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APPENDIX E – ROADSIDE DESIGN

E.10 – CONTOUR DESIGN

The development of contour grading and drainage plans is a technique long practiced in the design of a wide variety of projects and is recommended for the development of integrated design as a prelude to highway beautification. Contour grading and drainage plans are very advantageous for highway projects, particularly for complex urban or interstate design. Plans for contour grading and drainage shall be prepared for all interchange and other special areas including new alignments, at-grade intersections, grade separations, bridge sites, roadside service and rest areas, and borrow and waste areas.

The objective is to correlate the design and construction elements with each other and with the topography, to reduce maintenance, to increase safety, and to improve the appearance of the entire area. Contour lines shall be developed so as to have lines that are flowing and that well rounded curves are provided at junction points, and where a structure and roadway meet.

Contour plans provide a three-dimensional total design concept that:

- Gives visual proof of the correlation of proposed construction with existing topography and adjacent environment;
- Facilitates the visual study and review of the plans, in-the-field inspection, construction, and later for maintenance;
- Provides a basis for the design of seeding and planting plans; and
- Includes ditch designs addressing rockfall mitigation and erosion control where appropriate. Refer to the Materials Phase II report or special geotechnical report for further information.
- Design control information for contour grading plans is developed from computer data. In the case of consultant designs, the Designer should supply the following information to the district for preparing a template of the road section:
- Profile grade lines on the roadway and ramps.
- Ballast depths.
- The bottom of the ditches; crown for subgrade, subbase, base, surfacing; slopes; etc.
- Lines on which elevations are to be shown including center line or control line.
- Any other special design information considered necessary.

E.20 – SLOPE DESIGN

Refer to Materials Phase II, IV, and/or Special Geotechnical reports as appropriate. Also, see Standard Drawing P-2-E, Permanent Erosion Control Roadside Slope Treatment.

The steeper the slope and the more severe the erosion and surface runoff problems, the greater the need for proper slope design. Serrations and minibenches are most commonly used to stabilize slopes, assist in seeding, control surface runoff, and reduce erosion. Major benches are a structural feature intended to increase slope stability and their use is highly dependent on the geologic structure, terrain, slope aspect, soil texture and composition. Interceptor ditches are one method of controlling runoff over cut slopes.

E.20.01 Serrations, Terraces, Minibenches, and Major Benches. Serrations are defined as having horizontal and vertical dimensions or grooves of less than 1 foot apart and not more than 8 inches deep, while terraces and minibenches are defined as having horizontal and vertical dimensions or steps measuring approximately 1 to 4 vertical feet, with 4 feet being the largest optimum size. Major benches (have horizontal and vertical dimensions of more than 4 feet, usually 10 feet are often applied as a standard unless there are recommendations in the Materials reports to the contrary. Major benches should be designed on an individual project basis. Refer to Materials Phase II, IV, and/or Special Geotechnical reports as appropriate for specific recommendations.

Major Bench Considerations

The benches are to remain functional indefinitely and will require continuous maintenance. A design accommodating access to the major benches for maintenance purposes is necessary. In many instances, major benches can reduce local stability and create maintenance problems. Accumulations of material on major benches may act as a ramp to launch rocks into the roadway. Major benches constructed under adverse or extreme geologic structure or terrain may increase the potential for slope failure. Increases in ditch width may be more effective in retaining rock-fall than major benches. Refer to the Phase II Materials Report or Special Geotechnical Report for specific recommendations.

E.20.02 Design Options for Slopes. Recommendations regarding slope stability and slope design are typically contained in the Phase II Materials report. In special cases involving very steep or high slopes and unusual geologic or drainage conditions, it may be necessary to refer to a Special Geotechnical Report prepared for that specific portion of the project.

To determine the need for slope design with respect to vegetation reestablishment, slopes may be separated into three (3) types:

- *Sloping* (3:1 or flatter) (Sloping areas generally do not contain serrated or mini-benches since conventional tillage equipment can be used and topsoil, if used, will stay in place on a roughened surface and water can be controlled by cross-slope tillage.)

- *Steep* (steeper than 3:1 to 2:1) (Steep slopes may be considered for either serrating, terracing or minibenching.)
- *Very Steep* (steeper than 2:1) (Very steep slopes should be terraced or minibenched in most cases and major benched in specific areas. In areas with high moisture accumulation, vegetation establishes well for a distance of 30 to 40 feet on the slope immediately below a major bench that diverts the surface runoff. Major benches must be designed with adequate outlets such as grass-lined waterways, vegetated areas or other suitable outlets. However, treatment should be coordinated with geotechnical requirements.) Slopes steeper than ¾:1 that are typically in rock may require blasting to remove. Serrations or minibenches will be extremely difficult and expensive to construct on slopes requiring blasting (particularly pre-splitting) and would have minimal value. Avoid benching rock slopes and consider using wider ditches.

Additionally, when planning the size and design of various slopes, three (3) variables that should be considered are material, water, and vegetation. The following questions should be answered when designing slopes.

Material

- Is the material suitable for serration, terracing or minibenching?
- Is the material prone to rock-fall?
- Is major benching feasible or desirable

These questions will be addressed in the Phase II Materials Report or a special geotechnical report.

Water

Refer to the Materials Phase II Report or Special Geotechnical Report.

- Should water be removed or retained?
- Is the area subject to cloudbursts or heavy snow?
- Will underground water seep out on the slopes?
- Is it a low-moisture <15” or a high-moisture >15” area? (check mean annual precipitation) A general guide is under 15” retain water; over 15” divert water.
- Is the material particularly susceptible to erosion?

Determine the water source. If diversion is desired, refer to the Phase II Materials Report or Special Geotechnical Report and design accordingly.

Vegetation

- Can a good cover be obtained?
- If so, what kind of vegetation is suitable for the location and feasible for the conditions?
- What will the appearance and function of the cover be like after a few years?

- Can top soil be used to assist in re-vegetation? (A thin layer of topsoil 1inch to 2 inches is especially valuable on rocky benches and particularly south-and west-facing slopes, but care should be taken to not apply so much topsoil that the value of the benches is destroyed.)

When these questions are answered and conditions and needs are properly correlated with each other, the slope configuration can be designed to best stabilize the disturbed soil or rock and provide good seeding conditions. Access to major benches for both construction and maintenance equipment should be provided. A water disposal system at one or both ends consisting of a suitable waterway with erosion controlled by channel liners, seeding, or other suitable treatment should also be added. Serrations and minibenching should also be noted. Refer to Standard Drawing A-6.

E.30 – LANDSCAPING

A landscaping project is defined as "any action taken as part of a highway construction project, or as a separate action to enhance the aesthetics of a highway through the placement of plant materials consistent with a landscape design plan." Idaho's landscape projects are normally confined to rest areas, pedestrian and bicycle pathway's, urban areas and interchanges and differ from roadside seeding that is primarily for erosion control and roadway slope stability.

All work performed in association with the landscaping action shall be included in the total landscaping expenses. Functional planting shall be on the basis of engineering judgment and may include planting for erosion control, headlight screen, noise barriers, traffic safety, noxious weed control, native habitat restoration, wetland restoration or mitigation, roadway delineation, aesthetics, etc.

E.30.01 Roadside Landscaping. Projects for roadside landscaping shall be included in the annual construction program to allow the project costs to be viewed in proper perspective to the overall construction program. Unless otherwise specified, the degree of landscaping will be limited to what is necessary to ensure that the appearance of the highway is compatible with native or undisturbed landscape and the aesthetics of the surrounding area.

Local agencies shall be contacted before projects are designed for consideration of roadside landscaping. Landscaping projects shall be developed in coordination with local agencies and be consistent with their desire and ability to assume maintenance costs. The local agency shall enter into an agreement with the department to assume full responsibility for all future maintenance of the landscaping.

Unless otherwise specified, the degree of landscaping will be limited to what is necessary to insure that the appearance of the airport or highway is compatible with the appearance of the surrounding area and will not interfere with public safety and overall maintenance operations. Functional planting shall be on the basis of engineering and environmental judgment and may include planting for erosion control, headlight screen, noise barriers, traffic safety, noxious weed control, roadway delineation,

aesthetics, etc. (See the AASHTO Publication, *A Guide for Landscape and Environmental Design.*) The Maintenance section's Roadside Program Coordinator shall be given the opportunity to review all landscaping plans for concurrence with landscaping and roadside vegetation regulations and requirements.

Selection of the appropriate landscaping level of development shall follow these guidelines:

- Low Level Development: Use of primary grass, native shrubs and trees requiring minimal or no mowing and minimum water application. Cumulative maintenance costs expected to equal construction costs in 20-35 years.
- Medium Level Development: Use of primary grass, native shrubs and trees that require installation of a minimal irrigation system for limited watering. Mowing frequency equals irrigating frequency. Native dry-land shrubs and trees are desired. Cumulative maintenance costs are expected to equal construction costs in 10-15 years.
- High Level Development: Use of lawn grass, shrubs and trees that require installation of a complete irrigation system and frequent watering and mowing. Cumulative maintenance costs are expected to equal construction costs in 6-10 years.

Alternatives may be derived from combining elements of different levels to meet maintenance cost constraints.

E.30.02 Urban Structures Landscaping. The following procedures and standards shall be applied to interchanges, bridges and similar large structures when landscaping on an urban project has been approved.

- The proposed structures shall be given special study as to their form and composition of construction materials, to ensure a pleasing appearance and harmony with the surrounding area.
- The earthwork incident to any structure will be designed to use "contour grading and drainage plans" so as to blend with the surrounding topography. The earthwork will have rounded and gentle slopes and be covered with a layer of topsoil of sufficient quantity and depth to support a good vegetation cover.
- The availability of irrigation water will be one of the factors in determining the type of vegetation to be established. Water sources may be secured with the project right of way, or be furnished by the community. If a sprinkler system is to be installed, a determination of the water source must be made.
- Vegetative cover must be planned and designed to prevent erosion by wind and water, reduce invasive weed growth and fire hazard, and promote aesthetic values.
- Additional vegetation may be planned and designed to delineate structures and their approaches, reduce headlight glare, screen adjacent areas, provide barriers, etc.

E.30.03 Reclamation of Material Sources. All ITD materials sources, either owned or leased by the department will be reclaimed by vegetative or landscape means when the source site is retired. Source reclamation will include cleanup, leveling, smoothing of pit floors, visual inspection for existence of noxious or invasive species, and resloping of banks to a 2:1 or flatter slope whenever feasible. Top-soiling and seeding may be needed for sources where portions of the source have been depleted and can be restored to a natural appearance. A reclamation plan is required, prior to the operation of the materials source, and this reclamation plan will be submitted to the Idaho Department of Lands (DOL) for final approval.

For Federal-Aid Highway Systems, all new material sources shall be located out of sight of the main roadways, unless economic consideration prohibits. This setback restriction applies not only to sources that are purchased, but also to sources that are used under a lease arrangement. Existing sources that are along the present highway that must be used because of the State's investment, or new sources in view of the highway that are used because there is no feasible alternate, are to be given special landscaping treatment.

Gravel bars in and along rivers are excluded where excavation can be done in a manner that will not change the natural appearance of the river channel. When channels are present, emphasis must be placed on obliterating apparent damages from the excavation operation.

Reclamation shall be done upon closure and prior to disposal of the site if it is determined by the department that the material site is no longer operational or of benefit to the department. Beneficial uses such as potential use of the site for wetland mitigation, stockpile location, future construction staging area, etc. may be considered.

Each material source may receive different or special revegetation considerations depending on location or ownership of the site. Partial reclamation may be needed for source sites where portions of the source have been depleted. All source reclamation should be incorporated into highway construction contracts whenever feasible.

For more detailed information on materials source reclamation and operation, contact the district or headquarters Materials Engineer or refer to the Materials manual.

The department has a Memorandum of Understanding with DOL to allow retirement of our own material sources, but we must notify DOL that the site is being retired.

E.30.04 Wildflowers and Other Native Species Planting Requirements. All landscape projects require the use of native wildflowers and other native plants, however, waivers can be granted by FHWA when the state certifies that native wildflowers or seedlings cannot be grown satisfactorily, regional native wildflowers or seedlings are not available commercially, available plants or planting areas are scarce, or available planting areas will be used for agricultural purposes. Waivers must be considered on a project-by-project basis. Idaho's native wildflower planting approach will be to comply with the native wildflower requirements in a positive manner on all landscape projects. The department does not intend to try for a waiver or to do only the minimum required amount (1/4 of 1% of the landscaping costs), but wants to develop well-planned wildflower seedings and/or planting on each landscape project.

The planting of native wildflowers within the highway environment should be accomplished through proper planning and forethought, not haphazardly. According to the 1987 Surface Transportation and Uniform Relocation Assistance Act (STURAA) federal-aid projects must comply with "Guidance Material on the Native Wildflower Planting Requirement" (Figure E-01).

In general, planting areas are those locations within the highway right of way where landscape design, highway maintenance, and topographical features are conducive for planting wildflowers and or other native plants. Similarly, native wildflower planting areas in an urban setting may differ from rural settings. The following criteria should be considered for native wildflower planting sites:

- Visible to travelers
- Accessible to follow-up care and maintenance
- Outside the functional roadway zone (beyond the foreslope)
- Soil that lends itself to proper seed bed preparation or rocky or sandy areas where seeds will plant themselves or lodge in crevices
- Free of invasive or noxious plants
- Low-erosion risks

The "native seed" lists (see Subsection E.40.07) for south and north sites are the basic guides for species selection for landscape wildflower plantings. Do not apply grass or fertilizer to the native wildflower area. Selective noninvasive grass can be included but must be approved by the department. Certified noxious weed-free mulch, soil amendments, mulch mixtures, and/or combinations shall be used. Extra care should be taken with regard to weed control. Spraying, tilling, fumigating or other methods may be utilized to remove all weeds and weed seeds from these selected areas prior to planting. Additional species may be included as desired and as conditions warrant. Temporary irrigation or establishment water, when provided; may enhance plant establishment and increase growth. However, if no supplemental water can be provided, the listed species should be adhered to.

Any species used in addition to those shown in the standard lists should be indigenous or naturalized varieties. Generally, any "wildflowers" or other natives selected should originate in the Intermountain

Region or similar eco-regions in the Northwest and be certified to true genus, species, and/or variety. Do not use “exotics” or selections from endangered, invasive, or noxious weed categories. Cost of seed can also be a factor as to the suitability of a species.

Figure E-01

GUIDANCE MATERIAL

FOR

WILDFLOWER AND OTHER NATIVE SPECIES

PLANTING REQUIREMENTS

OFFICE OF ENVIRONMENTAL POLICY
ENVIRONMENTAL ANALYSIS DIVISION

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STATUTORY REQUIREMENT

Section 130 of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (STURAA) amended 23 USC, Section 319 by adding a requirement that native wildflower seeds or seedlings, or both, be planted as part of any landscaping project undertaken on the Federal-aid highway system. At least 1/4 of one percent of funds expended for a landscaping project must be used to plant wildflowers on that project. This provision requires every landscaping project to include the planting of native wildflowers unless a waiver has been granted. Federal-Aid Highway Program Manual, 6-2-5-1, has been changed to reflect the STURAA amendment.

OPERATION WILDFLOWER

The Federal Highway Administration has administered a voluntary, cooperative program titled "Operation Wildflower" with the National Council of State Garden Clubs and State highway agencies since 1973. Unlike Operation Wildflower, the program requirements of STURAA **are mandatory.** STURAA does not prohibit the acceptance of native wildflower seeds or seedlings donated by civic organizations or other organizations or individuals to be used in landscaping projects. State garden clubs may continue to pay for or supply wildflower seeds or seedlings. Neither the donated funds, nor the value of donated plant materials can be counted toward the minimum expenditure required by STURAA.

The new program requirement does not discontinue the program policies of Operation Wildflower. Federal funds are still available for participation in the cost of planting wildflowers supplied by garden clubs and other organizations or individuals, even though the planting may not be part of a landscaping project.

LANDSCAPING PROJECTS

The native wildflower planting requirement is applicable only to landscaping projects, not every Federal-aid highway construction project. A landscaping project is defined as "any action taken as part of a highway construction project or as a separate action to provide an environmentally beneficial landscape that shall complement and enhance the local environment, minimize adverse effects that landscaping may have on the natural environment, or enhance the aesthetics of a highway through the placement of plant materials consistent with a landscape design plan."

Seeding, temporary or permanent, undertaken for erosion control purposes does not constitute a landscaping project. This would include projects that do not have any plant materials (i.e., forbs, legumes, shrubs, trees, etc.) involved in the planting, but would only entail seeding, grass or sod to revegetate disturbed areas. Similarly, planting vegetation to screen certain areas or activities from view does not constitute a landscaping project. Activities falling within this category include screening for headlight glare and junkyard screening. In these instances, vegetative materials are primarily used to serve as a visual barrier rather than an act of landscaping. However, when plant materials are combined with other screening elements (walls, fences, berms, etc.) to enhance their

EXPENDITURE FORMULA

The 1/4 of 1 percent expenditure requirement is intended to establish a minimum amount of project landscaping expense that is to be devoted to planting native wildflowers or other natives. If the State chooses, they can expend more than this amount. The expenditure formula is to be applied only to the cost associated with the landscaping project. It does not include the total highway construction cost. However, all work performed in association with the landscaping action is to be included in the total landscaping expenses. This would include, but is not limited to, costs associated with development of the landscaping design plan, site preparation, irrigation systems, purchase of plant materials, planting activities and plant establishment periods.

WAIVERS

The FHWA may grant a waiver to the wildflower requirement only when the State certifies that:

1. Native wildflowers or seedlings cannot be grown satisfactorily; or
2. Regional native wildflowers or seedlings are not available commercially; or
3. There is a scarcity of available planting areas; or
4. The available planting areas will be used for agricultural purposes.

Waivers can only be considered on a project-by-project basis. The conditions on one project cannot automatically trigger a waiver on another, even when circumstances on one project are prevalent on another. Similarly, waivers cannot be based on geographic exclusions. That is, areas or regions of a State cannot be categorically exempted from wildflower planting.

Requests for waivers are to be forwarded to the FHWA Division Administrator for review and approval prior to the approval of the project's plans, specifications and estimate (PS&E). If the landscaping activities are being handled as a separate action, the waiver request should predate the PS&E approval for the landscaping project.

The States are to provide adequate information, justifying any waiver certification made concerning wildflower plantings. To simply state that wildflowers cannot be satisfactorily grown is not adequate to justify a waiver. There should be an identification of contributing factors that support this conclusion. Additionally, a waiver can be considered only on the basis of the three exemption criteria identified above. However, prior to issuing a waiver under criterion 2 or 3, clarification as to what shall be considered "planting areas" is needed. This is discussed in

E.40 – ROADSIDE SEEDING

Permanent and well established vegetation is a key component in roadside soil stabilization, erosion and dust control (surface runoff, wind and soil movement), sediment containment, beautification, and protection of wildlife habitat preservation, and valuable ground cover. It is the Department's policy and practice to promote sustainable vegetative growth and enhance native and other adaptable vegetation establishment, and management along roadsides. Revegetation or seeding of ITD property, in conjunction with the wise and discriminate reuse of excavated topsoil, should be incorporated into every applicable construction project, materials source reclamation, right of way encroachment, wetland mitigation or reclamation, and maintenance activities that disturb existing soils and/or vegetation on all properties under ITD jurisdiction.

The term, "seeding" as specified in this section, includes all seeding practices or "classes" and application methods to be used (i.e., soil preparation, fertilizing, mulching, mulch anchoring, and/or soil amendments) to obtain desirable and sustainable stands of vegetation on ground that has been disturbed by roadway construction. Seeding areas and practices should be carefully selected and may include site specific or sensitive areas for beautification or restoration improvements. Beautification resources are limited and these "Special Areas" have additional considerations (Subsection E.40.16, Special Areas) to consider when developing suitable seeding and planting alternatives and their related costs.

E.40.01 Seeding Design Procedures. Once the contours, terraces, minibenching, serrations, and major benches have been determined (if required) for the project and/or landscaping projects have been designated, the following seeding design procedures should be considered.

Select the seeding sites (foreslope, back slope, embankment, wetland, etc.); (most slopes are 6:1 in current reclamation plans) that require seeding considerations. When appropriate specify Special Areas (Subsection E.40.16) and Native Wildflower seeding sites (refer to the Wildflower Planting Requirement in Figure E-01).

Specify the *class for seeding* to be used by determining the amount of land to be disturbed and identifying seeding practices to be used (i.e., seed bed preparation, fertilizer, mulch, mulch anchoring, soil amendments, etc.) to obtain desirable and sustainable stands of vegetation on each site.

Designate the *season of seeding*. Site requirements should be determined by considering the "Mean Annual Precipitation" Map (Figure E-02), evaluating soil characteristics, regional climate, and local precipitation forecasts to determine the season for seeding.

Determine *fertilizer needs*. Determine if topsoil (overburden or excavated topsoil) consisting of the "plow layer" or "A horizon" on the plans will be reused and/or redistributed to areas within the project to be reseeded. Include the soil profile reports showing texture, fertility, soil components (macro-nutrients and micro-nutrients) and pH of the topsoil. Include Special Provisions for organic compost-based products and biological soil stimulants or amendments when needed.

Determine the *standard seed mix* including natives species to be seeded, for all disturbed areas including shoulder-foreslope mixes, and special use grasses, wetland, legumes and shrubs. Include requirements for any shrub and/or tree species that will be planted appropriate distances from the edge of pavement.

Determine need for *mulch, mulch anchoring, and erosion blankets*, as appropriate.

Include a *water plan* when establishment watering is necessary, or beautification plans are included in the project.

A further explanation regarding each seeding practice continues in the following subsections.

E.40.02 Seeding Site Selection. Seeding sites (foreslope, back slope, embankment, special areas, wetlands, etc.) shall be designated to enhance and assist with soil stability and erosion control along roadsides. Categories that will be used in the project shall be identified and specified.

E.40.03 Class of Seeding. The purpose of “class of seeding” is to designate the practices that will be used and to estimate the amount of land that will be involved for each seeding site within the project.

E.40.04 Season of Seeding.

Seedling survival and establishment are critical and careful consideration should be given to selecting the proper season during which seeding work is permitted to ensure successful results. Even if all other specifications are correct, if the timing of the seeding is incorrect, germination, establishment, and survival are likely to fail.

Although there is constant pressure to broaden the seasons which seeding work is permitted, the ideal time is usually a three to four week time period for sowing seed and should be specified when planning roadside seeding.

Site Type Determination

Site requirements should be determined by referring to the Mean Annual Precipitation (MAP) (Figure E-02), evaluating soil characteristics, regional climate, and local precipitation forecasts. Each roadside seeding project will usually fall under one of the following regions:

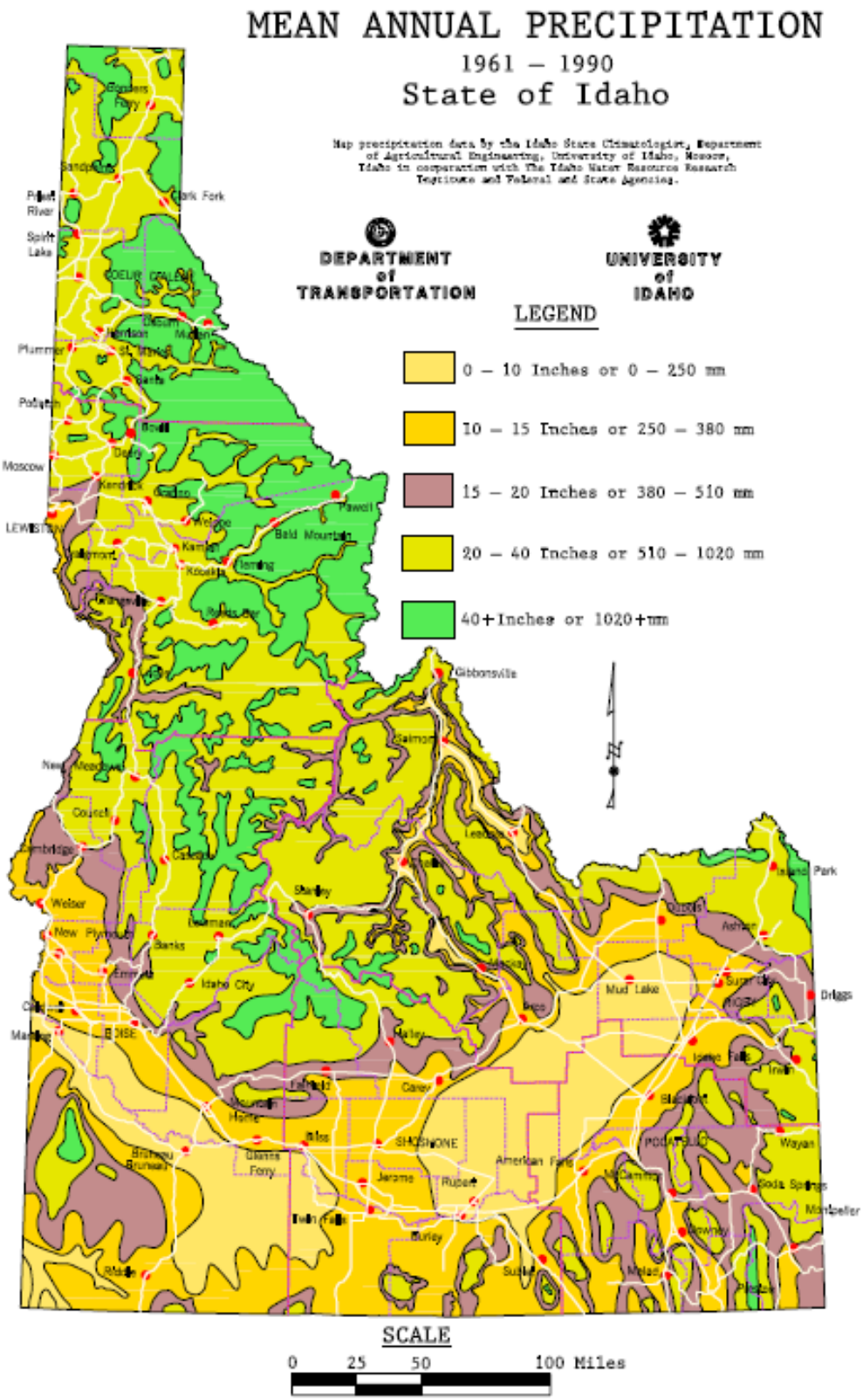
South Region: <10”, and 10 to 15 inches MAP

North Region: 15 to 20 inches, and >20 inches MAP

The terms "south" and "north" refer to the regions where the bulk of the seeding sites are located.

(“south region” or the “north region” precipitation range) Some judgment is necessary, particularly in regions that overlap or where the MAP of a project might fall between the two regions and requires educated decisions on which seed mix to use or whether to combine the seed mixes.

Figure E-02


MEAN ANNUAL PRECIPITATION
1961 – 1990
State of Idaho
Map precipitation data by the Idaho State Climatologist, Department of Agricultural Engineering, University of Idaho, Moscow, Idaho in cooperation with the Idaho Water Resources Research Institute and Federal and State Agencies.
DEPARTMENT of TRANSPORTATION
UNIVERSITY of IDAHO
LEGEND
0 – 10 Inches or 0 – 250 mm
10 – 15 Inches or 250 – 380 mm
15 – 20 Inches or 380 – 510 mm
20 – 40 Inches or 510 – 1020 mm
40+Inches or 1020+mm
SCALE
0 25 50 100 Miles

The region specified may also be used to determine the season of work as well as to select the seed mix. Dry-land roadside seedings, for Idaho regions can be categorized into three (3) seeding seasons (South-Fall, North-Fall, and North-Spring) as follows:

South Region Seeding Season

South Region Seeding Season	
MAP	**Fall Seeding Season**
<10”	Oct 1 to Nov 30
10”-15”	Oct 1 to Nov 15
North Region Seeding Season	
MAP	**Fall Seeding Season**
15”-20”	Sept 15 to Nov 30
>20”	Sept 15 to Nov 15
For sites with 15” or higher precipitation, where chances of early fall moisture are good, two possibilities can be used — seed early to take advantage of early fall moisture with time for establishment before freezing weather arrives; or delay with enough time to finish before bad weather begins to avoid losing newly germinated seedings.	
MAP	**Spring Seeding Season** *(Use primarily for completion of jobs already started.)*
15”-20”	Feb 15 to May 15
>20”	March 1 to May 30

Generally, the greatest risk of fall seeding is the seeding may be performed during a time when there is sufficient moisture for germination; however there may not be sufficient time for establishment before freezing temperatures set in. The new seedings is likely to die due to winter desiccation and frost heave. The greatest risk of seeding in the spring is the seeding may be completed too late in the season, even though there may be sufficient moisture for germination, there may not be sufficient time for plant establishment before dry, hot weather arrives. The new seedings are likely to die due to summer drought conditions.

For both fall and spring seeding, a minimum of 45 days growth is needed to assure seeding survival.

Be sure to allow sufficient time for work to be completed prior to the seeding begin date. Mulches, erosion blankets, mulch anchoring, benching, and an effort to maintain flatter slopes allows for better erosion control and makes it more feasible to plan fall seedings for most locations.

Seeding grass species only is generally performed in the fall or during seed dormancy, which is more successful in “south region”. For “north region”, successful seeding may be preformed either during the fall or in the spring. Seeding in the north regions may be completed the

following spring if it is impossible to finish the job in the fall, as planned. In the south region, if the seeding is not finished in the fall as planned, completion may be delayed until the following fall, unless establishment water can be used. In special situations, seeding may be performed outside the season of seeding when fall seeding would be difficult or impossible or temporary seeding is required for compliance with the Pollution and Storm Water requirements. Establishment watering may be required if seeding must be performed outside the normal or desired season of seeding.

E.40.05 Topsoil Application & Fertilizer Selection.

Topsoil Application

One consideration for determining whether fertilizers or other soil amendments are needed is to determine whether topsoil is to be used. Topsoil is that uppermost layer of soil capable of growing and supporting vegetation. Topsoil contains essential nutrients, organic matter and soil micro-organisms, and physical characteristics necessary for proper plant growth and establishment. The topsoil layer can vary from a depth of 3 inches to 24 inches or more, depending on the characteristics. If the pH level is above 7.8, the value of the material as topsoil is questionable. Native grass and shrub species that are not to be disturbed shall be identified and flagged prior to topsoil excavation or salvage operations. All large vegetative debris including trunks and stems of shrubs shall be stripped and removed from the topsoil prior to mass grading activities. **In most instances topsoil should be stockpiled and reused on the project to provide a better growing medium for new seedings.** Topsoil shall be placed in separate stockpiles or in composite stockpiles that shall not exceed 4 feet in height. Topsoil stockpiles should be stabilized for protection against wind and water erosion hazards and future reapplication during final grading activities. Stockpiles should be treated with soil binders or tackifiers in order to prevent erosion and minimize weak production. (Topsoil referred to in Section 213 should not to be confused with "select topsoil" as described under Subsection 711.09 for use in planting beds. Select topsoil specifications should be used as a guide in determining what good topsoil is.)

Topsoil is recommended on all disturbed sites and slopes 2:1 or flatter that will be permanently seeded, or an a planting medium for plantings or nursery stock. Topsoil may be added to a rock mulch to enhance slope protection and provide soil for seed germination and plant growth. Topsoil can be mixed with organic material such as compost or manufactured soil amendments to improve the growing capability of vegetation.

Generally, topsoil should not be used on slopes steeper than 2:1 or on sandy or silty slopes steeper than 3:1. Topsoil should not be placed on frozen, extremely wet, or smooth slopes.

When planning to reuse topsoil for roadside seeding, use the "best" soil obtained from the top few inches of soil surface within the construction area. Many areas to be seeded (especially cut slopes) are sterile and deficient in nutrients and micro-organisms because they are primarily obtained from subgrade soil. Most topsoil is better than any subgrade soil. Use the best material available.

For most applications, the desired topsoil depth is 6 inches. Unfortunately, there is usually a shortage of sufficient topsoil to cover all areas. Where quantities of topsoil are limited, it is more practical to redistribute available topsoil to site specific or critically disturbed areas to be the proper depth first, and then distribute any excess topsoil to other areas to be seeded if available. If necessary, the more favorable sites may be left without topsoil. Even 1-2 inches will aid considerably. However, for planning purposes, try to cover all exposed subsoils with available topsoil and make every effort to obtain the desired 6 inch coverage.

Medium-textured soils are preferred; however, this may be difficult to obtain in some areas. When reusing excavated topsoil, special care shall be given to exclude rocks and debris that interfere with seedbed preparation and seeding operations, as well as leaving the surface in a roughened condition before applying the topsoil to ensure it is not eroded away by wind or rain. The desired roughness shall be a series of horizontal serrations of 8 inches which shall cover the entire area where topsoil will be placed. Where embankments are constructed, offsetting lifts of material to create an uneven surface prior to topsoil placement should be considered. Smooth slopes are not acceptable.

Topsoil can be placed on benched slopes to assist in vegetation establishment. A thin layer of topsoil (1-2 inches) is especially valuable on rocky benches and particularly south-and west-facing exposure slopes, however, special care should be taken to not apply too much topsoil that the value of the benches is destroyed.

Fertilizer Selection Determination

Application of fertilizer ingredients on disturbed areas to be seeded is beneficial to new seedlings if the proper kinds and qualities of fertilizer are specified. Failure to apply necessary nutrients may result in poor vegetation establishment or complete failure of the seeding.

Organic-or compost-based products and/or biological soil stimulants or amendments that provide additional assistance or substitute for commercial fertilizer are now available and may be specified as special provisions. These products have proven to be very effective in establishing vegetation under adverse environmental conditions and can be hydro-applied in most instances. Seeding and organic or compost based products, biological soil stimulant, and/or tackifier(s) shall be applied in separate applications. Fertilizer, organic-based compost, biological soil stimulant and or tackiifier(s) shall not be mixed with the seed. The organic-or compost-based products can also replace mulching requirements.

Nitrogen needs or other soil components must be determined by taking a soil sample from the area(s) to be seeded and submitting the sample to an accredited laboratory for an accurate soil evaluation and determination of available nutrients or lack of nutrients critical for plan establishment. The following list illustrates an estimation of the nitrogen level needed as indicated from the available moisture:

This list is not to be used as the determining factor or in place of a soil analysis report.

Mean Annual Precipitation	<10 inches	7 lbs per acre
	10-15 inches	12 lbs per acre
	15-20 inches	18 lbs per acre
	>20 inches	20 lbs per acres

Some commercial fertilizers, especially nitrogen, leach out quite rapidly after application, so it is recommended that nitrogen fertilizer be specified as time, slow, or controlled release. The same nutrient requirements would apply.

After determining the moisture zone of the site(s) to be fertilized, consider additional factors that may affect moisture availability and fertilizer application:

- other sources of water (ground, surface, establishment water, natural springs etc.),
- soil type (sand, clay, silt, loam, etc.),
- quality and/or quantity of organic matter (high or low),

- slope aspect (south or north facing, etc.)
- other soil problems as indicated by the pH (soil test), the presence of indicator plants, sterile subsoils, or parent material (where top soil is not re-used).
- high salt, calcium or other mineral content
- type of vegetation seeded(Native Wild Flowers)

Soil tests shall be conducted from topsoil samples to determine nutrient levels and needs so fertilizer specifications can be based on those nutrient requirements and recommendations. Soil test results and nutrient requirements shall be included in the Materials Phase II report and used to make determinations for appropriate nutrient requirements. The General Soil Map for Idaho (Figure E-03) provides available soil data that may be used to help determine nutrient deficiencies as shown in the recommended nutrient list of the General Soil Legend (Figure E-04). The suggested nutrient quantities are provided in the General Soil Legend (Figure E-04) is in elemental form and should only be used as a guideline in determining appropriate nutrient requirements and should not substitute for soil analysis or test results. However, for ITD's planning and design work, always use the elemental quantities. Contact the Roadside Programs Administrator in headquarters Maintenance section for assistance in determining required nutrients.

E.40.06 Standard Seeding Mixes.

Seeding native dry-land grasses, forbs, and shrubs is the most effective and desirable revegetative practice; however, several years are usually required to meet satisfactory levels of vegetative growth and establishment, thus a combination of adaptable introduced species and native species shall be included in all seed mixes. Seeding shall commence after all seed bed construction requirements are completed. The preferred method of seeding shall be drill seeding for slopes 3:1 or flatter, either dry broadcast seeding or hydro-seeding methods for slopes 2.5:1 or steeper.

Each standard mix shall include a minimum of three native and introduced grass species, two legume species (including one native), and possibly two to five natives (forbs and/or shrub species) for each seeding project. The standard mixes shall be used for most situations. Legume and shrub species shall be specified for slopes and areas some distance away from the edge of pavement (or outside the mow zones.) Legume and/or shrub species may be omitted from the seed mix if it causes a maintenance or vegetation management problem, such as applying herbicide treatment to control invasive or noxious weed species. **Sometimes there are special situation, where natives, wild flowers or legumes are not included in the seed mix. Under these conditions, the "primary" grass species in each seed mix shall be increased by 2lb/A.** A cover crop or "nurse crop" may be included for situations requiring quick establishment, germination, green-up, or growth for erosion control and soil stability during vegetation establishment periods. The cover or nurse crop seed should be obtained from a local source and shall be certified under provisions as established by the Idaho Crop Improvement Association.

The Department shall furnish the seed mix for all projects, unless otherwise specified, and is not required to provide seed quality or certification documents. Seed rates shall be adjusted in the mixes supplied by the department to reflect "bulk seed" and should not specify Pure Live Seed (PLS) amounts. PLS has already been factored into the department's recommended seeding rates. The designer also has the option to require the contractor to furnish all or part of the

seed on construction projects where very little seed is required for projects where large quantities are required, or when the seed specified is not available through Headquarters' Supply Services. For Contractor-furnished seed, weed seed and inert matter content shall not exceed the minimum permitted by law and viability (TZ) test shall be no more than six months old. Contractors shall provide verification or letter of certification, original Association of Official Seed (AOSA) seed test results, and calculations of PLS content. Contractor shall also provide documentation of the seed source, vendor verification of the seed mix ordered including species, varieties, pounds of PLS to be delivered; and the estimated delivery date for all seed at least 30 days prior to the commencement of revegetation activities.

March, 2005

GENERAL SOIL MAP

IDAHO

APRIL 1973

10 0 10 20 30 40 Miles

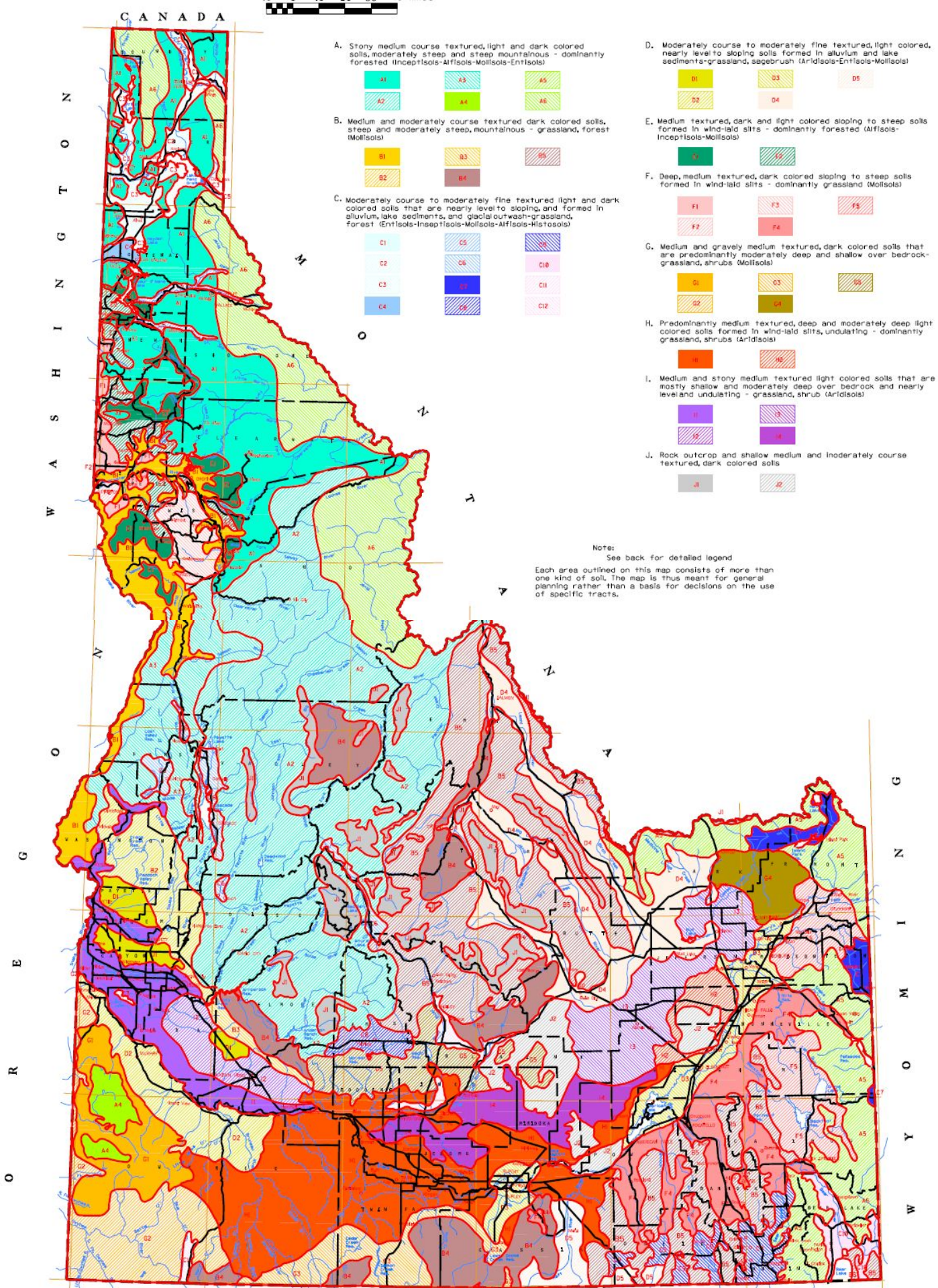


Figure E-04

GENERAL SOIL LEGEND		
N (nitrogen), **P** (phosphorous), **K** (Potassium), **S** (sulfur), **B** (boron), and **Zn** (Zinc).		
Legend Symbol	**pH Range**	**Recommended Nutrient**
A	4.5-7.0	N - based on available moisture P – 35 lb/A S – 10-15 lb/A B – 1-2 lb/A
B	6.0-7.5	N - based on available moisture P - 35 lb/A K - 35 lb/A S - 1-2 lb/A
C_1-C_7	5.0-7.6	N - based on available moisture P - 35 lb/A K – 40 lb/A S - 1-2 lb/A
C_8-C_{12}	6.5-8.5	N - based on available moisture P - 35 lb /A K - 35 lb /A S - 1-2 lb /A
D	6.5-8.0	N - based on available moisture P - 35 lb A Salt - can be excessive
E	4.5-7.0	N - based on available moisture P – 25 lb /A S - 1-2 lb/A B - 1-2 lb/A
F	7.0-8.0	N - based on available moisture P - 1-2 lb/A
G	6.5-8.5	N - based on available moisture P - 1-2 lb/A Salts - can be excessive
H	6.5-8.5	N - based on available moisture P - 1-2 lb/A Zn – 10 lb/A Salts - can be excessive
I	6.5-8.5	N - based on available moisture P - 1-2 lb/A Salts - can be excessive
J	6.0-8.5	Very Little Soil - primarily rock

Symbols for vegetation identification were taken from: USDA and NRCS. "Plant's Database ," 2003.

South Region (0" – 10" precip.)	**Lbs. Bulk Seed Per Acre**
PrimaryGrasses "Covar" Sheep Fescue (FEOVO) Thickspike W.G. (ELMA7) Sandberg Bluegrass (POSE) Bottlebrush Squirreltail (SIHY)	 4 6 2 8
Optional (Alternative Grasses) "Ephraim" Crested W.G. (AGCR) Siberian W.G. (AGFR) Basin Wildrye (LECI4) Streambank W.G. (ELLA3) Idaho Fescue (FEID) Indian Ricegrass (ORHY)	 5 5 8 6 6 6
Legume Ranger Alfalfa (MESA) SilkyLupin (LUSE)	 1 2
Cover Crop(Optional) Spring Wheat, Barley or Oats Hairy Milkvetch Triticale	2 2 3
Natives To be determined	 1-5
TOTALS	33-37

South Region (10" – 15" precip.)	**Lbs. Bulk Seed Per Acre**
Primary Grasses	
"Sodar" Streambank W.G. (ELLAL)	6
Intermediate W.G. (THIN6)	6
Hard Fescue (FETR3)	8
Sandberg Bluegrass (POSE)	2
Bottlebrush Squirreltail (SIHY)	8
Optional (Alternative) Grasses	
Streambank W.G. (ELLA3)	6
Thickspike W.G. (ELLA7)	6
Western W.G. (PASM)	9
Bluebunch W.G. (PSSPS)	6
Slender W.G.(ELTR7)	5
Mountain Brome (BRMA4)	8
Basin Wildrye (LECI4)	8
Blue Wildrye (ELGL)	8
Idaho Fescue (FEID)	6
Legumes	
Ladak Alfalfa (MESAL)	1
Silky Lupine (LUSE)	2
Cover Crop (Optional)	
Spring Wheat, Barley or Oats	4
Hairy Milkvetch	2
Tritical	3
Natives	
To be determined	1-5
TOTALS	33-37

North Region (15”-20” precip)	**Lbs Bulk Seed Per Acre**
Primary Grasses	
"Durar" Hard Fescue (FEOVD)	7
Intermediate W.G. (THIN6)	7
Canada Bluegrass (POCO)	2
Bluebunch W.G. (PSSPS)	8
Idaho Fescue (FEID)	6
Option (Alternative Grasses	
Thickspike W.G. (ELMA7)	6
Streambank W.G. (ELLA3)	6
Slender W.G. (ELTR7)	5
Smooth Brome (BRIN)	6
Columbia Brome (BRVU)	6
Basin Wildrye (LECI4)	8
Blue Wildrye (ELGL)	8
Tall Fescue (FEAR)	6
Western Needlegrass (ACOC3)	3
Prairie Junegrass (KOCI)	2
Legumes	
Ladak Alfalfa (MESAL)	1
White Dutch Clover (TRRE)	1
Silky Lupine (LUSE)	2
Cover Crop	
Spring Wheat, Barley or Oats	1
Hairy Milkvetch	2
Triticale	3
Natives	
To be determined	1-5
TOTALS	38-42

North Region (20+" precip)	**Lbs Bulk Seed Per Acre**
Primary Grasses	
"Durar" Hard Fescue (FEOVD)	7
"Fortress" Red Fescue (FERUR)	7
Canada Bluegrass (POCO)	2
Bluebunch Wheatgrass (PSSPS)	8
Idaho Fescue (FEID)	6
Optional (Alternative) Grasses	
Pinegrass (CARU)	2
Tufted Hairgrass (DECA)	2
Streambank W.G. (ELLA3)	6
Slender W.G. (ELTR7)	5
Blue Wildrye (ELGL)	8
Tall Fescue (FEAR)	6
Legume	
White Dutch Clover (TRRE)	1
Silky Lupine (LUSE)	2
Cover Crop (Optional)	
Spring Wheat, Barley or Oats	1
Hairy Milkvetch	2
Natives	
To be determined	1-5
TOTALS	37-41

E.40.07 Native Seed List The rates per acre for pure wildflower seeding are not specified and will need to be determined on a case-by-case basis. As shown on the Native Seed Lists, the wildflower seeds consist of native and adaptable species suitable for roadside revegetation and landscaping practices and are classed as very small (VS), small (S), medium (M), and large (L) sizes. Additionally, annual wildflower seeds should not make up more than 25% of the total wildflower mix.

Native wildflower seed vary in size, characteristics, reproductive and germination ability and therefore seed rates will vary and should be determined on a case-by-case basis. When wildflower varieties are combined a pro rata calculation would be required to provide approximately 70 to 80 seeds cu. ft. Adjustment of rates may also be needed when methods

other than drill seeding are used. Contact the Roadside Programs Administrator in Headquarters Maintenance Section for assistance.

NATIVE SEED LIST		
* VS = Very Small; S = Small; M = Medium; L = Large		
South Region	**Seed Size***	**Seed**
Perennial Wildflowers	S	Palmer Penstemon (PEPA)
	S	Western Yarrow (ACMIL)
	S	Eaton Penstemon (PEEA)
	M	Small Burnet (SAMI)
	S	Globe Mallow (SPMU)
	S	Purple Prairie Clover
	M	Lewis Flax (LILE)
	M	Arrowleaf Balsamroot (BASA)
	S	Yellow Buckwheat (ERFL4)
	S	Sulfurflower Buckwhear (EFUM)
	S	Western Goundsel (SEIN2)
	L	Louisiana Sagewort (ARLUM2)
	S	Silvery Lupine (LUAR3)
Annual Wildflowers	S	Farewell to Spring (CLARK)
	M	California Poppy (ESCA)
	S	Blazing Star (MELA2)
Shrubs	VS	Basin Big Sage (ARTRT)
	VS	Wyoming Big Sage (ARTRW)
	VS	Wyoming Big Sage (ARTRV)
	S	Purple Sage (SADO4)
	L	Curleaf Mtn. Mahogany (CELEL)
	L	Fourwing Saltbrush (ATCA)
	L	Shadscale (ATCO)
	S	Yellow Rabbitbrush (CHRY8)
	S	Rubber Rabbitbrush (ERNA10)
	S	Ceanothus (CEVE)
	M	Winterfat (CELAL)
	S	Antelope Bitterbrush (PUTR)
Trees	M	Rocky Mtn. Juniper (JUSC)
	L	Ponderosa Pine (PIPO)

	M M M	American Plum (PRAM) Siberian Pea Tree (CAAR) Lodgepole Pine (LUPAS)

North Region	Seed Size*	Seed
Perennial Wildflowers	S S S M S M M M S S L S S S	Rocky Mtn. Penstemon (PEST) Lance-Leaved Coreopsis (COLAZ) Alpine Penstemon (PEVE2) Blueleaf Aster (ASGL) Showey Goldeneye (VIMUM) Blanketflower (GAAR) Sticky Purple Geranium (GEVI) Arrowleaf Balsamroot (BASA) Silky Lupine (LUSE4) Yellow Buckwheat (ERFL4) Sulfurflower Buckwheat (ERUM) Fernleaf Biscuitroot (LODI) Canada Goldenrod (SOCA6) Gray Aster (EUGL19)
Annual Wildflowers	S M M	Plains Coreopsis (COTI2) Corn Poppy (PARH) Blanketflower (GAPU)
Shrubs	M M L L S L S S S L M M S	Dogwood (COSTS) Rodosier Dogwood (COSES) Chokecherry (PRVIM) True Mahogany (CEMON) Blueberry Elder (SACE) Rocky Mtn. Maple (ACGLG) Kinikinik (ARUV) Oregon Grape (MARE) Snowberry (SYAL) Wood Rode (ROSE sp.) Mtn. Ash (SOSCS) Shiny-leaf Spirea (SPBE) Syringa (Mock Orange) (PHILA)
Trees	S M M M M S M L	Willow (SALIX sp.) Hawthorn (CRDO2) Red Alder (ALRUS) Water Birch (BEOC2) Dwarf Birch (BENA) Lodgepole Pine (PICO) Grand Fir (ABGR) Douglas Fir (PSMEM)

E.40.08 Shoulder-Foreslope Mixes. Most projects require two seed mixes; one seed mix for the shoulder (mow zone) and the foreslope area (usually up to 20 feet from the edge of pavement); and another seed mix for all other areas to be seeded including slopes. Shoulder-foreslope mix shall normally be the two most suitable grasses from the appropriate "shoulder-foreslope grass" list. Usually this will be the foreslope area to near ditch bottom. No legumes or natives are to be included in these shoulder-foreslope mixes.

Shoulder-Foreslope Grasses	
Grass	**Precipitation Range**
Red Fescue (FERUR)	>20”
Hard Fescue (FEOVD)	12”+
Sheep Fescue (FEOVO)	10”+
Idaho Fescue (FEID)	10”+
Canada Bluegrass (POCO)	15”-20”
Sandberg Bluegrass (POSE)	8”+
Bottlebrush Squirreltail (SIHY)	6”-16”
Western Wheat Grass (PASM)	10”-15”
Thickspike Wheatgrass (ELMA7)	8”-20”
Intermediate Wheatgrass (THIN6)	14”+
Streambank Wheatgrass (ELLA3)	10”-25”
Bluebunch Wheatgrass (PSSPS)	10”+
Slender Wheatgrass (ELTR7)	12”+
Sand Dropseed (SPCR)	<8”
Inland Saltgrass (DISP)	5”+

E.40.09 Special Use Grasses and Legumes. If the sites to be seeded fall between regions or precipitation zones; or special conditions exist such as alkali, sand, or drought conditions, contact the Roadside Programs Administrator in Headquarters Maintenance Section for assistance in the use of "Special Use Grasses and Legumes" and combining mixes.

*Special Use Grasses and Legumes	
Alkali or Salt Tolerant "Alkar" Tall Wheatgrass (AGEL3) Alkali Sacaton (SPAIA) "Lemons" Alkaligrass (PULE) Inland Saltgrass (DISP) Fourwing Saltbush (ALCA2)	**Other** Small Burnett (SAMI) "Fults" Alkaligrass (PUDI) "Whitmar" Beardgrass W.G. (AGSPI) "Alta" Tall Fescue (FEAR3) "Secar" Bluebunch W.G. (AGSP3) "Paiute" Orchard Grass (DAGL) **High pH** Tufted Hairgrass (DECA)
Rocky or Steep Slopes Bluebunch W.G. (PSSPS) Idaho Fescue (FEID) Canby Bluegrass (POCA) Thurber's Needlegrass (ACTH7)	
Sand or Silty Soils "Volga" Mammoth Wildrye (ELGI) Indian Ricegrass (ORHYH) Sand Dropseed (SPCR) Thickspike W.G. (ELMA7) Basin Wildrye (LECI4) Prairie Junegrass (KOCI) Needle & Thread (HEOC26)	
*Seeding rates on these special use species to be determined according to conditions on each project where they may be needed.	

E.40.10 Mulch – Mulch Anchoring – Erosion Blankets. Obtaining a good stand of vegetation may require the use of mulch, mulch mixtures, soil amendments or an erosion blanket on disturbed areas in order to protect and enhance the establishment of permanent vegetation.

Mulch, mulch mixtures, soil amendments or erosion blankets are essentially applied and used:

1. to protect the seed and seedlings, from harsh weather conditions, variable temperatures and wildlife

to conserve and retain moisture,

to reduce and control erosion, surface run-off, and

to provide additional nutrients and organic materials.

The designer has several primary questions to address when planning for mulch.

- What areas should be mulched and with what?
- What areas should receive erosion blankets and what?
- How should the mulch be anchored?
- Will it need to be removed?

E.40.11 Mulch For seeding purposes, the decision on whether to use mulch, mulch mixtures, and/or soil amendments must be take into consideration along with the conditions such as amount of soil texture, slope, aspect, annual moisture or the potential for erosion or surface run-off. The site or soil variation may not always be reasonably isolated for different applications of mulch products; however, consideration of these factors may assist in making appropriate decisions as to various methods and mulches available.

In general, mulch or compost products should be applied to slopes 3:1 or flatter; while mulch, mulch mixtures, compost, soil amendments or an erosion blanket or a combination of these should be applied to slopes 3:1 or steeper.

There are numerous types of mulch products that are being promoted and used for mulching and mulch anchoring. A brief and general description of mulches that may be used follows:

Mulch Alternative. Gravel or crushed rock mulch with aggregate diameters from ½ inch to 2 inches applied to a depth of 2" does a good job of conserving moisture and may be used where risk of erosion is high either due to wind or storm water runoff. Unwashed material is acceptable and enhances vegetation establishment. ***Seed should be applied after the gravel is in place instead of before.***

Noxious weed free Grass hay or grain straw is sometimes desirable for slopes 3:1 or flatter and generally anchored by mechanically crimping the material to the soil surface. Grass hay or straw is not as effective as compost or other organic mulches which maybe cost prohibited. If conditions warrant it, a combination of crimping and tackifers may be used to anchor the mulch. If grass hay or straw is applied on slopes 3:1 or steeper, the mulch shall be anchored with a tackifier or a jute matting or comparable material. Both grass hay and straw provide nutrients to the soil as they break down, usually within two to three years.

Organic- or Compost-based products are very effective and should be to be considered on projects where the application can be accomplished without disturbing or damaging the seedbed preparation. Application methods include spinner trucks, manure spreaders, blowers, and hydro applicators. The advantage to using compost, which maybe derived from almost any organic matter, is that compost retains and conserves moisture, increases the temperature of the soil, promotes desirable soil micro-organisms, provides additional slow release minerals and nutrients, as well as provides erosion control at higher rates. The primary concern is the availability of compost and transport of the product to the site. New seed-meal/organic-based compost products are now available that can be hydro-applied at rates comparable to wood fiber mulch, rates.

Wood fiber, organic or natural fiber, or recycled paper (newsprint or cardboard) in many cases is convenient and the preferred mulch and is generally mixed in water slurry and applied with a hydro applicator. . These products and methods of application can place wood fibers, organic fiber, or recycled paper in either a mulch or erosion blanket classification and can be used effectively for erosion control. Wood fiber, organic fiber, or recycled paper in most instances can be applied on slopes 3:1 or steeper and should generally be the mulch of choice when other equipment cannot be transported into the areas to be seeded or mulched. This water slurry method of application also applies to seeding and fertilizing. In almost all instances tackifiers or soil binders should be used to anchor the mulch. Tackifiers or soil binders may be applied separately over the mulch or may be combined with the mulch in a thick slurry application and then applied to the site.

Under no circumstances should fertilizer or seed be applied in combination with wood fiber or cellulose mulch.

Mulch mixtures may also be used and generally consist of mulch or compost, soil amendments, soil biological stimulants, soil micro-organism inoculants, bonding fibers, tackfiers, natural plant materials or nutrients and/or combinations, which are usually specified as a complete package. The mulch mixture is usually combined into water slurry and applied with a hydro applicator in one application.

Wood chips or shredded bark, or wood bi-products are the least desirable mulches for several reasons, but can be used if the need arises. One of the primary concerns is that wood chips or shredded bark, or wood bi-products can tie up available nutrients or minerials in the soils or use nitrogen that should be readily available to the vegetation thus slowing or reducing germination and establishment. Wood chips or shredded bark are good landscaping mulches, are cheap, and more plentiful in some areas; but difficulty in hauling and applying it to construction sites is a major draw back.

E.40.12 Mulch Anchoring. There are generally two types of anchoring methods used to hold the mulch in place and bind it to the soil surface. This is done to reduce movement and displacement of the mulch.

Mechanical Anchoring is accomplished by using a crimper disc or other mechanical devise to incorporate grass hay or straw into the soil. Mechanical anchoring should be used on slopes 3:1 or flatter and shall be performed only along cross slopes only in order to create small furrows. Mechanical anchoring using a crimper disc may be performed on slopes 2:1 or flatter using appropriate equipment. On slopes 3:1 or steeper cat walking or yo-yo crimping are the preferred methods of mechanically anchoring grass hay or straw.

Tackifier is used to bind the fibers in various mulches together to prevent loss of mulch due to wind or storm water runoff. This procedure must allow for the penetration and retention of moisture, cannot interfere with or be harmful (toxic) to plant or animal life, and be non-staining to concrete or painted surfaces. On critical erosion prone areas, mechanical anchoring and tackifier may be used in combination with each other. In this case, the tackifier is applied as an overspray after the mulch has been mechanically anchored.

E.40.13 Erosion Blankets. Erosion Blankets may be applies as a solid or in liquid applied form and should be used on slopes 2:1 or steeper and especially in areas where highly erodible soils are present. Other critical areas may be water ways, wetlands or areas where blow sand is present on slopes 3:1 or steeper.

There are many different types of erosion blankets on the market. The following is a brief description of some types of erosion blanket and their use.

Straw and/or Coir(coconut) Blankets are generally in solid form and in some cases straw/coconut blankets do an excellent job of conserving moisture and controlling erosion. However, heavy or thick straw blankets may not be effective in helping establish satisfactory stands of vegetation.

Jute Matting or Jute Mesh or Burlap is a solid blanket made from natural fibers and primarily used in areas or situations where there is a need to anchor or hold down a grass hay or straw mulch and can be used on very steep slopes or embankments. The jute matting is often used in place of a tackifier on sites where a tackifier may not be enough to anchor or hold the mulch. Jute matting conforms to the soil surface and does not “tent up” like other rigid netting and can be left in place and seeded over.

Excelsior (wood fiber) Blankets are generally in solid form and performs better as an erosion control under high-intensity rain storm events or winds, but is not as effective as straw and/or coir blankets for establishing vegetation. Excelsior has a tendency to wick the moisture out of the soil, and may tent up or not adhere to the ground.

Hydro Blankets are made from natural and/or synthetic materials and come in many forms and packages including Bonded Fiber Matrix, wood fiber mulch, compost and/or combinations of materials that are sprayed on and adhere to the soil surface. Mixtures are nontoxic to animals, mico-organisms, aquatic plant and animals, and generally do not impede seed germination or establishment. However, some liquid blanket products can create impervious surfaces that can increase the amount and velocity of surface water runoff.

E.40.14 Establishment Water.

Establishment water may be used to supplement normal precipitation and enhance establishment for seeding dryland grasses on roadways. It has proven to be a valuable technique; but is not a remedy for all seeding problems and the watering systems remain very costly. However, this method of stand establishment "insurance" can be a cheaper in the long term and more successful in combating weed problems and promoting desired establishment than even reseeding. Good seeding practices should not be altered or shorted, nor should seeding seasons be improperly stretched beyond the recommended duration even where water is available.

The decision to use water should be based on careful analysis of all the conditions. Probability of adequate precipitation is a key factor in considering water application. The publication *Probability of Selected Precipitation Amounts in the Western Region of the United States* is the best guide for determining desired suitable and practical dates for applications and frequency and quantity of water available for any location under consideration as well as the nearest comparable local weather reports for sites in the vicinity under consideration as well as the nearest comparable local weather reports..

Reasons for considering adding extra water include:

1. Soil or site problems indicating seeding difficulty (blow sand or coarse droughty dry material, hardpan soils, south and west facing slopes aspects, or additional site factors);

Low or expected low MAP precipitation regions approaching the 10 inches level or less annual precipitation level or a probable seasonal low including long term droughts. (In these areas seedings are expected to fail unless above-normal moisture is received during the establishment period or establishment water is applied);

Conditions requiring the stretching of the normal seeding season beyond the recommended duration; and

Beautification requirements or the need for rapid growth. Rapid vegetation establishment may be required to reduce erosion and sediment loss and increase vegetative quality, thicker, healthier stand is desired. Some species used for beautification require establishment water in certain locations.

Should one or more of the above conditions exist, determine whether there is an adequate source of quality water available during the period needed and determine delivery feasibility and probable costs.

The most feasible and lowest cost method of delivering water to the area should be determined. Water may be applied by either a sprinkler system or water trucks or a combination of both.

The application period should be planned to supplement existing precipitation levels expected during normal seeding seasons. To be of greatest benefit and to extend the establishment seasons, water should be scheduled just before early fall rains or just after late spring rains. Consider climate, weed, germination and competition, species seeded and construction needs to determine whether to use spring or fall application.

Each water application provided for in the watering schedule should usually be an application of 1Ac. Unit/Acre. The following watering schedule will give the seeding 6 acre unit applications of water and should be adjusted for local conditions. For example, water applications for a water schedule beginning on or after August 15th would be as follows:

- 1st application — ¬1 Ac. Unit/Acre — 4-day interval
- 2nd application — 1 Ac. Unit/Acre — 6-day interval
- 3rd application — 1 Ac. Unit/Acre — 8-day interval
- 4th application — 1 Ac. Unit/Acre — 10-day interval
- 5th application — 1 Ac. Unit/Acre
- Additional applications applied as directed.

E.40.15 Preparing an Establishment Water Plan. The plan can be simple or detailed, depending on the needs and site condition. The plan generally will include:

A Layout Map that contains:

- Source of water.
- Areas to be watered by sprinkler including acreage and volume of water required.
- Areas to be watered by trucks including acreage and volume of water required.
- Proposed layouts for sprinkler lines.
- Proposed layouts for haul roads.
- Pump locations.
- Dimensions of areas to be watered.

The Written Explanation may include:

- Estimated length and size of mainline.
- Estimated length and size of laterals.

- Estimated number and horsepower of pumps to be used.
- Estimated number of and pressure required for each sprinkler heads.
- Spacing of heads, diameter of circle, and overlap required. (Normally, the water plan is based on a 50% of diameter overlap on the full and half-circle impact heads. Except in very unusual circumstances, impact heads should be the only type considered for use even though this may leave certain odd areas to be watered by truck.)
- Other (sump facilities, valves, etc.)

A detailed design is not needed in most cases; however, plans and specifications shall provide sufficient information for the general layout and provide quantities satisfactory for bidding purposes. For assistance, call the headquarters Maintenance section.

E.40.16 Special Areas. Where there is a desire for beautification, but resources are limited, the following guidelines should be used to assist in developing suitable seeding and planting alternatives and their related costs. The use of these guidelines provides a "safe" level and with some flexibility, either up or down, should desires change in future years.

Generally, there are only two alternatives for quality turf development:

- Standard dry-land seed mix which may not be very successful and/or result in a poor-quality turf with related undesirable weeds, or
- Turf seed or sod with complete irrigation system provides good quality turf but is costly to establish and requires a high degree of maintenance.

The following alternatives, if understood and used properly, will satisfy most needs, as well as construction, and maintenance resources. The alternatives are listed in the order of decreasing cost.

- High-Level Maintenance

High-level normally involves the seeding of a good lawn grass species (usually a combination of bluegrass and perennial rye mix or 100% perennial rye); installation of a complete, and permanent irrigation system (with irrigation interval at one to two weeks); very frequent mowing (one- to two-week intervals); and planting suitable shrubs, ground cover and trees as desired. This level provides the designer the greatest flexibility in formal planning and choice of planting materials; however, construction costs are much higher and maintenance costs remain high with little flexibility over the years.

- Medium-Level Maintenance

Medium-level is based on the seeding of appropriate primary grass species; installation of a permanent, irrigation system for minimal waterings (irrigation intervals set at two weeks to one month); and

planting less frequent mowing (two-week to one-month intervals) and planting native dry-land shrubs and trees as desired. This level provides the widest range of flexibility in maintenance costs.

A wider selection of shrubs and/or trees is permitted and mowing requirements would be related to irrigation. Should the irrigation water become unavailable, the turf will not be completely lost, but will survive and respond when water becomes available again. Should over-irrigation of the primary grass turf occur more often than two-week intervals, bluegrass would be expected to invade.

- Low-Level Maintenance

Low-level is based on the seeding of appropriate primary grass species as described earlier, along with the optional use of adequate amounts and combinations of establishment water, some or minimal mowing, and planting native (dry-land) shrub, tree seedlings, container plants. Low-level with no establishment water may consider broadcast seeding or a combination of drill seeding and broadcast seeding.

Summary of Relative Cost Estimates		
Beautification Level	**No. Yrs. for Mtce. Costs Equal to Constr. Costs**	**Yearly Mtce. Costs/ $100,000 Constr. Costs**
High	6-10	$10,000-$17,000
Medium	10-15	$7,000-$10,000
Low	20-35	$3,000-$5,000

The district should determine the level of turf quality that is appropriate for the area and that can be adequately maintained. Thorough discussions with the city, county or other agency personnel who may have the maintenance responsibilities are required so they will fully understand the alternatives and agree to the proposal.

Careful seedbed preparation and proper sowing techniques of desirable seed techniques of desirable and will greatly improve results. Fertilizer should be specified at seeding time for high medium and low (with water) levels as needed. Low-level (without water) should be fertilized the year following establishment.

The use of establishment irrigation water wherever feasible is very desirable to obtain a thicker turf in a much shorter time frame. A variation that might be used on the two lower levels is installation of a partial or drip irrigation system providing water to certain selected shrubs or trees to allow a wider choice of shrubs and/or trees and yet leave the larger turf area in the lower cost level. Native shrub seed may be necessary to achieve desirable results (particularly on the steep slopes), may be seeded two or three years later by planting native shrub and tree seedlings to supplement the direct seeding.

If mowing is necessary or planned, then, no shrubs should be included in the plan, or mowing should be limited to a specific area or part of the area.

Supplemetal seeding of irrigated areas. Three primary grasses including "Sodar" wheatgrass, "Durar" hard fescue, and/or “Covar” sheeps fescue may be supplemented or specified when planted on the appropriate sites (as shown in the seeding guide) when including irrigation provide additional levels of turf quality. They respond to irrigation water and provide a more dense cover as the amount of desired water is increased. Care should be taken to not over-irrigate, since over-irrigation will cause bluegrass to invade the Sodar and Fescue seedings. The bulk seeding rates for primary grasses at all levels are:

- "Sodar" Wheatgrass (AGRI) 30 lbs. /Ac.
- "Durar" Hard Fescue (FEOVD) 20lbs. /Ac.
- (It is desirable to include of White Dutch Clover at a rate 1 lb./Ac. with the "Durar.")
- “Covar” Sheep Fescue (FEOVO) 20 lbs. /Ac.
- Natives 3 lbs. /Ac.