Appendix F
Best Management Practices
and
Road Standards for Proper Drainage

Introduction

The following Best Management Practices, considered to be the most applicable to the planning area, were derived from a number of sources including: BLM OR/WA Manuals and Handbooks, Oregon Forest Practice Rules (Oregon Department of Forestry, 1980), Moll (1999), the US Forest Service San Dimas Technology Center, and internal RMP scoping comments.

Road Construction and Maintenance Guidelines

For additional, more detailed specifications concerning all aspects of road design, construction and maintenance refer to BLM Manuals 9113 - Roads, and 5420 - Preparation For Sale (Timber).

New BLM system road construction would focus on redesigning existing road systems for better access efficiency, recreation use, reduction in conflicts with adjacent landowners, and resource protection. Road system management would include maintaining existing roads, seasonal closures, permanent closures and rehabilitation of roads. Existing system roads would be maintained for proper water drainage and long-term service.

Any new roads would be designed to minimum standards consistent with the proposed use and traffic safety (see Table F-1). An in-depth field review for each feasible location should be performed prior to construction. For each feasible location, consider environmental impacts and resource value impacts, including suitability of soil and geology, potential for road surface erosion, and impacts due to extension of the drainage network on water quality and quantity. Consult hydrologists and fisheries biologists for stream crossings. Surfaced roads would include some county roads, roads receiving heavy use by the public, and some approved road rights-of-way. When designing long-term road networks, existing roads would be incorporated to the maximum extent possible unless new roads offer better long term conditions for resource conservation, visual resources, recreation or reductions in conflicts with adjacent landowners.

Geometric Standards-Design speeds, travelway widths, and maximum grades for various combinations of estimated average daily traffic (ADT), functional classification, and terrain types are shown in Table F-1 below:

Table F-1 Road Standards

Functional Classification	Estimated 20 yr. ADT	Terrain	Design Speed		Travelway Width		Maximum Grade	
			Preferred	Minimum	Preferred	Minimum	Preferred	Minimum
Resource	Less than 20	Level & Rolling	30	*	14	*	8	10
		Mountainous	15	*	14	*	8	16
Local	Less than 100	Level & Rolling	40	30	20	20	6	10
		Mountainous	20	15	14	12	8	15
	More than 75	Level & Rolling	50	40	24	20	6	10
		Mountainous	30	15	24	20	8	14
Collector	50-150	Level & Rolling	50	30	24	20	6	8
		Mountainous	30	20	24	20	8	12
	More than 100	Level & Rolling	50	40	24	20	6	8
		Mountainous	30	20	24	20	8	12

*If preferred design speed and travelway width are not feasible for specific resource roads, alternate values are determined by District Resource Specialists.

Road location would be designed to follow the terrain to minimize excavation to the essential amount needed to meet necessary road standards. Whenever possible, roads would be located away from streams, meadows, and riparian areas. Appropriate drainage structures would be incorporated into construction or reconstruction design.

Cut and fill slopes would be revegetated, preferably with native vegetation, to stabilize the slopes and reduce erosion. Seeding or planting would be done the first fall season following construction of long-term roads.

A local road with a design speed of 20 mph or less should be outsloped for sections where the grade does not exceed 6%. Outsloping roads is not recommended unless the subgrade materials are resistant to erosion and traffic volume is extremely low. All other roads should be crowned to ensure proper drainage.

Side ditches should be constructed adjacent to, and parallel with, the roadway shoulder. The ditch collects runoff from the roadway and from adjacent upslope areas. The shape and dimensions of the ditch are selected to carry adequately the anticipated runoff from a major storm without saturation of subgrade or surfacing material.

Where overtopping of the road could occur, a dip or grade roll should be designed to ensure that the overtopping flow crosses the road at a point that minimizes erosion (erodible-resistant surfacing is often added), and so that flow is not diverted along the road or away from its natural flow path.

For low-volume roads, surface cross drains provide an economical alternative to using ditches and culverts. Surface cross drains can be designed into any shape road surface template to divert water collecting on and running down the traveled surface. Surface dips are not recommended for grades over ten percent because of the steepness of the dip approach grade that would be required. Cross drains may also be used to relieve ditches and the inside edge of insloped roadways without ditches. Ditch dams are used to direct ditch water into the cross drain. Surface cross drains should be located at intervals close enough to prevent volume concentration that causes surface erosion or unstable slopes. Cross drains should be constructed with an outslope grade of 3 to 5 percent or equal to the existing out-slope grade. In colder climates where snow and ice create driving hazards, the outslope grade should be reduced. For drivable dips, the minimum freeboard should be 150 millimeters with a roll-out length of at least 6 meters. If the dip is unarmored, freeboard should be increased to allow for the tendency of the dip to lose its shape due to traffic. Drain dips and drivable water bars negotiable by high-clearance vehicles have steeper rollout grades. The above values should be adjusted according to local climate.

Locate cross drains far enough above stream crossings to avoid releasing drainage water directly into stream channels. Whenever possible cross drains should be located to release water on convex slopes or other stable areas

that will disperse water rather than channeling it. Surface and ditch water should be diverted and dispersed before it enters streams using lead-out ditches, settlement ponds, ditch dams, surface shaping, or other measures. Cross drains and outlets should be armored where soils are highly erodible or provide poor traffic support during wet weather use.

Dip orientation (skewed or perpendicular to the road centerline) depends on the type of traffic expected, length of the dip, and road grade. If dips are shorter and the traffic will include larger trucks with longer frames, then the dips should be oriented perpendicular to the direction of traffic. Dips skewed from perpendicular to centerline more effectively drain steep road grades, are more comfortable for vehicle occupants, and, if long enough, will not cause severe twisting of truck frames.

Culverts would be designed for all streams to pass a 100-year flood. Culverts would be designed for minimum impact on aquatic life. Open bottom shapes should be used if it is necessary to maintain the character of the streambed and would be the preferred option for fish-bearing streams. If a closed bottom shape is used in a fish-bearing stream, the type, size and gradient of the culvert should be assessed using the most current method of design for fish passage (for example, a software application for Windows called "FishXing, "developed by the Six Rivers National Forest Watershed Interactions Team available from the Stream Systems Technology Center (www.stream.fs.fed.us/fishxing) or from the USDA-Forest Service San Dimas Technology and Development Center). Rock or other appropriate lining would be provided for culvert outlet basins.

Waterbars would be installed on skid trails and temporary roads where there is potential for erosion due to soil type, terrain features, or future human uses. Waterbars are typically used in closed-off areas with little traffic, and should be oriented to lead the flow from the surface. One rule of thumb is to add five to the percent road grade and orient the waterbar at that many degrees off perpendicular.

All roads would be maintained during logging, mining, or other activities involving heavy vehicles or multiple trips. Roads would be maintained during and immediately after use periods as needed to control erosion and road degradation. Maintenance activities could include reconstruction, snow plowing, grading, cleaning ditches and culverts, installing new drainage structures, and replacing surfacing. Maintenance frequency would depend on traffic, weather, road condition, and soil type. During heavy industrial use, roads would be monitored during wet conditions and temporarily closed, if necessary, to prevent excessive damage.

All necessary road permits and road use agreements would be obtained before beginning industrial operations. Individual road use permits, agreements, contracts, and right-of-way grants would provide detailed stipulations for road use and maintenance for specific roads.

Temporary access roads would be closed and stabilized by a combination of the following methods: signing, blocking, disguising, scarifying, waterbarring, seeding, and mulching.

Design drainage ditches, waterbars, drain dips, culvert placement, etc. in a manner that will disperse run-off and minimize cut and fill erosion. Design of drainage ditches, waterbars, etc. will be done in a manner to ensure safety for road users.

Blocking and disguising would utilize large logs, branches, stumps, and/or boulders found in the local vicinity. Tees cut from adjacent areas may also be imported to facilitate road closures and rehabilitation.

Closed and obliterated road beds would be recontoured to match the adjacent natural slope and would be seeded with native seed.

Background of Road Influences on Hydrology

Proper drainage, from a watershed standpoint, is minimizing the cumulative volume-distance quantity of displacement by appropriate road and drainage feature location and design, coupled with appropriate routine maintenance. Three main components of proper drainage provision are: road location and design; drainage feature type, location, and design; and appropriate routine maintenance. Proper drainage provision is accomplished on each unique road segment by ensuring location and design of road alignments and drainage

features minimize changes to natural disposition of precipitation and groundwater. Road location must consider alignments, template geometry, aspect, location on hillside, geology, climate, vegetation, operational requirements, season of use, and management activities on surrounding terrain. Drainage feature considerations include type, spacing and shaping, applicability of drainage schemes to site conditions, including investigation of opportunities on the ground for minimizing water concentrations and their effects on areas adjacent to the road segment.

Appropriate routine maintenance ensures such drainage provision remains functional. Drainage features are tailored to site specific characteristics on each unique segment, within limitations dictated by access needs and safety requirements. Every opportunity is considered for minimizing water concentrations and related effects on surroundings by treatments that isolate contributing areas, whether on adjoining road segments or different parts of the cross section template on the same segment.

The simplest, most economical, and most effective technique for minimizing water displacement due to the typical segment involves addition of surface cross drainage. Here, the total water volume displaced may not be reduced much, but it is broken into smaller increments, travels a shorter distance during displacement, and is more quickly and easily absorbed into down slope locations, potentially lowering cumulative volume distance displacement. Surface cross drains consist of surface shaping and devices designed to capture water that collects on, and drains down, the road and release it in a manner that minimizes effects to adjacent areas and the watershed (USDA-FS, 1998). Surface shaping includes broad-based (drivable) dips, waterbars, and rolls in profile (twist of crown or inslope templates to outslope and back again). Devices include open top or slotted culverts (USDA-FS, 1995), metal waterbars, and rubber water diverters (USDA-FS, 1998).

Machine Operations (i.e. logging, mining, utility and facility installations)

Machine operations would be timed to minimize adverse impacts to other resources. Timing of operations on a daily and seasonal basis would include such concerns as sensitive soils, proximity to residences and recreational sites/designated trails, cultural resources, and special status plant and animal species.

Operations would be designed and implemented to minimize the loss of site productivity caused by soil compaction, displacement, or erosion.

Areas with sensitive soils or ground resources of special concern would be protected by logging with low-impact harvest techniques such as: designated skid trails; directional felling; boom mounted shears; harvester/forwarders; smaller, more maneuverable or low ground pressure equipment; logging during the dry season (between June 1 and October 31); and logging over a protective cover of snow and/or frozen ground.

Tractor skidding would normally be limited to slopes of less than 35%. Soil moisture conditions would be monitored and operations would be suspended before excessive compaction or displacement occurs.

Landings would be the minimum size commensurate with safety and equipment requirements. Landing locations would be selected outside specified buffer areas for streams, riparian areas, raptor nests, residential areas, and other sensitive sites. Landings would be located to avoid creating excessive excavation and sidecast or slope stability problems.

Previously disturbed areas and existing openings would be used where practicable to establish landing sites.

Some key landing sites may be retained and dedicated for future timber harvest operations.

Machine slash piling, other than on landings, would be avoided if there are other feasible options available such as whole tree or leave-tops-attached yarding, lop and scatter, or prescribed fire. Where machine piling is necessary, it would be accomplished with a crawler tractor or skidder equipped with a brush rake type blade to minimize soil displacement and provide soil-free piles.

Perennial stream crossings would be avoided during operations involving heavy equipment for logging, road construction or related activities.

Designated trails would be avoided during operations involving heavy equipment for logging, road construction or related activities to the maximum extent feasible. If avoidance is not possible, provisions for designating crossings, rerouting or temporary closure of designated trails will be made to ensure safety and reduce conflicts. Trails damaged during operations would be restored following operations.

Provide variable width no-cut or modified prescription management zones for perennial streams, springs, seeps, wet meadows, and other areas which could substantially affect water quality in perennial waters.

Where forest productivity is emphasized, landings, temporary roads and primary skid trails would be scarified following use. Scarification would be to a depth of at least 12 inches. Mounds and berms would be smoothed to the original contour.