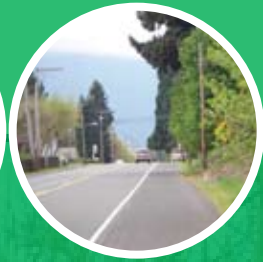


VEGETATION CONTROL FOR SAFETY

*A Guide for Local Highway and Street
Maintenance Personnel*



Revised August 2008



U.S. Department of Transportation
Federal Highway Administration

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A technical working oversight group was formed to guide the preparation of this document. The members included:

- Michael Blankenship, Consultant, Phoenix, AZ
- Rick Hollatz, Skamania County, WA Department of Public Works
- Mark Hood, Pennoni Associates, Inc., State College, PA
- Brandon Martin, City of Petersburg, VA
- Jon A. Oshel, Association of Oregon Counties, OR
- Dennis Trusty, Northern Plains Tribal Technical Assistance Program, Bismarck, ND

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I. INTRODUCTION

Scope and Objectives

Safety is a main concern of highway and street agencies. In fact, roadway safety cannot be achieved without a good maintenance program. Employees of local road agencies are responsible for reviewing their roads and rights-of-way, identifying hazards, and making conditions safer.

One potential hazard is vegetation. Trees close to the road can present a fixed object hazard. Grass, weeds, brush and tree limbs can obscure or limit a driver's view of traffic control devices, approaching vehicles, wildlife and livestock, and pedestrians and bicycles. Controlling vegetation helps reduce crashes and injuries.

The purpose of this guide is to help local road agency maintenance workers identify locations where vegetation control is needed to improve traffic and pedestrian safety, to provide guidance for maintenance crews, and to make them aware of safe ways to mow, cut brush and otherwise control roadside vegetation. This document is not intended to be a design guide; if further clarification is needed, maintenance personnel should consult an engineer.

Goals of Vegetation Control

The main goals of vegetation control include:

- Keeping signs visible to drivers.
- Keeping road users (vehicles, bicycles and pedestrians) visible to drivers.
- Improving visibility of livestock and wildlife near the road.
- Helping pedestrians and bicyclists see motor vehicles.
- Keeping sidewalks and pedestrian paths clear and free from overhanging vegetation.
- Removing trees close to the roadway which could result in a severe crash if hit.
- Improving winter road maintenance in snow and ice areas.

- Helping drainage systems function as designed.
- Preserving pavements through daylighting and root system control.
- Controlling noxious weeds in accordance with local laws and ordinances.

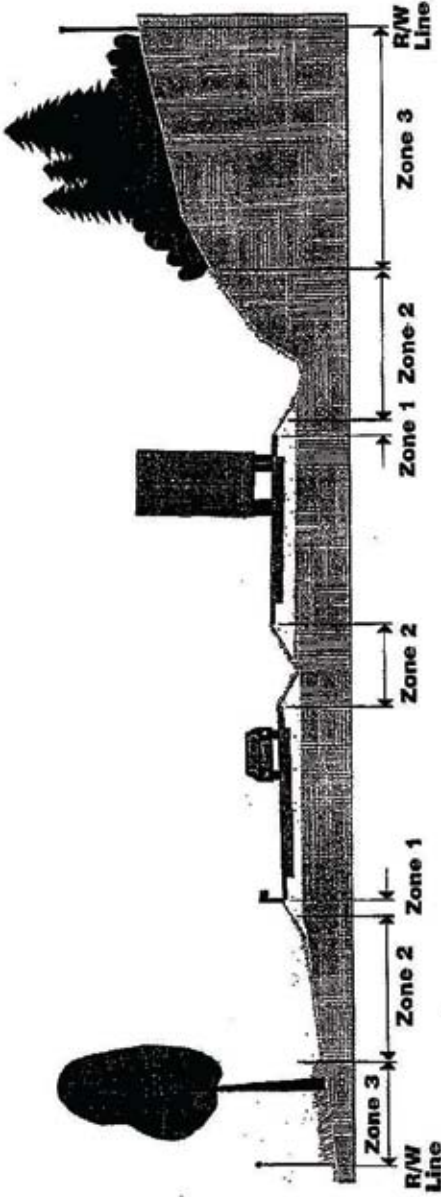
This publication describes conditions commonly found on local highways and streets and how road workers can identify potential hazards caused by vegetation. Detailed information is presented about sight distances, worker safety, and setting up temporary traffic control.

Roadside Vegetation Management

Roadway agencies are encouraged to develop roadside vegetation management programs to define the best maintenance practices for each location. An integrated roadside vegetation management program consists of eliminating or controlling vegetation through a variety of strategies including mowing, brush cutting (mechanical and hand), use of herbicides, grazing of livestock, cultivating desirable vegetation, and re-vegetation.

Be sure you know your state's laws and regulations dealing with vegetation control, including any record-keeping and reporting requirements. Consult with your local weed control specialist to determine the type of vegetation and the best way to control it. If noxious weeds are present, mowing, for example, will spread the seeds and spread the infestation so you have more work to do next year. Use of herbicides may not be permitted by local ordinance or a plant on the Threatened and Endangered Species list may be present. Different species require different treatments.

One useful way to look at how and why vegetation control is needed for safety is to think in terms of Roadside Management Zones. The figure on the next page shows the zones and the objectives of each zone, as developed by the Washington State Department of Transportation.



Functional Zone Objectives

Zone 1: Vegetation Free Zone
(width as necessary to meet operational needs)

- provide for surface drainage
- prevent pavement breakup by plants
- provide for visibility and maintenance of roadside hardware

Zone 2: Operational Zone
(from Zone 1 to meet operational needs)

- maintain a hazard free vehicle recovery area
- provide sight distance for passing and stopping
- provide sight distance at intersections
- maintain hydraulic capacity of ditches

Zone 3: Transition Zone
(from Zone 2 to R/W line)

- blend and/or screen adjacent surroundings
- control weeds
- remove danger trees
- manage trees to reduce shading in areas prone to roadway icing

Roadside Management Zones and Objectives
Source: Washington State Department of Transportation

II. SPECIFIC THINGS TO CHECK

Sign Visibility

Signs should be visible to drivers at all times. Maintenance patrols should be on the lookout for trees and brush that block the view of signs and other traffic control devices. Tree branches or brush in front of a sign can hide it from view of motorists. Right-of-way control signs (STOP and YIELD signs) are most critical; brush and tree branches in front of them should be cut immediately. It is important that motorists see warning and guide signs as well, so blocking vegetation in front of these signs should be trimmed as soon as possible. Suggested maintenance steps for keeping traffic control devices visible are presented in Section III.



(a)



(b)

The STOP sign is not visible at all from mid-block (a) and barely visible on immediate approach (b).



This warning sign (circled) is only partially visible in the spring. By mid-summer, it will be completely hidden by vegetation.

Clear Sight Lines

Tall grass, weeds and brush in the shoulder, ditch and backslope areas of a roadside can create problems. Low fixed object hazards such as culvert headwalls, drainage inlets, guardrail ends and any object markers in front of them can be hidden by tall grass, as can wildlife and livestock. High grass can also obscure the shoulder. Shoulder and roadside maintenance such as grading or mowing should be done to define the edge of shoulder and ditch so that motorists can see the shape, condition, and limits of the roadside.



This object marker and culvert headwall are almost completely obscured by dense vegetation.



Well-defined shoulder and ditch allow drivers to see the shape, condition, and limits of the roadside.

On the inside of horizontal curves, vegetation growth close to the edge of pavement can block a driver's view of motor vehicles (in the same or opposite direction), bicycles and pedestrians. Maintaining roadsides so headlights and taillights can be seen around the inside of horizontal curves can increase the horizontal sight distance available. More detailed information on determining how far back to trim vegetation on the insides of curves is presented in Section IV.

Drainage

Weeds, turf and sod can interfere with roadside drainage. A high shoulder creates a secondary ditch and damages the pavement. Water on the pavement due to high shoulders creates safety problems, including hydroplaning and isolated icy conditions during the winter. Grading may be necessary to make sure the shoulder continues the road crown smoothly.



High shoulder due to vegetation growth on the shoulder prevents water from running off of the pavement, saturating the road base and causing safety problems such as ponded water (and ice in the winter).

Side Road Visibility

Roadway intersections increase the chances of vehicle crashes. Safe and efficient vehicle movement through an intersection requires good visibility. As drivers approach an intersection, they need to check each quadrant of the intersection for the presence of entering vehicles. Similarly, drivers pulling out from a STOP sign need a clear view of oncoming traffic. A clear vision triangle at each corner of an intersection helps drivers avoid problems. Factors in determining required sight triangles are discussed in Section V.



Due to excessive vegetation in the corner sight triangle, drivers are not able to see traffic approaching from the left in time to enter or cross the intersection safely.

Visibility is a particular concern at rail-highway grade crossings due to the severe crashes that can occur. Brush and trees should not be allowed to obscure the railroad tracks and any approaching trains. A cooperative effort of the railroad and roadway agency is needed. Municipalities are responsible for controlling the vegetation on their right-of-way and railroads are responsible for controlling the vegetation on their right-of-way. Due to the size

of the sight triangles at grade crossings, private property owners may also need to participate in vegetation control.

Roadside Trees

One of the most common causes of fatal and serious injury crashes on rural roads involves vehicles leaving the road and striking a tree. The concept of a clear zone, an area adjacent to the traveled way in which slope, surface and an absence of fixed objects can permit recovery of a vehicle that leaves the roadway, is important to providing a safe roadside. The clear zone is more fully described in the Appendix A.

Trees are potential hazards because of their size and location with respect to vehicle traffic. Trees larger than 4 inches in diameter can be a hazard to a vehicle. The closer trees are to the travel lane, the more likely a vehicle is to strike them. Isolated trees provide a better opportunity for removal compared to forest conditions where removal involves significant cost. Recognize the sensitivity of removing individual trees. Removal should be based on potential crash frequency and severity. First priority should be on removing trees closest to the road. Trees in critical locations such as curves and intersections should be considered for removal. Trees that have been struck deserve additional attention.



Roadside trees are fixed object hazards for vehicles leaving the traveled way.



Trees near the road that have been struck before deserve special attention.

Cut trees close enough to the ground so that no stump remains to be a fixed object or snagging hazard. Small diameter trees should be cut off no more than 4 inches from the ground. Large diameter trees should be cut flush with the ground. Trees of any size growing on a slope should be cut flush with the ground. Snagging occurs when a vehicle undercarriage catches on a stump or other object. Generally, any stump higher than 4 inches above the surrounding ground can cause snagging.

All trees within the clear zone should be cut while they are still small saplings rather than small trees. At that time, they are easy to cut off at ground level and cause no stump problems. Also, no one will be tempted to try to save a beautiful, but hazardous, tree in the roadway clear zone. Note that while trees close to the road should be removed for safety, those that also provide shade for waterways should be mitigated to a safer location because water temperature is crucial to fish habitat. Your agency should have a policy on planting trees within the right-of-way; for example, do not allow trees within the clear zone or types of roadside trees allowed.

Dead and leaning trees within the roadway right-of-way that endanger the traveling public (including those over sidewalks and multi-use trails) should be felled and disposed of by an approved method. Potentially hazardous trees outside the right-of-way should be referred to property owners for removal unless an emergency situation exists. Documentation is especially important in this regard. Be sure to keep records of when notice was received, the date the situation was reviewed, the date a letter was sent to the property owner, the date the problem was resolved, who resolved it and other facts of this nature.



An opening completely through the tree is an indication that it has serious health problems. This tree near the road should be felled as soon as possible.



The general lack of leaves and branches on the tree in the background indicates that this tree is diseased. The fact that one part of the tree is leaning over the sidewalk and road means that it should be felled as soon as possible.

Winter Maintenance

When trees and shrubs (particularly evergreens) in the right-of-way cast shadows on the pavement, freeze-thaw cycles may create isolated ice patches on the pavement. Since the rest of the road is dry, these ice patches are not expected by drivers and can easily cause loss-of-control crashes. Work on the south and west sides of the roads first if you have limited time and money for brushing. “Daylighting” by cutting taller vegetation lets the sun help with thawing and ice control (and generally helps to preserve pavements). In areas receiving heavy snow, it is important to provide vegetation clear zones for snow storage such as illustrated below.

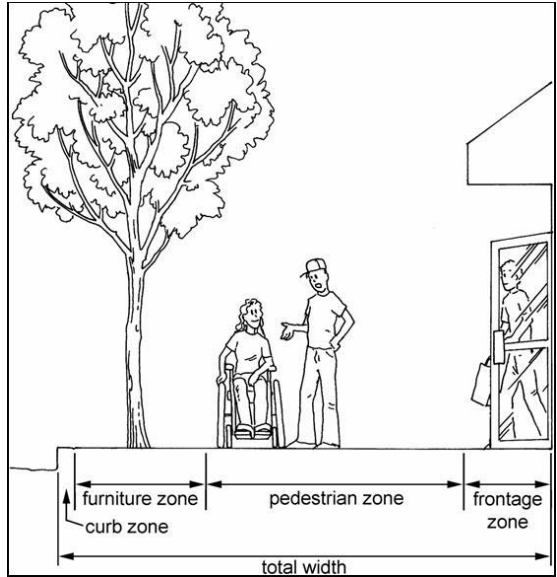


Providing vegetation clear zones for snow storage is important in high-snowfall areas.

Another problem is dead branches overhanging roadways. As crews do their winter maintenance dry runs in the fall, dead limbs overhanging the road should be identified. These should be removed in the fall. When winter snow and ice accumulate on the dead branches, the extra weight often causes them to fall on the roadway/traffic.

Pedestrian Paths

Today, there is increased emphasis on walking for exercise and transportation. It is important to pay attention to the effects of vegetation on pedestrian safety and walkway accessibility. Just like a roadway corridor, a sidewalk corridor is made up of different zones as shown on the figure to the right.



Zones making up a sidewalk corridor.

The pedestrian zone is specifically reserved for walking. The zone must be completely free of overhanging and protruding obstacles, including vegetation. According to the Americans with Disabilities Act *Accessibility Guidelines* (ADAAG), objects must not protrude: (1) lower than a height of 80 inches, (2) higher than



Tree branches that protrude into the sidewalk corridor must be cut or trimmed.

27 inches from the ground, and (3) outward more than 4 inches from posts, buildings or free-standing fixtures. Tree branches or shrubs that protrude into the sidewalk corridor must be cut or trimmed. This means that branches between the heights of 27 to 80 inches must be cut regularly. For people who are blind or with severe vision impairment and using a “white” cane, the maximum 27-inch lower height is important. The sweep motion of the cane will catch the presence of the protruding object. If the object is

higher than 27 inches from the ground, then the person might run into it and injure him/herself.

Another sidewalk safety concern that can be caused by vegetation is “changes in level”. A change in level is a vertical elevation difference between adjacent surfaces. They can be tripping hazards for pedestrians and can make a walkway inaccessible to wheelchair users. One of the most common causes of a change in level in sidewalks are concrete slabs heaved up by tree roots. While street trees have a number of advantages, the type of tree should be selected carefully to minimize the root problem. Use of root guards should be considered in some cases.



This change in level in the sidewalk due to tree roots creates a pedestrian tripping hazard and makes the sidewalk inaccessible to wheelchair users.

III. KEEPING TRAFFIC CONTROL DEVICES VISIBLE

Drivers need an unobstructed line of sight to any roadside signs or roadway hazards far enough ahead to allow them to react safely to each situation. The suggested maintenance steps are:

1. When on routine maintenance patrol, look for signs and other traffic control devices (including chevron signs in curves) blocked by brush, trees, grass, or weeds.

Often, a small branch from an overhanging tree or bush near the sign is all that needs to be trimmed. If vegetation along the ditch or shoulder blocks a driver's view of a sign, then cut enough to allow a driver sufficient time to see the sign and respond to its message. If your agency has a policy on how far from a sign vegetation has to be cleared for a safe view, follow that policy. If you do not have such a policy, Table 1 provides a suggested guideline that considers two groups of signs: critical signs, such as STOP, YIELD, ONE WAY, DO NOT ENTER, WRONG WAY or any sign that might require a motorist to stop, and all other signs. The distances for the critical signs are based on stopping sight distance (see table 2); the distances for the other signs are based on allowing 4 seconds to detect, read, and respond to the sign. These are to be considered minimum distances; longer distances are preferable.

Table 1. Clear Distance to See Sign

Speed Limit (mph)	Critical Signs (feet)	Noncritical Signs (feet)
30	250	150
40	350	200
50	450	250
60	600	300

2. Pull maintenance vehicle off of the traveled way and place temporary traffic control devices. (See Appendix F.)

3. Cut or trim trees, brush, weeds or grass to clear a driver's line of sight to the sign or traffic control device. Always wear appropriate personal protective equipment as noted below.
4. Watch for overhead power lines and electrified farm fences when cutting brush. Notify your utility company when crews come upon trees that are in conflict with power/phone lines, preventing crews from trimming. This way they can add it to their work list.
5. Paint the stubs of brush or small trees with a weed killer solution to keep it from growing back.
6. Collect limbs and large brush to haul away for disposal or run them through a chipper, if available. Reclaim trees as mulch or bark rather than burning.
7. Watch for moving traffic when removing the temporary traffic control and leaving the site. Drivers may not realize that you are through working and probably will not expect you to pull into the traffic lane.

Take along the suggested equipment (see list on next page) when cutting brush or other vegetation to clear the line of sight to signs or other traffic control devices. Note that this list does not apply to spraying.

Appendices F, G, and H of this guide contains three suggested temporary traffic control plans to help guide traffic around your work:

- One applies (F) when all vehicles and equipment are off the shoulder or completely over the street curb. The intent in this situation is to warn drivers that you are working off the edge of the road. You do not want them to drift off the road into your work area.
- Another (G) applies to two-lane, two-way roads where a shoulder has to be closed for a short duration.
- The third (H) applies when a lane may have to be closed when the shoulder or foreslope beyond the shoulder is too narrow to permit loading of trimmings or maneuvering equipment completely off the traveled lane.

Note that these suggested plans are not comprehensive and that other typical applications shown in the *Manual on Uniform Traffic Control Devices* may also be useful.

Field Equipment List

1. **Leather gloves** to protect your hands from cuts and nicks and lessen vibration when working with power tools.
2. **Safety glasses or goggles** to protect your eyes from flying chips or particles anytime you are using brush cutters, chain saws, brush chippers and string trimmers.
3. **Hard hat** to protect your head from a falling limb or flying debris during cutting and clearing.
4. **Safety apparel (meeting the requirements of ANSI 107 for Class 2 risk exposure)** to make you more visible to motorists.
5. **Proper footwear** (usually a good sturdy boot with ankle support) is important to protect your feet. A hardened toe cap reduces the chances of crushed toes.
6. **Safety chaps** if chain saws will be used.
7. **Chain saw, fuel and bar oil** to cut large brush and small trees.
8. **Gasoline-powered string trimmers** to cut grass and small weeds away from sign supports and similar areas.
9. **Brush knife or machete** to cut small brush.
10. **Loppers** (long-handled side cutters) to cut small, low-hanging branches that are blocking the view of signs.
11. **Tree-trimming saw with small branch lopper** (on a telescoping pole handle) to cut higher branches from overhanging trees that are blocking the view of a sign.
12. **Tall step ladder** to help cut branches near the tree trunk to limit re-growth.
13. **Axe** to chop down small saplings.

IV. STOPPING SIGHT DISTANCE ON CURVES

On horizontal curves, vegetation on the inside of the curve may restrict the driver’s line of sight. However, drivers need to be able to see ahead around the curve for the same stopping sight distance as they do at intersections. Weeds, brush or trees growing on the roadside on the inside of curves need to be cut so that drivers have adequate stopping sight distance.

Roads are safer when drivers can see as far ahead as it takes to stop their vehicles. The distance it takes to notice a problem, realize a stop is necessary and come to a complete stop is called stopping sight distance. Required stopping sight distances for different speeds are shown in Table 2.

Table 2. Required stopping sight distances

Speed Limit (MPH) (or Design Speed)	Stopping sight distance (ft)						
	0% Grade	Downgrades			Upgrades		
		3%	6%	9%	3%	6%	9%
15	80	80	82	85	75	74	73
20	115	116	120	126	109	107	104
25	155	158	165	173	147	143	140
30	200	205	215	227	200	184	179
35	250	257	271	287	237	229	222
40	305	315	333	354	289	278	269
45	360	378	400	427	344	331	320
50	425	446	474	507	405	388	375
55	495	520	553	593	469	450	433
60	570	598	638	686	538	515	495
65	645	682	728	785	612	584	561
70	730	771	825	891	690	658	631
75	820	866	927	1003	772	737	704
80	910	965	1035	1121	859	817	782

Source: American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, 2004

Stopping sight distance is important along all roadways. Where vegetation is close to the road, special attention needs to be given to stopping sight distance on the inside of curves. These areas should be checked when vegetation growth is at its peak to make sure stopping sight distances are adequate.

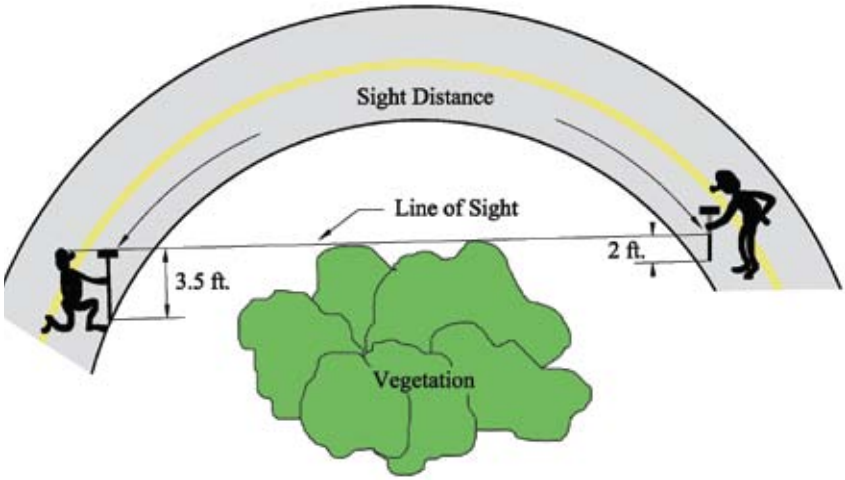
The conventional procedure used in measuring stopping sight distance assumes that a driver's eye is 42 inches above the road surface. The procedure also assumes that a driver must be able to detect an object that reaches 24 inches above the road surface on the road ahead.

Sight distance is measured along the travel path of vehicles. Therefore, measuring for stopping sight distance will require you to be in the travel lane with your back to traffic. Since you and an assistant will stand in the travel lane, extra people will be needed to watch for traffic. Establishing a short-term work zone with flaggers will be safer. Remember, you will be measuring a section of road that you suspect may not offer drivers adequate sight distance. Be sure to wear a hard hat and safety apparel meeting the requirements of ANSI 107 for Class 2 risk exposure. You and your assistant will also need:

- Sight distance measuring sticks (described below)
- Measuring wheel and long steel tape.

To measure sight distance, kneel in the travel lane and use a 42-inch sighting stick to get your eyes at the proper height. Have your assistant move the target stick (a 42-inch long stick with the lower 24 inches painted a bright color to make it easier to see) in the travel lane until you cannot see the brightly painted section of the target stick or until the assistant reaches the distance shown in Table 2. Remember, on curves, stopping sight distance should be measured along the travel path of the vehicle. As shown in the illustration on the next page, the line of sight is shorter than the sight distance. You should sight along a straight line between the two sticks but measure the distance between the two sticks in the curving travel lane.

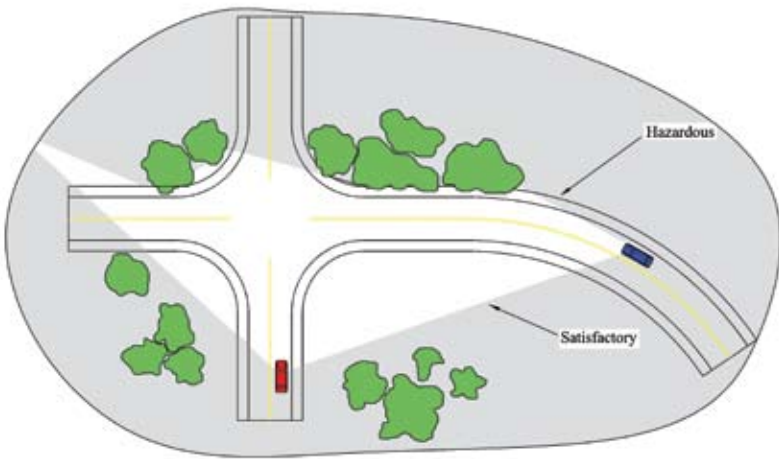
If you can still see the bright paint on the target stick when your assistant reaches the stopping sight distance needed, then there is adequate stopping sight distance. If you lose sight of the brightly painted section of the target stick before your assistant reaches the stopping sight distance listed in Table 2, then at least some trimming and brush cutting is called for.



Measuring for stopping sight distance.

V. INTERSECTION SIGHT DISTANCE

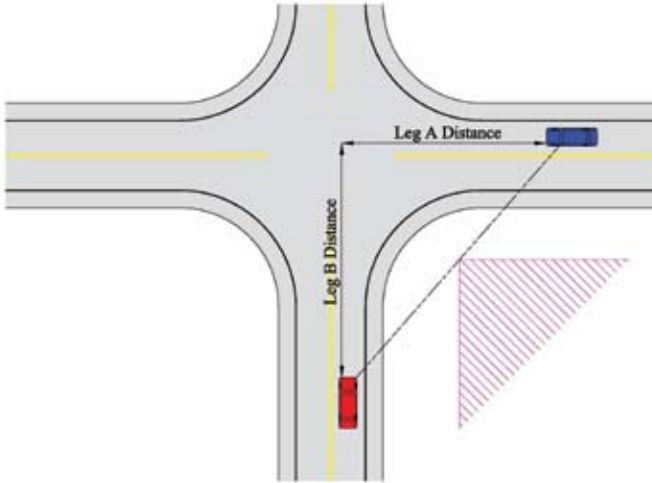
Another important sight distance requirement that can be affected by vegetation is intersection sight distance. Drivers approaching an intersection need a clear line of sight to the intersection and along the crossroads early enough to see any conflicting vehicles, bicyclists and pedestrians to avoid a collision. Together these sight lines provide a sight triangle. These sight triangles can be limited by the presence of horizontal and/or vertical curves, buildings and other physical objects, and vegetation. Providing adequate clear sight triangles is critical for safety of all road users, so you want to make sure that vegetation overgrowth is not limiting the sight distance at intersections.



Satisfactory and hazardous sight lines at an intersection.

There are several sight distance requirements for driver approaching and entering an intersection which are dependent upon the type of intersection control—uncontrolled, yield sign, stop sign, or a traffic signal—and the desired maneuver—turn left or right or proceed straight through. Of these combinations, frequently found on local roads is the uncontrolled intersection, meaning there is no yield or stop sign or traffic signal for any of the legs of the intersection. For this situation, a driver approaching an intersection should be able to see potentially conflicting vehicles in sufficient time to slow down, and if necessary, stop before reaching the intersection; this applies

for both roads. The corner sight triangle for this situation is determined by the length of the two legs, A and B, in the figure that follows. These distances are based on the vehicle speed as shown in Table 3. So, if road A has a speed limit of 35 mph and road B has a speed limit of 45 mph, the length of leg A would be 165 feet and for leg B 220 feet. If you know that the actual speeds are higher, use that speed in place of the speed limit to determine the corner sight triangle legs.



Defining clear sight triangle at intersections.

Table 3. Required Length of Leg for No Traffic Control

Speed Limit (MPH)	Length of Leg (Feet)
25	115
30	140
35	165
40	195
45	220
50	245
55	285
60	325
65	365

Source: American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, 2004

If a driver is stopped at the intersection, then there is also a need for sight distance to vehicles approaching from either direction of the opposing road so that the stopped driver can safely turn left, turn right or proceed across the intersection. Of the three options, the sight distance needed to turn left is the longest and can be used to establish the required corner sight triangle for both legs of the minor road. These distances are shown in Table 4 for automobiles turning left onto a two-lane, two-way roadway and level grades. Get the assistance of a traffic engineer if: the intersection approaches are on steep grades; the approaches are skewed; the major road has more than two lanes; or there are many trucks entering from the minor road. When checking the available sight triangle, you should position yourself about 15 feet back from the edge of the major-road travelway.

*Table 4. Intersection Sight Distance for Left Turn from Stop**

Speed Limit (MPH)	Intersection Sight Distance(Feet)
25	280
30	335
35	390
40	445
45	500
50	555
55	610
60	665
65	720

Source: American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, 2004

* For passenger cars turning left onto two-lane, two-way roadway and level grades.

If you find that vegetation is limiting the corner sight distance, then you should cut it back if it is within the public right-of-way lines. Usually, you are not permitted to work outside of right-of-way lines. Some municipalities have an ordinance giving them a sight distance easement. Such an ordinance gives maintenance workers the authority to ask the property owner to trim back any trees or shrubs blocking the corner sight triangle or to cut them. However, check with your supervisor before working outside

of the right-of-way. No shrubs or plants within the corner sight triangle should be allowed to grow more than 3 feet high.

Most private property owners are willing to cooperate in improving traffic safety. They should be required to keep all bushes and shrubs at a height of 3 feet or lower and to trim all trees and hanging branches to a minimum height of 7 feet. The Appendix includes a sample letter and attachments that could be used as a way of contacting property owners to ask them to remove vegetation blocking corner sight triangles. If notice is provided and homeowners do not respond in a reasonable time, most public agencies have the power to remove the designated vegetation at property owner's expense. Check with your supervisor.

For more detailed information on intersection sight distance for other types of intersection control (signal, stop or yield) and for vehicle types other than passenger vehicles consult *A Policy on Geometric Design of Highways and Streets*.

VI. MOWING FOR SAFETY

Types of Mowing

Road and street maintenance workers do three general types of mowing. In order of importance, these are: safety mowing, transition mowing and selective mowing.

Safety Mowing:

1. Makes sure signs and other traffic control devices, guardrails, and other safety features can be seen.
2. Provides good intersection sight distance for drivers approaching intersections and driving around curves.

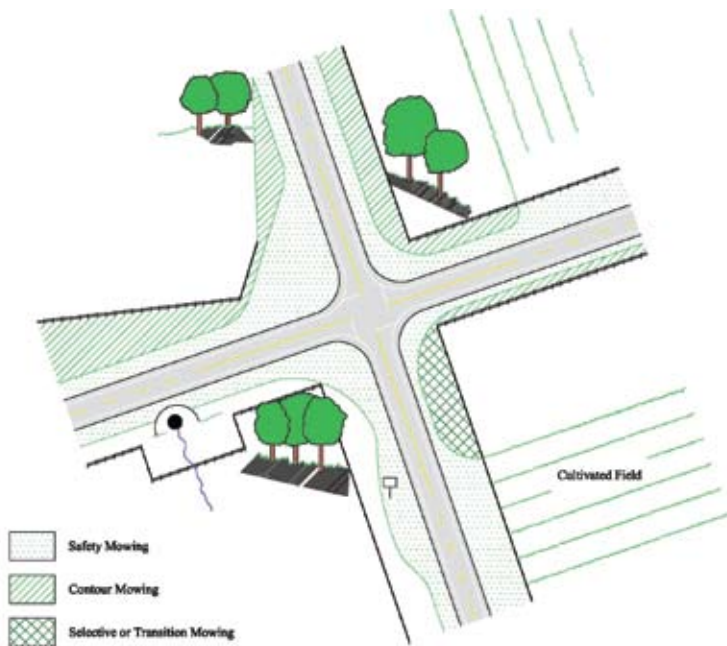
Transition Mowing:

1. Makes a smooth change from a narrow mowed width to a wide mowed width when different widths of right-of-way are mowed.

Contour or Selective Mowing:

1. Makes a natural blending on the maintained roadside with native or planted growth.
2. Shows off landscaping or wildflower areas or dresses up an interchange entrance to an urban area.

The three classes of mowing are illustrated on the next page.



Three classes of mowing.

Mowing Operations Hints

Don't

1. Mow too often. This wastes money, exposes mowing crews to traffic hazards more than needed, and can damage the vegetation.
2. Mow at the wrong time. Good timing reduces the frequency of mowing required by cutting the vegetation in the right stage of growth.
3. Mow too short. Leaving the proper height helps maintain the stand of vegetation and keeps small litter objects hidden.
4. Mow steep slopes if you don't need to. Steep slopes increase the risk of mower accidents.
5. Mow when wet. This is hard on equipment.

6. Operate equipment carelessly and scar trees and shrubs. Mowing is tedious but care must be taken to avoid accidents and preserve valuable plantings.

Do

1. Read the operator's manual thoroughly.
2. Protect yourself from the sun. Use the canopy on the mower. Wear sun screen and a hat and shirt.
3. Strip grass from around the tree, in a circle, to help avoid mower wounds that can kill trees. The radius of the circle should be 1 to 3 feet depending on the size of the tree. Remove low tree branches that can click an eye or throw the operator off balance.
4. Mow in the direction of oncoming traffic. This results in less impact if a missile is thrown out and also provides better visibility.
5. Ballast or weight the tractor properly.
6. Mow slopes steeper than 1:2.5 (Vertical:Horizontal) with a side-mounted mower on a boom if the tractor unit remains on flatter surfaces while mowing.
7. Operate side-mounted or boom mower units on the uphill side of the tractor to limit the possibility of overturning the tractor.
8. Be sure the mower has a roll-over protection structure (ROPS). Use the seat belt at all times.
9. Replace broken or lost chain guards to deflect debris immediately. Using flail type mowers reduces the amount of debris thrown.
10. Cover all V-belts, drive chains and power takeoff shafts.
11. Raise mowers when crossing driveways or roadways.
12. Shut off power before checking any mower unit.
13. Block a mower before changing, sharpening or replacing a blade. Any blade being re-installed should be checked for cracks or damage that will lead to failure.
14. Check for leaks before leaving the shop.
15. Refuel away from waterways.

16. Keep spill kits/materials on hand in case of oil or fuel leaks in field.
17. Use flashing lights and Slow-Moving-Vehicle emblems and road signal to alert traffic.
18. Use MOWING AHEAD or MOWING AREA signs or signs with similar legends to warn traffic. Signs should not be more than one to two miles ahead of the mowing.

Traffic Control for Mowing Operations

Mowing is a moving operation taking place off the roadway. Therefore, it requires different traffic control from other maintenance operations.

The most important thing to remember is to make the mower unit highly visible to drivers. That way, drivers will be alert to the mower unit and be able to avoid any potential collisions. Some tips include:

1. Operate rotating yellow lights on mower tractors.
2. Install Slow-Moving-Vehicle emblems on all mower tractors.
3. Install yellow flasher lights on roll bars on the top of tractor cabs and operate these at all times.
4. Install an orange flag or pennant on a whip to show the location of the tractor in high grass or over the edge of slopes.
5. Operate the tractor with headlights on at all times.

Warning signs such as MOWING AHEAD, ROAD WORK AHEAD and similar signs may be placed along the road. The MOWING AHEAD sign is preferred. The sign is to be used in advance of mowing operations on the right-of-way. Place it on the shoulder so that approaching drivers can read the message easily (2 feet off of traveled roadway).

As work progresses, move the signs so there are one to two miles between signs and the actual mowing work. Mount the signs on a breakaway portable support that will not be knocked over or

blown down easily. Cover or remove the sign during lunch break or any other times when work is not in progress. Do not cover or remove the signs if you have stopped mowing to repair or adjust equipment because the warning to drivers is important to safety operations.

VII. LEGAL ASPECTS

Tort Liability—tort law applies to lawsuits in which the plaintiff seeks to recover money to compensate for personal injuries or property damage that they claim was caused by the defendant. In order to recover money damages from a roadway agency in a negligence case, the plaintiff must prove the following four things:

1. that the roadway agency owed them a duty;
2. that the roadway agency breached that duty;
3. that the roadway agency's conduct was the proximate cause of the harm; and
4. and that the plaintiff was actually injured or damaged.

In general, the law imposes on anyone carrying out an activity that may cause harm to others the duty to exercise ordinary care to avoid that harm. The law requires that we act reasonably under the circumstances. Failure to do so is negligence.

In most states, as part of their duty, roadway agencies must keep streets open for travel and free from obstructions. The failure to do so is negligent road/street maintenance. So for example, shrubbery obstructing an intersection or tree limbs blocking a STOP sign in the street right-of-way can be considered to be negligence in failing to maintain the streets in reasonably safe condition.

Roadway agencies should have a risk management program with goals of reducing accidental injuries on streets and sidewalks and to increase their ability to produce evidence that they acted reasonably. Good records, such as when brush was trimmed, can be very helpful in defending against a lawsuit. The maintenance department should create a system that will document (1) the information coming into the department regarding street and sidewalk conditions; (2) the procedure used to prioritize the repair work according to the risk presented and (3) the action taken in making the repairs.

Liability for failure to correct a dangerous condition may be imposed even if the road agency did not have actual notice of the

condition if they reasonably should have known about it. This is called “constructive notice.” The better and more complete the information regarding road and street condition, the less likely the issue of constructive notice is to arise. Routine inspection for the purpose of gathering information and identifying dangerous conditions can complement the records system mentioned earlier. A program of regular inspections should be designed and implemented; the inspections should be done as often as is reasonable under the circumstances. Maintenance crews should be trained to do a general inspection of the area, including vegetation, whenever they are sent out on a job. For example, it is good practice to identify and remove dead limbs, hanging over the road, in the fall before snow/ice or wind brings them down onto traffic.

Americans with Disabilities Act (ADA)—the Americans with Disabilities Act is a civil rights law that prohibits discrimination against people with disabilities in all aspects of life. One of the five titles of ADA is Title II--“State and Local Government Services.” Government agencies must ensure that individuals with disabilities are not excluded from programs, services, and activities (pedestrian facilities). While a significant part of the *ADA Accessibility Guidelines* deals with designing facilities to eliminate architectural barriers such as narrow sidewalks, lack of curb ramps and the like, Title II also addresses maintaining accessibility. State and local governments must maintain the accessible features of facilities in operable working condition. It is recognized that poorly maintained facilities are neither accessible nor safe. Examples of vegetation-related maintenance include correcting sidewalk slabs heaved up by tree roots and trimming trees/landscaping so they do not protrude into the walkway.

Environmental Regulations—the herbicides, pesticides and fertilizers used in roadside vegetation management are substances of concern due to their potentially harmful effect on people, animals and the environment. There are a large number of regulations that govern the use, transport, storage and disposal of these materials. Violations of these regulations may lead to federal, state or citizen enforcement actions that can result in significant penalties. It is important that roadway agencies be familiar with the requirements, particularly in

terms of needed permits or licenses, training requirements and recordkeeping. Note that in addition to civil enforcement actions, federal and state agencies may criminally prosecute any person who knowingly violates certain provisions of the regulations. Knowledge of the requirements and good recordkeeping are the best defenses.

Records should be accurate and contain the following data:

1. Date and time of application.
2. Type of equipment used (including spray curtains and spray shields).
3. Herbicide(s) used, including MSDS.
4. Formulation.
5. Mixing information etc.
6. Rate of application.
7. Total area treated.
8. Location (route number, mile post or distance from nearest intersection, distance treated).
9. Target vegetation.
10. Weather conditions at time of application (temperature, humidity, wind speed and wind direction).
11. Name of applicator.
12. Miscellaneous comments (including spray pressure, nozzle type, nozzle size, speed at which spraying and distance from spray nozzle to target).

VIII. RESOURCES ON VEGETATION CONTROL FOR SAFETY

Publications

American Association of State Highway and Transportation Officials, *Roadside Design Guide*, Washington, DC, 2006.

American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, Washington, DC, 2004 (contains information on determining required intersection sight distances).

Berger, R.L., "Integrated Roadside Vegetation Management," *National Cooperative Highway Research Program Synthesis 341*, Transportation Research Board, Washington, DC, 2005.

Clark, J.R. and Matheny, N.P., "A Handbook of Hazard Tree Evaluation for Utility Arborists," International Society of Arboriculture, Savoy, IL, June 1993.

Federal Highway Administration, "Common Roadside Invasives," brochure produced by Office of Natural and Human Environment, FHWA-EP-02-003, Washington, DC, 2002.

Federal Highway Administration, *Manual on Uniform Traffic Control Devices for Streets and Highways*, Washington, DC, www.mutcd.fhwa.dot.gov (contains current information on temporary traffic control, including typical applications).

Matheny, N.P. and Clark, J.R., "A Photographic Guide to the Evaluation of Hazard Trees in Urban Areas," Second Edition, International Society of Arboriculture, Urbana, IL, 1994.

Merullo, V.D. and Valentine, M.J., *Arboriculture & the Law*, International Society of Arboriculture, Savoy, IL, 1992.

Neuman, T.R., Pfefer, R., Slack, K.L., Hardy, K.K., Lacy, K. and Zegeer, C., "Guidance for Implementation of the AASHTO Strategic Highway Safety Plan—Volume 3: A Guide for

Addressing Collisions with Trees in Hazardous Locations,” *NCHRP Report 500*, Transportation Research Board, Washington, DC, 2003 (electronic version available at <http://transportation1.org/safetyplan>)

Venner, M., “Control of Invasive Species,” *National Cooperative Highway Research Program Synthesis 363*, Transportation Research Board, Washington, DC, 2006.

Videos/DVD's

“Dangerous Travelers – Controlling Invasive Plants Along America’s Roadways,” 26-minute DVD, USDA Forest Service, San Dimas Technology and Development Center, San Dimas, CA, 2006.

“Highway Safety and Trees: the Delicate Balance,” 12-minute DVD, Federal Highway Administration, Washington, DC, 2006.

“Managing Trees for Public Safety: An Arborist’s Guide,” 36-minute videotape, International Society of Arboriculture, Savoy, IL, 1996.

“Managing Trees for Public Safety: The Role of Landscape Maintenance Personnel,” 17-minute videotape, International Society of Arboriculture, Savoy, IL, 1996.

“Some Mistakes Last Forever – West Virginia Logger’s Safety Video,” 13-minute videotape, WV Fatality Assessment and Control Evaluation, West Virginia University, Center for Rural Emergency Medicine, Morgantown, WV, February 2002.

Websites

Federal Highway Administration, Roadside Vegetation Management
<http://www.fhwa.dot.gov/environment/vegmgmt/index.htm>

International Society of Arboriculture
www.isa-arbor.com

National Roadside Vegetation Management Association
www.nrvma.org

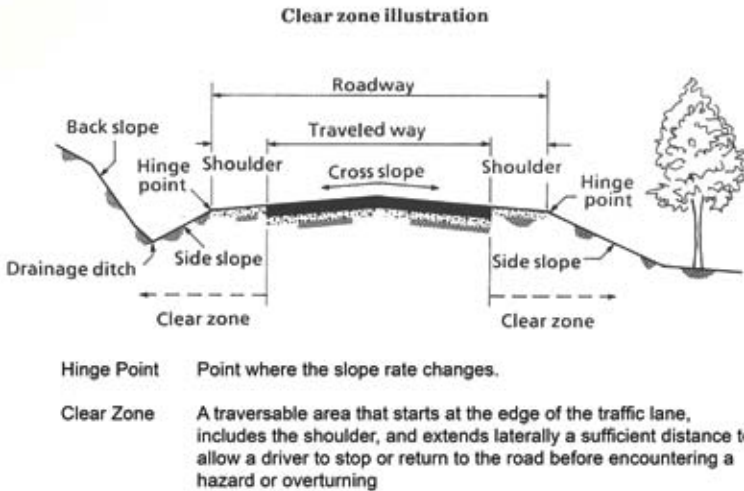
North Carolina Department of Transportation, Vegetation Management
http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/vegetation/maintenance/

Washington State Department of Transportation, Integrated Vegetation Management
<http://www.wsdot.wa.gov/maintenance/vegetation/default.htm>

IX. APPENDICES

A. Clear Zone Description

The concept of clear zone is an approach to minimize the number and severity of crashes involving vehicles running off the road. Simply stated, it is a traversable area that starts at the edge of the traffic lane and extends laterally a sufficient distance to allow a driver to stop or return to the road before encountering a hazard or overturning. The traversable area would be considered safe, if there were no fixed objects, unless they are breakaway, and if the roadside geometry (either the fore slope, back slope, or ditch) was flat enough that a vehicle could safely traverse the area without tipping and rolling over. Roadside safety features include breakaway sign and light posts, and traversable drainage structures. Curbs are not considered a roadside safety feature since they can be easily mounted by errant vehicles; hence, their presence does not alter how clear zone is measured.



A safe traversable slope can be either a recoverable slope or a non-recoverable slope with a clear run-out area at the bottom. A **recoverable slope** is a slope on which a motorist may, to a greater or lesser extent, retain or regain control of a vehicle and recover or stop. Slopes 1:4 (Vertical:Horizontal) or flatter are generally

considered recoverable. A **non-recoverable, traversable slope** is a slope which is considered traversable but on which an errant vehicle will continue to the bottom. Embankment slopes from 1:3 and 1:4 may be considered traversable but non-recoverable if they are smooth and free of fixed objects. A **clear run-out area** is the flatter area at the toe of a non-recoverable slope available for safe use by an errant vehicle. Slopes steeper than 1:3 are not considered traversable and should not be found in the clear zone.

The objective of roadside safety is to provide and maintain as much clear zone as practical. The design clear zone is the minimum width to be provided on a project and is dependent upon speeds, the roadside geometry, and traffic volumes. Further details on clear zone can be found in the *Roadside Design Guide*.

B. Summary of Safety Tips for Vegetation Control (Does Not Apply to Spraying)

1. Wear the proper Personal Protective Equipment (PPE) when conducting vegetation control:
 - A hard hat and safety goggles to protect your head and eyes from injury by twigs, flying chips, or debris that may be kicked up.
 - Leather gloves and shoes and boots with hard toes and hard soles.
 - Safety apparel meeting the requirements of ANSI 107 for Class 2 risk exposure.
2. Turn on rotating yellow lights when operating mower units.
3. Display a slow-moving vehicle symbol (reflective triangle) on the rear of a mower unit traveling on the roadway. If the tractor has flashing lights, turn them on to warn traffic that the unit is moving slowly.
4. Be alert for signs marking areas requiring limited mowing and vegetation control because of wildlife habitat. If these “no mow” areas appear to be creating a safety problem, report it to your supervisor for review.
5. Face oncoming traffic as much as possible when cutting vegetation around object marker panels and other signs or safety hardware near the edge of the roadway. Stay alert

at all times for out-of-control vehicles or one being driven too close to you.

6. Check the chain guard or other mower covers intended to keep debris from being thrown out of a mower before starting up any mower unit. Never operate a mower with a defective debris guard. A small rock, a piece of can or broken bottle thrown out from under a mower can be a lethal projectile.
7. Wear ear plugs, “muffs,” or other protective devices when operating a chain saw for any extended period of time and when operating a mower tractor.
8. Wear chain-saw resistant chaps or pants when using a chainsaw.

C. Chain Saw Operation Checklist

- Do you inspect your saw at the beginning of each shift?
- Is your saw adjusted and used according to the manufacturer?
- Do you fuel your saw at least 10 feet from ignition sources?
- Do you start your saw at least 10 feet from the fuel sources?
- Do you start your saw with the chain brake on and firmly supported or on the ground?
- Do you keep both hands on the saw and your footing secure?
- Do you clear the area of things that get in the way of cutting and retreating?
- Do you avoid cutting overhead?
- Do you shut off or throttle release before you retreat?
- If the terrain is hazardous or if you are going more than 50 feet, do you shut off or engage the chain brake?

Source: “West Virginia Logger’s Safety Field Guide,” West Virginia Fatality Assessment and Control Evaluation Program, WVU Center for Rural Emergency Medicine, Morgantown, WV, February 2002.

D. Mixing, Storing, Transporting and Disposing of Herbicides Safely

- Read the label and follow instructions exactly. Always use the safety equipment specified on the label.
- All measuring or mixing equipment should be thoroughly washed after each use and stored with the herbicides in a locked and secure area.
- Carry spill kits/containment materials in spray vehicle.
- Do not load or mix herbicides near waterways.
- Completely clean up any spills using an absorbent material, if needed.
- Always store herbicides in their original containers. Do not transfer or store herbicides in unmarked containers not intended for herbicide, such as soft drink bottles, jars or milk cartons.
- Keep herbicides in a locked, secure facility set aside and conspicuously posted for that purpose.
- Do not store safety equipment with herbicides.
- Check containers frequently for leaks. Should a leak occur, transfer the herbicide to a marked container meant to hold that herbicide. Completely clean up the leak.
- Keep an inventory of all stored herbicides.
- The name and phone number of the nearest hospital and poison control center should be posted in a prominent location in the storage facility.
- When transporting herbicides, do not place them in the cab or passenger compartment.
- Never leave a vehicle unattended with herbicide containers exposed.
- Always have the labels and MSDS (Material Safety Data Sheets) in the vehicle for the herbicides being used or transported.
- Use appropriate gloves, boots, clothing and respirators as required by the chemical being used.
- Never use leather gloves or shoes when spraying.
- When disposing of herbicide containers, follow the instructions on the label, including proper safety equipment and clothing.
- Learn, keep current with and strictly adhere to laws and regulations regarding use and disposal of all herbicides.

E. Corner Sight Distance—Sample Letter to Property Owner

(Month/Day/Year)

(Property Owner)
(Address)
(City/State/Zip)

In a recent survey of your area, street maintenance crews observed the following problems that exist on your property.

- _____ Your shrubs and bushes on the corner are obstructing driver sight lines and must be cut down to not more than 3 feet high (see attached drawing).
- _____ A tree branch hanging over the street or sidewalk limits view or access and must be cut to _____ feet above the surface of the street or sidewalk (see attached drawing).
- _____ A bush is obstructing the sidewalk or street and must be cut back to 12 inches from the edge of the sidewalk or curb (see attached drawing).

If you have questions, please call _____. If you need help correcting the problem, the City will do the work and bill you for the cost. To obtain a cost estimate and authorize the City to do the work, call _____ during business hours.

Thank you for your attention to this matter. We will inspect your property again in _____ days to check on the work unless you have arranged for the City to do the work before then.

Sincerely,

SIGHT OBSTRUCTION CORRECTION REPORTING

REFERENCE #: _____

OBSTRUCTION ADDRESS: _____

OWNER NAME AND ADDRESS: _____

FIRST LETTER SENT DATE: _____

PROBLEM: _____

DATE CORRECTED: _____

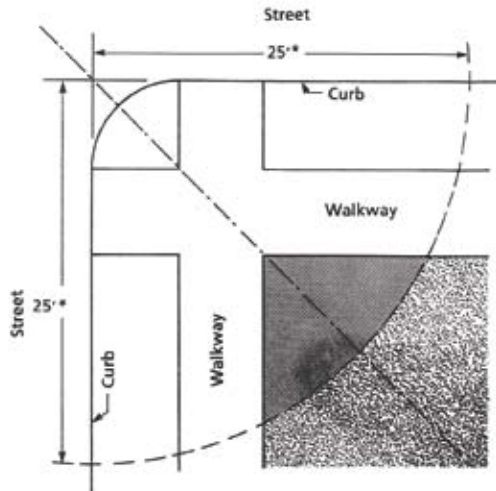
COMMENTS OR PROBLEMS: _____


NAME: _____

ADDRESS: _____

THANK YOU

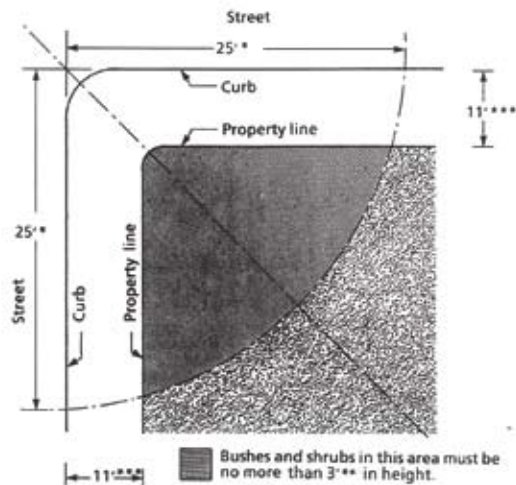
Street Corner With Walkway




 Bushes and shrubs in this area must be no more than 3'** in height.

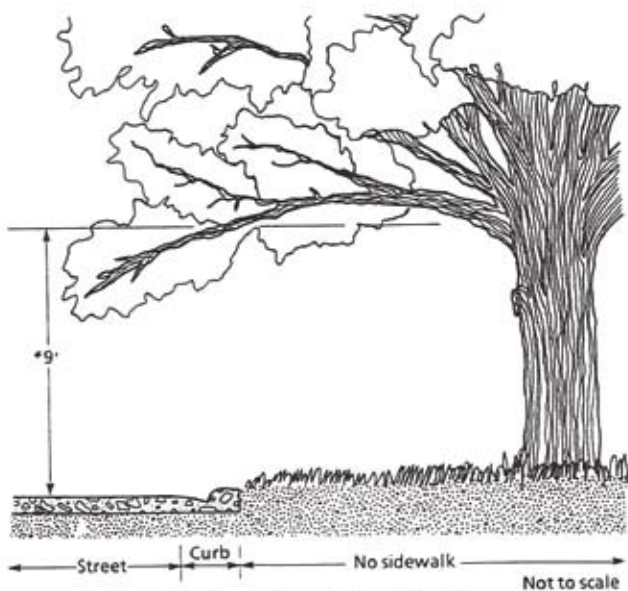
- * Change to your local requirements. Some agencies use 50'.
- ** Some agencies use 2.5'. Change to your local requirements.

Street Corner Without Walkway

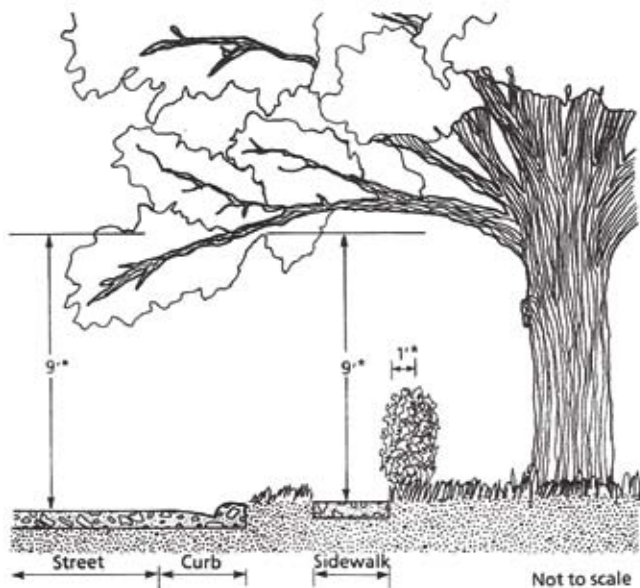


 Bushes and shrubs in this area must be no more than 3'** in height.

- * Change to your local requirements. Some agencies use 50'.
- ** Some agencies use 2.5'. Change to your local requirements.
- *** Plat and street plan distance from curb to property line. Change to specific distance for actual site location.



Branches should be trimmed so that there is 9' of clear space above the pavement (street and/or sidewalk).

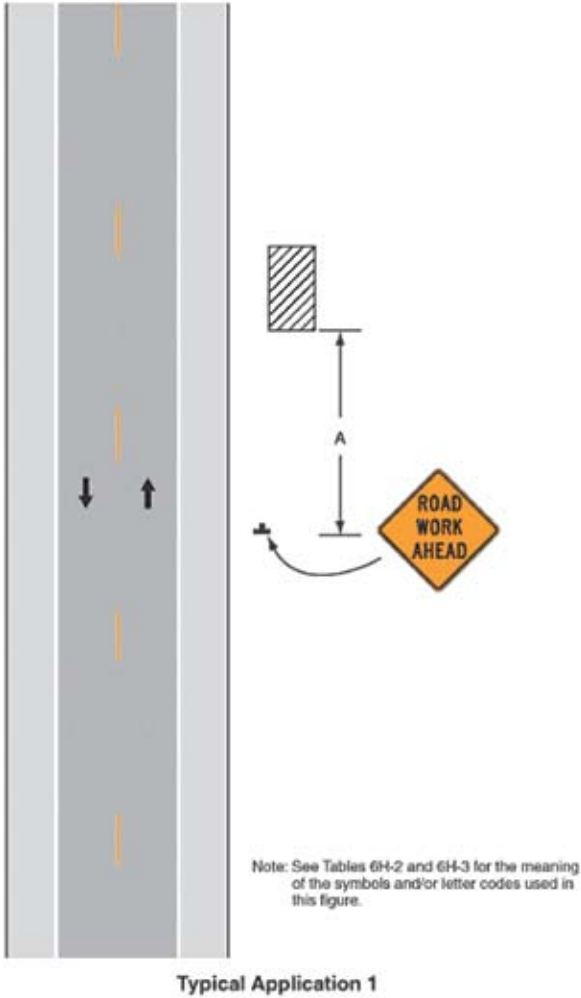


Branches should be trimmed so that there is 9' of clear space above the pavement (street and/or sidewalk). Bushes obstructing sidewalks should be trimmed back so that there is 1' clearance between the bush and the sidewalk.

*Change to your local requirements.

F. Typical Traffic Control Layout for Equipment Placed Off the Shoulder or Over the Street Curb

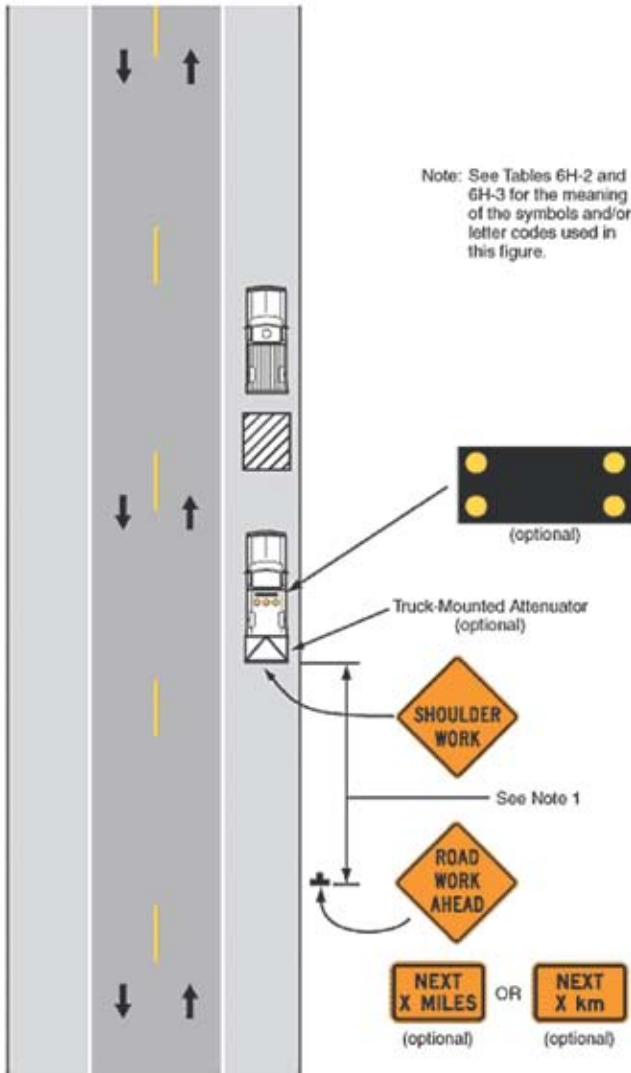
Figure 6H-1. Work Beyond the Shoulder (TA-1)



Source: MUTCD

G. Typical Traffic Control Layout for Short-Duration or Mobile Operation on Shoulder

Figure 6H-4. Short-Duration or Mobile Operation on Shoulder (TA-4)

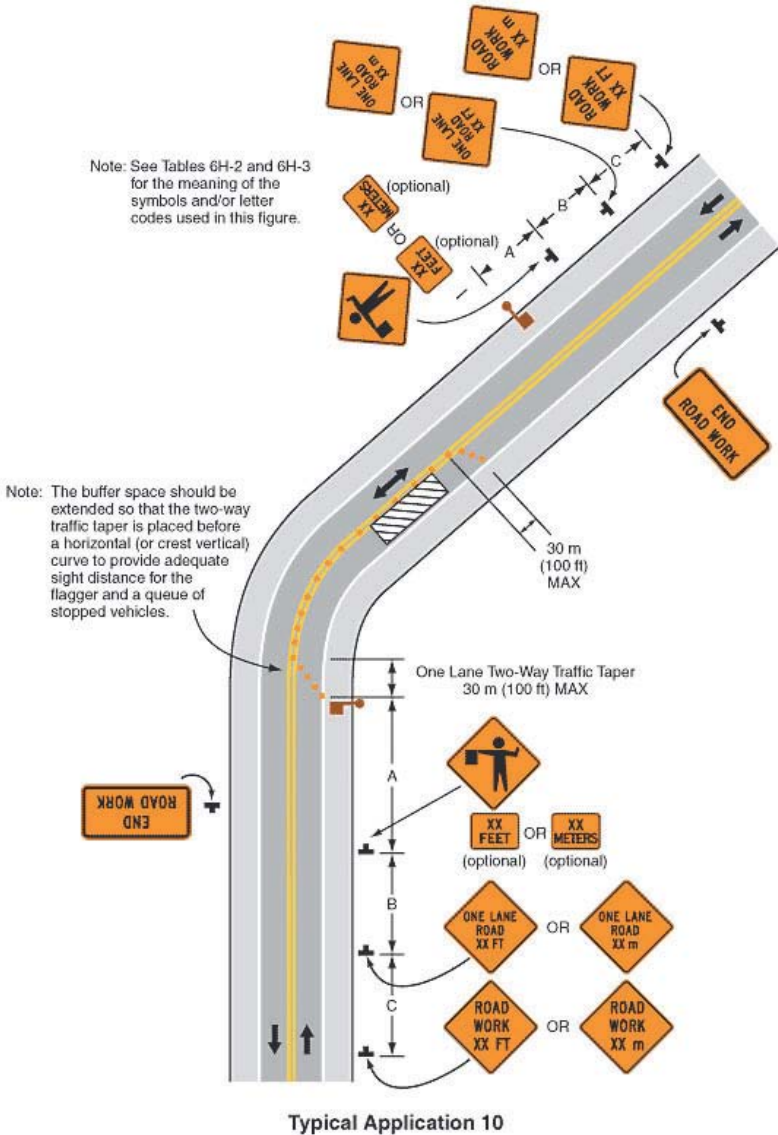


Typical Application 4

Source: MUTCD

H. Typical Traffic Control Layout for Lane Closure

Figure 6H-10. Lane Closure on Two-Lane Road Using Flaggers (TA-10)



Source: MUTCD

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**US Department of Transportation
Federal Highway Administration (FHWA)
Office of Safety
1200 New Jersey Avenue, SE
Washington, DC 20590**