



## COMMONWEALTH OF KENTUCKY

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COMMISSIONER OF HIGHWAYS

## DEPARTMENT OF HIGHWAYS

FRANKFORT, KENTUCKY 40601

March 15, 1973

ADDRESS REPLY TO:  
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H.2.33

MEMORANDUM TO: J. R. Harbison  
State Highway Engineer  
Chairman, Research Committee

SUBJECT: Research Report No. 360; "Establishment and Maintenance of Roadside Plantings and Turf;" KYHPR-65-33; HPR-1(8), Part II.

The attached report covers an era of research on grasses and legumes which was conceived somewhat intuitively and merged fortuitously with the current attitudes toward ecological and environmental purity. During the term of study, numerous answers to "What to do?" and "How to do?" questions were resolved and implemented into policies, practices, procedures and specifications. The report, therefore, follows after the fact but brings together in a historical way the research documentation and so-called implementation packages. The collective success of these efforts is evident.

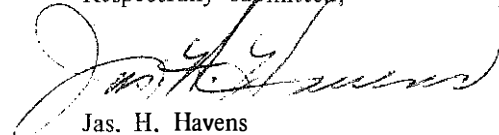
A companion phase of this project was devoted to the establishment of woody plants. That phase was completed and reported in January 1971 (Research Report 304; "Establishment of Wood Plants on Roadsides (Southeastern Kentucky)," by Samuel E. Whitaker). An interim report on the turf phase (by K. C. Arnold and J. T. Griffin) was issued in August 1967. Both phases were conducted entirely by the Division of Roadside Development.

As a matter of interest, we reported on the first use of "Blown Mulch..." in Kentucky in 1954 [US 60, Henderson-Morganfield Road, Project AF62(3)]. A research proposal on grasses and mulches was prepared in 1947 (indexed as Report No. 25); but apparently, the work was never undertaken. Apparently, the first use of blown mulch on a large scale was on the West Virginia Turnpike. We also reported on "...Stabilized Turf Shoulders..." (US 31W, north of Bowling Green) in 1955. Observed but not reported elsewhere were two experimental applications of green, pulp mulch on the West Kentucky Parkway and I 75 in the vicinity of Dry Ridge.

As mentioned in my transmittal of Report No. 304, Department assent to "roadside beautification is traceable back to 1929 (Ninth Biennial Report, p. 11)."

The report now submitted concludes all work planned under KYHPR-65-33. Any future research in this area will require definition of further objectives and work plans.

Respectfully submitted,

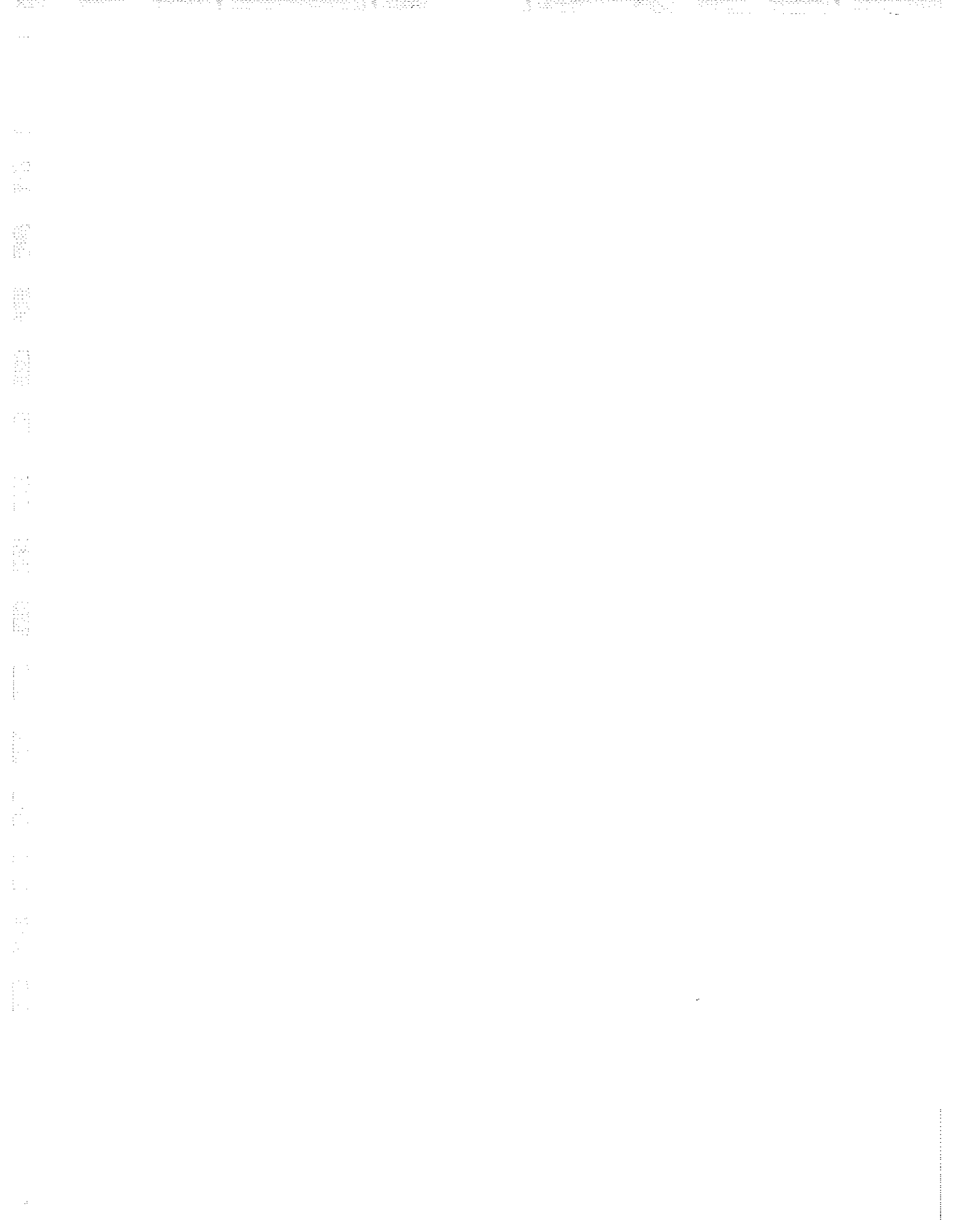


Jas. H. Havens  
Director of Research

JHH:dw  
cc's: Research Committee



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Research Report  
360

**ESTABLISHMENT AND MAINTENANCE OF  
ROADSIDE PLANTINGS AND TURF**

**FINAL REPORT  
KYHPR-65-33; HPR-1(8), Part II**

by

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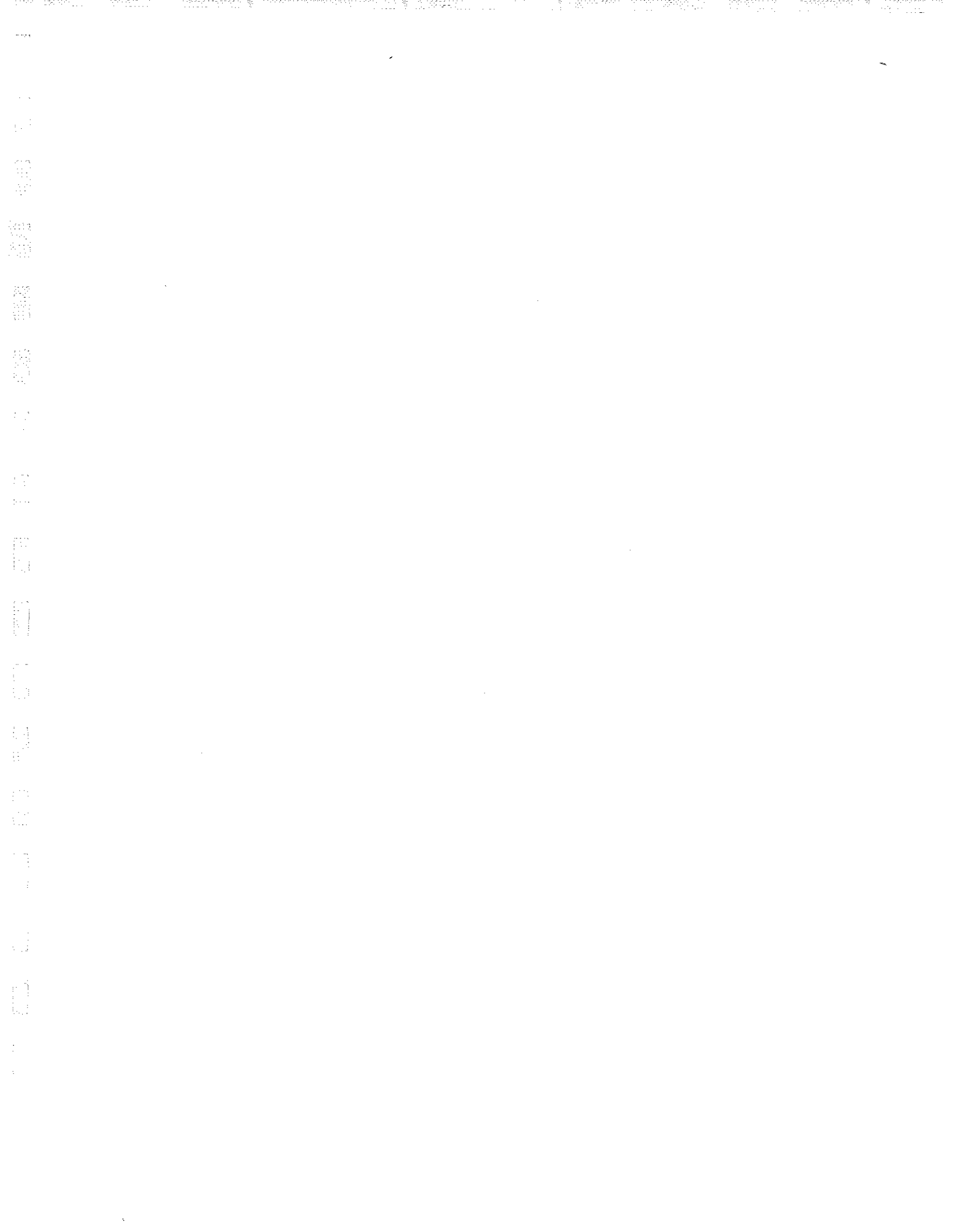
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**DEPARTMENT OF HIGHWAYS  
Commonwealth of Kentucky**

**in cooperation with the  
U.S. Department of Transportation  
Federal Highway Administration**

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**March 1973**



## SUMMARY

A series of experimental investigations initiated by the Kentucky Highway Department over a six-year period were designed for the purpose of studying the adaptability, establishment, and maintenance of roadside plantings and turf, including the stabilization and management of roadside soils.

Early plant survival studies provided valuable information in determining landscape plantings adaptable to roadside conditions and revealed the urgent need for planting maintenance soon after establishment. Ground cover studies revealed the superiority of crownvetch over other ground covers for roadside slope stabilization. Preliminary studies of the direct seeding of tree seeds onto roadside cuts were near failures; however, information gained led to seedings on actual grade and drain construction projects and to more detailed studies.

Turf establishment investigations began with the evaluation of the adaptability of various grasses and legumes for Kentucky roadsides. Small species screening studies were first initiated to closely study the growth habits of turf plants, and actual roadside seedings were made to better evaluate their adaptability and suitability to critical roadside conditions. Of the species evaluated, Kentucky 31 fescue and crownvetch were found to be superior in adaptability and growth on Kentucky roadside conditions; however, there were several less common species found to provide sufficient growth and showed potential as possible roadside plants. Smooth brome grass performed surprisingly well along with a new selection of tall fescue, Kenwell. The Bluestem native grasses of the midwest were also found to provide significant growth. Big bluestem appeared to be better adapted than the others; however, Elkan bluestem and sand bluestem grew well. Weeping lovegrass provided immediate growth but was subject to winter damage. However, the lovegrass appeared to recover well each spring. The legumes, sericea lespedeza and Wagner flat pea, also performed well under roadside growing conditions. A new variety of sericea lespedeza (Hi-Way) was found to be as equally adaptive as the common variety and had a more desirable appearance for roadside use with its shorter growing heights and smaller stems and leaflets.

The fact that crownvetch was a relatively new plant having possibilities of being an excellent ground cover for the stabilization of poor erosive roadside slopes suggested the need for intensive investigations of the plant. There had been some seedings made in the state previously and there appeared to be some problems in establishment of this ground cover. Studies were immediately begun to closely study crownvetch growth

from germination to establishment. Several actual roadside experiments with crownvetch resulted in failures, revealing a weakness in seedling growth. Seed-treating methods prior to seeding were found to be unnecessary. Seeding depth studies indicated seed coverage advantageous but not a critical factor. Time of year or season when seeded appeared to be a critical factor as droughts or freezing conditions at the time of seedling establishment were very detrimental. In one study where the seeding was performed in the early fall and excellent germination had occurred under a good mulch, there was still 50 percent loss during the winter. Continual observation of a site where near complete loss of the vetch seedlings had occurred revealed the ability of crownvetch to grow and spread from just a few surviving seedlings into a dense vegetative mat covering the entire slope. Seedings of vetch with companion grasses indicated weed growth to be as much a competitive factor as the growth of the companion grass. Kentucky 31 fescue sown in companion with crownvetch was no more competitive and resulted in as quick a stand of vetch as seedings without a companion grass.

Several erosion control and soil management studies were conducted to evaluate problem soils and various newly developed mats, mulches, nettings and methods for stabilizing these erosive roadside soils. Results indicated practically all materials studied were effective in controlling soil erosion when properly installed or applied. Excelsior mat, jute matting and fiberglass roving were found to be effective in stabilizing drainageways. Excelsior wood fiber mulch was found to be equivalent to a straw mulch in preventing erosion, conserving moisture and providing a seedling environment conducive to growth.

Certain problem subsoils in Central Kentucky were, surprisingly, found not to be significantly improved by the incorporation of topsoil or commercially available organic additives. Other factors such as moisture stress and time of seeding appeared to be more critical in turf establishment. A study designed to evaluate turf establishment as influenced by incorporation of fertilizer to different depths in the soil was felt to be inconclusive. Considerably more variation in the type of soils was encountered from the top to the bottom of the slope than was noted in the turf response from the different fertilizer treatments.

With the advent of newly developed liquids with possible soil-stabilizing properties, an investigation was directed to evaluate an experimental chemical (Dow's NC 1556-L). The field screening study indicated the chemical to have some short-term soil holding ability but did not show promise as a significant method of erosion control. However, the imperative need for quick,

effective, temporary soil stabilization during construction to minimize pollution makes it necessary that further and more extensive investigations be continued in the field of a liquid chemical erosion control system.

For a complete roadside development program, maintenance of vegetation is considered equally important with establishment. A series of experimental investigations was conducted concerning turf fertilization and the control of weeds and other undesirable vegetation on rights of way. These experiments were undertaken over a four-year period to determine the relative merits and effects of different forms and rates of fertilizer applications as related to turf establishment and maintenance. Special efforts were made toward the evaluation of the benefits that may be derived from various sources of nitrogen under Kentucky roadside conditions. A major problem on Kentucky roadsides is the fact that initial applications of fertilizer at the time of the seeding are lost before the new vegetation has time to become established well enough to effectively control soil erosion. Deterioration of the vegetation occurs rapidly if a second application of fertilizer is not soon made. These fertilization experiments showed the tremendous response and benefits that can be expected from follow-up applications with properly selected nitrogen sources and types and rates of fertilizers. The studies further proved the need for a two-stage approach for the establishment and maintenance of a desirable vegetative cover capable of controlling soil erosion. All experiments revealed a greater and more significantly noticeable grass response initially and over a longer period of time was obtained from the quick-release sources of nitrogen, such as ammonium nitrate, rather than the slow release ureaformaldehyde. The studies also indicated that the majority of Kentucky's roadside soils are generally deficient in all three basic plant nutrients and that a complete balanced fertilizer having a 2-1-1 ratio would provide the greatest overall results in correcting soil deficiencies and developing a vegetative cover.

Considering the advantages of liquid fertilizers over granular fertilizers in ease and speed of application onto steep terrain, a screening study was conducted to evaluate top-dress applications of liquid fertilizer on roadside turf. Foliage burn was evident at all rates studied, but this was only temporary and the turf recovered with an excellent growth response.

In developing a plant and turf maintenance program, the control of undesirable vegetation was considered a must. The Department was beginning to use herbicides as a very necessary and important tool in the roadside vegetation management program. The control of undesirable weeds and management of turf

and plants on roadsides was considerably different from that encountered in the field of agriculture. Before specific recommendations could be made, research was necessary for screening and evaluating herbicides on the market and methods of application for specific control of certain kinds of weed problems encountered on the roadsides.

Control of unwanted vegetation around individual trees and in shrub beds was a considerable problem; tractor mowers would leave tall grass around the plants or damage the trees by trying to get too close -- hand mowing or pulling was too slow and costly. Experimental studies showed that amazine, a mixture of 45 percent simazine and 15 percent amitrole, and Casaron (4 percent dichlorobenil) were effective in controlling a broad spectrum of weeds and grasses without damage to trees and shrubbery.

A study to evaluate the merits of tobacco stems as a mulch to control weeds around roadside plantings was performed. There was some reduction in weed growth where heavy rates of stems were used, but relatively little improvement in the visual appearance could be noted. The use of stems as a mulch did result in increased growth of trees, but the labor involved in handling and applying the stems made the marginal benefits questionable.

A series of investigations of several herbicides for possible weed control in existing turf, under guardrails and on dense graded shoulders was undertaken. Herbicide additives marketed for the purpose of reducing hazards of spray drift were also investigated. Two chemicals which could be mixed with the herbicide solution were evaluated in addition to an entirely new system of spraying called "invert-emulsion." Although some advantages in drift control could be noted, neither the chemicals or the new system afforded any significant improvement over present spraying techniques.

Control of vegetation under guardrails presented many problems which made the selection of an appropriate and effective herbicide difficult. Studies revealed that soil sterilants were subject to being washed down the slope killing desirable vegetation, and contact type herbicides gave only partial control requiring repeated applications. Paraquat herbicide was found to provide a quick "burn-back" effect to all vegetation; however, the effects were very short term and regrowth occurred within a few weeks. Amitrole was slow to affect the vegetation but provided complete control without regrowth for that season. Other herbicides studied showed little promise in effectively controlling vegetation under guardrails and on dense graded shoulders.

Another study concerned with the control of unwanted vegetation without using herbicides involved



the use of aluminum sheeting as a weed guard around delineator posts. These aluminum discs were difficult to install, easily damaged by mowers, and relatively ineffective in keeping the grass and weed growth away from the posts. No further studies were conducted.

A series of screening investigations was made to determine the effectiveness of new herbicides marketed for the control of woody vegetation. Both the fenuron and picolinic acid herbicides were found to be effective in controlling brush. The picolinic acid appeared to have more desirable properties, such as being selective for brush and broadleaf vegetation and not affecting the grass, easier to apply since it could be broadcast, and provided a quicker kill. Two percent picolinic acid in granular form was noted as being very effective in controlling a broad spectrum of broadleaf weeds and small brush and resulted in a significant improvement in grass cover along the roadside.

Effectively controlling Johnsongrass scattered along Kentucky roadsides was of major concern. Various kinds

and rates of herbicides were investigated for possible use as a spot treatment application for individual clumps and a broadcast application for heavy infestations. Granular prometone and borate-chlorate herbicides were found to be very effective in spot controlling Johnsongrass for two seasons. Where heavy infestations of Johnsongrass were growing in desirable fescue turf, two applications of monosodium acid methanearsonate were surprisingly noted as being effective in reducing the Johnsongrass vegetation without damaging the tall fescue.

Infestation of another grassy weed, giant foxtail, was increasing greatly along the roadsides. Investigations were begun to determine what herbicides and types of applications were the most effective in controlling this weed. Two separate studies revealed that post-emergent applications were relatively ineffective, but the use of granular trifluralin and siduron as pre-emergent treatments showed promise as an effective means of controlling giant foxtail.

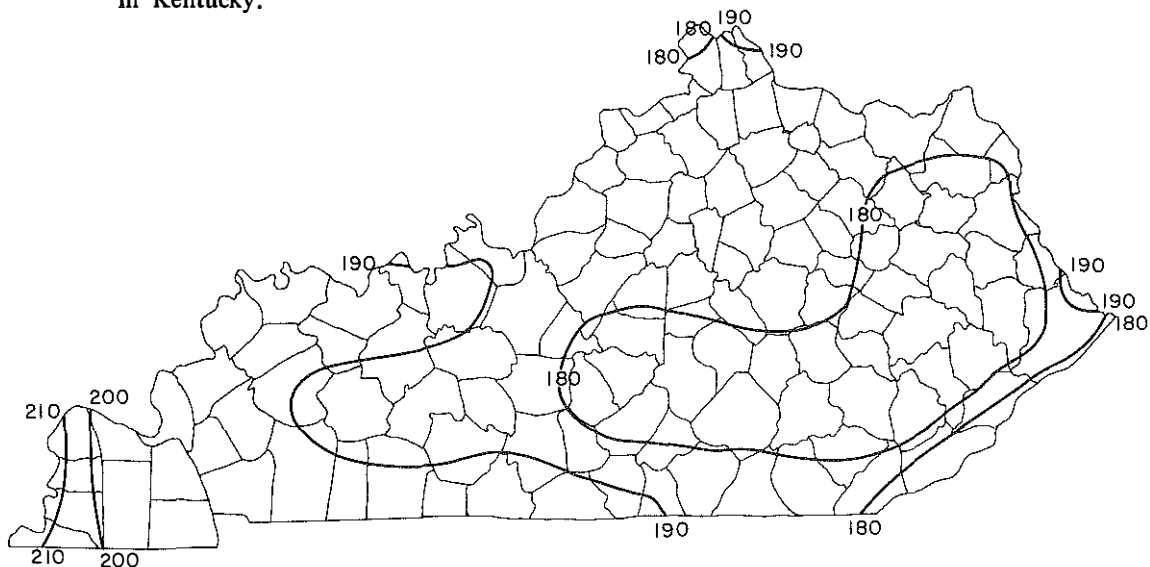
## INTRODUCTION

Kentucky, prior to the beginning of the major highway building programs in 1955, had about 21,000 miles of highways with approximately 91,000 acres of roadside area. Presently there are 3,500 more miles of roads and 45,000 more acres of roadside. This tremendous increase in roadside acreage has made the Highway Department one of the largest landowners in the state. Kentucky, like many other states, soon found itself responsible for developing and maintaining large areas of roadsides having varied and peculiar problems without adequate knowledge, information, or research results available. Most related research up to that time was primarily in the field of agriculture, and it was soon realized that conditions encountered on roadsides were quite different from those normally found in farm fields, forests, and lawns. The limited amount of roadside research conducted by other states was not applicable to Kentucky conditions since the state is characterized by marked differences and wide variations in soils, temperatures, rainfall and topography. These variations over the state can readily be noted from Figures 1, 2, and 3.

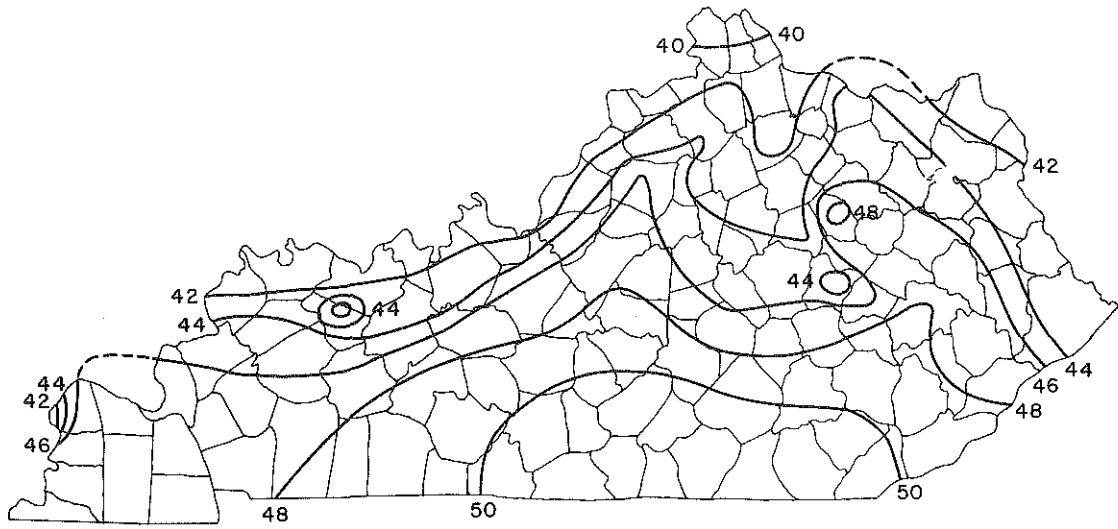
Surface soils encountered on roadsides after construction work generally consist of unclassified materials of subsoils and parent rock materials and are not agriculture soils in the usual sense. These existing soils usually contain very little if any organic matter and microorganism activity; are extremely low in available plant food nutrients; have poor structural and textural properties; lack sufficient moisture holding ability, proper drainage and aeration; and are often highly susceptible to erosion. Adding to this problem is the fact that Kentucky is located in a transitional climatic zone of plant adaptation (Figure 4), and different degrees of slope exposure encountered along the roadway make selection of adaptable species that will provide adequate growth even more difficult. Under these conditions, the establishment and maintenance of plants and turf became major problems.

Since the interstate program started so quickly and was to continue at an accelerated rate, basic applied roadside research was needed immediately. In 1964, an experimental research program in cooperation with the Bureau of Public Roads was undertaken to investigate the establishment and maintenance of woody and herbaceous plants and turf grasses on Kentucky

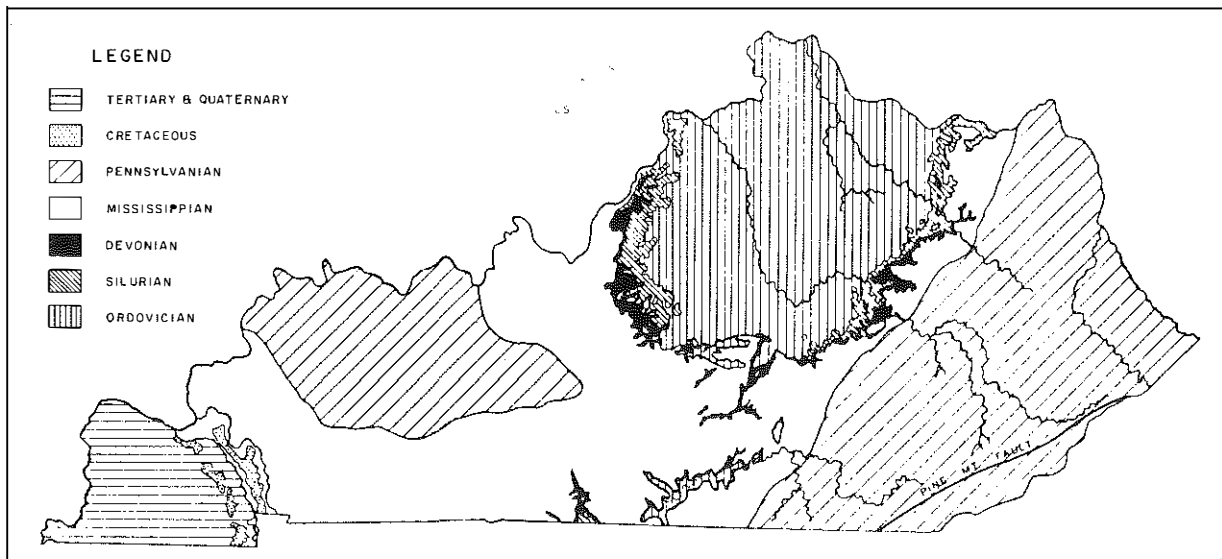
**Figure 1. Average Number of Days without Killing Frost in Kentucky.**



**Figure 2. Mean Annual Rainfall (in inches) in Kentucky.**



**Figure 3. Outline Geologic Map of Kentucky.**



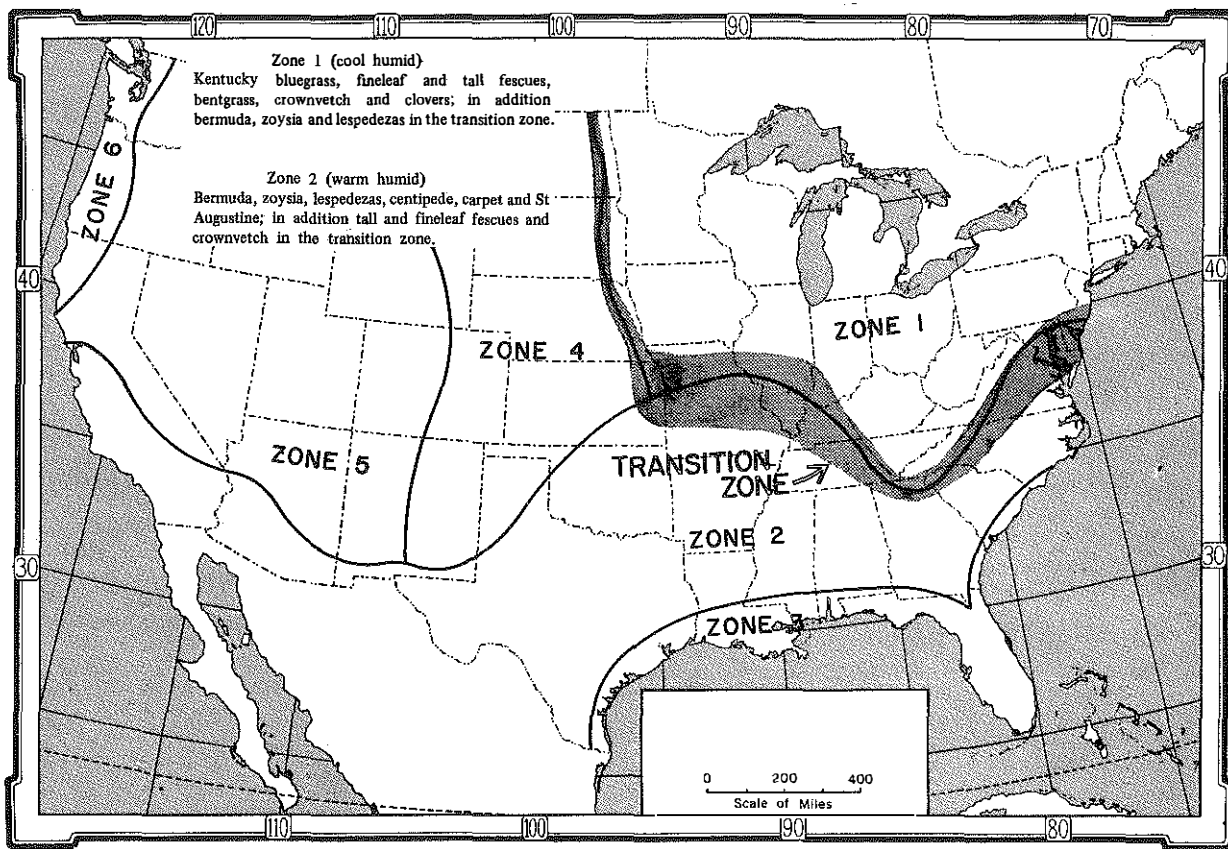


Figure 4. Regions of Turfgrass Adaptation Applicable to Kentucky.

roadsides. This involved a series of studies planned to develop methods of stabilizing and managing the soils encountered, evaluate the adaptability and suitability of grasses, legumes and woody plants under roadside growing conditions, develop techniques of seeding and planting conducive to sufficient growth, investigate growth inducing materials such as fertilizers and screen and evaluate herbicides for their effectiveness and safety in controlling undesirable vegetation.

The study was implemented as a closely related working function of the Department's Division of Roadside Development. As various programs were

planned, developed and implemented, the research program was used to screen and investigate new ideas, methods and materials. As problems or questions were encountered concerning any facet of the roadside program, experiments were designed and initiated immediately to evaluate possible solutions. As soon as significant findings were obtained, the information was implemented by appropriate means such as specifications, directives, policy procedures, contracts and (or) recommendations. This approach was considered a success for the research study and has been a significant factor in the growth and development of a progressive and functional roadside treatment program.

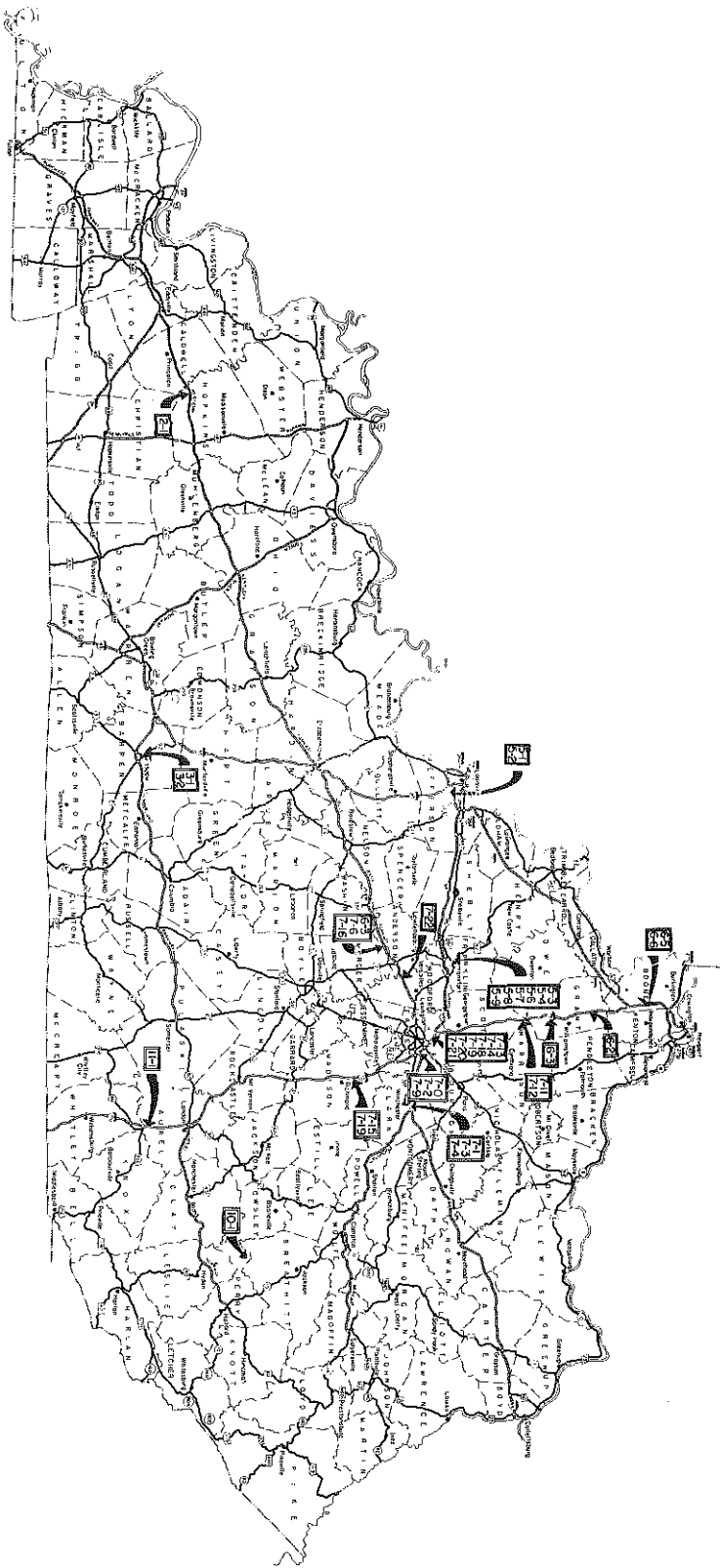


Figure 5. Location of Study Sites.

## REPORTS ON INVESTIGATIONS

To meet the objectives of this study, a number of field and laboratory investigations were undertaken for specific purposes. Some of these investigations had served their purpose and were completed and reported so in an interim report entitled *Establishment and Maintenance of Roadside Plantings and Turf* issued in August 1967. Investigations which had not been completed as of the 1967 report and which have been initiated since the 1967 report are reported in this document.

Some 37 investigations were undertaken. These can be grouped into two major categories with some five or six subcategories. The objectives, procedures, and specific findings of each investigation are reported in APPENDIX G. Distribution of the study sites across Kentucky are illustrated in Figure 5.

**TABLE 1**  
**SUMMARY OF INVESTIGATIONS**

- I. Vegetation Establishment
  - A. Plantings
    - 3-2 Evaluation of Direct Seeding of Tree Seeds on Kentucky Roadsides
    - 7-2\* Ground Cover
    - 7-3\* Landscape Planting Survival
    - 7-4\* Landscape Planting Survival
  - B. Turf
    - 6-1\* Crownvetch Nursery
    - 6-3 Adaptability of Grasses and Legumes to Kentucky Roadsides
    - 6-5 Effects of Various Seed Treatments on Crownvetch Seed Germination and Establishment
    - 6-6 Effects of Crownvetch Seeding Depth on Seedling Emergence, Survival and Establishment
    - 7-12 Effects of Soil Preparation and Mulching on Fall, Winter, and Spring Seedings of Crownvetch on Roadsides
    - 7-14 Grass and Legume Species Evaluation
    - 7-18 Competing Effects of Grasses when Sown with Crownvetch
    - 11-1 Evaluation of a New Variety of *Sericea Lespedeza* on Kentucky Roadsides
  - C. Soil Stabilization and Management
    - 3-1\* Erosion Control
    - 5-4\* Erosion Control Methods for Unprepared Roadside Ditches
    - 6-2 Incorporation of Fertilizers into Soil and Its Effect on Turf Establishment
    - 7-9 Effects of Subsoil Amendments in the Establishment of Turf
    - 7-11\* Straw-Excelsior Mulch
    - 7-17 Effect of Type of Cover and Slope Exposure on Soil Temperatures
    - 7-22 Evaluation of a Liquid Chemical System for Controlling Soil Erosion on Kentucky Roadsides
    - 10-1\* Excelsior Pad Mulch
- II. Vegetation Maintenance
  - A. Turf Fertilization
    - 2-1\* Fertilizer Experiment II
    - 7-0\* Fertilizer Experiment I
    - 7-6 Post-Emergent Application of Fertilizers on Roadside Turf
    - 7-16 Evaluation of Liquid Fertilizer on Roadside Turf
  - B. Weed Control
    - 1. Plantings
      - 5-1\* Weed Control around Roadside Plantings
      - 7-1\* Chemical Control of Weeds in Rest Areas
      - 7-13 Tobacco Stems as a Mulch for Landscape Plantings
    - 2. Turf
      - 5-2 Controlling Vegetation around Delineators with Aluminum Sheeting
      - 5-3 a, b, c and d -- Evaluation of Various Herbicides for the Control of Brushy and Weedy Vegetation
      - 5-6\* Herbicide and Herbicide Additives
      - 5-7\* Contact Control of Vegetation under Guardrails
      - 5-8\* Invert Emulsion
      - 5-9\* Paraquat Herbicide
      - 7-15 Spot Treatment Control of Johnsongrass with Non-Selective Herbicides
      - 7-19 Selectively Controlling Johnsongrass in a Fescue Turf with Herbicides
      - 7-20 Effectiveness of Post-Emergent Herbicides for Controlling Giant Foxtail
      - 7-21 Pre-Emergent Herbicidal Control of Giant Foxtail

\*Reported as completed in interim report, *Establishment and Maintenance of Roadside Plantings and Turf*, issued in August 1967.

## IMPLEMENTATION

### TURF ESTABLISHMENT:

Preliminary screening Study 7-2 to evaluate ground covers for possible roadside use indicated crownvetch (*Coronilla varia*) to be most promising. This finding resulted in a more extensive use of crownvetch as a ground cover for the stabilization of roadside slopes and for the aesthetic purpose of providing an attractive vegetative cover along highways. Special seedings of crownvetch on critical erosive slopes are now specified on most new highway construction projects throughout the state (APPENDIX A). In addition, special seedings of crownvetch are performed where needed at the time roadsides are being landscaped, the second stage of establishment of roadside vegetation (APPENDIX B), and during maintenance operations.

Increased use of crownvetch warranted the need for an evaluation of crownvetch establishment. Although some difficulty was encountered in establishing crownvetch experiments on actual roadside sites, useful information was gained from many of the studies.

Study 6-5 of crownvetch seeding depth revealed a significant increase in seedling survival can be expected through proper covering of the seed. Considerably more emphasis was thus indicated in seeding specifications concerning the importance of preparing a seedbed and covering the seed. Since a majority of crownvetch seedings are made onto roadside slopes which are steep and very difficult to till, strong emphasis is made on seeding the crownvetch as soon as possible after construction of the slope, taking advantage of loose soil conditions. On older slopes having a compacted soil surface, overseedings of crownvetch are specified for late winter and early spring when the soil surface is loose and open from freezing and thawing conditions during the winter (APPENDIX C).

Another study, Study 7-18, was initiated to obtain information on the competing effects of grasses and weeds on crownvetch establishment. At that time, most seedings of crownvetch were made with a companion grass seed mixture consisting primarily of Kentucky 31 fescue. However, in certain situations where an immediate cover of only crownvetch was desired, Kentucky 31 fescue was omitted and perennial ryegrass was sown, thinking there would be less competition from the ryegrass, thus resulting in quicker vetch establishment. Findings from this study did not substantiate this idea. The fact that seeding Kentucky 31 fescue with crownvetch did not significantly hinder vetch establishment and minimized weed growth led to a more extensive use of Kentucky 31 fescue rather than ryegrass as a companion grass with crownvetch (APPENDIX C).

Severe injury to crownvetch seedlings from freezing temperatures observed in Study 7-18 strengthened the present position of not allowing or recommending fall seedings of crownvetch whenever possible. The present progressive seeding program whereby seedings are performed as soon as soil areas are brought to final grade makes it difficult to limit the time of crownvetch seeding during the initial seeding, Stage I Erosion Control. But where the exact time of crownvetch seeding can be designated, such as during the second stage seeding and maintenance seedings, only late winter and early spring seedings are permitted (APPENDIX C).

Studies 6-3 and 7-14 provided considerable information of the growth habits, appearance and adaptability of selected grasses and legumes for possible roadside use in Kentucky. This information has been very helpful in selecting types of vegetation for specific roadside areas. As a result of these observations, weeping lovegrass is being used extensively on roadsides where high soil acidity and droughty conditions exist in the eastern and western areas of the state (APPENDICES D and E). More extensive use has also been made in the mountainous areas of eastern Kentucky of sericea lespedeza, which is somewhat more adaptable to the sandstone and low limestone soils than crownvetch (APPENDIX E). A new selection of tall fescue, Kenwell, is being used in rest areas and other finer turf areas in the western part of the state where Kentucky bluegrass does not perform well (APPENDIX D). Bermuda grass has also been recommended for use on droughty slopes of selected projects in the southern parts of western Kentucky.

### SOIL STABILIZATION AND MANAGEMENT:

Prior to Study 3-1, designed to evaluate various soil protective materials in 1965, the Kentucky Highway Department had been using a straw mulch tacked with asphalt as the primary method of protecting initial seedings on roadsides. Jute matting had only been used on a few trial projects in stabilizing drainageways. With the advent of various new soil stabilizing materials being brought onto the market, it was necessary to initiate a screening study to evaluate their effectiveness. The fact that most materials, if used properly, could effectively control soil erosion and enhance the establishment of vegetation on roadsides, as indicated by the study, greatly influenced the Department in developing new erosion control specifications in 1967. Continued use of a mulch tacked with asphalt was to still be the primary method of protection (APPENDIX A). On areas where the use of asphalt was not advisable, such as around concrete structures, buildings, bridges, and the edge of pavements, the use of straw tied down with a paper netting was used (APPENDIX A). Since jute



matting had already been used to some extent and none of the other ditch stabilizing materials were found to be significantly more effective, it was decided to expand the use of jute matting to supplement the sodding of drainageways (APPENDIX A). Revised specifications required a light rate of mulch to be used under the jute matting, an important observation of the study. Jute matting is being specified on construction projects to stabilize ditches on grades less than one percent which are subject to erosion (APPENDIX D).

Another material evaluated in Study 3-1, which had also been used to a limited extent by maintenance crews, was a fiberglass roving product called "Grassroot." This material showed considerable promise as a liner for ditches more critical than those designed for sod or jute. Study 5-4 was designed to determine the rates and methods of applying fiberglass strands and asphalt binding material. Information obtained from this study was very helpful in the writing of procedures and specifications for the use of fiberglass roving by contract. Presently, fiberglass material is used on the second stage erosion control contracts to correct and stabilize specific eroded drainageways (APPENDIX C).

In 1965, a preliminary study, Study 10-1, of a new shredded wood mulch mat, excelsior soil retention blanket, was conducted. The ability of the excelsior mulch mat to provide an excellent mulch for germination and seedling growth, to be free of weed seeds, and to be easy to apply and to store made it an ideal material for use. Practically all research seedings initiated after this observation were mulched with the excelsior pad mulch. Roadside maintenance crews also started using the excelsior mulch to stabilize eroded slopes and ditches. Presently, excelsior mulch pad is being specified for stabilization of drainageways on new highway construction projects.

Realizing that the excelsior wood fiber mulch was an effective mulching material comparable to straw, Study 7-11 was initiated to compare the persistence of the two mulches held in place by various rates of asphalt tack. Even though conclusive results were not obtained, some helpful information was gained. Excelsior mulch showed some ability to hold to the soil without an asphalt tack, but using a tack was considered a necessary treatment for adequate slope protection. Rates in the range of 200 to 400 gallons of bituminous emulsion per acre were found to be sufficient in holding both the excelsior and the straw for an adequate period of time.

Specification changes were made to include excelsior wood fiber along with straw as an acceptable mulching material for roadsides (APPENDIX A). Changes in the rate of bituminous tacking material were also made, requiring a rate of 300 gallons per acre (APPENDIX A).

#### TURF FERTILIZATION:

Studies conducted to evaluate turf response to various forms of nitrogen fertilizers were very important and became major factors in changing and developing the Department's roadside turf fertilization establishment and maintenance programs. The preliminary fertilizer Studies 7-0 and 2-1 indicated a tremendous immediate and surprisingly residual turf response to the quick-release nitrogen forms and brought about a realization that a closer evaluation of the slow-release nitrogen fertilizers which were being used extensively at that time was needed. The following Study 7-6 revealed similar results and strengthened the observation that even greater turf response over a longer period of time was obtained from the quick-release nitrogen sources such as ammonium nitrate rather than the slow-release nitrogen, ureaformaldehyde.

These studies also revealed the special need for second applications of fertilizers and the vegetation response that can be obtained. A proposal was made to the Federal Highway Administration in 1967 outlining a two-stage erosion control program for the establishment of roadside vegetation (APPENDIX B). Photographs and information gained from these studies were used as important documentation in the proposal. The proposal was approved and implemented, being one of the first stage erosion control programs for the establishment of roadside vegetation in the nation. Although fertilization was a very important aspect of this new program, the two-stage approach involved all facets of erosion control such as seeding, sodding, topsoiling and stabilization of drainageways and slopes (APPENDIX B).

Use of ureaform fertilizer was discontinued in favor of a two-application fertilizer approach. Information gained from the studies also revealed the general need for a complete fertilizer for best overall turf response. Today, a 2-1-1 fertilizer is the principle type fertilizer being recommended for top-dress applications for the second stage fertilization necessary for turf establishment and additional applications when needed for maintenance of the turf (APPENDICES D and E).

Study 7-16 conducted for the purpose of evaluating liquid fertilizer on roadside turf resulted in information that was used in developing specifications to allow contractors the option of using liquid fertilizers rather than dry fertilizers for the top-dress applications. The Department's present specifications reflect this option (APPENDICES A, C, D, and E). Wide use is also being made of liquid fertilizer in the Department's turf maintenance fertilization programs.

## WEED CONTROL:

The Department's initiation of a roadside vegetation control program involving extensive use of herbicides made it absolutely necessary that screening studies be conducted to evaluate the safety and effectiveness of herbicides for specific weed control problems. Herbicide studies conducted were extremely important to the selection and recommendation of herbicides for possible statewide roadside use.

Satisfactory performance of amizine in Studies 5-1 and 7-1 warranted its use for control of weeds around roadside plantings. Based primarily upon information gained from these studies, this herbicide was implemented into the Department's weed control program (APPENDIX F) and still is being used extensively with excellent results for controlling unwanted vegetation around plantings.

The effectiveness and safeness of the amitrole herbicide in controlling unwanted vegetation under guardrails, as observed in Study 5-7, were important factors that lead to the recommendation of the herbicide. In 1966, amitrole herbicide was included in the Department's statewide program to provide a tool for the non-selective control of vegetation without soil sterilization (APPENDIX F).

A series of screening observations, Study 5-3a, b, and c, were conducted to evaluate relatively new herbicides for the control of brush on roadsides. Both the fenuron herbicide (Dybar) and the picolinic acid herbicide (ten percent Tordon) were found to be effective in controlling brushy vegetation. The picolinic acid herbicide was observed as having some advantages over the fenuron herbicide, such as being selective for the control of the broadleaf vegetation and not damaging the grasses, providing a quicker kill of the brush, and less noticeable lateral movement. However, both pelleted chemicals were recommended for statewide use and directives which became part of the Herbicide Policy (APPENDIX F) were written. Fenuron herbicide was specified to be applied in small areas

around the base of the brush as a fall treatment. Picolinic acid was specified to be broadcast around the brush as an early spring treatment. The fenuron treatment is no longer recommended due to non-availability of the herbicide.

Picolinic acid in a lesser concentration and finer granule (two percent Tordon) was found to be very effective in controlling broadleaf weeds and small brush in another study. The great increase in grassy vegetation observed on the study site, a direct result from the effective control of the broadleaf weeds and brush, was very significant. Realizing the value of this herbicide for roadside vegetation control, the material was introduced into the Department's Herbicide Program. It was recommended to be used as a hand broadcast treatment supplementing the 2, 4-D spray program for the control of hard to kill broadleaf weeds and small brush where and when spraying operations were not advisable (APPENDIX F).

With increasing infestation of Johnsongrass along the roadsides, Studies 7-15 and 7-19 were conducted to screen for possible effective herbicides. A granular soil sterilant herbicide, borate chlorate, was noted in Study 7-15 as being very effective in controlling clumps and small areas of Johnsongrass for one complete growing season with a minimum of residual soil sterilization. The surprising degree of selectivity of the MSMA herbicide in effectively controlling Johnsongrass without damaging the turf grasses, especially Kentucky 31 fescue, in Study 7-19 was considered a very important finding.

Information gained from both studies contributed significantly in the development of the Department's statewide Johnsongrass control program. In 1969, directives were issued to roadside maintenance crews recommending the use of both herbicides, the borate chlorate as a spot treatment application for the control of scattered light infestations and MSMA as a broadcast treatment for the control of heavy infestations in existing grass turf (APPENDIX F).

## CONCLUDING REMARKS

This study, like most studies of this type conducted throughout the nation over the past several years, has provided basic and important information. Highway roadsides are unique; varied and different environmental conditions for plant growth are encountered from mile to mile. Not only is there a concern with the always changing ecological system of plants, soils and climate but also man's changes in environmental standards and values. Therefore, continued research is necessary to have progressive and responsible programs meeting the needs of highway departments.

With greater importance being placed upon pollution problems throughout the nation, there is an increased realization and concern of the polluting effect of highways on the environment. Stream pollution from soil erosion occurring on roadsides is a primary pollution concern. However, air and noise pollution from the highways must be considered also. Relatively little research has been done in these fields, leaving a tremendous demand for basic research.

With the current emphasis being placed upon immediate implementation of erosion control measures as soon as the earth is disturbed during the construction, there is a need for somewhat different erosion control methods and materials. Temporary as well as permanent measures must be considered. Studies of temporary measures for controlling soil erosion during construction might include such efforts as:

1. developing designs and criteria for construction of settling basins, dams and dikes to collect eroding soil,
2. evaluation of the effectiveness and feasibility of using trees, brush, and woodchips cleared and grubbed from the right of way to control soil erosion,
3. investigation of new chemicals and materials as means for temporarily stabilizing the soil surface,
4. evaluation of grasses and legumes for rapid, temporary covers,
5. investigation and evaluation of materials for temporary stabilization of drainageways, and
6. determination of economical benefits as well as effectiveness of pollution control programs and materials on highway construction.

There is also a need for improvement of permanent erosion control measures. Some possible

studies are:

1. Stabilization of drainageways has been and continues to be a major problem in highway construction. Normal methods of paving and sodding ditches for all situations has not been entirely satisfactory. Development of new ditch lining materials and stabilization methods which would be more flexible, more easily maintained and less expensive than paved ditches is greatly needed. Evaluation of new materials for the stabilization of less critical drainageways must be continued in hopes of finding a material that is more effective and economical than materials currently available.
2. Plant material evaluations must be continued as improvement in varieties and strains occurs. Changes in the ecology of plant life are always occurring. For instance, different insects and diseases can quickly develop, severely damaging stands of roadside turf. Keeping knowledgeable of roadside conditions at all times is important.
3. Fertility levels of roadside soils is a critical factor in establishment of vegetation. The need for fertilizers that are long lasting, non-polluting, and more effective in providing needed nutrients and significant growth under varied and adverse environmental conditions of roadsides is even greater today.
4. New mulching materials will continually be marketed and should be evaluated under field conditions. There is a definite need for a substitute material for bituminous emulsion for holding mulch in place. Asphaltic material used today is difficult to handle, requiring careful handling to prevent defacing of structures and objects with the spray. Equipment cleanup is also difficult, and the material is relatively ineffective in tacking the mulch during freezing temperatures.
5. The Department could greatly benefit from research designed to study and classify roadside soils and vegetation throughout the state. Such a study would provide valuable information that could be used in making more accurate recommendations for controlling soil erosion on roadsides. A classification of the kinds and types of soils

encountered along major routes, and their fertility levels, as well as the types of grasses and legumes found growing, would provide valuable tools in an effective erosion control program.

6. Maintaining and managing roadside vegetation continues to be an increasingly important responsibility of the

Department. Continued screening and evaluation studies of herbicides, insecticides and fertilizers, as well as methods and procedures of applying the materials more effectively, are very important to an effective roadside vegetation management program.

APPENDIX A

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KENTUCKY DEPARTMENT OF HIGHWAYS  
SPECIAL PROVISION NO. 57-D

EROSION CONTROL

This Special Provision shall apply to a project when indicated in the contract plans or proposal, and shall supersede and replace Sections 526, 527, 528, and any other conflicting requirements of the Department's 1965 Standard Specifications for Road and Bridge Construction.

I. GENERAL

Erosion control measures shall be progressively coordinated with the grading operations throughout the duration of the project in accordance with the current edition of Special Provision No. 46 for Water Pollution Controls and this Special Provision. As areas of erodible earth material are exposed to the elements of erosion, every effort shall be made to stabilize and protect the areas as quickly as possible as directed by the Engineer. Upon failure or neglect on the part of the Contractor to coordinate the erosion control measures with the grading operations in a manner to effectively control erosion and to prevent water pollution, the Engineer may suspend the Contractor's grading operations and withhold monies due the Contractor on current estimates until such time that all aspects of the work are coordinated in a manner acceptable to the Engineer.

II. BRUSH BARRIERS

In lieu of the disposal methods designated in Section 101, selected materials from the clearing and grubbing operations shall be used to construct brush barriers as required herein and by the Engineer on the project.

Brush barriers for use as erosion control measures shall be constructed as soon as brush is readily available from the clearing operation on the project and shall be located at sites which are near the clearing operation and which are designated in the plans or by the Engineer. Brush barriers will generally be located where the highway passes through wooded areas, pastures, or farm fields not likely to be commercially or residentially developed in the next few years. The sites generally selected will also be those which are on the lower side of proposed embankments which will be constructed of earth and/or other erodible material to heights of 15 feet or more. The brush barriers are to be left in place and the Engineer on the project will not require nor permit brush barriers at sites where the adjacent private property has been residentially or commercially developed. Further, the barriers shall not be constructed at any sites which would be easily and routinely seen and would detract from the appearance of either the adjacent property or the completed highway.

The brush barriers shall be formed by placing brush, limbs, small trees, and other vegetative growth, of which no pieces are larger than 12 inches in diameter, in small continuous ridges or piles as close as practical and no more than 15 feet outside of and generally parallel to the toes of the proposed embankments. No stumps shall be placed in the barriers. The barriers shall be "walked down" with a bulldozer so as to be dense and to have relatively uniform heights between 2 and 5 feet and widths between 4 and 10 feet.

No direct measurement and payment for the construction of brush barriers will be made, as this work will be considered incidental to the contract pay item of "Clearing and Grubbing."

III. PERMANENT SEEDING AND PROTECTION

Exposed earth and any other erodible areas shall be graded to a reasonably uniform and satisfactory cross section or slope, as soon as practical in the judgment of the Engineer, and then permanent seeding and protection shall be performed at the earliest practical time.

A. Description

This work shall consist of: (1) preparing the seed bed, (2) furnishing and incorporating into the soil all seed, agricultural limestone, and fertilizer, and (3) furnishing and placing mulch, all as specified and at the locations designated in the plans or by the Engineer, and in accordance with this Special Provision unless otherwise provided in the plans or proposal.

B. Materials

1. Agricultural Limestone. The agricultural limestone shall contain sufficient calcium and magnesium carbonates to be equivalent to not less than 80 percent calcium carbonate, and shall be of such fineness that not less than 90 percent passes a No. 10 sieve and not less than 35 percent passes a No. 50 sieve.

Where the steepness of the slopes of the soil surface makes it impractical to apply the agricultural limestone by conventional methods, 100-mesh ground limestone may be substituted for the agricultural limestone. This substitution shall be held to a minimum, and, when utilized, the material shall be applied by hydraulic methods only. At least 1500 pounds of 100-mesh ground limestone shall be substituted for each 2000 pounds of agricultural limestone specified.

The 100-mesh ground limestone shall be subject to the same quality requirements as specified for agricultural limestone and shall have not more than 15 percent retained on a No. 100 sieve.

Agricultural limestone and 100-mesh ground limestone (for use on steep slopes only) will be accepted either upon the basis of written certification by the vendor verifying that the materials comply with the requirements listed herein or upon the basis of sampling and testing by the Department. To be acceptable, a certification must include or be accompanied by test results from a recognized laboratory or agency, and must be presented to the Engineer in triplicate at the time of delivery of the material.

2. Fertilizer. The fertilizer shall be a commercial fertilizer complying with the Kentucky Fertilizer Law, and containing the plant nutrients of nitrogen, available phosphoric acid, and soluble potash as specified in the plans or proposal. Bagged fertilizer shall display the following information on the bag or on a sticker or tag attached to the bag:

1. Net Weight
2. Brand and Grade
3. Guaranteed Analysis
4. Name and Address of Manufacturer

Bulk fertilizer (dry or liquid) shall be accompanied by a statement from the manufacturer which contains the same information required for the bagged fertilizer.

Either bagged or bulk (dry or liquid) fertilizer manufactured and sold under the jurisdiction of the Division of Regulatory Services of the University of Kentucky Agricultural Experiment Station will be acceptable. Any other fertilizer shall be sampled and tested and approved prior to its use.

3. Seed. All seed shall be of the kind, variety, and quality hereinafter specified, and each variety tagged as required by State and Federal regulations and laws. The tag affixed to each package or bag of seed shall give the following information:

Name and Variety of Seed, Purity,  
Germination, Date Tested,  
Noxious Weed Seed or Bulblet Count,  
and Weed Seed Content.

No seed shall contain more than 1 percent weed seeds by weight. No seed shall contain more than 18 noxious weed seeds or bulblets per ounce. Further, the noxious weed seeds contained in any seed shall not exceed the maximum number specified in the following listing:

Noxious Weeds	Max. No. Seeds per Ounce
Johnson Grass ( <i>Sorghum halepense</i> )	0
Giant Foxtail ( <i>Setaria fabrii</i> )	3
Canada Thistle ( <i>Cirsium arvense</i> )	0
Wild Onion ( <i>Allium vineale</i> )	3
Nodding Thistle ( <i>Carduus nutans</i> )	0
Buckhorn ( <i>Plantago lanceolata</i> )	9
Corncockle ( <i>Agrostemma quithago</i> )	9
Dodder ( <i>Cuscuta sp.</i> )	9
Oxeye Daisy ( <i>Chrysanthemum leucanthemum</i> )	9
Quack Grass ( <i>Agropyron repens</i> )	9
Sorrel ( <i>Rumex acetosella</i> )	15

All seed shall meet the applicable minimum purity and actual germination percentages specified in the table, "REQUIREMENTS FOR SEEDS," with no tolerances below the minimum percentages being allowed, and shall not be used later than 12 months from the date of the tests approving the seeds.

All seed shall be sampled and tested by a representative of the Department, either prior to or after delivery to the project. Sampling and testing of seed prior to delivery to the project (pretesting) may be performed upon request by a seed vendor who supplies seed for use on highway projects and who agrees to comply with all of the following requirements:

- a. Select, set aside, and provide easy access to at least a total of 10,000 pounds of one or more kinds of seed each time a request is made for "pretesting."
- b. Provide the necessary labor to assist the Department's representative in handling the seed packages or bags during sampling and tagging.
- c. Reserve the quantity of seed "pretested" in storage until he is authorized by the Department to dispose of the seed for purposes other than highway uses.

\* See Page 8 for Table.

d. Preserve and leave attached, all tags and labels attached by the Department's representative, unless authorization to remove them is granted by the Department, and

e. Cooperate with, and aid the Department's representative in a manner that will expedite the "pretesting operations."

No seed shall be sown until the Engineer on the project has received verification that the seed complies with all requirements specified. Proper verification may be obtained by one of the following methods:

a. Pretesting Method. When seed is received with tags and seals or other methods of identification affixed to the bag, this indicates that the seed has been sampled for pretesting by a representative of the Department. The Project Engineer shall contact the District Materials Engineer to verify that the seed has met the requirements specified and that the 12 months approval period has not expired.

b. Project Sampling Method. This method consists of test reports from the laboratory indicating that samples taken and submitted by the Engineer on the project have met the requirements specified.

4. Mulch Material. Material for mulching shall be baled wheat, oat, barley, or rye straw, or excelsior wood fibers. Mulch material shall be reasonably free from weed seeds, stolens, foreign matter, chaff, and shall not contain any Johnson Grass, Canada Thistle, or Nodding Thistle. The mulch material shall be reasonably bright in color and shall not be musty, moldy, caked, or otherwise of low quality, and shall not contain chemicals toxic to plant growth.

Excelsior wood fibers shall consist of fibers cut from sound green timber. The cut shall be made in such a manner so as to provide maximum strength of fiber, but at a slight angle to the natural grain of the wood so as to cause splintering of the fiber when weathering occurs. The fibers shall possess these approximate physical properties: width .02 to .04 inches, thickness .02 to .04 inches, and length 4 to 6 inches.

Unless otherwise specified, the bituminous material to be used in Method 2 for "tacking down" the mulch material may be either SS-1, SS-1h, Primer L, MC-30, or MC-70 conforming to the Department's current applicable requirements. It shall be non-toxic to plants and shall be so prepared that the specified characteristics will not change during transportation or normal storage.

5. Netting. The netting shall conform to the requirements of the Standard Drawings and plans.

6. Jute Matting. The matting shall conform to the requirements of the Standard Drawings and plans.

7. Staples. The staples for securing the netting or matting shall conform to the requirements of the Standard Drawings and plans.

#### C. Construction Methods

All materials shall be in good condition at the time of their use. Any material that has been altered or damaged subsequent to its approval will be rejected by the Engineer on the project.



The following permanent seeding and protection procedures shall be used:

1. Preparing the Seed Bed. The areas to be prepared for seeding shall be cleared of all weed growth and shall be shaped to a rough and open surface acceptable to the Engineer. The areas to be prepared shall include all areas within the limits of the slope lines that can be expected to sustain plant growth, and shall extend beyond these limits to include any other areas within the construction limits not covered by desirable vegetation, as indicated in the plans or proposal, or as directed by the Engineer. Areas within the limits of rock slopes having sufficient soil to sustain plant growth shall be prepared and seeded as directed by the Engineer.

Prior to seeding, the seed bed shall be prepared by loosening the soil to the required depth by an approved rotary tool, disc, harrow, hand rake, cultivator, or other approved methods. The soil shall be loosened to a minimum depth of 3 inches on areas having a slope of 3:1 or flatter. On slopes steeper than 3:1 where it is difficult to use mechanized equipment, the soil shall be loosened to a depth of approximately 1 inch, except as hereinafter specified. All large or unsightly clods and stones, and other foreign materials brought to the surface shall be removed. Any gullies, washes, rills, or disturbed areas that exist or develop prior to seeding shall be repaired.

When specified in the contract, topsoil shall be applied in accordance with the applicable requirements of Sections 524 or 525 of the Standard Specifications.

2. Fertilizing and Liming. The fertilizer and agricultural limestone shall be applied uniformly on the designated areas at the rates specified in the plans or proposal. At the time of initial seeding the fertilizer and limestone shall be thoroughly incorporated throughout the depth of the loosened soil of the prepared seed bed, and may be applied prior to any tillage of the seed bed. These materials shall be applied by separate operations, except when applied by hydraulic methods, but may be incorporated into the soil in a single operation. When approved by the Engineer, the fertilizer and liming material may be applied and left on the soil surface where the steepness of slope makes it impracticable to further disturb the soil, provided that the surface is sufficiently loose and open to retain these materials.

After significant growth of the seeding on a portion or all of a project has occurred and when specified in the plans or proposal or by the Engineer, topdress applications of fertilizer and agricultural limestone shall be made onto areas where desirable grasses, legumes, and sod have been established or preserved. The topdress application will be considered the Stage II requirements necessary in the establishment of a permanent vegetative cover. The topdress applications shall not be made during the months of December and January but shall be made at the time designated in the plans or proposal or by the Engineer, and in all instances, after a satisfactory stand of vegetation exists.

Seeding completed during the latter part of the construction of a project may not have had time to attain significant growth before all the other specified contract items are completed. When this occurs, the project will be designated as complete without regard to the Stage II topdressing work. The Stage II topdressing work shall then be performed at a later time approved by the Engineer, and may be either prior to or after the inspection conducted between 3 and 6 months after completion as hereinafter mentioned. The time taken to satisfactorily complete the Stage II topdressing work will not be tabulated as a part of the contract time and no liquidated

damages will be assessed provided that the work is completed no later than 60 days after the aforementioned inspection.

Incorporation of the topdress application of fertilizer and agricultural limestone into the soil will not be required. The topdress materials shall be applied uniformly with methods and equipment which will not damage the vegetation being topdressed. Any vegetation severely damaged or destroyed by fertilizer burn because of an excessive application of fertilizer shall be reestablished at the Contractor's expense. Any areas which are topdressed and later exhibit streaked and missed areas shall be re-fertilized at the Contractor's expense.

### 3. Seeding.

Seeding shall be performed at any and all times during the year in a progressive manner as the earthwork progresses.

The variety and rate of each seed to be sown shall be as specified in the plans or proposal. Chaffy and non-chaffy seeds shall not be mixed together and sown as one operation, except when the seeds are sown by hydraulic methods. Further separation of various kinds of seeds for sowing may be required to insure even distribution of each kind of seed at the designated rate, as directed by the Engineer.

The seed shall be drilled or worked into the soil to a depth of approximately 1/4 inch. Compaction of the soil surface by means of a cultipacker or light roller will also be an acceptable means of covering the seed. When approved by the Engineer, seed may be sown and left on the soil surface without covering the seed where the steepness of slope makes it impractical to further disturb the soil, provided the soil surface is sufficiently loose and open to retain them.

Seeding shall be performed soon after the preparing of the seed bed, fertilizing, and liming, and when the weather is favorable. Seeding shall not be performed when the ground is frozen or muddy and when other conditions exist that would prevent proper seed distribution or covering with soil.

### Special Seeding -- Crownvetch

In addition to the seed mixture specified for a project, crownvetch seed, when specified in the contract, shall be uniformly sown onto all areas having a slope of 3:1 or steeper and onto any other areas designated in the plans or proposal or directed by the Engineer. When sloped areas are designated to receive the crownvetch seeding, soil seams and crevices within or adjacent to rock cuts and the flat areas of benched slopes shall also be seeded. Areas of solid rock are not to be seeded; however areas of mixtures of broken rock and soil are to be seeded.

The crownvetch seed shall be uniformly applied to the designated areas at the rate specified in the plans or in the proposal. In order to insure uniform distribution, crownvetch seed shall be sown separately from other seed unless seeding is done hydraulically, then one operation will be permitted.

4. Inoculating Legumes. Each type of leguminous seed such as crownvetch shall be inoculated with the appropriate bacteria in the amount and manner specified by the manufacturer of the inoculant before being sown or being mixed with other seeds for sowing. The seed shall be sown the same day that it is inoculated. When leguminous seed is sown by hydraulic methods, 5 times the manufacturer's recommended quantity of inoculant shall be used.

### 5. Protection. The methods of protection of the

seeding shall be as specified in the proposal. The placing of mulch materials for protection shall follow the seeding operation within 48 hours. In no instance shall the mulch be placed on eroded or crusted seeded areas. The mulch materials shall be placed uniformly in a manner that will provide a protective cover without hindering the growth of the grasses and legumes. All clumps of mulch material shall be loosened and scattered, and care shall be taken to avoid thicker applications of mulch than those hereinafter specified, as excessive mulch may hinder proper seed germination and survival of the seedlings.

The following methods shall be used where specified:

Method 1. Mulching with Netting. The mulch material shall be placed to a uniform depth of approximately 2 inches loose measurement (approximately 2 tons per acre) and tied down with netting at bridge abutments and other areas designated in the plans or proposal or by the Engineer in the manner specified in the Standard Drawings.

This method shall also be used for tying down mulch on areas where the edge of the mulch is within 8 feet of the edge of the traveled way or auxiliary lanes. On these areas, a one roll width of netting shall be installed adjacent and parallel to the traveled way or auxiliary lanes. The mulch material for these areas under the netting may be either plain or bituminous treated, unless otherwise specified.

Method 2. Bituminous Treated Mulch. Bituminous treated mulch material shall be placed by equipment that will blow or eject a controlled amount of mulch material in a uniform pattern and rate over the seeded area by a constant air stream. Jet nozzles shall be installed at the discharge spout of the equipment which are capable of spraying a uniform quantity of bituminous tacking material on the mulch material as it is ejected. The blowing equipment shall be of such design as to cause no appreciable cutting or breakage in the length of the mulch material.

The mulch material shall be fed into the blowing machine and applied in a manner to provide for even distribution of the mulch fibers over the seeded area to a uniform depth of approximately 2 inches loose measurement (approximately 2 tons per acre).

The bituminous material shall be applied uniformly at a minimum rate of 150 gallons per ton of mulch material (approximately 300 gallons per acre). If one application of the bituminous material to the mulch does not provide at least 150 gallons per ton, then additional applications of the neat bituminous material shall be made to insure that 300 gallons or more are applied to each acre of seeding and protection. The Contractor shall take precautionary measures to prevent the bituminous material from marking or defacing structures, traffic, pavements, utilities, or plant growth.

During cool and cold weather, the Contractor shall heat the bituminous material if deemed necessary by the Engineer in order to lower the viscosity so that a uniform distribution of the bituminous material is attained at all times.

Method 3. Mulch with Jute Matting. The jute matting shall be installed in continuous or strip installations as applicable, at the locations designated in the proposal and by the Engineer and in the manner specified in the Standard Drawings. The areas to receive jute matting shall have a seed bed prepared and all stones, roots, and other objects that prevent the matting from making reasonably close contact with the prepared

area shall be removed. Mulch shall be placed after the seeding operation and prior to placing the matting to a uniform depth of approximately one-half inch loose measurement (approximately one-half ton per acre).

The jute matting shall be installed in a continuous method where the protection of ditches and entire slope areas is specified. The jute matting shall be installed as erosion check strips on slopes where extremely erosive soils are encountered and on other areas when specified. The rest of the slope (unprotected areas between strips) shall be protected with Bituminous Treated Mulch, Method 2.

#### 6. Care and Restoration.

The Contractor shall be responsible for the care and restoration of the seeded and protected areas until final acceptance of the seeding and protection work has been made. Displaced mulch shall be replaced immediately, but only after any damage to the seeded area has been satisfactorily repaired.

#### 7. Guarantee.

All permanent seeding and protection work shall be performed under guarantee by the Contractor. Since progressive seeding will be required as the earthwork progresses, and since an area will only be measured for payment one time, except as provided hereinafter, regardless of how many times it has to be seeded and protected to be acceptable, the Contractor should use all precautions feasible to preserve the seeding and protection from damage by his continuing operations, vandalism, adverse weather, and other detrimental conditions. The Contractor shall guarantee a minimum of 150 live seedlings per square foot on at least 90 percent of the area seeded that are representative of the seed mixture at the inspection conducted between 3 and 6 months after completion as mentioned hereinafter, and no vacant area shall be larger than 250 square feet in size. Where crownvetch is seeded the Contractor shall guarantee a minimum of 2 live crownvetch seedlings per square foot. The seeding and protection shall be kept in a good state of repair at all times during the life of the contract.

An inspection will be made within the period of 3 to 6 months after the completion of the entire project by an authorized representative of the Department and the acceptance or rejection of the seeding and protection work will be determined at the time of the inspection. If the work is rejected at any time during construction of the project or at the inspection made within 6 months as mentioned above, the Contractor will be advised of the areas requiring additional work and the necessary action to be taken to fulfill the requirements of the guarantee. This action may include the preparing of a new seed bed, refertilizing, re-seeding, remulching, or any items that were originally specified or required. The Contractor shall perform the corrective work as soon as a favorable work period occurs after being advised by the Engineer. No payment for this additional work will be allowed, except as hereinafter provided for unavoidable damage.

If unavoidable damage to the seeding and protection occurs between the date the Project Engineer deems the project completed and the date of the inspection conducted within 3 to 6 months after the completion of the project, then payment will be allowed for additional seeding and protection work when authorized by the Engineer. Unavoidable damage may result from slides, vehicular traffic, fires, deluges, and suchlike. Failure of the seed to sprout or to live and grow will not be considered unavoidable damage.

#### D. METHOD OF MEASUREMENT

The quantity of "Agricultural Limestone" and "Fertilizer" to be measured for payment shall be the number of tons of each material weighed separately, and accepted in place. The materials shall be weighed as specified in Article 1, 9, 1-F. When "100-mesh" ground limestone is substituted for agricultural limestone at the rate hereinbefore specified, the actual number of tons substituted will be converted to its equivalent in tons of "Agricultural Limestone" for pay purposes.

The "Seeding and Protection" to be measured for payment shall be the number of square yards of surface area seeded and protected by the method specified and in accordance with all of the applicable requirements of this special provision. Areas which were covered with acceptable vegetative cover prior to construction operations and which were unnecessarily disturbed by the Contractor shall be seeded and protected but shall not be measured for payment.

The quantity of "Special Seeding -- Crownvetch" to be measured for payment shall be the number of pounds of seed furnished and applied as specified.

#### E. BASIS OF PAYMENT

The quantities thus measured will be paid for at the contract unit prices per ton for "Agricultural Limestone," per ton for "Fertilizer," per square yard for "Seeding and Protection" for each method, and per pound for "Special Seeding -- Crownvetch," which payment shall be full compensation for the preparation of the seed bed; for the furnishing, hauling, and placing of all materials specified for the work, including inoculation of leguminous seeds and fastening the mulching material in place; for the care and restoration of the seeded areas; for fulfilling the guarantee specified herein; and for furnishing all labor, equipment, tools, and incidentals necessary to complete the work.

#### IV. SODDING

##### A. DESCRIPTION

This item shall consist of furnishing, hauling, and placing sod on a prepared sod bed at locations specified in the plans or proposal or by the Engineer.

##### B. MATERIALS

###### 1. Sod.

Unless otherwise specified in the plans or proposal, the sod shall be either well-rooted Kentucky Bluegrass or Tall Fescue sod. The sod shall be completely free from noxious weeds, and reasonably free from other objectionable grasses and weeds and stones or other foreign materials detrimental to the development and future maintenance of the sod. The source of the sod shall be covered with grass having a height of not more than 3 inches, and shall be available for inspection and approval by the Engineer prior to cutting.

###### 2. Agricultural Limestone.

Agricultural limestone shall conform to the requirements specified hereinbefore under III Permanent Seeding and Protection.

###### 3. Fertilizer.

Fertilizer shall conform to the requirements

specified hereinbefore under III Permanent Seeding and Protection.

#### C. CONSTRUCTION METHODS

##### 1. Cutting Sod.

Prior to cutting the sod, the grass shall be mowed to a height of 2 inches or more and the mowed area shall be raked so as to eliminate all clippings, cuts, and trash. The sod shall be cut into rectangular sections as required. Sections may vary in length not to exceed 8 feet but shall be of uniform width of not less than 10 inches nor more than 18 inches, and shall be cut to a depth of not less than 1 inch and not more than 2 inches, depending on the nature or kind of the sod. The sod shall be cut to such thickness that practically all of the dense root system will be retained but exposed in the sod strip, and to such width and length so that it can be handled without undue tearing and breaking. Sod from light sand or heavy clay soils will not be accepted. When cut in strips, the sod shall be rolled without damage with the grass folded inside.

The sod shall be cut by means of an approved mechanical sod cutter. During dry weather, the sod shall be watered before cutting to prevent the loss of soil while handling. Sod shall not be cut when in a wet condition which would interfere with proper handling.

All sod must be delivered to the project and placed within 24 hours after being cut, unless placing is prevented by circumstances beyond the Contractor's control, in which case the Engineer may permit temporary storage.

##### 2. Temporary Storage.

When temporary storage of sod is permitted, the sod shall be placed in layers with grass to grass and roots to roots. To prevent the sod from drying out, the stack shall be sprayed with water and covered with moist burlap as directed by the Engineer.

Sod shall be rejected if permitted to decay or dry out to the extent that, in the judgment of the Engineer, its survival is doubtful. Rejected sod shall be disposed of at no expense to the Department.

##### 3. Preparation of Sod Bed.

The sod bed shall be loosened to a depth of 3 inches and shaped to a smooth even surface and shall be graded to such elevation so that the sod, when in place, shall be flush with any adjacent seeded or turfed area, pavement, curb or other structures, except when otherwise directed by the Engineer.

Topsoil, when included in the contract, shall be placed as specified in Section 524 or 525, as applicable.

Prior to the placing of the sod, the fertilizer and limestone shall be applied uniformly at the rates specified, and shall be harrowed, raked, or otherwise incorporated into the soil. The sod bed, if dry, shall be moistened to the loosened depth.

##### 4. Placing Sod.

Sod shall be placed as the earthwork progresses insofar as practical. Quantities of less than a normal truckload of sod will be deemed impractical and not required until a truckload can be used, unless extremely erosive conditions are encountered which demand immediate attention in the judgment of the Engineer.

Sod shall not be placed when the atmospheric temper-

ature is below 32° F, when the sod is frozen, nor when the soil in the sod bed is frozen.

The sod shall be carefully placed by hand so that each section closely joins the adjacent sections without overlapping. All open spaces or gaps shall be plugged with sod cut to the appropriate size and shape.

When placed on slopes, the sod shall be laid with the long edges of the strips parallel to the contour starting at the bottom of the slope. Successive strips shall be neatly matched and all joints staggered or broken. The sodding shall be carried at least 18 inches beyond the top of the slope to prevent surface water from undermining the sod.

When placed either on slopes 2:1 or steeper and 6 feet or more in height, or on areas subjected to the flow of substantial volumes of water, each strip or section of sod shall be staked securely with at least 2 wood stakes or wire staples not more than 2 feet apart and driven flush with the surface. The stakes and staples shall meet the approval of the Engineer.

The sod, after it is placed, shall be wetted thoroughly and tamped sufficiently with approved tampers to incorporate the roots into the sod bed and to insure tight joints between the sections or strips.

5. Care and Restoration.

All sodded areas, including the sod bed, shall be kept thoroughly moist for at least 2 weeks after sodding. The sod shall be maintained in a good state of repair at all times during the life of the contract.

6. Guarantee.

The Contractor shall guarantee a minimum of 90 percent live sod on the sodded areas at the inspection between 3 and 6 months after completion of the project as mentioned hereinbefore, and no vacant area of dead sod shall be larger than 15 square feet.

D. METHOD OF MEASUREMENT

Agricultural limestone and fertilizer will be measured for payment as specified hereinbefore under III. Permanent Seeding and Protection.

Sod measured for payment will be the number of square yards of surface area of sod conforming to the requirements specified herein and accepted by the Engineer.

E. BASIS OF PAYMENT

The quantities thus measured will be paid for at the contract unit prices per ton for "Agricultural Limestone," per ton for "Fertilizer," and per square yard for "Sod," which payment shall be full compensation for the preparation of the sod bed, for furnishing, hauling, and placing all materials specified for the work, for care and restoration of the sodded areas, for fulfilling the guarantee specified herein, and for furnishing all labor, equipment, tools, and incidentals necessary to complete the work.

V. TEMPORARY EROSION CONTROL MEASURES

Temporary erosion control measures may be used at any time during the life of the project as directed by the Engineer to prevent soil erosion and the pollution of streams.

A. DESCRIPTION

This work shall consist of the use of temporary berms, dikes, dams, drainage ditches, silt basins, slope drains, vegetation, mulches, ditch liners, or any other methods or devices that are necessary to minimize and control soil erosion on project areas all in accordance with this special provision.

B. MATERIALS

Materials for temporary erosion control measures shall be approved by the Engineer before being used. Testing of materials will not be necessary unless otherwise directed by the Engineer.

1. Fertilizer: The fertilizer used for temporary seeding shall meet the requirements set forth under III for permanent seeding and protection.

2. Seed: Seed used for temporary seeding may be accepted on the basis of the purity and germination values shown on the official tag on the seed bag, if the values conform to the table of "Requirements for Seeds" in Section II of this special provision. The seed need not be pretested but shall be approved by the Engineer on the project prior to being used.

3. Mulch: The mulch material used for temporary protection shall be wheat, oat, barley, or rye straw conforming to the requirements specified hereinbefore for permanent seeding and protection mulch. The bituminous material used for tacking down the straw mulch shall conform to the requirements specified hereinbefore for bituminous material for permanent seeding and protection.

4. Polyethylene: The polyethylene material used as a temporary liner for drainage ditches shall be a minimum of 6 mils in thickness and shall be furnished in widths of 6 and 12 feet as specified. The material shall be solid and not a perforated type.

5. Pipe: Pipe used for overflow pipe in the construction of temporary silt basins and for flumes shall be of any substantial type or material acceptable to the Engineer.

C. CONSTRUCTION METHODS

Temporary erosion control measures are to be used at any time during the construction of the project at locations designated in the plans or proposal or as directed by the Engineer.

1. Silt Basins: Dams, dikes, and pits shall be constructed of soil or broken rock to provide silt basins to retard the flow of water laden with eroded material in a manner so as to cause the eroded material to settle in the pits or behind the dams or dikes. The basins shall be constructed before major earth excavation takes place at locations designated in the plans or directed by the Engineer wherever it appears that eroded material will pollute adjacent property or streams. The size and type of basins including overflow pipes to be constructed at each location shall be either as designated in the plans or as directed by the Engineer on the project.

2. Temporary Silt Ditch: A special temporary ditch shall be constructed adjacent and parallel to the right-of-way in relatively level to rolling areas where in the judgment of the Engineer, adjacent property may be damaged from sheet-type soil erosion. This special ditch is not intended to carry large volumes of water but to catch

sediment from the surface runoff. Silt basins may also be constructed within the ditch or at the outlet. The special ditch shall be constructed in accordance with the plans and/or Standard Drawings at the locations designated in the plans or as directed by the Engineer.

3. Temporary Seeding and Protection. The work of temporary seeding and protection of erosive earth areas shall be done promptly at the locations and times directed by the Engineer.

a. Timing - Temporary seeding and protection shall be done under the following conditions as directed by the Engineer.

(1) When it is impossible or impractical to bring an area to final line, grade, and finish so that permanent seeding and protection work can be performed without subsequent serious disturbance by additional grading.

(2) When soil erosion occurs or is considered to be a potential problem on areas where construction operations are temporarily suspended.

(3) When an immediate cover would be desirable to minimize erosion, siltation, or pollution of any area.

b. Seed Bed Preparation - Areas to be temporarily seeded shall require the preparation of a seed bed only when the soil surface is hard and crusty. Disturbance of the soil surface by whatever means that is practicable such as discing or bulldozing to create a loose and roughened condition capable of retaining the seed and mulch will be required. The preparation of a seed bed will not be required when, in the judgment of the Engineer, the soil surface is in an acceptable condition from the normal grading operations.

c. Fertilizing - All areas to receive temporary seeding shall be fertilized. The fertilizer shall be applied onto the prepared seed bed and need not be incorporated into the soil. The fertilizer shall be applied separately unless hydraulic methods are used, then the fertilizer and seed may be mixed and applied in one operation. Unless otherwise specified, 10-10-10 analysis fertilizer shall be used for temporary seeding at the approximate rate of 12 pounds per 1000 square feet.

d. Seeding - Temporary seeding may be performed at anytime during the year as directed by the Engineer except during the period of December through February. In order to stabilize erodible areas with vegetation through the winter, the seeding must be performed by no later than November 30.

The seeding shall be made onto a prepared seedbed, however, working the soil surface to cover the seed will not be required. The seeding operation may be combined with the fertilizing operation when hydraulic methods are used.

Only rye grain or annual ryegrass seed shall be used for temporary seeding unless otherwise designated in the plans or proposal or directed by the Engineer. Rye grain (*Secale cereale*) shall be sown at the approximate rate of 2.5 pounds per 1000 square feet during the period of September 1 to November 30. Annual ryegrass (*Lolium multiflorum*) shall be sown at the approximate rate of 0.8 pound per 1000 square feet during the period of March 1 through August 31.

Protection - All seeded areas shall be promptly protected with a straw mulch. The straw mulch

shall be uniformly applied to the seeded areas at the approximate rate of 2 tons per acre and tacked down with 200 gallons of bituminous material per acre.

Areas requiring temporary erosion control measures during the period of December through February, when seeding is not permitted, shall receive only an application of straw mulch held in place with bituminous material. The rate of application of the straw mulch shall be 3 tons per acre and the rate of application of the bituminous material shall be 300 gallons per acre for this type of protection.

4. Temporary Drainageways - As erodible areas are exposed, temporary drainageways shall be constructed where needed to divert runoff from erosive soil areas to the silt basins or silt ditches. Interceptor ditches shall be constructed at the top of cut slopes as excavation begins. Surface ditches, roadside ditches, and flumes to carry the runoff from the roadway shall be constructed at the earliest possible time during the grading work.

Polyethylene material or pipe shall be used when needed as liners for these temporary drainageways. The type and location of the drainageways as well as the kind of liner to use will be determined by the Engineer. The polyethylene or pipe liner shall be installed in accordance with the plans and/or Standard Drawings.

When fill slopes have been constructed to such stages that protection of the face of the slope from roadway runoff is necessary, a temporary earth mound ditch shall be constructed at the outer edge of the shoulder along the top of the embankment in accordance with the plans and/or Standard Drawings. The ditch shall be constructed in such a manner so as to form an earth mound on the embankment side of the ditch. Run-off water from the roadway will be carried along the shoulder to the flumes and roadside ditches. Use of these temporary berm ditches at the top of fill slopes may be continued after the permanent seeding and protection work has been completed and until the surfacing operations begin. The ditch and mound may be stabilized by spraying with bituminous material or by installing a polyethylene liner when deemed necessary by the Engineer.

5. Care of Temporary Erosion Control Measures The temporary erosion control measures implemented on a project shall be maintained in a functional condition as directed by the Engineer. Seeded and protected areas which have failed shall be promptly repaired as well as temporary drainageway structures which have washed out. Silt basins and silt ditches which have become substantially filled with eroded material shall be cleaned out immediately.

#### D. METHOD OF MEASUREMENT

Overflow pipe for silt basins will not be measured for payment, but will be considered incidental to the work and will become the property of the Contractor after the silt basins are no longer needed in the judgment of the Engineer.

The total quantities of other satisfactorily completed temporary erosion control items will be measured for payment in the following designated units:

Fertilizer - Tons  
Seed - Pounds  
Mulch - Tons  
Bituminous Material - Gallons  
Polyethylene - Square Yards  
Pipe for Flumes - Linear Feet  
Earthwork - Cubic Yards

E. BASIS OF PAYMENT

The quantities thus measured will be paid for at the contract unit prices per ton for "Fertilizer," per pound for "Seed," per ton for "Mulch," per gallon for "Bituminous Material," per square yard for "Polyethylene," and per linear foot for "Pipe for Flumes," which payment shall be full compensation for the preparation of the seed bed, the furnishing, hauling, placing, and disposing, when required, of all materials specified for the work including excavation necessary to install and dispose of the drainageway liners, and for furnishing all labor, equipment, tools, and incidentals necessary to complete the work.

Payment for the earthwork necessary for the construction of silt basins, silt ditches, and earth mound ditches shall be at the contract unit price per cubic yard for either roadway excavation, borrow excavation, or embankment-in-place as applicable, which price will also include full payment for all overflow pipe used in the silt basins, and for the cleaning out, removal, and filling of the basins and ditches when and as directed by the Engineer.

APPROVED 1-4-73

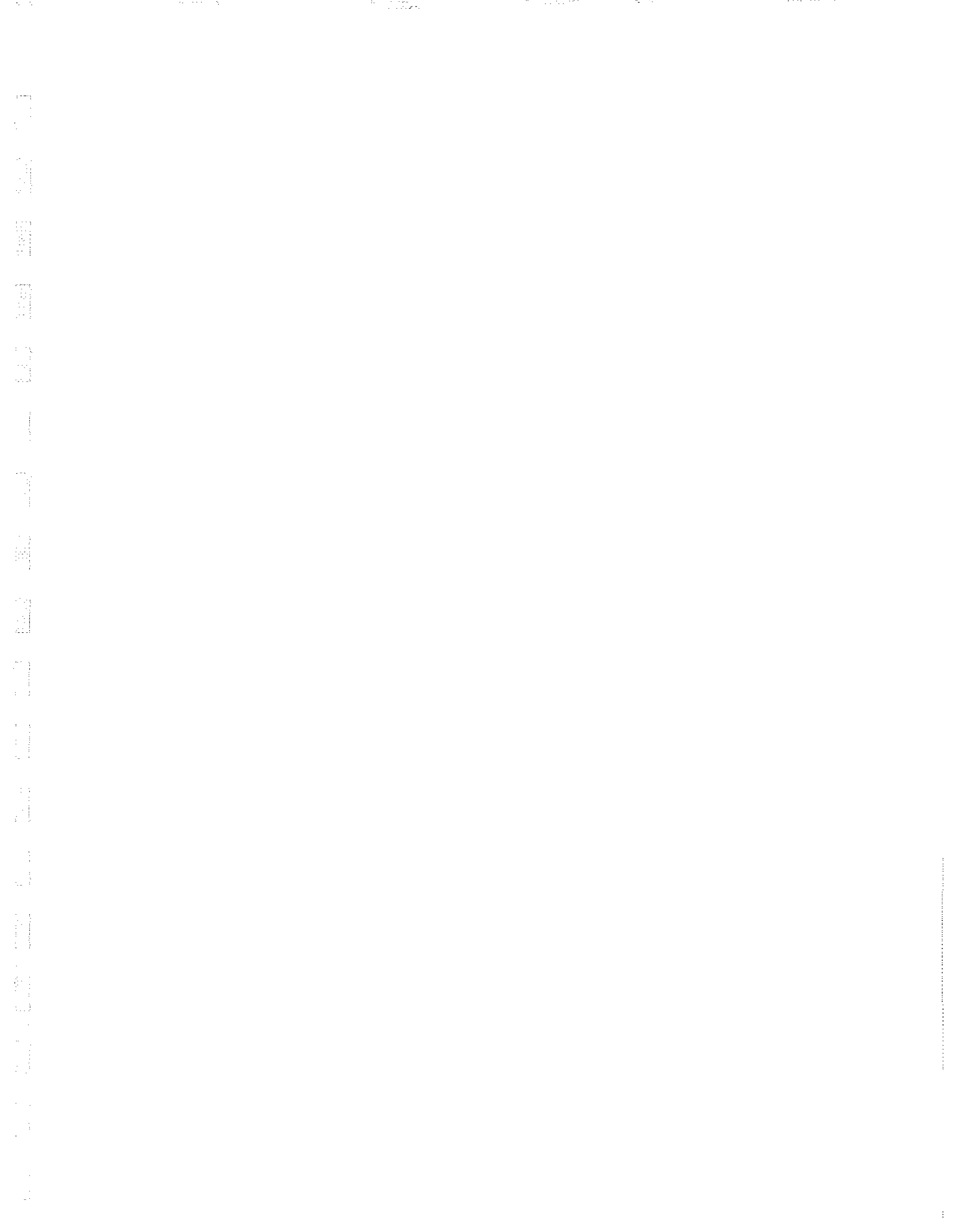
  
J. R. HARBISON  
STATE HIGHWAY ENGINEER

REQUIREMENTS FOR SEEDS

GRASSES		Purity (Minimum Per Cent)	Germination (Minimum Per Cent) Including Hard Seed	Hard Seed (Maximum Per Cent) Allowed in Germination
Chaffy Seeds	Bermudagrass, common (Cynodon dactylon)	95	80	
	Bluegrass, Kentucky (Poa pratensis)	81	70	
	Brome, smooth (Bromus inermis)	85	75	
	Canarygrass, reed (Phalaris arundinacea)	90	75	
	Fescue, Chewings (Festuca rubra var. commutata)	95	75	
	Fescue, meadow (Festuca elatior)	96	75	
	Fescue, red (Festuca rubra)	95	75	
	Fescue, tall (Festuca a. undinacea)	95	75	
	Orchardgrass (Dactylis glomerata)	85	80	
	Redtop (Agrostis alba)	90	80	
	Ryegrass, annual, common or Italian (Lolium multiflorum)	97	85	
	Ryegrass, perennial (Lolium perenne)	97	85	
	Lovegrass, Weeping (Eragrostis curvula)	96	75	
	Oat (Avena sativa)	96	80	
Non-Chaffy Seeds	Rye (Secale cereale)	96	80	
	Timothy (Phleum pratense)	98	80	
	Wheat, common (Triticum aestivum)	96	80	
	LEGUMES			
	Alfalfa (Medicago sativa)	98	85	30
	Clover, alsike (Trifolium hybridum)	96	80	35
	Clover, ladino (Trifolium repens)	97	80	35
	Clover, white (Trifolium repens)	96	80	35
	Crownvetch, (Coronilla varia)	96	70	30
	Lespedeza, Korean (Lespedeza stipulacea)	97	80	25
Lespedeza, sericea (Lespedeza cuneata)	97	80	25	
Sweetclover, white (Melilotus alba)	97	85	30	
Sweetclover, yellow (Melilotus officinalis)	97	85	30	
Trefoil, birdsfoot (Lotus corniculatus)	97	80	35	

**APPENDIX B**

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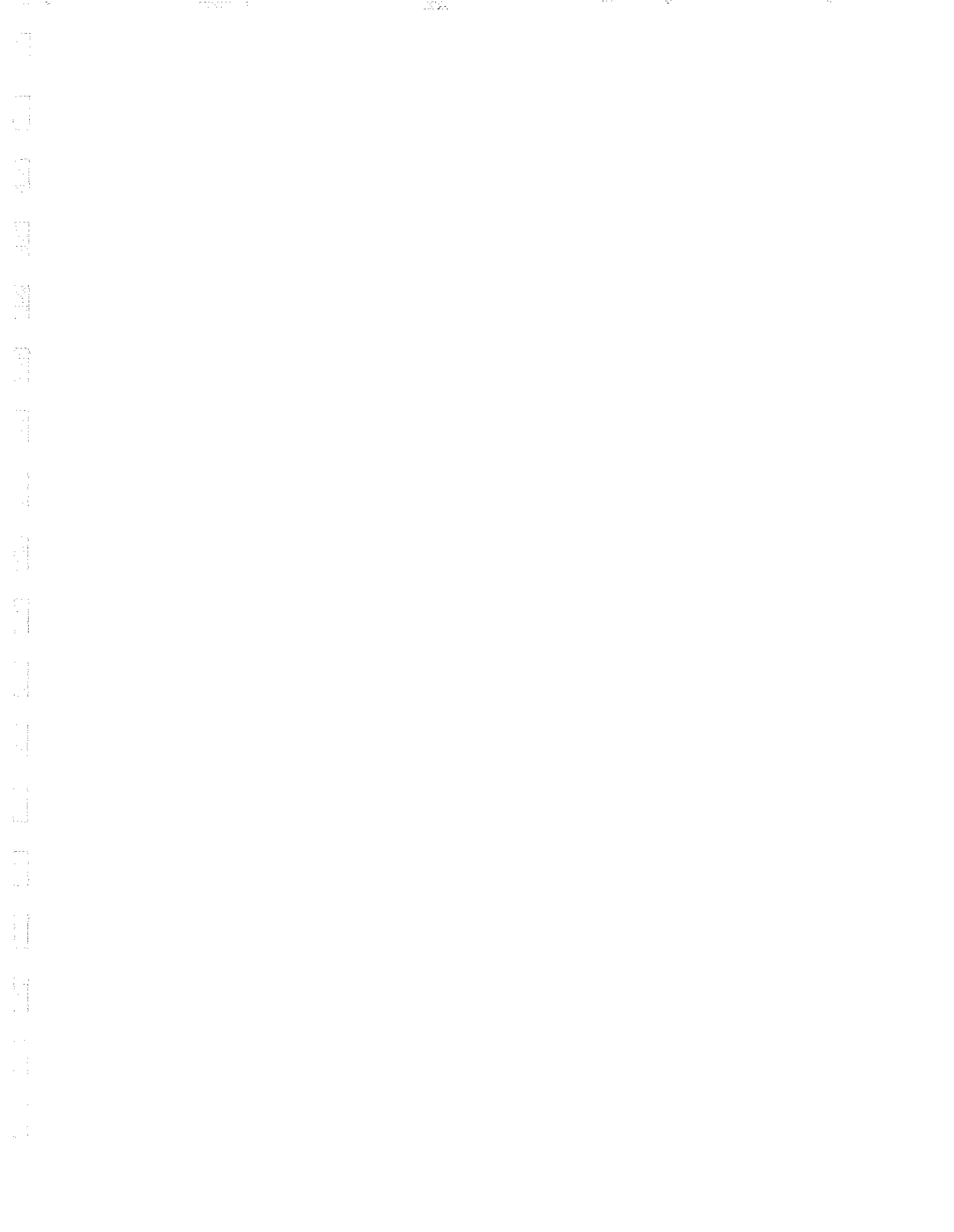


**STAGE CONSTRUCTION FOR EROSION CONTROL\***

	STAGE I	STAGE II		
Type of Construction	Grade and Drain Surfacing Grade, Drain and Surfacing	Roadside Development (Landscape and Erosion Control)		
Areas to Receive Erosion Control Work	All areas within the right of way without an established stand of desirable vegetation	Areas without desirable vegetation	Areas with desirable vegetation requiring establishment	**Unprotected drainageways
Seeding and Protection				
Method 1	Install where mulch displacement is a problem -- around bridges and edge of pavements	Install and replace as needed		
Method 2	Standard procedure except where severe conditions exist	Replace as needed		
Jute Matting	Install where soil stabilization is necessary -- drainage ways on 0-1% grade and erosive slopes			Install as required
Special Seeding Crownvetch	Apply to slopes and other non-mow areas	Reseed partial stands and seed new areas as required		
Sodding	Install where immediate vegetative cover is required -- drainageways on 1-4% grade, islands, lawns	Replace and install as required		Replace and install as required
Fertilizer	1-2-2 fertilizer applied to all seeded and sodded areas	Fertilize newly seeded and sodded areas	2-1-1 fertilizer for grass vegetation  1-2-2 fertilizer for crownvetch vegetation	Fertilize newly seeded and sodded areas
Agricultural Liming Materials	Apply to all seeded and sodded areas	Lime newly seeded and sodded areas as required	Apply to grass and crownvetch vegetation as required	Lime newly seeded and sodded areas as required
Topsoil Furnished and Placed		Applied to areas with insufficient soil to support adequate plant growth		
Paved Ditch	Install in drainage ways where soil stabilization with vegetation is not possible -- ditches on grades over 4%, flumes on fills			Install where needed
Special Curbs	Install on shoulders to protect fills from pavement drainage			Install where needed

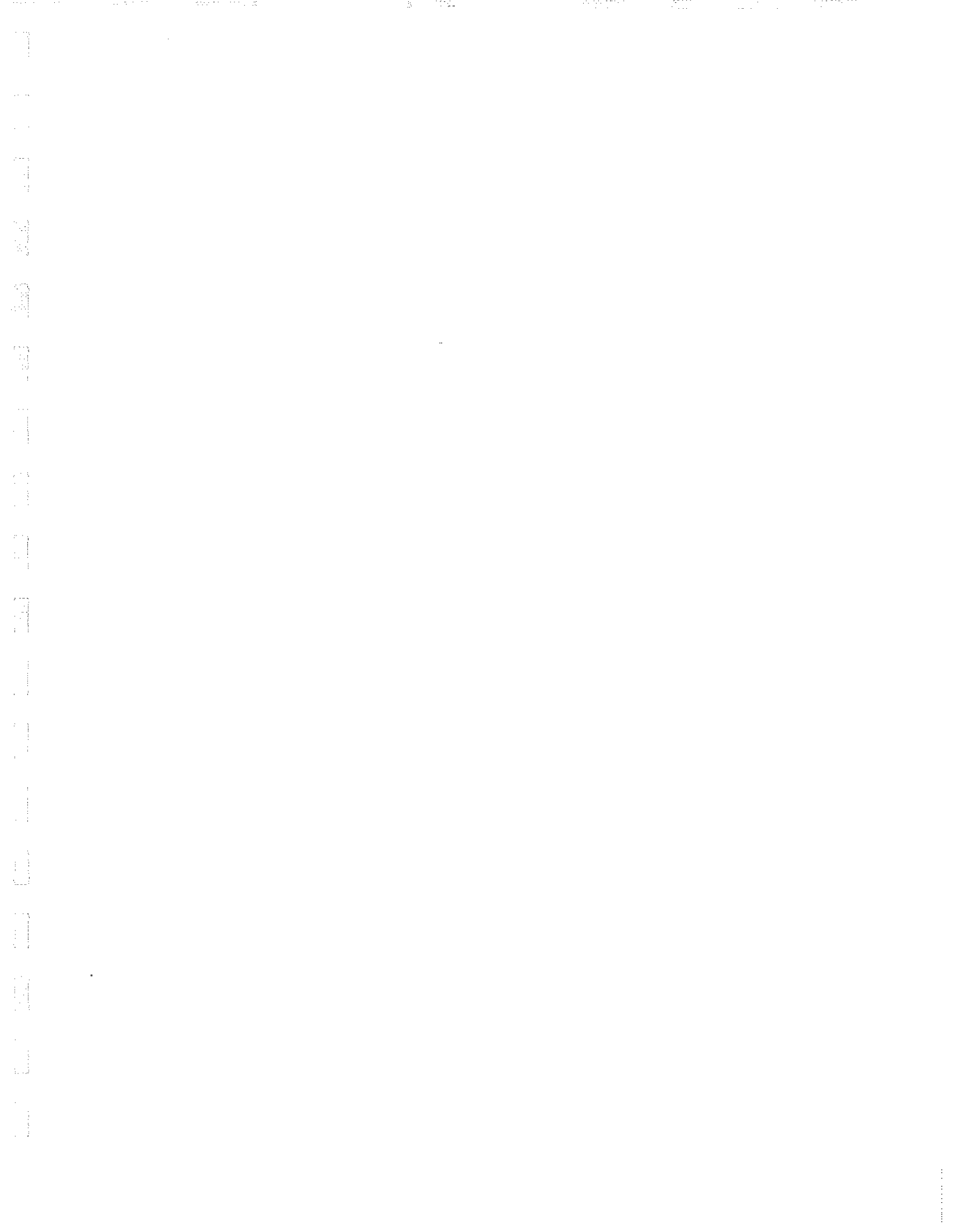
\*Table summarizes the "Proposal of Stage Construction for Erosion Control" features submitted to the Federal Highway Administration by letter dated March 15, 1968, and approved by letter dated June 25, 1968.

\*\*Loss of soil from erosion in drainageways shall be the responsibility of the State.



APPENDIX C

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**EROSION CONTROL NOTES  
FOR  
SEEDING AND PROTECTION AND SODDING  
FERTILIZATION, FIBER GLASS PROTECTION  
AND  
PAVED DITCH**

County:       Davies

Project No. LSU 556 (1)

Road:         Owensboro Beltline

SP 30-187

The following notes are applicable in addition to the specifications set forth under the Department's Special Provision No. 57-C for Seeding and Protection and Standard Specifications for "Sodding"

Erosion Control work as specified on this project shall be considered as the requirements necessary for Stage II construction of the establishment of roadside vegetation. This involves the seeding of areas not having a stand of desirable vegetation, top dress fertilization of all desirable vegetated areas and stabilization of drainageways.

**SEEDING AND PROTECTION**

**Main Line (Roadside Development):**

Roadside areas not having a stand of desirable vegetation as designated on plans or as directed by the engineer shall be seeded and protected as specified in the notes and the Special Provision. Areas to receive the crownvetch seed mixture are so designated on the plans and the seeding shall be performed as early as the weather conditions permit during the period of *February 1 to April 15, only*. It is extremely important that efforts be made to make the seeding of the crownvetch seed mixture as early as possible during the dates set forth.

**Seed Bed Preparation:**

Seeded areas on this project requiring the preparation of a seed bed are so designated on the plans, in the proposal or by the engineer.

Level areas designated to receive "Seed Mixture B" and some slight sloping areas designed for "Seed Mixture A" which are accessible with mechanical equipment shall have a seed bed prepared. These areas have a partial stand of desirable vegetation, therefore a seed bed shall be prepared with such a manner as to not damage the existing turf. The soil surface shall be tilled with discing, spiking or renovating type of tool which will break the soil crust and provide a surface loose enough to cover the seed. The discing, spiking or renovating operation may be performed either at the time of or immediately after the seeding. Care shall be taken not to damage any existing crownvetch.

On sloping areas designated for crownvetch seeding (Seed Mixture A) which are too steep for the use of equipment to prepare a seed bed, tillage will not be required and the limestone, fertilizer and seed shall be blown onto the soil surface. It will be acceptable to perform this at times when the soil is wet or frozen.

**Liming and Fertilizing:**

All seeded areas shall receive uniform applications of 12-12-12 fertilizer at the rate of 28 pounds per 1000 square feet.

**Seeding:**

Seed Mixture A shall be used on slope areas designated on the plans at the rate of 2 pounds per 1000 square feet.

Seed Mixture A.

45% Kentucky 31 Fescue (*Festuca arundinacea*)  
30% Creeping Red Fescue (*Festuca rubra*)  
\*25% Crownvetch (*Coronilla varia*)

Seed Mixture B shall be used on level areas as designated on the plans at the rate of 3 pounds per 1000 square feet.

Seed Mixture B.

50% Kentucky 31 Fescue (*Festuca arundinacea*)  
40% Creeping Red Fescue (*Festuca rubra*)  
10% White Dutch Clover (*Trifolium repens*)

\*The crownvetch seed of Seed Mixture A shall be paid for at the unit bid price per pound for "Special Seeding Crownvetch".

**Protection:**

Prompt coverage of all seeded areas with a mulch is required to prevent the formation of a hard crust on the surface of the soil. Mulching material shall be oat, wheat, barley or rye straw.

Method 2. All seeded areas shall be protected with Bituminous Treated Mulch, Method 2, of the Special Provision. If SS-1 or SS-1h type Bituminous materials are not available then MC-30 type asphalt may be used for tacking down the straw.

**TOP-DRESS FERTILIZATION**

All vegetated areas within this project which were originally seeded on previous construction projects shall receive a top-dressing of fertilizer. These are areas where a stand of vegetation does exist; however, fertilization is needed in order to establish a dense vegetation capable of controlling erosion.

Both dry and/or liquid fertilizer will be accepted and may be delivered to the project in bags, bulk or tank. If the dry form is used, a 12-12-12 analysis fertilizer shall be uniformly applied at the rate of 1200 pounds per acre (28 lbs. per 1000 square feet). If liquid is preferred, liquid fertilizer having an analysis ratio of 1-1-1 shall be applied at the rate required to furnish 144 lbs. of Nitrogen, 144 lbs. of Phosphorous and 144 lbs. of Potassium per acre. Application of fertilizer shall be made during the period of August 15 through October 31 and February 1 through May 15.

No application shall be made when the weather or climatic conditions will hinder the application or effectiveness of the material or when wet grounds would be damaged by equipment operations. Care shall be taken to avoid applications that would cause damage to grass from burning or cause unsightliness from streaked or missed areas. It is important that slope areas be fertilized in their entirety rather than leaving untreated areas at the top. If streaked or missed areas do exist additional applications of fertilizer shall be made to these areas to correct the unsightly condition.

The Contractor shall utilize application equipment, properly calibrated before use, that is capable of applying the fertilizer evenly over the entire designated areas at the specified rate without excessive drifting of material. The hydroseeder, power sprayers and/or mechanical blower type of broadcast spreaders are considered acceptable for slope and level areas. Mechanical drill type spreaders are acceptable for level areas only. Other acceptable types of equipment must be approved by the Engineer. The minimum solution rate per acre to insure uniform coverage shall be 200 gallons if a hydroseeder is used and 50 gallons per acre if a power sprayer is used.

**SODDING**

The item 'Sodding' on this project shall include minor grading operations to correct eroded

drainageways where needed. Sodding on this project shall be in accordance with the Standard Specifications unless otherwise specified in these proposals. The sod shall be used to stabilize drainageways at locations designated on the plans and by the engineer.

All eroded ditches to be sodded shall be graded and filled if needed and shaped to the grade, size and dimensions as indicated on the plans, in the Special Drawing and to the satisfaction of the Engineer. All loosely grades and filled material shall be compacted. The Sod bed shall be graded to such elevations so that the sod when placed will be flush with the existing turf, structure or seeded areas.

Application of 12-12-12 fertilizer at the rate of 23 pounds per 1000 square feet shall be made to the areas receiving sod.

The sod shall be placed in the bottom of the ditch and extended back on the side slopes to sufficient widths as designated on the plans and by the engineer necessary to prevent erosion from occurring at the edge of the sod. A one and one-half wide strip of sod shall be placed adjacent to the sides of all paved ditches.

### **FILL MATERIAL, FURNISHED AND PLACED**

**Description:**

This item shall consist of furnishing, placing and compacting fill material in severely eroded ditches in accordance with the proposals and as directed by the engineer.

**Material:**

Fill material shall consist of soil or a mixture of soil and small rock (less than 3 inches in diameter) from a source approved by the engineer, which when filled into ditches can be compacted and graded to a smooth and uniform surface. The source of the fill material shall be free of the noxious weeds Johnsongrass, Canada thistle and nodding thistle.

**Construction Methods:**

Severely eroded ditches shall be filled, graded and compacted to the designated grade as directed by the engineer.

**Basis of Payment:**

Fill material shall be paid for at the contract unit price per cubic yard, as measured at the source. Payment shall constitute full compensation for furnishing, hauling, placing and compacting fill material in ditches.

### **PAVED DITCH**

The item "Paved Ditch Type I" on this project shall include minor grading operation to correct eroded drainageways and to shape the ditches to the required dimensions and grades. The paved ditches used on this project shall be installed at the locations designated on the plans and as directed by the engineer, all in accordance with the Department's Drawing for Paved Ditch Type I.

Eroded ditches to receive paved ditch shall be filled as needed and compacted to the satisfaction of the engineer. The ditch shall then be shaped to the proper grade and size to allow the paved ditch to be installed properly. The paved ditches shall be tied to existing paved ditches and to concrete aprons of pipe headwalls where indicated.

### **FIBER GLASS PROTECTION**

**Description:**

This item shall consist of reshaping eroded ditches and shaping ditches which have been filled,

furnishing and placing fiber glass and asphalt to prevent the erosion of ditches as specified in these proposals and as directed by the engineer.

*Glass:* A multitude of continuous glass fibers (approximately 60 ends) are collected together and wound into a package of cylindrical shape. The glass fibers are lightly bound together in a ribbon form. A package of the materials weighs approximately thirty-five (35) pounds. The material shall be of consistency suitable for application by compressed air. The glass shall contain no petroleum solvents or other agents known to be toxic to plant life.

*Asphalt:* Asphalt shall be of an approved RC or MC type (rapid or medium curing asphalt) and shall be of low viscosity. The asphalt shall be uniformly distributed over the areas as specified.

*Equipment:* An air compressor shall be used in conjunction with applying fiber glass strands. A compressor capable of supplying 40 cu. ft. of air per minute at 80 to 100 pounds of pressure is recommended. A special kit is necessary for distributing the glass strands. A kit consists of one (1) air gun specially designed for spraying continuous glass fibers, 50 ft. of 3/8 inch ply rubber hose, and one bucket container. Suppliers of the fiber glass have kits for distribution; some may vary as to design from the above mentioned kit.

Other types of equipment which are capable of spreading the continuous glass fiber strands uniformly in a continuous pattern over the designated area may be used if approved and accepted. Equipment which cuts or breaks the glass fibers will not be permitted.

The coverage per package (35 lbs.) is approximately 58 square yards.

**Shaping Ditches:**

All eroded ditches to be protected with fiber glass shall be filled and compacted if needed and reshaped to the grade designated by the engineer. New ditches shall be reshaped to meet the satisfaction of the engineer. The bottom and side slopes of the ditch shall be left in a roughened but firm condition so the glass strands can adhere to the soil.

**Application:**

The following method shall be used for placement of the fiber glass and asphalt.

The glass and asphalt shall be applied to the ditch area in a "sandwich" type of method, two split applications of glass and asphalt. First, fiber glass strands are blown onto the soil area at the rate of 0.3 pounds per square yard. Then an application of asphalt is made over the glass at the rate of 0.7 gal. per square yard. Another application of glass at 0.3 pound is immediately applied on top of the asphalt. At this time, the glass is "feathered-out" onto the seeded or grassed area adjacent to the side slope of the ditch, in order to prevent the glass from slipping. The final application of asphalt shall then be made at the rate of 0.7 gal. per square yard.

The glass shall be anchored at the top end of the ditch by burying to a depth of 6 inches. The first application of asphalt must not have set before placement of the second layer of glass. Bare areas adjacent to the fiber glass ditches shall be seeded and protected with Seed Mixture B as designated. It is extremely important that these areas be seeded if vegetation does not exist.

**Maintenance During Construction:**

The contractor shall, during construction and prior to acceptance, properly care for all treated areas. Material which becomes displaced shall be repaired immediately, at no additional expense to the Department.

**Basis of Payment:**

This work will be paid for at the contract unit price per square yard for fiber glass protection complete in place as specified, which price will include all materials, equipment tools, labor and work incident thereto, also the specified maintenance of the work and disposal of unsuitable materials.

May 12, 1972



**APPENDIX D**

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**EROSION CONTROL NOTES  
FOR  
SEEDING AND PROTECTION AND SODDING**

County: Christian

Project No. I 24-3(17)86

Road: Paducah-Tenn. Stateline

SP 24-875

The following notes are applicable in addition to the specifications set forth under Special Provision No. 57-C for Seeding and Protection and 'Sodding' of the Department's Standard Specifications for Road and Bridge Construction.

Permanent erosion control work shall be coordinated with the grading operations in a progressive manner in accordance with Special Provision No. 46-C, Water Pollution Control. The permanent erosion control work shall be performed as soon as possible after areas have been brought to acceptable final grade.

The amounts of erosion control materials as specified for this contract except for the top dressing of fertilizer shall be considered as those requirements necessary for Stage I Erosion Control for the establishment of a roadside turf. The top dressing of fertilizer specified in this contract shall be considered as the necessary fertilizer requirement for Stage II. Other Stage II requirements such as additional amounts of limestone, seed, sod or any special mulching and ditch stabilizing materials which may be required to control soil erosion shall be specified at the time of the general landscaping contract.

**SEEDING AND PROTECTION**

**Main Line, Rest Area and Cross Roads (Grade, Drain and Surfacing):**

All areas which have been disturbed by construction operations on this project shall be seeded and protected unless sod is specified. Seeding and protection work shall be extended beyond the construction limits to include all areas within the right-of-way not covered by an acceptable growth of desirable vegetation. Areas of existing weed and brush vegetation will not be acceptable and shall be cleared and seeded and protected also.

**Liming and Fertilizing:**

All seeded and sodded areas shall receive uniform applications of Agricultural Limestone at the rate of 200 pounds per 1000 square feet and 10-20-20 fertilizer at the rate of 23 pounds per 1000 square feet.

**Seeding:**

The following Seed Mixture shall be used on this project at the rate of 2 pounds per 1000 square feet.

**Seed Mixture**

- 65% Kentucky Fescue (*Festuca arundinacea*)
- 25% Creeping Red Fescue (*Festuca rubra*)
- 5% Weeping Lovegrass (*Eragrostis curvula*)
- 5% White Dutch Clover (*Trifolium repens*)

Only Kenwell tall fescue (*Festuca arundinacea*) shall be sown in the rest area at the rate of 8 pounds per 1000 square feet.

Crownvetch (*Coronilla varia*) shall be uniformly sown at the rate of 1/2 pound per 1000 square feet in addition to the above specified seed mixture. All cut slopes and fill slopes on the main line, rest area and cross roads that are 3:1 or steeper, shall be seeded in Crownvetch as specified in the Special Provision.

**Protection:**

Prompt coverage of seeded areas with a mulch is required to prevent the formation of a hard crust on the surface of the soil. Mulching material shall be wheat, oat, barley or rye straw.

Mulch with Netting, Method 1, shall be used to protect areas adjacent to curbs and pavements and around bridges as specified in the Special Provision. Other seeded areas near structures where the spraying of asphalt would not be advisable should also be protected with Method 1.

All other seeded areas shall be protected with Bituminous Treated Mulch, Method 2, of the Special Provision except where jute matting is specified.

Jute matting shall be used in ditches on grades less than 1% as directed by the engineer. Roadway side ditches, surface ditches, special ditches, interceptor ditches, median ditches under 1% grade shall be seeded and protected with jute matting. Ditches under 1% grade shall be given careful consideration, for these ditches may be subject to considerable erosion, depending on the size of the area the ditch drains, length of ditch and velocity of water. Generally for most ditches, two strips of jute is needed to protect the ditch to sufficient width. Three strips shall be used for median ditches under 1%.

### SODDING

Sodding on this project shall be in conformity with the General Summary plan and profile, cross section sheets and as directed by the engineer.

Only fescue sod shall be used in the rest areas. Either fescue or bluegrass sod will be acceptable on the main line and cross roads.

A 12 foot wide strip of sod shall be placed in the median ditch on grades of 1 to 4%, as directed by the engineer. This strip of sod shall be centered on the lowest point of the median ditch. Two strips of sod extending 2 feet perpendicular to the sodded median shall be placed on each side of the sodded strip, every 50 feet, as directed by the engineer. All joints shall be staggered.

Roadway side ditches, surface ditches, interceptor ditches, and special ditches on grades of 1 to 4%, which in the opinion of the engineer are subject to erosion, shall be sodded. The sod shall be centered on the lowest point of the ditch and shall be placed in the ditch to sufficient widths as directed by the engineer to prevent the erosion of the side slopes.

### TOP-DRESS FERTILIZATION

All vegetated areas which were originally seeded on this contract shall receive a top-dressing of fertilizer. These are areas where desirable vegetation does exist; however, fertilization is needed in order to establish a dense vegetation cover capable of controlling erosion.

Both dry and/or liquid fertilizer will be acceptable and may be delivered to the project in bags, bulk or tank. If the dry form is used, a 20-10-10 analysis fertilizer shall be uniformly applied at the rate of 500 pounds per acre (11.5 lbs. per 1000 square feet). If the liquid is used, liquid fertilizer having an analysis ratio of 2-1-1 shall be applied at the rate required to furnish 100 lbs. of Nitrogen, 50 lbs. of Phosphate and 50 lbs. of Potassium per acre.

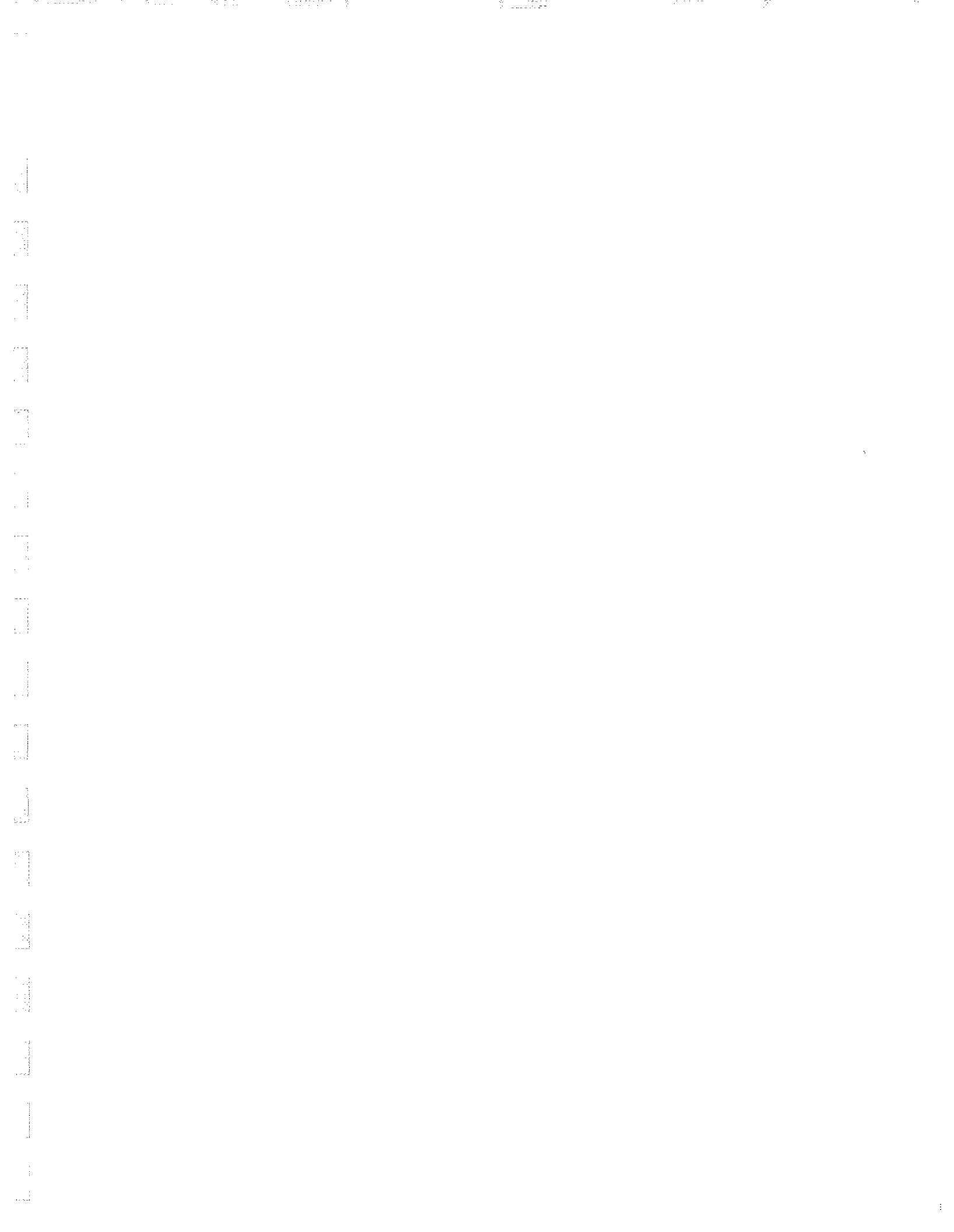
The top-dress applications shall be made, when directed by the Engineer, near the completion of the project after significant growth has occurred and the final acceptance of the seeding and protection work has been made. Applications during the months of December, January and February shall be avoided.

Application shall not be made when the weather or climatic conditions will hinder the application or effectiveness of the material or when wet grounds would be damaged by the equipment operations. Care shall be taken not to make applications of fertilizer that would cause damage to grass from burning or cause unsightliness from streaked or missed areas. Care shall be taken not to make applications onto germinating seedlings as severe damage from fertilizer burn may occur.

The contractor shall utilize application equipment, properly calibrated before use, that is capable of applying the fertilizer evenly over the entire designated areas at the specified rate without excessive drifting of material. The hydroseeder, power sprayers and/or mechanical blower type of broadcast spreaders are considered acceptable for slope and level areas. Mechanical drill type spreaders are considered acceptable for level areas only. Other acceptable types of equipment must be approved by the engineer.

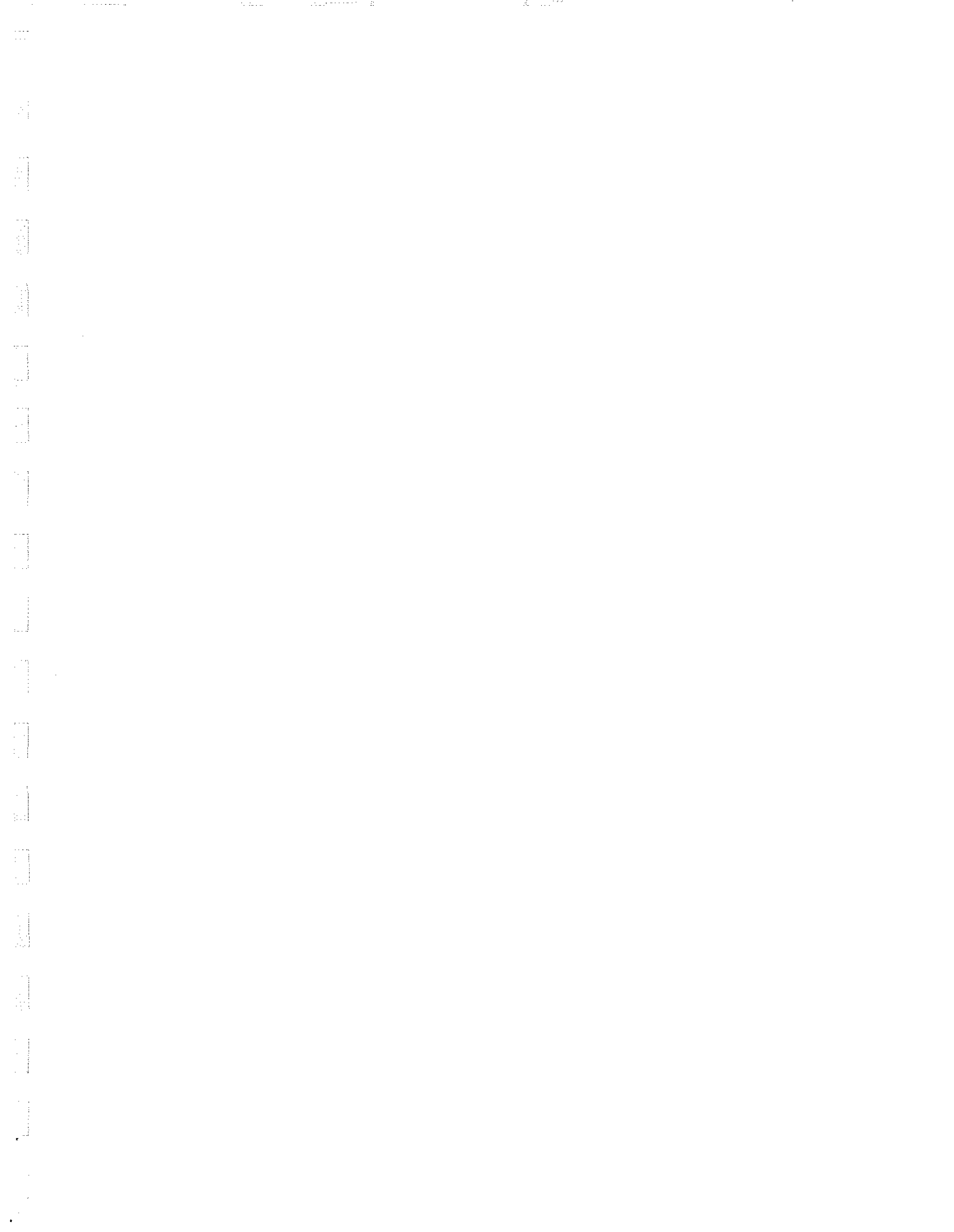
The minimum solution rate per acre to insure uniform coverage shall be 200 gallons if a hydroseeder is used and 50 gallons per acre if a power sprayer is used.

January 12, 1971



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**APPENDIX E**





**EROSION CONTROL NOTES  
FOR  
SEEDING AND PROTECTION AND SODDING**

County: Pike

Project No. APD 127(30)

Road: Jenkins-Pikeville Road (US 23)

AP 98-668

The following notes are applicable in addition to the specifications set forth under Special Provision No. 57-C for Seeding and Protection and "Sodding" of the Department's Standard Specifications for Road and Bridge Construction.

Permanent erosion control work shall be coordinated with the grading operations in a progressive manner in accordance with Special Provision No. 46-C, Water Pollution Control. The permanent erosion control work shall be performed as soon as possible after areas have been brought to acceptable final grade.

The amounts of erosion control materials as specified for this contract except for the top dressing of fertilizer shall be considered as those requirements necessary for Stage I Erosion Control for the establishment of a roadside turf. The top dressing of fertilizer specified in this contract shall be considered as the necessary fertilizer requirement for Stage II. Other Stage II requirements such as additional amounts of limestone, seed or sod or any special mulching and ditch stabilizing materials which may be required to control soil erosion shall be specified at the time of the general landscaping contract.

**SEEDING AND PROTECTION**

**Main Line and Cross Roads (Grade, Drain and Surfacing):**

All areas which have been disturbed by construction operations on this project shall be seeded and protected unless sod is specified. Seeding and protection work shall be extended beyond the construction limits to include all areas within the right-of-way not covered by an acceptable growth of desirable vegetation. Areas of existing weed and brush vegetation will not be acceptable and shall be cleared and seeded and protected also.

**Liming and Fertilizing:**

All seeded and sodded areas shall receive uniform applications of Agricultural Limestone at the rate of 200 pounds per 1000 square feet and 10-20-20 fertilizers at the rate of 23 pounds per 1000 square feet.

*Seeding:* The following Seed Mixture shall be used on this project at the rate of 2 pounds per 1000 square feet.

65% Kentucky 31 Fescue (*Festuca anundinacea*)  
5% Red Top (*Agrostis alba*)  
25% Sericea Lespedeza (*Lespedeza cuneata*)  
5% Weeping Lovegrass (*Eragrostis curuvla*)

*Protection:* Prompt coverage of seeded areas with a mulch is required to prevent the formation of a hard crust on the surface of the soil. Mulching material shall be wheat, oat, barley or rye straw.

Mulching with Netting, Method 1, shall be used to protect areas adjacent to curbs and pavements and around bridges as specified in the Special Provision. Other seeded areas near buildings and structures where the spraying would not be advisable shall also be protected with Method 1. Two (2) strips of netting shall be placed adjacent to the curb side of the road.

All other seeded areas shall be protected with Bituminous Treated Mulch, Method 2, of the Special Provision.

## SODDING

Sodding on this project shall be in conformity with the General Summary plan and profile, cross-section sheets and as directed by the engineer.

Roadway side ditches, surface ditches, interceptor ditches, and special ditches on grades on 0 to 4%, which in the opinion of the engineer are subject to erosion, shall be sodded. The sod shall be centered on the lowest point of the ditch and shall be placed in the ditch to sufficient widths as directed by the engineer to prevent the erosion of the side slopes.

## TOP-DRESS FERTILIZATION

All vegetated areas which were seeded and sodded on this project shall receive a top-dressing of fertilizer. These are where desirable vegetation does exist; however, additional fertilization is needed to establish a dense vegetative cover capable of controlling erosion.

Both dry and/or liquid fertilizer will be acceptable and may be delivered to the project in bags, bulk and tank. If the dry form is used, a 20-10-10 analysis fertilizer shall be uniformly applied at the rate of 500 pounds per acre (11.5 lbs. per 1000 square feet). If liquid is used, liquid fertilizer having an analysis ratio of 2-1-1 shall be applied at the rate required to furnish 100 lbs. of Nitrogen, 50 lbs. of phosphorus and 50 lbs. of potassium per acre.

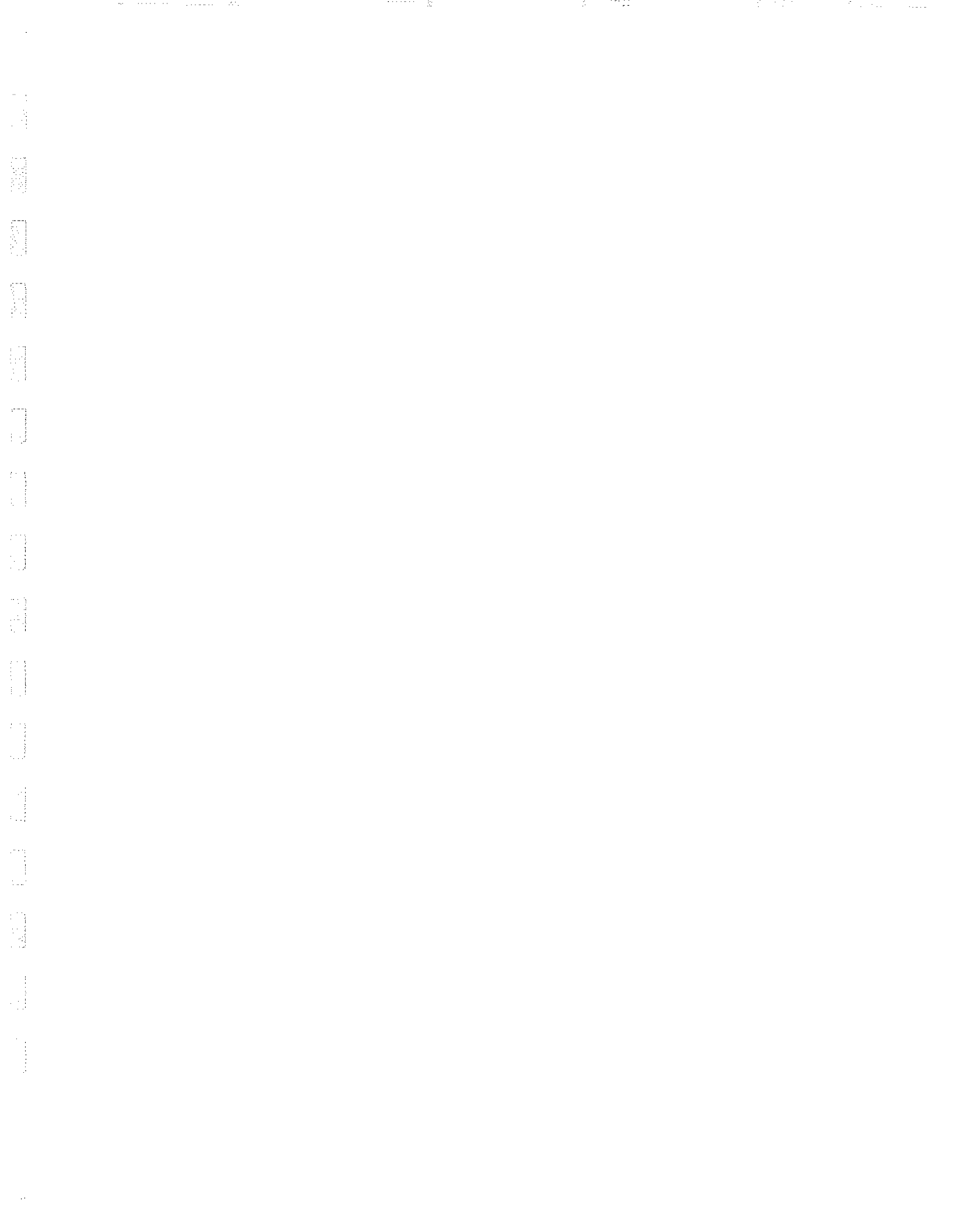
The top-dress applications shall be made, when directed by the Engineer, after significant plant growth has occurred and final acceptance of the seeding and sodding work has been made. The top dress of fertilizer should be made as near the completion of the project as possible allowing as much time for sufficient growth to develop before making applications.

Top-dress applications shall not be made during the months of December, January or February. Neither shall applications be made onto germinating seedlings as severe damage from fertilizer burn can be expected. Applications shall not be made when the weather or climatic conditions will hinder the applications or effectiveness of the material or when wet grounds would be damaged by equipment operations. Care shall be taken to avoid applications that would cause damage to grass from burning or cause unsightliness from streaked or missed areas. It is important that slope areas be fertilized in their entirety rather than leaving untreated areas at the top. If streaked or missed areas do exist, additional applications of fertilizer shall be made to these areas to correct the unsightly conditions.

The contractor shall utilize application equipment, properly calibrated before use, that is capable of applying the fertilizer evenly over the entire designated areas at the specified rate without excessive drifting of material. The hydroseeder, power sprayer and/or mechanical blower type of broadcast spreaders are considered acceptable for level areas only. Other acceptable types of equipment must be approved by the engineer. The minimum solution rate per acre to insure uniform coverage shall be 200 gallons if a hydroseeder is used and 50 gallons per acre if a power sprayer is used.

April 26, 1972

APPENDIX F



### HERBICIDE PROGRAM\*

	BROADLEAF WEED CONTROL	SUMMER WEEDS AND BRUSH CONTROL	STUMP TREATMENT FOR BRUSH CONTROL	BRUSH CONTROL (DORMANT CANE AND TRUNK)	CATTAIL CONTROL	GRASS GROWTH RETARDANT
Chemical	2, 4-D Amine	2, 4-D and 2, 4, 5-T Amine	2, 4, 5-T or 2, 4-D and 2, 4, 5-T	2, 4, 5-T or 2, 4-D and 2, 4, 5-T	Dalapon	MH-30
Rate of Application	1.5 lbs acid equivalent per acre (0.5 gal per acre)	3 lbs acid equivalent per acre (1 gal per acre)	15 lbs acid equivalent (5 gal)	6 lbs acid equivalent (2 gal)	20 lbs per acre	Spring: 1 1/3 gal per acre Fall: 1 2/3 gal per acre
Time of Application	When vegetation is in full leaf; Late April-June and August 15-Frost	Mid-June thru mid-October	Any time of year; soon as possible after brush is cut	After leaf drop; November 1 - March 1	Summer months	When grass is actively growing; Spring: April 1 to May 15 Fall: September 1 to October 1
Type of Treatment	Foliage-stems; broadcast	Foliage-stems; broadcast	Hand gun; directed spray	Liquid; broadcast to stems, trunk, and root crown	Foliage-stems; broadcast	Foliage; broadcast
Rate of Carrier	25 to 50 gal of water per acre	50 gal of water per acre	100 gal of oil per acre	100 gal of oil per acre	100 gal of water per acre	50 gal of water per acre
Maximum Height of Vegetation	30 inches	30 inches		30 inches and trunk diameter of three inches	36 inches	6 inches unless mowed 14 days following treatment
Special Features	Avoid applications that cause unsightly "brown out"	Avoid applications that cause unsightly "brown-out"	Wet stump and exposed roots until spray puddles around root collar	Spray to run-off		2, 4-D can be added for weed control
Precautions	Do not apply treatments when wind velocities exceed 10 mph. Be sure that all signs and safety features are in order and properly used. Do not remove vegetation by cutting until complete kill has occurred. Make sure to note all sensitive crops in advance and take measures to avoid damage. Be sure that proper instructions have been received and personnel properly trained before making applications. Make sure the applicator equipment is in top working condition and properly calibrated before making any treatments.					

\*A summary of the vegetation control program described in detail in Chapter 71-20 (dated July 8, 1970) of the DIVISION OF MAINTENANCE GUIDANCE MANUAL.

	JOHNSON GRASS CONTROL		NON-SELECTIVE VEGETATION CONTROL WITHOUT SOIL STERILIZATION	VEGETATION CONTROL AROUND LANDSCAPE PLANTS		SHRUB BED HERBICIDE
Chemical	Monosodium Acid Methanearsonate (MSMA)	Monoboro Chlorate	Amitrol-T Liquid	Amizine	Simizine	Casron G-4
Application	2 lbs acid equivalent per acre (1/3 gal per acre)	1600 lbs per acre, 1 lb/25 ft (1 clump 5 ft dia)	2 gal per acre	7 lbs per acre	3.5 lbs per acre	150 lbs per acre (3.5 lbs/1000 sq ft)
Time of Application	When grass is in full leaf	Late spring to dormancy in late fall	When vegetation is in full leaf, from emergence in spring to October 1	When vegetation is in active growing state or less than 8" tall; April - June	When vegetation is not in an active state of growth; December - April	November 1 - April 1
Type of Treatment	Foliage-stems; broadcast	Granular; Application by hand	Foliage-stems; directed spray	Foliage-stems	Soil treatment	Granular; apply by hand
Rate of Carrier	50 gal of water per acre	None	100 gal of water per acre	100 gal per acre	50 gal of water per acre	None
Maximum Height of Vegetation			30 inches	8 inches		
Special Features	Make 3 or 4 retreatments in one season	Lateral movement on slopes should be considered	Spray to wet all plant parts; Systemic activity maybe slow in kill	Spray to create a 6-foot diameter circle	Spray during dormancy	Do not apply when temperature is above 70°F
Precautions			Avoid applying chemical onto desirable vegetation	When vegetation is over 8", mow and then spray regrowth; Avoid spraying chemical on frozen ground	Do not spray when ground is frozen or run off is a problem	Do not apply until 4 weeks after transplanting of shrubs and trees or 6 months after planting of seedlings

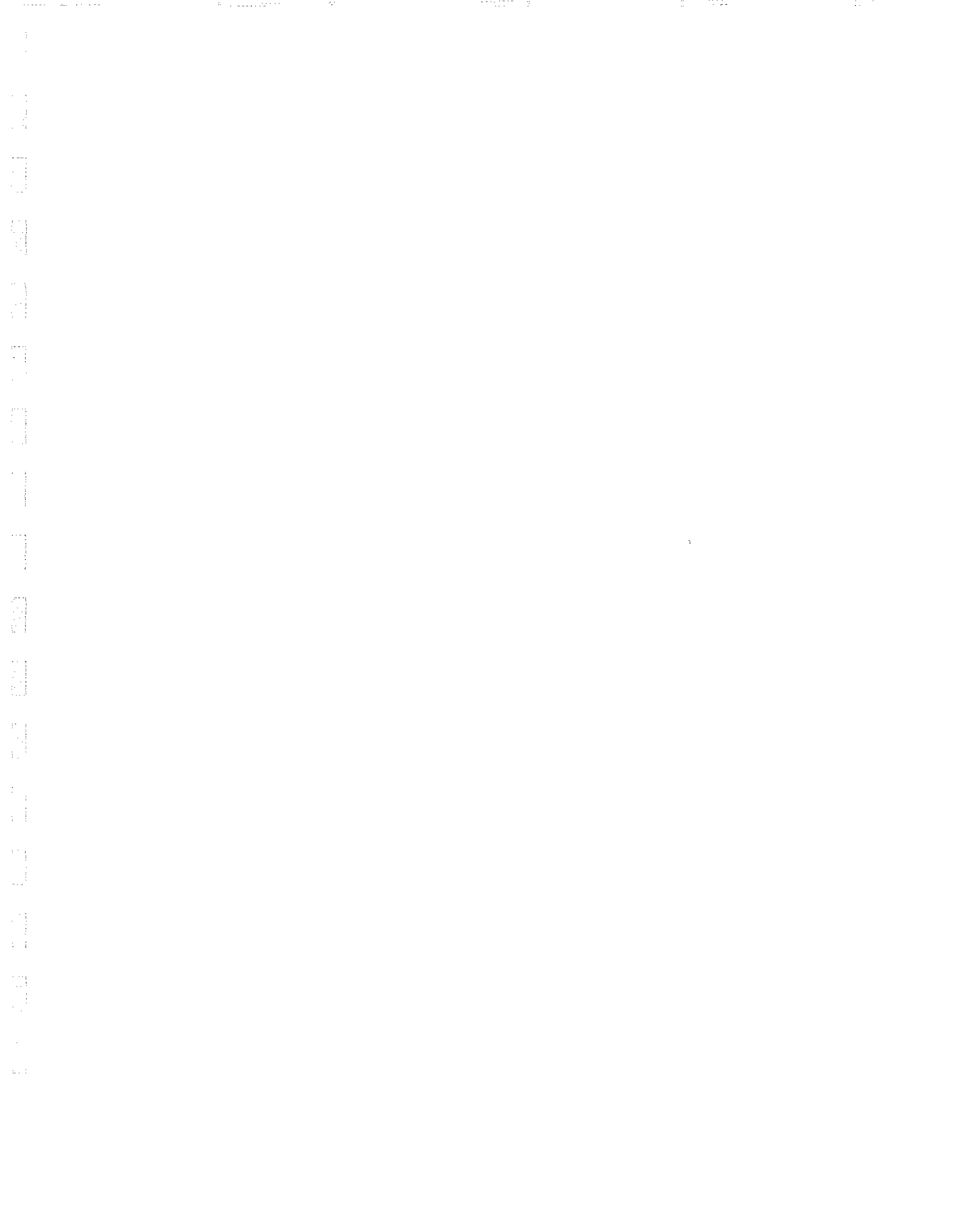
	VEGETATION CONTROL UNDER GUARDRAIL		PELLETS FOR BRUSH CONTROL	PELLETS FOR BROADLEAF WEED AND SMALL BRUSH CONTROL	INSECTICIDE INFORMATION
Chemical	Amizine	Simizine	Tordon 10-K	2% Tordon Pellets	Diazinon AG-500
Rate of Application	14 lbs per acre	8 lbs per acre	60 - 85 lbs per acre	Weeds - 120 lbs per acre Brush - 300 lbs per acre	As prescribed on label
Time of Application	When vegetation is in active growing state; April-August	When vegetation is not in active growing state; December-April	September - March	April 1 - November 1, when ground is not frozen	As needed
Type of Treatment	Foliage-stems	Soil treatment	Hand broadcast uniformly over the soil	Broadcast uniformly over soil	Foliage
Rate of Carrier	100 gal of water	100 gal of water	None	None	
Maximum Height of Vegetation	8 inches		Dormant; no limit	After full leaf - 30 inches	
Special Feature		Spray during dormancy	Do not use on newly seeded areas (may damage turf)	Do not use on newly seeded areas; Brush treatment may damage turf; Speed of effect depends on soil moisture	
Precautions	When vegetation exceeds 8", mow and then spray regrowth; Avoid applying chemical to desirable vegetation	Do not spray when ground is frozen; Chemical is a sterilant and can move	Avoid areas near drainage ditches or where chemicals can move onto desirable vegetation; Do not apply when soil is frozen	Avoid areas near drainage ditches or where chemical can move onto desirable vegetation	





**REPORTS ON INVESTIGATIONS**

**APPENDIX G**



EVALUATION OF DIRECT SEEDING OF  
TREE SEEDS ON KENTUCKY ROADSIDES  
(Study 3-2)

OBJECTIVES:

On December 2 and 3, 1965, an experiment was initiated to determine if direct seeding of certain selected species of trees would be suitable in the establishment of woody vegetative covers on some Kentucky roadsides.

LOCATION:

Two experimental sites were selected in the south central area of the state on US 31 E, eight miles south of Glasgow, and on US 127, one mile south of the Russell-Clinton County line. The cut slopes selected were eroded and practically void of vegetation, had a northwest exposure and consisted of a low fertility subsoil typical of the area. Tests of the experimental site revealed a soil having a 0.1 percent organic matter, a pH of 4.8, three pounds of available phosphorous and approximately 80 pounds of potassium per acre.

MATERIALS AND METHODS:

Three species of pine -- Virginia pine (*Pinus virginiana*), pitch pine (*Pinus rigida*) and white pine (*Pinus strobus*) -- along with black locust (*Robinia pseudocacia*) were studied. The Virginia and pitch pines were sown at a rate of 10 ounces per acre, the white pine at 20 ounces per acre and the black locust at 40 ounces per acre. Some mixtures of the four species were also sown. To study the effects of fertilization and mulching on initial establishment of the trees, 12-12-12 fertilizer was applied at the rate of 23 pounds per 1,000 square feet and a straw mulch was applied at a rate of two tons per acre on selected plots. Seventeen, one-tenth acre plots were staked off -- eight along US 31 E and nine along US 127. One additional plot was established on US 31 E for the purpose of using another fertilizer type, 20-10-10, and a second type of mulch, wood cellulose. The 20-10-10 was applied at a rate of 23 pounds per 1,000 square feet and the wood cellulose

mulch at a rate of one ton per acre.

On all plots except the special plot, applications were made by hand broadcasting the seed, fertilizer and straw onto an unprepared soil surface. The special plot was sown, fertilized and mulched with a hydroseeder.

OBSERVATIONS AND RESULTS:

On June 28, 1967, nearly 1 1/2 years after initial seeding, extensive erosion had occurred on all plots. It appeared that nearly four inches of soil had eroded from the surface of the plots and no more than five percent of the mulch was remaining on any plot. Seedling counts indicated an average of one seedling per square yard on all plots (Figure 3-2/1). The tree seedlings ranged in height from two to ten inches. Many of the seedlings were nearly detached from the soil due to winter heaving and subsequent soil erosion. Most of these seedlings were concentrated in the remaining mulched areas and on areas protected by rocks. The protected seedlings were growing vigorously. No particular species of tree seedling could be observed as having made greater growth. Neither could any marked response from the fertilizer treatments be noted. The mulching treatment appeared to be beneficial since most of the existing seedlings were located in the remaining mulch. Extensive soil erosion appeared to be the major factor and nullified any differences in the treatments studied.

CONCLUSIONS:

Although no valid conclusion could be drawn from this experiment, it is felt that satisfactory germination and growth can be expected from direct seeding of trees on critical roadside areas if appropriate measures are taken to control soil erosion.

From experience gained in this study, certain specific interstate construction projects were selected as trial projects for direct seeding of tree seeds on roadside areas. Pine seeds were sown onto certain selected slopes at the time initial erosion control work was performed on two construction projects, one on I 64 in Rowan County and the other on I 75 in Laurel County.

Figure 3-2/1. Pine seedlings growing on an eroded roadside slope 1 1/2 years after direct seeding.



**CONTROLLING VEGETATION AROUND  
DELINEATORS WITH ALUMINUM SHEETING  
(Study 5-2)**

**OBJECTIVES:**

Vegetation growing around posts along highway roadsides, especially the delineator posts on the interstate system, create an unsightly appearance. Mowers are not able to effectively cut growth around the posts. Considerable damage to the posts occurs from close mowing. Hand clipping around the posts is extremely time consuming and costly. Soil-sterilizing herbicides control vegetation; however, the chemicals are easily washed from around the posts, destroying other desirable vegetation and creating erosion problems. A local aluminum company was interested in investigating the possible use of aluminum sheeting as a weed guard around posts. An observation-type study was initiated in 1965.

**MATERIALS AND METHODS:**

This experiment involved two studies: the first a preliminary screening of different weights and shapes of sheeting and the second, an investigation of an improved guard.

On August 24, 1965, fifty aluminum sheets were installed around delineator posts on Newburg Road in Jefferson County. The sheets were approximately two feet by two feet and diamond shaped (Figure 5-2/1). Three different gauges of sheeting were evaluated -- 0.006, 0.008, and 0.010 inch thick. A slot was cut in each sheet, from one side to the center, so they could be fitted around the posts. They were pinned with large-headed spike nails.

The second phase of the study involved the investigation of an improved aluminum weed guard. The new guards were made of heavier gauge sheeting (0.012 inch thick) and were circular in shape (24 inches in diameter). An opening, the shape of the delineator posts, was made in the center of each guard to allow for closer fitting. On July 19, 1966, twenty-five of the newly designed guards were installed around the base of delineator posts on the ramps of the I 64 and US 127 interchange near Frankfort.

Periodic investigations were made to determine the effectiveness of the aluminum weed guards in controlling unwanted vegetation, the appearance of the guards, and the effects of salts and other corrosive chemicals on the metal.

**OBSERVATIONS AND RESULTS:**

*June 9, 1966:* Ten months after installation of the original aluminum sheets, an investigation revealed the sheets to be in the same condition as when installed. Salts and weather during the winter did not

appear to have any detrimental effects upon the metal. Spring vegetation had started growing through the open area around the posts and the split joint which was cut to fit the sheet around the post. All three gauge sheets appeared to be too light and were easily bent and torn during installation and by mowers. It was determined that a heavier gauge guard, which could be installed without having to slit the sheet, might be more effective in controlling the weeds.

*July 19, 1966:* The improved guards were installed. While weed controlling effects could not be evaluated at that time, installation of those disks was found to be impractical for two reasons. Installation of the disks required removal of all reflectors, signs, etc. from the posts. To prevent theft, most of the nut and bolt-type attachments had been peened. Removal of some of those were impossible without cutting bolts and replacing them with new ones. Secondly, close tolerance of the opening in the center of the disk did not allow insertion over the battered end of the post, caused by the sledge hammer when the posts were installed.

Installation of those disks appears practical only during original construction before any signs or markers are attached to the posts and only on metal posts of the type found on interstate. No allowance was made for wooden posts found on most Kentucky roads.

*September 25, 1966:* An inspection of the new guards indicated considerable improvement over the original guards. They were effective in controlling vegetation and showed no significant deterioration. Two of the guards were destroyed by mowers.

*June 23, 1967:* Observations nearly two years after installation indicated the original diamond-shaped aluminum weed guards were not effective for controlling growth of vegetation around delineator posts. The area covered by the guards was too small and vegetation lapped over the guards. The guards were too light and were pushed up by vegetation growing at the edge.

After nearly one year, the same problem was noted for the circular guards; i.e. growth at the outer edge of the guard lapped over the guard and tended to nullify the 24-inch diameter weed-controlled area around the post. The guards were observed to be easily damaged by mowers and many had been destroyed. No apparent damage from salts or other chemicals was noted.

**CONCLUSIONS:**

Even though the heavier gauge, circular aluminum weed guard was a considerable improvement over the original light gauge diamond-shaped guard, the effectiveness of both in controlling growth around delineator posts was not satisfactory. The area covered



**Figure 5-3a/1). Black locust controlled with fenuron brush pellets about eight months after application. Note movement of non-selective herbicide down slope from point of application.**

COMPARISON OF FENURON AND  
PICOLINIC ACID HERBICIDES  
FOR CONTROLLING BRUSH  
(Study 5-3b)

OBJECTIVES:

The development and marketing of a new brush control herbicide, picolinic acid (trade name Tordon), prompted the initiation of a study to compare the new chemical with the fenuron herbicide (trade name Dybar).

LOCATION:

Another roadside area having considerable large brush vegetation along KY 1429 in Franklin County was selected as the site for this comparison.

MATERIALS AND METHODS:

Tordon 10K pellets containing 10 percent 4-amino-3, 5, 6-trichloropicolinic acid and Dybar pellets containing 25 percent fenuron were applied at the manufacturers' rates and directions to certain selected brushy vegetation. The Tordon 10K pellets were broadcast to the drip line of each plant at the recommended rate of 85 pounds per acre. The Dybar pellets were applied to each brush clump at the recommended rate of one tablespoon to each of three spots around the base of the brush. The species treated were elm, black locust, redbud, hackberry, boxelder, cedar, and sassafras. Applications were made on March 22, 1966.

Periodic visual observations were made to compare the effectiveness of the two herbicides in controlling brush and the degree of damage to the grass.

OBSERVATIONS AND RESULTS:

*April 19, 1966:* One month after treatment, most of the brush species, except the black locust, were budding. The Tordon appeared to be very quickly absorbed by weeds and small brush for wild garlic, cedar, blackberry, buckbrush, broadleaf weeds and other small brush species, except boxelder, were showing herbicidal symptoms. Trees and large brush such as black locust were not showing any effects from the Tordon herbicides at that time. There was no apparent damage to the grass species except where Tordon was applied in heavy concentrations. There was little visible movement of Tordon.

Where Dybar herbicide was applied, some slight effect was noted on broadleaf weeds and garlic. There were no visible effects on any of the brush or trees at that time. However, there appeared to be considerable movement of Dybar from the point of application down slope, causing severe damage to grass.

*June 7, 1966:* All brush and tree species, including broadleaf weeds, appeared to be dead where Tordon herbicide was used (Figure 5-3b/1). Tordon appeared to show excellent selectivity, controlling only broadleaf weeds and brush and not significantly affecting grass. There was some movement of Tordon as herbicidal symptoms were noted on black locust trees ten feet from treated areas. That movement was noted in a low drainage area.

By that time, most of the woody species such as elm, boxelder, cedar, redbud, black locust and hackberry were showing herbicidal effects from the Dybar treatment. Leaf buds had opened but were small and deformed, and terminal growing points seemed to be dead. There appeared to be little or no effect on buckbrush, wild garlic or any of the other broadleaf weeds. Grass was dead for a distance of 15 feet down slope from the spot of application (Figure 5-3b/2).

*September 14, 1966:* By fall all trees, brush, and broadleaf weeds treated with the Tordon herbicide were dead. Most of the woody species, including black locust trees, could be pulled out of the ground by hand (Figure 5-3b/3). Grass around the brush showed no sign of damage from the Tordon and was growing vigorously. There was definite lateral movement of Tordon in the drainage area as trees and brush beyond the treated area were killed.

There were still some small deformed leaves present on some trees treated with Dybar. However, most of the brush was dead or in a seemingly dying stage. Lateral movement of the chemical was quite evident, and damage to the grass was considerable.

*June 23, 1967:* All trees and brush treated with Tordon and with Dybar had been completely killed with no resprouting noted. Both chemicals were effective in controlling black locust and preventing any resprouting. Dead trees could be easily removed by hand. Areas treated with Tordon had grass growing whereas bare spots remained where the Dybar chemical was used and had moved down slope (Figures 5-3b/4 and 5-3b/5).

CONCLUSIONS:

A study comparing picolinic acid (Tordon) and fenuron (Dybar) herbicides under similar conditions for the control of brush on roadsides revealed some major differences. Both herbicides were effective in controlling trees and brush; however, the picolinic acid herbicide appeared to possess certain characteristics more desirable than the fenuron, such as:

1. faster in producing a complete and effective kill of the woody vegetation.