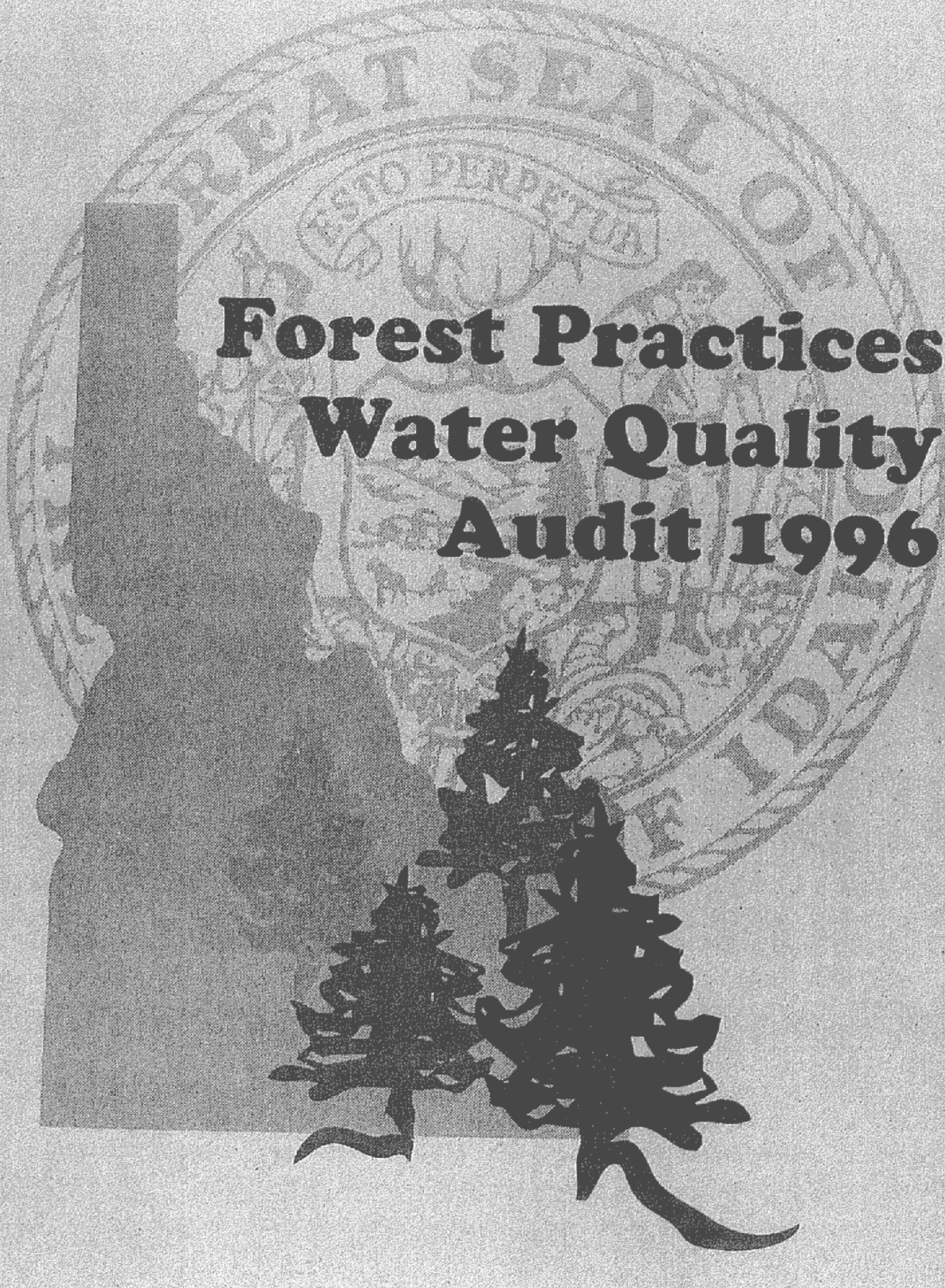
Forest Practices Water Quality Audit 1996



Forest Practices
Water Quality Audit

1996

Prepared by
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ACKNOWLEDGEMENTS

The members of the 1996 forest practices audit team express their appreciation to the Idaho Department of Lands and U.S. Forest Service staff members that assembled timber sale information and assisted with the sale visits made during this audit. We also recognize the assistance provided by the Idaho Forest Practices Act Advisory Committee with the 1996 audit. The quality of the final report was greatly enhanced through the editing and preparation assistance provided by Cheryl Flood of the Idaho Division of Environmental Quality.

EXECUTIVE SUMMARY

The *Forest Practices Water Quality Management Plan* (Bauer et al. 1988) calls for a statewide audit of the application and effectiveness of the Idaho forest practices rules at least once every four years. The forest practices audit was again conducted in 1996. Forty-two timber sales were audited with forty being scored as part of the audit and two serving as calibration audits for the audit team. The 1996 audit team was made up of representatives of the Idaho Forest Owners Association, Idaho Department of Fish and Game, U.S. Forest Service, Plum Creek Timber Company, U.S. Bureau of Land Management, Idaho Department of Lands (IDL) and the Idaho Division of Environmental Quality (DEQ).

The objectives of the 1996 forest practices audit were to assess the extent to which the Idaho forest practice rules are being implemented and to assess whether the management practices function as intended when properly implemented and maintained. Based on these findings, the audit team is making recommendations for rule and administrative revisions. Our primary findings and recommendations deal with rule implementation, rule effectiveness and road maintenance. We also address a number of other issues having an impact on water quality that do not directly pertain to the Idaho forest practices rules.

Forest Practices Rule Implementation

The rate of forest practices rule implementation was evaluated by dividing the number of instances where a rule was implemented by the number of instances where it was applicable. We found that the forest practices rules were implemented at a rate of 97% statewide. This was a higher rate than found in the 1988 and 1992 audits. When an Idaho forest practices rule was not implemented or maintained, it was a road rule (Rule 040) 69% of the time.

We recommend more preoperational inspections be conducted, particularly on non-industrial timber sales. Additionally, we suggest a mandatory operator certification program for loggers with a history of non-compliance be implemented and existing educational materials be made readily available to the public.

Forest Practices Rule Effectiveness

We evaluated rule effectiveness by assessing individual rule effectiveness and by pollutant delivery to streams or stream channels. On an individual rule basis, we found that when properly implemented and maintained, the practices described in the forest practices rules were effective 99% of the time. We also found that half of the timber sales we audited had sediment being delivered to streams or stream channels as a result of forest practices activity. This apparent inconsistency can be attributed to management practice design, construction, maintenance, rule interpretation and other factors. The impact of this sediment delivery on the beneficial uses of the streams within these sale areas was not assessed.

We recommend the Idaho forest practices road rule (Rule 040) be modified to account for differences in geologic stability between the Belt Supergroup and the batholitic granites. Suggested changes for Rule 040 are provided in Appendix G. In general, we found that one or two practices described in the rules may be adequate on stable ground but that multiple practices are required to reduce sediment delivery in unstable situations.

Miscellaneous Findings

The evaluation of rule implementation, rule effectiveness and pollutant delivery fulfills the first two objectives of the forest practices audit. However, an evaluation strictly focused on a rule-by-rule assessment of forest practices does not address all of the issues encountered in the 1996 audit. The issues listed have been identified through discussions and observations of the audit team and timber sale representatives. These issues include: maintenance responsibility on mixed ownership (i.e. home sites, state, county, recreation) roads; grazing and mining water quality impacts; pre-FPA logging; road-closure breaching; water quality and fire management conflicts; culvert and road-fill compaction; variances; cumulative effects of timber sales and other land uses; and administration of the road planning rules.

Not all of these issues can be addressed by the Forest Practices Act. However, since the integrity of a stream is influenced by all of the activities in its watershed, these findings are pertinent from a water quality perspective. For the most part, these issues do not suggest the need for a rule change, but an increased application of current rules and programs.

CHAPTER 1

INTRODUCTION

Background

The *Forest Practices Water Quality Management Plan* (Bauer et al. 1988) and the *Forest Practices Appendix to the Memorandum of Understanding Implementing the Nonpoint Source Water Quality Program in the State of Idaho* also *Memorandum of Understanding Implementing the Nonpoint Source Water Quality Program in the State of Idaho* (Idaho Department of Health and Welfare et al. 1993) both call for an audit of forest practices once every four years. These documents were produced under the authority of sections 208 and 319 of the Federal Water Pollution Control Act, as amended (Water Pollution Control Federation 1988). The management plan and the memorandum of understanding form the regulatory basis for conducting the forest practices audit.

The *Rules and Regulations Pertaining to the Idaho Forest Practices Act* (Idaho Department of Lands 1992) are identified in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* (Idaho Department of Health and Welfare 1996) as the approved best management practices in Section 350.03.a. for water quality protection from silvicultural activities. The forest practices audit is one step in the process to determine if silvicultural management practices are being implemented and maintained on the ground, and if they are being effective in controlling water pollutants. By conducting the audit and making rule revision recommendations, the audit team implements the monitoring and reporting provisions of the *Water Quality Standards and Wastewater Treatment Requirements* Section 350. Findings and recommendations from the audit are reported to the governor, forest practices steering committee, Idaho Board of Health and Welfare, Idaho Board of Land Commissioners, Idaho Department of Lands and Forest Practices Act Advisory Committee for their consideration as management or rule amendments.

Purpose and Objectives

The purpose of the forest practices audit is to conduct on-site reviews and assess the application and function of the silvicultural management practices described in the *Rules and Regulations Pertaining to the Idaho Forest Practices Act* (Idaho Department of Lands 1992). To accomplish this, the audit team assumed several objectives, which include:

- assess the extent to which the Idaho forest practices rules are implemented;
- assess whether the forest practices function as intended when properly applied and maintained; and
- make recommendations for rule and administrative revisions as indicated by findings from the audit.

Scope and Interpretation of the 1996 Audit

The methods used in the 1996 audit dictate the extent of appropriate interpretation that can be made from the findings. The methods selected for the 1996 audit needed to yield data comparable to previous audits and needed to fit within our time and logistical constraints.

For water quality purposes, monitoring of management practice effectiveness is done by answering three primary questions in order. These questions are: have the practices been properly applied and maintained; are the practices functioning as intended; and are the practices causing the desired in-stream results? The 1996 forest practices audit was designed to answer the first two of these three questions. Determining whether the applied practices are causing the desired in-stream results cannot be done with a one-time (2-hour) visual assessment of a forest practices activity that may have taken several years to conduct. Cause and effect determinations require quantitative monitoring to isolate forest practices effects from background and other land use effects.

The 1996 audit was not intended to be statistically robust or to evaluate the cumulative effects of forest practices within a specific drainage. No attempt was made to assess “within sale” or “between sale” variability. Storms and runoff events were not characterized for each sale. Timber sales were not weighted to account for differences in the amount of harvest, road work or spatial distribution. Not every cutting unit, road, landing or skid trail was observed in larger sales. The audit team selected the areas of the sale to be observed.

Audited timber sales were randomly drawn from the sales submitted as candidates. If sales meeting the selection criteria were not submitted, they were not included in the pool of sale candidates. The strength of the audit is in assessments made on a statewide basis. To a lesser extent, inferences can be drawn on the four land ownership categories.

One of the audit sale criteria was that all or most of the sale activity needed to be completed within the past two years. This criteria allowed for a more comprehensive assessment of roads and management practice maintenance. It also allowed natural events (fire, runoff, etc.) and subsequent sale activities to mask attributes of the sale being audited. The audit team accounted for this confounding in two ways. First, we rated the conditions we saw that day whether they were from the selected sale or subsequent forest activity.

Secondly, we based our conclusions and recommendations on the rule-by-rule evaluation as well as the judgement of the audit participants.

In many instances, more than one rule may apply to a given forest practices activity. In instances where the implementation or function of a management practice was insufficient, the most applicable rule was rated.

CHAPTER 2

METHODS

Audit Team Selection

The *Forest Practices Water Quality Management Plan* (Bauer et al. 1988) suggests interest groups and identifies agencies to participate on the forest practices audit team. The 1996 audit team was comprised of representatives from the Idaho Department of Lands (IDL), U.S. Department of the Interior – Bureau of Land Management, Idaho Department of Fish and Game, Idaho timber industry, Idaho Forest Owners Association, U.S. Department of Agriculture – Forest Service (U.S. Forest Service) and the Idaho Division of Environmental Quality (DEQ). Inquiries were made of several Idaho conservation groups and the U.S. Environmental Protection Agency as to their interest in audit team participation, but no representative was provided. Association and agency heads were initially contacted to announce the 1996 audit and to request participation as called for in the 1988 management plan.

Requests were also made for audit team members with specific areas of expertise. The 1996 audit team was made up of members with forestry, geology, fisheries biology, hydrology and water quality technical backgrounds. Designation of audit team members was made by the association or agency heads.

Timber Sale Selection

Timber sale candidates for the 1996 audit were provided by the IDL and the USFS. A timber sale data request form (appendix A) was sent to each national forest in Idaho and to the IDL Coeur d'Alene office on which to identify and briefly describe candidate sales. Criteria used to initially select audit candidates were:

- a Class I or Class II stream contained in the sale area;
- equal representation of private non-industrial, idustrial, state and federal land ownerships;
- completion of most or all of the harvest, road construction or road reconstruction activities in the past two years;

- the sale had to go through at least one spring or fall wet season; and
- travel logistics.

Timber sale selection in the 1996 audit differed from the 1988 (Harvey et al. 1989) and 1992 (Hoelscher et al. 1993) audits in that harvest volume and geographic stratification were not used as criteria for candidate sale selection. A table of random numbers (Zar 1984) was used to select private non-industrial, industrial and state sales based on their IDL compliance number. Identification numbers were assigned to the federal sales as they were received. These numbers were then mixed and “drawn from the hat.” Twenty sales from each ownership category were selected as audit semi-finalists. These 80 sales were then plotted on a map. The 40 sales that tended to be grouped most closely together geographically, thereby allowing the most logical travel, were selected as primary audit candidates with the remaining 40 serving as alternates. The timber sales audited in 1996 and their locations are listed in appendix B.

Project Rating

The 1996 forest practices audit assessed timber sales for compliance to the 1992 rules and regulations (IDL 1992). Specific rules that were considered in the audit include soil protection (3.c), location of landings and trails (3.d), drainage systems (3.e), treatment of waste material (3.f), stream protection (3.g), maintenance of related values (3.h), road specifications and plans (4.b), road construction (4.c), road maintenance (4.d), winter operations (4.e), Stream Segment of Concern notification (8.b) and site specific management practices (8.c). As a result, the forest practices evaluation worksheet used in the 1992 audit (Hoelscher et al. 1993) was modified only slightly for use in 1996. Modifications included adding timber salvage sales as a harvest prescription category; adjusting the slope criteria in the hazard rating to follow guidelines proposed in a report being prepared on preoperation inspection, canopy closure and large organic debris effectiveness (Hoelscher, unpublished); adding a questionaire concerning the issuance of variances, permits and site specific management practices; modifying the lower stream bank rock content criteria to stream bank stability; recording Rosgen (1994) channel type and replacing the minimum stream protection zone width question with fish passage and pre-operational inspection questions. The 1996 forest practices evaluation worksheet is contained in appendix C.

Quality Assurance Measures and Field Procedures

Calibration Audits

On July 2, 1996, the audit team assembled in Orofino and conducted calibration audits on a state and an industrial timber sale. This exercise aided the development of consistency between audit team members and supported evaluation consistency between timber sales. The calibration audits also served as a field test for the modified forest practices evaluation worksheet and an opportunity for team members to go through the individual forestpractices rules prior to scoring audits.

An audit handbook (Zaroban 1996) was compiled to aid the audit team members with consistency in rule interpretation, term definition and travel planning. The handbook contained copies of the 1992 and 1996 forest practices rules, blank forest practices evaluation worksheets, 1996 IDL forest practices rule guidance, stream channel alteration rules, audit calendar, audit sale list and audit team member list.

Timeframe

The audits were conducted from July 29, 1996, through Sept. 26, 1996. Field dates were interspersed throughout this period with office dates to accomodate team members' schedules and to allow for audit form processing and field trip preparation.

Field Procedures

The audit arrived at a predetermined location and met with timber sale representatives. At this meeting, introductions of personnel were made, overviews of the audit purpose and procedures were given, as appropriate, and travel logistics were arranged.

Once at the sale, maps of the sale area depicting roads and cutting units were distributed and discussed. If time or access did not allow the entire sale area to be viewed, cutting units demonstrating the applied harvest techniques (aerial, skyline, skidding, etc.); harvest prescriptions (salvage, clear cut, seed tree, individual selection, etc.) and roading activities (construction, maintenance, abandonment, etc.) were selected by the audit team for viewing. Stream reaches to be assessed for stream channel and riparian zone stability were selected on-site by the audit team. Geologic characteristics of each sale were gathered from road cuts and natural features. Taking the layout and size of the sale area into account, the audit team then determined if they would inspect the entire sale together or split into upland and stream groups. Once the preinspection planning was completed, the team toured cutting units and stream reaches on foot. Each audit team member took field notes and photographs as they deemed appropriate. All of the assessments done as part of the audit were strictly visual with the exception of gradient. Hand held clinometers were used to estimate stream, road and skid trail gradients.

Stream bank stability was rated based on the condition of the upper bank, lower bank and channel bottom. For this audit, we defined the upper bank as the upper portion of the channel to the one to three year bankfull line (the intermittently submerged portion of the channel). The remaining portion of the upper bank, from the break in general slope to the one to three year bankfull line, was not assessed. Our intent was to narrow impacts to those associated with the timber sale being audited. We defined the lower bank as the portion of the channel from the intermittently submerged level to the water's edge during summer low-flow periods. We defined the channel bottom as the submerged portion of the channel cross section which is totally an aquatic environment. Appendix D contains an illustration of these definitions.

The dominant substrate particle size was estimated at the time the channel stability rating was conducted. When two different size classes dominated the substrate, both were noted with the channel type (e.g. A2/3). The largest accessible stream was rated on sales where more than one stream occurred. The timber sale audit usually took one to two hours to complete.

After the timber sale audit was completed, the audit team would reconvene and rate the compliance and effectiveness of the sale, go over the stream channel and riparian stability rating and gather any additional information from the sale representatives. The sale was rated in the presence of the sale representatives, however, only audit team members were allowed to participate in audit scoring. The audit scoring process consisted of one team member reading through the individual rules, a discussion of team member observations and a second team member recording the team's rating. With the completion of the audit scoring and summary, the audit was concluded.

Data Compilation and Assessment

Findings and data gathered from the 40 audited timber sales were compiled by sale and put into tables. These tables are contained in appendix E. Assessment of the findings and data was done on a statewide basis, by land ownership category, individual rule basis and by geologic conditions. No conclusions or recommendations were drawn from individual sale findings since no audit replication occurred on individual sales. The conclusions and recommendations contained in this report represent the concensus opinion of the audit team.

Rule Implementation Assessment

The extent to which the 1992 rules were implemented was assessed by first counting the number of implemented rules and the number of applicable rules for each timber sale. The number of rules implemented was then divided by the number of applicable rules to determine an implementation rate for each landownership category.

Rule Effectiveness Assessment

The extent to which the 1992 rules were functional was assessed by counting in each timber sale the number of occasions a particular rule was given a rating from the compliance and effectiveness scales (please refer to the Idaho Forest Practices Evaluation Worksheet in appendix C). From this count, the number of occasions in each timber sale where the rules were not fully implemented was subtracted. The resulting number was then divided by the number of applicable rules to determine an effectiveness rate for each land ownership category.

Pollutant Delivery Assessment

The Forest Practices Act rules are intended to minimize, not totally eliminate, pollutant delivery. The extent to which pollutants were delivered to stream channels was assessed by counting the number of timber sales in which pollutant delivery was noted. Pollutant delivery was noted when management practices were not totally implemented or were not functional. While the in-stream impact from the noted pollutant delivery was not assessed, we did estimate the volume being delivered. The magnitude of the pollutant delivery was characterized on site using the compliance and effectiveness scales (please refer to the Idaho Forest Practices Evaluation Worksheet in appendix C). When assigning effectiveness scales in the field, sediment delivery events were characterized as “major” when five or more cubic yards of sediment were estimated to have left a site or had reasonable potential to erode from a site. When less than five cubic yards of sediment was estimated to have eroded or had a reasonable potential to erode from the site, it was rated as “minor” sediment delivery. In the overall audit assessment, sediment delivery was described as “major” when an effectiveness scale of 1, 2 or 3 was assigned in the field to account for prolonged sediment delivery. The other effectiveness scales were characterized as “minor” sediment delivery.

CHAPTER 3

RESULTS AND DISCUSSION

In the 1996 audit, we inspected 42 timber sales. The inspections of the first two sales served as a quality assurance step and team building effort. These two sales were not included in the 1996 assessment. Results from the remaining 40 sales were compiled and assessed. The assessment of these results fulfills the first two objectives of the audit described in the introduction.

Rate of Rule Implementation

To assess the extent to which the 1992 forest practices rules were implemented, we divided the number of times a rule was implemented by the number of times a rule was applicable. In 1996, the implementation rate of the Idaho forest practices rules ranged from 93% to 100% across the four land ownership categories. The rate of implementation in each land ownership category improved from the 1992 (Hoelscher et al. 1993) and 1988 (Harvey et al. 1989) audit results. Table 1 provides a comparison of rule implementation between the last three audits.

Table 1. Comparison of Idaho forest practices rule implementation rates (percent) between federal, state, industrial and non-industrial land ownership categories from the last three audits.

Ownership	1988 Audit	1992 Audit	1996 Audit
Federal	94%	93%	100%
State	97%	96%	98%
Industrial	95%	94%	95%
Non-industrial	86%	89%	93%

In the federal sale category, only one Idaho forest practices rule on one timber sale was not implemented. Since the rules were applicable in over 530 instances, one instance of non-implementation did not result in a percentage point drop in implementation rate. The rule which was not fully implemented was the location of landings, skid trails and fire trails (3.d). A fire line had been constructed down the bottom of a Class II stream channel.

In the state sale category, observations of rules not being fully implemented were made 12 times out of over 560 occasions where rules were applicable. Of these 12 occasions, road maintenance rules (4.d) were not fully implemented nine times. The remaining three occasions were the soil protection rule (3.c); location of landings, skid trails and fire trails (3.d); and stream protection (3.g).

In the industrial category, observations of rules not being fully implemented were made 23 times out of over 450 occasions where rules were applicable. Of these 23 occasions, road maintenance rules (4.d) were not fully implemented 15 times and road construction rules (4.c) four times. The remaining four occasions were the soil protection rule (3.c); location of landings, skid trails and fire trails (3.d); treatment of waste materials (3.f); and stream protection (3.g).

In the non-industrial category, observations of rules not being fully implemented were made 24 times out of 360 occasions where rules were applicable. Of these 24 occasions, road maintenance rules (4.d) and road construction rules (4.c) were not fully implemented six times each. The location of landings, skid trails and fire trails rule (3.d); stream protection rule (3.g) and maintenance of productivity and related values rule (3.h) were not fully implemented three times each. The remaining three occasions were the treatment of waste materials rule (3.f); road specifications and plans rule (4.b) and the site specific management practice rule (8.c).

A statewide summary of which rules were not fully implemented or maintained based strictly on rule implementation is contained in table 2. An evaluation of which rules are most likely to not be fully implemented or maintained reveals that road maintenance and road construction make up 67% of the rule implementation issues.

Table 2. Summary of which Idaho forest practices rules were not fully implemented or maintained, and the rate (percentage) at which these issues occurred.

Rule	Issue Occurrence Rate
Road maintenance (4.d)	50%
Road construction (4.c)	17%
Landing and trail location (3.d)	10%
Stream protection (3.g)	8%
Productivity and related values (3.h)	5%
Soil protection (3.c)	3%
Treatment of waste materials (3.f)	3%
Road specifications and plans (4.b)	2%
Site specific management practices (8.c)	2%

The extent to which the Idaho forest practices rules are implemented was estimated on a rule-by-rule basis. These data indicate that the rate of rule implementation on federal and non-industrial sales has increased since the 1988 and 1992 audits. The rate of rule implementation on state and industrial sales appears to be relatively constant at approximately 96%. This data also indicates that if an Idaho forest practices rule was not fully implemented or maintained, it was a road rule 69% of the time and a timber harvest or stream protection zone-related rule 31% of the time.

Rate of Rule Effectiveness

As with rule implementation, we first evaluated the rate of effectiveness of individual rules on a rule-by-rule basis. In this discussion, we are only evaluating the effectiveness of practices that were properly applied and maintained. The impact of instances where rules are not fully implemented or maintained is addressed in the "Pollutant Delivery" section of this chapter.

In federal sales we observed ten instances of rule ineffectiveness, five instances on state and industrial sales and three instances on non-industrial sales. To estimate the rate at which the 1992 forest practices rules were effective when properly implemented and maintained, we divided the number of times a practice was observed to be functioning by the number of times it was applicable. The effectiveness rate of the Idaho forest practices rules ranged from 98% to 99% across the four land ownership categories. We estimate the rate of effectiveness in each land ownership category remained essentially unchanged from the 1992 (Hoelscher et al. 1993) and 1988 (Harvey et al. 1989) audit results. Table 3 provides a comparison of rule implementation between the last three audits.

Table 3. Comparison of Idaho forest practices rule effectiveness rates (percent) between federal, state, industrial and non-industrial land ownership categories from the last three audits.

Ownership	1988 Audit	1992 Audit	1996 Audit
Federal	99%	99%	98%
State	98%	98%	99%
Industrial	99%	99%	99%
Non-industrial	--	99%	99%

Geologic Summary

The sales which were evaluated in the 1996 forest practices audit were located on nine geologic bedrock types. The geologic conditions and character of these bedrock types contribute to the stability of the land on which timber harvest and roading activities occur. An understanding of the geologic nature of the audited sales is important when evaluating the impacts of sediment delivery (second objective of the audit) and in making recommendations for rule or administrative revisions (third objective of the audit). The bedrock types encountered in the 1996 audit are briefly summarized below.

Bedrock type: glacial till

Glacial till is typically a poorly sorted, non-stratified, heterogeneous mixture of particle sizes from clay to gravel and sometimes boulders. The rock materials composing the till are derived from the bedrock that the ice has overridden. Till is deposited directly from ice often with a fabric of oriented, parallel and elongated stones. Natural, undisturbed slopes tend to be well packed due to the overlying weight of ice. On constructed surfaces, such as timber sale roads and landings, the till material compacts well and is bound together by both the varying particle size and the clay minerals present. Erosion of the constructed surfaces, aside from wet road rutting, is minimal due to the particle packing and the clay mineral binders.

Bedrock type: decomposed granite

Decomposed granite, or “grus,” is the fragmental product of in situ granular disintegration of granite or granitic rock due to physical or mechanical weathering processes. Such weathering is brought about by stresses originating within rocks and by stresses applied externally. The relief of these stresses produces fractures, joints and exfoliation. Rainwater and snowmelt freeze and thaw in these openings and, over time, physically tear the rock apart. The grus produced from such a process is identical to the parent rock only in much smaller fractions. The chemical alteration of the rock components varies from none to very little. While fine grain sizes may be produced by this process, there are no binding agents, such as clay minerals, present. The grus material when used to construct a timber sale road or landing does not compact well and can be extensively eroded by running water. Also, the constant pounding of heavy traffic can cause the relatively unconsolidated, unbound road material to fail.

Bedrock type: altered granite

Altered granites are produced by chemical weathering. Chemical weathering is the decomposition of rocks by surface processes that change the original chemical and/or mineral composition of the weathered material. The weathered product has a composition different from that of the original rock. Chemical weathering can involve solution, oxidation-reduction, ionic exchange, hydrolysis, carbonation, hydration or chelation of constituent minerals. The altered granites are usually high in clay mineral content, and timber sale roads and landings constructed from this altered material tend to pack well, are clay bound, and resist surface erosion. Heavy traffic will cause ruts on wet surfaces, but the overall roadbed is usually quite stable.

Bedrock type: metamorphic rocks

The metamorphic rocks of the Belt Supergroup in northern Idaho are usually greenschist facies siltstones, mudstones and argillites with hard, siliceous, vitreous quartzites. These rocks tend to be indurated, angularly fractured, and tough. These rocks do not weather easily and usually only a rind or fragment surface shows weathering. These rocks produce a good material for the construction of timber sale roads and landings. The hardness, toughness and angularity produce a very durable road bed that is relatively resistant to erosion by surface water. In fact, this material is often used as a surfacing “armor” on established roads.

Bedrock type: alluvium

Alluvium is a general term for silt, sand, gravel, or similar unconsolidated detrital material deposited by streams. The material can be either sorted or unsorted. There is usually no textural pattern to the alluvial material. Alluvium tends not to pack tightly and therefore leaves interstitial spaces between particles. These interstices can become filled with water (saturated) and then the alluvial material becomes unstable and subject to failure. Timber sale roads and landings constructed from alluvial material are susceptible to failure by over-saturation and the lack of a binding agent.

Bedrock type: sedimentary rocks

There are numerous types of sedimentary rocks, each with their own special characteristics and properties. The sedimentary rocks encountered in the audited timber sales, for the most part, were phosphorites, cherts, and conglomerates. Each of these particular sedimentary rock types are susceptible to weathering. Phosphorites tend to disaggregate into various grain sizes while the associated siliceous chert remains hard and produces hard, angular fragments. Roadways made from this material tend to pack tight and are resistant to erosion and failure, probably due to particle size and chemistry, and to armor plating with the hard chert. Conglomerates decompose to their individual constituents plus a clay matrix. Roadways made from this type of material tend to be resistant to erosion even though the wetted surface may rut.

Bedrock type: basalt

Basalt is a wide-spread, very hard, ferromagnesian lava. Basalt tends to fracture into angular fragments of varying sizes. Basalt is slow to weather but it can weather completely to clay minerals due to the lack of quartz in the rock. Typically, residue of basalt weathering is reddish. This color is due to iron oxides formed from the ferromagnesian mineral content. The angularity, toughness, and hardness characteristics make basalt a good material to use in road construction. The clay weathering products tend to help bind the material together.

Bedrock type: lacustrine sediments

Lacustrine sediments are sedimentary deposits consisting of material deposited on the bottom of a lake, in this case, a glacial lake. The deposits are typically sorted and show some stratification. The sorting occurs laterally in the deposit and not vertically. That is, the coarser fraction occurs nearer the lake margins while the fines, including clay, occur in the middle. Marginal sediments (near the lake edges) contain very little clay minerals and provide a substandard material for road construction. The material does not compact well and does not contain a binding agent, thereby making the roadway susceptible to erosion and water saturation. Clay sediments in the middle of the lake deposit contain very little aggregate material, causing the constructed roadways to be slippery and relatively fluid.

Bedrock type: dredge tailings

Dredge tailings are usually well-rounded gravel-, cobble-, and boulder-sized materials left after a placer dredge works a stream channel. The tailings deposits are poorly sorted, unconsolidated, and devoid of fines and clay minerals. Timber sale roads constructed from this material are permeable, porous and unstable. The road surfaces are highly erodible and subject to failure due to the unstable roundness of the dredge material.

Table 4 presents the audited sales by bedrock type and describes the suitability of on-site materials for road construction. More detailed descriptions of the geologic conditions observed at each audited sale are provided in appendix F.

Table 4. Summary of bedrock types and character of on-site construction materials encountered during the 1996 forest practices audit.

Audit No.	Bedrock Type	Geologic Character of Roads, etc.
Stable geologic conditions, good construction materials available on-site		
F-13, S-5	glacial till	generally good, low erosion potential due to clay content
S-9(cutting unit 3), N-A	altered granite	generally good, low erosion potential due to clay content
F-2, F-4, F-9, S-6, S-9 (cutting units 1, 2), S-32, I-7, I-10, I-12, I-16, I-17, I-18, I-19, N-4, N-5, N-6, N-12, N-13, N-C	metamorphic rocks	generally good due to toughness of rock and angularity, good armor
F-3, S-12	sedimentary rocks	generally good, low erosion potential due to clay content
S-24, S-29, S-30, I-20, N-3	basalt	generally good due to hardness, toughness and angularity
Unstable geologic conditions, poor construction materials available on-site		
F-1, F-11, F-14, S-13, S-28, I-6, I-9, N-15	decomposed granite	generally poor due to lack of binding agents in gravelly deposits
N-B	fluvial deposits	generally poor due to low degree of compactability
F-8	alluvium	generally poor due to low degree of compactability
F-19	dredge tailings	generally poor due to lack of fines and resulting high permeability

Pollutant Delivery

Sediment is the primary pollutant observed to have been eroded off-site and/or delivered to stream channels in the 1996 audit. Slash, although noted in stream channels on several occasions, was not observed to be causing water quality problems. No petroleum products, chemicals or other waste materials from forest practices were observed to have been delivered to stream channels. Therefore, we address only sediment delivery in this discussion.

Table 5 summarizes geologic and stream channel conditions for timber sales where major sediment delivery was noted from forest practices activity. Table 6 summarizes geologic and stream channel conditions for timber sales where minor sediment delivery was noted from forest practices activity. These tables contain the timber sales where sediment delivery was directly attributable to insufficient forest practices rule implementation or effectiveness. Sediment delivery to stream channels was observed in 20 of the 40 sales audited. Two federal sales were observed to have sediment delivery from forest practices as did six state sales, seven industrial sales and five non-industrial sales. Sediment delivery attributable to forest practices was aggravated in four sales due to natural events or activities other than timber harvest activities. Of the sales having major sediment delivery, nine occurred on stable geology and four occurred on unstable geology. Of the sales having minor sediment delivery, four occurred on stable geology and three occurred on unstable geology. Roading and road rules (rule 4) were cited as the issue 84% of the time when sediment delivery occurred. Timber harvesting and stream protection zone rules (rule 3) were cited as the issue 16% of the time when sediment delivery occurred. Rule 3 was revised in 1996. Any conclusions and recommendations made at this time concerning rule 3 would be premature.

Major sediment delivery from forest practices to stream channels was observed in 33% of the sales audited and minor sediment delivery in 17% of the sales audited. Observing sediment delivery in 50% of the sales audited seemed to contradict the findings from the rule implementation (statewide average rate of 97%) and effectiveness (statewide average rate of 99%) assessments. This contradiction can be explained by the fact that it only takes one failed culvert, water bar or eroding skid trail to deliver an observable amount of sediment to a stream channel. In contrast, one such failure accounts for very little, percentage-wise, when there are hundreds of rule applications on any given timber sale. Where practices are totally implemented and maintained, we observed no sediment delivery from forest practices. Table 7 lists timber sales where all of the applicable rules were implemented and effective, and/or, no sediment was delivered to stream channels, draws or floodplains. Fifteen of these sales occurred on stable geology, while five occurred on unstable geology. Based on these findings, the Idaho forest practices rules control sediment delivery on stable ground to a much greater extent than when applied on unstable ground.

Table 5. Summary of geologic stability, Rosgen (1994) channel types and stream channel stability ratings on timber sales where major sediment delivery was noted from forest practices activity.

Audit No.	Geologic Stability	Rosgen Channel Type		Stability Rating		Comments
		Above sale	Below sale	Above sale	Below sale	
F-1	unstable	A3a	A3	Poor	Poor	95 runoff
S-9	stable	A2a	A5	Good	Fair	
S-28	unstable	A4/5	B5	Fair	Fair	
S-29	stable	A3/4	A5	Fair	Fair	
S-30	stable	---	A3	---	Fair	grazing
S-32	stable	C5	C5	Fair	Fair	
I-17	stable	A4/5a	A4a	Poor	Poor	
I-18	stable	A4a+	A4/5	Excellent	Poor	
I-19	stable	A3	A3/1	Poor	Poor	
N-13	stable	B4	B4	Fair	Fair	
N-15	unstable	A3	A4	Fair	Fair	
N-B	unstable	B6	C6	Good	Good	
N-C	stable	B4	B4	Fair	Fair	

Table 6. Summary of geologic stability, Rosgen (1994) channel types and stream channel stability ratings on timber sales where minor sediment delivery was noted from forest practices activity.

Audit No.	Geologic Stability	Rosgen Channel Type		Stability Rating		Comments
		Above sale	Below sale	Above sale	Below sale	
F-19	unstable	A4/5a	A3	Fair	Good	fire line
S-24	stable	C6	C5/6	fair	fair	road closure breach
I-9	unstable	A3a	A3	Excellent	good	
I-10	stable	A3a	A5	Good	Fair	
I-12	stable	B5	B5	Good	Fair	
I-16	stable	B4	B4/5	Fair	Fair	
N-12	stable	A4a	A4a	Good	Good	

Table 7. Summary of geologic stability, Rosgen (1994) channel types and stream channel stability ratings on timber sales where all applicable rules were implemented and effective, and/or, no sediment was delivered to channels, draws or floodplains.

Audit No.	Geologic Stability	Rosgen Channel Type		Stability Rating		Comments
		Above sale	Below sale	Above sale	Below sale	
F-2	stable	--	--	--	--	no channels in sale area
F-3	stable	A4a	A4/5	poor	poor	grazing impacts to channel
F-4	stable	--	--	--	--	no upstream access
F-8	unstable	A	B4	excellent	good	no water/slide site above
F-9	stable	A4a	A5a	fair	fair	inactive channel from culvert
F-11	unstable	A4	A5	good	good	
F-13	stable	A2a	A3a	good	poor	grazing impacts to channel
F-14	unstable	A4/5	A3/4	fair	fair	
S-5	stable	--	--	--	--	no channels in sale area
S-6	stable	A2a	A3	excellent	good	historic logging
S-12	stable	A5	B5	poor	poor	
S-13	unstable	A4/5	A4	fair	good	
I-6	unstable	bog	bog	excellent	excellent	
I-7	stable	A4/5	C5/6	poor	poor	historic logging
I-20	stable	A3a	A4a	fair	fair	grazing impacts to channel
N-3	stable	A2/1	B3/2	fair	fair	slash in class II
N-4	stable	B2/3	B2/3	good	good	
N-5	stable	--	--	--	--	grazing impacts to channel
N-6	stable	--	--	fair	fair	residential construction impacts
N-A	stable	B	A	good	good	

Miscellaneous Findings

The evaluation of rule implementation, rule effectiveness and pollutant delivery answers the first two questions of management practice effectiveness monitoring. It also fulfills the first two objectives of the forest practices audit. However, an evaluation strictly focused on a rule-by-rule assessment of forest practices does not address all of the issues encountered in the 1996 audit. The issues addressed in this section of the report have been identified through discussions and observations of the audit team and timber sale representatives. Not all of these issues can be addressed by forest practices rules. However, since the integrity of a stream is influenced by all of the activities in its watershed, these miscellaneous findings are pertinent from a water quality perspective.

Road maintenance responsibility

In addition to issues directly relating to the forest practices rules, the issue of road maintenance responsibility was noted in 20 (50%) of the audited sales. Out of these, two were federal sales, five were state sales, six were industrial and seven were non-industrial sales. The overall issue of road maintenance responsibility is made up of two aspects. One aspect is multiple use, particularly on mixed ownership (i.e. home site, state, county and recreation) roads. The forest practices rules are not designed to deal with multiple use or mixed ownership roads. The second aspect is land owner versus operator responsibility. The forest practices rules can be applied to this aspect of road maintenance responsibility.

Grazing and mining impacts

Grazing and mining activities were identified as issues in 13 (33%) of the timber sales audited in 1996. Of these, four were federal sales, four were state sales, three were industrial and two were non-industrial sales. Sediment delivery to stream channels and streambank trampling were the primary impacts observed by the audit team. The forest practices rules are not intended to deal with grazing and mining water quality issues. On eight of these sales, however, the agencies which administer the forest practices rules also administer grazing and mining activities.

Pre-FPA logging

The Idaho Forest Practices Act (*Idaho Code*, Title 38, Chapter 13) was enacted in 1974. The *Rules and Regulations Pertaining to the Idaho Forest Practices Act* first became effective on March 17, 1976, with the approval of the state legislature (Braun 1979). Forest practices which were conducted prior to this time were considered pre-FPA logging. Pre-FPA logging still impacting water quality was observed and noted on one federal, one state, three industrial and three non-industrial timber sales. These sales comprised 20% of the sales audited. Sediment delivery is the primary water quality impact from the pre-FPA logging. Reduced large woody debris and shading were observed as secondary impacts.

Road closure breaching

Road closure breaching and unauthorized vehicular traffic were noted as factors contributing to increased road maintenance requirements on three of the State and two of the industrial timber sales audited in 1996. These sales make up 13% of all audited sales. Three of these five sales were observed to be delivering sediment to streams. These findings probably underestimate the extent of road closure breaching statewide. In discussions with the timber sale representatives, road closure breaching was considered a common issue with the majority of the federal, state and industrial land managers.

Water quality and fire management conflicts

Conflicts between water quality and fire management were observed on one federal, one state and one industrial timber sale. The conflict was the placement or size of fire lines in stream protection zones which resulted in sediment delivery or reduced stability of stream channels. This issue is addressed in rule 3.d of the forest practices rules (rule 030.04 of the 1996 version) but is not addressed in the *Rules and Regulations Pertaining to the Idaho Forestry Act and Fire Hazard Reduction Laws, Idaho Code Title 38, Chapters 1 & 4* (Idaho State Board of Land Commissioners 1988).

Fill compaction

Insufficient compaction of road and culvert fill was noted on two timber sales, one state and one industrial. This issue, although not occurring very frequently, is very important from a water quality perspective. Improperly compacted fills may take years to become evident or to fail, but when they do, they generally trigger major sediment delivery directly to streams. The fill compaction rules are particulary difficult to enforce since on-site inspection of each fill is not physically feasible.

Inappropriate use of variances

One non-industrial sale had a variance issued to it which subsequently failed and lead to major sediment delivery to a stream. On a number of other occasions, however, variances were granted but were not documented. These other occasions were rated as rule implementation or effectiveness issues on the primary rule which applied to the situation. Therefore, a single instance of variance failure underestimates the magnitude of this issue on a statewide basis.

Cumulative effects of timber sales and other land uses

The cumulative effects of timber sales within a given watershed were not addressed as an objective of the 1996 forest practices audit. However, cumulative effects (i.e. roads, recreation, home sites) were observed as an issue on one non-industrial sale and were discussed as an issue during the post-audit summary of a number of other sales.

Preoperational inspections were conducted on 27 (68%) of the sales audited. Preoperational inspections were done on all federal and state sales, two industrial sales and five non-industrial sales. These inspections are not required by the Forest Practices Act. They were, however, widely conducted and were considered to have been beneficial in the prevention of stream channel or water quality impacts, particularly in the non-industrial sales.

Road planning rule

One non-industrial sale was observed to have a road planning rule implementation issue. However, evaluation of the road planning rules (4.b) in the 1996 audit was not feasible overall since written plans generally were not available at the time of the audit and verbal plans were not documented. The audit team was repeatedly faced with the question “when does an idea, approach or concept become a plan?” There is no definition of what constitutes a plan in the rules, therefore a plan may be anything from a concept to a written document. From a water quality standpoint, the absence of a definition of a plan is not an issue. The lack of this definition does make evaluation and enforcement of rule 4.b virtually impossible.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

Forest Practices Rule Implementation

Conclusions

The rates of forest practices rule implementation increased across all land ownership categories when the 1996 rate was compared to the 1988 and 1992 rates (please note table 1). These results are not statistically robust, but do suggest a postive trend. When averaged statewide, the rate of rule implementation increased from 93% to 97%. On a rule-by-rule basis, little improvement in the rule implementation rate can be anticipated.

Federal timber sales are now beginning to exhibit the results of increased riparian zone protection requirements. These requirements generally preclude forest practices in riparian zones and therefore exceed the Idaho Forest Practices Act. The state and industrial implementation rates remain relatively unchanged. The rule implementation rate for the non-industrial timber sales continues to increase, up to 93% in 1996.

Recommendations

Despite little anticipated improvement in rule implementation rates, we recommend that pre-operational inspections be conducted on more non-industrial timber sales. Ideally, all non-industrial sales would receive a preoperational inspection. Since thousands of non-industrial sales occur each year and no increase in IDL staff is expected, this probably will not happen. A mandatory operator certification program for loggers with a history of non-compliance should be considered as an additional option within existing enforcement procedures. We also recommend State Forester Forum forms and instructional brochures be placed in areas of local IDL offices where they are readily available to the public.

Forest Practices Rule Effectiveness

Conclusions

We found that, when properly applied and maintained, the management practices described in the Idaho forest practices rules are effective 99% of the time. In contrast to this rule-by-rule evaluation, we also found that 50% of the sales audited had sediment being delivered to streams or stream channels as a result of forest practices activity (please note tables 5 and 6). This apparent inconsistency can be attributed to management practice design, construction, maintenance, rule interpretation or other factors. This illustrates the need to consistently implement **all** applicable management practices. The impact of this sediment delivery on the beneficial uses of these streams was not assessed. The sediment we observed being delivered was primarily from roads with comparatively minor contributions from harvest systems. In unstable geologic conditions, combinations of individual road management practices (beyond what is currently required) are needed to further reduce sediment delivery.

By design, the road rule is descriptive rather than prescriptive in nature. It is effective at minimizing sediment delivery, if correctly implemented in **all** applicable situations. Effective rule implementation in varying geologies is dependent on operator or landowner understanding of geologic conditions and the many road management practices that may be used.

Recommendations

We recommend the road rule (1996 Rule 040) be modified to account for differences in geologic stability and to make them easier to understand. We also recommend that training should emphasize the need to apply multiple practices on granitic soils. Figure 1 shows approximate locations of the Belt Supergroup (generally stable and good road construction materials), and Figure 2 shows approximate locations of the batholitic granite rocks (generally unstable and poor road construction materials). More detailed descriptions of these rock types are contained in appendix F. As a starting point for discussion, we are suggesting the Rule 040 text modifications contained in appendix G (please note that these suggested changes also address our concerns about road fill compaction and road planning).

We audited the 1992 timber harvest rule. This rule was modified in 1996 to address findings from the 1992 audit and therefore was not audited in the latest form. We are making no recommendations concerning the current timber harvest rule (1996 Rule 030).

Road Maintenance Responsibility

Conclusions

Inadequate road maintenance on multiple use or ownership roads was noted on half of the timber sales we audited. Road maintenance responsibility was also noted to be an issue between logging operators and land owners. Inadequate road maintenance is a contributing factor in sediment delivery to streams and stream channels. This issue cannot and should not be addressed by the Idaho forest practices rules alone. We conclude that these are administrative issues that need to be addressed by IDL (landowner-operator issue) and an interagency and interdisciplinary group (mixed ownership and issues concerning other uses).

Figure 1. Approximate locations of Belt Supergroup rocks in Idaho.

Figure 2. Approximate locations of batholitic granite rocks in Idaho.

Recommendations

We recommend that the road management initiative that was begun under Section 208 of the *Clean Water Act* be restored, updated and implemented. Representatives of Idaho cities, counties, road districts, private organizations, state and federal agencies all provided assistance to the development of two handbooks (Levinski 1982a and 1982b) of management practices for roads. The groups that were involved and the practices that were proposed could serve as the basis for addressing this issue and promoting use of cooperative road maintenance agreements. We further recommend that this initiative have the involvement of the governor's office for coordination and directive purposes. In instances where road maintenance responsibility is an issue between the landowner and logging operator, we recommend that the responsibility should be clearly defined in a contract or agreement between the parties.

Grazing and Mining Impacts

Conclusions

Management practices for grazing and mining activities are beyond the scope of the Idaho Forest Practices Act. However, the agencies which administer silvicultural activities on public and endowment lands also administer grazing and mining.

Recommendations

We recommend that public and endowment land managers implement and evaluate grazing and mining practices consistent with forest practices and to a greater extent than currently done.

Pre-FPA Logging

Conclusions

In 20% of the timber sales we audited, logging done prior to 1974 was still delivering sediment to streams and stream channels. Land ownership has changed since the logging occurred in many of these instances. We conclude that pre-FPA logging is still impacting Idaho's water quality and that steps should be taken to repair these situations.

Recommendations

We recommend the cumulative watershed effects process (IDL 1995) or other watershed analysis and monitoring process should be used to identify areas impacted by pre-FPA logging. Once these areas are identified and described, existing restoration tools, programs and funding sources need to be used to fix the problems. We recommend addressing these problems when new timber sales are being proposed in watersheds where in-stream beneficial uses are impaired.

Road Closure Breaching

Conclusions

Road closure breaching and unauthorized vehicular traffic is a common problem for the majority of federal, state and industrial land managers. It is a problem caused by parties other than the landowner which increases the amount of road maintenance needed. Increasing the number of regulations dealing with road closures probably would not reduce the problem.

Recommendations

We recommend that land managers increase their efforts to explain why road closures are needed on a site-specific basis. When a commonly or traditionally used road is to be closed, information should be supplied at the closure point which explains why the road is to be closed and what access is allowed, not just what is prohibited.

Water Quality and Fire Management Conflicts

Conclusions

We observed instances where fire management actions resulted in sediment delivery to streams or stream channels in three of the timber sales we audited. The forest practices rules address this issue but the fire hazard reduction rules do not. Fire management activities are conducted by the same agencies that conduct forest practices.

Recommendations

We recommend that fire managers be made more aware of water quality issues. We suggest that the Idaho fire hazard reduction rules be modified to require consideration of water quality in the placement and magnitude of fire management practices.

Fill Compaction and Road Planning Rules

Conclusions

The road construction and maintenance rule (1996 Rule 040) was found to be difficult to interpret and enforce from the aspects of road planning and fill compaction around culverts and on steep hillsides. Forest practices advisors and timber sale administrators cannot always be on-site to provide rule interpretation, recommendations or enforcement. The rules do not provide a definition of what constitutes a plan, thereby making enforcement subjective. The 1996 audit did not provide the information necessary to conduct a detailed assessment of fill compaction issues. However, the significant runoff experienced in 1995, 1996 and 1997 provides an opportunity to conduct this detailed assessment.

Recommendations

We recommend IDL and the Forest Service assess road fill stability in their internal audits. We suggest consolidating the road planning and construction rules to make them easier to understand. In appendix G we provide a revision of the 1996 road rule text as a suggestion.

Variances

Conclusions

A variance to the forest practices rules was found to be a water quality issue on only one timber sale we audited. We anticipate that more variances will be requested as a result of the 1996 rule modifications.

Recommendations

We recommend that forest practices advisors, timber sale administrators and land managers be reminded that the practices allowed under a variance need to be equivalent or better than those described in the rules. We also recommend that variances should be issued in a very prudent, judicious manner and always documented in writing.

Cumulative Effects of Timber Sales and Other Land Uses

Conclusions

We conclude that a number of factors are contributing to increased cumulative watershed effects from forest practices. These factors include multiple harvests, mixed or changing land ownership and fragmentation of timber lands. It is probably that cumulative effects will continue to increase.

Recommendations

We recommend that more preoperation inspections and watershed analyses be done prior to new timber sales. These may be done using the Idaho CWE process (IDL 1995) or other appropriate methods.

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APPENDIX A

Timber Sale Data Request Form

Sale name or identifier:____

Legal description: Section_____, Township_____, Range_____, County_________________

Predominant harvesting method:____

Is a Class I or Class II stream contained in the sale unit?: Yes_____ No_________

Distance of closest harvested area to a Class I or Class II stream:
__ feet

Data any harvest or roading activities started (month and year):______________________

Closest city to sale unit (please circle one):

Bonners Ferry Sandpoint Coeur d'Alene
Moscow Orofino Lewiston
Grangeville McCall Boise
Stanley Ketchum Salmon
Challis Idaho Falls Pocatello
Twin Falls

Approximate drive time to this city:____

Person to contact for further information on this sale:______________________________

Name:____

Phone:____

Fax:____

APPENDIX B

Appendix B. Locations of timber sales audited in 1996.

Audit No.	Sale Name	Section	Township	Range	County
F-1	Wrenn II Salvage	10-12	6N	8E	Elmore
F-2	Blue Creek Bay Negotiated	31	49N	2-3W	Kootenai
F-3	Red Sage 2	25	13N	25E	Lemhi
F-4	Bookum	30-32	45N	6E	Shoshone
F-8	North Creek Timber Sale	32-33	61N	3E	Boundary
F-9	Rocky Mountain	28-29	26N	21E	Lemhi
F-11	Hathaway Timber Sale	33	59N	5W	Bonner
F-13	Red Sage 4	30	13N	26E	Lemhi
F-14	Crooked River Salvage	31-33	6-7N	7-8E	Boise
F-19	Dudley Creek Timber Sale	34-36	49N	4E	Shoshone
S-5	Whitetail Flats	32	59N	4W	Bonner
S-6	West Tarlac	17	58N	3W	Bonner
S-9	Dem Bugs	10	37N	4E	Clearwater
S-12	Rasmussen Ridge	9,16	6S	43E	Caribou
S-13	Easter Creek	34	5N	5E	Boise
S-24	Placer Creek	11	36N	4E	Clearwater
S-28	Dendroctonous Ridge	11	6N	5E	Boise
S-29	Bond Creek	16	45N	1E	Benewah
S-30	Deer Creek Road	31	37N	3E	Clearwater
S-32	Rogers Creek	22	41N	1E	Clearwater
I-6	Crown Pacific Inland	18	54N	2W	Bonner
I-7	Potlatch Corporation	24	46N	1E	Shoshone
I-9	Idaho Forest Industries	15	53N	2W	Kootenai
I-10	Plum Creek	23	45N	5E	Shoshone
I-12	JD Lumber Company	12	54N	5W	Bonner
I-16	Idaho Forest Industries	29	49N	2E	Shoshone
I-17	Plum Creek	26	45N	4E	Shoshone
I-18	Louisiana Pacific	23	48N	3E	Shoshone
I-19	Crown Pacific	25	48N	1E	Shoshone
I-20	Crown Pacific Inland LP	28	46N	1E	Benewah
N-3	Boyer	16	35N	1W	Nez Perce
N-4	Marsan	30	50N	3W	Kootenai
N-5	Kopet	16	50N	4W	Kootenai
N-6	White	19	49N	4W	Kootenai
N-12	Erickson	29,32	50N	4W	Kootenai
N-13	Irvine	30	50N	4W	Kootenai
N-15	Walden	24	56N	4W	Bonner
N-A	Henderson	3	63N	1E	Boundary
N-B	Wromar	27	65N	2E	Boundary
N-C	Karlberg	2	61N	2E	Boundary

APPENDIX C

IDAHO FOREST PRACTICE EVALUATION WORKSHEET

DATE: ______________________

LOCATION

PROJECT NAME: ____

FPA FOREST REGION: North ( ) South ( ) COUNTY: ______________

DESCRIPTION (Sec., T, R): ____________________________________

FEDERAL ( ) STATE ( ) PRIV. INDUST. ( ) PRIV. NON-INDUST. ( )

OWNER: ____

OPERATOR: ____

PHYSICAL ENVIRONMENT

ELEVATION (ft): Mean ________________ Range ______________________

SLOPE (%): Mean ________________ Range ______________________

CLIMATE: Annual Precipitation (in) __________ Aspect _____________________

Antecedent Conditions ____

GEOLOGY AND SOILS (describe): _________________________________

____

VEGETATION: Forest Stand _______________________________________

Riparian Vegetation _____________________________________

PRACTICES

STAGE: Road Construction ( ) Harvest ( )

Slash Management ( ) Reforestation ( )

MILES OF NEW ROAD CONSTRUCTION: ________ RECONSTRUCTION: __________

ROADS (Describe): ____

____

____

____

____

____

include culvert spacing, road slope (0-5%, 5-10%, 10%+), prism width, sideslope %, aspect, road age, erosion practices (*e.g.* rolling dips, inslope, outslope)

HARVEST (describe): Clearcut _______ Seed Tree ________ Shelterwood _______

Over Story Removal _______ Individual Selection ___________

____

____

____

include acres, yarding system, number of landings and locations

SITE PREPARATION AND REFORESTATION (Describe): ____________________

____

HAZARD RATING: ____

(slope)(geologic type)(yarding system) Range: 1-45

Slope:		Geologic Type:	
<45%	-1	Hard metamorphics, glacial tills, hard sediments, and basalts	-1
45-70%	-2	Soft metamorphics, soft sediments, pyroclastics, and hard granitics	-2
>70%	-3	Glacial outwash, decomposed (low clay content) granitics	-3

Yarding System:	
Aerial	-1
Skyline	-2
Jammer & High Lead	-3
Rubber tire tractor	-4*
Track tractor	-5*

* *Reduce 50% if project on 12 inches or more snow or frozen ground.*

BMP COMPLIANCE AND EFFECTIVENESS

FOREST PRACTICES ACT RULE (EFFECTIVENESS SCALE)	RATING COMP	RATING EFX	COMMENTS
030.03 SOIL PROTECTION			
a. SKIDDING EROSION & COMPACTION			
45% SKIDDING LIMITATION			
b. 30% SKID TRAIL LIMITATION			
c. MINIMUM SKID TRAIL WIDTH & NUMBER			
TRACTOR SIZE APPROPRIATE			
d. CABLE YARDING			
030.04 LOCATION OF LANDINGS & TRAILS			
a. LOCATE LANDINGS & TRAILS OUT OF SPZ			
b. SIZE OF LANDINGS			
c. LANDING FILL STABILIZATION			
030.05 DRAINAGE SYSTEMS			
a. TRAILS STABILIZATION			
b. LANDINGS DRAINAGE			
LANDINGS STABILIZATION			
030.06 TREATMENT OF WASTE MATERIAL			
a. SLASH & DEBRIS OUT OF CLASS I			
b. SLASH & DEBRIS OUT OF CLASS II			
c. LANDINGS & TRAILS WASTE OUT OF SPZ			
d. OIL & FUEL OUT OF SPZ (3)			
030.07 STREAM PROTECTION			
a. LAKE RIPARIAN MGMT. PRESCRIPTION			
b. SKIDDING IN STREAMS			
c. TEMPORARY STREAM CROSSING			
d. CABLE SPZ CROSSING			
e.i. CLASS I SHADE & SOIL INTEGRITY			
e.ii. CLASS I 75% SHADE			
e.iii. CLASS I SPZ SHADE & FILTER			
e.iv. CLASS I LOD			
e.iv. CLASS II LOD			

BMP COMPLIANCE AND EFFECTIVENESS

FOREST PRACTICES ACT RULE (EFFECTIVENESS SCALE)	RATING COMP	RATING EFX	COMMENTS
030.08 MAINTENANCE OF RELATED VALUES			
b. CRITICAL AQUATIC HABITAT			
c. WET AREAS CONSIDERATION			
040.02 ROAD SPECIFICATIONS & PLANS			
a. PLAN ROADS TO MINIMIZE IN SPZ			
a. PLAN VEGETATION ROADS & STREAMS			
b. PLAN TO MINIMIZE ROAD WIDTH			
b. PLAN TO MINIMIZE CUT & FILL			
c. PLAN WASTE TO BE STABILIZED			
d. PLAN ROAD DRAINAGE			
e. PLAN RELIEF CULVERTS & ROAD DITCHES			
e. EROSION OF FILL			
e MINIMIZE SEDIMENT INTO STREAMS			
f.i. CULVERT SIZING			
f.ii. RELIEF CULVERT SIZING			
g. PLAN MINIMUM STREAM CROSSINGS			
g. PLAN CULVERT FISH PASSAGE			
h. PLAN REUSE & VARIANCE ON OLD ROADS			
040.03 ROAD CONSTRUCTION			
a. CONSTRUCTION FOLLOWED PLAN			
b. DEBRIS CLEARED FROM DRAINAGEWAYS			
c. STABILIZE EXPOSED AREAS			
d. COMPACT FILL NEAR STREAMS			
d. MINIMIZE SOFT & WOODY FILL			
e. STREAM CROSSING COMPLIANCE			
e. NO ROAD CONSTRUCTION IN STREAMS			
e. ROAD CONSTRICTION OF CHANNELS			
f. RETAIN OUTSLOPE & REMOVE BERMS			
g. QUARRY DRAINAGE			

BMP COMPLIANCE AND EFFECTIVENESS

FOREST PRACTICES ACT RULE (EFFECTIVENESS SCALE)	RATING C O M P	E F X	COMMENTS
040.03 ROAD CONSTRUCTION (CONTINUED)			
h. CROSS DRAINS & RELIEF CULVERTS TO MINIMIZE EROSION OF FILL			
h. INSTALL DRAINAGE INCOMPLETE ROADS			
h. RELIEF CULVERT GRADIENT (min. 1%)			
i. WET WEATHER CONSTRUCTION DELAYS			
j. OVERHANGING CUTS			
040.04 ROAD MAINTENANCE			
a. SIDECAST OUT OF STREAMS			
b. REPAIR & STABILIZE SEDIMENT HAZARDS			
c. **ACTIVE ROADS**			
c.i. CULVERTS & DITCHES FUNCTIONAL			
c.ii. SURFACE DRAINAGE & REMOVE BERMS			
c.iii. MINIMIZE SUBGRADE EROSION			
c.iv. DUST ABATEMENT OUT OF STREAM (3)			
d. **INACTIVE ROADS**			
d.i. DITCHES & CULVERTS CLEARED			
d.i. SURFACE DRAINAGE MAINTAINED			
d.ii. ROAD CLOSURE			
e. **ABANDONED ROADS**			
e.i. CONTROL SURFACE EROSION			
e.ii. DITCHES CLEANED			
e.iii. ROAD CLOSURE			
e.iv. BRIDGES & CULVERTS REMOVED			
040.05 WINTER OPERATIONS			
a. INSTALL SURFACE & CROSS DRAINAGE			
b. ROAD MAINTENANCE			
8.C2A SITE-SPECIFIC BMPS			

PROJECT SUMMARY

To what extent were the BMP's applied? ______________________________

____

____

Were the BMP's effective in preventing soil erosion? ______________________

____

____

Have pollutants been delivered to the stream(s) or potentially could they be? __________

____

____

Are there any implementation problems? ______________________________

____

____

Does this project suggest any rule changes? ____________________________

____

____

Does this project suggest any administrative changes? ____________________

____

____

What other nonpoint activities or natural factors are affecting the stream quality? _______

____

Stream Class: I ( ) II ( ) Class II SPZ (ft): ______________________

Minimum SPZ width (ft) protective of Class II stream? ____________________

STREAM CHANNEL AND RIPARIAN ZONE EVALUATION WORKSHEET

STREAM NAME:____ **STREAM CLASS: I ( ) II ( )**

REACH DESCRIPTION:___________________________________ **REACH LENGTH (ft):**________

ITEM RATED	STABILITY INDICATORS BY CLASSES							
RIPARIAN ZONE	**EXCELLENT**	**A**	**GOOD**	**B**	**FAIR**	**C**	**POOR**	**D**
UPPER BANKS								
Mass wasting	No evidence of past or potential mass wasting into stream channels.	6	Infrequent or very small. Mostly healed. Low future potential.	12	Moderate frequency or size. Some raw spots eroded during high flows.	18	Frequent or large. Sediment delivery nearly year long or imminent danger of same.	24
Bank protection from vegetation	>90% plant density. Vigor and variety suggests a dense, deep root mass.	2	70-90% plant density. Few species or low vigor suggests a less dense or deep root mass.	4	50-70% plant density. Fewer species or lower vigor form a discontinuous or shallow root mass.	6	<50% plant density. Still fewer species or lower vigor indicate a poor, discontinuous, or shallow root mass.	8
Stream surface shading	>75% stream surface shading.	1	50-75% stream surface shading.	2	25-50% stream surface shading.	3	Little or no stream surface shading.	4
Soil disturbance or sediment delivery	No raw soils or evidence of sediment delivery to the stream.	2	Some raw soils or slight sediment delivery to the stream.	4	Moderate raw soils or sediment delivery to the stream.	6	Raw soils abundant or obvious sediment delivery to the stream.	8
LOWER BANKS								
Bank rock content	>65% and large, angular boulders (>12") numerous.	2	40-65% and mostly small boulders to cobble (6-12").	4	20-40% and mostly in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes (<3").	8
Large organic debris. (Logs longer than one-half the channel width and functioning as flow deflectors or sediment traps).	Large quantities present. Stable in all flows.	2	Moderate quantities present. Moveable by flood flows.	4	Some present. Moveable at high flows.	6	Little or none present. If present, unstable in moderate flows.	8
Cutting	Little or none evident. Infrequent raw banks generally less than 6".	4	Some; intermittently at outcurves or constrictions. Raw banks up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs or sloughing evident.	12	Almost continuous cuts; some >24". Failure of overhangs frequent.	16
BOTTOM								
Consolidation or particle packing	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortment; easily moved.	8
Scouring or deposition	<5% of the bottom affected by scouring or deposition.	6	5-30% affected. Scour at constrictions or where grades steepen. Some deposition in pools.	12	30-50% affected. Scour at obstructions, constrictions, or bends. Some filling of pools.	18	>50% of the bottom in a state of flux or change nearly year long.	24
COLUMN TOTALS								

Add values in each column for a total reach score (A)_____+(B)_____+(C)_____+(D)_____ = _____

Reach score: ≤27=excellent; 28-54=good; 55-81=fair; ≥82=poor

STREAM CHANNEL AND RIPARIAN ZONE EVALUATION WORKSHEET

STREAM NAME: ____ STREAM CLASS: I ( ) II ( )

REACH DESCRIPTION: ____ REACH LENGTH (ft): __________

ITEM RATED	STABILITY INDICATORS BY CLASSES							
RIPARIAN ZONE	**EXCELLENT**	**A**	**GOOD**	**B**	**FAIR**	**C**	**POOR**	**D**
UPPER BANKS								
Mass wasting	No evidence of past or potential mass wasting into stream channels.	6	Infrequent or very small. Mostly healed. Low future potential.	12	Moderate frequency or size. Some raw spots eroded during high flows.	18	Frequent or large. Sediment delivery nearly year long or imminent danger of same.	24
Bank protection from vegetation	>90% plant density. Vigor and variety suggests a dense, deep root mass.	2	70-90% plant density. Few species or low vigor suggests a less dense or deep root mass.	4	50-70% plant density. Fewer species or lower vigor form a discontinuous or shallow root mass.	6	<50% plant density. Still fewer species or lower vigor indicate a poor, discontinuous, or shallow root mass.	8
Stream surface shading	>75% stream surface shading.	1	50-75% stream surface shading.	2	25-50% stream surface shading.	3	Little or no stream surface shading.	4
Soil disturbance or sediment delivery	No raw soils or evidence of sediment delivery to the stream.	2	Some raw soils or slight sediment delivery to the stream.	4	Moderate raw soils or sediment delivery to the stream.	6	Raw soils abundant or obvious sediment delivery to the stream.	8
LOWER BANKS								
Bank rock content	>65% and large, angular boulders (>12") numerous.	2	40-65% and mostly small boulders to cobble (6-12").	4	20-40% and mostly in the 3-6" diameter class.	6	<20% rock fragments of gravel sizes (<3").	8
Large organic debris. (Logs longer than one-half the channel width and functioning as flow deflectors or sediment traps).	Large quantities present. Stable in all flows.	2	Moderate quantities present. Moveable by flood flows.	4	Some present. Moveable at high flows.	6	Little or none present. If present, unstable in moderate flows.	8
Cutting	Little or none evident. Infrequent raw banks generally less than 6".	4	Some; intermittently at outcurves or constrictions. Raw banks up to 12".	8	Significant. Cuts 12-24" high. Root mat overhangs or sloughing evident.	12	Almost continuous cuts; some >24". Failure of overhangs frequent.	16
BOTTOM								
Consolidation or particle packing	Assorted sizes tightly packed or overlapping.	2	Moderately packed with some overlapping.	4	Mostly a loose assortment with no apparent overlap.	6	No packing evident. Loose assortment; easily moved.	8
Scouring or deposition	<5% of the bottom affected by scouring or deposition.	6	5-30% affected. Scour at constrictions or where grades steepen. Some deposition in pools.	12	30-50% affected. Scour at obstructions, constrictions, or bends. Some filling of pools.	18	>50% of the bottom in a state of flux or change nearly year long.	24
COLUMN TOTALS								

Add values in each column for a total reach score (A)_____+(B)_____+(C)_____+(D)_____ = _____

Reach score: ≤27=excellent; 28-54=good; 55-81=fair; ≥82=poor

BMP COMPLIANCE AND EFFECTIVENESS SCALES

COMPLIANCE SCALE

Y. Compliance with the rule
N. Noncompliance with the rule

EFFECTIVENESS SCALES

Scale 1: Sediment Delivery

1. Major and prolonged quantity of sediment delivered to Class I stream or delivery imminent, including from Class II stream.
2. a. Major and temporary or minor and prolonged quantity of sediment delivered to Class I stream or delivery imminent, including from Class II stream.
   b. Major and prolonged quantity of sediment delivered to Class II stream or delivery imminent.
3. a. Minor and temporary quantity of sediment delivered to Class I stream or delivery imminent, including from Class II stream.
   b. Major and temporary or minor and prolonged quantity of sediment delivered to Class II stream or delivery imminent.
4. Minor and temporary quantity of sediment delivered to Class II stream or delivery imminent.
5. Significant erosion and delivery of sediment to draws or floodplain. No sediment delivered to Class I or II streams.
6. Soils do not reach draws, channels, or floodplain.

Scale 2: Slash or Debris Treatment

1. Major quantity of slash or debris in Class I stream.
2. Minor quantity of slash or debris in Class I stream or slash or debris in Class II stream in quantity sufficient to depress DO of downstream Class I waters or with potential for transport to and blockage of downstream drainage structures.
3. Slash or debris removed from streams but likely to become entrained and transported to downstream drainage structures during stormflow.
4. Slash or debris removed or otherwise situated such that entrainment and transport are unlikely.

Scale 3: Hydrocarbon or Hazardous Waste

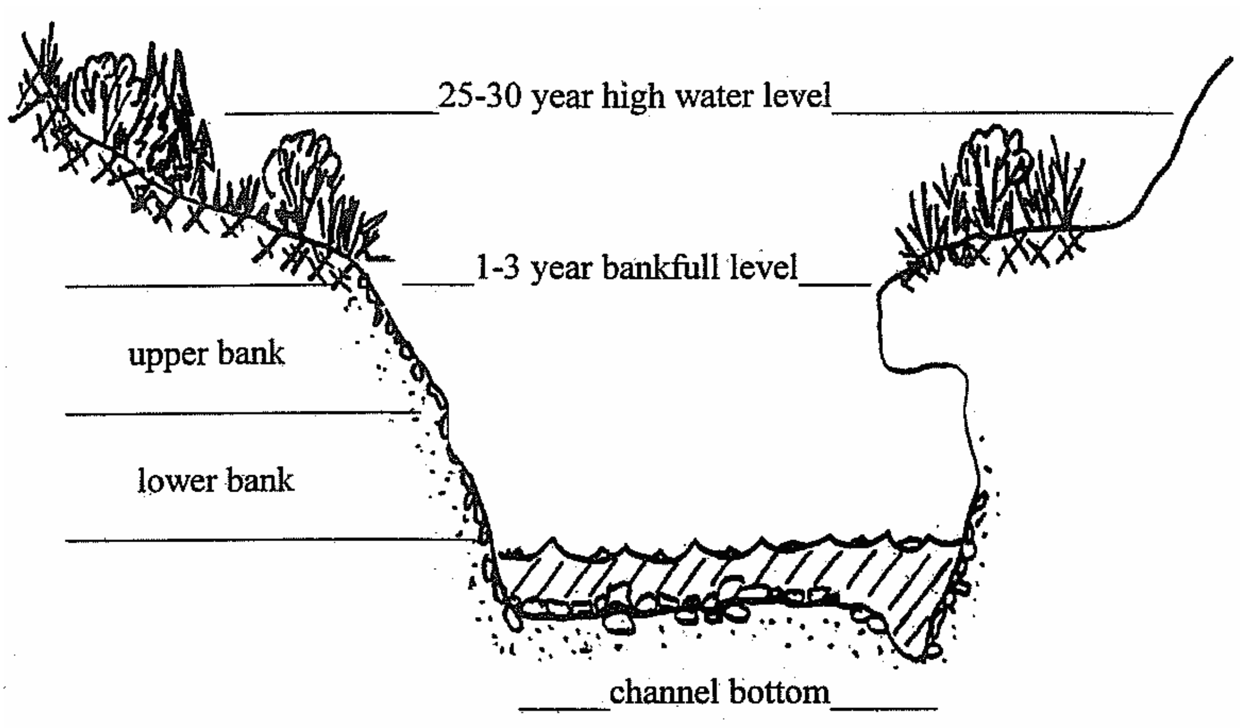
1. Hydrocarbons of hazardous wastes in stream.
2. Hydrocarbons of hazardous wastes in floodplain, draws, or other locations where it could readily contaminate waters.
3. Hydrocarbons of hazardous wastes isolated from streams.
4. Hydrocarbons of hazardous wastes not present.

Scale 4: Water Protection

1. Stream, lake, or wet area exposed to midday sunlight over substantial reach(es) or major and prolonged quantity of sediment delivered to stream, lake, or wet area or delivery imminent.
2. Stream, lake, or wet area exposed to midday sunlight for short reach(es) or major and temporary or minor and prolonged quantity of sediment delivered to stream, lake, or wet area or delivery imminent.
3. Stream, lake, or wet area exposed to midday sunlight occasionally or minor and temporary quantity of sediment delivered to stream, lake, or wet area or delivery imminent.
4. Little exposure to midday sunlight or no sediment delivery to stream, lake, or wet area.

APPENDIX D

DEFINITION OF TERMS AND ILLUSTRATIONS



Upper Bank - **That portion of the upper channel to the edge of the 1-3 year bankfull level. (Typical upper bank descriptions incorporate the area from the break in the general slope of the surrounding land to the 1-3 year bankfull level.)**

Lower Bank - **The intermittently submerged portion of the channel cross section to the water's edge during summer low flow periods.**

Channel Bottom - **The submerged portion of the channel cross section which is totally an aquatic environment.**

APPENDIX E

Appendix E. Summary of **federal** 1996 management practice compliance, effectiveness, implementation status and recommendations.

Audit No.	Forest Practices Rule Compliance: FPA rule	Forest Practices Rule Compliance: pollutant delivery	Management Practice Implementation or Administrative Issues	Management Practice Effectiveness: FPA rule	Management Practice Effectiveness: pollutant delivery	Recommendations & Comments
F-1	Complied with all applicable rules	Major/temporary sediment to Class I/II	Relief drainage being restored to road system	Ineffective on 4.d.iv.; 4.d.v.	Major/temporary sediment to Class I/II	Sediment delivery made worse due to1994 fire; 1995 post-fire runoff event and unstable geology - need geology specific roading rules
F-2	Complied with all applicable rules	None observed	None	Effective	None observed	None
F-3	Complied with all applicable rules	Sediment	None	Effective	None observed	Sediment from grazing
F-4	Complied with all applicable rules	None observed	None	Effective	None observed	None
F-8	Complied with all applicable rules	None observed	Hunting traffic	Effective	None observed	Multiple use road maintenance responsibility
F-9	Complied with all applicable rules	None observed	Implemented PACFISH standards	Effective	None observed	Hunting and fire wood cutting road use
F-11	Complied with all applicable rules	Minor/temporary sediment from roads	None	Effective	Minor/temporary sediment from roads	Rules need to tailor practices to fit the geology
F-13	Complied with all applicable rules	None observed	Skidded on slopes > 30% - no observed erosion; riprapped end of water bars	Effective	None observed from forestry	Sediment from grazing
F-14	Complied with all applicable rules	None observed	None	Effective	None observed	Geology more stable - practices more effective
F-19	Noncompliance on 3.d.i.	Minor/temporary sediment to class II stream	Harvest rules complied with, fire suppression practices in direct conflict with water quality	Effective	None observed from timber harvest	Need to address areas where fire control conflicts with water quality

Appendix E. Summary of **state** 1996 management practice compliance, effectiveness, implementation status and recommendations.

Audit No.	Forest Practices Rule Compliance		Management Practice Implementation or Administrative Issues	Management Practice Effectiveness		Recommendations & Comments
	FPA rule	pollutant delivery		FPA rule	pollutant delivery	
S-5	Complied with all applicable rules	None observed	Multiple use roads	Effective	None observed	Road maintenance rules need to cover all uses
S-6	Complied with all applicable rules	None observed	Multiple use roads, maintenance went beyond the norm with gravelled rolling dips and bridge approaches	Effective	None observed	Road maintenance rules need to cover all uses
S-9	Noncompliance on 4.d.ii.; 4.d.iv.a.	Sediment to Class II	Road closure breaching, rock costs, mixed ownership	Ineffective on 4.d.iv.b.	Sediment to Class II	Water bars ineffective - need rock; road practices need to be tailored to geology
S-12	Complied with all applicable rules	Sediment to Class II from grazing	Relocated existing road out of stream bottom	Effective	None observed	Class II stream receiving sediment from grazing
S-13	Complied with all applicable rules	None observed	Initial green timber sale shifted to salvage sale after fire	Effective	None observed	Need to develop mechanism to address historic logging impactsand fire suppression impacts
S-24	Complied with all applicable rules	None observed	Road closure breaching, “cut” quotas, 7 years to complete logging, moved road out of SPZ	Ineffective on 4.d.iv.b.	None observed	Need to address breaching of road closures
S-28	Noncompliance on 4.d.ii.;4.d.iv.a.	Major/prolonged delivery to Class II	Reused old road in wet draw	Ineffective on 3.h.iii.	Sediment to Class II	Historic and current mining stream impacts
S-29	Noncompliance on 3.d.i.; 3.g.iv.; 4.d.iii.a.	Major/temporary and minor/prolonged delivery to Class II	Road closure breaching, fire suppression - water quality conflicts	Ineffective on 3.d.i.; 3.g.iv.; 4.d.iii.a.	Sediment to Class II	Road closure breaching needs to be addressed, road maintenance needs to be accelerated, skid trails over 30% were effective
S-30	Noncompliance on 4.d.iii.a.	Major/temporary or minor/prolonged sediment to Class II	“Trespass” grazing	Ineffective on 4.d.iv.a.; 4.d.iv.b.	Major/temporary or minor/prolonged sediment to Class II	Road closure breaching needs to be addressed, road surface drainage not maintained, unauthorized grazing having impacts
S-32	Noncompliance on 3.c.ii.; 4.d.ii.; 4.d.iv.a.	Major/temporary or minor/prolonged sediment to Class I	No means to enforce fill compaction rules	Ineffective on 3.c.ii.; 4.c.viii.; 4.d.ii.; 4.d.iv.a.	Major/temporary or minor/prolonged sediment to Class I	Grazing and historic logging still contributing heavily to stream impacts, need mechanism to address historic logging impacts

Appendix E. Summary of **industrial** 1996 management practice compliance, effectiveness, implementation status and recommendations.

Audit No.	Forest Practices Rule Compliance: FPA rule	Forest Practices Rule Compliance: pollutant delivery	Management Practice Implementation or Administrative Issues	Management Practice Effectiveness: FPA rule	Management Practice Effectiveness: pollutant delivery	Recommendations & Comments
I-6	Complied with all applicable rules	None observed	None noted	Effective	None observed	Pre-operational inspection was required, completed and was effective
I-7	Complied with all applicable rules	None observed	Road closure breaching, historic logging impacts, multiple use roads	Effective	None observed	Rules need to address historic logging and multiple use roads, need to address road closure breaching
I-9	Noncompliance on 4.d.ii.	Minor/temporary sediment to Class II	Operator and owner road maintenance responsibility, long term/short term road responsibility	Ineffective on 4.d.ii.	Minor/temporary sediment to Class II	Rules need to be clarified on operator/owner and short/long term road maintenance responsibilities. Planning rules combined with construction rules
I-10	Noncompliance on 3.f.ii.; 4.d.ii.	Minor/temporary sediment to Class II	Fire suppression conflicts with water quality	Ineffective on 3.f.ii.; 4.d.ii.	Minor/temporary sediment to Class II	Slash wind rows catching much sediment, water bars on roads not completely installed, pre-operational inspection done and was effective
I-12	Noncompliance on 3.d.i.; 4.c.iv.	Minor/temporary sediment to Class II	Definition of a road construction plan, multiple use roads	Ineffective on 3.d.i.; 4.c.iv.; 4.c.viii.	Minor/temporary sediment to Class II	Road planning rules need to be incorporated into road construction rules, multiple use road maintenance needs to be addressed
I-16	Noncompliance on 4.c.ii.; 4.c.iv.; 4.d.i.; 4.d.ii.; 4.d.iv.; 4.d.iv.a.	Minor/temporary sediment to Class II	Determination of road maintenance responsibility, road closure breaching	Ineffective on 4.c.ii.; 4.c.iv.; 4.d.i.; 4.d.ii.; 4.d.iv.; 4.d.iv.a.	Minor/temporary sediment to Class II	Road closure breaches need to be addressed, road maintenance responsibilities need to be clarified
I-17	Noncompliance on 3.c.i.; 3.g.iv.; 4.d.i.; 4.d.ii.; 4.d.iii.a.; 4.d.iv.a.	Major/prolonged sediment to Class II	Historic logging impacts, 1996 north Idaho runoff event	Ineffective on 3.c.i.; 3.g.iv.; 4.d.i.; 4.d.ii.; 4.d.iii.a.; 4.d.iv.a.	Major/prolonged sediment to Class II	Need mechanism to address historic logging practices that still impact streams. Runoff event contributed to noncompliance and ineffectiveness
I-18	Noncompliance on 4.d.iii.a.; 4.d.iv.a.	Major/prolonged sediment to Class II	Multiple use roads, multiple land ownerships	Ineffective on 4.d.iii.a.; 4.d.iv.a.	Major/prolonged sediment to Class II	Rules need to address road maintenance responsibility in mixed ownership drainages
I-19	Noncompliance on 4.c.iv.	Major/temporary and minor/ prolonged sediment to Class II	Compaction standard compliance, historic logging, 1996 runoff event	Ineffective on 4.c.iv.; 4.c.viii.	Major/temporary and minor/ prolonged sediment to Class II	Road fill compaction rule not enforced and road fill failed; rules need a mechanism and standards for road fill compaction, historic logging impacts
I-20	Noncompliance on 4.d.iii.a.	None observed	Multiple use roads, grazing	Effective	None observed	Road maintenance responsibility on multiple use road needs to be clarified.

Appendix E. Summary of **non-industrial** 1996 management practice compliance, effectiveness, implementation status and recommendations.

Audit No.	Forest Practices Rule Compliance		Management Practice Implementation or Administrative Issues	Management Practice Effectiveness		Recommendations & Comments
	FPA rule	pollutant delivery		FPA rule	pollutant delivery	
N-3	Noncompliance on 8.c.ii.a.	None observed	None	Effective	None observed	Pre-operational inspection was done and proved effective
N-4	Complied with all applicable rules	None observed	Multiple use roads	Effective	None observed	Multiple use roads need to be addressed
N-5	Complied with all applicable rules	None observed	Grazing	Effective	None observed	Road maintenance responsibility an issue between the land owner and the operator, especially long term; cattle trampled out stream channel
N-6	Complied with all applicable rules	None observed	Conversion to a residential lake lot	Effective	None observed	Not an issue on this sale, but land use conversions can be used to avoid FPA rule compliance
N-12	Noncompliance on 3.f.ii.	Minor slash to Class II	Ineffective water bars	Ineffective on 3.f.ii.; 3.e.i.	Minor/temporary sediment to Class II	Maintenance responsibility on multiple use roads needs to be addressed
N-13	Noncompliance on 3.d.i.; 3.g.i.; 4.d.ii;; 4.d.iv.a.	Major prolonged and minor temporary sediment to Class I	Variance was ineffective, multiple use roads, increased number of variances pre-supposed for implementation of 1996 rules	Ineffective on 3.d.i.; 3.g.i.; 4.d.ii;; 4.d.iv.a.	Major prolonged and minor temporary sediment to Class I	Pre-operational inspection was ineffective and variance was detrimental on this sale
N-15	Noncompliance on 3.d.i.; 3.d.iii.; 3.h.iii.; 4.d.iii.a.	Minor prolonged sediment to Class II	Multiple use roads, cumulative effectss of private non-industrial sales, land use conversions	Ineffective on 3.d.i.; 3.d.iii.; 3.h.iii.; 4.d.iii.a.	Minor prolonged sediment to Class II	Need pre-operational inspections on all private non-industrial sales, need cumulative effects assessment
N-A	Noncompliance on 4.b.viii.	None observed	Unwritten pre-operational inspection was effective in improving road maintenance, mixed land ownership	Effective	None observed	Need pre-operational inspections on all private non-industrial sales
N-B	Noncompliance on 4.d.iii.b.	Minor prolonged sediment to Class I	Road constructed in wetland - only access available	Ineffective on 3.h.iii; 4.d.iii.b.	Minor prolonged sediment to Class I	Relief culverts need to follow natural slope, pre-operational inspection was effective
N-C	Noncompliance on 3.g.iii.c.; 3.g.iv.; 3.h.ii.; 3.h.iii.; 4.c.iii.; 4.c.iv.; 4.c.v.; 4.d.ii.; 4.d.iii.a.	Major/temporary and minor/prolonged sediment to Class I	Multiple use roads	Ineffective on 3.g.iii.c.; 3.g.iv.; 3.h.ii.; 3.h.iii.; 4.c.iii.; 4.c.iv.; 4.c.v.; 4.d.ii.; 4.d.iii.a.	Major/temporary and minor/prolonged sediment to Class I	Multiple use road maintenance responsibility needs to be addressed

APPENDIX F

WREN II SALVAGE
F-1
T. 6 N., R. 8 E., Sections 1-4, 9-16
T. 6 N., R. 9 E., Sections 6, 7, 18
T. 7 N. R. 8 E., Section 36

The rocks underlying the timber sale area belong to the Cretaceous Idaho batholith, specifically the rocks of the Atlanta lobe of the batholith (Johnson et al. 1988 and Worl et al. 1995). Road cuts and outcrops in the timber sale area show two basic rock types; medium- to coarse-grained biotite granodiorite, and medium- to coarse-grained muscovite-biotite granite. The biotite granodiorite seems to be the most predominate rock in the timber sale area. The rock is light-gray in color and contains crystals of feldspar, quartz and biotite as large as one inch.

The second rock type seen in the timber sale area, muscovite-biotite granite, is massive, medium- to coarse-grained, light-colored, and with crystals of quartz, feldspar, biotite, and muscovite as large as 1-3 inches. According to Johnson, et al. (1988), these two rock types form the main phase of the Atlanta lobe of the Idaho batholith.

Both the biotite granodiorite and the muscovite-biotite granite rocks display the spheroidal weathering pattern common to the Idaho batholith. Natural outcrops have a rounded appearance due to weathering. The principal type of weathering of the rock of the timber sale area is mechanical. Mechanical weathering is the physical disintegrating of the rock into smaller and smaller fragments, usually by freezing and thawing action of water. The chemical composition of the weathering products does not change from the chemical composition of the unweathered rock.

The soils produced by the mechanical weathering of the biotite granodiorite and the muscovite-biotite granite rocks are granular, porous, and unconsolidated. The descriptive term for this type of weathering product is “grus”. There are no binding agents in the material and grus erodes easily by running water (snow melt, rain, and flood). The timber sale roads built on and out of this grus material are highly erodible and require extensive maintenance and numerous removal systems, such as culverts and water bars. With little or no binding agents in the grus soil, roads are unstable.

BLUE CREEK - BLM

F-2

T. 49-50 N., R. 2-3 W., Sections 1, 6, 31, 35

There are several rock types in the timber sale area (Griggs 1973). At the lower elevations in the area, rocks of the Precambrian Pritchard Formation of the Belt Supergroup are exposed. These rocks consist of medium-grained, dark-gray, laminated shale with a few thin layers of quartzite interspersed. These very old rocks weather to a dull rust-colored appearance. Above the Pritchard Formation, and up to nearly the top of ridge on the east side of the timber sale area, dark-gray to black basalt of the Columbia River Basalt of Miocene age crops out in road cuts and natural rock knobs. This basalt is a very typical basalt of the Columbia River Basalt. The basalt weathers to cobbles with a rust-colored shell or rind around a dark gray core. Farther up on the ridge and capping the high points on the east side of the area are poor exposures of older Tertiary gravels. These gravels represent an old valley surface that existed prior to the current erosional surface (Anderson 1940). Rock fragments in these gravels indicate that the gravels are a product of erosion of Belt Supergroup rocks.

The soils derived from the erosion and weathering of these three very different rock types has produced a locally gravelly, silt-loam soil that compacts well. The roads in the timber sale area do not show susceptibility to erosion or washing. In fact, they are quite stable. There is no steep topography and erosion is at a minimum.

RED SAGE II
F-3
T. 13 N., R. 26 E., Section 31

The bedrock of the timber sale area is a Pliocene conglomerate that is poorly sorted, very coarse, and composed mainly of very large angular to subrounded boulders of Kinnikinic Quartzite and subrounded boulders of dolomite of the Saturday Mountain Formation and Jefferson Dolomite (Ruppel 1981). The matrix of the conglomerate is sand, clay and tuffaceous material.

Surrounding the conglomerates of the timber sale area is Pleistocene glacial till (Ruppel et al. 1970, 1981). This till contains several different rock types, including quartzite, siltite, limestone, dolomite, and volcanic and granitic rocks, all in a clay and sand matrix. The predominant rock type in the glacial till is quartzite derived from the Middle Ordovician Kinnikinic Quartzite. Also found in the till are fragments of siltstones, quartzites and argillites from the Proterozoic Gunsight Formation of the Lemhi Group.

The Kinnikinic Quartzite is white to light-gray, fine- to medium-grained, vitreous quartzite. Some of the fragment show mottling with blebs of reddish-brown oxidation products. The quartzite is very hard and breaks with a conchoidal fracture.

The Gunsight Formation of the Lemhi Group is probably equivalent to units within the Belt Supergroup seen in the northern part of Idaho, however the relationship has never been proved. The rocks of this formation consist of light, multi-colored feldspathic quartzites with some interbeds of siltstone and argillite.

The sandy to clayey nature of the Pliocene conglomerate and overlying glacial till, along with the hard, vitreous quartzite fragments makes an excellent material for the construction of roads. The timber sale roads, landings and skid trails made from or founded in this material are very stable and relatively resistant to erosion by running water. The clay acts as a binding agent, the sandy fraction allows some internal drainage, and the hard quartzite fragments act as an armored surfacing. The timber sale roads and water management structures only seem to require minimum maintenance.

BOOKUM - USFS
F-4
T. 45 N., R. 6 E., Sections 30-32

The rocks exposed within the area of the timber sale are Precambrian metamorphic rocks of the Belt Supergroup. These rocks were deposited from 1,450 to 850 million years ago b.p. (before the present) (Heitanen 1984). Specifically, the rocks of the timber sale area are massive and banded, dark-gray to light-gray quartzites of the Wallace Formation of the Belt Supergroup (Heitanen 1984 and Wagner 1949).

Also seen in the area of the timber sale are thin interbeds of micaceous schist separating the more massive quartzite. These interbeds contribute the bulk of the fine-grained mica fragments that is seen in the heavy soil cover that is pervasive over the timber sale area. Some of the muscovite-biotite schist rocks have incipient grains of a highly altered iron-based mineral, probably garnet. These minerals are so altered they are unrecognizable and just form blebs of iron stain in the schist.

The soil in the timber sale area is principally derived from weathering of the medium- to dark-gray quartzites of the Wallace Formation. The grain size in the soil is very uniform. There is some clay minerals present in the soil that acts as a binding agent. Roads constructed in the timber sale area show minimal erosion and require only routine maintenance and water management. The principal haul roads, although thoroughly water-barred, are generally self-draining because of the nature of the fill material and bedrock.

NORTH CREEK
F-8
T. 61 N., R. 3 E., Section 32, 33

Kirkham and Ellis (1926) mapped the area of the timber sale as a sequence of basic granitic sills (Moyie sills) interjected between layers of metamorphic rocks belonging to the Belt Supergroup, probably the Pritchard Formation. In the area of the timber sale, the Pritchard Formation is predominantly quartzite with a minor amount of argillite. The quartzites are massive, occurring in beds as thick as eight feet while the interbedded argillites are thin, averaging six inches.

The Moyie sills are injected, tabular, igneous masses that range in thickness from 30 to 2,000 feet and are exposed over a very large area. The lithology of these sills are variable but mainly altered gabbro and diabase with local dioritic phases. Because of the sills' superior resistance to erosion, they generally are exposed in ridges, peaks or cliffs.

No bedrock of any kind was seen during the audit team's visit to the timber sale. Quaternary alluvium masks the underlying bedrock. However, bedrock fragments were seen in several cuts made along timber sale roads, enough to draw conclusions as to what lies below. Some of the road cuts were observed making water in small seeps and some road cuts were failing and being rock cribbed. This would indicate an intrinsic instability of the alluvium as road making material, and in fact, the roads probably will require constant maintenance.

ROCKY MOUNTAIN
F-9
T. 26 N., R. 21 E., Sections 20, 21, 28, 29

Anderson (1959) has mapped the bedrock of the area of the timber sale as Swauger Quartzite, a unit of the Belt Supergroup. The Swauger Quartzite is usually light-gray to white weathering quartzite with interbeds of dark argillite and with some green to dark gray impure quartzite (Ross 1963). The quartzite is relatively coarse-grained and in places resembles a coarse grit.

Scattered throughout the mapped area of the quartzite are small granitic intrusions. These granitic rocks are also seen in the area of the timber sale. These granitic rocks of variable composition are probably related to the Idaho batholith. The bedrock specifically seen in the area of the timber sale is a grayish colored granite with some dark argillaceous, slaty metamorphics.

The granitic rocks are chemically weathered, that is, the constituent minerals have been broken down chemically into other mineral compounds. The feldspar content of the granitic rocks has been altered to clay minerals. This clay acts as a binding agent for the soil materials that are used in producing stable timber sale roads, skid trails and landing surfaces. Road surfaces constructed from these clayey materials will tend to rut when wet, however this material, once properly packed, is resistant to erosion and only routine maintenance of roadways and water management systems is necessary. What little metamorphic rocks that were used in road construction and water management present no problems because of angularity and hardness.

HATHAWAY
F-11
T. 59 N., R. 5 W., Section 33

The bedrock of the timber sale area is quartz monzonite of the Kaniksu batholith. The Kaniksu batholith is approximately 70 million years old (Late Cretaceous to Tertiary) (Savage 1967). The bedrock of the timber sale area is light-colored in appearance and is medium- to coarse-grained in texture. The darker colored mineral is muscovite and the lighter colored minerals are quartz and feldspar.

The quartz monzonite rocks display a spheroidal weathering pattern. What few natural outcrops present in the timber sale area display a rounded appearance due to weathering. The principal type of weathering of the rock of the timber sale area is mechanical. Mechanical weathering is the physical disintegrating of the rock into smaller and smaller fragments, usually by freezing and thawing action of water. The chemical composition of the weathering products does not change from the chemical composition of the unweathered rock.

The soil produced by the mechanical weathering of this quartz monzonite rock is granular, porous, and unconsolidated. The descriptive term for this type of weathering product is “grus”. There are no binding agents in the material and grus erodes easily by running water (snow melt, rain and flood). The timber sale roads, skid trails and landings built on and out of this grus material are highly erodible and require extensive maintenance and numerous removal systems, such as culverts and water bars. With little or no binding agents in the grus soil, roads are unstable.

RED SAGE IV
F-13
T. 13 N., R. 26 E., Sections 19, 30

The area of the timber sale is completely covered by Pleistocene glacial till (Ruppel et al. 1970, 1981). This till contains several different rock types, including quartzite, siltite, limestone, dolomite, and volcanic and granitic rocks, all in a clay and sand matrix. The predominant rock type in the glacial till is quartzite derived from the Middle Ordovician Kinnikinic Quartzite. Also found in the till are fragments of siltstones, quartzites and argillites from the Proterozoic Gunsight Formation of the Lemhi Group.

The Kinnikinic Quartzite is white to light-gray, fine- to medium-grained, vitreous quartzite. Some of the fragments show mottling with blebs of reddish-brown oxidation products. The quartzite is very hard and breaks with a conchoidal fracture.

The Gunsight Formation of the Lemhi Group is probably equivalent to units within the Belt Supergroup seen in the northern part of Idaho, however the relationship has never been proved. The rocks of this formation consist of light, multi-colored feldspathic quartzites with some interbeds of siltstone and argillite.

The sandy to clayey nature of the glacial till, along with the hard, vitreous quartzite fragments makes an excellent material for the construction of roads. The timber sale roads, landings and skid trails made from or founded in this material are very stable and relatively resistant to erosion by running water. The clay acts as a binding agent, the sandy fraction allows some internal drainage, and the hard quartzite fragments act as an armored surfacing. The timber sale roads and water management structures only seem to require minimum maintenance.

CROOKED RIVER SALVAGE
F-14
T. 6 N., R. 7 E., Section 1
T. 6 N., R. 8 E., Sections 4-8
T. 7 N. R. 7 E., Sections 24, 25, 36
T. 7 N., R. 8 E., Sections 28-33

The rocks underlying the timber sale area belong to the Late Cretaceous Idaho batholith, specifically the rocks of the Atlanta lobe of the batholith (Johnson et al. 1988 and Worl et al. 1995). Road cuts and outcrops in the timber sale area show two basic rock types, medium- to coarse-grained biotite granodiorite and medium- to coarse-grained muscovite-biotite granite. The biotite granodiorite seems to be the most predominate rock in the timber sale area. The rock is light-gray in color and contains crystals of feldspar, quartz and biotite as large as one inch.

The second rock type seen in the timber sale area, muscovite-biotite granite, is massive, medium- to coarse-grained, light colored with crystals of quartz, feldspar, biotite and muscovite as large as 1-3 inches. According to Johnson et al. (1988), these two rock types form the main phase of the Atlanta lobe of the Idaho batholith.

Both the biotite granodiorite and the muscovite-biotite granite rocks display the spheroidal weathering pattern common to the Idaho batholith. Natural outcrops have a rounded appearance due to weathering. The principal type of weathering of the rock of the timber sale area is mechanical. Mechanical weathering is the physical disintegrating of the rock into smaller and smaller fragments, usually by freezing and thawing action of water. The chemical composition of the weathering products does not change from the chemical composition of the unweathered rock.

The soils produced by the mechanical weathering of the biotite granodiorite and the muscovite-biotite granite rocks are granular, porous, and unconsolidated. The descriptive term for this type of weathering product is “grus”. There are no binding agents in the material and grus erodes easily by running water (snow melt, rain, and flood). The timber sale roads built on and out of this grus material are highly erodible and require extensive maintenance and numerous removal systems, such as culverts and water bars. With little or no binding agents in the grus soil, roads are unstable.

DUDLEY CREEK
F-19
T. 48 N., R. 4 E., Sections 2, 3, 4, 10
T. 49 N., R. 4 E., Sections 34, 35

The bedrock of the timber sale area has been mapped by Hobbs et al. (1965) and Gott and Cathrall (1979) as belonging to the Belt Supergroup. Specifically, rocks of the Wallace Formation, the St. Regis Formation, the Revett Quartzite, and monzonite of the Dago Peak Stocks occur in the area of the timber sale.

The Revett Quartzite is mostly a light colored, fine to medium grained pure quartzite. The beds within this unit are usually one to six feet thick and uniform in content. The quartzite typically forms cliffs and ridges. The quartzite weathers with a rusty, speckled appearance due to the presence of segregations of iron oxide.

The St. Regis Formation is usually composed of impure quartzites, mudstones, and argillites that have a characteristic reddish to reddish-purple color. Gradational bedding, mud cracks and ripple marks are common in this unit.

The principal rock types in the Wallace Formation are calcareous to dolomitic quartzite and calcareous argillite (Hobbs et al. 1965). The quartzites tend to be light gray to greenish-gray in color. The quartzite is interbedded or interlaminated with black to dark gray calcareous argillite and siltite. The Wallace Formation is unique among the Belt Supergroup rocks in that they are almost all calcareous but not enough to be called limestones or dolomites. The argillites exposed in the timber sale area show incipient mud cracks and well formed ripple marks, thus showing a possible shallow water to intertidal environment of deposition.

Cretaceous intrusive rocks also occur in the timber sale area. These are monzonites and associated rocks of the Dago Peak stocks (Gott and Cathrall 1979). These rocks are light-gray medium- to coarse-grained monzonite or quartz monzonite with potassium feldspar phenocrysts. These rocks were not observed in the timber sale area during the audit.

Most of the road material in the timber sale area was derived from the dredge tailings that are locally available. This caused the roads to be relatively porous and unstable and they need frequent maintenance. The road surfaces are erodible and water bars seem to contribute to the erosion problem.

WHITETAIL FLATS
S-5
T. 59 N., R. 5 W., Section 33

The area of the timber sale is underlain by material derived from a recessional phase of late Wisconsin (Pinedale) glaciation (Savage 1967). This material in the timber sale area was probably deposited by glacial meltwater rather than by direct deposition from ice. The material consists of relatively unconsolidated clay, silt, sand, and gravel. There appears to have been some local reworking of the glacial material by later water and wind action. These reworked sediments are thinly laminated and stratified.

The dominent rock type in this glacial material is Belt Supergroup metamorphic rocks with some granitic material probably derived from the Kiniksu batholith. Roads, skid trails, and landings constructed from this glacial material seem to be stable and relatively resistant to erosion. This is probably due to the clay content acting as a binding agent.

WEST TARLAC
S-6
T. 58 N., R. 3 W., Sections 16, 17, 20, 21

The bedrock exposed in the timber sale area is predominantly medium- to dark-gray argillite interbedded with quartzite. These rocks are part of the Belt Supergroup, probably equivalent to the Pritchard Formation (Savage 1967). The bedding of the argillite and quartzite is regular and uniform, averaging about 2 to 6 inches in thickness. This gives a “flaggy” appearance to the outcrop. The rocks weather with a reddish or rusty color due to the iron content. The biotite and muscovite mica content in the bedrock lends a shiny veneer to the derived soils. Ripple marks were seen on the scarce outcrops within the timber sale area.

Soils developed on these rocks are silty to sandy and poorly consolidated. Roads, skid trails and landings built with this native soil material are intrinsically unstable and highly erodible. This is probably due in part to the seemingly high mica content of the soil (platy texture) and in part to the lack of suitable clay binding materials. Without frequent and regular maintenance, roadways tend to rut and fills collapse. Water management efforts (water bars, culverts, etc.) are highly subject to erosion due to the lack of the ability to compact the material adequately.

DEM BUGS SALVAGE
S-9
T. 37 N., R. 4 E., Sections 10, 11, 12
T. 38 N., R. 4 E., Sections 31, 32

This timber sale area is divided into three widely separated parts. The geology of each part is different. The bedrock of cutting units 1 and 2 are metamorphic quartzites and siltites of the Precambrian Belt Supergroup, probably equivalent to the Pritchard Formation (Anderson 1930). The metamorphic rocks have been severely altered by the intrusion of the nearby Idaho batholith. The Belt rocks have been chemically altered to clay with included fragments of the parent rock. This alteration product seems to make a good roadbed for the timber sale roads and landings.

Cutting unit number 3 of the timber sale area is underlain by granitic rock of the Idaho batholith (Anderson 1930 and Bond 1963). The batholith rocks are late Cretaceous in age and are principally made up of quartz, feldspar and biotite minerals. The rock is light gray to yellowish in color and contains large phenocrysts of quartz and orthoclase feldspar.

The granitic rocks in cutting unit 3 have been weathered chemically, that is, the feldspars have been altered to clay minerals. The heavy soil cover derived from this chemical process is rich in clay with some retained, relatively unaltered biotite and feldspar grains. There are some hard local relatively unaltered knobs indicating that the alteration is sporadic and is intense in some places and non-existent in other places. Roads developed with this material tend to have a low susceptibility to erosion by running water. The roads in this unit of the timber sale area do not show much gullying or washouts.

RASMUSSEN RIDGE
S-12
T. 6 S., R. 43 E., Sections 9, 16

Roberts (1982) mapped several sedimentary units in the area of the timber sale. These units are:

Qs - unconsolidated surficial deposits
Trdl - Dinwoody Formation, yellowish-brown, sandy calcareous siltstones, forms low rolling hills, hummocky surfaces with some ledges and ridges
Ppc - Phosphoria Formation, cherty shale member, dark gray, cherty siltstone and mudstone, non-resistant, forms smooth rolling hills, exposed only in stream gullies
Ppr - Phosphoria Formation, Rex Chert Member, gray to dark-blue-black chert, massive, up to 30 m. thick, very resistant ledge and ridge former
Ppm - Phosphoria Formation, Meade Peak Phosphatic Shale Member, dark brown to black phosphorite, shale, and siltstone, non-resistant, swale forming, poor to no outcrops
Ppg - Grandeur Tongue of Park City Formation, light-colored sandstone, dolomite, and cherty dolomite, resistant ledge former
Pwu - Upper Wells Formation, light rusty brown, silty sandstone and quartzite, resistant, supports steep, rugged topography

The main haul road through the timber sale area follows the strike of the underlying beds. The rocks exposed in places along the road were representative of the black, hard, highly siliceous chert of the Rex Chert with minor amounts of phosphorite from the Meade Peak Member. The slopes on the east side of Reese Creek were being held up by rocks of the Dinwoody Formation while the slopes on the west side of Reese Creek were being held up by the Wells Formation. The creek bottom and a good portion of the sale area was covered by unconsolidated alluvium.

The haul roads, landings and skid trails were relatively resistant to extensive erosion due to the sedimentary materials and alluvium used in their construction. Only minimum regular maintenance of road surfaces and water management systems would be necessary.

ROGER'S CREEK
S-32
T. 41 N., R. 6 E., Section 22

The rocks exposed within the timber sale area are metamorphic rocks of the Belt Supergroup of Precambrian age. These rocks were deposited from 1,450 to 850 million years ago (Heitanen 1984). Specifically, the rocks of the timber sale area are massive and banded, dark gray to light gray quartzites of the Wallace Formation of the Belt Supergroup (Heitanen 1984).

Also seen in the timber sale area are thin interbeds of micaceous schist separating the more massive quartzite. These interbeds contribute the bulk of the fine grained mica fragments that is seen in the heavy soil cover that is pervasive over the timber sale area. Some of the muscovite-biotite schist rocks have incipient grains of a highly altered iron based mineral, probably garnet. These minerals are so altered, they are unrecognizable and just form blebs of iron stain in the schist.

The soil in the timber sale area is principally derived from weathering of the medium to dark gray quartzites of the Wallace Formation. The grain size in the soil is very uniform. There is some clay minerals present in the soil that acts as a binding agent. Roads constructed in the timber sale area show minimal erosion and require only routine maintenance and water management. The principal haul roads, although thoroughly water-barred, are generally self-draining because of the nature of the fill material and bedrock.

EASTER CREEK
S-13
T. 4, N., R. 5 E., Sections 3, 4
T. 5 N., R. 5 E., Sections 27, 28, 33, 34

The rocks underlying the timber sale area belong to the Cretaceous Idaho batholith, specifically the rocks of the Atlanta lobe of the batholith (Johnson et al. 1988 and Worl et al. 1995). Road cuts and outcrops in the timber sale area show two basic rock types, medium to coarse grained biotite granodiorite and medium to coarse grained muscovite-biotite granite. The biotite granodiorite seems to be the most predominate rock in the timber sale area. The rock is light gray in color and contains crystals of feldspar, quartz and biotite as large as one inch.

The second rock type seen in the timber sale area, muscovite-biotite granite, is massive, light colored with crystals of quartz, feldspar, biotite, and muscovite as large as 1-3 inches. According to Johnson et al. (1988), these two rock types form the main phase of the Atlanta lobe of the Idaho batholith.

Both the biotite granodiorite and the muscovite-biotite granite rocks display the spheroidal weathering pattern common to the Idaho batholith. Natural outcrops have a rounded appearance due to weathering. The principal type of weathering of the rock of the timber sale area is mechanical. Mechanical weathering is the physical disintegrating of the rock into smaller and smaller fragments, usually by freezing and thawing action of water. The chemical composition of the weathering products does not change from the chemical composition of the unweathered rock.

The soils produced by the mechanical weathering of the biotite granodiorite and the muscovite-biotite granite rocks are granular, porous and unconsolidated. The descriptive term for this type of weathering product is “grus”. There are no binding agents in the material and grus erodes easily by running water (snow melt, rain and flood). The timber sale roads built on and out of this grus material are highly erodible and require extensive maintenance and numerous water removal systems, such as culverts and water bars. With little or no binding agents in the grus soil, roads are unstable.

PLACER CREEK
S-24
T. 36 N., R. 4 E., Sections 11, 12, 14

The timber sale area has been mapped by Anderson (1930) and Hietanen (1962, 1963). The bedrock of the timber sale area is basalt of the Columbia River Basalt Group. There were no basalt outcrops observed by the audit team but the heavy soil cover contains 2-8 inch cobbles of weathered basalt. The cobbles are weathered to a yellowish-brown limonite rind surrounding a dark gray to black core. In the northern part of the timber sale area, the soil is the same yellowish-brown color as the basalt cobbles. In the southern part of the timber sale area, the soil contains a large amount of biotite mica, resulting in a shiny, micaceous veneer on the yellowish-brown soil. The mica veneer imparts a crust to the undisturbed soil that is resistant to minor erosion. This mica is probably derived from the border facies of the Idaho batholith located not far to the south of the timber sale area.

The soil derived from the basalt has a moderate clay content. Construction done in the timber sale area, such as roads, landings, skid trails, etc., compact well with basalt fragments as aggregate and clay soil as filler and binder. Roads tend to rut during wet periods due to heavy traffic but are fundamentally stable and require only routine maintenance, as do the water management systems (water bars, culverts, etc.).

DENDROCTONUS RIDGE
S-28
T. 6 N., R. 5 E., Sections 10, 11

The rocks underlying the timber sale area belong to the Cretaceous Idaho batholith, specifically the rocks of the Atlanta lobe of the batholith (Johnson et al. 1988 and Worl et al. 1995). Road cuts and outcrops in the timber sale area show two basic rock types, medium to coarse grained biotite granodiorite and medium to coarse grained muscovite-biotite granite. The biotite granodiorite seems to be the most predominate rock in the timber sale area. The rock is light gray in color and contains crystals of feldspar, quartz and biotite as large as one inch.

The second rock type seen in the timber sale area, muscovite-biotite granite, is massive, light colored with crystals of quartz, feldspar, biotite and muscovite as large as 1-3 inches. According to Johnson et al. (1988), these two rock types form the main phase of the Atlanta lobe of the Idaho batholith.

Both the biotite granodiorite and the muscovite-biotite granite rocks display the spheroidal weathering pattern common to the Idaho batholith. Natural outcrops have a rounded appearance due to weathering. The principal type of weathering of the rock of the timber sale area is mechanical. Mechanical weathering is the physical disintegrating of the rock into smaller and smaller fragments, usually by freezing and thawing action of water. The chemical composition of the weathering products does not change from the chemical composition of the unweathered rock.

The soils produced by the mechanical weathering of the biotite granodiorite and the muscovite-biotite granite rocks are granular, porous and unconsolidated. The descriptive term for this type of weathering product is “grus”. There are no binding agents in the material and grus erodes easily by running water (snow melt, rain and flood). The timber sale roads built on and out of this grus material are highly erodible and require extensive maintenance and numerous removal systems, such as culverts and water bars. With little or no binding agents in the grus soil, roads are unstable.

BOND CREEK
S-29
T. 45 N., R. 1 E., Section 16, 20

The north half of the timber sale area is underlain by the basalt of the Columbia River Group (Bishop 1969). This basalt is Pliocene in age and is an olivine-rich basalt of local origin. There are poor exposures of the basalt throughout the northern sale area. The basalt is highly weathered and produces rounded cobbles exhibiting red-brown to brown weathered rinds, and dark-gray to black, fine-grained vesicular cores with plagioclase, pyroxene and abundant olivine phenocrysts. This spheroidal weathering leads to a granular soil with little to no clay binders.

Also in the area of the sale, there are scattered outcrops of laharic breccias or hot mudflows, related closely to the basalt lava flows. These breccias produce a shallow to moderate soil cover that masks the underlying bedrock. These rocks represent old mudflows carrying basaltic debris.

The southern half of the timber sale area contain rocks of the Wallace Formation of the Belt Supergroup. The Wallace Formation is a thick sequence of carbonate bearing laminated black and white argillite, green argillaceous siltites, and sparse limestone and dolomite (Kleinkopf et al. 1972). In the southern part of the timber sale area, some of the siltites display ripple marks, indicating a shallow water environment of deposition. Sale roads for the most part seem to be stable and only require routine maintenance and water management.

DEER CREEK ROAD
S-30
T. 37 N., R. 2 E., Section 36
T. 37 N., R. 3 E., Sections 30, 31

The bedrock of this timber sale area is composed of local origin basalt of the Columbia River Basalt (Anderson 1930 and Bond 1963). The basalts are Miocene to early Pliocene in age. The basalts are finely crystalline, uniformly fine grained and slightly porphyritic with phenocrysts of labradorite (a plagioclase feldspar) and olivine. The basalts are dark gray to black in fresh exposure. The basalt weathers to a red-brown to brown rind around a fresh appearing core. A reddish rubbly soil is developed over the flows. The heavy soil cover contains 2-8 inch cobbles of weathered basalt.

The soil derived from the basalt has a moderate clay content. Construction done in the timber sale area, such as roads, landings, skid trails, etc., compact well with basalt fragments as aggregate and clay soil as filler and binder. Roads tend to rut during wet periods due to heavy traffic but are fundamentally stable and require only routine maintenance, as do the water management systems (water bars, culverts, etc.).

CROWN PACIFIC - FIRE DRAW
I-20
T. 45 N., R. 1 E., Sections 3, 5
T. 46 N., R. 1 E., Section 33

The bedrock of this timber sale area is composed of local origin basalt of the Columbia River Basalt and rocks of the Belt Supergroup (Bishop 1969). The basalt is highly weathered to a red-brown to brown color. A reddish rubbly soil is developed over the flows. Large cobbles of weathered basalt are contained in the soil profile.

Underlying the basalt and exposed in numerous places in the timber sale area are rocks of the Wallace Formation of the Belt Supergroup (Kleinkopf et al. 1972). These rocks are mudstones, siltstones, and greenschist argillaceous siltites . The rock pit in the SW¼SW¼, Section 28, T. 46 N., R. 1 E. is within the greenschist facies of the Belt Supergroup. These rocks probably were originally fine grained siltstones and sandstones. Some of the siltites of the Wallace Formation exposed in the timber sale area display rudimentary ripple marks, indicating a shallow water environment of deposition.

Timber sale roads constructed from soil materials derived from either the basaltic rocks or the Belt Supergroup rocks seem to require only routine maintenance. The materials pack hard and resist erosion. Many of the sale roads have been riprapped by greenschist material from the rock pit. This material is hard and quite durable.

CROWN PACIFIC INLAND
I-6
T. 54 N., R.2 W., Section 18

The bedrock of the timber sale area is igneous rock of the Kaniksu batholith that is intermediate between granodiorite and quartz monzanite (Sampson 1928 and Savage 1967). The Kaniksu batholith is approximately 70 million years old (Cretaceous to Tertiary) (Savage 1967). These two rock types are difficult to distinguish between in hand sample. The bedrock of the timber sale area has a black and white (salt and pepper) appearance and is medium- to coarse-grained in texture. The dark colored minerals are hornblende and biotite and the light colored minerals are quartz and feldspar. There is an occasional larger phenocryst of hornblende that lends a localized porphyritic texture to the rock. Also found in the timber sale area is a cover of Quaternary glacial drift with some fluviatile and slopewash material overlying the Kaniksu rocks.

Both the biotite granodiorite and the quartz monzonite rocks display a spheroidal weathering pattern. The principal type of weathering of the rock of the timber sale area is mechanical. Mechanical weathering is the physical disintegrating of the rock into smaller and smaller fragments, usually by freezing and thawing action of water. The chemical composition of the weathering products does not change from the chemical composition of the unweathered rock.

The soils produced by the mechanical weathering of the biotite granodiorite and the quartz monzonite rocks are granular, porous, and unconsolidated. The descriptive term for this type of weathering product is “grus”. There are no binding agents in the material and grus erodes easily by running water (snow melt, rain and flood). The timber sale roads built on and out of this grus material are highly erodible and require extensive maintenance and numerous removal systems, such as culverts and water bars. With little or no binding agents in the grus soil, roads are unstable.

POTLATCH - MOE'S RANCH
I-7
T. 46 N., R. 1 E., Sections 23, 24, 25, 26

In the timber sale area, the bedrock is composed of rocks of the lower Wallace Formation of the Belt Supergroup (Griggs 1973, Hietanen 1984 and Kleinkopf et al. 1972). These rocks are Precambrian in age, about 1,250 to 1,450 million years b.p. (before the present). The principal rock types in the sale area are carbonate-bearing laminated black and white argillites, green argillaceous siltites, quartzites and sparse beds of limestones and dolomites. The quartzites tend to be light-gray to greenish-gray in color. The quartzites are interbedded or interlaminated with black to dark-gray calcareous argillite and siltite (Griggs 1973). The Wallace Formation is unique among the Belt Supergroup rocks in that the rocks are almost all carbonate-bearing but not enough to be called limestones or dolomites. The argillite exposed in the timber sale area shows incipient mud cracks and well-formed ripple marks, thus showing a possible shallow water to intertidal environment of deposition.

The rocks of the timber sale area, regardless of whether they are quartzite or argillite, tend to weather to a blocky texture and with a tan or rusty, reddish weathering rind. This color may be due to by-products of hydrothermal alteration of constituent minerals, principally ferroan dolomite. The rock breaks down to a cobbly, rubbly texture that shows the weathering rind around a dark-gray to black core. The soils derived from these rock tend to have a low clay content, and grain size is medium to fine.

Roads developed from these soils should only require routine maintenance and water management because the material will pack tight and not be subject to a high degree of erosion. However, wet roads may rut relatively easy.

Idaho Forest Industries
I-9
T. 53 N., R.2 W., Section 15

The bedrock of the timber sale area is igneous rock of the Kaniksu batholith that is intermediate between granodiorite and quartz monzanite (Sampson 1928 and Kun 1974). Anderson (1940) mapped the granodiorite as the Bayview batholith. The Kaniksu batholith is approximately 70 million years old (Cretaceous to Tertiary) (Savage 1967). These two rock types are difficult to distinguish between in hand sample. The bedrock of the timber sale area has a black and white (salt and pepper) appearance and is medium to coarse grained in texture. The dark colored minerals are hornblende and biotite and the light colored minerals are quartz and feldspar. There is an occasional larger phenocryst of hornblende that lends a localized porphyritic texture to the rock. Also found in the timber sale area is a cover of Quaternary glacial drift with some fluviatile and slopewash material overlying the Kaniksu rocks.

Both the biotite granodiorite and the quartz monzonite rocks display a spheroidal weathering pattern. The principal type of weathering of the rock of the timber sale area is mechanical. Mechanical weathering is the physical disintegrating of the rock into smaller and smaller fragments, usually by freezing and thawing action of water. The chemical composition of the weathering products does not change from the chemical composition of the unweathered rock. The granodiorite weathers with a limonite staining on the exposed surfaces.

The soils produced by the mechanical weathering of the biotite granodiorite and the quartz monzonite rocks are granular, porous, and unconsolidated. The descriptive term for this type of weathering product is “grus”. There are no binding agents in the material and grus erodes easily by running water (snow melt, rain and flood). The timber sale roads built on and out of this grus material are highly erodible and require extensive maintenance and numerous removal systems, such as culverts and water bars. With little or no binding agents in the grus soil, roads are unstable.

PLUM CREEK - WILLIAMS
I-10
T. 45 N., R. 5 E., Section 23

The rocks exposed within the timber sale area are metamorphic rocks of the Belt Supergroup of Precambrian age. These rocks were deposited from 1,450 to 850 million years ago (Heitanen 1984). Specifically, the rocks of the timber sale area are massive and banded, dark gray to light gray quartzites of the Wallace Formation of the Belt Supergroup (Heitanen 1984 and Wagner 1949).

Also seen in the area of the timber sale are thin interbeds of micaceous schist separating the more massive quartzite. These interbeds contribute the bulk of the fine-grained mica fragments that is seen in the heavy soil cover that is pervasive over the timber sale area. Some of the muscovite-biotite schist rocks have incipient grains of a highly altered iron-based mineral, probably garnet. These minerals are so altered they are unrecognizable and just form blebs of iron stain in the schist.

The soil in the timber sale area is principally derived from weathering of the medium to dark gray quartzites of the Wallace Formation. The grain size in the soil is very uniform. There are clay minerals present in the soil that acts as a binding agent. Roads constructed in the timber sale area show minimal erosion and require only routine maintenance and water management. The principal haul roads, although thoroughly water barred, are generally self-draining because of the nature of the fill material and bedrock.

J. D. LUMBER, INC.
I-12
T. 54 N., R. 5 W., Section 13

The bedrock exposed in the timber sale area is primarily medium to dark gray argillite interbedded with quartzite. These rocks are part of the Belt Supergroup, probably equivalent to the Pritchard Formation (Savage 1967). The bedding of the argillite and quartzite is regular and uniform, averaging about 2 to 6 inches in thickness. This gives a “flaggy” appearance to the outcrop. The rocks weather with a reddish or rusty color due to the iron content. The biotite and muscovite mica content in the bedrock lends a shiny veneer or crust to the derived soils. Ripple marks were seen on the scarce outcrops within the timber sale area.

Soils developed on these rocks are silty to sandy and poorly consolidated. Roads, landings and skid trails built with this native soil material are intrinsically unstable and highly erodible. This is probably due in part to the high mica content of the soil (platy texture) and in part to the lack of suitable clay binding materials. Without frequent and regular maintenance, roadways tend to rut and fills collapse. Water management efforts (water bars, culverts, etc.) are highly subject to erosion due to the lack of the ability to compact the material adequately.

Idaho Forest Industries - BEAR CREEK
I-16
T. 49 N., R. 2 E., Sections 29, 32

The upland portion of the timber sale area is underlain by rocks of the Belt Supergroup, specifically, the Burke Formation of the Ravalli Group (Griggs 1973). The rock types in the upland part of the timber sale area are reddish-purple argillites and gray to greenish-gray siltites with some evidence of iron staining on weathered roadcuts and outcrops (Anderson 1940 and Hosterman 1956). Some of the exposures show a faded weathered rind that contrasts with the darker fresher core rock. Ripple marks are seen on some of the outcrops and roadcuts, indicating a shallow water environment of deposition.

The lower portion of the timber sale area is covered with unconsolidated alluvium derived from the Belt Supergroup rocks. Fragments of various colored quartzites and argillites are the dominant rock types in the alluvium.

The roads developed for the timber sale for the most part are good quality, show very little tendency to erode and only require routine maintenance and water management. The quartzite and argillite material used in the construction are quite durable rocks and not easily erodible.

PLUM CREEK - BURTON 26
I-17
T. 45 N., R. 4 E., Section 26

The rocks exposed within the timber sale area are metamorphic rocks of the Belt Supergroup of Precambrian age. These rocks were deposited from 1,450 to 850 million years ago (Heitanen 1984). Specifically, the rocks of the timber sale area are massive and banded, dark gray to light gray quartzites of the Wallace Formation of the Belt Supergroup (Heitanen 1984 and Wagner 1949).

Also seen in the timber sale area are thin interbeds of micaceous schist separating the more massive quartzite. These interbeds contribute the bulk of the fine grained mica fragments that is seen in the heavy soil cover that is pervasive over the timber sale area. Some of the muscovite-biotite schist rocks have incipient grains of a highly altered iron-based mineral, probably garnet. These minerals are so altered they are unrecognizable and just form blebs of iron stain in the schist.

The soil in the timber sale area is principally derived from weathering of the medium to dark gray quartzites of the Wallace Formation. The grain size in the soil is very uniform. There are clay minerals present in the soil that act as a binding agent. Roads constructed in the timber sale area show minimal erosion and require only routine maintenance and water management. The principal haul roads, although thoroughly water barred, are generally self-draining because of the nature of the fill material and bedrock.

OSCON - LOUISIANA-PACIFIC
I-18
T. 48 N., R. 3 E., Sections 23, 24

In the timber sale area, the bedrock is composed of rocks of the lower Wallace Formation of the Belt Supergroup. These rocks are Precambrian in age, about 1,250 to 1,450 million years b.p. (before the present). The principal rock types in the timber sale area are calcareous to dolomitic quartzite and calcareous argillite (Hobbs et al. 1965). The quartzites tend to be light gray to greenish-gray in color. The quartzite is interbedded or interlaminated with black to dark gray calcareous argillite and siltite (Griggs 1973). The Wallace Formation is unique among the Belt Supergroup rock in that they are almost all calcareous but not enough to be called limestones or dolomites. The argillite exposed in the timber sale area shows incipient mud cracks and well-formed ripple marks, thus showing a possible shallow water to intertidal environment of deposition.

The rocks of the timber sale area, regardless of whether they are quartzite or argillite, tend to weather to a tan or rusty, reddish appearance. This color may be due to by-products of hydrothermal alteration of constituent minerals, principally ferroan dolomite. The rock breaks down to a cobbly, rubbly texture that shows a weathering rind around a dark gray to black core. The soils derived from these rocks tend to have a low clay content, and grain size is medium to fine.

Roads developed from these soils should only require routine maintenance and water management because the material will pack tight and not be subject to a high degree of erosion. However, wet roads may rut relatively easy.

CROWN PACIFIC - PINE CREEK
I-19
T. 48 N., R. 1 E., Section 25
T. 48 N., R. 2 E., Section 30

The timber sale area has been mapped by Griggs (1973) as containing rocks of the Pritchard Formation and the Burke Formation, both of the Precambrian Belt Supergroup, and older terrace gravels. Rocks exposed in road cuts in the timber sale area are predominantly mudstones and argillites, probably of the Pritchard Formation with occasional light-colored quartzites of the Burke Formation. Overlying all of these rocks are older terrace gravels. These gravels are made up of well rounded boulders derived from the bedrock of this area and are stained orange by iron oxides. These gravels are of Pliocene and Pleistocene age. These gravels are remnants of gravel deposits that were once continuous and pervasive throughout the area.

Most of the rocks have been subjected to mechanical weathering, that is, by freezing and thawing. This has resulted in rounded cobbles, medium to coarse grained debris with little to no fines. The timber sale roads made from both this material and the older terrace gravels contain little to no binding agents and are highly erodible. The roads and water management features require regular and frequent maintenance. Road failures were commonly noted during the audit. Cut slopes are unstable and highly erodible.

CROWN PACIFIC - FIRE DRAW
I-20
T. 45 N., R. 1 E., Sections 3, 5
T. 46 N., R. 1 E., Section 33

The bedrock of this timber sale area is composed of local origin basalt of the Columbia River Basalt and rocks of the Belt Supergroup (Bishop 1969). The basalt is highly weathered to a red-brown to brown color. A reddish rubbly soil is developed over the flows. Large cobbles of weathered basalt are contained in the soil profile.

Underlying the basalt and exposed in numerous places in the timber sale area are rocks of the Wallace Formation of the Belt Supergroup (Kleinkopf et al. 1972). These rocks are mudstones, siltstones, and greenschist argillaceous siltites . The rock pit in the SW¼SW¼, Section 28, T. 46 N., R. 1 E. is within the greenschist facies of the Belt Supergroup. These rocks probably were originally fine grained siltstones and sandstones. Some of the siltites of the Wallace Formation exposed in the timber sale area display rudimentary ripple marks, indicating a shallow water environment of deposition.

Timber sale roads constructed from soil materials derived from either the basaltic rocks or the Belt Supergroup rocks seem to require only routine maintenance. The materials pack hard and resist erosion. Many of the sale roads have been riprapped by greenschist material from the rock pit. This material is hard and quite durable.

BOYER
N-3
T. 35 N., R. 1 W., Section 16

The timber sale area has been mapped by Bond (1963) and Hubbard (1956). The rocks exposed in the timber sale area and in the cliffs of Six-Mile Canyon are basalts belonging to the Columbia River Basalt Group, and are Miocene to early Pliocene in age. The basalts are finely crystalline, uniformly fine-grained and slightly porphyritic with phenocrysts of labradorite (a plagioclase feldspar). The basalts are dark-gray to black and weather to a lighter shade of gray. The more complete the alteration to clay, the lighter the color becomes.

There are five separate basalt flows exposed in the walls of Six-Mile Canyon. The flows are lithologically indistinguishable from each other and only can be differentiated by the "stair-step" appearance of the flows. The flows display jointing but the joint pattern does not appear to be systematic. The basalts exposed in Six-Mile Canyon represent only a portion of the "Upper Basalt" section of Bond (1963) as the exposures in Lapwai Creek, a few miles west of the timber sale area, indicate at least 19 separate flows of "Upper Basalt" for a maximum thickness of 2,800 feet.

The soil developed on the weathered basalt is light yellowish-brown and is called the Gwin Silt Loam (Bond 1963). This soil has a high water holding capacity, a great depth in places, fine texture, and large pine trees grow well in the Gwin soil. The timber sale road and landing area developed in this soil profile have held up well and the reclamation has been completed successfully.

MARSAN
N-4
T. 50 N., R. 2 W., Section 30

There are several rock types in the timber sale area (Griggs 1973). At the lower elevations in the area, rocks of the Precambrian Pritchard Formation of the Belt Supergroup are exposed. These rocks consist of medium grained, dark gray, laminated shales with a few thin layers of quartzite interspersed. These very old rocks weather to a dull rust colored appearance. Above the Pritchard Formation, and up to nearly the top of ridge on the east side of the timber sale area, dark gray to black basalt of the Columbia River Basalt of Miocene age crops out in road cuts and natural rock knobs. This basalt is a very typical basalt of the Columbia River Basalt. The basalt weathers to cobbles with a rust colored shell around a dark gray core. Farther up on the ridge and capping the high points on the east side of the area are poor exposures of older Tertiary gravels. These gravels represent an old valley surface that existed prior to the current erosional surface (Anderson 1940). Rock fragments in these gravels indicate that the gravels are a product of erosion of Belt Supergroup rocks.

The soils derived from the erosion and weathering of these three very different rock types has produced a locally gravelly, silt loam soil that compacts well. The roads in the timber sale area do not show susceptibility to erosion or washing. In fact, they are quite stable. There is no steep topography and erosion is at a minimum.

KOPET
N-5
T. 50 N., R. 4 W., Section 16

The rocks of the timber sale area have been mapped by Anderson (1940) and Griggs (1973) as argillites, siltites, quartzites, mica schists and gneisses of the Pritchard Formation of the Belt Supergroup. These rocks range in age from 1,450 to 850 million years b.p. (before the present). Also in the vicinity of the timber sale area are basalts of the Miocene Columbia River Group. The argillites and siltites are generally bluish-gray, the quartzites are usually grayish-white to white and the mica schists and gneisses are generally dark gray. Most of these rocks weather to a reddish, rusty appearance due to the included grains of pyrite. Rocks of the Pritchard Formation tend to be laminated, and form prominent ridges and ledges due to their relative resistance. The Columbia River basalts are dark gray, vesicular and glassy in texture. The basalts are very resistant and form the higher areas in the timber sale.

The soil in the timber sale area has a high mica content and presents a shiny appearance. This is due to the abundant mica contained in the bedrock of the area. The detritus also contains fragments of basalt from the surrounding hills. Roads made from the native material in and near the timber sale area will probably be stable due to the toughness of the metamorphic rocks.

DAVE WHITE
N-6
T. 49 N., R. 4 W., Section 19

The rocks of the timber sale area have been mapped by Anderson (1940) and Griggs (1973) as argillites, siltites, quartzites, mica schists, and gneisses of the Pritchard Formation of the Belt Supergroup. These rocks range in age from 1,450 to 850 million years b.p. (before the present). Also in the vicinity of the timber sale area are basalts of the Miocene Columbia River Group. The argillites and siltites are generally bluish-gray, the quartzites are usually grayish-white to white and the mica schists and gneisses are generally dark gray. Most of these rocks weather to a reddish, rusty appearance due to the included grains of pyrite. Rocks of the Pritchard Formation tend to be laminated, and form prominent ridges and ledges due to their relative resistance. The Columbia River basalts are dark-gray, vesicular and glassy in texture. The basalts are very resistant and form the higher areas in the timber sale.

The soil in the timber sale area has a high mica content and presents a shiny appearance. This is due to the abundant mica contained in the bedrock of the area. The detritus also contains fragments of basalt from the surrounding hills. Roads made from the native material in and near the timber sale area will probably be stable due to the toughness of the metamorphic rocks.

ERICKSON
N-12
T. 50 N., R. 4 W., Sections 29, 32

The rocks of the timber sale area have been mapped by Anderson (1940) and Griggs (1973) as argillites, siltites, quartzites, mica schists, and gneisses of the Pritchard Formation of the Belt Supergroup. These rocks range in age from 1,450 to 850 million years b.p. (before the present). The argillites and siltites are generally bluish-gray, the quartzites are usually grayish-white to white and the mica schists and gneisses are generally dark gray. Most of these rocks weather to a reddish, rusty appearance due to the included grains of pyrite. Rocks of the Pritchard Formation tend to be laminated, and form prominent ridges and ledges due to their relative resistance.

The soil in the timber sale area has a high mica content and presents a shiny appearance. This is due to the abundant mica contained in the bedrock of the area. The detritus also contains fragments of basalt from the surrounding hills. Roads made from the native material in and near the timber sale area will probably be stable due to the toughness of the metamorphic rocks.

IRVINE
N-13
T. 50 N., R. 4 W., Section 30

The rocks of the timber sale area have been mapped by Anderson (1940) and Griggs (1973) as argillites, siltites, quartzites, mica schists, and gneisses of the Pritchard Formation of the Belt Supergroup. These rocks range in age from 1,450 to 850 million years b.p. (before the present). The argillites and siltites are generally bluish-gray, the quartzites are usually grayish-white to white and the mica schists and gneisses are generally dark gray. Most of these rocks weather to a reddish, rusty appearance due to the included grains of pyrite. Rocks of the Pritchard Formation tend to be laminated, and form prominent ridges and ledges due to their relative resistance.

The soil in the timber sale area has a high mica content and presents a shiny appearance. This is due to the abundant mica contained in the bedrock of the area. The detritus also contains fragments of basalt from the surrounding hills. Roads made from the native material in and near the timber sale area will probably be stable due to the toughness of the metamorphic rocks.

WALDEN
N-15
T. 56 N., R. 4 W., Section 24

The rocks of the timber sale area are granodiorite and/or quartz monzanite of the Kaniksu batholith. The Kaniksu batholith is approximately 70 million years old (Cretaceous to Tertiary) (Savage 1967). These two rock types are difficult to distinguish between in hand sample. The bedrock of the timber sale area has a black and white (salt and pepper) appearance and is medium to coarse grained in texture. The dark colored minerals are hornblende and biotite and the light colored minerals are quartz and feldspar. There is an occasional larger phenocryst of hornblende that lends a localized porphyritic texture to the rock.

Both the biotite granodiorite and the quartz monzonite rocks display a spheroidal weathering pattern. What few natural outcrops present in the timber sale area display a rounded appearance due to weathering. The principal type of weathering of the rock of the timber sale area is mechanical. Mechanical weathering is the physical disintegrating of the rock into smaller and smaller fragments, usually by freezing and thawing action of water. The chemical composition of the weathering products does not change from the chemical composition of the unweathered rock.

The soils produced by the mechanical weathering of the biotite granodiorite and the quartz monzonite rocks are granular, porous and unconsolidated. The descriptive term for this type of weathering product is “grus”. There are no binding agents in the material and grus erodes easily by running water (snow melt, rain and flood). The timber sale roads built on and out of this grus material are highly erodible and require extensive maintenance and numerous removal systems, such as culverts and water bars. With little or no binding agents in the grus soil, roads are unstable.

HENDERSON
N-A
T. 63 N., R. 1 E., Section 3

The timber sale area is underlain by granite and granodiorite of the Kaniksu batholith (Alt and Hyndman 1989). The batholith rocks are Cretaceous in age and are principally made up of quartz, feldspar and biotite minerals. The rock is light gray to pink in color and contains large phenocrysts of quartz and orthoclase feldspar (Kirkham and Ellis 1926).

The granitic rocks have been weathered chemically, that is, the feldspars have been altered to clay minerals. The soils derived from this chemical process are rich in clay and roads developed with this material tend to have a low susceptibility to erosion by running water. The roads in the timber sale area, while reseeded, do not show much gullying or washouts, however they will rut under heavy traffic in wet conditions.

There is some evidence of glacio-fluvial sediments in the vicinity of the timber sale area. These lake sediments are generally unconsolidated, fine- to medium-grained, and roughly stratified. Some of the gravels in the stream channel of Rock Creek may be derived from these sediments.

WROMAR
N-B
T. 65 N., R. 2 E., Sections 27, 28

The materials exposed at the surface within the timber sale area are Quaternary glacio-fluvial sediments derived from Glacial Lake Kootenai (Newton et al. 1960). The materials consist of unconsolidated silts, sands and gravels. The principal rock types found in these unconsolidated sediments are granite, quartz diorite and Pre-Cambrian Belt Supergroup rocks. In the timber sale area, Kirkham and Ellis (1926) mapped a granitic sill underlying the surficial lake sediments. This sill, as well as others in the vicinity, consists of a graditional series of rocks ranging from altered gabbro and diabase to diorite, quartz diorite and granite. The lake bed sediments show all of these rock types.

The hills surrounding the timber sale area are formed from rocks of the Belt Supergroup. Specifically, the rocks are part of the Pritchard Formation and consist of dark colored gray and bluish-banded argillite and slate with some quartzite. All of this material, in addition to the granitic material, shows up in the lake sediments.

Timber sale roads developed in the lake sediments from native materials require routine maintenance and extensive water management. The unconsolidated sediments are erodible, but with the judicious use of water bars, culverts and sloping, erosion of the roads should be kept to a minimum.

KARLBERG
N-C
T. 61 N., R. 2 E., Section 2

Kirkham and Ellis (1926) mapped the bedrock of the timber sale area as a sequence of basic granitic sills (Moyie sills) interjected between layers of metamorphic rocks belonging to the Belt Supergroup, probably the Pritchard Formation. In the timber sale area, the Pritchard Formation is predominantly quartzite with a minor amount of argillite. The quartzites are massive, occurring in beds as thick as eight feet while the interbedded argillites are thin, averaging six inches.

The Moyie sills are injected, tabular, igneous masses that range in thickness from 30 to 2,000 feet and are exposed over a very large area. The lithology of these sills are variable but are mainly altered gabbro and diabase with local dioritic phases. Because of the sills' superior resistance to erosion, they generally are exposed in ridges, peaks or cliffs.

No bedrock of any kind was seen during the audit team's visit to the timber sale. Quaternary alluvium masks the underlying bedrock. However, bedrock fragments were seen in several cuts made along timber sale roads, enough to draw conclusions as to what lies below. Some of the road cuts were observed making water in small seeps and some road cuts were failing and being rock cribbed. This would indicate an intrinsic instability of the alluvium as road making material, and in fact, the roads probably will require constant maintenance.

APPENDIX G

040. ROAD CONSTRUCTION AND MAINTENANCE

01. Purpose. Provide standards and guidelines for road construction and maintenance that will maintain forest productivity, water quality, and fish and wildlife habitat.

02. Road Design ~~Specifications and Plans~~. Road design ~~specifications and plans~~ shall be consistent with good safety practices. Design ~~Plan~~ each road to the minimum use standards adapted to the terrain and soil materials to minimize disturbances and damage to forest productivity, water quality, and wildlife habitat.

a. Design ~~Plan~~ transportation networks to avoid ~~minimize~~ road construction within stream protection zones, except for approaches to stream crossings. Design to leave or reestablish areas of vegetation between roads and streams.

b. Roads shall be ~~planned~~ no wider than necessary to safely accommodate the anticipated use. Minimize cut and fill volumes by designing the road alignment to fit the natural terrain features as closely as possible. Use as much of the excavated material as practical in fill sections. Adequately compact fill material or dispose of on geologically stable sites. ~~Plan minimum cuts and fills particularly near stream channels.~~

~~c. Design embankments and waste so that excavated material may be disposed of on geologically stable sites.~~

c.~~d.~~ Design ~~Plan~~ roads to drain naturally by out-sloping or in-sloping with cross-drainage and by grade changes where possible. Plan dips, water bars, ~~or~~ cross-drainage, or subsurface drainage on roads when necessary.

d.~~e.~~ Relief culverts and roadside ditches shall be planned whenever reliance upon natural drainage would not protect the running surface, excavation or embankment. Design culvert installations to prevent erosion of the fill by properly sizing, bedding and compacting. Plan drainage structures to achieve minimum direct discharge of sediment into streams.

e.~~g~~ ~~Plan~~ Stream crossings, including fords, ~~to~~ shall be minimum in number and designed and installed in compliance with the Stream Channel Proection Act ~~minimum standards for stream channel alterations under the provisions of~~ Title 42, Chapter 38, Idaho Code and with culvert sizing requirements of subsection 040.03.f. ~~Plan all culvert installation on Class I streams to provide for fish passage.~~

~~h. If reuse of existing roads would violate other rules, the operator shall obtain a variance according to Subsection 020.01. Consider reuse of existing roads when reuse or reconstruction would result in the least long-run impact on site productivity, water quality, and fish and wildlife habitat.~~

03. Road Construction. Place debris, overburden, and other materials associated with road construction in such a manner as to prevent entry into streams. Deposit excess material and slash on stable locations outside the Stream Protection Zones.

a. To reconstruct existing roads located in stream protection zones, the operator shall obtain a variance in accordance with Subsection 020.01. Consider reconstruction or reuse of existing roads in SPZs, over new construction out of the SPZ, when it will result in the least long-run impact on site productivity, water quality, and fish and wildlife habitat.

b.~~a.~~ Roads shall be constructed in compliance with the ~~planning guidelines~~ design standards of Subsection 040.02.

c.~~b.~~ Clear ~~drainage ways of~~ all debris generated during construction or maintenance which potentially interferes with drainage or water quality.

d.~~c.~~ Where exposed material (road surface, excavation, embankment, borrow pits, waste piles, etc.) is potentially erodible, and where sediments would enter streams, stabilize prior to fall or spring runoff by seeding, compacting, rocking, riprapping, benching, mulching or other suitable means.

e.~~d.~~ In the construction of road fills near streams, compact the material to reduce the entry of water, minimize erosion, and settling of fill material. Minimize the amount of snow, ice, or frozen soil buried in embankments. No significant amount of woody material shall be incorporated into fills. Available slash and debris should ~~may~~ be windrowed along the toe of the fill, but must meet the requirements of the Idaho Forestry Act and Fire Hazard Reduction Laws, Title 38, Chapters 1 and 4. ~~Subsection 040.04.c.~~

~~e. Construct stream crossings in compliance with minimum standards for stream channel alterations under the provisions of Title 42, Chapter 38, Idaho Code. Roads shall not be constructed in stream channels. Roads that constrict upon a stream channel shall be constructed in compliance with minimum standards for stream channel alterations under provisions of Title 42, Chapter 38, Idaho Code.~~

f. The following rule applies to installations of new culverts and reinstallations during road reconstructions or reinstallations caused by flood or other catastrophic events. Culverts used for temporary crossings are exempt from the fifty (50) year design requirement ~~this rule~~, but they must be removed immediately after they are no longer needed and before the spring run-off period. Culvert installations on Class I streams must provide for fish passage.

i. Design culverts for stream crossings to carry the fifty (50) year peak flow using engineering methods acceptable to the department or determine culvert size by using the culvert sizing tables below. The minimum size culvert required for stream crossings shall not be less than eighteen (18) inches in diameter, with the exception of that area of the Snake River drainage upstream from the mouth of the Malad River, including the Bear River basin, where the minimum size shall be fifteen (15) inches.

CULVERT SIZING TABLE - 1

USE FOR NORTH IDAHO AND THE SALMON RIVER DRAINAGE

This culvert sizing table will be used for the area of the state north of the Salmon River and within the South Fork Salmon River drainage. It was developed to carry the 50-year peak flow at a headwater-to-diameter ratio of 1.

Required Watershed Area (acres)	Culvert Diameter (inches)	Culvert Capacity (in cubic feet/sec)
less than 32	18	6
33 - 74	24	12
75 - 141	30	20
142 - 240	36	32
241 - 366	42	46
367 - 546	48	65
547 - 787	54	89
788 - 1027	60	112

Strongly consider having culverts larger than 60 inches designed, or consider alternative structures, such as bridges, mitered culverts, arches, etc.

1028 - 1354	66	142
1355 - 1736	72	176
1737 - 2731	84	260
2732 - 4111	96	370
4112 - 5830	108	500
5831 - 8256	120	675

Culverts larger than 120 inches must be designed; consider alternative structures.

CULVERT SIZING TABLE - 2

USE FOR SOUTH IDAHO

This culvert sizing table will be used for the area of the state south of the Salmon River and outside the South Fork Salmon River drainage. It was developed to carry the 50-year peak flow at a headwater-to-diameter ratio of 1.

Required Watershed Area (Acres)	Culvert Diameter (inches)	Culvert Capacity (in cubic feet/sec)
less than 72	18#	6
73 - 150	24	12
151 - 270	30	20
271 - 460	36	32
461 - 720	42	46
721 - 1025	48	65
1026 - 1450	54	89
1451 - 1870	60	112

Strongly consider having culverts larger than 60 inches designed, or consider alternative structures, such as bridges, mitered culverts, arches, etc.

1871 - 2415	66	142
2416 - 3355	72	176
3356 - 5335	84	260
5336 - 7410	96	370
7411 - 9565	108	500
9566 - 11780	120	675

Culverts larger than 120 inches must be designed; consider alternative structures.

\# See exception for southeast Idaho in subparagraph i. of this rule.

ii. Relief culverts, and those used for seeps, springs, wet areas, and draws shall not be less than twelve (12) inches in diameter for permanent installations.

f. During and following operations on out-sloped roads, retain out-slope drainage and remove berms on the outside edge except those intentionally constructed for protection of road grade fills.

g. Provide for drainage of quarries to prevent sediment from entering streams.

h. Construct cross drains and relief culverts to minimize erosion of embankments. ~~Minimize the time between construction and installation of erosion control devices.~~ Use riprap, vegetative matter, downspouts and similar devices to minimize erosion of the fill. Install drainage structures or cross drain incompleted roads which are subject to erosion prior to fall or spring runoff. Install relief culverts with a minimum grade of one (l) percent.

i. Earthwork or material hauling shall be postponed during wet periods if, as a result, erodible material would enter streams.

j. ~~In rippable materials,~~ Roads shall be constructed with no overhanging banks. ~~and~~ Any trees that present a potential hazard to traffic shall be felled concurrently with the construction operation.

04. Road Maintenance. Conduct ~~regular~~ preventive maintenance operations, for the serviceable life of the road, to avoid deterioration of the roadway surface and minimize disturbance and damage to forest productivity, water quality, and fish and wildlife habitat.

a. Sidecast all debris or slide material associated with road maintenance in a manner to prevent their entry into streams.

b. Repair and stabilize slumps, slides, and other erosion features causing stream sedimentation to the degree needed to reasonably insure the situation has been stabilized.

c. Active roads. An active road is a forest road being used for hauling forest products, rock and other road building materials. The following maintenance shall be conducted on such roads.

i. Culverts and ditches shall be kept functional.

ii. During and upon completion of seasonal operations, the road surface shall be crowned, out-sloped, in-sloped or water barred, and berms removed from the outside edge except those intentionally constructed for protection of fills.

iii. The road surface shall be maintained as necessary to minimize erosion of the subgrade and to provide proper drainage. Log hauling shall be postponed during wet periods if, as a result, sediments would enter streams.

iv. If road oil or other surface stabilizing materials are used, apply them in such a manner as to prevent their entry into streams.

d. Inactive Roads. An inactive road is a forest road no longer used for commercial hauling but maintained for access (e.g., for fire control, forest management activities, recreational use, and occasional or incidental use for minor forest products harvesting). The following maintenance shall be conducted on inactive roads.

i. Following termination of active use, ditches and culverts shall be cleared and the road surface shall be crowned, out-sloped or in-sloped, water barred or otherwise left in a condition to minimize erosion. Drainage structures shall be maintained thereafter as needed.

ii. The roads may be permanently or seasonally blocked to vehicular traffic.

e. Abandoned Roads. An abandoned road is not intended to be used again. No subsequent maintenance of an abandoned road is required after the following procedures are completed:

i. The road is left in a condition suitable to control erosion by out-sloping, water barring, seeding, or other suitable methods;

ii. Ditches are cleaned;

iii. The road is blocked to vehicular traffic;

iv. The department may require the removal of bridges and culverts except where the owner elects to maintain the drainage structures as needed.

05. Winter Operations. Due to risk of erosion and damage from roads and constructed skid trails inherent in winter logging, at minimum the following shall apply:

a. Roads to be used for winter operations must have adequate surface and cross drainage installed prior to winter operations. Drain winter roads by installing rolling dips, driveable cross ditches, open top culverts, outsloping, or by other suitable means.

b. During winter operations, roads will be maintained as needed to keep the road surface drained during thaws or break up. This may include active maintenance of existing drainage structures, opening of drainage holes in snow berms and installation of additional cross drainage on road surfaces by ripping, placement of native material or other suitable means.