# III.1 CORE TOPIC - EROSION PROCESSES

## EROSION PROCESSES

Analysis Questions:

*What are the dominant historical and current erosional processes within the watershed (e.g., surface erosion, mass wasting)? Where have they occurred and how likely are they to occur?*

*What are the rates of landsliding and surface erosion within the analysis area?*

*How and where have management activities played a role in producing landslides? How have they affected sediment routing in the analysis area?*

*What are the influences and relationships between erosion processes and other ecosystem processes (e.g., vegetation, woody debris recruitment, aquatic habitat, etc.)? How have management activities affected these relationships?*

*What are the management objectives for erosional processes and sediment within the watershed?*

Erosion is a process that dislodges and transports soil particles in wind and/or water. Erosional processes common in the analysis area include mass wasting (landslides), rotational slumps, channel incision, stream-bank failures, and surface erosion. Mass wasting is the most common process and accounts for a substantial amount of sediment delivery downslope and to stream channels. Three types of mass wasting were noted during analysis of erosion processes in Big Creek: debris torrents, debris avalanches, and shallow-rapid debris failures. A debris torrent is the rapid movement of large amounts of soil and woody debris, under the influence of water, down a stream channel. The torrent usually consists of a liquid flowing mass that can travel considerable distances downstream. A debris avalanche often results from the under-mining of the toe of a slope, or from over-steepening of a slope past the natural angle of repose. The avalanche usually consists of a mass of soil, moving downhill under the influence of gravity. Shallow-rapid debris failures are slides which move the top few feet of soil short distances downslope, contributing fine sediments to stream channels if not filtered out. For all types of mass wasting, potential for sediment delivery to stream channel is dependent upon the nearness of the failure to a stream channel and the length of the slide's downhill run.

## REFERENCE CONDITION

All types of erosional processes were present before human influences occurred in the analysis area. Natural events, such as fire and floods, probably produced large quantities of sandy and clayey sediments from exposed surfaces. It is assumed that the historic rate of surface erosion within the subwatershed alternated between periods of high and low based on the occurrence of episodic events (i.e., fire, floods) spread over a long time-span. No historic rates can be determined for events such as landslides, although researchers speculate that they were probably infrequent (Ketcheson 1978).

Analysis of reference condition with respect to erosional processes and rates was conducted using aerial photos from 1943 to the present to determine the distribution and prevalence of types of erosion in the watershed.

Mass Wasting
No evidence exists that will support an estimate of the historic rate of magnitude or mass wasting processes in the Big Creek watershed. It is reasonable to assume that certain erosion processes were more common in some parts of the drainage than others based on topography and underlying geology. For example, aerial photo analysis indicates that the northern part of the analysis area (which is geologically younger and steeper) appears to produce more shallow-rapid debris slides than elsewhere in the drainage.

Surface Erosion
No historic surface erosion rates are known or can be developed for the watershed. Typically, the rate and magnitude of erosion is influenced by the presence and composition of vegetation. We may therefore predict that events within the watershed that changed the distribution and composition of vegetation (such as fire and large avalanches) produced changes in erosion rates. The analysis area is known to have had large fires in the upper portion of the drainage in the 1860s and 1930s.

## CURRENT CONDITION

### Types of Erosion
Mass Wasting/Landslides
The type and number of landslides across the drainage were determined based on analysis of aerial photos (photo years 1943, 1976, 1992). For each occurrence, underlying soil-type and land-management activity thought to precipitate the slide were identified. It should be noted that landslide inventory from aerial photographs tends to underestimate the number of landslides in undisturbed forests because shadows cast by steep, narrow ridges, and tall, dense forest vegetation makes failure within forested areas difficult to identify (Skaugset 1992). It is also difficult to distinguish natural slides from those caused by a harvest activity if the slide occurs on land that is sufficiently vegetation. For this analysis, slides found on land vegetated for 10-15 years were considered a natural slide and not a function of a management activity.

Aerial photo interpretation determined that 196 slides occurred between photo years 1943 and 1992. Most of these slides were shallow-rapid debris failures and debris avalanches on steep (>50%) slopes. These debris-torrent failures were associated with steep slopes and ephemeral channels, while debris avalanches were most often correlated with management activities such as timber harvest and road construction (see further discussion below).

The second most common type of failures were slumps and associated earthflows, which occurred on deeper, clayey soils. Rotational slumps and earth-creep soil movement were evident, particularly in Jones Creek (the southeastern end of the drainage). Shallow-rapid slides were also observed in the headwaters of the Fall, Brownson, and Axe Creek drainages.

Almost all slides occurring in this period delivered sediments to the stream channel, but no estimates for volume delivered were determined during this analysis. Based on the size of exposed area, 2/3rds of all slides occurring between 1976 and 1992 exposed areas greater than 1000 $yds^2$ (.2 acres). The remaining 1/3 of the slides covered less than 1000 $yds^2$.

Surface Erosion

Typically, surface erosion in a forested environment is not a major contributor of sediment at the common erosion rate of less than 0.1 ton/ac/yr. Soil erosion rates for the Big Creek subwatershed were modeled using the Revised Soil Loss Equation[2]. According to the model, the watershed can be expected a similar rate of 0.01 to 0.10 tons/ac/yr from most of the land surfaces, once vegetation reaches 20 years of age (Fig III 1-1). However, higher rates (up to 8 to 10 tons/ac/yr) may occur when vegetation is removed from extremely steep slopes, but subsequently drops to 2 to 4 tons/ac/yr 3 to 5 years later, following revegetation of the exposed ground.

In managed watersheds such as Big Creek, surface erosion occurs when there is disturbance to the ground and vegetation is removed or when there is high volumes of traffic on dirt or gravel spur roads. However, there must be water available for conveyance of soil to the stream as either overland flow or as uncontrolled flow of water across road surfaces, in ditches and around culverts

**Natural and Anthropogenic Factors Contributing to Erosion in the Big Creek Watershed**

Before attempting to determine the effects (if any) of management activities on erosional processes, it is important to first identify the natural factors causing occurrences (total numbers) or rates (i.e. number per year) of landslides.

Natural Rates of Landsliding and Surface Erosion

According to aerial photo analysis, the type and number of landslides in the Big Creek subwatershed appears to be correlated with underlying geology, sensitivity of land-forms and topographic-types, soil type, and BLM land-type designations.

*Geology*: In the analysis area, failure events appear to be more common in certain lithographies. For example, the Jones Creek drainage appears to be prone to slow earth-creep and slump-bench failures. This is due, in part, to the fact that the Jones Creek area is relatively old (nearly 9 times older than the rest of the analysis area) and the soil has a very high clay content. The large debris torrent in the lower portion of the Bear Pen Creek drainage and the rotational slump in the upper portion of the Jones Creek drainage are characteristic of the underlying geologies in those drainages. In contrast, the northern area (consisting of the geologically younger and steeper Tyee and Flournoy formations) produces more shallow-rapid slides than elsewhere in the drainage.

A small island of the Otter Point formation containing high clay content exists in the southern portion of the drainage (Figure I-5). Although slopes are not steep in this area, evidence of earth creep in 30 to 40 year old stands of trees and encroachment of cut-slopes on road surfaces indicated there is risk of land failure in this area.

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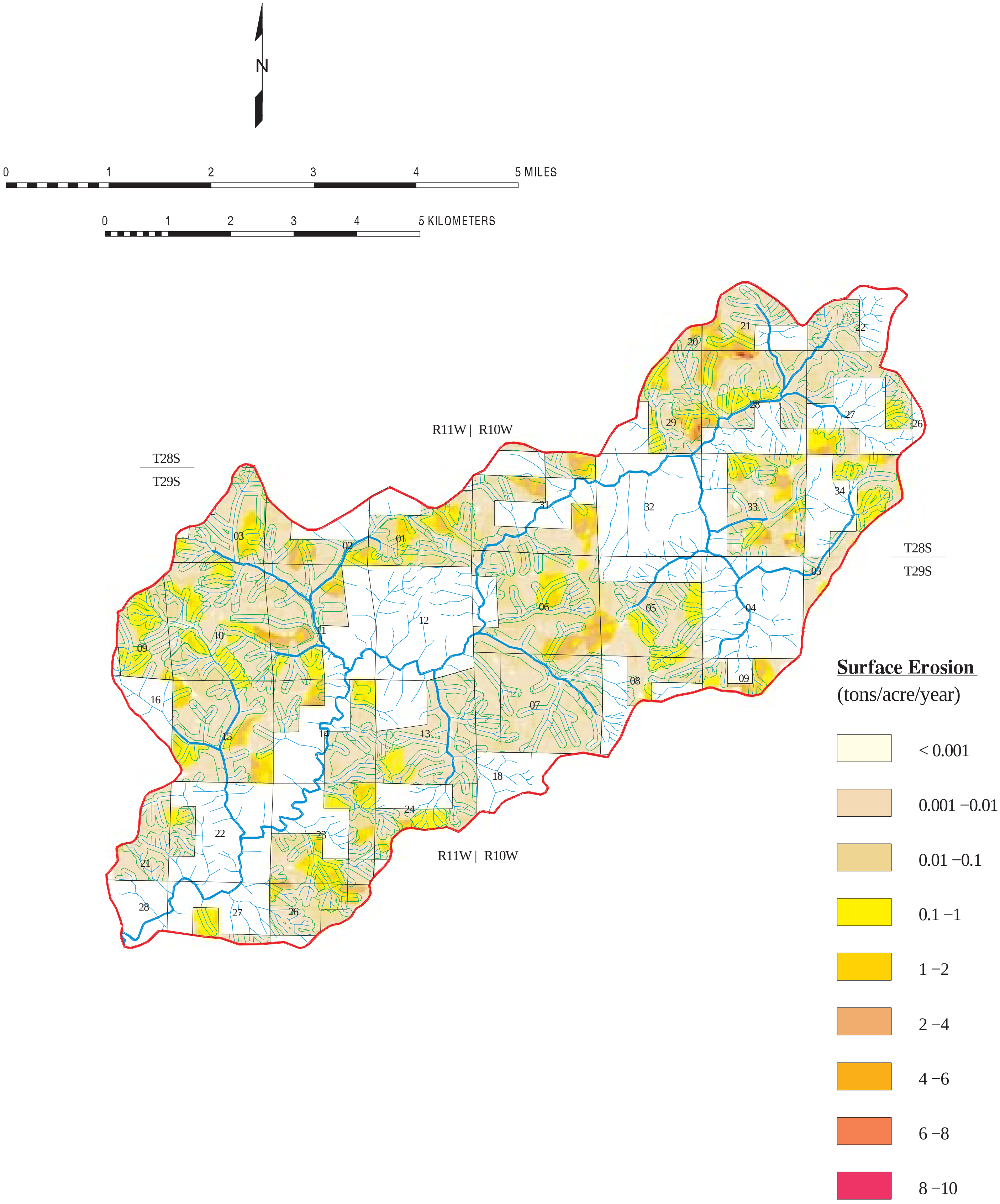
[2] Values for rainfall amount, percent of bare soil, and canopy height were set at highest levels possible for the area ("worst case scenario). The model may therefore not represent actual conditions after disturbance.

# Figure III.1−1 Surface Erosion modeled with MSLE




Scale = 1:84480 (3/4" = 1 mile)

Table III.1-1 summarizes the relationship between geological formation and landside frequency.

**Table III. 1-1 Rate of Landslides by Geological Formation for all Photo Years**

| | Roseburg | Looking glass | Flournoy | Tyee | Roseburg w/volcanics | Serpentine | Quaternary Alluvium |
|---|---|---|---|---|---|---|---|
| Formation Acres | 8146 | 5824 | 1057 | 255 | 173 | 421 | 729 |
| Total Slides | 103 | 59 | 20 | 6 | 3 | 4 | 1 |
| Percent of Landbase | 48.9 | 35 | 6.3 | 1.5 | 1 | 2.5 | 4.4 |
| Percent of slides | 52.6 | 30.1 | 10.2 | 3.1 | 1.5 | 2 | 0.5 |
| Slides/100 acs. | 1.3 | 1 | 1.9 | 2.4 | 1.8 | 1 | 0.1 |

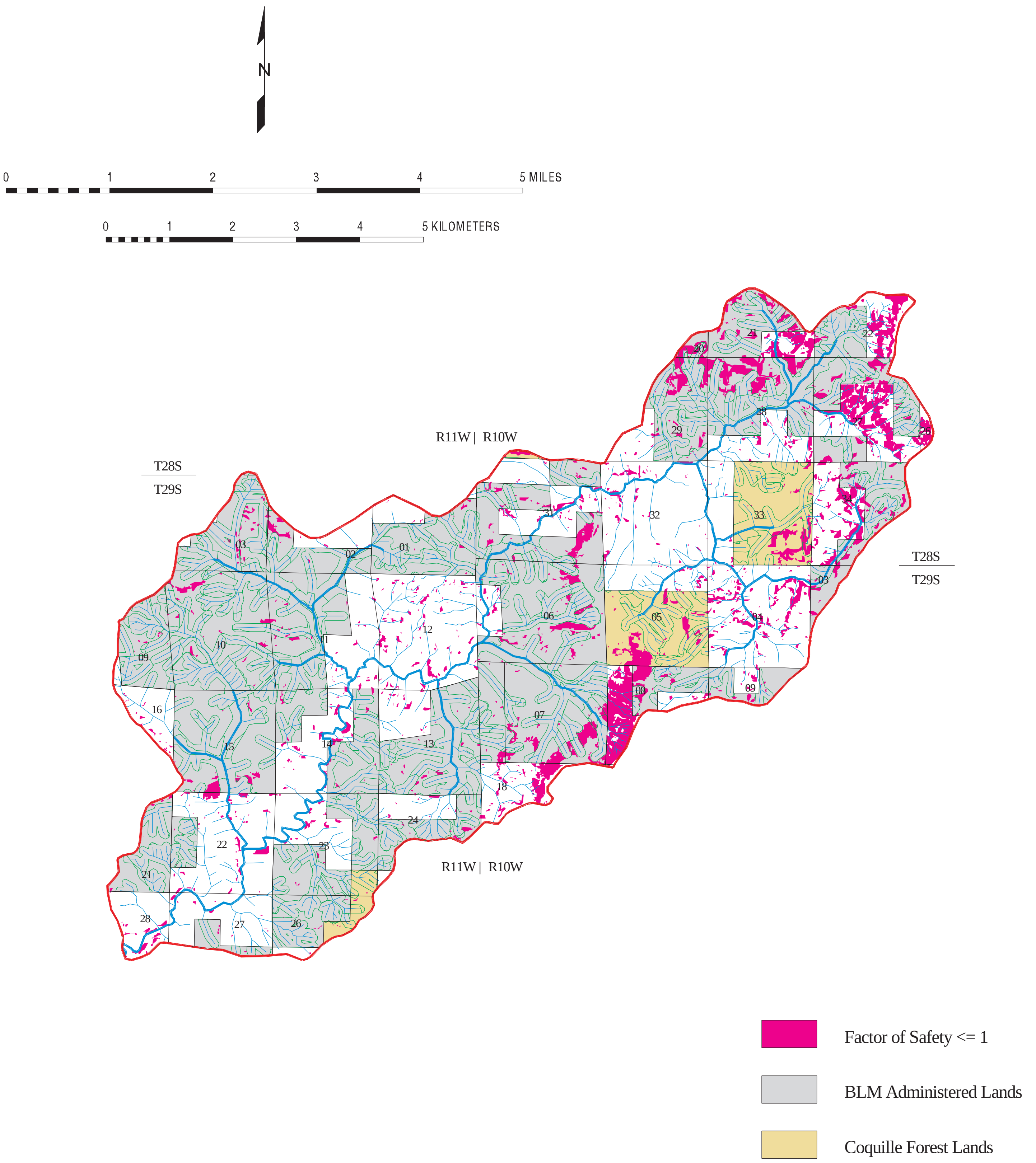
*Sensitive Landforms and Topography*: Land-form and topography are partly the product of underlying geology. Like sensitive rock formations, certain landforms and topography are more prone to failure events than others. Critical and sensitive land forms in the analysis area were identified based on land stability and the natural or background tendency (i.e., not caused by management) towards erosion. The Infinite Slope Equation (I.S.E.)[3] was used to model a natural tendency towards mass movement as a Factor of Safety.

Results of the analysis indicates that natural landslide failures are predicted in draws and midslope areas where water concentrates and topography is steep- exceeding 65% (Figure III.1-2) These predicted failures correlate well with slope analysis (Figure III.1-3). Steep areas are located in the northern end of the analysis area. Other areas steep enough to initiate debris avalanches are an uplifted portion of the Lookingglass formation (a ridge primarily located at the joining of Sections 7 and 8 of T.29 S., R.10 W. and extending into Section 5 and the eastern half of Section 6 extending up to the SE 1/4, SE 1/4 of Section 31).

As indicated earlier, photo analysis revealed a positive correlation between predicted areas of failure (steep topography) and numbers of actual slides. The I.S.E. model predicted more unstable areas in less-steep portions of the watershed (the Lookingglass formation) than actually occurred. The discrepancy between model predictions and number of slides experienced may be partially explained by drought conditions in the watershed during critical years following harvest.

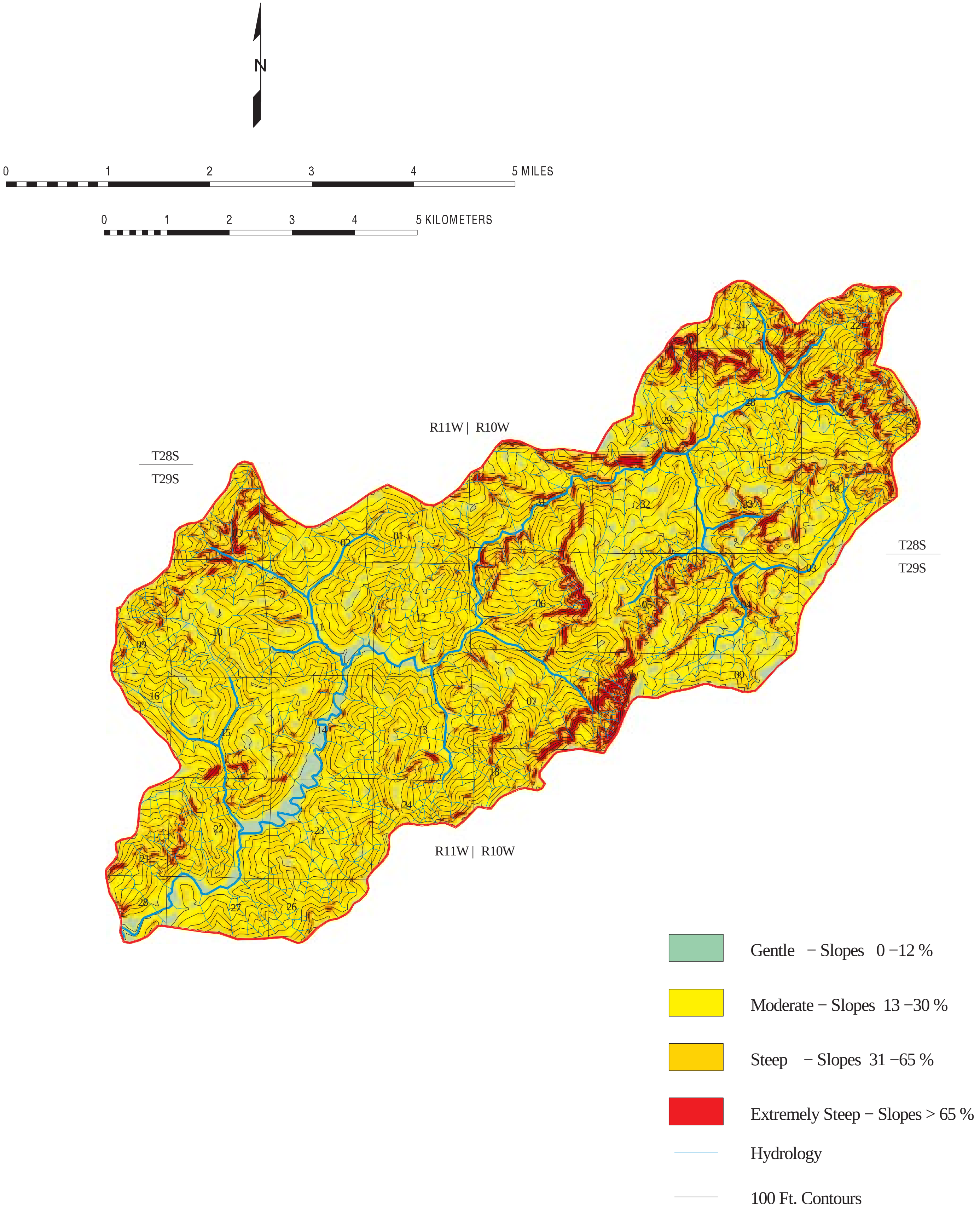
[3]The following conditions and assumptions used during modeling with the Infinite Slope Equation:
1. A predicted Factor of Safety less than 1.0 was used to identify areas predicted to fail under a set of "worst cases."
2. The conditions assumed maximize the forces producing slides and minimizes forces adding resistance to slides.
3. To minimize retention forces and simplify the equation, no residual forest for all lands after harvest was assumed (even through live green tree retention is required on BLM-administered lands).
4. The full width of Riparian Reserves are forested as per the Northwest Forest Plan.

# Figure III.1−2 Mass wasting modeled with ISE



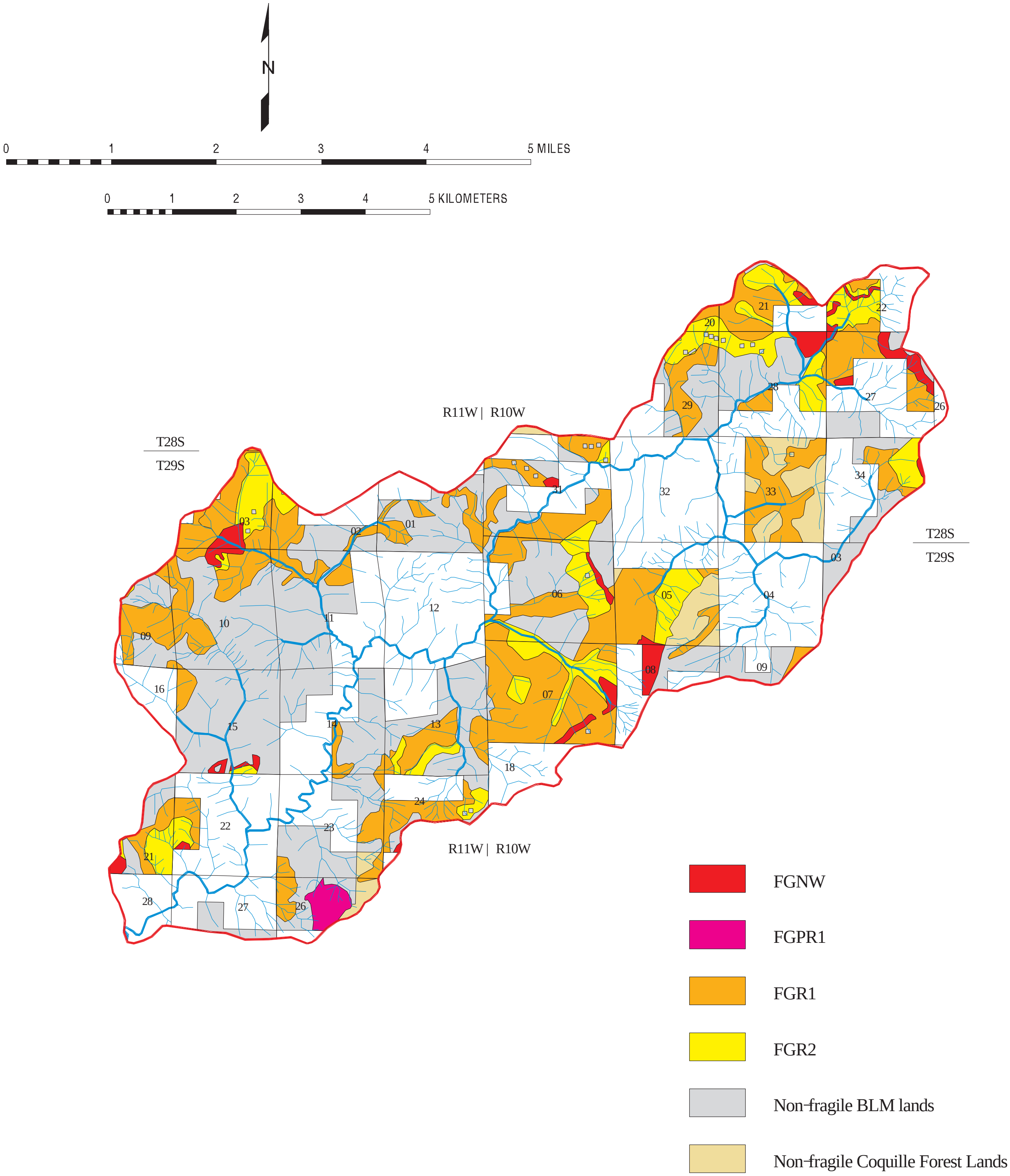

Scale = 1:84480 (3/4" = 1 mile)

# Figure III.1−3  Slope Hazard Classes




Scale = 1:84480 (3/4" = 1 mile)

# Figure I–4 TPCC Fragile and Withdrawn Areas on Federally Administered Lands




Scale = 1:84480 (3/4" = 1 mile)

*Designated Land-type and Tendency towards Failure*: Analysis using the I.S.E. model revealed a positive correlation between predicted areas of failure and land type (i.e., FGNW, FGR2, etc.) This model suggested that some TPCC areas (Figure III.1-4) have higher incidence of landslides.

*Landslides and Soil-Types*: Landslides were found to occur more frequently on five soil-types (14F, 15F, 46F, 38F, and 58F) (Figures III.1-5 and Table III.1-2). Although these soil types make up only 58% of the Big Creek subwatershed, nearly 83% of all failures occurred on these soil types. In particular, soil types 15F, 38F, and 58F were particularly sensitive to landsliding, with slide rates four to thirty-four times what would be expected based on the number of slides per 100 acres of the particular soil type.

**Fig III. 1-5 Landslides Observed on Most Prone Soil Types by Management Activity**

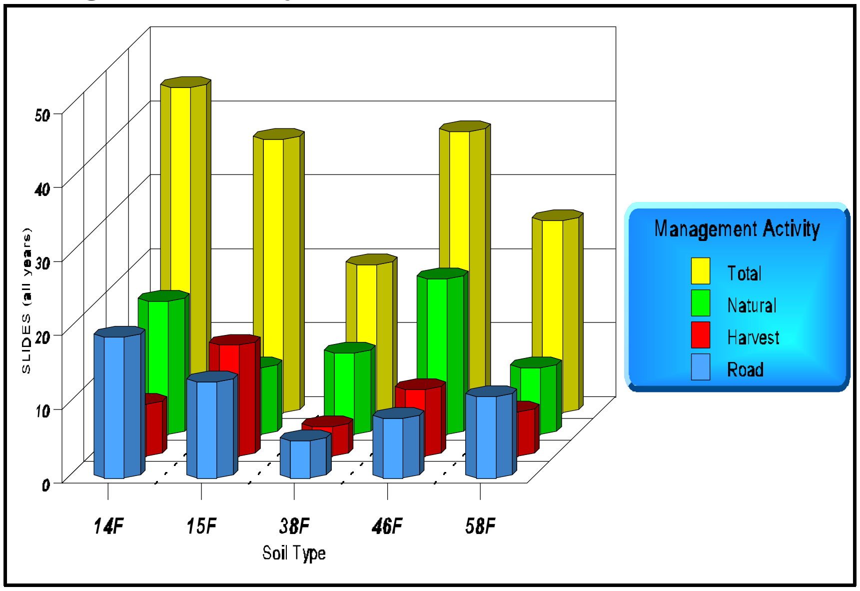



**Table III. 1-2 Comparison of Landslides by Soil Type**

| Soil Type | Percent of Land Base | Percent of Slides | Number of Slides per 100 acs. |
|---|---|---|---|
| 14F | 23.7 | 22 | 1.09 |
| 15F | 5.1 | 19 | 4.34 |
| 46F | 19.2 | 19 | 1.16 |
| 58F | 4.6 | 13 | 34.07 |
| 38F | 5.1 | 10 | 23.31 |

<u>Management Activities and Mass Wasting</u>

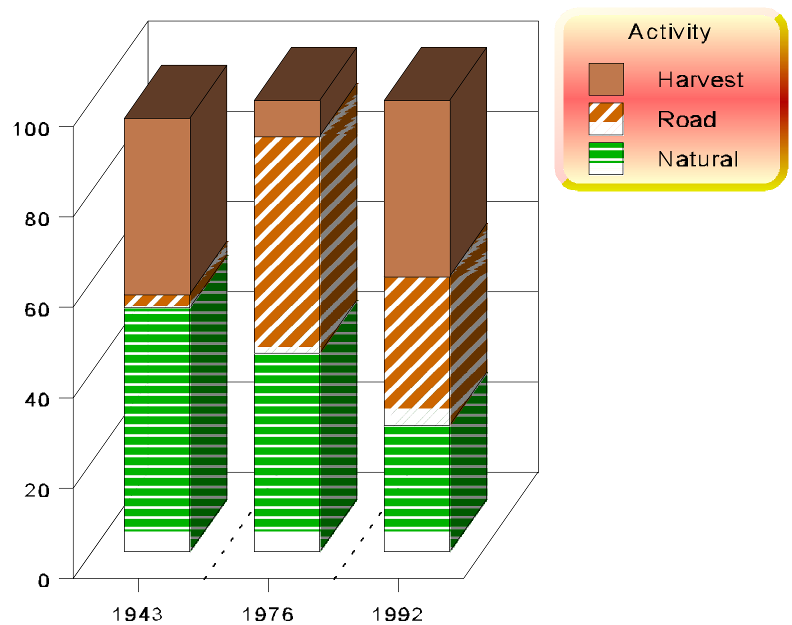
*Fire and Harvest*: According to aerial photo analysis, natural slides made-up the largest portion of all slides. Accuracy of this conclusion, however, is suspect because of the difficulty in separating fire-caused slides from harvest-related events. For example, if one assumes an error rate of 10% in distinguishing between harvest and fire-related slides, the two activity-types would be approximately equal in producing slides.

Although the number of failures related to other factors (such as roads) increased in the 1970s, the number of harvest-related failures did not;  in fact, harvest-related failures showed a conspicuous drop (to about 1/3 of other years) in the mid-1970s.  This is unexpected because harvesting levels in the 1960s and 70s were similar to previous decades.  A possible explanation is that harvest *intensity* was reduced in the 1970s (i.e., relying on salvage rather than high-intensity, clear-cut harvest) while harvest *levels* continued unabated.

*Roads*:  The number of road-related failures is second in total number of slides.  The increase in the number of road-related failures in the late 1960s and early 1970s is noteworthy because of the number of road improvements that were made during this period. These roads were built with techniques that allowed much sidecasting and partial bench locations .  A noticeable reduction in landslides related to road failures was also observed on 1992 photos, but it is not known if this is the result of improved construction and maintenance techniques or the result of drought.

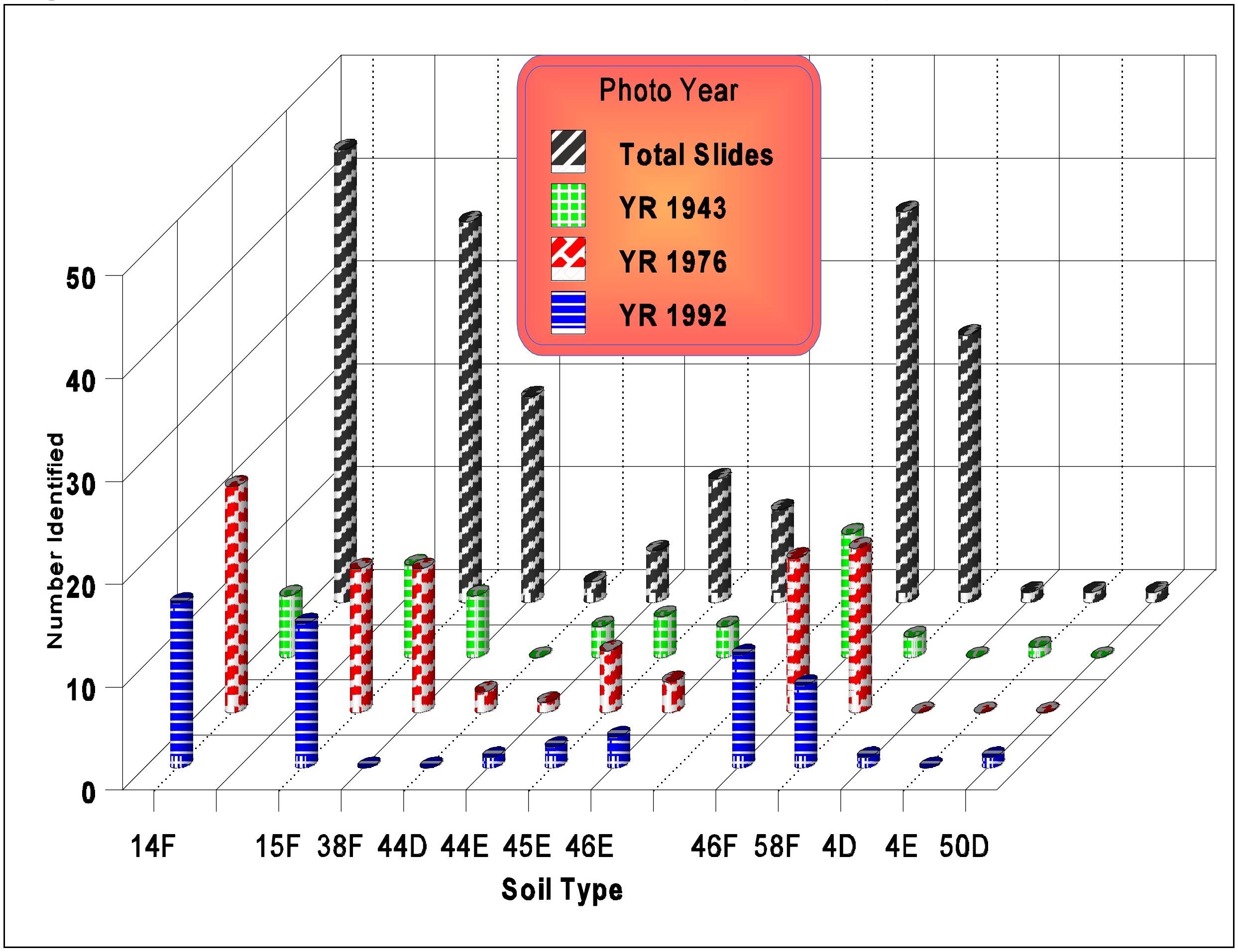
The percentage of total slides related to management activity in a given photo year is illustrated in Figure III. 1-6.  It is interesting that 1943 contained the lowest portion of management-related slides while in 1992, management-related failures made up a majority of the total

**Figure III.1-6 Percent of Landslides by Management Activity**

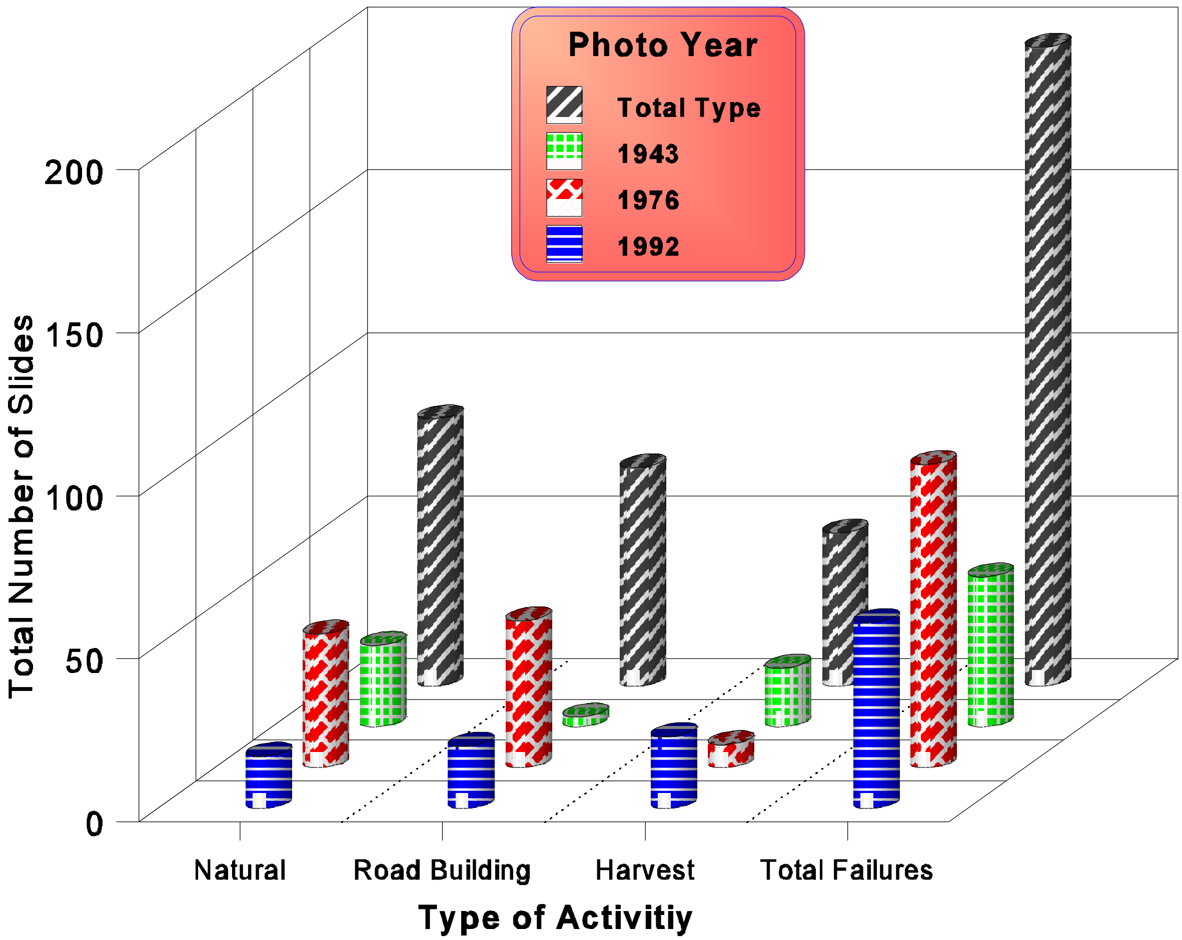



*Soil-types*:  Stratification of  landslides by soil type (Figure III 1-7) and management activity (Figure III.1-8) suggest that, with the possible exception of road-building,  management activities do not necessarily increase the susceptibility of certain soil-types to landslides .

# Figure III. 1-7 Landslides Classified by Soil Type



# Figure III. 1-8   Landslides Classified by Management Activity




**Erosion Rates and Management Activities**

<u>Erosion and Management Activities</u>
It is apparent that deteriorated, poorly located or poorly installed culverts (not on stream grade or disconnected from the channel), are contributing sediment to stream channels.  Culverts along the Big Creek Mainline Road were inventoried and several found to be rusted through and replaced under the 1996 "Job- in-the-Woods" program.  Culverts were randomly surveyed in November 1996 by members of the analysis team.  Most of these culverts were considered in fair to poor shape with numerous rusted through or deteriorated to a point where they will failure in the near future ( approx. 5 years).  Culverts which had the most advanced deterioration were located along the older roads (cira 1970) and along the lower mainstem transportation systems.  Culverts and natural-surfaced roads on private lands in T28S, R10W, Secs. 32 and 33, and in T29S, R10W, Secs. 4 and 5 were severely deteriorated.  Grade culverts, which carry storm runoff from the road surface and group water intercepted from cut banks, were not similarly affected.  All soils in the analysis are corrosive to uncoated steel.  This factor, combined with the age of many culverts in the subwatershed, may explain their poor condition.

## SYNTHESIS & INTERPRETATION

<u>Mass wasting</u>

Effective management of erosional processes requires an understanding of what processes, and levels of those processes are natural to the area. Debris torrents, avalanches, and other types of erosion were present in the analysis area prior to human influences. These events were infrequent, but contributed many important structural components to the lower river system. For example, landslides carried large wood and boulders, providing key structural components that build lasting debris dams on lower-gradient stream segments. These structures subsequently created habitat for aquatic organisms, filtered sediments, and provided long-term storage of water for later release in the summer.

Not all types of erosional processes have the potential to produce ecological benefits to riparian and stream ecosystems. For example, other natural processes such as surface erosion from non-vegetated areas, rotational slumps, and earth-creep soil movements (such as those evident in Jones Creek) deliver pulses of fine sediment downslope without the quantities of large wood and boulders that are generally delivered from the debris slides.

Although mass wasting events such as landslides and debris torrents contributed important structural components to stream and riparian ecosystems, these events probably also contributed a substantial amount of fine particles to streams. Excess sedimentation and turbidity in stream channels reduce habitat quality for aquatic biota, can smother benthic biota, cause widespread mortality to fish eggs and alevins, and cause physiological distress for fishes. Fishes in the Pacific Northwest have evolved behavioral and physiological responses to sediment pulses such as those historically contributed by landslides and debris torrents, and to long-term, low-level inputs such as those contributed by erosion from exposed surfaces. However, when management activities, such as timber harvest and road-building, accelerate the rate and increase the magnitude of these events, the amount of sediment contributed to stream channels can overwhelm the behavioral and physiological capacity of aquatic biota to compensate, resulting in reduced production and survival.

Without actually conducting sediment sampling throughout the drainage to determine if fine sediment level is above normal, this analysis uses the data gathered in the lower reaches of various drainages (see Section III.4 Water Quality) to infer that high levels of fine sediment is being delivered to the streams. This level may be normal for the geology and stream network but without a long term sediment sampling regime this data gap exists.

Effective management of erosional processes as well as fish and wildlife resources in a watershed requires an evaluation of the effects of these management activities on the rate and magnitude of soil movement events. Increases in the rate and magnitude of erosion have implications for soil and forest productivity and survival of biota. In the analysis area, it is apparent that management activities such as road-building and timber harvest have probably influenced the rate and magnitude of these natural processes; however, using available data, it is difficult to define the *level* of influence, or to describe the cumulative effects of management contributions of sediments to streams.

No clear pattern emerges that reflects a landscape-level response to management activities.

Between 1943 and 1992, there were 196 slides, with the largest portion coming from natural and road-related activities. As management intensity increased on the landscape, so did the number of slides (as evidenced by a two-fold increase in 1976). However, only slight increases over previous levels were seen in 1992, even though the proportion of the drainage exposed to management disturbance continued to increase.

Additionally, while management practices (particularly roads) were probably responsible for some of the slides observed in the 1976 photos, many of the slides occurring during those years could also be a reflection of the amount of water delivered. During the years from 1943 to 1976, the watershed experienced a large flood in 1964 as well as above-average wet periods in 1955, 1971, and 1974. Furthermore, depressed annual rainfall during the 1980s may have contributed to the increase in soil stability by limiting the amount of slippage from water, thus reducing the number of slides prior to the 1992 photos could have been influenced by factors other than management practices.

It is clear from the analysis described above that road-building activities disturb the ground and produce slides. It is also clear that the overwhelming majority of all slides originating from roads delivered sediment to stream channels in the analysis area. However, the rate at which this occurred depended largely on location, method of construction, and subsequent weather patterns.

Surface Erosion

Surface erosion from ground-disturbing activities appears to be under control by vegetation which grows back in on the site following harvest and burning.

Roads within the drainage were surveyed by members of the analysis team. Gravel and bituminous surfaced roads are in good shape with only few that require additional drainage or repair of surface conditions to further minimize sedimentation. Overall, little sediment is occurring from this source. The dirt spur roads show signs of past and present delivery into the stream system, but much of the sediment is being filtered prior to water reaching the stream.

Although sediment delivery from surface erosion has not been quantified for the watershed, it should not be assumed that an elevated rate is occurring primarily as a result of management.

Trends

The trend within this analysis area is that it will continue to receive pulses of fine sediment as lands are harvested. However, the rate of onsite soil loss should be less than from previously managed areas as there will be less new road construction, roads will be located with long term stability in mind, harvesting disturbance from ground-based systems will be reduced, and improved site preparation techniques will be employed. Existing BLM-controlled roads that have been degraded will be improved or possibly be closed to traffic reducing sediment production. Sediment routing and levels will return to near historic conditions as culverts are restored and roads are erosion-proofed. On BLM-administered lands, the rate of surface erosion in harvest units will decrease through the establishment of Riparian Reserves, less-intensive harvesting levels, and lower open road densities.

It is expected that federal administered (GFMA) lands will be managed with a minimum 60 year rotation, while private lands will be managed under a short (35-50 year) timber harvest rotation. Connectivity lands will be managed to contain a mix of ages, with approximately 1/3 of these lands in seral, mid-seral and old-growth stages. Riparian Reserves and LSR's have no specified rotation age, but will be managed for function of long-term, old-growth ecosystems. It is assumed that lands obtained by the Coquille Tribe will be managed under the same constraints as GFMA lands with Riparian Reserves, as stated in the NFP . For this analysis, it is assumed these lands will be harvested under the NFP, but to what extent is currently unknown.

Howerer, the lower harvest levels under the NFP/RMP should reduce the frequency of harvest-related slides as well as mitigate the effects of a slide on stream channels should they occur. It is difficult to precisely predict the effects of NFP practices on the occurrence of harvest related slides since initiation of these events is dependant on a complex set of conditions that need to be met in a precise time frame. Although the establishment of Riparian Reserve areas may not affect the rate or magnitude of slides occurring on mid-slopes, sediments occurring from those slides will be filtered out by the Riparian Reserve vegetation prior to entering the stream, thus lessening effects on stream channels and aquatic biota.

Road-related failures will continue in the future as older portions of the watershed road system fail. However, because newly constructed roads and improved old roads are expected to fail less, the frequency of slides should drop as the majority of the transportation system in the watershed undergoes improvements.

<u>Management Objective</u>
The management objective for BLM-administered roads and lands is to return to historic timing and types of landslides, delivery and routing of woody material and sediment in stream channels. It is also desirable to minimize the effects of management activities on the rates of surface erosion and fine sediment delivery to streams. This can be accomplished by striving to meeting the Aquatic Conservation Strategy during management activities. A reduction in the rate of road-related failures and harvest failures should be strived for on both the private and Federally administered lands within the watershed.

## SOIL PRODUCTIVITY

<u>Analysis Questions</u>:

*What is the overall status of soil productivity within the watershed?*

*Has soil productivity suffered a loss through past management practices?*

*What soil components are most prone to degradation and result in lower site productivity?*

*What level of compaction due to roads and other management activities exists within the watershed?*

*Is compaction of the watershed hindering soil or plant functions in the watershed?*

*What are the influences and relationships between soil productivity and other ecosystem processes (e.g., vegetation, woody debris recruitment, aquatic habitat, etc.)? How have management activities affected these relationships?*

*What is the management objective for soil productivity within the analysis area?*

“Productivity” is the capacity of the soil to sustain the ecological processes of the site and produce a given product (usually plants)without sustaining a long-term decline in production levels. The physical and biological properties found in the soil environment, together with the processes that link them to a growing plant, define soil productivity.

## REFERENCE CONDITION

There is no reference condition for soil productivity that can be defined in absolute values. In general, the productive capacity a site is dependent on five factors: infiltration rate, moisture holding capacity, base nutrient levels, organic matter levels, and activity levels of related organisms. Coastal forest ecosystems are characterized by their high capacity to store nutrients, rapid infiltration rates, and low bulk soil density. These qualities distinguish coastal mountain forests from many other forested slopes throughout the world.

## CURRENT CONDITION

Soil Productivity

A soils “site index” is an indicator that incorporates many of the variables which characterize soil, resulting in a measure of relative productivity. According to analysis of site index classes, index classes 2 and 3 dominate in the Big Creek subwatershed. Index class 4 is present on the rocky and shallower soils such as 15F, 38F, and 58F. In general, this watershed is highly productive, is closely linked to processes that provide nutrients, and is resilient to management activities.

Baseline or natural productivity (as defined by the Soil Index) may be increased by the introduction of additional nutrients into soil (i.e., fertilizers, nitrogen fixation by plants and micro-organisms such as fungi and lichens, or nutrients contained within precipitation). In the analysis area, both private timber companies and the Bureau of Land Management have applied nitrogen fertilizer to portions of the watershed as part of intensive silvicultural management activities.

Nitrogen-fixing native plants such as *Ceanothus* and red alder, along with lichens and micro-organisms, help accumulate nitrogen in adjacent soils, subsequently helping to maintain or increase local productivity. Additionally, there are exotic species present in the watershed which also fix nitrogen, including Scotch and French broom. The distribution and abundance of *Ceanothus* and red alder has been reduced in some areas through maintenance contracts and herbicide spraying, reducing the amount of time which nitrogen fixation could have occurred there. Since Scotch and French brooms are considered noxious weeds, they are not encouraged to grow on any lands.

Nutrients may be removed from soils during removal of tree boles and burning. Soil productivity in the subwatershed has probably not been reduced as a result of these activities with the exception of areas with shallow soils and rocky outcrops such as Upper Big, Swamp, and Bear Pen Creek drainages. In these areas, fires burned hot enough to completely consume organic matter in the soils, and productivity has subsequently been reduced.

Harvest and burning may affect soil productivity *directly* through the removal of nutrients; however, these activities may also *indirectly* reduce productivity by affecting other processes (such as microbial activities or reduction of infiltration rates) contributing to overall soil productivity. For example, yarding and road-building compact soils, reducing the infiltration capacity, causing overland flow and the subsequent removal of nutrients. The degree to which management activities such as harvesting, burning, and herbicide applications have affected these processes is unknown.

Certain shallow soil-types are more susceptible to nutrient degradation resulting from management activities. In the Big Creek subwatershed, these are the Digger-Preacher-Umpcoos (14F), Digger-Umpcoos-Rock outcrop (15F), Milbury-Bohannon-Umpcoos (38F), and the Umpcoos-Rock outcrop (58F). All of these are noted in the Coos County Soil Survey as having 10-20 inches of soil above bedrock in one or more of the soil types. These soil groupings make up 39% of the analysis area, but the area covered by these very shallow soils only covers a little under 10% of the watershed. Rock outcrop and Umpcoos soil types normally are found on the narrow ridges, steep side slopes or convex side slopes adjacent to rock outcroppings. These soil types are rated soil class 4, or are not rated, and do not commonly grow commercial tree species.

<u>Soil Compaction</u>

*Roads and skid-trails*: It is possible to indirectly measure the level of compaction within the drainage due to yarding from past monitoring reports and a calculation of road-miles in the watershed transportation system. The roads and identified equipment trails, present in the GIS data base, represent 202 acres of the 16,661 acres in the analysis area. This calculates to an average level of compaction of 1.21%. (Road length was converted to acres using an assumed width of 14 feet for all surfaces and only those roads and cat trails identified from the GIS database were used in the calculation.)

Lands taken out of production for the purpose of roads are not expected to grow plants and are not considered when calculating the productivity of the watershed. No systematic survey of the analysis area was conducted to determine the level of recovery of the compacted skid trails. However, a field review of the past entry areas showed the skid trails to be in various states of recovery. Skid trail construction usually removes the top soil so that many skid trails may never fully recover to the unroaded condition.

*Timber harvest:* The level of compaction due to harvest within the analytical area has not been measured. Based on an aerial photo review from 1943 to 1992, harvest activity and subsequent compaction has been more extensive on private than on BLM-administered lands.

Harvest on private lands generally employs extensive use of ground based yarding systems, -a type of activity that is still evident within the drainage today. Lands harvested using ground-based systems (which can lead to compaction rates of up to 30% of area harvested) were generally found on slopes below 40%. As a general rule, Hi-lead cable systems were employed on slopes greater than 40% or where ground-based systems needed excessive skid trails. These Hi-lead cable systems have been found to increase the level of compaction from 3% of the harvested unit to 12%. Private lands comprise nearly 40% of the total drainage. Due to the location of these lands on steeper slopes the harvest system most often employed was the cable system that provides better protection of the soil resources. Because private lands are a mixed mosaic of ground and cable systems, many times on the same piece of ground, and much of these lands are now covered by 20 to 40-year-old timber, it is difficult to place a level of compaction due to harvesting on these lands in this watershed analysis. However, based on the aerial photo analysis conducted during the landslide inventory process the level of compaction would be approaching the 12% level as an estimate.

On BLM-administered land, entry with ground-based systems in the 1943 photos occurs in the northern portion of the watershed (in response to the 1936 Brewster-Sandy fire). Roads were constructed with equipment of the time and crossed some of the steepest slopes in the watershed in an effort to salvage the timber. Since that time, most of the BLM lands have been harvested using cable systems. Past monitoring of harvest units on BLM administered lands in the watershed for compaction and soil disturbance has not identified a level of compaction that exceeds 5%, well below the 12% level established in the monitoring process (USDI Handbook 1734-1).

**SYNTHESIS & INTERPRETATION**

Integrity of soil is vital not only for maintaining plant and timber production but also for maintaining inputs of elements important to habitat for terrestrial and aquatic biota Management activities which affect the ability of the land to re-vegetate after disturbance not only diminish the ability of the land to produce products but have implications for survival and abundance of terrestrial and aquatic flora and fauna. Losses in soil productivity ultimately reduces the level of inputs of large wood, an important habitat component in aquatic and terrestrial ecosystems. Management activities which reduce the soil’s ability to re-vegetate after disturbance result in surface erosion, inputs of sediments into streams, and ultimately, reductions in water quality.

The factors contributing to creating and maintaining soil productivity are:(infiltration rate, moisture holding capacity, base nutrient levels, organic matter content, and level of biological activity of micro-organisms within the soil). The two soil components that are most prone to degradation by management activities are soil bulk density and organic matter content.

Certain harvest conditions (poor log suspension during inhaul, wet soil conditions or poor operator) may particularly affect soil bulk density and organic matter content by reducing air space between soil particles or eliminating the upper portion of the soil. This type of harvesting is common where ground-based systems are used to remove trees or where broadcast burning is poorly controlled and fire intensity/duration are high enough to remove the organic layer. In situations such as these, where timber is removed without regard for maintaining the normally high infiltration rates, and where widespread removal of organic matter from the upper horizon occurs, there can be substantial reductions in soil productivity.

The introduction of road systems and the various methods to remove timber from this watershed have increased the level of compaction above natural levels. However, some of these early trails have been re-vegetated for a length of time sufficient to reduce or remove influences on surface runoff or growth rates. Furthermore, increases in stream networks as a result of road surfaces do not appear to be a major factor due to the low percentage (1.21%) of the land in the roaded state (although no formal inventory to determine stream network extension has been conducted). Areas compacted more recently, however, continue to affect runoff and plant growth, and are of particular management concern; however, given our present level of knowledge, there is no reason to suspect widespread reductions in that any soil or plant functions in the Big Creek subwatershed. There may be some local influence on private land.

Trends

On private lands, the use of ground-based systems for harvest is being replaced by the use of low ground-pressure mechanical harvesting methods which substantially lowers disturbance to soils when compared to ground-based systems. The level of compaction imposed on the land by low ground-pressure systems is still unknown; however, because of the added ability of low ground-pressure systems to operate on slash (reducing compaction to soil) combined with reliance of previously-constructed road and trails, levels of compaction are thought to be comparable to cable systems.

On BLM administered lands, the trend will be towards fewer permanent roads open to traffic. Harvesting will be conducted with the "build, use, and close" policy as a means of reducing road densities and lowering maintenance costs. The TMO process used in this watershed analysis recommended many closures and improvements that will lessen the level of compaction over time and reduce sediment delivery in the near future.

In general, soil productivity has not been substantially reduced on either private or public lands by past management practices. Typically, soil is fairly resilient. This level of basic resiliency, combined with the naturally high nutrient levels of the soils in the Coast Range, the abundance of nitrogen-fixing vegetation, and fast re-vegetation rates (which helps hold soils in place) helps minimize soil degradation. It is important to note that, despite the resiliency of Coast Range soils, degradation from management activities on a continual basis can, in time, reduce soil productivity. For example, soil productivity modeling for the RMP, demonstrated that removal of timber on less than a 40 year rotation, would ultimately result in loss of soil productivity. On private lands where rotations may be less than 40 years, there may ultimately be productivity losses; however, on public lands, the NFP and RMP do not allow such short rotations and set large areas of Reserves that will be managed for old-growth habitat.

Continued high productivity of the soil is vital for maintaining elements important to habitat for terrestrial and aquatic biota, such as the key large woody material and shade. The ability of the land to re-vegetate after disturbance will lengthen and allow the process of surface erosion to become more important in producing fine sediment in the stream systems. Water quality and quantity could be reduced if components of soil productivity are reduced. Other plant and tree species become better at occupying some soils and although diversity would increase the ability to provide wood products would decrease.

Management Objective

For any soil, the maintenance of soil productivity requires that forest-management activities minimize the withdrawals of soil resources (remove Nitrogen) and the timely replenishment of those resources. Four actions should be optimized when striving to maintain soil productivity. 1) Minimize disturbance severity (i.e., intense burn, soil compaction or erosion), 2) retain organic matter, 3) re-vegetate with indigenous species and associated soil organisms, 4) recognize shallow soils as those most susceptible to productivity losses.

The level of compaction on BLM administered lands set forth in the RMP is not to exceed 12% of the land. This excludes roads and is confined to the operable land surface. An increase over that percentage will affect the ability of the land to produce timber at the prior calculated rate and is unacceptable.

# III.2 CORE TOPIC - HYDROLOGY

Analysis Questions:

*What are the dominant hydrologic characteristics and other notable hydrological features and processes in the watershed?* (refer to Section 1 - Characterization)

*What are the historical hydrological characteristics (e.g., peak flows, minimum flows) and features in the watershed?*

*What are the current conditions and trends of the dominant hydrologic characteristics and features prevalent in the watershed?*

*What are the natural and human causes of change between historical and current hydrologic conditions?*

*How have natural and human caused changes in water quantity and timing of flows affected water quality?*

*How much surface water is being used for out of stream uses, and where are points of diversion (including domestic sources)? What effect does this have on available summer flow?*

*What are the influences and relationships between hydrologic processes and other ecosystem processes (e.g., sediment delivery)?*

*What is the management objective for the hydrologic processes in the watershed?*

Watershed hydrology includes floods, distribution of flows, annual yield, and minimum flows. A general overview of the analysis area's hydrology and watershed characteristics is contained in Section I, Characterization.

**REFERENCE CONDITION**

There is insufficient monitoring data to establish a comparison between current and historic hydrology and changes from land management.

**CURRENT CONDITION**

Peak Flows
Runoff is described as instantaneous peak flow in cubic feet per second (cfs), calculated from a flood frequency curve or estimated by other methods. Annual peakflow for a given drainage is highly variable from year to year. A frequency analysis establishes a relationship between the magnitude of the flood and its return period.

There are no precipitation or runoff gaging stations in the Big Creek analysis area. Bankfull and extreme over bank floodflows were estimated using several methods. Results are summarized in Table III.2-1. Descriptions of historic floods, in the region with a 20-year return frequency or greater, are shown in Appendix B-3:Floods.

**Table III.2-1 Estimated Bankfull (2-year) and Extreme (100-year) Flows.**

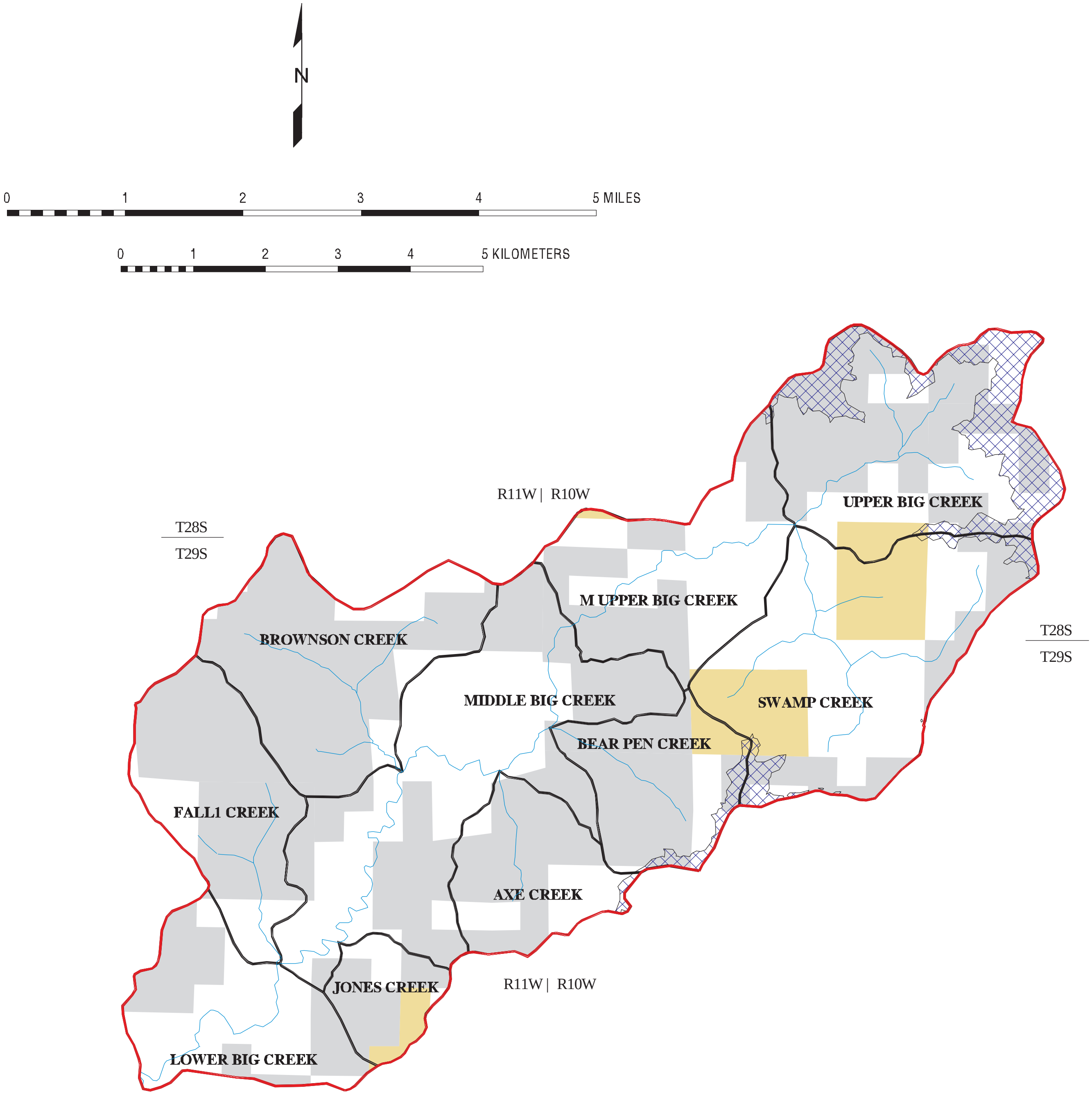
| Method* | 2 Year Flow (Bankfull) Estimate (cfs) | 100 Year Flow Estimate (cfs) |
|---|---|---|
| Channel Geometry** | 1100 | 3080 |
| Basin Characteristics*** Regression with USGS Coastal Gaging Stations | 1480 | 3530 |

* Estimated flows are for the entire watershed (26.03 $mi^2$).
** Grant 1992
*** Harris & Hubbard 1979

Precipitation as snow can accumulate in the higher elevations of the Big Creek watershed (above 1800 feet), but usually is transient and only persist a few days to weeks each winter (Figure III.2-1). Weather conditions including warm winds and rain can cause rapid melting of the stored water equivalent as snow pack. Snow will accumulate and melt faster in openings than the surrounding forest. This process can increase peak flows, depending on drainage factors and vegetative age and condition. Upper Big Creek, Swamp Creek and Bear Pen Creek are the most susceptible to this phenomenon as about 32%, 5%, and 9% of these drainages can retain snow for short periods. Long time residents remember that the flood of 1955 caused considerable flooding along Big Creek, when snow melted in the uplands.

Interviews with local residents suggest that 1955, 1964, and 1971 were the worst flood years in the recent past. The residents also remember that the flood of 1971 destroyed the bridge on Big Creek, just above Fall Creek. The November 1996 storm did not produce substantial flooding in the Big Creek watershed. This event ranks as a 50 year flood at the nearest South Fork Coquille USGS gaging station, (refer to Appendix B-3), but did not express similar effects along Big Creek. An explanation for this could be that the analysis area is located further to the east and in a slight rain shadow from the Siskiyou Mountains. This shields the area from storms orientated from the Southwest.

# Figure III.2−1  Intermittent Snowzone Areas (Elevations above 1800')




| Transient Snow Zone | |
|---|---|
| **Upper Big Creek** | **744 ac** |
| **Swamp Creek** | **140 ac** |
| **Middle Upper Big Creek** | **5 ac** |
| **Bear Pen Creek** | **94 ac** |
| **Axe Creek** | **17 ac** |

Areas above 1800' elevation

BLM administered lands

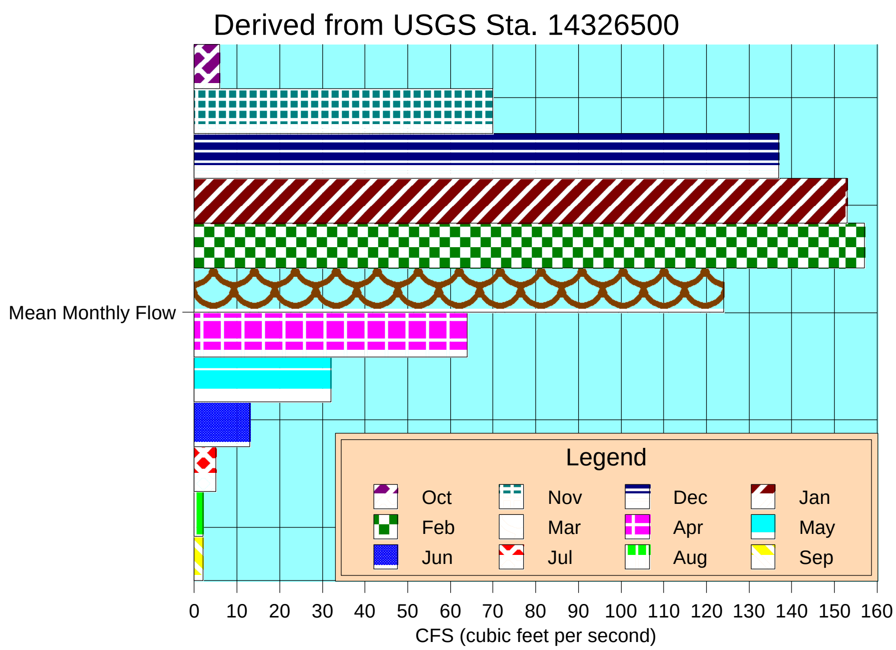
Coquille Forest Lands

Scale = 1:84480 (3/4" = 1 mile)

Annual Flow and Yield

Figure III.2-2 shows that approximately 60% of the annual runoff occurs between December through February, with January being the highest month. June through October contribute only 4% of the annual runoff and results in very low stream flows. This annual runoff distribution very closely follows the precipitation pattern.

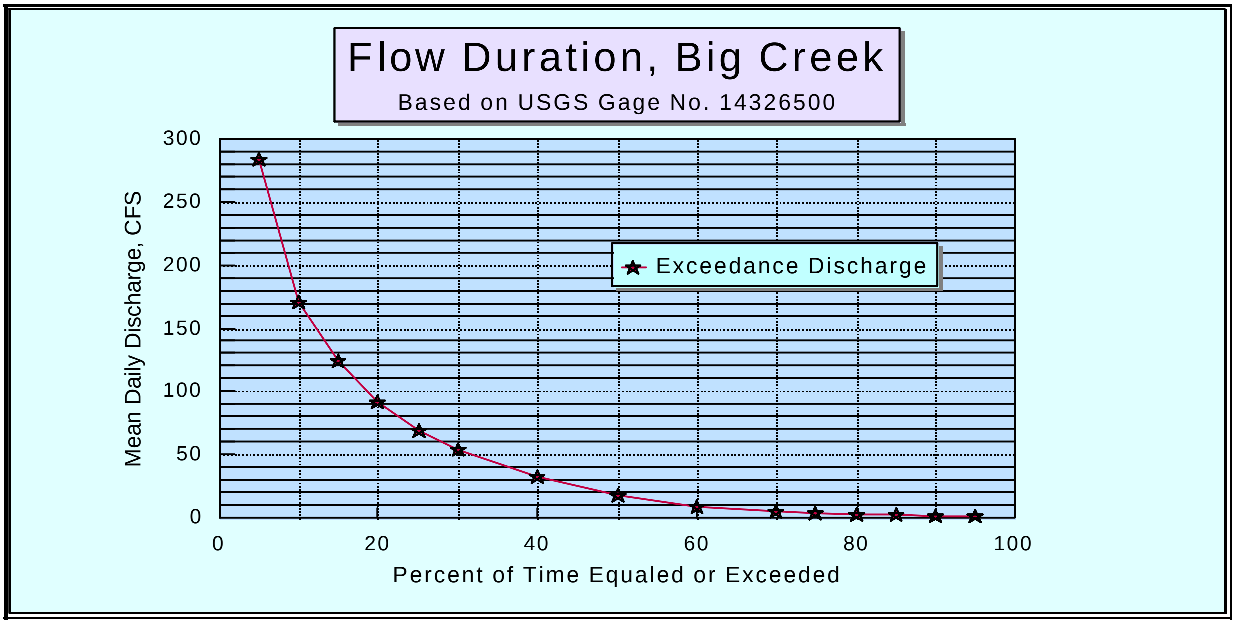
**Figure III.2-2 Mean Monthly Flow for the Big Creek Analysis Area**




Flow Distribution

Figure III.2-3 shows how flow is distributed throughout the year in terms of flow duration. Large to extreme flows occur less than 5% of the time, moderate flows occur 45% of the time, and low flows occur 50% of the time. Channel formation processes are caused by flows which fill the channel to bankfull or beyond, while channel dimensions are maintained by the frequent flows (flows less than bankfull).

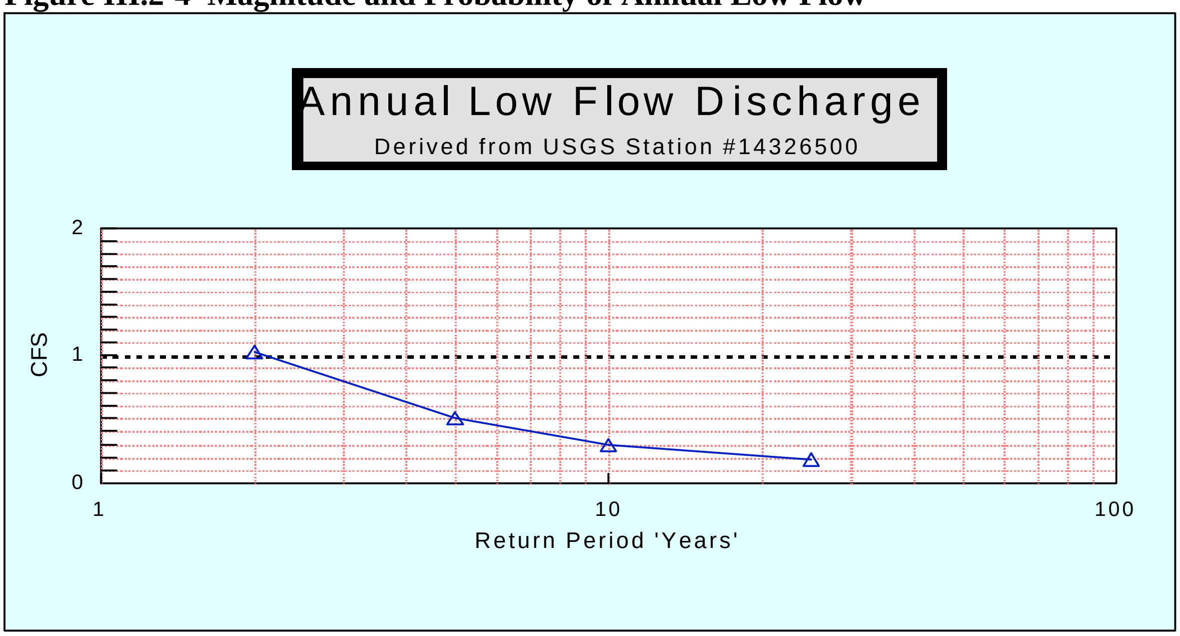
**Figure III.2-3 Daily Flow Duration for the Big Creek Analysis Area**




Minimum Flow

Because rain is infrequent in the summer, stream flows become extremely low in mid August-October along Big Creek and other tributary streams. Figure III.2-4 shows the magnitude and frequency of low flow in the Big Creek watershed (It should be kept in mind that these are estimates of the lowest live flows in Big Creek for a consecutive seven day period for the indicated return period or years. This estimate does not consider live flow which becomes subterranean further down the channel). The average 7-day low flow is about 0.04 cfs/mi$^2$ for a two year recurrence interval and <0.046 cfs/mi$^2$ for consecutive periods of up to 30 days. These values are nearly one half the amount of other Coast Range streams.

**Figure III.2-4 Magnitude and Probability of Annual Low Flow**



Information from the USGS stream flow gage 14325000, near Powers OR. indicates that significant 7-consecutive-day low flows occurred between September-October in 1931, 1933, 1939, 1974, 1987, 1991, 1992 and 1994. It may be interpreted that low flows also occurred within the analysis area during these years. The return period for these 7 day low flows are 20 years or greater. The low flows in 1933, 1991, 1992 and 1994 were 100 year events (Wellman et al. 1993). During these periods, there was essentially no live flow.

Many of the "headwater" first order streams are formed on coarse textured high permeability soils and dry up as the summer progresses (Figure III.8-1, shows a representation of these intermittent streams). Streams which originate from seeps and drain fine textured, deep, high porosity soils types have a very low, constant flow, but may have "dry spots" in the channel in later summer. Higher order channels may have pools in late summer, but little live flow. During the summer/fall period, live stream flows are so low they are measured in gallons per minute. Stream flows may actually increase slightly at night, because evapotranspiration demand is at its lowest point.

Water Uses

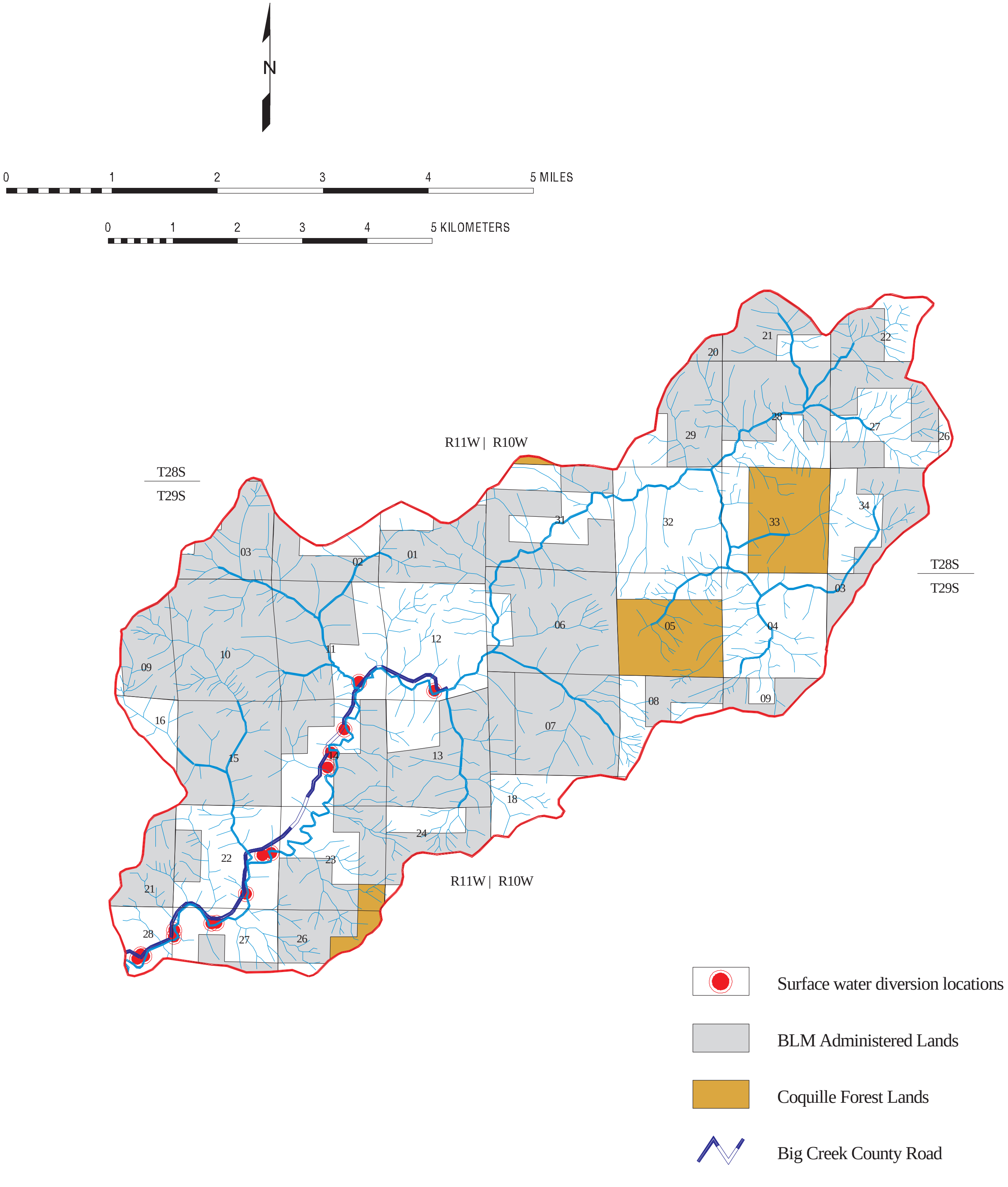
Drainages in the analysis area supply drinking, domestic, and irrigation water to local residents living along the rural forest interface. In addition, numerous wildlife and plant species are dependent upon the drainages for both drinking water and habitat.

The removal of water from Big Creek for consumptive uses is permitted by the State of Oregon and totals 0.648 cfs (Oregon Water Resources Department WRIS System, 1997). The actual consumption is not metered and is therefore unknown. A representative of the Coos Bay Water Board stated that for average rural residential user, the consumption was 350 gal/day/household. There are 22 occupied residences in the analysis area. Of these; nine use surface water from Big Creek or springs, seven have wells, and six residences could not be contacted to determine where they receive their drinking water. Figure III.2-5 shows the present locations of surface water diversions for domestic water supplies along Big Creek.

Water quality data of drinking water specific to Big Creek is not available at present. Water quality testing is not required by state or federal laws because any one water system does not supply more than three households. This was verified by representatives from the Oregon ODEQ, Oregon Health Division, and Coos County Health Dept. Many of the surface-water withdrawal systems include a catch basin and/or settling tank to reduce particulates; some systems have neither. Only two residences reported having water treatment system; one using an ultraviolet light, and the other a carbon filtration system. It should be noted that a few residents cited occasional periods when their tap water was discolored by sediment.

ODFW has applied to the Oregon Water Resources Department for various minimum instream flows on Big Creek (ODFW 1992). Application #72525 has a summer minimum flow of 105 cfs and is located between rivermile 0.0 and 7.8 on Big Creek, with a priority date of 6/30/92.

# Figure III.2−5  Surface Water Diversions for Domestic Water Supplies




Scale = 1:84480 (3/4" = 1 mile)

This application would greatly exceed the amount of available water during the dry period. Other streams in the analysis area do not have any instream minimum flow protection pending, but are at low risk for water withdrawals or flow modification.

A reservoir water source option has been identified on the Big Creek located in T.29 S.,R.11 W. Sec.12 (CH2MHill 1993). A new dam and reservoir would be constructed on the mainstream of Big Creek. The water would be diverted, treated and piped to demand centers. This option is considered fatally flawed because anadromous fish runs exist in this section of the river and ODFW highly opposes its construction.

## SYNTHESES AND INTERPRETATION

### Extreme and Frequent Flows

Little evidence exists to determine whether forest management activities have had an effect on the infrequent peak flows in the precipitation dominated Coast Range. Watershed studies in the northwest have shown that following road building and timber cutting, peak flows may increase, decrease or remain unchanged. The magnitude of the change varies from a 36% decrease to 200% increase and depends on specific watersheds and storm factors (Reiter et. al. 1995). Harvest in the Upper Big Creek drainage may increase peak flows if enough area in the intermittent snow accumulation zone is less than 40 years old.

Extreme flood flows (greater than a 20-year return frequency), measured at the South Fork Coquille USGS gaging station, have occurred in 1934, 1955, 1964, 1971, and 1974, and 1996. Because the analysis area may lie within a rain shadow, the magnitude of these extreme flows is probably less in the Big Creek watershed. The South Fork Coquille extreme floods were the result of natural weather patterns and flashy watershed response. Forest management has had little to do with significantly increasing the magnitude of these events.

Minor increases in the amount of daily flow in the spring and fall may result following harvest activities. This is a result of the younger vegetation transpiring less water and allowing more water to route to the stream channel. This increase is usually considerably less in magnitude than the frequent flows (those flows that occur several times each winter, but are less than the annual high flow) and has little effect on overall flow.

The importance of these types of flows to the stream channel is that frequent flows (those high discharges that return several times each winter season) and the bankfull flow (return period of 1.5-2 years that fills the active channel) are responsible for maintaining channel dimensions and moving most of the sediment load. Major channel adjustments have resulted from infrequent extreme flood flows.

### Annual Yield

The amount of increased annual runoff in the analysis area is not known, but suspected to be in the range of 10-20%. Annual yield typically increases as a result of the effects of forest harvest and road building, as shown by studies in the coast range (Ziemer et. al. 1996). This increase is a result of reductions in evapotranspiration following the removal of coastal forest vegetation. The current vegetative condition shows 30% of the analysis area is less than 15 years of age and 42%

less than 25 years of age. These are hydrologically immature timber stands, which use water at less than potential transpiration rates.  As more acres of forest vegetation reach hydrologic maturity (±40 years old), this increased yield will decline.

However, because of increased evaporation and soil detention storage on cleared land, not all of this additional water is available for runoff.  Compacted surfaces including roads, landings and skid trails can permanently increase runoff and yield and advance timing.

Timing of Flows

Forest management can have an effect on the timing of flows.  Flows appear to occur earlier in the fall than in the past. Reduced transpiration from hydrologically immature trees results in increased soil moisture content.  As the fall rains occur, less precipitation is needed to saturate these soils and the excess water enters the stream system either through primarily subsurface flow. This results in a rise in streams levels earlier in the year than under undisturbed conditions.

The response time of streams to storms have always been "flashy" because of limited soil and groundwater storage.  It is thought that roads and clearcuts in a watershed act positively in advancing timing for a particular storm (Jones et. al. 1996). Roads and ditchlines may be acting as extensions of the stream network and channel the precipitation directly into the stream system. Midslope roads could be intercepting subsurface flow moving in a downslope direction.  These factors result in a quicker rise of the stream flow followed by a quicker drop than may have happened in the past.  Runoff from compacted areas can also advance this timing in the tributary streams, however, compaction in the analysis area is thought to be low (refer to Section III.1-subsection Soil Productivity).

Minimum Flows

Low Flows have undoubtedly been increased by regeneration cutting in the watershed.  However species conversion to hardwoods that are more efficient at transpiring water during the summer and changes in stream channel condition may have diminished these increases.  The removal of beaver dams and pools created by log jams also reduced water volume during low flows.  Beaver dams and log jam pools release water slowly over the summer and probably supply cooler water due to thermal stratification in the deeper pools.  Management activities that change riparian areas from conifer to hardwood could have some effect on reducing low flows, because of increases in the transpiration rate.

Summer flows are a result of subsurface flow being released during the late spring/summer and is primarily dependant upon soil types, soil depths and porosity. Many soil types in the watershed are shallow and coarse textured and do not retain much water.  The bedrock geology in the watershed does not favor ground water accumulation.

The reader is referred to Section III.3-Stream Channel for a more in depth look at low flow and stream channel processes.

Trends

Annual yield will decrease and the frequent flows may decrease as young timber stands in the analysis area age and become more efficient at transpiring water.  Extreme peak and minimum flows are dependant on climatic patterns.

Management Objective

The management objective for the analysis area is to: A) continue with forest management and other activities in such a way as to minimize the risk of increasing peak flows or altering timing of runoff, B) encourage activities that will retain or increase flows and pool volume during the ‘low-flow’ summer months, and C) provide uninterrupted supplies of high quality water at the boundaries of BLM administered lands to domestic and other water uses.

# III.3 CORE TOPIC - STREAM CHANNEL

Analysis Questions:

*What are the basic morphological characteristics and processes in the analysis area drainages?* (refer to Section 1- Characterization)

*What were the historical morphological characteristics and processes in the analysis area drainages?*

*What are the current conditions and trends of stream channel types and sediment transport and deposition processes prevalent in the analysis area drainages?*

*What are the natural and human causes of change between historical and current channel conditions?*

*What effect have changes in channel morphology and riparian vegetation had on summer low flows?*

*What are the influences and relationships between channel conditions and other ecosystem processes in the watershed?*

*What is the management objective for stream channel types in the analysis area drainages?*

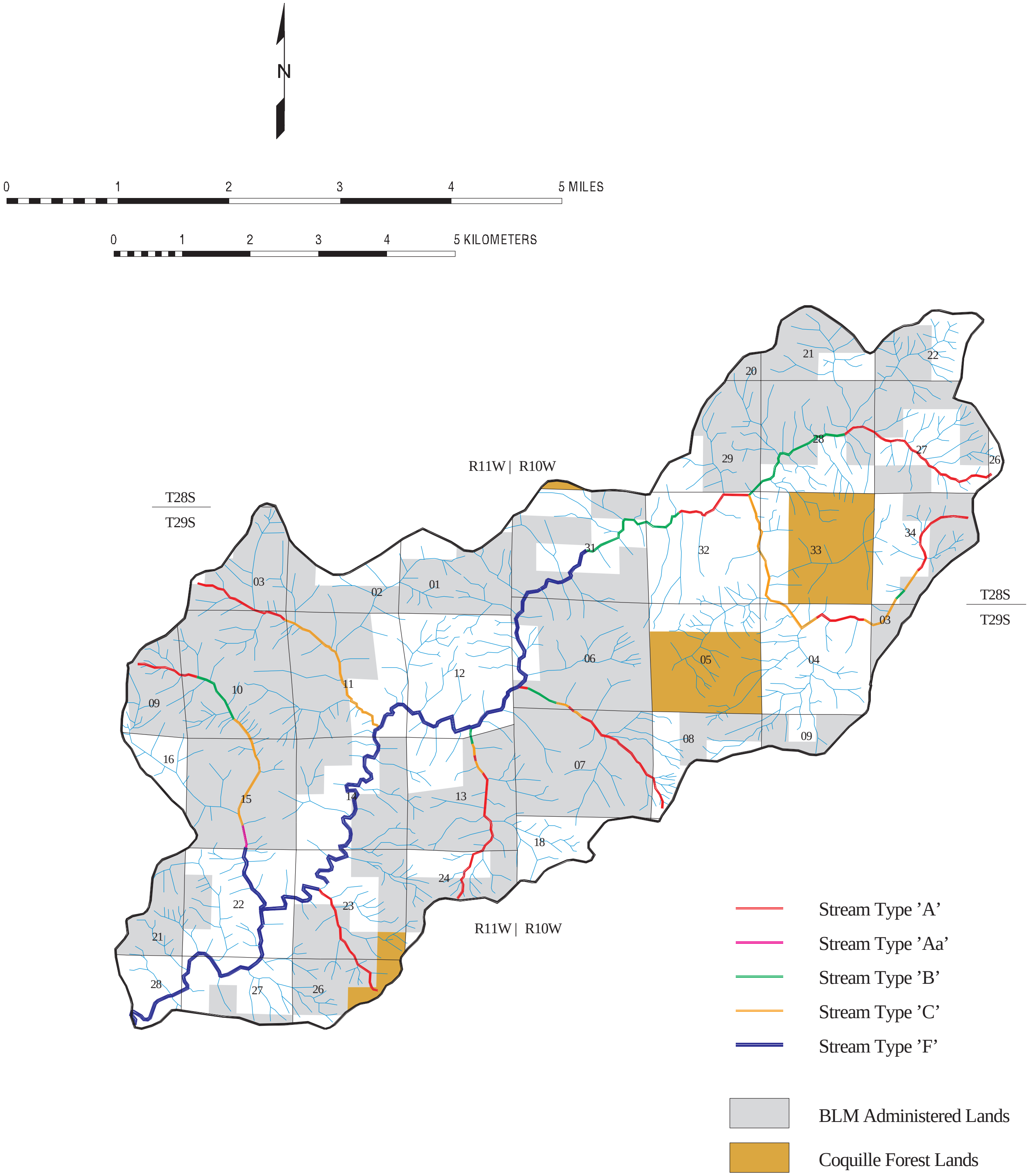
Stream types can best be described by stream channel similarities and differences. Rosgen classification system was used as a basis for comparisons (Rosgen, 1994). The letter designation in Rosgen's classification system identifies the channel gradient and other general hydraulic relationships. The number designation refers to the substrate type. Table A-1, Appendix A shows a brief outline of this classification system and hydraulic relationships, for stream types found in the analysis area. Figure III.3-1 shows generalized Rosgen Stream Types for the Big Creek analysis area.

**REFERENCE CONDITION**

High Gradient Channels, Rosgen A Stream types
These high gradient (4-10%+) stream channels are usually first and second order streams. Streams in unmanaged timber stands are still representative of the historic condition.

Moderate Gradient Channels, Rosgen B Stream types
These moderate gradient (2-4%) transitional stream channels are usually 3rd order streams. Few reference areas remain in the analysis area. This channel type contained steps formed by Large Woody Debris (LWD) that are critical to maintain stream energy dissipation and prevent lateral adjustment and bankcutting. Embedded LWD spanning the channel creates low velocity flats onto which sediments are deposited for long term storage.

# Figure III.3−1 ROSGEN Stream Channel Types




Most 1st and 2nd order streams were also considered to be Type 'A' streams.
(* See classification system in Table A−1 of Appendix A)

Scale = 1:84480 (3/4" = 1 mile)

Low Gradient Channels, Rosgen C Stream types

These low gradient (<2%) stream channels are usually 4th order and greater streams. The probable historic condition for these channel types included streams that were narrow, unconfined by the stream bank at flood stage, and used the floodplains during floods. Their stream banks were stabilized by root masses including myrtle, maple, cedar and other tree species. Greater numbers of downed LWD were in these channel types, but the living trees provided bank stability and were more important than the influence of log steps. These channels dissipate energy by meandering and flowing over roughness elements along the banks and streambed.

Beaver dams and high densities of LWD in log jams are thought to have contributed a larger role in maintaining pools and storage of water in the channel. This water would slowly be released during the summer low flow period.

**CURRENT CONDITION**

High Gradient Channels, Rosgen A Stream types

These are steep, V shaped, erosional, straight channels which lack a floodplain. Many are confined by bedrock channels and steep banks. About 147 miles (79%) of all channels in the analysis area fit this type. The main process affecting these channels are infrequent landsliding and debris torrents. Review of past aerial photography indicates that although incidences of debris avalanches and debris slides into channels have increased from forest management, rapid movement down first and second order channels by torrenting has probably not been accelerated, except in the Upper Big Creek drainage (see Section III.1-Erosion Processes).

The analysis area has many type A first order channels on bedrock (A1). These stream types are associated with soil mapping units 14F, 15F, 46D, 46E, 46F and 58F. A1 channels on these soils are often intermittent, because the catchment areas are small (20-60 acres), soils are shallow with high water infiltration (2-6"/hr.), and bedrock is basically impermeable to water. Figure III.1-1 shows these stream segments on BLM administered lands. These channels are moderately sensitive to disturbance, have good recovery potentials and moderate stream bank erosion potentials. Sediment supply is low-moderate, except when fire or torrents occur.

A1a+ stream types are steep (>10%) stream types on bedrock and prone to the debris avalanche and shallow rapid debris flow process. The most frequently occurring landslides were found on soil mapping units 14F, 15F, 38F, 46F and 58F (Table III.1-2). The avalanches, debris slides and sometimes resulting torrents usually occur when concave hollows on headwalls above these channels are loaded with colluvium, soil materials and organic debris by natural or disturbance processes. When prolonged precipitation saturates thin soils, shear strength is reduced and failures are likely. This has been observed to be associated with the 5-10 year (or greater) recurrence interval storm. Shallow rapid debris torrents travel at 35-40 mph and are devastating to low order channels. They are responsible for scouring bed and banks, carrying huge volumes of sediment, and leaving depositional fans at high angle, tributary junctions. This perpetuates the A1a+ channel type, by passing large debris, gravels, and high sediments downstream to higher order depositional stream types. This process occurs on an infrequent basis.

Other type A first-second order channels occur on silt/clay substrates and are associated with soil mapping units 4D, 4E, 10B, 17B, 33, 47B, 63B, 63C, 53D, and 53E. These A5-A6 channel types originate from seeps and have a very low continuous summer flow. Some of these channels are draining perched layers of water in deep soils on gently sloping land forms. They are very sensitive to disturbance, have poor recovery potentials and very high streambank erosion potentials. Sediment supply is very high.

The upper extent of intermittent streams on District lands has been studied in two different geologies by using the intermittent stream ROD definition and interpretive criteria and found to form at drainage areas between 4-13 acres with a tendency of about 7 acres (Carpenter 1995).

Moderate Gradient Channels, Rosgen B Stream types

These are moderately sloped, slightly meandering channels which either lack a floodplain or have very limited development. About 20 miles (11%) of all channels in the analysis area fit this type. Many B stream types are perennial. The main processes affecting these channels are the input of water, sediment and LWD from upslope channel segments, and some bankcutting and entrenchment. Much LWD has been removed from this channel type, which is necessary for energy dissipation through step/pools. A consequence of the past practice of removing downed LWD and riparian trees has led to channel widening and downcutting or entrenchment. Sediment is being accessed from streambanks, or moved in from upstream stream types (A types), and temporarily stored behind obstructions or localized flats where natural stream grade controls are present. Where stream slopes exceeds about 2%, fine and coarse sediments are moving downstream during frequent flows. This stream type will not aggrade, even when sediment supply is high. However, without LWD wood structure in the stream, limited areas are available to trap gravels for fish spawning beds.

Low Gradient Channels, Rosgen C and F Stream types

These are low lying, meandering, wide and slightly entrenched to entrenched channels with a variety of substrates but with a high proportion of fines. About 19 miles (10%) of all channels in the analysis area fit these types. All C and F channels are perennial. These channel types are located lower in the drainages, along 4-5th order streams and have larger contributing areas. This includes middle and lower Big Creek, as well as some reaches in the lower mainstems of Fall, Brownson, Axe, Bear Pen and Swamp Creeks. The main processes affecting these channels are the input of water and sediment from upstream channels (A and B stream types) and lateral and vertical adjustments through bankcutting and channel scouring.

Early century modification of these channel types has occurred, including splash damming, riparian and flow changes, causing concurrent hydraulic changes and loss of stream pool volume and axial stream water storage in floodplains. Log drives were common in the lower 4.5 miles of Big Creek from 1896-1915, when much of the Douglas-fir and Port Orford cedar were driven down Lower Big Creek on dam released flood waves. Riparian zone hardwoods and conifers were also cut and spanner logs removed to facilitate log transport.(Farnell 1979).

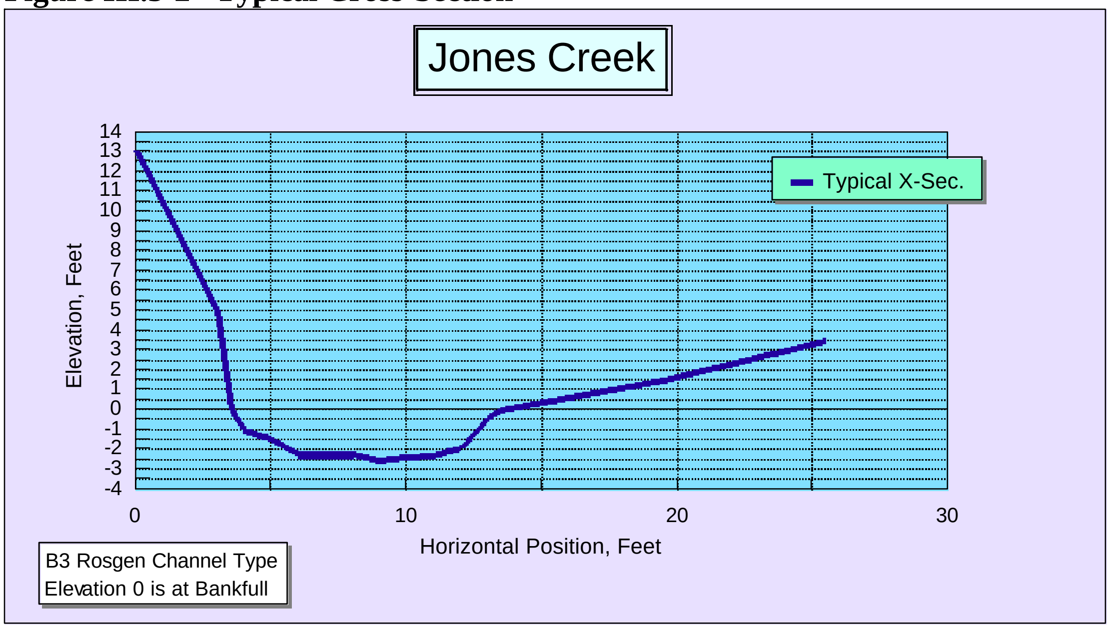
Low gradient channels are depositional areas for fine sediments. These stream types can easily be identified in longitudinal profiles shown in Appendix A-4. The higher frequent flows will move sediment along the bed and banks and will be redeposited downstream.

Stream Channel Characteristics

Each of the 10 drainages in Big Creek were inventoried in the field. Typical cross sections of the channel, pebble counts of the surface substrate of the channel bed, and longitudinal profiles of the channel gradient were created. Figures III.3-2, III.3-3 and III.3-4 show examples of these graphics for Jones Creek. This data, when looked at together, gives important information about stream channel characteristics and aids channel classification. Additional figures for other Big Creek drainages can be found in Appendix A-4.

A typical cross section was measured with a tape and rod in the lower portion of each drainage in low gradient (<2%) Rosgen B3c, C or F channel types at a site representative of the reach. The cross section contains information about bankfull width, depth and cross sectional area, and whether a floodplain is present above bankfull.

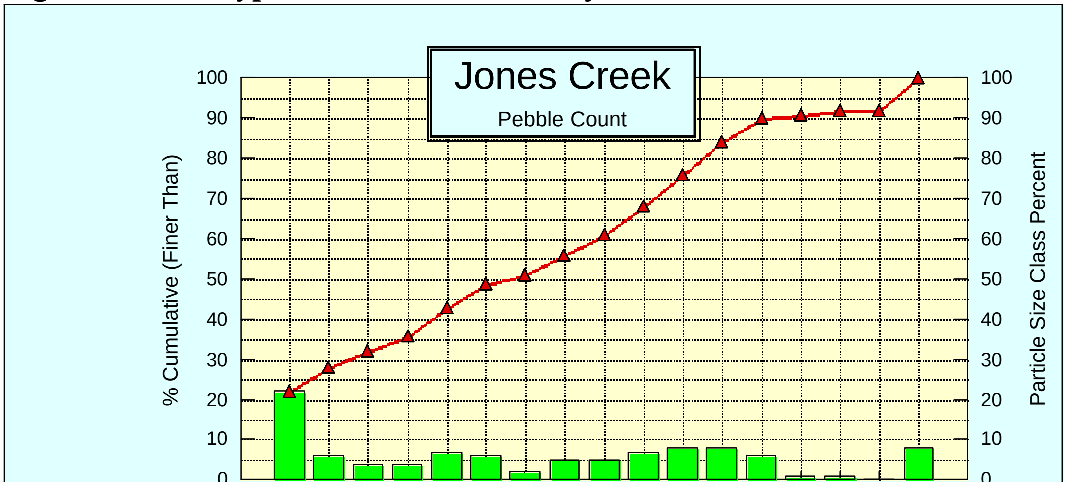
**Figure III.3-2 Typical Cross-Section**




A pebble count of the streambed substrate was taken in the same area in riffle sections. Table III.3-1 summarizes the results. Although only 10 measurements were taken, the sample is stratified within low gradient streamtypes. More replicate samples could be taken to determine confidence and trend of the data.

The initial pebble count data indicate that Jones Creek and Upper Big Creek have a significantly higher amount (28%) and (26%) of fine sand/silt/clays comprising the streambed substrate. The small size of substrate in Brownson Creek is mostly due to the absence of larger cobble sizes rather than a high amount small particles. Conversely, the Upper Big Creek channel is predominately bedrock. Figure III.3-3 typifies a pebble count diagram. Pebble count diagrams for all survey sites are in Appendix A-4.

**Figure III.3-3 Typical Pebble Count Analysis**




| Particle Size, mm | 0.06 | 0.09 | 0.19 | 0.38 | 0.75 | 1.5 | 3 | 6 | 12 | 24 | 48 | 96 | 192 | 384 | 768 | 1536 | 3072 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 22 | 28 | 32 | 36 | 43 | 49 | 51 | 56 | 61 | 68 | 76 | 84 | 90 | 91 | 92 | 92 | 100 |
| | 22 | 6 | 4 | 4 | 7 | 6 | 2 | 5 | 5 | 7 | 8 | 8 | 6 | 1 | 1 | 0 | 8 |

Longitudinal profiles of the stream gradient were developed for each drainage, by intersecting GIS contour and hydrography coverages. These profiles give a picture of the stream gradient. This information is used to aid in stream classification.

**Figure III.3-4 Typical Longitudinal Profile**

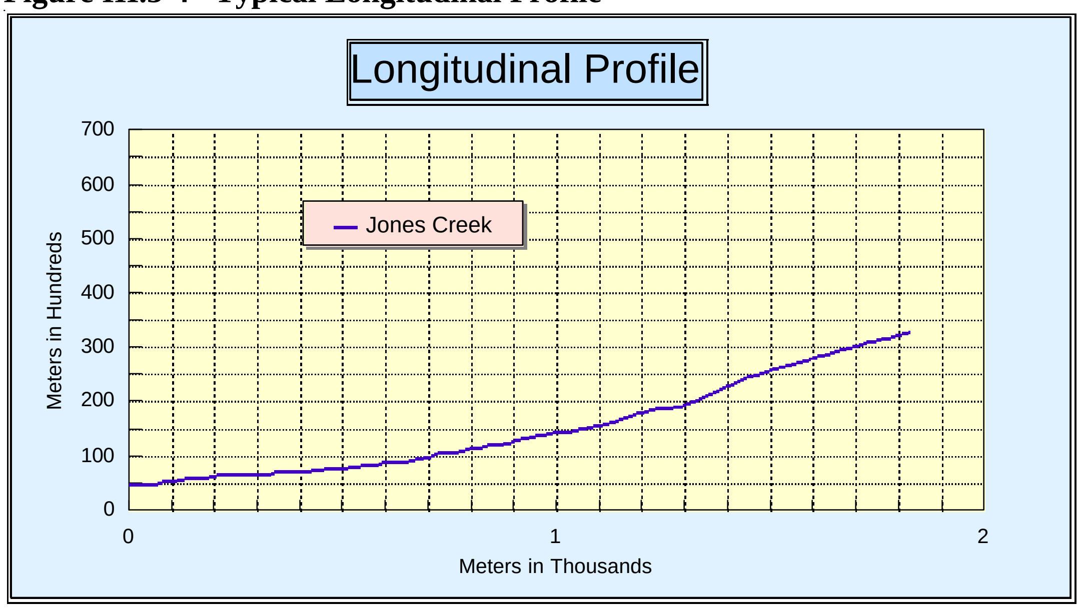


**Table III.3-1 Stream Channel Characteristics at Selected Sample Sites**

| Stream Name | Cross Section Information | | | | Longitudinal Profile | | | Pebble Count | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rosgen Type | Ave. Depth | Max. Depth | Ave. Width | Average* Gradient | Mainstem Distance | Stream Relief | Dominant Particle | Description | D50** |
| Lower Big Cr. | F4 | 1.9 ft | 2.9 ft | 42 ft | 0.78% | 10161 ft | 79 ft | 48 mm | very coarse gravel | 20 mm |
| Middle Big Cr. | | | | | 0.59 % | 28408 ft | 167 ft | | | |
| Middle Upper Big Cr. | | | | | 3.4 % | 13313 ft | 453 ft | | | |
| Upper Big Cr. | B3c | 1.9 ft | 2.7 ft | 21 ft | 9.5 % | 14531 ft | 1378 ft | 3072 mm | Bedrock | 72 mm |
| Swamp Creek | B3c | 1.6 ft | 2.2 ft | 27 ft | 6.6 % | 19340 ft | 1270 ft | 96 mm | small cobble | 62 mm |
| Brownson Cr. | F3 | 1.8 ft | 2.3 ft | 20.5 ft | 8.5 % | 12369 ft | 1047 ft | 12 mm | medium gravel | 5 mm |
| Fall Creek | B3 | 2..2 ft | 2.9 ft | 15.5 ft | 7.9 % | 16099 ft | 1270 ft | 96 mm | small cobble | 34 mm |
| Bear Pen Cr. | B3c | 2.0 ft | 2.3 ft | 18 ft | 18 % | 9688 ft | 1745 ft | 96 mm | small cobble | 31 mm |
| Axe Creek | B4 | 2.0 ft | 2.3 ft | 18 ft | 10.5 % | 9314 ft | 978 ft | 96 mm | small cobble | 31 mm |
| Jones Creek | B3 | 2.0 ft | 2.5 ft | 10.5 ft | 15.3 % | 5994 ft | 919 ft | <0.062 mm | silt/clay | 3 mm |

*Average gradient is the entire mainstem length divided by the relief, rather than the reaches where the pebble counts were taken. This data is intended to give the reader a very general picture of overall stream rise, although it should be noted that all drainages have low gradient flats in the lower reaches and steeply inclined channels near the headwalls. See Appendix A-4 to view longitudinal profile plots.
**D50 = 50% of the channel surface substrate is at or less than the indicated size in millimeters

## SYNTHESIS & INTERPRETATION

Management Effects on Stream Channels

Splash dam logging, which began in the lower watershed in 1896, and systematic upper watershed road building and logging, which begin in the analysis area in the early 1950's, has affected the stream channel's ability to function and remain stable. More than 46% of BLM lands and 56% of Big Creek has young timber stands less than 40 years old, which is considered hydrologically immature. Increases in annual yield has occurred and some peak flows may have been elevated. Existing roads may be causing quicker runoff to tributary channels because road system ditches act as extensions of the stream network and storm flow is quickly routed (see Section III.2-Hydrology). Roads and ground based logging, primarily from private lands, have compacted sites in the analysis area approaching 12% (see Section III.1- subsection Soil Productivity). These factors may have elevated annual or frequent discharges allowing degradation to occur in the A and B stream types.

Removal of LWD in stream channels by logging and removing of log jams has led to degradation of all stream types, especially the moderate gradient B stream types. Channel shape, substrate composition and the processes through which the transitional channels dissipate stream energy have changed in response to man's activities. The channel complexity, which involves energy dissipation through turbulent flow and channel roughness has been simplified. Much of the channel roughness provided by LWD has been removed, which changed the flow from a turbulent or varied velocity profile to laminar or a consistent velocity profile. Essentially, the amount of backwater or low velocity, depositional areas provided by log steps have been eliminated. The decreased number of velocity breaks tends to cause the channels to widen and downcut to dissipate the stream energy no longer used in the step/pool flow pattern.

Removal of mixed stands of hardwood and conifer riparian trees, which anchored the stream banks, has led to channel instability along the low gradient C stream types. These streams also cut downward into the floodplain, widened, lowered the water table within the floodplain and converted many C stream types to an entrenched F type. Splash dam logging in the early century converted Big Creek, below Axe Creek, from an C to F Rosgen channel type.

Photo-interpretation reveals that the number of landslides increased during the mid 1970's (Section III.1-Erosion Processes). This suggests that soil delivery to A and B channels was above natural levels. However, the numbers decreased during the 1980's, possibly as a result of drought years during this time or changes in management practices. Extra or chronic sedimentation to channels, instead of pulses with lapses for a large number of years, has caused hydraulic adjustments. Degradation is continuing in the transitional B stream types, primarily by bankcutting. Aggradation/degradation cycles are continuing in C and F stream types, depending on flow levels and corresponding stream energies.

Sediment Transport and Depositional Processes

The A and B stream types, because of their steep gradients, rapidly transport coarse and fine sediment through them. Because of the small watershed areas, streamflows are normally low and the majority of the sediments is carried in only a few storms each winter. The debris avalanche/torrent process, although infrequent, is the most important transport mechanism of coarse and fine sediments in these streamtypes. Middle and Upper Big Creek, and Bear Pen

Creek show the highest evidence of these channel torrents from natural conditions and road and channel intersection failure. Mid-slope roads acting as interceptors, channel landform constrictions, LWD, and debris torrent deposits can slow the routing process. Once depressions are filled by sediments behind obstructions, a new equilibrium is reached and incoming sediments will be held in suspension during the frequent flows and moved downstream. Sediment stored behind LWD or in debris fans will remain in storage for long periods of time. It can be mobilized again when the organic debris decay or a flood flow rearranges channel debris. Some aquatic organisms, particularly amphibians and invertebrates, are sensitive to the presence of fine sediments, which fill in interstitial spaces between rocks and degrade habitat quality for those species.

C channels are low gradient, and the active channel dimensions are maintained by the frequent flows. These channels are unconfined at flood stage and entrained sediment will deposit on adjacent lateral floodplains. This is because the floodplains have wide areas spreading water at shallow depths and vegetation providing roughness, which lowers velocity to where coarse and fine sediments cannot be held in the water column. C channels tend to be fairly stable. If chronic or frequent pulses of sediment from upstream activities overwhelm the transport capability of the stream, aggradation will occur at moderate flows. With a high watershed sediment supply, high flows will build a new higher floodplain, but the C channel will retain its approximate channel dimensions, but at a higher base level in the valley. Pebble count information shows sand/silt/clay particle sizes range between 14-25% of the surface bed material for C type streams. Although the sediment supply is high, the surface streambed armor layer does not appear to be overwhelmed with fine sediments. A large percentage of coarse and fine sediments are near the bankfull stage at the margins of the active channel. This implies sediment transport is flow limited rather than supply limited.

F channels in the analysis area have converted from C types, including much of middle and lower Big Creek. These are low gradient, entrenched, moderate width channels. Cycles of scour and fill and movement downstream with coarse and fine sediments at moderate flows will continue in these channels until they widen sufficiently so that the cross sectional area diminishes water velocity, depositing sediments during frequent or high flows. In this way a new floodplain will be built by the river within the entrenched channel.

Bank Erosion

Bank erosion, particularly in entrenched B and F channels, contributes sediment to the stream system. During high flows, a larger channel is required to convey the discharge and dissipate the high stream energy. In B channels, the removal of LWD has left stream channels with no way in which to reduce the water velocity in plunge pools, as many channels are downcut to bedrock. Consequently, the channel adjusts laterally, cutting away at the streambank, causing coarse and fine sediments to be suspended in the stream flow.

Down valley low gradient C stream types that have converted to an entrenched F type, exhibit bankcutting during frequent flows. This is most evident on the outside of bends where stream flow is cutting under the tree rooting zone. Brush and conifer/hardwood species on the high abandoned floodplain banks can slow, but not stop this widening process.

The F stream type in Lower Big Creek has clay streambanks derived from the Roseburg

Formation geology. These clays have shrink/swell potential, form a hard surface, and appear to resist and slow bank erosion, even when streamflows and bank shear stress are moderately high. Bank collapse, rather than bank undercutting, may be a more important mechanism along Lower Big Creek during high flows. Reduced root strength, by cutting of riparian trees would place more bank areas at risk of failure.

Jones Creek has a dominant bed particle size of silt clay, due to Serpentine and Roseburg Formation geologic parent materials. This stream has an armor layer of gravel/cobble, but can be expected to mobilize sediment, primarily from the banks, during frequent flows. During high flows, stream turbidities are an order of magnitude higher than other drainages (See Section III.4-Water Quality), and most of this sediment is coming from bank areas. Fall, Brownson, Axe, and Bear Pen Creeks streambeds are well armored with gravel/cobble but can also be expected to mobilize coarse and fine sediments stored in the banks during flows near or exceeding bankfull.

Channel Morphology and Riparian Vegetation Effects on Low Flows

Water availability during late summer from base flow is poor, due to the lack of water holding characteristics in the watershed (Section III.2-Hydrology). The drainages ability to produce summer low flows has not changed, but the channel morphology and riparian vegetation has changed. The ability to detain water, and slowly release it over a longer time period has been lost.

There is an implied assumption that the low flow hydrology of the drainages has changed in response to natural events and management activities. This assumption is based on studies in similar drainages. A good discussion on the changes of low flow can be found in Part II, Chapters 3 of "Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska" (MacDonald et al. 1991). Changes in channel morphology and riparian vegetation have affected low flows. Removal of forest vegetation has been shown to increase low flows by reducing evapotranspiration (Hicks et al. 1991; however, because summer stream flows are very low in the Big Creek drainage, the additional volume of yield from harvested areas is small. Conversion of tree species from conifer to hardwood species such as Red Alder, can actually decrease summer low flows from preharvest conditions, because this species transpires more water during the summer low flow period and acts as phreatophytic vegetation. No studies quantifying summer water loss in streams due to species conversion have been thoroughly studied (Beschta, 1996).

Morphological changes affecting the retention of low flows in the high gradient (>10%) low order (1-2) high energy channels have been slight. These correspond to the A type channels. Because most of these channels are intermittent; they do not retain summer water. Exceptions are channel types A5-A6 draining deep soils or small perched water tables. Some of the type A channels have been soured to bedrock by debris flows. LWD has been removed from these channels, which acted as energy dissipation steps and sediment catchments. However, this change is thought to have little effect on retention of summer water.

Morphological changes affecting the retention of low flows in the moderate gradient (2-10%) middle order (2-3) transitional channels have been moderate. These are step/pool A and B type streams. Removal of LWD has eliminated the steps and flats behind them. These flats stored large volumes of sediment and near surface groundwater. Pool frequency and depth was higher, below each step. These conditions would allow more summer storage of water, when stream flows were naturally low.

Morphological changes affecting the retention of low flows in the higher order (4-5), low gradient (<2%), depositional stream channels, have been the greatest. The Middle and Lower Big Creek have converted from a C to an F Rosgen stream type. Today these stream reaches are totally confined and entrenched, and cannot reach old floodplain terraces. Therefore, loss of floodplain connectivity has occurred. There was considerable near surface groundwater storage in the floodplain alluvium, but cannot be maintained and has been drained by channel incisement. These stream reaches have also undergone much widening, increasing stream width and reducing depth. Removal of streambank riparian vegetation , instream LWD, and beaver dams are largely responsible. Wide, shallow streams retain little water in pools. Sediment delivery from upstream sources may have further decreased pool volume by filling. More beaver dams were probably in the C stream types in the past, and their dams would have retained summer water volume.

Stream Channel Trends

The A1 stream types are static, and neither improving nor degrading. A5-A6 stream types are degrading at a slow rate due to headcutting. B stream types are continuing to degrade, where sufficient LWD is absent to form log steps, and when the base level is above bedrock. Many of the C stream types along lower Big Creek have converted to an F type, and cannot reasonably return to a former state. This is unfortunate, because channel entrenchment has drained much of the floodplain stored water. Many F streamtypes would require sharp rises in the base level to access a flood prone area, and may not be possible under the present climate. It is more likely that eventually these F channel types will widen by bankcutting processes, and the river will construct a floodplain within the overfit channel. Bank cutting is being slowed in Lower Big Creek by streambank materials and their properties. Eventually, a C channel type may be restoring within some of the wide F segments, but may take many years.

Management Objective

The management objective for stream channel types is to attain a stable channel. Stability means that the stream has the ability over time to transport the sediment and flow produced by the watershed in such a manner that the channel maintains its dimensions, pattern and profile without either aggrading or degrading (Rosgen 1994). In addition, channel LWD structure needs to be reintroduced and beaver encouraged in the B and C stream types to improve channel condition and ability to store summer water.

# III.4 CORE TOPIC - WATER QUALITY

Analysis Questions:

*What are the historic and current processes delivering sediment to tributary streams and along Big Creek?*

*What is the response of the watershed to storm events in regard to producing sediment?*

*Where are the source areas causing sedimentation or stream and is it suspected to interfere with beneficial uses?*

*How quickly can the analysis area recover from the effects of sedimentation after a major storm event?*

*Are there are roads that are contributing sediment to stream and if so where? What is the future management of the road system to reduce sedimentation and other potential problems?*

*What are the processes that are increasing summer stream water temperatures above State ODEQ Water Quality Standards? Which stream segments have frequent exceedances?*

*Are there processes affecting dissolved oxygen levels within the analysis area? If so, identify the processes and what streams are affected?*

*Are there processes contributing to fecal coliform levels within the analysis area? If so, identify the processes and what streams are affected?*

*What are the influences and relationships between water quality and other ecosystems processes in the watershed?*

*What is the management objective for water quality the analysis area?*

*What management actions (restoration, maintenance, protection, etc.) could be undertaken that would maintain and/or restore water quality within the analysis area?* (refer to Section IV-Recommendations)

**REFERENCE CONDITION**

Sediment Delivery

Limited reference condition information is available, consequently, quantitative estimates for sediment delivery have not been determined. There has always been a natural source component of sediment delivery to stream channels. Landsliding, debris avalanches and shallow rapid debris torrents, surface erosion after historical fires, stream channel sediment adjustments and flooding have contributed soil material.

Water Temperature
Stream temperatures are thought to have been cooler in the past. It is known that the riparian zones contained contiguous cover of conifer and hardwood trees shading the stream (see Section III.6 - Riparian Vegetation). Stream channel dimensions may have been different in the low gradient depositional stream types in the past, by streams being narrower and deeper and connecting to a floodplain. Water moving downstream received less solar heating, and may have exchanged with and replaced bank stored water in lowland alluvial reaches. This effect would act as a heat pump, removing heat from the stream in a down valley direction (Beschta 1996). A stream temperature measurement was taken at the mouth of Big Creek by the Fish and Wildlife Department on 7-15-69, with a indicated value of 64 F ° (Thompson et. al. 1972).

Dissolved Oxygen
Although dissolved oxygen levels fluctuate with the seasons, it is thought that they were seldom below saturation. Factors including decreased stream temperatures, lack of algae, less hardwood detritus, and narrower and deeper streams storing larger volumes of in-channel water, are thought to be characteristics that prevented significant oxygen reductions in stream water.

Fecal Coliform
There is not enough information to formulate a reference condition.

**CURRENT CONDITION**

Sediment Delivery
The main processes delivering sediment to tributary streams include debris avalanches and shallow rapid debris flows, from first and second order steep headwall channels. This delivery mechanism yields a high volume of sediments and debris, but occurs on an infrequent basis. Avalanche initiation areas include undisturbed vegetated headwalls on shallow to deep fine textured soils, old roads and over steepened landings above channels. Usually soils must already be in a saturated condition and a rainfall event exceed four inches or more in a 24-hour period for significant initiation to occur.

Natural source areas contributing sediment to streams include steep hillslopes and headwalls above first order channels. Figure III.1-2 shows probable initiation or failure sites based on a model output using the infinite slope equation.

Substantial stream channel bank sources of sediment loss occur in all drainage in Big Creek, except Middle Upper Big, Upper Big, and Swamp Creeks. This corresponds to Rosgen stream types; including A5, A6, B5, B6, F5 and F6.

Sediment sources due to forest management, especially forest roads, is well documented. Delivery of sediment to streams can occur for 1-2 years along intermittent channels after broadcast burning, until vegetation reestablishes the site. This results in a large amount of fine sediment input that may take several years for the stream system to flush out.

The higher stream discharges that occur several times a winter, and extreme events that occur infrequently, carry the majority of the sediment load. Flooding can cause soil loss and delivery to streams and extend the stream network to capture unconsolidated colluvium in hollows.

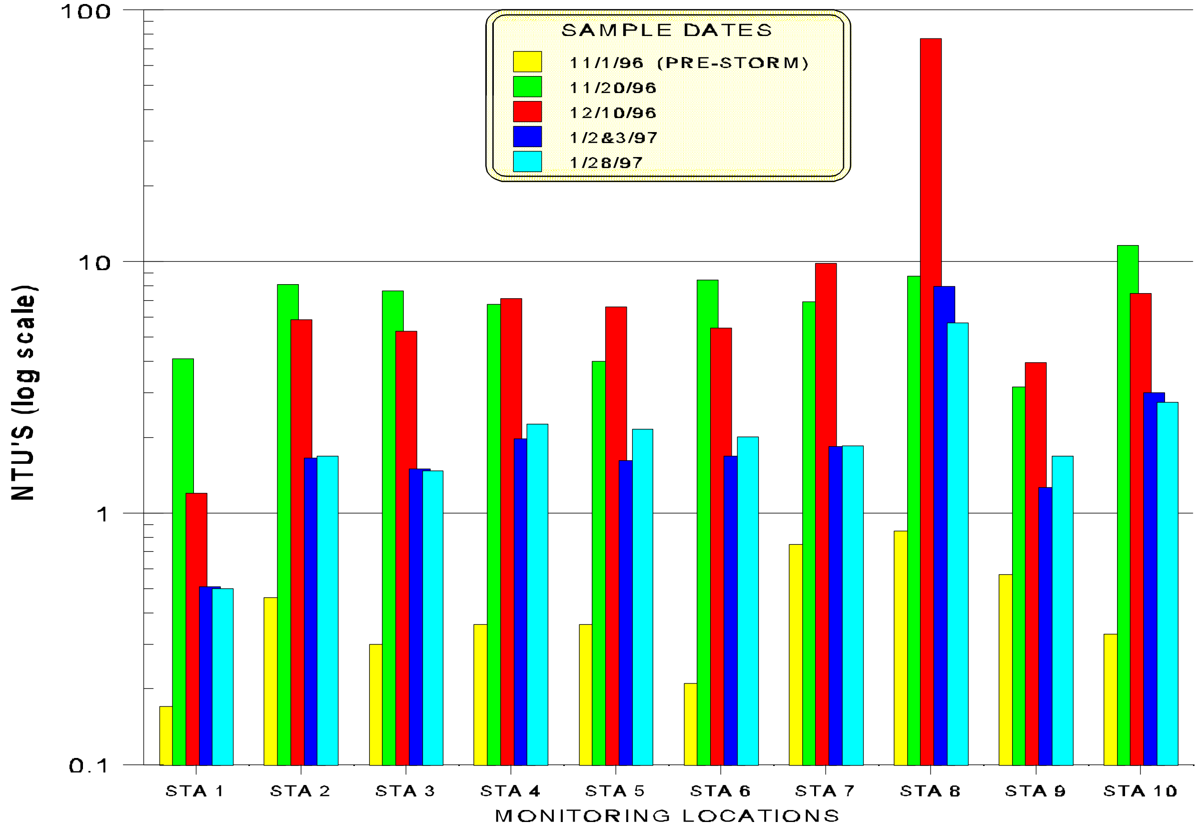
Exceptionally heavy rainstorms (1 in 50 to 1 in 100-year events), like the one on November 18, 1996 can cause widespread landsliding directly into streams of all sizes.

Figure III.2-3 shows that high flows which carry the greatest sediment loads occur less than 5% of the time. Figure III.4-1 shows results of a source search sediment monitoring in Big Creek, in the winter of 96-97. Pre-storm samples were compared with four storm periods at one location in each drainage in Big Creek. Results show that prior to storms, turbidities were the lowest in Upper Big Creek (1.7 NTU) and highest along Jones Creek (8.5 NTU). Storm monitoring indicated turbidity increases of 13 times greater than pre-storm conditions (Brownson Creek, 98 NTU ) to 90 times greater than pre-storm conditions (Jones Creek, 768 NTU). Turbidity is a measure of the cloudiness of water, but can be correlated with a suspended sediment load. Jones Creek is draining a serpentine geology which may partially explain the highest turbidity. Jones Creek also had the largest amount of smaller particles in the bed of any drainage surveyed in Big Creek, with 50% of the bed material sand size or smaller.

Watershed recovery in terms of reduced sediment yield, after a major storm event is fair to good. No quantitative estimates are available, but streams tend to clear up in 2-5 days as stream flow levels decline.

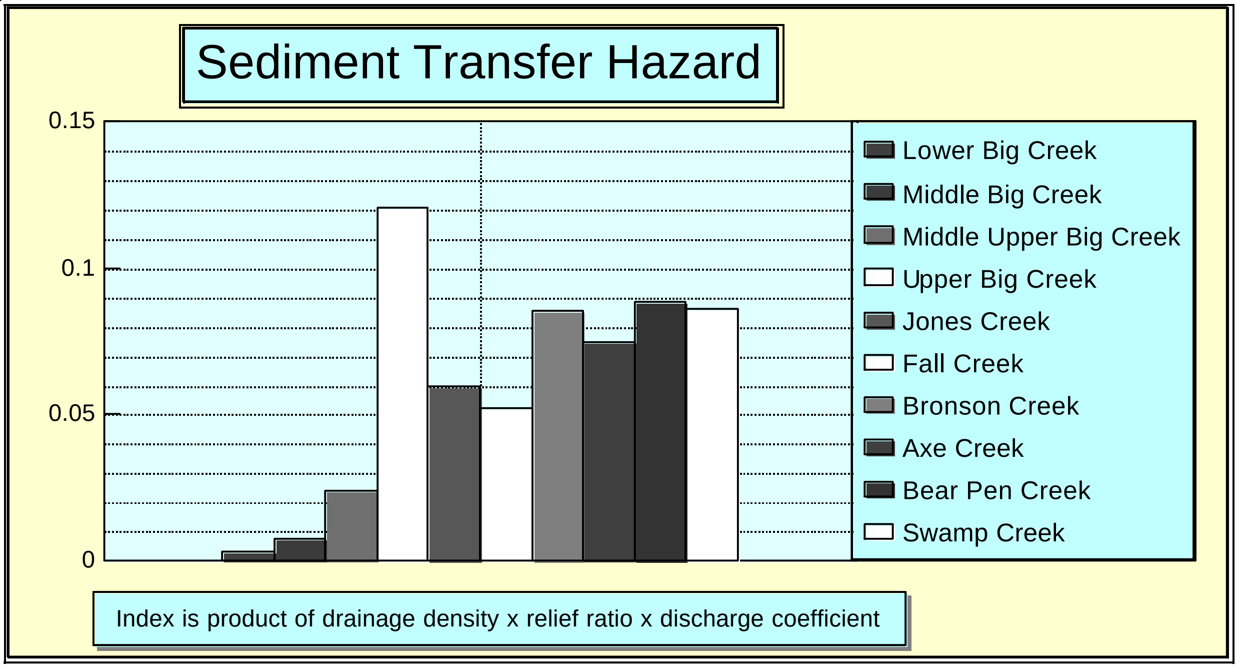
The likelihood of sediment transfer was determined for the Big Creek drainage (Geier et al. 1995). The sediment transfer hazard represents both the transport efficiency of the streams and the bankfull runoff of the drainage. The bankfull flow is closely associated with the 2-year flood event. Figure III.4-2 shows a comparative sediment transfer hazard from the Big Creek drainage. Upper Big Creek has the highest sediment transfer hazard risk with Bear Pen, Swamp, Brownson and Axe Creeks with a moderately high risk.

**Figure III.4-1  Big Creek Sedimentation Monitoring Winter 1996-1997**




| Turbidity Station Location | |
|---|---|
| 1 | Upper Big Creek |
| 2 | Swamp Creek |
| 3 | Middle Upper Big Creek |
| 4 | Bear Pen Creek |
| 5 | Axe Creek |
| 6 | Middle Big Creek |
| 7 | Bronson Creek |
| 8 | Jones Creek |
| 9 | Fall Creek |
| 10 | Lower Big Creek |

**Figure III.4-2 Streams with High Transport Efficiency**




<u>Sediment Delivery - Roads</u>
Roads alter the hydrology of drainage in several ways: increased surface runoff from compacted roadways because of reduced infiltration rates, interception of subsurface water by cut slopes, and more rapid routing of water to stream channels via road ditches and culverts. In essence the ditch system may operate much like an extended stream network. All of these effects tend to result in increases of annual yields and peak flows.

Old roads, natural surface roads, improper road drainage, and runoff from landings and other compacted areas are source areas for sediment delivery to stream channels. In average or drier years, dirt roads are probably the greatest source of fine sediments to streams during a typical rainy season. The fines (silt and clay) move as suspended sediment rather than as bedload. Sands and gravels (bedload) usually do not travel far in road side ditches due to low water volumes and velocities. Excess fines from roads should only be a potential problem during and immediately following heavy rainstorms and only if the sediment actually reaches a stream. If water from the road surface and ditch line filters through 50 to 100 feet or more of vegetation before reaching a stream, most of the sediment will drop out.

Within the analysis area, 7% of the BLM road system has natural surfacing, while at least 15% of the private road system is natural surfaced. The surfacing on 66% of the private road system is not known, but could be assumed that a high percentage of these roads are also natural surfaced. As most of these roads are inadequately maintained and lack a vegetative cover, they could be sources of sediment.

IA cursory inventory of culverts along Fall Creek Road, Bear Pen, and other roads constructed in the late 1960's and early 1970's revealed that many of the road culverts are starting to rust through the bottom. These failing culverts are or will soon begin to supply small amounts of sediment to the stream system. Failed culverts along Brownson Creek Spur Road (29-11-11.1) were replaced in 1990 and along Big Creek Mainline Road were replaced under the 1996 "Jobs-in-the-Woods" program to correct erosion problems.

Sediment Deposition and Storage

Depositional streams include middle and lower Big Creek, and flats along the lower reaches of Fall, Brownson, Axe, and Swamp Creeks. These stream types are low gradient pool/riffle C and F Rosgen type streams and have the highest risk for sediment deposition. Aggradation by sediments can reduce pool space, and change the size distribution of substrates toward the finer particles. Aggradation can cause channel widening. This can lower the habitat quality of stream reaches by increased widths and shallower depths.

Surveys of the channel materials were taken at transects at representative low gradient stream types in all of the 10 drainage in the Big Creek analysis area. These pebble counts were taken in riffles within the bankfull channel. Of the total surface substrates, sand sized and smaller particles made up between 19% and 49% of the total. Jones Creek had the highest percentage of fine materials and Swamp Creek the lowest (See Appendix A-4). Sediment may be interfering with some beneficial uses including fish and aquatic life in these pool/riffle low gradient streams.

Water Temperature

Streams in southwestern Oregon are known for their relatively high summertime temperatures, but it is not clear whether this is related to a latitudinal gradient, high solar radiation loads, low flows, or other related factors (Beschta et. al. 1987). Monitoring of stream temperatures during the drought of 1992 did not show a strong correlation between maximum stream temperature and elevation (Oregon Forest Industries Council 1993). Direct daytime heating of stream water from lack of shade is a principal factor to explain increased temperatures during critical summer months when the incoming solar radiation load is high. It is also known that temperatures increase in a downstream direction.

Elevated water temperatures have been noted throughout Big Creek, although actual recorded data is quite limited. High temperatures are attributed to loss of riparian vegetation providing shade, extremely low flows and changed morphology with poor functioning of stream channels. Based on BLM's 1994 temperature monitoring data, lower Big Creek from the mouth to the headwaters was listed on ODEQ's 303(d) list of water quality limited streams. The seven-day rolling average maximum temperature exceeded the basin criteria of 64° F for several periods during the summer (Table III.4-1). Violations of State South Coast Basin standards were noted at the mouth of Big Creek and along Big Creek near Bear Pen Creek near rivermile 5. The monitoring site on Brownson Creek did not exceed standards.

**Table III.4-1 BLM and DEQ 1994-1995 Temperature Monitoring Summary for Big Creek**

| Streams | Seasonal Max. | Date | Seasonal Min. | Date | Delta T | Date | 7 Day Max. | 7 Day Min. | 7 Day Delta T | Days >64E | Seasonal Max. 64E |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Big Crk Mouth | 68.8 | 7/21/94 | 48.9 | 10/5/94 | 8.9 | 7/20/94 | 66.9 | 60.8 | 6.1 | 54 | 4.8 |
| Mouth,. DEQ | 70.5 | 7/17/95 | 54.2 | 8/26/95 | 9.5 | 7/31/95 | 68.2 | 60.6 | 7.6 | 59 | 6.5 |
| Brownson Crk | 59.2 | 7/25/94 | 49.7 | 10/5/94 | 2.5 | 7/9/94 | 59.0 | 58.0 | 1.0 | 0 | 0 |
| Big, near Bear Pen Crk | 66.9 | 7/21/94 | 49.4 | 6/16/94 | 8.3 | 7/19/94 | 65.7 | 59.1 | 6.6 | 18 | 2.9 |

Definitions:
Delta T - Highest value of daily difference between max. and min. for the season
7 Day Max. - Average value of daily maximums for the highest seven consecutive 7 days
7 Day Min. - Average value of daily minimums for the same 7 days
7 Day Delta T - Average of the daily difference between max. and min. for the same 7 days
Seasonal Max. 64E - Number of degrees seasonal max. is above 64E F

<u>Dissolved Oxygen</u>

The amount of oxygen dissolved in water can affect water quality and aquatic habitat. The solubility of oxygen in water is inversely proportional to temperature and directly proportional to atmospheric pressure. Most tributary streams are at saturation for their given elevation and temperature, because of stream tumbling and aeration, except for low stream flow periods. Dissolved oxygen levels may be reduced due to microbial decomposition of organic matter, known as biochemical oxygen demand. During late summer/fall, when flows are low, dissolved oxygen may fall below saturation due to the addition and decomposition of leaf litter from riparian forests (Taylor and Adams 1986).

Although no measurements have been recorded, dissolved oxygen in lower Big Creek in the gentle gradient stream reaches probably declines to low levels during late summer low flow. Results from an ODEQ ambient stream monitoring site at rivermile 0.2 on the Middle Fork Coquille, west of the analysis area, show dissolved oxygen exceeding basin criteria for 18% samples taken (ODEQ 1994). Decomposition of algae in these valley bottom stream types is suspected of depressing oxygen levels.

<u>Fecal Coliform</u>

Sampling for fecal coliform has not been done in the analysis area. However, results from an ODEQ ambient stream monitoring site at rivermile 0.2 on the Middle Fork Coquille, down river of the analysis area, show fecal coliform levels exceeding basin criteria for 9% of samples taken (ODEQ 1994). Sources for elevated fecal coliform levels may be from cattle grazing in lower Big Creek, or seepage from sewer systems. Private residence’s setback requirements for septic drain fields were narrower in the past (ODEQ 1996b).

## SYNTHESIS & INTERPRETATION

The NonPoint Source Assessment (ODEQ 1988) shows sediment, and nutrients for Big Creek as a moderate problem. Downstream, ODEQ has established the Coquille River as a Water Quality Limited TMDL (total daily maximum loads) stream because pollution controls from sewage treatment plants and other point sources in the lower river below the analysis area have not been stringent enough to achieve the State's water quality standards. Non-Point Source contributors are not included in the TDML listing at this time, nor is sediment one of the measured parameters. The 1972 Federal Clean Water Act, section 303(d), requires that stream segments that do not meet the State's water quality standards be listed. Recent clarifications by ODEQ require that the state demonstrate good cause for not listing a waterbody.

Delivery of sediments and other materials will continue to provide inputs to stream channels. Debris avalanches and rapid debris flows are the primary mechanisms of channel recruitment of sediment. Upper Big Creek drainage has the highest sediment transfer hazard risk because of high drainage density, relief, and runoff including rain-on-snow. Magnitude and probability of occurrence of debris torrents is variable, depending on damaging storms, but usually with a return period of five years or greater. Sediment lodged in low order channels in debris fans is reworked downstream over a number of years.

Bank erosion is the second most important source of sediment in the analysis area. In the lower watershed throughout the Roseburg geologic formation, fine sediments are available in the streambanks. Although most drainage streams have an adequate amour layer on the streambed, this fine bank material can be accessed at annual high flows or greater, or where there is lateral migration of the channel, bank collapse and bank undercutting. Jones Creek is a special situation, because of it's Serpentine parent material. Even though Jones Creek has a lower sediment transfer hazard risk, it does have clay materials in the banks that are mobilized at higher flows. The turbidity graph showed that during storms, most of Big Creek's discoloration is coming from this stream.

Downstream depositional stream morphology is suspected to have changed by channel widening and subsequent entrenchment, and is not able to store excess sediment on floodplain terraces. As these floodplains have become abandoned, stream sediment is being temporarily stored in the stream channel, filling pools and streambeds. Results of pebble counts (Appendix A-4) show that between 19-49% of the surface substrate of the analysis area's low gradient streams have sand, silt or clay sediments.

Early century splash dams and downstream log drives in lower Big Creek have removed most of the log structure and probably was key in downcutting the channel. This new lower channel base level has stranded former floodplains, is causing tributary streams to incise to Big Creek's level. Where entrenched streams have not widened enough for the frequent discharge to deposit sediment, (ie. no floodplain present) it will be carried downstream to the estuaries. Large woody debris that has been removed from low order channels may have been sinks for sediment to be deposited in long term storage behind them, instead of routing downstream.

During high runoff conditions, sediment is being flushed into Big Creek and out to the Middle Fork Coquille river and transported to the estuaries or ocean. This results in the sediment moving through the system faster both in time and space. The addition of sediment in this manner results in the inundation of aquatic habitat with fine sediment materials. The sediment covers fish spawning areas, reducing oxygen to fish eggs and thus reducing populations. Other stream processes that are affected are the populations of macro invertebrates, riparian dependent species such as Southern torrent salamanders, and nutrient cycling processes related to the woody materials in the stream environment.

Sediment Delivery - Roads

Many road crossing culverts in the watershed are rusting out through the bottom and need to be replaced. Small quantities of sediment may be expected to be lost until a replacement program can remedy the situation. Road drainage problem areas and compacted areas contribute additional sediment to higher order streams. In contrast, field observation reveals that gravel and bituminous surfaced roads are contributing only minimal amounts of sediment (Section III.I Erosion).

Water Temperature

The Aquatic Conservation Strategy and pattern of Riparian Reserves on intermittent and perennial stream channels will provide thermal control by shading the streams, except in cases of natural disturbance. Stream temperatures through private lands in lower Big Creek will continue to be elevated, unless streamside shade is restored. Water temperature in seeps and springs are primarily dependant upon the underground soil temperature.

Dissolved Oxygen

Little information is available to know if oxygen depletion is a problem in the analysis area. Isolated and slow-moving pools on flats within transitional tributary streams are suspected to have oxygen levels below saturation for short periods in autumn when flow is very low and leaf input is high. The wider, slow-moving sections of the lower 5 miles of Big Creek are suspected to have oxygen levels below saturation in summer, due to increased stream temperatures, low flow, and decomposition of algae.

Fecal Coliform

State water quality exceedances for fecal coliform are suspected in the lower Big Creek, and are thought to coincide with agricultural operations and human occupation. There is low dispersed recreation use throughout most of the drainage on BLM administered lands, so fecal coliform contribution to tributary streams is not expected.

Management Objective

The management objective is for clean, cool water that fully supports beneficial uses and meets or exceed Water Quality Standards for the South Coast Basin, or as amended by basin wide standards or criteria referred to in "Oregon's Criteria for Listing Waterbodies" (ODEQ 1996a). It also includes ensuring that actions do not degrade water and meets Oregon's Antidegredation Policy. Soil and Water Conservation Practices, implemented as a Best Management Practice (BMP) design for a project will be carried out to meet Oregon's water quality goals. The *Northwest Forest Plan FSEIS* and *Coos Bay District's 1995 Resource Management Plan Appendix D* list many of these BMP's to be routinely used in management actions.

Sedimentation is the chief parameter of concern from BLM administered lands, and has the highest probability of occurrence.  Drainage of chief concern include upper Big Creek and Jones Creek.

Restoring streams, including control of livestock and increasing streamside shade on private lands in lower Big Creek, should have positive effects on water quality by reducing fecal coliform, lowering stream temperatures and increasing oxygenated water during the summer.

Because of the lack of LWD in most all stream types, interim Riparian Reserve width's should not be reduced below 100 feet on each side of intermittent and non fish bearing perennial streams.  Fish bearing perennial streams along third order and higher channels will have a 440-foot (2 site tree lengths) reserve maintained along each side of the stream.  This not only provides thermal protection during the summer, but is also wide enough to influence microclimates and likely retain cooler air temperatures.

# III.5 CORE TOPIC - VEGETATION

## GENERAL VEGETATION

Analysis Questions:

*What is the historical array and landscape pattern of plant communities and seral stages in the analysis area?*

*What naturally-caused disturbances occurred in the analysis area?; how big were they?; and in what way did they form vegetative characteristics found within the analysis area?*

*What and where were the human-caused disturbances, and what impact did they have on the character and composition of the watershed?*

*Has the diversity of the various natural plant communities changed and how abundant are they, Are any communities missing or represented by only small remnant populations?*

*Are there any special status or survey and manage plant communities in the analysis area?*

*What are the current conditions and trends of the prevalent plant communities and serial stages in the watershed (riparian and non-riparian)?*

*What are the influences and relationships between vegetation and other ecosystem processes (e.g., hydrologic maturity, channel stability, disturbance, species movement, soil and erosion processes, etc.)?*

*What is the management objective for vegetation in the analysis area?*

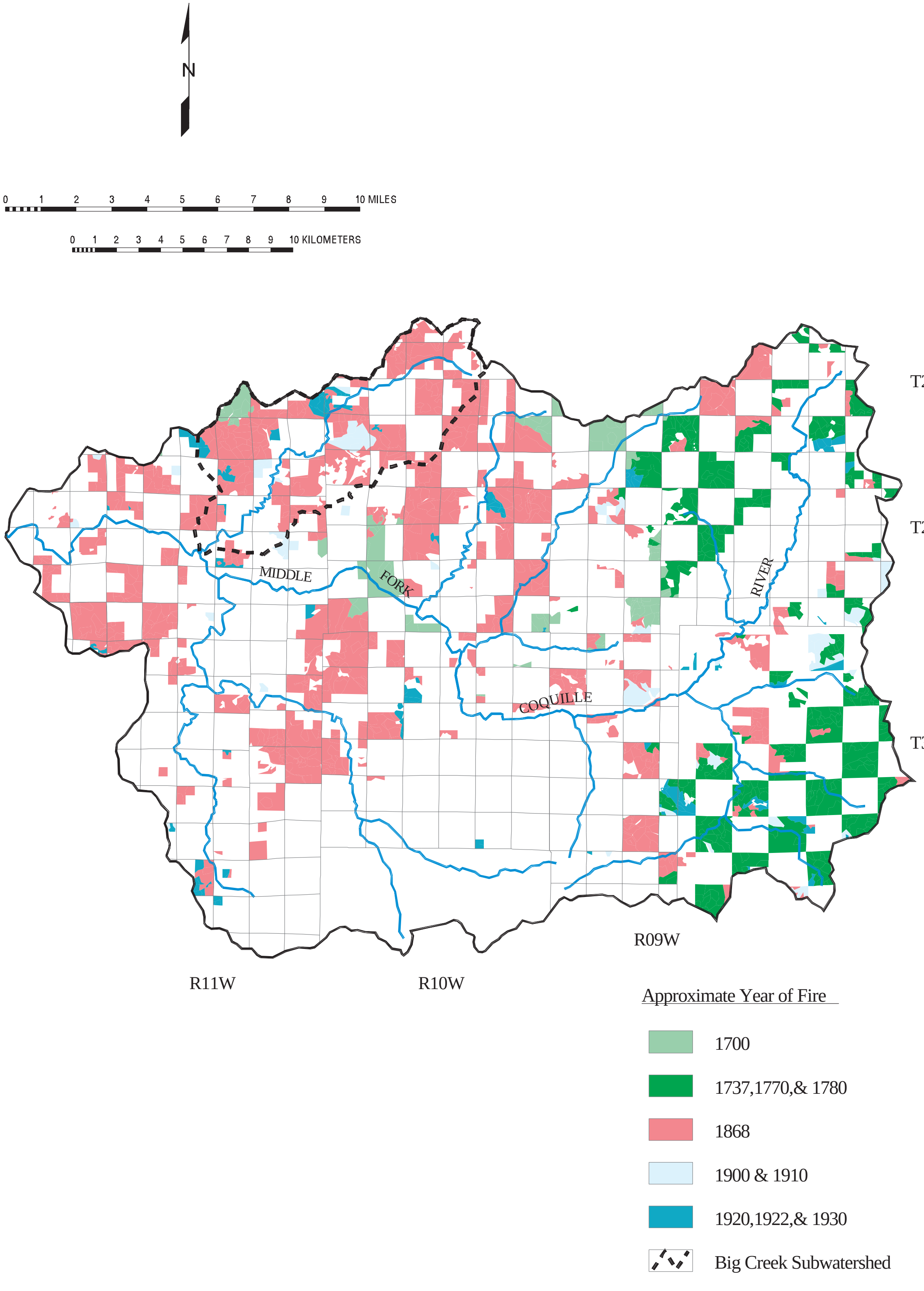
*What management actions (restoration, maintenance, protection, etc.) could be undertaken that would maintain and/or restore the integrity and productivity of the vegetation within the analysis area?* (see Section IV - Recommendations)

### REFERENCE CONDITIONS

Historical Array

The historic landscape throughout most of the entire Coast Range was characterized by large, similar aged patches (ranging in age from 0 to 500+ years old) on the order of many square miles. Most of these patches formed mosaics, containing scattered old-growth trees (i.e., remnant trees >200 yrs. old), patches of old-growth, and small patches of various younger age classes. At any one time, any particular subwatershed could be dominated by one seral stage, but still contain components of both young and old stands. Research by Ripple (1994) calculated that 61% of all conifer Coast Range forests were in old growth condition prior to the widespread fires of the late

# Figure III.5−1  Fire Disturbance Pattern −Middle Fork Coquille Watershed




Scale = 1:253440 (1/4" = 1 mile)

1840s. These fires, thought to set by early white settlers, burned approximately 35% of the Coast Range (Teensma et. al. 1991) so that only 43% of the forests were in old growth condition by the late 1800's.

The vegetation array throughout the Middle Fork Coquille was similar to that characterized for the entire Coast Range. For an approximate picture of landscape patterns prior to 1943 (the first year aerial photography was available), vegetation patterns were reconstructed by using FOI birth dates of residual stands (Figure III.5-1). Acknowledging the fact that the FOI may be inaccurate for these older dates, it is still evident that large stands of similar ages occurred throughout the watershed. Stands dating from around 1780 are concentrated towards the eastern third of the watershed, near Camas Valley, OR, while the more recently aged stands are concentrated in the western half. More recently aged stands resulted from a large fire in 1868 (Peterson, 1952) and appear to be the most widespread, as residual stands of this age can be located throughout the entire Middle Fork Coquille watershed. This landscape could be characterized as a large scaled, soft edged, slowly changing mosaic.

The 1868 fire in the Middle Fork Coquille watershed burned a majority of the vegetation in the Big Creek analysis area, resulting in a current abundance of trees 100-120 years old and the scarcity of older forests. One isolated pocket of older aged stand (birth date c.1700) survived and is located in the northwest portion of the area in Sec 3, T. 29 S., R. 11 W.

<u>Vegetation Diversity</u>
The landscape was generally forested with perhaps occasional meadows (Sec 15, T. 29 S., R. 11 W.). By examining existing 100-120 year old stands, it appears that their characteristics are similar to those which developed from large scale stand replacement fires. These conditions fit stand descriptions described by Franklin (1973) for mid-seral staged stands within the western hemlock zone. The percentage of Douglas-fir stems from harvested stands throughout the analysis area ranges from 60 to 75%, with a mixture of Port-Orford cedar (<15%), western hemlock (<15%), hardwoods (<15%), grand fir (<10%), and a trace (<1%) of western red cedar. Visual observations of these stands indicate that the understory is comprised of small hemlock, Myrtle, chinkapin, tanoak, and a variety of brush species.

Harvest data from the older aged stand in Sec 3, T. 29 S., R. 11 W. (i.e., where the 1868 burn was less intense) similarly confirm anticipated results from low intensity fires or underburns. Data from previous a timber sale in that stand reveals an understory stand heavy to Port-Orford cedar and western hemlock (45%), with the remnant Douglas-fir comprising 54% of the tree stems. The process of fire succession is well documented by Agee 1993 and this pattern is consistent with current theories about fire disturbance.

Lowland riparian areas probably contained many hardwood forests of Oregon ash, Oregon myrtle, and red alder (see Section III.5, subsection-Riparian vegetation). There were no exotic weed species, nor Port-Orford-cedar root rot (*Phytophthora lateralis*).

Plant diversity includes vascular plants, non-vascular plants (bryophytes - mosses, liverworts and hornworts), lichens, and fungi. This diversity not only includes the number of species (richness), but also the genetic diversity within species, community, and ecological process diversity. It is unlikely that any plant species have been extirpated from the watershed. Historically, plant diversity within the watershed most likely remained stable over time with the species composition fluctuating depending on the age of the forest stands in the watershed. Following disturbance events many early successional species most likely invaded these disturbed areas. Once canopy closure was reached the plant diversity temporarily decreased until the stand reached an age where canopy gaps began to develop and diversity again increased.

No data is available to make an accurate estimate of the diversity and biomass of bryophytes, lichens, and fungi within the analysis area, although some assumptions can be made when comparing historic and current disturbance patterns. Current disturbance patterns are typically human caused (extraction of forest products) and tend to simplify forest conditions (such as creating a single aged stands, removing large down wood, and intense site preparation) which create definite edges. These current disturbances also occur on a more regular basis, and are repeated over shorter time frames. Historic disturbances (fire, wind, pests, and landslides) on the other hand, were generally low in intensity (the exception being stand replacing events) thus creating more of a mosaic across the landscape which in some cases maintained or enhanced forest structure through the creation of more snags, increasing the amount of large down wood, retaining live trees (both in small clumps and scattered), and creating forest gaps. Because of these factors, the diversity and biomass of bryophytes, lichens and fungi was probably higher than what currently exists in the watershed. Over time, the diversity of these species probably remained static but the biomass probably fluctuated based on disturbance events.

<u>Naturally-caused Disturbances - Fire</u>
Fire is assumed to be the primary disturbance which resulted in this mosaic of varied age classes throughout the Middle Fork Coquille watershed. Fires probably occurred on or about 1700, 1780, 1820, 1868 (Peterson, 1952), and 1910, based on FOI birth dates. Historically, it appears that the larger disturbances (circa 1700, c.1780, and 1868) created areas of similar aged stands covering a third or more of the $5^{th}$ field watershed each time. Each fire, while large, did not consume all vegetation within their boundaries. Scattered old-growth trees, snags and downed logs (remnants), and isolated pockets of older aged stands containing these characteristics remained to create the varied mosaic. The relative abundance, condition, and distribution of shrubs, hardwoods, and conifers also varied in response to the fire severity. A mosaic of fire intensities resulted in a complex landscape with gradual transitions between stands and many complex stands with varying species compositions and differing amounts of residual stand components.

A detailed field examination of stumps and stand ages is needed to determine exact fire dates. For the Oregon Coast Range, Ripple (1994) calculated a 406-year fire cycle (the same stand being burned over again). The fire frequency (a fire occurring within a given area) calculated for the Tioga Creek subwatershed for the period from 1404 to 1923 was 17 years (BLM 1996a).

<u>Naturally-caused Disturbances - Wind</u>
Wind has played a limited role as a disturbance factor resulting in only a few salvage sales in 1963 and 1976. For this part of the Coast Range, storms generally originate from the south and southwest. The orientation of Big Creek itself is northeast-southwest. Areas of windthrow are generally located along east-west orientations, which parallels the current understanding of how wind storms affect windthrow (Andrus and Froehlich 1992).

The 1962 Columbus Day storm resulted in a 51 acre unit in Sec. 10, 29 S., R. 11 W. (TS 63-37). According to old cruise notes, the unit contained only 25% blowdown. An additional salvage sale of 55 acres (TS 63-38) was located also in Sec. 10 and adjacent Sec. 11. The November 10, 1975 storm was responsible for the 169 acre Bear Pen Creek Salvage sale (TS 76-46). This sale is situated along a prominent ridge system within the analysis area and was largely unharvested at that time. A 10 acre sale (TS 91-303) was also located along this ridge system in Sec 5, but cannot be associated with a large wind storm. Recently, the December 12, 1995 storm, has resulted in a small 5 - 10 acre patch located along an exposed high ridge in Sec 10 & 11, T. 29 S., R. 11 W.

Fine scale disturbance

Fine scale disturbances like individual tree and patch blow down, low severity fire, insects, disease, drought, and soil movement create small gaps throughout the landscape. In addition to these agents, riparian vegetation is also modified by flooding, stream bank erosion, and saturated soils. These disturbances are present, but a determination of their frequency or scale was not conducted due to their limited large scale impacts. Most stands were influenced by combinations of all these disturbance processes, occurring at varying frequencies and unevenly distributed throughout the stand and the subwatershed. These natural processes created a landscape which provided vegetative complexity and diversity at a variety of scales.

Insect and disease - Laminated root rot and black stain disease can kill patches of sapling and pole size trees. Bark beetles usually kill trees already weakened by other agents like drought, fire or disease, but may become epidemic following extensive fire or blowdown. Other pathogens and insects attack trees in this analysis area but none are known to cause significant mortality in established stands.

Land slides - Land slides usually affect only small areas at a time but the severity of that disturbance can be very high. Landslides result in the loss of the top soil and organic layer at their point of origin. Where they come to rest, they bury developed soil profiles with material that is predominantly subsoil and fractured rock. In extreme cases, all soil is lost down to bedrock. The loss of the organic layer and top soil to landslides sets back plant succession, and favors pioneer species. Red alder is particularly successful in occupying slide tracks and deposits because of its small winged seed facilitates long distance disbursal, rapid juvenile growth, and ability to fix nitrogen. From the stand point of red alder's regeneration strategy, fresh road cuts and fills provide the same conditions produced by landslides. Landslides that reach the creek can deliver structural material (woody debris, and boulders), gravel, fine sediment, and fine organic matter.

Floods - Like landslides, floods affect only a small part of the landscape but it too is a significant process. Flooding can kill or damage vegetation by burying small plants under sediment and breaking plants with brittle stems. Flooding affects the species composition on the flood plain by killing plants that do not tolerate saturated soils. This frees growing space for those plants that have mechanisms to survive saturated soil conditions or can regenerate on sediment deposits.

## CURRENT CONDITIONS

As interpreted from 1943 aerial photos, approximately 20 - 25 % of the analysis area already had been harvested, either clearcut or partial cut. The main access roads through the area were already constructed by this time. Areas of harvest were concentrated along Big Creek itself, private timber company lands in the South Upper Big Creek drainage, the 1932 fire along the Elk Creek divide, and the 1936 fire adjacent to the Weaver Ridge Road. Human activities have altered 74% of the analysis area, resulting in a significant change in the age composition of plant communities. General information on the present distribution of age classes throughout the analysis area can be found in the Section I - Characterization and Figure I-10.

Vegetation Diversity

There are approximately 230 vascular plant species representing 70 plant families (Appendix F-3) documented or suspected (species with habitat present and ranges that overlap the watershed) to occur within the analysis area. This is a conservative estimate for the number of species since some genera (such as *Carex*) may have many species present in the watershed.

Exotic vegetation now comprise approximately 20% of the watershed flora (43 species). Most of these have been purposely introduced for various reasons and are associated with roads and disturbed areas. While most of the introduced vegetation does not persist over a period of time, some species, such as orchard grass (*Dactylis glomerata*), blackberry (*Rubus* sp.), and tall fescue (*Festuca arundinacea*) have the ability to spread and potentially displace native vegetation. (see the following subsection on Noxious Weeds)

Across the landscape (including private land), early seral habitats are more common than late-seral habitats and there is little difference among watersheds in the Middle Fork Coquille River system (adjacent watersheds look fairly similar). The historical large blocks of similar aged stands have been replaced with a highly fragmented pattern characterized by hard edges (distinct contrast between adjacent stands) and small patch size (on the order of 40 acres). During the 1970's and 1980's the Bureau restricted clearcut size to approximately 40 acres, and attempted to distribute their locations so that adjacent areas were at least 10 years old. The belief at that time was that this practice would benefit wildlife due to the resultant edge-effect (Thomas 1979). On private lands, larger areas were clearcut areas, and clearcuts were often adjacent to the previous years harvest, resulting in larger tracts of land uniform in age.

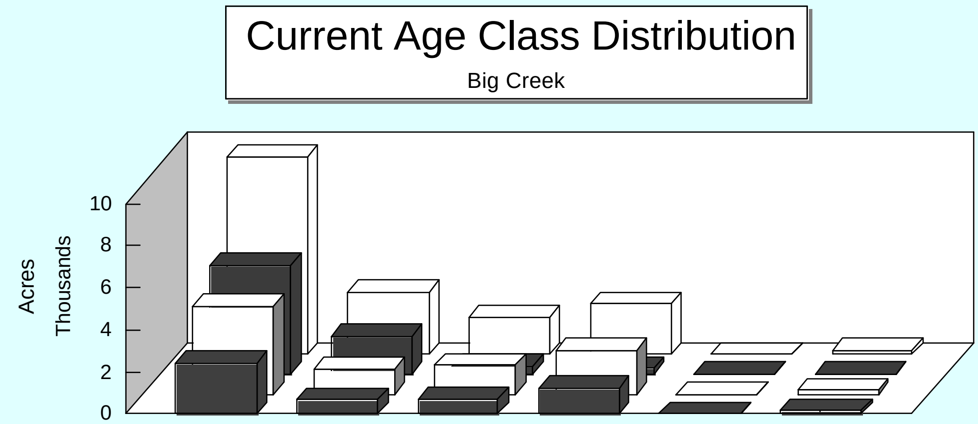
It is estimated that over 300 species of bryophytes and lichens probably occur within the watershed. The diversity of fungi is unknown but probably exceeded 500 species. It is unknown how these estimations compare with historical conditions. Overall the biomass of these species is most likely less than historic conditions with the increased forest activities within the watershed

Abundance

Age distribution of the area can best be characterized by young stands (<= 40 years of age) covering 56 %, mature stands covering 25 %, and old growth forests ( > 200 years of age) occurring on only 1% (Figure III.5-2). Only 20 %of the area is in what could best be described as ‘pole-timber’ (41-80 years ).

Age distribution on BLM lands is roughly similar with the two largest age groupings being the young stands (46 %) and mature timber (35 %). The age class distribution in Reserve areas mirrors that of the watershed as a whole.

**Figure III.5-2  Current age class distribution of forests in Big Creek**




| Forest Age Class | 0-40 | 41-80 | 81-120 | 121-160 | 161-200 | 200+ |
|---|---|---|---|---|---|---|
| ■ Reserve Areas | 2451 | 668 | 728 | 1252 | 7 | 166 |
| ☐ All BLM | 4179 | 1184 | 1369 | 2102 | 13 | 169 |
| ■ Private Lands | 5186 | 1794 | 381 | 278 | 0 | 0 |
| ☐ All Lands | 9365 | 2978 | 1750 | 2380 | 13 | 169 |

Based on 1997 FOI

On private land, cursory aerial photo interpretation suggests that only about 40 acres has not yet been harvested; therefore, old growth forest habitat is virtually absent from private land.  Private land is primarily managed for timber production or livestock grazing and will likely never provide significant amounts of late-successional or old growth forests.

<u>Special Status Plant Communities</u>

Special status plant species currently known within the watershed include one occurrence of California globe mallow (*Iliamna latibracteata*) occurring along Big Creek Road just below the junction with Road No. 28-10-31.0.  This species is currently at the northern extent of its range. The population size at this location is under 10 plants.

Special status plant species are those that are of concern because of their rarity and/or threats. These species include those listed as Endangered or Threatened under the Endangered Species Act, federal candidates, state listed species and BLM sensitive species (Bureau sensitive, Bureau assessment, and Bureau tracking).  Each list of species has its own management requirements.

No formal inventories have been conducted for bryophytes, lichens and fungi (Survey and Manage and Protection Buffer species) within the Big Creek watershed.  Any locations of these species in the watershed are found when conducting other inventories.  Although many of these species potentially could occur in the watershed, the only known occurrences of these species are *Usnea longissima*, *Lobaria oregana*, *Pseudocyphellaria anthrapsis*, and *Sarcosoma mexicana*. The first three species have been found in older stands within the watershed while *Sarcosoma mexicana* have been located in northwest corner of Section 10, T.29 S., R.11 W.  Of these, only *Sarcosoma mexicana* requires any specific management.  This species is a protection buffer species and results in adding unmapped areas to Managed Late-Successional Areas.  Specific management for this species is included in Section IV.1 Recommendations.

<u>Human-caused Disturbances- Logging</u>
Logging has had the most impact on vegetation since the 1940's. To date, 44% of BLM's ownership has been harvested compared to 99% of private ownership (Table III.5-1). Aerial photography reveals that private landowners harvested over 40 % of their ownership by the late 1950's. Since then, harvest from both private and BLM lands has been relatively stable each decade.

**Table III.5-1 Logging Disturbance by Decade**

| BLM Ownership** (includes Coquille Tribal Forest) (10,068 ac) | | | Private Ownership (6,593 ac) | | TOTAL (16,661 ac) |
|---|---|---|---|---|---|
| Decade | Acres harvested | % of Federal ownership | Acres harvested | % of PVT ownership | |
| 1930's & 1940's | 602 | 6 % | 2206 | 23 % | 17 % |
| 1950's | 754 | 8 % | 1911 | 20 % | 4 % |
| 1960's | 954 | 10 % | 1372 | 14 % | 14 % |
| 1970's | 856 | 8 % | 813 | 8 % | 10 % |
| 1980's | 1297 | 13 % | 247 | 3 % | 9 % |
| **1990 to 1992 | 1170 | 12 % | ***699 | 7 % | 11 % |
| Totals | 5638 | 56 % | 7248 | 99 % | 73% |

*** includes second rotation harvest of areas previously harvested in 1940's and 1950's

The District policy to salvage of dead or dying trees during the mid-1960's to early 1970's was concentrated in only a few sections. Documentation of timber harvest showed that salvage sales occurred throughout Sections 28,29,33, & 34, T. 28 S., R. 10 W.; Sections 3 & 5, T. 29 S., R. 10 W.; and limited areas in Sections 10, 14, & 15, T. 29 S., R. 11 W. In addition, it was common practice on timber sales during the 1970's to fall or harvest dead trees within 200 feet of roads or the boundaries of clearcut units. Therefore, in the remainder of the analysis area, most snags and down logs within remnant stands may be at or near natural levels (refer to III.6 Species & Habitat).

A portion of Sec. 9, T. 29 S., R. 10 W. was commercially thinned under the Sandy Bear-Pen Thinning Sale No. 70-47.

Because of the early harvest of private lands, logging of the second rotation of timber has begun, most notably in Secs. 31 & 32, T. 28 S., R. 10 W. and Sec. 4, T. 29 S., R. 10 W. This pattern is expected to continue for private ownership as the timber stands reach 40 to 50 years of age. As part of their forest management practices, herbicide application to control noncommercial species generally occurs within the first 15 years following harvest. Fertilization of older stands may also occur.

<u>Human-caused Disturbances- Fire</u>
There have been several human-caused fires within the analysis area since 1931 based on documentation from the Oregon State Board of Forestry (Figure III.5-3). Typically, these fires were small (1000 acres or less) and incendiary in origin (Appendix B-1). All of the fires occurred between August to October and were more frequent during the 1930's, as these were drought years. Surprisingly, there was no documentation of fires attributed to lightning, including those less than 10 acres in size. Wide scale fires due to lightning in the Coast Range are rare. The probable cause of the 1868 stand replacement fire, as well as others occurring in the mid 1800's, was European settlers (Zybach 1993).

## SYNTHESIS & INTERPRETATION

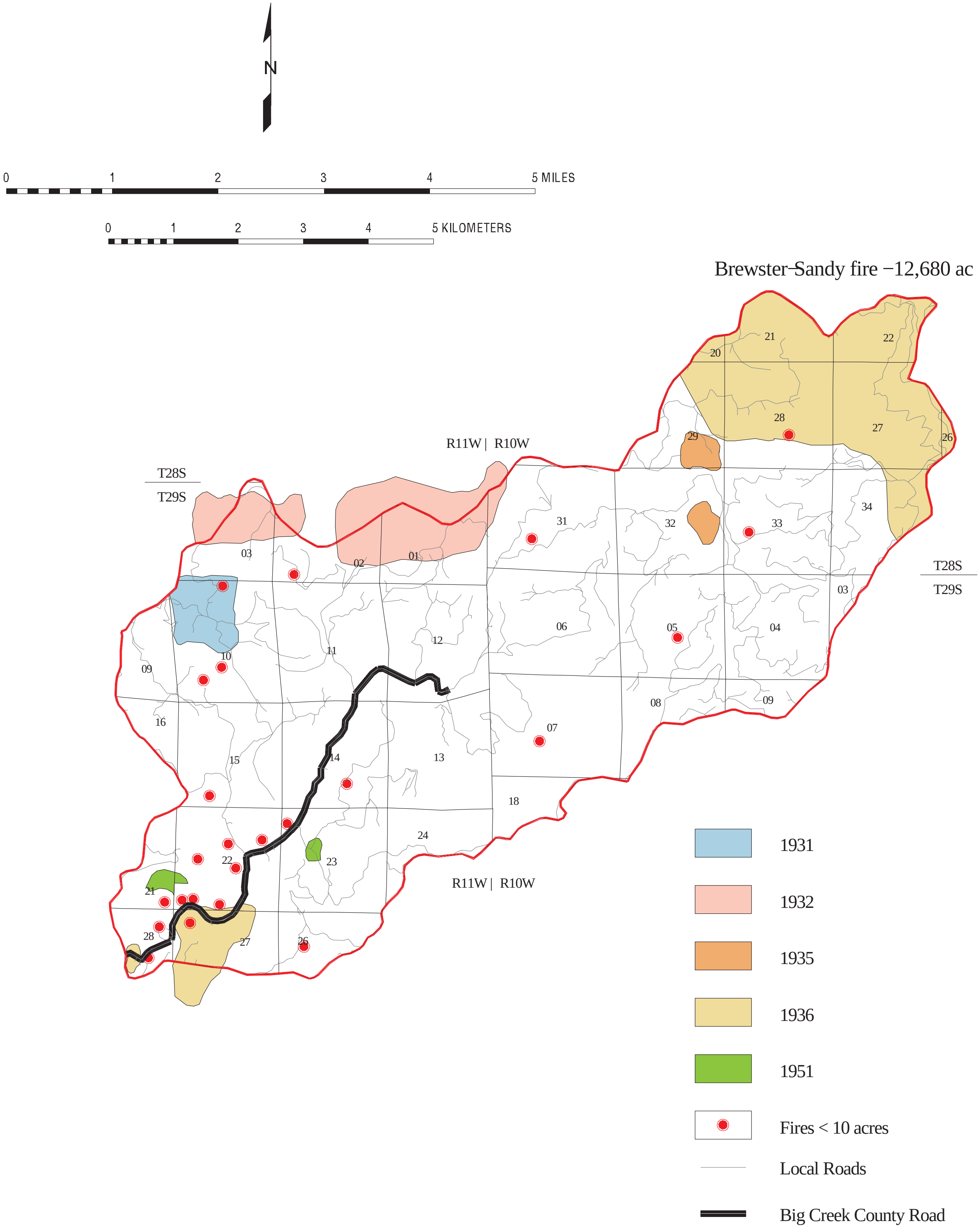
General discussion the effects of natural and human disturbance processes on vegetation are found in Appendix B. How these processes specifically influence the analysis area is discussed below:

<u>Disturbances</u>
The likelihood of widespread disturbance due to wind is relatively low. The analysis area appears to be protected from large scale windstorms by the ridge systems (Bone Mtn., Eden Ridge, White Mtn.) to the south. Some localized, small scale, windthrow can be expected along exposed ridgetops. The probability of large scale fires due to lightning or human activities is also relatively low. Lightning caused fires are infrequent for this part of the Coast Range. The combination of an efficient transportation system with the proximity of the analysis area to the Coos Forest Protection office in Bridge, Oregon, results in a fast response to extinguish fires before the can grow to any large size.

<u>Vegetation diversity</u>
Plant diversity has probably remained relatively the same over time with minor fluctuations based on the amount of and time since the last disturbance event (natural- or human-caused). There appears to be no vascular plant species restricted entirely to late-successional forest conditions although some species reach their highest biomass in these communities, such as some mycotrophic plant species (Franklin et al. 1981). While some studies (Habeck 1968, Schoonmaker and McKee 1988) indicate that early successional stages have a higher plant species diversity, data from Spies (1991) indicates that species diversity may be higher in older forests (this is especially true when bryophytes, lichens and fungi are included).

An often overlooked component of plant communities include bryophytes (mosses and liverworts), lichens, and fungi. These species are not thought of being important in forest ecosystems, because of their small size and inconspicuous nature. In spite of this, these species have many important ecological roles within temperate forest ecosystems. It is estimated that

# Figure III.5−3  Location of Human Caused Fires since 1931




Scale = 1:84480 (3/4" = 1 mile)

for every two acres of temperate forests, the biomass of epiphytes alone is one ton (Moffett 1997). Nadkarni (1984) determined that the mineral content of epiphytic bryophytes on bigleaf maple trees exceeded the biomass of the tree's foliage.

Bryophytes are found on all substrates (rock, soil, dead wood, and tree trunks and branches) and occur in all stages of forest development. Many species are restricted to specific microhabitats and substrates, such as the upper sides of tree branches in the upper canopy. These species have their greatest biomass and diversity in older aged forests. Studies (Norris 1987, McCune 1993) have shown that bryophyte biomass and diversity is significantly lower in younger forests. In logged over areas, some species do not appear until the forest reaches 100 years old (Norris 1987). As with vascular plants there appears to be a definite successional pattern of bryophyte species as a forest matures.

Bryophytes play important roles in the maintenance of ecosystem stability including regulating water relations and nutrient cycling. They also provide food and habitat for many invertebrates and vertebrates, maintenance of forest stream ecosystems, help increase soil stability, and providing a seed bed for many plant species.

Although lichens occur on all substrates, the species of most concern are those which occur on live trees (epiphytes). Like bryophytes, most lichens require specific environmental conditions (the physical and chemical nature of the substrate, wetting and drying frequency, temperature regimes, and light) in order to survive and appear to have definite successional patterns as a forest matures (Lesica et al. 1981). Studies have shown that lichen biomass and diversity increase with forest age (Neitlich 1993).

Until recently, fungi have had a negative image in a product-oriented society that equates disease and decay with the destruction of a resource which yields goods and services for humans. Fungi are now being looked upon as important species in the maintenance of forest ecosystems. In the Pacific Northwest, fungi are extremely diverse. Hawksworth (1991) estimated there are at least six species of fungi for every vascular plant species. Fungi occur in a variety of substrates including soil, needle duff, dead wood, and closely associated with the roots of most vascular plant species (mycorrhizal).

Fungi profoundly affect nearly all ecological processes and events, either directly or indirectly, which occur in coniferous forest ecosystems (Trappe and Luoma 1992). Ecological roles that fungi have include, mycorrhizal associations with nearly all woody vegetation which aids growth and in some cases protection from diseases, nutrient cycling (saprophytic fungi), soil aggregation, food webs, and diseases, such as *Phellinus*, which helps create forest gaps thus increasing forest complexity. Some arboreal rodents are mycophagists and play important roles in the dispersal of certain fungi spores (Carey 1991).

While the age of the forest is important in determining the biomass and diversity of bryophytes, lichens and fungi, it probably is a result of many environmental and structural factors associated with older, mature forests. Older forests typically have greater canopy structure which provides more available and stable substrates, aids in air circulation, therefore ameliorating the relative humidity (lichens are unable to tolerate continuous high relative humidity (Goward 1992)), have greater amounts of large woody debris in all decay classes, and a higher diversity of tree species

(Franklin et al. 1981, Spies and Franklin 1991). Therefore, it appears to be these habitat features associated with older forests and not stand age that influence the bryophyte and lichen diversity and biomass. It is quite possible for a younger forest with these habitat features to have a greater diversity and biomass of these species than an older aged forest.

The simplification of forest ecosystems through past intensive forest practices most likely has lead to a reduction in bryophyte, lichen and fungi diversity and biomass across the watershed. This reduction also results in losing the important ecological roles that these species have in these ecosystems. Recently there have been some efforts by Tappenier and others to look at how some forest activities (thinning, density management) may increase the diversity of the these species in younger aged forests. Again, the direct cause of increased diversity and biomass of these species is not stand age, but the characters associated with older forests. If we can create some of these habitat characteristics in younger forests we may be able to maintain these species across the landscape. The creation of forest gaps, retention of green trees, snags, and large woody debris retention are important habitat components for these species. Work by Neitlich (1995) has shown some promising results that the diversity of these species can be maintained for younger age classes.

Trends

With 56% of BLM lands in a 'Reserve' land allocation and an additional 15% being managed at a 150 year rotation, plant communities associated with late-successional forests will be well represented throughout the analysis area over time. Eventually, most Reserve areas will be in late-successional forest condition and most GFMA areas will be age classes <= 60 years of age (early and mid-successional). Age class projections show a steady increase in the amount of 80+ year old stands each decade until all Reserve areas reach this age. Acreage in stands >40 years of age increases steadily until the year 2037 when BLM-administered land reaches an equilibrium with around 82% of BLM lands in this age class. No stands enter the 200+ year old age class until 2057 (Appendix C, Figures C-1, C-2, & C-3). A small portion of Reserve areas may be affected by varying intensities of natural and forest management disturbances.

Private lands and those BLM managed lands designated as GFMA will be maintained in an early to mid-seral stage (40-80 yrs. old) depending upon ownership and timber market conditions. If private lands are managed on 60 year rotations, age classes may be fairly evenly split between 0-20, 21-40, and 41-60 year age classes. Coquille Forest lands will be managed consistent with the Northwest Forest Plan and may maintain age class distributions similar to BLM-administered land.

Influences and Relationships

The landscape will become less fragmented in Reserve areas as vegetation matures and the contrast between edges decreases. By concentrating harvest units in space and time, and if harvest areas mimic past natural disturbances, fragmentation also has the potential to decrease on GFMA lands. Some edge effects will continue to result where harvest areas abut Reserves (see Section III.6 - Species & Habitats).

The combination of fire and salvage logging of snags and down logs has greatly reduced the availability of these habitat features for wildlife (see Section III.6 - Species & Habitat).

It is not fully understood what impact the introduction of non-native grasses and forbs has had. Some early seral species have benefitted from their presence and surface erosion has been reduced, but the long term effects on the ecosystem are unknown.

Even with the trend towards removing the vegetation at regular intervals (60 year harvest cycle), it appears that surface erosion from harvesting should be within an acceptable rate, especially from BLM lands due to the filtering effects of the Riparian Reserve network. Harvest areas rapidly revegetate with sufficient ground cover to limit surface erosion. Riparian Reserve areas adjacent to streams will act to filter out sediment (see Section III.8 - Riparian Reserve Evaluation).

It could be assumed that elevated peak flows would continue as approximately 60% of the analysis area would be harvested on a 60 year rotation. Stands less than 30-40 years of age are not up to their full evapotranspration potential (see Section III.4 - Water Quality)

Management Objectives

With BLM's current management direction it is not likely that historic patterns of vegetation can be restored on non-Reserve designated lands. GFMA lands will be managed for timber production and early seral species. Forest practices under the Standards and Guides incorporates some of the key structural components produced by natural disturbance processes (ie., snags & down logs, species mixes, and landscape patterns). These objectives may also provide some benefit for mid and late-seral species. Silvicultural practices, such as precommercial thinning, commercial thinning, release treatments, hardwood and brushfield conversions, can be used to promote stand vigor, species mix, diversity, and fully implement ecosystem management.

Native plant diversity (including genetic, species, and community diversity) should be maintained over time. The extirpation of native plant species from the watershed should be viewed as a irreversible and irretrievable loss of a resource within the watershed. The management objectives for these species should be an attempt to maintain the diversity and biomass across the landscape to the extent practical. Future planning of forest activities should consider the potential impacts to these species and way to create habitat features for the benefit of these species.

Within Reserve areas, it is desirable to strive towards late-successional forests with old-growth characteristics.

## RIPARIAN VEGETATION

Analysis Questions:

*What is the historical array and landscape pattern of riparian plant communities and seral stages in the analysis area?*

*What processes are important in shaping/maintaining riparian vegetation?*

*Is there adequate riparian canopy closure to maintain desirable stream temperatures for aquatic organisms?*

*Is there adequate potential for recruitment of down wood to streams and riparian areas?*

*What components of riparian vegetation are important to maintain water quality and habitat quality for aquatic and riparian dependant species?*

*What are the influences and relationships between vegetation and other ecosystem processes (e.g., hydrologic maturity, channel stability, disturbance, species movement, soil and erosion processes, etc.)?*

*What are the current conditions and trends of the prevalent plant communities and seral stages in the watershed (riparian and non-riparian)?*

*What is the management objective (desired condition) for riparian vegetation in the analysis area?*

*What management actions (restoration, maintenance, protection, etc.) could be undertaken that would maintain and/or restore the integrity and productivity of the riparian habitat within the analysis area?* (see Section IV - Recommendations)

### REFERENCE CONDITION

Historical riparian vegetation may be classified into two somewhat distinct types: lowland (inhabiting floodplain terraces along the Middle Fork Coquille River and the lower 5 miles of Big Creek-up to the mouth of Axe Cr.) and upland communities (inhabiting Big Creek above the mouth of Axe Cr. and along the higher-gradient tributaries of Big Creek).

*Lowland Communities*-No historical data or pre-human impact aerial photos exist for riparian vegetation along Lower Big Creek. However, it is possible to make generalizations about historical conditions based on knowledge of processes affecting lowland riparian vegetation. Typically, lowland vegetative communities are structured and maintained by the interaction of the stream channel with the floodplain. Vegetation in the floodplain and riparian zone respond to soil composition, structure, moisture content as well as to riparian disturbance (flood innundation, scour, deposition) (Mitsch and Grosslink 1993). Vegetation may also be affected by the construction of dams and diversions by beaver which raise the water table, trap sediments on streambanks, and create side channels. Thus, lowland riparian vegetation typically consists of moisture-tolerant and disturbance/colonizer species such as shrubs and low-growing woody vegetation (such as willow, vine maple), and hardwoods such as alder, ash, maple and myrtle (Mitsch and Gosselink 1993, Franklin and Dyrness 1973). Historical and anecdotal accounts of vegetation along the M. Fk. Coquille river support these generalizations, suggesting that at the time of first settlement, lowland areas were dominated by mixed hardwood stands of myrtle, maple and ash, with widely dispersed cedar (Stickroth 1992, BLM 1997a). Lowland riparian vegetation along Lower Big Creek was probably very similar. Additionally, anecdotal evidence suggest there were also extensive stands of Port Orford cedar along the lower five miles of Big Creek on terraces and abandoned floodplains.

*Upland Communities*-The upland community is associated with the higher-gradient, hillslope-constrained reaches of Big Creek and its tributaries, as well as higher terraces along Lower Big Creek. These communities are typically structured/maintained by disturbance processes such as infrequent floods, debris torrents, windthrow, and fire. (Swanston 1991 and others). Beaver dams, sporadically present in the upper reaches, create high water tables and canopy openings adjacent to ponds.

The composition of these upland communities in Big Creek is interpreted from 1943 aerial photographs and recent examination of reference areas with relatively little or no apparent human influence. The communities fall into three categories:

**Conifer-Dominated Reaches**: Conifer species include Douglas fur, Western redcedar, Port-Orford cedar, Hemlock and grand fir. These reaches located along hillslope-constrained, erosional headwater streams and the upper reaches of low-order streams. V-shaped valleys, steep streambanks result in narrow or no discernable riparian “zones” (i.e., zone of hydrologic interaction characterized by hydrophilic plants). Narrow or no discernible riparian “zones.” Canopy cover is often 100%. Examples: Upper Fall Creek (Sec. 15 SW 1/4 NE 1/4), Upper Big Creek (in Sec. 28)

**Hardwood-Dominated Reaches**: primarily located along low-gradient, depositional reaches and in U-shaped valleys with floodplains of varying width containing recent or historic fluvial deposition. Beaver activity is common. In areas with frequent or recent fluvial disturbance, flooding tolerant species such as alder and ash are most common while longer-lived hardwoods such as maple and myrtle are found in moist terraces and protected lenses above zones with frequent flooding and innundation. Examples: middle reaches of Bear Pen Creek, lower Brownson and Swamp Creeks. Canopy cover along these hardwood-dominated reaches can be highly variable, ranging from little (in the event of recent disturbance or intense beaver activity) to 100%. Hardwood-dominated reaches may also be located along high-gradient, hillslope-constrained streams where frequent disturbance precludes conifer establishment. Examples may be seen in several unnamed small tributaries along the length of Big Creek.

**Mixed Reaches**: located along streams with moderate floodplains alternately constrained by hillslopes. Riparian area is a diverse mosaic of stands depending on local conditions (i.e., floodplain development, disturbance patterns, etc.). Hardwoods predominate where floodplains are well-developed; conifers predominate (with a narrow band of hardwoods immediately adjacent to the stream) where there is a little interaction between the stream channel and riparian area. Examples: Upper Middle Big Creek (Secs. 6, 31, 32). Canopy cover along these reaches is high, often completely covering the channel.

**CURRENT CONDITION**

*Lowland Community*-Impacts to lowland riparian vegetation probably began shortly before the turn-of-the-century when homesteaders began settling along the lower reaches of Big Creek. Settlers cleared riparian vegetation for grazing and cultivation and built valley-bottom roads. Additionally, crude roads (such as “plank” roads) were constructed through riparian zones along tributaries (such as Brownson Creek) to provide access for timber operations (BLM 1997a). According to a former resident of the Big Creek valley most of the riparian vegetation along Big Cr. had already been removed by farmers by 1927. In the 1930s, freshets associated with splash dams scoured and removed streamside vegetation, eliminated beaver dams and wood accumulations.

Currently, the riparian zone along Lower Big Creek is predominately agricultural and residential. Tree diversity and abundance are low (according to 1994 ODFW survey data, average no. of trees of any species and size in a 100' transect from the stream was 10.3; species other than red alder were very uncommon). In some cases, native riparian plant species have been replaced by exotics and escaped cultivars (such as Himilayan blackberry).

The stream channel in Lower Big Creek is downcut (average height of first terrace is approx. 9'). Furthermore, the channel lacks any structures (debris jams, beaver dams) substantial enough to aggrade the streambed and divert water to floodplains. As a result, interaction between the stream channel and floodplain has been eliminated along most of Lower Big Creek. Elimination of a high water table in the floodplain, combined with agriculture and residential development, has resulted in the conversion of predominately wetland, riparian vegetation to predominately dryland species.

Average canopy cover in Lower Big Creek exceeds 75%, which meets ODFW Benchmark Criteria for “good” habitat conditions. Notable exceptions may be found where grazing and agriculture have encroached on riparian vegetation. In several locations in sections 12, 14, and 16, riparian vegetation consists of only a thin strip of single trees bordering the stream.

*Upland Communities:* The primary impacts to upland riparian vegetation include timber harvest and road building. Clearcut harvesting (with no or inadequate riparian buffers) and repeated salvage of trees and logs have eliminated many large old-growth conifers and logs from riparian areas. Red alder is more abundant in upland areas than it was historically, particularly in areas where roads have been constructed and where harvest with ground-based systems has occurred. In some areas, selective removal of large conifer trees from “mixed” reaches has resulted in establishment of a dense myrtlewood understory, allowing the growth of few understory hardwoods or conifer.

In general, mature and old-growth confers are lacking throughout the watershed. FOI analysis indicates that roughly 58% of Riparian Reserves in the Big Creek watershed are dominated by conifers younger than 80 years; only 2.4% of Reserves are dominated by conifers 161 years or older. Comparison of aerial photos between 1943 and 1992 indicates incursion by red alder throughout the watershed, particularly along roads.

On average, canopy cover in the watershed exceeds 75%. While the average is high, there are several reaches along tributaries with little or no canopy cover. For example, Jones Creek averages only 33% and a substantial portion of Upper Swamp Creek is bordered only by shrubs and scattered alder.

**SYNTHESIS & INTERPRETATION**

Riparian vegetation is unique in the terrestrial ecosystem because it is shaped by both fluvial and terrestrial processes. Characteristics unique to riparian vegetation and riparian ecosystems which provide important ecological functions in watersheds include:

1. *Surface and soil moisture*: Riparian zones contain a diverse mosaic of surface soil moisture conditions which vary in time and space. These conditions range on a gradient from saturated soils and standing water beside the wetted stream channel to subirrigated sites on high terraces and inactive floodplains where seasonally high water tables recede to below the rooting zone in late summer. These assorted soil and hydraulic conditions support a diverse array of moisture-dependent plant species as well as obligate hydrophilic animals (amphibians, invertebrates, waterfowl, aquatic mammals). A variety of upland species may also be associated with the diverse or unique vegetation found in riparian zones.

2. *Diversity and interspersion of habitat features:* Riparian zones are structurally complex. They are characterized by assorted physical processes such as earth movement, deposition, erosion, disturbance, and often contain an array of terraces, old channels, down wood, snags, etc. Furthermore because riparian zones are at the interface between aquatic and terrestrial systems, they are a classic example of the ecological principle of the "edge effect" (Odum 1979). As a result, riparian plant and animal species diversity is often very high.

3. *Linear nature of riparian vegetation and riparian zones*-Riparian vegetation and ecosystems generally have a linear form as a consequence of their proximity to streams, enhancing their importance in landscape ecology. The linear nature of riparian vegetation and habitats provides protective pathways for animals. The migration and dispersal of fishes and terrestrial organisms often depends on the integrity of riparian ecosystems.

4. *Interaction of riparian vegetation with the aquatic ecosystem:* Riparian vegetation provides components necessary for stream ecosystem function, including shade, nutrients, energy dissipation, streambank integrity, and aquatic habitat structure and complexity. The interaction of vegetation and streams may be particularly important in headwater and small streams, where allocthonous inputs are the foundation for aquatic food-webs.

Over the last 100 years, timber harvest, road-building, and agricultural development in the Big Creek watershed have profoundly affected these major functional and ecological values of riparian vegetation and riparian ecosystems.

1. *Surface and soil moisture*: Management activities (particularly in Lower Big Creek) such

as stream cleaning, splash dams, and removal of streamside vegetation and large-wood inputs have increased scour, channel downcutting, and have simplified stream channels. The result has been the disconnection of the stream from its floodplain, eliminating the floodplain-water table connection and soil moisture gradients. Lower Big Creek is currently unable to support certain kinds of wetland and riparian vegetation as well as organisms requiring moist habitat conditions. Additionally, the capacity of riparian systems and stream channels to store moisture (and subsequently maintain summer base flows) is greatly diminished.

2. *Diversity and interspersion of habitat features:* Interruption of stream channel-riparian zone interaction, removal of riparian vegetation and down wood, diminished contribution of large materials from landslides, and road building have reduced structural complexity in riparian zones throughout the analysis area. In some cases, however, management activities have resulted in a more pronounced "edge effect" between riparian and upland vegetation because the riparian vegetation areas contain the only remaining trees following timber harvest.

3. *Linear nature of riparian vegetation, riparian zones:* Throughout the watershed, harvest and road-building in riparian areas have disrupted the continuity of riparian ecosystems. This process has been exacerbated by land-ownership patterns in the drainage. For example, riparian reserves adjacent to Big Creek which are dominated by conifers $\geq$ 80 years old exist only on federally managed land. These older reserves are separated by long reaches of much younger trees. Riparian fragmentation is also apparent along Fall, Axe, and Brownson Creeks. Fragmentation and disruption of riparian vegetation reduces its utility for migration and dispersal of fish and wildlife.

4. *Interaction of riparian vegetation with the stream:* Management activities along streams in the watershed which reduced the abundance, size, or diversity of vegetation have subsequently reduced inputs from riparian zones to the aquatic ecosystems. Harvest of conifers has removed large wood inputs, reducing habitat complexity and energy-dissipating structures in the stream channel. Widespread elimination of riparian vegetation in the watershed has resulted in higher water temperatures in lower mainstem Big Creek.

In addition to reducing the *amount* of wood inputs, management activities have changed the *nature* of inputs. For example, down wood in analysis area streams is now composed predominately of hardwoods (which tend to be smaller and have a much shorter lifespan in the stream than do conifers). The predominance of hardwoods and brushy species in riparian zones previously dominated by conifers alters the nature and amount of nutrient inputs. Deciduous shrubs and trees typically contribute greater amounts of organic litter to streams than do conifers, and deciduous litter is often the preferred food source of aquatic shredders (Anderson and Sedell 1979). However, the beneficial effects of increased nutrient inputs from a hardwood-dominated riparian zone will not be realized if insufficient instream structure (caused by lack of large wood in the channel) prevents retention of these added nutrients.

<u>Management Objectives</u>

The management objective for riparian vegetation in the Big Creek subwatershed is threefold:

- The first is to re-establish, to the extent possible, dynamic, hydrologic interaction between stream channels and riparian zones. This connection is required in order to re-establish soil moisture, substrate conditions, and disturbance regime necessary to maintain many riparian species historically present, such as ash, willow, and hydrophilic shrubs and forbs. This condition will support diverse riparian plant and wildlife species

- The second is to re-establish historic vegetation assemblages to the extent possible. Specifically, lowland riparian areas would consist of mixed hardwood stands, with scattered conifers on raised "lenses," extending from streamside to the edge of the floodplains and flood-prone terraces. The understory would include a lush profusion of native shrubs and herbacious species. Upland riparian systems would consist of narrow bands of hardwoods in the zone of hydrologic interaction between stream channel and riparian area, with a dominance of conifer and scattered hardwoods in the outer riparian overstory. The understory would include a mixture of native shrub species varying with site conditions.

- The third is to re-establish connectivity between and among riparian systems throughout the watershed. Explore the possibility of cooperative riparian projects among BLM, Big Creek watershed landowners, and the Coquille Watershed Association which focus on re-establishing missing vegetation. Projects such as these would provide connectivity across sections where riparian vegetation has been removed.

## PORT-ORFORD CEDAR

Analysis Questions:

*What is the current distribution and level of infestation of POC root-rot in the watershed?*

*What is the potential for the continued introduction and spread of the disease?*

*What ecological processes would be altered should POC be lost, or populations greatly reduced in the ecosystem?*

*What management actions (restoration, maintenance, protection, etc.) could be undertaken that would reduce the spread or help prevent the introduction of the disease into new areas?*

### REFERENCE CONDITION

Port-Orford cedar (*Chamaecyparis lawsoniana*) has historically been a component of the forests within the analysis area. It can comprise up to 30 % the forest stands, but is found in a codominant to understory position.

### CURRENT DISTRIBUTION

*Phytophthora lateralis*, Port-Orford cedar root rot, was unintentionally introduced in the northwest as early as 1923, causing in some cases, 100% mortality. The spores of the fungus, being highly mobile in water, travel downstream infecting previously uninfected areas. Spores also are transported by construction equipment, vehicles, man and animals.

A systematic survey to identify all locations nor the severity of the disease is currently being undertaken within the Resource Area, but has not been completed in the analysis area as yet. Figure III.5-4 shows infected locations based on informal roadside surveys.

**SYNTHESIS & INTERPRETATION**

<u>Potential</u>
The disease will continue to be spread throughout the watershed given the climatic conditions and the methods of spread. As water is the major method of transporting the spores through the soil and into the stream network, the disease will spread downslope from current infected sites. Humans, animals, equipment, and vehicles transport infected soil to uninfected areas. Areas adjacent to roads are common points of infection. Some spread occurs from root contact between trees.

Current thought is that there appears to be some variation in resistance to the disease by individual POC trees. The level of infection within an area appears to be correlated with resistance.

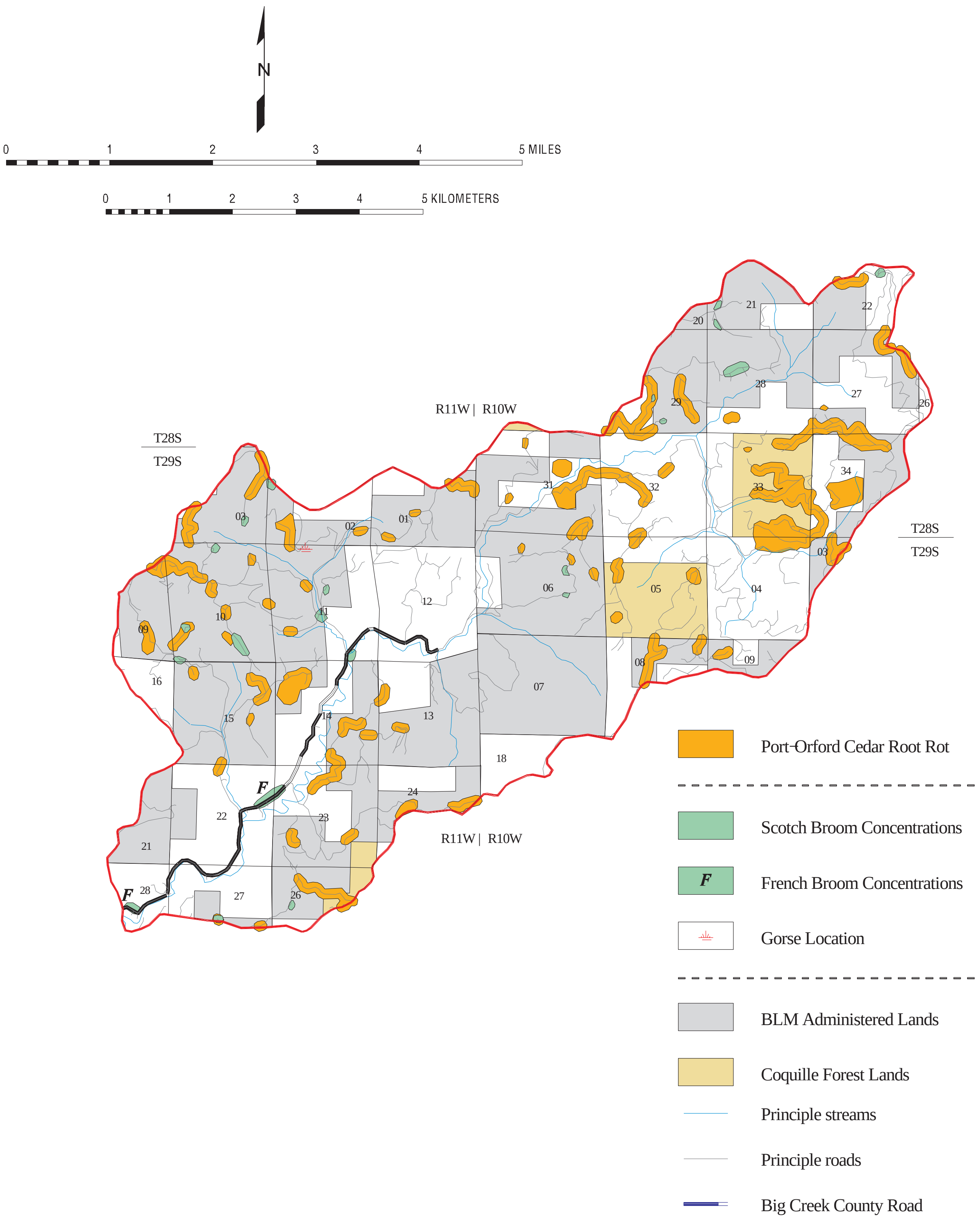
<u>Ecological Processes</u>
Because of the prolific seeding capability of POC (Goheen 1996), the tree species will continue to be present in the ecosystem (Zobel 1985), though that population maybe at a reduced level. It is thought that POC occupies a similar ecological role as Douglas fir (Franklin and Dryness 1973), so the ecological role it holds will not disappear altogether. However, reduction from historic levels will undoubtably have some affect on stand diversity.

<u>Management Objectives</u>
The overall objective is to maintain the presence of POC within the watershed by reducing the rate of spread of infection, isolate and treat infected areas, and prevent infection of healthy areas. Strategies for management of POC root disease are listed in the BLM's, 'Port-Orford Cedar Management Guidelines' (BLM 1994b). These guidelines include: washing of vehicles/ equipment prior to operating in uninfected areas, timing of projects for drier seasons of the year, and requiring roadside sanitation treatment by removing POC. Infected riparian reserves within the watershed which are adjacent to roads can be treated by cutting of POC. Infection centers in headwall regions of a riparian zone can be treated by establishing a POC free zone of at least 50 feet around each infection center.

Salvage operations to remove infected or non-infected POC (in infected area) must adhere to the 'Port-Orford Cedar Management Guidelines' which state that steps must be taken to reduce the probability of introducing *Phytophthora lateralis* PL into uninfected areas. Substitution of down logs with other POC or other species is not consistent with this strategy.

Research is currently being conducted to test POC trees that appear resistant to *Phytohthora lateralis*. Those found most resistant will be placed in a seed orchard for propagation and eventually will be out- planted. Some randomly collected POC has been planted in seed

# Figure III.5−4 Infected Port−Orford Cedar and Noxious Weed Concentrations




Scale = 1:84480 (3/4" = 1 mile)

orchards in an early attempt to preserve genetic material. POC treatment recommendations will be made for each action within the watershed area.

## NOXIOUS WEEDS

Analysis Questions:

*What is the current status of the spread of noxious weeds in the analysis area?*

*What is the potential of noxious weeds to spread and impact the analysis area?*

*What management actions (restoration, maintenance, protection, etc.) could be undertaken that would reduce the spread or help prevent the introduction of the disease into new areas?*

### REFERENCE CONDITION

Noxious weeds and other exotic vegetation did not exist until after white settlement began in the area. Most exotic species were introduced into southern Oregon during the late-1800's to mid-1900's and have since spread from their source of introduction. Therefore, it may have taken many years for these species to reach this watershed. Some of these species did not establish themselves until more areas were disturbed by human activities and propagules were transported in from infested areas.

### CURRENT CONDITION

Noxious Weeds - Currently, noxious weeds are known throughout the watershed but at this time appear to generally occur as scattered populations (Figure III.5-4). There are 31 documented occurrences of gorse (*Ulex europaea*), Scotch (*Cytisus scoparius*) and French (*Genista monospessulanus*) broom within the watershed (Table III.5-2). This information is based on data up to 1994 and recent surveys along the main roads.

**Table III.5 -2 Noxious Weed Occurrences of French Broom, Scotch Broom, and Gorse within the Analysis Area.**

| Noxious Weed | # of occurrences |
|---|---|
| Gorse (*Ulex europaea*) | 1 |
| French Broom (*Genista monospessulana*) | 2 |
| Scotch Broom (*Cystisus scoparius*) | 28 |

Four of the these sites are known from along roads adjacent to private lands. Some of these sites have had prior treatments, such as pulling and some herbicide treatment. Most populations are at the level where manual treatments would be somewhat effective.

Occurrence data for tansy ragwort (*Senecio jacobaea*) and Klamath weed (*Hypericum* *perforatum*) are unknown, but generally consist of low numbers that inventories have not been conducted. Also, these species are effectively controlled by biological agents and are deemed at levels where they do not pose any resource risks.

All of the gorse and broom populations are highly associated with roads. The majority of the populations are under 100 individual plants with only four sites having population sizes over 100 plants. One large occurrence of French broom occurs along Big Creek County road just prior to the junction of Jones Creek road (29-11-23.0) and has the ability to act as a seed source for the rest of the watershed. French broom, in recent years, has rapidly spread throughout Coos County at rates much faster than gorse and Scotch broom.

It is likely that new weeds may become introduced (either unintentionally or intentionally) in this and other watersheds in the future.

## SYNTHESES & INTERPRETATION

Noxious weeds have the ability to out compete and possibly eliminate native vegetation by competing for water, sunlight, soil nutrients, and space. The two broom species and gorse have the ability of fix-nitrogen (i.e. able to take it out of the air) therefore they are able to establish on nutrient poor (disturbed) sites. This adaptation also gives these plants an advantage over native species. Indirectly, these species may impact wildlife species (if infestations become large) by creating less desirable forage and reducing habitat quality. Very few wildlife species appear to utilize these species.

Gorse and broom species have seeds which can remain dormant for many years (possibly up to 70-80 years, if under optimum conditions). Therefore, if areas are infested following logging, there is a likelihood that these species could eventually disappear (when canopy reaches closure) only to reestablish once the stand is logged in the future. This is more likely to occur in stands with shorter rotations (60-80 years), such as matrix and private lands.

The current conditions for noxious weeds indicate that these areas are still treatable. The occurrences are scattered and not very dense at this time. Without any management, weed populations will increase in the future, primarily along road corridors. Besides the infestations within the watershed, there is the possibility of spreading weeds into and from adjacent watersheds. The Sandy Creek watershed, immediately to the east, has a bigger noxious weed problem which potentially poses a risk to Big Creek from vehicles transporting seeds from one watershed to another.

<u>Management Objectives</u>

The goal for noxious weed management within Big Creek watershed is to manage noxious weeds populations where they don’t pose a risk to resources. Currently, the level of infection lends itself to efficient control, if action is undertaken promptly. It is practically impossible, and under tight budget constraints impractical, to remove these species from a watershed, but continued management can keep them at levels where the risk of spread is low. The current situation in this watershed indicates that effective management actions for noxious weeds will keep them at acceptable management levels. The further introduction of non-native plant species should be kept at a minimum.