist for establishing a temporary traffic control zone" and the *Traffic Manual,* "traffic control planning and strategy checklist".

- Maintain traffic flow as close to normal highway situations as possible.
- Do not surprise the motorist. Locate and place devices to maintain adequate sight distance for driver recognition and reaction on straight highway sections if possible.
- Prepare, understand, and implement a traffic control plan. Don't routinely rely on minimum standards. Evaluation of the work operation, site and traffic conditions should be determined to the appropriate level of traffic control measures.
- Avoid frequent and abrupt changes in alignment.
- Minimize worker exposure time to traffic.
- Provide adequate warning, delineation, and channelization.
- Remove inappropriate pavement markings on long-term projects. (Work occupying a location 3 days or more)
- Provide flagging only when other methods of traffic control are inadequate.
- Inspect traffic set-up control measures prior to work.
- Monitor traffic control and modify where changing traffic conditions warrant.
- Remove, cover, or turn control devices away from traffic when not needed or in use.
- Channelize traffic with pavement markings, signing, cones, plastic barrels, water filled barriers, or lightweight devices.
- Sand bags may be used for sign ballast. Do not use heavy, solid weights, (e.g., concrete blocks) for stabilizing portable sign supports.
- Traffic control measures must be selected and implemented with the drivers' perspective in mind. Credible messages must be sent to the driver to provide a reasonable expectation that the driver will comply.
- Plan ahead for work operations and the associated traffic control. Don't rely completely on standard devices and procedures when more effective measures should be considered.
- Use traffic control devices (cones and barrels) to define the closed portion of the roadway that is the work zone. Even short term operations can realize a safety benefit from placing cones in a manner that sends an obvious message to drivers that a portion of the road is closed and they must divert around the work zone.

Traffic Control Zones

The traffic control zone is the work area between the first advance warning sign and the point beyond where traffic is no longer affected. Traffic control zones are divided into the following areas:

- Advance warning area
- Transition area (for lane or shoulder closures)
- Buffer space
- Work area
- Termination area

1. **Advance warning area** - The Advance Warning Signs are located before the transition area to provide ample opportunity for motorists to accomplish a desired maneuver. Where there is no lane or shoulder closure, as in mowing operations, one sign will suffice. Use signs on both sides of two-way, two lane highways and multilane roadways.

   Message - Information - Action (MIA) - signing must relate to all three action words.

   The first sign to appear in the advance warning area tells motorists they are approaching a work zone (e.g., ROAD WORK AHEAD). The next sign display provides more detailed information about the situation ahead (e.g., ONE LANE ROAD AHEAD), and the third sign states what action to take (e.g., BE PREPARED TO STOP).

2. **Transition area** - This is the zone where the lane and/or shoulder is closed by channelizing devices. The rate of taper is in accordance with the traffic control plans in the M 54-44. If restricted sight distance is a problem (e.g., sharp vertical or horizontal curve), begin the lane closure well in advance of the view obstruction. Do not hide the beginning of lane closures behind curves.

3. **Buffer space** - This is the unoccupied space between the transition and work areas. It is there to provide a margin of safety for both traffic and workers. With moving operations, buffer space is the space between the attenuator/buffer truck and the work vehicle.

4. **Work area** - Where equipment and workers perform maintenance functions.

5. **Termination area** - Allows traffic to resume normal driving immediately after leaving the work area.

Traffic Control Devices

Traffic control devices are used to warn, regulate, and guide traffic. They include: signs, signals, lighting devices, pavement markings, delineators,

channeling devices, hand signaling devices, and temporary barriers. **Traffic control devices must conform to WSDOT and MUTCD standards.** Use traffic control devices where necessary. Remove, cover, or turn them away from traffic when they are not in use or no longer applicable.

1. **Signs and Supports -** Sign supports are either portable or fixed depending on the duration of work. Small sand bags may be used to stabilize portable sign supports. Do not use objects that could become a projectile upon impact (e.g., concrete, chain, etc.). Sign supports should be lightweight, yielding or breakaway in composition.

   Signs on portable supports must be (1) foot minimum above the roadway. Those mounted on fixed posts must be (5) feet above the roadway in rural areas and (7) feet above the roadway in urban areas.

   Sign spacing is set forth in Appendix A. Follow these sign spacing requirements but also consider in-place existing signs when developing and implementing traffic control plans.

   Regulatory signs - (e.g., KEEP RIGHT, DO NOT PASS) These signs impose legal restrictions, and are placed where the regulation applies. Most regulatory signs are black on white. **(Use them only as necessary)**

   Reduced legal speed limits - Only use reduced legal speed limits when other efforts to control traffic prove to be inadequate. For emergency and other speed reductions, follow speed reduction guidelines outlined in RCW 47.48.020, the WSDOT *Construction Manual* (M 41-01), and WSDOT Directive D 55-20, Reduced Speed in Maintenance and Construction Work Zones.

   To change a speed limit, submit a request to do so to the Regional Traffic Engineer. To ensure a work zone is adequately signed, post the speed limit signs in the work zone. Remove all signs when the reduced speed limit is not in effect.

   Warning signs - Their purpose is to give motorists notice of potentially hazardous conditions for traffic. They are erected in advance of the condition. Use warning signs when conditions warrant, particularly if the hazard is not obvious or cannot be seen by approaching motorists. Don't overuse warning signs or they will lose their attention-getting value.

   All warning signs shall have black legends on an orange background (except the round railroad advance sign, which is black on yellow). **Do not use double faced (back-to-back) signs.**

   Changeable message signs - These signs are recommended for high speed, high volume roadways, or work operations that require a highly visible message. Use them to supplement or enhance work zone safety and not to replace required signs. Two message panels are the maximum allowed. Consider truck mounted Portable Changeable Message Signs (PCMS) for shadow/ buffer vehicles.

Some typical situations include:

- Locations where speed of traffic is expected to drop substantially
- Locations where significant delays are expected
- Accident or incident management

Make messages clear and brief, keeping messages to a maximum of two panels. If special messages are necessary, be consistent with conventional signs and standards normally used. Whenever possible use the pre-programmed stored messages the PCMS is equipped with. Never display a message with an arrow from a PCMS that is located on the same shoulder as the arrow direction (right shoulder/right arrow or left shoulder/left arrow).

2. **Channelizing Devices -** Channelization devices are used to direct traffic away from or around a work area, or to separate two-way traffic. Channelization devices must be reflective for night use.

   Cones - These are the most common device used to separate and guide traffic past a work zone. Cones must be at least 18 inches tall for normal situations. But, they must be 28 inches tall minimum, for high speed, or high volume operations.

   Reduced device spacing around work zones is recommended. Make provisions for large work vehicle access as needed (routed off the existing shoulder or through a stagger of channelization devices).

   Place barrels or cones diagonally across closed lanes to show motorists which lanes are closed.

   Refer to the *Work Zone Traffic Control Guidelines* Book for more information on channelization devices, application and placement.

Cone Placement Procedure

Prior to establishing traffic control with cones, a meeting is held by the involved parties to discuss the following procedures:

- Technique (e.g., a whistle or voice actuated headset) for signaling between the cone handler and truck operator.
- Will cone tapers across the closed lanes be done by hand?
- Set up and take down a line of cones along lane or center lines:
- The cone handler should ride in a cone setting cage attached to the front, back or side of the traffic control vehicle, to set and remove cones in the work zone.
- The driver is responsible for: safe operation of the vehicle, maintaining the vehicle at a safe speed, watching the cone side and the front of the vehicle, and watching the cone handler.

- The cone handler is responsible for setting and removing cones, and signaling the driver in case of any obstruction or emergency.
- The driver and cone handler will decide if a shadow vehicle with a truck mounted attenuator is required to protect the cone handler while exposed to traffic.

Traffic Safety - Drums are used on freeways due to greater target value and imposing size.

Barricades - They protect spot hazards and close roadways and sidewalks with appropriate signing. Barricades can also be used to provide additional protection to work areas. **Lights used to** channelize traffic must be steady burning, "Type C". Do not use flashing, "Type A", warning **lights on barricades to channelize traffic.**

Temporary pavement markings - These markings delineate lanes and tapers on long-term projects. Remove existing markings that may confuse motorists. For short-term maintenance operations, it is not practical to remove and then restore pavement markings. If it is necessary to divert traffic across existing pavement markings, the channelizing device used must be so dominant that a motorist's attention is drawn completely away from the existing marking. Reduced device spacing is recommended. The use of removable black mask tape (see QPL, *Qualified Products List*) may also be considered to temporarily cover existing markings.

High level warning devices - They are tall, portable stands with flags or flashing lights visible above traffic. Used with flags only, they may have a sign or flashing light attached, or be attached to vehicles used in moving or mobile work operations. (See MUTCD, Part VI).

3. **Temporary Barrier** - There are several types of barrier protection used in work zones: concrete barrier, movable concrete barrier, steel barrier and water-filled barrier. While barriers are effective and provide positive protection to work operations, they may result in more damage to an impacting vehicle.

   Concrete barriers - They are a rigid barrier designed to prevent intrusion of errant vehicles into work areas considered the most substantial type of barrier to enhance worker safety. Contact the Region Traffic Engineer for site specific placement information.

   Consider the use of concrete barriers for:

   - High speed roadways and areas with a high potential for worker injuries.
   - Work zones in "no escape" areas (e.g., tunnels, bridges, and lane expansion work).
   - Long term, stationary jobs (work occupying a location for more than 3 days).

- Worker and traveling public exposure considerations (e.g., high speed and volume of traffic), when workers are not protected by a vehicle, and in proximity to traffic (e.g., concrete slab repair on freeways).

Movable barriers - This specialty barrier requires a Transfer/Transport Vehicle (TVV) to physically move the barrier. NW region owns two TVV's and barrier.

- High volume traffic conditions with very short-term lane closures.
- Continuous operation over an extended period of time, where there is a need to get the lane back in operation at some point in the day. (Could be used in lieu of reduced lane widths or lane reduction, e.g., lane additions, wall next to roadway).

Protect the ends of concrete barriers with approved crash cushions, unless flared outside the clear Zone. Refer to *Design Manual* Chapter 720 and consult with the Region Traffic Engineer to determine the appropriate end treatment. Do not use concrete barriers as a channelizing taper, but when/if flared or tapered, channelization must be used in advance (e.g., temporary edge line, cones, or plastic barrels) to provide a recovery area for errant vehicles).

Steel Barrier- A rigid portable barrier designed to prevent intrusion of errant vehicles into work areas. Recommended for work operations where concrete barrier may also be used. The benefits of using steel barrier include a light weight stackable design that reduces transport costs when compared to traditional barrier. Several hundred feet of the barrier can typically be transported on a single truck with the stacking capability. Optional casters can also be installed to simplify deployment and movement by allowing the barrier to be pushed and pulled into position.

Water filled barriers- They are a portable traffic barrier designed to prevent intrusion of errant vehicles into work areas. Recommended for stationary work areas with high exposure to high speed traffic where it may not be practical to use concrete barrier, but more protection than channelization devices is desired. Be aware that up to 23 feet of lateral deflection can occur if the barrier is impacted at high speed.

Consider the use of water barriers for:

- Short term projects (zero to three days) of a minimum 100' in length.
- **Do not use in lane transitions** until further testing or the situation meets with manufacturer's specifications.
- Evaluate risk and site conditions. If used, follow manufacturer's guidelines and specifications. Consult with the Region Traffic Office prior to use.

(Additional information on barriers is located in Chapter 710 of the *Design Manual*, Chapter 5 of the *Traffic Manual*, M 51-02 and the *Work Zone Traffic Control Guidelines Book*).

4. **Hand Signaling Devices -**If other methods of traffic control are inadequate to warn and direct drivers and flagger traffic control is implemented, stop / slow paddles must be at least 18 inches in diameter and reflective for night use. For high speed, high volume traffic or those locations where more advance driver attention is desired, consider the use of 24" stop/ slow paddles or the Flashing Stop/ Slow Paddle (FSSP).

5. **Lighting Devices -** Use to call attention to hazardous situations, especially at night. Includes warning lights, flashing vehicle lights, floodlights, and flashing arrow boards.

   Warning lights - These lights are either flashing or steady burn (Types A, B, or C or strobe) mounted on channelizing devices, barriers and signs. Secure warning lights to the channelizing device or sign so they will not come loose and become a dangerous flying object if impacted by a vehicle. See the MUTCD, Part VI for additional information.

   Steady burning lights (Type C) - Lights used in a series of channelizing devices or barriers form a taper or separate the work area from traveled lanes. Never use any type of flashing light in sequence for transitions or continuous channelization.

   Flashing vehicle lights - These lights alert motorists to the potential hazards of maintenance vehicles and workers near the traveled lanes. Use flashing lights to warn of isolated hazards or signs. Snow-removal and other highway maintenance equipment use flashing lights for purposes of identification when working. Use flashing lights anytime over width equipment is on the highway per WAC 468-38-390.

   Floodlights - Use them to illuminate nighttime work. Floodlights permit the crew to see what they are doing and make the crew visible to motorists. Where planned, night operations require flaggers; flood lighting must be provided to illuminate the flagger. Shield the light source to protect motorists from glare.

   Flashing arrow boards and changeable message signs - They <u>are required</u> for day and nighttime tapered lane closures and moving operations. At night, flashing arrow boards are required to use a photocell which automatically dims (minimum 50% dimming) so that motorists will not be temporarily blinded. When used for lane closures tapers, they are located in the lane (or partially on the shoulder) being closed, behind the taper of channelizing devices, usually within the first one third of the taper.

   Do not use arrow boards or arrow displays on changeable message signs when:

   - Work does not require lane closures, except for moving operations on multilane facilities.
   - All work is on or outside the shoulder with no interference requiring closure of the adjacent traveled lane.

- The work is on a two-lane, two-way roadway.
- A shoulder closure only is required.

Do not use more than one arrow display per lane being closed. An arrow display with a shadow vehicle (early warning) is allowed on mobile or moving lane closure operations. The caution mode (flashing four corner lights only) may be used as supplemental warning at work area not requiring a lane closure.

Arrow displays used on PCMS's must meet the same performance standards for flashing arrow boards, see MUTCD, Part VI.

Traffic Control Procedures

Controlling traffic for maintenance operations is dependent upon the activity being performed, the estimated duration of the activity, type of highway, traffic speeds and traffic volume. Safety clothing will be worn by WSDOT employees while in the highway work zone (for more information, see Chapter 3 of the *Safety and Procedures Guidelines Manual*, M 75-01).

Providing advance warning to drivers approaching road work is required. The specific requirements for advance warning depend on the actual site conditions and could be the flashing beacon on a work vehicle or a series of portable signs and a PCMS. (Refer to the *Work Zone Traffic Control Guidelines* Book and the MUTCD, Part VI for specific advance warning requirements).

Use an advance warning sign when:

- Any work activity that may distract the driver or require the driver to react, beyond the normal driving requirements for that section of road.
- Work is performed on or immediately adjacent to the roadway (within 15' of the edge of the roadway).
- Equipment may be moved along or across the highway.
- The shoulder is occupied or closed.
- There is encroachment into traveled lanes.

Typical traffic control plans and additional guidance for maintenance activities are contained in the MUTCD, Part VI and the *Work Zone Traffic Control Guidelines* Book. These plans establish typical signing procedures. The maintenance employee in charge must determine the extent of traffic control required to provide motorist and worker safety. Modification to or the development of new traffic control plans may be necessary to accommodate a work operation.

After establishing traffic control, the maintenance employee in charge will drive through the work area at expected motorist speeds to determine the plan's effectiveness. Periodic monitoring is required to ensure traffic control devices remain in place.

Changing conditions such as traffic, work, or time of day require traffic control adjustment. If an accident or near accident occurs after the control has been set up, make necessary adjustments immediately and monitor for a reasonable period. Remove, cover or turn traffic control devices during non-working hours.

Refer to the *Work Zone Traffic Control Guidelines* Book and the MUTCD, Part VI for guidance on specific work operations, duration of work requirements and flagging operations.

Off-Road Activities

Where work is being conducted off the roadway and shoulders, but within the right of way, the hazards are usually minimal. However, minimize risks by using an appropriate warning sign (e.g., MOWER). (See above section on advance warning signs).

Nighttime Activities

Nighttime maintenance activities are commonly performed because of lower traffic volumes and reduced traffic disruption. Nighttime work is also necessary to respond to emergencies such as fallen trees, mud slides, etc.

Night operations present additional safety concerns. All signs used at night shall be reflective as specified in the MUTCD. Street or highway lighting does not meet the requirements for traffic control device illumination.

Floodlights may be necessary to provide work area illumination and to permit the crew and flaggers to be visible to the motorist. The light source must be shielded to protect drivers from glare. Consult the Safety and Traffic Offices to review WSDOT illumination practices.

The effectiveness of flagging is diminished at night as the flagger may not be visible to the motorist. Make efforts to control traffic by other means when possible. When used, the flagger is located within a coned area (usually the shoulder or other relatively safe location) but not within the taper itself. As with other workers in night work zones, flaggers shall wear traffic vests made of highly visible materials supplemented with reflective material visible on all sides of the wearer and a highly visible hard hat with reflective qualities.

Automated Flagger Assistance Device (AFAD)

The AFAD is an automated flagging machine that is operated remotely by a flagger located off the roadway and away from traffic. The device is a safety enhancement for projects that use alternating traffic control by physically placing the human flagger off the roadway while maintaining control of the traffic movements approaching the work zone. Contact the region traffic office for specific guidance and advice on the use of these systems. A traffic control plan is required for use of these systems.

Temporary and Portable Signal Systems

Temporary traffic control signals are typically used in work zones to control traffic such as temporary one-way operations along a one-lane, two-way highway where one lane is closed and alternating traffic movements are necessary. Examples of work operations are temporary one-way operations on bridges and intersections. Contact the region traffic office and signal superintendent for specific guidance and advice on the use of these systems. A traffic control plan is required for use of these systems.

- Temporary signal system - typically a permanent signal system modified in a temporary configuration such as temporary pole locations during intersection construction, span wire systems, adjustment of signal heads to accommodate a construction stage.
- Portable traffic signal system – a trailer mounted traffic signal used in work zones to control traffic. These versatile, portable units allow for alternative power sources such as solar power, generator and deep cycle marine batteries in addition to AC power.

Non-motorized Traffic Control

Give consideration to pedestrian and bicycle traffic where appropriate. Provide alternative routes where designated walkways or bicycle routes are temporarily interrupted due to maintenance operations. Alternative routes need to be free of obstructions and hazards (e.g., holes, debris, mud, construction and stored materials, etc.). Clearly delineate all hazards near or adjacent to the path (e.g., ditches, trenches, excavations, etc.). Bicyclists are subject to the same flagging procedures as vehicles. Do not place signs and other traffic control devices to pose a hazard.

Pedestrian Control

Alternative pedestrian walkways are provided when pedestrian activity is apparent where:

- Walkways traverse the work zone.
- A designated school route traverses the work zone.
- Significant evidence of pedestrian activity exists (e.g., a worn path).
- Existing land use generates pedestrian activity.

Consider the following principles for designing/constructing alternative pedestrian facilities:

- Separate pedestrians and vehicles by barrier or channelizing devices. Use barriers on high speed facilities. Use channelizing devices on low speed (35 mph or less) facilities.
- Walkways used at night, (especially if adjacent walkways are lighted) need temporary lighting.

- Use warning lights to delineate pathways and mark hazards.
- Pedestrians will not go out of their way. Make alternate pathways reasonable.

Bicycle Control

Bicycles have a legal right of access to most highway facilities and provisions for their safe conduct through work zones are necessary.

Provide and sign an appropriate alternate route when maintenance activities close a designated (signed) bicycle path or shoulder bikeway. Where horizontal separation for bicycles and pedestrians existed prior to work, give consideration to separating during work.

When laying out alternative bicycle paths, make sure no overhead obstructions present a direct hazard to normal bicycle operation.

Safety

The safety and welfare of WSDOT employees is paramount. Injuries are costly in terms of both human suffering and economics. For these reasons, WSDOT initiated the employee safety program over 50 years ago.

Guidelines for maintenance employee safety are contained in the Department's safety manual. Any questions about safety concerns can and should be raised to the employee's supervisor or the regional safety officer. Accidents involving equipment, falls, and other trauma injuries are a major part of worker safety. As the materials and chemicals used in maintenance become more complex, then the risks to employees also increase. Employees must be trained to know the rules, policies and practices intended to promote a safe work environment.

Safety pays dividends on all jobs. A positive attitude toward safety will not only help to protect the employee from injury, but will also lead to continued job satisfaction. Every employee needs to develop the habit of thinking safety before and during the work to be done.

Work Zone Operations

Maintenance operations require employees to be on the alert to protect themselves, fellow crew members and the traveling public. Performing jobs safely is a priority and an integral part of maintenance operations. The fundamental guide for all staff in the control of maintenance work zones is Part VI of the "Manual on Uniform Traffic Control Devices" (MUTCD).

Work zone safety has two aspects that are sometimes not kept in balance. One is when there is too much pressure for production efficiency. The other is when there is too much fear of liability resulting from a traffic accident. Each maintenance employee, as well as each motorist, is entitled to have a work or traffic environment which is reasonably safe. Every effort must be made

to ensure that the most effective traffic control strategy is implemented. This strategy must address the needs and requirements of both the workers and drivers. The development and implementation of a comprehensive traffic control strategy will satisfy the concerns of production and potential liability while providing an effective and safe work zone.

Maintenance employees may have innovative ideas that will create improved flow of traffic through a work zone or better protection of the workers. Make sure to get formal approval from the Regional Traffic Engineer to test and evaluate the idea in the field if it is a deviation from the Maintenance Manual or MUTCD. This will limit WSDOT's liability if a motor vehicle accident occurs during the testing.

Enforcement

Maintenance supervisors should encourage law enforcement officers to patrol through work zones as frequently as possible. The presence of law enforcement near work zones increases safety and motorist compliance with traffic control regulations.

Contractual use of law enforcement in work zones is based on a combination of local knowledge, sound judgment, and the advice of the Regions' Traffic Engineering staff. Consider the type of work activity, complexity of the traffic control plan, possible speed reduction needs, traffic volumes, nighttime work activity, geometric conditions, associated cost for use of enforcement (cost benefit analysis), and actual traffic problems observed as the work progresses.

Refer to Instructional Letter IL 4008.00 for specific guidance on the use of WSP traffic control assistance.

An agreement GCA 5080, between WSDOT and WSP exists to keep the payment process consistent statewide. Maintenance offices charge enforcement work to the particular work order number for the control section where the work is done. Contact the Region Traffic Office for assistance with WSP traffic control assistance.

Resources for Traffic Control and Work Zone Safety

The following information may provide additional guidance and more specific detail. This list includes manuals, reference documents and staff mentioned throughout this chapter.

- *Work Zone Traffic Control Guidelines* M 54-44 (required for each crew)
- MUTCD Part VI (required for each crew)
- *Traffic Manual*, Chapter 5, M 51-02
- Work Zone Safety Task Force Recommendations
- Quality Guidelines for Temporary Work Zone Traffic Control Devices (ATSSA)

- Work Zone Traffic Control Supervisors Notebook
- Planning and Scheduling Work Zone Traffic Control (FHWA IP-81-6)
- IL 4008.00 WSP Traffic Control Assistance
- Directive D 55-20, Reduced Speed in Maintenance and Construction Work Zones
- Region Maintenance or Traffic Office and Public Information Officer (Traffic Engineer or Traffic Control Specialist)
- HQ M&O Traffic Office, State Traffic Control Engineer

General

The roadway is the paved or otherwise improved portion of a public highway ordinarily used for vehicular travel. The roadway surface is normally classified as rigid (consisting of Portland Cement Concrete) or flexible (consisting of asphaltic materials).

A smooth surface with good skid resistance, free of alligator cracks, pumping, pushing, wheel rutting, raveling, frost heaving, and pot holing, is desirable for safe travel by the people we serve.

Maintenance of the state's roadways must include a program to preserve these characteristics. Ideally, the maintenance of pavement should be accomplished with minimum expense and with the least possible traffic disruption. Maintenance of pavements is a necessary investment made to protect the pavement from costly renovation or reconstruction.

Preventive maintenance is much more cost effective than performing major repairs. Area maintenance staff are required to inspect each section of highway at least once a year to detect and schedule deficiency repairs prior to their becoming a major problem.

A biennial appropriation corresponding with a specific, (LOS) Level of Service for roadway maintenance and operations activities is provided by the Washington State Legislature. The maintenance area's roadway surface program should be managed to meet these LOS commitments. In doing so, it is essential that each Area work with its Program Management, Design and Construction offices to ensure that the work being planned is coordinated with the work that these offices are planning and/or constructing.

It is advised that written recommendations for pavement repairs be submitted to the Regional Maintenance Engineer. The Regional Maintenance Engineer then shares the region wide roadway surface maintenance program with the Regional Construction Engineer. This allows better coordination between the maintenance and construction programs.

Pay special attention to the drainage of roadway sections when planning maintenance activities. Poor drainage can lead to premature aging of the roadway surface and sub-grade.

Work zone safety and traffic control are extremely important. Maintenance employees are required to know and closely follow the chapter in this manual on traffic control and safety.

Maintenance of Flexible Pavements

Flexible pavements generally are referred to as asphaltic concrete pavement (ACP) or bituminous surface treatment (BST). Flexible pavements develop strength from the tight interlocking of crushed rocks with an asphalt material binding them together. This mixture deflects when loaded by traffic and exerts pressure on the subgrade. Consequently, both the pavement and the subgrade must be in good condition to avoid maintenance problems.

Load & Speed Restrictions

If the subgrade temporarily lacks strength to carry heavy loads due to excess moisture and/or thawing, any class of vehicles can be restricted by weight and/or speed. Maintenance staff must monitor the roadway condition during threatening weather conditions. Take action according to directive D 54-43 (MR), Emergency Restrictions for Roads, before the subgrade becomes saturated and soft. This will avoid unnecessary stress which can lead to permanent damage.

Restrictions should be no more severe or of longer duration than necessary to protect the roadway. Consider the economic effect to the users. The damage caused by failure to place restrictions on soft roadways can have a severe effect on a maintenance budget and their ability to meet LOS targets.

Pavement Deficiencies

Damage and deterioration of pavements will become apparent in a variety of ways. A number of factors can contribute to the appearance of pavement deficiencies. For example, an overlay with excess asphalt or poorly graded or inadequately fractured paving material may not have adequate particle interlock; thus pushing, rutting, & humps may develop. Poor subgrade drainage, heavy tonnage, and accelerating or decelerating traffic are all potential sources of surface irregularities. Pavement deficiencies are explained in more detail as follows:

Rutting

Rutting is a surface depression within the wheel path and is a result of permanent deformation of the pavement or subgrade. This condition is normally caused by heavy loads on roads lacking sufficient strength to support the loading. In some cases, rutting can also be caused by studded tire use. Wheel ruts, if not repaired, can trap water and cause hydroplaning.

Alligator Cracking

The condition known as alligator cracking is attained when discontinuous longitudinal cracks begin to interconnect to form a series of small polygons that resemble an alligator's skin. This distress is usually caused by poor drainage, poor mix design, or subgrade failure.

Ideally the surface should be treated with a seal coat or overlaid with suitable material before water has an opportunity to penetrate the surface and lead to alligator cracking. If it is neglected and alligator cracks appear, heavy traffic can push the surfacing rock into the wet soil beneath it. This forces mud up through the asphalt surface (pumping) causing permanent damage that can not be repaired by a seal or overlay. Spots where severe pumping has occurred will often need to be dug out, and the base rock, surfacing rock, and asphalt replaced.

Longitudinal Cracking

A longitudinal crack follows a course approximately parallel to the centerline. These are typically resultant of natural causes or traffic loading.

Transverse Cracking

Transverse cracks run roughly perpendicular to the roadway centerline. They may be due to surface shrinkage caused by low temperatures, hardening of the asphalt, or cracks in underlying pavement layers such as PCCP slabs. They may extend partially or fully across the roadway.

Potholes

Potholes are voids in the roadway surface where pieces of the pavement have become dislodged. Areas in which many potholes occur become suspect for fundamental problems such as inadequate drainage, pavement strength, or base/subgrade problems. Single or infrequent potholes may be the only pavement distress to occur in an area, and beyond the treatment of the individual pothole no other pavement repair work may be required.

The location of potholes which receive a temporary fix should be documented so they are addressed as part of the Area's annual permanent fix program. The number of potholes that appear in the wet or winter seasons is often an indicator of the effectiveness of the permanent fix program.

Raveling & Pitting

Raveling and pitting distresses are characterized by the loss or dislodgment of surface aggregate particles. Oxidized asphalt binder is often the cause of raveling and pitting. It could also be caused by poor compaction, letting the mix get cold when paving, dirty aggregate, not enough asphalt in the mix, overheating the mix during manufacture, or aging.

Routine maintenance repairs are made to raveled or pitted surfaces is made as soon as conditions permit and/or materials are available. The most important consideration in scheduling repair of raveled or pitted areas is to perform the repairs before a more serious condition develops, and prior to the onset of inclement weather.

Open grade pavements that allow water to drain through and out the side don't need to be sealed if they are properly constructed. But, pavement that is raveling must be sealed. Unsealed pavements will continue to ravel and will also age and harden at a much faster rate than normal. This condition may also encourage the loss or stripping of the asphalt within the pavement. Timely sealing can add significantly to the life of the pavement. Open grade pavements should be fog sealed on a schedule recommended by the Region Materials Engineer. Failure to do so can lead to premature failure of the open grade mat and lead to difficult maintenance problems.

Flushing

Flushing (or bleeding) is free asphalt on the surface of the pavement caused by, too many fines in the mix, too few voids, too much asphalt in patches, or a chip seal that has lost its rock. This type of distress often shows as a shiny, glass-like reflective surface. It is inherent to unstable mixes and often results in other roadway surface distresses if not corrected.

Removal and replacement of flushed or bleeding pavement areas is an expensive, but sometimes cost-effective method of repair. Thin overlays of flushed or bleeding areas will frequently have the "fat spot" show through in hot weather and exhibit the same characteristics as in the "before" condition. If repairs are not possible prior to a seasonally wet period, contact the Regional Traffic Engineer to evaluate the need for posting "Slippery When Wet" signs.

Sags and Humps

Sags and humps are localized depressions or elevated areas of the pavement that result from settlement, pavement shoving, displacement due to subgrade swelling, or displacement due to tree roots. The deficiency usually occurs in isolated areas of the roadway surface.

Edge Raveling

Edge raveling occurs when the pavement edge breaks and is most commonly found on those roadways that were constructed without curbs or paved shoulders.

Pavement Maintenance Techniques

Patching

All flexible pavements require patching at some time during their service life. Surface patching should be performed to a standard commensurate with resource availability and the objective of retaining a smooth ride as long as possible. Since patching materials are one of the larger material costs a high quality patch is one of the most cost effective means of utilizing available resources.

There are two principal methods of repairing asphalt pavements:

1. Remove and replace the defective pavement and surfacing or base material.
2. Cover the defective area with an overlay of a suitable material to renew the surface, seal the defective area, and stabilize the affected pavement.

These repairs can be called 'dig-outs' or 'overlays' according to the method used.

Patching with Base Repair

'Dig-out patches' are used for making permanent repairs to the pavement. Defective pavement and unstable surfacing materials are removed down to a stable base. This may mean removal of some of the subgrade material. The excavated area should extend into the good pavement around the defective area by about 12 inches. Cut the edges of the patch area vertically and in straight lines to provide a good line for compaction later. A pavement saw makes a good tool for a fast, neat cut in pavement patching.

After the cut is made and the defective pavement and/or base material is removed, level and compact the base material. This will make an adequate foundation for the new asphalt concrete material. Surfacing materials (gravel base, crushed surfacing) and pavement must always be replaced in depths at least equal to the original design or by additional depth of ACP compacted in lifts of (1) to (3) inches. Apply a tack coat of asphalt to the vertical sides of the hole to assure a good bond and seal between old and new pavements.

For best results in a patch of this nature, back fill the hole with a hot plant-mix material such as Asphalt Concrete Class B. The asphalt should be compacted in lifts of no more than 3 inches thick to obtain optimum patch life. Small patch projects can be compacted with a vibrating plate compactor, while a roller works best on large patches. During hot weather it might be advantageous having some water on hand to help cool the mix between lifts. Standing water should not be allowed on the mix between lifts.

After the intermediate lifts of the patch have been compacted sufficiently, the surface lift can be completed. Take special care to ensure that it is compacted to be even and flush with the surrounding surface, so it provides a good riding surface. Some compaction will occur by traffic as the mix is further kneaded into place. The patch should be cool enough before traffic is allowed on it, so it will not leave marks in the surface. Deeper patches will require more time to cool and must be planned for accordingly.

Potholes and localized failures should be repaired as soon as possible after they are reported. Asphalt pre-mix (cold mix) should be available throughout the year so any potholes that appear can be patched immediately. Fiber reinforced, and other specialized ‘winter mix’ have been found to be effective in many locations. Many times the use of a propane torch to dry the holes and heat the mix for good compaction is time well spent.

The use of an asphalt ‘tack’ is highly recommended. A higher success rate is normally achieved when they are squared up and tack is added to the edge of the pothole. If the lack of availability or storage of standard tack is a problem, try using one of the cold pour crack pouring materials. They are available in (5) gallon buckets with a pour spout. Many pothole patching crews use this as standard procedure.

Don’t use sand, clay, or other temporary patching material to patch or “pad” potholes or frost boils. On today’s roads these methods usually cost more in the long run and often leave unsafe conditions for the traveling public. Asphalt pre-mix is the preferred method, even if it has to be replaced when final repairs are made.

For permanent pothole patching proceed as follows:

- Remove the defective material down to a stable base
- Square off the edge of the hole vertically
- Dry the hole as much as possible (fiber reinforced mix often does well in wet holes).
- Tack the hole if possible
- Place and compact the mix

Compaction is very important in making the repair permanent (heat applied to the mix is very beneficial to good compaction). If traffic is picking the fresh mix out of the hole try dusting the finished patch with some roadside dirt. Spend a little more time patching the pothole the first time. This will often keep you from returning to patch the same hole repeatedly. Permanent repairs are normally made with hot mix if available.

Overlay Patches

Overlay patches are generally applied when an area is too large to be economically repaired by hand with a small crew. The overlay patch, with hot plant-mix asphalt, also has the advantage of setting quickly. It does, however, commit a considerable investment in labor, equipment, and materials.

Typically, overlay patches are applied in areas of pavement failure or wear problems rather than areas with a base or subgrade problem. Ruts, raveling, pitting, minor cracking, and oxidation are typical failures where overlay can be effective in quickly and permanently restoring the surface. When addressing pavement rutting, mix should be placed in lifts when patching rutted areas in order to get uniform compaction. This method of compaction will help prevent the rut from reflecting into the finished patch. To obtain proper compaction in the wheel ruts, a rubber tired roller should be used. Steel wheel rollers will bridge the rut and very little compaction will occur. After the ruts are filled and if it is decided to overlay the entire lane then a steel wheel roller would be used for compaction.

Application of any overlay patch requires a considerable degree of skill, coordination, and planning. All loose, broken asphalt should be removed and replaced, Any deep ruts, depressions, or humps should be repaired or pre-leveled in advance of the overlay so that the overlay may proceed efficiently. It is necessary to repair these areas prior to the overlay in order to provide an even platform for the new pavement. This is essential to proper compaction and consequently to pavement life. If, for instance, wheel path ruts are overlaid without pre leveling, the ruts will not get the same compaction from rolling that the thinner high spots will. Then traffic wheel loads will eventually compact the deeper new sections, causing ruts to reappear. All areas should be tacked before patching to ensure a good bond and minimize raveling in thin areas. The tack rate should be 0.4 to 1.4 gallon per square yard of applied tack (0.2 to 0.8 residual).

Be careful when repairing the roadway surface in an area of unpaved shoulders. Widening over thin gravel or dirt shoulders will usually lead to cracking and failure. This is because of the lack of sufficient top course material. If there is the need to

widen the paved roadway, make sure the shoulder is prepared properly to support the anticipated loading.

Spreader Box Patching

On small paving jobs it is often convenient and economical to use a tow-behind paver, or spreader box. These pavers hook to the rear of the trucks that are hauling the mix. The asphalt is dumped directly in the hopper of the paver which places it on the roadway or base material.

As the towing vehicle moves ahead, the mix is struck off by an adjustable height blade (cutter bar or screed) and is surface-finished by the screed. Starting the paving at full depth requires setting the screed on blocks before filling the hopper. The hopper should be kept uniformly full during paving to ensure an even spread. An even towing speed is necessary to maintain a uniform spread thickness.

Spreader boxes vary greatly in size, operating controls, accessories, and capabilities. Working with them requires skill and experience. Manufacturers and construction equipment dealers can provide assistance in the operation and care of particular models.

Clean-up of equipment and tools after each day's operation is essential to good patches. This is especially true of the spreader box. It must be kept free from the accumulation of cold asphalt. Diesel is generally the most common and effective release agent used for cleaning tools and equipment. However, the diesel-asphalt waste mixture must be captured (i.e. not allowed to spill on the ground) and placed into (55) gallon containers for disposal as a "Dangerous Waste". A "Dangerous Waste" label should be placed on the waste container and the date entered as to when the accumulation began.

Spreader box patching with hot plant-mix material has the advantage of providing a smooth finished surface, when the equipment is properly operated. Several people are required to operate a spreader box efficiently. Careful planning of the patching operation is very important to economical and cost-effective pavement maintenance. The spreader boxes can work well if surface irregularities are pre-leveled with equipment appropriate for the conditions. The entire surface should be tacked, both before pre leveling and before starting the spreader box patch.

Rolling of the hot plant-mix should begin immediately after placement of the mix. If the mix is allowed to cool below 185 degrees before rolling, adequate compaction will not be possible.

Grader Patching

Road graders are a useful pavement patching tool. These graders vary in size, model, and capabilities depending on their intended use.

One efficient way of blade patching is using two graders facing each other. This method is quicker than the single blade method, and can help in getting the patch laid before the mix gets cold. It helps keep coarse mix away from the ends of the patches, making smoother approaches, and helps keep a straighter edge. Also, a two grader operation offers a good opportunity to train inexperienced grader operators.

Hot plant-mix patching with graders is frequently accomplished when it is not practical or economical to use other means. Graders are especially valuable for leveling to eliminate sharp depressions or sags and to lay a leveling course of pavement prior to placing finish courses with asphalt spreader boxes. They are excellent to place a leveling course to restore the roadway grade and shape when it cannot be done with a paver or spreader box. All of the area to be blade patched should be tacked. Road graders with a long wheel base and smooth-tread tires are often used for spreading hot plant-mix asphalt in leveling operations. The roller must follow the grader immediately after the mix is spread while it is still hot.

Graders are not efficient at carrying large quantities of material over long distances, so the dumping of asphalt should be carefully controlled for an efficient operation. A dump person should be utilized. Make as few passes as possible with the grader to reduce segregation of the material.

Rolling Hot Mix Patches

It is always desirable to use the most effective tools for the job at hand, including asphalt work. The use of a finish lute person on the patching crew is highly desirable. The quality and ride of the patch is often much better due to their expertise. If short handed, consider borrowing people from an adjacent section so you can provide a quality product. Since patching is one of the most expensive operations to perform, it is essential to develop work schedules that ensure the following are present: desirable weather conditions, adequate staffing and proper equipment.

A ten ton or larger steel-wheeled roller is valuable to an efficient asphalt patching operation. A lighter vibratory roller is a poor substitute, as it can slow the operation considerably. On larger paving projects, one roller may be used to do the breakdown rolling or initial compaction, with another used for the finish rolling.

The patching operation should match the speed of the roller. If the patching crew outpaces the roller, it forces the rolling of mix that is to cold and a poorer quality patch can result. If the operation needs to move faster and the roller can't keep up, use a larger roller or a second roller. Do not compact hot mix asphalt concrete at a temperature below 185 degrees F. Rolling mix that is too cold can cause it to crack. Rolling mix that is too hot can cause pushing. The maximum temperature of mix from the plant is 350 degrees.

Compaction is among the most important phases of the operation. All asphalt concrete patches, small or large, must be compacted to consolidate the material. The properly compacted asphalt patch will be tough and dense and will stand up to the wear of traffic and weather much better than if compaction is inadequate. However you compact the mix, do it well; it is very important.

Rolling for compaction should begin as soon as the paving material is laid. The initial rolling or "breakdown" gives the highest percentage of compaction of any rolling phase. Consequently, it also offers the most potential for material displacement at the edges. It is important to make the initial breakdown pass at least 4 inches away from the edges of the mat. A subsequent pass will level this edge.

Avoid stopping the roller or reversing direction on the hot mat. Do not turn on the mat while moving. This can affect the ride of the patch.

Intermediate rolling further compacts and seals the surface. Finish rolling removes any roller marks and other blemishes left by prior rolling.

Various roller types are used in asphalt compaction. Steel-wheeled, vibratory, and pneumatic tired are the types most commonly available. Steel wheeled and vibratory rollers are used for all three phases of asphalt rolling. Vibratory rollers should not be operated on thin lifts and so are not generally used in maintenance patching operations. Rubber-tired rollers are not normally used in maintenance operations.

All rollers used in asphalt paving or patching operations should be:

- In good operating condition.
- Used according to the manufacturer's recommendations.
- Capable of reversing direction without backlash.
- Able to operate at speeds low enough to avoid displacement of the hot asphalt.

Do not use rollers producing pickup, washboard, uneven compaction, or otherwise undesirable effects. Vibratory rollers under vibration should not exceed (3) mph. Steel-wheeled rollers should be limited to (4) mph and pneumatic tired rollers to (5) mph maximum. The drive wheel of the roller should always be pulling the roller to prevent displacement and pushing of the material. This is particularly important on steeper grades and in breakdown rolling passes.

Effects of Traffic on a Patching Operation

Timing is critical while doing hot asphalt mix patching. Cold asphalt mix yields inferior patches. Flaggers must avoid delaying asphalt trucks and paving equipment while hot mix patching. Don't let traffic drive on any unrolled mix. A finished patch should be cool enough to hold your hand on before traffic is allowed to drive normal speeds on it. A pilot car offers a big advantage for multiple patches over an extended section of roadway. The use of a third flagger to keep traffic off the

unfinished mix and away from the equipment is desirable. Traffic striping that is blacked out or covered should be remarked the same day for safety reasons.

Crack Sealing (or Pouring)

There are significant costs involved in filling cracks, both for materials and labor, the supervisor needs to be aware of the nature, extent, and severity of the cracking problem and also of the next scheduled contract for resurfacing. Filling cracks in an area scheduled for immediate reconstruction or resurfacing by contract is not recommended unless it is a part of the overall project. Minor repair and crack sealing is often part of the contractor's responsibility. However, sealing minor cracking may extend the useful pavement life for several years when an overlay project is not scheduled.

Generally, alligatoring or more general cracking can be repaired most cheaply by chip seals. Serious cracking and settlement of the pavement may indicate the need for excavation to repair the subgrade before patching can be successful.

The main purpose of crack pouring is to prevent water from entering the subgrade and causing damage. There are two widely used types of crack pouring material in highway maintenance, hot pour and cold pour. The two types use different techniques and equipment. The purpose of the two is the same, to minimize water entry and resulting damage.

Over-poured cracks can be a safety hazard to motorcycles. Overband (over-poured) crack pouring, especially on longitudinal cracks, can cause loss of control for motorcycles. The problem is compounded on curves or when the surface is wet. Cracks that are not over filled do not seem to cause a problem. Areas that have excessive crack pouring material from past practices should be addressed.

Hot Pour Method

This method utilizes blocks of crack pour material heated in specialized crack pouring machines. The most common type in maintenance are trailer mounted, oil jacketed units. This method is often used by contractors and maintenance crack sealing distressed areas that are not going to be removed and repaired prior to an overlay. It is a common method of sealing the joint between the edge of a PCC road surface and the asphalt shoulder. It works well for large volume work involving large cracks. Often the cracks are routed out first. If not, they should be cleaned and dried with compressed air prior to pouring. Filling cracks with this method requires a large crew and specialized equipment.

Safety is a big concern in a hot crack pour operation. This material is extremely hot and can cause severe burns when loading the machine or applying the material.

Cold Pour Method

This method utilizes cold applied liquid material and does not require specialized equipment. This type of material is available in five gallon to fifty gallon

containers. It can be sanded lightly after application and opened to traffic. One person can apply it using the spout on the five gallon bucket it comes in.

Experience has shown that for maintenance purposes cold pour seems to prevent water entry into the subgrade as well as hot pour material. It also resists build up on bumps better than the hot material does.

Cold pour is excellent as tack for small asphalt patches and pothole repairs. It greatly simplifies the problems of tack storage, transporting, and application. A sealed five gallon bucket can be carried easily by a pothole patching crew.

This material works well for hand pouring the cracks around an isolated bridge drain or catch basin if a piece of foam 'backer rod' is poked down into the crack before pouring to serve as a bottom for the material. It can also be poured against rubber expansion joints without melting the rubber joint.

Maintenance of Rigid Pavements

Rigid pavements are generally referred to as Portland Cement Concrete Pavement (PCC). PCC pavements should be patched with Portland Cement Concrete or one of the WSDOT approved patching materials. Prepare and apply patching materials according to the manufacturer instructions. If recommended by the patching material manufacturer, use a bonding agent.

The PCC surface to be repaired should have all loose material removed down to solid material or to full depth if necessary. A jackhammer or similar equipment may be necessary to remove some of the material in the area to be patched. The area to be repaired needs to be squared by concrete sawing, then sand blasted, cleaned and dried.

Delamination occurs when a thin layer of surface concrete has lost bond with the underlying concrete. The area around the patch should be checked for delamination. Tapping on the surface with a hammer and listening for a hollow sound is one way to find the delaminated areas.

If reinforcing steel is encountered, remove or neutralize all rust. Coat exposed reinforcing steel with a WSDOT approved product to prevent rust from reoccurring. Then proceed with patching the area.

Traffic should be kept off the new patch as specified by the manufacturer, until it gains sufficient strength to support traffic.

Portland Cement Concrete Pavement Crack Pouring

Joints in Portland Cement Concrete Pavements (PCC) compensate for thermal movements of the pavement and provide load transfers between slabs. Properly sealed joints in concrete pavements prevent water from entering into and weakening the underlying base and subgrade materials. Properly sealed joints

also prevent incompressible materials such as dirt and gravel from penetrating into joints, which then restricts thermal joint movements. Materials that restrict the natural expansion of the pavement joints can cause diagonal slab cracking, slab blowups, or tipping and spalling.

PCC joints and cracks should be checked before the wet season to make sure they are sealed to prevent entry of damaging water.

Even fine cracks in steel reinforced slabs can be serious. They can allow water or chlorides to reach the steel causing corrosion and serious damage.

PCC crack pouring is most effective when the pavement is cold and has contracted and opened the cracks. Don't pour cracks when the pavement temperature is below 45 degrees. Always use WSDOT approved crack sealant material.

Cracks must be routed out before pouring. If not, they should be cleaned and dried with compressed air prior to pouring. Foam backer rod can be used in larger cracks to keep the sealant in the top (1) inch of the crack.

Safety is a big concern in a hot pour operation. This material is extremely hot and can cause severe burns when loading the machine or applying the material.

ASPHALT CONCRETE PAVING QUANTITIES (TONS/100 LIN FT)

WIDTH (FT)	DEPTH OF MIX (COMPACTED)					
	1"	**2"**	**3"**	**4"**	**5"**	**6"**
2	1.2	2.4	3.6	4.8	6	7.6
4	2.5	5	7.5	10	15	15.2
6	3.8	7.6	11.4	15.2	19	22.8
8	5	10.1	15	20	25	30.4
10	6.3	12.6	18.9	25.2	31.5	38
11	7	14	21	28	35	42
12	7.6	15.2	22.8	30.4	38	45.6
16	10.1	20.2	30.4	40.6	50.7	60.8
18	11.4	22.8	34.2	45.6	57	68.4
20	12.4	25.2	37.2	49.6	62	76
22	14	28	41.8	56	70	83.7
24	15.2	30.4	45.7	60.8	76	91.3

MIX QUANTITIES IN PATCHES

MIX CLASS	SIZE	
CLASS A	5/8”-0”	higher grade mix, more fractured rock, has good strength
CLASS B	5/8”-0”	standard mix in many areas
CLASS D	3/8”-0”	open grade mix, used in thin overlays, can ravel bad as it ages
CLASS E	1 1/4”-0”	coarse mix
CLASS F	5/8”-0”	lower grade mix, less fracture, more round rock, contains more fines & has less strength
CLASS G	3/8”-0”	fine mix, good for wheel ruts & skin patches
ASPHALT TREATED BASE MIX	2”-0”	specs allow down to 1/2” maximum size rock

CLASSES OF ASPHALT CONCRETE PAVEMENT (ACP)

Sources for Additional Pavement Maintenance Information

Asphalt Institute publications:

MS-4 The Asphalt Handbook
MS-5 Introduction to Asphalt
MS-8 Asphalt Paving Manual
MS-14 Asphalt cold-Mix Manual
MS-15 Drainage of Asphalt Pavement Structures
MS-16 Asphalt in Pavement Maintenance
MS-17 Asphalt Overlays for Highway and Street Rehabilitation
MS-19 Basic Asphalt Emulsion Manual

WSDOT Publications:

Standard Specifications for Road, Bridge, and Municipal Construction (M 41-10)
Construction Manual (M 41-01)
Design Manual (M 22-01)

Asphalt Emulsion Surface Treatment

Preventive maintenance programs started early in life of a pavement (1-3 years) provide the protection needed to greatly improve service life. For aged pavements, surface treatments can delay the costs of major reconstruction. Asphalt emulsion surface treatments are excellent for preventing the development of early pavement damage or distress. The surface treatment seals the pavement, retards the aging process and prevents the old pavement from further hardening. One method of sealing minor cracks and providing a renewed roadway surface is called Bituminous Surface Treatment (BST). BST is used to seal small cracks, repair a dry raveling surface and provide a skid resistant surface.

Fog Seals

In instances of a pavement with very minor raveling, a fog seal may adequately seal the pavement and prevent further raveling. Fog Seals are very light applications of diluted, quick breaking asphalt emulsions. Some of the asphalt materials used for fog seals are: CSS-1 and STE-1 which are cationic (positively charged) emulsions, while HFE-100S-50% diluted is an Anionic (negatively charged) emulsion. These products may require cover material (1/4 - 0) depending on the surface and application rate. The decision whether to use a cationic or anionic formulation should be based on knowledge of the charge of the existing materials used as part of the pavement. Understand that like charged materials repel each other and opposites attract. We want the materials to attract each other and make a tight bond. The Region or the Headquarters Materials Lab can assist in the determination.

Asphalt emulsions used for fog seals are usually diluted 50% with water or other types of cut-backs as prescribed by the manufacturer. The Fog Seals are applied at the rate of 0.1 to 0.2 gallons (of diluted material) per square yard, depending on the texture and porosity of the old pavement. The application rate will be determined by the amount of emulsion the old pavement surface can absorb without becoming slippery. Traffic control may be required for up to two hours, depending on location and volume of traffic.

Sand Seal

Where more raveling has occurred, a sand seal may be needed to adequately seal the surface and provide a quality surface. A sand seal is an application of liquid or emulsified asphalt covered with fine aggregate. It is used to seal against air and water infiltration, or improve skid resistance. Applications are 0.1 to 0.2 gallons of CRS-2 or CMS-2 per square yard covered with ten pounds of 3/8 minus aggregate. Some regions have found 1/4 minus to be better suited for sand seals.

Aggregate (Chip) Seal

If the raveling becomes more advanced, an aggregate or chip seal may be needed. In cases where raveling is allowed to progress to the point where the ride is affected, a thin overlay, or pre-leveling followed by a chip seal, might be needed. An aggregate seal is a single spray application, usually of a liquid or emulsified asphalt. Immediately following is a single layer of aggregate of as uniform a gradation (size) as practicable. This type of seal reduces the infiltration of air and water into the mat and may be used to improve skid resistance of slippery pavements.

Chip seals are useful and can be applied in many different ways: Full lane width, partial lane width, short longitudinal sections or for long sections.

A typical example of a BST uses application rates for CRS-2 or HFE-100S at .40 to .60 gallons/per square yard with 30 to 40 pounds of 5/8 - 1/4 Crushed Cover Stone per square yard. Look in the Standard Specification Manual, section 5-02, 9-02, and 9-03.4 for additional information on Bituminous Surface Treatment and materials.

Pavement Conditions for a Successful Project

Prior to sealing thoroughly, examine the roadway surface. Then decide what kind of repair is needed. A chip seal does not add to the structural integrity of pavement. Therefore, the existing pavement must be structurally sound in order to obtain a long performance life. Existing pavements may have to be repaired; patched, crack sealed and then allowed to cure before a chip seal can be applied. Always clean the existing roadway surface before starting the chip seal process.

Since chip seals follow the original profile of the pavement, they do not correct surface irregularities. Chip seals cannot be used on pavements with more than 3/8” to 9/16” of rutting. Aggregates in the ruts can not be fully compacted. Cleaning loose aggregate from the rut with a power broom will dislodge the aggregate from the non-rutted area. If the surface has light-to-moderate bleeding, the binder application rate should be reduced. Don’t use a chip seal on pavements with a high severity of bleeding.

Material Selection

Asphalts and Emulsions

The two general types of asphalt for seal coating are liquid asphalt and emulsified asphalt. Liquid asphalts are graded by viscosity. SC-Slow Cure-70, MC-Medium Cure-70, RC-Rapid Cure-70, have the lowest viscosity. SC, MC, RC 3000 have the highest viscosity. Liquid asphalts are also graded by the type of solvent used to thin them: SC with light oil, MC with kerosene, and RC with naphtha cutback. MC 3000, RC 3000, or RC 800 are the liquid asphalts used for chip sealing. Emulsified asphalts are manufactured by suspending asphalt particles in water with the aid of an emulsifying agent. Asphalts for Bituminous Surface Treatment are listed in the Standard Specification Manual. (9-02)

Common Types of Emulsions Used for Chip Seals

CRS-2 (Cationic Rapid Set Emulsion) is one of the most widely used emulsions. This emulsion will run into wheel ruts and down super elevated roadways if applied at rates above 0.4 gallons per square yard. CRS-2 provides a good seal on low volume highways.

HFRSP2/HFE-100S (Anionic Styrelf Polymer High Float Emulsion) is used for chip seals. It is a rapid setting emulsion that binds the chips very fast and can be used on high volume roads. This product should not bleed under high pavement temperatures.

Aggregate

Aggregate for bituminous surface treatment must conform to the requirements in the Standard Specifications Manual 9-03.4 for grading and quality. The material must meet the requirements for grading and quality when placed in hauling vehicles for delivery to the roadway. During manufacture and placement into a temporary stockpile the exact point of acceptance will be determined by the Engineer or Area Superintendent. The finished product shall be clean, uniform in quality, and free from wood, bark, roots, and other contaminants. Crushed screenings must be substantially free from adherent coatings.

Weather

The best time of year for a seal coat is when the weather is hot and dry during, and for some weeks after, treatment. Specifications require the air temperature in the shade to be at least 60 degrees Fahrenheit before work begins. No matter what the temperature of the asphalt when sprayed, it will cool to the temperature of the pavement surface in one minute. BST treatments should be placed between May 15th and August 15th for best results.

Never start a BST when the surface is wet or when it is threatening to rain. If the fresh seal gets wet, the combination of water, fresh seal coat, and traffic will result in loss of the cover aggregate.

Roadway Preparation

The surface should be thoroughly cleaned of all loose materials prior to application of asphalt. Sweep the roadway surface before starting the job. This allows the dust to be either flushed with water or blown off the roadway surface by traffic.

If patching is needed, allow time for the patch material to cure prior to sealing. Generally, two weeks should be allowed for hot mix to cure. Allow six weeks at temperatures of 50 degrees to 60 degrees Fahrenheit for cold mix to cure. To preserve the centerline location place flexible reflective markers prior to the seal. These can also be used to indicate the beginning and end of no passing zones. Flexible reflective markers have a removable cover so that they retain their reflectivity after the seal. They will also function as guidance for the striper truck.

Equipment

Before any work begins, examine all equipment to ensure it is in good working condition. Check spreader boxes or aggregate spreaders to see they are in proper working order. The roller operator should make sure that each tire on the roller is equally inflated to correct pressure and that controls for steering, starting, and stopping operate smoothly. All tires should be the same size and the water spray and scraper system must be checked to ensure material does not bond to the tires.

Distributor

New distributors use a ground speed control sensor and computer to regulate material application rates. Set the computer to the desired rate and the application will be correct even if the vehicle speed varies.

Older distributors are equipped with hydrostatic drive systems. The hydrostatic drive consists of a variable output pump driven by the truck power take off (P.T.O.). This in turn drives the distributor asphalt pump with a hydrostatic motor. Once the correct ratio between ground speed and pump flow rate is established for a given transmission setting, the truck ground speed may be varied without affecting the application rate. The operator needs a dry run to establish correct ratio between pump flow rate and ground speed.

Determine from the road computator (Slide Rule) the correct ground speed (F.P.M.) and pump flow rate (G.P.M.) for the desire spray bar length (FT.) and application rate (GAL/SQ.YD.). Follow the correct operation procedures set up in your distributor manual for calibration.

Calibration Procedures

Distributor Calibrations

Step 1

Calculate how much material is in the holding tank. The following methods work to calibrate an older distributor and calculate the application rate.

Method 1

Determine the number of gallons in the distributor. This can be done by several methods. The first and most accurate is to weigh the distributor before loading and after loading. Subtract the weights and divide by the pounds per gallon the emulsion weighs. This equals the total gallons.

Method 2

Find a level spot (the distributor tank must be level). Use a dip stick to dip the tank. Measure the number of inches covered with asphalt. After you know the size of the tank, you can calculate the number of gallons in the tank.

Method 3

Use the meter on the distributor tank. This is a good method for checking the above calculations but is **not recommended** for calibrating purposes.

Methods 1 and 2 are recommended for Measuring Distributor Tank (MDT) equipment prior to the start of the project.

Step 2

Apply asphalt to a known distance (minimum 200 feet) and established width.

Step 3

Determine the total square yards covered with emulsion. This can be done by doing the following calculation:

$$\frac{\text{Length Traveled (feet) x Width Covered (feet)}}{9} = \text{Square Yards}$$

Step 4

Determine the number of gallons remaining on the distributor. Again use Method 1 or Method 2 explained in Step 1.

Step 5

Subtract the total gallons on the distributor originally from the total gallons left on after applying asphalt. This will give the gallons used.

Step 6

Divide the total gallons used by the total square yards covered:

$$\frac{\text{Total Gallons}}{\text{Total Sq. Yd}} = \text{Gallons/Sq. Yd.}$$

Step 7

To check your application rate on the project, follow the same steps except use Method 3 outlined in Step 1 to determine the number of gallons on the distributor.

Nozzle Size

The spray bar and nozzles are an important part of the distributor. The proper quantity of asphalt must be spread uniformly on the road surface through the spray nozzles. To achieve good results, correctly sized nozzles must be selected for the job conditions. For example: if nozzles are too large for the desired application, pulsation of the spray may occur, resulting in uneven longitudinal spreading of the asphalt.

Each equipment manufacturer has specific recommendations for the size of spray nozzles to be used for different applications. Use the manufacturer's recommendation when choosing the correct nozzle size. All nozzles selected for use at any one time should have the same size opening.

Proper Pressure

The spray bar must have a constant, uniform pressure along its entire length for equal output from all nozzles. Be sure the spray bar and nozzles are CLEAN.

Although several methods are used to maintain pressure, distributors use gear-type pumps to deliver asphalt to the spray bar. Pressure is governed by variable pump speed on some distributors and by constant pump speed and a pressure relief valve on others. Each application should be checked, as recommended by the manufacturer.

The correct pump speed or pressure are critical to the proper application of the asphalt. Too low a pressure will result in a non-uniform discharge/streaking of material from the individual nozzles. Too high a pressure, in addition to atomizing the asphalt, will distort the spray fan.

When a metering system is used, the manufacturer supplies the distributor with charts for finding the proper pump speed for each application rate.

When a pressure relief valve is used, the pump runs at a constant speed and the pressure is automatically held in the spray bar. The manufacturer supplies charts for determining the discharge in gallons per minute for each size nozzle, the proper truck speeds for various application rates, and the corrections for temperature-viscosity variations.

GALLONS OF EMULSIFIED ASPHALT REQUIRED PER 100 LINEAR FEET: VARIOUS WIDTHS AND RATES

Gals. per Sq. Yd.	WIDTH—FEET														
	1	2	6	7	8	9	10	11	12	14	16	18	20	22	24
0.10	1.1	2.2	6.7	7.8	8.9	10.0	11.1	12.2	13.3	15.6	17.8	20.0	22.2	24.4	26.7
0.15	1.7	3.3	10.0	11.7	13.3	15.0	16.7	18.3	20.0	23.3	26.7	30.0	33.3	36.7	40.0
0.20	2.2	4.4	13.3	15.6	17.8	20.0	22.2	24.4	26.7	31.1	35.6	40.0	44.4	48.9	53.3
0.25	2.8	5.6	16.7	19.4	22.2	25.0	27.8	30.6	33.3	38.9	44.4	50.0	55.6	61.1	66.7
0.30	3.3	6.7	20.0	23.3	26.7	30.0	33.3	36.7	40.0	46.7	53.3	60.0	66.7	73.3	80.0
0.35	3.9	7.8	23.3	27.2	31.1	35.0	38.9	42.8	46.7	54.4	62.2	70.0	77.8	85.5	93.3
0.40	4.4	8.9	26.7	31.1	35.6	40.0	44.4	48.9	53.3	62.2	71.1	80.0	88.9	97.8	107.
0.45	5.0	10.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	70.0	80.0	90.0	100.	110.	120.
0.50	5.6	11.1	33.3	38.9	44.4	50.0	55.5	61.1	66.7	77.8	88.9	100.	111.	122.	133.
0.55	6.1	12.2	36.7	42.8	48.9	55.0	61.1	67.2	73.3	85.5	97.8	110.	122.	134.	147.
0.60	6.7	13.3	40.0	46.7	53.3	60.0	66.7	73.3	80.0	93.3	107.	120.	133.	147.	160.
0.65	7.2	14.4	43.3	50.6	57.8	65.0	72.2	79.4	86.7	101.	115.	130.	144.	159.	173.
0.70	7.8	15.6	46.7	54.4	62.2	70.0	77.8	85.5	93.3	109.	124.	140.	156.	171.	187.
0.75	8.3	16.7	50.0	58.3	66.7	75.0	83.3	91.7	100.	117.	133.	150.	167.	183.	200.
0.80	8.9	17.8	53.3	62.2	71.1	80.0	88.9	97.8	107.	124.	142.	160.	178.	196.	213.
0.85	9.4	18.9	56.7	66.1	75.5	85.0	94.4	104.	113.	132.	151.	170.	189.	208.	227.
0.90	10.0	20.0	60.0	70.0	80.0	90.0	100.	110.	120.	140.	160.	180.	200.	220.	240.
0.95	10.6	21.1	63.3	73.9	84.4	95.0	106.	116.	127.	148.	169.	190.	211.	232.	253.
1.00	11.1	22.2	66.7	77.8	88.9	100.	111.	122.	133.	156.	178.	200.	222.	244.	267.
1.10	12.2	24.4	73.3	85.5	97.8	110.	122.	134.	147.	171.	196.	220.	244.	269.	293.
1.20	13.3	26.7	80.0	93.3	107.	120.	133.	147.	160.	187.	213.	240.	267.	293.	320.
1.25	13.9	27.8	83.3	97.2	111.	125.	139.	153.	167.	194.	222.	250.	278.	306.	333.
1.30	14.4	28.9	86.7	101.	116.	130.	144.	159.	173.	202.	230.	260.	288.	318.	347.
1.40	15.6	31.1	93.3	109.	124.	140.	156.	171.	187.	218.	249.	280.	311.	342.	373.
1.50	16.7	33.3	100.	117.	133.	150.	167.	183.	200.	233.	267.	300.	333.	367.	400.
1.75	19.4	38.9	117.	136.	156.	175.	194.	214.	233.	272.	311.	350.	389.	427.	467.
2.00	22.2	44.4	133.	156.	178.	200.	222.	244.	267.	311.	356.	400.	444.	489.	533.
2.25	25.0	50.0	150.	175.	200.	225.	250.	275.	300.	350.	400.	450.	500.	550.	600.
2.50	27.8	55.6	167.	194.	222.	250.	278.	306.	333.	389.	444.	500.	556.	611.	667.
2.75	30.6	61.1	183.	214.	244.	275.	306.	336.	367.	428.	489.	550.	611.	672.	733.
3.00	33.3	66.7	200.	233.	267.	300.	333.	367.	400.	467.	533.	600.	667.	733.	800.

Note: *Formula used for calculation:* $Q = \frac{100W}{9} R = 11.11WR$

Where: *Q = Quantity of asphalt required, in gallons per 100 ft. (l/m)*
R = Rate of application in gallons per sq. yd. (l/m^2)
W = Width of application, in feet (m)

For metric conversion factors see pages 6-A&B *Metric formula for calculation: Q = LWR where L = length in metres.*

Spray Bar Height

The height of the spray bar above the pavement surface is probably the most important adjustment to assure uniformity of asphalt spread. Correct height must be maintained during the entire application. If the spray bar is too low or too high, streaking will result.

The preset height above the pavement surface should not vary more than 1/2-inch. The bar will not stay within this tolerance, however, unless the manufacturer or the contractor takes steps to ensure that it does. As the asphalt leaves the spray bar, the load lightens and the springs raise the distributor. If there is an appreciable amount of deflection in the springs, the spray bar can rise as much as 4 inches, resulting in an uneven application.

Excess vertical movement of the spray bar can be corrected in several ways. After the bar height is adjusted with a full load in the tank, the frame of the distributor can be tied down to the axle during the spreading runs. If it is a truck-mounted distributor and has an adjustable type spray bar, mechanical controls can be supplied by the manufacturer to maintain the proper height, regardless of the deflection in the springs. On trailer-mounted distributors, bar height control is not necessary because of the small deflection of trailer springs. In any event, the height of the bar should be checked after each run and any necessary adjustment made at that time.

Triple Coverage: This is where any point on the roadway surface will receive overlapping spray from the two adjoining nozzles.

4-Inch nozzle

Best results with 4-inch nozzle spacing will come from an exact triple coverage of the spray fans. A simple test procedure assures the proper height setting of a spray bar with 4-inch nozzle spacing. One can determine by visual inspection whether or not an exact single coverage of asphalt is being applied. To begin, the second and third, fifth and sixth, eighth and ninth, etc., nozzles are closed, using the center section of the bar only. The distributor is then operated at the correct pump speed/ pressure with the spray bar height changed not more than 1/2-inch at a time until the proper height is obtained. When an even single coverage of asphalt , heated to the proper spraying viscosity, is applied to the surface, it will give a uniform triple coverage with all nozzles operating.

6-inch nozzle

The height of bar necessary to give a triple coverage will frequently cause wind distortion of the spray fans, resulting in non-uniform application. A double coverage is therefore recommended for 6-inch nozzle spacing.

Double Coverage: This involves the same procedure as above except that every other nozzle is left open; the remaining ones are shut off. If the distributor has already been checked for double coverage, increasing the spray bar height by 50 percent will give triple coverage.

Proper Nozzle Angle

Adjust nozzle opening angles so the spray fans will not interfere with each other. The nozzle angle will vary according to the make of the distributor. The angle recommended by the Asphalt Institute, measured from the spray bar axis, is 15 degrees to 30 degrees.

Manufacturers furnish special wrenches for setting the angle of the nozzles. The use of these wrenches is recommended, as it is extremely difficult to obtain a uniform spread with visually set nozzles. All nozzles should be set at the same angle except for the cut-off nozzle. (end nozzle) Manufacturers make a nozzle with 1/2 spray pattern for this purpose.

At the time the angle of the nozzles is set, the edges of the nozzle openings should be inspected to see that they are not damaged. A nicked or otherwise damaged edge will produce a distorted fan of asphalt.

Streaking Will Occur:

- If the asphalt is too cold.
- When the viscosity of the asphalt is too high.
- If the snivies are not at the same angle.
- When the bar is too high.
- When the bar is too low.
- When the bar pressure is too high it cuts furrows because the snivies are too small and/or there is too much pump pressure.
- When the bar varies in height from a full to an empty distributor, blocking or locking against the overload springs will reduce or eliminate this variance in height.
- When the bar is too long and/or the snivy openings are too large for the pump capacity, this results in narrow and fluttering fans. Smaller snivies and/or higher pump capacity will correct this.
- If the pump pressure is too low it will create narrower spray fans and fluttering.
- If the distributor tank is allowed to run completely empty, an irregular pattern of misses and fluttering will occur across the bar. For this reason, the shot should be terminated while approximately 100 gallons are left in the distributor.

Cleaning of Distributor

Cleaning of the distributor should take place in an area determined by its characteristics that are protective of the environment. For example: areas near waterways or with high seasonal water tables would not be necessarily suitable. These cleaning areas may require all fluids to flow through an oil water separator and all tank and bar cleaning agents to be barreled and labeled for disposal. No discharging or blowing your distributor bars in the ditch line, upon the right-of-ways or on private property is allowed, this could result in a serious violation.

Checking the Bitumeter

A bitumeter consists of a rubber-tired wheel, mounted on a retractable frame, with a cable leading to a circular dial in the cab of the vehicle. The dial registers the rate of travel in feet per minute and the total distance of each trip in feet. At least one manufacturer furnishes a dial that registers the application rate in gallons per square yard in addition to travel in feet per minute.

Check the bitumeter at regular intervals to ensure accurate registering of speeds when the distributor is spraying asphalt. To check the bitumeter, a distance of 500 feet to 1,000 feet is marked off accurately on a straight and level length of road. The distributor is driven at constant speed over this length and the trip is timed with a stopwatch. Then the speed in feet per minute is calculated and compared with the bitumeter dial reading recorded during the run. This procedure is repeated for a number of other speeds, bracketing the speed to be used for spraying.

Errors found at the various speeds are tabulated or plotted on a graph so they can be readily applied when using the distributor. The bitumeter when used must be kept clean to ensure accurate registering of the truck speed. A build-up of asphalt on the wheel will produce an error.

Traffic Control

Traffic control is important and must be maintained throughout the work area. High speed traffic over a fresh seal coat displaces aggregate, causing bleeding of asphalt. Traffic should be allowed only in the lane not being sealed. When work is completed, traffic speed should be maintained at less than 35 mph, or the legal speed if under 35 mph, until the asphalt sets. Warning signs, flag persons, and pilot cars are essential for traffic control. Route trucks hauling aggregate to the aggregate spreader in a direction opposite of the seal coat operation. This prevents loaded trucks being turned on freshly placed seal coat.

Some emulsions such as High Floats may require up to 24 hours of traffic control or until the first sweeping occurs. This is in areas of high volume traffic or areas where vehicle weight exceeds the normal load range.

Application of Asphalt

It is very important that the correct amount of asphalt be applied to the surface, as too much or too little asphalt will cause a slick roadway surface. If not enough asphalt is shot, the rock will ravel off leaving a surface rich in asphalt. If too much asphalt is shot, it will flush to the surface.

Many factors are used to determine the amount of asphalt to shoot, including the grade of asphalt, size of aggregate, condition of roadway surface, and traffic. After a rate of application is determined, a shot of asphalt should be put down, covered with aggregate, and rolled. A field check should be made by checking to see that the asphalt depth is approximately three-quarters of the way up on the firmly placed aggregate. Any adjustment needed should be made in the asphalt application rate at

this time. A field check should be performed periodically during the day to assure correct application rates are maintained throughout the entire project.

Rough and unsightly transverse joints can be avoided by starting and stopping the asphalt spread on building paper. The distributor, traveling at the correct speed for the desired application rate, starts spraying on the paper so that a full, uniform application of asphalt results when reaching the exposed surface. The use of smaller, more absorptive aggregate at the ends has been successfully used instead of paper.

A longitudinal joint is usually unavoidable because traffic lanes must be maintained. If possible, longitudinal joints should be made along the centerline or center of lane of the pavement and never in the wheel tracks. To prevent aggregate from building up on the longitudinal joint, the edge of the aggregate spread should coincide with the edge of the full thickness of applied asphalt. This allows a width where asphalt is present in partial thickness, due to outside nozzle spray, that can be overlapped when asphalt is applied in the adjacent lanes.

Spreading Aggregate

All aggregate required for the planned spread should be on hand before starting. It should be dampened if necessary, as described in the section on Material Selection. When the distributor moves forward to spray asphalt, the aggregate spreader should follow immediately behind it. The asphalt must be covered as soon as possible, otherwise the cooling of the asphalt will prevent good adhesion between asphalt and aggregate. It is important that the aggregate be spread uniformly and at the proper rate of one rock thickness. Marking the length that each truckload of aggregate should cover aids in controlling distribution.

Chip spreader Calibration

The following is a step-by-step procedure on how to calibrate your chip spreader and calculate the application rate.

1. Construct a one square yard shallow box or tarp, with shallow and narrow sides.
2. Place the box/tarp in the middle of the roadway a minimum of 50 feet in front of the chip spreader.
3. Get the chip spreader up to speed and apply chips over the top of the box/tarp.
4. Remove the box/tarp with the chips from the road.
5. Find an accurate materials scale. If in the field, the scale must be leveled and checked.
6. Place the chips from the box/tarp in a small bucket and weigh the bucket with the chips.
7. Empty the chips out and weigh the empty bucket.
8. Subtract the weight of the empty bucket from the weight of the bucket with the chips.

9. Since you had a one-square yard box/tarp, the weight from Step 8 is your pounds per square yard of chips.
10. Repeat the process at two to three gears and two to three RPM or speeds. You can then develop a chart.

NOTE: The aggregate weight may vary a couple of pounds if the chips are wet.

TONS OF AGGREGATE REQUIRED PER MILE FOR VARIOUS WIDTHS AND RATES

Spread Rate	Spread Width (in Feet)						
	8	9	10	12	16	18	20
lb/yd^2	Tons Per Mile	Tons Per Mile	Tons Per Mile	Tons Per Mile	Tons Per Mile	Tons Per Mile	Tons Per Mile
5	12	13	15	18	23	26	29
10	23	26	29	35	47	53	59
15	35	40	44	53	70	79	88
20	47	53	59	70	94	106	117
25	59	66	73	88	117	132	147
30	70	79	88	106	141	158	176
35	82	92	103	123	164	185	205
40	94	106	117	141	188	211	235
45	106	119	132	158	211	238	264
50	117	132	147	176	235	264	293
60	141	158	176	211	282	317	352
75	176	198	220	264	352	396	440
100	235	264	293	352	469	528	587
150	352	396	440	528	704	792	880
200	469	528	587	704	939	1056	1173
250	587	660	733	880	1173	1320	1467
300	704	792	880	1056	1408	1584	1760

To convert from	*to*	*Multiply by*
Feet	*metres*	*0.3048*
lb/yd^2	*kg/m^2*	*0.542492*
tons/mi	*Mg/km*	*0.563698*

Chip Spreader

Chip spreaders kick the aggregate backward or drop the aggregate straight down to reduce aggregate rollover and reduce the degree to which the aggregate picks up on vehicle tires after the section has been opened to traffic. The spreader is a variable width machine and calibrated on pounds per square yard. Dump trucks work in combination with the chip spreader to achieve a uniform application of aggregate.

Rolling

Rolling seats the aggregate in the asphalt and promotes the bond necessary to resist traffic stresses. Pneumatic tired rollers should be used on all seal coat jobs to give uniform ground pressure over the entire area to achieve proper embedment of the aggregate in the asphalt binder. Steel wheeled rollers tend to compact only high spots and can fracture soft aggregates.

Rolling should begin immediately after the aggregate has been distributed and should continue until the aggregate is properly seated in the binder. Rolling should begin at the outer edge of the treatment and proceed in a longitudinal direction, working toward the center of the road. Each trip should overlap the previous trip by about one-half the width of the front wheels. As soon as the asphalt has a definite set or hardening, rolling should be discontinued, to prevent the bond between the surface and aggregate from being broken by the roller.

Rollers should be operated at slow speeds (4 to 6 mph) to set the rock, not displace it. The number of rollers required for a seal coat project depends on the length of the operation. It takes two to four passes of the roller to set the rock. These rollers should have tire pressures of (45) psi or more.

Loose aggregate should be swept along the longitudinal joint and from the uncovered lane prior to application of asphalt. Brooming loose aggregate on a completed sealed surface should be done as soon as practicable, and during the cool part of the day, to minimize flying rock problems.

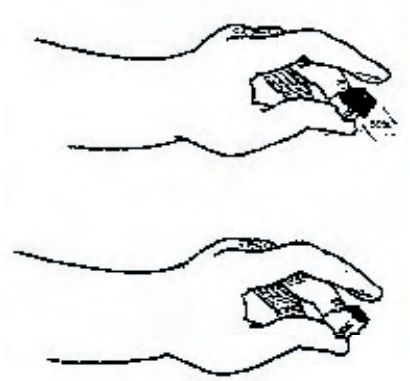
Relying on traffic to seat the aggregate has been successful, if speed is controlled, but using rollers gives better control and improves the chances for success.

Spreading of Fines or Choking - Optional

The need for applying fines will vary with the types of emulsions used and application rates. Those rates must be closely monitored. The most common material used for choking is 3/8” to #10 or 1/4” minus maintenance sand. In urban areas clean masonry sand can be used. Spreading these fines on a seal helps fill the voids, key the stone, reduces the chances of bleeding, and stops the squeezing and tracking of asphalt. The application of these fines prior to the roller, or after the roller depends on the types of emulsions used, and the location of the project. Fines application should not cover the coarse aggregate but merely fill the voids. The spreading of fines could be achieved by using a Hopper Sander with a mid mount spinner. This vehicle may be placed before or after the rollers depending on the type of operation.

Post-Seal Inspection

The embedment of the aggregate into the asphalt should be checked a day or so after the construction of the seal coat. Remove several of the largest stones and determine if the 50 percent to 70 percent embedment has been obtained.



If an inadequate application of asphalt was applied, a fog seal can enrich and tie down the seal rock. A diluted CSS-1 (usually 50/50) is applied at the rate of .1 to .2 gallons per square yard of the dilution. (Application can vary depending on pavement texture, local conditions, and traffic). No cover aggregate is required; however, if a tighter seal is desired, a sand or 1/4Ó-0 cover may follow. Traffic should be controlled until the CSS-1 has cured.

DOs of Seal Coating

- Do turn spray nozzles so that fans are at proper angle to spray bar, so sprays do not touch or merge.
- Do check bar height at start of each shot to determine ground-to-nozzle distance over entire bar length.
- Do check spraying pressure so as to give constant uniform spray. Pressure too high will cause spray to fog and distort, pressure too low will cause spray to sag with heavy edges and pronounced longitudinal streaking.
- Do heat asphalt to upper part of spraying temperature range to eliminate heavy edge that is characteristic of all fan type sprays.
- Do keep spray bars in proper working order by regular cleaning and inspecting of strainers. Clean spray bars after each day's operation.
- Do keep aggregate stockpiles clean and free of contaminates.
- Do clean out tank thoroughly when changing asphalts from emulsified to cutback asphalts or from cationic to anionic emulsions.
- Do keep equipment on the same side of the roadway that the sealing operation is on, so traffic flow is not impeded.
- Do cover shot as soon as possible and roll immediately to ensure a good bond.

DO NOTs of Seal Coating

- Do not use worn nozzles or ones that have mechanical imperfections.
- Do not heat asphalt material above maximum temperature range, which would cause spray patterns of the fans to be uneven.
- Do not use asphalts that are too cold. Material will be too viscous and cause narrow spray fan, and materials will not flow together.
- Do not try to seal a wet or dirty road surface.
- Do not try to seal coat if air or road surface is too cold. Don't seal when windy.
- Do not make shots too long before applying aggregate.
- Do not turn equipment on a fresh patch.

Blade Mixed Asphalt Mix

Blade mixing of asphalt cold mixes is an economical and versatile method of producing material for construction or repair of highway pavement. High production rates are possible with a comparatively low expenditure, and entirely satisfactory pavements can be achieved with blade mixed cold asphalt. However, proper attention must be devoted to ensuring uniform quantities of aggregates, uniform aggregate gradation, and correct, uniformly applied quantities of asphalt are combined into the final mix design.

A wide variety of aggregates ranging from well graded crushed rock to silty sands can be mixed satisfactorily by cold blade methods. The optimum results will be obtained by using a uniformly graded manufactured aggregate with a maximum particle size of 1/2 inch or less and not more than 10 percent passing the No. 200 sieve.

Emulsified or cutback asphalts may be used in the production of cold mixes. Up to 3 percent surface moisture may be required on aggregates for successful mixing with emulsified asphalts and subsequent compacting of the mixture. The surface moisture of aggregates should be as low as possible if cutback asphalts are used.

Well graded mixes are made using an asphalt with a fairly slow rate of curing such as MC, SC, SS, or CSS. Open graded mixes are made with a faster curing asphalt such as MC or CMS, or RC if it is to be spread and compacted immediately. Asphalt cold mixes which are to be made and placed into stockpile for future use are made with an MC or SC asphalt of 250 or 800 grade.

Prior to beginning the mixing operation, a permanent base pad must be prepared at the site upon which the cold mix will be made. The pad should be reasonably level, 3 to 4 feet wider than the distributor spray bar, and must be surfaced with compacted hot or cold asphalt mix. The length of the pad can vary depending upon conditions but should be approximately 400 feet if possible.

The cold mix is made in batches, the size of which will depend upon the capacity of the distributor and the desired asphalt content. For a uniform manufactured aggregate of 1/2 inch to 0 inch gradation, with a desired asphalt content of 5 percent

and using a 1,000 gallon distributor, the batch size will be approximately 60 cubic yards.

Using a truck and tail gate or chip spreader, a layer of aggregate the width of the distributor spray bar is uniformly spread upon the length of the base pad at a rate of approximately 50 pounds per square yard. Heated asphalt is then shot over the layer of aggregate at a rate calibrated to yield the desired asphalt content. The amount of asphalt required will depend on the gradation of the aggregate and will normally range from 4 to 7 percent by weight of the completed mix. Successive layers of aggregate and shots of asphalt are placed one on top of the other until the batch is completed.

Mixing is accomplished by turning and blending the mixture with a grader. If several batches are being produced for stockpiling and production is a factor, the mixing is more efficiently accomplished by using two blades working in opposite directions. Well graded mixes will require a relatively greater mixing effort to coat all of the particles evenly than will be required for open graded mixes. Mixing should continue until a thoroughly uniform mixture is produced. The completed mix is then windrowed and picked up by a front-end loader and placed into stockpile.

Stockpiled mixes made with MC or SC cutback asphalts should be allowed to cure out for a period of time before the mix is used. Cure time varies depending on weather conditions but will normally be approximately two weeks.

Handling Emulsified Asphalts

DO when heating emulsified asphalt agitate it to eliminate or reduce skin formation. Agitation also prevents the asphalt lying next to the heating chamber from becoming overheated and boiling.

DO protect pumps, valves, and lines from freezing in winter. Drain pumps or fill them with anti-freeze according to the manufacturer's recommendations.

DO blow out lines and leave plugs open when they are not in service.

DO use pumps with proper clearances for handling emulsified asphalt. Tightly fitting pumps can cause binding and seizing.

DO use a mild heating method to apply heat to the pump packing or casing to free a seized pump. Discourage the use of propane torches.

DO warm the pump to about 150 F (65 C) to ease start-up.

DO when a pump is to be out of service for even a short period of time, fill it with No. 1 fuel oil to ensure a free start-up.

DO before diluting grades of emulsified asphalt, check the compatibility of the water with the emulsion by testing in a flask.

DO if possible, use warm water for diluting and always add the water slowly to the emulsion (not the emulsion to the water).

DO avoid repeated pumping and recycling, if possible, as the viscosity may drop and air may become entrained, causing the emulsion to be unstable.

DO guard against mixing different classes, types and grades of emulsified asphalt in storage tanks, transports, and distributors. For example, if cationic and anionic emulsified asphalts are mixed, the blend will break and separate into water and coagulated asphalt that will be difficult to remove. Because it is hard to determine visually the difference between various emulsified asphalts, always make a trial blend of the newly-delivered emulsion and the stored emulsion before pumping off. Check the trial blend for compatibility.

DO place inlet pipes and return lines at the bottom of tanks to prevent foaming.

DO pump from the bottom of the tank to minimize contamination from skinning that may have formed.

DO remember that emulsions with the same grade designation can be very different chemically and in performance.

DO haul emulsion in truck transports with baffle plates to prevent sloshing.

DO mix by circulation, or otherwise emulsions that have been in prolonged storage may not be the proper consistency, as emulsions tend to separate when stored for extended periods.

DO NOT use tight-fitting pumps for pumping emulsified asphalt; they may “freeze”.

DO NOT apply severe heat to pump packing glands or pump casings. The pump may be damaged and the asphalt may become even harder.

DO NOT dilute rapid-setting grades of emulsified asphalt with water. Medium and slow setting grades may be diluted, but always add water slowly to the asphalt emulsion. Never add the asphalt emulsion to a tank of water when diluting.

DO NOT recirculate emulsified asphalts for too many cycles. They tend to lose viscosity when subjected to pumping. Also, air bubbles may become entrained which would render the emulsion unstable.

NOTE: Reprinted from Asphalt Institute’s/Asphalt Emulsion Manufacturers Associations: A Basic Asphalt Emulsion Manual. Please refer to this manual for additional information.

Chapter 4 Drainage

General

Water, either liquid or frozen, is the greatest natural destructive element that affects state highways.

Controlling water on the right of way requires a drainage system that effectively responds to the immediate environment. A typical highway drainage system includes ditches of all types, gutters, drains, culverts, storm sewers, and other miscellaneous drainage structures.

The system is designed and constructed to collect and remove water from the highway right of way. It must be properly maintained to:

- Permit the maximum use of the roadway
- Prevent damage to the highway structure
- Protect natural resources
- Protect abutting property from physical damage.

Maintain and preserve drainage facilities as nearly as possible in the condition and at the capacity for which they were originally designed and constructed. Inspect the entire drainage system at least twice a year and correct deficiencies. Additional inspections may be required during heavy storms and periods of high runoff in order to determine the effectiveness of the system. Observe and record high water marks. Look for conditions that threaten damage to the drainage facility or the highway. Maintenance personnel must be continually alert to assure that all natural water course channels crossing the right of way remain open.

Drainage from Abutting Properties

Storm water is the only effluent allowed to be discharged upon the highway right of way. State law "RCW 47.44" allows persons and entities who have been issued utility franchises or permits to encroach on or cross highway right of way to install and maintain the item for which the permit was granted.

Population growth, urban sprawl, and numerous new regulations restrict how maintenance crews can maintain surface and subsurface drainage systems. Regulations that may affect drainage maintenance:

- Endangered species act
- Storm water management
- Wetlands preservation
- Growth management
- Shorelines
- Irrigation limitations

It is important that the Department not allow abutting property owners to discharge water onto the highway right of way without obtaining a permit. Property owners may obtain permits by applying at the WSDOT Area or Region office. Drainage design engineers and maintenance staff review potential drainage impacts from the abutting property to the highway right of way. The property owner may be required to mitigate water quality and/or quantity impacts to obtain a permit.

Maintenance personnel who routinely patrol a roadway section must be trained in the basic knowledge of what types of direct drainage and sheet flow from abutting property may require a permit. These include new:

- Commercial developments such as shopping centers
- Subdivisions
- Industrial development
- Automobile wrecking yards
- Dairy and other intensive farming activities

Maintenance personnel should report land use changes they observe to their supervisor. The supervisor will forward this information to the appropriate reviewer.

Ditches and Gutters

Open ditches should be routinely checked and maintained to the line, grade, depth and cross section to which they were constructed. Where practical, non-standard ditches should be modified to produce a relatively flat, shallow ditch to enhance motorist safety.

Vegetation in ditches often helps prevent erosion and treats storm water. Remove vegetation only when flow is blocked or excess sediments have accumulated. Remove vegetation using “best management practices” that minimize erosion and sediment escape to water bodies.

Excessive erosion of drainage ditches must be controlled or repaired. Ditch linings of loose or grouted rock and concrete or other energy dissipation methods can control erosion. However, these linings need be checked frequently and repaired as necessary.

Keep ditches and gutters free of litter and debris. Repair all cracks and breaks as necessary.

Be especially careful when chemicals are used for brush and grass control in open ditches. Herbicides must be carefully controlled so as not to contaminate water or to transfer and concentrate chemicals in adjacent areas where environmental damage may result. Always follow product application instructions.

Be alert for diversion ditches on top of cut slopes that prevent slope erosion by intercepting surface drainage. Diversion ditches must be maintained to retain their diversion shape and capability.

Surplus material that results from ditch cleaning can often be used for widening. Material placed into the adjacent portions of the highway or disposal areas must not obstruct or impair other roadside drainage areas. Do not use material that may cause sedimentation problems to water bodies. Take care to avoid causing erosion problems or loose unstable fills. Don't use non-porous materials such as clay. They can become unstable when wet and trap water in the existing fill. If there is doubt about using such surplus material contact the Region Soils Engineer for assistance.

Don't blade ditch cleanings across roadway surfaces. Dirt and debris remaining on the pavement after ditch cleaning operations must be swept from the pavement.

Avoid undercutting the roadway back slope or in slope. Undercutting weakens the slope and will cause damaging slip-outs and other forms of slope erosion.

Rockfall Ditches and Slope Benches

Keep rock fall ditches and slope benches clean. Large amounts of slough or rock fall and other slide material that effectively block the ditch or bench should be removed as soon as possible after they occur.

Dry Wells

Dry wells accommodate the drainage flow in certain areas where:

- Natural outfalls for a drainage system were not available.
- Their use reduces the need for or size of downstream facilities.

These dry wells should be inspected periodically. Replace the drain rock if storm water no longer percolates into the soil.

Culverts

A culvert is a conduit or pipe used as an artificial channel under a roadway or embankment to maintain flow from a natural channel or drainage ditch. Inspect all culverts at least twice a year. Keep them clean and in good operating condition.

Changes in the up stream watershed due to logging, land development activities, farming practices, forest fires, etc., may increase water run off, sedimentation and debris. With these conditions more frequent inspections, particularly after periods of high runoff, are necessary to enable maintenance personnel to take corrective measures if damage has occurred. During storms and floods, critical areas need to be inspected and the culvert inlets kept clear.

Repair and replace badly worn or broken culverts to minimize the possibility of damage to the roadbed by water saturating the fill material.

Culverts with 50 percent or more constriction should be flushed or otherwise cleaned to restore the culvert's original capacity. (Use BMP's to minimize fish impacts when doing this work). Some of the larger culverts in flowing streams are designed for construction below the stream bed, to accommodate fish life. In these cases, the culvert should also be cleared of obstructions that may be detrimental to the passage of fish.

Check culverts for scour around the inlet and outlet. Repair scoured areas with rip-rap or some other protection if necessary. In some cases standing water is desirable at the inlet end of the culvert to settle out sediment. Vegetation at culvert ends can be controlled by residual herbicides or mechanical means.

Controlled burning of vegetation at culvert ends is a feasible alternative at some locations. Whatever method of vegetation control utilized needs to be accompanied by erosion and sediment control features/practices.

Pavement markings that show the location of culverts should be renewed annually. These markings are critical for quickly locating culverts for both emergency and routine maintenance. Pavement markings of more permanent materials, such as thermoplastics, are encouraged.

Automatic Pumps

Automatic pumps, sumps, and pipes at underpass structures or draining depressed sections of highway must be kept in good operating condition at all times. Each installation must be inspected on a routine basis, at least once per week. Inspections should include the electrical, ventilation, greasing and drainage systems.

Under Drains

Under drains are often constructed in the sub-grade to intercept subsurface water from springs and seepage water from the surface or percolating from below. Control of this water is essential to ensure the stability of the sub-grade upon which the highway is constructed.

Inspect under drains on the same schedule as culverts. Keep their outlets open and clean. Choked under drains can be cleaned by high pressure flushing with water or flexible sewer rods. In cases where roots effectively block the drainage, the use of herbicides may be indicated. Whatever method of cleaning is used, consideration for erosion and sediment control is needed.

Storm Sewers

In many areas underground pipe systems are necessary to carry storm runoff normally handled by ditches. Storm sewers are often used in long, depressed highways or along curbed sections on city streets. Water carried by the system is generally collected through inlets, catch basins, or manholes and carried by pipe to an out fall on a natural waterway.

Clogged pipes can often be cleaned with high-pressure water jets. But, if tree roots or broken pipes are causing the clogging, more service will be required. Flexible rotary cutters will remove roots intruding into a pipe.

Broken pipes may be repaired by jacking an insert liner into the failed location. Otherwise, the failed pipe may have to be excavated and relayed to repair it. Whatever method of cleaning is selected, consideration for erosion and sediment control is needed. In no case can debris or sediment be allowed to enter a water body.

Manholes are generally used where there is a change in profile or alignment and also at strategic points in long, straight sections in order to provide access for cleaning the conduit.

Periodically inspect and clean inlets, catch basins, and manholes using a vacuum truck or manual cleaning methods. Conduct inspections during storms to ensure that the inlet grates are not becoming clogged with water-born debris. Schedule sweeping operations to help prevent the accumulation of leaves, paper, or other clogging debris.

When pavement is overlaid by contract or maintenance work crews be sure that the manhole covers are flush with the finished pavement elevations.

Bank Protection

Maintenance personnel must be continually alert to conditions that may cause scour, undermining, or washout of highway embankments or structures by storms, floods, or wave action.

Highways adjacent to water courses, drainage ways, and embankments throughout the state are protected in a variety of ways against damage due to high water. These include barbs, stone rip-rap, grouted rip-rap, pile revetments, retaining walls and cribs, rock and wire mesh (gabions), and vegetation.

These features must be inspected during storms or periods of high water, as well as at least once each spring or after major high water periods, and repairs made where required. Make repairs with materials similar to those in place. If possible take corrective measures to eliminate the direct cause of the damage.

Hydraulic permits may be necessary and protection measures for fish habitat are required.

When the need for significant additional bank protection around structures or embankments is indicated, the Area Superintendent is to be notified immediately and a determination made as to whether or not the protection materials will be placed by maintenance or construction forces.

Detention Ponds and Tanks

Designers are increasingly specifying the use of detention ponds and tanks that store water runoff and release it slowly through a controlled out fall or outlet. In this way the size of downstream pipes and culverts can be reduced, erosion is mitigated, and solids that settle out can be removed.

To function correctly the controlled out fall or outlet pipe must be free of debris. Accumulated settled materials must be removed on a schedule based on experience at each site. If oil separators are combined with these facilities, timely removal and proper disposal of oils is essential.

If inspection or cleaning necessitates working inside an underground detention tank, confined space procedures must be followed.

Oil Separators

Oil separators are being used increasingly by WSDOT in conjunction with catch basins, manholes, and other drainage structures. While they vary in design, all function in much the same manner by reducing the velocity of the water flow through the drainage structure and not allowing floating debris to be flushed through. This allows oils carried by the water to accumulate and be contained within the drainage structure.

Once contained, these oils must be periodically removed and properly disposed of to prevent their being released back into the flow of the drainage system.

Generally, the same conditions that determine the schedule of inspection and cleaning required for standard catch basins and manholes also applies to units with oil separators. Oil separators, however, increase the rate of silt buildup within any drainage structure in which they are installed. Therefore, oil separators may require more frequent inspection and cleaning. Experience can best determine what schedule of inspection and cleaning is required to maintain these units in proper working order.

The Maintenance Accountability Process “MAP” sets the level of service for performing drainage maintenance.

General

The proper care of structures is vital to the preservation of the highway network and to the safety of the traveling public. This chapter discusses those items in which area maintenance personnel assist in this maintenance effort. Other more comprehensive references are available to the Maintenance Engineer.

For general responsibilities refer to the Transportation Structures Preservation Manual, M 23-11. For specific responsibilities for movable bridges, refer to the specific Operation, Inspection, and Maintenance Manual (OIM).

Major Structures

For maintenance purposes, major structures are identified as those bridges included in the Bridge List (M 23-09). The State Bridge and Structures Engineer is the responsible authority for these structures and must be contacted prior to any major maintenance or modifications to them. The designated contact in Olympia is the Bridge Preservation Engineer.

Bridges and other transportation structures closed due to structural damage, require approval from the Bridge Preservation Engineer before opening.

Minor Structures

For maintenance purposes, minor structures are identified as those drainage structures (culverts, etc.), retaining walls, acoustical barriers, cribbing, etc., that are not listed in the Bridge List. The Region Maintenance Engineer is the responsible authority for minor structures.

Any defects or damage to minor structures should be referred to the Area Maintenance Superintendent, who will coordinate the required action.

The structural components of sign bridges, bridge-mounted sign brackets, and high-mast luminaries are inspected and inventoried by the bridge preservation office. Major maintenance or modifications to these structures is to be coordinated through the Bridge Preservation Office. The designated contact in Olympia is the Bridge Preservation Engineer.

Inspection

Federal regulations require that all major highway structures be inspected by a crew under the supervision of a professional engineer, at intervals not exceeding two years. This requirement is met by the WSDOT Headquarters' Bridge Preservation Engineer and staff. Certain bridges, such as steel bridges, untreated timber bridges, bridges having a posted load limit, movable bridges, floating structures and bridges with pending repairs are inspected annually.

A bridge's condition can change in much less than two years. The Bridge Preservation Office relies on Region maintenance personnel to be alert for settlement, washout, collision damage, and other problems, and to notify their superintendent as appropriate.

Area maintenance crews are also expected to maintain or repair minor approach settlements, approach guardrail damage, plugged bridge drains, sweeping of bridge decks, asphalt overlays and other items that are considered part of normal maintenance operations.

Additionally, removal of dirt and debris accumulation on timber caps, timber stringers, steel expansion devices (bearings), lower chords of steel bridges and sign bridge bases are considered routine maintenance activity. However, at times these can become critical to a structure and will be added to the repair list.

Modifications to bridges need to be detailed in drawings and submitted to the Bridge Preservation Engineer for as-built documentation and future reference. All bridge structural as-built information is maintained at the Bridge Preservation Office.

All minor structures, related to bridges, should be inspected at least annually by the designated region maintenance supervisors or crews. Inspect more often if warranted by weather conditions or past experience.

The Bridge Preservation Office distributes a list of scour critical bridges to each region Bridge Maintenance office. These bridges are to be closely monitored during high water events. Scour critical bridges require close monitoring due to a high susceptibility to foundation damage caused by high water events. Area Maintenance Superintendents are responsible for monitoring weather conditions in anticipating high water events for scour critical bridges in planning for advance deployment of crews to monitor each bridge's condition. Scour is the number one cause of bridge failures in Washington.

Region bridge maintenance personnel are responsible to inspect all bridges and designated minor structures annually. Record all deficiencies. Keep the records on file until the deficiencies are corrected.

Review bridge inspection report notes, repairs, and photos to identify items to focus on during inspections.

During inspection, the following items should be checked. Deficiencies should be immediately repaired or scheduled for future work.

Approach Fills. Note any deficiency. Pay particular attention to the pavement seats of the structure. Look for sagging, pot holing, scaling, or spalling.

Asphalt Wearing Surface. Note potholes, scaling, wheel rutting, and general pavement condition.

Concrete Deck. Note scaling, spalling, cracks, and any exposed reinforcing steel.

Grid Decks. Look for and note broken welds or clips, loss of a section due to rust and any bent members.

Curbs and Railings. Note any deterioration, cracking, spalling, or damage.

Paint. Note the general condition of the paint. Look for cracking, peeling, fading, and presence of rust or algae.

Stringers, Caps, and Floor Beams. Note any crushing at bearing points, and any warping, cracking or debris buildup.

Steel Truss Members. Note bent or damaged steel, deflection, cracking, vibration, debris buildup on chord members, and deterioration due to rust. Pay particular attention to pinned joints at hinges, excessive rust, vibration, missing nuts, or loose plates. Immediately inform the designated bridge maintenance representative of any known or suspected problems.

Wood Truss Members. Look for and note damaged or broken members, crushing, cracking, warping, vibration, and deterioration due to rot or boring insects.

Expansion Joints. Note loose, banging, and jammed expansion joints. Also, note the presence and condition of the joint material.

Abutments, Bulkheads, Piers, and Intermediate Bents. Note any type of tilting, bulging, and deterioration. Pay particular attention to the buildup of drift debris and any scouring or undermining due to high water and erosion.

Bridge Drains. Note plugged bridge drains. Check pipe outfall areas to see if soil erosion is occurring. Plugged drains may result in saturation of the bridge approach fills and may explain any unusual erosion or undermining of abutments or bulkheads.

Waterways. Note scour and conditions that could cause log jams or ice jams during high water stages. Look for any logs or other debris jammed against piers, bulkheads, or piling. In the winter check all bridges with piers or bulkheads in the water with a floating debris problem during and after each flooding condition.

General Conditions. Look for accumulation of dirt, excessive bird droppings or debris on the roadway at bearing points and on the caps or lower chords. Pay particular attention to the presence of materials that might pose a fire hazard or

restrict access for maintenance activities. Note any unauthorized attachments such as private fences. Have electrical fences removed from bridge access areas or clearly mark them with warning signs.

Walls and Cribbing. Inspection can be of a cursory nature according to guidelines designated by the Area Maintenance Superintendent. Check walls for tipping, bulging, cracking, spalling, and water runoff over or through wall. Check all weep holes to assure that they are open. If the structure is wooden, check for rot and the presence of fire hazards.

Tunnels. Condition of walls, ceiling, or liner. Look for cracking, spalling or loose overhead hazards. Note increased water seepage, and the condition of wire retention fabrics. Check for tears or failures that may indicate potential structural hazards and impact on portals or overhead members.

Bridge Repair Guidelines

Any major or structural repairs need to be coordinated through and approved by the WSDOT Headquarters Bridge Preservation Engineer. If there is any doubt about the structural significance of a damaged or deteriorated bridge component, notify the WSDOT Headquarters Bridge Preservation Engineer. Generally, bridge repairs are identified on the bridge repair list.

There are six priority definitions in the repair lists. "Emergency" or "Urgent" priorities are intended to recognize the various levels of work accomplished by Bridge Maintenance. As maintained previously, these six repair priorities represent a priority level hierarchy; therefore, repairs that are not completed in a timely manner may be moved to a higher priority. Only four priorities will be published on the repair list since "Emergency" and "Urgent" repair lifecycles will be anticipated to be much shorter than the repair list publication cycle. They will be tracked in the Bridge Preservation Office repair database.

The use of "Emergency" and "Urgent" priorities will be authorized by the Bridge Preservation Engineer. These types of repairs will be reported directly to each region.

The priority definitions are as follows:

- **Emergency** – Repair work requiring immediate action when structures are partially or completely closed.
- **Urgent** – Repair work requiring prompt action that must be completed when structural details and bridge crews become available.
- **Priority 1**- Repair work required when damage to primary structural elements directly affects safety, reliability of transportation system, protecting public investment, and maintaining legal mandates. Secondary and minor items will qualify for this priority if they pose a hazard to traffic.

- **Priority 2** - Work should be accomplished within regular work schedule or programmed in the biennial work schedule.
- **Priority 3** - Generally a minor nonstructural or 'housekeeping' type of repair, which may evolve into a higher priority if not corrected.
- **Priority 4** - A condition that requires the structure to be monitored primarily by the bridge inspection teams, and may evolve into a higher priority.

The WSDOT Headquarters Movable Bridge Engineer prepares and updates individual maintenance manuals for all movable bridges. Consult these manuals for both routine and specialized maintenance tasks. Direct any questions to the Movable Bridge Engineer in the Bridge and Structures Office in Olympia.

Minor repairs to railings, curbs, concrete decks, expansion joints, etc., can be performed without the individual approval of the WSDOT Headquarters Bridge and Structures Office. Similarly, drift may be removed, clearance lights changed, etc.

Bridge Information

Bridge information is available to all DOT staff through the Bridge Engineering Information System—BEIST. Go to the Bridge and Structures website for a link to BEIST.

BEIST contains inventory data, bridge plans, inspection reports, the repair list, and related files. Additionally, BEIST contains the Sign Bridge Repair List and Standard Plans.

Environmental Aspects

WSDOT environmental staff will provide Maintenance Engineers, Area Superintendents and Maintenance Supervisors with training and education on which regulations apply to specific maintenance activities and what is the appropriate response to the regulatory process.

In addition to federal regulations, state environmental agencies, tribes and city or county health ordinances may have environmental restrictions on work done on or near bridges.

Before initiating bridge repair activities, the Maintenance Engineer, Superintendent, or Supervisor will confirm if environmental permits are required. They will also review the proposed repair method with the environmental staff to determine whether it is both appropriate and/or environmentally sound. The following list provides some of the environmental concern factors that impact bridge maintenance in some localities. This list is not comprehensive or current because the list of environmental factors to be considered continues to change. However, it does provide some insight into the degree to which maintenance is being held to an increasing level of environmental accountability.

- State or federal list of threatened or endangered species
- Species if high interest to state or federal agencies

- Migratory waterfowl habitat
- Anadromous fish habitat
- Trout and other cold water fish habitat
- Habitat for birds of prey (Must have Bridge and Structures approval to attach platform, boxes or any other structure to any part of a bridge).
- Wetlands and wetland habitat
- Riparian habitat
- Migratory corridors
- Wintering areas and other critical feeding areas of wildlife
- Important wildlife reproductive habitat
- Public water supplies, including important aquifers
- Islands and other coastal barriers
- Hazardous waste
- Regulatory flood ways and other flood plain areas
- Commercial fish and shellfish production areas
- Important sport fishing areas
- Highly erosional soils
- Listed or proposed wild and scenic rivers
- Navigable waterways
- Significant historic resources
- Natural resource agency holdings or interests (refuges, parks, habitat areas, etc.)

The Bridge and Structures Office is concerned with the placement of temporary or permanent wildlife habitat structures (peregrine falcon platforms, bat boxes, etc.) on state bridges due to their potential negative impact to inspections of all bridges in accordance with the federally-mandated National Bridge Inspection Standards and the potential negative affects to maintain the bridge structure itself. The Bridge and Structures Office discourages the practice of placing these habitat structures on state bridges.

Therefore, all plans to place temporary or permanent wildlife habitat structures on state bridges are to be reviewed by the Bridge Preservation Engineer. This is consistent with the review process for all other attachments to bridges.

Maintenance agreements established with any regulatory agency that includes bridges must have approval from the Bridge and Structures Office. Agreements that define or limit access to a bridge due to the Endangered Species Act, affect inspections and repairs.

Utility Installations

Bridge Maintenance Superintendents need to work directly with region utility engineers to coordinate utility installations to ensure construction inspectors are aware of the utility installation and inspect the construction for proper installation per the franchise agreement and structural details approved by the Bridge and Structures Office. Scaffolding attached to or setting on any portion of the bridge is to be included in the review by the bridge office.

Construction inspectors are to ensure that the utility contractor is following DOT-prescribed construction practice in accordance with WSDOT Standard Specifications.

General

This chapter addresses roadside maintenance issues primarily as they relate to vegetation management. It also covers maintenance in relation to litter control and auxiliary features such as Safety Rest Areas, viewpoints, and historical markers. Roadside issues as they relate to areas of maintenance such as drainage, pavement, and maintenance of structures are covered in other chapters of the *Maintenance Manual.*

This chapter has been written to integrate with information relating to roadside management topics presented in all other departmental documents. In particular it is tied to the contents of the *Roadside Manual*, the *Roadside Classification Plan*, and the *Design Manual*. Roadside Maintenance Managers should be familiar with the contents of these other documents as they relate to roadside maintenance.

Definitions

Roadside: The roadside is the area outside the traveled roadway. This applies to all lands managed by the Washington State Department of Transportation (WSDOT) and may extend to elements outside the right of way boundaries. It includes unpaved median strips and auxiliary facilities such as rest areas, roadside parks, viewpoints, heritage markers, pedestrian and bicycle facilities, wetlands and their associated buffer areas, stormwater treatment facilities, park and ride lots, and quarries and pit sites within the right of way.

Roadside Management encompasses the planning, design, construction, and maintenance of the roadside.

Its goals include:

- Provide for all the highway functional and operational objectives.
- Protect the environment.
- Create and/or maintain desirable visual quality.

These goals can be achieved with the lowest life cycle costs by:

- Applying consistent, long term strategies throughout the management process.
- Using appropriate site specific Best Management Practices (BMPs).
- Using appropriate Integrated Vegetation Management (IVM) techniques.

Integrated Vegetation Management: Integrated Vegetation Management (IVM) is defined as a coordinated decision making process that uses the most appropriate vegetation management strategy on a site specific basis.

It utilizes a monitoring and evaluation system to ensure achievement of roadside maintenance program goals and objectives. IVM practices are environmentally responsible and economically sound. WSDOT uses IVM to design and construct roadsides which will grow and evolve with the natural ecosystem. The type of site specific vegetation chosen is designed to require the least possible attention from maintenance over the long term.

Best Management Practices (BMPs): They are physical, structural, and/or managerial practices that, when used singly or in combination, reduce the downstream quality and quantity impacts of stormwater.[1] Typical BMPs include biofiltration swales, wet ponds vegetated filter strips, and wet vault/tanks. BMP details can be found in the *Highway Runoff Manual,* Chapter 8.

Reference

Roadside Manual, WSDOT, M 25-30

Roadside Classification Plan, WSDOT, 1996

Integrated Vegetation Management for Roadsides, WSDOT, July 1997

WSDOT Maintenance Manual for Water Quality and Habitat Protection Guidance, WSDOT, IL 4020.00, July 1, 1999

Highway Runoff Manual, Chapter 8, WSDOT, M 31-16

Design Manual

Maintenance Accountability Process Handbook

Resources

Headquarters Maintenance Office

Region Landscape Architects

Headquarters Roadside and Site Development Office

Regional Environmental Offices

Roadside Functions

The roadside is managed to fulfill four functional categories: **operational, environmental, visual, and auxiliary functions**. By fulfilling highway needs in these four categories, the roadside contributes to WSDOT's delivery of transportation services. Table 6-1 explains the functions and gives examples.

[1] *Highway Runoff Manual*, M 31-16. WSDOT, pp Glossary 1-2.

Function	Examples
Operational	Those functions that provide safe and multi-use roadsides. Operational functions include access control, providing vehicle recovery areas and sight distances with accommodations for signs and utilities, and snow storage. The *Design Manual* provides the primary guidance for operational roadside design guidance.
Environmental	Those functions that protect and enhance our natural and built surroundings. Environmental functions mitigate the roadway's impact on its surrounding ecosystem. Major environmental functions include: • Water quality (preservation, protection, and improvement) • Storm water detention and retention • Wetland and sensitive area protection • Noxious weed control • Noise control • Habitat protection and connectivity • Air quality improvement • Erosion control
Visual	Those functions that are designed and experienced primarily from a visual perspective. Visual functions promote a positive quality of life and are integral to operational, environmental, and auxiliary functions. They include enhancing guidance and navigation, distraction screening, corridor continuity, roadway, and adjacent property buffering, and scenic view preservation. There are two primary roadside views: Those from the roadway, and those toward the roadway. In addition many activities such as noxious weed control, wetland and sensitive area preservation, and habitat preservation are readily perceived and evaluated through sight.
Auxiliary	Those functions that provide additional operational, environmental, and visual functions to support or supplement the transportation system. Examples of auxiliary facilities are community enhancement areas, safety rest areas, roadside parks, viewpoints, agricultural uses, heritage markers, bicycle and pedestrian facilities, park and ride lots, and stockpile sites.

Table 6-1

Roadside Treatment

The *Roadside Classification Plan* (RCP) provides the basis for solutions to site specific questions on how to develop and manage the roadside. This document provides guidance for resolving the roadside functional needs with variations in site conditions, vegetative patterns, and geographic surroundings.

Maintenance Involvement in the Roadside Management Process

Maintenance plays the major role in the roadside management process. The overall goal of roadside maintenance is to sustain the roadside in a manner that satisfies the intent of the RCP and performs as many functions as possible, while requiring the least amount of care.

Roadside maintenance is a unique element within the highway maintenance program because much of the work involves caring for and/or controlling vegetation. Roadside plant communities are alive and part of a dynamic, ever evolving natural process. Therefore, proper maintenance of the roadside requires understanding of the many factors which contribute to the natural evolution of vegetation over time.

It is in the best interest of design and construction organizations to solicit input from the maintenance crews during the process of planning, designing, and constructing roadside features. Maintenance personnel should also take the initiative to provide documented input for consideration during this process.

It is vital that local maintenance employees be involved in the regional project development process as it relates to the roadside. The project delivery process within each region will vary. But, before a contract is finalized the project must be thoroughly reviewed by the local maintenance personnel with responsibility to care for the highway and roadside affected. Maintenance personnel can also offer valuable input during construction.

It is in the role of Design and Construction to continuously solicit maintenance input on the processes of building, preserving, and/or improving the highway. Maintenance personnel must take the initiative in offering appropriately documented input for consideration throughout the process of planning, design, and construction.

Roadside Maintenance and the Maintenance Accountability Process

The **Maintenance Accountability Process** (MAP) is used by WSDOT to explain the relationship between maintenance service levels and the resources required to deliver those levels. The MAP is a comprehensive management program that provides a clear link between maintenance goals, activities, service levels, the budget, and maintenance performance measures.

The major elements of roadside maintenance are referred to in the MAP as Group 3 – Roadside and Landscape Maintenance. The MAP defines roadside maintenance as having five major activities:

- Litter Pick Up
- Noxious Weed Control
- Nuisance Vegetation Control
- Control of Vegetation Obstructions
- Landscape Maintenance

These elements serve as "service level" or outcome indicators, and are intended to measure how well the roadside is fulfilling the major functional needs of the highway. All MAP activities are field measured on a regular basis to determine service levels statewide, as well as at the regional and maintenance area level.

One of the most valuable features of the MAP for roadside maintenance is its provision of consistent statewide outcomes for roadside maintenance decisions. These service level commitments serve as a basis for setting roadside maintenance action thresholds and help the areas plan roadside activities.

A unique result of applying an outcome based management system to the vegetation management process is the ability to measure results. It is possible to demonstrate an increasing service level over time without an increase in funding.

Roadside vegetation, if managed properly, can become more naturally self-sustaining over time and require less control from maintenance as it grows and matures. With IVM, the overall service levels for Group 3 will improve over time under the following conditions:

- Consistent adequate resources to use BMPs.
- Ability to apply properly timed target specific roadside maintenance treatments.

Roadside Management Zones

To address the highway's functional needs (as describe above), the roadside may be divided into as many as three major bands of area referred to as Zone 1 – Vegetation Free, Zone 2 – Operational, and Zone 3 – Transition/ Buffer. Roadside maintenance priorities within these zones are established beginning with activities relating to the safe highway operations and maintenance, and preservation of the highway roadway.

Most "high priority" and routine roadside maintenance activities occur in Zones 1 and 2. They are designed and maintained to facilitate operational roadway functions, such as surface and subsurface drainage, traffic operations visibility and site distance. Zones 1 and 2 also allow unobstructed vehicle recovery where traffic may accidentally leave the roadway (referred to as the **Design Clear Zone**). The *Design Manual* provides guidance on the required extent of the roadside "clear zone" (Zone 2) for varying highway configurations. In some cases the actual requirements for the clear zone may extend beyond the right of way lines.

Zone 3 is present where adequate right of way area exists beyond what is necessary to deliver operational functions of the highway. Zone 3 is managed to address some safety functions such as hazard trees and trees shading the roadway. There are other operational functions which may be addressed within the area of Zone 3, such as drainage, noise and visual attenuation, and stormwater management needs. However, Zone 3 is primarily developed and maintained to address the visual, auxiliary, and non-regulated environmental functional needs of the highway. Zone 3 offers the greatest opportunity to create and maintain self-sustaining, low maintenance plant communities.

Roadside maintenance program objectives are established and prioritized to deliver the functional needs of the highway within the three zones.

Figure 6-1 shows a cross-section of a typical divided highway, illustrating typical relationships of the Roadside Management Zones within the highway right of way and giving examples of the functional objectives as they apply to the three zones.

Maintenance of Zone 1

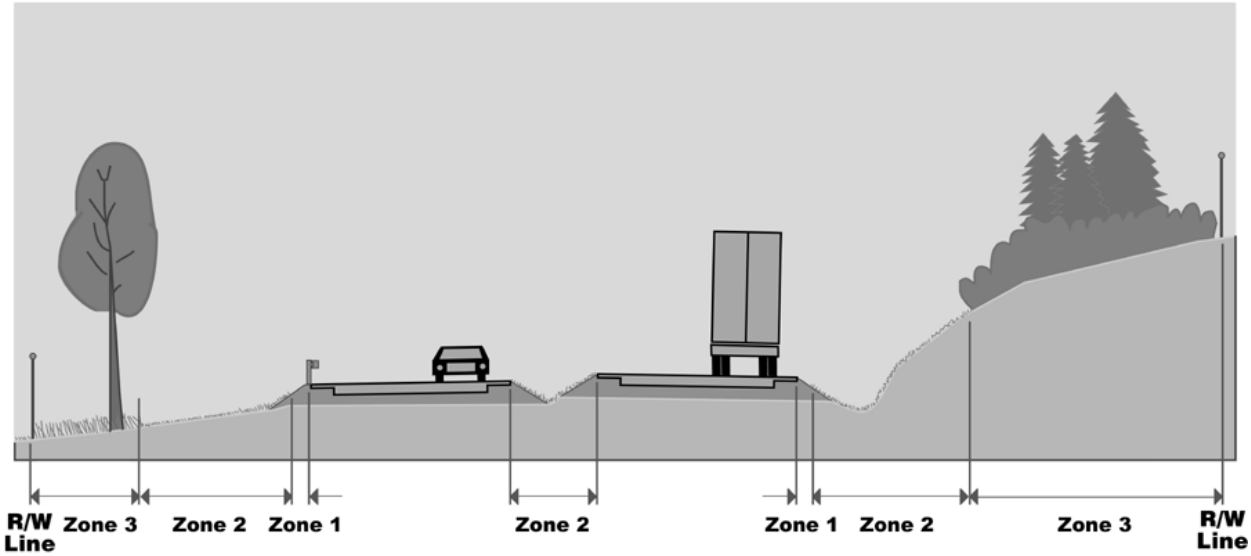
Policy

Zone 1 is maintained to remain free of vegetation. This zone begins at the edge of the pavement and extends outward to Zone 2. Zone 1 is no wider than necessary to achieve the functional objectives.

The optimum maximum width is two feet or to the back side of roadside hardware (guide posts/guardrail) if present. Variations in this width may be justified based on the following considerations.

Areas where Zone 1 requirements are less than two feet or unnecessary:

- Roadsides and medians that have adequate profile and ditch to provide surface runoff.
- Required by environmental commitment.
- Immediately adjacent to flowing or standing water.
- Abutting curb and sidewalk sections.



Functional Zone Objectives

Zone 1 – Vegetation Free

(0 to 2 feet from pavement or as necessary)

- Provide for surface drainage
- Reduce fire potential
- Provide for visibility and maintenance of roadside hardware
- Prevent pavement breakup by invasive plants
- Provide sight distance for passing, stopping, and at intersections
- Prevent the buildup of wind blown debris and winter sand at the pavement edge

Zone 2 – Operational

(From Zone 1 or pavement edge to meet operational and maintenance needs)

- Maintain design width for vehicle recovery
- Provide sight distance for passing, stopping, at interchanges and at intersections
- Maintain hydraulic capacity of ditches
- Eliminate vegetative obstructions (trees with a trunk diameter of 4″ or more
- Control weeds
- Prevent erosion
- Provide wildlife habitat where compatible with roadway traffic
- Accommodate underground utilities
- Enhance visual quality

Zone 3 – Transition/Buffer

(From Zone 2 to Right of Way line)

- Promote self-sustaining plant communities
- Blend and/or screen adjacent surroundings to meet the goals and objectives of the *Roadside Classification Plan*
- Eliminate hazard trees causing excessive shade (ice and frost potential) on the highway pavement
- Control weeds
- Prevent erosion
- Maintain and enhance visual quality
- Preserve wetlands and wildlife habitat
- Accommodate utilities
- Preserve and conserve native plants and wildflowers

Typical Roadside Management Zones
Figure 6-1

- Turf grass areas in rest areas and formal landscapes.
- Adjacent to full depth pavement (where shoulder pavement functions as Zone 1).
- By agreement/permit where maintenance is done by others.

Areas where Zone 1 may be wider than two feet:

- Where visibility and maintenance of highway hardware such as guardrail or fencing must be facilitated.
- Where there is a high risk of fire.
- Natural rock and gravel ditches where it is impractical to maintain desirable vegetation.
- Narrow areas adjacent to formal shrub beds.
- Where farming activities take place very close to the roadway shoulder and it's impractical to maintain a strip of grass.
- Where drifting sand or snow may accumulate on the roadway as a result of vegetation growth at the edge of the pavement.
- For sight visibility at selected intersections or approaches when mowing is not practical.

Methods

Because Zone 1 is maintained to be free of vegetation, it requires more regular and routine maintenance attention than any other zone. The primary tools available to accomplish this are non-selective herbicide products which bind within the soil profile and suppress seed germination throughout the growing season. Non-selective herbicides which eliminate existing living plant material through contact with the leaves or stem may also be used to control emergent vegetation in this zone. But, the use of these non-selective post-emergent products alone may require more than one treatment during a single growing season. Labor time intensive non-herbicide controls are available for special situations.

Maintenance of Zone 2

Policy

Zone 2 is maintained to fulfill the safety and operational functions of the highway roadside. However, maintenance of this zone also has a significant impact on the visual functions, due to human perceptions of roadside neatness and degree of care. Negative visual impacts, such as brown outs from herbicide applications, should be avoided whenever possible.

Zone 2, when present, begins at the edge of the pavement or the outside edge of Zone 1. It extends outward to the right of way line or the edge of Zone 3 (where present). The optimum minimum width is determined by the clear zone vehicle recovery criteria which is given in the *Design Manual* and the site distance criteria given in the *Design Manual*. Roadside clear zone requirements may be eliminated, when appropriate, with the installation of guardrail or concrete barrier.

Variations from the optimum minimum width may be justified based on the following:

Areas where Zone 2 may be less than the minimum width specified in the *Design Manual*:

- Where compromises exist on older highways and adequate widths were not established during previous construction and maintenance funding levels do not provide for improvement.

Areas where Zone 2 may be wider than the minimum width specified in the *Design Manual*:

- Where the edge between Zone 2 and 3 has been set through the Design and Construction process and maintenance has adequate resources to sustain Zone 2 beyond the minimum required width.
- Where the outside edge of Zone 2 was not established through design and construction, but the *Roadside Classification Plan* allows for and maintenance has adequate resources to accomplish Nuisance Vegetation Control beyond the required minimum width.
- Where visual access is desirable across the right of way either from the road out or from lands adjacent to the right of way.

Methods

Most maintenance activities applied in Zone 2 are intended to keep vegetation from encroaching on the highway's safety and operational functions. The maintenance focus in Zone 2 is to selectively cut back or remove vegetation which impacts these functions. Selective methods should be used whenever possible to control unwanted vegetation. An example is using a broad leaf controlling herbicide to remove noxious weeds or nuisance vegetation from a grass stand. Other methods may be non-selective, such as mowing of a grass stand as needed to prevent undesirable vegetation from maturing or setting seed.

Maintenance work in Zone 2 presents some of the most visible evidence of roadside management. Methods selected may have a significant impact (positive or negative) on visual quality. The MAP does not directly measure

visual quality as part of the service level for roadsides. However, visual quality is important to the traveling public who perceive this as an indication of the overall maintenance service level.

Legislative service level commitments and funding levels often do not allow for consideration of the visual impact from Zone 2 maintenance. Plan the timing of herbicide applications for tree and brush control in Zone 2 to minimize "brown-outs." Avoid the use of flail or rotary type side arm mowers for side trimming of native vegetation whenever possible.

Maintenance of Zone 3

Policy

Zone 3 exists only when there is adequate right of way beyond the requirements for Zone 2. It is managed to be self sustaining to the greatest degree possible, naturally evolving over time to blend with the surrounding vegetation and compliment the human built environment.

Zone 3 begins at the outside edge of Zone 2, or behind guardrail or concrete barrier. It extends to the right of way boundaries on the outside shoulder, or an opposing edge of Zone 2, such as in a wide median strip or the interior of an interchange configuration. Zone 3 may also include a managed strip along the outside edge of the right of way managed to allow for maintenance access if needed.

Methods

If Zone 3 has been properly designed and developed, very little attention from maintenance normally is required. Zone 3 maintenance activities are selective whenever possible. Examples of selective maintenance treatment include the removal of noxious or nuisance weeds, hazard trees, or the thinning of trees in areas where shading increases the likelihood of frost or ice on the roadway. Some pruning of trees may be required. The majority of this work must be done by hand. Chippers may be used to dispose waste material on site. Trees should be dropped in place and left to decompose within Zone 3 whenever possible.

Preserve desirable vegetation when nuisance vegetation such as Himalayan blackberry or Scotch broom is removed from Zone 3.

Integrated Vegetation Management

Integrated Vegetation Management is a coordinated decision making process that uses the most appropriate vegetation management methods and strategy, along with a monitoring and evaluation system, to achieve roadside maintenance goals and objectives in an environmentally and economically sound manner.

The majority of roadside management work is focused on the control of undesirable vegetation. This goes hand in hand with the establishment of and care for desirable vegetation. To accomplish this, WSDOT is required under RCW 17.15 to utilize Integrated Pest Management (IPM) principles.

WSDOT has defined IPM methodology as it applies to roadside vegetation management in the document *Integrated Vegetation Management for Roadsides, July 1997* and uses the term Integrated Vegetation Management (IVM) as synonymous with IPM. An IVM approach can be applied beginning at any point throughout the roadside management process.

Methods

The four basic groups of methods employed to manage vegetation are: biological, chemical, cultural, and mechanical. Use of the most effective method, or combination of methods within an IVM decision-making framework as described above will result in the highest roadside service levels at the lowest life-cycle costs.

- **Biological:** Methods which use living organisms to inhibit a host plant's ability to survive or reproduce are considered biological controls. Insects, diseases, and foraging animals, such as deer and cattle are examples of biological control organisms. Biological methods are typically applied only when weed infestations are so well established that total eradication is not practical or possible. Predators are dependent on the presence of host plants for survival. Careful testing and screening must be applied prior to releasing biological control organisms to ensure they will not also attack native or other desirable plants.
- **Chemical:** The use of herbicides to control weeds and undesirable vegetation, the use of plant growth regulators to reduce pruning or mowing requirements and the use of insecticides to control predatory insects of desirable plants are examples of chemical control methods. There are a wide variety of chemical control products available for vegetation management. Chemical methods can be somewhat controversial due to the potential impact of certain products on human health and the environment. Extra care must be taken when utilizing chemical controls to address public sensitivity to these tools and to minimize potentially adverse impacts.
- **Cultural:** Techniques which benefit the development and/or health of desirable, competitive plant material are considered cultural methods. Cultural methods also include the planting or seeding of desirable species. Planting and establishing the right of way in compliance with the *Roadside Classification Plan,* through project design and construction are cultural control techniques.

- **Mechanical:** Methods which use equipment to mow, cut, prune, or cultivate in a manner which reduces, removes or prevents undesirable plant growth. Mowing Zone 2 to remove seedling trees and undesirable brush from a grass stand is an example of mechanical vegetation management.

There are many factors to consider when planning for and implementing an IVM program. These include prioritizing needs, and selecting the proper tools and strategies. Roadside maintenance priorities and Best Management Practices (BMPs) must be developed by the local maintenance crews for their geographic area. Priorities will be specific to the areas unique set of roadside configurations and based on service level commitments in the MAP. It is important for maintenance employees to utilize the many information resources and personnel with roadside expertise within the agency when planning for and carrying out roadside maintenance in their area.

Specific factors to consider when planning for and applying vegetation management techniques include the following:

- **Noxious Weed Control:** Noxious weed species and the processes for regulation and control are defined in RCW 17.10. All state agencies are required to control noxious weeds on lands they own.

  Noxious weed control is important because new infestations often appear first along highway corridors. Management of the right of way, because of its linear nature, can impact an enormous number of neighbors. WSDOT must be a responsible steward of state owned land. It supports commerce and the economic viability of the agricultural community. The agency also values environmental preservation. To meet responsibilities it is necessary that noxious weeds be controlled. State law requires the control of certain weed species within highway right of ways. Activities required for control have to be given priority over all other vegetation management activities except those that directly and immediately affect the safety of the public.

  Sometimes maintenance resources do not allow for full control of all noxious weed infestations within a given year. In these situations the area Maintenance Superintendent and the local county weed board will need to negotiate a multi-year strategy for regaining control.

When prioritizing control efforts apply the following guidelines:

- **First Priority:** Control all Class “A” noxious weed infestations and those weeds on the Class “B” list as designated by each individual county weed board or district to an acceptable level. The highest priority is for new infestations and established weed populations where adjacent neighbors are making an effort to comply with noxious weed regulations.

- **Second Priority:** Areas where WSDOT has controlled noxious weeds in the past which are adjacent to neighbors that are not making an effort to comply with noxious weed regulations.

  Work cooperatively with local weed boards and districts to achieve compliance on the adjacent lands where possible by:

  1. Sharing information on new infestations with weed boards.
  2. Advising weed boards of adjacent lands that are not in compliance.
  3. Requesting from the weed boards that appropriate "Weed Free" buffers be provided on lands adjacent to WSDOT right of ways.
  4. Participating in joint control efforts contracted by weed boards.

- **Lowest Priority:** These are areas where there is no potential for neighbors to be in compliance with noxious weed regulations and there will be ongoing seed production onto the highway right of way.

Danger Trees

Dead, leaning, or structurally unsound trees within the right of way can pose a threat to the traveling public. They can also damage the pavement, structures, or other parts of the highway. Remove all danger trees as soon as possible after they have been identified.

When practical, debris and wastes may be left on site within the boundaries of Zone 3. The Regional Maintenance Engineer will direct off site disposal or reuse of the wood. Danger trees outside the highway right of way (or permit boundaries such as in National Forests) may also be removed by WSDOT maintenance. If possible, consult with the property owner where the danger tree was grown prior to removal. If an emergency exists due to a danger tree outside the right of way, remove the tree immediately and notify the property owner at the earliest opportunity.

In areas where logging activities occur, adjacent clear-cuts may create a fringe of unstable trees on the highway right of way if not removed or thinned at the time of the adjacent logging. Whenever possible dangerous trees should be removed prior to or in conjunction with the adjacent logging operation. The process for removal and disposal (or sale) of timber from state property is outlined in RCW 47.12.140.

Clear cuts adjacent to the highway may create undesirable views from the road. Especially on corridors designated as scenic and recreational highways, care should be taken to preserve and protect as much of the smaller trees and native vegetation on the right of way as possible to maintain the desirable visual character of the corridor.

Disposal of Logs Dumped on Right of Way

Logs dumped on any state roadway, in any state highway drainage ditch, or within 30 feet of the edge of pavement, are to be removed immediately. Logs that remain within the state right of way for a period of 30 days should be confiscated and removed or disposed of as directed by the Maintenance Superintendent.

The log transporting firm is required to immediately remove any logs dumped on the roadway or drainage ditch. If it becomes necessary for the WSDOT to remove such logs in order to comply with the law, the transporting firm will be billed for the operation including any damage to the highway.

If any logs are left on state right of way for a period of 30 days, the region will notify the transporting firm, by letter, that the logs have been confiscated by the state.

The method of disposing of such logs is at the discretion of the Regional Administrator, taking into account the merchantable value.

Removal of Dangerous Objects and Structures

WSDOT has the authority to remove any structure, device, or natural or artificial object located sufficiently close to a state highway to constitute a hazard or obstruction.

Maintenance personnel should not arbitrarily remove any object from the roadside unless the object represents a definite danger to the highway itself or to highway users. The matter should be brought to the attention of the region office for an initial decision unless immediate local action is required. In some cases “Memorandums of Understanding” are in place with agencies like the Forest Service and National Park Service in order to handle these issues in the areas where they have jurisdiction.

Trespass and Encroachment

All WSDOT maintenance employees are required to obtain permission from property owners before entering private property, except in cases of an immediate emergency.

Encroachments – General

Maintenance field personnel are not expected to be familiar with all the laws and policies pertaining to the use of public right of way for non-state highway purposes; however, they should at least be aware of the following basic facts:

- No work of any kind shall be permitted on state right of way except that authorized by law. The department has adopted policies, rules, and regulations governing legal encroachments, and permission to occupy the right of way is always covered by a written permit, franchise, or agreement.

- On some highways the access rights of abutting property owners have been purchased by the state. This means that no approach roads to the highway can be constructed except those authorized in the access control plan as a result of right of way agreements.

Encroachment – Maintenance Crew Responsibilities

Maintenance Superintendent assigned to sections are charged with the responsibility of reporting to their superintendent any evidence of intended or actual encroachment on the right of way by individuals, firms, or agencies for non-state highway purposes.

Most violators are not aware of the law or have encroached inadvertently because of poor communication and/or unclear delineation of the right of way line.

Good public relations require that the local Lead Technician politely inform violators of the legal requirements as soon as an impending encroachment is observed, rather than to permit unauthorized work to proceed without such warning while the matter is being referred to someone else for handling. Major work is quite often contracted, and a contractor's crew may not have knowledge of a permit or franchise even if one has been granted. By a radio inquiry to his area office, the maintenance technician can usually determine if authority has been requested or granted.

Generally it can be assumed that permission has not been granted for anyone to install or erect signs, sub-standard or otherwise, on the right of way. Contact the local Maintenance and/or Region Traffic Office if there are questions about the legality of any sign.

Maintenance crews should be familiar with the right of way widths on their sections in order to detect possible encroachments.

Franchises and Permits

Franchises and permits are issued on standard forms that contain applicable legal requirements. Each encroachment document will include its exact location, any applicable special provisions required in the project, and how the installation is to be constructed.

A single application form, in which the applicant describes, with the aid of sketches and/or maps, what he wants to do, is used for both permits and franchises. An area or region employee makes a field investigation to determine whether or not the proposed work is permissible by law, what its effect will be on existing highway conditions, and what construction designs must be adopted to protect the interests and legal requirements of the state. If all is in order, the field investigator submits a recommendation that the application be accepted and approved and what, if any, conditions or restrictions should be included.

Maintenance should check to ensure adequate provisions are included for revegetation of any and all disturbed soil.

Franchises are issued for all utility encroachments that extend along the highway for a distance of more than 300 feet. Approval can only be granted by action of the department after the applicant has furnished proof that he has complied with all the legal requirements of posting and advertising.

Permits are issued for encroachments less than 300 feet in length. Permit forms are shorter than franchise forms and there are no posting and advertising requirements.

All permits on restricted access highways, and permits for any gas or petroleum products crossings, except local gas service line on any highway, regardless of access restrictions, must be approved by the department.

The department has extended authority to the Regional Administrator to approve all other encroachment permits, including those for local gas service crossings and for the cultivation and/or growing of agricultural crops.

See the *Utilities Manual* (M 22-87) for further information on WSDOT policy on franchises and permits.

The Use of Pesticides

Pesticides are an essential part of an IVM program. Herbicides are the major type of pesticides used by WSDOT. When applied properly, as instructed on the product labels, and used in combination with other vegetation management methods, herbicides are one of the most effective and economical tools available to the roadside vegetation manager.

Within the IVM decision-making process, herbicides are often used to achieve initial control of weed infestations. Once the infestation has been reduced or eliminated through herbicide applications, other methods can be employed for long-term vegetation management. Therefore, in a successful IVM program, overall herbicide use should decrease and applications become increasingly selective over time as beneficial competitors are allowed to become more established on the roadside.

Use and Evaluation of New Products

Any and all new pesticide products with potential application for roadside vegetation management by WSDOT will be formally evaluated for environmental and human health impacts prior to addition to the statewide contract and use on highway right of ways. No pesticide products will be used on WSDOT right of way without approval through the process as described below. The intent of this policy is to formalize the evaluation process for alternative pesticide products, not to discourage the use or research of new products.

1. Submit request for review/evaluation to the appropriate Eastside or Westside Roadside Vegetation Maintenance Manager.
2. If warranted an internal evaluation will be conducted by the Headquarters Maintenance Office to determine if a formal risk assessment is needed.
3. If a formal risk assessment is determined necessary, the product will be referred to an independent consultant for analysis evaluation and formal report on risk associated with the product.
4. The Headquarters Maintenance Office will review the formal risk assessment and a determination regarding use will be made. If the product is approved for use the product will be added to the state contract. If the product poses unacceptable risk it will not be included on the contract and the results of findings will be documented.

Pesticide License

All pesticides applied by WSDOT including herbicides, insecticides, fungicides, or other pest control agents must be applied by WSDOT employees or contractors licensed through the Washington State Department of Agriculture (WSDA). Licenses are obtained by passing uniform tests administered by WSDA. In order to maintain a pesticide license, applicators must attend and receive credit for continuing education certified through WSDA. Forty (40) recertification credits are required every four years and no more than fifteen (15) credits can be counted for any one year.

Record Keeping

Record all pesticide application information within the computerized application database on DOT Form 540-506 EF, Pesticide Application Record. State law, RCW 17.21, requires that records of all pesticide applications be retained for seven years.

Product Labels

The label for each pesticide restricts how and where the individual product may be used. This protects the environment and non-target plant material, and ensures the safety of the applicator and the public.

Posting Requirements

Immediately after the application of pesticides, it is required that signs be posted in those areas that are intended for public access, such as Safety Rest Areas and bicycle/pedestrian paths. RCW 17.21.410 lists legal requirements for posting public access. For all other applications made on the right of way with power equipment, posting is required in the form of placards on the spray apparatus. Requirements for posting right of way applications can be found in RCW 17.21.400.

Aquatic Pesticide Applications

Pesticide applications made in or over open water or within delineated wetlands are subject to additional regulation and come under the jurisdiction of the Washington State Department of Ecology (WSDOE). Operators making such applications must have aquatic certification on their pesticide applicator's license and a special permit must be obtained through WSDOE. The permit includes limitations on the products available for use and provisions for public posting and notification. The Headquarters Maintenance Office is responsible for negotiating and maintaining statewide coverage for aquatic pesticide applications.

Pesticide Sensitive Individuals

State law requires that pesticide applicators, prior to making an application, will notify individuals who have been medically certified as "pesticide sensitive" and live within one-half mile of the highway application site. The WSDA maintains and annually updates a list of individuals who have received this certification and their addresses. The HQ Maintenance Office is responsible for supplying information on pesticide sensitive individuals to the maintenance areas where notification is required. RCW 17.21.420 explains the process and requirements for establishing the list through WSDA. RCW 17.21.430 explains the requirements for notification of individuals on the list.

Container Disposal

The Washington Administrative Code (WAC) 16-228-185(2) states in part: "No person shall transport, handle, store, load, apply, or dispose of any pesticide, pesticide container or apparatus in such a manner as to pollute water supplies or waterways, or cause damage or injury to land, including humans, desirable plants and animals, or wildlife:...."

To comply with the law, all pesticide containers shall be triple rinsed (three times) each time, using a volume of an appropriate solvent (water, diesel, oil, etc.) equal to approximately 10 percent of the container's capacity. Rinsing of containers shall be accomplished as soon as possible after emptying. The rinse solution shall be added to the spray tank and considered as part of the pesticide carrier. Proper triple rinsing removes the "hazardous" stigma from the containers. However, the rinsed container must still be disposed of in the proper manner, as listed on the pesticide label.

The need for rinsing and disposal of containers can be eliminated if products are available in refillable bulk containers. Utilizing bulk and "mini-bulk" containers and metered pumps to transfer products from the container to the spray equipment reduces the chance of human contact. Where this system is used in conjunction with injection type spray equipment, unused product may be returned to the bulk container at the end of the day.

Use of Mowing Equipment

Mowing is often used to achieve a neat and aesthetically pleasing appearance on the roadside, giving the impression of a high maintenance service level. However, mowing can also be an important part of an IVM program on the roadside. In this way mowing is used to maintain the desired service level in relation to controlling vegetative obstructions and nuisance vegetation in Zone 2. Use the minimum number of mowing cycles necessary to accomplish IVM objectives for the specific site. In some cases mowing cycles may be reduced to once every two or three years (or more) without compromising service level commitments.

Annual multiple mowing cycles of non-irrigated erosion control grasses that are not regularly fertilized will cause thinning of the plant population. This will reduce the grasses' competitive capabilities and allow undesirable seedling trees, brush, and weeds to become established.

Avoid mowing in areas where wildlife habitat enhancement is a recognized part of the roadside management scheme. Essential mowing can be accomplished after the nesting period for upland game birds.

Do not remove more than one-third of the total grass height in a single mowing activity, unless the grass has produced seed and dried. Mowing frequency is dictated by this principle for turf areas in formally landscaped situations. Height of mowing for erosion control grasses shall not be less than four inches and preferably between six and eight inches.

Whenever possible, mowing activities should take place after erosion control grasses have matured and set seed. This is desirable for the health and long-term survival of the grass stand because it allows for root growth and development. It is also important to mow during the seasonal dry period to avoid damage to the grass stand from the tires of the mowers. Mowing when soil is wet causes tire slip and compaction. Tears and exposed soil from tire slip creates windows for erosion and weed invasion.

Do not mow newly seeded erosion control grass stands until the grass has been in place one full year.

As a rule of thumb, mowing will be necessary only for turf within formal landscaped areas to improve sight distance and to respond to local aesthetic considerations. When in doubt about the need to mow, look at the surrounding property. Keep the appearance of the highway roadside compatible with adjacent private property.

Other Cutting Methods

Use saws, axes, and other cutting implements to selectively remove individual plants or parts of plants and to remove plants that are too large to remove by mowing.

When the total plant is removed by cutting, a follow-up application with an herbicide labeled to prevent re-sprouting at the stump may be used. Cutting conifer trees below the lowest limb will eliminate regrowth. Re-sprouting of any tree or shrub will be minimized if the cutting takes place in the summer after the spring growth period is complete. The months of July, August, and September are the most effective period in which to cut trees, brush, and shrubs.

Avoid non-selective trimming on the sides of trees whenever possible. Trees should never be topped. If possible, remove the entire tree rather than damaging its natural form by pruning or topping.

Pruning of trees and shrubs may be necessary to remove unsightly dead stubs or other conditions that may endanger the plant's health.

Cultural Control Methods

Enhancing the competitive capabilities of a desirable vegetation by meeting its nutrient, moisture, and light requirements enables it to dominate the plant community and crowd out undesirable vegetation. Except in irrigated landscapes it is generally not possible to affect the moisture available to plants. Selective removal of plants that are shading desirable vegetation that needs high levels of light can be done in an integrated management plan. Nutrients are supplied through applications of fertilizers that replenish a depleted food supply.

Cultural control methods are essential to establish a desirable plant complex for the future once the competitors have been eliminated by cutting and/or spraying.

Biological Control

Predators normally depend on a very small number or plant species for their survival, which is what makes them effective control agents. However, a host plant will never be totally eradicated by biological methods alone. The population ratio of the host plant and its predator varies on a cycle of approximately seven years. When the population of the predator is high, it will dramatically reduce the population of the target host plant. However, when the host plant population begins to dwindle, fewer predators can be supported and the predator population will also begin to decrease.

Generally, biological control only works on introduced species of weeds that dominate due to a lack of natural predators in the ecosystem that the weed has invaded. In most cases, biological control measures are employed to suppress the spread of existing, well established weed infestations.

Biological control combined with cultural control can sometimes lead to eradication of a weed species such as Tansy Ragwort. Cinnabar Moth larvae feed on the Tansy Ragwort blooms. A Seed Fly reduces seed production, and a Flea Beetle reduces the plant's vigor by feeding in the crown and stems. Tansy Ragwort is a biennial plant that blooms and then dies if seed is produced in the second year. By introducing the biological predators, the seed produced is very limited. This limited number of seeds has little chance of establishing as plants if the surrounding soils have grass or other native vegetation that has been enhanced by a good fertilizer program.

The Cooperative Extension Service through Washington State University can provide assistance in evaluating the potential success of a biological control program.

Burning Debris

Burning of brush, slash, tumbleweeds or any other waste shall be accomplished in a manner and time that conforms to the rules and regulations of the regulatory agency for that area. Contact local air pollution authorities and fire departments regarding burning requirements.

Illegal Tree Removal

RCW 47.40 states that removal or damage to any desirable plant on the right of way by an unauthorized individual is a misdemeanor and punishable by law. RCW 64.12.030 and 040 discuss how courts assess damages for injury or removal of desirable plants. In cases where actions are witnessed or where it is obvious who the perpetrator is, the State Patrol and the Attorney General's Office should be called in for assistance.

Unauthorized removal of materials often occur when adjoining parties feel that the trees are blocking visibility across the highway right of way. A desire to have better visibility for their establishment, their product advertising, or simply wanting a better view of the surrounding area may lead these parties to remove vegetation without proper permission.

While it is difficult to continually monitor the entire right of way for this type of illegal activity, certain locations are more prone to neighbor's visibility issues than others and should be watched.

Significant Roadside Activities

Maintenance actions on the roadside can have a significant impact on adjacent property owners and others in the public. Involving appropriate customers in significant roadside maintenance activities will often help improve the publics confidence in WSDOT's ability to manage its transportation system in a manner that is responsive to customer needs.

Advance coordination mandated by this policy may increase the initial cost of any project. But, better communication and public involvement will result in fewer complaints, enhance department credibility and improve public trust.

Definitions

Maintenance Activity: Any activity undertaken by WSDOT maintenance employees within or adjacent to highways right of ways to preserve, protect, and enhance the safe mobility of the traveling public, the highway facility and the environment.

Significant Roadside Activity: Any activity that will substantially alter the visual appearance of a roadside. Significant activities include, but are not limited to:

- Removal of large stands of vegetation.
- Grading to re-contour slopes or ditches.
- Removal of natural or constructed noise or visual barriers.
- Any activity that alters the visual appearance of more than 1,000 linear feet of roadside.

Significant activities do not include ditch and culvert cleaning, herbicide applications, mowing, erosion/slide repairs, grass seeding/fertilizing, highway hardware repair/ installation, litter pick up, and/or emergency activities that are required as a result of a national disaster.

Notification

Notify the public and appropriate agencies about upcoming significant activities at least one week prior to action. Notification may include, but is not limited to the following actions:

1. Telephone call.
2. Flyer delivered to each residence.
3. Mailed notice.
4. Posted sign.
5. Newspaper news release.
6. Personal one on one contact.
7. Posted notice on local bulletin boards.

8. Public service announcement on radio or television.
9. Legal notice.
10. Town meeting.

Removal of Debris and Rubbish

Debris and rubbish deposited on or along the highway is picked up and disposed periodically as necessary. Debris such as fallen branches and articles that have fallen from vehicles, rocks, or earth slides onto the traveled portion of the roadway or onto shoulders or ditches should be removed immediately.

The remains of animals killed by motor vehicles should be removed promptly and buried at convenient locations. If license tags are present on domestic pets, notification of appropriate city or county is encouraged. The Wildlife Road Kill Report, Form 335-002, should be completed, especially for deer and elk, and submitted to Headquarters. This record of killed wildlife aids in the placement of signing and other preventive measures.

Occasionally, items of value are cleared from the right of way. If possible, the owners of the property should be notified. Otherwise, the property is retained for 30 days and the area office is notified. Generally, owners of such property will contact the department. If the property is not returned to the owners, the region either places the item in inventory or declares it surplus.

Litter Control and Partnerships for Roadside Enhancement

Litter is highly visible. A clean or littered roadside creates a perceived indication of the overall maintenance service level. Litter control and local community roadside enhancement are not high maintenance priorities. Roadside partnerships allow WSDOT to accomplish roadside clean up and enhancement at minimal cost.

Responsibility for litter control on state highways is shared between WSDOT and WSDOE.

WSDOE administers a fund generated through a state tax on the sale of all containerized goods, and is charged with leading education and prevention programs. WSDOE also utilizes a portion of the fund to pay for litter pick up programs, which may be employed to assist with cleaning litter on state highways.

The majority of litter pick up initiated by WSDOT takes place through the administration of the Adopt-a-Highway (AAH) program. WSDOT maintenance employees typically pick litter in advance of mowing operations to prevent shredding and spread of litter by mowing equipment, or where large debris such as discarded furniture items and tire shreds are present and pose a hazard to traffic.

The largest maintenance expenditure for litter control results from the pick up and disposal of bags filled by AAH volunteers, and WSDOE sponsored programs.

Adopt-a-Highway

The Adopt-A-Highway Program (AAH) allows citizens and businesses an opportunity to contribute to a cleaner environment and an enhanced roadside appearance through partnership with the WSDOT. The program is authorized and governed by state law as defined in RCW 47.40.100.

The program is intended for use in those situations where a volunteer group or business entity wishes to help WSDOT in the performance of litter control or other activities that will enhance the appearance of the roadside. Any activity undertaken as part of this program must be in the primary interest of the traveling public and must contribute to an improved visual and/or environmental condition. The outcome of any activity must be compatible with the surrounding roadside conditions and the department's overall policy and program goals.

Program Rules

It is important to maintain a level of consistency in administration of the program throughout the state, but the individual area maintenance offices must be somewhat flexible in their interaction with participating groups. Management of the program will therefore vary to some degree throughout the state; these rules and procedures are intended to provide consistency on statewide programmatic and legal issues.

Participant Eligibility

Any organization, individual, family, business, corporation, or combination thereof may participate in the Adopt-a-Highway Program by either voluntary efforts or by financially sponsoring roadside enhancement activities. The terms for each assignment shall be specified on the Adopt-a-Highway Agreement and subject to the following rules:

The name displayed on the AAH recognition sign shall be the official name of the organization, individuals, or business. Only the name may be displayed on the sign, no other information may be included. In the case of privately sponsored adoptions, where logo panels are provided by the sponsoring organization, additional information may be included if it is part of the organization's official logo.

Organizations shall <u>not</u> be eligible if their name:

1. Endorses or opposes a particular candidate for public office.
2. Advocates a position on a specific political issue, initiative, referendum, or piece of legislation.

3. Includes a reference to a political party.
4. Includes any words or reference to anything that may be considered or construed to be obscene to the general public.

Organizations whose agreements are terminated for failure to comply with terms shall be ineligible for participation until five years from the date of the termination.

Assignment of Sections

Sections shall be assigned on a first come, first served basis. Consider the type of location and anticipated volume of litter in relation to the type of group or privately sponsored adoption. Assignment of groups, locations, management of waiting lists, and special limitations or restrictions are determined by the regions. Limit volunteer adoptions due to safety concerns in locations with high traffic volumes, high litter volume, or difficult access. Sponsored adoptions may occur anywhere except construction zones. Standard litter control sections range from a minimum of two centerline miles to a maximum of ten centerline miles in length. Single organizations may adopt as many sections as desired, but each section adopted by that organization on a given route must be separated by a minimum of ten miles in the direction of travel. Wherever possible assign new adoptions next to existing adoptions.

Sometimes the AAH Program is used to initiate a roadside enhancement in addition to or other than litter control. The activities may include planting projects or graffiti removal. In these situations assignments may be made for specific locations less than two miles in length, such as at interchanges or bridge crossings.

For type and placement of AAH participant recognition signs, see *Traffic Manual* (M 51-02) Chapter 2.7.J and Appendix 2-9, signs 16-901 thru 16-905.

AAH agreements last for a minimum period of two years. The termination or renewal date for all agreements is February 28, unless otherwise canceled by either party. Agreements can be terminated by either party upon 30 days notice. For routine two year renewals, organizations with previously assigned sections have first right of refusal for their sections upon renewal.

Interruption of agreements may occur due to highway construction or improvement projects. WSDOT will notify all affected participants in the event of interruptions. During this period the area will be reserved for the original participants. Upon completion of construction the original participants have the option of renewing or terminating the agreement.

In some cases it may be desirable to establish agreements for special clean up or enhancement activities through a General Permit with Special Provisions for Roadside Maintenance.

Volunteer Adoptions

Volunteer adoptions are established through the form titled Adopt-a-Highway Agreement for Volunteers (Form 520-029) (see Figure 6-2).

Each volunteer organization participating in the program shall have a designated leader or coordinator.

All participants shall be at least 15 years of age.

All participants will submit a signed Adopt-a-Highway Participant Registration Form (see Figure 6-3) to WSDOT. This includes the requirement for signed parental consent to be submitted for all minors (participants under the age of 18), prior to their participation in any roadside activities.

During roadside clean up or enhancement activities, there shall be at least one adult supervisor present for every eight minors.

Upon completion of any and all AAH events, volunteers shall complete and submit to the department within seven days an Adopt-a-Highway Volunteer Participant Activity Report (see Figure 6-4).

Sponsored Adoptions

Sponsored adoptions are established through the form titled Adopt-a-Highway Agreement for Privately Sponsored Work (Form 520-028) (see Figure 6-5). This is a three party agreement between WSDOT, the sponsoring organization, and the organization providing the clean up or enhancement. WSDOT is not responsible for agreements or contracts made between a sponsoring organization and the organization providing the clean up or enhancement. Sponsored adoptions may be initiated by either a sponsor or a potential contractor wishing to solicit a sponsor. Agreements are granted on a first come, first served basis and will only be granted when a sponsor or contractor presents a copy of a signed contract to conduct the required work.

The cost of privately sponsored adoptions and the work involved is intended to be covered by the sponsor. The agreement between the sponsor and the sponsor's contractor must include provisions for all the equipment, materials, labor, and insurance necessary to accomplish the work specified in the agreement. Sponsors are required to pay a fee to the department covering the cost of sign fabrication, installation, and maintenance. The fee is based on the size and total number of signs required to satisfy the agreement, times the average cost per square foot for fabrication, and installation of the signs. The per sign cost also includes a nominal administration fee to help defer the cost of establishing the agreement and coordinating with the sponsor and the sponsor's contractor over time.

Washington State Department of Transportation

Adopt-a-Highway Agreement for Volunteers

Agreement Number:

This Agreement is made and entered into and between the Washington State Department of Transportation (WSDOT), hereinafter called the "Department" and

_____,
hereinafter called the "Grantee".

Whereas, the Department is granted the authority under RCW 47.40 to establish a state-wide Adopt-A-Highway Program: And whereas the Grantee wishes to contribute toward the effort to enhance roadside appearance;

The Department does hereby authorize the Grantee permission to participate in the Adopt-A-Highway Program by picking up litter, and conducting other enhancement work if specified, within the assigned section of highway designated below, in accordance with the following terms and conditions:

The Grantee does hereby agree:

1. To conduct activities in a safe manner and comply with any conditions as may be required by the Department for safety of the participants. Safety is the number one priority of the program.

2. To assign a leader to each crew, and that crew leader shall have a copy of this agreement with him/her while working on the roadside.

3. To pick up litter no less than _____ times per year. Additional clean ups should be done as necessary to maintain a neat appearance. Recommended interval for cleanup is:

   _____.

   One cleanup shall take place during the month of _____.

4. To have all participants wear the hat and vest furnished by the Department when out on the roadside. No more than _____ people shall participate in the activity at one time.

5. To have no more than _____ vehicles parked on the highway shoulder within the assigned area during an activity.

6. Participants shall be 15 years of age or older. The Grantee shall furnish supervision by one or more adults for every eight (8) minors (under 18 years of age) participating in the activity.

7. Each participant shall receive and review safety training materials and training aids provided by the Department before participating in a roadside activities.

8. To obtain supplies and materials from the Department during regular business hours.

9. To comply with all specifications in the attached Adopt-a-Highway Program Traffic Control Plan when conducting program activities.

10. To place filled bags at the highway shoulder for pickup and disposal by the Department.

11. Participants who find anything that they suspect to be hazardous shall not touch it, but take appropriate precautions and report the location and description of the material/substance to the Department Representative.

DOT Form 520-029
Revised 1/98

Adopt-a-Highway Agreement for Volunteers (Form 520-029)
Figure 6-2

Adopt-a-Highway Participant Registration Form

Name of Adopting Organization			
Name of Participant		Last four digits of Social Security Number	
Address	City	Zip Code	Telephone Number
Person to notify in case of emergency		Relationship	
Address	City	Zip Code	Telephone Number

The Washington State Department of Transportation's Adopt-a-Highway Program allows volunteers to enhance the appearance of Washington's state highways. Participants are advised that working adjacent to a state highway can be hazardous and shall exercise due care in performing litter pick up activities. Participants must receive safety training utilizing training aids furnished by the WSDOT prior to participating in any cleanup activities. Participants shall wear the hat and vest furnished by WSDOT, and appropriate protective clothing during cleanup activities.

Participants are entitled to receive full coverage for medical treatment necessitated by an injury incurred during participation in the Adopt-a-Highway Program under the Medical Aid Provisions of the Worker's Compensation Act, which is administered by the Department of Labor and Industries, but not for loss of time due to injury or illness or for lasting disability or death.

By signature below I verify that I am a volunteer, 15 years of age or older, have viewed the Adopt-a-Highway Safety Video, and read the Adopt-a-Highway Safety Tips Brochure. I also understand the right, responsibilities, and privileges of participation in the Adopt-a-Highway Program, and agree to hold harmless the Washington State Department of Transportation and their employees from liability for damages or injury resulting from my participation in this program.

Signature of Participant
Signature of Parent of Guardian if Participant is under the age of 18 years

Adopt-a-Highway Participant Registration Form
Figure 6-3

Adopt-a-Highway Volunteer Participant Activity Report

All participants must have a signed Adopt-a-Highway Volunteer Registration Form on file with WSDOT.

Name of Organization Agreement Number

Name of Group Leader

Date	Participant Name (Please print)	Last Four Digits of Social Security Number	Hours Worked		
			From	To	Total

Number of Bags Picked Up _____ Total Hours This Sheet

List any activities accomplished other than litter control:

Completion of this form after each event is required by law to secure provision of program medical aid benefits.
Return completed form within seven calendar days after each litter pick up to:

Adopt-a-Highway Volunteer Participant Activity Report (Form 520-030)
Figure 6-4

Washington State Department of Transportation

Adopt-a-Highway Agreement for Privately Sponsored Work

Agreement Number:

This Agreement is made and entered into and between the Washington State Department of Transportation (WSDOT), hereinafter called the "Department" and

_____ ,
hereinafter called the "Grantee".

Whereas, the Department is granted the authority under RCW 47.40 to establish a state-wide Adopt-A-Highway Program: And whereas the Grantee wishes to contribute toward the effort to enhance roadside appearance;

The Department does hereby authorize the Grantee permission to participate in the Adopt-A-Highway Program by privately contracting with:

_____ ,
hereinafter called the "Grantee's Contractor",

to accomplish (1) the work described below, (2) within the assigned section of highway designated below, and (3) only in accordance with the following terms and conditions:

The Grantee does hereby agree:

1. Maintain and honor a separate contractual agreement with the Grantee's Contractor to accomplish all work as described in this agreement.

2. To pay a fee of $_____ to the Washington State Department of Transportation, to cover the cost of sign fabrication, installation and maintenance, and the cost of administering this agreement.

3. To notify the Department in the case of any change in party designated as the Grantee's Contractor and cooperate in the execution of a new agreement prior to new Grantee's Contractor engaging in any work.

4. To ensure that the Grantee's Contractor's work is in compliance with the terms of this agreement. Non-compliance will result in a termination of this agreement upon 30 days written notice.

5. To ensure that the Grantee's Contractor complies with all the necessary safety requirements, private insurance requirements, reports to the Department, procedural requirements and all other terms and provisions as described in this agreement.

6. In the case where the Grantee's Contractor is a private and independent contractor, the Grantee shall obtain at its sole cost, or cause the Grantee's Contractor to obtain at its sole cost, and keep in force during the term of the agreement, for the operations specified in this agreement, the following insurance requirements with companies licensed to conduct business in the State of Washington and approved by the State Insurance Commissioner pursuant to Chapter 48.05, RCW:

   A. Commercial General Liability Insurance written under Insurance Services Office Form CG0001 or its equivalent with minimum limits of $1,000,000 each occurrence and $2,000,000 in the aggregate for each policy year with the State of Washington named as an additional insured in connection with the Grantee and Grantee's Contractor's performance of the work specified in this agreement.

   B. Commercial Auto Liability Insurance providing bodily injury and property damage liability coverage for all owned and non-owned vehicles assigned to or used in the performance of the work for a combined single limit of not less than $1,000,000 each occurrence with the State of Washington named as an additional insured in connection with the Grantee/Grantee's Contractor's performance of the work specified in this agreement.

DOT Form 520-028
Revised 6/98

Adopt-a-Highway Agreement for Privately Sponsored Work (Form 520-028)
Figure 6-5

Each sponsoring organization shall have a designated contact person. Each organization providing clean up or enhancement work shall have a designated crew leader for each adopted section and a designated central contact for the organization.

If, during the agreement period, the sponsoring organization fails to meet its financial obligation for the activities specified, WSDOT will allow the organization providing the clean up or enhancement to continue work under the agreement for up to 30 days, at their own expense. If the organization providing the enhancement work fails to obtain a new sponsor within 30 days, the agreement automatically terminates and all agreed upon conditions for default shall apply.

If, during the agreement period, the organization providing the clean up fails to meet its obligation or otherwise dissolves its agreement with the sponsoring organization and discontinues work, the sponsoring organization has 30 days to find a new organization to provide the clean up. If the sponsoring organization fails to contract with a new organization to provide the clean up within 30 days, the agreement automatically terminates and all agreed upon conditions for default shall apply.

Upon completion of AAH events, the organization providing the clean up completes and submits a monthly report to the department.

General Permits for Roadside Enhancement

In some cases a General Permit with Special Provisions for Vegetation Management may serve as the most appropriate means to accomplish proposed roadside enhancement or special clean up work. Use this as an option over an AAH agreement if:

- The permit Grantee is not interested in recognition through the AAH program.
- The proposed work overlaps with existing AAH litter control assignments.
- The proposed work is a situation where an abutting neighbor maintains, such as a “No Spray” agreement.
- The proposed work consists of a limited number of events.

Fill out all General Permits for roadside enhancement work using the AAH database program. This allows information to be recorded and accessed in relation to any questions regarding statewide roadside partnerships.

AAH Administrative Roles and Responsibilities

Each region, and each maintenance area has unique personnel resources and responsibilities. They must assign responsibilities for the AAH Program to fit their maintenance and operations management structure.

Maintenance and Operations Responsibilities

The State Maintenance Engineer will designate the AAH Program Manager. This position will be responsible for:

1. Establishing and maintaining standard procedures to provide uniform implementation of the statewide AAH Program.
2. Providing, maintaining, and updating a statewide network database containing all participant information and standard forms, agreements, correspondence letters, and recognition certificates for the AAH Program.
3. Developing, producing, updating, and distributing to the regions all public information on the AAH Program. This includes brochures, safety literature, safety videos, and the WSDOT Web site.
4. Maintaining records on all participating sponsored contractors including proof of insurance, and monthly reports.
5. Assisting the regions in coordination of AAH partnerships throughout the state including litter control and enhancement efforts.
6. Overseeing and commenting on all procedures and issues relating to the AAH Program, including review of all proposed agreements which include enhancement activities other than litter control prior to signature.
7. Pay premiums or assessments required under the Revised Code of Washington (RCW) 51.12.035 to secure medical aid benefits under Chapter 51.36 RCW for all volunteers participating in the Program.
8. Record all agreement information and participant activity on the statewide AAH Database and update as needed.

Region Responsibilities

The Regional Administrator may delegate responsibilities for regional management and operation of the AAH Program to best serve the Program in that region. Day-to-day interaction with AAH participants will occur at the maintenance area level, but the area offices will receive varying levels of assistance from the regional offices throughout the state. The regions shall delegate responsibility for the following:

1. Assignment of participating groups or sponsors to appropriate sections of highway.
2. Work with potential partners to develop proposals for roadside enhancement other than litter control.
3. Determine appropriate specifications for all agreements, including frequency of litter pick up, special provisions, and plans for special enhancement projects.

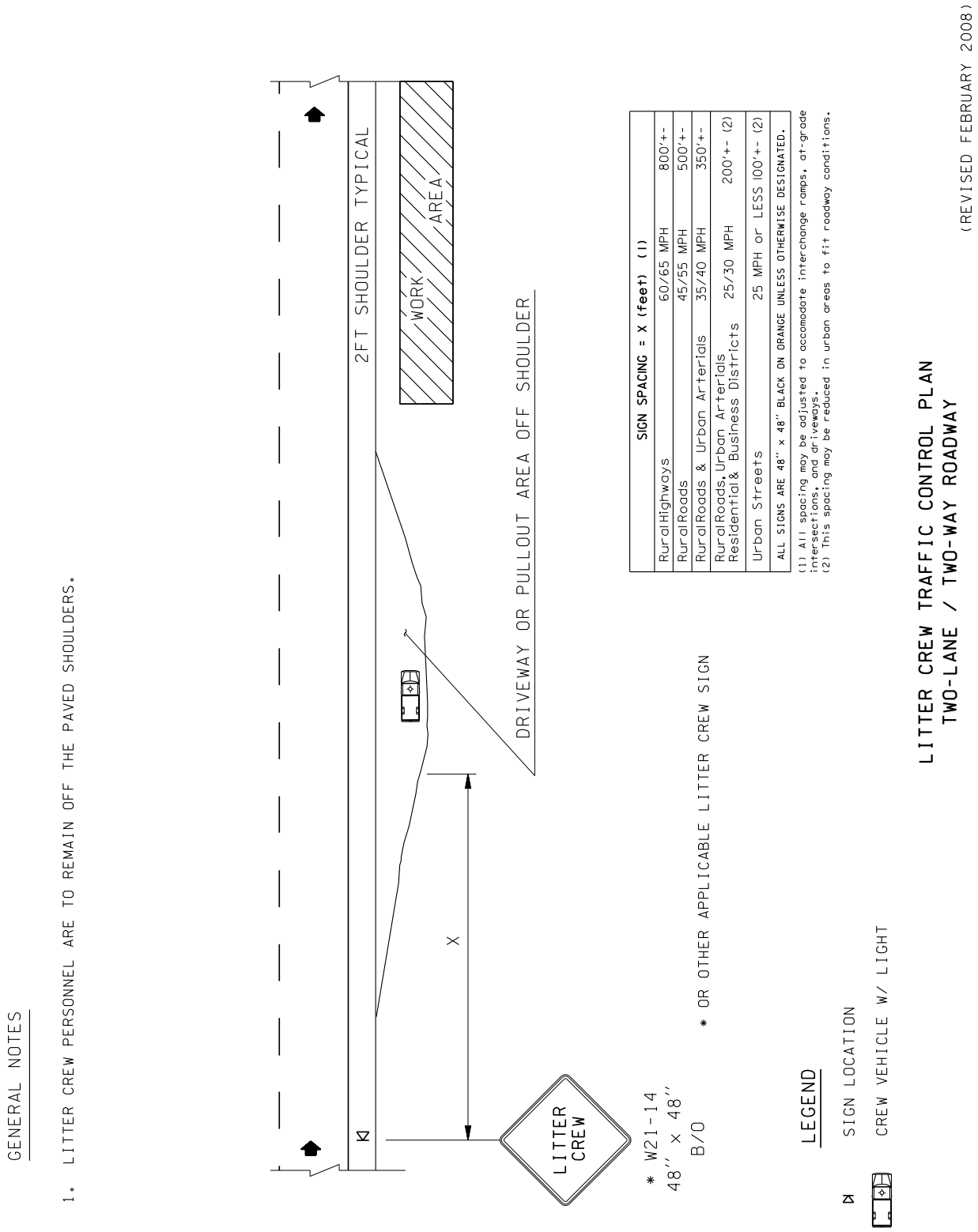
4. Inform and discuss, if requested, with the Washington Federation of State Employees; regional Chief Shop Steward, any projects other than volunteer litter control prior to approval of the agreement.
5. Erect and maintain AAH Recognition Signs in accordance with signing guidelines contained in the *Traffic Manual* (M 51-02) Chapter 2.7.J.
6. Furnish volunteer groups with trash bags, required sign(s) and stand(s), a warning light, hats and vests for all volunteer participants, and all or a portion of the materials and provide assistance required for implementation of enhancement projects other than litter control.
7. Distribute safety information, training aids, and provide consultation to volunteer groups and sponsored contractors.
8. Pick up and dispose of litter bags collected by volunteer participants.
9. Collect and distribute funds paid for privately sponsored agreements to cover costs of sign fabrication, installation and maintenance, and processing agreement.

Guidelines for Litter Crew Traffic Control

- Review traffic control plans prior to going out to pick up litter.
- Drive through assigned section and determine what safety concerns you will be facing.
- No stopping, parking, or buffering in the travel lane.
- Choose a safe place to let crew members out of the vehicles.
- Passengers should get out of the vehicle on the side away from traffic.
- Litter crew members should not walk on the paved shoulder.
- Walk facing traffic whenever possible.
- All litter crew members are required to wear an approved safety vest.

Two-lane/Two-way Roadway (see Figure 6-6)

1. Work areas should be limited to 2-mile increments.
2. Pick litter up only one side of the road at a time.
3. Use pullouts and driveways to get safely off the road.
4. Vehicles must stay off the paved, traveled portion of the highway and should use pullouts and driveways for buffering and loading and unloading.



Litter Crew Traffic Control Plan – Two-lane/Two-way Roadway
Figure 6-6

Shoulder Closure – High Speed Roadway (see Figure 6-7)

1. Work areas should be limited to 2-mile increments.
2. Pick litter up on one side of the road at a time.
3. Vehicles must stay off the paved, traveled portion of the highway.
4. Find a safe place to set up signs and unload crew members.
5. When parking on shoulder, a minimum of 2 feet from the travel lane is required.

Median Shoulder Closure (see Figure 6-8)

1. Work areas are 2-mile increments.
2. Find a safe place to set up signs and unload crew members.
3. Vehicles must stay off the paved, traveled portion of highway.
4. When parking on a shoulder, a minimum of 2 feet from the travel lane is required.

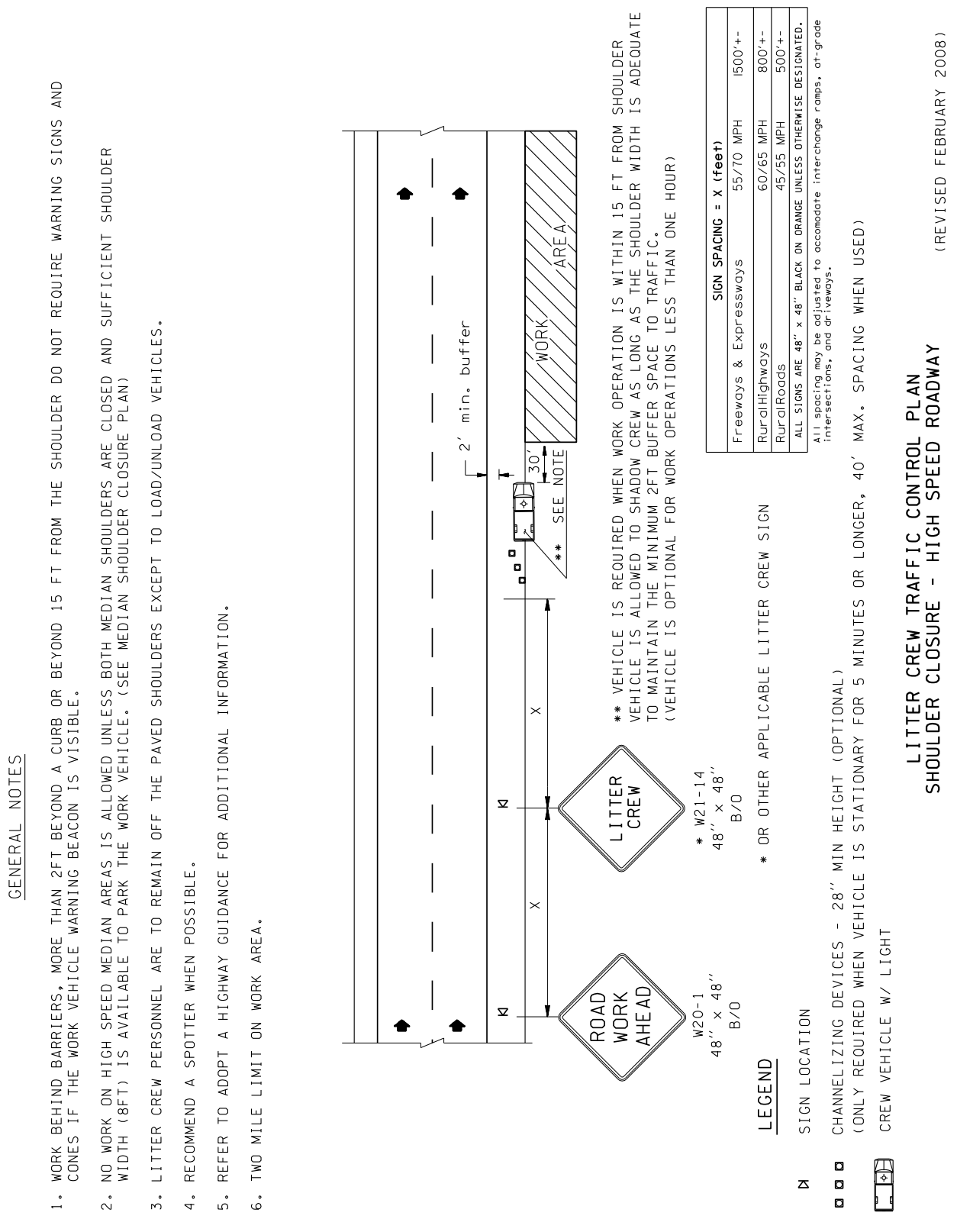
Auxiliary Facilities

Safety Rest Areas

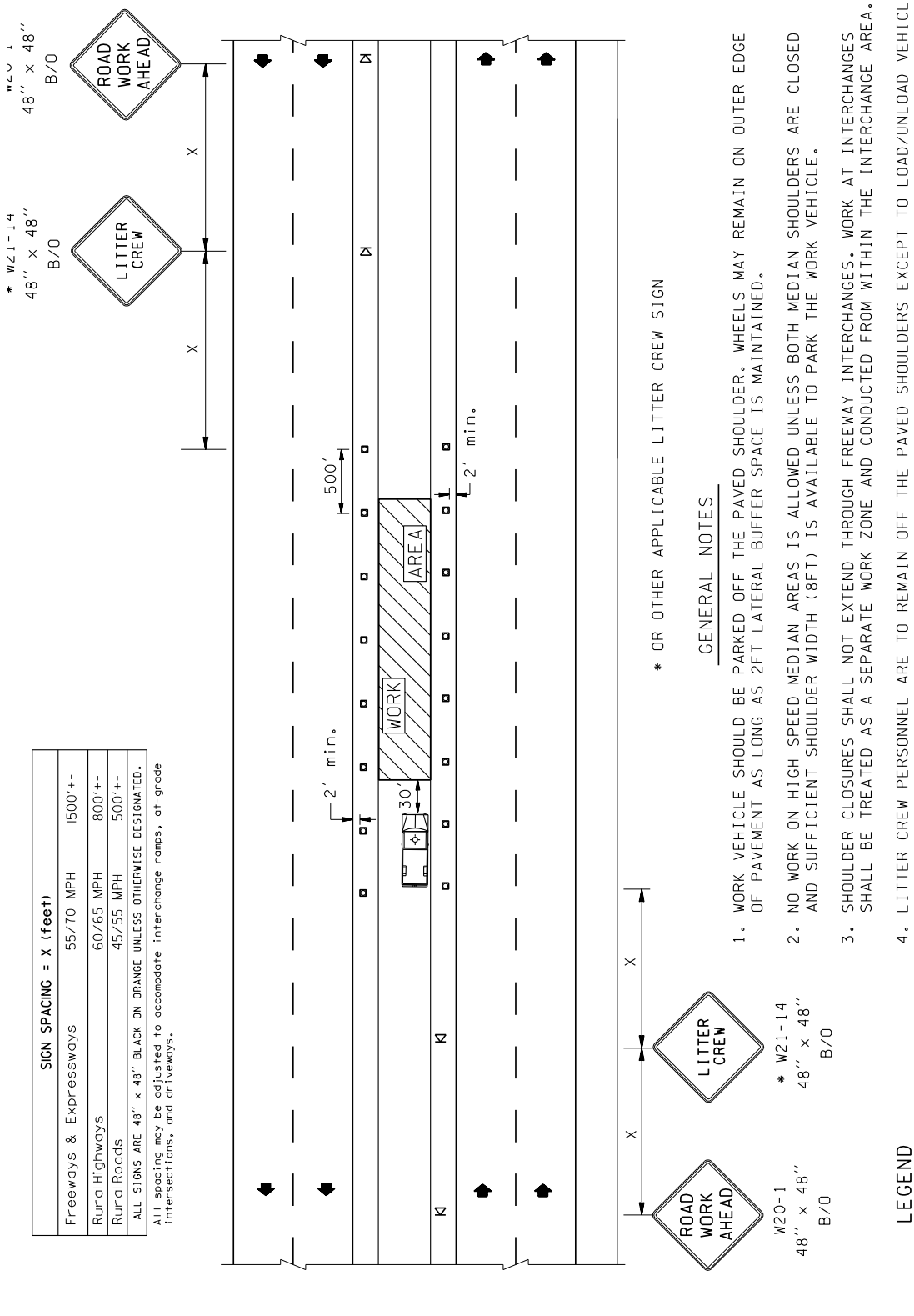
Safety rest areas have been developed throughout the state adjacent to the highway and within the right of way. These facilities provide places where motorists can get off the highway for short periods to nap, stretch, snack, and/or use the rest room. They also provide a safe place to pull over and telephone for help in the event of vehicle break down. Rest areas contribute to highway safety by allowing drivers to become refreshed and more alert when they resume their journey.

Regular maintenance of rest areas is important. A clean functioning rest area gives visitors and taxpayers a good impression of the state and of WSDOT. Frequency of maintenance depends largely on the use of the individual areas. Clean and service rest rooms at least twice per day or at four-hour intervals during periods of high use. Empty all trash cans. Pick up ground litter and have it removed on schedule. Wash and clean picnic tables and benches at least once a week or as often as necessary to maintain a neat appearance.

A poorly maintained safety rest area will tend to collect added trash. Users will have little respect or desire to put his trash in a litter barrel when large amounts of trash are already scattered about. Similarly, graffiti and other vandalism must be quickly repaired or additional abuse is likely. Some areas with toilets that are maintained by the department must receive extra attention and be maintained to a high degree of sanitation. Sewage disposal facilities



Litter Crew Traffic Control Plan – Shoulder Closure – High Speed Roadway
Figure 6-7



SIGN SPACING = X (feet)		
Freeways & Expressways	55/70 MPH	1500'+-
Rural Highways	60/65 MPH	800'+-
Rural Roads	45/55 MPH	500'+-
ALL SIGNS ARE 48'' x 48'' BLACK ON ORANGE UNLESS OTHERWISE DESIGNATED.		

All spacing may be adjusted to accomodate interchange ramps, at-grade intersections, and driveways.

GENERAL NOTES

1. WORK VEHICLE SHOULD BE PARKED OFF THE PAVED SHOULDER. WHEELS MAY REMAIN ON OUTER EDGE OF PAVEMENT AS LONG AS 2FT LATERAL BUFFER SPACE IS MAINTAINED.
2. NO WORK ON HIGH SPEED MEDIAN AREAS IS ALLOWED UNLESS BOTH MEDIAN SHOULDERS ARE CLOSED AND SUFFICIENT SHOULDER WIDTH (8FT) IS AVAILABLE TO PARK THE WORK VEHICLE.
3. SHOULDER CLOSURES SHALL NOT EXTEND THROUGH FREEWAY INTERCHANGES. WORK AT INTERCHANGES SHALL BE TREATED AS A SEPARATE WORK ZONE AND CONDUCTED FROM WITHIN THE INTERCHANGE AREA.
4. LITTER CREW PERSONNEL ARE TO REMAIN OFF THE PAVED SHOULDERS EXCEPT TO LOAD/UNLOAD VEHICLES.
5. MAXIMUM 2 MILE WORK AREA.

Litter Crew Traffic Control Plan – Median Shoulder Closure
Figure 6-8

need scheduled maintenance of septic tanks, drain fields, pumps, filters, and back-flow prevention devices. In some rest areas chemical toilets are provided and maintained under private contract. Check them to assure that they are properly maintained. If they need attention or if there is indication of vandalism, report it immediately.

Some areas are provided with drinking water from springs or wells. Check these regularly for repair and sanitation. Take test samples of water to ensure a clean water supply. Turn off or divert contaminated water supplies until the source of contamination is found and corrected.

Park and Ride Lots

It is the policy of WSDOT to plan, coordinate, develop, and implement effective partnerships for park and ride facilities. Clean, well maintained facilities help to instill a sense of confidence and safety for the users. Maintenance is critical for customer and vehicular safety, accessibility, utilization, protection of the infrastructure investments, and reduction of potential liabilities for the department and/or transit agency.

Whenever possible, maintenance of park and ride facilities is arranged through agreement with the local transit agency. In cases where WSDOT maintenance is responsible for care of a facility, the *WSDOT Park and Ride Facilities Manual* (M 3010.00) provide guidance on activities and procedures.

Historical Markers

Historical markers and other interpretive signing within the right of way are maintained jointly with the Washington State Parks and Recreation Commission. Historical or interpretive signs and associated structures are maintained by Parks. WSDOT maintains road approaches, parking areas, litter barrels, and advance advisory signing.

Viewpoints

Viewpoints have been provided at many scenic locations. Like safety rest areas they are a definite asset and safety factor to the motorist. They generally consist of a parking area with litter barrels. Maintenance requirements are not as intense as for rest areas. But, viewpoints do require regular checks to keep litter barrels emptied and trash picked up. Maintain parking areas and keep fences and guardrail in good repair. Assure all warning signs are in place and clearly legible. Remove all undesirable brush that would reduce sight distance and obstruct the view. Dispose the debris away from the viewpoint.

General

Removal of snow and ice from the roadway is extremely important and takes precedence over all non-emergency work.

The roadway must be plowed, sanded or deiced if necessary, and widened as quickly as possible. Snow and ice removal continues until the job is done, even if it involves working extra hours at night, weekends, or legal holidays. Work vigorously to maintain the roads in as good a condition as is possible with the equipment, materials, and personnel assigned to the work.

The department's policy is to remove snow from all high priority regularly traveled highways. After priority highways are cleared, snow removal occurs on lower priority highways according to established region/area criteria.

Some mountain passes are closed each year once deep winter snows arrive. These road closures occur where light traffic and deep snowfall does not justify the hazard and expense of attempting to keep roads open.

The snow removal operation is intended to provide the prudent motorist with a reasonably safe traveling surface. Although plowing starts soon after the storm begins, it takes time to complete the operation. During heavy snowfalls there may be periods of time when the roads will not be sanded or deiced and the motorist may need to install chains or other traction devices.

Safety for the traveling department and public personnel is the primary consideration at all times.

Economy and efficiency of operation is the goal of all maintenance personnel.

The Snow and Ice Plan is available to view at:
http://wwwi.wsdot.wa.gov/maintops/SI_PlanNovember04-1.pdf .

Preparation for Winter Operations

Make plans early for winter work. Get snow plowing equipment, anti-icing/deicing equipment, sanding equipment, radio equipment, equipment operators, deicing materials, sanding materials, and supplies including signs, flags, barricades, small tools, and equipment parts ready for the first frost or snowstorm. Don't be caught unprepared for an early snow.

Prepare each roadway for effective plowing.

- Keep side ditches clean.
- Shoulders should be smooth and flush with the pavement.
- Clean sand out from under guardrail.
- Cut and remove all tall weeds, grass, and brush that may cause snow drifting.
- Clear right of way fences of wind-blown weeds and sand drifts.
- Erect snow stakes, if necessary, to indicate hazards or the edge of the roadway which may be covered with snow.

Each Area Maintenance Superintendent has maps that shows local priority routes for anti-icing, snowplowing and sanding in multilane and urban sections. Equipment operators are responsible to study the maps and become thoroughly familiar with the priority routes. These maps are available at each maintenance section shed before winter begins.

Maintenance Supervisors are responsible to:

- Assure their employees know what is expected of them.
- Keep records that document work directions given to crews.
- Instruct all operators in the proper operation and maintenance of equipment.

WSDOT has a Winter Snow and Ice Training Program in place that instructs employees on how to properly perform winter anti-icing, deicing, snow plowing and sanding. This training especially targets the intermittent, seasonal and new permanent employee.

Calibrate each sand spreader to make the spreads required at a reasonable speed. Several drivers typically operate the same piece of sanding equipment during the winter. Some drivers may not be familiar with the specifications (or quirks) of a particular vehicle. To remedy this, post a card in the cab of each vehicle showing the truck speed or tachometer reading and adjustment to the spreader to deliver specified spreads. Variations from this calibrated rate may be necessary in accordance with actual field conditions.

Get stockpiles of sand ready for winter use. Locate stockpiles on smooth surfaces. If possible, set stockpiles up to work from the south side with maximum exposure to sunlight. Get loaders ready for operation at these sites.

Snow and ice control chemicals should be mixed into winter abrasives stockpiles only at locations where cold winter weather would typically freeze an un-conditioned stockpile.

When abrasives stockpiles are conditioned, either rock salt or solid, corrosion-inhibited chemicals may be used for this purpose. No more than the minimum amount of chemicals needed to keep the abrasives stockpile workable

should be used. In many locations around the state, this will be a ratio of 20:1 (twenty parts abrasives to one part chemical) by volume. In some areas with wetter climates, a stronger concentration, up to 10:1, is required to keep stockpiles from freezing.

At times, stockpiles are conditioned at a rate stronger than the minimum concentration needed to keep them workable so that ice-melting capabilities are added to the abrasives. This is generally viewed as a less-than-optimal approach to snow and ice control. The current belief is that straight chemicals should be used to melt snow or ice and that adding abrasives to this equation results in costs and adverse impacts that outweigh its benefits. However, if maintenance personnel are working with some unique circumstances where such a mixture provides the most cost-effective method for improved road conditions, they can mix and use stockpiles with stronger concentrations of anti-icing chemicals. In such cases of stockpiles being conditioned at a chemical concentration of stronger than 10:1, only corrosion-inhibited chemicals shall be used.

Highway Categories

The priority of maintenance given to a state highway facility is influenced by the functional class and amount of use (traffic) that it receives. In general highways are prioritized according to the following categories.

Category -1- Highway
Interstate with an ADT (greater than) > 80,000

Category -2- Highway
Interstate or Principal Arterial with an ADT (greater than) > 20,000

Category -3- Highway
Interstate or Principal Arterial with an ADT (less than) < 20,000
Minor Arterial with an ADT (greater than) > 10,000

Category -4- Highway
Principal Arterial with an ADT (less than) < 10,000
Minor Arterial with an ADT (less than) < 5,000
Collector with an ADT (greater than) > 5,000

Category -5- Highway
Principal Arterial with an ADT (less than) < 5,000
Minor Arterial with an ADT (less than) < 5,000
Collector with an ADT (less than) < 5,000

Special Criteria

The priority of a highway may be raised or lowered a category, based on the following special criteria:

1. Importance to commerce, truck routes, etc.
2. Important commuter routes
3. School bus routes
4. Proximity to population centers
5. Curvature and grade of highway alignment

Work on State Highways

Area of Responsibility. Snow and ice control operations on state highways are restricted to the highway right of way. This includes those portions of intersecting public roads that are within the state highway right of way.

Snow Control Operations. Snow control operations consist of removing accumulated snow from the traveled way, shoulders, widened areas, and public highway approaches within highway right of way. When accumulated snow becomes compact and removal is not possible with available equipment, the accumulation is treated as an ice control operation.

Ice Control Operations. Ice control operations are done on the highway and on public accesses within highway right of way. This can consist of pretreatment of the roadway surface with anti-icing chemicals or the application of abrasives and/or deicer chemicals. When removal of compact snow and ice is not immediately possible, an abrasive application at bridges, curves, intersections, railroad crossings, steep grades, and isolated shaded areas is acceptable. Ice and compact snow are best removed under thawing conditions.

If possible, schedule ice and compact snow removal operations during the temperature rise that often occurs between 11:00 a.m. and 3:00 p.m. Use this time to clear surfaces of melting snow and ice, and to remove as much slush as possible prior to evening temperature declines. The use of road graders for ice removal is most effective during this period. Proper use of this warmer temperature period can make the difference between efficient and non-efficient cleanup operations.

Anti-icing & Deicing Chemicals. The use of anti-icing and deicing chemicals containing reduced chlorides such as Calcium Chloride and Magnesium Chloride or no chloride like Calcium Magnesium Acetate is encouraged. Use anti-icers/deicers in all areas where the Regional Administrator has determined there are benefits of such application.

Adverse impacts of a storm can be reduced when forecasts are used to apply anti-icing chemicals. Roadway weather information systems such as “RWIS” help WSDOT estimate the onset of road surface ice. With this information maintenance crews can apply anti-icing treatments just before a storm or ice condition hits.

Level of Service Coordination. Proper snow and ice control operations include coordination between adjacent regions. This assures that obvious changes in level of service on continuous sections of highway are avoided.

Tandem Plowing. Tandem plowing can be used for snow removal on multilane highways. Where reversible plows are available, it is often advantageous to operate one plow toward the left plowing to the median strip. In areas where drifting snow is a frequent problem, caution should be exercised in placing snow on the median A narrow median filled with snow can cause drifting in adjacent lanes. Also, melting snow in the median can cause icy roadways during colder nights. Take care to assure that plowed snow is not thrown into the path of oncoming vehicles or onto a roadway below the highway being plowed.

Spinner Shut-off. In most cases spinner assemblies are used to distribute abrasives. In these situations, turn off the spinner temporarily when the sanding truck meets oncoming traffic. Stop sanding temporarily to allow backed up traffic to pass.

Operations at Interchanges. Interchange ramps are considered as separate roadways independent of the highway they serve. Priorities are determined by traffic volume. Ramp roadways are normally treated after one or more lanes are open on the main roadway.

Railroad Crossings. Never leave a windrow of snow on a railroad grade crossing. Drivers are to raise or otherwise adjust the blade before reaching the crossing to prevent damage to the crossing and/or equipment. Be aware of and avoid any conflicts between snow removal operations and approaching railway traffic.

Widening. Widening for snow storage, established turnouts, mailboxes, etc., may be accomplished when available manpower and equipment permit. Shoulders are often plowed in conjunction with the traveled way, or immediately after the storm is over. Clearing shoulders provides storage space for additional snow, makes the highway safer for motorists, helps prevent drifting, damage to the roadbed from moisture infiltration, and excessive runoff onto the pavement. Perform shoulder plowing in the direction of travel. Always establish proper traffic control before plowing against traffic on the median shoulder of divided highways.

Drainage Ways. Clear all drainage ways from the roadway surface prior to thawing conditions. Utilize a road grader or wing plow if possible.

Highway Sign Installations. Clear snow-covered highway signs after normal snow and ice control operations have been accomplished. Give first attention to regulatory and warning signs.

Construction Projects. Perform state-force snow and ice control operations on construction projects only if the project is open to traffic. Before beginning, assure that appropriate arrangements between region maintenance, construction staff and the contractor have been agreed to.

Pedestrian Facilities. In some urban locations, plowing operations may clog sidewalks or other pedestrian facilities. Regions need to initiate coordination with local jurisdictions in the fall to establish responsibilities and priorities for keeping pedestrian facilities free of snow. Keep in mind that areas outside the curb line are a city responsibility.

City Streets on the State Highway System

RCW 47.24.20 defines the jurisdiction of the state and the cities for those city streets that serve as a part of the state highway system within the corporate limits of a city.

In respect to snow and ice control, the law provides that a city or town shall remove all snow at its own expense. Except, WSDOT is responsible to plow snow on the roadway when necessary. Cities are also required to clean the streets, including catch basins.

Cities generally plow city streets and are expected to plow the state highways in the city as well. State crews are expected to assist by plowing on the way through town. However, plowing on city streets is a secondary priority to be completed after rural lanes have been cleared.

The general exception is routes within cities that are designated as limited access highways. In those instances, the state exercises full responsibility for the entire facility and all maintenance operations.

Work on Other Roads and Areas

Other Governmental Agencies. Snowplowing for other governmental agencies may be performed when authorized, on a reimbursable basis. When winter operations are conducted for other agencies, agreements are processed by the Region Administrator or his/her authorized representative.

Snow and ice control operations on roads and other facilities under the jurisdiction of other governmental agencies are secondary to work on state highways. Work is completed in accordance with the provisions of the agreement with the other governmental agency.

Private Approaches. Snow and ice control on private approaches, including that portion that may be located within the state highway right of way, is the responsibility of the abutting property owner.

WSDOT does not remove snow, ice, or sleet from private driveways, including any portion that may be located within the state highway right of way. All such activities are the responsibility of the abutting property owner.

Snow and ice control activities may inadvertently result in the deposit or the wind rowing of snow, ice or sleet onto private approaches. The department does not assume responsibility for the removal or clearance of such material, even if caused by normal winter maintenance operations. However, all employees involved in snow control operations are expected to be sensitive, considerate, and courteous when carrying out these policies.

Mailbox turnouts on the shoulders may be plowed as a part of the shoulder widening operation.

Abandoned or Illegally Parked Vehicles

RCW 46.55.085 allows the State Patrol to impound abandoned or illegally parked vehicles after documented attempts to notify the owner. This process can require several days. However, if the vehicle is determined to be a hazard, the Patrol can arrange for immediate removal. The State Patrol has requested that WSDOT record any department requests for such removal, in order to support the Patrol's actions should a conflict arise with the owner of the vehicle.

Closures

Occasionally winter conditions are so severe they overwhelm the capability of maintenance crews to effectively respond. This happens despite our best planning efforts and highly motivated crews. Temporary road restrictions or closures may be the only safe alternative in these situations.

The Secretary or his designated representative may temporarily close or place temporary traffic restrictions on any state highway for any reason. The Secretary or designee may also close any state highway, without delay, in an emergency. When it becomes apparent that a road section will be closed by snow, ice, snow slides, or for any other reason, maintenance personnel must take immediate action to safeguard themselves, and the public.

The following actions are taken when a road must be closed for more than an hour.

- The Regional Administrator or designee notifies the State Patrol and other pertinent organizations.
- Immediately erect appropriate traffic control devices advising motorists of the closure and possible detours.
- Take all necessary measures to prevent motorists from entering and becoming stranded in the closed section.

- Keep the Regional Public Information Officer apprised of road conditions so that the news media can be informed of closures. Emergency closures require that the Area Superintendent, Regional Maintenance Engineer, Regional Administrator and the Regional Public Information Officer be notified as soon as possible.
- Keep the State Maintenance Engineer informed of all closures that are expected to last for four hours or more and of all actions taken to reopen the roads.

Emergency Assistance

During winter maintenance operations, limit emergency assistance to actions that safeguard life and property. Time spent helping motorists with minor problems could result in road conditions that would cause more serious problems for other motorists.

Employees may render emergency assistance to motorists, at the motorist's request. Stranded vehicles may be pulled onto the highway, provided the vehicle is driveable. The motorist must make his/her own tow chain or cable hookup and disconnect. This kind of assistance is typically permissible only when snow or ice conditions are reasonably under control and when private towing trucks are not available.

It may be necessary occasionally for an employee to exercise judgment as to whether a motorist is capable of driving his vehicle. Sometimes it appears that the motorist is inebriated or otherwise unsuited to drive. In these situations notify law enforcement agencies by radio or other available means as soon as possible. Employees are required to notify the State Patrol about any accidents that occur on the highway.

Never tow any vehicle that may be unable to proceed because of lack of power or traction, except when the vehicle blocks the traveled way. In this instance, the stalled vehicle may be towed a sufficient distance to clear the normally traveled portion of the roadway to allow the safe passage of other vehicles.

Department employees may not accept compensation of any kind for this or any other type of assistance.

WSDOT desires to avoid situations that can cause the department or its employees to be sued. This has resulted in a general policy that non-employees do not ride in state-owned vehicles. However, employees may provide transportation in state-owned vehicles to stranded motorists under emergency conditions. Employees are advised to consider the particular circumstances and exercise careful judgment.

Precautions

Take precautions to prevent damage to signs, mail box posts, sign posts, and other roadside appurtenances. Rotary snowplow operators are to reduce speed when in an area where adjacent buildings or facilities might be damaged from the flying snow. Redirecting the chutes helps minimize this danger. Utility lines and transformers can also be damaged by rotary plows.

Trucks must be operated at moderate speeds when removing snow, especially when slush exists. When plowing shoulders or when meeting traffic, operators need to be aware of what is going on around them. Stop or slow down occasionally to allow traffic from the rear to pass. Plowing slush at high speeds deposits the slush on signs and other vehicles and thereby obliterates warning signs. Plowing snow at high speeds causes excessive snow clouds, making the highway less safe for the traveling public.

Be especially careful when passing or being overtaken by other traffic. Avoid throwing snow onto windshields and obstructing the vision of other drivers.

Take care while removing snow in the vicinity of cars parked adjacent to the highway. Even though the cars may be illegally parked on the traveled way, take reasonable care consistent with the necessity of accomplishing the work.

Raised traffic buttons are often used in western Washington for lane stripe delineation. Care must be taken to minimize damage to the raised traffic buttons. Snowplows with rubber bits are used for this purpose—they are effective in slushy snow or in snow that has not been compacted by traffic.

Service Level Quality Measurement

The Headquarters Maintenance Office has developed quality performance measurements for snow and ice control. These performance measurements have been established to assess how well maintenance offices are able to control snow and ice. The purpose is to find the best ways to do our jobs with reduced funding and personnel. These measures focus on providing targeted levels of service for snow and ice control based on the highway category and local maintenance area priority. For more details on how this process affects you, check with your supervisor.

General

Traffic services are maintenance functions necessary for the safe and efficient movement of traffic. These include maintaining highway signs, delineators, pavement markings, traffic islands, curbs, impact attenuators, barriers, guardrail, traffic signals, and highway illumination. Each serves a definite function in the control and guidance of traffic. Functions that utilize electricity, including traffic signals, ramp meters, data accumulator systems, changeable message sign systems, and highway illumination systems are discussed in Chapter 10.

The application, installation, and maintenance of all traffic service functions must conform to the accepted practice and standards set forth in the FHWA Manual on Uniform Traffic Control Devices (MUTCD), the WSDOT *Design Manual*, and the WSDOT *Standard Plans for Road, Bridge, and Municipal Construction*.

Reconstruction Principles

The following are samples of items that are subject to reconstruction to meet current design standards. The list is not all-inclusive, but serves to illustrate the updating that can be accomplished.

- Breakaway bases on all sign supports and luminaire poles.
- Guardrail terminals and transitions.
- Guardrail post spacing.

Use the "K Job Estimating Program" to estimate the cost of repairing damaged highway hardware in kind. When upgrading damaged hardware to current standards, attach a sheet to the Repair Cost Estimate to document why the original installation does not conform. This sheet will also show estimated additional materials, labor, and costs to bring the installation up to present design standards. Where possible, take photographs before and after repair and updating, and include in the job file.

The Maintenance Program is intended to fund the repair or replacement of damaged or broken highway appurtenances to current standards. Funding for some upgrades of substandard items, such as the Breakaway Cable Terminal (BCT), will be funded from the P-1 Program. When upgrades of substandard items, such as the BCT, are approved and funded from the P-1 Program an Instructional Memorandum will be sent from the state Maintenance Engineers' Office. It will be used to communicate the item funded, procedural guidance, and work order-coding information.

Use federal aid interstate participation to fund the total cost of updating on interstate highways. If there are any recovered funds from responsible

motorists, subtract these from the amount used to match federal aid interstate participation.

Repair and updating is accomplished by state forces or by contract. On state force work, include the work order number to be charged against on employee time sheets. A standby contract will be used to provide early contractor mobilization to assure fast repair of critical highway hardware damage.

In a region level contract, the Regional Administrator awards a contract in accordance with the delegated authority for contracts. Guidance for administering region level contracts can be found in Directive 51-30 and the *Advertisement and Award Manual* (M 27-02). The amount of State Force Work participation in contracts is governed by the monetary limits shown in RCW 47.28.030.

Signing

Highway signs are erected to convey specific messages to the traveling public. They provide regulatory, warning, and guidance information.

Signing Responsibility

The Regional Traffic Engineer has the authority for the design, location, height, and other features associated with the installation of new signs, and for any revisions that may become necessary.

Region maintenance personnel are responsible for maintaining signs once they are in place, in consultation with the Regional Traffic Engineer.

Sign Installation

Most signs are mounted at approximately right angles to approaching traffic. Parking signs may be installed at an angle 30 degrees or 45 degrees or even parallel to approaching traffic in order to provide visibility to vehicles adjacent to the sign.

Orientation. Normally, signs should be vertically-mounted at right angles to the direction of, and facing, the traffic that they are intended to serve. Where mirror reflection from the sign face is encountered to such a degree as to reduce legibility, the sign should be turned slightly away from the road. Signs that are placed 30 feet or more from the pavement edge should be turned toward the road. On curved alignments, the angle of placement should be determined by the direction of approaching traffic rather than by the roadway edge at the point where the sign is located.

Sign Clearance. Erect signs and their supports with maximum practical lateral and vertical clearance in accordance with the MUTCD or Chapter 820 of the *Design Manual*. This will provide the most safety for motorists who may accidentally leave the roadway.

The near edge of signs is normally located more than six feet outside the edge of shoulder or twelve feet from the edge of the traveled lane. Where curb exists, locate the near edge of the sign no less than two feet from the face of the curb.

Take care when installing signs and their supports behind roadside barriers. Many barriers are designed to deflect upon impact. An inappropriately located sign or support within that area could prevent proper functioning of the barrier and may result in a potentially hazardous situation. Do not locate signs or supports within the deflection areas listed below:

Barrier Type	System Type	Deflection
Cable Barrier	Flexible	11.5 ft.
Beam Guardrail Type 1, 1a, and 10	Semi-rigid	3 ft.
Double sided beam guardrail Type 3 and 4	Semi-rigid	2 ft.
Concrete Barrier-Unanchored	Unrestrained-rigid	2 ft.
Concrete Barrier-Anchored	Rigid	No Deflection

Use two checks when determining the height of post-mounted signs.

1. Assure the vertical clearance from the bottom of the sign to the roadway surface meets MUTCD specifications. This ensures good visibility.
2. Install signs as shown in the standard plans. This ensures that the safety mechanism (i.e., breakaway, slip base, load concentrating coupling, etc.) of the support system will function properly.

Maintenance

Keep all signs in proper position, clean, and legible. Conduct periodic day and night inspections for position, damage, legibility, and general condition. In addition, check sign structures and sign-to-structure connections for structural integrity.

Inspection. In snowy areas, signs may be damaged by plows or by thrown snow or ice. Inspections are most effective after the winter weather has ended. Another inspection is recommended in the fall to ensure readiness for winter driving. In areas where weather is less severe, inspections may be correlated with other maintenance work.

Periodically check sign bridge and cantilever structure end post and metal sign post base connections. In addition, inspect sign mounting bolts and beam clips for proper tightness. Replace or secure missing or loose hand hole covers on overhead sign structure supports. Give special attention to steel sign post base and fuse plate connections. To properly function as a breakaway support while resisting wind loading, the bolt torque specified in the standard plans must be maintained.

Field Repair. Good judgment and sound economics dictate when to perform field repairs. Field repair minor sign damage whenever possible. More extensive damage normally requires sign replacement. Signs such as STOP and YIELD, whose absence can be life threatening, must receive priority replacement.

Signs that are repeatedly knocked down by vehicles may be reinstalled farther away from the roadway or at a different location along the roadway. Care must be taken to ensure that the new location meets MUTCD requirements.

Sign supports within the "clear zone" described in Chapter 2 must meet functional requirements of current safety standards. Sign support design elements are shown in the standard plans.

Never weld the steel sign post web to prevent wind blow-down. Proper fuse plate bolts and bolt torque will prevent blow-down.

Along with proper bolt torque, the area around the sign post base must be clear of obstructions that may prevent the post from slipping free of the base. Ensure that the base stub-post does not project more than 2 ½ inches above the ground. Projections above that height may snag the undercarriage of a vehicle.

Sign Visibility

Promptly remove obstructions that prevent adequate sign visibility. Vegetation trimming is sometimes necessary to ensure adequate sign visibility. Maintenance crews must be particularly careful to avoid parking equipment in front of traffic signs.

At times, highway sign faces are obscured as a result of roadway snow removal. Clear all signs as soon as possible. Regulatory and warning signs have first priority.

Sign Storage and Transportation

Store signs indoors whenever possible to prevent sign sheeting failure. The signs may be packaged if dry. If packaged signs become wet, immediately unpack and separate them to allow drying.

At times, it is necessary to store signs outside. In this situation, remove the packing materials so that nothing is against the sign face. Never lay signs flat. Water accumulating between signs laying flat will cause sign sheeting failure.

Store signs upright on edge on blocks or other material to keep the signs off the ground. Install spacers along the sign edges to allow air circulation and normal moisture evaporation from the sign face. Avoid sign sheeting contact with treated wood. Avoid storage where dirt or water may splash on the sign face.

Transport signs on edge, face to face or back to back, to prevent sign face damage.

Delineation

Delineation is defined as one, or a combination of devices, (excluding signing), that warn or provide guidance to the roadway user. These devices include pavement markings, guideposts, guardrail delineators, and barrier delineators. Delineation of environmentally sensitive areas are identified with specifically marked green guideposts.

Pavement Markings

Pavement markings are divided into two categories: long line and transverse and symbol. Long line markings are the markings that are applied parallel to the roadway. Typically long line markings are renewed with a spray application of new material applied from a striping truck. Typically transverse and symbol markings are renewed by hand, by spray, or extruded application of new material.

Long line markings include the following: center line, no-pass line, double center line, double lane line, wide lane line, double wide lane line, lane line, edge line, solid lane line, dotted extension line, wide line, wide dotted lane line, wide broken lane line, drop lane line, barrier center line, two way left turn center line, and reversible lane line.

Transverse markings include the following: Crosswalk line and stop line. Symbol markings include the following: traffic arrows, traffic letters, access parking space symbol, high occupancy vehicle (HOV) lane symbols, railroad crossing symbols, bicycle lane symbols, drainage markings, and aerial surveillance markers.

Raised pavement markers (RPMs) are installed either as positioning guides along with longitudinal markings or they are installed as a complete substitute for long line markings. Surface mounted RPMs are installed on roadways where snow removal operations use rubber blades. Recessed RPM applications consist of the installation of an RPM in a groove that has been cut into the pavement. Recessed RPM applications are allowed in areas where snow removal operations use steel blades. Various markings are identified by color code as follows:

RPM Type	Color
Type 1W	White non-reflective
Type 1Y	Yellow non-reflective
Type 2W	White one side only
Type 2WR	White and red
Type 2Y	Yellow one side only
Type 2YY	Yellow both sides
Type 2YR	Yellow and red

Descriptions and dimensions of markings are shown in the *Standard Plans,* Section M, PAVEMENT MARKINGS. Application requirements for various markings are shown on the Standard Plans, noted by type as follows:

Marking Application	Standard Plan
Center Line	M-20.10
Center Line supplemented with RPMs	M-20.30
Lane Line	M-20.10
Lane Line substitution with RPMs	M-20.50
Left Turn Channelization	M-3.10
Left Turn Channelization substitution with RPMs	M-20.50
Two Way Left Turn Center Line	M-20.10
Single Lane On and Off Ramps	M-1.20
Drop Lane Line	M-20.10
Two Lane On and Off Ramps	M-1.40
Collector Roads	M-1.60
Traffic Arrows	M-24.20 M-24.40

Marking Application	Standard Plan
Crosswalk line	M-15.10
HOV Lane Symbol	M-7.50
Access Parking Space Symbol	M-24.60
Aerial Surveillance Marking	M-24.60
Railroad Crossing Symbol	M-11.10

RPMs installed as positioning guides along with longitudinal markings are shown on *Standard Plans* M-20.30 and M-20.40. RPMs installed as substitute applications for longitudinal markings are shown on Standard Plan M-20.50.

Materials

Pavement markings are renewed with a material that is compatible with the original application material. Painted markings are renewed at a thickness of 0.015 inches or 15 mils. The glass beads are applied at a minimum rate of seven pounds per gallon of paint. Thermoplastic markings are renewed at a thickness of 45 mils for long line markings and 90 mils for transverse markings. Methylmethacrylate markings are renewed at a thickness of 45 mils for long line markings and 90 mils for transverse markings. RPMs are replaced in kind.

Application

Apply all pavement marking materials in accordance with the material manufacturer's recommendation. Apply all materials when the pavement is clean and dry. Moisture in the pavement is the major cause of most marking failures. Apply paint and thermoplastic materials when the pavement temperature is 50 degrees and rising. Methylmethacrylate material can be applied when the pavement temperature is 40 degrees and rising, provided the pavement is dry.

Paint and methylmethacrylate material is purchased by the liquid gallon. Thermoplastic material is purchased by the pound, then heated and applied as liquid. Material requirements for pavement marking materials for a continuous four inch line are as follows:

Millage	Gallons/Mile (Liquid)	Pounds/Mile (Dry)
15	16.4	-
45	49.2	1100
90	98.3	2200

The Striping Supervisor is advised to contact the area Maintenance Supervisor in advance of any long line marking applications to coordinate maintenance activities and arrange for sweeping of the roadways.

Surface Moisture Test

The presence of moisture on the pavement should be checked whenever conditions are questionable. Presence of pavement surface moisture can be determined as follows:

- *Asphalt or Concrete Surfaces* - Place a 12 x 12 inch square piece of plastic wrap on the pavement surface using duct tape to affix the edges. Let stand approximately 15 minutes and check for moisture bubbles on the inside surface of the plastic. If moisture bubbles on the plastic are larger than a pencil eraser, then the pavement contains too much excess water. Notify the contractor of this condition and postpone all marking operation until the pavement is dry enough to prevent the large moisture bubbles from forming on the plastic.
- *Thermoplastic Applications on Asphalt Only* - Using roofing felt paper, place a 12 x 12 inch square of felt on the asphalt and install the thermoplastic material directly onto the felt paper. Let it cool for approximately 10 seconds, then lift the paper to check for moisture on the back side. If moisture bubbles larger than a pencil eraser are present on the back side of the roofing paper, then the pavement contains too much excess water. Notify the contractor of this condition and postpone all marking operations until the pavement is dry enough to prevent the large moisture bubbles from forming on the back of the felt paper.

Marking Renewal or Replacement Frequency

Pavement markings are renewed when they no longer provide guidance during daytime and nighttime conditions. Markings that may appear adequate in the daytime may have no reflectivity at night. Typically markings fail by loss of reflectivity long before they fail by daytime appearance.

On the majority of our highways, the longitudinal paint stripes will have to be restriped every year to maintain adequate line presence and retroreflectivity.

On low volume highways with minimal snow plowing activity, paint striping may last more than one year. A stripe evaluation should be done that evaluates both the amount of paint remaining on the roadway surface (durability) and

the retroreflectivity of the stripe. The study should determine if the stripe will remain adequate until the next striping maintenance cycle.

Renew applications on the following schedule:

Marking Type	Frequency
Long line painted markings	At least once a year or less determined by evaluation
Heavy wear long line painted markings	At least once a year or less determined by evaluation
Thermoplastic transverse applications	At least once every two years
Methylmethacrylate transverse applications	Every five years
Reflective RPMs (except yellow)	By group every two years
Reflective yellow RPMs supplementing the yellow edge lines on divided highways	Every four years
Non reflective RPMs	Replaced as needed when the associated reflective RPMs are replaced

Removal of Markings

Removed pavement markings can sometimes reappear and confuse motorists. All removed pavement markings must be unidentifiable as pavement markings under day or night, wet or dry conditions.

Do not over-paint markings with black paint or bituminous solutions. This treatment has proven unsatisfactory because the original lines eventually reappear as the overlying material wears away. In addition, lines covered in this manner may still be visible under wet conditions or low angle illumination (headlights) conditions.

Guideposts

Guideposts are classified as guide markings rather than required warning devices. Guidepost type designations and mounting details are noted on *Standard Plan* H-1. Guidepost placement guidelines are noted in *Standard Plan* H-1a-e.

Studies have shown that wildlife warning reflector systems are ineffective at reducing the accident potential for motor vehicle/wildlife collisions. WSDOT policy is to no longer design, place, or maintain wildlife reflectors.

Barrier delineation is used in areas with guardrail or concrete barrier where guideposts are required by other roadway conditions. The spacing of

barrier delineators for these applications is the same as the spacing noted for guideposts. Promptly replace damaged or missing guideposts and barrier delineators.

Traffic Barriers and Impact Attenuators

Traffic barriers, such as beam guardrail, cable barrier, and concrete barrier are used to protect vehicles from hazards within the Design Clear Zone (as defined in Chapter 2) that cannot be removed or otherwise relocated. Hazards may be a single point, such as a bridge pier, or an extensive area, such as steep embankments. Elements of traffic barriers include the standard run of barrier, terminals or anchors for the treatment of the ends, and transitions for connecting to stiffer barriers.

Maintain records with descriptions of observations and repairs.

Maintenance

Barriers must be properly maintained to ensure that they will perform properly when struck by errant vehicles. Keep the area under and around barriers clean and free of vegetation and debris. Do not allow objects that could become projectiles to be placed on top of barriers.

Inspection

Inspect barriers periodically, either by visual drive-by or by physical inspections.

Inspect for:

- The overall condition of the barrier.
- Proper interconnection of units.
- Proper installation of anchor cables and connecting pins.
- Tightness of blocks and fasteners.
- Proper overlapping of beam guardrail.
- Secure attachment of beam guardrail.

Repair

Repair damaged roadside barriers promptly. A response within two weeks is desired unless higher priorities preempt action. Once a damaged barrier has been identified, determine if the barriers will be repaired, replaced, or removed.

Removal of a barrier may be the best solution, but this requires an evaluation of the requirement for a barrier. In some instances the need for the barrier can be eliminated (by flattening slopes or removal of a fixed object for

example). Contact the Region Traffic Engineer for guidance on evaluating the requirement for a barrier. The following guidance is provided for evaluating the requirement to upgrade a barrier:

Standard Run of Barrier

The standard run of barrier is the majority of the barrier run. It includes all of the barrier except the terminals and transition sections. Barriers have evolved over many years and as a result there are systems on Washington State highways that no longer meet current design standards.

Examples of non-standard barriers include:

- W-beam guardrail with 12'-6" post spacing and no block outs.
- W-beam guardrail on concrete posts.
- Cable barrier on wood or concrete posts.
- Half moon or C shape rail element.

If damage to these barriers requires the reconstruction of a significant portion of the run, consider upgrading the entire run to current standards. For minor repairs, upgrade the damaged portion of w-beam barriers to current standards (post spacing, block outs, etc.). Minor repairs to non-standard cable, half moon, or C shaped rails can be repaired in kind as upgrading may not be practical.

Terminals and Anchors

A guardrail anchor is required at the ends of a standard run of guardrail to develop its tensile strength throughout its length. In addition, when the end of any barrier is subject to head-on impacts, a crash worthy terminal is required. Guardrail anchorage may be provided as part of the terminal, as a connection to a rigid structure, or by an anchor whose only purpose is to strengthen the run (Type 4 and 7 anchors).

Many different terminal designs have been used on Washington State highways. Upgrade damaged guardrail ends that do not have a crash worthy design.

Common features of non-crash worthy designs are as follows:

- No cable anchor.
- A cable anchored into concrete in front of the first post.
- Second post not breakaway (CRT).
- Design A end section (Design C end sections are acceptable to be left in place).
- Beam guardrail on both sides of the posts (two sided).

A common terminal that was used on Washington State highways is the Breakaway Cable Terminal (BCT). These terminals included a Type 1 anchor and a parabolic flare that offset the end four feet from the tangent run of guardrail. BCTs that have sustained damage, requiring replacement of one post or one rail section, should be upgraded to a current crash worthy design. The P-1 Program will pay for the cost of upgrading the BCT less the amount billed to a third party using the "K Job Estimating Program." Upgrade damaged BCTs with less than a three feet offset.

If a BCT is to be repaired, no washers can be permitted on posts 2 through 7.

When upgrading to current standards it may be possible to extend the run to a location where the end is less likely to be struck or where it can be buried in a back slope. When burying the end is not possible, consider a flared terminal as shown on *Standard Plan* C-4b or a non-flared terminal as shown on *Standard Plan* C-4e. These terminals are proprietary devices (they can only be manufactured by a licensed company) and the specific details are not shown on the standard plan. The manufacturers drawings that are used in Washington can be obtained from the manufacturer or downloaded from the Internet.

http://www.wsdot.wa.gov/EESC/Design/Policy/RoadsideSafety/Chapter710/Chapter710B.htm

Transitions

Transitions are used to stiffen a system, such as w-beam guardrail before a more rigid barrier such as a bridge rail. Stiffening is accomplished by nesting the rail elements, using bigger posts and reducing the post spacing. The transitions that are currently used are shown in the *Standard Plans*.

If no transition is in place, upgrade a damaged rail by installing a transition as follows:

Connection	Transition Type Installation
Safety shaped bridge rail	Type 1 transition with a B connection
Connection to a bridge rail with a parapet that is less than 20 inches	Type 2 transition with a B or C connection (depending on the width of the curb)
Connecting to unrestrained pre-cast concrete barrier	Type 3 transition with an A connection
Unsure of the proper transition	Contact the Regional Traffic Office

Sometimes damage to a transition is minor, not requiring the replacement of all of the posts. In these situations, existing transitions that have a w-beam rail element can be upgraded by adding an additional (nested) rail element. Upgrading the connection is not required for minor repairs.

Impact Attenuators

Impact attenuators can be used as an end treatment for barriers or to prevent errant vehicles from impacting other fixed objects. Keep records of impact attenuators in use: brand, an illustrated layout showing parts order numbers, module locations and weights, and a photograph of the installation.

Maintenance

Replace and repair impact attenuators in accordance with the manufacturer's recommendations. Check for proper restraining cable tightness, anchor bolt tightness, diaphragm and hardware in good condition, and fender panels securely in place.

Inspect sand-filled barrels to ensure lids are firmly in place and not dented. Make sure there is no moisture inside the modules, no damage or visible cracks in the outer shell. Check that each barrel is filled with the correct amount of dry sand or dry pea gravel. (See manufacturer's specifications.)

If the sand is found to contain moisture, mix salt with the sand at a rate of 10 percent to 20 percent (by volume) to prevent freezing. Some sand may need to be discarded before adding the salt to prevent overfilling the barrel.

Replace damaged water cell units. If one is to be left in place, check for leakage.

Islands

Islands must be properly maintained to provide protection of motorists and pedestrians. Keep island passageways clear of debris. Repaint outlines of islands as directed by the Regional Traffic Engineer. Replace missing or damaged raised pavement markers when more than three consecutive markers are missing.

Displaced or missing raised curb must be repositioned or replaced. Paint raised curb as directed by the Regional Traffic Engineer.

Transit Vehicle Stop Zones

Maintenance

Transit stops along state highways outside cities are maintained by the state. These locations should be kept free of debris, potholes and other obstacles that could cause tripping. The responsibility for maintaining transit stops on state highways inside cities is covered in the agreement discussed in the *Traffic Manual's* transit vehicle stop zone guidelines. An inventory of transit stops is available at the Regional Traffic Office.

Chapter 9 Electrical System Maintenance

General

All electrical systems require periodic maintenance in addition to non-scheduled maintenance caused by unpredictable events such as storms, accidents, and equipment failure. The intent of periodic maintenance is to keep the system operating at an acceptable level of service to the public.

Certain maintenance activities are common to all systems, regardless of type. These activities should always be performed on the cycle applicable for the system. These activities are defined as follows:

Wiring and Connection Maintenance

- Clean conductors, terminals, and connectors of all corrosion.
- Tighten terminals and connectors including breaker, transformer, and contactor connectors.
- Check the equipment grounding system including conduit end bushing connections, bonds, equipment grounding conductors, enclosure grounding connections, and pole grounding connections.
- Check the grounding electrode, grounding electrode conductor, and associated connections.
- Check conductor insulation for damage, and repair if necessary.
- Replace deteriorated or missing conductor and terminal identification markings.
- Reference Standard Specification 8-20.3(5), 8-20.3(8), 8-20.3(9), and Standard Plan J-9a.

Enclosure Maintenance

- Clean enclosure inside and out.
- Repair corroded surfaces, fasteners, and anchor bolts.
- Lubricate lock, latch assembly, and hinges.
- Check door gaskets and base seals.
- Clean vent filter and replace if necessary.
- Clean drain hole.

Documentation

- Note all checks and repairs that are performed.
- Note major repairs that are required.

Changeable Message Sign Systems

- Observe operation.
- Lubricate hinges on varicom signs and check springs.
- Relamp bulb matrix signs.
- Spot-paint changeable message sign lamp visors, sunscreen, and background, where necessary.
- Clean legend on disk signs.

Drain Pump Systems

- Check pump pit for water.
- Check water pipes for corrosion.
- Clean sump.
- Check high water alarm.
- Test pump and lubricate.
- Check heater and thermostat.

Gate and Barrier Systems

Minor

- Check relays, test switch, and limit switches.
- Operate per instructions and check all moving parts.

Major

- Check relays, test switch, and limit switches.
- Operate per instructions and check all moving parts.
- Clean gate surface.
- Tighten all mechanical connections.
- Lubricate shear pins, bull gear, and shaft.
- Check transmission level.
- Check collars.
- Check brake.
- Check heater.
- Remove flash guards and inspect.

Intersection Control Beacons (Includes Hazard Beacons)

- Check flasher assembly.
- Relamp. (Reference Standard Specification 9-29.16(2)A.)
- Clean lens and reflector.
- Spot-paint deteriorated areas of visor and head.
- Check signal mounting.
- Check signal supports.
- Check vertical clearance (16’6" minimum for overhead locations).

Illumination Systems

Roadway Illumination Systems

- Relamp.
- Clean reflector and refractor.
- Check fusing in pole base (Standard Specification 9-29.10).
- Check bolt torque on slip bases.
- Check if conductors are secured on breakaway base installations at adjacent junction boxes (Standard Plan 1e).

- Replace damaged or missing pole identification markings.
- Check junction boxes, adjust if necessary.

Sign Lighting Systems

- Relamp.
- Clean reflector and refractor.
- Check support mountings.
- Check fusing.

Services

- Check photocell.
- Check timers.
- Check contactors.
- Megger test any illumination circuits.
- Replace deteriorated or missing service identification markings.
- Check control transformer on 480 volt services.
- Check test switch.
- Check heater and thermostat.

Signal Systems

(Includes traffic signal systems, reverse lane signals, emergency vehicle signals, data accumulator stations, and ramp meter signals.)

Vehicle Detection Systems

- Check amplifier operation by observing traffic and display panel indicators.
- Check loops and repair if required (Standard Plan 8a).
- Megger test loop circuits and record.

Pedestrian Detection and Display System

- Check all buttons for operation.
- Replace damaged buttons and/or signs (Standard Plan J-5a).
- Clean lens and reflector.
- Relamp incandescent heads (Standard Specification 9-29.20).
- Repair neon grid assemblies as required.
- Spot-paint mounting brackets as required.

Vehicle Display Systems

- Relamp displays. (Standard Specifications 9-29.16(1)A and 9-29.16(2)A.)
- Clean lens and reflector.
- Spot-paint steel mounting brackets. Aluminum or bronze mountings will not require painting.
- Check mountings for wear and tightness.
- Check tether cable assemblies.
- Check seals on aerial junction boxes.

- Check vertical clearance (16’6" minimum for overhead displays).
- Check signal supports, messenger cable connections, and back guys.
- Replace missing cable ties on span wire systems.
- Adjust junction boxes, replace missing or damaged lids.

Signal Control Systems

- Observe controller timing functions.
- Check load switches.
- Check display panel, replace burned out indicator lights.
- Check coordination and communication equipment.

Sprinkler Systems

- Cycle controller on 5 minute cycle.
- Check solenoids.
- Adjust junction boxes.

Television Systems

- Lubricate mounting assembly.
- Check operation.
- Remove camera and shop-test.

Right of Way Fences

Fencing is provided to discourage encroachment onto highway rights of way. Fencing on a controlled access highway is usually owned and maintained by the state while fencing on non-controlled access highways is normally owned and maintained by the abutting property owner. Questions regarding maintenance responsibilities of a given section of fence should be resolved by the Area Superintendent.

Road Approaches- General

No road approaches are allowed without WSDOT authorization. A road approach for private access requires a permit, available at region and area offices, which stipulate the conditions under which it is granted. Such conditions often include allowed width, turn radii, paving and culvert requirements, and specific location to ensure adequate sight distance. The permit holder is normally responsible for maintenance of the approach between the edge of pavement and the property line. If permit violations are identified, the Area Superintendent should be notified. There is a fee charged by WSDOT for new road approach permits. This is to cover the administrative cost of investigating, writing and reviewing the permit. The charge is $50.00 for an individual single family approach and an additional $50.00 for each added user of the same approach.

Typical Maintenance Responsibilities in Cities

Maintenance on streets may become complicated, depending on the type of installation. In accordance with RCW 47.24 and WAC 468-18-050, cities with a population greater than 22,500 have different requirements for some types of maintenance than do cities with a population less than 22,500. In general, the city or town is responsible for any portion of the facility beyond the curbs. If no curb is installed, the city or town's responsibility begins at the shoulder edge.

The following guidelines are designed to clearly identify typical maintenance responsibilities, as determined by statute, agreement, or policy, on city streets that are certified as part of a non-controlled access state highway route. They are general in nature and do not preclude WSDOT and individual cities from entering into agreements to address particular circumstances.

Table 1
City/State Maintenance Responsibilities for City Streets as Part of the State Highway System

Maintenance Item	Population of Cities	
	Over 22,500	**Under 22,500**
Roadway Surface	State	State
Roadway Shoulders	State	State
Stability of cut and fill slopes	City	State
Sidewalks	City	City
Curbs	State	State
Parallel Roadside Ditches	City	City
Roadside Approach Culverts	City	City
Cross Culvert	City (3)	City (3)
Snow Plowing	See Note (4)	See Note (4)
Sanding and De-icing	City	City
Snow Removal	City	City
Sand Removal	City	City
Channelization	City(1)	City
Crosswalks	City (1)	State
Striping	City (1)	State
Directional Signs/Route Markers	State	State
Parking Signs	City	City
Regulatory Signs	City	State
Stop Signs- (Intersecting Streets)	City	State (7)
Signals	City	State
Guardrail, Concrete Barrier, Impact attenuators, etc.	State/City (2)	State/City (2)
Illumination	City (6)	City (6)
Street Cleaning	City	City
Street Sweeping	City	City
Vegetation	City	City

Maintenance Item	Population of Cities	
	Over 22,500	**Under 22,500**
Noxious Weeds	City (5)	City (5)
R/W Encroachments	City	City
R/W Cleanup	City	City
Utility Franchises	City	City
Underground Facilities	City	City

NOTES

1. As a part of state reconstruction/resurfacing projects the state will replace in kind at no cost to the local agency only pavement markings that are damaged or removed as a result of the reconstruction or resurfacing project. This does not apply to durable markings that have exceeded their useful life. Installation of higher quality pavement markings will be at the expense of the city. Early communication and plan reviews between WSDOT and the city is essential to enable local agencies to avoid installation of pavement markings, especially the more durable markings prior to construction.
2. Traffic barriers installed on state highways in areas without curbs shall be maintained by WSDOT. Traffic barriers installed beyond the curb shall be maintained by the cities. Curb in the context of RCW 47.24.020(2) refers to a standard curb and gutter and not to be extruded curb such as those placed on fill sections for erosion control. Guardrail, concrete barriers, impact attenuators and similar devices are all considered to be traffic barriers.
3. Within all cities, regardless of population, the state shall solely maintain the structural integrity of box culverts, multiplates and individual culverts greater than 60 inches in width that are within rights of way and are not part of an enclosed drainage system. These are the size appropriate to identify natural stream flows. Those structures that are less than 60 inches in width will be maintained be the cities. Cities shall maintain all other parallel roadside ditches and road approach culverts. Grass-lined swales constructed by the state solely for state highway runoff will be maintained by WSDOT.
4. RCW 47.24.020(6) provides that the cities have responsibility for snow and ice removal within their jurisdiction and that the state shall, when necessary, plow the snow on the roadway. The meaning of "when necessary" is that the state will plow snow, with city concurrence, on the traveled lane of the state highway on the way through the cities not having adequate snow plowing equipment.
5. RCW 47.24.020(2) states that the city or town shall exercise full responsibility for and control over any such street beyond the curbs and if no curb is installed, beyond that portion of the highway used for highway purposes and, thus, are responsible for noxious weed control.
6. The state has responsibility for maintenance of illumination systems within fully access controlled areas. In addition, the state may, with city concurrence, maintain and operate luminaires at locations where the electrical service powers electrical equipment under both state and city responsibility.
7. WSDOT, with city concurrence, may install stop signs and posts to the city's standards or may contract with the city to have them perform these installations.

Table 2
City/State Maintenance Responsibilities For Bridges That Convey Non-Limited Access State Highways That Are Also City Streets
(Unless Otherwise Covered Under A Separate Agreement)

Maintenance Item	Population Cities	
	Over 22,500	Under 22,500
Structural Related Bridge Maintenance	State	State
Bridge Condition Inspections	State	State
L/C Overlays on Structures	State	State
Bridge Deck Membranes	State	State
Structural Asphalt Overlay on Bridge	State	State
Non-Structural Asphalt Overlay on Bridge	State	State
Approach Slab	State	State
Bridge Deck Joints	State	State
Bridge Railings	State	State
Graffiti	City	City
Deck Sweeping	City	City
Bridge Drains/Drainage	City	State
Striping	City	State
Illumination	City (2)	City (2)
Snow Plowing	See Note (1)	See Note (1)
Snow Removal	City	City

NOTES

1. RCW 47.24.020(6) provides that the cities have responsibility for snow and ice removal within their jurisdiction and that the state shall, when necessary, plow the snow on the roadway. The meaning of "when necessary" is that the state will plow snow, with city concurrence, on the traveled lane of the state highway on the way through the cities not having adequate snow plowing equipment.
2. The state has responsibility for maintenance of illumination systems within fully access controlled areas. In addition, the state may, with city concurrence, maintain and operate luminaires at locations where the electrical service powers electrical equipment under both state and city responsibility.

Table 3
State Owned Bridges That Convey City or County Traffic Over a Limited or Non-Limited Access Highway Corridor
(Unless Otherwise Covered Under A Separate Agreement)

Maintenance Item	City/State	City/State
Structural Related Bridge Maintenance	State	State
Bridge Condition Inspections	State	State
L/C Overlays on Structures	State	State
Bridge Deck Membranes	State	State
Structural Asphalt Overlay on Bridge	State	State
Non-Structural Asphalt Overlay on Bridge	City(1)	County (1)
Approach Slab	City (2)	County (2)
Bridge Deck Joints	See Note (3)	See Note (3)
Bridge Railing	State	State
Graffiti	City	County
Deck Sweeping	City	County
Bridge Drains/Drainage	City	County
Striping	City	County
Illumination	City	County
Snow Plowing	City	County
Snow Removal	City	County

NOTES

1. Cities/counties should obtain the states concurrence prior to performing non-structural asphalt deck overlays on state owned structures.
2. Approach slab maintenance is the primary responsibility of the city/county. In the case where the state performs a structural overlay on the bridge deck, the state may extend the overlay onto the approach slab to provide for a smooth transition on or off the bridge.
3. Joints located on the bridge deck are the responsibility of the state. Back of pavement seat joint repairs are the responsibility of the city/county unless they affect the structural integrity of the bridge.

The State has full maintenance responsibility for bridges conveying a State Route or Interstate traffic in a limited access corridor (unless otherwise covered under a separate agreement).

Maintenance Yards

All maintenance yards are to be kept in a neat, clean, and orderly condition. All buildings are to be kept in good repair, inside and out, and are to be repainted when necessary.

Truck sheds are to be kept clean of debris and free from fire hazards. Gasoline and other highly flammable materials should not be stored in buildings where trucks or equipment are stored. Oily rags should be kept in metal containers.

Materials and supplies are to be stored in an orderly manner and an inventory is to be kept of all materials and supplies on hand. All buildings and yards are to be kept locked when not occupied by responsible personnel.

Hazardous wastes i.e. (solvent contaminated rags, methyl methacrylate wastes, and paint residues) are to be placed in proper containers, labeled with a yellow hazardous waste label and disposed of properly within (90) days.

Stockpile Sites

Stockpile sites are to be cleared of all vegetation, trees, brush, rocks, or other debris, and a uniform ground surface is prepared prior to depositing stockpile material. The site chosen should attempt to minimize visual impact, especially in urban areas. Stockpiles are to be constructed in a neat and regular shape, occupying as small an area as practical, and accessible for loading material onto trucks without obstructing the highway. Stockpiles are built up in layers. Plank runways are required for operating trucks on stockpiles where there is danger of tracking dirt or other foreign matter onto the material.

Signs that identify the material as state property should be placed at each stockpile.

Sites where materials are stockpiled year-round or for a considerable period of time should be fenced with signs placed along the fence line identifying the site as state property and the gates kept locked.

Stockpiles should periodically be inspected for vegetation growth, which should be removed.

Maintenance personnel should inspect stockpiles regularly and be on the alert against any removal of materials by unauthorized persons. The inspection should also note potential storm water impacts off-site and corrections should be made as appropriate.

Material used by state forces is to be promptly charged out and reported to the area office. Excessive amounts of materials should not be allowed to accumulate in stockpile sites. If use of stockpiled materials is not anticipated, the area office should be notified so the material can be declared surplus.

Materials from State Quarries or Pits

Materials produced or manufactured in state-owned or leased pits or quarries may not be sold, or otherwise disposed of, to private individuals or concerns.

Counties and cities or other governmental agencies may participate by having their requirements included in the state's crushing contract, with proper financial arrangements. It is the state's policy to assist other governmental agencies in need of small quantities of crushed rock by selling them material from existing stockpiles at current inventory prices if the material can be spared.

When quarry or pit sites are obtained from the Department of Natural Resources, the material is to be used for state highway construction or maintenance, or by other approved public agencies. Notify the area office when material from such pits and quarries is used.

Ecology storm water permits are required at pits and quarries where aggregate is being mined or crushing operations are taking place. Contact the regional Environmental Office for information.

Procurement of Materials

Materials necessary for highway maintenance are generally available from the inventory of materials in stores. Stores should be checked well in advance of need, if possible, to help ensure that materials will be available when required. Materials not available must be purchased by personnel in the area or region office. This purchasing process can take weeks or even months for certain materials. Therefore, it is imperative to plan ahead whenever possible.

Material Specifications-General

It is WSDOT policy that all materials used by state forces to repair or reconstruct highway facilities and buildings conform within reason to the specifications adopted for like material in new construction.

Specifications are necessary to ensure that the department receives the quality of material required for the intended use, and to permit vendors to quote prices on an equal basis. It is difficult to dispute the quality of any material received if the original order did not explicitly define what was expected. It is imperative that maintenance personnel recognize the importance of specifications. There is a reason for a particular design, mix, formula, type, or dimension being specified. Good workmanship will not counteract the effects of the use of inferior material, material intended for another purpose, or material that would be adequate only under different conditions.

Disposal of Surplus Items

Equipment

If a crew determines that a piece of equipment is no longer needed or is no longer functional they should advise the superintendent or supervisor, providing information on needed repairs, problems, and future needs. This should be done to facilitate the decision on whether to transfer the equipment or dispose of it. A crew is charged for equipment even if it is not being used; therefore, it is important to be sure the equipment is necessary and operable.

Inventoried Items

If it is determined to scrap an article that is carried on an inventory, the region office should be provided with a description of the article, its inventory number, and a statement of its condition. Generally, requests for replacements, with any necessary justification, should accompany the recommendation for disposal.

Non-Inventoried Items

Non-inventoried items with potential trade-in or resale value may be declared surplus and turned in to the area office. Disposal of all items will be in accordance with the Disposal Manual, M 72-91.

Instructions for Radio Operation

General Technique

A standard radio operating procedure has been adopted by WSDOT to promote efficient use of radio facilities. All personnel have been assigned identifying numbers that are used when calling or referring to these units. The first digit identifies the district in which the unit is located, the second digit identifies the division, and the third and fourth digits identify the person. The name of the location of the base station in lieu of the base station number is preferred.

When the channel is clear, a calling operator may initiate a call by stating which number the operator is calling and identifying who is calling. Example: 1755 wishes to contact 175, 1755 would transmit - “175 from 1755.” 1755 then waits for a reply. Don’t repeat a call more than twice if you are not answered. If you are not acknowledged after two calls, sign off by transmitting your call number and wait at least two minutes before repeating a call. A called person should acknowledge a call by answering his own number. As in earlier stated example, 175 would acknowledge by transmitting simply - “175.” If you are unsure of your call number or of the number of the person that you are calling, it is acceptable to use names.

Helpful Reminders

1. Emergency or urgent calls take priority over routine traffic. Therefore, all messages should be broken occasionally to permit another station to interrupt if there is an emergency.
2. At all times keep messages as brief, professional, and simple as possible.
3. Speak into the microphone in a normal tone of voice. Speak as clearly as possible. This is especially important when relaying technical information that the receiver may be unfamiliar with.

4. When receiving numbers in a transmission, the unit receiving should confirm the numbers with the transmitting unit.
5. Before beginning a transmission, listen for radio transmissions already in progress to avoid interrupting any other traffic.
6. Before beginning a transmission, hold the "talk switch" down for a short period (approximately a second).
7. You cannot receive radio traffic while the "talk switch" is down. Be sure to release it after completing your traffic and waiting for the reply.

For more complete instructions, refer to the WSDOT/ Highway Division Standard Operating Procedure Manual, M 58-01 Revised 1984.
Reference: Directive D 58-03.

Work Scheduling and Reporting

The previous sections of this manual were directed at specific maintenance activities. This section briefly covers the need to budget, plan, and report those activities. Since procedures change and various district policies vary, details for these processes are not included. The basic principles, however, will remain the same.

Budget

A new budgetary biennium begins on July 1 of every odd-numbered year. At this time the department begins to spend an appropriation of money that has been established by the legislature. A portion of these funds goes to Maintenance and Operations. In exchange for the biennial appropriation, the department commits to providing a certain, statewide level of service (LOS) for each of the forty activities identified in the Maintenance Accountability Process (MAP). Each region receives its share of these funds. The Regional Maintenance Engineer is responsible for seeing that each Area and Section office receives the appropriate share of the Region's allocation in order to meet the LOS commitments made to the legislature. Specific planning is necessary to determine anticipated work activities and their fund requirements. The key word in this budget plan is "anticipated." It is expected that actual work will not exactly match "anticipated" work. However, most work is expected and the budget plan is the basis for changes in the number of employees, equipment, and materials to accomplish the work.

By state law, units within the department may not overrun their budgets. Supervisors should be notified if budget problems begin to arise.

Scheduling

Throughout the biennium, supervisory personnel must have one eye on the work to be done and one eye on the budget. To ensure that the most important jobs are accomplished within the budget limits, the biennial budget plan must be refined into a work plan for each month's activities. This enables coordination of materials and equipment availability with the work having the greatest priority for that month. Consistent with that monthly plan, Supervisors prepare a daily plan of specific work assignments for the upcoming week. This daily plan will not only recognize the priority items addressed in the monthly plan, but will also be adapted to fit current weather conditions, unexpected events, employee absences, equipment

breakdowns, etc. This is the backbone of good management and alerts all employees of the following day's activity so they can make proper preparation and wear proper clothing.

Reporting

The requirement to report what was accomplished in a day, by whom, and with what equipment and materials is often viewed in the field as relatively unimportant. But even though this reporting may seem excessive, it is the basis for budgeting and planning. Without accurate data on what work is actually done, it is impossible to properly prepare the next budget. And if the budget is unrealistic, planning will suffer and employees, equipment, or materials may be sent to the wrong location. Supervisory personnel should always encourage accurate reporting.

Environmental Sensitivity

Maintenance is WSDOT's most visible activity with respect to environmental consequences. Painting, sanding, anti-icing, herbicide application, mowing and brush control, landscaping, and maintaining drainage are activities that can raise environmental objections. All material handling can have environmental safety implications for our employees and the general public. Environmental, health and safety issues are being addressed through an education and training program provided by Headquarters.

Acronyms and Abbreviations

AAH-	Adopt a Highway
ACP-	Asphaltic Concrete Pavement
BMP-	Best Management Practices
BST-	Bituminous Surface Treatment
DOE-	Department of Ecology
HPA-	Hydraulic Project Approval
IVM-	Integrated Vegetation Management
LOS-	Level of Service
MAP-	Maintenance Accountability Process
MDT-	Measuring Distributor Tank
MUTCD-	Manual on Uniform Traffic Control Devices
PCC-	Portland Cement Concrete
PDA-	Preliminary Damage Assessment
PTO-	Power Take Off
RCP-	Roadside Classification Plan
RPM-	Raised Pavement Marker
RWIS-	Roadway Weather Information System
VMS-	Variable Message Signs
WDFW-	Washington State Department of Fish & Wildlife
WSDA-	Washington State Department of Agriculture
WSDOT-	Washington State Department of Transportation
WSP-	Washington State Patrol

Appendix 1

City Streets as Part of State Highways

Guidelines reached by the Washington State Department of Transportation and the Association of Washington Cities on the interpretation of selected topics of RCW 47.24 and figures of WAC 486-18-050 for the construction, operations and maintenance responsibilities of WSDOT and cities for such streets

April 30, 1997

City Streets as Part of State Highways

The jurisdiction, control, and duty of the state and city or town for city streets that are a part of state highways is specified in RCW 47.24.020; however, the implementing WAC's, directives and manuals have been subject to interpretation. This report documents agreed upon guidelines that have been reached by the Washington State Department of Transportation (WSDOT) and the Association of Washington Cities (AWC) on the interpretation of construction, operations and maintenance responsibilities of WSDOT and cities for such city streets.

These agreed upon guidelines are derived from:

- The draft Task Force Report on City Streets As Part Of State Highway.
- Response to the legislative change that increased the 15,000 city population threshold to a 22,500 population threshold for state versus city responsibilities for certain maintenance responsibilities contained in RCW 47.24.
- Additional discussions by the Department, AWC and several cities on the interpretation of state versus local agency maintenance responsibilities that are illustrated in figures contained in WAC 468-18-050 and on other maintenance responsibilities for city streets that are part of state highways.

These guidelines are designed to facilitate the allocation of maintenance responsibilities between the WSDOT and Washington Cities pursuant to RCW 47.24. The guidelines of this report are not intended to reflect past practices but to apply to future practices. They are general in nature and do not preclude the WSDOT and individual cities from entering into agreements to address particular circumstances.

These agreed upon guidelines will be incorporated in WSDOT manuals and related guidance for maintenance, operations, and construction activities. AWC will distribute copies of this report to their members.

Agreed Upon Guidelines

The agreed upon guidelines of State and city responsibilities for city streets that are part of state highways are contained in the following tables:

- Table 1, City/State Maintenance Responsibilities For City Streets As Part Of The State Highway System
- Table 2, City/State Maintenance Responsibilities Of Bridges That Convey Non-Limited Access State Highways That Are Also City Streets (Unless Otherwise Covered Under A Separate Agreement)
- Table 3, State Owned Bridges That Convey City Or County Traffic Over A Limited Access Or Non-Limited Access Highway Corridor (Does Not Apply To City Or County Owned Bridges)

The following is an explanation of selected items of the above tables that are related to specific sections of RCW 47.24 and to WAC 468-18-050:

1. **Guardrail (Barriers) Maintenance**

   Background: RCW 47.24.020(2) states that "The city or town shall exercise full responsibility for and control over any such street beyond the curbs and if no curb is installed, beyond that portion of the highway used for highway purposes." The statement "...used for highway purposes..." has led to differing interpretations of WSDOT and local agency responsibilities for the maintenance of guardrail.

   Agreed Upon Guideline: Traffic barriers installed on state highways in areas without curbs shall be maintained by the WSDOT. Traffic barriers installed beyond the curb shall be maintained by the cities. Curb in the context of RCW 47.24.020(2) refers to a standard curb and gutter and not to extruded curb such as those placed on fill sections for erosion control. Guardrail, concrete barriers, impact attenuators and similar devices are all considered to be traffic barriers.

2. **Parallel Ditches and Cross Culverts**

   Background: The issue is clarification of what is meant by the RCW 47.24.020(2) statement "...for highway purposes..." for use in interpreting responsibilities of WSDOT and local agencies for maintenance of parallel ditches and cross culverts. Also at issue is responsibility for grass lined swale construction for water treatment purposes as compared to a ditch solely for drainage purpose. In addition a distinction needs to be made between cross culverts related to streams and maintaining natural flows as opposed to those constructed for storm drainage.

   Agreed Upon Guideline: Within all cities, regardless of population, the state shall solely maintain the structural integrity of box culverts, multiplates and individual culverts greater than 60 inches in width that are within rights of way and are not part of an enclosed drainage system. These are the size appropriate to identify natural stream flows. These structures that are less than 60 inches in width will be maintained by the cities. Cities shall maintain all other parallel roadside ditches and road approach culverts. Grass-lined swales constructed by the state solely for state highway runoff will be maintained by the WSDOT.

3. **Betterments - Pavement Markings**

   Background: RCW 47.24.020(13) provides that cities and towns having a population greater than 22,500 are responsible to install, maintain, operate and control all traffic control devices. This has been interpreted to mean that the city or town must replace pavement markings and similar devices when a street is resurfaced (i.e., these markings are not included in the project costs). The issue is that a WSDOT project may destroy very recently installed pavement markings that, especially if they are durable markings (e.g., thermoplastic, raised pavement markers, etc.), involve expense to the city. The cities recommend that in-kind replacement of these markings be a part of the project costs.

   Agreed Upon Guideline: As a part of State reconstruction/resurfacing projects the State will replace in-kind at no cost to the local agency only pavement markings that are damaged or removed as a result of the reconstruction or resurfacing project. This does not apply to durable pavement markings that

have exceeded their useful life. Installation of higher quality pavement markings will be at the expense of the city.

Early communication and plan reviews between WSDOT and the city is essential to enable local agencies to avoid installation of pavement markings, especially the more durable markings, shortly before the construction activity takes place.

4. **Snow Plowing**

Background: At issue is the meaning of the phrase in RCW 47.24.020(6) that states "...except that the state shall when necessary plow the snow on the roadway." This statute states that the city or town, at its expense, is responsible for snow removal. The meaning of "when necessary" and responsibility of snow plowing versus snow removal needed clarification.

Agreed Upon Guideline: RCW 47.24.020(6) provides that the cities have responsibility for snow removal within their jurisdiction and that the State shall, when necessary, plow the snow on the roadway. The meaning of "when necessary" is that the State will plow snow, with city concurrence, on the traveled lane of the state highway on the way through the cities not having adequate snow plowing equipment.

Table 1
City/State Maintenance Responsibilities For City Streets As Part Of The State Highway System

Maintenance Item	Cities Over 22,500	Cities Under 22,500
Roadway Surface	State	State
Roadway Shoulders	State	State
Stability of Cut & Fill Slopes	City	State
Sidewalks	City	City
Curbs	State	State
Parallel Roadside Ditches	City	City
Road Approach Culverts	City	City
Cross Culverts	City (3)	City (3)
Snow Plowing	See Note (4)	See Note (4)
Sanding & De-icing	City	City
Snow Removal	City	City
Sand Removal	City	City
Channelization	City (1)	State
Crosswalks	City (1)	State
Striping	City (1)	State
Directional Signs/Route Markers	State	State
Parking Signs	City	City
Regulatory Signs	City	State
Stop Signs (Intersecting Signs)	City	State (7)
Signals	City	State
Guardrail, Concrete Barrier, Impact Attenuators, etc.	State/City (2)	State/City (2)
Illumination	City (6)	City (6)
Street Cleaning	City	City
Street Sweeping	City	City
Vegetation	City	City
Noxious Weeds	City (5)	City (5)
R/W Encroachments	City	City
R/W Cleanup	City	City
Utility Franchises	City	City
Underground Facilities	City	City

NOTES

1. As a part of State reconstruction/resurfacing projects the State will replace in-kind at no cost to the local agency only pavement markings that are damaged or removed as a result of the reconstruction or resurfacing project. This does not apply to durable markings that have exceeded their useful life. Installation of higher quality pavement markings will be at the expense of the city. Early communication and plan reviews between WSDOT and the city is essential to enable local agencies to avoid installation of pavement markings, especially the more durable markings, shortly before the construction activity takes place.
2. Traffic barriers installed on state highways in areas without curbs shall be maintained by the WSDOT. Traffic barriers installed beyond the curb shall be maintained by the cities. Curb in the context of RCW 47.24.020(2) refers to a standard curb and gutter and not to extruded curb such as those placed on fill sections for erosion control. Guardrail, concrete barriers, impact attenuators and similar devices are all considered to be traffic barriers.
3. Within all cities, regardless of population, the state shall solely maintain the structural integrity of box culverts, multiplates and individual culverts greater than 60 inches in width that are within rights of way and are not part of an enclosed drainage system. These are the size appropriate to identify natural stream flows. These structures that are less than 60 inches in width will be maintained by the cities. Cities shall maintain all other parallel roadside ditches and road approach culverts. Grass-lined swales constructed by the state solely for state highway runoff will be maintained by the WSDOT.
4. RCW 47.24.020(6) provides that the cities have responsibility for snow removal within their jurisdiction and that the State shall, when necessary, plow the snow on the roadway. The meaning of "when necessary" is that the State will plow snow, with city concurrence, on the traveled lane of the state highway on the way through the cities not having adequate snow plowing equipment.
5. RCW 47.24.020(2) states the city or town shall exercise full responsibility for and control over any such street beyond the curbs and, if no curb is installed, beyond that portion of the highway used for highway purposes and, thus, are responsible for noxious weed control.
6. The state has responsibility for maintenance of illumination systems within fully access controlled areas. In addition, the State may, with city concurrence, maintain and operate luminaries at locations where the electrical service powers electrical equipment under both State and City responsibility.
7. WSDOT, with city concurrence, may install stop signs and posts to the city's standards or may contract with the city to have them perform these installations.

Table 2
City/State Maintenance Responsibilities Of Bridges That Convey Non-Limited Access State Highways That Are Also City Streets
(Unless Otherwise Covered Under A Separate Agreement)
(This table provides an interpretation of the figures of WAC 468-18-050)

Maintenance Item	Cities Over 22,500	Cities Under 22,500
Structural Related Bridge Maintenance	State	State
Bridge Condition Inspections	State	State
L/C Overlays on Structures	State	State
Bridge Deck Membranes	State	State
Structural Asphalt Overlay on Bridge	State	State
Approach Slab	State	State
Bridge Deck Joints	State	State
Bridge Railing	State	State
Graffiti	City	City
Deck Sweeping	City	City
Bridge Drains/Drainage	City	State
Striping	City	State
Illumination	City (2)	City (2)
Snow Plowing	See Note (1)	See Note (1)
Snow Removal	City	City

NOTES

1. RCW 47.24.020(6) provides that the cities have responsibility for snow removal within their jurisdiction and that the State shall, when necessary, plow the snow on the roadway. The meaning of "when necessary" is that the State will plow snow, with city concurrence, on the traveled lane of the state highway on the way through the cities not having adequate snow plowing equipment.
2. The state has responsibility for maintenance of illumination systems within fully access controlled areas. In addition, the State may, with city concurrence, maintain and operate luminaires at locations where the electrical service powers electrical equipment under both State and City responsibility.

Table 3
State Owned Bridges That Convey City Or County Traffic Over A Limited Access Or Non-Limited Access Highway Corridor
(Does Not Apply To City Or County Owned Bridges)
(This table provides an interpretation of the figures of WAC 468-18-050)

Maintenance Item	City/State	County/State
Structural Related Bridge Maintenance	State	State
Bridge Condition Inspections	State	State
L/C Overlays on Structures	State	State
Bridge Deck Membranes	State	State
Structural Asphalt Overlay on Bridge	State	State
Non-Structural Asphalt Overlay on Bridge	City (1)	County (1)
Approach Slab	City (2)	County (2)
Bridge Deck Joints	See Note (3)	See Note (3)
Bridge Railing	State	State
Graffiti	City	County
Deck Sweeping	City	County
Bridge Drains/Drainage	City	County
Striping	City	County
Illumination	City	County
Snow Plowing	City	County
Snow Removal	City	County

NOTES

1. Cities/counties should obtain the states concurrence prior to performing non-structural asphalt deck overlays on state owned structures.
2. Approach slab maintenance is the primary responsibility of the city/county. In the case where the state performs a structural overlay on the bridge deck, the state may extend the overlay onto the approach slab to smooth traffic flow.
3. Joints located on the bridge deck are the responsibility of the state. Back of pavement seat joint repairs are the responsibility of the city/county unless they affect the structural integrity of the bridge.

The State has full maintenance responsibility for bridges conveying a State Route or Interstate traffic in a limited access corridor (unless otherwise covered under a separate agreement).

Attachments - Intersection Diagrams from WAC 468-18-050

Concurrences

With the concurrence of WSDOT Executive Management, this report will be transmitted to WSDOT Assistant Secretaries and Regional Administrators and to the Association of Washington Cities for implementation of the agreed upon guidelines.

Respectfully submitted for acceptance,

Dave Dye Date
Maintenance Engineer
Field Operations Support Service Center

Dennis B. Ingham Date
Assistant Secretary
TransAid Service Center

Craig Olson Date
Transportation Coordinator
Association of Washington Cities

Concurrences with Recommendations for Acceptance

John Conrad Date
Assistant Secretary
Field Operations Support Service Center

E.R. "Skip" Burch Date
Environmental & Engineering
Service Center

Recommendations Accepted

Stan Findelstein Date
Executive Director
Association of Washington Cities

S.A. Moon Date
Deputy Secretary for Operations
Department of Transportation

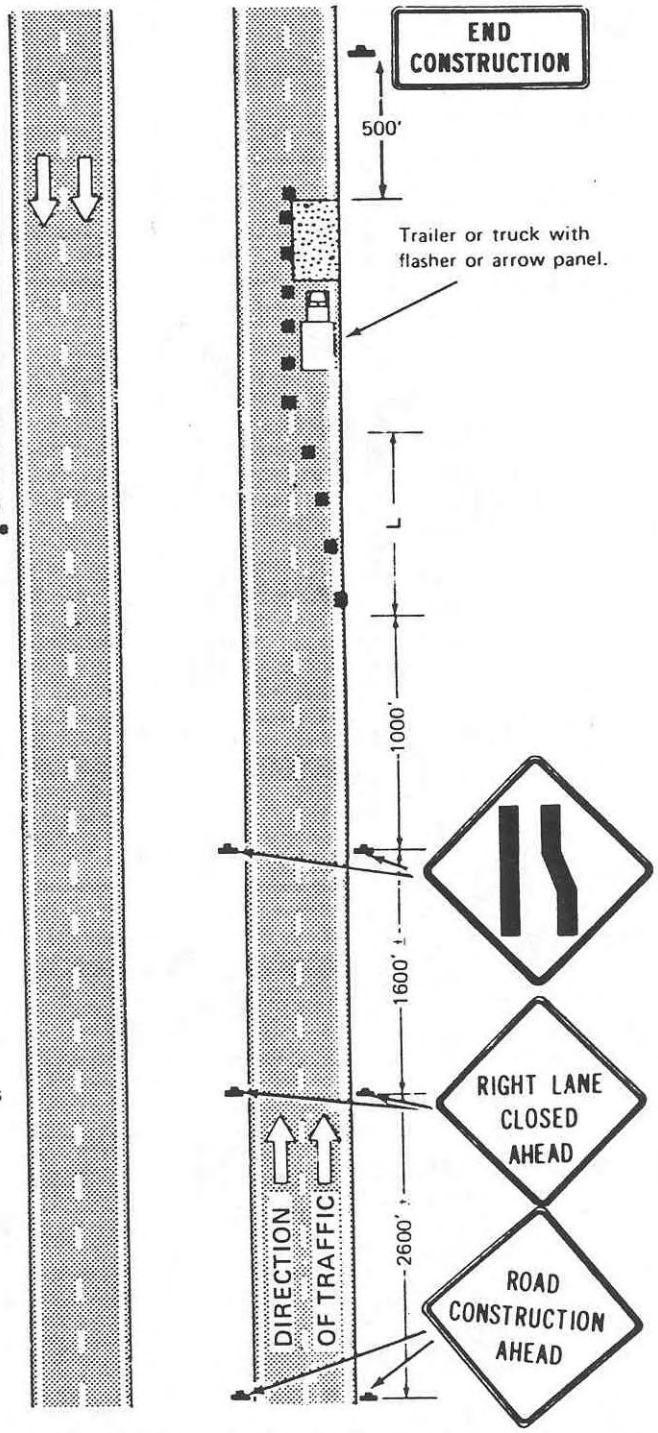
GENERAL NOTES

MINIMUM TAPER LENGTH (L) IN FEET							
	Posted Speed (mph)						
Lane Width (feet)	25	30	35	40	45	50	55
10	105	150	205	270	450	500	550
11	115	165	225	295	495	550	605
12	125	180	245	320	540	600	660

The maximum spacing between channelizing devices in a taper should be nearly equal in feet to the speed limit; the maximum spacing between channelizing devices used to separate traffic should be 2 times the speed limit.

All sign placement distances are ±.

KEY:
■ ■ Channelizing devices



Typical application—daytime maintenance operations of short duration on a 4-lane divided roadway where half of roadway is closed.

Figure A1

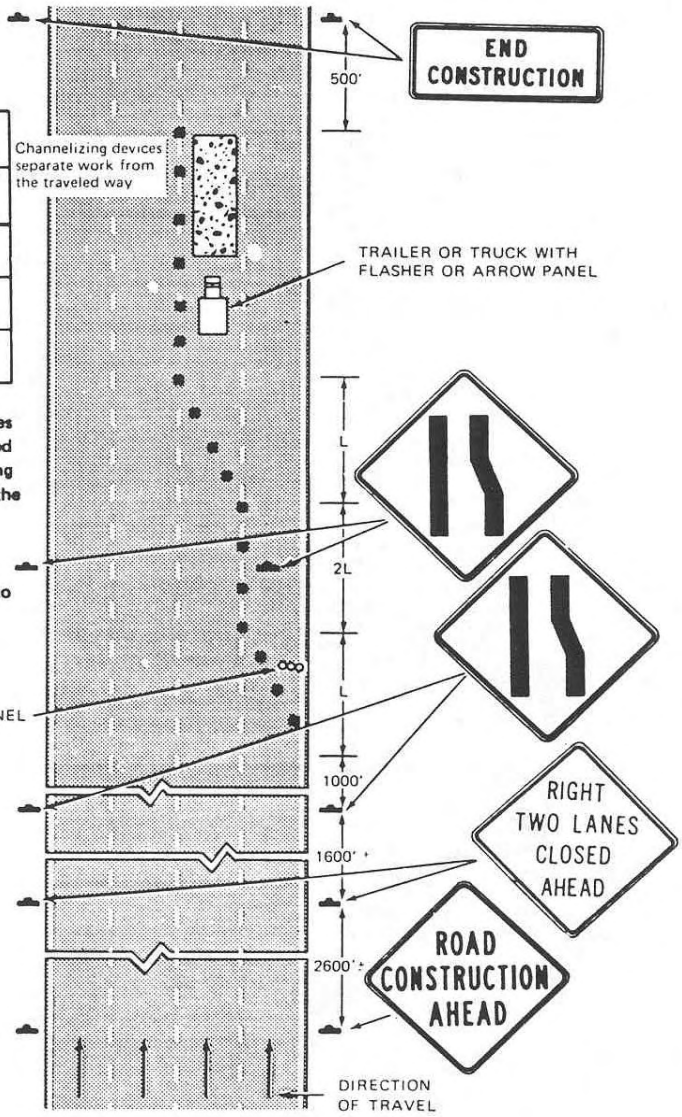
GENERAL NOTES

MINIMUM TAPER LENGTH (L) IN FEET							
	Posted Speed (mph)						
Lane Width (feet)	25	30	35	40	45	50	55
10	105	150	205	270	450	500	550
11	115	165	225	295	495	550	605
12	125	180	245	320	540	600	660

The maximum spacing between channelizing devices in a taper should be nearly equal in feet to the speed limit; the maximum spacing between channelizing devices used to separate traffic should be 2 times the speed limit.

Flashing warning lights and/or flags may be used to call attention to the early warning signs.

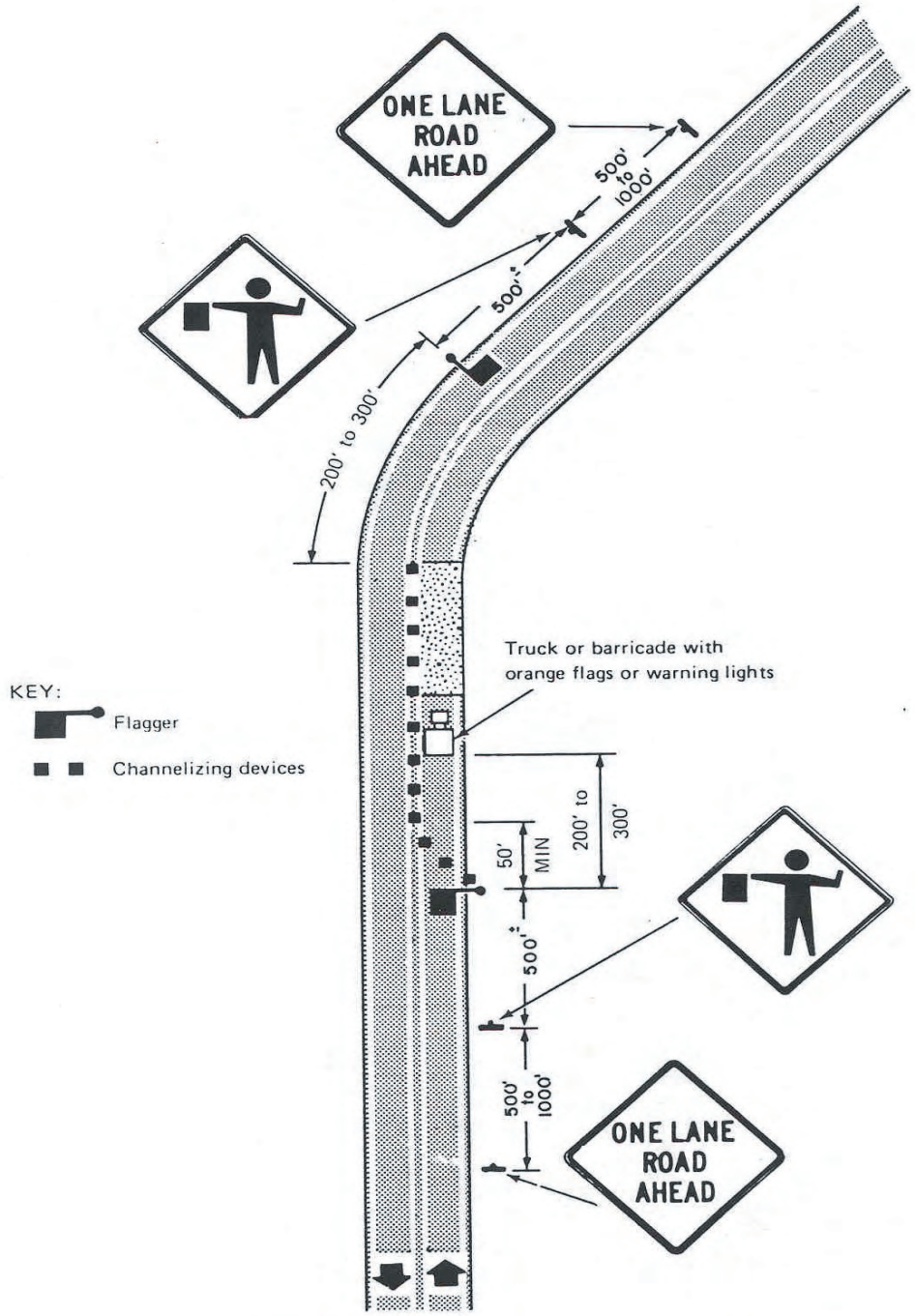
All sign placement distances are ±.



KEY:
■ ■ Channelizing devices
ooo Arrow Panel (Optional)

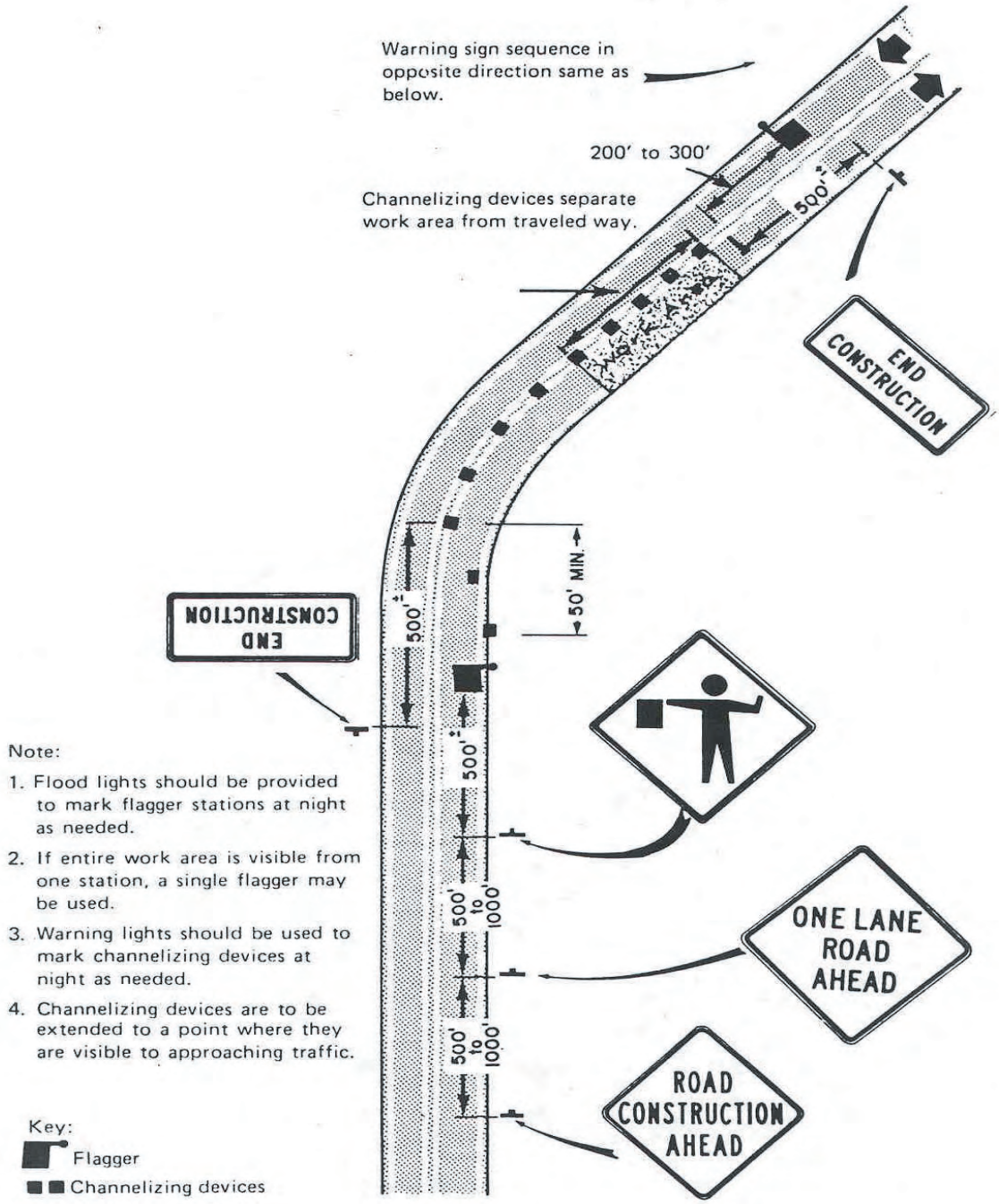
Typical application—closing multiple lanes of a multilane highway

Figure A2



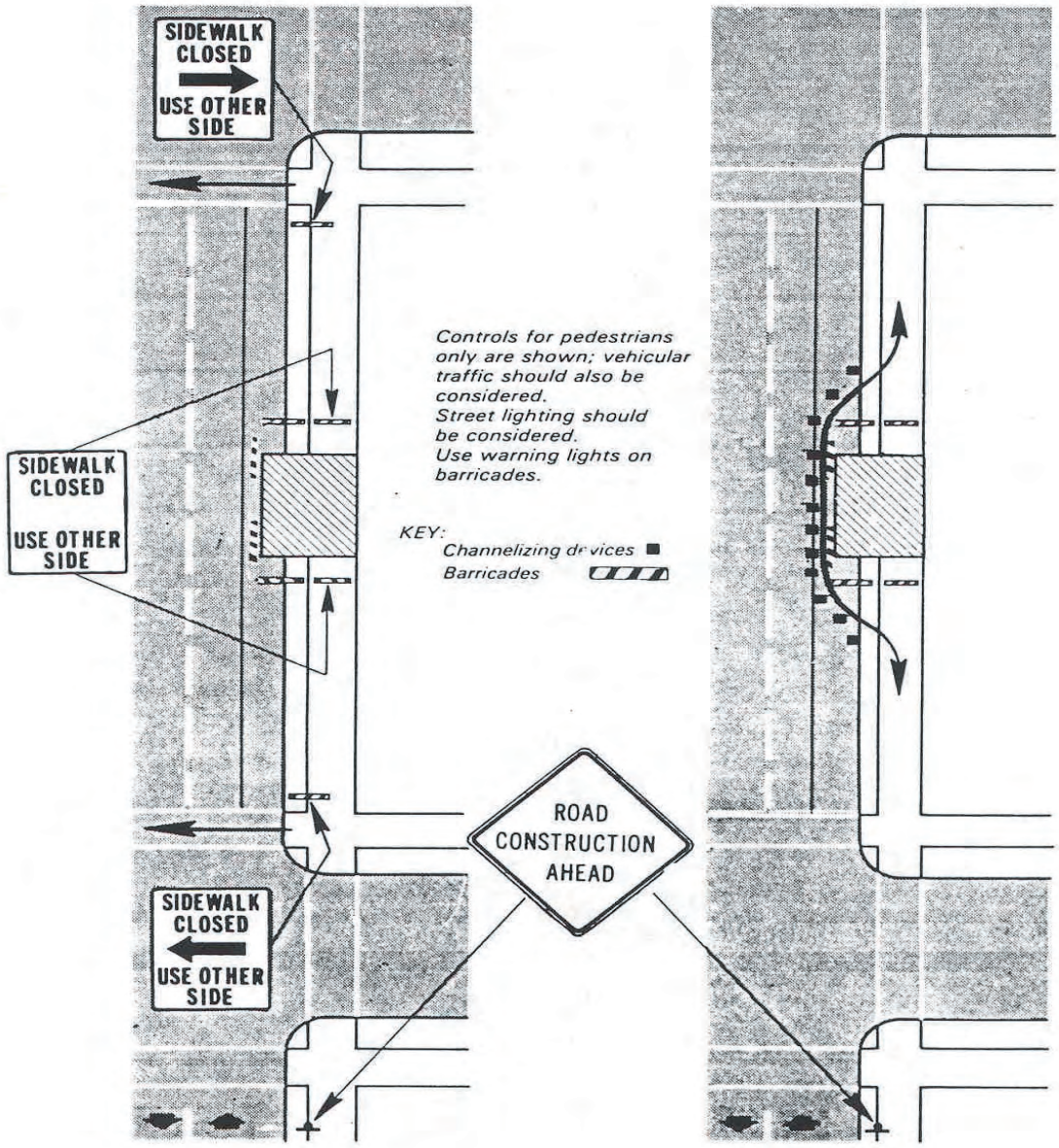
Typical application—daytime maintenance operations of short duration on a 2-lane roadway and flagging is provided.

Figure A3



Typical applications of traffic control devices on 2-lane highway where one lane is closed and flagging is provided.

Figure A4



Typical applications—two methods for controlling pedestrian traffic by either directing pedestrians to another route or providing a walkway

Figure A5

Appendix 2 Emergency Restrictions for Roads

RCW 47.48, RCW 46.44.080, and WAC 468-38-080 authorize the Washington State Department of Transportation (WSDOT) to impose emergency road restrictions when conditions exist that could cause normal traffic to damage the roadway.

General

WSDOT may impose load and speed restrictions when freeze-thaw or other conditions may subject the roadway to damage from normal traffic. There are two types of load restrictions that may be imposed depending upon the highway and weather conditions:

- **Emergency Load Restrictions** – This restriction may be applied to any road when the untreated pavement layers (base course and sub-grade) are supersaturated and unstable. Evidence of surface deflection under traffic loading or free water in the base materials under less than six inches of treated materials supporting the roadway may be cause to apply these restrictions.
- **Severe Emergency Load Restrictions** – This restriction may be applied only to a roadway whose surfacing depth is insufficient to resist subgrade swell pressure or is surfaced with a thin bituminous treatment. This restriction may also be used for other roadway types displaying signs of severe distress during a freeze-thaw cycle or unusual weather conditions.

Notify the public, other WSDOT offices, and law enforcement agencies to ensure compliance with pending and current restrictions, and to minimize inconvenience to the public. Provide courtesy notices on highways leading to restricted roads to the extent possible under the circumstances, and in consideration of the expense to be incurred by WSDOT.

Special permits to operate on restricted roads may be issued to school buses and trucks hauling perishable commodities or commodities necessary for the health and welfare of local residents.

School buses may be given a general exemption from weight restrictions by letter, subject to speed restrictions. In no event may an exemption be granted to a vehicle with a gross load weight on each tire exceeding 550 pounds per inch of tire width.

Actions

As part of your annual snow and ice planning, alert road user groups, freight associations, and the media that emergency road restrictions may be imposed when and where necessary. Provide a list of roads that could be affected.

When weather forecasts indicate that restrictions will likely be imposed, notify Commercial Vehicle Services (www.wsdot.wa.gov/commercialvehicle), and alert road user groups, freight associations, and the media that road restrictions will occur if conditions develop as predicted.

Determine the condition of roads subject to freeze-thaw or other weather conditions using the experience of local WSDOT maintenance crews, historical roadway performance, or the expertise of WSDOT materials engineers.

When restrictions must be imposed:

1. Post the road with appropriate signs.
2. Notify regional managers, the Region Administrator, and the traffic management center.
3. Notify Commercial Vehicle Services.
4. Notify local law enforcement agencies and the WSP detachment.
5. Provide courtesy notices to principal road users as circumstances allow.

After restrictions are imposed:

1. Continually monitor restricted roads and remove or change restrictions as conditions change or improve.
2. Establish permit speed and weight restrictions. Issue permits or provide exemptions for school buses and trucks hauling necessary commodities.
3. Notify the public, other WSDOT offices, and law enforcement agencies when restrictions are lifted or modified.
4. Continue to assess road conditions to determine if further restrictions are necessary.

Signing Instructions

Restrictions are legal only when “Emergency Restriction” signs are posted at each end of a restricted roadway. “Emergency Restriction” signs must also be posted at each crossroad intersection on the right-hand side of the restricted road. Intersection signs should be located within 50 feet of the intersection, preferably at 25 feet, so that motorists intending a right or left turn should see them prior to making the turn. The signs should not prohibit motorists from crossing the restricted road. When signing closely spaced intersections, determine the number and location of signs needed to provide reasonable notice to motorists.

The appropriate sign, “Emergency Load Restrictions” or “Severe Emergency Load Restrictions”, must be attached to “Emergency Restriction” signs when load restrictions apply.

Standard speed limit signs displaying the speed restriction must be posted 500 feet ahead of “Emergency Restriction” signs at each end of the posted road, and 500 feet after signs posted at crossroads. When signing closely spaced intersections, determine the number and location of signs needed to provide reasonable notice to motorists.

“Speed Zone Ahead” signs shall be posted ahead of the speed limit signs as specified in the MUTCD. If the restricted area immediately follows a zone having a lower posted speed, “Speed Zone Ahead” signs are not required.

Existing speed limit signs within the restricted area will be covered, turned away from traffic, or covered with the appropriate restricted speed limit sign.

Courtesy signs should be placed in advance of a restricted roadway to inform motorists and minimize backtracking. Courtesy signs are not necessary if only speed restrictions are imposed. The appropriate sign for either “Emergency Load Restriction” or “Severe Emergency Load Restriction” may accompany road restrictions signs.

The posting distance preceding the restricted area will depend upon circumstances. A good rule of thumb is not exceed ten signs posted at locations most likely to be seen by motorists that could be affected by the restrictions.

Emergency Load Restrictions

Sign examples and size requirements:

Conventional Tires		Tubeless or Special With .5 Marking	
Tire Size	**Gross Load Each Tire**	**Tire Size**	**Gross Load Each Tire**
7.00	1800 lbs.	8-22.5	2250 lbs.
7.50	2250 lbs.	9-22.5	2800 lbs.
8.25	2800 lbs.	10-22.5	3400 lbs.
9.00	3400 lbs.	11-22.5	4000 lbs.
10.00	4000 lbs.	11-24.5	4000 lbs.
11.00	4500 lbs.	12-22.5	4500 lbs.
12.00 or over	4500 lbs.	12-24.5 or over	4500 lbs.

Sign size: 24" wide by 17" high. Black lettering on white background.
Attach to space provided on "Emergency Restrictions in Force" sign.

Severe Emergency Load Restrictions

Sign examples and size requirements:

Conventional Tires		Tubeless or Special With .5 Marking	
Tire Size	**Gross Load Each Tire**	**Tire Size**	**Gross Load Each Tire**
7.00	1800 lbs.	8-22.5	1800 lbs.
7.50	1800 lbs.	9-22.5	1900 lbs.
8.25	1900 lbs.	10-22.5	2250 lbs.
9.00	2250 lbs.	11-22.5	2750 lbs.
10.00	2750 lbs.	11-24.5	2750 lbs.
11.00 or over	3000 lbs.	12-22.5 or over	3000 lbs.

Sign size: 24″ wide by 17″ high. Red lettering on white background.
Attach to space provided on "Emergency Restrictions in Force" sign.

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