APPENDIX A
Best Management Practices

INTRODUCTION

Best Management Practices are the primary mechanism to enable the achievement of water quality standards (Environmental Protection Agency 1987). This Appendix: 1) describes the Forest Service's BMP process in detail; 2) lists the key Soil and Water Conservation Practices (SWCP) that have been selected to be used in the Gallatin; and 3) describes each SWCP that will be refined for site-specific conditions in order to arrive at the project level BMPs that protect beneficial uses and meet water quality objectives.

BMPs include, but are not limited to, structural and nonstructural controls, operations, and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters (40 CFR 130.2, EPA Water Quality Standards Regulation). Usually BMPs are applied as a system of practices rather than a single practice. BMPs are selected on the basis of site-specific conditions that reflect natural background conditions and political, social, economic, and technical feasibility.

The Gallatin National Forest Plan states that "Soil and water conservation practices as outlined in the Soil and Water Conservation Practices Handbook (FSH 2509.22, May 1988) will be incorporated into all land use and project plans as a principal mechanism for controlling non-point pollution sources; meeting soil and water quality goals; and to protect beneficial uses. Activities found not in compliance with the soil and water conservation practices or State standards will be brought into compliance, modified, or stopped." (FP, p. II-23). Montana State Water Quality Standards require the use of Reasonable Land, Soil, and Water Conservation Practices (analogous to BMPs) as the controlling mechanism for non-point pollution. Use of BMPs is also required in the MOU between the Forest Service and the State of Montana as part of our responsibility as the Designated Water Quality Management Agency on National Forest System (NFS) lands.

The Practices described herein are tiered to the practices in FSH 2509.22 and include the Montana Forestry BMP's which were updated by Montana DNRC in 2004 and used in the Montana Forestry BMP audit process. They were developed as part of the NEPA process, with interdisciplinary involvement, and meet Forest and State water quality objectives.

BMP IMPLEMENTATION PROCESS

In cooperation with the State of Montana, the USDA Forest Service's primary strategy for the control of non-point sources is based on the implementation of preventive practices (BMPs) determined necessary for the protection of the identified beneficial uses.

The Forest Service Non-point Source Management System consists of:

1. BMP selection and design based on site-specific conditions; technical, economic and institutional feasibility; and the designated beneficial uses of the streams.
2. BMP Application.
3. BMP monitoring to ensure that they are being implemented and are effective in protecting designated beneficial uses.
4. Evaluation of BMP monitoring results.
5. Feeding back the results into current/future activities and BMP design.

The District Ranger is responsible for ensuring that this BMP feedback loop is implemented on all projects.

A. ***BMP Selection and Design***. Water quality goals are identified in Forest Plans. These goals meet or exceed applicable legal requirements, including State water quality regulations, the Clean Water Act, and the National Forest Management Act. Environmental assessments for projects are tiered to Forest Plans, using the NEPA process. Appropriate BMPs are selected for each project by an interdisciplinary team.

BMP selection and design are dictated by water quality objectives, soils, topography, geology, vegetation, and climate. Environmental impacts and water quality protection options are evaluated and alternative mixes of practices are considered. A final collection of practices are selected that not only protect water quality but meet other resource needs. These final selected practices constitute the BMPs.

B. ***BMP Application*****.** The BMPs are translated into contract clauses, special use permit requirements, project plan specifications, and so forth. This ensures that the operator or person responsible for applying the BMP actually is required to apply it. The site-specific BMP prescriptions are taken from plan-to-ground by a combination of project layout and resource specialists (hydrology, fisheries, soil, geology, etc.). This is when final adjustments to fit the BMP prescriptions to the site are made before implementing the resource activity.

C. ***BMP Monitoring***. During project activities (ex., timber harvest or road construction), timber sale administrators, engineering representatives, resource specialists, and others ensure that the BMPs are implemented according to plan. BMP implementation monitoring is done before, during, and after resource activity implementation. This monitoring answers the question: Did we do what we said we were going to do? Once BMPs have been implemented, further monitoring is done to evaluate if BMPs are effective in meeting management objectives and protecting beneficial uses of water. State water quality standards, including the beneficial uses, will serve as one evaluation of the criteria for the sale.

D. ***BMP Monitoring Evaluation***. The technical evaluation/monitoring described above will determine how effectively BMPs protect and/or improve water quality. Water quality standards and conditions of the beneficial uses of water will serve as one-evaluation criteria. If the evaluation indicates that water quality standards are not being met and/or beneficial uses are not being protected, corrective action will consider the following three components:

1. The BMP: Is it technically sound, properly designed, and effective? Is it really best, or is there a better practice, which is technically sound and feasible to implement?
2. The implementation program or processes: Was the BMP applied entirely as designed? Was it only partially implemented? Was it properly designed? Were personnel, equipment, funds, or experience lacking with a result of inadequate or incomplete implementation?
3. The water quality criteria: Do the parameters and criteria used for effects evaluation adequately reflect human induced changes to water quality and beneficial uses?

E. ***Feedback***. Feedback of the results of BMP evaluation is both short- and long-term in nature. Where corrective action is needed, immediate response will be undertaken. This action may include: modification of the BMP, modification of the activity, or ceasing the activity. Cumulative effects over the long-term may also lead to the need for possible corrective actions.

I DEFINITIONS

1**."Hazardous or toxic material"** means substances which by their nature are dangerous to handle or dispose of, or a potential environmental contaminant, and includes petroleum products, pesticides, herbicides, chemicals, and biological wastes.

2."Stream," as defined in 77-5-302(7), MCA, means a natural watercourse of perceptible extent that has a generally sandy or rocky bottom or definite banks and that confines and conducts continuously or intermittently flowing water.

3. **"Streamside Management Zone (SMZ)"** or "zone" as defined at 77-5-302(8), MCA means "the stream, lake, or other body of water and an adjacent area of varying width where management practices that might affect wildlife habitat or water quality, fish, or other aquatic resources need to be modified." The streamside management zone encompasses a strip at least 50 feet wide on each side of a stream, lake, or other body of water, measured from the ordinary high water mark, and extends beyond the high water mark to include wetlands and areas that provide additional protection in zones with steep slopes or erosive soils.

4. **"Wetlands"** mean those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include marshes, swamps, bogs, and similar areas.

5. **"Adjacent wetlands"** are wetlands within or adjoining the SMZ boundary. They are regulated under the SMZ law.

6. **"Isolated wetlands"** lie within the area of operation, outside of the SMZ boundary, and are not regulated under the SMZ law.

II STREAMSIDE MANAGEMENT

The Streamside Management Law (77-5-301 through 307 MCA) provides minimum regulatory standards for forest practices in streamside management zones (SMZ). The "Montana Guide to the Streamside Management Zone & Rules" is an excellent information source describing management opportunities and limitations within SMZs.

III ROADS

A. Planning and Location

1. Minimize the number of roads constructed in a watershed through comprehensive road planning, recognizing intermingled ownership and foreseeable future uses. Use existing roads, unless use of such roads would cause or aggravate an erosion problem.

2. Review available information and consult with professionals as necessary to help identify erodible soils and unstable areas, and to locate appropriate road surface materials.

3. Fit the road to the topography by locating roads on natural benches and following natural contours. Avoid long, steep road grades and narrow canyons.

4. Locate roads on stable geology, including well-drained soils and rock formations that tend to dip into the slope. Avoid slumps and slide-prone areas characterized by steep slopes, highly weathered bedrock, clay beds, concave slopes, hummocky

topography, and rock layers that dip parallel to the slope. Avoid wet areas, including moisture-laden or unstable toe slopes, seeps, wetlands, wet meadows, and natural drainage channels.

5. Minimize the number of stream crossings and choose stable stream crossing sites.

6. Locate roads to provide access to suitable (relatively flat and well-drained) log landing areas to reduce soil disturbance.

B. <u>Design</u>

1. Properly design roads and drainage facilities to prevent potential water quality problems from road construction.

2. Design roads to the minimum standard necessary to accommodate anticipated use and equipment. The need for higher engineering standards can be alleviated through proper road-use management.

3. Design roads to balance cuts and fills or use full bench construction (no fill slope) where stable fill construction is not possible.

4. Design roads to minimize disruption of natural drainage patterns. Vary road grades to reduce concentrated flow in road drainage ditches, culverts, and on fill slopes and road surfaces.

C. <u>Road Drainage</u>

Road Drainage Road Drainage is defined as all applied mechanisms for managing water in a non-stream crossing setting, road surface drainage, and overland flow; ditch relief, cross drains and drain dips) #

1. Provide adequate drainage from the surface of all permanent and temporary roads. Use outsloped, insloped or crowned roads, and install proper drainage features. Space road drainage features so peak flow on road surfaces or in ditches will not exceed capacity.

    a. Outsloped roads provide a means of dispersing water in a low-energy flow from the road surface. Outsloped roads are appropriate when fill slopes are stable, drainage will not flow directly into stream channels, and transportation safety can be met.

    b. In-sloped roads, plan ditch gradients steep enough, generally greater than 2% but less than 8%, to prevent sediment deposition and ditch erosion. The steeper gradients may be suitable for more stable soils; use the lower gradients for less stable soils.

   c. Design and install road surface drainage features at adequate spacing to control erosion; steeper gradients require more frequent drainage features. Properly constructed drain dips can be an economical method of road surface drainage. Construct drain dips deep enough into the subgrade so that traffic will not obliterate them.

2. Design all ephemeral draw culverts with adequate length to allow for road fill width. Minimum culvert size is 15 inch. Install culverts to prevent erosion of fill, seepage and failure as described in V.C.4 and maintain cover for culverts as described in V.C.6.

3. Design all relief culverts with adequate length to allow for road fill width. Protect the inflow end of all relief culverts from plugging and armor if in erodible soil. When necessary construct catch basins with stable side slopes. Unless water flows from two directions, skew ditch relief culverts 20 to 30 degrees toward the inflow from the ditch to help maintain proper function. #

4. Where possible, install culverts at the gradient of the original ground slope; otherwise, armor outlets with rock or anchor downspouts to carry water safely across the fill slope.

5. Provide energy dissipaters (rock piles, slash, log chunks, etc.) where necessary to reduce erosion at outlet of drainage features. Crossdrains, culverts, water bars, dips, and other drainage structures should not discharge onto erodible soils or fill slopes without outfall protection.

6. Prevent downslope movement of sediment by using sediment catch basins, drop inlets, changes in road grade, headwalls, or recessed cut slopes.*

7. Route road drainage through adequate filtration zones or other sediment-settling structures to ensure sediment doesn't reach surface water. Install road drainage features above stream crossings to route discharge into filtration zones before entering a stream.

D. <u>Construction</u> (see also Section IV on stream crossings)

1. Keep slope stabilization, erosion and sediment control work current with road construction. Install drainage features as part of the construction process, ensuring that drainage structures are fully functional. Complete or stabilize road sections within same operating season.*

2. Stabilize erodible, exposed soils by seeding, compacting, riprapping, benching, mulching, or other suitable means.

3. At the toe of potentially erodible fill slopes, particularly near stream channels, pile slash in a row parallel to the road to trap sediment (example, slash filter windrow). When done concurrently with road construction, this is one method that can effectively control sediment movement, and it can also provide an economical way of disposing of roadway slash. Limit the height, width and length of "slash filter windrows" so wildlife movement is not impeded. Sediment fabric fences or other methods may be used if effective.

4. Minimize earthmoving activities when soils appear excessively wet. Do not disturb roadside vegetation more than necessary to maintain slope stability and to serve traffic needs.

5. Construct cut and fill slopes at stable angles to prevent sloughing and other subsequent erosion.

6. Avoid incorporating potentially unstable woody debris in the fill portion of the road prism. Where possible, leave existing rooted trees or shrubs at the toe of the fill slope to stabilize the fill.

7. Consider road surfacing to minimize erosion.

8. Place debris, overburden, and other waste materials associated with construction and maintenance activities in a location to avoid entry into streams. Include these waste areas in soil stabilization planning for the road.

9. Minimize sediment production from borrow pits and gravel sources through proper location, development and reclamation.

10. When using existing roads, reconstruct only to the extent necessary to provide adequate drainage and safety; avoid disturbing stable road surfaces. Prior to reconstruction of existing roads within the SMZ, refer to the SMZ law. Consider abandoning existing roads when their use would aggravate erosion.

E. Maintenance

1. Grade road surfaces only as often as necessary to maintain a stable running surface and adequate surface drainage.

2. Maintain erosion control features through periodic inspection and maintenance, including cleaning dips and crossdrains, repairing ditches, marking culvert inlets to aid in location, and clearing debris from culverts.

3. Avoid cutting the toe of cut slopes when grading roads, pulling ditches, or plowing snow.

4. When plowing snow, provide breaks in snow berm to allow road drainage.*

5. Haul all excess material removed by maintenance operations to safe disposal sites and stabilize these sites to prevent erosion. Avoid sidecasting in locations where erosion will carry materials into a stream.

6. Avoid using roads during wet periods if such use would likely damage the road drainage features. Consider gates, barricades or signs to limit use of roads during spring break up or other wet periods.

7. Upon completion of seasonal operations, ensure that drainage features are fully functional. The road surface should be crowned, outsloped, insloped, or water-barred. Remove berms from the outside edge where runoff is channeled.

8. Leave abandoned roads in a condition that provides adequate drainage without further maintenance. Close these roads to traffic; reseed and/or scarify; and, if necessary, recontour and provide water bars or drain dips.

IV TIMBER HARVESTING, AND SITE PREPARATION

A. Harvest Design

1. Plan timber harvest in consideration of your management objectives and the following*:
   a. Soils and erosion hazard identification.
   b. Rainfall.
   c. Topography.
   d. Silvicultural objectives.
   e. Critical components (aspect, water courses, landform, etc.).
   f. Habitat types.
   g. Potential effects on water quality and beneficial water uses.
   h. Watershed condition and cumulative effects of multiple timber management activities on water yield and sediment production.
   i. Wildlife habitat.

2. Use the logging system that best fits the topography, soil type, and season, while minimizing soil disturbance and economically accomplishing silvicultural objectives.

3. Use the economically feasible yarding system that will minimize road densities.

4. Design and locate skid trails and skidding operations to minimize soil disturbance. Using designated skid trails is one means of limiting site disturbance and soil compaction. Consider the potential for erosion and possible alternative yarding systems prior to planning tractor skidding on steep or unstable slopes.

5. Locate skid trails to avoid concentrating runoff and provide breaks in grade. Locate skid trails and landings away from natural drainage systems and divert

runoff to stable areas. Limit the grade of constructed skid trails on geologically unstable, saturated, highly erosive, or easily compacted soils to a maximum of 35%. Use mitigating measures, such as water bars and grass seeding, to reduce erosion on skid trails.

6. Minimize the size and number of landings to accommodate safe, economical operation. Avoid locating landings that require skidding across drainage bottoms.

7. Implement the Revised Gallatin National Forest Soil Protection Guidelines for all ground-based activities. These are as follows:

<u>Gallatin National Forest Revised Best Management Practices (BMP's) for Protecting Soil Resources (Keck 2009)</u>

<u>OBJECTIVE:</u> Protect soil productivity and soil quality by limiting the extent of detrimental soil disturbance associated with ground based harvest systems on the Gallatin National Forest

<u>EFFECTIVENESS:</u> Moderate to High

<u>JUSTIFICATION:</u> The predominant sources of long term detrimental soil disturbance associated with timber harvests are temporary road construction, the construction and use of landings, and instances where poorly laid out timber sales result in excessive soil erosion. These disturbances pose the greatest threats to long term soil and site productivity. Revised Gallatin National Forest Best Management Practices (BMP's) are designed to minimize the most critical soil disturbances though proper timber sale design and byrenovating critically impacted areas along temporary roads and at landings in a manner that fits the silvicultural prescription.

Tractor-based methods of timber harvest have the potential to cause significant soil disturbance. Past studies on the Gallatin National Forest have shown that the largest contributor of detrimental soil disturbance was dispersed ground-based harvesting using motorized, tracked or wheeled equipment (Shovic and Widner, 1991; Shovic and Birkland, 1992). Inconsistencies in the soil bulk density data reported in the 1992 report and the ad hoc criteria used to identify detrimental soil disturbance in both studies make exact interpretations of results from these studies difficult. It does seem reasonable, however, that unfettered used of ground-based harvesting equipment and site scarification using a dozer blade can result in unnecessary levels of soil disturbance. Such practices are no longer used on the Gallatin National Forest.

Dispersed skidding practices using equipment with low ground pressure have been successfully used to harvest timber while limiting detrimental soil disturbance on Forests having deep layers of organic material and slash (broken branches). The protective layer in these instances ranges from 6 to 20 inches thick and is comprised of existing organic surface horizons plus slash from the harvest operation. This organic layer protects the soil surface from displacement and prevents compaction. Use such thick organic mats to minimize disturbance during dispersed mechanical harvesting is considered a standard

Best Management Practice (BMP) on many of the highly productive; west-side Forests in Region One (Shovic 2008)

Harvest activities on the Gallatin National Forest, in contrast, leave much less slash behind because trees are generally smaller and they are often more widely spaced than on more productive, west-side Forests. What soils on the Gallatin National Forest do have is abundant rock fragments. Rock fragments in the soil, especially in surface horizons and on the surface, will provide a significant armoring effect that can limit detrimental soil disturbance even more effectively than thick organic matter layers.

Actual results depend on site specific conditions. The Soil Survey for the Gallatin National Forest reports 65 percent of the map units as having skeletal surface textures (>35% rock fragments in surface horizons) and 72% of the total acreage within the soil survey boundary as having skeletal surface textures (USDA 1996, Tables 2 and 5) for the Forest as a whole. Soil classifications (USDA 1996, Table 13) identify 71 percent of the soils on the Forest as being skeletal in the particle-size control section (that portion of the soil used to determine the family particle-size classification.

Recent field observations of past timber sales in the Swan, Moose, and Portal Creek drainages (units 33E, 77A, 22, 108, and 22P) and Lewis Gulch in the East Bolder drainage indicate that disturbances on and off skid trails were healing relatively quickly on stable landscape positions. Exceptions occurred when skid trails were located on highly erodible landscape positions or on unsuitable soils or when major disturbances from dispersed skidding occurred in the same type of locations.

Despite armoring by rock fragments in many areas, Gallatin National Forest BMP's require a systematic skid trail pattern to be used during logging. Mechanical, ground-based skidding and harvesting equipment may be used off skid trails only to the degree necessary to harvest the available timber based on the soil administrator's judgment and only during favorable soil moisture conditions (see details below). An average skid trail spacing of 75 feet is required for all commercially harvested, partial cuts and 100 feet for clear cuts.

The level of compaction, detrimental or not, associated with the use of mechanical harvesting equipment depends in large part on soil moisture conditions and soil texture. Han et.al. 2006 studied the effects of multiple passes by harvesting equipment over a loess derived, silt loam soil at three different water levels: low, medium, and high. Although three levels of water were applied, the resulting water content in the top 30 centimeters (12 inches) of soil was the same for the medium and high water treatments. Soil water contents in both the medium and high treatments were just below 30 percent moisture in the top 0-4 inches which is approximately the soil moisture level at field capacity for a silt loam. Soil moisture levels in the 4-8 inch and 8-12 inch depths were at approximately 25 percent for both the medium and high treatments which is somewhat below field capacity. Soil moisture in the low water treatment ranged from 10 to 15 percent or approximately ⅓ to ½ field capacity.

Results from Han, et. al. (2006) show a limited increase in penetration resistance for the highly compactable, silt loam soil in the low moisture treatment from multiple equipment passes. Substantial increases in penetration resistance were recorded for the medium water treatment below the 2.5 cm (1 inch) depth. Revised soil best management practices for the Gallatin National Forest factor in both soil moisture and soil texture of the top 6 inches of soil through use of a simple field soil moisture estimation technique (USDA-NRCS 2005) to determine when conditions are suitable for equipment use off skid trails, if needed to harvest the available timber. For fine textured soils, loams, clay loams, silt loams, silty clay loams, silty clays, and clays, the recommend soil moisture level is 50% of field capacity or less. For less compactable sandy loams, the recommended soil moisture level is 75% of field capacity or less. There are no soil moisture criteria for sands or loamy sands although some moisture in the soil may help minimize excessive soil disturbance in coarse soils.

Renovation of temporary roads and landings, the abundance of rock fragments in most soils, proper layout and spacing of temporary roads and skid trails, and the use of combined soil moisture and soil texture criteria for controlling the use of harvesting equipment off skid trails will ensure that detrimental soil disturbance is maintained below the 15 percent allowable on Region One Forests. The Soil Scientist on the Gallatin National Forest will be actively involved during timber harvesting and renovation activities to that end. Post harvest monitoring of soil disturbance is scheduled for the second and fifth year after harvesting to verify the desired results were obtained and that no long term reduction in overall site productivity results from timber harvesting.

IMPLEMENTATION:

- Require a systematic skid trail pattern during logging. Mechanical ground-based skidding and harvesting equipment may be used off of skid trails only to the degree necessary to harvest the available timber and only when soil moisture conditions are favorable. (See below for details.)

- Use ground-based harvest systems only on slopes having sustained grades less than 35 percent.

- Maintain an average of at least 75 feet between skid trails in all tractor harvest partial cuts. Skid trails may be closer than this spacing where converging so long as the overall spacing averages 75 feet or more.

- Lay out skid trails in a manner that minimizes or eliminates extended sections of trail running up and down slopes on grades steeper than 15%.

- Avoid placing skid trails or temporary roads over convex knobs or along narrow, rocky ridges (areas least able to recover from disturbance) to the extent possible.

Use of Skidding and Harvesting Equipment Off Skid Trails (non-winter harvesting)

- Ground based skidding equipment may travel off of the established skid trails but only to the extent reasonably necessary to harvest timber based on the sale administrator's judgment and only when the top 6 inches of soil will not form a ball when squeezed in the palm of the hand that will withstand a moderate amount of handling. (Criteria integrates the combined influence of soil texture and soil moisture – *see USDA Technical Guide for Estimating Soil Moisture*)

- Feller/buncher/mechanical harvesters may be used off established skid trails to the extent reasonably necessary to harvest timber but only when the top six inches of soil will not readily form a ribbon between between the thumb and forefinger. (*Criteria integrates soil texture and soil moisture effects – see USDA Estimating Soil Moisture Tech. Guide)* Repeat passes over the same ground should be minimized.

Winter Harvesting Restrictions

- Tractor harvesting over snow or frozen ground in the winter should be limited to periods when there is a minimum of 8 inches of settled snow covering the ground or, in the absence of sufficient snow, when the top 4 inches of mineral soil is either frozen or dry. Harvesting should not proceed if ponding occurs at the mineral soil surface due to partial thawing of a surface frost layer. Previously noted limitations to off skid trail use based on soil texture and moisture conditions and the need for a systematic skid trail system do not apply to winter harvesting providing the settled snow depth or frozen ground criteria are met.

Landings, Temporary Roads, and Skid Trails

- Landings --Cut and fill slopes, if present, around the margins of landings are recommended to be re-contoured at the completion of logging. The landing base should be ripped to a depth of at least 6 inches in accordance with provision K-G.6.3.3# subject to the following: 1) Scarification (ripping) of landings with burn piles only needs to be completed in areas of exposed mineral soil areas surrounding the burn pile, 2) The scarification (ripping) requirement may be waived on soils having abundant large rock fragments (25 percent or more 3 inch or larger rock fragments) or more than 50 percent rock fragments overall in the top 6 inches of soil.

- Temporary Roads --- Cut and fill slopes, where present, should be re-contoured in accordance with provision K-G.6.3.2. In all other areas, the road prism should be scarified (ripped) to a minimum depth of 6 inches into the mineral soil, in accordance with provision K-G.6.3.3# . This requirement may be waived on soils having abundant large rock fragments (25 percent or more 3 inch or larger) or more than 50 percent rock fragments overall in the top 6 inches of soil.

- Skid Trails --- Scarification (ripping) will not be required on skid trails except in areas where detrimentally compacted mineral soil is exposed at the surface or where wheel tracks ~~ruts~~ have formed at least 2 inches deep on slopes greater than 15% or continuous to slopes greater than 15%. Detrimental compaction, as defined in Detrimental Soil Disturbance Standards for the Gallatin National Forest, has a minimum 2 inches of compacted soil at the mineral soil surface or a minimum of three inches of compacted soil within six inches of mineral soil ~~surface~~. Compacted soil is identified by the presence of massive soil conditions or medium to coarse, strong platy structure (moderate if moist) not present in adjacent undisturbed reference areas.

Logging Slash and Other Woody Debris

- Leave at least 10 tons per acre (where available) of coarse woody debris (3" inch or larger) scattered on the ground in treatment units of lodgepole pine stands with mainly coarse-textured, glacial drift derived soils. Coarse woody debris protect the soil surface, slow surface runoff, and return soil nutrients to the soil. Slash at an approximate rate of 15 tons per acre should be placed across skid trails with slopes steeper than 15% in lodgepole areas at the completion of logging.

- Leave at least 7 tons per acre (where available) of coarse woody debris (3" inch or larger scattered on the ground in all other treatment units, mainly Douglas-fir dominated stands occurring on limestone derived soils. Coarse woody debris protect the soil surface, slow surface runoff, and return soil nutrients to the soil. Slash at an approximate rate of 10 ~~15~~ tons per acre should be placed across skid trails with slopes steeper than 15% in Douglas-fir areas at the completion of logging.

- To the extent reasonable, leave some unmerchantable material adjacent to temporary roads and landings during harvest so it can be used for slashing these areas by the Forest Service at the end of the project.

B. <u>Other Harvesting Activities</u>

1. Avoid operation of wheeled or tracked equipment within isolated wetlands, except when the ground is frozen (see Section VI on winter logging).

2. Use directional felling or alternative skidding systems for harvest operations in isolated wetlands.

3. For each landing, provide and maintain a drainage system to control the dispersal of water and to prevent sediment from entering streams.

4. Insure adequate drainage on skid trails to prevent erosion. On gentle slopes with slight disturbance, a light ground cover of slash, mulch or seed may be

sufficient. Appropriate spacing between water bars is dependent on the soil type and slope of the skid trails. Timely implementation is important.

5. When existing vegetation is inadequate to prevent accelerated erosion, apply seed or construct water bars before the next growing season on skid trails, landings and fire trails. A light ground cover of slash or mulch will retard erosion.

C. Slash Treatment and Site Preparation

1. Rapid reestablishment of vegetation of harvested areas is encouraged to reestablish protective vegetation.

2. When treating slash, care should be taken to preserve the surface soil horizon by using appropriate techniques and equipment. Avoid use of dozers with angle blades.

3. Remove all logging machinery debris to proper disposal site.

4. Limit water quality impacts of prescribed fire by constructing water bars in firelines; not placing slash in drainage features and avoiding intense fires unless needed to meet silvicultural goals. Avoid slash piles in the SMZ when using existing roads for landings.

V STREAM CROSSINGS

A. Legal Requirements

1. Under the Natural Streambed and Land Preservation Act of 1975 (the "310 law"), any activity that would result in physical alteration or modification of a perennial stream, its bed or immediate banks must be approved in advance by the supervisors of the local conservation district. Permanent or temporary stream crossing structures, fords, rip-rapping or other bank stabilization measures, and culvert installations on perennial streams are some of the forestry-related projects subject to 310 permits.

   Before beginning such a project, the operator must submit a permit application to the conservation district indicating the location, description, and project plans. The evaluation generally includes on-site review, and the permitting process may take up to 60 days.

2. Stream-crossing projects initiated by federal, state or local agencies are subject to approval under the "124 permit" process (administered by the Department of Fish, Wildlife and Parks), rather than the 310 permit.

3. A short-term exemption (3a authorization) from water quality standards is necessary unless waived by the Department of Fish, Wildlife and Parks as a condition of a 310 or 124 permit. Contact the Department of Environmental Quality in Helena at 444-2406 for additional information.

B. <u>Design Considerations</u> (Note: 310 permit required for perennial streams)

1. Cross streams at right angles to the main channel if practical. Adjust the road grade to avoid the concentration of road drainage to stream crossings. Direct drainage flows away from the stream crossing site or into an adequate filter.

2. Avoid unimproved stream crossings. When a culvert or bridge is not feasible, locate drive-throughs on a stable, rocky portion of the stream channel.

C. <u>Installation of Stream Crossings</u> (Note: 310 permit required for perennial streams)

1. Minimize stream channel disturbances and related sediment problems during construction of road and installation of stream crossing structures. Do not place erodible material into stream channels. Remove stockpiled material from high water zones. Locate temporary construction bypass roads in locations where the stream course will have minimal disturbance. Time construction activities to protect fisheries and water quality.

2. When using culverts to cross small streams, install those culverts to conform to the natural stream bed and slope on all perennial streams and on intermittent streams that support fish or that provides seasonal fish passage. Ensure fish movement is not impeded. Place culverts slightly below normal stream grade to avoid culvert outfall barriers. Do not alter stream channels upstream from culverts, unless necessary to protect fill or to prevent culvert blockage.

3. Design stream-crossings for adequate passage of fish (if present), minimum impact on water quality, and at a minimum, the 25-year frequency runoff. Consider oversized pipe when debris loading may pose problems. Ensure sizing provides adequate length to allow for depth of road fill. #

4. Install stream-crossing culverts to prevent erosion of fill. Compact the fill material to prevent seepage and failure. Armor the inlet and/or outlet with rock or other suitable material where feasible.

5. Consider dewatering stream crossing sites during culvert installation.*

6. Maintain a 1-foot minimum cover for stream-crossing culverts 15 to 36 inches in diameter, and a cover of one-third diameter for larger culverts, to prevent crushing by traffic.

7 .Use culverts with a minimum diameter of 15 inches for permanent stream crossings.

D. <u>Existing Stream Crossing</u>

1. Existing stream crossing culverts shall have adequate length to allow for road fill width and have adequate capacity to allow for the passage of the 25-year frequency runoff. To prevent erosion of fill, provide or maintain armoring at inlet and/or outlet with rock or other suitable material where feasible. Maintain fill over culvert as described in V.C. 6.

VI Winter Logging

A. <u>General</u>

1 . Consider snow-road construction and winter harvesting in isolated wetlands and other areas with high water tables or soil erosion and compaction hazards.

2. Conduct winter logging operations when the ground is frozen or snow cover is adequate (generally more than one foot) to prevent rutting or displacement of soil. Be prepared to suspend operations if conditions change rapidly, and when the erosion hazard becomes high.*

3. Consult with operators experienced in winter logging techniques.

B .<u>Road Construction and Harvesting Considerations</u>

1. For road systems across areas of poor bearing capacity, consider hauling only during frozen periods. During cold weather, plow any snow cover off of the roadway to facilitate deep freezing of the road grade prior to hauling.

2. Before logging, mark existing culvert locations. During and after logging, make
sure that all culverts and ditches are open and functional.

3. Use compacted snow for road beds in unroaded, wet or sensitive sites. Construct snow roads for single-entry harvests or for temporary roads.

4. In wet, unfrozen soil areas, use tractors or skidders to compact the snow for skid road locations only when adequate snow depth exists. Avoid steeper areas where frozen skid trails may be subject to erosion the next spring.

5. Return the following summer and build erosion barriers on any trails that are steep enough to erode.

VII. HAZARDOUS SUBSTANCES

A. General

1. Know and comply with regulations governing the storage, handling, application (including licensing of applicators), and disposal of hazardous substances. Follow all label instructions.

2. Develop a contingency plan for hazardous substance spills, including cleanup procedures and notification of the State Department of Environmental Quality.

B. Pesticides and Herbicides

1. Use an integrated approach to weed and pest control, including manual, biological, mechanical, preventive and chemical means.

2. To enhance effectiveness and prevent transport into streams, apply chemicals during appropriate weather conditions (generally calm and dry) and during the optimum time for control of the target pest or weed.