GUIDELINES FOR REMOVING HAZARDOUS TREES FROM HIGHWAY RIGHTS-OF-WAY: A MANAGEMENT MANUAL

FOR

MICHIGAN DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

NOVEMBER 1979

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The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Michigan Department of Transportation or the Federal Highway Administration.

ACKNOWLEDGEMENTS

This manual was prepared by Asplundh Environmental Services (AES) for the Michigan Department of Transportation (MDOT) and the Federal Highway Administration (FHWA). Development of a methodology, collection of data, and analysis and review of findings resulted from a project team effort to which the following individuals made major contributions:

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Special acknowledgement is given to the project review committee whose guidance have enabled this project to reach fruition. As manager of the Environmental Liaison Division, Michigan Department of Transportation (MDOT), Jan Raad provided overall guidance with specific review from the following: Larry Holbrook, Supervisor, Statistical Analysis Unit, MDOT; Richard Mastin, Engineer, Local Government Unit, MDOT; Dick Blost, Traffic and Safety Division, MDOT; and to Ron Jones of the Federal Highway Administration.

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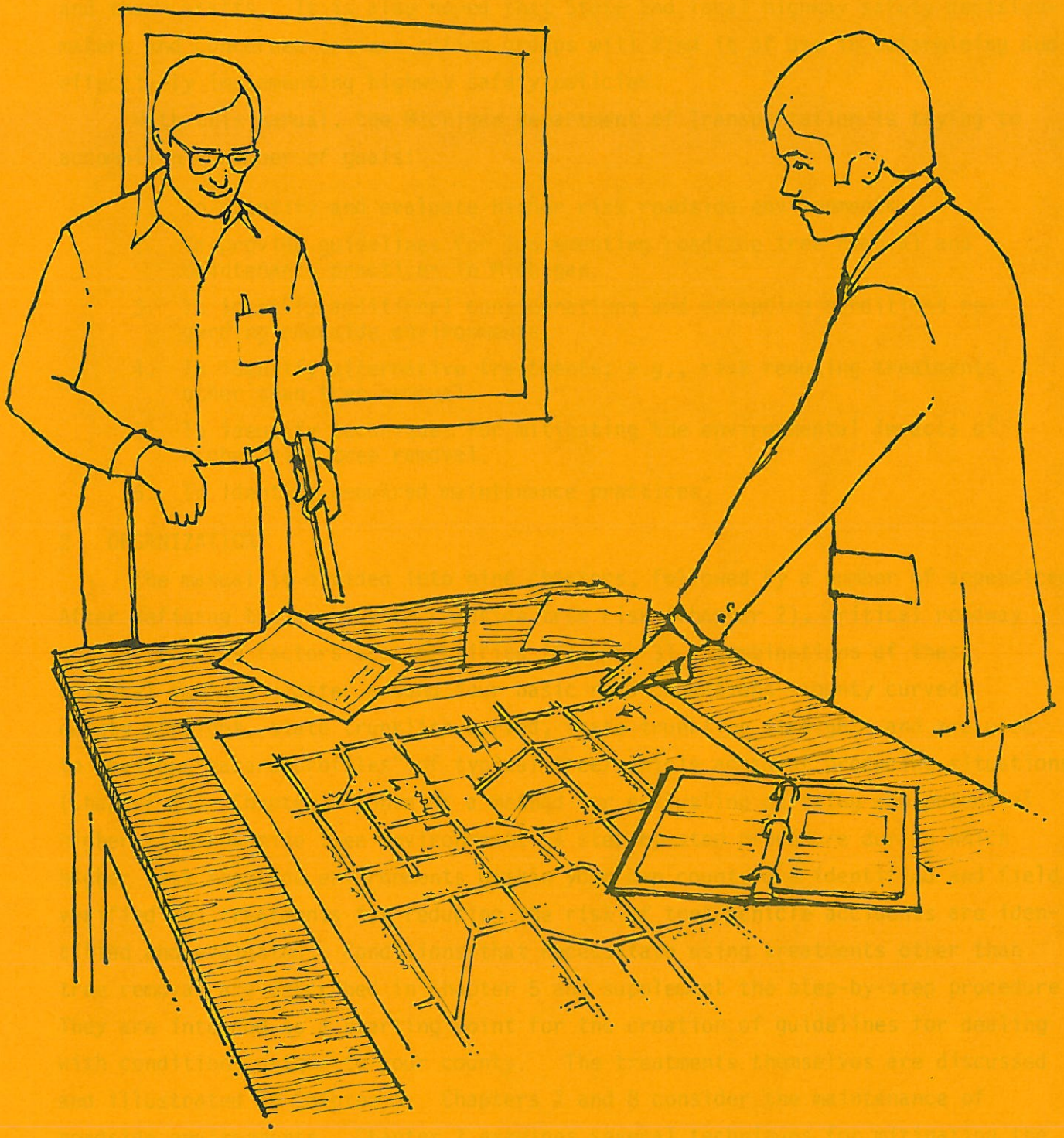

Using This Manual

9 looks at ways in which to involve the community in the roadside tree removal program and perhaps alleviate the doubts and objections of concerned citizens and groups.

A great deal of supporting material is presented in the appendices: a complete description of the Generic Roadside environments on which the hazard profiles are based (A), references (B), and sources of additional assistance (C).

3 HAZARD PROFILES

Since the bulk of this manual is based on the concept of hazard profiles, combinations of initial factors present a fatal tree/vehicle accident sites, it is strongly suggested that the reader familarize him/herself with the material in Chapter 3. For Additional information about the 16 generic roadside environments, see Appendix A of this report and the Phase 2 Report: Identify Typical Roadside Environments prepared by Asplundh Environmental Services and the University of Michigan Highway Safety Research Institute, available from the Michigan Department of Transportation.

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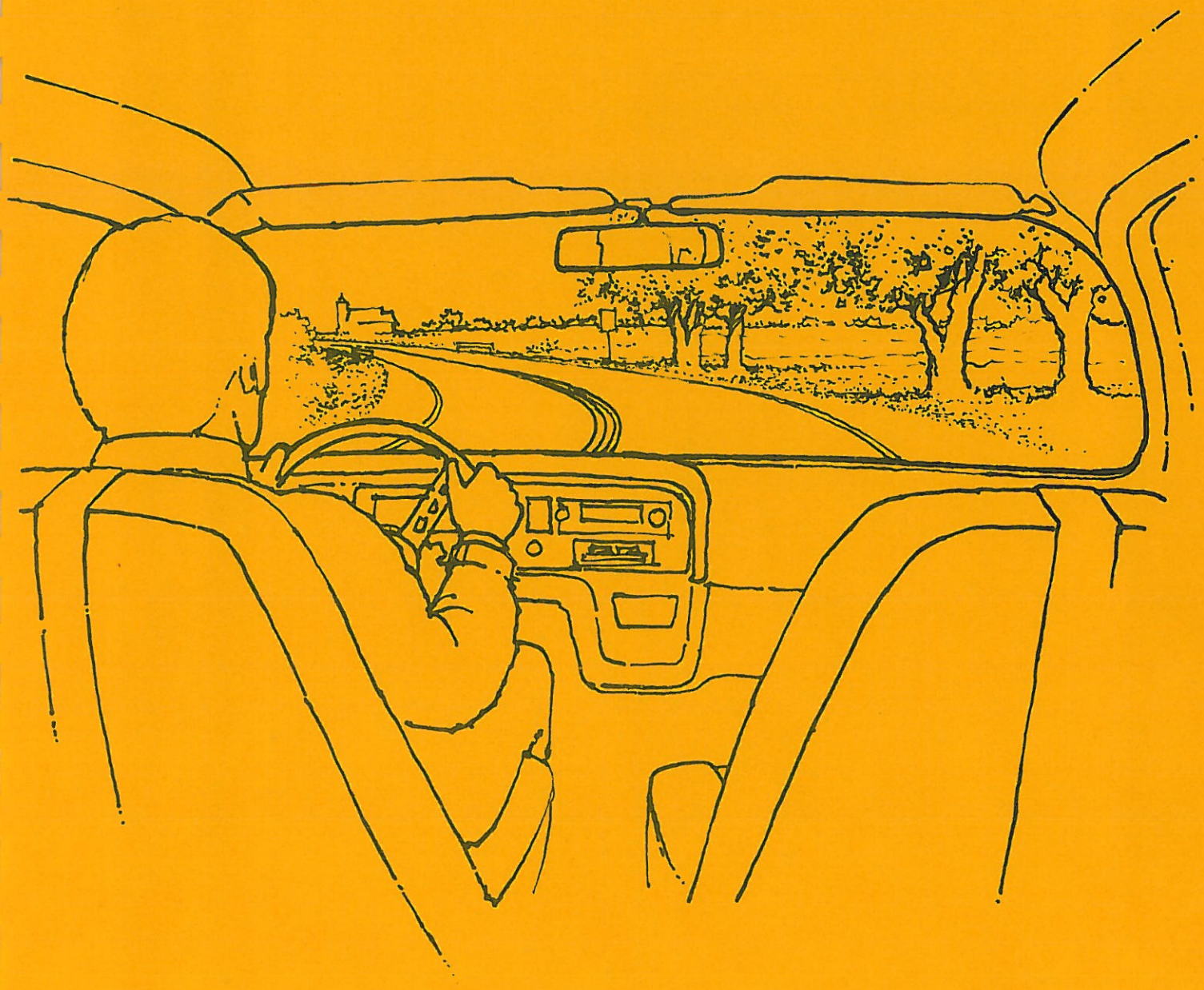

Roadside Tree Risks

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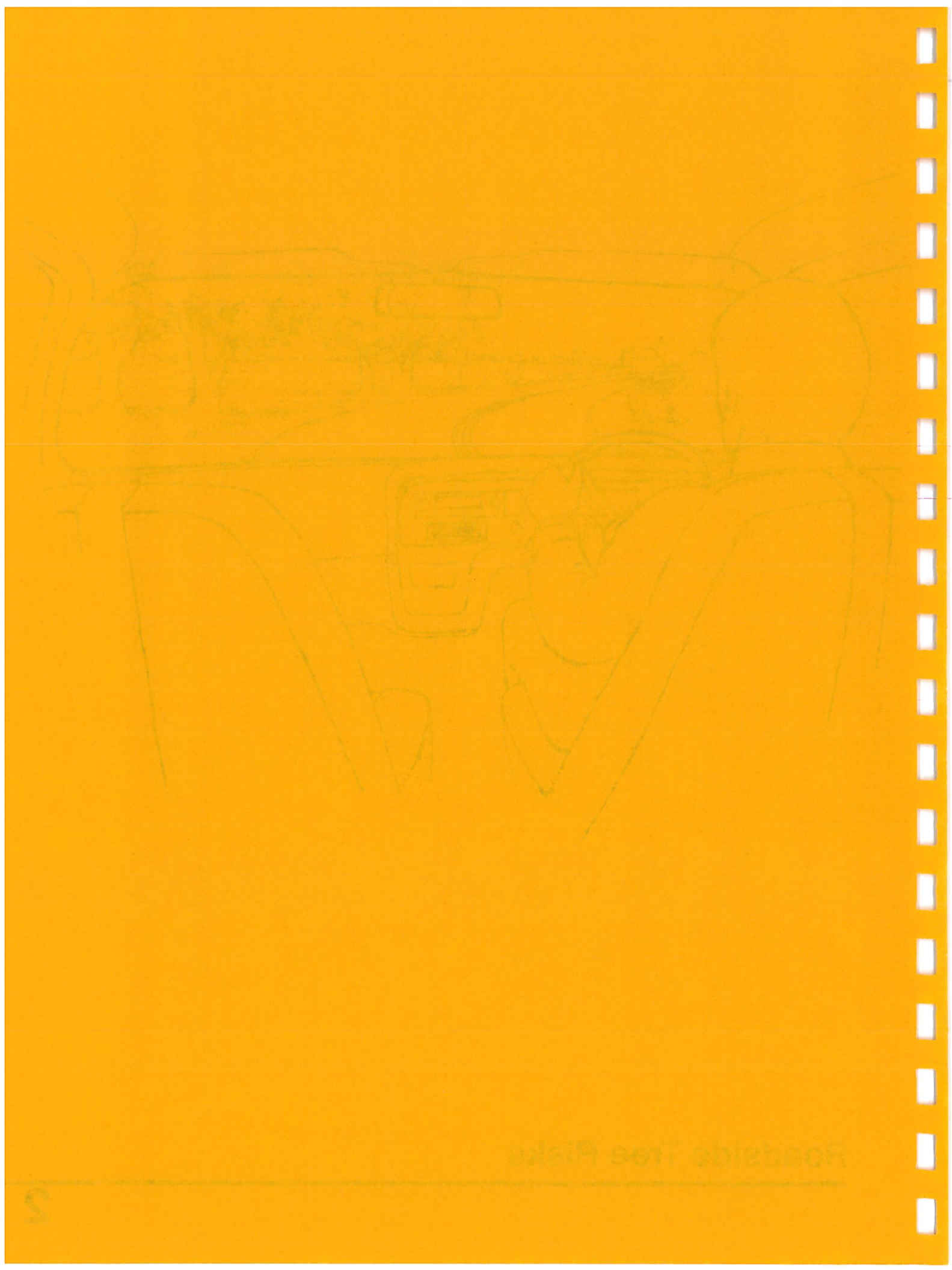


1 DEFINING THE PROBLEM

Trees that surround our highways, primary and secondary roads, and city streets have come under the scrutiny of safety-oriented programs in recent years. Although statistics show tree involvement in only 1.6 percent of vehicle accidents, trees are involved in 12 percent of all accident fatalities. In Michigan, over half of the 10,067 tree/vehicle accidents in 1976 resulted in death or serious injury. One or more occupants in 163 vehicles died; one or more occupants in 4839 vehicles were injured. A cumulative study of Michigan traffic fatalities from 1971 to 1976(Figure 2-1)revealed that despite significant variance in the proportion of tree-related deaths from year-to-year, the absolute frequency of these deaths remained constant--even during the 1974 energy crisis when all other traffic fatalities substantially decreased.

Abundant research has been devoted to identifying, prioritizing, and tabulating the risk potential of many characteristics of tree/vehicle accidents (see References, Appendix B). These characteristics fall into three categories:

1. driver characteristics
2. the road environment
3. trees and the roadside environment.

DRIVER CHARACTERISTICS

Traffic-related research has drawn a profile of the driver most typically involved in run-off-road accidents: he's a young (20-25 years old), weekend driver, out during the early morning hours (2:00-4:00 am), driving faster than the posted speed limit. He may also be intoxicated and/or unfamiliar with the road.

Age and Sex

Over 60 percent of the fatalities in run-off-road accidents are under 35 years old. Drivers under 20 years of age have an accident involvement index (the ratio of the percentage of drivers in accidents to the percentage of vehicle miles driven) six times higher than the average for all drivers. The risk of having a single vehicle accident decreases with age.

Accidents involving males predominate over those involving females by a ratio of more than 2 to 1.

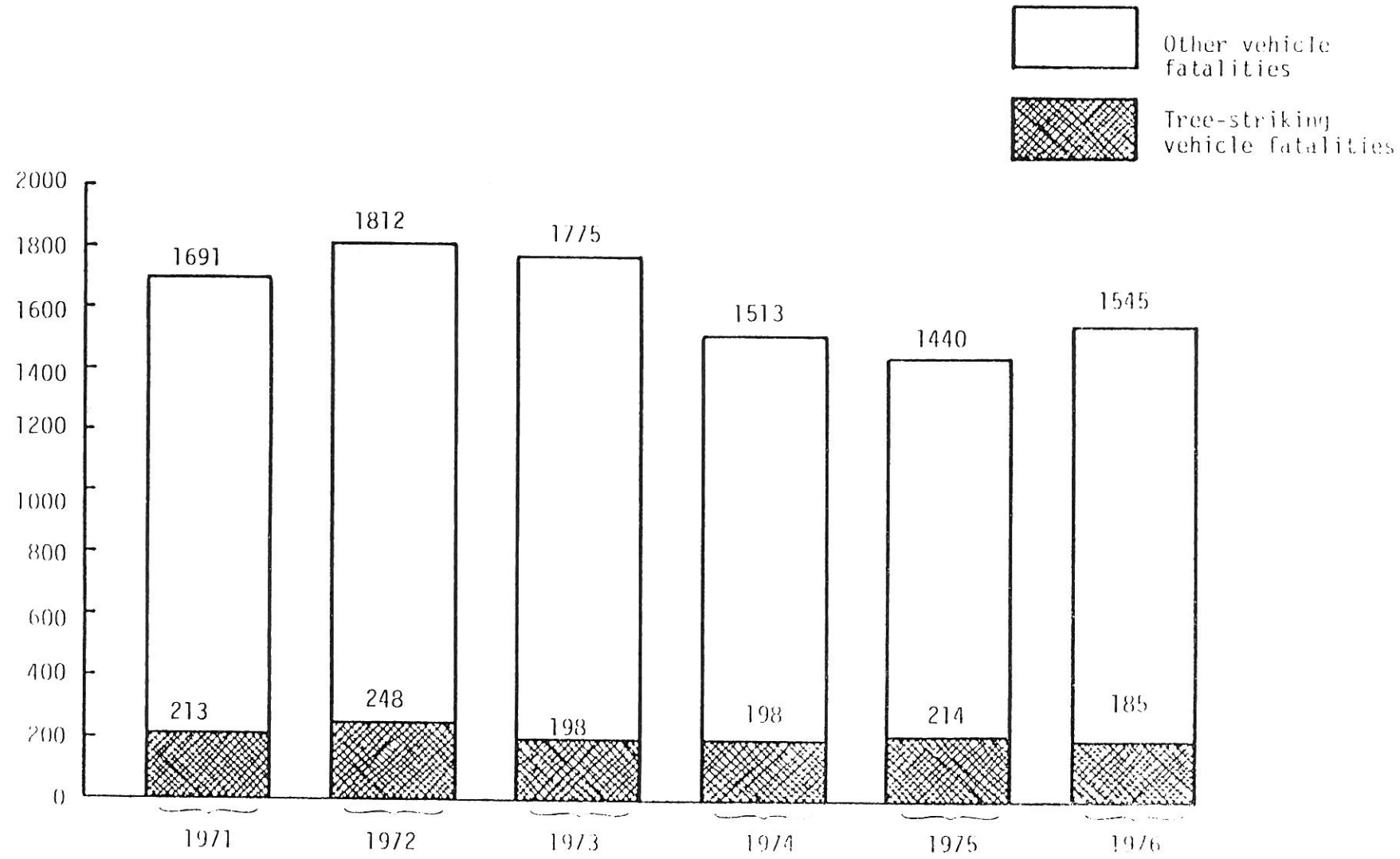


Figure 2-1 Michigan vehicle fatalities, 1971-1976, totals and those for which vehicles struck a tree (pedestrians and bicyclists have been excluded from this figure).

Influence of Alcohol

Drinking is a common ingredient in tree/vehicle accidents. More than 60 percent of the drivers killed in tree/vehicle crashes had been drinking; less than 30 percent of the drivers involved in property damage-only accidents were so reported.

Residence of the Driver

Unfamiliarity with the road may be a significant factor in tree-related crashes. Out-of-county residents are overrepresented in accident statistics of the various Michigan counties.

Time of Day, Week, Year

More than two-thirds of tree-related collisions occur on weekends, especially Friday and Saturday evenings, usually between the hours of 2:00 and 4:00 a.m. Crashes are most frequent during the winter months, suggesting some correlation with longer periods of darkness and, perhaps, icy roads.

Driving Speed

No method exists to determine the precise speed of a car upon impact with a tree. The probability of accident involvement, however, increases by a factor of 10 with a deviation of 15 mph above or below the designated speed limit.

Many of the factors that contribute to speeding, such as nighttime hours and young drivers, are also typical of run-off-road accidents. In accident records, however, police officers have reported "speeding" more than any other violation as the reason for the tree/vehicle crash.

Driver's Intent

Drivers involved in tree-related, run-off-road accidents most commonly attribute losing control of their vehicles to attempts to avoid pedestrians, other cars, objects, or animals. "Hazardous action," usually a violation of some traffic law, though not an intentional action, is another common explanation for driving behavior. Mechanical failure is the third most cited factor by tree/vehicle accident victims.

THE ROAD ENVIRONMENT

Tree/vehicle accidents typically occur on winding rural roads--the vehicle leaves the pavement on the outside of a curve. The road type and various physical features of the road (lane and shoulder width, traffic volume and direction, presence of curves, etc.), as well as the driver characteristics described above, determine the probability of running off the road.

Road Type--For this manual, Michigan roads have been divided into four types:

1. Interstates--Federally-funded, limited access highways with four to eight lanes;
2. Trunklines--State-funded, limited to partial access highways with two to four lanes;
3. County--rural, local, or township, partial to full access, paved or non-paved, two-lane, locally maintained roads;
4. Urban--any roadways that pass through city limits.

Accidents involving trees are mainly rural phenomena, occurring most frequently on county or township roads. Of the fatal accidents, 81.6 percent occurred on rural roads; 70.8 percent of the injury-producing, and 65.8 percent of the property damage-only tree/vehicle accidents occurred in unincorporated areas.

Compared to the abundance of trees found along county roads, few trees are found along interstates and State trunkline highways traversing rural, suburban, and urban regions of the State. Consequently, these roadways have a relatively low tree-involved accident frequency associated with them. With curves, however, the potential tree risk increases on highway sections. This risk is further compounded by darkness.

Urban tree accidents are not an insignificant part of the total number of tree accidents in Michigan; about 10 percent of the fatal tree accidents occur in urban areas. Little data, however, have been accumulated on the potential tree risk on urban roadways. The lack of available data is compounded by a loose definition of "urban" roads--any roadways that pass through city limits. Obviously, some portions of Michigan interstates and trunklines, as well as roads that also traverse rural areas, pass through city limits. Although the techniques and strategies for determining the risk of tree/vehicle accidents and alternatives to tree removal developed in this manual are not specifically based on data on urban roads, the discussions included in the various chapters of this manual may be applicable to urban roadways where they closely resemble characteristics associated with their rural counterparts.

Lane width and markings--Standard lane widths are characteristic of the various road types: widths of 20-24 feet are standard for two-lane roads

(10-12 feet wide lanes); 12 foot lanes are used on multi-lane roads. Lane width on secondary roadways is selected according to the traffic volumes estimated for the particular road in the future.

With widths less than 10 feet, the number of tree crashes is expected to increase, although some drivers may compensate for narrow lanes by reducing their speed.

In general, lane markings and delineation reduce the number and severity of accidents across all road types. Better lane delineation is recommended for all hazardous locations where night and/or weather conditions may obscure pavement markings.

Medians--At this time, no data are available on the effect of medians on tree-related accidents.

Shoulder width--For road segments along which a tree-related accident occurred, the mean width of the shoulder was 5.5 feet. Although some studies report the property damage accident rate has been found to decrease steadily with an increase in shoulder width from 3 to 10 feet, and the fatal and injury accident rate have a downward trend with an increase of shoulder width from 3 to 8 feet, our review of the data indicates that width considered alone had no bearing on accident rates of two-lane straight roads.

Rather, composition of the shoulder may be of more importance. Injury accident rates increase with paved shoulder widths--perhaps paving of wide shoulders induces motorists to use them as an additional acceleration and passing lane. Accidents are reduced, however, as gravel shoulder width is increased.

An accident index (the ratio of the percentage of the total number of accidents to the percentage of total travel in any category of shoulder width and alignment) found that medium width shoulders had lower accident indices than narrow shoulders under all conditions of horizontal and vertical alignment, but that alignment had more effect on accident experience than shoulder width. Shoulder width may only be unimportant, however, if the zone immediately beyond the shoulder is free of roadside hazards.

Grade--Grade, the rate of ascent or descent in elevation, positively correlates with accident rates. That is, the grade may increase or reduce the speed of vehicle before a solid object is struck. Road sections with gradients of more than three percent constitute zones with a higher than average accumulation of accidents.

Curves-- Seventy-seven percent of tree-related accidents on curves occur at "outside" curves; that is, to the right of a left curve or the left of a right curve (see Figure 2-2). Inside curves account for 23 percent of the crash frequency. Most tree/vehicle crashes involve right departures at left curves.

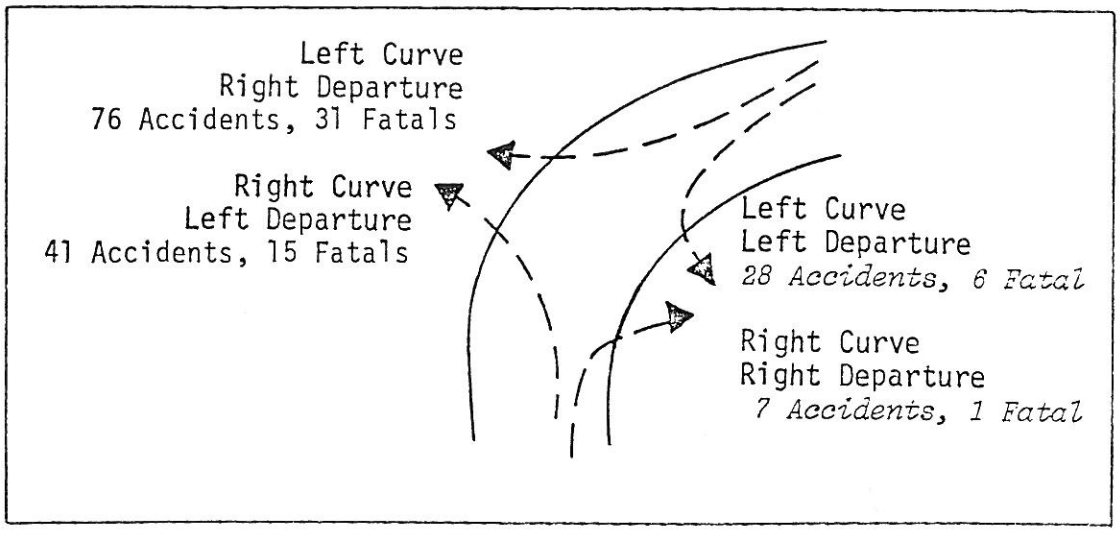


Figure 2-2 Curve Direction and Accident Frequency

Traffic volume-- Under volumes of 4000 vehicles per day, the frequency of tree-related accidents correlates positively with traffic volume. At higher volumes, the number of incidents actually decreases--perhaps due to increased driver attentiveness, or physical conditions that limit driving speeds: e.g., congestion.

TREES AND THE ROADSIDE ENVIRONMENT

The typical tree/vehicle accident involves a larger tree within 30 feet of the road edge, located in a drainage ditch or at the bottom of a downward grade. The target tree and its immediate surroundings (size, density, distance from the road, the presence of other obstructions, etc.) determine the probability of the vehicle striking the tree.

Tree size-- Fatal tree accidents are more closely associated with larger trees than are non-fatal accidents. The median tree diameter in fatal tree accidents is 20 inches; in non-fatal tree accidents, the median tree diameter is 15 inches. Of 154 fatal crashes, eight involved trees under 6 inches in diameter--thus, hitting a small tree does not insure safety in a run-off-road collision.

Distance of trees from road-- Although accident-involved trees have been as far away from the pavement edge as 90 feet, 85 percent of the trees involved in tree/vehicle crashes were within 30 feet of the road edge (see Figure 2-3).

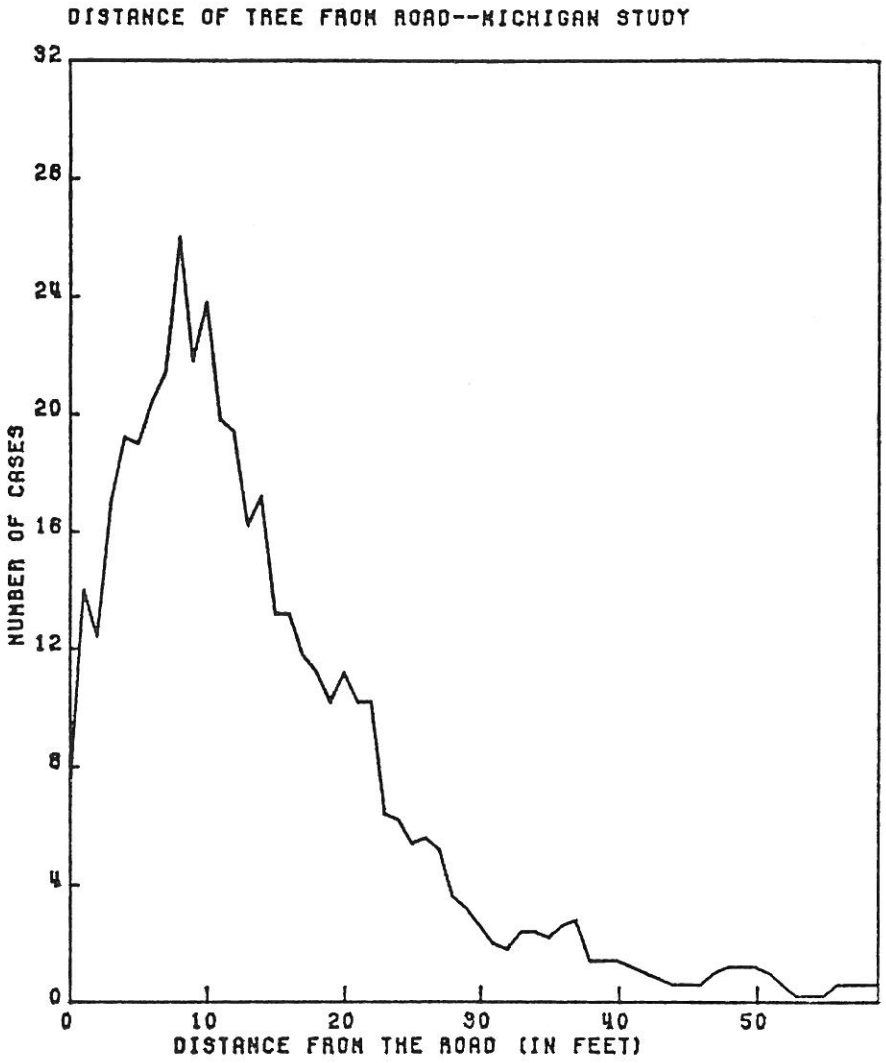


Figure 2-3 Distance from Road of Struck Trees--Frequency Distribution

Tree density-- Accident frequency and severity diminish with increasing distances between trees. Perhaps, the presence of "gaps" between trees allows drivers of run-off-road vehicles to avoid collision.

Other environmental factors-- A number of other factors may reduce or increase the probability of striking a tree as well as affect the severity of the crash. For instance, the presence of guardrails may change the character of the accident;

slope design may reduce the speed of a vehicle before it strikes a solid object; a drainage ditch may guide the vehicle directly into a tree.

2 SOLVING THE PROBLEM

To reduce the risk of tree/vehicle collisions substantially, three approaches are apparent.

The first approach is to address the animate, rational element, the element most responsible for creating this dangerous situation--the driver. Driving speed appears to be the most modifiable of the driver characteristics. Slow the driver down and there will be fewer tree/vehicle accidents. Although some attempts have been made to raise drivers' consciousness about the incompatibility of driving and drinking and the hazards of speeding, the major behavior modifications required to affect changes in American driving habits are a sociological puzzle that cannot be solved here.

The second approach to reducing roadside tree risk is to alter the road itself. Higher risk elements of road design, such as curves and narrow lanes and shoulders, can be modified. Guardrails and other protective barriers can be installed along higher-risk road segements. Drainage ditches can be realigned to channel vehicles away from solid objects.

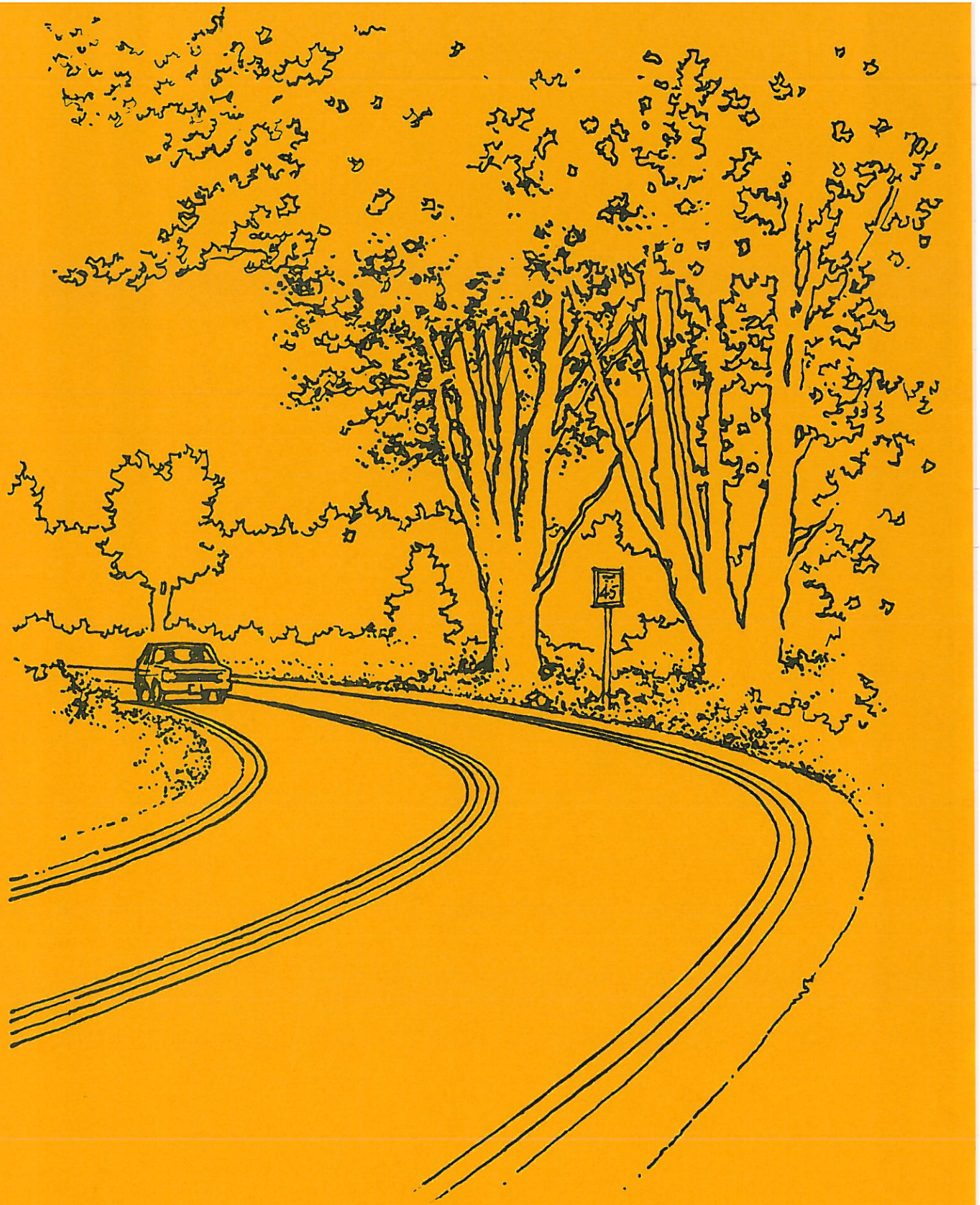
A third approach is to remove the risk of hitting the tree. Since there is no absolute minimum tree diameter or distance from the pavement edge that assures complete safety for run-off-road drivers, some individuals might argue that tree accident risk will vanish only if the entire population of roadside trees within a 90 foot margin are removed. A continuum of alternatives to total tree removal is available--ranging from building barriers around existing trees, spacing trees to create "safety gaps," to slowing down traffic in higher-risk areas, or otherwise channelling the run-off-road traffic away from roadside trees.

Only the consolidation of these three approaches will successfully minimize the overall risk of tree-related accidents. Major factors such as speed, road type, and horizontal alignment (straight or curves) and distance and alignment of trees from the road can be modified to form a program of tree/vehicle collision risk reduction--a program that is cost-efficient, environmentally sound, and effective in reducing or eliminating that risk.

Since sufficient resources do not exist to remove all hazards in the roadside environment, those sites with a higher risk of serious accident involving a tree must be identified. To do this, one must determine what factors make a

particular site dangerous. In Chapter 3, the critical factors that tend to be present at sites of fatal tree accidents are identified. Hazard profiles are combinations of critical factors present at particularly dangerous road segments, are then defined. These hazard profiles allow particularly hazardous sites to be designated and treated. Less dangerous sites along a given road type can be given a lower priority for the treatment.

Chapter 4 provides a step-by-step method for determining the risk potential or road segments using the hazard profiles as guideposts for analyzing local conditions. The tree/vehicle collision risk reduction methods outlined in subsequent chapters are based on the driver characteristics, the road environment factors, and the characteristics of trees along roadsides described in this chapter.



Hazard Profiles

Considering run-off-road accidents as the end result of a single feature of the road environment does not account for the total number of fatalities that occur and cannot be used to determine the level of risk present. For example, the distance of the involved tree from the road is not sufficient by itself; accidents involving trees have occurred at all distances from the pavement's edge. Employing such one-dimensional models extremely limits our ability to understand and, consequently, to prevent fatal and non-fatal tree/vehicle accidents.

In the development of comprehensive tree removal guidelines, identifying and ranking the relevancy of specific non-human factors that contribute to the risk of tree/vehicle accidents is an essential task. Two realms of the total roadside environment must be considered: the actual roadway and the off-roadway environments. Studies performed for this project indicate that the various roadway and off-roadway characteristics discussed in this chapter cluster together into particular patterns associated with road type and alignment. These hazard profiles allow potentially dangerous sites to be designated and treated. Less dangerous sites along a given road type can be given lower priority for treatment.

So that their individual impact on tree-involved accidents can be better understood, the roadway and non-roadway characteristics are defined in Section 1, below. For our purposes, the area within 5 feet of the roadway edge is considered part of the roadway environment. Off-roadway characteristics are grouped into two categories: characteristics of the area 5-40 feet beyond the roadway; and characteristics of the area within a 1/2 mile radius of roadway section. The hazard profiles themselves are presented in Section 2.

1. CRITICAL FACTORS

CHARACTERISTICS OF THE ROADWAY ENVIRONMENT

Road class--1-lane/1-way, 2-lane/1 way, 2-lane/2-way, 4-lane/2-way non-divided, 4-lane/2-way divided, or 5-lane/2-way non-divided. Most accidents occur along 2-lane/2-way roads.

Lane width--9 feet, 11 feet, or 12 feet. Lane width is determined by the distance from the pavement edge to the centerline for two-lane roads and from the pavement edge to the next lane mark for four-lane roads. If the road is unpaved or unmarked, lane width may only be estimated.

Road type--Four types of roadways are considered:

Interstate--Federally funded, limited access divided highways with 4 to 8 lanes.

State trunklines--State funded, limited to partial access highway with 2 to 4 lanes.

County (and Township) roads--paved or non-paved, two-lane, partial to full access roads that are locally maintained.

City streets--roadways that pass through city limits.

Cross-section--Level, crowned, super-elevation, banked or reverse super-elevated. Cross-section is determined by taking a cut-away view of the roadway and determining its alignment with the shoulder and off-road surfaces. Elevated cross-sections, the road surface higher than adjacent surfaces, are more common than level sections in run-off-road tree accidents.

Surface--Paved or unpaved.

Maintenance condition--Good, fair, poor, bumpy, spalls/cracks, potholes, or washboard. (The maintenance condition of all 16 generic roadside environments in Michigan was found to be good.)

Horizontal alignment--Straight, curved left, or curved right.

Vertical alignment--Level, dip, hillcrest, upgrade, downgrade, or other. The road surface may be level, decline into a dip, rise, fall, or align vertically in some other manner.

Gradient--0%, 1-2%, 2-4%, or 4+%. The percent of roadway elevation. Higher elevation, 2-4% or greater,is considered more hazardous.

Horizontal alignment for 1/2 mile approach to recorded accident site--Straight, gentle curves, winding/S-curves, right-angle turns, other angle turns, or other. This is an extended horizontal alignment evaluation beyond the specific road section.

Vertical alignment for 1/2 mile approach--Level, rolling, slight downgrade (1-2%), moderate downgrade (2-4%), steep downgrade (4+%), slight upgrade (1-2%), moderate upgrade (2-4%), steep upgrade (4+%).

Shoulder surface--Paved, gravel, grass, part gravel/part grass, or no shoulder.

Shoulder maintenance condition--Stable, unstable, potholed, rutted, washed out, or brush or weed covered. This feature does not apply to urban streets for which shoulders are not constructed.

Shoulder width--2 feet, 4 feet, 8 feet, or not applicable.

Roadway terminated by curbing--Curbs are most prevalent along city streets.

Roadway segment accident site--Traffic conditions present at recorded accident site--straight section, curved section 4-way intersection, T-intersection, right side T-intersection, left side T-intersection, right hand intersection, left hand intersection, entrance ramp, exit ramp, gore area, driveway, or other.

ADT-Average daily traffic volume--0-750 vehicles; 751-2000; 2001-5000; 5001-10,000; 10,001-20,000; 20,001-90,000.

Night illumination--Present or absent.

Traffic controls--Markings--the presence or absence of a center-of-the road (centerline) marking; a reflective line along the edge of the road (edge line); curbing. Signs--stop, yield, arrow indicating curve/intersection, warning, information.

Objects that would be contacted before impact with tree(s)--Guardrail, ditch/trough, embankment/up-slope, embankment/down-slope, fence, hedge, utility pole(s), guy wire(s), brush/bushes, curbing, traffic sign post(s), sidewalk, other.

Vertical profile--This feature pertains to the degree to which the area within 5 feet of the roadway edge slopes--no slope (level, 1 to 2 foot incline or decline (fill slope/shallow), 2 to 4 foot incline or decline (fill slope/medium), 4+ foot incline or decline (fill slope/steep), 10+ foot incline or decline (fill slope/precipitous).

Terrain condition--The nature of the terrain within 5 feet of the pavement--field/grass, cultivated, or weeds; hedge; pasture; lawn; bushes/underbrush; woodland/forest; stumps; rocks/boulders; sand/gravel; ditch/trough; gully; swamp; creek/river; pond/lake/ sidewalk; paved area/parking lot; embankment; retaining wall; other.

CHARACTERISTICS OF THE OFF-ROADWAY ENVIRONMENT

The Area 5-40 Feet beyond the Roadway

Vertical profile--The slope of the area 5-40 feet beyond the roadway--level, 1 to 2 foot incline or decline (fill slope/medium), 4 to 10 feet incline or decline (fill slope/steep), 10+ foot (precipitous).

Terrain condition--The nature of the vegetation 5 to 40 feet beyond the roadway, same as above.

Previous damage indications--Presence or absence of accident scars, etc.

Tree density--Lone tree, one of several, one of a clump, one of a row, among brush, part of adjacent woodlot. The spatial distance of a target tree from other trees at a potential accident site.

Tree origin--Natural, planted, or unknown. Whether the tree occurred naturally or was planted intentionally.

Right-of-way maintenance--Natural free growth or lawn. This feature refers to the easement adjacent to all public roadways. It has either been left in its natural growth state or has been maintained in some other way, mowed or cleared, or replaced with a lawn (grass).

Nearby trees which evidence vehicle accident damage--Whether some of trees along the roadway display signs of involvement in tree/vehicle accidents (e.g., scarring).

Site of previous accident--If site is mentioned in accident reports or tree scars indicate that previous tree/vehicle accidents occurred.

Within 1/2 Mile of the Roadway

Topography--Determined by field observation, topography of the roadway (see Figure 3-1) may be nearly level (0-2% gradient); gently sloping (2-6% gradient); moderately to strongly sloping (6-25% gradient); or steeply sloping (25% plus gradient).

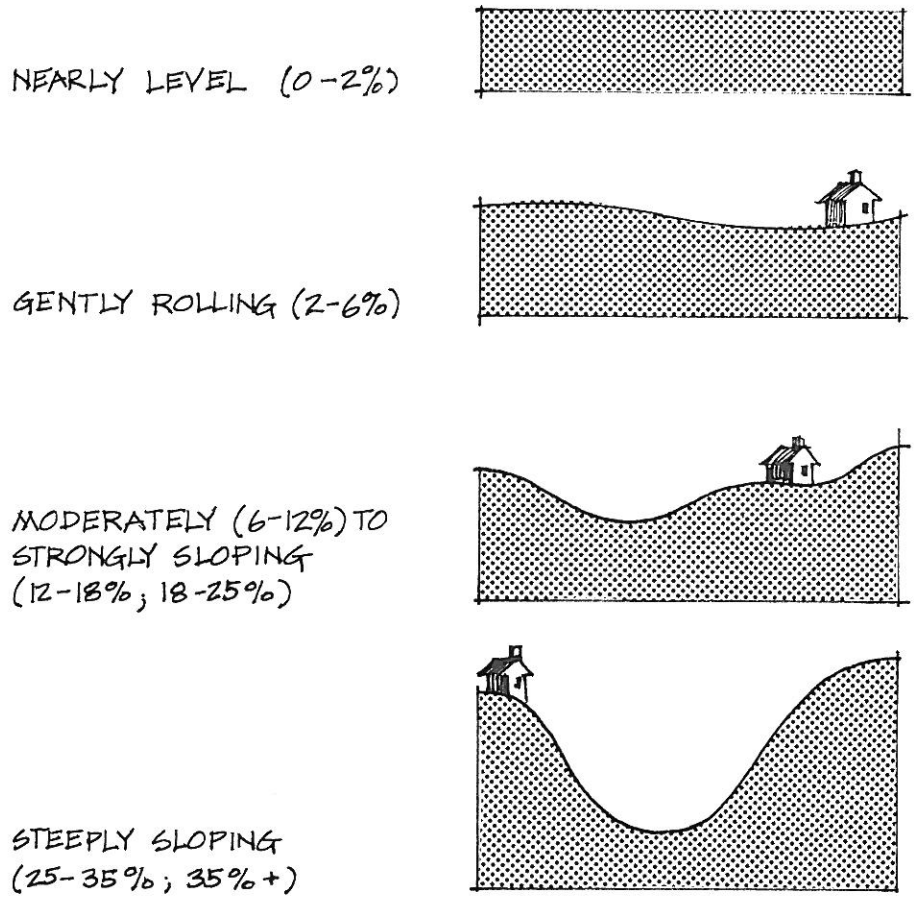


Figure 3-1 Topography

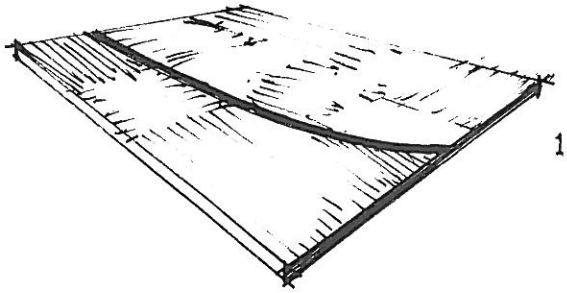
Land cover--Basically open, scattered trees, woodlots, wooded with openings, or forest (see Figure 3-2). Basically open areas consist of 4% or less wooded area; scattered trees is typified by 5-14% wooded area; woodlots are 15-39% wooded; wood with openings is an area that is 40-69% wooded; forest is 70-100% wooded.

Development patterns--Urban, suburban, scattered suburban, strip, rural residential, farmstead, or undeveloped (see Figure 3-3).

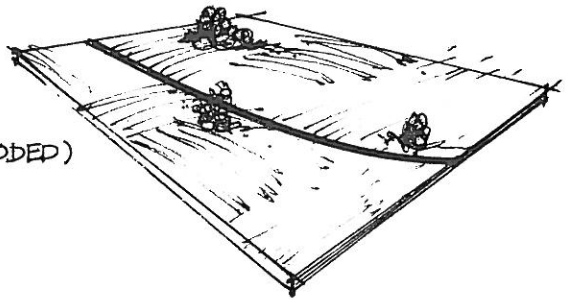
Middle ground view existing--This feature indicates whether or not the characteristics of the roadway are visible 1/4 to 3-5 miles away by the approaching driver.

Land use adjacent to site--Residential; cropland, rotation and pasture; herbaceous rangeland; broadleaved forest; non-forested wetlands.

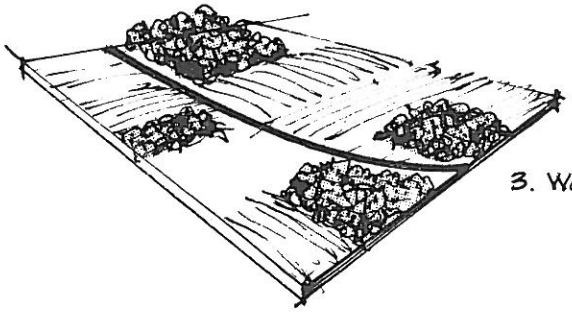
Most prominent land use in 1/2 mile radius--Residential; open and other; cropland, rotation and pasture; broadleaved forest; non-forested wetlands.



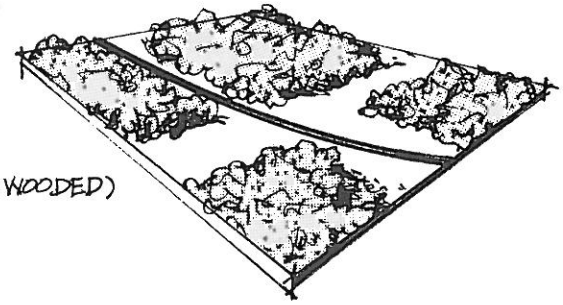
1. BASICALLY OPEN (0-4% WOODED)



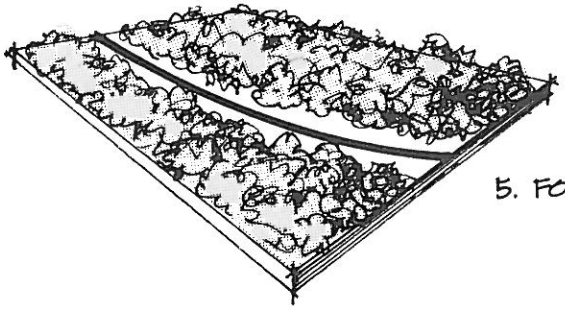
2. SCATTERED TREES (5-14% WOODED)



3. WOODLOTS (15-39% WOODED)



4. WOODED WITH OPENINGS (40-69% WOODED)



5. FOREST (70-100% WOODED)

Figure 3-2 Land Cover

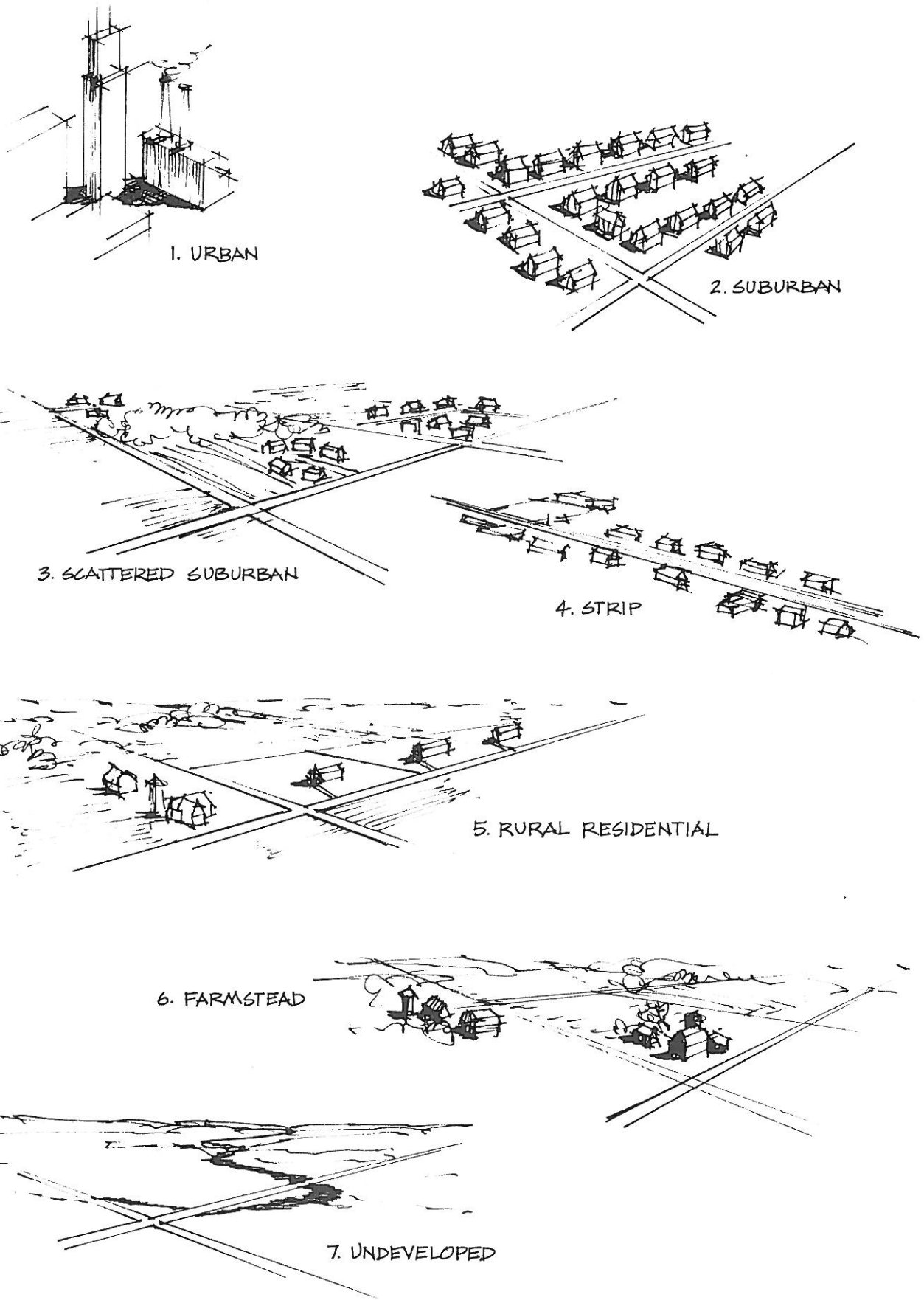


Figure 3-3 Development Patterns

Distance of trees from road--Although accident-involved trees have been as far away from the pavement edge as 90 feet, 85 percent of the trees involved in tree/vehicle crashes were within 30 feet of the road edge.

2 HAZARD PROFILES

The hazard profiles relate directly to the road types identified in Chapter 2--interstates, trunklines, and county roads--and the horizontal alignment--curved or straight--of those roads. This analysis yields six road conditions: Interstate curved, interstate straight, trunkline curved, trunkline straight, and county curved and county straight.

In 1976, county roads accounted for over three-quarters of all fatal tree/vehicle accidents in Michigan (Table 3-1). Interstate highways, on the other hand, were very rarely the scene of such accidents; only three fatalities involving trees occurred along Michigan interstates in 1976 (less than 3% of all fatalities).

Table 3-1

Number of Fatal Tree Accidents at Each Type of Road Segment

	Road Segment Type						
	Interstate Curve	Interstate Straight	Trunkline Curve	Trunkline Straight	County Curve	County Straight	Total
Number of Accidents	0	3	10	17	40	56	126
Percent of Total	0	2.3	7.9	13.5	31.7	44.4	100.0

Curved county roads are by far the most dangerous, followed by curved trunklines, then straight county roads and trunkline segments. Fatalities arising out of impacting trees are very rare occurrences along interstate highways in Michigan. Given the heavy traffic load carried by these interstates, (Table 3-2), the danger of a fatal tree/vehicle accident along an interstate highway is almost negligible. Thus, the hazard profiles presented below are for county roads and state trunklines only. It is on these road types that your hazard removal programs should be focused.*

*As stated in Chapter 2, difficulty of defining "city streets" and a lack of data on tree/vehicle accidents occurring along this road type prevent inclusion of city streets as a separate element in the discussion that follows. Because county roads and state trunklines that pass through city limits are considered "city streets." the hazard profiles may be applicable to that road type there they closely resemble rural conditions.

Table 3-2

Average Volumes And
Miles Traveled Per Fatal Tree
Accident on Each Type of Road Segment

	Interstate Curve	Interstate Straight	Trunkline Curve	Trunkline Straight	County Curve	County Straight	Total
Total Vehicle Miles Traveled (Billions)	.136	13.446	.188	18.390	.200	19.800	52.160
Percent of Total (above)	.261	25.778	.360	35.257	.383	37.960	100.0
Miles per Death (Millions)	Infinite	4,482	18.8	1,082	5.0	353.6	

In the hazard profile descriptions below, critical roadway and off-roadway factors are identified, then clustered together into scenarios of typical accident conditions. These typical conditions are the hazard profiles.

CURVED COUNTY ROAD SECTIONS

Curved county roads constitute a substantially more dangerous driving environment than do straight county roads. Most curved county road accident sites are found on left-hand turns with downhill gradients, following a series of curves. Likelihood of an accident increases with tree density near the outside of the curve. The impacted tree is often 20 feet or more from the road edge--calling into question the advisability of tree removal on county road curves where trees are part of a woodland. Many trees would have to be removed, at a considerable distance from the road edge.

Critical Factors

Horizontal alignment: curves left

Horizontal alignment for 1/4 mile approach: multiple curves

Terrain condition: downgrade

Tree density: one of a row or part of adjacent woodlot

Traffic controls: inadequate signs

Hazard Profiles

1. Super-elevated cross-sections with downhill segments, downbanks, and unstable shoulders.
2. Left turns and narrow lanes, particularly on downhill segments.
3. Clusterings of trees at the curves; with clusters up to 20 feet or more from the road's edge.

In 85% of all accidents along curved county roads, another tree was struck prior to the fatal one.

CURVED STATE TRUNKLINE SECTIONS

In every case studied, accidents along curved state trunklines occurred on left-hand curves. Most often, the fatal tree was one of a cluster of trees and was rarely the first tree struck. Typically, the vehicle ran down an embankment into a cluster of trees. Almost half of the accidents studied occurred at the scene of at least one previous serious tree/vehicle accident.

Treatment of curved trunklines is more difficult than treatment of curved county roads. The trees tend to be even further from the road's edge.

Critical Factors

As was the case with curved county road accidents, vehicles often miss a left turn and plunge down an embankment into a tree. Slope of the road is a less critical factor on trunklines than on county roads, however.

Horizontal alignment: curved left

Cross-section: super-elevated

Terrain condition: embankment; downgrade

Tree density: clusters or groupings of trees

Distance of tree(s) from the road: 20 feet or more

Site of previous accident: yes

Hazard Profiles

1. Vehicle runs down embankment, strikes tree, careens into fatal tree.
2. Vehicle misses left turn and strikes tree 20 feet or more from road's edge.

STRAIGHT COUNTY ROAD SECTIONS

Straight sections of county roads have quite different hazard profiles than curves. The distances of fatal trees from the road's edge tend to be appreciably less along straight county roads. Typically, the vehicle enters a ditch from a narrow and often unstable shoulder and is then channelled into several trees.

Considering the total number of fatalities that occur along Michigan roads, straight county road sections are the leading category. Treatment of the risk associated with this road type is a problem because this roadway type represents the greatest number of miles within the State. The most cost-effective approach

to treatment may be to rank order the road segment types by fatalities per vehicle mile traveled (VMT) and treat them in that order. Assuming that the treatment costs per mile are not remarkably different from section to section, this approach allows the greatest increase in safety per unit cost.

Critical Factors

Gradient: downhill
Terrain condition: ditch
Distance of tree(s) from road: close (often less than 15 feet)
Tree density: row of trees, part of adjacent woodlot
Site of previous accident: often
Shoulder maintenance condition: unstable

Hazard Profiles

1. Crowned cross-section, narrow shoulder, and a ditch. These factors appear to steer the vehicle into the ditch and into a tree.
2. Narrow shoulders, trees close together, and trees within 10-14 feet from the road's edge. Another tree struck prior to the fatal one.
3. Trees in ditches; ditch leads vehicle right into tree. Another tree usually struck before the fatal one.
4. Downbanks leading to woodlots.

STRAIGHT STATE TRUNKLINE SECTIONS

The impacted trees along straight State trunkline sections are farther from the road's edge than trees along county roads. The ditches are usually wider and less likely to direct the vehicle into a tree. Another tree is usually struck first; the vehicle then careens into the fatal one.

Critical Factors

Terrain condition: ditch
Tree density: on a row or part of an adjacent woodlot
Distance of tree(s) from road: fatal tree 20 feet or more from road's edge

Hazard Profiles

1. Vehicle enters ditch; hits another tree; strikes fatal tree. Fatal tree typically is 20 feet or more from road's edge; first tree struck is 10 feet or less from road's edge.

2. Vehicle runs down embankment and hits tree. Tree is 20 feet or more from road's edge and part of adjacent woodlot.

HOW TO USE HAZARD PROFILES

Hazard profiles are combinations of critical roadway and off-roadway factors that occur frequently at fatal crash sites along straight and curved county roads and State trunklines. These hazard profiles allow you to easily designate potentially dangerous sites and prioritize them for treatment. The most dangerous road conditions are, in order to risk:

1. curved county road sections
2. curved State trunkline sections
3. straight county road sections
4. straight State trunkline sections

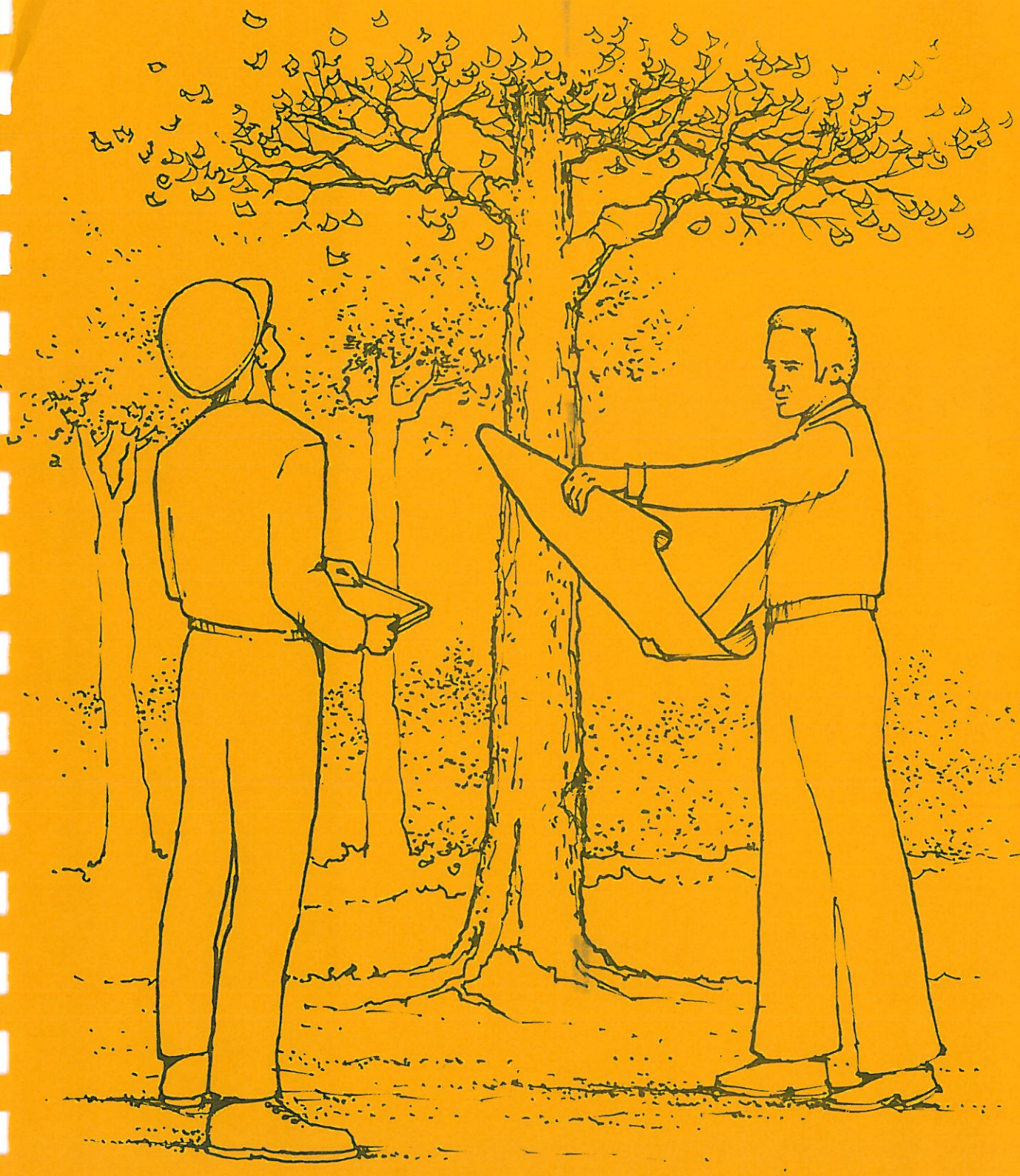
As sites are designated, less dangerous sites (those not fitting the hazard profiles presented) along a given road condition can be given lower priority for treatment. In Chapter 4, this priority system is taken one step further. Average daily traffic data are added, allowing you to rank order the particular roads in your county by ADT. Thus, you are considering those roads most frequently travelled in your county first.

The main strength of this method is that it provides an easy method to classify road sections by risk. Interstates are eliminated from consideration, thus eliminating 3% of Michigan's rural roadways from the treatment plan. Hazardous road sections are treated in order of highest risk. Generalization into hazard profiles facilitates creation of a general treatment plan, a much more cost-effective treatment program than treatment on a site-by-site basis entirely.

Limitations of the Method

The fact that certain factors are often present at tree/vehicle accident sites does not necessarily imply that they caused in any way or even contributed to the accident. This limitation requires that common sense accompany analysis and field verification to determine whether or not a given site is dangerous enough to warrant a hazard reduction treatment.

By necessity, the hazard profiles are generalizations. Few critical factors were present at <u>every</u> accident site within a specific road condition. It is highly likely that other site-specific factors play a role on an individual basis.



A Method For Evaluating Existing & Potential Higher Risk Roadside Tree Environments

4

This chapter contains a step-by-step procedure for determining which roadside trees in your county should be considered for removal or an alternative treatment. This procedure is of use for two functions:

1. To create a master map of your county that pinpoints the locations of all higher risk accident sites, trees bearing accident scars, and historic, big, or endangered trees (trees that demand alternative treatment).
2. To determine whether a specific tree or trees should be removed or an alternative treatment applied.

The procedure involves performing five tasks--the first, second, fourth and fifth in your office, the third out in the field. Materials required for each task are specified. Checklists and worksheets are included for your use.

To perform any of the tasks, you must have a county map or a set of county maps with enough detail that road curves are apparent and roads are clear, identifiable as either: 1) Interstate, 2) trunkline or State, 3) county or township, and 4) city. Detailed county maps are available from the Michigan Department of Transportation.

1 THE TASKS

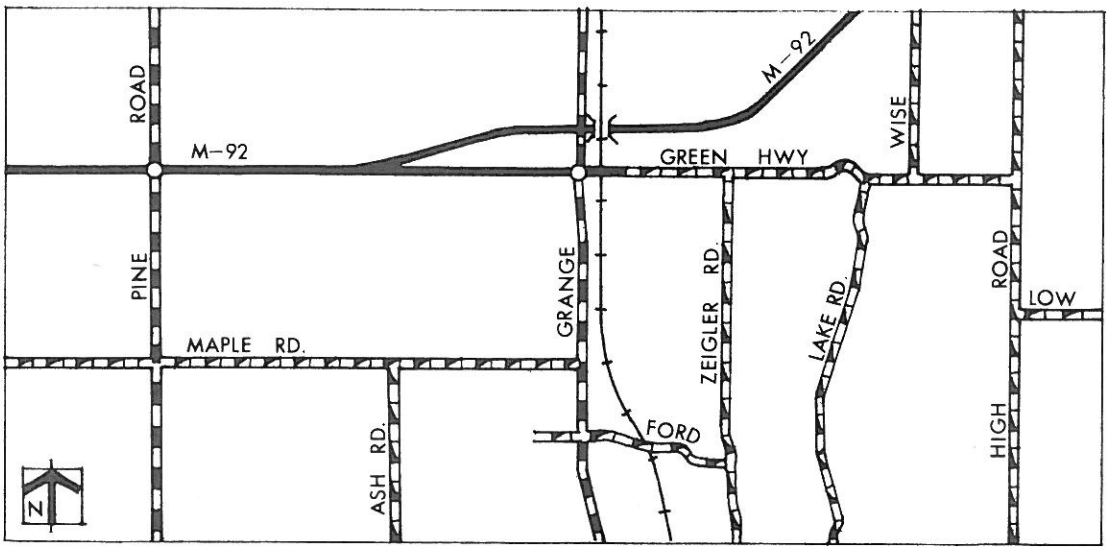
Task 1: Identify Higher Risk Roadside Sections

In your office, using accident reports and existing information about your county, you will identify the higher risk road sections and the site-specific conditions associated with the interestate highways, state trunklines, and county and township roads in your county and manually plot that information on county maps. You will then assign priorities for field verification, Task 2.

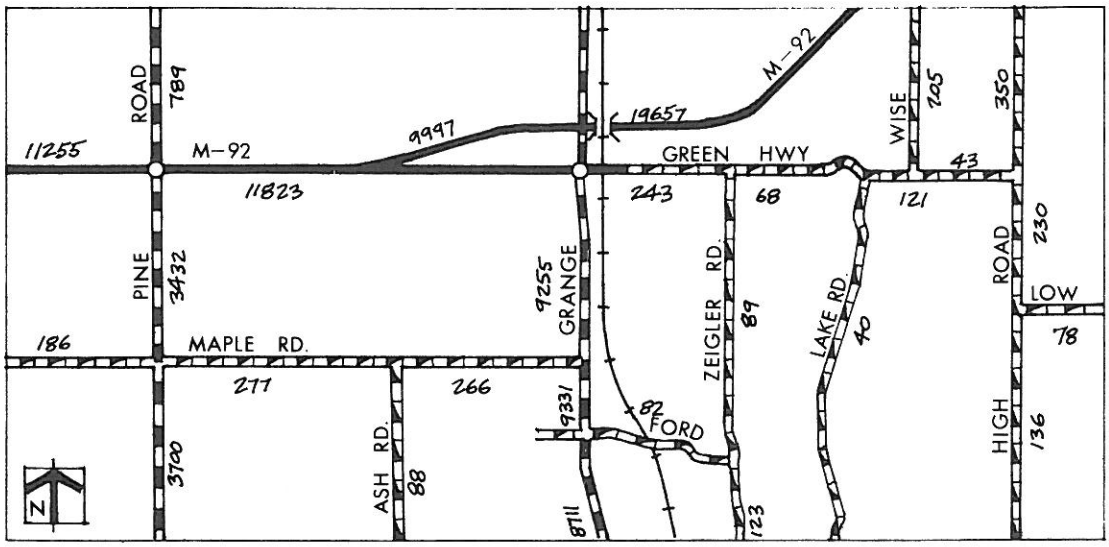
Materials required:

- county ADT data
- county area road map(s)
- accident reports
- Historic and Big trees registries
- State and Federal endangered/threatened species lists

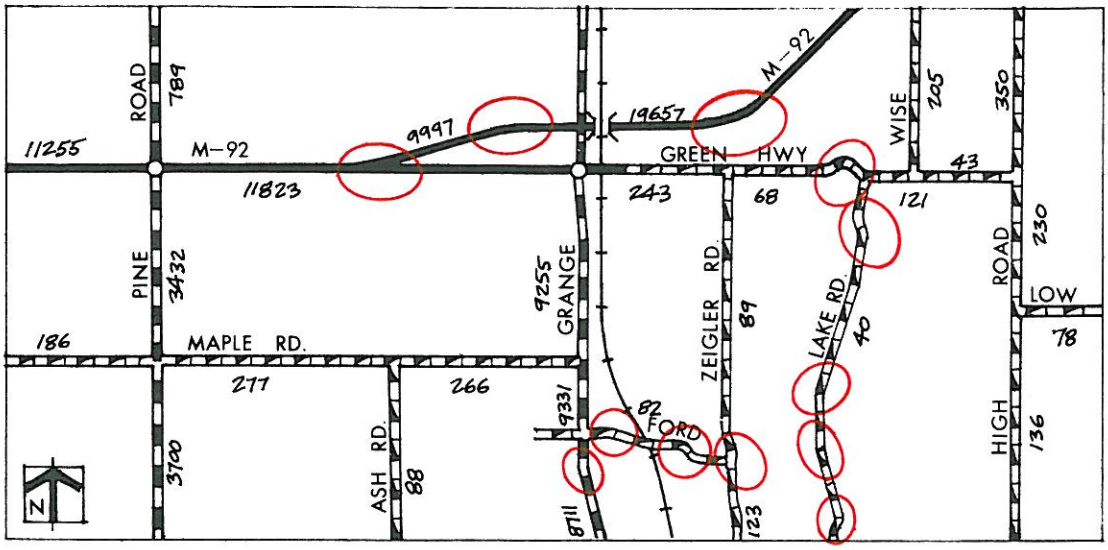
Step 1: Be able to identify rural roads in your county area map by road type: interstate, trunkline, county, and city. (see illustration).



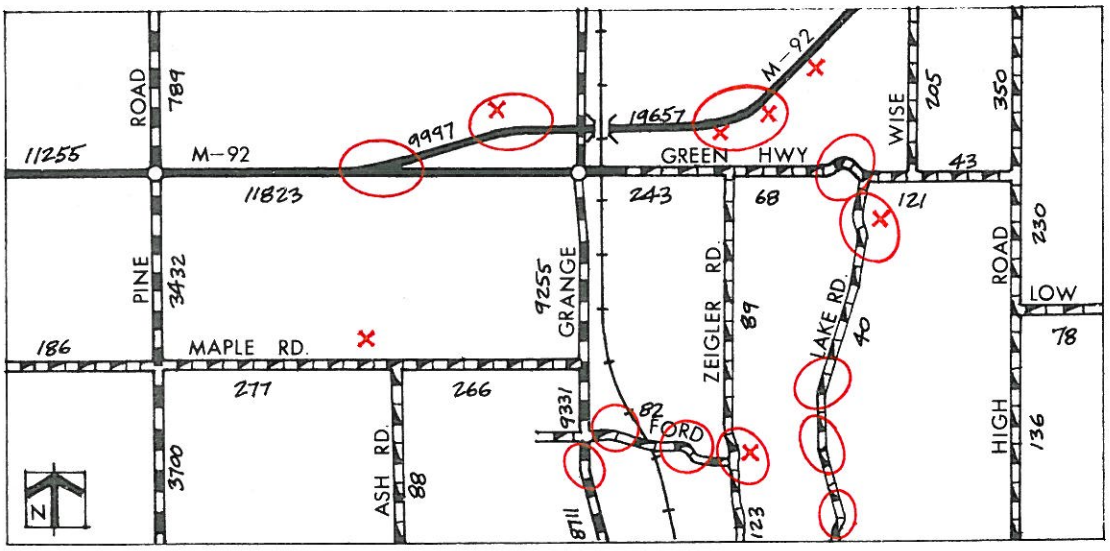
Step 2: Write the ADT, or best estimate, by each road section on the map. (See ADT data for your county).



Step 3: Circle, in red, all curved county road and State trunkline sections.

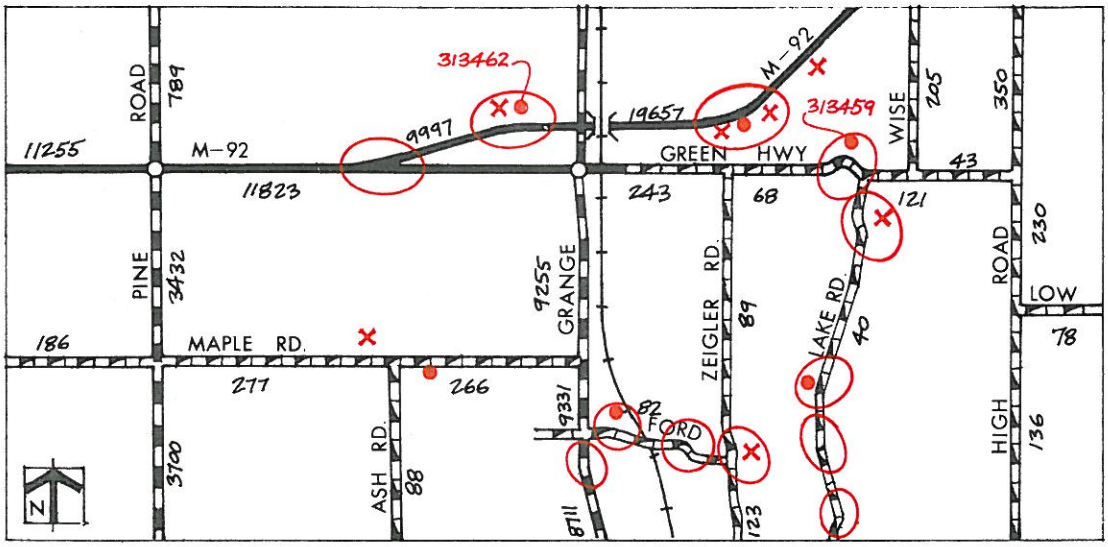


Step 4: Place a red x in all locations of past tree/vehicle accidents (fatal and non-fatal).

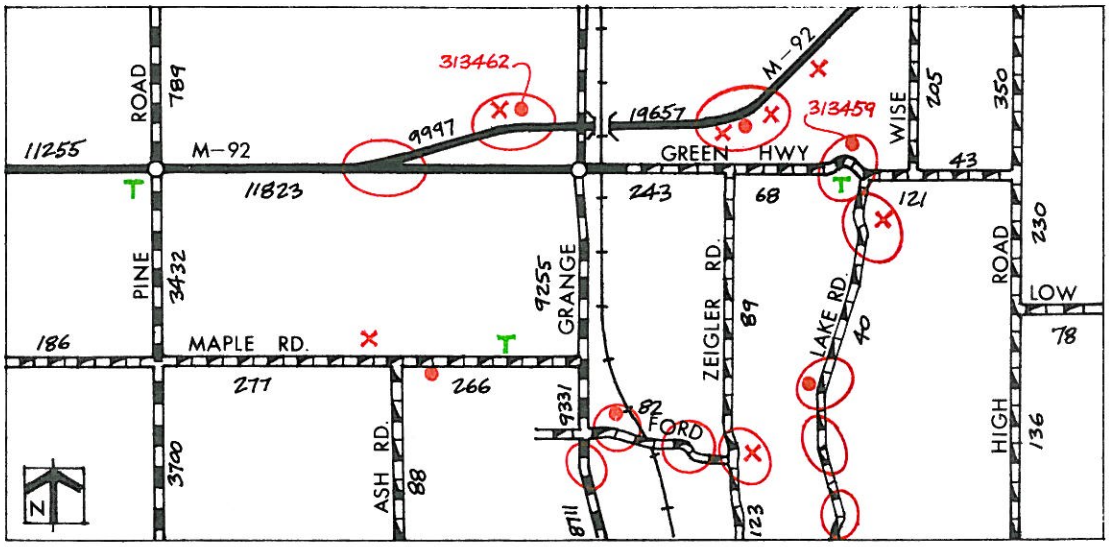


Include the accident file number if known.

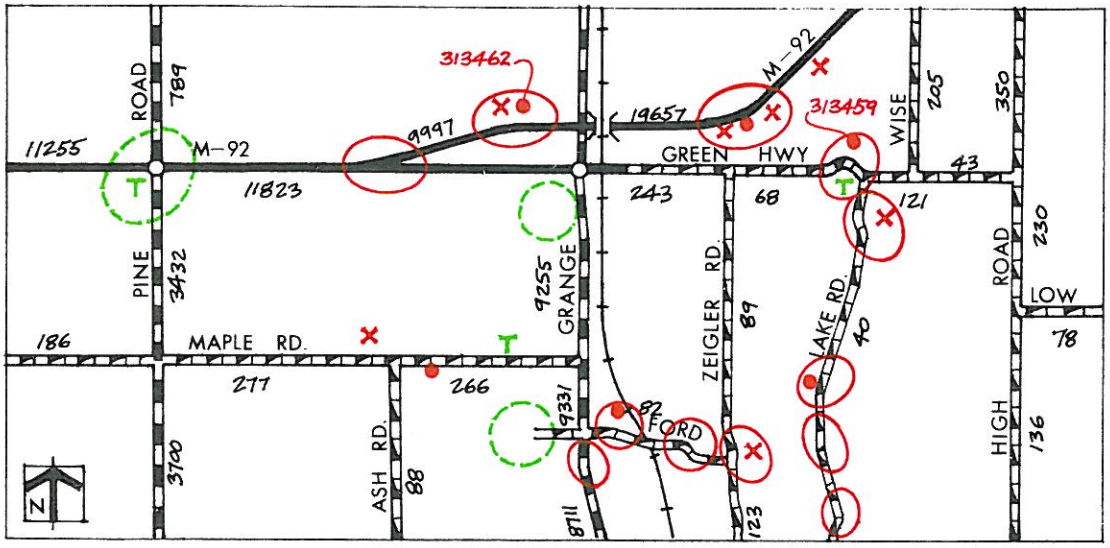
Step 5: Plot, via a red dot ( ), known locations of trees with accident scars. Include the accident file number if known.



Step 6: Plot, using a green "T" sign (T), the locations of known Historic trees, "Big trees," endangered/threatened species.



Step 7: Circle in green areas considered by the community to be of cultural significance (cultural or Historic properties). This should specifically include location of existing or potential "Natural Beauty Road Act" designations.



This colorful county map will serve as your "road map" for determining the appropriate treatment for higher risk road sections in your county.

Task 2: Assign Priorities for Field Verification

This task is also done in your office. A number of factors can be used to determine the order in which you field verify the higher risk road sections in your county: ADT's, whether the road curves or not, or whether tree/vehicle accidents have already occurred in certain locations. The technique described here takes into account these factors.

We have already established that curved county road sections are the most dangerous, followed by curved State trunklines, straight county roads, and straight State trunklines. You could simply treat those roads in your county that pose a hazard in that order.

Or, you can take this analysis a step further and tailor your treatment program to the actual conditions in your county. Given the potential hazard of the various road conditions, it is more responsive to treat those hazardous road sections that are most frequently travelled first.

You should already have identified ADT's for the roads in your county by type (Task 1, Step 1). Table 4-1 identifies the risk associated with various road conditions (road type and horizontal alignment, curved or straight). The risk levels represent approximate grouping of all fatal tree/vehicle accident sites from 1976 into 10 levels, from higher to lower risk using ADT's. The ADT's listed show the minimum ADT associated with each risk level by road type. These ADT's do not represent the average ADT for any road condition; rather, they define the range of road conditions between risk levels.

A reasonable approach, then, for identifying the higher risk road sections in your county is to rank order the road conditions present from higher to lower risk; associate the appropriate ADT's with the road sections, then treat the higher risk sites first, then the next higher risk sites, and so on.

Do not be surprised if most of your sites for field verification fall into only 2 or 3 risk groups. Curved county roads accounted for 30 percent of the accident sites in 1976. On a statewide basis, 95 percent of the curved county roads fall in the three highest risk categories.

Table 4-1 Curve and Straight Road Sections Associated with Average Daily Traffic Volumes by Risk Levels.

Risk Level (Higher to Lower)	Road Type Curve and Straight Sections	Average Daily Traffic Volume (ADT)
Level 1	County Curve	2,500 +
Level 2	County Curve	1,000-2,499
Level 3	County Curve	175-999
	Trunkline Curve*	29,001 +
Level 4	County Curve	150-174
	Trunkline Curve	7,500-29,000
	County Straight	8,600 +
	Trunkline Straight	35,000 +
Level 5	County Curve*	23-149
	Trunkline Curve	2,000-7,499
	County Straight	2,000-8,599
	Trunkline Straight	15,000-34,999
Level 6	County Curve*	18-22
	Trunkline Curve	1,500-1,999
	County Straight	1,500-1,999
	Trunkline Straight	9,000-14,999
	Interstate Straight	45,000 +
Level 7	County Curve*	14-17
	Trunkline Curve	1,000-1,499
	County Straight	1,000-1,499
	Trunkline Straight	6,500-8,999
	Interstate Straight*	31,750-44,999

Table 4-1 (continued)

Risk Level (Higher to Lower)	Road Type Curve and Straight Sections	Average Daily Traffic Volume (ADT)
Level 8	County Curve*	11-13
	Trunkline Curve*	800-999
	County Straight	800-999
	Trunkline Straight	4,500-5,499
	Interstate Straight	24,000-31,750
Level 9	County Curve	4-10
	Trunkline Curve*	294-799
	County Straight	125-799
	Trunkline Straight	800-4,499
	Interstate Straight	7,500-23,999
Level 10	County Curve*	3 or less
	Trunkline Curve*	293 or less
	County Straight	124 or less
	Trunkline Straight*	799 or less
	Interstate Straight*	7,499 or less

Based on data analysis from "Phase 2 Report - Identify Typical Roadside Environments," August 16, 1979.

* These road types, curve or straight sections, were added to provide a complete table for manual reference.

  This is an expansion of a similar table in the Phase 2 report, which listed only road type curve and straight sections where accidents actually occurred as part of the original data set. By using "Tables of ADT and Accident Rate" (pages C-28 to C-51 of Phase 2 report), developed as part of the data analysis, additional road section types associated with average daily traffic volumes by risk levels were interpolated into the table.

On the basis of the approach above, your field verification priority list might look like this:

Risk Level (1 higher 2 next higher, etc.)	Road Condition	Road Location
Level 1	County Curve	Grange Rd. S. of Ford Rd.
Level 2	None	
Level 3	None	
Level 4	Trunkline Curve	M-92, 1/2 mile E. of Grange Rd.
	Trunkline Curve	M-92, 2/10 mile W. of Grange Rd.
	Trunkline Curve	M-92, M-92 and Green Highway
	County Straight	Grange Rd. S. of Green Highway
Level 5	County Straight	Pine Rd. S. of M-92
	County Straight	Grange Rd. N. of Green Highway
	Trunkline Straight	M-92 E. of Grange Rd.

Task 3: Field Verify the Higher Risk Road Sections

In the order established in Task 2, field verify the risk associated with the road sections you have identified on your county map(s).

Materials required:
- Field Verification Form (one for each site to be visited)
- Tape measure (at least 100 feet)
- Site Risk Verification Worksheet (one for each site)
- Instant camera (Polaroid type) and film
- Stapler
- Tree Density Field Form
- County map(s) from Task 1

For each site, complete a Field Verification Form (Appendix 4-A) then follow the steps outlined below:

Step 1: Verify the locations of the accident and historic/big/endangered/threatened trees already identified on your county map(s).

Step 2: Plot the location(s) of all trees or groups of trees with potential of being hazardous (e.g., within 40 feet from edge of road, in a ditch, at bottom of a downgrade). Plot any additional trees found with accident scars.

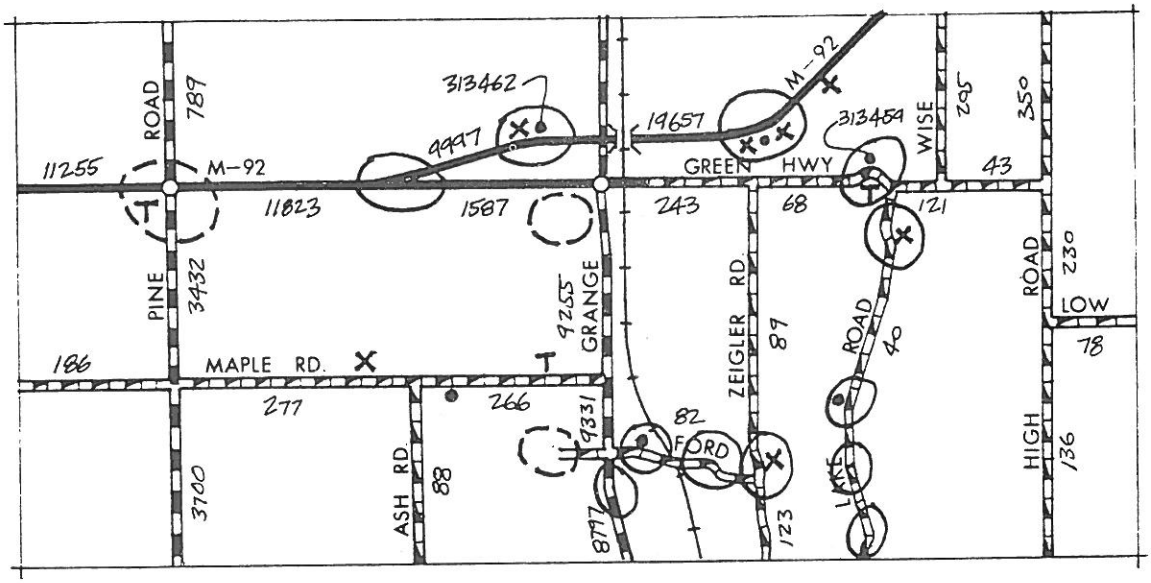
Step 3: Verify the risk associated with each site. Using the Field Verification form, complete the site risk verification work sheet. (Appendix 4-B)

Step 4: Contact property owner(s) and adjacent owner(s).

Confirm knowledge of previous tree/vehicle accidents
Confirm knowledge of historic/big/endangered/threatened trees
Identify additional tree/vehicle accident sites
Identify any additional considerations and excepting conditions

Step 5: Field verify any additional accident sites or other considerations and excepting conditions identified by property owner/adjacent owner(s) and plot findings on county maps. Be sure to complete appropriate forms for each additional site verified.

Your field-verified county map now looks like this:



Task 4: Select the appropriate treatment(s) for alleviating or reducing the risk of tree/vehicle accidents.

This task, done in your office, involves a review of the field verifications forms and rank ordering of risk associated with the road sections in your county to determine the order in which road sections should be treated. The treatment(s) selected will be based on a simplified cost-benefit analysis and a consideration of alternatives appropriate for the site(s).

A variety of factors must be considered to determine the appropriate treatment(s) (or even non-treatment) for each site. Since most treatments are costly, the size of the state budget will exercise a controlling influence on the number and source of treatments that can be undertaken. Ideally, treatments are selected to yield the greatest reduction in expected fatalities, within the available budget. This yield, however, must be discounted by the amount of environmental damage (aesthetic and ecological) resulting from the treatment.

Monetary costs of specific treatments include not only those of implementation, but also costs expected in the future--repair, maintenance, replacement. Environmental effects of treatments further complicate selection. Impacts may be short--or long-term. A treatment that will reduce the risk of run-off-road accidents may increase the risk of serious erosion problems. Environmental effects could well tip the balance in favor of a slightly more expensive treatment.

Materials required: county map(s)
field verification forms (Field Verification Form, Site Risk Verification Worksheet, Tree Density Field Form)

Step 1: Based on the field verification, re-prioritize the higher risk road sections in your county for treatment.

Step 2: For each higher risk road section, identify possible treatments:

A. Look at the recommended treatments for the particular generic environment being considered. (Appendix A).

B. Consider the presence of other considerations and excepting considerations (Chapter 5).

C. Consider the suggested treatments for higher risk sites and hazard profiles (Chapter 3).

D. Consider the environmental impact associated with tree removal and alternative treatments (Chapter 6).

Step 3: Evaluate the treatment(s) identified.

A. Consider the road condition involved. Curved/county roads are clearly the most dangerous overall, followed by curved/trunkline, straight/county roads, and straight/trunkline.

B. Weigh the road conditions present at the various sites by the average daily traffic (ADT) pass the site. A curved/county road section that has almost no traffic is less likely to be the site of an accident than a straight/county road section that is heavily traveled. Using the relationships presented in the hazard profiles, (see Chapter 3), makes this procedure less difficult.

C. List the feasible (physically possible) treatments for each site. For each of these technically feasible treatments, you must balance:

1. implementation costs--tree cutting, sign or barrier erection, grading, etc.,

2. maintenance costs--clearing, painting, brush control, etc.,

3. replacement or repair costs--repair or replacement of damaged sign, guardrails, or protective vegetation and berms.

D. On a site specific basis, evaluate the suitability of each feasible treatment in terms of its effectiveness in preventing or reducing the severity of roadside accidents.

E. Add in site-specific costs. If the easement on private land must be purchased for a specific treatment (e.g., clearing all trees over 20 feet from the edge of a curved/trunline section), these costs should be added as appropriate.

F. Consider environmental effects. The expected environmental impacts of each treatment are discussed in Chapter 6, Alernative Treatments. It cannot be over-emphasized that aesthetic and ecological impacts of a given treatment must be considered along with direct, monetary costs. In certain cases, a lower cost treatment will be categorically ruled out by the environmental costs involved.

Step 4: Select the most appropriate treatment(s). If tree removal is selected, determine the distance from the edge of the road that trees must be removed to reduce the risk of tree/vehicle accidents. This distance should be based on the hazard profile present, tree density (see Appendix 4-C), and your professional judgment.

Step 5: Incorporate techniques to mitigate environmental impacts of the treatment(s) selected (see Chapter 7).

Task 5: Perform the Treatment(s) Selected

This task involves contacting local property owners and adjacent owners, securing their permission to perform the selected treatment, and performing the treatment.

Step 1: Notify the property owner(s) and adjacent owner(s) of the treatment(s) to be performed

A. Use the standard letter forms included in Appendix D and notify the individuals involved by registered mail.

Step 2: If permission is received, perform the treatment(s) specified. If the landowner(s) refuse(s) to grant permission or adjacent owner(s) voice(s) objections, re-evaluate the selected treatment based on these objections and considerations (return to Task 4, Step 2, and work through the remaining steps).

If after re-evaluation, an alternate treatment is chosen, notify the property owner(s) and adjacent owner(s), obtain written permission, and perform the treatment(s).

If after re-evaluation, all alternatives must be rejected, further negotiation or legal action toward settlement must be considered (see Chapter 9, Public Relations).

Appendix 4-A

FIELD VERIFICATION FORM

To Evaluate Higher Risk Roadside Tree Accident Sites

A. GENERAL

Site Visit Date: _ _ / _ _ / _ _

MSP Accident Report No. _ _ _ _ _ _, if appropriate (for site-specific cases only).

Form filled out by_____(your name)

Located on the N S E W side of_____

Road between the intersections of_____Road and_____Road.

County _____, Township_____,City_____

B. SPECIFIC ROAD SECTIONS YES NO

Beginning_____(tenths of mile) (feet) N S E W of _____Roads intersection, and continuing_____ (tenths of mile) (feet) N S E W.

C. SITE-SPECIFIC TREE LOCATIONS YES NO

Higher risk tree site is on the N S E W side of_____ Road, _____(tenths of mile) (feet) N S E W of_____ _____Road,_____feet off the road.

The tree site is _____feet N S E W of:_____ _____(street address).

Status of tree(s) impacted:_____

a. still standing
b. removed, but could locate
c. knocked down
d. broken off
e. stump only
f. could not identify

Distance of Tree(s) from Roadway Edge:_____ft., _____in.

Diameter of Tree(s):_____inches

Attachments to tree(s):_____

Attachments to tree(s):_____

a. fence
b. sign(s)
c. reflector/delineators
d. other:_____
e. none

D. HAZARD PROFILE COMBINATIONS (see Chapter 3 of Manual)

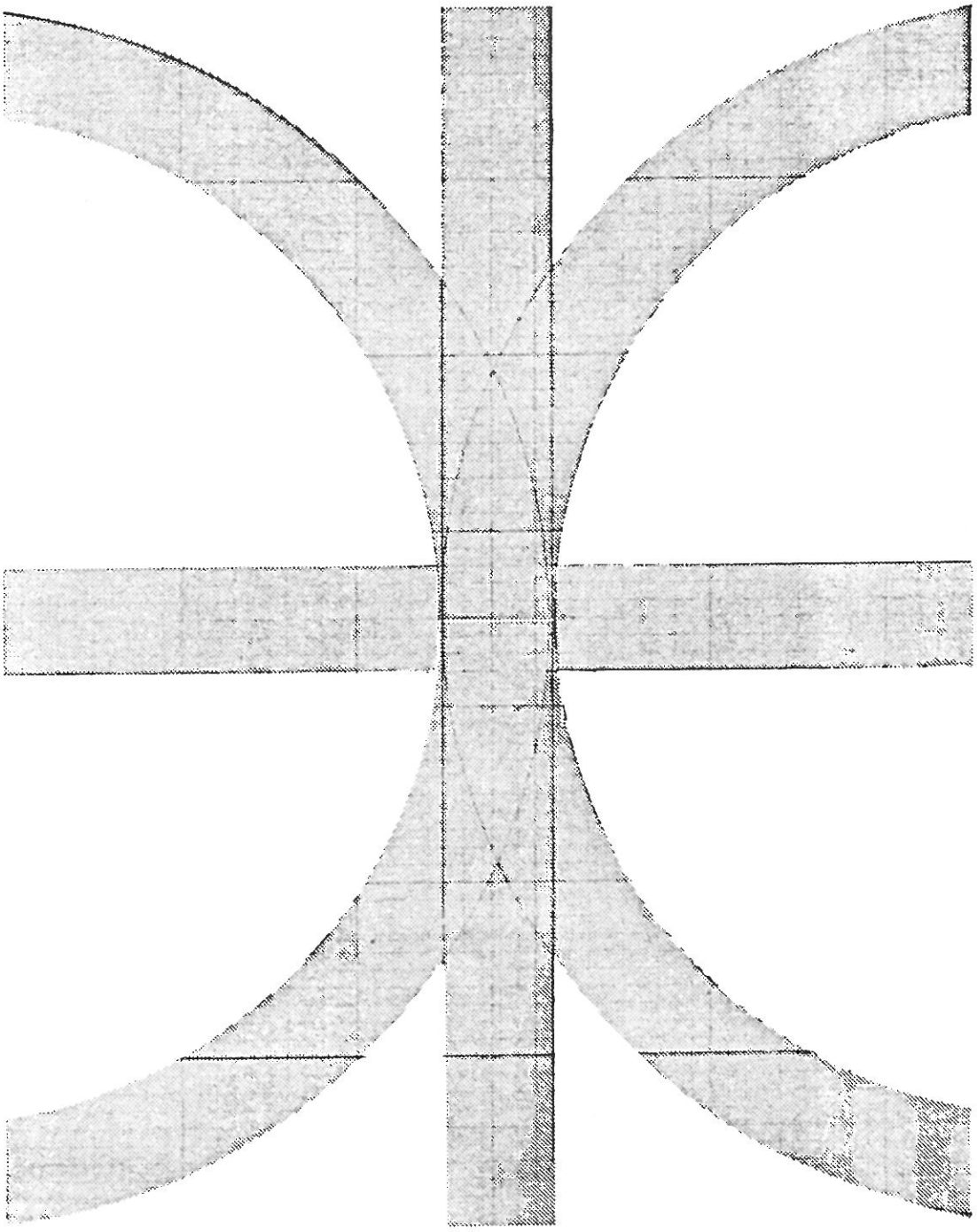
1)_____

2)_____

3)_____

4)_____

Use back of sheet if necessary to list additional combinations present.



E. SITE OBSERVATIONS Indicate presence of each: + = yes; - = no

___Site of frequent accidents

___Confusing signing/markings

___Contradictory striping/markings

___Inadequate signing/markings

___Signs/signals obscured by trees/ foliage/other object

___Site obviously dangerous

___Enforcement inadequate

___Speed limit too high for condition

___Speed limit ignored

___Allowed passing inconsistent with environmental conditions

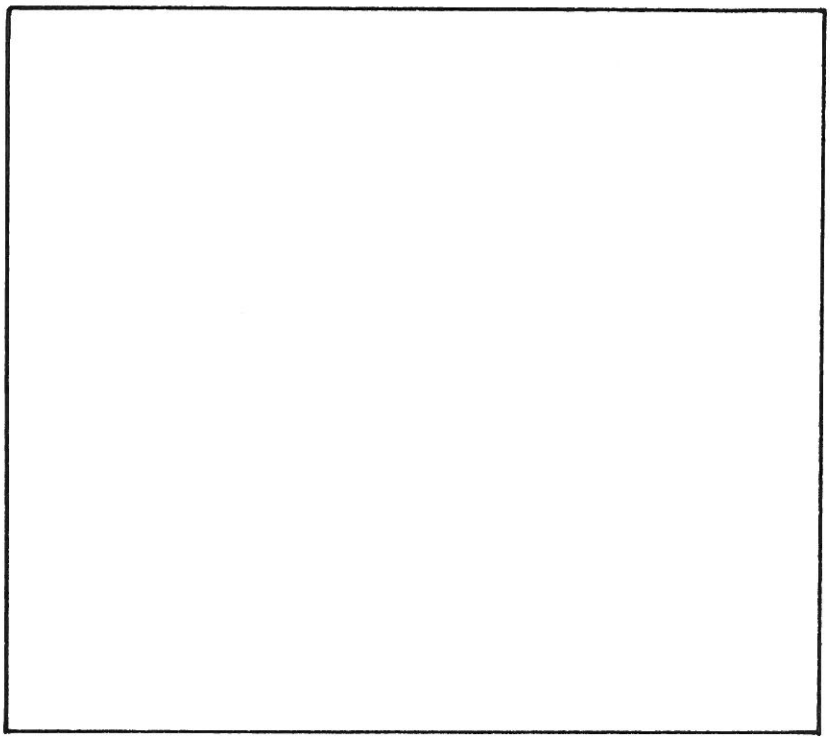
___No Passing signs/markings ignored

___Residents' complaints re. site dangers allegedly ignored

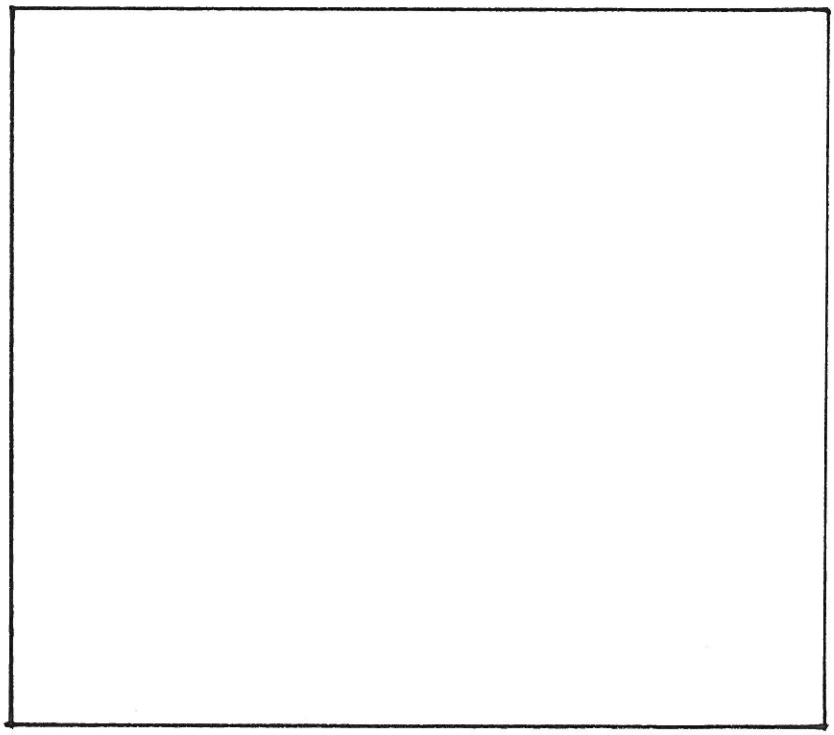
___Other:_____

F. PHOTOGRAPHS TAKEN AT ACCIDENT SITE:

1) Approach view of tree/ obstacle site (place a red sticker on tree(s) considered for removal)

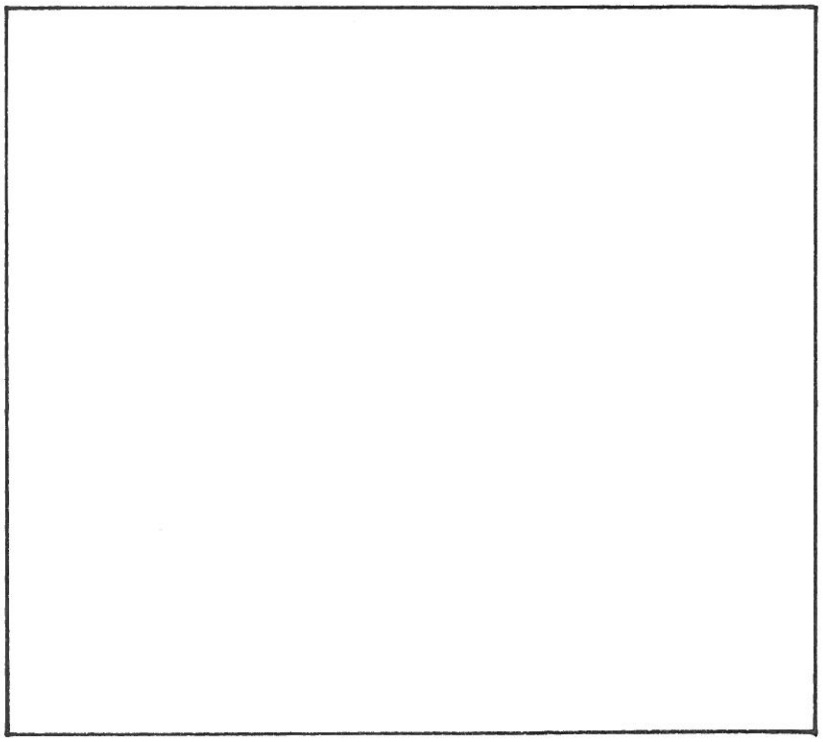


2) View of tree scar (as close as possible)

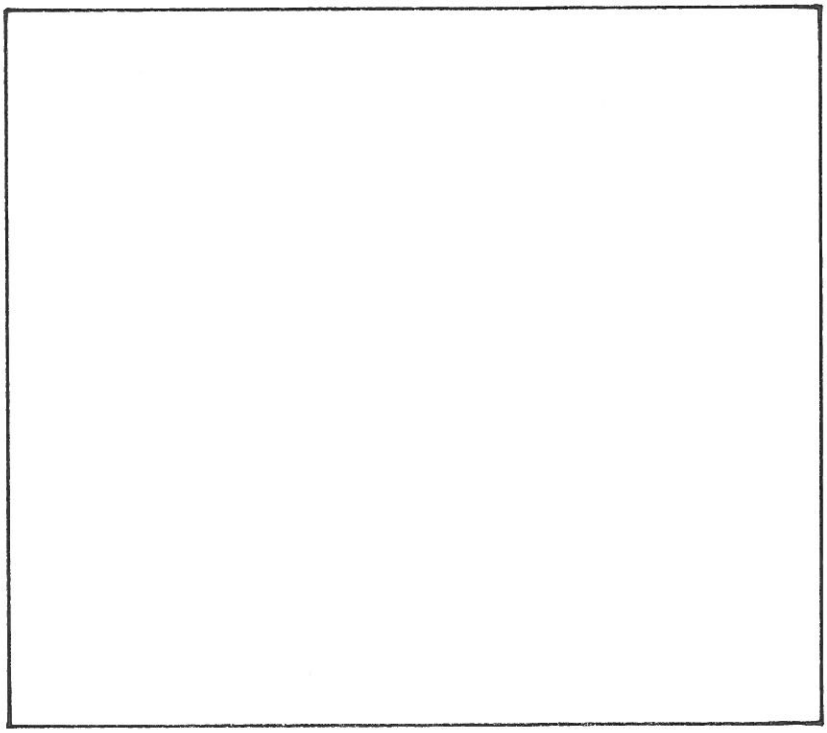


OTHER SUGGESTED PICTURES: Label & Use Other pages as needed

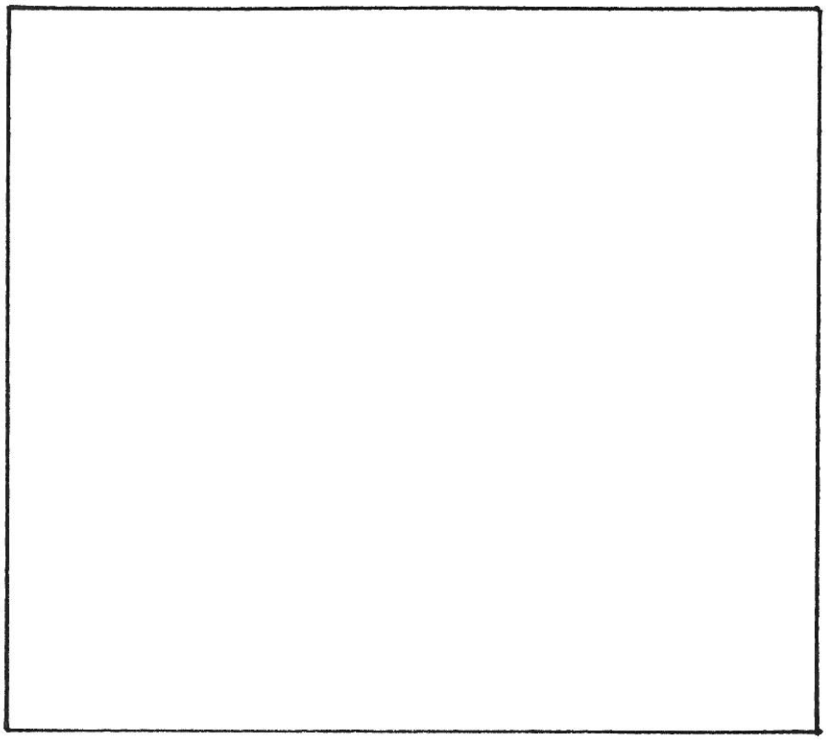
3) Tree/roadside view (looking back from site to vehicle approach route)



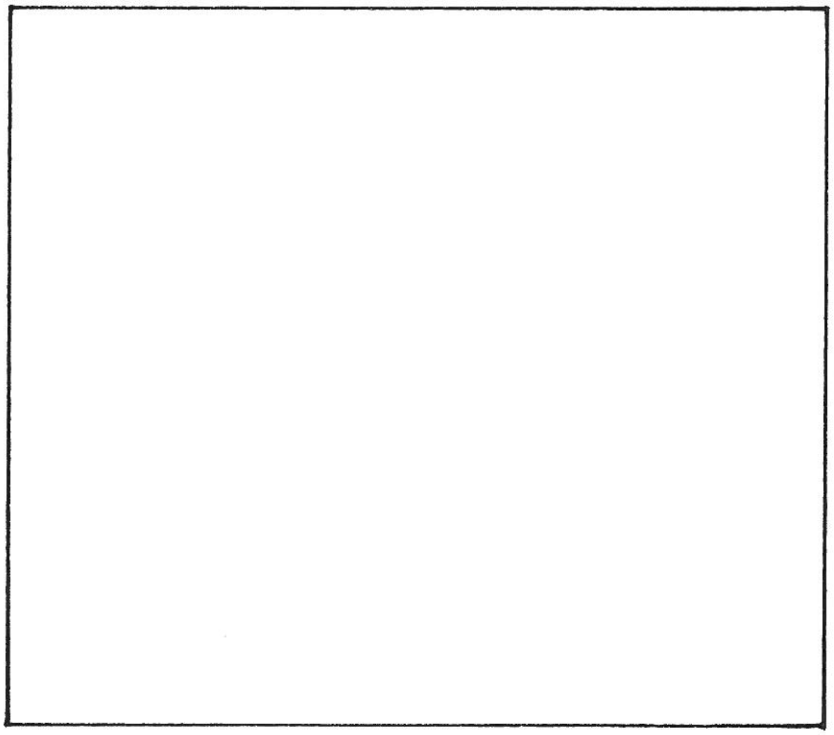
4) Tree/roadside view (looking forward from site to vehicle intended route)



5) View of opposite side of roadway (from site)

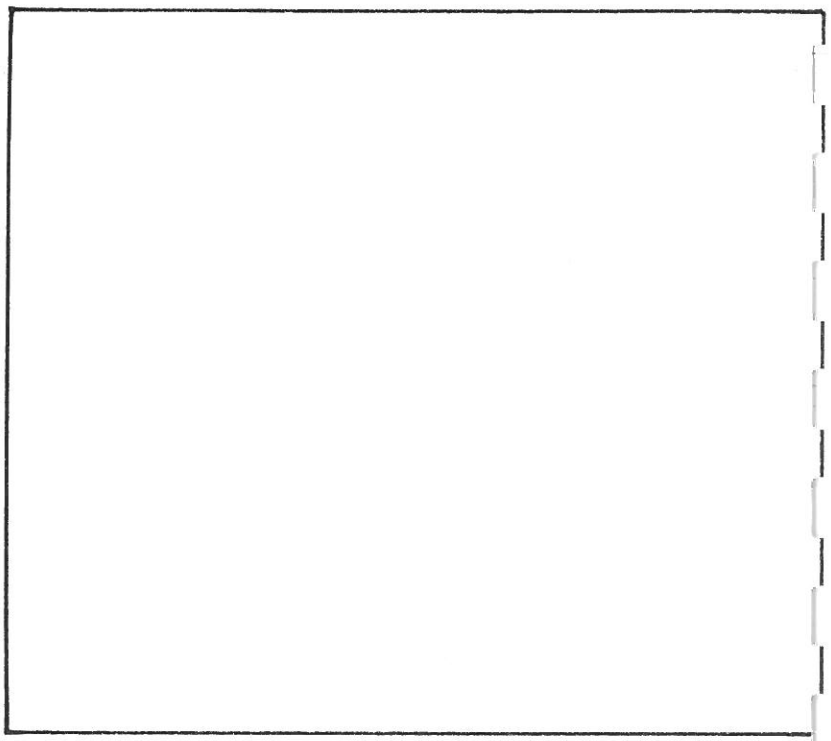


6) View of site from opposite side of roadway



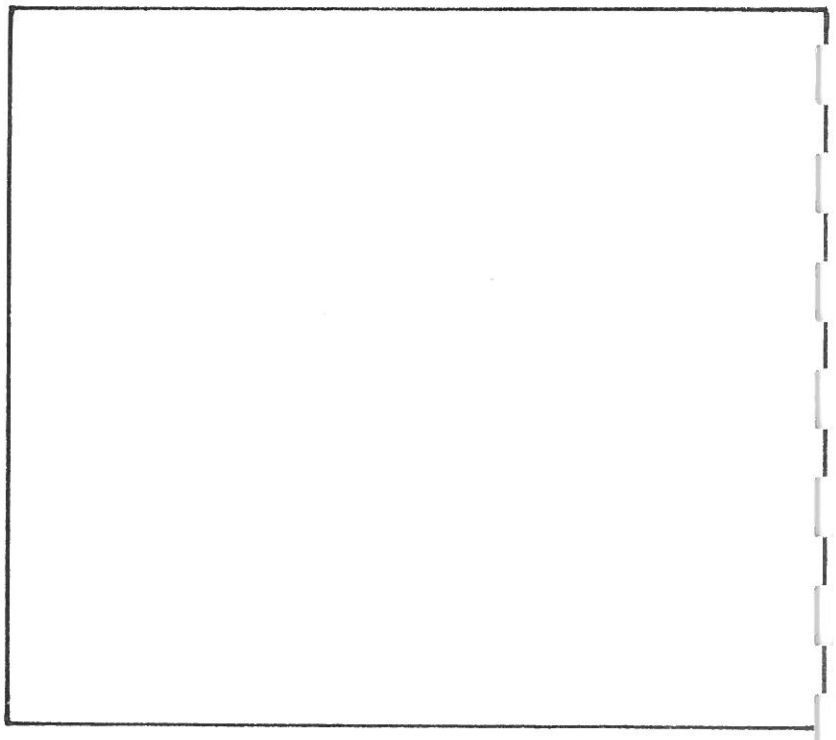
7) Other:_____

_____



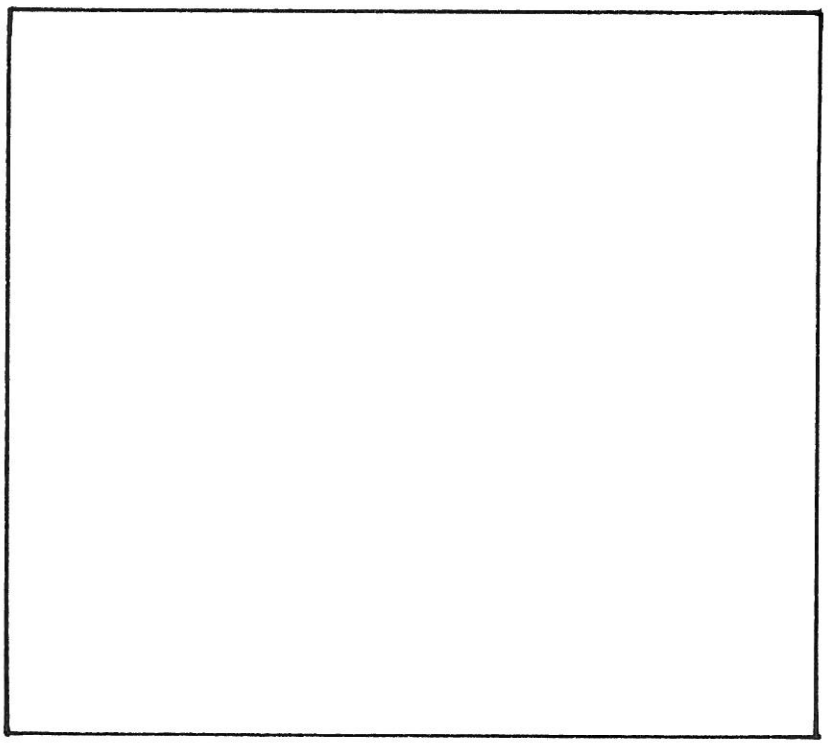
8) Other:_____

_____



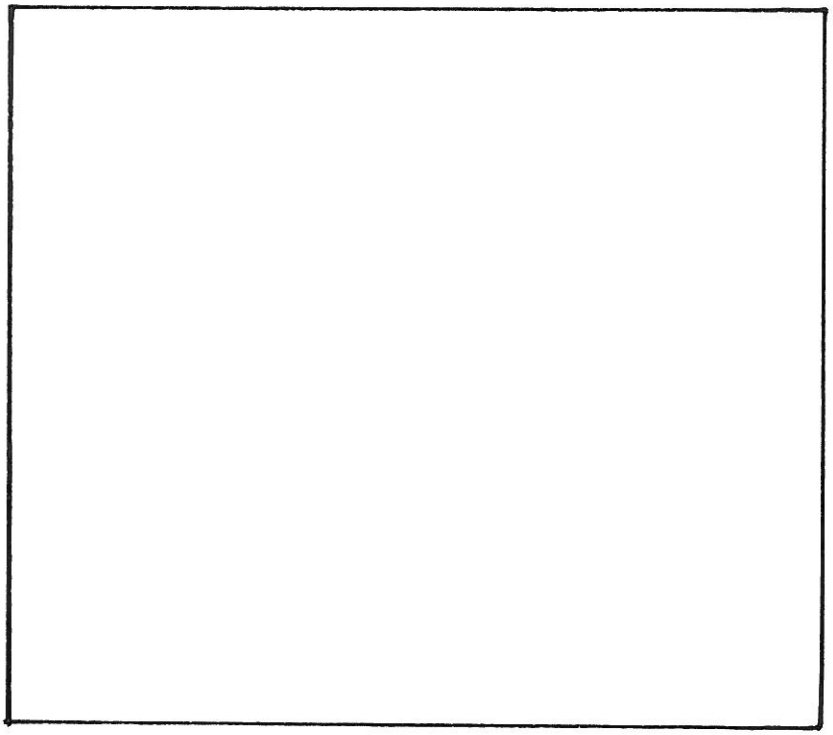
9) Other:_____

_____



10) Other:_____

_____



G. GENERIC ROADSIDE ENVIRONMENT

Identify the GENERIC ROADSIDE ENVIRONMENT most associated with characteristics present at the site and/or section to one of the 16 listed below:

Generic Roadside Environment:_____(1-16)

1: Interstate/Straight	9: County/Curve/Forest
2: Interstate/Curve	10: County/Curve/Other
3: Trunkline/Curve	11: County/Straight/Urban & Built-up
4: Trunkline/Straight/Urban & Built-up	12: County/Straight/Agriculture
5: Trunkline/Straight/Forest	13: County/Straight/Forest
6: Trunkline/Straight/Other	14: County/Straight/Other
7: County/Curve/Urban & Built-up	15: City/Straight
8: County/Curve/Agriculture	16: City/Curve

H. CONDITIONS THAT NECESSITATE ALTERNATIVE TREATMENTS (Refer to Chapter 5; use extra sheets is necessary)

1. Ownership: _____

2. Endangered/threatened/rare species: _____

3. Tree species size: _____

4. Historic trees and cultural resource aspects of tree removal: _____

5. Erosion, sedimentation/Wetlands, streams: _____

6. Safety: _____

7. Other Factors: _____

APPENDIX 4-B

SITE RISK VERIFICATION WORK SHEET

Using the information gathered on the Field Verification Form, fill in the chart below according to these directions:

1. Average daily traffic volume (ADT) of road section:_____

2. Check the road type and condition under B-1 that best identifies the higher risk road section.

3. Identify the risk level (from Table 1) associated with the road section or site and write that number after the road type in B-2.

4. Identify hazard profiles which exist. If one or more hazard profiles exist, place a plus (+) in column B-3 after the risk level.

5. The higher the risk level (Level 1 higher, then level 2, etc.) the greater the overall risk of a tree/vehicle accident at this road section, and the greater priority for treatment.

   The plus shows whether this risk is higher because one or more hazard profiles exist.

   The risk of a site or road section should first be based on the risk level, within each risk level road conditions should be treated in the following priority:

   1. county curves
   2. trunkline curves
   3. county straight
   4. trunkline straight
   5. interstate curve and straight

   Within the above order, road conditions having hazard profiles should be treated first.

B-1 Road type and condition	B-2 Risk Level	B-3 Hazard Profile (+)
___ County curve	_____	_____
___ Trunkline curve	_____	_____
___ County straight	_____	_____
___ Trunkline straight	_____	_____
___ Interstate curve	_____	_____
___ Interstate straight	_____	_____

APPENDIX 4-C

TREE DENSITY FIELD FORM

COUNTY: _____/TWNSHP:_____ DATE _____

ROAD TYPE: I T R/L CREW _____

ROAD NAME: _____between_____

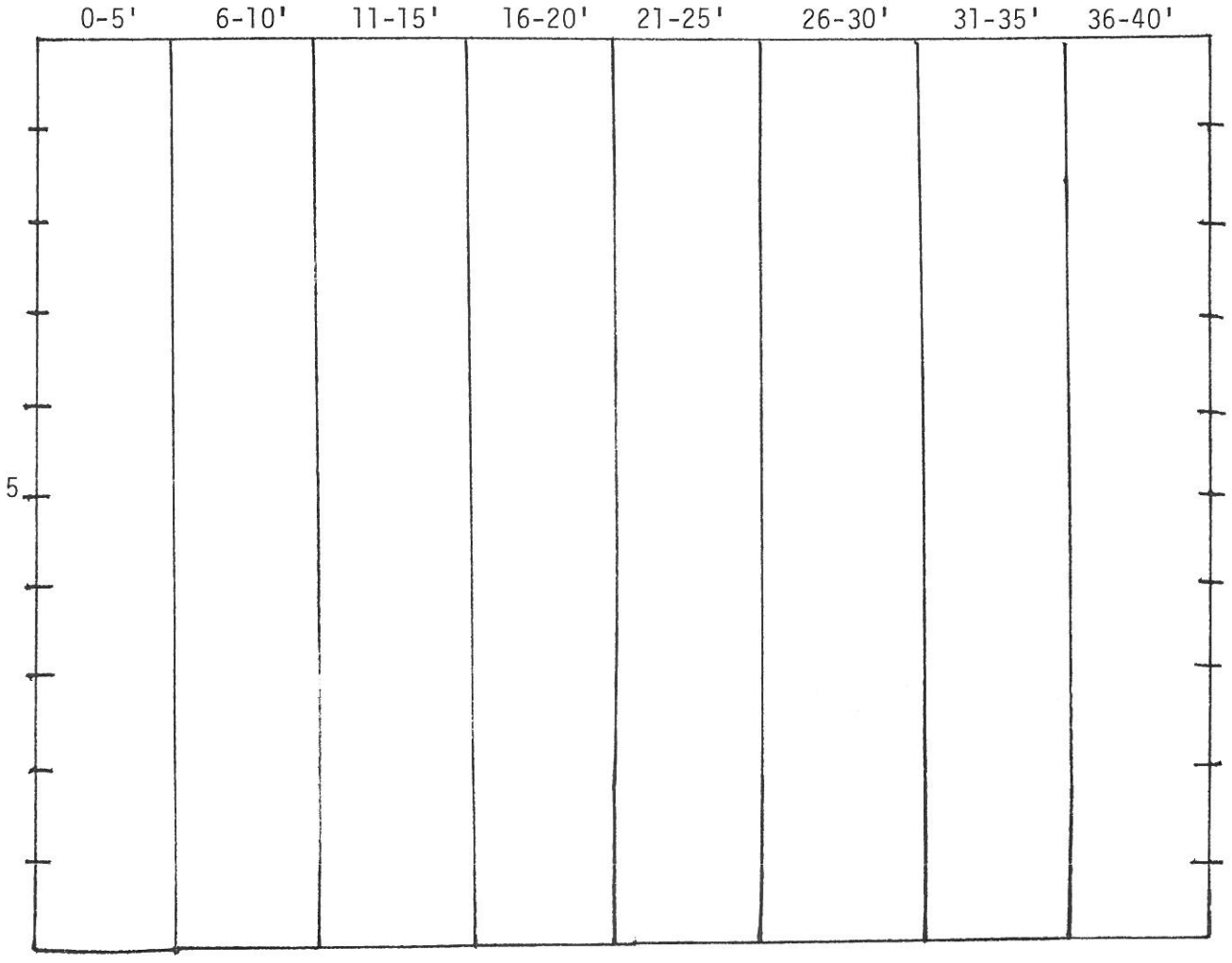
_____

ROAD SIDE SURVEYED N S E W

DISTANCE ROW IS MOWED: _____

DISTANCE ROW IS CLEARED OF ALL WOODY VEGETATION_____

TREES (__ 4" DBH)



Additional comments:

APPENDIX 4-D

(Tree on Right-of-Way)

July 1, 1980

Dear Mr. and Mrs. Jones:

As part of its safety program, the Monaghan County Road Commission is removing trees that are hazardous because of their location near the roadway. Our field investigation indicates that an elm tree located on the right-of-way fifteen feet from the edge of the roadway near the west end of your property at 2135 West River Road is hazardous. Under state law, trees located on the right-of-way may be removed by the Road Commission when necessary for road purposes. Therefore, the tree described above will be cut and removed. There will be no expense to you. So that you will have an opportunity to cut the tree yourself, or have it cut or transplanted (at your expense) if you desire to do so, the road commission will not cut the tree until after August 1, 1980.

If you have any questions regarding this, please give me a call.

John Smith
Monaghan County Road Commission

(Tree not on Right-of-Way)

July 1, 1980

Dear Mr. and Mrs. Jones:

As a part of its road safety program, the Monaghan County Road Commission is removing trees that are hazardous because of their location near the roadway. Our field investigation indicates that an elm tree located fifteen feet from the edge of the roadway near the west end of your property at 2135 West River Road is hazardous.

Therefore, we request your permission to enter your property and cut and remove this tree. If you grant this permission, the Road Commission will repair any damage to the ground caused by the cutting and removal of the tree.

If you are willing to grant this permission, please do so by signing in the space indicated below, and return this letter in the enclosed envelope. If you have any questions, please give me a call.

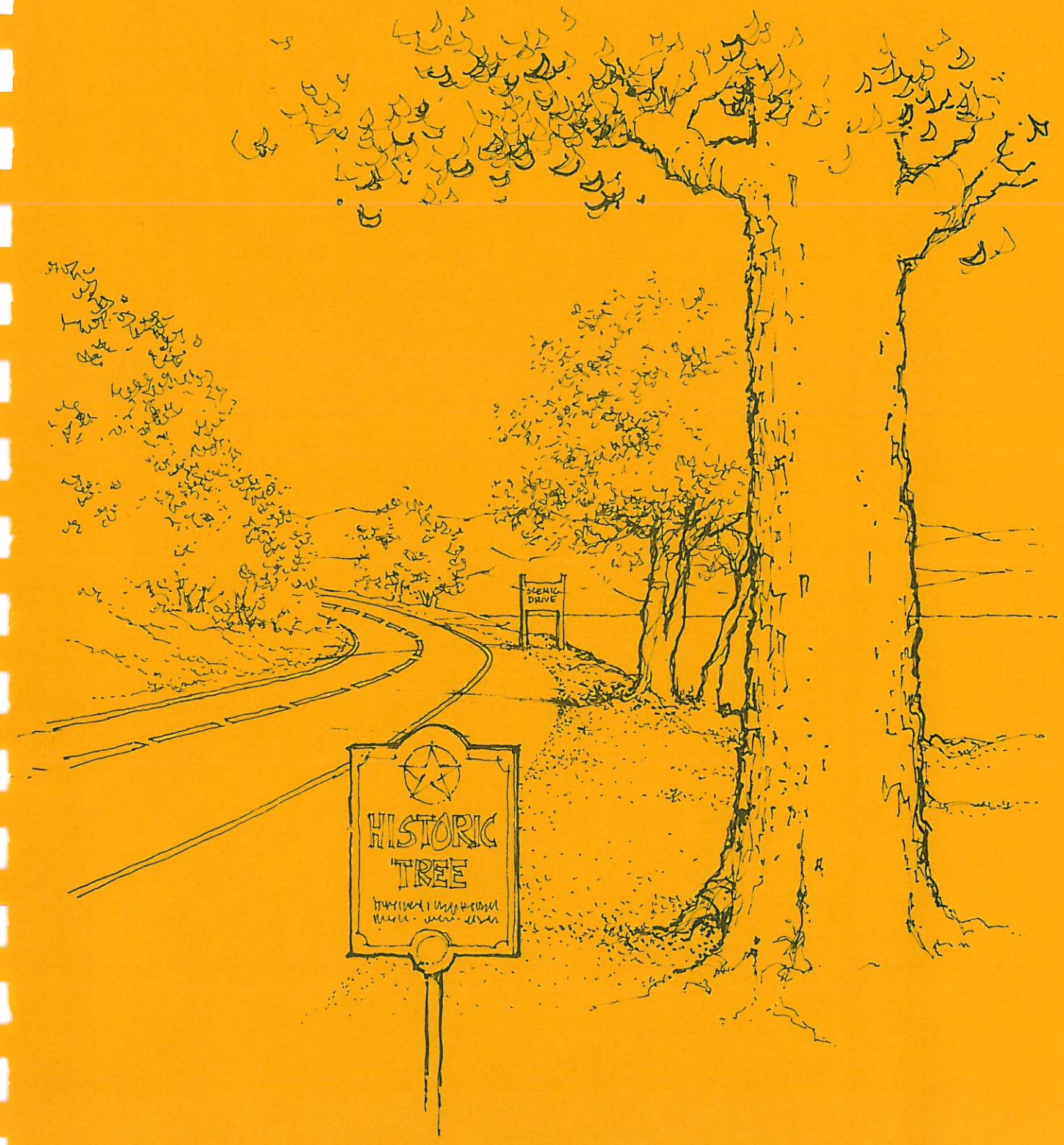
Yours truly,

John Smith
Monaghan County Road Commission

I/We have read the above letter, understand it, and hereby grant permission to the Monaghan County Road Commission or its designee to enter our land and cut and remove the tree described above.

Thomas Jones

Elmira Jones



Conditions That Necessitate Alternative Treatments

This chapter presents situations in which alternative treatments to tree removal must be considered. These situations involve problems arising out of ownership, presence of endangered/threatened or rare species, tree species size, historic trees, danger of erosion/sedimentation and impact on wetlands or streams, and safety issues.

Conditions under which alternatives to removal would be appropriate are identified in two sections: the first section considers situations in which trees within higher risk zones[1] are exceptions tions to the higher risk definition. The second section identifies specific instances in which higher risk trees should not be cut, regardless of the location of the tree(s).

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[1] Higher risk zones are generally defined as those road types (curve-inside vs. outside, and straight) which have a higher expected number of tree crashes per ¼ mile section. Other site-specific conditions will positively or negatively affect the level of risk within or outside of a higher risk zone.

1 EXCEPTIONS TO THE HIGHER RISK ZONE

TREES WITHIN THE HIGHER RISK ZONE

Trees existing within higher risk zones may be exceptional because an intervening object, such as a guardrail, large ditch, or embankment between the road and the tree(s), or other such roadway or off-roadway characteristics makes it impossible for a run-off-road vehicle to hit the tree(s). These situations are field verified by the absence of evidence of previous tree/vehicle accidents (tree scars, accident reports, reports by adjacent property owners) for the tree(s) in question.

If during field verification, no evidence can be found that associates the tree(s) with run-off-road accidents, or no run-off-road accidents have occurred since the existence of an intervening object, then the tree(s) may be considered an exception to the accident zone definition (unless the tree(s) would be classified a "danger tree" because of decayed, overhanging branches, or other conditions posing a potential safety hazard).

TREES OUTSIDE THE HIGHER RISK ZONE

Instances also exist, however, in which trees outside the higher risk zones are actually higher risk trees. The tree(s): 1) may show signs of having been hit by run-off-road vehicles (accident scars), or 2) may be "danger trees" because they are dead or dying and may fall on the road shoulder or pavement causing a safety problem, or may be located in such a way as to obstruct vision or pose a similar safety hazard.

If during field verification, off-roadway trees (not already identified from accident reports):

a. show visual evidence of having been involved in a tree/vehicle accident,
b. are dead or severely declining "danger trees" which, if they fall, would jeopardize road safety
c. obstruct drivers' vision,

plot the data above on your county map(s) and treat the site as a higher risk site. Continue with Task 2 of the Step-by-Step Procedure outlined in Chapter 4.

2 INSTANCES IN WHICH ALTERNATIVE TREATMENTS MUST BE CONSIDERED

Alternative treatments to removing danger trees or trees within higher risk roadside accident zones must be considered in situations involving some ownership conditions, presence of endangered/threatened or rare species, tree species size, historic trees, danger of erosion/sedimentation and impact on wetlands or streams, and safety issues. In this section, situations in which alternatives to removal should be considered for higher risk trees are described. Guidelines for dealing with these situations are presented in Chapter 6.

OWNERSHIP

The aesthetic and functional relationship of trees to the site and to adjacent property should be considered prior to roadside tree removal, particularly if the tree is located off the road right-of-way. Ornamental or aesthetic relationships of trees may be particularly significant when removal will radically alter the "landscape character." Functional aspects of trees may be of real significance for sun filtration, wind breaks, noise abatement, visual buffer, and even physical protection from run-off-road vehicles. These and other considerations which may not be apparent or otherwise known, but may have significant relevance for or against tree removal or other mitigative actions, might not be realized without prior contact with the property owners before any tree removal. In addition, laws have been established to protect "natural river"[2] or "natural beauty road"[3] areas within definable limits and must be considered. The importance of roadside trees for aesthetics and tourism (fall color tours, etc.) should not be underemphasized, especially with regard to designated Natural Beauty Roads.

Determining which form of ownership exists requires that deeds, land contracts, or other documents be located and interpreted. This interpretation, as well as the exercise of judgement that might be required in unusual cases can best be done by an attorney or under the supervision of an attorney.

In the case of vacant land, the owner(s) should be identified by a search of the records in the Office of the County Registrar of Deeds. If the property is privately owned, the results of the search should be checked against the identity of

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[2] Natural River Act of 1970, P.A. 1970, Na 231; M.C.L.A. 281.76 et seq., M.S.A. 11.501 et seq.

[3] Natural Beauty Roads Act, P.A. 1970 N150, M.C.L.A. 247,381 et seq., M.S.A. 9.195 (61) et seq.

the persons actually occupying the property. If there is a discrepancy, consult the occupants. It is not sufficient when the property is occupied to rely on the records of the registry of deeds. It is common, for example, for land contracts not to be recorded, so that the real owner (land contract purchaser) may not appear in the real estate records.

Once identified, the landowners must be contracted before the selected treatment may be performed. Notification should be in writing (see sample letters in Appendix D of Chapter 4). The letter should identify the land parcel, specify the tree(s) involved, and should offer the owner(s) the opportunity to make separate arrangements or to cut or transplant the tree(s) themselves. The letter can be prepared in such a way that the landowner(s) need merely sign it and return it to indicate their consent. It should include a grant of the right to cut the tree(s) (and remove the wood, if appropriate) and the right to enter the owner(s)' land in order to do so. Sufficient time must be given to the property owner(s) to perform the treatment themselves or make other arrangements.

Even for locations for which tree removal might take place within the right-of-way, the adjacent property owner(s) should be notified in writing (see sample letters in Appendix F of Chapter 4). Sufficient time must be given to the property owner(s) to transplant the tree(s) or make other such arrangements.

If a landowner refuses to grant permission to cut trees on his property, and if negotiations fail, it may be necessary to take legal action to obtain authority to cut the trees. There are two ways in which this might be accomplished. First, the power to eminent domain (condemnation)[4] might be used. Second, the road authority might treat the trees as a public nuisance and sue to require the owner to "abate the nuisance" by removing the trees. There is authority that trees are a nuisance when they "endanger the safety of travelers" (39 AM Jr. 2d Highways, streets and Bridges 300).[4]

ENDANGERED/THREATENED AND RARE SPECIES

In situations in which an endangered/threatened and/or rare plant or animal species or its habitat will be detrimentally influenced by actions associated with tree cutting, removal, or maintenance, alternative treatments must be considered. These

[4] 39 AM Jr. 2d Highways, Street and Bridges 300

instances are protected by law.[5] Actions which may jeopardize these habitats and associated species must withstand a detailed review. State laws and regulations controlling water pollution, fill and dredge, coastal zone management, natural rivers, highway construction, and land use planning can be used to varying degrees on both public and private lands to protect the habitats of these plant and animal species.

Prior to any tree cutting or removal, contact the Michigan Department of Natural Resources (DNR) to verify known or potential endangered/threatened or rare plant or animal species and critical habitats within those areas being considered for treatment. Written documentation from the DNR as to the existence, suspected existence or absence of endangered/threatened or rare species for each potential sites should be received prior to the selection of the treatment.

If based on the DNR review, the higher risk site is not a critical habitat or does not include an endangered/threatened or rare plant or animal species, appropriate action, which may include cutting or removal, may be considered.

If an endangered/threatened or rare plant or animal species or its critical habitat is identified, and the proposed treatment will detrimentally affect the species or habitat, a suitable alternative measure should be evaluated. If no alternative can be identified, additional negotiations or legal proceedings may be required to resolve the issue.

TREE SPECIES SIZE

Species designated as champion trees of Michigan[6] or included in the National Register of Big Trees[7] require special consideration because their location, life expectancy, and possible historic value may be extraordinary and worth preserving.

Based on field verification and consulation of available registers of Champion Trees in Michigan and Big Trees, determine which trees have been formally designated either state Champion trees or national Big trees, or are in the process of being formally designated.

If a tree has been registered, mitigative measures other than cutting or removal must be considered. If no other suitable means to reduce accident risk at the

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[5]Endangered Species Act of 1974, Michigan P.A. 203

[6]Champion Trees in Michigan, Michigan Botanical Club, March, 1977

[7]National Register of Big Trees, American Forestry Association, April, 1977

site can be identified, resolution must be determined by the State of Michigan regional forester, local, state, and federal agencies, and commissions or organizations associated with "Big Tree" or Champion Tree designations.

If, during field verification, a tree is identified as having exceptional size for its species, consult "Champion Trees in Michigan" and the "National Register of Big Trees" for initial verification of a potential champion. If the tree meets or nearly meets "Big Tree" qualifications, contact the State of Michigan regional forester before taking any further action which might detrimentally affect the tree. If the tree is verified as a "Big Tree," measures other than removing or cutting must be considered.

HISTORIC TREES

Trees are often associated with historic properties that represent the heritage of a particular community, region, or the State of Michigan[8]. Usually such trees are older, possibly recognizable as a large specimen, and may be a landmark or command a prominent position with the landscape. As a public asset to the community, state, or nation, preservation of such trees is in the best interest of protecting the country's heritage and should be considered a public asset whose loss would be irreplaceable. In some cases, these properities are listed in the State or National Register of Historic Places. Nationally registered sites are protected under law when Federal funds are involved in any land modifying activity that may impact such a site. Since removal of trees can affect the integrity of the site or the environment, such removal must undergo review according to the procedures outlined by the Advisory Council of Historic Preservation (Procedures for the Protection of Historic and Cultural Properties, 36 CFR 800).

If a tree has been formally designated/registered as having historic significance by local, state, federal authorities or is in the process of being registered; if a tree has not been formally registered but is identified by local community authorities, agencies, or commission as having important local significance (and has no history or evidence of run-off-road vehicle accidents); if the tree is located on an historic property, contact the State Historic Preservation Officer (State History Division, Lansing) and the recognized local community and county historic commission, and statewide organizations such as the Michigan Forest Association before taking any further action that might detrimentally affect the tree. Alternative approaches to mitigate accident risk must be considered. If no alternatives other than cutting or removal are suitable, negotiations or legal action with appropriate local and state historic authorities must be considered.

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[8] "Michigan's Famous and Historic Trees." Michigan Forest Association, February, 197

DANGER OF EROSION/SEDIMENTATION, IMPACT ON WETLANDS AND STREAMS

The State of Michigan Soil Erosion and Sedimentation Control Law (Act 347) was enacted to protect Michigan's valuable land and water resources. Sediment, as a pollutant, is incorporated into waters or deposited in new locations where it interferes with land uses, degrades water quality, and destroys natural plant growth. Additionally, sediment may carry or contain chemical pollutants. Careful consideration is needed prior to tree cutting or removal to insure that such actions, even when combined with erosion and sedimentation controls, will not seriously affect surrounding land and water uses. Special care should be taken in areas of high erosion potential, such as steep slopes, drainageways, and stream banks.

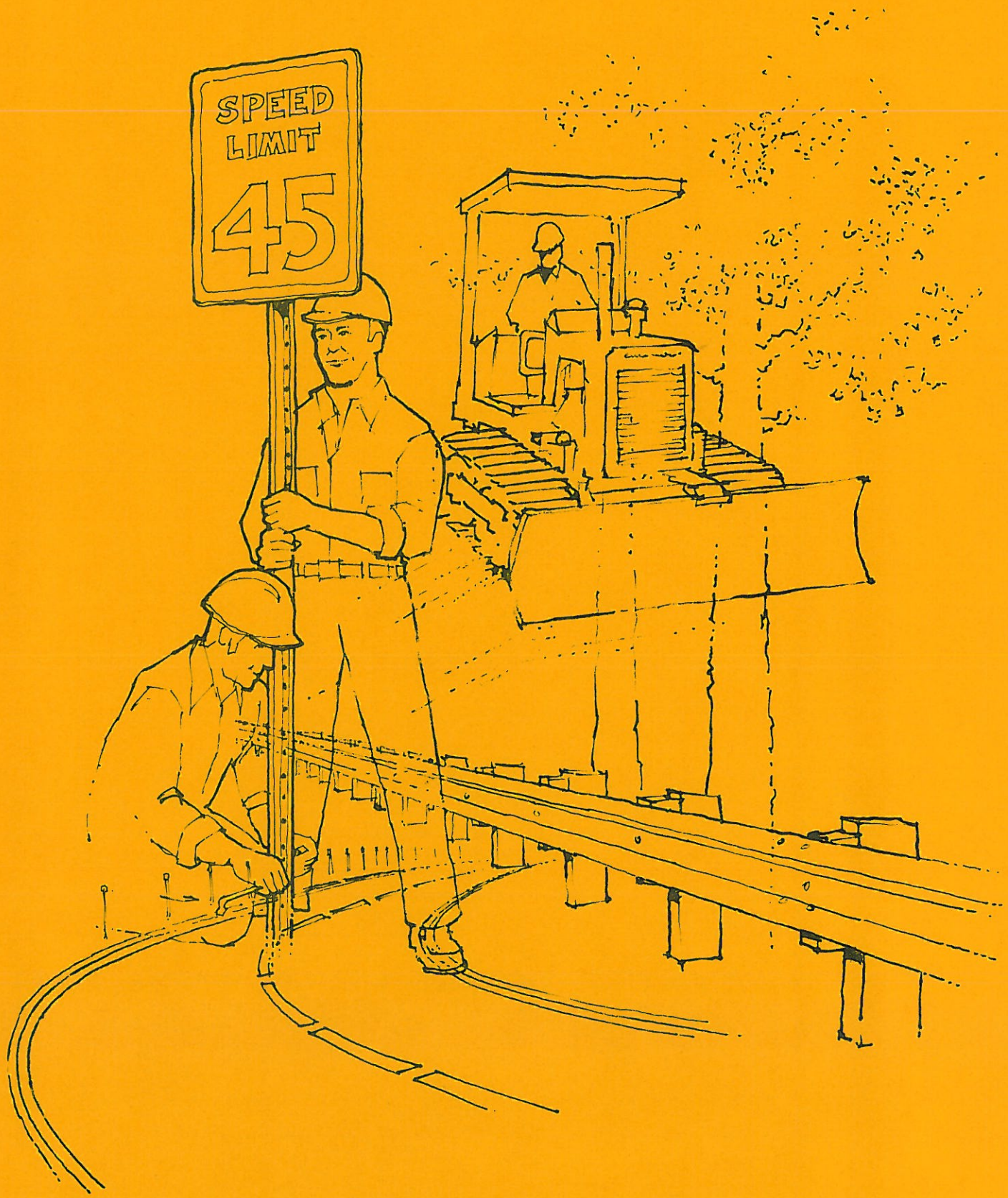
Several situations necessitate contact with the Department of Natural Resources Fisheries Division or Water Quality Division before performing any mitigative procedures:

a. if there is a steep slope and/or highly erodible soils,
b. if the trees to be cut or removed are the main vegetative binding or the soil,
c. if the site is adjacent to an existing high quality trout stream and/or tributaries designated by the DNR,
d. if tree cutting or removal will cause degradation of water quality either through increased sun filtration or erosion/sedimentation.

If, according to DNR review, no significant degradation will occur, the appropriate mitigative measure may be pursued. If degradation of water quality is likely to occur, alternative measures must be evaluated. If no suitable alternative is found, negotiations or legal action may be pursued.

SAFETY ISSUES

Prior to cutting or removing higher risk accident trees, additional consideration should be given to situations that would expose residents, occupants of other buildings, or pedestrians to run-off-road vehicles or provide an unimpeded approach for run-off-road vehicles to go over a cliff into a lake or river or to hit other obstacles. Consideration of these situations might avoid creation of a new set of injury risks. A treatment other than tree removal may be a more suitable alternative.



Alternative Treatments

This chapter contains three sections. Section 1 describes the on-roadway treatments that can be performed to alleviate the risk of run-off-road tree/vehicle accidents. These treatments for the most part include an upgrading of the informational and warning sign system, better marking of the roadway, or change in roadway classification or use. On-roadway protection is relatively inexpensive and can be performed along with regular maintenance procedures. Section 2 presents modifications to the off-roadway environment that can prevent tree/vehicle accidents. This presentation assumes that the vehicle has left the traveled portion of the roadway. All of these treatments require at least a nominal modification of the off-roadway environment. Section 3 describes treatments that are expensive and require heavy equipment; thus, they should only be performed as part of a major roadway reconstruction project.

A standard format is used to discuss each alternative treatment. The treatment and what it entails is descriptively defined. Installation requirements are noted. Then the environmental impact(s) of the treatment is/are delineated and assessed for each road condition. On a site-specific basis, the off-roadway area of possible environmental impact is limited for most treatments. Natural factors which may be affected include soil-water relationships, vegetation, and drainage. Human factors of greatest significance are effects on adjacent land use, traffic flow, and aesthetic qualities. Generally, for both on-roadway and off-roadway treatments, the extent of impact is proportional to the extent of soil disturbance. Most impacts are of short duration (occurring during construction) and site-specific. Road relocation, boulevard construction, and shoulder-widening, however, may have significant impacts that require impact assessment.

Feasibility is a measure of the practicality and appropriateness of the treatment. Each treatment is rated using the following system:

- F Feasible; based on basic design and safety requirements.
- F/L Feasible with limitations; possible application depending on the width of the right-of-way and/or road alignment.
- NF Not feasible; impractical based on engineering considerations.

Effectiveness is the extent to which the treatment has been shown to be effective in reducing the number or severity of all types of accidents. Generally, treatments that do not significantly affect traffic flow and that result in a hazard continuing to be a hazard were ranked slightly lower.

The decision to employ or not employ a particular treatment or no treatment is also determined by cost-effectiveness. For purposes of comparison, treatments are ranked as follows:

least costly
moderate cost
highest cost.

In considering treatments, several assumptions are made:

1. The tree or trees involved is or are a safety hazard.
2. The tree or trees will not be removed because of special circumstances.
3. Costs of the treatments are an important consideration.
4. Effectiveness in reducing tree/vehicle accidents is a major consideration.
5. The alternative treatment must not result in a potentially more hazardous situation than the original tree obstacle.
6. Unlike tree removal, the other treatments will not eliminate the total hazard, but will lessen the frequency or severity of run-off-road accidents.
7. The treatment will satisfy the responsible authority's liability to improve safety.

In all considerations of treatments, existing standards, guidelines, and warrant systems are assumed to continue in effect. In any consideration, one must analyze:

1. The type of highway activity planned: new construction, reconstruction, or maintenance. In construction and reconstruction activities, treatment of hazard trees leads to an integrated satety design which resolves the tree hazard problem. Maintenance application views the hazard as a problem and attempts to use a special treatment to solve that particular problem. Each type of highway activity may have a different funding source and varying standards and requirements.
2. Applicability of alternative treatments--those that can be applied generally to all situations and those that require certain physical conditions, such as the hazard involves one or more road elements in addition to the tree(s); see hazard profiles in Chapter 3.
3. The type of control inherent in the treatment: to keep vehicles on the roadway (implies traffic control, a more passive treatment), or to protect run-off-road vehicles (includes treatments to redirect, deflect, or deaccelerate run-off-road vehicles).
4. Design effectiveness criteria: effectiveness of the treatments will vary by road type. Higher volume roads often have been designed or upgraded to already include one or more of the alternative treatments, lessening the choices available.

Each of the four aspects discussed above should, in various degrees, be considered when evaluating alternative treatments to removing trees. Because of the variabil-

ity posed by situational factors and the need to consider existing design and location standards, typical treatment recommendations cannot be made in this manual. The final decision can only be made by the responsible authority after evaluating all appropriate locational, feasibility, effectiveness, and cost factors.

When selecting the appropriate treatment to alleviate the risk of run-off-road accidents, keep in mind that the interaction of the driver, his/her vehicle, and the roadway is a complex relationship. Therefore, combinations of treatments rather than one treatment used exclusively are likely to alleviate the risk of tree/vehicle accidents to a greater degree.

1 ON-ROADWAY PROTECTION

PAVEMENT MARKING

Description--Pavement markings (center line, edge line, and curbs) help drivers stay in their lanes at night and during periods of inclement weather. They can be used along roadways of all types. Markings are especially effective for roads with heavy nighttime traffic, areas frequently innundated with fog, and sections of roadways with narrow pavement. They are less effective when obscured by snow and ice. Reflectorized markings may be used on long, continuous sections of road or through short stretches where there are many changes in horizontal alignment.

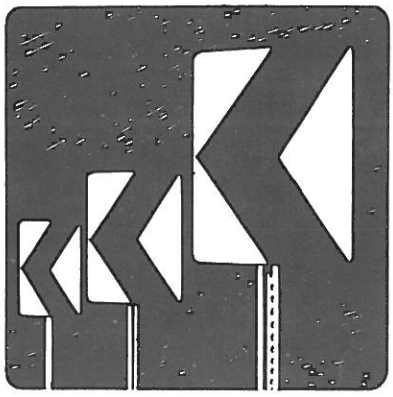
Installation--Pavement markings can be done at the same time and utilizing the same equipment and materials as centerline pavement marking routinely performed by maintenance units. Extreme care should be taken to adhere to the principles set forth in the Michigan Manual of Uniform Traffic Control Devices. Field observations indicate that durability is a factor which may influence future maintenance. Markings at curves are crossed more often than on straight sections and thus wear faster. In such areas, wider markings or more durable paint may be appropriate.

Environmental impacts--Pavement markings produce no significant environmental effects. However, visual uniformity may be a consideration in scenic or special use areas.

Feasibility--F, for all road conditions.

Effectiveness--Effective, across all road conditions.

Cost--One of the least costly alternative treatments.



DELINEATORS AND ADVANCE WARNING SIGNS

Description--Roadway delineators, placed at consistent intervals along the edge of shoulders, permit the driver better visual perception of changes in roadway alignment. This treatment is effective for roadways with heavy nighttime traffic and especially along curves. Installation of reflectorized delineators, mounted on posts, and warning signs can help reduce the number of run-off-road incidents and is among the least costly alternatives. Suggested spacing of delineators is discussed in the Michigan Manual of Uniform Traffic Control Devices. All traffic signs should conform in design and placement with the requirements outlined by that document. Field observations show that the proximity of the sign to the hazard is important, and warning signs for hazards should not conflict with other signs and treatments.

Installation--Both delineators and advance warning signs can be installed using the same equipment, materials, and procedures used for installing standard traffic signs. Highway departments do not install delineators on trees, but residents living along the roadway sometimes mount them on trees themselves, particularly near driveways.

Environmental impacts-- Roadway delineators and signs produce no significant environmental effects; however, visual conflicts may occur. For example, the positioning of the signs can affect the integrity or aesthetic qualities of structures of historical importance.

Feasibility--F, across all road conditions.

Effectiveness--Roadway delineators are effective across all road conditions. On-tree delineators are less effective, signing is effective across all road conditions.

Cost--One of the least costly alternative treatments.

SPEED LIMIT RESTRICTIONS

Description--Excessive speed and curvilinear alignment increase the possibility of run-off-road accidents. Advisory speed plates can be used to supplement warning signs or to emphasize the need for reduced speed through an area within a higher risk roadside section. A speed limit restriction may be imposed on a road section only after the limit has been established by law or regulation and a thorough engineering and traffic investigation has been performed according to established traffic engineering practices.

Installation--The signs can be erected using equipment, materials, and procedures utilized to install standard traffic signs. All traffic signs should conform in design and placement to the requirements of the Michigan Manual of Uniform Traffic Control Devices.

Environmental impacts--Creates no significant environmental effects.

Feasibility--NF, along interstates; F, across remaining road conditions. Speed reduction at higher risk locations (curves), below the already existing 55 mile per hour limit, was considered not practical because these roads were originally designed for 70 mile per hour traffic; enforcement would also be a problem.

Effectiveness--Studies have shown that speed reductions have little or no effect on 85 percent of the drivers or in the number of accidents. Additional enforcement of existing speed limits also has shown little effect.

Cost--One of the least costly alternative treatments.

DESIGNATION OF ROAD AS SCENIC DRIVE (WITH SPEED RESTRICTIONS)

Description--An inexpensive and effective method of reducing run-off-road accidents in areas where roadside vegetation is extremely dense and there are numerous large trees adjacent to the traveled portion of the roadway is to disignate half mile and longer sections as scenic drives. A speed limit restriction is usually imposed with the designation, acting as a further deterrent to run-off-road accidents (see discussion of speed limit restrictions above.) This restriction may be imposed only after an engineering and traffic investigation has been made in accordance with established engineering practices.

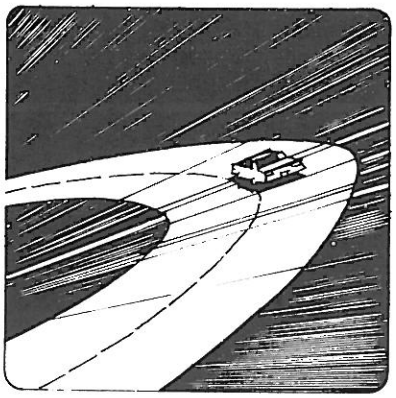
Installation--The signs must be installed according to the Michigan Manual of Uniform Traffic Control Devices. The signs may be installed along with standard traffic signs using the same equipment, materials, and procedures.

Environmental impacts--This treatment may eventually allow more vegetation to grow closer to the road's edge, reducing sight distances and decreasing sun filtration, thus increasing road icing in the winter and creating hazardous driving conditions. The presence of roadside trees, however, reduces glare on the roadway. Creation of a road as a Scenic Drive (Natural Beauty Road Act designation) have positive resource implications for aesthetics and tourism (fall color, tours, etc.) on a local and state wide basis.

Feasibility--NF, along interstates and trunklines; F, along county roads, especially curved roads of at least 1/4 mile in length.

Effectiveness--If drivers are forced to go slower because of the road alignment and speed reduction, this treatment may be effective on a site-specific basis. However, drivers may choose to ignor speed limit restrictions.

Cost--One of the least costly treatment alternatives.



SUPER-ELEVATION OF ROAD SURFACE

Description--In a number of areas, particularly on old county roads, an excessive crown or incorrectly shaped crown directs vehicles off the road and towards trees. By using bitumious materials to wedge up the outside edges of the pavement, a new surface contour can be created which will assist in steering vehicles away from roadside trees.

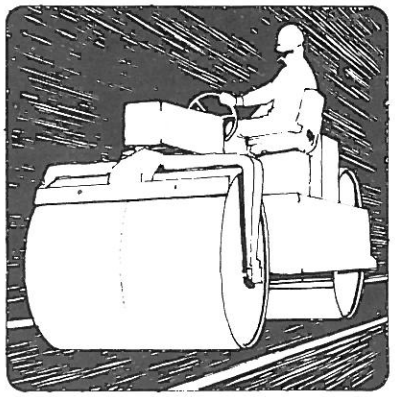
Installation--Super-elevation is usually done by the maintenance staff using road graders, spreader boxes, and steel rollers.

Environmental impacts--The primary environmental impact of this treatment is restricted traffic flow during application. Off-road use of heavy equipment, such as asphalt pavers and trucks transporting asphalt, might destroy ground cover and promote local soil erosion. Generally, no significant environmental impacts result if activities are restricted within the road shoulders.

Feasibility--F, along trunkline curves and county curves.

Effectiveness--Somewhat effective along county and trunkline curves.

Cost--Moderate cost.



SHOULDER WIDENING AND PAVING

Description--Shoulder widening and paving can be used as spot treatments to improve the recovery potential of vehicles straying off the roadway.

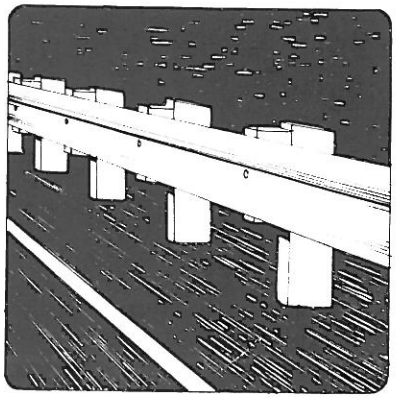
Installation--Shoulder widening and paving is usually done by maintenance staff using road graders, spreader boxes, and steel rollers.

Environmental impacts--Assuming trees are not removed, this treatment has little environmental impact because most of the activity takes place on already disturbed areas immediately adjacent to the roadway. Earth moving and fill can cause significant erosion and sedimentation of adjacent water and wetland areas, particularly if no erosion control measures are taken. Since water and wetland areas occur infrequently on a statewide basis, impacts, if any, would be limited to site-specific situations.

Feasibility--F, along trunkline curves and county roads.

Effectiveness--Research on shoulder surface type indicates that paved shoulders have clearly lower run-off-road accident rates than unpaved shoulders of the same width on two-lane rural highways. On horizontal curves, a number of studies indicate that, as shoulder width increases, accident rates decrease.

Cost--Moderate.



2 OFF-ROADWAY PROTECTION

GUARDRAILS

Description--Guardrails can prevent run-off-road vehicles from striking trees as well as other roadside obstructions. A properly designed and installed guardrail, conforming to the standard plans developed by the Michigan Department of Transportation and documented in the American Association of State Highway and Transportation's Guide for Selecting, Locating, and Designing Traffic Barriers, can effectively dissipate the vehicle energy before contact is made with the tree(s) or can channel the vehicle away from the tree(s). Guardrails should only be used when the severity of striking a roadside object is greater than striking the guardrail; this is usually the case with mature trees. Using a section of guardrail horizontally longer than the width of the tree, however, may create a greater problem than leaving the tree unprotected. A minimum guardrail length of approximately 320 feet is needed to be cost effective when protecting run-off road vehicles from hitting trees, according to the AASHTO guide above. Only reasonably healthy trees should be considered for guardrail installation since the guardrail itself becomes a non-functional obstacle if the tree dies and is removed.

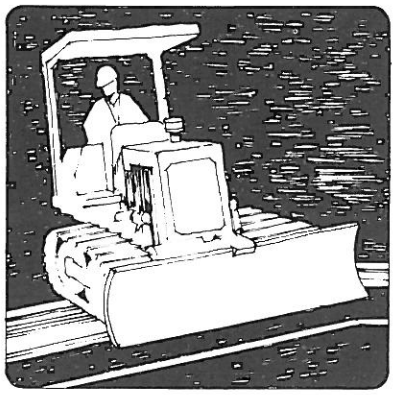
Installation--Guardrail installation can be done by regular maintenance crews using power augers and hand tools.

Environmental impacts--The installation of a single guardrail, as a spot treatment, affects the environment minimally. It may reduce visual quality in some areas, such as near historical or aesthetically sensitive locations. On curves, guardrails discourage deer crossings, which often cause run-off-road accidents. If grading or extensive excavation is necessary, soil erosion may occur. The effects of traffic flow alterations during installation are minimal.

Feasibility--F, along all road conditions.

Effectiveness--Guardrails have proven effective in reducing the severity of impacts with fixed objects such as bridge piers and abutments, street posts, and trees. They do not always reduce the number of accidents, however, particularly when the guardrail protects a narrow object such as a tree.

Cost--Moderate.



REGRADING DITCH SECTIONS

Description--All too frequently, roadside ditch maintenance results in ditch lines that are constructed extremely close to existing trees. Typically, trees are left on the backside of ditch slopes, but within impact range of a channelized vehicle. Field observations of accident sites have indicated that the vehicle leaves the traveled portion of the roadway, becomes trapped in the ditch, and is channeled directly into the tree(s). Relocation or regrading of ditches can eliminate this problem.

The hazard of trees along ditch lines is often subtle, especially when obscured by other vegetation. In most cases where this hazard exists, removal or alteration of the fixed object is often preferable. Regrading is impractical if it is likely to affect the roots of preserved trees. If other non-hazard trees must be removed to permit regrading, the benefits of preserving one hazard tree may be negated.

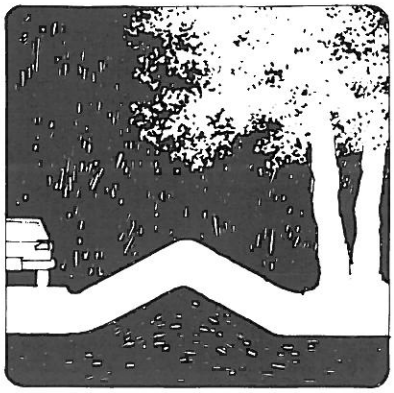
Installation--The work can be done as part of a routine maintenance operation with gradalls, motor patrol graders, or backhoe equipment.

Environmental impacts--Since the amount of regrading required to direct vehicles away from hazard trees varies with each situation, the extent of potential impacts also varies. No effects on drainage can be anticipated, but excessive drainage might occur in special situations. The primary environmental impact may be soil erosion and sedimentation during and after construction. If additional right-of-way is required, the effects on adjacent land use and drainage may be important.

Feasibility--F, for interstates and trunklines; F/L for county roads.

Effectiveness--Effective in eliminating the problem of vehicles becoming channelized in ditches.

Cost--Moderate.



PROTECTIVE BERM CONSTRUCTION

Description--Where there is sufficient room between the traveled portion of the roadway and the tree(s), a protective earth berm can be constructed to direct run-off-road vehicles away from trees. Berms can be landscaped and/or shaped in such a way that they do not impose on the roadside environment or pose a hazard themselves. Their design should not permit a vehicle to vault into the preserved tree or other objects, to channel a vehicle into another object, or to contribute to vehicle roll-over. Proper drainage, however, should be maintained, and care should be taken not to create sight distance problems.

Installation--Berm construction is usually done with earth moving equipment such as graders, front-end loaders, gradalls, or small earthmovers.

Environmental impacts--Excavation or fill material on the right-of-way, and particularly off the right-of-way, may create negative environmental impacts, depending on site characteristics. Drainage of the right-of-way may be altered and affect adjacent areas and the roadway itself. Placement of fill material to construct the berm may alter soil moisture and soil aeration relationships of adjacent vegetation. Soil erosion and sedimentation may have to be controlled.

Feasibility--F along straight sections of interstates; F/L along trunkline and county road sections. Typically, there is insufficient room for installation on county sections.

Effectiveness--Effectiveness has not been demonstrated.

Cost--Moderate.

SLOPE ALTERATIONS

Description--Front slopes of road embankments or backslopes of ditch sections frequently lead directly downgrade to trees. In some cases, it is possible to regrade the slope to direct run-off-road vehicles away from the trees or provide additional space to permit the driver to regain control of his/her vehicle. The effect of the slope alteration on the vigor of the tree(s) is an essential consideration before treatment is initiated. The operation may be limited by the horizontal distance between the shoulder edge and the tree.

Installation--Slope alterations can be done with graders, front-end loaders, gradalls, or small earthmovers and can be included in routine maintenance work.

Environmental impacts--Environmental concerns with this treatment are similar to those of ditch regrading--soil erosion, sedimentation, and drainage.

Feasibility--F along interstates and trunklines; F/L along county roads.

Effectiveness--An effective treatment for all road types.

Cost--Moderate.

PROTECTIVE PLANTINGS

Description--Protective plantings of dense shrubs can be used to shield trees from run-off-road vehicles. Care must be taken to select shrubs which are indigenous to the area, require little continuing maintenance, and can be planted with a high degree of growth success. The plants will not form an effective barrier until 5-10 years after planting.

Installation--Shrubs can be planted by maintenance units, and do not require heavy equipment. Little continuing maintenance is required.

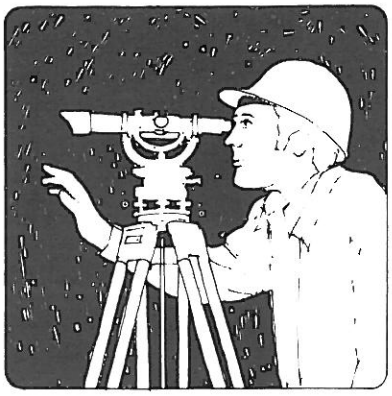
Environmental impacts--The functional role of vegetation is generally associated with positive environmental effects (i.e., noise abatement, aesthetics, wildlife habitats, etc.). Use of natural barriers should not obscure other hazardous objects or reduce sight distance.

Feasibility--F along interstates; F/L along trunklines; NF along county roads. Plantings along county roads are considered impractical because the right-of-way area is generally insufficient to provide the area required for planting.

Effectiveness--Plantings of dense shrubs have been effectively used to protect bridge piers located too close to the traveled portion of the roadway. However, dense shrubs may pose a hazard to drivers themselves.

Cost--Moderate.

3 MAJOR RECONSTRUCTION PROJECTS



ROAD RELOCATION/REALIGNMENT

Description--Road relocation/realignment is particularly effective when roads are being reconstructed and improved. During the realignment of the new road, curves can be flattened and relocated to obtain increased isolation distance from the roadside trees. Design and space requirements are essential factors to be considered. Construction activities should be planned so that preserved trees are not affected. The total impact of realignment should not be greater than removal of the hazard tree(s).

Installation--Road realignment requires the use of heavy equipment and trained personnel; it is usually done during road reconstructions and improvements.

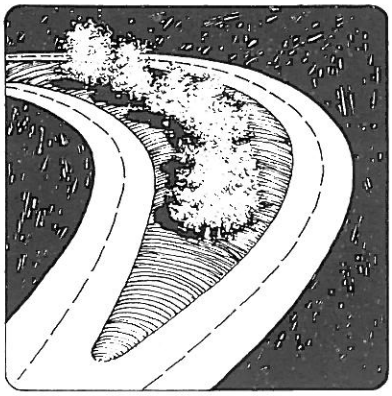
Environmental impacts--This treatment entails more extensive cost and impact considerations. Significant short-term impacts will occur. Long-term impacts will be site-specific. Projects which require additional rights-of-way to place the roadway further from trees will have the most environmental impact. An extended period of traffic detouring will disrupt local travel patterns and shift the associated impacts to other roads for the period of reconstruction.

Road relocation may mean direct habitat loss to vegetation and wildlife. Indirect effects may be disruptive to habitat continuity and travel lanes for wildlife. An environmental assessment is required before this method can be employed. Such activity should not occur without a proper cultural resource survey of the projected impact area done under the auspices of the Michigan Department of Transportation and the State of Michigan History Division.

Feasibility--F for all road conditions.

Effectiveness--Highly effective; but may create different hazards. Road relocation has been effectively applied to S curves; accidents other than those involving trees may also be reduced in number and severity.

Cost--High.



BOULEVARD CONSTRUCTION

Description--Boulevard construction is effective in areas where multiple lane pavements are planned on an existing road. The construction of additional lanes frequently brings the edge of the roadway extremely close to mature trees. By obtaining additional right-of-way behind the tree row, it is possible to construct a boulevard section, divide the roadway into separate direction lanes, and increase the distance from the trees to the edge of the pavement. Additionally, this treatment separates oncoming traffic, provides median space for turning lanes, and enhances the roadside environment. The preserved trees must be of significant value and able to withstand possible effects of construction.

Installation--Boulevard construction is usually done as part of a major reconstruction project.

Environmental impacts--The permanent surfacing of lanes and shoulders removes these areas from other uses. Adjacent land acquired for the wider right-of-way will also have limited use. The extent of environmental impact depends on site sensitivity. Large projects may require environmental impact statements or assessments. To be considered, the impacts of the project should not be greater than the impact of removing the trees, which are the target of preservation.

Feasibility--F/L along trunklines and county roads.

Effectiveness--Most effective when additional lanes are being constructed

Cost--High.

Mitigating Environmental Impacts

Any program selected to reduce the risk of run-off-road tree/vehicle accidents, whether it involves the removal of trees or not, will impact the environment in two ways: functionally and aesthetically. Functional impacts are those that interfere with or eliminate practical aspects of the environment; examples are sun filtration, windbreaks, noise abatement, visual buffer, or even physical protection. Aesthetic impacts are those that affect the ornamental or natural characteristics of the environment.

This chapter presents seven measures which may be used to mitigate environmental impacts of tree removal (Section 1). Where the number of potential viewers is high, these measures may help minimize aesthetic impacts. Various mitigative measures are particularly useful and necessary in areas in which landscapes are associated with high scenic values and concerned viewers (tourists) are important, especially where landmarks or high traffic volumes exist. In some instances, however, environmental damage is inevitable. These situations are discussed in Section 2.

For areas where soils have been disturbed and soil stabilization is required, refer to the Michigan Soil Erosion and Sedimentation Guidebook.

1 MEASURES TO MITIGATE ENVIRONMENTAL IMPACTS

MINIMIZE THE AREA DISTURBED

In all instances, the disturbed area should be limited as much as possible. Vegetative cover should be reestablished; tree(s) may be replaced from nursery stocks.

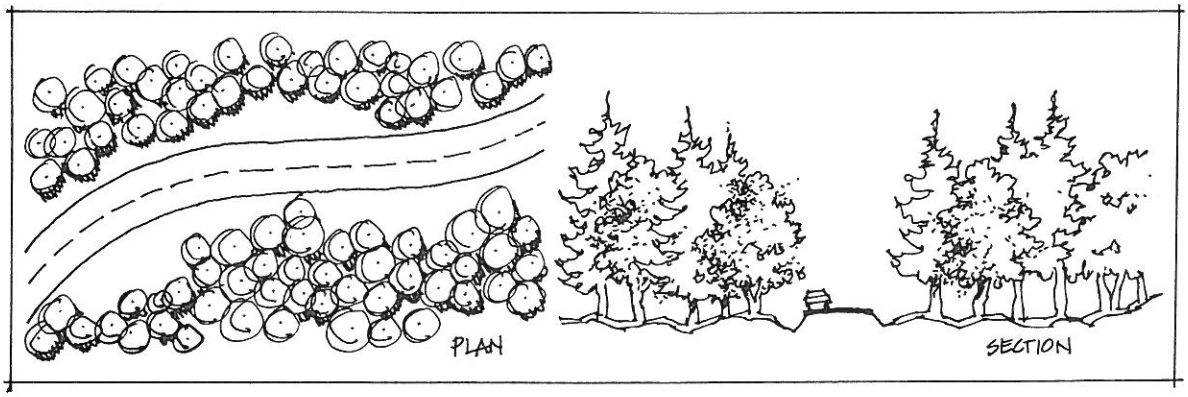
ESTABLISH IRREGULAR, FREE-FORM CLEARING LIMITS

Due to their high degree of contrast, edges formed by clearing limits are potential focal points. An undulating tree edge will often help reduce such contrast, breaking up an otherwise straight line that reinforces the unnatural line of the road itself. A side benefit of this treatment is that it provides the traveler with a sequence of enclosures and openings that add variety to the driving experience.

FEATHERING CLEAR EDGES FOR A GRADUAL TRANSITION

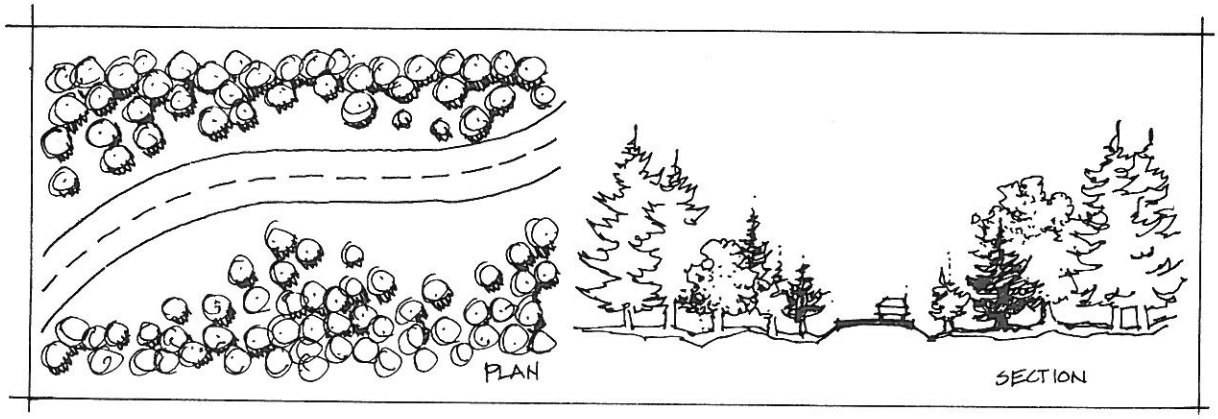
In addition to undulating the clearing line, another key method of reducing the line, form, color, and texture contrast caused by tree removal is to feather the edges Successful feathering involves a reduction of vegetative density in transitional degrees as well as a gradation of tall vegetation down to low vegetation at the clearing edge; the contrast fades into a wide transitional band and focalization on an artificial line decreases. As an added benefit, feathering reduces possibilities of large trees falling across or onto the highway. Windthrow is less likely to occur.

Irregular Clearing



When selectively removing trees or shrubs on newly cleared projects to attain feathered edges, cull out those which will be less likely to survive the new conditions produced: those which require shade to exist, are subject to wind-throw, are intolerant of ice melting chemicals, are subject to sunscald, have highly sensitive moisture requirements, are sensitive to air pollution levels anticipated, or are dying or diseased.

Irregular Clearing and Feathering



TREAT STUMPS

The color contrast of freshly cut stumps can be reduced if they are treated. Painting, or even a shovel full of dirt on top of the stump provides a short-term solution.

PLANT TREES

Where either the functional or aesthetic loss of trees is great, consider planting trees outside the clear zone. The Guide for Establishing Values of Trees and Other Plants (see references) may be used to determine when a tree warrants replacement. Planting should also be considered in special situations or where trees requiring removal are located outside the right-of-way, particularly in viewer-sensitive areas such as residents or intensively used parks or recreational areas.

MITIGATE THE VISUAL IMPACT OF TREATMENTS

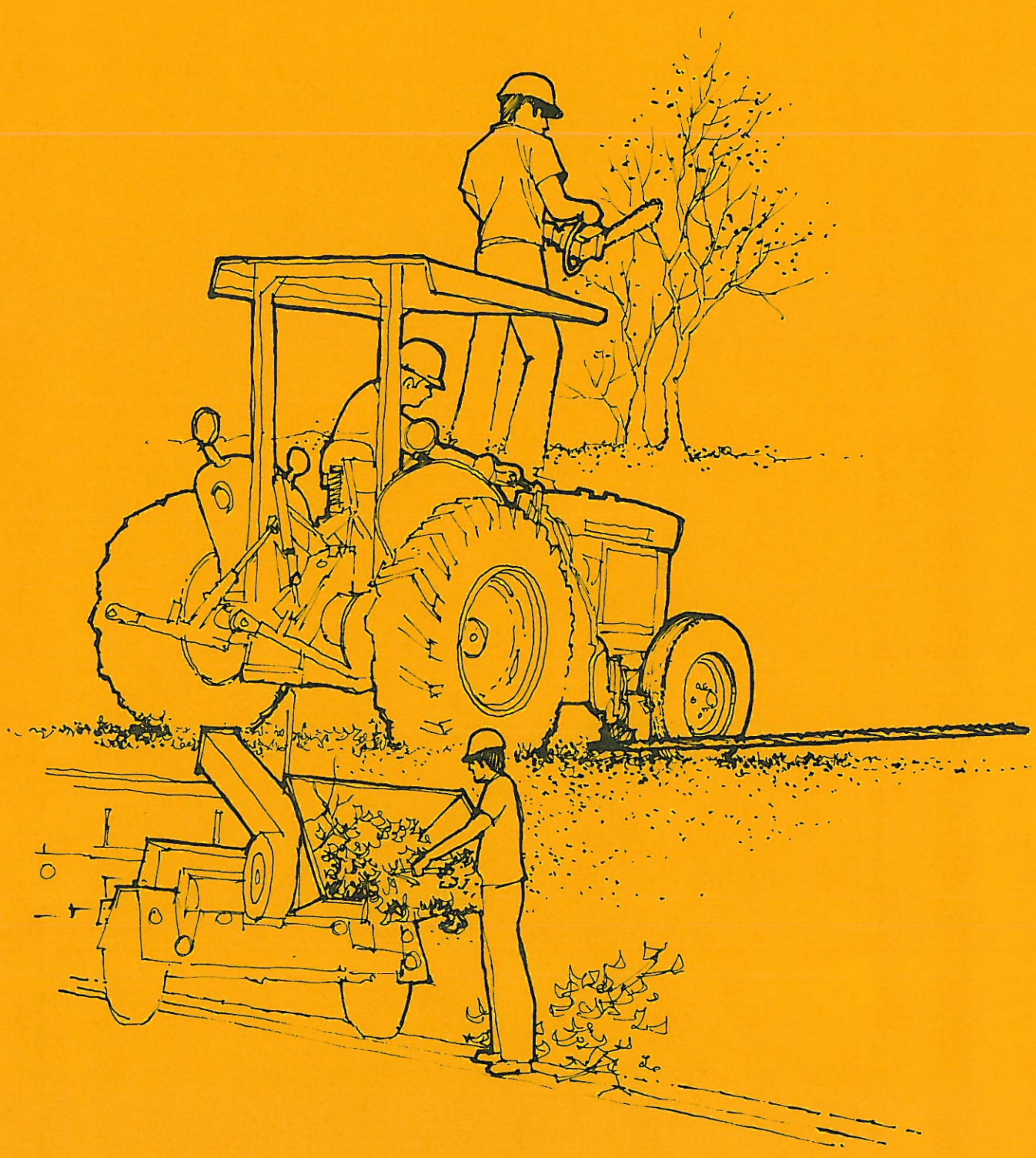
Effort should be made to reduce the visual impact of the treatment(s) performed.

Signs-- Although signs must be seen, read, and understood to be useful, unnecessary visual impacts of signs can be reduced. The mounting technique and the reverse side of the sign are not inherent parts of the sign's message and can therefore be subjected to contrast reduction. The reverse side of the sign and the entire post can be painted to match the existing backdrop. Grays, gray-browns, and gray-greens are most successful. Harmonious signs will cause highway viewers to be less distracted from the highway and landscape.

Guardrails-- Although guardrails are of standard designs, opportunities to reduce the apparent size of the guardrail should be used. Guardrails of self-weathering steel or galvanized steel, guardrails dipped in galvanprime or a similar solution turn a dull or very dark gray, blending into the existing backdrop.

2 WHEN ENVIRONMENTAL DAMAGE IS UNAVOIDABLE

When for some treatments, such as road relocation or boulevard construction, environmental damage is unavoidable, opportunities to employ site-specific mitigation measures may exist. One should note that mitigation of an environmental impact does not necessarily mean replacing one with another. Using road relocation as an example, loss of a particular land use may be mitigated if the former location of the road right-of-way can be returned to the same land use lost by road relocation, or enhanced to a higher or better quality. Loss of a wildlife habitat can be mitigated to a limited extent by providing a more diversified habitat. Often, however, although mitigation might be achieved in the long run, considerable environmental impacts occur in the short run.



Maintaining Clear Zones

8

Once the higher risk roadside accident zones in your county have been treated, the responsibility for maintaining these "clear zones" usually shifts to the maintenance unit of the Michigan Department of Transportation district, or to the county, township, municipality, etc. Supervisors and crews different from those that evaluated the potential higher risk roadside environments and treated selected areas to reduce the risk of tree/vehicle accidents will be responsible for maintaining the risk-reducing treatment.

Close coordination between State, county, local, and municipal or utility maintenance programs is essential for overall efficiency and to avoid duplicating maintenance efforts. New equipment and techniques are constantly being developed and should be evaluated and included in maintenance programs as they seem appropriate. Communication with the public, either through notification prior to performing maintenance work, or some other disclosure of work effort, is essential.

This chapter describes guidelines to enable each maintenance unit to develop a specific brush and tree maintenance program for the clear zones (higher risk roadside accident zones that have been treated) that exist within its jurisdiction. Guidelines may be used by the State, counties, townships, and municipalities as well as private individuals or groups. They should be used at all levels--from statewide policymakers to local field personnel--to carry out the operations required. A general procedure is described that enables those responsible to: 1) determine the area(s) to be maintained on a priority basis and establish the distance from the road that maintenance should be performed; 2) select the appropriate maintenance method(s); and 3) integrate the brush and tree maintenance program into the overall maintenance schedule.

Brush and tree maintenance programs developed from these guidelines should be integrated into the unit's overall maintenance program. Whenever possible, existing personnel and equipment and standard crews and work schedules should be used. Safety devices such as advance warning signals, flagmen, flashing lights, etc., used to safeguard the workers as well as the public, should be used at all times when performing maintenance operations.

1 DETERMINING THE AREA(S) TO BE MAINTAINED AND THE DISTANCE FROM THE ROAD THAT MAINTENANCE SHOULD BE PERFORMED

Obviously, the areas to be maintained are those higher risk accident zones designated for treatment in chapter 4. In chapter 4 of this manual, you performed five tasks: 1) You identified the roadside sections in your area along which a higher probability for run-off-road tree/vehicle accidents exists. 2) You ranked them according to risk. 3) You field verified the roadside sections along which a higher probability for run-off-road tree/vehicle accidents exists. You talked to property owners and adjacent landowners, evaluated the existence of other considerations and excepting conditions, and classified the higher risk sites by generic roadside environment. 4) You selected the appropriate treatment(s) for alleviating or reducing the risk of tree/vehicle accidents. 5) You performed the treatment(s) selected.

Since each higher risk accident zone was evaluated independently, information is available for each area that must be maintained explaining the treatment prescribed and the factors associated with it, i.e., distance from road's edge that the treatment should be performed, cost of treatment, materials or equipment required, maintenance intervals, etc. These factors affect the maintenance schedule.

2 SELECT THE APPROPRIATE MAINTENANCE METHOD(S)

Because of local variations in weather, topography, etc., a single maintenance method cannot be applied to occurrences of the same generic roadside environment throughout the State. Rather, several methods or combinations of methods must be employed to achieve the desired maintenance goal. The final selection of method or methods must be based on the site-specific conditions encountered and documented on the Field Verification Form.

GENERAL MAINTENANCE METHODS

Three basic maintenance methods are employed to maintain clear zones:

1) mowing
2) tree trimming, thinning, removal
3) herbicide application.

Mowing-- When correctly performed, mowing can be used to control developing woody vegetation, enhance the natural beauty of the roadside, and improve safety conditions by providing definition to the roadside beyond the roadway. "Meadow-lawn" mowing, the most common mowing practice, creates an area of vegetation

of uniform height--between 4 and 8 inches tall. Guidelines for meadow-lawn mowing are as follows:

1. At top of cut slopes, mow whichever comes first: designated "clear zones" lines or steep up-sloping embankment which would prohibit a run-off-road vehicle from going further.
2. At top of fill slopes, mow 2 to 3 feet in back of guardrail, if present; otherwise to "clear zone" lines.
3. Medians may be mowed in their entirety or to designated "clear zone" lines, whichever comes first.
4. Vegetation control along roads should include cutting through the existing ditch line so that a run-off-road vehicle cannot hit existing trees or brush.
5. Where there is a well-defined ditch line or where a run-off-road vehicle could vault over or travel beyond a ditch, mowing should extend to the clear zone limits.

Four types of mowing equipment are available:

1. reel mower--a single unit or multiple units, referred to as "gang mowers." This type of mower is generally a pull type; however, some models are attached in multiple units under the tractors and operated hydraulically. A reel mower is practical for medians and other level roadside areas where parklike appearances are desired.
2. rotary mower--composed of one or more units, this mower is either pulled or mounted on the vehicle which powers it. Such a mower is ideal for median, shoulder, and other roadside areas which are reasonably level or have slopes that are flat. A rotary mower is fast, requires little maintenance, and cuts close to obstructions such as fences and curbs. It will also mow tall, heavy growth. Heavy duty units are capable of cutting brush up to three inches in diameter.
3. sickle mower--most universally used because of its adaptability to rough terrain. The bar can be raised over obstacles; it will cut tall weeds and grass; it can be angled to cut on a steep slope; it can span a small ditch. The sickle mower, however, is slow; maintenance costs are high. The knife must be sharpened or replaced often.
4. flail mower--has a high production rate; the blades can be quickly replaced. The flail mower will cut heavy growth and can be used on a steep slope and on rough terrain. It will not throw objects; the

vegetation is pulverized into a desirable mulch which is evenly spread behind the mower rather than windrowed.

Mowing for brush and tree maintenance within the clear zone need not be scheduled more frequently than once a year. Intervals of 2 to 3 years or longer may be suitable in areas where growth is slow.

Areas not to be mowed include:

1. areas beyond designated "clear zone" lines.
2. up-cut slopes beyond which, in the judgment of the designated county, State, or other responsible persons, a run-off-road vehicle cannot reasonably encroach.
3. steep slopes beyond 2 to 3 feet of guardrails.
4. slopes, medians, or interchange areas where crown vetch is already, or in the process of being, established.

Areas beyond the mowing limits should be left to develop naturally. If mowing cannot be reasonably accomplished because of steep down-sloping terrain, trees, rocks, or other obstacles, other maintenance methods should be considered to provide an adequate clear zone.

Mowing can be used in all generic roadside environments and has limited aesthetic or other environmental impacts when properly performed. Specific standards should be developed to insure best results within practical maintenance requirements.

Tree trimming, thinning, removal-- Tree trimming, thinning, and removal are applicable to all generic roadside environments. When using these treatments, however, the procedures outlined in chapter 4 should be strictly observed.

All property owners affected by roadside trimming, thinning, or removal operations on or off the road right-of-way should be notified and informed of the limits and extent of the proposed work. (See forms in Appendix 4-D). Where the adjoining landowner is not in agreement with the maintenance program, the procedures outlined in chapter 4 should be used to negotiate a satisfactory resolution for all parties.

All available trees, shrubs, and vines should be preserved at all times when they exist beyond clear zone limits. All stumps resulting from cutting trees and brush should be treated with an herbicide (as described on page 8-6). Sprout growth should be treated with herbicides before attaining a height of five feet. Unless the volume of sprout growth is so intense as to justify boradcast-foliage spraying, basal spray application should be adequate. Foliage spraying should be limited

to minimize "brown-outs" (concentrations of dead brush) and preserve as much desirable vegetation as possible (for further information, see section on herbicide spraying).

Trimming--Trimming operations should be limited to day-lighting (trimming trees to allow the ordinary light of day to reach a curve) curves, removing dead and windthrown trees, and preserving desirable existing and new growth. On median and interchanges or other roadway areas, thinning should be confined to the clear zone limits.

Removal--It is strongly recommended that large tree removal work be performed by specialized crews, comprised of workers experienced in tree removal techniques and the use of all tools common to the trade. These specialized crews should be adequately covered by liability insurance.

When removing trees, stumps should be cut as low as possible. In no case may tree stumps extend more than 6 inches above the ground line. Any stump which constitutes a hazard to traffic or to road maintenance equipment should be clearly marked until such time as it can be removed to a point below the ground line.

Special consideration should be given to the removal of trees, especially evergreens, where shading impedes snow removal or creates icing conditions on the pavement.

Disposal of resulting brush--All timber and brush should be removed from the right-of-way. Adjacent owners have "first choice" on all wood taken from trees. In most rural areas, especially where the wood will be removed by these adjacent property owners, the timber should be cut into lengths less than 2 feet only when it can be justified as the least expensive method of disposal.

When permission is obtained from adjacent property owners to pile brush, the piles should be neat and out of view of the traveling public. Brush burning may be performed only where local ordinances and weather conditions permit, and then at a safe distance from wooded slope areas. One person should be assigned to the burning operation at all times to keep the fire under control. All brush not piled should be chipped and, where permission can be obtained, the chips should be scattered on the site. Chips not scattered should be disposed of at approved dump sites.

Herbicide applications--Selective herbicide applications may be used to minimize mowing and control woody vegetation in areas where the height of herbaceous

vegetation (up to 4-6 feet in late summer) can be tolerated. Selective herbicide applications can be used to control individual stems or small groups of plants with little or no effect to untreated vegetation.

Herbicidal control of vegetative growth must be used with care to prevent damage to desirable plants. Herbicides should be used only on a selective basis, and only where treatment is most appropriate (see statement by Department of Natural Resources). Urban and built-up areas should not be considered for general treatment. Because the public is particularly sensitive to the use of herbicides, even though their use plays an important role in an overall maintenance program, an information program, explaining the use of herbicides and expected results and safety precautions, may be implemented (see Chapter 9).

Selective foliage application--Selective foliage application is done from either the ground or the air. On the ground, high pressure pumps and spray guns throughly wet all foliage and stems on the target plants. Aerial application can give good coverage, but not enough spray penetrates lower portions of the plant and understory plants. Selective foliage applications can be used to control growth or noxious weeds in grassy or other areas where desirable growth will not be adversely affected. Treatment must be done during the growing season and full-leaf development period. In Michigan, selective foliage applications can be made only during periods of active plant growth--from the time when full leaf growth has developed until mid-August.

Unsightly "brown-out" (dead brush) increases as the height and density of the brush increases. One method to eliminate brown-out is to cut all brush over 5 feet tall and spray the stumps.

Selective basal application--This method involves wetting stems from about knee level to the ground or root collar zones. Exposed roots should also be treated. Selective basal applications can be used where undesirable woody growth exists in close proximity to desirable species. This treatment can be applied at any time of the year when stems are dry.

Cut and stump spraying--Spraying and brushing the exposed wood of freshly cut stumps with herbicide can prevent sprouting. It is an effective and economical method of preventing regrowth from cut stumps. This treatment may be applied at any time of the year.

3 INTEGRATING THE BRUSH AND TREE MAINTENANCE PROGRAMS INTO THE OVERALL MAINTENANCE SCHEDULE

The maintenance techniques outlined in this chapter are the basic techniques already utilized by maintenance units throughout the State. These techniques are thus suitable for all areas, not just areas where trees have been removed.

By adding the higher risk roadside sections that have been treated to the regular maintenance schedule, the need for special crews and equipment will be eliminated and the cost of the additional maintenance requirements effectively contained. Knowledge of higher risk roadside sections may also enable crew members to better understand the purposes and design behind the right-of-way maintenance program.

Treatment Programs And Public Relations

Public relations is the planned effort to influence opinion through good character and responsible performance, based upon mutually satisfactory two-way communication. [1]

Let's break that down. Public relations is a planned effort. It's deliberate and it's well-organized. The goal of public relations is to influence opinion, to convince someone of something. How do you influence people? Through good character and responsible performance. You give them all the facts; you do your job. Public relations must be mutually satisfying--both parties must get something out of the deal. Public relations is two-way communication--you listen and you learn.

Every direct contact your agency or personnel from your agency has with the public is public relations. Field interviews, permission-to-apply-treatment letters, public hearings, litigation--all of these activities have at their core public relations. Like it or not, you're in the public relations business.

Whether the potential impacts of your hazardous tree removal program are major or minor, long-term or short-term, the choices being made affect people. Participation is their opportunity to help determine what tradeoff among alternatives should be made.

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[1] Scott M. Cutlip and Allen H. Center. Effective Public Relations. 5th Edition. Englewood Cliffs, NJ, 1978

1 FIELD INTERVIEWS

The community is an important source of information for you. What better way to find out whether a certain tree is dangerous than to ask the people who live near it? During Task 2 of the step-by-step procedure outlined in Chapter 3 you are instructed to do just that.

Your interview during the field verification process is public relations. Here are some guidelines to follow:

1. Introduce yourself and show your county identification card.
2. Briefly explain what you are doing and what you want them to do: "We're verifying the risk of accidents associated with trees along roads in this area. We'd like you to confirm our information since you have more direct knowledge of this area."
3. Ask about trees that have been singled out as being dangerous because they bear accident scars, were identified on an accident report, etc. "We found some scars on these trees that indicate they've been hit by a vehicle. Is that true? Are there any other trees in this area that you know are dangerous?"
   Point to the trees as you ask about them.
4. Ask about the conditions that may necessitate a treatment other than removal; e.g., big trees, historic trees, sedimentation/erosion or safety problems; presence of wetlands/streams/ rivers, endangered/ threatened or rare species.
5. Ask if there are any other factors you should know about, for instance, particular cultural importance of area, etc.
6. Ask them what THEY think should be done to reduce the risk of run-off-road accidents.
7. Make sure you get the person's name, address, and phone number.
8. Thank them and tell them that they may be contacted again regarding treatment of dangerous trees on their property or on adjacent property.

2 PERMISSION-TO-APPLY-TREATMENT LETTERS

Before proceeding with any hazard reduction program, you must contact the owner(s) of the property on which the hazard tree resides as well as adjacent property owners.

For on-ROW locations, reasonable notice is required before the treatment may be initiated (see sample letter A). You must give the owner notice and a reasonable opportunity to alleviate the hazard himself; or he may sign off immediately and you can perform the treatment. At the end of the notice period, you may perform the treatment yourself, unless the owner has indicated that he disapproves of the proposed treatment, in which case further negotiations are in order. For on-ROW locations, then, permission to perform the necessary treatment is not required; the ROW belongs to the public. Notice of the proposed treatment is required. To maintain a climate of cooperation, it is recommended that you seek signed permission from the landowner(s) and adjacent property owners to perform the treatment.

For off-ROW locations, you must have permission to perform the hazard reduction treatment. In this case, also, the owner has the option of performing the necessary treatment himself. Or, if he gives you permission, you can go ahead and perform the treatment. If the owner refuses to give you permission to perform the recommended treatment, you must return to Task 5 of the step-by-step procedure outlined in Chapter 4 and determine if an alternative treatment would be appropriate. If so, inform the owner by mail of the intended alternate treatment and perform that treatment if you receive permission. If no alternative treatment is appropriate, you may have to enter litigation to permit the treatment to be performed.

3 PUBLIC HEARINGS

For many Federal projects, public hearings are required by law; some states also have hearing requirements. Consequently, you will be holding some hearings. You may choose to hold additional hearings.

Formal hearings are not a method of mutually satisfying two-way communication. Communication is typically limited to brief question and answer periods and to making statements. Many people are uncomfortable because of the size of the meeting or its formality and will not speak out or will not even attend.

Public hearings are a chance for people to make their views known; a chance for people to hear the views of others expressed and explained.

Legally, your agency must announce the hearing in some way (usually via newspaper) and notify by mail every group or individual that it has reason to believe is interested. The agency should make sure that the public is well informed about the issues weeks in advance so that concerned groups and individuals have adequate time to prepare their presentations.

Prior to the hearing, any information should be made available to the public for their review, usually at the agency office or at city or county hall. If a draft environmental impact statement is required, it must be circulated prior to the hearing.

In essence, you are organizing an information campaign aimed at educating the public about your hazard reduction program. Basically, the methods you can use include:

Newspaper--Use the local papers. Try to get the newspapers to write about the issues as part of their community coverage. If the papers are uninterested, as a last resort, you should run large paid advertisements announcing the time, date, and location of the hearing.

Displays--Understanding of issues is increased by using concrete examples. Make every effort to familiarize the public with the issues through displays in municipal buildings, schools, etc.

Brochures--Short, printed pieces on specific issues should also be available for the asking from the agency. These brief, simple brochures should detail the problems of tree/vehicle accidents and efforts underway to reduce risk.

Posters, billboards, signs--To use these media, your message must be short; a graphic representation of the message is even more appropriate. These posters and signs should be placed anywhere there are people--on buses, in grocery stores, at the laundromat.

News releases-Periodically your agency should report to the public about the progress of the program. A news release should be short and factual; the first two paragraphs should contain the who, what, where, when, and why of your message. Since a news release is used to announce something that has occurred or will occur, it should be written in past or future tense. Any statement of opinion must be attributed to a real person and should be put in quotation marks. News releases should be sent to the city editor of the local papers, radio and television stations at least 10 days to 2 weeks before the event being announced will occur.

Letters to the Editor--Almost everyone reads this section of the newspaper. Your agency may wish to write letters to the editor announcing the program or explaining a specific point of the program. Letters to the editor give you an opportunity to explain exactly those items you wish to deal with in an informal way, from your agency's point of view.

Existing community programs--Perhaps the most important method to use to get your message out is programs that already exist in your community. Most organizations have regular meetings. Ask if they would like someone from your office to come and speak to them and answer their questions about the program (make sure you send a representative who is a good speaker and knowledgeable about the program; prepare a slide show and bring along brochures). Distribute informational material through their office. Ask if you can put a notice or an article in their newsletter.

Evaluating Your Information Program

How do you determine whether you reached the people you wished to reach? You should keep track of whether or not your news releases were used (often as a basis for a story or even word-for-word). If they're not, ask the editor why. Or you could count heads at the hearing; but this method won't tell you whether all the interests of the public were represented. To determine whether your information program was successful, you should ask yourself:

1. Were all the people affected by the program allowed an equal opportunity to participate?
2. Were their contributions and preferences given due consideration?

4 LITIGATION

Occasionally the agency and the property owners involved will not be able to come to a satisfactory agreement on the hazard reduction treatment to be applied. After reconsidering all possible alternatives and having all alternatives proposed to the property owners rejected, you may have to go to court and get a court order to perform the recommended treatment. There are two ways this might be accomplished. First, the power of eminent domain (condemnation) might be used. To have the tree(s) condemned, you will have to produce expert witnesses who can explain the hazard involved in retaining the tree(s). Secondly, you might claim the tree(s) to be a public nuisance and sue to require the owner to "abate the nuisance" by removing the tree(s) or performing the treatment recommended. There is a precedent that trees are a nuisance when they "endanger the safety of travelers"[2] (39 Am Jur. 2d Highways, Streets and Bridges 300).

Going to court cannot be taken lightly. This is a last resort when your agency truly believes that the recommended treatment is the only way to insure the safety of the property owners and travelers. Coupled with the use of litigation should be an information campaign explaining the decision to go to court, a public hearing if appropriate, and door-to-door direct contact with citizens if at all possible.

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[2] 39 Am Jur. 2d Highways, Streets and Bridges 300.

Appendices

APPENDIX A THE SIXTEEN GENERIC ROADSIDE ENVIRONMENTS

In the pages that follow, the generic roadside environment types are pictured and described according to the characteristics defined in Section 1. With the exception of the first two generic types--Interstate/Straight and Interstate/Curve--each roadside environment is described individually. Generic roadside environments 1 and 2 are described together. The other 14 generic roadside environments described in the following pages are:

- Trunkline/Curve
- Trunkline/Straight/Urban & Built-up
- Trunkline/Straight/Forest
- Trunkline/Straight/Other
- County/Curve/Urban & Built-up
- County/Curve/Agriculture
- County/Curve/Forest
- County/Curve/Other
- County/Straight/Urban & Built-up
- County/Straight/Agriculture
- County/Straight/Forest
- County/Straight/Other
- City/Straight
- City/Curve

Following each description is a short listing of the characteristics of the roadway and off-roadway environments that may be altered to alleviate tree/vehicle accident risk.

GENERIC ROADSIDE ENVIRONMENT 1: INTERSTATE/STRAIGHT
GENERIC ROADSIDE ENVIRONMENT 2: INTERSTATE/CURVE

These generic roadside environments are Federally-funded, limited access divided highways with four to eight lanes. There is a higher risk of tree/vehicle accidents along Interstate/Curve road sections than along Interstate/Tangent sections.

Figure A1 Scene showing typical Generic Roadside Environment 1-Interstate/curve

Figure A2 Scene showing typical Generic Roadside Environment 2-Interstate/straight

Roadway Environment

Road class--4-lane/2-way divided

Lane width--12 feet

Surface--Paved

Maintenance condition--Good

Horizontal alignment--Straight away

Vertical alignment--Level

Gradient--1-2%

Horizontal alignment for 1/2 mile approach--Straight

Vertical alignment for 1/2 mile approach--Level

Shoulder surface--Paved

Shoulder maintenance condition--Stable

Shoulder width--8 feet

Roadway terminated by curbing--No

Roadway segment accident site--Straight section

ADT--20,001 to 90,000

Night illumination--No

Centerline--No

Edge line--Yes

Arrow indicating curve/intersection--No

Warning sign--No

Information sign--No

Ditch/trough--Yes

Embankment/up-slope--Yes

Embankment/down-slope--No

Terrain condition--Other; embankment down-slope

Off-roadway Environment: 5-40 Feet beyond Roadway

Terrain condition--Ditch/trough

Previous damage indications--None

Tree density--Part of adjacent woodlot

Off-roadway Environment: Within 1/2 Mile of Roadway

Topography--Gently sloping

Land cover--Woodlots

Development patterns--Undeveloped

Middleground view existing--No

Land use adjacent to site--Broadleaved forest

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Night illumination

Ditch/trough

Arrow indicating curve/intersection

Warning sign

Information sign

GENERIC ROADSIDE ENVIRONMENT 3: TRUNKLINE/CURVE

This generic roadside environment is a State-funded, limited to partial access highway with two to four lanes and curves. Most examples of this roadside environment are located in suburban and outlying regions of the State.

Figure A3 Scene showing typical Generic Roadside Environemnt 3-Trunkline/curve

Roadway Environment

Road class--2-lane/2-way

Cross-section--Super-elevated

Surface--Paved

Maintenance condition--Good

Horizontal alignment--Curved left

Vertical alignment--Level

Gradient--1-2%

Vertical alignment for 1/2 mile approach--Level

Shoulder surface--Gravel

Shoulder maintenance condition--Stable

Shoulder width--8 feet

Roadway terminated by curbing--No

Roadway segment accident site--Curved section

Night illumination--No

Centerline--Yes

Edge line--Yes

Arrow indicating curve/intersection--Yes

Warning sign--No

Information sign--No

Ditch/trough--No

Embankment/up-slope--No

Embankment/down-slope--Yes

Off-roadway Environment: 5-40 Feet beyond Roadway

Tree origin--Natural

Off-roadway Environment: Within 1/2 Mile of Roadway

Middleground view existing--Yes

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Night illumination

Warning sign

Information sign

Embankment/down-slope

GENERIC ROADSIDE ENVIRONMENT 4: TRUNKLINE/STRAIGHT/URBAN & BUILT-UP

This generic roadside environment is a straight section of a State-funded, limited to partial access highway with two to four lanes. Straight trunkline road sections in urban or built-up areas are considered intermediate in potential tree/vehicle accident risk.

Figure A4 Scene showing typical Generic Roadside Environment 4- Trunkline/straight/urban & built-up

Roadway Environment

Lane width--12 feet

Cross-section--Level

Surface--Paved

Maintenance condition--Good

Horizontal alignment--Straight away

Vertical alignment--Level

Gradient--1-2%

Horizontal alignment for 1/2 mile approach--Straight

Vertical alignment for 1/2 mile approach--Level

Shoulder surface--Gravel

Shoulder maintenance condition--Stable

Roadway terminated by curbing--No

Roadway segment accident site--Straight section

Edge line--Yes

Arrow indicating curve/intersection--No

Warning sign--No

Ditch/trough--No

Embankment/up-slope--No

Embankment/down-slope--No

Off-roadway Environment: 5-40 Feet beyond Roadway

Previous damage indications--None

Off-roadway Environment: Within 1/2 Mile of Roadway

Middleground view existing--No

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Arrow indicating curve/intersection

Warning sign

GENERIC ROADSIDE ENVIRONMENT 5: TRUNKLINE/STRAIGHT/FOREST

This roadside environment type is a State-funded, limited to partial access highway with two to four lanes located in sections of broadleaf, coniferous, or mixed forests. Straight trunkline sections carry an intermediate tree/vehicle accident risk.

Figure A5 Scene showing typical Generic Roadside Environment 5-Trunkline/straight/forest

Roadway Environment

Road class--2/lane/2-way

Cross-section--Level

Surface--Paved

Maintenance condition--Good

Horizontal alignment--Straight away

Vertical alignment--Level

Gradient--1-2%

Horizontal alignment for 1/2 mile approach--Straight

Vertical alignment for 1/2 mile approach--Level

Shoulder surface--Gravel

Shoulder maintenance condition--Stable

Shoulder width--8 feet

Roadway terminated by curbing--No

Roadway segment accident site--Straight section

Night illumination--No

Centerline--Yes

Edge line--Yes

Arrow indicating curve/intersection--No

Warning sign--No

Information sign--No

Embankment/up-slope--No

Vertical profile--Fill slope (-)

Off-roadway Environment: 5-40 Feet beyond Roadway

Tree density--Part of adjacent woodlot

Tree origin--Natural

Right-of-way maintenance--Natural free growth

Nearby trees which evidence vehicle accident damage--None

Off-roadway Environment: Within 1/2 Mile of Roadway

Land cover--Woodlots

Middleground view existing--Yes

Land use adjacent to site--Broadleaved forest

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Night illumination

Arrow indicating curve/intersection

Warning sign

Information sign

Off-roadway--Right-of-way maintenance

GENERIC ROADSIDE ENVIRONMENT 6: TRUNKLINE/STRAIGHT/OTHER

This straight, State-funded, limited to partial access highway with two to four lanes is located in an area whose primary land use is agriculture, rangeland, water or wetland.

Figure A6 Scene showing typical Generic Roadside Environment 6-Trunkline/straight/other (agriculture, rangeland, water or wetland)

Roadway Environment

Road class--2/lane/2-way

Lane width--11 feet

Cross-section--Level

Surface--Paved

Maintenance condition--Good

Horizontal alignment--Straight away

Vertical alignment--Level

Horizontal alignment for 1/2 mile approach--Straight

Vertical alignment for 1/2 mile approach--Level

Shoulder surface--Gravel

Shoulder maintenance condition--Stable

Shoulder width--8 feet

Roadway terminated by curbing--No

Roadway segment accident site--Straight section

ADT--5001 to 10,000

Night illumination--No

Centerline--Yes

Edge line--Yes

Arrow indicating curve/intersection--No

Warning sign--No

Information sign--No

Ditch/trough--No

Embankment/up-slope--No

Embankment/down-slope--No

Terrain condition--Field, grass

Off-roadway Environment: 5-40 Feet beyond Roadway

Vertical profile--Fill slope/steep (4-10')

Previous damage indication--None

Tree density--One of a row

Tree origin--Natural

Nearby trees which evidence vehicle accident damage--Yes

Off-roadway Environment: Within 1/2 Mile of Roadway

Topography--Nearly level

Middleground view existing--Yes

Most prominent land use in 1/2 mile radius--Cropland, rotation & permanent pastur

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Night illumination
Arrow indicating curve/intersection
Warning sign
Information sign

GENERIC ROADSIDE ENVIRONMENT 7: COUNTY/CURVE/URBAN & BUILT-UP

This generic roadside environment consists of curved county or township roads with partial to full access. These rural roads are paved or non-paved, two-lane, and locally maintained. In 1976, curving county/urban & built-up county, town, and township road sections were the site of over 12.3 percent of all tree-related vehicle fatalities.

Figure A7 Scene showing typical Generic Roadside Environment 7-County/curve/urban & built-up

Roadway Environment

Road class--2-lane/2-way

Cross-section--Super-elevated

Surface--Paved

Maintenance condition--Good

Gradient--1-2%

Shoulder maintenance condition--Stable

Roadway terminated by curbing--No

Roadway segment accident site--Curved section

Night illumination--No

Centerline--Yes

Arrow indicating curve/intersection--Yes

Warning sign--No

Information sign--No

Ditch/trough--No

Embankment/up-slope--No

Off-roadway Environment: 5-40 Feet beyond Roadway

Tree origin--Natural

Off-roadway Environment: Within 1/2 Mile of Roadway

Topography--Gently sloping

Land cover--Woodlots

Middleground existing view--No

Characteristics That Might BE Altered to Alleviate Risk

Roadway--Night illumination
Warning sign
Information sign

Off-roadway--Middleground existing view

GENERIC ROADSIDE ENVIRONMENT 8: COUNTY/CURVE/AGRICULTURE

This generic roadside environment consists of curved county or township roads in outlying agricultural regions with partial to full access. These rural roads are paved or non-paved, two-lane, and locally maintained. In 1976, five percent of all fatal tree/vehicle accidents occurred along curving county roads crossing agricultural areas.

Figure A8 Scene showing typical Generic Roadside Environment 8-County/curve/agriculture

Roadway Environment

Road class-2-lane/2-way

Lane width--11 feet

Surface--Paved

Maintenance condition--Good

Gradient--1-2%

Vertical alignment for 1/2 mile approach--Level

Roadway terminated by curbing--No

Roadway segment accident site--Curved section

ADT--751 to 2000

Night illumination--No

Centerline--Yes

Edge line--Yes

Arrow indicating curve/intersection--Yes

Warning sign--No

Information sign--No

Ditch/trough--Yes

Embankment/up-slope--No

Embankment/down-slope--No

Off-roadway Environment: 5-40 Feet beyond Roadway

Vertical profile--Level

Previous damage indications--None

Off-roadway Environment: Within 1/2 Mile from Roadway

Land use adjacent to site--Cropland, and permanent pasture

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Night illumination

Warning sign

Information sign

Ditch/trough

GENERIC ROADSIDE ENVIRONMENT 9: COUNTY/CURVE/FOREST

This generic roadside environment consists of a curved county or township road that runs through sections of broadleaved forests. These rural roads are paved or non-paved, two-lane with partial to full access, and are locally maintained. In 1975, seven percent of the tree-related accident fatalities occurred along sections of this road.

Figure A9 Scene showing typical Generic Roadside Environment 9-County/curve/forest

Roadway Environment

Road class-2-lane/2-way

Surface--Paved

Maintenance condition--Good

Horizontal alignment--Curved left

Gradient--1-2%

Shoulder maintenance condition--Stable

Roadway terminated by curbing--No

Roadway segment accident site--Curved section

Centerline--Yes

Arrow indicating curve/intersection--Yes

Warning sign--No

Information sign--No

Ditch/trough--No

Embankment/up-slope--No

Off-roadway Environment: 5-40 Feet beyond Roadway

Tree density--Part of adjacent woodlot

Tree origin--Natural

Right-of-way maintenance--Natural free growth

Nearby trees which evidence vehicle accident damage--No

Off-roadway Environment: Within 1/2 Mile of Roadway

Middleground existing view--No

Land use adjacent to site--Broadleaved forest

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Warning sign
Information sign

Off-roadway--Right-of-way maintenance

GENERIC ROADSIDE ENVIRONMENT 10: COUNTY/CURVE/OTHER

This roadside environment is a curving section of a two-lane, paved or non-paved, locally maintained, county or township road with partial to full access. Most often found in rangeland and water and wetlands, this environment is classified as having low risk of potential tree/vehicle accidents.

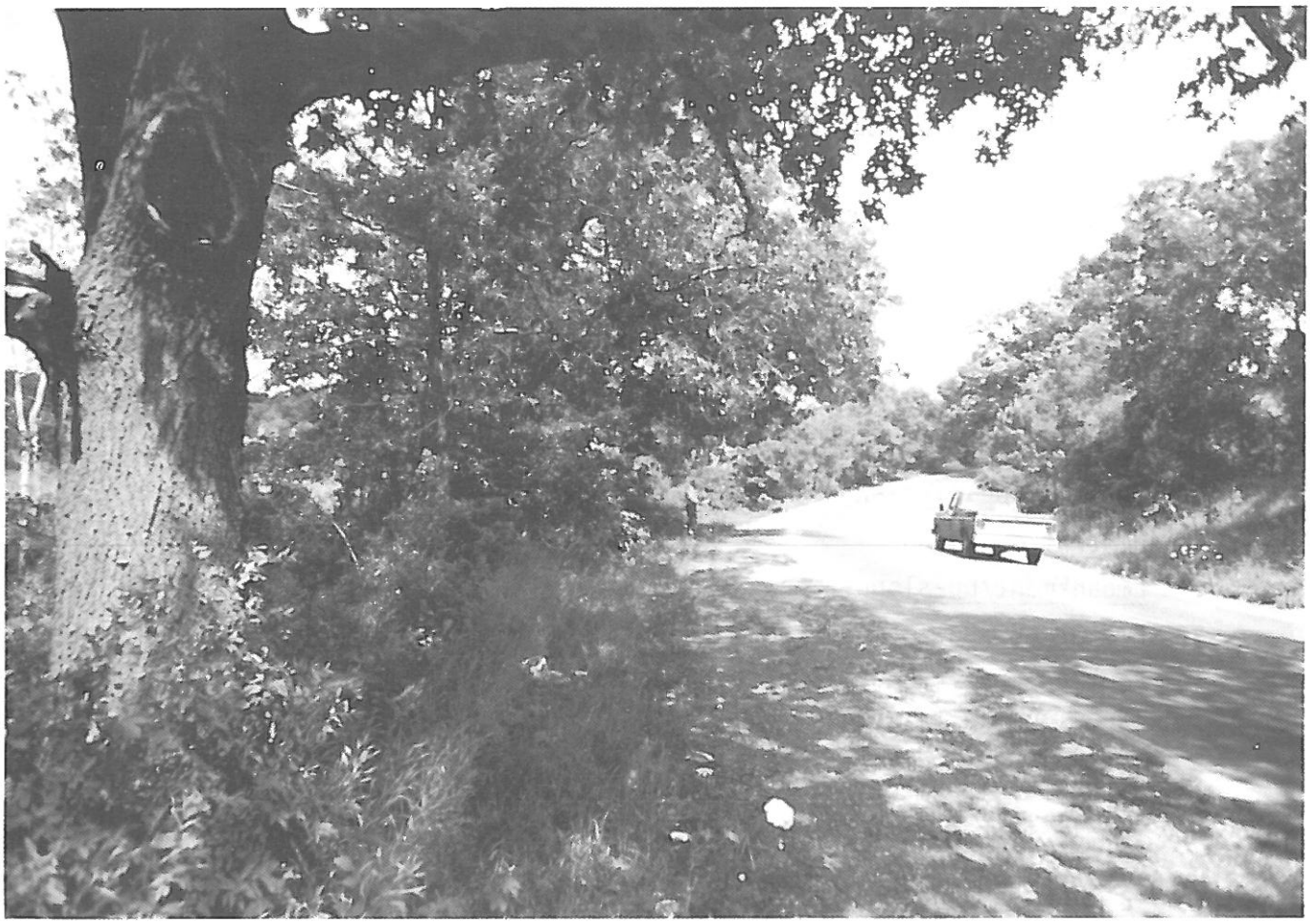

Figure A10 Scene showing typical Generic Roadside Environment 10-County/curve/other (rangeland or water and wetland)

Roadway Environment

Road class--2-lane/2-way

Lane width--9 feet

Cross-section--Super-elevated

Surface--Paved

Maintenance condition--Good

Horizontal alignment--Curved left

Vertical alignment--Dip

Gradient--2-4%

Horizontal alignment for 1/2 mile approach--Winding/S-curves

Vertical alignment for 1/2 mile approach--Rolling

Shoulder surface--Gravel

Shoulder maintenance condition--Unstable

Shoulder width--4 feet

Roadway terminated by curbing--No

Roadway segment accident site--Curved section

ADT--751 to 2000

Night illumination--No

Centerline--Yes

Edge line--Yes

Arrow indicating curve/intersection--Yes

Warning sign--Yes

Information sign--No

Ditch/trough--No

Embankment/up-slope--No

Embankment/down-slope--No

Vertical profile--Fill slope (-)/shallow

Terrain condition--Field, weeds

Off-roadway Environment: 5-40 Feet beyond Roadway

Vertical profile--Fill slope/medium

Terrain condition--Brushes/underbrush

Previous damage indications--None

Tree density--One of a row

Tree origin--Natural

Right-of-way maintenance--Natural free growth

Nearby trees which evidence vehicle accident damage--Yes

Off-roadway Environment: Within 1/2 Mile of Roadway

Topography--Moderately to strongly sloping

Land cover--Wooded with openings

Development patterns--Scattered suburbs

Middleground view existing--Yes

Land use adjacent to site--Non-forested wetlands

Most prominent land use in 1/2 mile radius--Non-forested wetlands

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Vertical alignment

Shoulder maintenance condition

Night illumination

Information sign

Off-roadway--Vertical profile

Terrain condition

Right-of-way maintenance

GENERIC ROADSIDE ENVIRONMENT 11: COUNTY/STRAIGHT/URBAN & BUILT-UP

This roadside environment is a straight section of a two-lane, paved or non-paved, locally maintained, county or township road with partial to full access. Among straight road sections, this type is rated second highest in potential tree/vehicle accident risk; 20 of 154 accident fatalities in 1976 occurred on straight county local roads traversing urban/built-up areas.

Figure A11 Scene showing typical Generic Roadside Environment 11-County/straight/urban & built-up

Roadway Environment

Road class--2-lane/2-way

Cross-section--Level

Surface--Paved

Maintenance condition--Good

Horizontal alignment--Straight away

Gradient--1-2%

Horizontal alignment for 1/2 mile approach--Straight

Shoulder maintenance condition--Stable

Roadway terminated by curbing--No

Night illumination--No

Centerline--Yes

Information sign--No

Ditch/trough--No

Embankment/up-slope--No

Embankment/down-slope--No

Off-roadway Environment: 5-40 Feet beyond Roadway

Terrain condition--Lawn

Previous damage indications--None

Nearby trees which evidence vehicle accident damage--No

Off-roadway Environment: Within 1/2 Mile of Roadway

Middleground existing view--No

Land use adjacent to site--Residential

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Night illumination

Information sign

GENERIC ROADSIDE ENVIRONMENT 12: COUNTY/STRAIGHT/AGRICULTURE

Traversing agricultural land, this generic roadside environment consists of partial to full access, paved or non-paved, two-lane, locally maintained county or township roads. Straight county road sections in agricultural areas have the highest incidence of tree-related accidents associated with them--13.6 percent of the fatal tree/vehicle accidents.

Figure A12 Scene showing typical Generic Roadside Environment 12-County/straight/agriculture

Roadway Environment

Road class--2-lane/2-way

Cross-section--Level

Surface--Paved

Maintenance condition--Good

Horizontal alignment--Straight away

Gradient--1-2%

Horizontal alignment for 1/2 mile approach--Straight

Shoulder maintenance condition--Stable

Shoulder width--4 feet

Roadway terminated by curbing--No

Roadway segment accident site--Straight section

Night illumination--No

Centerline--Yes

Arrow indicating curve/intersection--No

Warning sign--No

Information sign--No

Embankment/up-slope--No

Embankment/down-slope--No

Off-roadway Environment: 5-40 Feet beyond Roadway

Vertical profile--Level

Right-of-way maintenance--Natural free growth

Nearby trees which evidence vehicle accident damage--None

Off-roadway Environment: Within 1/2 Mile of Roadway

Development patterns--Farmstead

Middleground view existing: Yes

Land use adjacent to site--Cropland, rotation and permanent pasture

Most prominent land use in 1/2 mile radius--Cropland, rotation & permanent pasture

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Night illumination
Arrow indicating curve/intersection
Warning sign
Information sign

Off-roadway--Right-of-way maintenance

GENERIC ROADSIDE ENVIRONMENT 13: COUNTY/STRAIGHT/FOREST

This generic roadside environment consists of partial to full access, paved or non-paved, two-lane, locally maintained county or township roads that traverse broadleaved forested areas. In 1975, over 10% of all fatal tree/vehicle accidents occurred along straight county roads through forested areas.

Figure A13 Scene showing typical Generic Roadside Environment 13-County/straight/forest

Roadway Environment

Road class--2-lane/2-way

Cross-section--Level

Horizontal alignment--Straight away

Vertical alignment--Level

Gradient--2-4%

Roadway terminated by curbing--No

Roadway segment accident site--Straight section

ADT--0 to 750

Night illumination--No

Edge line--No

Arrow indicating curve/intersection--No

Warning sign--No

Information sign--No

Embankment/up-slope--No

Embankment/down-slope--No

Off-roadway Environment: 5-40 Feet beyond Roadway

Previous damage indication--None

Tree density--Part of adjacent woodlot

Tree origin--Natural

Right-of-way maintenance--Natural free growth

Off-roadway Environment: Within 1/2 Mile of the Roadway

Middleground view existing--No

Land use adjacent to site--Broadleaved forest

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Night illumination
Edge line
Arrow indicating curve/intersection
Warning sign
Information sign

Off-roadway--Right-of-way maintenance

GENERIC ROADSIDE ENVIRONMENT 14: COUNTY/STRAIGHT/OTHER

This generic roadside environment consists of partial to full access, paved or non-paved, two-lane, locally maintained county or township roads that cross rangelands, water, or wetlands. A low potential risk of tree/vehicle accidents is associated with this generic type.

Figure A14 Scene showing typical Generic Roadside Environment 14-County/straight/other (rangeland, water or wetland)

Roadway Environment

Road class--2-lane/2-way

Lane width--9 feet

Surface--Unpaved

Maintenance condition--Good

Horizontal alignment--Straight away

Vertical alignment--Other

Gradient--2-4%

Horizontal alignment for 1/2 mile approach--Straight

Vertical alignment for 1/2 mile approach--Rolling

Shoulder surface--Gravel

Shoulder maintenance condition--Stable

Shoulder width--2 feet

Roadway terminated by curbing--No

Roadway segment accident site--Straight section

ADT--0 to 750

Night illumination--No

Centerline--No

Edge line--No

Arrow indicating curve/intersection--No

Warning sign--No

Information sign--No

Ditch/trough--No

Embankment/up-slope--No

Embankment/down-slope--No

Vertical profile--Fill slope/medium

Terrain condition--Field, weeds

Off-roadway Environment: 5-40 Feet beyond Roadway

Vertical profile--Fill slope/medium

Terrain condition--Field, weeds

Previous damage indications--None

Tree density--Lone tree

Tree origin--Natural

Right-of-way maintenance--Natural free growth

Nearby trees which evidence vehicle accident damage--No

Off-roadway Environment: Within 1/2 Mile of Roadway

Topography--Moderately to strongly sloping

Development patterns--Farmstead

Land use adjacent to site--Herbaceous rangeland

Most prominent land use in 1/2 mile radius--Open and other

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Night illumination

Centerline

Edge line

Arrow indicating curve/intersection

Warning sign

Information sign

Off-roadway--Vertical profile

GENERIC ROADSIDE ENVIRONMENT 15: CITY/STRAIGHT

Any straight roadways that pass through city limits belong to this generic roadside type. Though significantly safer overall than the other roadside environments, straight city streets are the site of more than twice the number of fatal and non-fatal tree/vehicle accidents than curving city streets.

Figure A15 Scene showing typical Generic Roadside Environment 15-City/straight

Roadway Environment

Surface--Paved

Maintenance condition--Good

Horizontal alignment--Straight away

Vertical alignment--Level

Gradient--1-2%

Horizontal alignment for 1/2 mile approach--Straight

Vertical alignment for 1/2 mile approach--Level

Shoulder surface--No shoulder

Roadway terminated by curbing--Yes

Night illumination--Yes

Edge line--No

Arrow indicating curve/intersection--No

Warning sign--No

Information sign--No

Ditch/trough--No

Embankment/up-slope--No

Embankment/down-slope--No

Off-roadway Environment: 5-40 Feet beyond Roadway

Vertical profile--Level

Off-roadway Environment: Within 1/2 Mile of Roadway

Topography--Nearly level

Land cover--Scattered trees

Middleground view existing--No

Land use adjacent to site--Residential

Characteristics That Might Be Altered to Alleviate Risk

Roadway--Centerline
Edge line
Arrow indicating curve/intersection
Warning sign
Information sign

GENERIC ROADSIDE ENVIRONMENT 16: CITY/CURVE

Curved roadways that pass through city limits belong to this generic roadside type. This type is regarded as low in potential tree/vehicle accident risk. In 1975, only 6 of 154 fatalities occurred on curving city streets.

Figure A16 Scene showing typical Generic Roadside Environment 16-City/curve

Roadway Environment

Road class--2-lane/2-way

Cross-section--Level

Surface--Paved

Maintenance condition--Good

Horizontal alignment--Curved left

Gradient--1-2%

Horizontal alignment for 1/2 mile approach--Straight

Vertical alignment for 1/2 mile approach--Level

Shoulder maintenance condition--Stable

Roadway segment accident site--Curved section

Edge line--No

Arrow indicating curve/intersection--Yes

Warning sign--No

Information sign--No

Ditch/trough--No

Embankment/up-slope--No

Embankment/down-slope--No

Off-roadway Environment: 5-40 Feet Off Roadway

Previous damage indications--None

Off-roadway Environment: Within 1/2 Mile of Roadway

Middleground view existing--No

Most prominent land use in 1/2 mile radius--Residential

Characteristics That Might be Altered to Alleviate Risk

Roadway--Centerline

Edge line

Warning sign

Night illumination

Information sign

CHAPTER 6 TREATMENTS

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CHAPTER 7 MITIGATING ENVIRONMENTAL IMPACTS

Council of Tree and Landscape Appraisers. 1979. The Guide for Establishing Values of Trees and other Plants.

U.S. Forest Service, USDA. 1977. National Forest Landscape Management, Vol. 2 Chapter 4, Roads. U.S. Government Printing Office, 60 p.

APPENDIX C ADDITIONAL ASSISTANCE

PUBLIC AGENCIES AND ASSOCIATIONS

Environmental Protection; Permits and License . Michigan Department of Natural Resources, Environmental Enforcement Division, Bureau of Management Services, Lansing, MI.

River Management and Protection:

Michigan Department of Natural Resources, Division of Land Resource Programs, Natural Rivers Program Unit, Lansing

Soils:

Cooperative Extension Service, Michigan State University, East Lansing.

Cooperative Extension Service, County Director, (usually located in County Building)

Soil Conservation Service, Department of Agriculture, East Lansing

County Soil Conservation District

Soil Conservation Service District Conservationist, (usually located in County Building)

County Planning Commission

Michigan Department of Natural Resources, Land Resource Program Division, The Soil Erosion and Sedimentation Control Unit.

Water Resources

Michigan Department of Natural Resources, Lansing

Water Management Division

Water Quality Division

U.S. Geological Survey,Department of Interior, District Office in Okemos, Michigan. Sub-office at Escanaba. Field office in Grayling.

Cooperative Extension Service, Michigan State University, East Lansing.

County Planning Commission

Woodlot Management

Michigan Department of Natural Resources, Forest Management Division, Lansing - (can also provide list of District Offices and Area Foresters in the state.)

Cooperative Extension Service, Michigan State University, East Lansing.
County Soil Conservation Districts
Soil Conservation Service, Department of Agriculture, East Lansing.

Wildlife Habitat and Fisheries (Endangered/Threatened & Rare Species)

Michigan Department of Natural Resources, Wildlife Division, Lansing - (can also provide name of nearest District or Area Office)
Fisheries Division, Lansing - (can also provide name of nearest District or AREa Office)
U.S. Fish and Wildlife Service, Department of Interior, East Lansing

Historic Trees

Local, County Historic Commissions (usually in County Building) Michigan Forest Association, Traverse City, Michigan. (Members may be contacted through Michigan DNR Forest Management Division, District Offices, and area foresters)

Big Trees

Michigan Big Trees, Michigan Botanical club (members may be contacted through Michigan DNR, Forest Management division, district offices and area foresters.
National Big Trees, American Forestry Association, Washington, D.C.

Books and Publications

- Books and publications - books usually available at local libraries or college book stores.
- Michigan Soil & Sedimentation Control Guidebook, Division of Land Resource Programs, Department of Natural Resources, 1975.
- Council of Tree and Landscape Appraisers - 1979. The Guide for Establishing Values of Trees and other Plants.
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- "Permits and Licenses," Michigan Department of Natural Resources, Environmental Enforcement Division, Bureau of Management Services, June, 1979.

- "Natural Resource Laws Volume 1," Department of Natural Resources, Information and Education Division, Lansing.
- "Natural Resource Rules and Orders Volume II," Department of Natural Resources Information and Education Division, Lansing.

Note: If U.S. Government bulletins are not available at local SCS offices, they may be obtained from the U.S. Government Printing Office, Washington, D.C. for the price shown.

GLOSSARY

ACCIDENT INVOLVEMENT INDEX - is the ratio of the percentage of drivers in accidents to the percentage of vehicle miles driven.

ACCIDENT RATIO - is the ratio of the percentage of the total number of accidents to the percentage of total travel in any category of shoulder width and alignment.

ADJACENT PROPERTY OWNER - is the 1) legal owner(s) of property immediately adjacent to and on a line perpendicular with road row/easement and high risk accident tree(s) and/or 2) all legal property owner(s) within a tree height distance in any direction from high risk accident tree(s).

AVERAGE DAILY TRAFFIC (ADT) - the number of vehicles which pass a specific location during a 24 hour period.

BIG TREES - trees included in the National Register of Big Trees, trees designated as champion trees of Michigan, or trees of sufficient size that they meet the requirements for Big Trees status.

BITUMINOUS MATERIALS - paving material for resurfacing roads, more commonly known as asphalt.

CLEAR ZONES - higher risk roadside areas that should be kept clear of trees for safety.

COST-BENEFIT ANALYSIS - comparison of costs associated with specific action and the benefits derived from the action.

COUNTY ENGINEER - shall mean the county road or highway engineer, his equivalent, and/or designer who is responsible for that county's road maintenance, including all aspects of roadside tree maintenance, clearing and mowing operations.

CRITICAL HABITAT - is an area where alteration could result in damage to the environment of the area, where an organism and all of its life requirements can be found; the natural environment of a plant or animal.

CULTURAL RESOURCE - a manmade structure or object, below or above ground, which has value to man or his cultural heritage.

DANGER TREE - any tree adjacent to a road right-of-way/easement that could fall into or otherwise endanger the area or areas of the road.

ENDANGERED SPECIES - (as defined by Michigan endangered Species Act)
"A species of fish or wildlife, or plant life which is in danger of extinction throughout all or a significant part of its range."
The state list of "endangered" species will be those species listed by the Secretary of Interior as endangered and resident in any part of their life cycle

in Michigan. It will also include those indigenous species which the State of Michigan feels should be included on the national list of endangered species because they are on the verge of extinction. The definition refers to the worldwide status of a species. Also, it recognizes subspecies of fish or wildlife, or plant life, or lower taxa in a common spatial arrangement, that reproduce and represent a truly unique, identifiable form.

ENVIRONMENTAL IMPACT - any action, natural or manproduced, that alters or affects the natural environment

ENVIRONMENTAL IMPACT STATEMENT (EIS) - is a written analysis of the environmental aspects of any proposed policy, project, or program, that by virtue of its scope or complexity could cause a sizeable or serious impact on or alteration of the human and natural environment (of which man is an integral part), or could cause a significant alteration in the quality of human life.

EROSION - wearing away by the action of water, wind, or ice.

GORE AREA - a tapering or triangular piece of land located where a road forks (e.g. interstate exit).

HABITAT - the place or type of site where a plant or animal naturally or normally lives and grows.

HAZARD PROFILES - combinations of critical factors, both on-roadway and off-roadway conditions, which are associated with a high frequency of fatal tree accidents.

HIGH RISK ZONE - an area within which the combined probability of vehicle(s) running-off-road, hitting a tree, and of injury to occupants is equatable to an above average tree accident risk probability per year, for any 300" section of road.

HISTORIC TREES - trees of specific historical value or trees associated with historic properties that represent the heritage of a particular community, region, or the State of Michigan.

LANDMARK - a prominent or conspicuous object or distinguishing feature, marking a site or lacation.

LANDSCAPE CHARACTER - the qualities associated with area resulting from juxtapositioning of natural and manmade features, their visual and functional relationships.

LOW RISK ZONE - roadside area which does not represent a risk to run-off-road vehicles by its location or make-up.

NATURAL BEAUTY ROAD - a road having outstanding beauty or natural qualities which has been formally designated under Natural Beauty Road Act, P.A. 1970 No. 150.

NATURAL RIVER - means a river which has been designated by the Michigan Commission of Natural Resources for inclusion in the "Wild, Scenic and Recreational Rivers System."

NEGATIVE DECLARATION - documents the reasonableness of deciding not to file an environmental impact statement. It must discuss alternatives.

POWER OR EMINENT DOMAIN - the right of condemnation.

PROPERTY OWNER - is the legal owner of property.

PUBLIC NUISANCE - an annoying, unpleasant, or obnoxious thing or practice.

PUBLIC RELATIONS - the planned effort to influence opinion.

RARE OR SCARCE - (as defined by the Michigan Endangered Species Act)
A species or lower taxon that while not "endangered" or "threatened", is extremely uncommon in Michigan and deserves further study and monitoring. Peripheral species, not listed as "threatened" may be included in this category along with those species which were once "threatened" or "endangered" but now have increasing or protected, stable populations.

RIGHT-OF-WAY - the legally defined area within which the physical road, and maintenance jurisdiction and rights exist.

SCENIC DRIVE - a roadway which has been formally designated and posted as scenic generally provides for natural growth of vegetation along the roadside.

SEDIMENTATION - the process of forming or depositing matter (sediment) by water, wind or ice.

SPECIES - a group of individuals which is reproductively isolated from other groups of individuals under natural conditions.

THREATENED SPECIES - (as defined by the Michigan Endangered Species Act)
"A species which is likely to become an endangered species within the forseeable future throughout all or a significant portion of its range..."
The state list of "threatened" species include those species, and lower taxa as defined under endangered, that are threatened with extirpation in Michigan. For the purpose of state law, the Michigan range is considered significant except when the state portion of the range is considered to be peripheral. Peripheral species will not be listed as "threatened" unless their populations are also threatened in their primary range outside of Michigan. Species whose range is now reduced to a relatively few isolated populations that do not interbreed are included within this definition, as are species which were once extirpated, but are now in the process of becoming re-established through introductions.

TOPOGRAPHY - natural features of a place or region. The configuration of a surface including its relief and the position of its features.

WETLAND - land or areas containing wet and spongy soil, as a marsh, swamp or bog.

APPENDIX B REFERENCES

CHAPTER 2 ROADSIDE TREE RISKS

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