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16. Abstract The environmental risks associated with the use of seven herbicides and three insecticides comprising a portion of the Texas Department of Transportation's roadside pest management program were assessed. The materials were classified as EPA Category 3 or 4, signifying minimal toxicity. Although the chemicals used may pose a threat to environmental components in some situations, the manner in which they are used combined with the small roadside area treated mitigates the effects and treatment such that the risk is insignificant. This document contains recommendations including guidelines and mitigation measures for mechanical, chemical, cultural, and biological methods for TxDOT's use in developing an integrated pest management program.			
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**FINAL
ENVIRONMENTAL IMPACT STATEMENT:
ROADSIDE PEST MANAGEMENT PROGRAM,
VOLUME 1**

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Research Study Title: Environmental Concerns in Maintenance: A Proactive Initiative

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IMPLEMENTATION STATEMENT

This report is an assessment of the Roadside Pest Management Program for the Texas Department of Transportation (TxDOT) and its impacts on the environment in the vicinity of the highway corridor. The findings are used to evaluate five program alternatives formulated for the purpose of this study. The results from this study are expected to enhance TxDOT policies and procedures for systematically incorporating environmental concerns into the planning and operational phases of roadside maintenance.



DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes.

ACKNOWLEDGMENTS

This report and the attendant public hearings continue the scoping effort toward the development of a final Environmental Impact Statement concerning the Roadside Pest Management Program for the Texas Department of Transportation. The authors gratefully acknowledge the interest shown by and participation of individuals, citizens' groups, and government agencies who offered their appraisal of the impacts of roadside pest management on the environment. The input received to date has been invaluable in establishing research study parameters.

The Design Division of TxDOT furnished a list of individuals, groups, and agencies concerned with the impacts of highways on the environment.

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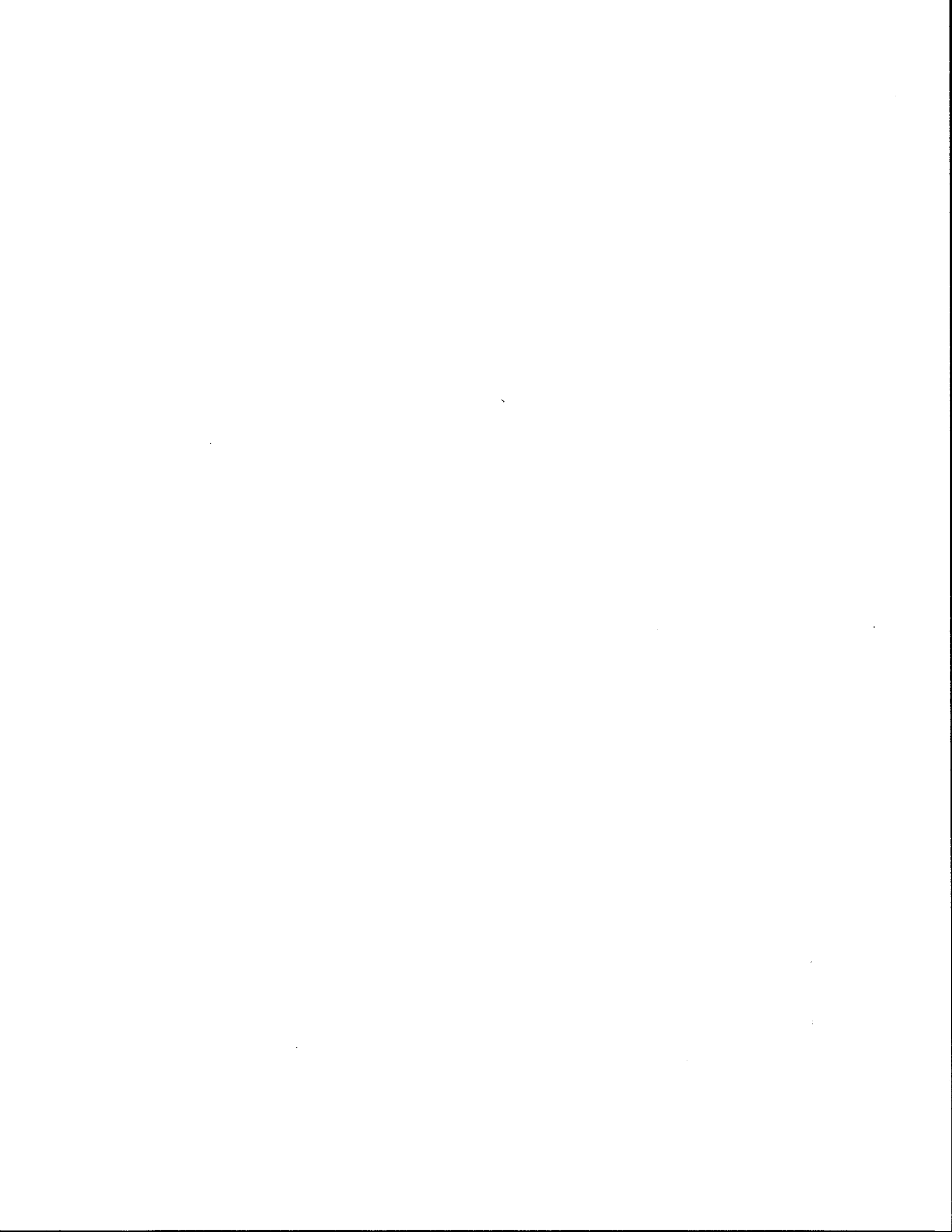
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List of Abbreviations

BMP - best management practice
Caltrans - California Department of Transportation
DEIS - draft environmental impact statement
EIS - environmental impact statement
EPA - Environmental Protection Agency
FEIS - final environmental impact statement
IMS - TxDOT's Insect Management System
IVM - integrated vegetation management
IPM - integrated pest management
MTO - mower-thrown object
MOU - memorandum of understanding
MSA - metropolitan statistical area
NPDES - National Pollutant Discharge Elimination System
PMP - TxDOT's pest management program
RMP - Roadside Management Plan
ROW - right-of-way
TDA - Texas Department of Agriculture
TPWD - Texas Parks and Wildlife Department
TWC - Texas Water Commission
TNRCC - Texas Natural Resource Conservation Commission
TTI - Texas Transportation Institute
TxDOT - Texas Department of Transportation
USFS - United States Forest Service
USFWS - United States Fish and Wildlife Service
VMS - TxDOT's Vegetation Management System
WSDOT - Washington State Department of Transportation



Summary

EIS
Pest Management Program



Summary

This draft environmental impact statement (DEIS) analyzes the impacts of several alternatives TxDOT is evaluating for managing pest plants and insects on roadsides. It also suggests alternatives to avoid or minimize adverse impacts. TxDOT is not required by state or federal regulations to conduct an EIS review of its pest management practices, but the Department felt a proactive review is in the best interests of the public and the environment. The National Environmental Policy Act (NEPA) used by federal agencies is standard and was used as a guide for preparing this DEIS.

Living organisms are considered as necessary components of a roadside ecosystem. For example, plants stabilize roadside soils against erosion, provide a visible boundary at the pavement edge, and offer a pleasant and colorful driving experience. Insects recycle plant residues, provide channels in the soil for aeration and water movement, and pollinate flowers. When plants and insects threaten the safety or comfort of the traveling public or TxDOT employees, jeopardize the capital investment in highway infrastructure, or endanger environmental quality (Executive Order 1-92, 1992), pest management procedures may be initiated. A major portion of TxDOT's Pest Management Program (PMP) consists of a Vegetation Management System (VMS); the other element of the PMP is an Insect Management System (IMS).

The PMP of TxDOT begins with organization of the roadside into distinct roadside management zones. These management zones are designated as active and passive zones (see Figure 1-1 in Chapter 1). The active zone (Zone 1) extends from the juncture of the main travelway and the shoulder (paved or unpaved) to the centerline of the drainage channel; the passive zone (Zone 2) continues to the limit of the ROW.

The treatments for pest management described in the DEIS include mechanical, chemical, cultural, and biological methods. These are initiated after the revegetation activities associated with highway construction are completed. Mechanical methods include the use of heavy machinery to mow, disk, cut brush, or perform any other similar activity involving machinery. They also include all manual treatment for vegetation control, such as hand weeding and the use of hand tools (powered or non-powered). Chemical methods involve the use of pesticides to manage roadside vegetation and insects. Cultural methods include the preparation and planting of areas with desirable species and other activities which would be expected to enhance soil productivity and promote more desirable plant communities. Often, such activities as mowing and application of herbicides may be used to promote the growth of desirable species and, technically, could be considered as cultural methods. However, delineation between chemical and mechanical methods for weed control and chemical

and mechanical treatments to enhance plant growth could be extremely difficult. For that reason, a narrower view of cultural methods is being used throughout this DEIS. Biological methods are limited to the use of a species-specific insect or disease. Biological treatments would be used when they would be appropriate under the constraints and restrictions of the selected pest management alternative.

The vegetation management alternatives offered for use by TxDOT include: Alternative A - No Action; Alternative B - Short-Term Remedial Action; Alternative C - No Chemical Approach; Alternative D - Current Practices; and Alternative E - Integrated Long-Term and Locally-Based Approach. See Section 0.4 for a discussion of these pest management alternatives. Also, definitions are included in Chapter 1, Section 1.1.3, and the Glossary.

The DEIS identifies specific pest management issues which require evaluation and analysis in greater depth. The changes suggested in this document and those resulting from other developments around TxDOT's pest management program could require additional funds and legislative support before they would be realized. It is important to note that these proposed changes could be considered a direct result of increasing public concern for environmental quality.

In accordance with NEPA, this programmatic (non-project) EIS identifies how each of the alternative pest treatment programs impacts the environment and then analyzes the alternatives.

0.1.0 Public Participation

0.1.1 Scoping Process

A major consideration in developing the scope of the EIS was to determine which of the issues would be of most concern to the public. A Notice of Intent was published in the *Texas Register* and Letters of Intent were mailed to individuals, government agencies, and groups known to have an interest in the interaction of highways and the environment. Comments were sent by mail to TxDOT headquarters in Austin. Responses and concerns expressed were considered in development of the information provided in this document.

0.1.2 Public Comment on the Draft EIS

This DEIS will be available for review and for oral and/or written comment. The schedule and locations of five public hearings will be given in the Notice of Availability announcement in the *Texas Register*. Signed, written comments may be delivered to the public hearing or mailed to one of these two addresses:

Vegetation Management Program
Texas Transportation Institute
The Texas A&M University System
College Station, Texas 77843-3135

Mr. Roy L. Smith
Vegetation Management Section
Construction and Maintenance Div.
Texas Department of Transportation
125 E. 11th Street
Austin, Texas 78701

Written comments must be received before 5:00 pm on the date specified in the Notice of Availability.

0.2.0 Affected Environment

The present methods of vegetation management used by TxDOT together with suggested alternatives were analyzed for potential impact on elements of the environment associated with highway ROWs. These elements include geology and soils, air quality, water quality, flood plains, wetlands, vegetation (including rare and endangered species), wildlife and wildlife habitat (including rare and endangered species and their habitat), visual quality, cultural resources, service areas, and human health. The impacts of the treatment methods and the alternatives were analyzed for each of these elements (Table 0-1). In addition, the impacts on these elements were discussed for ten separate vegetation regions in the state. These vegetation regions have been designated: Pineywoods; Gulf Prairies and Marshes; Post Oak Savannah; Blackland Prairies; Cross Timbers and Prairies; South Texas Plains; Edwards Plateau; Rolling Plains; High Plains; and Trans-Pecos. These regions are broad areas of relatively homogenous conditions in terms of geology and climate and result in similarly homogenous vegetation and wildlife communities (see Figure 3-1 in Chapter 3).

0.3.0 EIS Organization

Chapter 1 of this EIS discusses the purpose and need for the action, defines the treatment methods, reviews the history of the TxDOT pest management program and policies, and summarizes the results of the public scoping comments. Chapter 2 introduces and describes the alternatives. Chapter 3 presents the findings documented in Appendices A and B (Volumes 2 and 3) as a comparative analysis.

0.4.0 Alternatives

Alternative A: No Action

Objective: To eliminate management of ROW vegetation or insects along TxDOT-maintained highways.

Under Alternative A, no action would be taken to manage vegetation or insects in any portion of the highway corridor. Vegetation and insect infestations would grow uncontrolled, producing some of the following scenarios:

- Vegetation in the active zone could clog both parallel and cross-drainage systems.
- Vegetation tall enough to contact a catalytic converter could present a potential fire hazard to a vehicle and occupants.
- Uncontrolled vegetation could grow tall enough to restrict visibility of cross-traffic and create a potential hazard to the safety of road users.
- Deterioration of paved surfaces and edges could be accelerated, directly impacting the capital investment and the safety of motorists.
- Noxious weed infestations from seed produced on roadsides could impact the agricultural economy of the adjacent enterprise, the local area, and the entire state.
- Stinging, biting, and other noxious insects would be free to harass the traveling public and highway maintenance workers.

This alternative is offered for comparative purposes only and is not an option for the TxDOT program.

Alternative B: Short-Term Remedial Action Approach

Objective: To manage and control ROW vegetation or insect pests only after it has been determined that public or worker safety, function of the highway facility, or capital investment could be threatened. Treatment would be undertaken at the lowest available cost (labor, materials, and equipment) with an emphasis on worker productivity and immediate treatment results.

Under Alternative B, all methods would be available for use. No acreage would be treated using cultural methods, however, because of the length of time it takes to effect control. Biological methods would not be used unless predator insects were available

for Texas ROW conditions and pest species. Priority would be given to mechanical and chemical methods, as these methods generally provide immediate control of problem vegetation and insects.

Alternative C: No Chemical Approach

Objective: To manage roadside vegetation and insects without the use of chemicals.

Under Alternative C, no chemical herbicides or insecticides could be used for pest management, but other treatment methods (mechanical and cultural) would be available.

It is estimated that mechanical methods required under this alternative to meet management needs would be comprised of 65 percent mowing, 15 percent grading, and 20 percent manual treatment.

Alternative D: Current Practices

Objective: To continue the current vegetation and insect management practices as they are presently employed by TxDOT.

TxDOT vegetation and insect management practices are decentralized decisions carried out in the local maintenance sections. Treatment methods are selected based on situation-specific conditions and implemented by a local Maintenance Supervisor, and vary among districts depending on local policies and priorities. The District provides guidance to sections concerning budgeting and public concerns to be implemented with the limited labor available. TxDOT headquarters in Austin provides guidelines for decision strategies and specialized expertise upon request.

Prevention of pest problems is addressed through the establishment and maintenance of desirable vegetation. Treatments can be selected on the basis of observed infestations using some integrated pest management principles.

All control methods could be available for use under Alternative D. Preference is given to methods which provide the greatest benefit within the constraints of local priorities. The method and amount of treatment varies among districts.

See Chapter 1, Section 1.1.4, for a description of current TxDOT practices.

Alternative E: Integrated Long-Term and Locally-Based Approach

Objective: To integrate good environmental procedures and practice into the utilization of highway pest management activities along the ROW on a situation-specific basis,

using a strategy which would be expected to increase the competitive ability of desirable vegetation and hinder establishment of undesirable plants.

The ultimate aim of Alternative E is to implement documented strategies for long-term management of vegetation and insects based on prevention of problems and employment of minimal maintenance. Establishment of a stable, desirable vegetative cover requiring minimal maintenance is a primary focus. Selection of an appropriate control methodology for a given area of ROW should consider but not be limited to:

- Environmental concerns such as soil erosion, and impacts on humans and other organisms, wildlife habitat, and water quality.
- Safety considerations such as visibility of traffic and traffic control devices.
- Preservation of capital investment in the infrastructure.
- Hazards to production and market value of salable agricultural commodities from adjacent properties.
- Presentation of a varied and aesthetically pleasing travel experience to the traveling public.

This alternative incorporates some of the decentralized aspects of Alternative D. This allows for localized, situation-specific decision-making within the framework of department-wide management strategies. Under this alternative, a statewide procedure would be established for each of TxDOT's districts to develop management plans written in a standardized format. The Vegetation Management Plans (VMPs) would provide a means for documenting the rationale supporting management decisions, tracking the efficacy and costs of control methods, identifying environmentally-sensitive areas as well as provide a means for continuing public input.

Each administrative level within TxDOT would contribute to the selection, integration, and implementation of integrated pest management principles and practices.

0.5.0 Environmental Consequences

0.5.1 Geology and Soils

In terms of specific management techniques, mechanical treatments could be expected to have the greatest potential to impact soils, particularly if grading were used to reconfigure the roadside vegetation patterns. The repeated use of wheeled equipment for mechanical treatments, particularly with wet soil conditions, could cause soil compaction and inhibit the natural improvement process. Some chemical treatments

could impact soils directly if application to susceptible plants left the soil exposed. Biological and cultural management techniques would be expected to maintain or enhance the stability of soils on slopes once establishment of desirable, competitive plant communities has been achieved.

Alternatives B and C likely would have the greatest adverse impact on geology and soils. Alternatives D and E also could adversely impact geology and soils, but the adverse impacts of Alternative E could be expected to decrease over time.

0.5.2 Air Quality

In terms of specific management techniques, mechanical treatments could impact air quality the most through the introduction of particulates (dust) into the air. Mechanical treatments also burn more fossil fuels than the other treatments, but this impact would be expected to be minor when compared with the use of fossil fuels statewide. Chemical misapplications could introduce spray drift and objectionable odors into the local environment. These would be short-term impacts and would be relatively easy to mitigate. Biological control of unwanted vegetation would not be expected to impact air quality. Cultural treatment impacts on air quality would be the same as for mechanical treatments because mechanized equipment would be used in plant establishment operations, but without repeated impacts.

The greatest potential for adverse impacts on air quality from the burning of fossil fuels would come from Alternatives C and E, which would emphasize mechanical and cultural treatments, although the need for mechanical treatments with Alternative E would decrease over time. Alternative D would offer the greatest potential impact on air quality with respect to the use of herbicides, particularly if volatile chemicals were used.

0.5.3 Water Quality

Mechanical, chemical, and cultured treatment impacts both surface and ground water. Mechanical treatments potentially could disturb soils to the point that runoff would increase. This increased runoff would increase erosion with additional loading of sediments and other pollutants into the receiving waters.

Impacts from chemical treatment may be either direct or indirect. Direct impacts could result in the introduction of herbicides or insecticides directly into water from drift, runoff, or leaching. Adverse impacts from chemical methods would not be expected if proper mitigation measures were used (Harris et al., 1994. See Appendix B, Chapter 4 for assessment of risks from surface and leaching losses). If chemical treatment encouraged the establishment and maintenance of an improved vegetative cover, then indirect impacts from increased erosion would not be expected. Continued close

liaison with the Texas Natural Resource Conservation Commission (TNRCC) would yield consensus decisions on acceptable mitigation procedures.

The impacts on water quality from cultural treatments would be similar to those from mechanical treatment in the near term. For, example, seedbed preparation leaves the soil bare for planting, but this condition is mitigated by surface mulching and establishment of a seedling stand of plants.

The greatest adverse impacts on water quality due to sediment and nutrients loading would be expected to result from Alternatives B and C. Direct chemical impacts on water quality would be most likely be under Alternative B. Alternatives D and E could be expected to impact water quality, but the need for mechanical, and perhaps chemical treatment, could be expected to decline over time in most instances. Biological treatments would not be expected to impact water.

0.5.4 Flood Plains

Roadside pest management is not expected to have significant impacts on flood plains. Construction of highways and associated developments on flood plains results in displacement of flood waters and an increase in the severity of flooding. However, the management of roadside vegetation and pest insects after construction does not have a measurable effect on high water conditions.

0.5.5 Wetlands

Mechanical treatments have a low potential to impact wetlands. Chemical treatments can have both a direct and indirect impact on wetlands. The introduction of chemicals through drift or runoff could adversely impact wetlands. Cultural and biological treatments generally would be expected to have a low potential to adversely impact wetlands. Continued close consultation with TNRCC and implementation of mitigation measures would be essential to protect wetlands.

The greatest adverse impacts on wetlands from increased erosion and sedimentation would come from Alternatives C and E, where there is an emphasis on mechanical and cultural treatments. Alternative E would decrease the need for mechanical treatments over time.

0.5.6 Vegetation

Mechanical treatments may be a very effective treatment for small non-sprouting trees, shrubs, and herbaceous vegetation. However, operation of equipment on some soils could reduce vegetative cover and allow invasion of undesirable species. Constant mowing of bunch grasses and forbs to maintain a lawn-like appearance reduces plant

vigor and makes the plants more susceptible to invasion by noxious weeds or disease, but sod grasses are more tolerant of such treatment. The greatest potential impact on plant communities resulting from the use of herbicides is the possibility of adversely affecting non-target vegetation. Use of selective chemicals could decrease the potential injury to non-targeted species. Threatened and endangered plant species present in the highway ROW may be impacted by mechanical, chemical, cultural, or under some circumstances, even biological methods. Continued close consultation with the Texas Parks and Wildlife Department's (TPWD) Natural Heritage Program is essential for the protection of these species. Adverse effects on desirable vegetation should not be expected from cultural activities or biological treatments.

The impacts on vegetation could vary considerably from one alternative to another. In each of the alternatives, some types of vegetation would benefit and other types would not. Overall, if treatments are applied properly, the best alternative for vegetative health would be Alternative E.

0.5.7 Wildlife and Wildlife Habitat

Well-timed mechanical control which considers seasons that are critical to wildlife present could be a very effective tool for improving habitat for small mammals and birds. The use of mechanical equipment could compact the soil, however, possibly destroying habitat for burrowing animals. Manual techniques would not be expected to adversely impact wildlife. The toxicological impacts to wildlife of herbicides and insecticides used by TxDOT can be found in Appendix B, Chapter 3. Although it is possible that individual animals occasionally may experience short-term symptoms of exposure, it is highly unlikely that animal fatalities would occur from proper use of these chemicals. None of the chemicals proposed for use by TxDOT would be expected to adversely impact any wildlife populations. Habitat manipulations as a result of herbicide applications may benefit some animals but disadvantage others. Insecticide application to individual mounds would not be expected to adversely impact wildlife populations and may be beneficial. Close consultation with the TWPD's Natural Heritage Program regarding the known occurrences of threatened and endangered species and associated habitat as well as situation-specific evaluation of areas proposed for treatment should mitigate potential hazards to sensitive species. Most wildlife species would benefit from cultural treatments used to establish communities of low maintenance native and other adopted plants. Biological treatments should not adversely impact wildlife populations.

The potential impacts of roadside pest management methods on aquatic habitats and aquatic species could be directly related to the water quality impacts described previously. Potential effects include reduced survival or reproduction of aquatic organisms resulting from accidental exposure to toxic concentrations of pollutants. In

general, however, roadside pest management treatments used by TxDOT have not been known to have caused substantial impacts to aquatic organisms in adjacent waters.

Alternatives A and B would provide the most forage and cover in the short term for larger wildlife. If cultural techniques are employed to enhance wildlife habitat, Alternatives D and E could best enhance wildlife habitat along roadsides over the long term.

0.5.8 Hazardous Materials and Hazardous Waste

A hazardous material is a substance capable of posing an unreasonable risk to health, safety, and property--- (CFR 49, Chap.1, Part 171.8). Herbicides and insecticides have the potential to be classified as hazardous material.

- Herbicides and insecticides are not considered hazardous when they are stored, mixed, and applied as stated on the label.
- Hazardous materials may include discarded pesticides, unrinsed pesticide containers, pesticide rinse water, soil contaminated by pesticides, and pesticides being transported if they contain a designated formulation or exceed the maximum limits of amount carried (49 CFR 171.8 and CFR177).

Alternatives A and C would not yield any hazardous material since there are no inputs. Alternatives B, D, and E may be subject to chemical treatment, but usage according to label directions should prevent occurrence of hazardous materials.

0.5.9 Visual Quality

Chemical treatments, unless they are applied when plants are bare of foliage or during autumn coloring, may cause discoloration and death of some or all of the treated foliage or plant. Cultural techniques, such as fertilization, could improve plant health and overall visual attractiveness. Biological methods using insects and diseases to control unwanted vegetation may cause defoliation, discoloration, or death of targeted plant species, but scattered plants likely would be noticed. The impacts to visual quality from mechanical methods depend upon the season, vegetation type, and amount of cutting. Cutting in the spring could expose brown and shattered stems for a short time until they are hidden by new foliage. Excessive mowing could leave plants more susceptible to damage from disease and pests.

Frequent and/or close mowing of unirrigated bunch grasses reduces the health and vigor of the stands, allowing increased susceptibility to invasion by weedy plant species. Other visual problems with mowing include occasional bare spots due to mower scalping.

Alternatives D and E would provide better visual quality than the other alternatives. In the long-term, Alternative D would provide more mowed landscapes, and Alternative E would provide more land in native, stable vegetation.

0.5.10 Cultural Resources

Mechanical methods have the potential to physically damage historically significant properties, especially archaeological sites and historic structures and objects along roadsides such as old boundary markers, centennial markers, town entry markers, masonry retaining walls, drainage/soil erosion control structures. However, any method where mechanized equipment traverses Roadside Management Zone 2 (the passive zone) has a potential for damage to cultural resources. Chemical methods will not physically impact historically significant areas unless these areas include vegetation or insect pests, or plants which should be protected. Cultural methods of vegetation management have the greatest potential to damage archeological sites since disturbance of the soil surface is required for establishing vegetation. Biological methods of pest management likely will not have an effect on cultural resources. TxDOT should be aware of these areas throughout the state and modify pest management practices in order to prevent damage to these sites or objects.

Alternatives C and E could have the greatest impact on cultural resources because of their heavy emphasis on cultural methods of vegetation management. The risk to these sensitive sites would not decrease over time because of the long-term emphasis on cultural treatments.

0.5.11 Highway Safety

Mechanical, chemical, and cultural methods can help maintain the structural integrity of the highway and enhance highway safety. Proper follow-up management techniques should be implemented to discourage establishment of undesirable vegetation, to prevent soil erosion, and to reduce potential fire hazards. Cultural and biological management techniques help improve growing conditions of desirable plants and discourage establishment of undesirable plants which can adversely affect the structural integrity and public safety of the highway. Most cultural and biological techniques will have no adverse impacts on the integrity and safety of the highway.

Alternatives A and B will undoubtedly have the greatest adverse impact on highway safety. Alternative C would be inadequate to satisfy safety needs. Both Alternatives D and E would be adequate to satisfy highway safety needs.

0.5.12 Traveler Facilities

The highway system provides traveler facilities for public use. These facilities include traveler information centers, park and ride areas, bus stops, safety rest areas, picnic areas, and scenic and historic facilities. Users of high-contact service facilities such as rest areas may be exposed to chemicals applied to vegetation or to ant mounds. The human health risk of such exposure is minimal and is discussed in Appendix B, Chapter 2. Mechanical equipment may produce projectiles during operation which could endanger travelers in the immediate vicinity. Other potential impacts may include dust, smoke, and objectionable odors.

Alternative A would cause the greatest adverse impacts on services, since no pest management would occur with this alternative. Alternative C would not meet management needs regarding fire ants, placing the traveling public and TxDOT workers at risk in high-contact traveler facilities. Alternatives D and E would maintain traveler facilities at appropriate levels.

0.5.13 Human Health

Each treatment technique potentially could pose a threat to humans. Workers using heavy machinery or hand tools are at potential risk from accidents. Contact with certain plants may cause eczema or erythema. Risk from biological control methods would be extremely remote.

Risk assessments of chemicals to human health may be assessed by calculating a hazard index (HI) for each chemical under consideration. In this EIS, HIs for each of the 10 materials involved were determined with several identical scenarios. These scenarios considered assumption regarding the application methodology for each chemical. Hazard indices of 1 or less would be presumed to have minimal impact on human health. HIs greater than 1 may be associated with increased risk of noncancer effects from chemical exposure, and emphasize the need for protective clothing and other precautions during treatment.

Under average use scenarios, risk to TxDOT workers and the general public from chemical application by TxDOT are negligible or low (Table 3-3). Even with maximum use scenarios, the risk of noncancerous effects could be considered well mitigated. The following observations can be applied to various HIs presented in Table 3-3:

- TxDOT workers engaged in chemical application could be considered at great risk because mixer/loaders and spray truck drivers would have opportunities to come into direct contact with the materials. TxDOT employees are trained in chemical application to roadsides and are licensed for noncommercial applications.

- HIs derived for both average and maximum TxDOT applications should be tempered by:
 - (a) Chlorpyrifos mixed and sprayed from a small hand sprayer so the quantities being handled are quite small and spray truck drivers are not involved. Chlorpyrifos is an alternative treatment to the preferred fenoxycarb, and application is made to individual ant mounds. Since it is applied as a spot and not an area treatment, contamination of vegetables and fish from TxDOT applications should be highly remote.
 - (b) Triclopyr poured into a small hand sprayer directly from the container so no mixing or spray truck driving would be involved. Application is made to the lower 30 cm (12 inches) of the mesquite stem base, which makes crop or water contamination virtually impossible. The triclopyr now in use is formulated in vegetable oil rather than being diluted with diesel oil.
 - (c) Hexazinone having a HI of 2 at the maximum rate and less than 1 at the average rate. It should be usable with proper precautions where a higher rate is indicated.

The greatest risk to the TxDOT employees comes from labor-intensive activities. Alternatives C and E treat the largest number of acres with the most labor-intensive methods of vegetation management and, therefore, present the greatest risk to TxDOT employees. Risk from chemical exposures to workers and the public, while negligible, would be greater for Alternatives B, D, and E.

0.6.0 Mitigation Measures

Suggested mitigation measures are listed below for each category of treatment. Operational decisions often must be made in the field concerning the relevancy of a particular mitigation measure. Whenever possible, an integrated approach should be taken to yield the most efficient vegetation management practice having the least adverse impact.

Many of the suggested mitigation measures are already used by TxDOT as standard operating procedure. Suggested mitigation measures presently in use by TxDOT are identified with the symbol ♦. Mitigation measures which are not implemented or only partially implemented are marked with the symbol ◇.

0.6.1 General

- ◇ Adapt an integrated approach whenever possible to utilize the most efficient management practice which offers the least impact.
- ◆ Requirements of persons sensitive to chemicals, areas containing threatened or endangered plants or animals, and similar situations should be managed with sincerity and understanding.
- ◇ TxDOT should strongly consider job classification down to district level for employment of staff persons with an interest in integrated pest management and training in range management or a similar field stressing practical ecology, soils, and vegetation management.
- ◇ Guidelines for an Insect Management System similar to those for vegetation management should be developed for direction and reference of TxDOT personnel.
- ◇ Systematic and regular communication should be initiated with the public concerning roadside pest management needs, available treatment options, program constraints, and program benefits.
- ◆ Use warning devices to advise roadway users of upcoming maintenance activities.

0.6.2 Mechanical Treatment Methods

- ◆ Operate heavy equipment on stable slopes, and, if possible, only on slopes flatter than 33 percent. Heavy equipment can cause erosion that contributes to water quality and aquatic wildlife impacts.
- ◆ If possible, limit the use of heavy wheeled machinery in Zones 1b and 2 (Figure 1-1) to reduce soil compaction and impacts on native vegetation and wildlife, as well as cultural resources.
- ◆ Wear safety equipment when operating heavy equipment or hand tools.
- ◆ Have workers wear safety appropriate equipment when working along roadsides.
- ◆ Fence off or mark known cultural resources when machinery is used in order to avoid direct physical impacts to these properties.
- ◆ Limit the use of machinery in habitat that may support ground-nesting birds during the spring and early summer months.

- ◆ Limit operations of heavy equipment to calm days to reduce dust, especially in the drier regions.
- ◆ Utilize low ground-pressure equipment when operating in roadside areas to minimize compaction.
- ◆ Schedule roadway maintenance for periods of reduced traffic. (TxDOT does this in areas having high ADT).
- ◇ Schedule work seasonally to optimize response of desirable species and minimize disturbance.
- ◆ Always use the proper equipment for the job.
- ◇ Minimize hazards from projectiles during mowing operations by ensuring that safety devices are installed and functioning correctly on mowers, by mowing at the proper height, and by using proper mowing techniques.
- ◇ Where space is available, maintain drainages as flat-bottom ditches.

0.6.3 Chemical Treatment Methods

- ◇ Install and use pressure gauges on portable hand sprayers.
- ◆ Discard rinse water from sprayer tanks on pest-infested areas targeted for treatment.
- ◆ Mix concentrated chemicals in areas away from wells or other known areas of vulnerable ground or surface water.
- ◆ Use appropriate chemicals or nonchemical methods acceptable to regulating authorities in aquifer recharge zones or fractured areas.
- ◇ Areas of shallow ground water overlain by rapidly permeable soils or those with direct aquifer recharge require additional interdisciplinary study to determine whether geologic or other environmental conditions render chemical use inappropriate. This concern is of particular importance where ground water is used for domestic supply. Indications of shallow ground water include definite riparian vegetation; persistently green, unirrigated grass or herbaceous vegetation; springs; evidence of seasonal flooding; or low topographic position in relation to nearby surface water, springs, and riparian vegetation (Jones and Stokes Associates, 1991).

- ◆ Spray chemicals in low wind velocities and use other strategies that limit spray movement away from the target area or plant.
- ◆ Use drift control adjuvants to increase spray droplet size and minimize spray drift to passing traffic and non-target vegetation and to reduce off-site exposure to wildlife and aquatic habitats.
- ◇ Delineate in long-lasting, durable form (such as paint on pavement) the no-spray areas established by TxDOT. (Also, see discussion of Alternative E and supporting documents.)
- ◆ When using pesticides, follow all label precautions concerning timing of application rates, protective clothing and equipment, re-entry periods, and proper rinsing, disposal, and recycling of empty containers.
- ◇ Follow all label restrictions regarding buffer restrictions for drainage. Additional increased buffers can be established on a situation-specific basis.
- ◆ Provide adequate storage of herbicides and insecticides to prevent and contain spills.
- ◇ Devise spill control plans.
- ◆ Select chemicals based on target pest, efficacy, and potential impacts on non-target pest for each specific project.
- ◇ Use adjuvants to reduce or eliminate objectionable odors caused by the application of herbicides or insecticides.
- ◇ Avoid the use of herbicides with a high potential for movement through the soil column.
- ◆ Avoid herbicide applications when precipitation is imminent.
- ◆ Continue to use target-specific spot applications rather than broadcast applications to reduce the environmental exposure.
- ◇ Emphasize the use of selective herbicides to control vegetation, and timing of applications to avoid "brown-outs."
- ◆ Use the lowest application rates possible that still provide adequate control, and schedule applications when they will be most effective.

- ◆ Do not apply herbicides to edible plants or to plants while they are bearing edible fruit. Use buffers around edible vegetation, such as vegetable gardens during the growing season.
- ◆ Provide annual training of TxDOT employees in the proper use and handling of pesticides. All applicators and maintenance supervisors must maintain current and applicable pesticide handling licenses.
- ◇ Add new low-impact herbicides to the program as they are registered and evaluated.
- ◇ Take advantage of new equipment and application technologies which minimize required application rates and maximize target area delivery.
- ◆ Apply chemicals only when it is part of a situation-specific, integrated solution.
- ◆ Adhere to maximum allowable wind speed for herbicide and insecticide spraying to minimize chemical drift.
- ◇ Utilize joint studies of regional impact such as the possible ingestion of spray materials by mixer/applicators.

0.6.4 Cultural Treatment Methods

- ◇ Maintain dense, healthy vegetation to reduce erosion impacts to soils and water quality, and to resist invasion by undesirable plants.
- ◆ Use mulch to stabilize disced and seeded beds until the vegetation is established in order to reduce erosion impacts.
- ◇ Determine strategies needed to utilize competition exhibited by native and other desirable plants.
- ◇ Establish predictable norms for stand composition and density, the procedures for implementation, and the management inputs needed to maintain competitive stands of desirable vegetation.

0.6.5 Biological Treatment Methods

- ◇ Very few adverse impacts for biological methods have been identified; therefore, mitigation is not needed.
- ◆ Monitor technical literature for the progress of biological control of roadside pests.

Table 0-1. Summary of Impacts by Alternatives

	Geology and Soils	Air Quality	Flood Plains	Aquatic Wildlife and Wildlife Habitat	Water Quality	Wetlands	Vegetation, including rare & endangered species
Alternative A	Possibility of greater fire hazard could lead to post-fire erosion.	In drier areas, possible increase of windblown dust. In more humid areas, natural vegetation growth would prevent windblown dust problems.	Negligible effects on flood plains, but drainage may be slowed or blocked.	Possible contamination from erosion. No potential for chemical contamination related to pest management.	Dense vegetation could increase retention time and filtration capacities, but channels could also be blocked. In drier areas, increased erosion from runoff.	Potential to increase sedimentation. No potential for chemical contamination.	Would lead to weed domination on disturbed sites, possibly attracting insect pests and diseases.
Alternative B	Effects similar to Alternative A. Similar to C and D on land treated by mechanical or chemical.	Similar to Alternative A. Additional impacts would include wind erosion, airborne particulates, exhaust emissions.	Pest management has negligible effects on flood plains.	Some mitigable potential for contamination, although less than Alternative D.	Similar impacts as with Alternative A. Vehicle emissions, erosion, and potential contamination by chemical herbicides.	Potential for contamination, although substantially less than that of Alternative D.	Similar to Alternative A for untreated lands. Impacts on treated lands will be similar to Alternatives C and D.
Alternative C	Heavy equipment use would increase possible erosion scenarios. Destruction of deep-rooted vegetation could reduce stability on steep slopes.	Impacts include exhaust emissions, airborne particulates, and soil lost to wind erosion.	Pest management has negligible effects on flood plains.	Possible contamination from erosion. No potential for chemical contamination related to pest management.	Mechanical removal could reduce filtration capacity. Decreased infiltration, increased erosion, and pollutant transport possible.	No potential for chemical contamination from pest management activities.	Heavy equipment use could compact soils and remove desired vegetative cover. Repeated mowing could weaken less competitive desirable species.
Alternative D	Impacts would vary, depending on treatment methods. Impacts similar to first few years of Alternative E.	Impacts would vary, depending on treatment methods. No change from current impacts would be expected over time.	Pest management has negligible effects on flood plains.	Mitigable potential for impact to aquatic organisms and contamination of aquatic habitats.	Impacts would vary, depending on treatment method. No change from current impacts would be expected over time.	Mitigable potential for contamination of surface water.	Impacts would vary, depending on treatment method. No change from current impacts would be expected over time.
Alternative E	Similar to C and D. Cultural and biological techniques would have no adverse impact on soils or geology. Impacts would decrease with time.	Similar to C and D. Cultural impacts include dust generation during seedbed preparation. Overall impacts would decrease with time.	Pest management has negligible effects on flood plains.	Potential for contamination, although less than Alternative D. Over time, less potential for chemical and sediment contamination.	Similar to Alternatives C and D. Impacts would decrease as emphasis shifts away from mechanical and chemical treatments to cultural treatment methods.	Potential for contamination, less than Alternative D. Over time, less potential for chemical contamination.	Similar to Alternatives C and D. As management emphasis shifts from mechanical and chemical methods to cultural, negative impact would decrease with time.

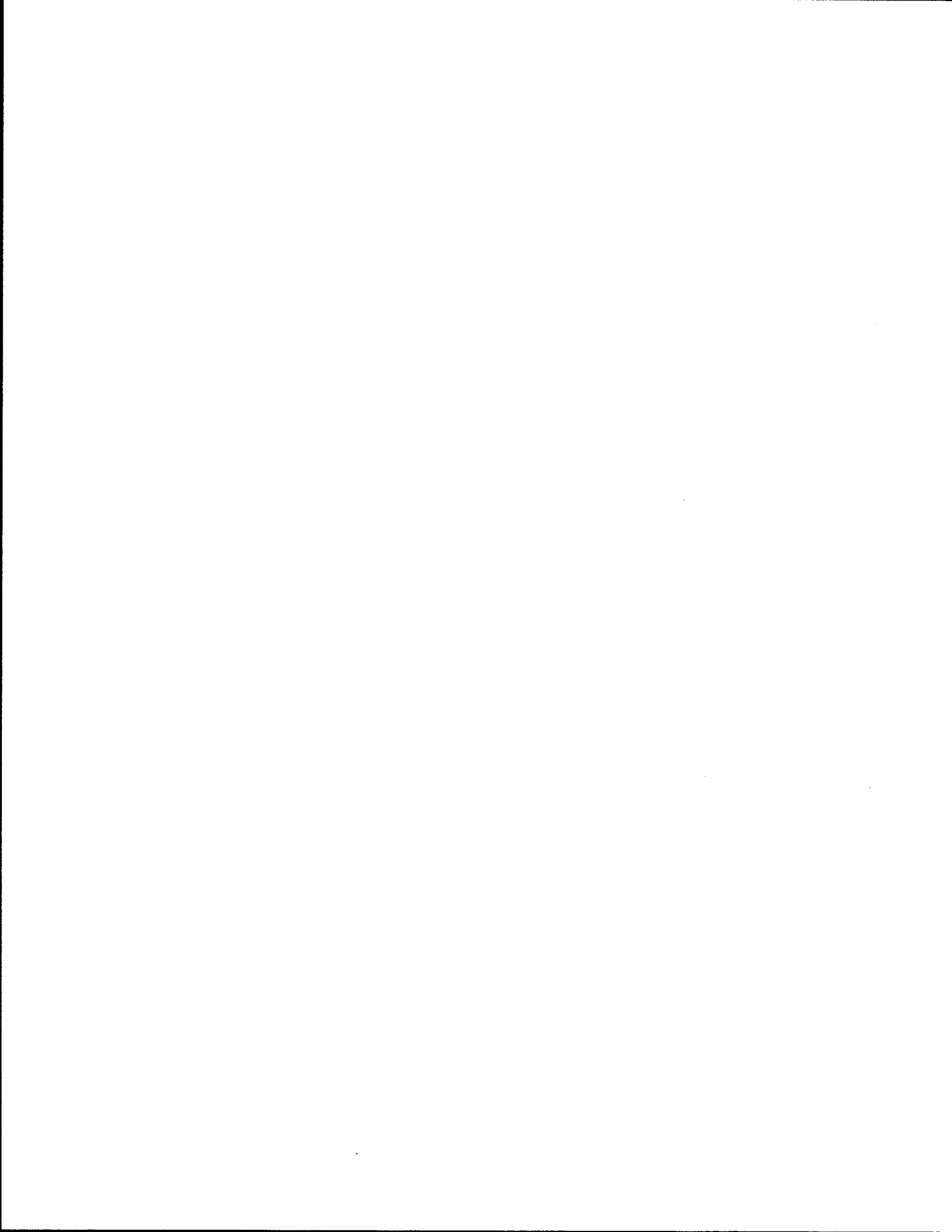
Table 0-1. Summary of Impacts by Alternatives (continued)

	Wildlife and Wildlife Habitat, Rare & endangered wildlife and habitat	Hazardous Materials and Waste	Visual Quality	Cultural Resources	Transportation	Services Traveler Facilities	Human Health
Alternative A	Would favor animal species associated with the plant communities that would establish. Could attract large mammals.	No hazardous material produced under this alternative.	Unmanaged vegetation would produce the poorest visual quality of any of the alternatives.	Unmanaged vegetation would allow damage to occur unchecked to cultural, historical, and archeological resources.	No pest management would cause the deterioration of the state's transportation facilities.	Service areas would not be maintained	No adverse effect from chemical applications. Greatest human health risk due to poor visibility/sight distances.
Alternative B	Similar to Alternative A in areas not receiving treatment. Impacts on treated lands would be similar to Alternative C.	Except for Alternative A, smallest amount of hazardous material from equipment and chemicals.	Would provide poor visual quality.	Allow damage to cultural resources to go unchecked.	Damage to the transportation system may occur before action is taken.	Service areas would not be maintained.	Health risk from accidents and air quality associated with mechanical equipment. Chemicals would provide negligible health risks.
Alternative C	Possible increase in erosion and damage to the habitat of burrowing animals.	Alternative C would produce more than Alternative B. No potential for creating hazardous material from herbicides.	Would provide moderate visual quality.	May impact cultural resources from no chemical use.	Damage to the road surface could occur without herbicides to maintain active zone, Zone 1.	Control of some noxious weeds may be difficult without the use of herbicides.	Health risks greater than Alternative B. No health risks associated with herbicides.
Alternative D	Impacts would vary, depending on treatment methods. No change from current impacts would be expected over time.	Alternative D would create more waste associated with mechanized equipment, as would Alternative B.	Alternative D uses all available vegetation management methods and would provide good visual quality.	Vegetation management methods available under this alternative would be adequate for the protection of cultural resources.	This alternative would provide an adequate level of protection of transportation facilities.	Maintenance of service areas would occur.	The health risks associated with this alternative are similar to Alternative E during its early period.
Alternative E	Similar to Alternative C. Cultural treatments could improve habitat by proper plant selection.	More mechanical waste, less chemical waste than Alternative B. Waste would decrease over time.	Would provide good visual quality. After early period it would provide the highest visual quality of any of the alternatives.	Would be adequate for the protection of cultural resources.	This alternative would provide an adequate level of protection of transportation facilities.	After early period, this alternative would probably provide the most visibly pleasing service areas.	Similar to Alternative C during first 5 years for mechanical methods and Alternative B for chemical methods of vegetation management. Risks would decrease.



Record of Decision

EIS
Pest Management Program



RECORD OF DECISION

TEXAS DEPARTMENT OF TRANSPORTATION FINAL ENVIRONMENTAL IMPACT STATEMENT *Roadside Pest Management Program*

I. INTRODUCTION

The Texas Department of Transportation (TxDOT) formulated an Environmental Impact Statement (EIS) as a proactive documentation of its pest management practices for review and reference within TxDOT, and for the benefit of other agencies and the general public. At the time this EIS was conceived, TxDOT was not required by state or federal regulations to conduct an environmental review of its pest management practices, but the department felt a proactive review placed them in compliance with the spirit of the National Environmental Policy Act and was in the best interest of the public and the environment. Subsequently, TxDOT adopted a policy requiring evaluation of environmental reviews at least every five years. Also, TxDOT environmental actions subject to the Texas Coastal Management Program (CMP) must be consistent with CMP goals and policies.

This document describes how the pest management program (PMP) of TxDOT will be conducted on 123,314 centerline kilometers (76,640 centerline miles) comprising the state highway system. A major portion of TxDOT's pest management program consists of a Vegetation Management System (VMS); the other element of the PMP is an Insect Management System (IMS).

Living organisms are considered necessary components of a roadside ecosystem. For example, plants stabilize roadside soils against erosion, provide a visible boundary at the pavement edge, and offer a pleasant and colorful driving experience. Insects recycle plant residues, provide channels in the soil for aeration and water movement, and pollinate flowers. When plants or insects threaten the safety or comfort of the traveling public, TxDOT or contract employees, jeopardize the capital investment in highway infrastructure, or endanger environmental quality, pest management procedures may be initiated.

This document considered and evaluated the impacts of PMP from a mix of alternative methods of treatment including biological, mechanical, manual, and chemical treatments. The EIS examines environmental impacts of the pest management methods. Its preparation included: (1) using public comments to identify issues; (2) developing alternatives and analyzing their effects based on all relevant research; (3) publishing a draft EIS for public comment and evaluation; and (4) preparing a Final EIS that responded to these comments.

II. AFFECTED ENVIRONMENT

TxDOT is charged with designing, constructing, and maintaining a state-wide network of transportation corridors to facilitate the safe and efficient movement of people, goods, and services. The goal of TxDOT's Vegetation Management System (VMS) is to establish and manage roadside vegetation in an environmentally sensitive and uniform manner consistent with any special conditions presented by local climate, topography, vegetation, soil, and level of urbanization. The Insect Management System (IMS) is concerned with neutralizing biting, stinging, or nuisance insects. For example, fire ants may nest in mounds close to roadside parks and rest areas, or interfere with the electric circuitry of fixtures. Wasps and hornets often nest in overhead luminaries and may be quite aggressive if disturbed. Other insects are attracted to picnic areas and restroom facilities.

The PMP of TxDOT delineates the roadside into two distinct management zones, an active zone and a passive zone (see Figure 1-1 in Chapter 1). The active zone extends from the edge of the travelway to the drainage ditch and is managed intensively. For example, shoulder pavements and pavement edges are sprayed to eliminate vegetation in cracks and joints. Front slopes and drainage ditches are mowed to provide for errant vehicle recovery, emergency stops, sight distance, and to facilitate drainage. The passive zone is managed less intensively to provide habitat for wildlife and to provide drainage off the right-of-way.

Methods of vegetation management currently used by TxDOT together with suggested alternatives were analyzed for potential impact on elements of the environment associated with ROWs. These elements include geology and soils, air quality, water quality, flood plains, wetlands, vegetation (including rare and endangered species), wildlife and associated habitat (including rare and endangered species), visual quality, cultural resources, service areas and human health. In addition, the impacts of these elements were discussed for ten separate vegetation regions in the state. These vegetation regions have been designated: Piney Woods; Gulf Prairies and Marshes; Post Oak Savanna; Blackland Prairies; Cross Timbers and Prairies; South Texas Plains; Edwards Plateau; Rolling Plains; High Plains; and Trans-Pecos. These regions show a close association with the district organization of TxDOT.

III. ALTERNATIVES

Five alternatives were analyzed in detail in the EIS. They range from doing nothing to increasing the amount and intensity of vegetation management above present levels. They also vary the methods and tools allowed, the intensity and frequency of treatments used, and the mitigation measures required. The use of prescribed fire was not considered as an option. It is considered by most people to be a vital ecological process, but TxDOT feels the advantages are outweighed by the management difficulties.

Following is a brief description of alternatives considered in this EIS:

Alternative A: No Action

Objective: To eliminate management of ROW vegetation or insects along TxDOT-maintained highways.

Under Alternative A, no action would be taken to manage vegetation or insects in any portion of the highway corridor. Vegetation and insect infestations would be permitted to grow uncontrolled.

This alternative is offered for comparative purposes only and is not an option for the TxDOT program.

Alternative B: Short-Term Remedial Action Approach

Objective: To manage and control ROW vegetation or insect pests only after it has been determined that public or worker safety, function of the highway facility, or capital investment could be threatened. Treatment would be undertaken at the lowest available cost (labor, materials, and equipment) with an emphasis on worker productivity and immediate treatment results.

Under Alternative B, all methods would be available for use. No acreage would be treated using cultural methods, however, because of the length of time it takes to effect control. Biological methods would not be used unless predator insects were available for Texas ROW conditions and pest species. Priority would be given to mechanical and chemical methods, as these methods generally provide immediate control of problem vegetation and insects.

Alternative C: No Chemical Approach

Objective: To manage roadside vegetation and insects without the use of chemicals.

Under Alternative C, no chemical herbicides or insecticides could be used for pest management, but other treatment methods (mechanical and cultural) would be available.

It is estimated that mechanical methods required under this alternative to meet management needs would be comprised of 65 percent mowing, 15 percent grading, and 20 percent manual treatment.

Alternative D: Current Practices

Objective: To continue the vegetation and insect management practices as they are presently employed by TxDOT.

TxDOT vegetation and insect management practices are decentralized decisions carried out in the local maintenance sections. Treatment methods are selected based on situation-specific conditions, implemented by a local Maintenance Supervisor and vary among districts depending on local policies and priorities. The District provides guidance to sections concerning budgeting and public concerns to be implemented with the limited labor available. TxDOT headquarters in Austin provides guidelines for decision strategies and specialized expertise upon request.

Prevention of pest problems is addressed through the establishment and maintenance of desirable vegetation. Treatments may be selected on the basis of observed infestations using some integrated pest management principles.

All control methods could be available for use under Alternative D. Preference is given to methods which provide the greatest benefit within the constraints of local priorities. The method and amount of treatment varies among districts.

See Chapter 1, Section 1.1.4, for a description of current TxDOT practices.

Alternative E: Integrated Long-Term and Locally-Based Approach

Objective: To integrate good environmental procedures and practice into the utilization of highway pest management activities along the ROW on a situation-specific basis, using a strategy which would be expected to increase the competitive ability of desirable vegetation and hinder establishment of undesirable plants.

The ultimate aim of Alternative E is to implement documented strategies for long-term management of vegetation and insects based on prevention of problems and employment of minimal maintenance. Establishment of a stable, desirable vegetative cover requiring minimal maintenance is a primary focus.

This alternative incorporates some of the decentralized aspects of Alternative D. This allows for localized, situation-specific decision-making within the framework of department-wide management strategies. Under this alternative, a statewide procedure would be established for each of TxDOT's districts to develop management plans written in a standardized format. The Vegetation Management Plans (VMPs) would provide a means for documenting the rationale supporting management decisions, tracking the efficacy and costs of control methods, identifying environmentally-sensitive areas as well as providing a means for continuing public input.

Each administrative level within TxDOT would contribute to the selection, integration, and implementation of integrated pest management principles and practices.

IV. PUBLIC PARTICIPATION

Public involvement was sought to develop the scope of issues on which an analysis should focus. A notice of intent describing the EIS project was published in the *Texas Register*, and letters of intent were mailed to individuals, government agencies, and groups known to have an interest in the impact of highways on the environment.

Scoping comments expressed concern for the quality of various environmental compartments including water, air, soil, wildlife and wildlife habitat, aesthetics, vegetation, and human health. Other comments expressed concern regarding the need for vegetation management, legal compliance with applicable regulations, coordination with other agencies, and costs for each treatment method.

Several common themes emerged as concerns in comments received during scoping.

Action of Herbicides: Comments ranged from advocating the continued use of herbicides to eliminating their use. A few comments urged the use of herbicides with greater selectivity.

Use of Native Vegetation: The general consensus was to increase the use of low maintenance native vegetation along roadsides. Several respondents suggested eliminating noxious weeds.

Desire for Alternative Techniques: Comments suggesting alternative techniques, strategies and tools were varied and useful. Comments proposed a review of design and construction standards which may encourage pest infestations and the use of mitigation measures for chemical use.

Scoping responses were edited, collated, and published as TTI Research Report 1933-1, *Summary of Scoping Issues for the Environmental Impact Statement on TxDOT's Pest Management Program*.

The Draft EIS was issued in November 1995. Copies were sent to scoping participants and others who requested to be included on the mailing list. Comments were solicited in the transmittal letters and in a notice published in the *Texas Register*. Public hearings were scheduled at five locations during January-February 1996 in Austin, Beaumont, Dallas, Lubbock and Pharr. Written comments were accepted until 5:00 p.m. on March 15, 1996.

Comments were not offered at any of the public hearings, but six written responses were received. The written comments focused on specific alternatives, suggested risk mitigation measures, air and water quality issues, regulatory compliance, and chemical/pesticide use.

V. DECISION

The decision is to implement Alternative D. The decision serves two objectives: (1) protecting human health through measures to minimize risks to the traveling public, TxDOT employees, and contract workers, and (2) utilizing efficient maintenance features to provide safe travel facilities, protect capital investment in facility, mitigate impacts of maintenance on the environment, and restore the biodiversity of native flora and fauna and their habitats in highway corridors. This alternative is meant to stress prevention of pest management problems before they occur by establishing a vegetative cover, or to minimize the impact of an imposed maintenance practice which is effective and presents the least risk to the environment.

VI. DECISION RATIONALE

Statutory Concerns: TxDOT is charged with planning, designing, and constructing a safe and efficient system of highways. The travel surface is the focus of highway use, so it must be kept serviceable. Also, anything such as a pest plant or insect which interferes with the safe, efficient, or enjoyable use of a facility or its maintenance should be controlled.

Perspective On Methods: Herbicides and insecticides are registered by EPA under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and may differ from many other chemicals. To be registered for commercial sale and public use, these materials must provide specific economic and social benefits. This does not mean that pesticide use is free from environmental hazard or risk. In registering these materials for commercial sale and public use, EPA must determine whether a pesticide poses an unreasonable risk to human health or the environment. Each material already enjoys a regulatory finding by EPA that it poses no unreasonable risk to human health or the environment in light of the benefits from its use.

TxDOT's decision cannot and does not end with reliance on EPA's judgements under FIFRA that each pesticide may be commercially sold and publicly used. After considering the EIS disclosures, TxDOT has decided that the pesticide's environmental hazards and risks are acceptable ones to take. The decision to use these materials also results from the determination that forgoing their use substantially compromises TxDOT's efforts to control or reduce the adverse effects of vegetation or insect pests. Without treatment, increased environmental and other costs could result.

Biodiversity is a desired goal of the Vegetation Management System which requires a flexible approach designed on a situation-specific basis. Encroachment of some species cannot be contained with herbicides, and other methods such as mechanical must be utilized, although this often results in soil disturbance and other negative environmental impacts. It is TxDOT's decision that where necessary, the short term negative impacts on

the soil may result in longer term stabilization of the soil and a more desired diverse plant community. Manual vegetation treatment often is more desirable and will be used to the extent of practicality and availability of funding and work force.

Biological control still is in its infancy, and much research remains to be done. Predator-prey relationships are extremely specific and require considerable time to achieve a measurable effect. Biological treatments presently are not prescribed for highway ROW.

TxDOT will use the following herbicides: Escort (metsulfuron methyl), Oust (sulfometuron methyl), and Rodeo and Roundup (glyphosate); and the following insecticides: Diazinon (Diazinon 4 E), Dursban Turf (chlorpyrifos), and Logic (fenoxycarb). The following herbicides are under evaluation for specification: Arsenal (imazapyr), Pathfinder II (triclopyr), and Transline (clopyralid). The use of Velpar (hexazinone) has been discontinued.

VII. MANAGEMENT REQUIREMENTS AND MITIGATION MEASURES

A pest management program for Texas highways is concerned with management of vegetation and with insects. The Vegetation Management System (VMS) is more intensive and documented with a choice of chemical, mechanical, biological, and cultural treatments available for use. An Insect Management System (IMS) is expected to become more programmatic in time. Chemical treatment of insects is preferred because a quick neutralization is required in many cases.

1. The treatable vegetated acreage is estimated at 326,000 hectares (805,200 A). Roadside management zones are distinctive, operational or engineering roadside areas having contrasting management requirements. The active zone extends from the pavement edge to the drainage ditch, and a passive zone extends from the drainage ditch to the Right-of-Way boundary. For Alternative D, it is estimated that mechanical treatments constitute 88% of the program, chemical treatments from 11% of the program, and cultural treatments are used on 1% of the program. Chemical applications are generally restricted to the paved shoulder and pavement edge of the active zone; mechanical treatments are used on the remainder of the active zone and over the passive zone.
2. No increase in acreage treated is anticipated with programmatic Alternative D. Chemical use should decrease slowly as the vegetative cover is stabilized and needs become fewer. It will, however, remain the treatment choice for vegetation on shoulder pavements and along pavement edges. Mechanical treatment should decrease with a decline in mowing acreage and frequency. It is the treatment of choice in vegetated areas and drainage channels.
3. Only herbicides offering the least health and environmental risks will be applied at not more the average TxDOT rates (see Table C-2, Volume 1). Average TxDOT rates range from 10 to 80% of the maximum label rate, except Pathfinder

II which is pre-formulated for application. Spot treatments, application to individual plants or plant groups, are favored over broadcast treatment. Only licensed applicators are assigned to apply herbicides.

4. There exists within the human population a small number of individuals who react to very small quantities of pesticides or other synthetic chemicals. These individuals are said to be hypersensitive to a chemical and suffer from Multiple Chemical Sensitivity (MCS). The reason for this hypersensitivity is often unknown but may be due to genetic, nutritional, or other health factors. TxDOT spray applications avoid known communities of MCS individuals. However, since these individuals make up such a small fraction of the population, the probability of them being exposed to routine maintenance pesticide applications is remote.
5. Integrated Pest Management (IPM) principles which stress prevention of problems will be used as a basis for VMS.
6. Geology and soils. Soils are most susceptible to damage from mechanical treatments. Wheeled equipment generally has a greater impact on dry, sandy soils or wet, clay soils than track vehicles. Generally, the rather severe early impact gives way to little or no impact in time.
7. Air Quality. Mechanical treatments burn more fossil fuels than other treatments, but this impact would be expected to be minor when compared to the use of fossil fuels statewide. Special care should be taken in non-attainment areas to abide by prescribed activity schedules. Chemical application could inject spray drift into the local environment. The generation of fine spray particles more subject to drift can be reduced by spraying at lower pressures and using spray additives.
8. Water Quality. Mechanical treatments impact soils by increasing runoff and the resulting sediment load. Adverse impacts from chemical methods would not be expected if proper mitigation measures were used. Chemical treatment could introduce herbicides or insecticides into surface or ground water, but TxDOT uses buffers or vegetated filter strips to lessen the possibility of this impact. Impacts on water quality from cultural treatments would be similar to those from mechanical treatment in the near term. For example, seed bed preparation leaves the soil bare for planting, but this condition is mitigated by surface mulching and the resulting seeding stand of plants. Alternative D could be expected to impact water quality, but the need for mechanical and chemical treatment would decline over time in most instances.
9. Wetlands. Potential impacts of roadside pest control methods on wetland habitats and resources would be directly related to any impacts upon water quality. Impacts could result from any of the identified treatment methods. Increased sediment and nutrient loading may be mitigated by buffers, filter strips, or

mechanical measures such as filter fabric. TxDOT policy prohibits overspraying open water or water channels, together with buffers on stream banks, and avoidance of karst areas.


10. **Vegetation.** Vegetation treatments would benefit as well as adversely impact both target and non-target vegetation. Some injury or loss of non-target vegetation may occur from all methods, particularly from herbicide use. Changes in species composition, plant community structure, species diversity, and productivity could result where all vegetation is treated. Some species will be enhanced by treatment; others will be suppressed on the treated site.

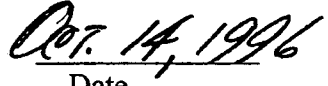
The possible impacts to special status plant species are potentially the same as those for vegetation in general. However, the distribution and occurrence of special status species generally is known, and appropriate measures, such as avoidance, should be taken to protect those species present. TxDOT avoids treating or disturbing ROW areas where these plants occur.

11. **Wildlife and Wildlife Habitat.** A memorandum of understanding has been developed between TxDOT and the Texas Parks and Wildlife Department to reserve certain areas in the passive zone for the use of small animals and ground nesting birds. Habitat manipulations as a result of herbicide applications may benefit some animals but disadvantage others. Insecticide application to individual mounds could not be expected to adversely impact wild populations and may be beneficial. TxDOT maintains close consultation with TWPD Natural Heritage Program regarding the known occurrences of threatened and endangered wildlife species.
12. **Visual Quality.** Chemical treatments, unless they are applied when plants are bare of foliage or during autumn coloring, may cause discoloration or death of some or all of the treated plants. Mechanical methods applied in the spring could expose brown and shattered stems for a short time until they are hidden by new foliage. Frequent and/or close mowing of unirrigated bunch grasses reduces the health and vigor of stands, allowing increased susceptibility to invasion by weedy plants.
13. **Cultural Resources.** Mechanical methods have the potential to physically damage historically significant properties. TxDOT should be aware of these areas throughout the state and modify pest management practices to prevent damage to these sites or objects. Application of chemicals or use of mechanical equipment should be scheduled during times of low use.
14. **Human Health.** Workers using heavy machinery or hand tools are at potential risks of accidents which can be mitigated by proper training and supervision. Persons applying chemicals should use proper clothing or additional protective devices where it is specified by the label. Spray applications should be made downwind.

15. Mitigation. Suggested mitigation measures are a combination of common sense and careful application. Requirements of persons sensitive to chemicals, areas containing threatened or endangered plants or animals, and similar situations should be managed with sincerity and understanding.
16. Monitoring. Applications should be monitored during and after treatment to ensure that treatments are implemented as designed and that mitigation is effective.
17. Updating. As additional technology becomes available, vegetation management practices will be incorporated into TxDOT's programs.

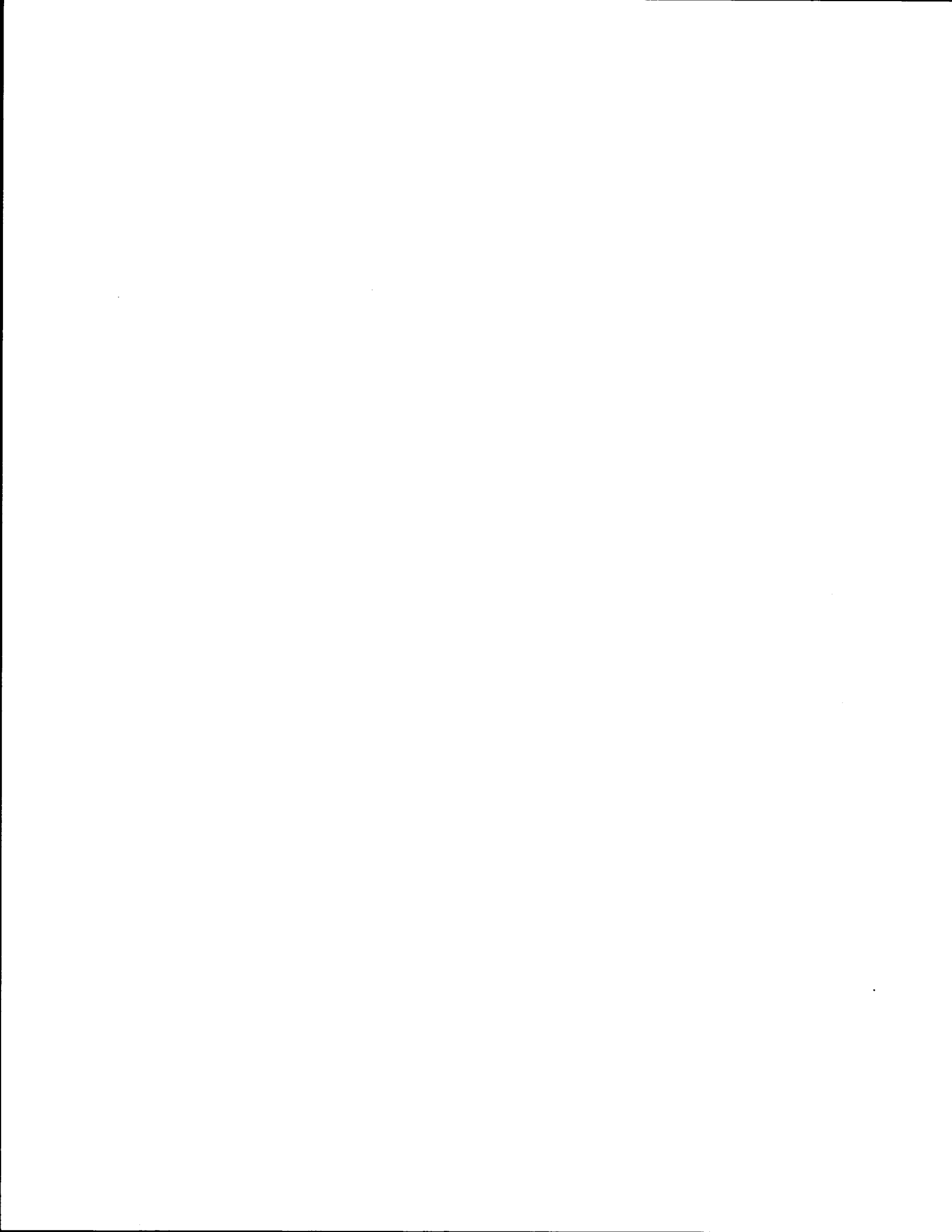
This document will become effective on the date signed.


B. F. Templeton
Assistant Executive Director of Field Operations
Texas Department of Transportation


Date

Chapter 1

EIS
Pest Management Program



1.1.0 Introduction

A goal of the Texas Department of Transportation (TxDOT) is to establish and maintain roadsides to ensure the safety of highway users; to enhance environmental quality; and to promote efficiency in highway maintenance activities, while at the same time implementing policies which would ensure the structural integrity and longevity of the roadway itself (Executive Order 1-92).

TxDOT's Pest Management Program (PMP) plays an important role in attaining these goals. The PMP includes all planning, establishment, and maintenance of desirable plants as well as the control of undesirable plants which threaten either public or worker safety or the integrity of the highway system. Some control of fire ants is necessary to protect TxDOT workers engaged in vegetation management and other maintenance activities as well as the traveling public using highway facilities.

TxDOT's PMP is divided into a Vegetation Management System (VMS) and an Insect Management System (IMS). TxDOT's stated aim in its VMS is to establish and manage roadside vegetation in an environmentally sensitive and uniform manner consistent with any special conditions presented by local climate, topography, vegetation, soil, and level of urbanization (TxDOT, 1991). TxDOT's policy calls for the installation and management of perennial grasses, legumes, and wildflowers to achieve its goals.

The two major categories of vegetation management could be the (1) establishment and management of desirable vegetation and (2) the control of undesirable vegetation. Both desirable and undesirable plants require maintenance to prevent interference with highway safety and maintenance operations.

The establishment and management of desirable vegetation contributes to roadside VMS objectives by:

- Maintaining stable slopes and controlling erosion;
- Resisting invasion by noxious weeds;
- Using vegetated strips to filter contaminants;
- Providing compatible habitat (food and cover) for diverse wildlife species;
- Fostering vegetative biodiversity;
- Preserving some of the last remnants of Texas' native flora and fauna;

- Reducing roadside maintenance costs;
- Reducing roadside fire hazard;
- Uniting the roadside aesthetically with adjacent lands; and
- Creating a pleasing traveling experience (such as wildflower displays) for roadway users.

The prevention and control of undesirable vegetation assists in achieving roadside VMS objectives by:

- Ensuring adequate roadway drainage;
- Maintaining proper sight distances for roadway users;
- Keeping roadway recovery zones (shoulder, safety strip) free of obstructions;
- Preventing noxious weed infestation;
- Preserving visibility of roadway delineations and fixtures;
- Reducing the deterioration of roadway integrity resulting from vegetation encroachment; and
- Reducing roadside fire hazard.

TxDOT's IMS is the basis for the control of fire ants and other insects where they threaten public or worker safety. Insect control generally occurs in traveler facilities such as safety rest areas and picnic areas. Fire ants also have an affinity for electronic circuitry, and nest in base supports at ground level and in signal lights above the roadway.

1.1.1 Purpose of the EIS

Development of this EIS is a proactive initiative by TxDOT to evaluate the impact of pest management practices on the environment. At the time this EIS was initiated, TxDOT was not subject to legal or regulatory directive to prepare this document. Rather, it reflected their concern for the safety of the traveling public and TxDOT workers, for the permanence of the highway infrastructure, for possible impacts on adjacent property, and for habitat and other environmental components within the highway corridor. Currently, the TxDOT Vegetation Management Program (1) is subject to review within TxDOT (19 TexReg 9732, 9742, Sections 2.41 and 2.47), and (2) must comply with Coastal Management Program (CMP) goals and policies (20 TexReg 8688, Section 505.11).

This environmental impact statement (DEIS) reviews the entire pest management program for TxDOT, making it programmatic in scope. Existing data were used to produce the EIS. No original research, other than quantitative risk assessments, was conducted. Sources of information for the DEIS include existing literature, information received from TxDOT, state and federal regulations, and other EISs.

The objectives of the EIS include:

- Document TxDOT's current pest management practices;
- Identify alternative programs that TxDOT may use in place of the current program;
- Identify significant impacts that program alternatives may have on Texas' environment;
- Identify mitigation measures which may be used to prevent or minimize significant adverse effects of the alternatives; and
- Provide a resource TxDOT could use when making ongoing decisions for pest management in order to avoid adverse impacts on the environment.

Five pest management alternatives are examined in this DEIS. Each alternative is discussed in detail in Chapter 2. The five pest management alternatives are: Alternative A, No Action approach; Alternative B, Short-Term Remedial Action approach; Alternative C, No Chemical approach; Alternative D, Current Practices; and Alternative E, Integrated Long-Term and Locally-Based approach. Each alternative will be examined to determine consequences on the following areas:

Geology and Soils

Air Quality

Water Quality

Wetlands

Vegetation, including rare and endangered plants

Wildlife and Wildlife Habitat, including endangered and threatened species and habitat

Hazardous Materials and Waste

Visual Quality

Cultural, Historic, and Archaeological Resources

Highway Safety

Traveler Facilities

Human Health

1.1.2 Description of Treatment Methods

Mechanical, chemical, biological, and cultural methods are four candidate treatment methods available to TxDOT to manage pest vegetation in the highway corridor. Prescribed burning, often used to manage native vegetation, is considered by TxDOT as too hazardous for ROW use. For insect pests, chemical treatment is the only method currently available which meets TxDOT's objectives. This DEIS also will consider combination treatments and the use of no-treatment methods as pest management alternatives. The following is a description of the four methods.

Mechanical

Mechanical control techniques include cutting or trimming herbaceous and woody plants and the occasional cultivation of soils to reduce or eliminate undesirable vegetation growth. Mechanical methods used by TxDOT include: operation of tractor-mounted flail, sickle or rotary mowers and other powered machines that chop, cut, mow, grub, blade, or cultivate; and the manual techniques of grubbing, pulling, cutting, sawing, and mulching. Manual techniques employ both powered and non-powered hand tools.

Chemical

Applications of herbicides and insecticides are used to reduce or eliminate undesirable plants and insects, respectively. Most herbicides are applied with truck-mounted spray equipment, while a few herbicides and insecticides are applied as spot treatments using portable handguns.

The applied chemical enters the plant by foliar absorption or from the soil solution via plant roots. Selective herbicidal action targets selected growth forms such as grasses or trees, or their action may be limited to a narrow group of plants. Nonselective herbicidal action is indiscriminate against all plants in the target area. Selective or nonselective response, while based on reactions of applied chemicals with life processes within plants, also is a function of the rate of herbicide applied and the method of treatment. Generally, a lighter rate of application functions as a selective material, which becomes progressively nonselective as the rate increases. TxDOT does not specify nonselective treatment.

Liquid insecticides function as contact materials. Granular baits depend on system action by the ingested material.

Selection of chemicals for treating pests in the highway roadside emphasizes protection and enhancement of the highway corridor and the safety of individual persons.

Biological

This treatment strategy is based on a predator-prey relationship which would interfere with reproduction or normal functioning of the targeted plants or insects. If the prey organisms do not succumb directly, they would survive as poor competitors or possibly be more susceptible to other treatment methodology.

A biological method must be specific for a particular pest, free of any possible predator organisms, self-perpetuating, and offer a high degree of environmental safety. The

most successful biological controls usually involve natural control agents imported from the home territory of the imported pest.

Grazing livestock are not used along TxDOT roadsides for biological control.

Cultural

This method of treatment involves the selection and use of management practices which encourage the competitive dominance of desirable organisms. Such management practices include but are not limited to:

- Selection and installation of native grasses, forbs, and wildflowers favored by an extensive system of management used on roadsides;
- Use of a mixture of planting materials to initiate biodiversity following reconstruction or maintenance;
- Utilization of soil materials free of seeds and/or rhizomes of undesirable plants;
- Employment of site preparation, seed placement, and surface mulch to encourage plant establishment; and
- Interseeding areas that have only thin plant cover.

ROWs supporting desirable plant communities are considered to be resistant to erosion, invasion by undesirable plants, and damage from disease and insects. Preferred vegetation generally possesses the following characteristics:

- Perennial growth and habit;
- Absence of invasive roots;
- Drought resistance;
- Disease resistance;
- Ability to control erosion;
- Ability to maintain dominance over invading species;
- Compatible wildlife habitat;
- Attractiveness; and
- Growth habit to satisfy management needs of the roadside management zone in which the plant is located.

Native plants, particularly prairie species, often possess these characteristics. Tolerant of extreme temperatures, resistant to drought and adaptable to a wide range of soils and soil characteristics, native grasses, legumes and wildflowers could be well-suited for less-than-hospitable roadside environments. Further, perennial native species generally

are long-lived and have deep, fibrous root systems which aid in erosion control (Harrington, 1991). The enhancement or reestablishment of native plants restores the biodiversity of natural communities and benefits both plants and wildlife.

The competitive action of desirable plants would be enhanced by preventing pest establishment on the ROW through such cultural practices as: specification of seed materials free of pest plants; minimizing the use of sand, gravel, or topsoil from infested sources; using thick mulch for transplanted ornamentals in landscape plantings; and cleaning maintenance equipment thoroughly after use in pest-infested areas. Cultural methods to establish desirable vegetation involves any or all of the following: site preparation; seeding; surface mulching; reseeding after reconstruction or maintenance; or interseeding areas of thin cover.

The technique and timing of other treatment methods (such as mowing and herbicide spraying) and plant susceptibility can be used to enhance plant competition when applied specifically to favor desirable plants and penalize aggressive invaders. Mowing heights may be set to favor certain species, or mowing may be postponed until after desirable plants set seed, for example. Selective herbicides may be used to affect only annual, invasive plants in a stand of stable, perennial vegetation. While cultural considerations in the application of mechanical and chemical methods is an essential component in TxDOT's pest management program, the delineation between mechanical and chemical methods which could be used to enhance growth and those which would not is extremely difficult. For that reason, a more narrow definition of cultural method which does not include mowing and chemical applications is used in this EIS.

1.1.3 Definitions

TxDOT Terminology

Several terms used throughout this document are specific to TxDOT's roadside pest management program. Key terms are defined below to help the reader understand the basic concepts of roadside pest management. A glossary of technical terms and general management terms used throughout this DEIS is located in the Glossary of the main body of the EIS.

Active Zone : See Roadside Management Zone.

Best Management Practices (BMP): BMPs would be the physical, structural, and/or managerial practices that when used singly or in combination reduce the impacts of some action. It should be noted that the term BMP was originally created in reference to water quality issues and has recently come to cover a broader range of disciplines.

Broadcast treatment : Spraying chemicals over a large area or entire site, specifically for target species or areas within the site. Usually accomplished by truck-or tractor-mounted sprayers. Contrast with spot treatment.

Designated vehicle recovery area: An area adjacent to the roadway shoulder where a driver whose vehicle has left the roadway may be able to recover control.

District: One of 25 regional TxDOT administrative zones in the state.

Divided highway: A highway with roadbeds separated horizontally or vertically for vehicles traveling in opposing directions.

Drainage channels: Roadside ditches designed to carry water away from the roadbed to collection channels or storage areas.

Environment: In this EIS, the environment is an extensive system of roadway ROW and adjacent facilities throughout Texas. The environment includes water, air, land, plants, humans, and other animals living in or on water, air, or land and the interrelationships which exist among these as well as ecological, socioeconomic, and cultural resources (TxDOT, 1993).

Expansion joint: A narrow space between roadway slabs to allow for expansion and contraction of rigid slabs without damage.

Fixtures: Delineators, guardrails, and other highway devices used to enhance roadway user safety.

Fog line: Continuous white line painted between the right lane edge and the shoulder to mark the roadway edge in poor visibility conditions.

Glare screen: A barrier placed along the center of the median to block glare from headlights of oncoming traffic. Shrubs are sometimes planted along the median for this purpose.

Herbicide: Chemical compound designed to limit or regulate plant growth.

Highway, Street or Road: General terms denoting a public way for purpose of vehicular travel, including the entire area within the ROW. Recommended usage in urban areas is highway or street; in rural areas, highway or road.

IPM: Integrated Pest Management, a decision-making process which may employ any or all available pest management methods to address situation-specific management needs.

Insecticide: Chemical compound designed to regulate or limit pest insects.

Inside shoulder: A shoulder that is part of a median.

Interchange: A system of connecting roadways in connection with one or more grade separations providing for the interchange of traffic between two or more roadways on different levels.

Landscape planting: Ornamental vegetation usually installed for aesthetic purposes.

Levels of Urbanization: Each segment of TxDOT ROW is classified using average daily traffic (ADT) and development of adjacent property on scale of 1 (developed urban) through 4 (rural). Segments receive levels of pest management commensurate with their levels of urbanization, with intensive management for urban areas and less detailed management for rural areas. See Table 1-1 for a more detailed description of this classification scheme.

Maintenance Section: TxDOT has divided the state into 254 geographical areas following county delineations for the purpose of ROW maintenance. Each maintenance section has a maintenance supervisor and resident maintenance crew who are responsible for highway maintenance within the area.

Median: The portion of a divided highway separating the traffic lane opposite directions; medians may be paved or unpaved; median width is measured from the edges of the traveled ways.

Mitigation: Mitigation of impact means either avoiding the impact entirely by not undertaking a certain action or a part of the action; minimizing the impact by limiting the magnitude of action; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or compensating for the impact by replacing or providing substitute resources or environments (Christopher, 1992).

Outside shoulder: Shoulder adjacent to safety strip.

Passive Zone: See Roadside Management Zone.

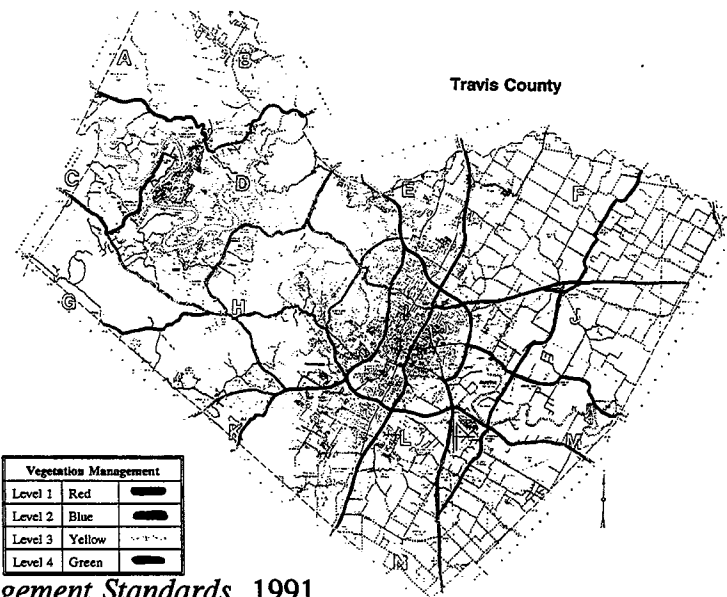
Pavement cracks: Fractures or fissures in an asphalt or concrete surface.

Table 1-1. TxDOT's Classification of Levels of Urbanization for Linear ROW Segments (and Illustration)

How to Determine Levels

Use the average daily traffic (ADT) ranges and descriptions of surrounding property use from the table below to determine the appropriate level of vegetation management for each segment of state maintained roadway in the district. The color corresponding to each level will be used on the district map showing the level of vegetation management for each state maintained roadway, as described in the subsection following this table.

If the ADT is...	And the surrounding property use is...	Then the Level is...	Color
varied	Developed urban (residential, commercial, or services)	1	Red
10,000 and above	Partially developed urban or rural	2	Blue
3,000 to 10,000	Rural (moderately maintained interstate, U.S. and high-volume state highways and high-volume FM and RM roads)	3	Yellow
0 to 3,000	Rural (low maintenance areas: low volume state highways and FM and RM roads)	4	Green



Source: *Vegetation Management Standards*, 1991.

Pavement edge: The outer limit of a pavement.

Program: TxDOT's pest management program is comprised of the entirety of activities directed at the control of insects and vegetation found along the state highway system. The vegetation management system (VMS) is the larger portion of the pest management program, and is comprised of all operations performed to manage vegetation. The Insect Management System (IMS) is by far the smaller portion of the program, primarily controlling fire ants in safety, rest, and picnic areas.

Right-of-way (ROW): The corridor provided for a highway, usually including the roadway itself, shoulders, and areas between the roadway and adjacent properties. (TxDOT, 1993).

Roadbed: The roadway portion existing between curb lines or shoulder lines; divided highways would be considered to have two roadbeds, one in each direction.

Roadside: Land extending from the roadway to the ROW boundary, and including median areas of divided highways.

Roadside Management Zones: Roadside management zones are distinctive operational or engineering roadside areas which have contrasting management requirements and outermost travel lane objectives. The active zone extends from the edge of the roadway pavement to the centerline of the roadside drainage channel, and is managed relatively intensively. The passive zone extends from the drainage channel to the limits of the ROW, and is a source of wildlife habitat. (Figure 1-1)

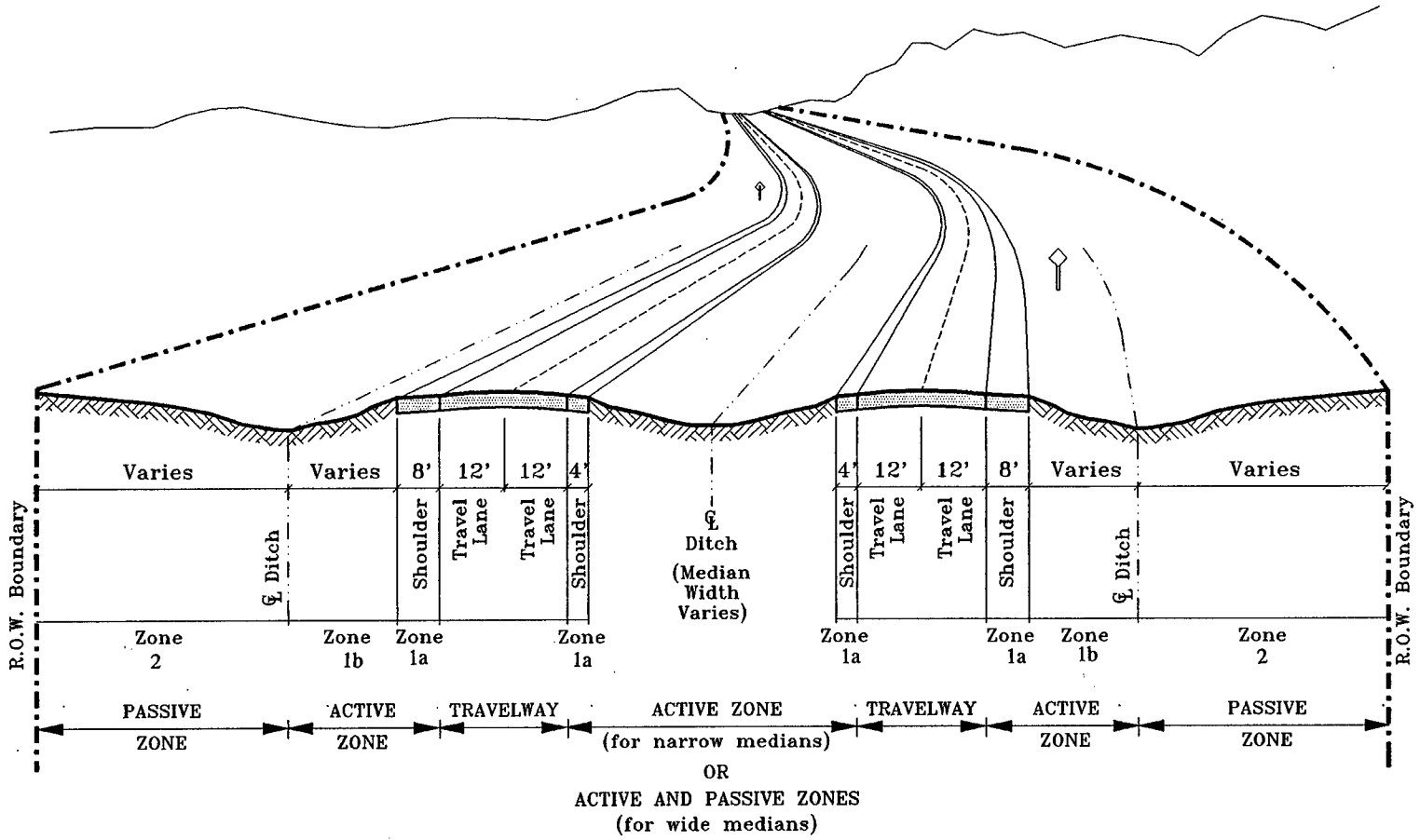
Active Zone (Zone 1): The active zone contains Zone 1a, the asphalt shoulder pavement, where present, and Zone 1b, a vegetated safety strip extending from the edge of the shoulder pavement (or roadway pavement, in the absence of a shoulder) to the centerline of the drainage channel. Zone 1a is kept free of encroaching vegetation. Zone 1b is managed for recovery of errant vehicles, for protection from erosion, and for fire protection.

Passive Zone (Zone 2): The passive zone is vegetated and extends from the limits of active zone to the ROW boundary. It is an important source of wildlife habitat and biodiversity on the ROW.

Ropewick: A selective method of application in which an herbicidal solution is metered onto a rope for wiping onto target vegetation.

Safety rest area: Also called a safety roadside rest area; an area containing parking, drinking water, toilets, picnic tables, or other amenities for roadway users.

Figure 1-1. TxDOT's Classification of Roadside Management Zones for ROW Cross-Sections



Safety strip: A vegetated strip 1.5-4.6 m (5-15 feet) wide adjacent to the edge of a paved or unpaved shoulder to provide space for recovery of an errant vehicle or for other emergency needs. Management of the vegetative cover would enhance environmental quality, prevent erosion, provide visibility of signs and other roadside fixtures, and discourage the incidence of wild fires.

Shoulder: A paved or unpaved area adjacent to the travel lanes designed to accommodate roadway emergencies and in some cases, bicyclists or pedestrians. Shoulders also provide lateral stability for surface pavement and base courses.

Sight distance: The continuous length of highway visible to the driver.

Spot treatment: Target-specific chemical treatments to a small area or distinct target, such as a clump of undesirable plants, the base of a highway fixture (for herbicides) or an ant mound (for insecticides). Often involves the use of a selective chemical affecting a specific target pest, leaving adjacent species unaffected. Usually accomplished by portable handheld sprayers or by one or more nozzles on truck- or tractor-mounted sprayers.

Spray: A liquid application of chemicals such as herbicides or insecticides.

Stockpile: A storage pile of highway construction materials such as gravel.

Travelway: The portion of highway which functions as roadway to vehicular traffic in standard paved lanes.

Zones: See Roadside Management Zones.

1.1.4 Description of TxDOT's Current Practices

1.1.4.1 Program Objectives

Roadside pest management is used by transportation agencies to protect public safety and capital investment in the highway corridor. TxDOT's pest management program expands these universal management goals as follows (TxDOT, 1993). Roadside pest management is undertaken to:

- Ensure the safety of highway users and TxDOT maintenance personnel;
- Prevent erosion through the establishment of permanent vegetative cover;
- Enhance environmental protection within and adjacent to the highway corridor;

- Promote and preserve native wildlife habitats and native flora in each of the ten vegetational regions of Texas; and
- Promote coordination and efficiency in maintenance activities.

TxDOT's VMS is designed to achieve these goals in concert with IMS to protect the public in TxDOT traveler facilities and workers engaged in maintenance tasks. While safety is paramount, other objectives such as the restoration of desirable plant communities, biological diversity, and relative increases or decreases in desirable forage or cover for wildlife are achievable within a roadside pest management program. Descriptions of program objectives and activities follow.

Maintenance for Visibility: Unobstructed views of vehicular and pedestrian traffic, pavement edges, and highway fixtures along the ROWs are essential for highway safety. Appropriate sight distances must be maintained to allow roadway users adequate time to respond to changes in the condition of the road ahead, traffic conditions, and signage for traffic direction.

Maintenance for Drainage: Pavement integrity and user safety depend on adequate drainage of water from pavement areas. Ponding of sheet flow may be a problem if vegetation is permitted to encroach beyond the pavement edge. Water ponding on the roadway may cause operators to lose control of their vehicles from hydroplaning, resulting in the loss of life or property. Lack of a designated subsurface drainage also causes roadway base failure. Excessively tall vegetation in drainage channels may impede flow from the pavement, particularly those channels with very slight grades. Loss of channel function is a design or maintenance problem. The channel must be stabilized (as in a grassed waterway), but vegetation should be low enough to not impede flow. Flat-bottom ditches usually are mowed with mowers 1.5-1.8 m (5-6') wide. Encroachment is not the problem.

The maintenance of vegetative cover is essential in areas of rapid drainage, whether sheet (uniform, low volume) or channel (concentrated, higher volume and velocity) flow. Vegetation tends to increase infiltration rates and decrease runoff volume. Decreased runoff volume and velocity reduce erosive effects and improve water quality (Dillaha et al., 1989).

Maintenance for Clearance: In addition to lateral encroachment over the paved surface, vegetation may encroach into airspace above the roadway through normal growth, creating a tunnel effect. For example, tree branches may extend into the space required for the passage of trucks and other large vehicles traveling the roadway. Riparian species sometimes surpass the height of bridge decking or encroach upon the roadway through bridge banisters.

An unobstructed area immediately adjacent to the roadway allows roadway users to make emergency stops, recover control of vehicles leaving the roadway, or see animals entering the roadway.

Protection of Roadway Integrity: Encroachment of vegetation into or onto pavement accelerates deterioration of these facilities. Vegetation growing in joints or cracks threatens roadbed integrity by funneling water beneath the pavement, which softens and destabilizes roadbed materials. The weakened roadway base allows overlying pavement to become stressed and fail. Vehicles traveling over these stressed areas promote the formation of potholes. Plant growth and freeze/thaw cycles perpetuate the deterioration cycle by enlarging joints and cracks.

Control of Erosion: Vegetation plays a major role in preventing soil erosion. Soil erosion along roadways increases stream sedimentation and risks for aquatic ecosystems and may result in deposition of sediment on the highway surface and adjoining lands. Excess sediment clogs drainage facilities requiring more frequent cleaning. Extreme erosion reduces stability in cutbanks and fills, increasing the risk of slope failure. Soil erosion resulting from inadequate vegetation may cause such problems as undermining of the shoulder, roadway, and other structures. Maintaining soil cover is especially important when overstory vegetation is removed to satisfy other described needs. Soil erosion threatens capital investment, increases maintenance costs, and scars the landscape.

Control of Noxious Weeds: Noxious weeds are plants classified by the Texas Department of Agriculture as detrimental to agriculture or public health, safety, and welfare. Prevention of the importation of these weeds is accomplished through the seed law, while control of established weeds is the responsibility of the landowner.

In certain ROWs the control of noxious weeds removes a potential seed source for infestation on adjacent properties. Such plants may be a nuisance, be poisonous to livestock, or lower the quality and market value of a harvested crop. Noxious weed infestations from seed produced on the ROW could impact the agricultural economy of an individual enterprise, the local area, and the entire state. Most noxious weeds can readily invade disturbed or bare soils. Maintaining a dense cover of native or preferred vegetation would discourage invasion by noxious weeds.

Reduction of Fire Hazard: Dry vegetation outside pavement edges could be ignited by contact with catalytic converters, mufflers, or discarded smoking materials. Smoke from resulting fires limits highway visibility, while fires may damage highway facilities and adjacent properties. The potential for fire varies widely among the different regions of the state, depending largely on climate and on type and quantity of fuel. Close mowing of safety strips reduces the risk of fire ignition and intensity, and its

spread into outer portions of the ROW and adjacent properties (Hauser and McCully, 1993).

Removal of Hazardous Vegetation: Dead or dying limbs, trees, and large shrubs can fall onto the roadway or shoulders, striking vehicles or requiring sudden evasive maneuvers to avoid collision. Such events usually occur during windstorms or periods of heavy rainfall. Ice storms may weigh down and break trees and limbs, causing them to fall onto the roadway. Dead or weakened vegetation on the ROW is susceptible to infection by microorganisms or attack by insects. Invaded vegetation then becomes a host for such organisms, placing the health of the adjacent ROW vegetation at risk.

Aesthetic Maintenance of ROW and Ornamental Landscape Plantings: Both the definition of an attractive roadside and the relative importance granted to maintaining roadside appearance varies widely among individuals and regions. Situations considered unattractive by TxDOT include volunteer vegetation along paved medians and weedy growth in landscaped areas. In addition to its unattractive appearance, this weedy growth competes with the landscape plantings for soil moisture and nutrients.

Maintenance of Signal Function: Fire ants have been known to invade electric signal boxes and strip insulation from wires, causing short circuits, which disable traffic signals and luminaries (MacKay et al., 1991). It is imperative that ants be controlled in signal boxes to ensure the safety of the traveling public and workers servicing these installations.

Protection and Enhancement of the Environment: TxDOT's highways pass through diverse environments, ranging from humid prairies and forest in the southeast and east to desert shrub, grassland, and mountain forests in the west (TxDOT, 1993). TxDOT's pest management goals are to balance the needs of highway users with environmental concerns. Important environmental concerns of pest management include: controlling soil erosion, maintaining water quality, enhancing wildlife habitats, enhancing native vegetation, controlling noise, providing a pleasant visual environment, and protecting the health and safety of TxDOT workers and the public.

Establishing desirable vegetation helps control soil loss due to erosion. Planting permanent erosion control vegetation has a direct bearing on long-term vegetation management requirements. It is consistent with roadside maintenance to establish low-maintenance vegetation, either by manipulation of the existing plant community or by actively planting desirable species. Zone 2 of the roadside could support wildlife and restore biodiversity in a manner that would not conflict with the safe use of the highway. To the extent practical, native vegetation should be used along highway ROWs. Where the use of native vegetation is impractical, careful consideration should be given to the selection of adapted species to ensure they meet TxDOT's needs and do not conflict with ecological concerns.

Some areas would be intended for active use by the traveling public (Zones 1a and 1b), while others would need to integrate the transportation facility into the environment through which it passes (Zone 2). Visual impacts could be important considerations for quality of life enjoyed by both users and adjacent landowners. Well-maintained vegetation in Zones 1b and 2 of the ROW contribute to the water quality of an area by: 1) preventing soil erosion, 2) acting as a filter to effectively trap sediment and pollutants, and 3) slowing the flow of runoff.

Traveler and Worker Comfort and Convenience: TxDOT maintains the highway environment for the pleasure and comfort of both users of the highway and those TxDOT personnel charged with maintenance in the highway corridor.

1.1.4.2 Current Management Approach

TxDOT's current vegetation management philosophy is to maintain highway vegetation in an environmentally sensitive and uniform manner consistent with differing needs in the roadside management zones and the special conditions presented by local climate, topography, vegetation, and level of urbanization (TxDOT, 1993). See the discussion of levels of urbanization and roadside management zones in Section 1.1.3., (Definitions).

TxDOT's current pest management program is comprised of mechanical, chemical, and cultural treatments targeting primarily undesirable vegetation along with some fire ant infestations in ROW areas. Treatments would be prescribed on the basis of level of urbanization, roadside management zone needs, individual pest species present, and environmental conditions found in distinct portions of the ROW. Usually two or more component treatments could be applied within a given cross-section of the highway corridor. A description of each component of TxDOT's pest management program follows.

1.1.4.2.1 The Mechanical Component

In the mechanical component of VMS, TxDOT performs mowing as follows:

- **Full-width** mowing operations may be scheduled over most of the ROW (Zones 1b and 2) except for designated non-mow areas. Mowing should not be scheduled for desirable vegetative communities which require no management or on slopes considered too steep for treatment. Full-width mowing is performed in rural sections during the late fall or winter dormant season to avoid critical wildlife nesting periods and annual seed-producing periods for desirable vegetation.

- **Strip mowing** may be performed adjacent to the shoulder (Zone 1b) in scheduled cycles to support the various functions of the active zone. The width of the safety strips maintained using strip treatment varies from 1.5-4.6 m (5'-15') depending on specific roadside conditions such as the presence or lack of a paved shoulder and width of ROW. Appropriate sight distances and fire hazard reduction could be achieved using strip mowing treatments.
- **Spot mowing** could be performed adjacent to the shoulder (Zone 1b) when safety needs arise between scheduled mowing cycles. Sight distances for intersections, private entrances, signs, delineators, highway ramps, or drainage ditches, for example, may become obstructed by excessive vegetative growth produced by unusually high rainfall, threatening public safety and requiring immediate action.

Other mechanical treatments include string trimming around fixtures, some chopping or cutting operations, and occasional clearing of drainage channels or regrading of shoulders.

1.1.4.2.2 The Chemical Component

In the chemical component of VMS, TxDOT applies chemicals in three conservative, target-specific applications along the ROW:

- **Edge treatments** use truck-mounted spray equipment and prescribed nozzle arrangements to treat a narrow band (usually 0.6 m (24")) of encroaching vegetation along the edge of the shoulder pavement (Zone 1a). If the encroachment is small and scattered, it may be treated using spot application. The narrow edge band may be extended inward if the shoulder pavement is also infested.
- **Spot treatments** are intermittent applications to targeted fixtures or plants for increased safety, or when an area application is not feasible, using a prescribed nozzle arrangement with a truck-mounted sprayer or a portable hand sprayer. The usual targets are isolated fixtures such as signposts, delineators, or guardrails; or foliage, stems, or other portions of individual plants or small clumps of vegetation.
- **Overspray treatments** use truck-mounted spray equipment with a prescribed nozzle arrangement or ropewick applicators to treat stands of undesirable plants in Zones 1b and 2. Selectively controlling target plants favors desirable plants in their competition for sunlight, nutrients, water, and space.

In the chemical component of IMS, the contact chemicals Diazinon® and Dursban® are applied to individual fire-ant mounds using portable hand sprayers. In addition to contact materials which neutralize fire ants immediately, bait chemicals (Logic®) are

available for broadcast treatment. Chemical baits eaten by worker ants and queens alike arrest the development of ants and eventually kill them. Fire ant treatments are restricted to areas where people congregate and come into contact with fire ants, as in the vicinity of picnic or safety rest areas, and to electrical equipment serviced by technicians.

1.1.4.2.3 The Cultural Component

The cultural component of the VMS consists of such activities as seeding of grasses, legumes, and wildflowers after construction to compete with undesirable plants; reseeding after reconstruction or maintenance; interseeding in areas of thin vegetative cover; site preparation; surface mulching; installation of native and other adapted perennial plants; or similar treatments undertaken to enhance the establishment and competitive ability of desirable plants. Preventing the establishment of pest plants is achieved through such activities as the specification of seed materials free of pest plants; minimizing the use of soil materials from infested areas; and the thorough cleaning of maintenance equipment after use in infested areas.

While TxDOT's application of other vegetation management activities, such as mechanical and selective herbicide treatments, could be timed or formulated to enhance the establishment and competitive ability of desirable vegetative cover, this EIS does not define these applications as cultural applications. This is due to the difficulty in establishing which mechanical and chemical treatments specifically enhance desirable plants and which control all plants for safety reasons. As many treatments accomplish both objectives, it is nearly impossible to separate such treatments.

1.1.4.3 Public Involvement

The public has input concerning TxDOT's pest management practices through contact with local maintenance supervisors, a District Engineer or Vegetation Manager at the district level, and with the Vegetation Management staff in the Construction and Maintenance Division at the state level. If problems occur as a result of the program, the maintenance supervisor should be the first contact made by the complainant. On most occasions, the problem can be resolved locally.

TxDOT elected to voluntarily go through the EIS scoping process as a means of gathering public input. Public involvement in the EIS process is discussed in section 1.3.2 of this chapter.

1.2.0 History of Project

Vegetation management along roadsides has been an important part of TxDOT's roadside safety and maintenance program for decades. Although the reasons for controlling vegetation on ROWs have not changed significantly over the years, the methods used to control roadside vegetation have. The most notable change has been the development and uses of the current technology. In addition, it is important to look at what pest management goals would be desirable for the future in order to provide some understanding of the direction to pursue. The alternatives can then be assessed with these goals in mind.

1.2.1 Past Practices

Early roadside vegetation management programs across the country employed a reactive management strategy in order to meet the early vegetation management needs. Early maintenance programs were not as refined nor as complex as today's programs. The goals were to ensure the safety of the traveling public, protect the capital investment, and maintain roadside aesthetics. Chemicals were first used to control vegetation on roadsides in the early 1900s. As chemical products and procedures became more refined after World War II, the use of chemicals for vegetation and insect management became widespread and economical.

Prior to 1982, most of the highway corridors in Texas received routine, repeated mowing across their entire widths, ranging from 15.2-61.0 m (50-200'). These blanket treatments did not account for plant or animal species or habitat present in the ROW, variations in management needs from areas immediately adjacent to the travel lanes to the ROW boundary, or variations in levels of management based upon level of urbanization. Beginning in the 1950s, herbicides were used increasingly in situations where other methods were not feasible. As was common for the period, most herbicide applications employed nonselective soil-active chemicals.

Revisions to the PMP since 1982 have redefined the program, replacing soil-active materials with foliar spray treatments; implementing prescription treatments based on a situation-specific basis; designating vegetation managers in each district to formulate and implement the program in their areas; and providing for the publication of guidelines and conducting extensive annual training for personnel involved in pest management on TxDOT's ROWs.

In terms of treatment methods used, mowing has been reduced in extent. Some portions of the passive zone of the ROW (Zone 2 in Figure 1-1) have been returned largely to natural status. Herbicide treatments were increased in situations where other methods were not feasible. The spread of fire ant infestations into much of Texas in the late 1980s spurred the addition of some insecticide treatments to the former

vegetation management program, requiring a terminology shift to a "pest management system" comprised of a vegetation management system (VMS) and an insect management system (IMS). Cultural treatments have received increasing emphasis both as a distinct treatment method and as guidelines for application of mechanical and chemical treatments.

1.2.2. Development of Current Practices

1.2.2.1 TxDOT Policies - Decentralized Management

Vegetation management staff in the Construction and Maintenance Division establishes guidelines for pest management strategies, treatment methods, and environmental considerations, although a district has some operational latitude in selecting treatments and establishing priorities. TxDOT trains personnel in application techniques and equipment operation, and educates them concerning safety and legal requirements.

TxDOT staff have published three program policy manuals to guide district personnel in the formulation and implementation of pest management programs tailored to specific conditions in each local area:

A Practical Guide to the Establishment of Vegetative Cover on Highway Rights-of-Way (1993) contains extensive descriptions of and guidelines for cultural methods, including seedbed preparation; seeding and sodding procedures; and lists, descriptions of and uses for native and introduced grasses, legumes, and wildflowers suggested for ROW use.

Roadside Vegetation Management: A Volume of the Infrastructure Manual (1993) contains discussion and guidelines for contrasting levels of urbanization; roadside management zones; mechanical, chemical, and cultural methods; erosion control; managing wildlife habitat for common as well as threatened and endangered species; restoring the biodiversity of flora and fauna in the ROW; and legal program requirements. This document details TxDOT's findings that highway corridors could support diverse plant and animal communities and help protect threatened species. TxDOT has worked cooperatively with the Texas Parks and Wildlife Department and Texas Natural Resource Conservation Commission to develop strategies to achieve this goal. Memoranda of Understanding (MOUs) assure ongoing cooperation and consultation.

Herbicide Operations Manual (1991) contains detailed information regarding safety and legal requirements for the use of herbicides; strategies for individual pest plant species; the application of, limitations for, and precautions in using each chemical; and the description and use of various equipment, techniques, and materials.

Another useful TxDOT reference for maintenance personnel is the *Standard Specifications for Construction of Highways, Streets, and Bridges* (1993). The earthwork section contains useful narrative, definitions, tables, and figures for vegetation establishment and maintenance. Seeding specifications are presented by vegetation region, district, and soil type. The manual also gives planting dates.

Headquarters staff are available to district personnel for consultation on pest management strategies, policy compliance, and appropriate applications of the mechanical, chemical, and cultural components of the TxDOT PMP.

A pest management program for an individual district is planned and implemented in compliance with TxDOT PMP policies presented in the above published guidelines and associated memoranda, and legal opinions. Variations between districts occur due to differences in regional environmental conditions, pest species, and treatment situations, for example. District vegetation managers, in consultation with others, are involved in monitoring and evaluating situation-specific variations and pest infestations in an effort to create a pest management program appropriate for the district.

Program development begins in a maintenance section with a listing and prioritization of needs and requirements for highway maintenance. Similar programs from each section are submitted to the District Maintenance office for evaluation and consideration. One of the budget categories is Vegetation Management, and section requests are reviewed by the maintenance staff including the District Vegetation Manager, District Environmental Coordinator, and District Maintenance Supervisors. The program plan and associated budget approval by the District Engineers are forwarded to TxDOT headquarters in Austin for review and approval or modification.

1.2.2.2 Employee Training

Effective training is possibly the most important element of a successful program. The purpose of TxDOT's training program is to keep employees updated on changing regulations, products, and new technologies in vegetation and insect management. All aspects of vegetation management which could be used to make employees aware of project development and design concepts are part of the training program, including the sharing of employee experience and knowledge.

Training and other technology transfer is accomplished through extensive worker training and the publication of its policy manuals. TxDOT holds seminars and other training programs on methods and materials for vegetation management. These seminars involve agency and non-agency personnel at both field and management levels. These training seminars may include an annual herbicide training program.

1.2.2.3 Certification and Recertification

All TxDOT employees engaged in the practice of ROW pesticide application are required to obtain a non-commercial pesticide applicator's license from the Texas Department of Agriculture (TDA) prior to handling pesticides or recommending the use of pesticides on roadsides. This licensing process requires employees to attend and complete a TDA-approved training program. After successfully passing an examination and obtaining a license, a person would renew the license annually through the accumulation of specified continuing education credits.

TxDOT's annual herbicide training program includes such topics as principles, laws, methods, techniques, safety, record-keeping, and public relations. It emphasizes the use of chemicals as only one component of an overall program. Other topics included in the annual course help prepare the workers to accomplish their tasks in the most efficient and effective manner.

1.2.2.4 Maintenance Safety and Accident Records

TxDOT's Construction and Maintenance Division provides for pesticide safety training throughout each district. Particular care is taken to train employees regarding safety techniques during the mixing and application of pesticides.

TxDOT has suffered no accidents related to chemicals which have required hospitalization. Accident rates are highest for personnel performing mechanical treatments on the ROW. Collisions between maintenance personnel and vehicles traveling the roadway adjacent to pest management operations have resulted in death.

1.2.2.5 Management by Owners of Adjacent Property

TxDOT will allow property owners to mow the ROW adjacent to their property for hay. Arrangements should be made with the local maintenance office and certain conditions met. Also, some residents mow the segment of roadside in front of their home.

1.2.3 Future Practices

Determination of future pest management practices which may be implemented by TxDOT will depend on the selections of one of the five alternatives examined in this EIS. TxDOT's goals would be a primary concern, but national trends in management should also be considered.

A number of trends in vegetation management have been adopted in recent years. One of these trends is a reduction in chemical use because of potential or perceived

environmental impacts. This is countered by the fact that herbicide use can manage vegetation, in many cases, with greater attainment of management needs, at significantly lower cost, and with less disturbance to some environmental compartments than other available methods. In some cases, management needs cannot be met at this time without the use of chemical tools.

Another trend in vegetation management is the practice of monitoring sensitive areas. Computers can often be used to monitor sensitive areas and can program the best management practice (BMP) for all vegetation, not just a sensitive area.

Lastly, the trend towards establishment of stable, low-maintenance plant communities in the equivalent of TxDOT's safety strip (Zone 1b) and passive zone (Zone 2, Figure 1-1) is gaining momentum. The use of cultural methods to establish low-maintenance communities using native or other adapted competitive plants restores native flora and fauna to the areas and stimulates increased biodiversity. Stable communities require little or no management once established, and yield economic, aesthetic, and environmental benefits.

President Bill Clinton signed a memorandum on April 26, 1994, directing federal agencies to improve landscaping practices by, among other items, using regionally native plants (FHWA, 1994). The memorandum was drawn from the work of an interagency task force which included the U.S. Department of Transportation. It is hoped that the federal agencies charged with this initiative will lead state agencies by example.

Integrated pest management is the selection, integration, and implementation of pest control through the prevention and monitoring of pest populations. IPM could establish an action threshold level at which treatment should take place, and select and implement one or more treatments which could fully satisfy safety and maintenance requirements with a focus on preventing the recurrence of the pest problem. TxDOT's current program incorporates elements of integrated pest management into maintenance decisions. One alternative presented in this document expands TxDOT's current program to more fully achieve integrated pest management goals. Alternative E calls for:

- Defining long-term goals and objectives in local plans. Long-term planning using the principals of IPM is probably the most important aspect of Alternative E;
- Documenting the rationale behind management decisions. This could, in time, enhance future management decisions by providing a history of the decision-making process;

- Monitoring the efficacy and cost of chosen control methods. This, coupled with the documentation of rationale, would provide management a means to evaluate past and current control methods; and
- Identifying environmentally sensitive areas. This promotes employment of optimal pest management practices for the enhancement of these sensitive areas.

1.3.0 Community and Interagency Coordination

The following summarizes the means used by TxDOT to notify the public and other government agencies of scoping for the DEIS. Scoping input was obtained through an official public announcement and a selective mailing. A Notice of Intent (NOI) was published in 16 *Texas Register* 2330 on April 23, 1991. Respondents were asked to submit comments by May 30, 1991. In addition, 35 Letters of Intent (LOI), dated May 29, 1991, were sent to selected individuals, government agencies, and groups known to have an interest in the interaction of highways and the environment. A copy of TxDOT's Herbicide Applications Summary Chart was enclosed in each letter for reference. Respondents were asked to submit comments by June 28, 1991, although comments were accepted after this date.

1.3.1 Summary of Scoping Results

All comments and letters from respondents received during the initial scoping period were considered in developing the following summary. Further, the concerns expressed established the study parameters of the EIS.

Comments expressed concern for the quality of various environmental compartments including water, air, soils, wildlife and habitat, aesthetics, vegetation, and human health. Other comments expressed concern regarding the need for vegetation management, legal compliance with applicable regulations, coordination with other agencies, and costs for each treatment method.

Scoping responses were edited, collated, and published as TTI Research Report 1933-1, *Summary of Scoping Issues for the Environmental Impact Statement on TxDOT's Pest Management Program*. Copies may be requested from:

Texas Transportation Institute
Information and Technology Exchange center
The Texas A&M University System
College Station, Texas 77843-3135

1.3.2 Summary of Issues Raised

There were a number of common themes in the concerns and comments received during scoping as mentioned in Section 1.3.1

Action of Herbicides: Comments ranged from advocating the continued use of herbicides to the elimination of their use. There were a few comments that urged the use of herbicides with greater selectivity.

Use of Native Vegetation: This was a very popular subject throughout the comments. The general consensus was to increase the use of native vegetation along roadsides. Respondents suggested the elimination of noxious weeds while leaving native vegetation.

Desire for Alternative Techniques: Comments suggesting alternative techniques, strategies, and tools were varied and useful. Comments proposed the use of selective chemicals only; the establishment of action levels at which point pests should be treated; the review of design and construction standards which may encourage pest infestations; and the use of mitigation measures for chemical use.

Other treatment techniques included integrated pest management; increased mowing and manual methods; the use of biological and cultural methods; and especially the installation of low-maintenance native plant species.

1.4.0 Purpose of and Need for Action

1.4.1 How Transportation Needs are Met

TxDOT has designed roadsides to perform operational, visual, and environmental functions in a cost-effective manner. The highway and roadside are engineered environments which require maintenance to protect the safety of the traveling public and the investment made in the highway infrastructure. Roadside pest management is vital to keeping roadways, signs, and safety hardware operational and safe for the highway user.

TxDOT's vision incorporates environmental enhancement into the basic transportation needs for the highway ROW. TxDOT's ROW maintenance goals are:

- Maintaining safe travel on the highway;
- Maintaining the capital investment in the highway facility;
- Mitigating the impact of the transportation facility on the environment; and

- Restoring the biodiversity of the native flora and fauna in the highway corridors in each region of the state.

1.4.2 How Regulatory Requirements Could Be Met

TxDOT has no legal requirements to develop an environmental impact statement for its pest management programs. The purpose of this DEIS is to analyze TxDOT's existing pest management program. The DEIS could give TxDOT a better understanding of current effects of vegetation and insect management techniques on the environment and on the health of the general public and TxDOT employees. Using knowledge gained from the EIS process, TxDOT could select a management program which would improve long-term efficiency of its pest management practices and increase environmental and human safety.

This analysis should provide an understanding of current practices and their effects on human health and the environment, even though all chemicals used by TxDOT in its roadside management activities have been tested, registered, and approved for general use by US EPA. The EIS should provide for:

- Analyzing statewide effects of vegetation management;
- Improving consistency of methods between the various management areas;
- Improving long-term efficiency of management practices;
- Evaluating environmental safety; and
- Evaluating human safety, both for citizens and TxDOT employees.

TxDOT would use the information and recommendations given in the EIS to better serve the citizens of the state of Texas and protect the environment.

Table 1-2. Summary of Primary Needs for TxDOT Treatment Situations

ROW Treatment Situation	Primary Management Needs	Targeted Vegetation Types	Targeted Insect Types	Preferred Vegetation Types
Pavement and curb joints and cracks (Zone 1a)	Clearance Visibility of pavement edge Drainage Roadbed and pavement integrity Reduction of fire hazard	All	---	None
Surfaced shoulders and paved medians (Zone 1a)	Clearance Visibility of pavement edge Drainage Pavement integrity Reduction of fire hazard	All	---	None
Fixture bases (Zone 1b)	Visibility of fixture Reduction of fire hazards to fixture Maintenance access	Plants tall, summer-senescent.	Ant mounds which obstruct access for maintenance	Perennially green, low-growing plants
Bridges and fences (Zones 1 and 2)	Clearance Visibility Maintenance Access Reduction of fire hazard	Plants tall, summer-senescent.	Ant mounds which obstruct access for maintenance	Perennially-green, low-growing plants
Safety strips (Zone 1b)	Clearance for vehicle recovery Reduction of fire hazard Visibility of pavement edge Appearance Roadbed and pavement edge integrity Drainage	Woody plants; invasive plants; summer-senescent plants; tall plants.	---	Noninvasive, perennially green, low-growing plants
Sightlines and general ROW areas (Zones 1b and 2)	Sight-distance visibility Wildlife visibility Enhance visual quality (wildflower displays)	Tall plants which obstruct sight-distance visibility	---	Native vegetation; low-growing plants adjacent to roadway; Allowable plant heights increase with increasing distance from roadway
Drainage channels and culvert headwalls and endwalls (Zones 1b and 2)	Drainage Visibility	Tall woody and large herbaceous plants which obstruct drainage	Various ants	Low-growing plants which do not obstruct drainage and help prevent scour during heavy flow.
Landscape plantings (Zones 1b and 2)	Appearance Reduction of fire hazard Reduction of soil-moisture competition	Volunteer plants incompatible with visual quality objective	Ant mounds which obstruct access for maintenance	Landscape plants such as selected grasses in lawns, ground covers, shrubs, and trees
Stockpiles (Zone 1b)	Construction material integrity Appearance	All	All	None
Electric signal boxes (Zone 1b)	Integrity of electrical function	Taller-growing plants at base	Ant mounds in boxes	Low-growing plants at base
Safety rest areas and picnic areas (Zones 1b and 2)	Visitor safety	Varies	Ant mounds in high-contact areas	Varies

Source: TxDOT; (adapted from Jones and Stokes, 1991.)



Chapter 2

EIS
Pest Management Program



2.1.0 Introduction

Based on concerns identified during the scoping process, five alternative strategies were formulated to evaluate the impacts on the environment of the various treatment methods available to TxDOT for roadside pests. Alternatives to be assessed in this DEIS are based on specific approaches to pest management. The various management approaches place limitations on or give priority to certain methods of treatment. Impacts to the environment could vary between alternatives, based on the limitations and priorities selected by each pest management approach. This DEIS assesses mechanical, chemical, biological, and cultural treatment methods.

Alternative A, the "No Action" alternative, will serve as a baseline to which the impacts of other alternatives will be compared. **Alternative B**, the "Short-Term Remedial Action" alternative, is a reactionary approach where vegetation will be managed only when the highway facility is unsafe for operation. This alternative is designed to provide the quickest control at the lowest cost. **Alternative C**, the "No Chemical" alternative, is presented as an alternative to the use of chemicals for pest management. This alternative eliminates the use of herbicides and insecticides as a treatment method. **Alternative D**, the "Current Practices" alternative, is the current pest management program used by TxDOT. **Alternative E**, the "Integrated Long-Term and Locally-Based" alternative, is a long-term management approach designed to establish stable plant communities in the early years, thus reducing the cost of maintenance in subsequent years. The decision-making process for this alternative is locally-based to allow for situation-specific treatment strategies.

TxDOT maintains 123,314 centerline kilometers (76,640 centerline miles) of highway in Texas to effectively move people and goods throughout the state. The state highway system comprises approximately 404,720 hectares (1,000,050 acres), or 6 percent of the land area of Texas. Native or naturalized vegetation covers nearly all acreage of roadsides and medians (Kingston, 1989), while isolated landscape plantings of ornamental trees and shrubs may be found in urban areas.

Only a portion of total ROW is treatable roadside acreage. Some ROW areas contain slopes too steep for vegetation treatment, for example. For the purpose of this EIS, treatable roadside acreage is defined as the area extending from the joint between the outside travel lane and paved shoulder to the boundary of the ROW, as well as medians from travel lane to travel lane. It is estimated TxDOT has 326,000 hectares (805,200 acres) of treatable ROW acreage. Table 2-1 lists the estimated number of treatable

roadside acres by TxDOT district. These districts are delineated in Figure 3-1, "Ten Vegetational Regions with TxDOT District Overlay" located in Chapter 3 of the main body of the EIS.

2.1.1. Programmatic Boundaries

Environmental impact statements may be divided into two very general categories, project EIS and programmatic EIS. A project EIS is designed to address very specific environmental concerns that could relate to a specific project, such as the construction of a bridge or an interstate corridor. These EISs would be applied to a very limited physical area that is generally defined by the borders of a specific project. It is inappropriate to use a project EIS from one project to identify environmental concerns and mitigations for a different project because each EIS is very site-specific.

Programmatic (non-project) EISs are designed to bridge the gap between different projects and provide an environmental assessment of all activities that could be available at all possible sites. This DEIS is a programmatic EIS. It is designed to address the environmental consequences and mitigations that may occur from a collection of program management alternatives designed to manage roadside pest plants and insects along TxDOT highways.

Since this is a programmatic EIS, there would be no project boundaries as in a project EIS. It would, however, assess the impacts on pest management within highway corridors in Texas. Therefore, the effective boundaries of this EIS would be the Texas state lines between New Mexico, Oklahoma, Arkansas, Louisiana, Mexico and the Gulf of Mexico.

This DEIS includes only the ROW for state-owned and maintained highways, and would not be an assessment of pest management practices for any area within the state other than state highway ROWs. Also, it does not include the ROWs for county, private, or other roadways that are not owned and maintained by the state of Texas. In addition, in areas where state-maintained roads run through United States Forest Service (USFS) or National Park Service (NPS) boundaries, the USFS and NPS EISs apply for pest management in these areas. Therefore, this DEIS assesses the programmatic (non-site specific) environmental consequences on the 326,000 hectares (805,200 treatable acres) in the Roadside Management Zones 1a and 1b (active) and 2 (passive) shown in Figure 1-1.

Table 2-1. Total Treatable Acreage by TxDOT District

District	Treatable Area		Percent
	(ac.)	ha	
Paris (1)	(30,140)	12,197	3.7
Ft. Worth (2)	(34,350)	13,901	4.3
Wichita Falls (3)	(25,640)	10,376	3.2
Amarillo (4)	(43,350)	17,544	5.4
Lubbock (5)	(48,170)	19,494	6.0
Odessa (6)	(40,930)	16,564	5.1
San Angelo (7)	(38,440)	15,556	4.9
Abilene (8)	(35,190)	14,241	4.4
Waco (9)	(33,270)	13,464	4.1
Tyler (10)	(35,995)	14,567	4.5
Lufkin (11)	(25,480)	10,312	3.2
Houston (12)	(32,960)	13,339	4.1
Yoakum (13)	(37,410)	15,140	4.6
Austin (14)	(29,300)	11,858	3.6
San Antonio (15)	(46,130)	18,669	5.7
Corpus Christi (16)	(28,300)	11,453	3.5
Bryan (17)	(31,080)	12,578	3.9
Dallas (18)	(37,510)	15,180	4.7
Atlanta (19)	(28,300)	11,453	3.5
Beaumont (20)	(24,360)	9,858	3.0
Pharr (21)	(20,340)	8,231	2.5
Laredo (22)	(24,540)	9,931	3.0
Brownwood (23)	(24,300)	9,834	3.0
El Paso (24)	(24,390)	9,870	3.0
Childress (25)	(25,360)	10,263	3.1
Total	(805,235)	325,873	100.0

2.1.2 Description of the Alternatives

Alternative A: No Action

Objective: To eliminate management of ROW vegetation or insects along TxDOT-maintained highways.

Under Alternative A, no action would be taken to manage vegetation or insects in any portion of the highway corridor. Vegetation and insect infestations would grow uncontrolled, producing some of the following scenarios:

- Vegetation in the active zone could clog both parallel and cross-drainage systems.
- Vegetation tall enough to contact a catalytic converter could present a potential fire hazard to a vehicle and occupants.
- Uncontrolled vegetation could grow tall enough to restrict visibility of cross-traffic and create a potential hazard to the safety of road users.
- Deterioration of paved surfaces and edges could be accelerated, directly impacting the capital investment and the safety of motorists.
- Noxious weed infestations from seed produced on roadsides could impact the agricultural economy of the adjacent enterprise, the local area, and the entire state.
- Stinging, biting, and other noxious insects would be free to harass the traveling public and highway maintenance workers.

This alternative is offered for comparative purposes only, and is not an option for the TxDOT program.

Alternative B: Short-Term Remedial Action Approach

Objective: To manage and control ROW vegetation or insect pests only after it has been determined that public or worker safety, function of the highway facility, or capital investment are threatened. Treatment will be undertaken at the lowest available cost (labor, materials, and equipment) with an emphasis on worker productivity and immediate treatment results.

Under Alternative B, all methods will be available for use. No acreage will be treated using cultural methods however, because of the length of time it takes to effect control. Biological methods will not be used because of the current lack of predator insects for Texas ROW conditions and pest species. Priority will be given to mechanical and

chemical methods, as these methods generally provide immediate control of vegetation and insect problems.

Alternative C: No Chemical Approach

Objective: To manage roadside vegetation and insects without the use of chemicals.

Under Alternative C, no chemical herbicides or insecticides would be used for pest management, but other treatment methods (mechanical and cultural) would be available.

It is estimated that mechanical methods required under this alternative in the attempt to meet management needs will be comprised of 65 percent mowing, 15 percent grading, and 20 percent manual treatment.

Alternative D: Current Practices

Objective: To continue the vegetation and insect management practices as they are currently employed by TxDOT.

TxDOT vegetation and insect management practices are decentralized decisions carried out in the local maintenance sections, and vary among districts depending on local policies and priorities. The District provides guidance to sections concerning budgeting and public concerns to be implemented with the limited labor available, and TxDOT headquarters in Austin provides guidelines for decision strategy and specialized expertise upon request. Treatment methods are selected based on situation-specific conditions and implemented by a local Maintenance Supervisor.

Prevention of pest problems is addressed through the establishment and maintenance of desirable vegetation. Treatments are selected on the basis of observed infestations using some integrated pest management principles.

All control methods are available for use under Alternative D. Preference is given to methods which provide the greatest benefit within the constraints of local priorities. The method and amount of treatment varies among districts depending on operational constraints and priorities.

See Chapter 1, Section 1.1.4, for a description of current TxDOT practices.

Alternative E: Integrated Long-Term and Locally-Based Approach

Objective: To use a long-term, integrated pest management program that utilizes all available treatment methods to control vegetation and insects along ROWs.

The ultimate aim of Alternative E is to implement documented strategies for long-term management of vegetation and insects based on prevention of problems and employment of minimal maintenance. Establishment of a stable, desirable vegetative cover requiring minimal maintenance is a primary focus. Selection of an appropriate control methodology for a given area of ROW will consider but not be limited to:

- Environmental concerns such as soil erosion, impacts on humans and other organisms, wildlife habitat, and impacts on water quality,
- Safety considerations such as visibility of traffic and traffic control devices,
- Preservation of capital investment in the infrastructure,
- Hazards to production and market value of salable agricultural commodities from adjacent properties, and
- Presentation of a varied and aesthetically pleasing travel experience to the traveling public.

This alternative incorporates some of the decentralized aspects of Alternative D. It allows for localized, situation-specific decision-making within the framework of department-wide management strategies. Under this alternative, a statewide procedure would be established for guidance to each of TxDOT's districts to develop management plans written in a standardized format. The Vegetation Management Plans (VMPs) would provide a means for documenting the rationale supporting management decisions, track the efficacy and costs of control methods, and identify environmentally-sensitive areas, as well as provide a means for continuing public input.

Each administrative level within TxDOT would contribute to the selection, integration, and implementation of integrated pest management principles and practices.

The state office would formulate policies and procedures to:

- Prevent pest problems;
- Provide for monitoring and evaluation of pests, damage, and results of treatment;
- Define the action threshold, or population level, of various pests which could be tolerated based on legal, economic, health, or aesthetic thresholds;
- Rely on mechanical, cultural, and biological treatment of ROW pests wherever they fully satisfy the safety and maintenance requirements of the program; and
- Specify all aspects of judicious pesticide use consistent with the principle goal of preventing the recurrence of the problem situation.

These policies and procedures would be distributed in published manuals, executive orders, memoranda of understanding, legal opinions, and similar documents. Guides are in place for vegetation management; similar guides should be developed for treatment of insect pests.

Each TxDOT district would formulate a vegetation management plan (VMP) written in standard format and based on guidelines for statewide policies and procedures. The VMP would:

- Identify each specific pest problem;
- Identify available control measures;
- List designs or structural improvements which would mitigate the need for treatment;
- Target non-treatment areas;
- List the pest management objectives;
- Assess the risk for various treatments to the environment or to humans;
- Determine the cost effectiveness over the long term (5-10 years); and
- Monitor and record the results of treatment.

See Chapter 1, Section 1.1.4. for a discussion of TxDOT's published manuals and other program guidance.

The policies and procedures developed at state and district levels provide a basis for decentralization and implementation. Local maintenance supervisors, in coordination with the District Vegetation Manager, using the framework of the VMP, could determine priorities, plan treatment schedules within the framework of department policy and best management practices, and monitor treatment results.

Table 2-2. Treatment Distributions Under Alternative A - No Action

<i>Control Method</i>	<i>Percent of Program</i>
Mechanical	0
Chemical	0
Biological	0
Cultural	0

	0

Table 2-3. Treatment Distributions Under Alternative B - Short-Term Remedial Approach

<i>Control Method</i>	<i>Percent of Program</i>
Mechanical	70
Chemical	30
Biological	0
Cultural	0

	100

Table 2-4. Treatment Distributions Under Alternative C - No Chemical Approach

<i>Control Method</i>	<i>Percent of Program</i>
Mechanical	96
Chemical	0
Biological	0
Cultural	4

	100

Table 2-5. Treatment Distributions Under Alternative D - Current Practices

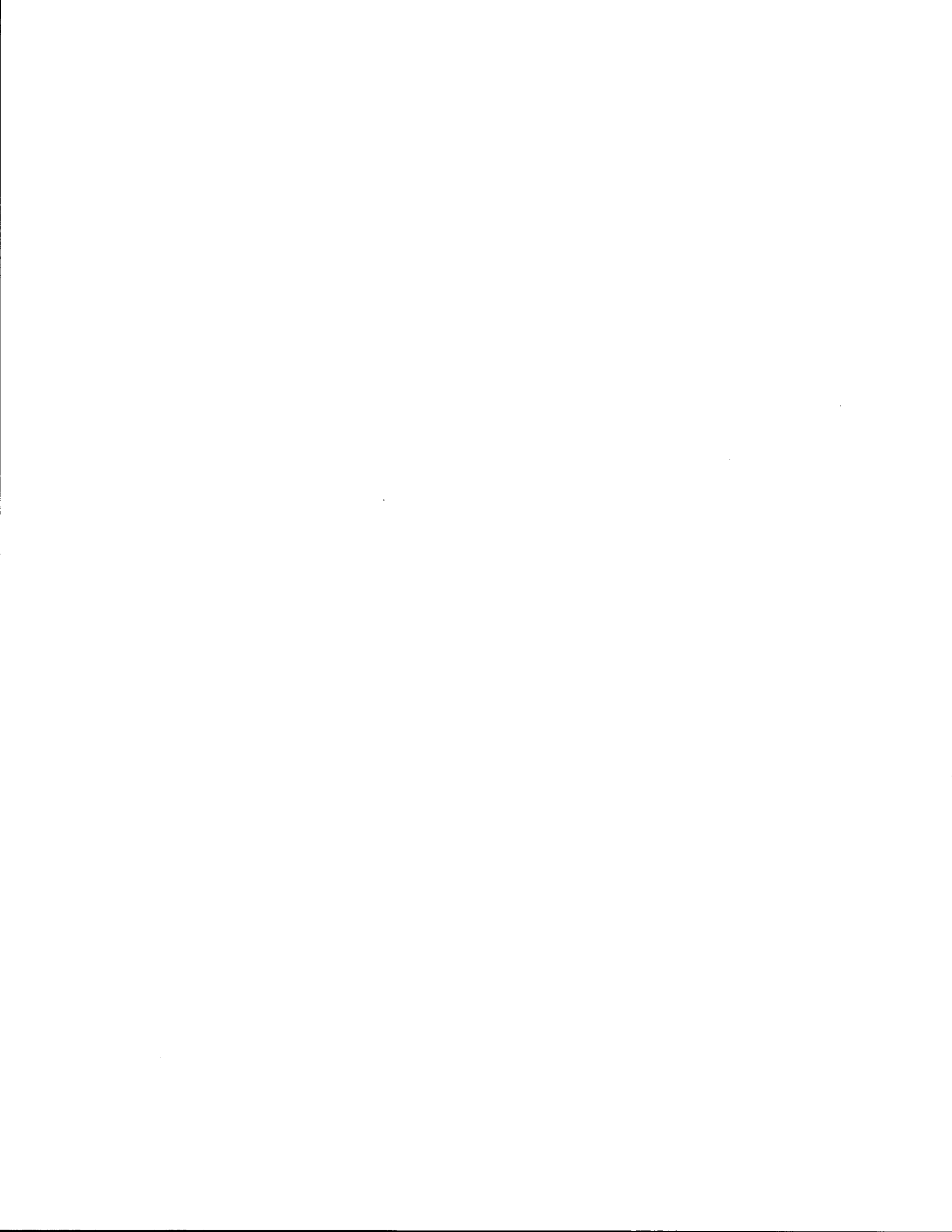
<i>Control Method</i>	<i>Percent of Program</i>
Mechanical	88
Chemical	11
Biological	0
Cultural	1

	100

Table 2-6. Treatment Distributions Under Alternative E - Integrated Long-Term and Locally-Based Approach

<i>Control Method</i>	<i>Percent of Program</i>
Mechanical	86
Chemical	8
Biological	0
Cultural	6

	100



Chapter 3

EIS
Pest Management Program



3.1.0 Introduction

This DEIS examines and compares the environmental impacts of the four viable roadside pest management program alternatives (B, C, D, and E) considered for use by TxDOT and the one non-viable alternative (A), which is used for comparison. The impact analysis in this chapter evaluates the different pest management alternatives in various environmental components. Management alternatives were developed from various combinations of treatment methods now used by TxDOT, as well as other methods shown useful in certain situations, and reflect concerns identified during the scoping process. Treatments used in one or more alternatives include mechanical, chemical, and cultural methods. Biological methods are an alternative method of treatment. Predator insects have been tested for controlling musk thistle (*Carduus nutans*) and goathead (*Tribulus terrestris*). Candidate predators are being evaluated for use on fire ants. However, biological predators presently are not specified for use on Texas roadways. Thermal treatment, such as controlled burning, was also considered but rejected. Controlled burning offers limited application potential for managing roadside vegetation and smoke from a fire posing a hazard to traffic (see p 1-3, Section 1.1.2, Chapter 1).

3.1.1 Environmental Matrix

The following sections of this DEIS examine the affected environment, potential impacts on the environment from each of the alternatives, and possible mitigation efforts for geology and soils, air quality, water quality, flood plains, wetlands, vegetation, wildlife, hazardous waste, visual quality, cultural resources, highway safety and services, and human health. Although these different aspects of the environment are discussed separately, they could be interrelated, and actions that directly impact one area often indirectly affect other areas. For example, removing vegetation may accelerate soil erosion, leading to water quality problems. Likewise, soil and moisture conditions determine the vegetation which may grow in any particular site, but the vegetation could determine the species of wildlife present. These interactions among environmental elements are discussed where appropriate.

3.2.0 Affected Environment, Impacts, and Mitigation

3.2.1 Geology and Soils

The state of Texas is located in one of the most diverse regions of North America in terms of environment and vegetation. It encompasses barrier islands, bays and estuaries coastal plains, rolling hills and broad flats, deeply-dissected uplands, mountain ranges, salt flats, and gypsum dunes. Precipitation, temperature, soils, and geology vary greatly throughout the state. Vegetation types range from marsh species to prairie grasslands to mixed-species forests to desert scrub. Appendix A, Chapters 1 and 2 discuss in more detail the vegetational regions, geology, and soils.

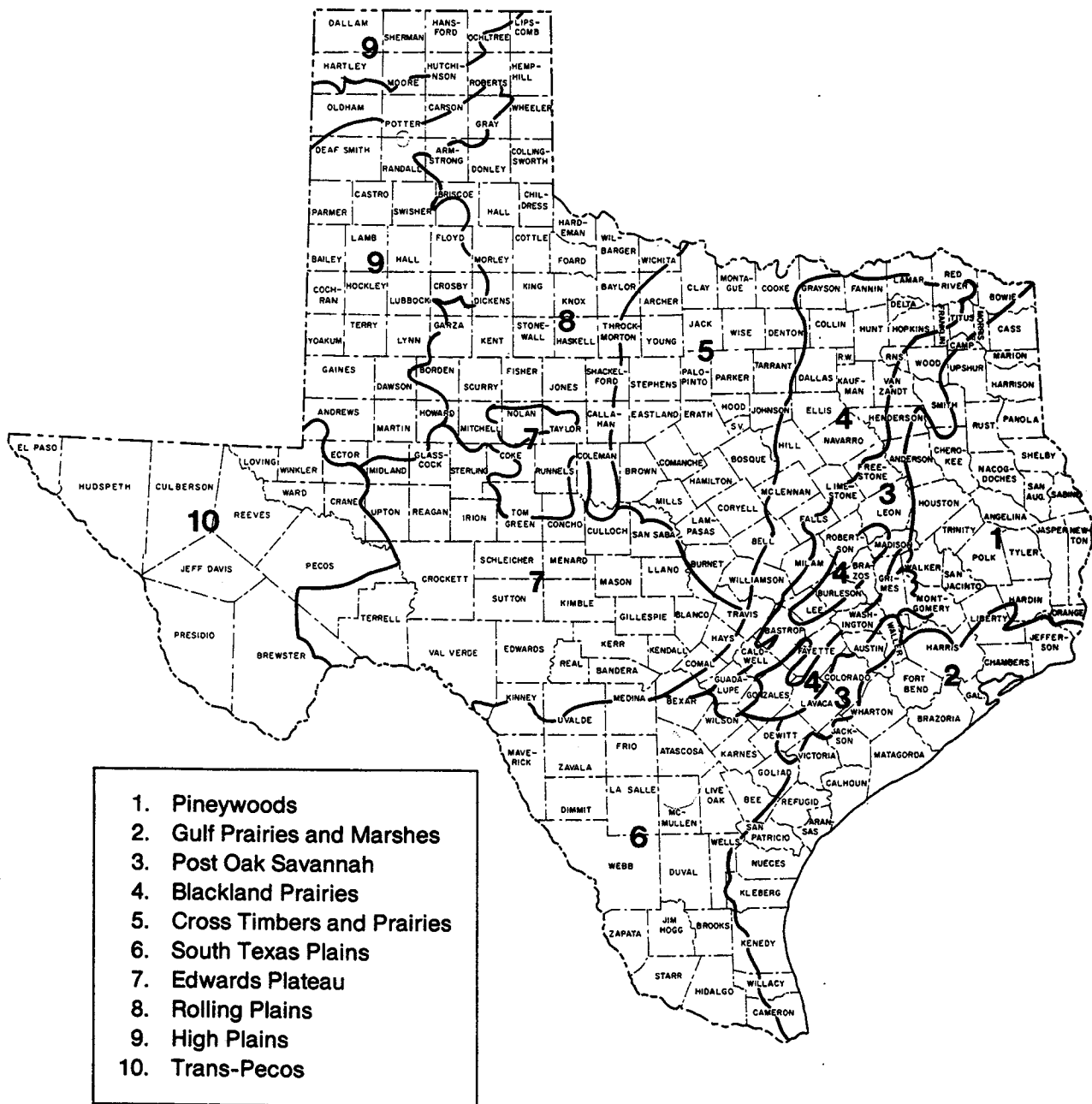
In a treatise on the natural vegetation of Texas, Gould, Hoffman and Rechenthin (1960) divided Texas into the ten major vegetational regions (Figure 3-1):

- (1) Pineywoods
- (2) Gulf Prairies and Marshes
- (3) Post Oak Savannah
- (4) Blackland Prairies
- (5) Cross Timbers
- (6) South Texas Plains
- (7) Edwards Plateau
- (8) Rolling Plains
- (9) High Plains
- (10) Trans-Pecos

Vegetation regions are broad regions of relatively homogeneous conditions in terms of geology and climate. Stratification by vegetation region reduces the environmental diversity of Texas into manageable proportions. The broad vegetational patterns and general geologic, hydrologic, soil, and climatic features in each of the ten vegetational regions are discussed in Appendix A, Chapters 1 and 2.

Stratification by vegetation region allows the environmental consequences of alternative roadside pest management practices to be evaluated and discussed more effectively than if presented holistically for the entire state highway system. Although the management of roadside vegetation in Texas may vary considerably among districts, the prescribed treatment remains reasonably similar within a region. Each TxDOT district may at least partially overlap two vegetation regions, with an accompanying variation in environmental conditions. Thus, there often could be multiple issues, approaches, and methods associated with a specific vegetation management operation.

Figure 3-1. Ten Vegetational Regions with TxDOT District Overlay



Source: TxDOT, Hatch et al., 1991.

Geology and soils often are important physical factors in determining slope stability, shoulder drainage, surface erosion, and water quality along Texas highways. Geology may directly influence ROW slope stability. Slope failures, in turn, could affect water quality and, in more severe cases, impact the physical condition of the highway ROWs. A good vegetative cover on highway ROWs also is extremely important. A good vegetative cover protects the function, stability, and condition of soils needed to support the development and implementation of workable vegetation management techniques.

3.2.1.1 Environmental Consequences of Alternatives

Potential adverse environmental impacts of roadside vegetation management techniques on geologic and soil resources include accelerated surface erosion, slope failures, soil compaction, and reduced soil productivity. Losses of surface soil may be accelerated by a reduction of vegetative cover, increasing erosion by wind or water. Vegetation removal and soil disturbance also could cause slope failures where unstable or moist soil conditions exist. Surface soil erosion removes the topsoil horizon, which tends to be richest in organic material, thus leading to reduced soil productivity.

Soil compaction may also reduce vegetative productivity by physically restricting root growth, limiting water and air storage and movement to the rooting zone, and forming an inhospitable seedbed. In addition, accelerated surface soil erosion is more probable on compacted soils. Although ROW soils often are disturbed and compacted during road construction, natural soil-forming processes may lessen compacted conditions over time.

Vegetation with deep roots, such as coniferous and deciduous tree species, is effective in maintaining cohesiveness of a soil mass. In addition, vegetation is effective in dewatering soil masses and in creating internal drainage channels to enhance slope stability.

In terms of specific management techniques, mechanical treatments would have the greatest potential to impact soils, particularly where grading is used to reconfigure the roadside terrain. The repeated use of equipment exerting a high ground-pressure, particularly under wet conditions, could cause soil compaction and inhibit the natural ameliorating process. Soil compaction resulting from roadside maintenance equipment is of most concern in portions of the state where soil texture is fine and soil moisture high. Mechanical mowing or flailing of live, deep-rooted vegetation has the potential for adverse impacts on slope stability, particularly on loose, sandy soils. Intensive manual control also could reduce slope stability due to the loss of soil stabilizing functions of vegetative cover.

Chemical treatment would not impact soils directly. Large-scale chemical destruction of live, deep-rooted vegetation has a potential for adverse impacts on slope stability similar to that of mechanical techniques. Soil compaction would not be a problem with chemical treatments, since spray trucks stay on the highway surface or on the paved shoulder during application.

Biological and cultural management techniques usually would maintain or enhance the stability of ROW slopes. Biological treatment aimed at specific undesirable plant species should reduce competition and enhance the growth of more desirable species that may be more effective in controlling erosion and improving slope stability. Cultural methods also would accelerate the development of desirable vegetative communities, again minimizing potential soil erosion problems. Adverse impacts of cultural and biological treatment methods on geologic and soil resources should be negligible. Short-term negative impacts related to cultural activities would include some soil erosion from ground preparation and planting.

3.2.1.1.1 Alternative A - No Action

Under Alternative A, personnel would take no action to manage roadside vegetation. During highway construction, ROW soils may be severely disturbed and compacted in Zones 1a and portions of Zone 1b, while soils in Zone 2 could be left largely intact. Following construction activities, disturbed areas could be seeded or planted with desirable plant species. However, without a vegetation management program to ensure establishment and maintenance of a healthy vegetative cover, roadside soil surfaces would be more vulnerable to invasion by weeds and to storm events that may lead to significant erosion. Loss of soil through accelerated erosion would cause further deterioration of plant community structure and productivity, as well as affecting water quality in stormwater runoff.

Without vegetation management, erosion would proceed uncontrolled. Unchecked, small rills and gullies could develop into major erosion problem areas. Under this alternative, no action would be taken to control noxious weeds. Weeds invade disturbed areas faster than desirable species and usually are less capable of preventing erosion than well managed desirable plant species. Noxious weeds also damage the productivity of adjacent agricultural lands. Roadside vegetation communities particularly susceptible to fire would become established in some areas. With greater potential for fires within the ROW, there would be a corresponding increase in fire potential on adjacent lands, as well as increased potential for soil erosion and water quality impacts. The absence of fire ant mound management would allow fire ant infestations in soils and other areas to proceed unchecked, presenting marked increases in hazards to users of safety rest areas, picnic areas, and to personnel maintaining electrical signals.

3.2.1.1.2 Alternative B - Short-Term Remedial Action Approach

Under Alternative B, remedial action would be taken to control vegetation only after a determination that public or worker safety, function of the highway facility, or capital investment were threatened. It is estimated that mechanical treatments would comprise 70 percent of the program, with chemical methods comprising 30 percent.

Fire ant mounds would be treated only after a determination that public or worker safety was threatened. Preventative treatments in safety rest areas would decrease, and hazards to the public would increase. No impacts to geology and soils would be expected.

Chemical degradation processes in soils are noted in Appendix B, Chapter 4. In the same appendix, through the use of the GLEAMS model, risks from pesticide transport and mobility within the soil profile and off-site losses through transport with sediment in stormwater runoff and in groundwater could be estimated for each chemical proposed for use by TxDOT (Harris et al., 1994).

The environmental impacts and consequences on geology and soils would be similar to those for Alternative C, but would have a smaller impact than those for Alternative A.

3.2.1.1.3 Alternative C - No Chemical Approach

Mechanical treatment methods, including mowing, grading, and manual techniques, would be the primary vegetation management approach under Alternative C. It is estimated that mechanical methods would comprise 96 percent of treatments and cultural four percent. Mechanical techniques would impact geology and soil resources through repeated compaction and inhibition of natural soil-forming processes. Compaction would inhibit plant productivity and accelerate soil erosion. Soil compaction by heavy equipment would be of greatest consequence in moist fine-textured soils.

Mechanical cleaning of the ditch to improve roadside drainage would disturb local areas of surface soils and reduce vegetative productivity. Natural nutrient cycles, which involve both soil and vegetation, would be disrupted and nutrients lost through water transport. Thus, the fertility base to establish and maintain healthy vegetation may be altered, leaving exposed mineral soil subject to accelerated water and wind erosion.

The heavy emphasis on mechanical techniques in Alternative C could lead to problems of mass soil movement, particularly in areas with high potential for mass soil movement activity. Mechanical mowing or flailing of live, deep-rooted vegetation has

the potential to adversely impact stability of loose, sandy slopes. If manual control is used intensively, it could also impact slope stability in localized areas.

The unavailability of chemicals under Alternative C would allow fire ant mounds to proliferate unchecked, presenting increased hazards to users of safety rest areas and picnic areas and to TxDOT personnel charged with maintaining the highway corridor. Ant mounds would infest many soils.

3.2.1.1.4 Alternative D - Current Practices

Currently, districts implement statewide policy dealing with pest management on roadsides. As in Alternative E, all available vegetation management techniques could be applied under this alternative, although a much heavier emphasis would be placed on mechanical methods and less emphasis on chemical or cultural methods. It is estimated that mechanical methods would comprise 88 percent of treatments, while chemical methods would comprise 11 percent, and cultural methods would comprise 1 percent. Chemical herbicides and insecticides would have no known direct impact on geology or soils. While chemicals could affect soil microorganisms, the limited roadside area treated and the natural repopulation characteristics of organisms would limit the severity of this impact. Chemicals, which would be subject to degradation by soil microorganisms, may actually stimulate microorganism populations during degradation.

For an assessment of potential surface and leaching losses from chemical use in TxDOT's current program, see Appendix B, Chapter 4. No adverse effects to soils would be expected (Harris et al., 1994).

The chemical treatment of ant mounds is not expected to impact geology or soils.

The immediate environmental consequences of Alternative D would be similar to those of Alternative E. However, the impacts on geology and soils over the long term would not diminish, as no decrease is expected in mechanical or manual treatments.

3.2.1.1.5 Alternative E - Integrated Long-Term and Locally-Based Approach

Alternative E would use all available vegetation management techniques on a situation-specific basis. Over time, the proportion of acreage treated by mechanical and chemical methods would decrease. During the early years, it is estimated that mechanical methods would comprise 86 percent of the program, while chemical methods and cultural methods would comprise 8 and 6 percent, respectively. Later, as stable vegetative cover is established, the need for mechanical and chemical maintenance is expected to decrease. Short-term impacts from cultural methods may include increased erosion. Biological methods would have no adverse effects on geology and soils. The immediate impacts of mechanical and chemical techniques

would be similar to those discussed in Alternative C. The long-term impacts on geology and soils would be expected to decrease as chemical and mechanical treatments decrease.

Chemical treatments would be used to control fire ants in high-contact areas. No impacts to geology and soils would be expected.

3.2.1.2 Unavoidable Adverse Impacts

Several components of vegetation management control techniques have the potential to cause unavoidable adverse impacts on the geology and soils of highway roadsides. All mechanical techniques may cause soil compaction, and some soil-intensive mechanical treatments expose mineral soil. These would accelerate erosion and reduce vegetative productivity. In areas of high soil instability, large-scale removal of deeply-rooted vegetation could lead to mass soil movement and water quality degradation during wet seasons. However, compared with the initial disturbance caused by road construction, the effects of roadside vegetation management on geology and soils generally are minimal.

3.2.1.3 Mitigation Measures

Most impacts of mechanical vegetation treatments can be minimized or avoided by limiting the number of treatments of any kind applied along a specific ROW, scheduling the activity during seasons with dry soil conditions, and restricting treatment to areas with flatter slopes. Roadside areas dominated by desirable grass communities should not be mowed until the grass has matured. Grading to reconfigure roadside terrain should be kept to a minimum and well-planned when used. Where soil surfaces are exposed, hydromulching or other planting methods should be used to protect the soil surface and to establish new vegetation as quickly as possible. In addition, vegetation removes water from soil masses and creates internal drainage channels that enhance slope stability. Maintenance of desirable vegetative cover would stabilize soils in the ROW corridors.

Unintended impacts related to herbicide and insecticide applications and potential off-site transport could be minimized by strict adherence to product labels. All chemical usage should be determined on a situation-specific basis. Factors considered to help promote maximum effectiveness include the target species, the type of chemical, the concentration and application rate of that chemical, seasonal weather conditions, and the availability of alternative strategies.

3.2.2 Air Quality

The air quality in Texas may vary considerably from region to region. The principal sources of contaminants often are motor vehicle emissions, industrial process emissions, and industrial fuel use. As a result, poorer air quality is generally correlated with the higher population densities of the state. Although more rural areas of the state may have better air quality overall than the urban centers, they could still experience air quality impacts. Dust and smoke from agricultural and forestry practices reduce air quality on a localized, short-term basis. Contaminants generated by these processes primarily include sulfur oxides (SO_x), particulates, carbon monoxide, nitrogen oxides (NO_x), fluorides, and hydrocarbons. With the exception of exhaust from motorized equipment (which contains carbon monoxide, sulfur oxides, nitrogen oxides, hydrocarbons, and particulates), relatively minor amounts of these contaminants would be generated by vegetation management activities in transportation corridors. Appendix A, Chapter 3 contains a discussion of air quality.

3.2.2.1 Environmental Consequences of Alternatives

The potential adverse impacts that roadside vegetation management might have on air quality would include both localized and regional impacts. Localized impacts would consist of short-term reduction in air quality as a result of dust generated from the use of heavy machinery. The use of chemicals also can have a localized adverse impact on air quality because of the potential for drift and the possibility of introducing objectionable odors into the air. These localized impacts generally are very short-lived.

Regional impacts would include the introduction of pollutants into the air as a result of the burning of fossil fuels. All of the heavy machinery, trucks, spray rigs, and many of the smaller powered hand tools burn fossil fuels. This introduces carbon dioxide, carbon monoxide, and other pollutants into the air that contribute to regional air pollution problems. However, the consumption of fossil fuel as a result of vegetation management techniques is a very small fraction of the total consumed in Texas, and it is not expected to degrade the overall air quality in the state.

In terms of specific management techniques, mechanical treatments would have the greatest impact on air quality through the introduction of particulates (dust) into the air. Mechanical treatments also burn more fossil fuels than the other treatments, but this impact is expected to be minor when compared with the use of fossil fuels statewide.

Chemical applications could introduce spray drift and possibly objectionable odors into the local environment. These are short-term air quality impacts.

Biological control of unwanted vegetation is not expected to impact air quality significantly.

Cultural treatment impacts on air quality would be the same as for mechanical treatments for initial treatments, but overall impacts would decrease as areas become established with low-maintenance vegetation.

3.2.2.1.1 Alternative A - No Action

Without vegetation management, there may be an increase in exposed mineral soil surfaces along roadsides, particularly in drier parts of the state. During windy conditions, airborne soil particles or dust generated along these roadsides could create a localized traffic safety hazard. While soil loss by wind erosion from roadside ROWs may be insignificant compared with that occurring on nearby agricultural lands, it is a factor in air quality deterioration.

In more humid parts of the state, where vegetation may regenerate more quickly, a lack of vegetation management would have minimal adverse impacts on air quality.

3.2.2.1.2 Alternative B - Short-Term Remedial Action Approach

Remedial action techniques under Alternative B would be primarily mechanical, with chemical treatment in some areas. The objective would be for immediate relief for specific safety problems. The reactive nature of this approach would preclude the use of biological and cultural management methods. The primary impacts on air quality would be through wind erosion, generation of airborne particulates, and vehicle emissions. There could be localized negative effects to air quality from applications of chemicals. The expected impacts of Alternative B would be similar to those of Alternative A. However, because of the consequences of mechanical and chemical treatments in some areas, the overall impacts of Alternative B on air quality would be greater than those of Alternative A.

3.2.2.1.3 Alternative C - No Chemical Approach

Alternative C depends heavily upon mechanical techniques to control roadside vegetation. The primary adverse impact of mechanical activities on air quality is the odor generated by exhaust emissions from gasoline- or diesel-powered machinery. Air quality may also be adversely affected by other exhaust emissions, including volatile organic compounds, carbon monoxide, particulates, NO_x, and SO_x. It is also possible to generate airborne particulates during activities such as grading and mowing. Where graders are used to clean ditches and areas between lanes, the surface soil would be exposed and wind erosion possible. Windblown particulates may be carried long distances in the atmosphere, depending on the soil type and climatic conditions.

Cultural techniques used under Alternative C would be expected to have short-term impacts on air quality through airborne particulates following soil preparation. There would also be some impacts from vehicle emissions.

Biological techniques of managing vegetation under Alternative C would have no known adverse impacts on air quality.

3.2.2.1.4 Alternative D - Current Practices

Alternative D would be a continuation of the current management procedures, with each district implementing statewide policy. Impacts from chemicals could be more significant with this alternative, but would apply to any alternative including chemicals as an option. Chemicals inadvertently carried by the wind (spray drift) have three potential impacts: occupational exposure, exposure of nearby human populations, and exposure of non-target plants and wildlife.

Occupational exposure of workers applying chemicals from inhalation of spray or direct contact with chemicals is a potential hazard which may require the use of protective clothing (see Appendix B, Chapter 2). The potential for effects on the general public also is considered in Appendix B. The effect of drift on non-target species depends on application techniques and their sensitivity to the type of chemical being used. Selective chemicals affect only related species, while nonselective chemicals will affect more species. Drift from applications would have negligible effects on wildlife. There also is a very slight potential for odor impacts associated with the use of specific chemical formulations.

The immediate environmental consequences of this alternative would be similar to those of Alternative E. The adverse impacts on air quality over the long term, however, would not diminish with time, as there would be no expectation to decrease the present emphasis on chemical and mechanical techniques.

3.2.2.1.5 Alternative E - Integrated Long-Term and Locally-Based Approach

All vegetation techniques would be available for use in Alternative E. The immediate impacts from mechanical and chemical techniques would be similar to those discussed in Alternatives B and D.

Cultural vegetation management methods may have several possible impacts on air quality, both positive and negative. Preparation of seedbeds or planting areas may generate dust emissions, which would be expected to be short-term and localized. However, after plantings are established, the potential for wind erosion of soil would decrease with the development of root systems and ground cover. These wind erosion impacts would also be expected to be short-term and localized.

Positive impacts of enhanced vegetation include the consumption of carbon dioxide (CO₂) and trapping of airborne pollutants. Another positive impact of cultural vegetation management techniques is a reduction in vehicle and equipment emissions due to a reduction in acreage requiring annual maintenance. No biological control agents are known to have adverse impacts on air quality when properly applied.

The long-term impacts on air quality under Alternative E would be expected to decrease as needs for chemical and mechanical techniques decrease.

3.2.2.2 Unavoidable Adverse Impacts

Roadside vegetation management may have several potentially unavoidable impacts on air quality. Dust emissions are likely during activities that disturb soil layers, including cultural and mechanical techniques that must be applied during dry weather. Exhaust emissions are an unavoidable result of all activities that require the use of motor vehicles or gasoline or diesel-powered equipment. Unpleasant odors occasionally are associated with the application of herbicides or insecticides. In addition, there is a slight potential risk of exposing people, wildlife, and other non-target organisms to airborne chemicals, particularly in areas where it would be impractical to remove non-target organisms or to prevent their entry during or immediately after chemical applications.

3.2.2.3 Mitigation Measures

A variety of potential mitigation methods are available to reduce or eliminate possible adverse impacts on air quality from the various management techniques. Electric-powered equipment could be considered as an alternative to gasoline or diesel-powered equipment, thus reducing objectionable odors and potential adverse health effects from exhaust emissions. Electric-powered equipment may be impractical, however, and can indirectly create exhaust emissions from either portable generators or power plants. Alternative fuels would be another option, and the cleaner-burning compressed natural gas already is being used by TxDOT. Dust emissions could be reduced by restricting activities that cause soil disturbance, such as mowing or occasional discing, to periods when winds are minimum.

To minimize possible adverse impacts on air quality due to chemical treatments, it is necessary to implement appropriate occupational safety and health training and controls for all employees responsible for chemical applications. Herbicides and insecticides should be selected and applied in a manner consistent with federally-approved warning labels to minimize the potential for exposures to non-target species of plants and wildlife. Chemical applications should be restricted to environmental conditions that

minimize the probability of drift outside the treatment area. Application methods, nozzle configuration of sprayers, and physical delivery systems should be selected to maximize droplet size and product efficacy. Adjuvants which reduced drift and mask odors should be added to spray solutions.

Air quality impacts of cultural vegetation management techniques could be mitigated by restricting activities that cause soil disturbance to periods when weather and soil conditions are likely to generate minimal particulate emissions. Dust suppression techniques could be used where appropriate, including water sprays to reduce dust generated by machinery, and straw mulch or tarps to cover small areas of exposed soil to minimize erosion.

TxDOT is formulating a procedure for containment of wildfires until suppression forces arrive. Under dry, windy conditions, wildfires may not always succumb to containment precautions.

Because biological control agents are considered to have no adverse impacts on air quality when properly applied, mitigation measures would not be necessary.

3.2.3 Water Quality

Protecting water quality is one of the primary reasons for maintaining a healthy vegetative cover in the roadside environment. Fresh water is defined as all non-salt water lakes and drainage waters including lakes, ponds, rivers, creeks, and irrigation canals. The marine waters of the state include the Gulf of Mexico and related bodies. The term ground water is used in this document to broadly mean all water below the ground surface. Appendix A, Chapter 4 contains a more in-depth discussion of water quality. Appendix B, Chapter 4 evaluates the risk of off-site movement of chemicals into surface and groundwater.

The greater the precipitation, the greater the likelihood of experiencing runoff for a given area. Runoff is defined as the movement of water across the soil surface until it reaches a defined natural stream channel. Runoff probably has the greatest impact on surface water quality throughout the state. If the soil surface on highway ROWs is disturbed during construction and maintenance, the infiltration capacity may be significantly reduced and runoff may occur. During heavy rain events (thunderstorms), even undisturbed sites could experience runoff. Moreover, the impervious road surface creates additional runoff.

Protecting ground water quality is of concern because of its importance as a resource for public drinking water supplies, irrigation, and industrial uses. The occurrence of aquifers is determined by the underlying geologic units. Figures 3-2 and 3-3 show Texas' major and minor groundwater reservoirs.

3.2.3.1 Environmental Consequences of Alternatives

Potential impacts on water quality from roadside vegetation management are primarily related to mechanical, cultural, and chemical methods which may cause accelerated soil erosion, transport, and deposition of sediment (including sediments from road surfaces), and to the use of the chemical pesticides which could introduce chemicals into non-target waters. Accelerated erosion may result from vegetation management where soil disturbance and compaction influence the natural infiltration and runoff processes. Adverse effects on streams and lakes resulting from the transport and deposition of eroded sediments include nutrient enrichment, increased turbidity, decreased dissolved oxygen levels (if nutrient concentrations sufficiently stimulate algal blooms), and the accumulation of toxic pollutants. These effects, in turn, may adversely impact fish and other aquatic resources.

In terms of treatment methods, mechanical treatments have the potential to disturb and compact the soils to the extent that runoff increases. This could increase erosion, which may transport sediment and chemicals into local surface waters. Frequent scouring of the ditch bottom also increases erosion and could destabilize ditch slopes.

Chemical treatment impacts can be summarized as either direct or indirect. Direct impacts would result from the introduction of chemicals directly into the water from drift, runoff, or leaching. Indirect impacts would result if the vegetative cover were reduced to the degree that erosion increased.

Cultural treatments would have similar impacts on water quality as would mechanical, in the sense that the soil would be disturbed in the preparation of seedbeds or plantings. This would cause a temporary increase in erosion from exposed soils and from compaction by equipment.

3.2.3.1.1 Alternative A - No Action

After revegetation associated with construction activities, there would be no further vegetation management under Alternative A. If any barren areas develop in the vegetation, or if erosion becomes a problem, no action to implement vegetative solutions would be taken to correct these conditions. In addition to the natural minerals, soils adjacent to roadways often contain elevated concentrations of pollutants that may be carried by surface runoff into water bodies. In vegetation management Zone 1b, the native soils may have been removed or altered, making these areas less suitable than undisturbed areas for encroachment by native species. The natural succession of plant species would be less likely to control erosion problems than on undisturbed soils.

In areas with more temperate climates, a lack of vegetation management may lead to prolific growth of roadside vegetation. Usually, a mixture of grasses, legumes, and wildflowers would be established in vegetation management Zone 1b following construction. These grasses act as a filter for roadway pollutants. However, where woody vegetation encroaches into Zone 1b and out-competes the planted grasses, a decrease in filtration of contaminants could occur. In general, the absence of vegetation management could increase the risk of erosion of roadside soils and decrease soil stability, thereby reducing the ability of the ROW to filter pollutants from stormwater before it reaches receiving waters. Excessive vegetation growth could block natural or artificial drainage channels, increasing stormwater detention times that allow for greater particulate settling. On the other hand, blocked drainage channels could cause ponding or flooding on the travelway, a marked safety hazard, or divert runoff and cause erosion new channels.

3.2.3.1.2 Alternative B - Short-Term Remedial Action Approach

Treatment techniques under Alternative B would be primarily mechanical, with chemical treatment in some areas. Biological and cultural methods are not effective short-term reactive measures. The primary impacts on water quality would come from particulates in vehicle emissions from mechanical equipment, increased compaction of surface soils contributing to increased erosion, and possible contamination with chemical herbicides. Impacts of mechanical and chemical methods are discussed in greater detail under Alternatives C and D.

For an assessment of risks from leaching and surface losses of chemicals used at TxDOT's current rates, see Appendix B, Chapter 4.

Because water quality concerns may not relate directly to safety issues, roadside vegetation management under this alternative would address potential water quality problems only incidentally. In this aspect, the impacts of Alternative B would be similar to those of Alternative A. However, because of the impacts related to mechanical and chemical treatments in some areas, the overall adverse impacts on water quality are likely to be greater for Alternative B than similar impacts associated with Alternative A.

3.2.3.1.3 Alternative C - No Chemical Approach

The management emphasis in Alternative C is on mechanical techniques. Impacts of these techniques on water quality relate primarily to increased runoff, soil erosion, and sedimentation. Mechanical vegetation management activities that remove extensive areas of vegetation from drainage swales may reduce the filtration capacity and the removal of pollutants. In addition, mowing, cutting, and trimming may temporarily

reduce the ability of vegetation to protect the soil surface from erosion and to filter pollutants from stormwater.

Frequent use of heavy machinery for mechanical or cultural management of vegetation would result in significant soil disturbance or compaction. Grading or seedbed preparation may, in the short term, increase sheet erosion. It is important to remember that cultural practices such as interseeding would be used to reclaim areas which already have an erosion problem.

Chemical herbicides and insecticides would not be applied under this alternative.

Biological techniques available for vegetation management would not have any direct impacts on water quality. However, in areas where biological control results in extensive plant removal, there may be a temporary reduction in the ability of roadside vegetation to filter pollutants from runoff. Biological techniques, if used alone, may not react quickly enough to allow clearance of intended drainage areas or to prevent undesirable vegetative cover.

3.2.3.1.4 Alternative D - Current Practices

Alternative D would be a continuation of the current management procedures, with each district implementing statewide policy. Most herbicides and insecticides will have little to no negative impact on water quality if applied in accordance with registered label directions. Application of chemicals is more likely to affect water quality through the removal of vegetative cover rather than through contamination by the chemical itself.

Several mechanisms prevent or retard the migration of organic chemicals through the soil column. These mechanisms include chemical precipitation, chemical degradation, volatilization, physical and biological degradation, biological uptake, and adsorption. Furthermore, many organic substances have extremely low water solubility. Also, clays and organic matter in the soil adsorb trace metals and certain complex organic pollutants. As a result of these reactions, the pollutant load available to leach through the soil column for entry into ground water could be reduced significantly (Harris et al., 1994). Potential impacts to water resources from the use of specific chemicals for pest management are described in Appendix B, Chapter 4.

The immediate environmental consequences of Alternative D would be very similar to those for Alternative E. The impacts on water quality over the long term, however, would not diminish with time unless the present emphasis on chemical and mechanical techniques were shifted to cultural or biological techniques.

3.2.3.1.5 Alternative E - Integrated Long-Term and Locally-Based Approach

All vegetation management techniques would be available for use in Alternative E. The immediate impacts from mechanical and chemical techniques would be similar to those discussed in Alternatives B and D. The potential water quality impacts of cultural and biological techniques would be similar to those described for Alternative C. The long-term impacts on water quality would decrease as the need for chemical and mechanical techniques decreased as a result of the establishment of stable desirable vegetation.

3.2.3.2. Unavoidable Impacts

Highway pollutants in stormwater could continue to have an unavoidable adverse impact on water quality regardless of the alternative selected. Contamination of water from these sources overwhelms impacts from most treatment alternatives. Accelerated erosion as a result of soil compaction and reduced vegetative cover by specific vegetation management activities, especially mechanical treatments, would have an unavoidable adverse impact on water quality.

3.2.3.3 Mitigation Measures

Potential water quality impacts from mechanical vegetation management could be minimized by avoiding the use of heavy equipment on steep slopes or loose soils and by maintaining dense, healthy vegetation in the roadside environment, particularly in drainage swales.

Where chemicals are used as a control technique, the following practices would minimize their potential adverse impacts on water quality.

- Apply herbicides and insecticides according to label instructions and appropriate regulations; prepare and implement spill control plans; and dispose of cleaning waste and containers properly.
- Utilize vegetation buffers and exclusion in the vicinity of critical areas.
- Apply pesticides at the lowest possible rate to achieve the desired results.
- Use selective chemicals that do not persist in the environment and that are not readily transported through soil by leaching.
- Avoid chemical applications when precipitation is imminent.
- Control spray drift by increasing droplet size, using adjuvants to maintain spray droplet size, and spraying only during prescribed wind conditions.
- Use selective chemicals or use targeted, spot applications to individual plants or ant mounds.
- Avoid scouring ditch bottoms or creating vegetation free conditions on un-paved portions of the ROW (Zones 1b and 2).

For cultural methods of vegetation management, the use of mulch would greatly reduce the amount of sediment entering waterways until seeded plants become established.

3.2.4 Flood Plains

Transportation routes through Texas have often followed streams and rivers. Many miles of highways were located in flood plains due to topographic constraints, and land development has grown up around these transportation corridors. Highway encroachments onto flood plains and associated developments have been an integral part of economic growth in Texas. Flood plains provide many natural and beneficial values, including fish and wildlife habitat, scenic beauty, opportunities for scientific study, outdoor recreation, agriculture, forest resources, natural moderation of floods, water quality maintenance, and groundwater recharge. Appendix A, Chapter 5 discusses possible impacts to flood plains from pest management activities.

3.2.4.1 Environmental Consequences of Alternatives

Roadside vegetation management is not expected to have significant impacts on flood plains. Construction of highways and associated developments on flood plains results in displacement of floodwaters and an increase in the severity of flooding. However, the management of roadside vegetation does not have a measurable effect on high water conditions. Some increased runoff can be expected from roadside areas where soil is compacted, but the highway corridor is usually only a small portion of a watershed and does not have a significant effect on flooding.

The alternatives that utilize mechanical or chemical treatments could cause minor increases to localized runoff as a result of soil compaction or vegetation removal. However, impacts to flood plains generally would be minor because roadside areas represent very small proportions of watersheds contributing runoff to the flood plains.

3.2.4.2 Unavoidable Adverse Impacts

No unavoidable adverse impacts to flood plains can be foreseen under any of the pest management alternatives. In the event of special local conditions in which specific vegetation treatments could increase storm runoff to the extent that flood plains would be impacted, different management techniques could be used. Alternatively, mitigation could be required to compensate for increased flooding.

3.2.4.3 Mitigation Measures

In general, roadside vegetation management alternatives would be expected to not significantly impact flood plains, and mitigation would not be necessary.

Many of the mitigation measures described in Section 3.2.1.2 would limit soil compaction and erosion and increase soil infiltration rates. These measures also would be effective in limiting increases in storm runoff. If there are areas where increased runoff from roadsides has the potential to increase flooding, additional detention facilities could be installed to detain the runoff and release it gradually.

Mulch or other materials used on the roadside should not be stockpiled within flood plain limits where they could displace, or be removed by, flood waters.

3.2.5 Wetlands

Wetlands, often referred to as "marshes" or "bogs," provide a transition between land and water environments. They would be lands where groundwater is usually at or near the surface, or where the land is covered by shallow water for 7-21 days and primary hydrological indicators are present. Wetlands can be further defined as lands where saturation with water is the dominant factor determining the nature of soil development and the types of plants and animal communities living in the soil or on its surface (TWC, 1989). However, a consistent methodology for delineation of a "wetland area" is currently under debate. Appendix A, Chapter 6 contains an expanded discussion of the effects of roadside pest management to wetlands. Appendix B, Chapter 4 contains an assessment of potential off-site movement of chemicals which may threaten wetlands.

3.2.5.1 Environmental Consequences of Alternatives

The potential impacts to wetlands resulting from roadside pest management could be directly related to the water quality impacts described above, and include methods causing accelerated soil erosion, transport and deposition of sediment, and use of chemicals. Adverse effects on wetlands resulting from the transport and deposition of eroded sediments include nutrient enrichment, increased turbidity, decreased dissolved oxygen, and accumulation of toxicants. These effects, in turn, may adversely impact fish and other aquatic organisms using wetland habitats.

In terms of the treatment methods, mechanical treatments have a low potential to impact wetlands, except in areas where the slopes are steep and the operation of equipment on these slopes causes slope instability and increased erosion and sedimentation in wetlands. Clippings and other organic debris from mechanical control may reduce oxygen (O₂) levels in wetlands due to decomposition.

Chemical treatments can have both a direct and indirect impact on wetlands. The introduction of chemicals through drift or runoff may adversely impact wetlands.

Cultural treatments generally have a low potential to impact wetlands adversely.

Biological treatments would not be expected to impact wetlands adversely.

3.2.5.1.1 Alternative A - No Action

The No Action alternative would have minimal adverse impacts upon wetlands. A lack of vegetation management may lead to prolific growth of roadside vegetation which could reduce erosion and the transport of pollutants by increasing the filtration and evapotranspiration capacity of roadside areas. There also would be no potential for chemical contamination, except from road surface runoff.

However, without roadside vegetation management, the potential for soil erosion would exist, particularly in drier parts of the state. During periods of precipitation, these soils and any associated pollutants could be carried by surface runoff into wetland areas, thus degrading water quality. Without vegetation management, no action would be taken to control rills, gullies, or other types of erosion once they had begun. In general, the absence of vegetation management activities would result in poor stands of desirable vegetation which would reduce the ability of roadside areas to retard water movement, stabilize soils, and filter pollutants from stormwater before it reaches receiving waters. Undesirable plants would continue to compromise the number and function of desirable vegetative species. Additionally, the No Action approach would leave the areas susceptible to noxious weed invasion.

3.2.5.1.2 Alternative B - Short-Term Remedial Action Approach

The primary impacts on wetlands of Alternative B would be those resulting in degraded water quality from additional vehicle emissions related to use of mechanical equipment, increased compaction of surface soils contributing to increased erosion, and possible contamination with chemicals. Impacts of mechanical and chemical methods are discussed in greater detail under Alternatives C and D.

3.2.5.1.3 Alternative C - No Chemical Approach

The management emphasis in Alternative C is on mechanical techniques. Mechanical methods, such as mowing, generally have a low potential to impact wetland habitats through soil erosion because they result in substantial retention of soil cover. However, grass clippings and organic debris entering wetland areas may lead to a decline in dissolved O₂ due to vegetation decomposition. Soil-intensive mechanical treatments, such as discing, create a high potential for soil erosion by exposing soil which could then be carried to aquatic habitats during storm events. The resulting sedimentation would degrade aquatic habitats.

Cultural techniques generally have a low potential for adversely affecting wetland habitats.

Biological techniques, such as the introduction of pest organisms or the introduction of insects and plant pathogens, likely would not adversely impact water quality. Both of these techniques are considered species-specific and, therefore, would be very selective. Erosion is not a likely consequence of biological management techniques, and non-target effects would be minimal. However, in areas where biological control results in extensive target plant mortality, there may be a temporary reduction in the ability of roadside vegetation to prevent erosion or filter pollutants from runoff.

3.2.5.1.4 Alternative D - Current Practices

Alternative D would be a continuation of the current management procedures, with each district implementing statewide policy to accommodate local conditions.

Chemical methods of vegetation management along TxDOT ROWs potentially could have both direct and indirect effects upon wetland habitats and resources. The use of chemical methods could affect water quality because of accidental direct application, spray drift, or the transport of herbicides to surface waters in runoff.

Chemical residues could be mobilized by surface transport or overland flow entering surface waters in solution or absorbed on particulate matter. An ecological risk assessment is presented in Appendix B, Chapter 3, that describes the potential risks of chemical-contaminated water to aquatic organisms. The risks of surface transport of chemicals with sediment or in stormwater runoff to non-target areas are assessed in Appendix B, Chapter 4.

A number of indirect effects to wetland habitats could be from chemical applications to TxDOT ROWs. Soil erosion could result in increased sedimentation in adjacent wetlands, injuring or destroying fish spawning and nursery areas. Erosion could also reduce shoreline stability along streams, resulting in loss of protective cover for organisms using such habitats. It is important to note that only vegetation management Zone 1a, paved shoulder, requires the use of nonselective applications of herbicide in order to maintain a vegetation-free zone. This zone would rarely be directly adjacent to wetlands.

Direct application of herbicides to wetland areas potentially could impact wetland vegetation, thereby degrading many of the functions of a wetland, including water quality protection, flood control, shoreline stabilization, contributions to groundwater and stream flows, and wildlife and fisheries habitat.

Because approximately 20 percent of the species listed by the federal government as threatened or endangered depend heavily on wetlands (DOE, 1988), any impacts on wetlands potentially could affect special-status species. However, few aquatic plant species currently are considered pests which should be controlled through the use of

herbicides. Purple loosestrife (*Lythrum salicaria L.*) which invades and eliminates wetlands, together with cattails and willows would be controlled mostly by chemical means.

The immediate environmental consequences of Alternative D would be similar to those of Alternative E. The impacts to wetlands would be directly related to those of water quality. Those would not diminish with time as there are no reliable cultural and biological techniques.

3.2.5.1.5 Alternative E - Integrated Long-Term and Locally-Based Approach

All vegetation management techniques would be available for use in Alternative E. The immediate impacts from mechanical and chemical techniques would be similar to those discussed under Alternatives B and D. The potential impacts to wetlands and water quality from cultural and biological techniques are discussed under Alternative C. The long-term impacts on wetlands due to possible chemical contamination and soil erosion would be expected to decrease if the treatment levels of chemical and mechanical techniques were reduced.

3.2.5.2 Unavoidable Adverse Impacts

Any of the techniques employed for the management of roadside vegetation likely could impact the environment adversely to some degree. As discussed above, the most likely impact is from soil erosion due to elimination of groundcover. In the case of chemical application, some of the chemical may be deposited directly in wetland habitats as a result of spray drift or surface runoff. The degree of impact depends on the type of chemical used and application method, the concentration to which non-target organisms would be exposed, the duration of that exposure, and the time of year the exposure occurs.

3.2.5.3 Mitigation Measures

Because the impacts to wetlands can be related directly to the impacts on water quality, the mitigation measures for wetlands would be much the same as those for water quality. Impacts due to mechanical techniques could be minimized by avoiding the use of heavy equipment on steep slopes and by maintaining adequate groundcover along the roadside environment, especially in areas near wetland habitats or areas that have the potential to drain to wetlands.

Where chemicals are used, the following practices would minimize their potential adverse impacts on wetlands.

- Apply herbicides according to label instructions and appropriate regulations; prepare and implement spill control plans; dispose of cleaning waste and containers properly.
- Use selective chemical herbicides that do not persist in the environment and that can not be transported readily through soil by leaching.
- Avoid herbicide applications when precipitation is imminent.
- Control spray drift by using methods to increase droplet size adjuvants to maintain spray droplet retention, and by spraying only during periods when wind velocities are low.
- Use spot, target-specific applications rather than broadcast applications wherever possible.

3.2.6 Vegetation

In the following discussions, the concepts of vegetation region and roadside management zone must be maintained as separate entities. A vegetation region is an environmental subsection of the state supporting relatively homogeneous plant communities dominated by a specific group of potential climax plant species (Figure 3-1). These regions cover thousands of acres and classify the types of geology, soils, climate, and wildlife in a particular area. The conceptual breakdown of highway roadsides into roadside management zones (Zones 1a, 1b and 2) is discussed in Chapter 1 (see Figure 1-1).

Construction of cut and fill slopes (Roadside Management Zones 1a and 1b) generally results in soil conditions unlike any under the adjacent natural vegetation. Therefore, it cannot be assumed that roadside vegetation would have the same species composition or productivity as occurs outside the heavily impacted construction zones. Roadside Management Zone 2 is much less disturbed during construction and subsequent management activities. Therefore, naturally occurring plant communities may establish easily in this zone. Species composition within all three management zones would reflect soil conditions, planting practices, seed sources available in adjacent habitats, and seeds transported by vehicular traffic from other areas.

3.2.6.1 Environmental Consequences of Alternatives

The ultimate goal of roadside vegetation management is to maintain plant communities that have the desired growth characteristics for roadside safety and aesthetics, require low maintenance, discourage large animal use, and provide storm runoff biofiltration while not greatly impeding flows. Vegetation management techniques to create the desired conditions may include mechanical, chemical, cultural, or biological

treatments. These treatments have widely varying costs (both financial and environmental) that often differ among vegetation zones and TxDOT districts.

The vegetative responses to roadside management programs can be assessed in this document in only a very generalized manner. Every combination of trees, shrubs, forbs, and grasses would respond differently to treatment. This response variability is often increased when native and exotic species have been intentionally planted along ROWs. The plant community response, as opposed to individual species responses, often depends upon climate, species composition, dominance and phenology, treatment type, extent of treatment, and site properties.

Evaluation of vegetation responses to management programs must be addressed as a specific evaluation of site/species/disturbance relationships on each individual area. Currently, TxDOT accomplishes this by having resident vegetation managers in each district. Particular attention must be paid to prevent inadvertent application to threatened, endangered, or sensitive species or high-quality native plant communities. In areas of intensive agricultural activity, sometimes the only remnant examples of individual species or entire climax plant communities would be located in Roadside Zone 2, between the actively managed road system and the annually disturbed agricultural fields. The Natural Heritage Program of the Texas Parks and Wildlife Department should be consulted routinely where projects would be planned which have the potential to disturb native plant communities.

Mechanical treatments could be very effective for managing small trees, shrubs, and herbaceous vegetation. However, the operation of equipment on some soils may reduce vegetative cover, allowing invasion of undesirable species. Constant mowing of bunch grasses and forbs to maintain a lawn-like appearance reduces plant vigor and makes the plants more susceptible to invasion by noxious weeds or disease; sod grasses can be mowed shorter without weakening them.

Chemical treatments can be used for roadside vegetation management to eliminate all vegetation in Zone 1a (the paved shoulder) and to control or eliminate only undesirable plant species in Zones 1b and 2. In addition, if not applied correctly, herbicides could create an environment that is conducive to invasion by undesirable vegetation, such as noxious weeds. Misapplication could also reduce the vigor of existing non-target vegetation.

Cultural treatments, generally, would encourage the establishment of vigorous plant communities which would better resist disease and invasion by undesirable vegetation. No adverse effects to vegetation would be expected from cultural activities.

Biological treatments would have no adverse impacts on desirable vegetation.

3.2.6.1.1 Alternative A - No Action

If vegetation management activities were not used to control roadside vegetation, nature would take its course. The natural biological requirements of plants provide them with highly competitive niches. Any native or exotic plant species that could establish itself in direct competition with other plants would grow within its environmental constraints, unimpeded by management activities.

Over time, vegetation would develop along normal successional pathways. On sites where some topsoil remains or has been replaced following construction, desirable native species could be established rapidly. However, due to the highly disturbed nature of ROWs (cut and fill slopes of bare soils), most sites may revert to early successional plant communities composed of weedy annual and perennial grass and forb species. On sites where all upper soil horizons have been removed, communities of pioneer species may dominate the disturbed sites for long periods of time.

A No-Action approach to roadside vegetation management would be undesirable because of the need to meet requirements of highway safety. Under this alternative, native and exotic weedy vegetation could establish and dominate recently-disturbed areas of ROW. Weed dominance on ROWs could attract undesirable insect pest populations and diseases and could contribute to weed invasion into adjacent land. These invasions would cause problems where they occur adjacent to large-scale agricultural operations. Although most agricultural pests can be controlled directly on the crop, effective and economical control of noxious weeds, insects, and diseases requires that additional repositories, such as ditches and ROWs, also be free of host species.

3.2.6.1.2 Alternative B - Short-Term Remedial Approach

On the roadside areas where no action is expected, the consequences of Alternative B would be similar to A. Thus, implementation of this alternative would generally have the same adverse effects as discussed above. In areas treated with mechanical and chemical techniques, impacts would generally be similar to those described under Alternative D.

3.2.6.1.3 Alternative C - No Chemical Approach

The major management emphasis in Alternative C is the use of mechanical techniques. Tractor-mounted sickle, flail, or rotary mowers would be used to control small trees, shrubs, and herbaceous vegetation. To maintain the function of the active zone along roadway, fast-growing herbaceous species would require periodic mowing throughout the growing season. However, repeated mowing of grass and forb species may weaken the plants and mechanically degrade soil surfaces. Operation of even lightweight

tractor-mounted mowers on wet, fine-textured soils could remove vegetative cover and allow invasion by undesirable species. Operation of this equipment could also compact subsurface soil layers and lead to surface erosion and slumping of soils.

Shrubs and trees controlled by mechanical methods often resprout from roots and root-crowns, creating higher plant-stem densities than before control. Many shrubs and resprouting tree species respond most vigorously after above-ground material has been removed during the dormant season, producing more and bigger stems, limbs, and suckers than if not pruned. Mechanical vegetation control measures should be applied in a manner that has the greatest adverse effect on the target species. Proper timing and treatment application is critical. Otherwise, removal of regrowth may be required two or more times per year.

Vegetative encroachment onto pavement cannot be treated mechanically. Hand treatment is tedious and slow and exposes the worker to safety hazards associated with nearby traffic. The alternative is to replace the infested pavement every 2-4 years, where the expected life is 20 years.

Manual methods for managing vegetation would include use of hand tools and hand-operated power tools to cut, clear, or prune vegetation, generally above or at ground level, to enhance site conditions for desired plants. Due to the large scale of most TxDOT projects, this control method would be relegated to sites where chemicals would not be feasible and mechanized equipment could not operate because of site limitations. Disturbance would be minimal with manual treatment techniques, but the ability to affect plant community composition would also be very limited. Pulling or digging out plant root systems to prevent sprouting and regrowth would be extremely difficult or impossible in the often highly compacted soils at road edges (Zone 1a) and on adjacent slopes (Zone 1b).

Manual treatment techniques generally require multiple visits to a site to control regrowth of a single species or to treat different selected species. Forbs and grasses generally would be too numerous to be controlled efficiently by manual techniques, except in small roadside areas infested with noxious weeds. Manual control can be very effective in some situations, however, since it is highly selective for species being targeted for control. Desirable species would be beneficially affected through minimal exposure to disturbance and reduced competition from undesirable species for nutrients, water, and space.

3.2.6.1.4 Alternative D - Current Practices

Alternative D would be a continuation of the current management procedures.

Herbicides would be used to remove vegetation in Zone 1a (the paved shoulder) and to selectively control pest and noxious plants in Zones 1b and portions of Zone 2. The impacts of chemical treatments would vary depending on how closely the target and non-target species are related, and the selectivity of the herbicide.

Annual plants, generally more sensitive to herbicides, would be affected to a greater degree than perennial plants, especially if treated before producing seed. Annual and perennial weed species growing at a site for more than a few years often have large seed reserves in the upper soil horizons. Weed-infested sites could require repeated control measures until the majority of weed seeds have germinated and been killed. Repeated applications of broad-leaf selective herbicides could lead to grass-dominated roadsides.

The initial environmental consequences of Alternative D would be similar to those of Alternative E. Adverse impacts on vegetation over the long term, however, would not diminish, as there would be no expectation to reduce the level of use of chemical and mechanical techniques.

3.2.6.1.5 Alternative E - Integrated Long-Term and Locally-Based Approach

All vegetation management techniques would be available for use in Alternative E. The immediate impacts from mechanical and chemical techniques would be similar to those discussed in Alternative D. Biological techniques would not be expected to have adverse impacts on desirable vegetation, but would suppress undesirable, target plant species. Cultural vegetation management techniques that encourage the establishment of highly competitive, stable, native plant communities would have no adverse impacts on desirable vegetation. Impacts from mechanical and chemical use would decrease in time as low-maintenance vegetation required fewer treatments.

3.2.6.2 Unavoidable Adverse Impacts

The various alternatives proposed for roadside vegetation management could have several adverse impacts on vegetation. Repeated mowing or other mechanical treatments could reduce plant vigor by preventing the plants from completing their natural cycle of flowering and die-back. Operation of heavy equipment could destroy vegetative cover and cause increased soil compaction and erosion.

Both the diverse topographic and climatic conditions in Texas and the widely varied potential effects of vegetation management techniques on plant communities indicate the need for detailed evaluation on a situation-specific basis. The potential impacts at any given site would depend on the existing conditions of that site and on the technique, or combination of techniques applied.

3.2.6.3 Mitigation Measures

Mitigation efforts would minimize the adverse impacts of roadside vegetation management on desirable vegetation, while continuing to provide for public safety concerns. Because impacts would vary with the specific conditions at different sites, mitigation efforts must be considered on a situation-specific basis. Different approaches would be appropriate in the different zones of the roadside environment.

In order to maintain the structural integrity of the roadway surface, Zone 1a is currently maintained free of any vegetation. Zone 1b should be seeded with low-maintenance grasses, legumes, and wildflowers that have a high probability of successfully competing with exotic weedy species. In Zone 2, the most effective mitigation measure would be to promote and maintain vegetation in as close to a natural condition as possible. Mechanical and chemical disturbances within this zone should be minimized. If chemical treatments were used in Zones 1b and 2, spot applications of highly selective chemicals would minimize the impacts on non-target species. In all cases, chemical treatment must be applied in strict adherence with product labels and EPA requirements.

Grass-forb communities, a major component of the roadside vegetation in many areas, remain healthiest when allowed to complete their life-cycle of flowering and summer/fall die-back. Frequent mowing reduces vigor of grass species and removes flowers before seeds mature fully. Mid- to late-summer mowing or merely knocking down the dried stems and leaves would aid the spread of seeds and incorporation of organic matter into the generally poor roadside soils. Dry season operation and low ground-pressure maintenance equipment could moderate possible soil disturbance.

Herbicides should be used to improve the potential success of desirable vegetation, not as a rapid, inexpensive means to remove vegetation from a site. Proper herbicide usage requires a large investment in planning of chemical selection, application rate, phenology of target and non-target species, and situation-specific environmental constraints. Planning for the safety of workers applying the chemicals and all potential off-site recipients of residues also is a must. Where desirable vegetation is established, spot treatments with selective herbicides on small populations of undesirable or noxious plants could be very effective for maintaining and enhancing the growth of preferred species.

Situation-specific use of cultural or biological techniques in preference to mechanical or chemical methods would minimize adverse impacts on non-target plant species and would help promote the growth of desirable native vegetation.

3.2.7 Terrestrial Wildlife and Wildlife Habitat

The topographic and vegetational characteristics of Texas encompass a broad range of environmental features and conditions, providing habitats for more than 1,100 species of mammals, birds, reptiles, and amphibians. An assessment of chemical impacts to wildlife is presented in Appendix B, Chapter 3 (Volume 2).

3.2.7.1 Environmental Consequences of Alternatives

Highways may affect wildlife populations through their impact on habitats and animal movements. Depending on the type of road and characteristics of the surrounding habitat and wildlife community, roads could act as either corridors or barriers to animal movements, enhancing or isolating populations. For example, in forested landscapes, species that favor open habitats use roadways as travel and hunting routes. Other animals typically avoid well-traveled roads. Some smaller vertebrates may choose never to cross roads.

Highway mortality of animals is a serious problem in some areas, particularly for animals with home ranges that encompass well-traveled roads. Additionally, deer mortality can be a serious seasonal problem on roads that intersect traditional migration corridors and feeding sites. Although accurate roadkill statistics are not available in Texas, there is evidence that roads may significantly affect animal populations in some circumstances. This mortality appears to be a function of roadway location more than of maintenance practices.

Roadside vegetation management could influence wildlife populations through its effects on habitat and through direct impacts on the wildlife. These effects may be either beneficial or harmful depending on the location, site characteristics, species affected, and the timing, intensity, and frequency of treatment. In most cases, the effect depends on the habitat changes caused by the treatment, rather than the particular method utilized. To the extent that vegetation management supports habitat use and normal movements of desirable native species of wildlife, it would be a beneficial management tool. Where vegetation management reduces the diversity of native vegetation, or promotes the dispersal of opportunistic, invasive organisms, it is undesirable. Wildlife and habitat responses to vegetation management must be evaluated on a situation-specific, individual treatment basis. Situation-specific pest management decisions should be made in cooperation with representatives of the TPWD and/or USFWS, particularly in areas where threatened and endangered species of plants or animals exist.

Mechanical treatment could be a very effective tool for improving habitat for small mammals and birds. However, along with increased wildlife would come increased predators and a greater likelihood of roadkills. Studies show roadkills are related to the presence of a highway through preferred habitat on adjacent land, however, and not vegetation management practices on the narrow ROW corridor (TxDOT, 1993). Mowing reduces nesting cover and reduces food availability. It can be especially damaging to ground-nesting birds during breeding season. The use of machinery also could compact the soil, destroying burrowing animal habitat. Manual techniques would not be expected to impact wildlife significantly.

Chemical treatments could impact wildlife either directly through toxicities to animals, or indirectly through manipulation of habitat. A risk assessment of toxicological impacts to terrestrial and aquatic wildlife species is presented in Appendix B, Chapter 3. None of the chemicals proposed for use by TxDOT would adversely impact any wildlife populations if used properly (Hendricks, 1994).

Habitat manipulations as a result of herbicide applications would benefit some animals and harm others. For example, the elimination of shrubs could lead to a decline in wildlife that depend on shrubs for nesting cover and browse foods, but would increase numbers of grass-adapted species. The elimination of noxious weeds is beneficial to some, but not all, species.

In general, wildlife impacts depend on the chemical used, its specific characteristics, and how and when it is applied.

Cultural treatments would benefit most wildlife species by establishing native species, if native species selected for planting were a source of food or cover.

Biological treatments are not expected to adversely impact wildlife populations.

3.2.7.1.1 Alternative A - No Action

Under Alternative A, roadside vegetation management treatments would be eliminated. A lack of periodic disturbance to soils and vegetation could allow native plant communities to remain or become established on some sites, favoring animals associated with these habitats. Many sites however, would be subject to invasion by aggressive exotics.

No treatment of fire ants would increase very slightly the food available for insect-eating wildlife species. On the other hand, however, wildlife would experience an increase of attacks from the proliferation of these aggressive ants.

3.2.7.1.2 Alternative B - Short-Term Remedial Action Approach

The effects of Alternative B would be similar to Alternative A on more than 70 percent of the roadside area where no action is expected. In those areas treated with mechanical and chemical techniques, however, the impacts would generally be similar to those described under Alternatives C and D.

No adverse effects would be expected from the use of chemicals at TxDOT's current rates under Alternative D. Proper mitigation measures must be monitored at all times, particularly in areas of known habitat for threatened and endangered species. Chemical treatment of ant mounds would remove some fire ants from foraging predators. No significant impacts to wildlife would be expected from the chemical.

3.2.7.1.3 Alternative C - No Chemical Approach

Intensive management of vegetation in the roadside environment by maximizing the use of mechanical methods would have some adverse impacts on wildlife and wildlife habitat. More frequent disturbance to soils and vegetation caused by vegetation management activities could prevent native plant communities from remaining or becoming established.

Mowing of roadside vegetation would reduce cover for nesting and hiding and food availability for many small birds and mammals. Mowing during the breeding season could damage habitat, destroy nestlings, and reduce productivity of ground-nesting birds. Conversely, mowing may stimulate the production of palatable grasses and forbs, thus providing food for various wildlife species. The use of mechanical equipment could result in soil compaction and accelerated erosion which, in turn, inhibits the growth of new vegetation and damages the habitat of burrowing animals. The widely varied effects of mechanical treatment on wildlife dictate the need for situation-specific evaluation.

Cultural techniques may be used to a lesser degree in this alternative. Impacts on wildlife from cultural techniques would be similar to those described under Alternative E.

While non-treatment of ant mounds would increase the numbers of ants available to foraging predators, greater negative impacts to wildlife could be expected from fire ant attacks in infested areas.

3.2.7.1.4 Alternative D - Current Practices

Impacts of chemical vegetation control include direct toxicological effects and indirect effects from habitat alteration. This section addresses the effects of herbicide use on

wildlife habitats. Toxicological impacts to terrestrial and aquatic wildlife species are discussed in Appendix B, Chapter 3.

Habitat change resulting from herbicide applications could be beneficial to some animals and harmful to others. Species-shifts from grasses to grass-forb communities shifts the associated wildlife community which depends on the available vegetation for food or nesting cover.

Chemical treatment of noxious weeds could be beneficial to most, but not all, wildlife species since some of these plants are highly utilized as food. Seeds of certain thistles and annual weeds, for example, would be eaten by many species of finches. Although they may be beneficial, the need to control these weeds overrides their value as a wildlife food item.

As with other treatments, the response of wildlife to chemical control would depend on the chemicals used, how and when they are applied, their effect on habitat, and the relative availability of cover and forage in treated and adjacent untreated areas. Direct applications of selective herbicides would be less harmful because they treat only specific target plant species.

No adverse impacts to wildlife from chemical treatment of ant mounds would be expected (Hendricks, 1994). See Appendix B, Chapter 3 for a detailed toxicological assessment for terrestrial and aquatic wildlife on each chemical evaluated.

The immediate environmental consequences of Alternative D would be very similar to those of Alternative E. The impacts on wildlife and wildlife habitat over the long term, however, would not diminish with time.

3.2.7.1.5 Alternative E - Integrated Long-Term and Locally-Based Approach

All vegetation management techniques could be used in Alternative E. Cultural and biological techniques would be used more heavily in this alternative than in other alternatives.

Cultural control of roadside vegetation by planting desirable competitive native species could improve wildlife habitat and have variable effects on wildlife populations. Animals would benefit, for example, from planting of species utilized as food. Where plantings result in the establishment of native plant communities and the reduction of noxious weeds, wildlife species also would benefit.

Biological control could be a long-term process with limited potential for roadside habitat improvement. To the extent that biological control would allow more palatable native vegetation to become established along roadsides, wildlife habitats would

improve. Whether this change would result in greater wildlife use of roadside habitats would depend on plant community characteristics, adjacent habitat types, and affected wildlife species.

The immediate impacts from mechanical and chemical techniques used in Alternative E would be similar to those discussed in Alternative C. The negative long-term impacts on wildlife and wildlife habitat under Alternative E could be markedly less than under Alternative C if established low-maintenance vegetation reduced the need for chemical and mechanical methods.

Impacts to wildlife from chemical applications to ant mounds would be similar to those discussed under Alternative D.

3.2.7.2 Unavoidable Adverse Impacts

As long as vegetation is present along roadsides, it will be occupied by wildlife, either permanently or temporarily. In this setting, some animals would be at increased risk of highway mortality. Predator/prey relationships may differ in the roadside environment, and species composition may be different from the surrounding habitats. Where vegetation management techniques reduce the structural and compositional diversity of native vegetation, or promote the dispersal of opportunistic, invasive organisms, they may cause unavoidable adverse impacts. In addition, mechanical vegetation control may have direct impacts on wildlife through contact with heavy machinery, crushing small vertebrates or destroying nests or burrows. Likewise, chemical treatments may have direct toxicological effects on wildlife, although the risk is very low under ROW conditions. The widely varied potential effects of vegetation management techniques on wildlife and habitats indicate the need for evaluation on a situation-specific basis.

3.2.7.3 Mitigation Measures

Mitigation efforts can minimize the impacts of roadside vegetation management on wildlife and wildlife habitat while continuing to provide for public safety concerns. Different approaches would be appropriate in the different zones of the roadside environment. Zone 1a is kept free of any vegetation in order to maintain the structural integrity of the road surface. In Zone 1b, vegetation is managed for increased visibility and public safety. In Zone 2, the most effective mitigation measure for protecting wildlife and wildlife habitat would be to promote and maintain vegetation in as close to a natural condition as possible. Mechanical and chemical disturbances within this zone should be minimized. Wherever possible, the maintenance of a natural diversity of native plant species, in contrast to grass monocultures, would ensure productive habitat for the greatest number of wildlife species. Vegetation management by TxDOT fulfills most of these requirements.

3.2.8 Aquatic Wildlife and Wildlife Habitat

Aquatic habitats in Texas are quite diverse, ranging from the marine environments of the Gulf Coast to the freshwater environments of the interior basins and plateaus. Habitat diversity is reflected in the varied fauna and flora found in the lakes, rivers, and estuaries of the state. Freshwater and marine fish and invertebrates are found within waters of the state of Texas. Appendix A, Chapter 8 contains more detailed discussion of aquatic habitats and species within the state of Texas. Appendix B, Chapter 3 presents an assessment of toxicological risks to aquatic wildlife, but very few data are available for protected species (see Table 44 Appendix B, Chapter 3). Where good toxicological data is not available for protected or closely related species, application should be avoided to areas frequented by these organisms. Also, treatments should not be made which would alter the characteristics of local habitats frequented by these organisms.

3.2.8.1 Environmental Consequences of Alternatives

The potential impacts of roadside vegetation management methods on aquatic habitats and aquatic species would be directly related to the water quality impacts described previously. Potential effects include reduced survival or reproduction of aquatic organisms resulting from habitat degradation or exposure to toxic concentration of pollutants. In general, however, roadside vegetation management treatments are known to have caused substantial impacts to aquatic organisms in adjacent waters (Jones and Stokes, 1991). Nonetheless, the potential for adverse effects on special-status aquatic species should be recognized. The following are some of the potential adverse effects on special status aquatic organisms:

- Habitat alteration could interrupt the food chain;
- Individual species of aquatic organisms may react differently to applied materials or to particular formulation of the same materials;
- If an excessive loading of sediments or decaying organic matter occurs, excessive turbidity or oxygen depletion, respectively, may occur in these aquatic habitats.

Aquatic habitat quality depends on hydrology, water temperature, total dissolved oxygen, food supply, protective cover, sediment and nutrient loads, availability of spawning and breeding areas, and the presence of toxic substances. Aquatic habitat degradation resulting from increased sediment and nutrient loading is the most likely adverse effect of roadside vegetation management. Effects could include turbidity-induced gill abrasion, covering of spawning habitat, and reduced dissolved oxygen concentrations due to the eutrophying effects of nutrient loads.

For treatment-related impacts see, Section 3.2.3, Water Quality, of this chapter. Chemical strategies in aquatic situations would be stressed, as mechanical treatments would be restricted.

3.2.8.1.1 Alternative A - No Action

The No Action alternative would have minimal, if any, adverse impacts upon water quality, and thus upon aquatic organisms. A lack of vegetation management may lead to prolific growth of roadside vegetation which could reduce erosion and the transport of pollutants by increasing the filtration and evapotranspiration capacity of roadside areas. There also would be no potential for chemical contamination from vegetation management activities.

However, without roadside vegetation management, there would be a potential for soil erosion, particularly in the drier provinces of the state. During periods of precipitation, soils and any associated pollutants could be carried by surface runoff into aquatic habitats, thus degrading the quality of those habitats and adversely affecting aquatic organisms. The absence of vegetation would reduce the ability of roadside areas to retard water movement, stabilize soils, and filter pollutants from stormwater before it reaches receiving waters.

3.2.8.1.2 Alternative B - Short-Term Remedial Action Approach

The primary impacts of Alternative B on aquatic habitats and aquatic organisms would be those resulting in degraded water quality from additional vehicle emissions related to use of mechanical equipment, increased erosion, and possible contamination with chemicals. Impacts of mechanical and chemical methods are discussed in greater detail under Alternatives C and D.

The impacts of Alternative B would be similar to those of Alternative A on the roadside area where no action is expected.

3.2.8.1.3 Alternative C - No Chemical Approach

The management emphasis in Alternative C is on mechanical techniques. Mechanical methods such as mowing generally have a low potential to impact aquatic habitats through soil compaction and erosion because they result in substantial retention of soil cover. However, grass clippings and organic debris entering wetland areas may lead to a decline in dissolved oxygen due to vegetation decomposition. Grading and discing create a high potential for soil erosion by exposing soil which can then be carried to aquatic habitats.

Cultural techniques generally have a low potential for adversely affecting aquatic habitats.

Biological techniques, such as the introduction of pest organisms or the introduction of insects and plant pathogens, are not likely to impact water quality adversely. Both of the techniques are species-specific and are, therefore very selective. Erosion is not a likely consequence of biological techniques, and non-target effects would be minimal. However, in areas where biological control results in extensive target plant mortality, there may be a temporary reduction in the ability of roadside vegetation to filter pollutants from runoff or a loading of decaying organic material and a temporary depletion of oxygen.

3.2.8.1.4 Alternative D - Current Practices

Chemical methods of vegetation management along TxDOT ROWs have the potential to directly affect aquatic habitats and resources from spray drift or from the transport of chemicals to surface waters in runoff.

A number of indirect effects to aquatic habitats may result from improper herbicide application to ROWs. Loss of protective cover could reduce shoreline stability along streams, depleting the protective cover for organisms using these habitats. Increased sedimentation in adjacent aquatic habitats could injure or destroy spawning and nursery areas. Rodeo®, a companion formulation to Roundup® from glyphosate for aquatic habitats, is the material of choice for treating these areas.

Residues from soil active herbicides may be mobilized by surface transport or overland flow and enter surface waters in solution or absorbed on soil particles. A risk assessment is presented in Appendix B, Chapter 3, that describes the potential risks to aquatic organisms from the chemicals proposed for use by TxDOT. The ecological risk assessment consists of three sections: toxicity (hazard) assessment, exposure assessment, and risk characterization.

Risk to ecological receptors from exposure to a potentially hazardous substance is determined by two equally important factors: duration of exposure and the concentration or dose of the chemical (which is a function of the potency or toxicity of the chemical). Using the exposure and toxicity rating for the chemicals considered for use by TxDOT yielded a wide range in risk to fish and aquatic invertebrates (Tables 1-40, Appendix B, Chapter 3). The highest risk was posed by the two parathion-based insecticides, Diazinon and Dursban. In the case of each material, the risk to organisms from these two materials was much greater for fish and aquatic invertebrates than to mammals or amphibians. However, Diazinon has been identified by USFWS as likely to jeopardize the continued existence of certain endangered terrestrial species, especially birds. Application is restricted to liquid sprays over granules.

Definitive information is lacking on several of these materials for aquatic species, and care should be exercised in application pending additional experience and controlled studies.

No adverse effects would be expected when proper mitigation techniques for chemical applications are followed. See Appendix B, Chapter 3 for a more detailed discussion.

Alternative D would be a continuation of the current management procedures, with each district implementing statewide policy. The immediate environmental consequences of Alternative D would be similar to those of Alternative E. The impacts of aquatic habitats and aquatic species would be directly related to those on water quality and would not diminish with time, as there is no expectation to reduce the present emphasis on chemical and mechanical techniques.

3.2.8.1.5 Alternative E - Integrated Long-Term and Locally-Based Approach

All vegetation management techniques would be available for use in Alternative E. The immediate impacts from mechanical and chemical techniques would be similar to those discussed under Alternatives C and D. The potential impacts to aquatic organisms and water quality from cultural and biological techniques is discussed under Alternative C. The long-term impacts to aquatic habitats due to chemical contamination and soil erosion would be expected to decrease as the use of chemical and mechanical techniques decreased.

3.2.8.2 Unavoidable Adverse Impacts

Any of the techniques employed for the management of roadside vegetation are likely to adversely impact the aquatic environment to some degree. As discussed above, the most likely impact is from soil erosion due to elimination of groundcover. In the case of chemical application, some of the chemical might be deposited directly in aquatic habitats as a result of spray drift or surface runoff. The degree of impact depends on the concentration to which non-target organisms would be exposed and the duration of that exposure.

3.2.8.3 Mitigation Measures

Because the impacts to aquatic habitats usually are related directly to the impacts on water quality, the mitigation measures for aquatic habitats would be much the same as those for water quality. Impacts due to mechanical techniques can be minimized by avoiding the use of heavy equipment on steep slopes and by maintaining adequate groundcover along the roadside environment, especially in areas near aquatic habitats or in areas that have the potential to drain into aquatic habitats.

Where chemicals are used, the following practices would minimize their potential adverse impacts on aquatic resources.

- Apply herbicides and insecticides according to label instructions and appropriate regulations; prepare and implement spill control plans; and dispose of cleaning waste and containers properly.
- Use selective chemicals that do not persist in the environment and that are not readily transported through soil by leaching.
- Avoid using herbicides and insecticides close to surface water bodies and wetland areas, unless the herbicide is registered for use in such areas.
- Avoid chemical applications when precipitation is imminent.
- Control spray drift by using adjuvants to increase spray droplet size and by spraying only during calm conditions.
- Use spot applications rather than broadcast applications wherever possible.

3.2.9 Hazardous Material and Waste

Pesticides become hazardous waste material when the container is damaged, the expiration date has passed, or when unrecoverable spills occur. Also, unrinsed or improperly rinsed containers become hazardous waste. Pesticides classed as hazardous material should be disposed of using specified procedures. Tank and equipment waste water can be incorporated into a spray solution for roadside application. Re-usable containers are being considered to mitigate the need to dispose of pesticide containers.

3.2.9.1 Environmental Consequences of Alternatives

Mechanical methods of vegetation management use tractor-mounted mowers and small hand-operated power equipment to control vegetation growth. Areas where vegetation is to be controlled by mechanical methods frequently require annual treatments, mowing at least yearly and sometimes brushing less frequently. However, an area may be treated with mechanical methods more than once a year.

Cultural methods require the use of equipment for seedbed preparation, transporting and planting stock, and mulching. Some maintenance activity may be required for several years following the initial planting of an area. Mechanical and chemical methods frequently are required to help establish the desired vegetation. The goal of cultural methods is to establish vegetative cover which requires very little maintenance. Consequently, when the vegetation is established, little, if any, maintenance is required, thus little hazardous waste is produced.

Biological methods require the use of equipment for transportation and distribution of workers, equipment, and biological agents. Biological methods produce a negligible amount of hazardous waste from the use of motorized equipment when compared to the

other vegetation management methods. Ideally, after distribution of the biological agent, no additional treatment of any kind is required for the area. Often, however, repeated annual applications may be needed to eliminate the seedbank of the pest plant. Biological agents would be applied by hand or spray equipment.

Chemical methods produce the same hazardous waste problems associated with motorized equipment as do other treatment methods. Properly stored and handled pesticides are classified as hazardous materials. Pesticides do not become a hazardous waste, however, unless they are allowed to become contaminated, they exceed their expiration date, they produce an unrecoverable spill, or their containers are not adequately rinsed. TxDOT routinely rinses and recycles its pesticide containers.

It is difficult to weigh the relative production of hazardous waste associated with motorized equipment. It is assumed that cultural methods will produce more waste than chemical methods and less than mechanical methods the first year of treatment. However, this depends on variables which cannot be calculated in this DEIS, such as the number of times an area is mowed, frequency of pesticide applications, and for cultural methods, the amount of site preparation required before planting.

3.2.9.1.1 Alternative A - No Action

Under this alternative, no vegetation management activity would occur; therefore, no hazardous materials would be stored, and no hazardous waste would be generated or disposed of due to vegetation management activities. However, as discussed under the Water Quality section of this chapter, vehicles using the highways generate pollutants including lead, zinc, copper, chromium, iron, nitrogen, phosphorous, and hydrocarbons. Other hazardous materials could be introduced into the roadside environment by spills and equipment/vehicle leakage of oils and fuels not related to vegetation management.

3.2.9.1.2 Alternative B - Short-Term Remedial Approach

Under this reactive management strategy, only mechanical and chemical methods of vegetation control would be used, since these methods generally provide immediate vegetation control. Of all alternatives, the remedial action approach would treat the fewest acres annually by mechanical, chemical, or cultural methods. This approach would produce the least amount of the hazardous waste related to motorized equipment. Its risk of creating hazardous waste associated with pesticide use is the smallest of any alternative using chemical methods of vegetation control.

3.2.9.1.3 Alternative C - No Chemical Approach

No pesticides would be used in this alternative. However, all other methods of vegetation management will be used, with an emphasis on mechanical control. The No Chemical approach would produce more hazardous waste related to motorized equipment than would Alternative B. This approach has little potential to create hazardous waste from pesticide use.

3.2.9.1.4 Alternative D - Current Practices

Alternative D uses mechanical, chemical, and cultural treatment methods. This alternative would produce more waste associated with motorized equipment than Alternative B. It could produce the same amount of waste as Alternative E in the early years, but more hazardous waste than Alternative E in subsequent years.

The storage of hazardous material and the potential risk of creating hazardous waste material associated with pesticide use is much greater than Alternative B, and more than Alternative E.

3.2.9.1.5 Alternative E - Integrated Long-Term and Locally-Based Approach

With this alternative, the number of acres treated annually by mechanical and chemical methods should decline after the early years with an emphasis on establishment of a stable vegetative cover.

In the early years, this approach would produce somewhat more hazardous waste associated with motorized equipment than would Alternative B.

3.2.9.2 Unavoidable Adverse Impacts

The storage and use of hazardous and potentially hazardous materials and the generation of hazardous wastes, including pesticides, motor fuels, and lubricants, cannot be avoided except under Alternative A.

3.2.9.3 Mitigation Measures

Many specific actions can be taken which would reduce the amount of hazardous material generated by pest management activities. Practices also could be used which will greatly reduce any threat to the environment that may exist from hazardous materials generated by pest management activities. Many options available to TxDOT would mitigate unavoidable impacts of vegetation management activities. TxDOT has already incorporated all the practices described below into the current pest management program.

For Pesticides:

- Use all pesticides before the expiration date. This requires careful consideration of future needs when ordering. Use pesticides for their intended use, and dispose of excess quantities properly.
- When spraying pesticides, sequence applications to minimize change-overs from one spray solution to another. If possible, dedicate equipment to compatible spray activities. Mix only the amount of pesticide that is needed.
- Properly rinse all pesticide containers. Reuse water for rinsing of additional containers and/or as make-up for the next spray. If properly rinsed, pesticide containers would not be considered a hazardous waste.
- Provide adequate storage conditions in order to avoid damage to the product or escape of the product if a spill should occur.
- Establish a spill response plan. Procedure to control and clean up spills of hazardous or potentially hazardous materials should be in effect, including adequate training of employees.

3.2.10 Visual Quality

3.2.10.1 Environmental Consequences of Alternatives

The visual consequences of pest management vary with type, frequency, and time of year for each method. The four basic categories of maintenance practices are chemical, cultural, biological, and mechanical strategies. Chemical techniques typically cause discoloration and death of some or all of the treated foliage or plant. Cultural techniques improve plant health and usually improve visual quality. Biological methods, using insects and diseases to control unwanted vegetation, can cause defoliation, discoloration, or death of the targeted plant species. The impacts of biological techniques usually would be visible to the traveling public. Mechanical techniques involve cutting, mowing, and thinning to maintain roadside vegetation. The impacts to visual quality depend upon season, vegetation type, and amount of cutting. Cutting in the spring can expose brown stems, which contrast sharply with new foliage. Lawns, on the other hand, require frequent cutting to maintain visual quality.

3.2.10.2 Unavoidable Adverse Impacts

Work crews and equipment used to maintain roadside vegetation may temporarily impact visual quality of the roadway.

3.2.10.3 Mitigation Measures

Seasonal timing of vegetation management practices is the key to reducing the visual impact of vegetation management practices. Maintenance practices should also be

timed to avoid peak commuter hours, tourist seasons, and other high visibility periods. Proper selection of maintenance practices is necessary to minimize visual impacts.

3.2.11 Cultural Resources

Cultural resources could be any prehistoric or historic building, sites, districts, structures, or objects listed in or eligible for listing in the National Register. Cultural resources often will not be found in Roadside Management Zone 1a (Figure 1-1) unless the road, bridge, etc., is considered to possess historical significance. However, there are some historically meaningful structures and objects in Zone 1b, such as boundary markers, town entry markers, and Texas Centennial markers. A much greater number of cultural resources exist in Roadside Management Zone 2, particularly archeological sites. Also, a number of picnic areas are eligible for listing in the National Register.

3.2.11.1 Environmental Consequences of Alternatives

Buildings, memorials, and other architectural features may be affected by surrounding vegetation management activities. Views of cultural resources can be obscured or preserved through vegetation management practices. Lack of adequate vegetation control could indirectly damage the structures. Overgrown structures would be subject to increased decay (moisture retention), damage from tree roots, increased chances for damage from fire, etc.

The roadside vegetation itself may be considered a cultural resource. For example, a tree may be the site of an important historical event, have religious significance, or be a source of food for aboriginal peoples. The effects of the various alternatives would be situation-specific. However, Alternatives A and B would not provide for the protection of cultural resources. Alternative C, the No Chemical approach, may not adequately protect some cultural resources, such as historic structures, and may cause additional mowing of some sites. The most important element in preserving these resources is knowledge of their importance and a flexibility in vegetation management strategies.

All mechanical methods have the potential to damage archaeological sites, historic markers, masonry walls, and drainage and soil erosion control structures.

Chemical methods would not impact culturally significant areas unless these areas include vegetation. TxDOT should be aware of these areas throughout the state and modify vegetation management practices in order to prevent damage to these sites.

Vegetation management Zone 2 has the greatest potential to contain archaeological sites. Cultural methods of vegetation management have the greatest potential to damage archaeological sites in Zone 2, since disturbance of the soil surface is required

for establishing vegetation. However, any method where mechanized equipment traverses vegetation management Zone 2 has a potential to damage cultural resources.

Biological methods of vegetation management probably will have a minimal effect on cultural resources.

3.2.11.2 Unavoidable Adverse Impacts

TxDOT must control or remove plants which may impact highway user safety or the structural integrity of the road. Mowing may damage archaeological sites and other constructed features.

3.2.11.3 Mitigation Measures

TxDOT should develop a situation-specific pest management plan which addresses the preservation of a cultural site's unique value to the public. Methods of vegetation management which could have as little impact as possible should be employed on and/or around all cultural sites. Equipment traffic should be avoided in all areas where historic or prehistoric features are evident or known to exist. However, if equipment traffic is required, all vehicular activity should take place during dry soil conditions. Vehicles with the lowest possible ground-pressure should be used. Seeding should be used instead of planting established plants. Woody trees and shrubs should not be planted on known archaeological sites. Also, known historic properties, such as walls, markers, or other structures should be temporarily fenced to insure that they are not physically damaged by machinery.

3.2.12 Highway Safety

The highway system provides visual and physical aids for the safety of motorists. Vegetation management techniques must help maintain structural integrity of the highway. They also reinforce visual and physical aids to road users which are visible and functional and, thus, protect public health, safety, and welfare. Appendix C, Chapter 1 contains a more detailed discussion of roadside vegetation management's effects on transportation.

3.2.12.1 Environmental Consequences of Alternatives

Effects of chemical management techniques on vegetation occur in one day, for a few weeks, or for as long as a year depending on the type of chemical used. Chemicals which take effect within a short time after application could have significant impacts to the highway. Proper follow-up management techniques should be implemented to discourage establishment of undesirable vegetation, prevent soil erosion, and reduce potential fire hazards. Cultural and biological management techniques help improve

growing conditions of desirable plants and discourage establishment of undesirable plants which could affect the structural integrity and public safety of the highway. Effects of cultural and biological management techniques occur over several months and for as long as a year or more. Most cultural and biological techniques would have little or no adverse impacts to the integrity and safety of the highway. Competitive planting, however, may introduce aggressive plants which could have adverse impacts on the highway. Mechanical and chemical techniques provide adequate visibility of highway safety appurtenances such as signs, lights, guardrails, and drainage channels. Mechanical management techniques could have the same effects as chemical techniques if follow-up management techniques are not implemented. See Appendix C, Chapter 1, which describes impacts of individual maintenance management techniques that may affect structural integrity and public safety of the highway.

3.2.12.1.1 Alternative A - No Action

Alternative A would not provide protection for the roadways' structural integrity or safety of the highway user.

3.2.12.1.2 Alternative B - Short-Term Remedial Action Approach

Under Alternative B, action would be taken only after it has been determined that the highway facility or public safety is threatened. This is an inadequate alternative to protect highway facilities and public safety.

3.2.12.1.3 Alternative C - No Chemical Approach

Under Alternative C, the No Chemical Approach, maintenance of the vegetation-free Zone 1a would not be possible. The vegetation-free zone on shoulder pavement is essential to protection of the highway structure and for public safety. This alternative would inadequately protect the highway facilities and public safety.

3.2.12.1.4 Alternative D - Current Practices

Alternative D would adequately protect the highway structure and public safety.

3.2.12.1.5 Alternative E - Integrated Long-Term and Locally-Based Approach

Alternative E would adequately protect the highway structure and public safety.

3.2.12.1.6 Unavoidable Adverse Impacts

The generation of dust, noise, or odors; interruption of traffic; and distraction of motorists could be consequences of vegetation management techniques which may temporarily impact motorists.

3.2.12.2 Mitigation Measures

Large-scale use of chemical and mechanical management techniques which expose soils to erosion or invasion of undesirable vegetation should be minimized and followed by cultural revegetation techniques. To minimize potential injury to the public as well as unavoidable adverse impacts, the use of chemical and mechanical techniques should be performed during periods of low vehicular traffic.

3.2.13 Traveler Facilities

The highway system provides service facilities for public use. These facilities include bus stops, emergency areas, park and ride areas, picnic areas, rest areas, and scenic and historic facilities. Vegetation management techniques should preserve the usability of these facilities, as well as maintain public safety. Appendix C, Chapter 2 describes the different traveler facilities associated with transportation corridors and how maintenance management techniques would improve or impact the use and safety of these facilities.

3.2.13.1 Environmental Consequences of Alternatives

The public is exposed to management techniques at traveler facilities because these areas are maintained intensively in order to facilitate public use. Users may come into contact with chemicals applied to vegetation or ant mounds. Mechanical management may produce sharp edges and points on vegetation which could potentially injure users of traveler facilities. Mechanical equipment could produce projectiles during operation which could endanger the public. Other potential impacts may include dust, smoke, and objectionable odors.

3.2.13.1.1 Alternative A - No Action

Under this alternative, no vegetation management activity would occur. This alternative would not preserve the usability of roadside facilities or maintain public safety.

3.2.13.1.2 Alternative B - Short-Term Remedial Action Approach

Under this reactive management strategy, only mechanical and chemical methods of vegetation control would be used since these methods generally provide immediate vegetation control. Of all the alternatives, the remedial action approach would treat the fewest acres annually by mechanical, chemical, or cultural methods. This approach would not preserve the usability of roadside facilities.

3.2.13.1.3 Alternative C - No Chemical Approach

Pesticides would not be an option in this alternative. However, all other methods of vegetation management could be used, with an emphasis on mechanical control. Since the use of pesticides is prohibited, fire ants and other pests could pose a threat to users of highway travelers facilities.

3.2.13.1.4 Alternative D - Current Practices

Alternative D uses all vegetation control methods available. This alternative would adequately preserve the usability of the roadside facilities and provide for the public safety.

3.2.13.1.5 Alternative E - Integrated Long-Term and Locally-Based Approach

With this alternative, the number of acres treated annually by mechanical and chemical methods would decrease. This alternative would adequately preserve the usability of the roadside facilities and provide for the public safety.

3.2.13.2 Unavoidable Adverse Impacts

Dust, noise, glare, odors, and the presence of equipment associated with chemical and mechanical maintenance activities could temporarily impact the use of traveler facilities.

3.2.13.3 Mitigation Measures

Mechanical techniques using shearing equipment which produces sharp edges and points should not be used in high-contact areas such as along sidewalks, bus stops, picnic tables, restrooms, and interpretive facilities in order to minimize potential injury to the public. Mechanical techniques should be performed in traveler facilities during hours of low usage to minimize unavoidable adverse impacts.

3.2.14 Human Health

The analysis of the risk to human health from the chemical component of a roadside pest management program is presented in Chapter 2 of Appendix B. The alternative programs presented in this EIS represent different combinations of mechanical, chemical, biological, and cultural treatment methods. This section of the EIS is designed to look at how these different methods could be combined in the alternatives, and to identify how human health concerns may differ from one alternative to another based on the specific combination of treatment methods.

3.2.14.1 Environmental Consequences of Alternatives

Each of the treatment methods presents its own set of risks to human health. Therefore, before discussing the differences in human risk between alternatives, the human health risk for each of the treatment methods is summarized below.

Mechanical Methods

Mechanical treatments include manual techniques, such as hand weeding and the use of hand power tools, in addition to mowing, grading, and other activities using heavy machinery. The greatest threat to human health from the use of mechanical vegetation control is the risk to workers from the possibility of accidents involving heavy machinery and hand tools. Also included in the risk to workers is the possibility of accidents with vehicles traveling the roadway passing motorists. Soil erosion that may adversely affect water quality, the possible reduction in air quality from the burning of fossil fuels, and the increase in dust from the use of heavy machinery could be other risks related to the use of mechanical vegetation control.

Many of the mechanical control byproducts to which TxDOT workers would be exposed are reported to adversely affect human health. It is suspected that diesel exhaust may cause lung cancers and other cancers; carbon monoxide may cause carboxyhemoglobin hypoxia; asbestos may cause asbestosis or lung cancer; lead may cause neurobehavioral effects; and inhaling dust may cause respiratory irritation or expose workers to silica.

Chemical Methods

A detailed analysis of the risks to human health from using herbicides and insecticides is discussed in Appendix B, Chapter 2. In general, the risk of experiencing either short- or long-term effects from using pesticides is somewhat greater for TxDOT workers than it is for the general public.

Risks evaluated in Chapter 2 of Appendix B ultimately are expressed as hazard indices (HIs). The analysis uses estimated human exposure data (single-day dose) and oral reference doses (RFDs) derived from laboratory animal studies in which the no observable effect level (NOEL) is modified by a safety factor. The ratio between the estimated human exposure dose and the oral reference dose is deliberately referred to as the hazard index (HI):

$$\text{HI} = \frac{\text{estimated single-day dose}}{\text{oral reference dose}}$$

The hazard index is used to estimate the relative risk that an individual may experience under conditions similar to those outlined in risk exposure. Chemicals having hazard indices equal to or less than 1 are presumed to have a minimal impact on human health. As the estimated dose increases and exceeds the RFD, the HI becomes greater than 1, and the probability increases that the pesticide under consideration may produce unfavorable reactions. Since the reference doses often are based on data derived from chronic studies in which the pesticide is fed daily, the risk to the general public from a single exposure is often overestimated. Hazard indices were derived for workers as well as for members of the general public using TxDOT's average and maximum pesticide application rates. The exposure estimates, and subsequently the estimates of risk based on these exposures, are not intended to show what will happen, but rather what potentially could occur if all the parameters and assumptions were met (Jones, 1994).

It should also be remembered that:

- HI is an index and not a finite risk; and
- A relatively high HI can be overcome by the use of common sense, protective clothing, avoiding the material being dispensed, and using application techniques which favor large spray droplets.

TxDOT mixer/loaders and spray applicators involved in chemical control of vegetation or insect pests were evaluated as to their potential risk of experiencing adverse health effects. Under an average exposure scenario (average TxDOT application rates), the HI exceeded 1 for workers spraying chlorpyrifos using truck-mounted equipment (Figure 3-3). All other scenarios resulted in HIs of less than 1. All other maximum exposure scenarios resulted in HIs of less than 1 (Jones, 1994). Table 3-2 compares TxDOT's average and maximum application rate with maximum label rates. Table 3-3 shows increased noncancer risks associated with chemical exposure.

Under the maximum exposure scenario (maximum TxDOT application rates), HIs were projected to exceed 1 for workers spraying chlorpyrifos, hexazinone, or triclopyr; for

workers mixing or loading chlorpyrifos; for members of the public eating lettuce contaminated by triclopyr or chlorpyrifos; and for members of the general public consuming fish contaminated by chlorpyrifos. All other scenarios generated HIs of less than 1. The following observation should be applied to mitigate the HIs shown:

- Where the use of protective clothing is prescribed, TxDOT workers are instructed to do so.
- The exposure scenario assumed that triclopyr and chlorpyrifos were mixed individually in 500-gallon batches and applied broadcast. Actually, chlorpyrifos is mixed in small batches (2.5 gallons) and applied to individual ant mounds. Triclopyr has been reformulated using a nontoxic vegetable oil instead of diesel. The material comes ready to apply to the lower 12" of woody stems which bypasses the mixing phase. The material can be applied from a handsprayer or using a handgun on a spray truck, depending on the extent of treatment.
- Using the revised treatment techniques described above, the likelihood of drift or direct application to vegetable gardens by TxDOT workers on foot is extremely remote. Also, washing the lettuce before ingestion should remove a large portion of the residue.
- TxDOT guides specify that chlorpyrifos should not be applied directly to water or to dry stream courses. Again, the possibility of accumulating measurable quantities of chlorpyrifos in fish habitat from the small amounts applied to individual ant mounds seems extremely remote.

The risks to human health from the movement of herbicides into surface and ground waters were determined to be less than an HI of 1.

The carcinogenic risks to TxDOT workers and the public from long-term exposures to these herbicides at average application rates is negligible, as all chemicals used by TxDOT are registered by EPA as noncarcinogens (Jones, 1994).

Biological Methods

Neither TxDOT workers nor the public would be at risk from biological control methods unless they inhibit road use and visibility. Biological methods are slow to show results, and safety problems could occur prior to a reaction to a biological treatment.

Cultural Methods

Cultural control activities require the use of heavy machinery, so the risk of injury to workers and to the public would be similar to the risks from the use of heavy machinery for other mechanical control treatments.

3.2.14.1.1 Alternative A - No Action

Under Alternative A, no action would be taken to control pest vegetation or insects. Neither the public nor TxDOT workers would be at risk from the use of chemicals. TxDOT employees would not be at risk from inhalation of airborne contaminants or accidents caused by passing vehicles or from accidents incurred from mechanical or manual control of vegetation. Air quality would not be adversely affected as a result of no action, but water quality could be affected by unchecked erosion.

There could be, however, considerable environmental and human health consequences to a No Action approach to pest management. The major problem would be safety. Numerous safety hazards would become evident, such as low visibility from encroaching vegetation and deteriorating roadways. Fire ant infestations would threaten roadway users at safety rest areas and other traveler facilities. These problems, undoubtedly, make this alternative a greater threat to human health than any of the other alternatives.

3.2.14.1.2 Alternative B - Short-Term Remedial Action Approach

Under Alternative B, measures to control pest vegetation and insects would not be employed until it was determined that public safety, function of the highway facility, or capital investment could be threatened. Since biological and cultural control methods would be slow, this alternative would involve only mechanical and chemical methods of vegetation control.

In this alternative, only a portion of the ROW would be treated with either mechanical (70 percent) or chemical (30 percent) methods. The effects on those areas not receiving any vegetation pest management would be similar to those described under Alternative A.

The primary impact to human health would be the risks associated with mechanical vegetation management, such as accidents, reduction in air quality from combustion of fossil fuels, and water quality impacts from increased erosion.

3.2.14.1.3 Alternative C - No Chemical Approach

The primary method of pest control under this alternative would be mechanical treatments. Cultural treatments, which have a very low potential for adversely affecting the health of human populations, also would be used under this alternative.

The human health risks associated with the implementation of this alternative would be the same as those described for Alternative B. However, since a larger portion of the ROW is treated under this alternative, it is expected that the risks would be greater.

The greatest increase in risk would be to TxDOT employees managing vegetation. The risk to the public would not necessarily increase as drastically as for TxDOT employees, since this alternative is less reactionary than Alternative B and may prevent roadside hazards earlier.

Users of roadsides and traveler facilities would be increasingly subject to attack by fire ants as infestations grow unchecked. TxDOT workers would be at greater risk for significant increases of insect attacks.

3.2.14.1.4 Alternative D - Current Practices

Alternative D describes current pest management practices. This alternative also is dependent on mechanical and chemical treatments, as is Alternative B, and the impacts on humans should be similar. The risks from chemical and mechanical treatments should not decrease over time, as is the case for Alternative E.

The greatest risks from the use of chemicals for pest management are to TxDOT workers. TxDOT workers wearing protective devices as needed and otherwise following label directions should be at little or no risk.

3.2.14.1.5 Alternative E - Integrated Long-Term and Locally-Based Approach

Alternative E is designed to ultimately reduce dependence on chemical and mechanical means through the establishment and maintenance of stable, low-maintenance vegetation along the ROW. This alternative would have much of the same chemical risks as described in alternatives B and D and the same kinds of risks associated with mechanical control as described in Alternative C.

Risks to human health are expected to decrease as do the applications of chemical and mechanical methods.

3.2.14.2 Unavoidable Adverse Impacts

Probably the biggest unavoidable impact on human health is the threat to TxDOT employees of collisions with passing vehicles, operation of heavy equipment, or the use of powered hand tools. Although many of these accidents could be avoided, every accidents cannot be prevented.

It will be difficult for TxDOT employees working along highways to avoid inhaling some exhaust fumes, possibly contaminated with carbon monoxide, carbon dioxide, lead, and dust.

Some impacts on water and air quality from the use of mechanical, chemical, and cultural methods also could be unavoidable, but the impacts these could have on human health likely will be insignificant.

3.2.14.3 Mitigation Measures

Chemical Methods

The main mitigating practice is to follow the label directions for application, mixing, and safety equipment recommendations. Water quality can be protected by not spraying over surface water or over water channels. The use of adjuvants to reduce drift and mask any offensive odors would significantly reduce the impacts on local air quality and reduce the possibility of drift to non-target vegetation. Using spot applications and limiting applications to when there is little or no air movement also would reduce the probability of drift.

Mechanical Methods

Adequate notification of a roadside work zone, conducting maintenance activities during periods of low traffic volume, wearing proper clothing, and using other safety devices are routine precautions for TxDOT personnel. Avoiding the use of heavy equipment on steep slopes, moist soils, and fine-textured soils could prevent equipment-related accidents and adverse water quality impacts. Activities to control dust, such as watering exposed, dry soils and limiting the use of heavy machinery in dry regions during windy days would improve local air quality and reduce the possibility of collisions caused by poor visibility.

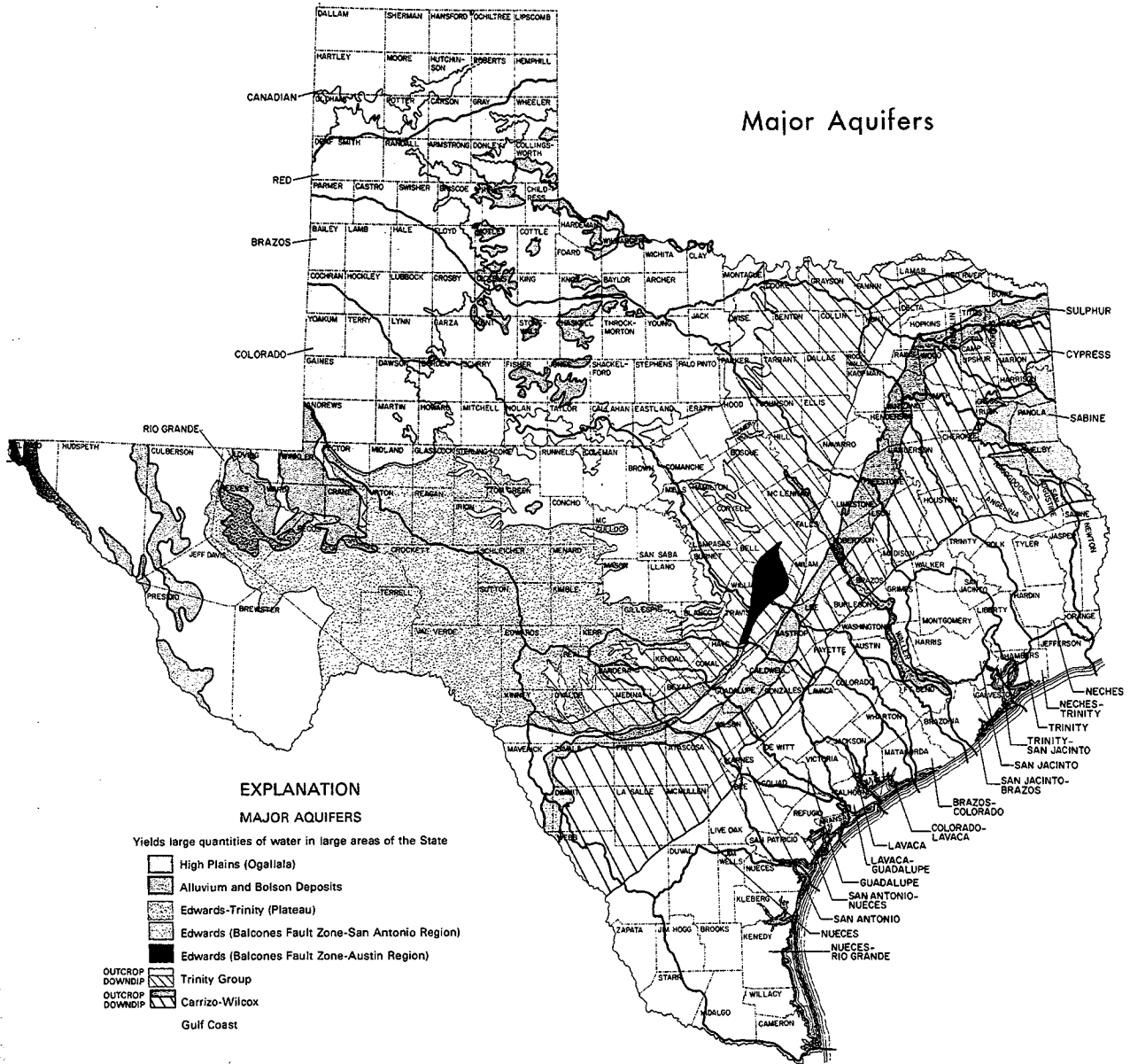
Cultural and Biological Methods

Since the use of cultural and biological control methods are not expected to affect human health adversely, no mitigation measures are necessary.

Table 3-1. TxDOT Districts Comprising Vegetational Regions

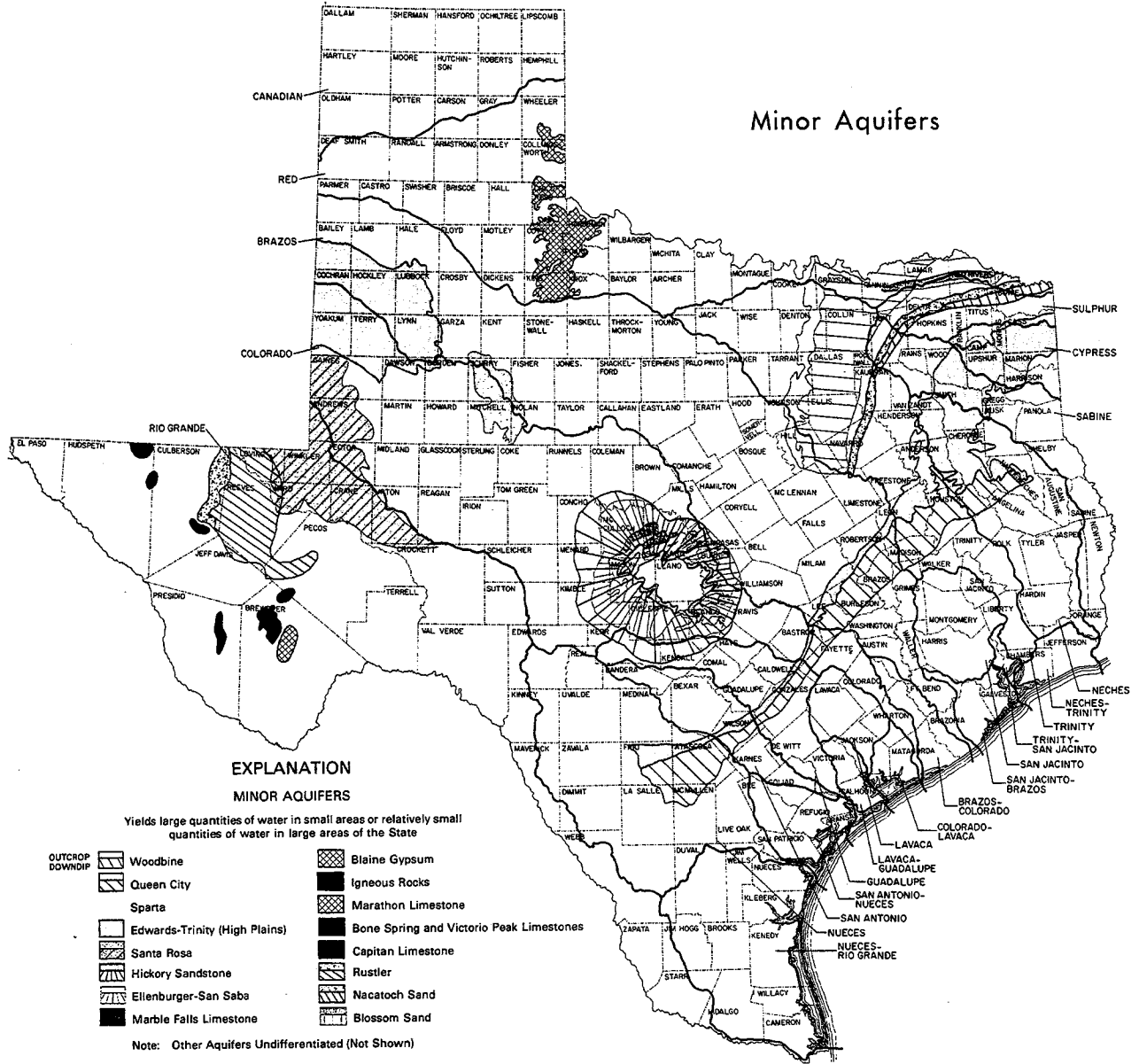
Vegetational Region	Districts
Pineywoods (1)	Atlanta, Beaumont, Bryan, Houston, Lufkin, Tyler
Gulf Prairies and Marshes (2)	Beaumont, Corpus Christi, Houston, Pharr, Yoakum
Post Oak Savannah (3)	Atlanta, Austin, Bryan, Houston, Paris, San Antonio, Tyler, Waco
Blackland Prairies (4)	Austin, Bryan, Dallas, Paris, San Antonio, Waco, Yoakum
Cross Timbers and Prairies (5)	Abilene, Austin, Brownwood, Dallas, Fort Worth, Paris, Tyler, Waco, Wichita Falls
South Texas Plains (6)	Corpus Christi, Laredo, Pharr, San Antonio, Yoakum
Edwards Plateau (7)	Abilene, Austin, Brownwood, El Paso, Laredo, Odessa, San Angelo, San Antonio
Rolling Plains (8)	Abilene, Amarillo, Brownwood, Childress, Lubbock, San Angelo, Wichita Falls
High Plains (9)	Abilene, Amarillo, Childress, Lubbock, Odessa
Trans-Pecos (10)	El Paso, Odessa, San Angelo

Figure 3-2. Major Aquifers in Texas



Source: TWC, 1990.

Figure 3-3. Minor Aquifers in Texas



Source: TWC, 1990.

Table 3-2. Maximum Labeled Rates Compared with TxDOT's Average and Maximum Rate of Pesticide Application

Chemical	Maximum Labeled rate product/acre	Average TxDOT Application Rate product/acre	Approximate Percent of Maximum Labeled Rate	Maximum TxDOT Application Rate product/acre	Approximate Percent of Maximum Labeled Rate
Herbicides					
Clopyralid (Transline®)	1.5 L (20 fl oz)	0.7 L (10 oz)	50	1.5 L (20 fl oz)	100
Glyphosate (Roundup®) (Rodeo®)	11.7 L (5 qt)	1.2 L (0.5 qt)	10	7.0 L (3 qt)	60
	8.8 L (3.75 qt)	7.0 L (3.0 qt)	80	7.0 L (3.0 qt)	80
Hexazinone (Velpar®)	56.1 L (6 gal)	18.7 L (2. Gal)	33	37.4 L (4 gal)	67
Imazapyr (Arsenal®)	7.0 L (3 qt)	2.3 L (1 qt)	33	4.7 L (2 qt)	67
Metsulfuron methyl (Escort®)	113.2 gm (4 oz avoird.)	28.3 gm (1 oz avoird.)	25	85.0 gm (3 oz avoird.)	75
Sulfometuron methyl (Oust®)	113.2 gm (4 oz avoird.)	56.1 gm (2 oz avoird.)	50	56.1 gm (2 oz avoird.)	50
Triclopyr (Pathfinder II®)	Pre-formulated for application	Wet basal 12" of mesquite stem(s)	100	Wet basal 12" of mesquite stem(s)	100
Insecticides					
Chlorpyrifos (Dursban Turf®)	Dilute 0.03 L (1 fl oz) to 15.2 L (4 gal) and apply 3.8-7.6 L (1-2 gal) as a drench to each active ant mound				
Diazinon (Diazinon 4E®)	Dilute 0.06-0.09 L (2-3 fl oz) to 3.8 L (1 gal) and wet (not drench) each active ant mound				
Fenoxycarb (Logic®)	680.4 gm (1.5 lb avoird.)	453.6 gm (1.0 lb avoird.)	67	680.4 gm (1.5 lb avoird.)	100

Source: Herbicide Summary Chart and Roy Smith, TxDOT.

Table 3-3. Increased Noncancer Risk Associated with Chemical Exposure

Hazard Index *		
Exposure Categories	Average Application Rate	Maximum Application Rate
Worker		
Mixing / Loading	NA	Chlorpyrifos (3)*
Spray truck driving	Chlorpyrifos (2)	Hexazinone (2) Triclopyr (2) Chlorpyrifos (10)
Public		
Dermal contact with sprayed vegetation	NA	NA
Exposure by ingestion of sprayed vegetables		
Tomatoes	NA	NA
Lettuce	NA	Triclopyr (2) Chlorpyrifos (3)
Beans	NA	NA
Exposure by ingestion of contaminated surface water	NA	NA
Exposure by ingestion of contaminated groundwater	NA	NA
Exposure by consumption of wild game exposed to pesticides		
Ingestion of deer meat	NA	NA
Ingestion of fish	NA	Chlorpyrifos (30)
Exposure from picking berries		
Dermal exposure	NA	NA
Ingestion of berries	NA	NA

* The Hazard Index is an estimate of the risk an individual may experience under the above conditions. It is derived by dividing the estimated single-day human exposure dose by the oral reference dose.



Chapter 4

EIS
Pest Management Program

4.1.0 Introduction

The Draft Environmental Impact Statement (DEIS) was issued on November 22, 1995. Public announcement of the DEIS was made in the Texas Register (20 TexReg 10160, November 25, 1995). This public notice specified a 114-day period for the receipt of public and agency comments in written or oral form. Five (5) comment public hearings were scheduled by TxDOT/TTI at the following locations as noted in the public notice:

Austin	January 31, 1996
Lubbock	February 2, 1996
Dallas	February 9, 1996
Beaumont	February 27, 1996
Pharr	February 29, 1996

Exact times and locations were published in the public notice. The public comment period was terminated at 5:00 pm on March 15, 1996.

4.1.1 What This Chapter Contains

This chapter deals with public comments on the DEIS. Copies of the DEIS were furnished to individuals and organizations who provided input into the initial scoping as well as to those specifically requesting a copy. Additionally, a copy of the DEIS was made available for public review at the Construction and Maintenance Division of TxDOT in Austin and at each of the TxDOT district offices.

People and organizations who responded to the DEIS, a summary of the issues raised, summary responses, copies of the public comments, and specific responses to issues raised in the comments are provided. All comments received during the comments period are included here in their entirety.

4.1.2 The Need For Increased Public Input

Public involvement and interagency/intergovernmental coordination and consultation are essential elements in the development of an Environmental Impact Statement (EIS). TxDOT is grateful for the time spent in developing and presenting the thoughtful comments and suggestions during scoping and in the review of this report. TxDOT feels that the proactive gesture of developing this EIS for their roadside vegetation

management practices emphasizes a desire for a more productive interaction with the public.

4.2.0 Summary of Public Comments

Comments in letters addressed to TxDOT and TTI concerning the DEIS were considered during production of the Final EIS and while developing the following summaries. A total of six public comments was received and several relevant issues were raised. Topics addressed in the comments ranged from preferred alternatives to environmental quality, mitigation, regulation, and pesticide use. The public's comments will be addressed individually later in this chapter.

4.2.1 Public Hearings

Five public hearings were held as scheduled, and no comments were offered at any of the hearings.

4.2.2 Written Comments

Written responses to the DEIS were submitted by the following persons or agencies.

Adams, T.C., State of Texas, Office of the Governor, Austin, Texas
Wheeler, Sidney, Texas Natural Resource Conservation Commission, Austin, Texas
Sutherland, E.M., Texas Department of Transportation, Environmental Affairs
Division, Austin, Texas
Lea, Wayne A., Army Corps of Engineers, Fort Worth, Texas
Frye, Roy G., Texas Parks and Wildlife Department, Austin, Texas
Pitman, Susan, The Chemical Connection, Wimberly, Texas

4.2.2.1 Summary of Issues Raised

All comments collected during the comment period and letters of comment addressed to the Texas Department of Transportation were considered during the production of the Final EIS. The number of public comments received was low (6 written, 0 oral); however, several relevant issues were raised. Those issues include comments on the specific alternatives, suggested risk mitigation measures, water quality issues, regulatory compliance, and chemical/pesticide use. The public comments are included in their entirety later in this chapter.

4.2.2.2 Summary Response

Responses to individual comments and statements are included on the comments themselves later in this chapter. Because the comments offered were so few, no attempt was made to collect the responses into groups.

4.2.2.3 PMP and IPM

Integrated Pest Management (IPM) was mentioned in the original scoping document and several times since in individual reviews. TxDOT's Pest Management Program (PMP) can be partitioned into a Vegetation Management System (VMS) and an Insect Management System (IMS). VMS incorporates IPM as part of the decision-making process. The term IPM originated in agriculture, and while it fits nicely as a segment of the VMS, it cannot be the entire roadside vegetation management plan.

4.3.0 Public Comments

Comment 1

1.1 See comment 2, this comment is a summary of comment 2.



STATE OF TEXAS
OFFICE OF THE GOVERNOR

GEORGE W. BUSH
GOVERNOR

February 8, 1996

Dr. Wayne McCully (Veg Mgt Prg)
Texas Transportation Inst. - Tx A&M Univ.
The Texas A&M University System
College Station, Texas 77843-3135

RE: TX-R-95-12-22-0001-50-00 / DRAFT EIS ROADSIDE PEST MANAGEMENT PROGRAM

Dear Dr. McCully:

Your environmental impact statement for the project referenced above has been reviewed. The comments received are summarized below and are attached.

1.1

The Texas Natural Resource Conservation Commission (TNRCC) commented that the Draft EIS has done a reasonable job of presenting the potential impacts to water quality of the various alternatives considered in the document. However, it seems that the minimal potential impacts of herbicide usage assume that all of the mitigation measures discussed in Section 3.2.3.3 are fully implemented. However, when the mitigation measures are not followed stringently, herbicide impact to water quality can be very significant. For that reason, TNRCC urges TXDOT to develop, if it has not already done so, a training program for its employees and those of its contractors to assure that all of these mitigation measures are fully implemented. The Final EIS should consider General Conformity in the four nonattainment areas: El Paso - Ozone (serious), PM10 (moderate), Carbon Monoxide (moderate); Dallas/Ft. Worth - Ozone (moderate); Beaumont/Port Arthur - ozone (severe); and Victoria, which is an ozone maintenance area. No other comments were received.

We appreciate the opportunity afforded to review this document. Please let me know if we can be of further assistance.

Sincerely,

T. C. Adams
T. C. Adams, State Single Point of Contact
TCA/yjy
Enclosures

Vegetation Management

FEB 12 1996

TEXAS TRANS. INSTITUTE

XC - Roy Smith
2/12/96

Post Office Box 12428 Austin, Texas 78711 (512) 463-2000 (Voice)/(512) 475-3165 (TDD)

Comment 2

- 2.1 **TxDOT spray applicators undergo a standard certification training course and are licensed as non-commercial pesticide applicators by the Texas Department of Agriculture (See sections 1.2.2.2 and 1.2.2.3).**

Barry R. McBee, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
John M. Baker, *Commissioner*
Dan Pearson, *Executive Director*

RECEIVED
JAN 23 1996

JAN 23 1996
GOVERNOR'S BUDGET OFFICE

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
Protecting Texas by Reducing and Preventing Pollution

January 24, 1996

Mr. T.C. Adams
Governor's Office of Budget and Planning
P.O. Box 12428
Austin, Texas 78711

Re: TxDOT/Draft EIS/Roadside Pest Management Program
TX-R-95-12-22-0001-50-00

Dear Mr. Adams:

The following staff of the Texas Natural Resource Conservation Commission (TNRCC) has reviewed the above-referenced project and offer the following comments:

Water Planning & Assessments Division:

2.1

The staff of the Research and Environmental Assessment Section has reviewed the above-referenced Draft EIS. The Draft EIS has done a reasonable job of presenting the potential impacts to water quality of the various alternatives considered in the document. However, it seems that the minimal potential impacts of herbicide usage assume that all of the mitigation measures discussed in Section 3.2.3.3 are fully implemented. TNRCC would concur that when properly used, herbicide impacts to water quality are minimal. However, when the mitigation measures are not followed stringently, herbicide impacts to water quality can be very significant. For this reason, TNRCC urges TxDOT to develop, if it has not already done so, a training program for its employees and those of its contractors to assure that all of these mitigation measures are fully implemented.

If you have questions regarding water quality comments, please feel free to contact Mr. Tom Remaley, Research and Environmental Assessment Section, at (512) 239-4576.

Office of Policy and Regulatory Development:

The Office of Policy and Regulatory Development has reviewed the above-referenced project for General Conformity impacts in accordance with 40 CFR Part 93 and Chapter

Comment 2 Continued

Mr. T.C. Adams
Page 2

January 24, 1996

2.2 TxDOT does, and will continue to, comply with local regulations concerning nonattainment.

101.30 of the TNRCC General Rules. The Final EIS should consider General Conformity in the four nonattainment areas:

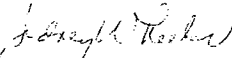
2.2

El Paso - Ozone (serious), PM10 (moderate), Carbon Monoxide (moderate);
Dallas/Ft. Worth - Ozone (moderate);
Beaumont/Port Arthur - ozone (severe); and
Victoria, which is an ozone maintenance area.

Should you have any questions regarding air quality, please feel free to contact Mr. Buddy Henderson, Air Policy and Regulations Division, at (512) 239-1510.

Thank you for the opportunity to review this project.

Sincerely,



(Ms.) Sidney Wheeler
Program Administrator
Intergovernmental Relations Division

Comment 3

3.1 The Vegetation Management Program should submit to TAC section 2.47 concerning environmental review. Section 1.1.1 of the EIS has been corrected to reflect this regulatory requirement.

3.2 TxDOT Vegetation Management Program will continue to be consistent with goals and policies of the Texas Coastal Management Program.



DEWITT C. GREER STATE HIGHWAY BLDG. • 125 E. 11TH STREET • AUSTIN, TEXAS 78701-2483 • (512) 463-8585
February 9, 1996

Wayne G. McCully, Ph.D.
Texas Transportation Institute
Suite E 112, 707 Texas Avenue
Texas A&M University
College Station, Texas 77843-3135

Re: DEIS - Roadside Pest Management Program

Dear Dr. McCully:

Upon further review of the Draft Environmental Impact Statement of the Pest Management Program, this office has several comments related to relatively recent changes in environmental regulations. Our comments are as follows:

3.1 • In February, 1995, TxDOT adopted environmental rules related to transportation projects. The rules were published in the *Texas Register* on December 9, 1994. Section 2.51 of the rules requires environmental review of TxDOT maintenance programs. Vegetation management is one of the programs subject to review, therefore, the DEIS should reference and comply with this requirement. Also, the statement on page 1-2 (first paragraph under section 1.1.1, second sentence) should be corrected to reflect the regulatory requirement.

3.2 • The Texas Coastal Management Program (CMP) was approved last October by the Coastal Coordination Council. The final rules for the program were published in the *Texas Register* on October 20, 1995. Although the implementation date is still not set, we feel that the approval of the DEIS and subsequent FEIS will be subject to the CMP requirements. The rules require that TxDOT maintenance programs be consistent with the goals and policies of the CMP (§505.11). The DEIS should address the requirements of the CMP and make a determination of consistency as required by the regulations (§505.30).

If you have any questions or need additional information, feel free to call me at (512) 416-2608.

Vegetation Management

FEB 14 1996

TEXAS TRANS. INSTITUTE

cc: Mr. Joe Graff, TxDOT-CMD
Mr. Roy Smith, TxDOT-CMD

Sincerely,

E. M. Sutherland
Director of Natural Resources Management
Environmental Affairs Division

An Equal Opportunity Employer

Comment 4

4.1 Thank you for commenting. TxDOT has and should continue to comply with the permitting regulations of the Clean Water Act and with NPDES.



DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102-0300

REPLY TO
ATTENTION OF:

February 29, 1996

Operations Division
Regulatory Branch

SUBJECT: Project Number 199500890

Wayne G. McCully, Ph.D.
Range Scientist
Texas Transportation Institute
The Texas A&M University System
College Station, Texas 77843-3135

Dear Dr. McCully:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement (EIS) concerning proposed vegetation management practices on the state highway system in the state of Texas, dated April 1993 and revised November 1994; April 1995 and August 1995. This project has been assigned Project Number 199500890. Please include this number in future correspondence concerning this project.

We have reviewed this Draft EIS relative to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. Under Section 404, the U. S. Army Corps of Engineers (USACE) regulates the discharge of dredged and fill material into waters of the United States, including wetlands. Waters of the United States include any part of the surface water tributary system, from large rivers to small streams, and any lake, pond, or other waterbody on the tributary system, as well as wetlands. Waters of the United States can include man-made as well as natural areas. For example, abandoned construction and mining pits may be waters of the United States. Under Section 10 of the Rivers and Harbors Act of 1899, we regulate any work in, or affecting, navigable waters of the United States.

4.1 It appears that most activities discussed in the Draft EIS would generally not require Department of the Army authorization under Section 404 and/or Section 10. However, activities that would involve a discharge of dredged or fill material into waters of the United States or activities in, or affecting, a navigable water of the United States would require Department of the Army authorization in the form of a permit. You should keep these requirements in mind when planning individual projects.

Thank you for your interest in our nation's water resources. If you have any questions concerning our regulatory program, please contact Mr. Jim Herrington at the address above or telephone (817)334-2188.

Sincerely,

Presley B. Hatfield
Wayne A. Lea
Chief, Regulatory Branch

Copy Furnished:

Mr. Rollin MacRae
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

Comment 5

5.1 Thank you for commenting. Your comments, including your support for Alternative E, are noted.



TEXAS PARKS AND WILDLIFE DEPARTMENT
4200 Smith School Road • Austin, Texas 78744 • 512-389-4800

ANDREW SANSDOM
Executive Director

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Ft. Worth

March 14, 1996

Dr. Wayne McCully
Vegetation Management Program
Texas A&M University
Texas Transportation Institute
College Station, Texas 77843-3135

Re: Draft Environmental Impact Statement (DEIS): Roadside Pest Management Program

Dear Dr. McCully:

The above referenced document has been reviewed by Department staff. The following comments are provided.

The DEIS analyzes anticipated impacts associated with five alternative programs that would guide the Texas Department of Transportation in the management and control of roadside plants and insects which are declared pests. Treatments evaluated include mechanical, chemical, cultural, and biological methods.

The DEIS represents a thorough, comprehensive evaluation of the five alternative approaches and would serve as a very good research document in the study of vegetation control methods, including the implications of the use of chemical pesticides.

The Department supports Alternative E (Integrated Long-term and Locally-Based Approach) as the preferred strategy with emphasis on the incorporation of both current and proposed mitigation measures as summarized in Section 0.6.0, page xxix of Volume 1.

Incorporation of Alternative E would provide increased wildlife habitat over a longer period. This Alternative would allow the planning and application of mechanical vegetation control treatments according to localized needs and conditions, reduce the use of chemical herbicides in comparison to current levels, and emphasize rights-of-way maintenance measures which favor locally occurring native plants preferred by wildlife

Thank you for providing the opportunity to comment.

Sincerely,

Roy C. Frye
Habitat Assessment Branch
Resource Protection Division

Vegetation Management

MAR 19 1996 (w/ mailing postmark)

TEXAS TRANS. INSTITUTE

RGF:dab

cc: Diana Noble, TxDOT Environmental Affairs Division

*XC Roy Smith
2/19/96
(Postmark 2/15/96)*

5.1

Comment 6

- 6.1 The human health risk assessment utilized the latest techniques and the best data available. Toxicity hazard data for the chemicals analyzed in this EIS are abundant.
- 6.2 The risk assessments in this document were performed by experienced people with advanced college degrees.
- 6.3 TxDOT recognizes IPM as a decision-making process, and incorporates IPM into it's current Vegetation Management System.

Facsimile Cover Sheet

To: Mr. Roy Smith
Company: TxDOT
Phone: 416-3094
Fax: 416-3044

From: Susan Pitman
Company: The Chemical Connection, A Public Health Network of Texans Sensitive to Chemicals
Phone: 512-255-7046
Fax: 512-255-7053

Date: 03/15/98

Pages including this cover page: 4

Comments on Draft Environmental Impact Statement Concerning Vegetation Management Practices:

- 6.1 This document is an embarrassment to the State of Texas because it grossly under-estimates human health effects. How can you do a risk assessment if you don't even acknowledge the risk?
Numbers are lovely but mean absolutely nothing when they are based on a lack of data and false and incomplete assumptions.
- 6.2 Since the scoping comments, I have been approved by both the Texas Structural Pest Control Board and the Texas Department of Agriculture to teach a CEU class on the human health effects of pesticides. I'd suggest that the people preparing the final draft be instructed to take that class before going any farther.
- 6.3 I'd also suggest they learn what IPM is all about. The IPM Alternative is missing the most important input -- the need to choose the method AND the products that pose the least risk to people and the environment. IPM is a decision making process. The Structural Pest Control Board has done rulemaking on this subject and defines the principles of IPM as:
1. Strategies that rely on the best combination of pest management tactics that are compatible with human health and environmental protection.
2. Proper identification of pest problems

Comment 6 Continued

- 6.4 Spot applications are used by TxDOT for fire ant control to minimize human and non-target animal exposure to the pesticide being used.
- 6.5 As mentioned in the first paragraph of page 3-5, chemical overuse could lead to erosion problems. This should not occur with proper chemical usage.
- 6.6 See section 3.2.2.3 for a discussion of measures used to mitigate chemical drift.
- 6.7 In some cases, an adjuvant conceivably could increase the chance for exposure of humans to a pesticide, or possibly make a compound more toxic. However, in most cases adjuvants reduce the toxicity of a given pesticide by reducing the dosage applied.
- 6.8 Washing food plants is a common practice to remove contaminants such as soil. Many pesticides are not systemic in nature, and persist on the plant surface. Washing that plant is a quick and effective method of removing surface residues of the pesticide.
- 6.9 The presence of chlorine in a chemical does not necessarily make the chemical one of the persistent organochlorine pesticides (such as DDT). Many chlorine-containing compounds, such as the few used by TxDOT, are not persistent, are not taken up by the food chain, and do not bioaccumulate in human and animal tissues.
- 6.10 Your comment is noted.
- 6.3 (cont)
3. Monitoring
4. Use of no-chemical management strategies whenever practical.
5. Preferential use of least-toxic chemical controls when pesticides are needed. Attached to these comments is the Structural Pest Control Board definition of "least toxic" pesticides and application methods. The designation of pesticides as EPA Category III & IV is not an statement of safety. Do take a look at how the SPCB tried to address this problem.
- 6.4 Dursban and Diazinon have no place in an IPM program for fire ant control. You should be anticipating the problem and, when chemical controls are necessary, using a bait (like the Logic on your list.) The DEIS however restricts the use of pesticides for fire ants to mound treatments (3-17) which would preclude the effective way to use Logic which includes broadcast application at the proper season under the proper conditions.
- 6.5 The assumption of no impact on soil by chemical use (3-5, 3-7, etc.) is not correct. These chemicals kill soil organisms that allow the wanted vegetation to be healthy (so it can crowd out the unwanted vegetation) and increase watering and erosion problems due to lack of maximal soil health.
- 6.6 Drift is repeatedly (including 3-11) mentioned as the only pathway for human exposure except for a brief comment about volatilization products (vapors) on B2-4. It is the experience of chemically sensitive people that volatilization products lasting up to (or longer than) a month after spot application along highway ROW cause adverse health effects. The fumes from chlorpyrifos last for years indoors and cause adverse health effects for vulnerable people.
- 6.7 Perhaps this is what is meant by the reference on 3-9 to "possibly objectionable odors." It is not the odor that is a problem, it is the interference in human life functions including the nervous, immune, hormonal, and detoxification mechanisms that is a problem. When it is suggested that adding an adjuvant to mask offensive odors would be an acceptable mitigation measure, the State is walking a thin line of liability because, although odor is not the problem, odor is a warning signal to humans so that they can choose to avoid exposure if they wish.
- 6.7 The DEIS incorrectly calls chemical drift and possibly objectionable odors a "short term air quality impact."
- 6.7 Please note that adjuvants to control drift can make the toxicity of the compound being applied even more toxic to people. Robert McInlyre out in West Texas has reported this problem and requested that they not be used in this area.]
- 6.8 It is unbelievable that "washing lettuce" would be included as a mitigation measure for accidental contamination of gardens and food. Anyone who knew the first thing about pesticides (including glyphosate) would know that much of the pesticide is absorbed into the plant itself. Washing does little to reduce the risk.
- 6.9 The choice of chemicals includes at least three that contain chlorine, making their safety highly suspect. Chlorinated chemicals have been found generally be persistent, taken up by the food chain, and bioaccumulative in animal and human tissue. Nasty choice for the State to impose on its people and environment.
- 6.10 Perhaps the most personally offensive statement in the DEIS after we went to all the trouble to submit comments in the scoping stages, is that only 0.13% of the population would be hypersensitive to chemical controls and that the "probability that those individuals will be exposed to pesticides used by TxDOT is remote." The National Academy of Sciences estimated in 1989 that 15% of the population is unusually sensitive to common chemicals. With increasing pollution, especially indoor air pollution, these numbers are growing rapidly. Most of us have problems driving on highways which have been treated, although many people don't know why

Comment 6 Continued

6.11 Your comment is noted.

6.12 Thank you for commenting on the Draft EIS. Your comments have been noted and considered in the production of the Final EIS.

6.10
(cont) they are sick. With herbicides it is easy to tell because several days after the symptoms begin to occur while driving there is a visible herbicide burn.

6.11 Finally, there is no mention of using posting and notification of pesticide applications as a mitigation measure. It would be unreasonable to ask that pesticides never be used. On the few occasions they may be necessary, vulnerable people can protect themselves from injury if they know not to use the highway.

6.12 Thank you for the opportunity to comment on the draft EIS. I apologize for waiting until the last minute. It is, however, a daunting tome. Many people have mentioned to me that they wanted to comment on it but didn't have the time or knowledge necessary to figure out what it was talking about.

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References

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Glossary

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Pest Management Program



Glossary

The following are definitions of technical terms used in the risk assessments and general terms used in discussions of pest management. For specific highway or management terms used by TxDOT, see Chapter 1, Section 1.1.3.

Absorbed dose: The amount of a substance (e.g., a chemical) that enters the body of an exposed organism.

Absorption: The movement of a substance (e.g., a chemical) through a membrane into the body after exposure has occurred.

Active ingredient: The effective part of a pesticide formulation, or the actual amount of the technical material present in the formulation.

Acute effects: Effects that show up soon after exposure.

Acute exposure: Exposure over a short period of time.

Additive effect: Refers to situations where the combined effect of two or more substances (e.g., two or more chemicals) is equal to the sum of their individual effects.

Adenoma: Gland-like benign growth (tumor). An adenoma in a rat that has received a test chemical is considered evidence that the chemical might cause cancer in a human.

Adjuvant: Something added to the pesticide mixture to help the active ingredient do a better job. Examples: wetting agent, spreader, adhesive, emulsifying agent.

Adsorb: To take up by attraction and hold to a surface. Chemicals are often adsorbed by soil particles, dust, activated charcoal, or other substances.

Allergen: A foreign substance that induces a response from the immune system of some people so that subsequent exposures to the substance cause an allergic reaction (wheezing, sneezing, runny nose, red eyes, hives, other dermatitis, headaches, shock, etc.). Also called an antigen.

Allergic reaction: A reaction to an antigen or allergen (such as pollen or a chemical) that is acquired from previous contact with the material and that is far stronger than would be expected in most people.

Aces assay: A standardized screening test using a mutated strain of *Salmonella* bacteria to determine whether introduction of a given substance causes further mutations in the bacteria. Mutagenesis is believed to be an indication of carcinogenesis.

Annual (plant): A plant species living and growing for only one year or season.

Antagonism: Interference or inhibition of the effect of one substance (e.g., a chemical) by the action of another substance (e.g., another chemical).

Antibody: A protein, produced by the immune system, that recognizes antigens and attempts to destroy or inactivate them.

Antigen: See allergen.

Assay: A test for a particular substance or effect.

Biofiltration: The use of vegetation or microorganisms to filter out sediment or pollutants.

Biota: The animal and plant life of a region; flora and fauna collectively.

Benign tumor: A tumor confined to the territory in which it arises, not invading surrounding tissue or metastasizing to distant organs. Benign tumors can usually be excised by local surgery.

Bile: The fluid secreted by the liver. Contains red blood cell pigments, fat, cholesterol, cellular debris, etc. Aids digestion and excretion of some xenophobics.

Bioaccumulation: The retention and concentration of a substance by an organism.

Bioassay: An evaluation of the effects of a substance on a living organism.

Bioconcentration: The accumulation of a substance (e.g., a chemical) in tissues of an organism (such as fish) to levels that are greater than the level in the medium (such as water) in which the organism resides. See bioaccumulation.

Biodegradation: Decomposition of a substance into more elementary compounds by biological action.

Biological diversity: The variety of life and its processes, including all life forms from one-celled organisms to complex organisms such as insects, plants, birds, reptiles, amphibians, fish, animals and the processes, pathways and cycles that link such organisms into natural communities.

Buffer strip: A strip of vegetation that is left unmanaged or is managed to reduce the impact that a treatment or action on one area would have on an adjacent area.

Cancer: The uncontrolled, invasive growth of cells. Cancerous cells can metastasize; they can break away from the original tumor, relocate, and grow elsewhere in the body.

Candidate species: Any species for which the Texas Parks and Wildlife Department has substantial information to support the biological appropriateness of proposing to list as endangered or threatened but has not yet issued proposed rules because of preclusion by other listing activity.

Capillaries: Finest subdivisions of the blood vessels; they bring the blood into intimate contact with the tissue.

Carcinogen: A substance that causes or induces cancer.

Central Nervous System (CNS): Portion of the nervous system that consists of the brain and spinal cord; protected from the body (and toxicants) by the blood brain barrier.

Chromosome: Rod-like structure in the nucleus of a cell composed of DNA and protein. Chromosomes contain genes responsible for heredity.

Chronic: Of long duration. Chronic exposure usually refers to long-term, low-level exposure. Chronic toxicity refers to the effects produced by such exposure. Chronic exposure may cause latent damage that does not appear until later.

Compatibility: The degree to which development with specific visual characteristics is visually unified with its setting.

Concentration: The quantity of a substance per unit volume or weight.

Critical period: The time during development of an embryo or fetus when it is most sensitive to the effects of a chemical or virus. The critical period for many chemicals in humans is during the first trimester (the first three months of gestation).

Cumulative exposure: The summation of exposures of an organism to a substance (e.g., a chemical) over a period of time.

Cytoplasm: Cellular material within the cell membrane and surrounding the nucleus.

Degradation: Chemical or biological breakdown of a complex compound into simpler compounds.

Dermal exposure: Contact between a substance (e.g., a chemical) and the skin.

Dermatitis: A skin inflammation or rash.

Diffusion: The movement of suspended or dissolved particles from a more concentrated to a less concentrated region as a result of the random movement of individual particles. The process tends to distribute the particles uniformly throughout the available volume.

Distribution: In pharmacology, the dispersion of a chemical within the body of an organism that has been exposed. Distribution depends to a large extent on the physical properties, such as water or fat solubility, ionization, particle size, and ability to bind to blood protein.

DNA: The molecule that encodes genetic information (genes) contained in chromosomes. It may be altered by mutagens.

Dose: The quantification of exposure. For oral and dermal exposure, it is typically expressed as the amount of chemical in grams or milligrams per kilogram of body weight, and for inhalation, as the concentration of the chemical in the air.

Dose-response: A quantitative relationship between the dose of a substance (e.g., a chemical) and an effect caused by substance.

Edema: Swelling caused by excessive fluid buildup in tissue.

Edwards Aquifer Recharge Zone: That area at the ground surface where the water-bearing units of the Edwards aquifer outcrop as delineated by the Texas Water Commission (now the Texas Natural Resource Conservation Commission) on official recharge zone maps.

Endangered species: Any species that is seriously threatened with extinction throughout all or a significant portion of its range in Texas and designated officially by the Texas Parks and Wildlife Department.

Environmental fate: The destiny of a substance (e.g., a chemical) after release to the environment. Involves considerations such as transport through air, soil, and water; bioconcentrations; and degradation.

Enzyme: A large protein that speeds up the rate of a biochemical reaction.

Ephemeral stream: A stream that flows less than 10 percent of the time, only in direct response

to rainfall, with a channel that may be scoured or unscoured and is always above the water table.

Epidemiology: The study of the patterns of disease in groups of people.

Escape cover: An assemblage of vegetation exhibiting a specific growth form to allow escape and concealment by organisms from predators.

Estuarine: Of, pertaining to, or formed in an estuary.

Eutrophication: The process whereby a body of water becomes highly productive of aquatic plants, such as algae, due to the input of large quantities of nutrients.

Evapotranspiration: That portion of precipitation returned to the air through evaporation and transpiration.

Excretion: Any physiological process through which waste or toxic materials are removed from the body; routes of exit may include urine, feces, sweat, milk, and expired air.

Exposure: Contact between a substance (e.g., a chemical) and a potentially affected biological system that permits interaction.

Exposure assessment: The determination or estimation (qualitative or quantitative) of the magnitude, frequency, duration, route, and extent (number of people) of exposure to a substance.

Exposure scenario: A set of conditions or assumptions about sources, exposure pathways, concentrations of toxic chemicals, and populations (numbers, characteristics, and habits) that aid the investigator in evaluating and quantifying exposure in a given situation.

Extrapolation: Estimation of unknown values by extending or projecting from known values.

Fat-soluble: Dissolves in fat.

Fetus: The later stages of a developing organism. In the human, it is the unborn child during the period of uterine life from the end of the second month until birth.

Forbs: A group of herbaceous (non-woody) plants other than grasses generally including wildflowers and many plants commonly referred to as "weeds."

Formulation: The form in which a pesticide is packaged or prepared for use. A chemical mixture that includes a certain percentage of active ingredient (technical chemical) with an inert carrier.

Gastrointestinal (GI) tract: Includes the mouth, esophagus, stomach, duodenum, small intestines,

appendix or cecum, large intestines, and the rectum.

Gavage: Force-feeding (or dosing) by stomach tube.

Gene: The unit of inheritance; part of a DNA molecule.

Genetic: Having to do with genes. Genetic toxicants affect the germ cells (egg, sperm, or their precursors) of the parents; the effects will be manifested only in the offspring, not the parents.

Germ cell: A reproductive cell.

Gram (g): One-twenty-eighth of an ounce; the weight of one milliliter of water.

Grasses: A group of herbaceous (non-woody) plants with fibrous roots, jointed stems, sheathed, alternating leaves originating from nodes, and flowers occurring from spikelets.

Gut: The alimentary (digestive) tract, especially the intestines. "Gut flora" are all the microorganisms that normally inhabit the gut.

Half-life: The length of time required for the mass, concentration, or activity of a chemical or physical agent to be reduced by one-half.

Hazard: Potential for a chemical to cause an adverse health effect. A source of risk that does not necessarily imply potential for occurrence. A hazard produces risk only if an exposure pathway exists and if exposures create the possibility of adverse consequences.

Hazard identification: Involves gathering and evaluating data on the types of injury or disease that may be produced by a substance and on the conditions of exposure under which injury or disease occurred.

Hazard Index (HI): A relative determination as to whether exposure to a particular chemical under a set of exposure assumptions may result in significant adverse health effects. The ratio between estimated single-day dose and oral reference dose (RFD).

Hepatic: Pertaining to the liver

Hepatoma: A malignant tumor occurring in the liver.

Herbaceous: A plant that does not develop persistent woody tissue above ground (annual, biennial, or perennial), but whose aerial portion naturally dies back to the ground at the end of a growing season. Herbaceous plants include such categories as grasses, grass-likes (sedges, rushes), and forbs.

Herbicide: A chemical that regulates the growth of or kills specific weeds or undesirable plants.

Histamine: A substance released by injury tissue; causes redness, itching, shock, and other responses.

Histology: The study of the structure of the cells and tissue. Usually involves microscopic examination of tissue slices.

Hormone: A chemical substance secreted in one part of an organism and transported to another part of that organism where it has a specific effect.

Hydrolysis: A chemical reaction in which water reacts with another substance to form two or more new substances.

Hypersensitive: Greater sensitivity than usual to a substance (e.g., a chemical) but not showing an "allergic" reaction.

Hyposensitive: The quality of being less sensitive to a substance (e.g., a chemical) than most people.

Immune system: The body's system which protects against infectious agents, controls white blood cell (leukocyte) maturation and immuno/globulin production, and guards against the proliferation of cancerous cells.

Individual lifetime risk: The estimated incremental lifetime risk of an adverse effect incurred by an individual owing to exposure to a specified concentration of risk for a given period of time.

Inert ingredients: All ingredients in a formulated pesticide product which are not classified as active ingredients.

Insecticide: A chemical that kills a specific pest insect.

Intactness: The integrity of visual order in the natural and man-built landscape, and the extent to which the landscape is free from visual encroachment.

Intake: Amount of material inhaled, absorbed through the skin, or ingested during a specified period of time.

Integrated Pest Management (IPM): Integrated Pest Management or "IPM" in a roadside pest management program means the selection, integration, and implementation of pest control that consists of prevention of pest problems; monitoring and evaluation of pests, damage and results of treatment; acknowledgement of population levels of pests that can be tolerated based on legal,

economic, health, or aesthetic thresholds (i.e., the action threshold); reliance to the maximum extent possible on biological, mechanical, and cultural treatment of pests wherever they fully satisfy the safety and maintenance requirements and specifications of all aspects of judicious pesticide use consistent with the principle goal of preventing the recurrence of the problem situation.

Intermittent stream: A stream that flows seasonally (10-90 percent of the time) in response to a fluctuating water table, with a scoured channel that is at least 1 meter (3 feet) wide.

Interspecies extrapolation: The act of applying a set of data or an individual test result on one species, under certain conditions and subject to particular dose levels of a toxic substance and application methods, to another population of the same or different species. Conservative safety factors are applied.

Intestine: See gut.

In vitro: Phrase-literally, in glass - used to refer to experiments that take place outside the living animal.

In vivo: Phrase-literally, in the living being - used to refer to experiments that take place in the living animal.

Irreversible effect: An effect characterized by the inability of the body to partially or fully repair injury caused by a toxic agent.

Irritation: Transient, reversible effects, including redness, pain, and itching.

Karst: Topography formed on limestone or other soluble rock and characterized by sinkholes, cave, and underground drainage.

Kilogram (kg): A Kilogram is 2.205 pounds.

LC₅₀ (Median Lethal Concentration): A measure of acute toxicity, the concentration that kills 50 percent of the test animals exposed. Used in aquatic toxicity and inhalation studies.

LD₅₀ (Median Lethal Dose): A measure of acute toxicity, the dose level that kills 50 percent of the test animals exposed.

Leukemia: A form of cancer characterized by the rapid multiplication of abnormal white blood cells (leukocytes) in the blood and blood-forming tissue.

Lifetime Average Daily Dose (LADD): Estimated single-day exposure (or average daily dose)

adjusted to reflect lifetime exposure.

Lifetime exposure: Total amount of exposure to a substance that a human would receive in a lifetime (usually assumed to be 70 years).

Likelihood: Statistical probability that an event such as harm or injury may occur as a result of exposure to a risk agent.

Linear relationship: Straight-line. When the statistical relationship between two variables increases on a direct unit-for-unit basis, this relationship, when plotted on a chart, will form a straight line.

Lipid: Fat and fat-like material; any substance that originates from living organisms and that dissolves in organic solvents, such as ethyl alcohol, ester, benzene, etc. Along with proteins and carbohydrates, lipids are the principal structural element of the living cells, especially the cell membrane.

Liter (l): A liter is a metric measure a little larger (1.057) than a quart.

LOAEL (Lowest Observed Adverse Effect Level): In dose-response experiments, the lowest exposure level which causes a statistically significant increase in the frequency or severity of an adverse effect between the exposed population and its appropriate controls.

LOEL (Lowest Observed Effect Level): In dose-response experiments, the lowest exposure level which causes a significant increase in the frequency or severity of any effect between the exposed population and its appropriate controls.

Lymphatic system: The system of vessels and nodes that return the lymph (clear fluid that is collected from body tissues) to the blood.

Lymphoma: Any of several types of cancerous conditions of the lymphatic tissue, including lymphosarcoma and Hodgkin's disease.

Maintenance: Activities which involve the repair or preservation of an existing facility to prevent that facility's disintegration to an unsafe or irreparable state, or which involve the treatment of an existing facility or its environs to meet acceptable standards of operation or aesthetic quality. Such activities generally do not require the acquisition of additional right-of-way.

Malignant: A tumor that has invaded neighboring tissue and has undergone metastasis to distant body sites, at which point the tumor is called a cancer.

Maximum Tolerated Dose (MTD): Dose that allows the survival of animals exposed for a

lifetime carcinogenicity test.

Mechanism of action: The way in which a substance (e.g., a chemical) exerts its toxic effect(s).

Memorandum of Understanding: A formal document which outlines the relationship between agencies or parties, including the responsibilities and jurisdiction of each party, and which sets forth within its provisions agreements between parties.

Metabolism: 1) The sum of the chemical reactions occurring within a cell or a whole organism; includes the energy-releasing breakdown of molecules (catabolism) and the synthesis of new molecules (anabolism). 2) In toxicology, the altering of a chemical to a different chemical (biotransformation).

Metabolite: Any product of metabolism, especially a transformed chemical.

Microgram (μg): One-millionth of a gram.

Microliter (μl): One-millionth of a liter.

Milligram (mg): One-thousandth of a gram.

Milliliter (ml): One-thousandth of a liter.

Mitigation measure: An action taken to lessen adverse impacts or enhance beneficial effects.

Modeling: Use of mathematical equations to simulate and predict real events and processes.

Morbidity: Illness.

Mortality: Death.

Mutagen: A substance that can produce change in the genetic material (DNA) of cells that can be transmitted during cell division.

Mutagenicity: The capacity of a chemical or physical agent to cause permanent alteration of the genetic material within living cells.

Nanogram (ng): One-billionth of a gram.

National Environmental Policy Act of 1969 (NEPA): This is the basic national charter for protection of the environment. It establishes policy, sets goals, and provides means for carrying out the policy. NEPA is binding upon federal agencies, including the Federal Highway

Administration, and is usually followed as an environmental guideline by state and local agencies. In this document, NEPA includes the act itself and its subsequent amendments.

Natural communities: An assemblage of organisms indigenous to an area which is characterized by distinct combinations of species occupying common ecological zones and interacting with one another.

Necrosis: Death of cells or tissue from irreversible damage.

Neoplasm: (See tumor).

NPDES: The National Pollutant Discharge Elimination System, under which the Administrator of the U.S. Environmental Protection Agency can delegate permitting authority to the State of Texas in accordance with Section 402 of the Federal Water Pollution Control Act.

Nesting cover: An assemblage of vegetation exhibiting a specific growth form to allow nesting activities associated with wildlife reproduction.

Neurotoxicity: Exerting a destructive or poisonous effect on nerve tissue.

NOAEL (No Observed Adverse Effect Level): In dose-response experiments, it is the exposure level which causes no statistically significant increase in the frequency or severity of any adverse effect between the exposed population and its appropriate controls.

NOEL (No Observed Effect Level): In dose-response experiments, it is the exposure level which causes no statistically significant increase in frequency or severity of any effect between the exposed population and its appropriate controls.

Non-target: Any plant, animal, or other organism that a method application is not aimed at, but may accidentally be injured by the method.

Noxious weed(s): Plants classified by the Texas Department of Agriculture as detrimental for agriculture or public health, safety, and welfare. A plant regulated or identified by law as being undesirable, troublesome, and difficult to control.

Ocular: Pertaining to the eye.

Parasympathetic: Pertaining to part of the nervous system, below the level of consciousness, that participates in the regulation of the involuntary functions of the body (for example, heartbeat, breathing rate).

Pathogenic agent: A substance, living or inanimate, or a force, the excessive presence or relative lack of which is cause of a particular disease.

Pathologic: Pertaining to a disease state.

Perennial: A plant species having a lifespan of more than two years.

Perennial stream: A stream that flows year-round (more than 90 percent of the time) with a scoured channel that is always below the water table.

Peritoneal cavity: The abdominal cavity, which contains such organs as the stomach, intestines, and liver.

Persistence: Resistance to degradation. A persistent substance is expected to remain in the environment for a long time.

Pesticide: Any substance used for controlling, preventing, destroying, repelling or mitigating insects, rodents, fungi, weeds, or other forms of plant or animal life that are considered to be pests.

Petrochemical: A chemical derived from petroleum.

pH: A term used to express the degree of acidity or alkalinity of a solution. A pH of 7 is neutral. Acid solutions have pH below 7, and alkaline solutions have pH greater than 7.

Pharmacokinetics: The study of the changes in a toxicant in parts of the body over time. Involves absorption, distribution through the body, biotransformation, and excretion of the toxicant.

Photolysis: Chemical decomposition induced by light.

Placenta: The organ that forms the bridge between the fetal and maternal blood streams.

Plant community: An association of plants of various species found growing together in different areas with similar site characteristics.

Plasma: A clear, yellowish fluid portion of blood, lymph, or intramuscular fluid in which cells are suspended.

Poison: A substance that may be dangerous to life or health. Often considered to be a substance with relatively high acute toxicity; legally defined as having an acute oral toxicity of less than 50 milligrams per kilogram of body weight.

Potency: Amount of a substance or material necessary to produce a given level of deleterious effect.

Procarcinogen: A chemical that must be activated by an enzyme reaction before it is carcinogenic.

Promoter: An agent causing an initiated cell to produce a tumor.

Proposed candidate species: Any species for which the Texas Parks and Wildlife Department has information to propose listing as endangered or threatened but cannot provide conclusive data to support the biological appropriateness of such a proposal. The taxa in this category are not being considered as proposed additions to the list unless further information becomes available.

Public involvement: An ongoing phase of the project planning process which encourages and solicits public input, and seeks to provide the public the opportunity to become fully informed regarding project development.

Qualitative: The non-numerical presentation of information.

Quantitative: Numerical or measured information, such as the dose needed to produce an effect, or the number of people affected.

Reference Dose (RFD): Estimate of the largest amount of a substance to which a person can be exposed on a daily basis that is not anticipated to result in adverse effects, usually expressed in mg/kg/day. The RFD is derived from laboratory animal studies in which the no observable effect level (NOEL) is modified by a safety factor. Same as Acceptable Daily Intake (ADI).

Renal: Pertaining to the kidney.

Reproductive toxicant: A substance that can alter the reproductive process at any point, including fertilization, implantation, maternal metabolic changes, embryonic and fetal growth, placenta functioning, birth, lactation, postnatal growth, and maturation.

Reservoir: A tissue in an organism or a place in an organism where a substance accumulates, from which it may be released at a later time.

Respirable: Capable of being inhaled.

Respiratory system: All structures through which air enters the body.

Reversible effect: An effect that is not permanent, especially an adverse effect that diminishes after exposure to a toxic substance ceases.

Right-of-Way (ROW): The land provided for a highway, usually including the roadway itself, shoulders, and areas between the roadway and adjacent properties.

Risk: In risk assessment, the probability that an adverse effect (injury, disease, or death) will occur under specified conditions of exposure or use.

Risk agent: Chemical substance, biological organism, radioactive material, or other potentially hazardous substance or activity.

Risk characterization: Integration of the data and analysis involved in hazard identification, exposure assessment, and dose-response assessment to estimate the nature and likelihood of adverse effects.

Risk estimate: A description of the probability that organisms exposed to a specified dose of a substance (e.g., a chemical) will develop an adverse response (for example, cancer).

Route of exposure: The avenue by which a substance (e.g., a chemical) comes into contact with an organism; such avenues include inhalation, ingestion, and dermal contact.

Safety: Practical certainty that a substance will not cause injury under carefully defined circumstances of use.

Safety factor: A factor conventionally used to extrapolate human tolerance for chemical agents from no-observed-effect levels in animal test data.

Scoping: The process by which significant issues relating to a proposal are identified for environmental analysis. Scoping includes eliciting public comment on the proposal, evaluating concerns, and developing alternatives for consideration.

Sensitization: The process (chemical exposure and immune response) through which a person acquires an antibody-mediated sensitivity to a chemical or other allergen.

Single-Day Dose (SDD): The estimated level of chemical exposure to an organism engaged in an activity for one day, for which exposure assumptions have been made.

Sink: A place in the environment where a compound or material collects. See reservoir.

Site preparation: The removal of competition (including woody slash), and conditioning of the soil to enhance the germination of seed.

Skin cancer: Common cancers (over 500,000 cases per year in the United States) associated with excessive exposure to the sun and some occupational exposures. Most serious type is malignant

melanoma.

Slope failure: Gradual or rapid downslope movement of soil or rock under gravitational stress, often as a result of human-caused factors, e.g., removal of material from the base of a slope.

Slope stability: The resistance of a natural or artificial slope to failure by landsliding.

Solvent: A liquid capable of dissolving another substance. Many solvents are organic, or carbon-based; many of these are volatile, flammable, and toxic. Examples: acetone, trichloroethylene (TCE), perchloroethylene, and benzene. Water is a nonorganic solvent.

Somatic: Pertaining to the body cells, as opposed to reproductive cells.

Sorption: A surface phenomenon that may be either absorption or adsorption, or a combination of the two; often used when the specific mechanism is not known.

Statistically significant: Experimental results that are "not likely" to have occurred by chance. "Significant with .05 probability" means there is only a 5 percent probability that the results were attributable to chance and a 95 percent probability that the results were attributable to the experiment.

Subchronic: Of intermediate duration, usually used to describe studies or levels of exposure between 5 and 90 days.

Sublethal: Pertaining to a dose level that is less than an amount necessary to cause death.

Substance: Refers to chemicals and other external, nonliving sources of potential hazard, such as ionizing radiation and microwaves.

Succession: The progressive development of trees or other plants toward their highest role in their ecology; their climax. The replacement of one forest, or other plants, by others.

Synergism: Effects from a combination of two or more events, efforts, or substances that are greater than would be expected from adding the individual effects.

Synthetic: Made by humans.

Systemic effects: Effects observed at sites distant from the entry point of a chemical owing to its absorption and distribution into the body.

Teratogenic: Capable of producing birth defects.

Threatened species: Any species that is not presently endangered but could become so in the foreseeable future.

Technical chemical or pesticide: The pesticide as it is first manufactured by the company before formulation. It is usually almost pure.

Threshold: A dose or exposure below which there is no apparent or measurable adverse effect.

Tissue: A group of similar cells that form one of the structural materials of a plant or animal.

Toxicant: See poison.

Toxicity: The quantity or degree of being poisonous or harmful to plant, animal, or human life.

Toxicology: The study of toxic chemicals and their effects on organisms.

Toxin: A poison of biological origin.

Transformation: Changes in the visible characteristics and/or growth patterns of cells, usually accompanied by the ability to cause tumors when inoculated into a host organism.

Tumor: Abnormal tissue that keeps growing after the original stimulus to growth has ceased. Also called neoplasm. A benign tumor does not form metastases (secondary tumors) and does not invade and destroy nearby normal tissue. A malignant tumor invades, destroys, and metastasizes and is likely to kill the host unless treated.

Tumor incidence: Fraction of animals having a tumor of a certain type.

Uncertainty factors: Factors used to adjust for multiple sources of uncertainty encountered in using experimental data for predicting effects on humans, such as intraspecies variation, interspecies variation, synergism, and different routes of exposure (oral versus inhalation). EPA guidelines provide the following uncertainty factors:

Factor used to extrapolate from:

10	Valid human evidence
100	Valid long-term animal studies
1000	Animal studies of less than chronic exposure
1-10	Additional factor used to extrapolate from a LOAEL instead of a NOAEL

Unity: The degree to which the visual resources of the landscape join together to form a coherent, harmonious visual pattern. Unity refers to the compositional harmony or inter-compatibility between landscape elements.

Vividness: The memorability of visual impression received from contrasting landscape elements as they combine to form a striking and distinctive visual pattern.

Water-soluble: Dissolves in water

Wetlands: Those areas that are inundated by surface or ground water often enough to support plants and other aquatic life that requires saturated or seasonally saturated soils for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds.

Wildlife: Non-domesticated living organisms including both vertebrates and invertebrates living within the Texas landscape or occurring as a result of introduction.

Wildlife habitat: A place and environment where a wildlife organism lives or spends most of its time. Consists of four basic components: food, cover, water, and interspersed (arrangement of the parts).

Xenobiotic: Foreign substances, or ones not usually found in a particular organism.

