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Chapter 3: Affected Environment

Introduction

This chapter describes the existing condition of resources within the Tower Fire area[1]. These conditions can be used to compare the consequences of the alternatives (which are described in Chapter 4). This information is generally organized in the same order as the issues listed in Chapter 1. Bolded sections are associated with the Key Issues identified in Chapter 1 and, as such, are most relevant to the decision.

- Forest Vegetation (covers Key Issue 1)
- Water and Soils (covers Key Issue 2)
- Fish and Aquatic Habitat (covers Key Issue 3 and the Proposed, Endangered, Threatened and Sensitive species tracking issue, as well as Forest Plan required Management Indicator Species)
- Recreation (covers Key Issue 4, and recreation, roadless area, and wild and scenic river tracking issues)
- Wildlife Habitat (covers wildlife habitat, Proposed, Endangered, Threatened and Sensitive species, and Management Indicator Species tracking issues)
- Socio-Economic (covers economics/social tracking issue)
- Non-Forest Vegetation (covers noxious weed and Proposed, Endangered, Threatened and Sensitive species tracking issues)
- Fuels/Air Quality (covers fire management/air quality tracking issue)
- Transportation System (covers accessibility and maintenance tracking issue)
- Cultural Resources (covers cultural resources tracking issue)

Forest Vegetation

Prior to the fire, forest stand health was generally poor as reflected in changes in species composition, stocking, and overall vigor. Between 1937 and 1996, dry forest types declined within the area by 47 percent, with a corresponding increase in moist forest types (Tower Fire Recovery - Forest Vegetation Analysis 1997). Past management activities (such as fire suppression and selective harvest) resulted in overstocking, species mixes not suited to site conditions, and a massive increase in fuels. Thick layers of organic material accumulated beneath the invading fir trees, tying up nitrogen and other nutrients that are cycled slowly without fire (Tower Fire Ecosystem Analysis 1997). Particularly in the warm, mixed conifer stands, fir and lodgepole pine encroached, increasing stocking levels above what the sites could sustain and providing insects with weakened, susceptible hosts. These conditions, in turn, made stands more susceptible to drought and insect-induced tree mortality (the latest episode occurring in the late

[1] For more detailed information, request a copy of the pertinent specialist report (contained in this project's analysis file) from the North Fork John Day Ranger District.

1980s/early 1990s), which increased fuel loads even further. The roadless area in particular, with its numerous acres of fir, was heavily hit by insects, which resulted in mortality across whole drainages (Tower Fire Ecosystem Analysis, 1997; Camas Ecosystem Analysis, 1995). The northern portion of the analysis area contained a large infestation of *Armillaria* root disease, which mainly occurred in stands where past skidding techniques had caused more soil impacts than allowed under the current Forest Plan (Schmitt and Scott 1996). This disease caused mortality and sparse stocking and will continue to impact affected stands for many years. The analysis area also supported several unique, natural stands of white pine prior to the fire. These were important because they occurred on the extreme western boundary of their range, offered a unique habitat for wildlife, and served as a major source of white pine seed for the District's reforestation program.

The fire created a range of vegetation conditions. Vegetative mortality varies, from underburned tree stands with scattered, individual dead trees and recovering ground vegetation to complete vegetative mortality where intense fire burned branches off trees and consumed organic material down to mineral soil. Based on color infrared photographs taken about three weeks following the fire, complete or near-complete mortality[2] occurred in 45 percent of the forests as a direct result of the fire (Tower Fire Ecosystem Analysis 1997). The rest of the area sustained partial tree mortality; however, this is somewhat misleading in that many stands are now experiencing high levels of delayed mortality. Widespread mortality has caused a major shift in stand structures over the 11 subwatersheds, moving most of the acres into an early structural stage by causing mortality in all canopy layers of the stands. As a result, the analysis area is now below the range of historical variation for acres of late, old structural stages in multi- and single-layer stands. In addition, the fire extirpated 60 to 70 percent of the natural white pine populations on the North Fork John Day Ranger District (Tower Fire Ecosystem Analysis 1997).

Where high mortality occurred, tree stocking is less than the minimum level described in the Umatilla National Forest Land and Resource Management Plan (except where lodgepole pine has reseeded) and very few seedlings of tree species other than lodgepole pine have been observed (Cable Silviculture Report, 1998). Acres that were severely[3] burned now lack seed sources for tree re-establishment, severely limiting achievement of characteristics described in the Desired Future Conditions for the affected Forest Plan Management Areas. This has been compounded in some areas that contained *Ceanothus* brush prior to the fire. The naturally robust response of this shrub to fire provides heavy competition to conifer seedlings and can be a considerable deterrent in reforestation success. Where lodgepole pine is becoming established, stocking levels are far above those described in the Forest Plan to the point of excluding establishment of other species in those areas. Also, many of the green (live) stands in the area are currently overstocked[4]

Green trees remain in the outer fringes of the burn and outside of the fire area, but they are at risk of loss. Stands vary in condition from recently non-commercially thinned lodgepole pine stands to overstocked, warm, dry, ponderosa pine stands containing remnant large, old ponderosa pine to unharvested, cool, moist stands with previous spruce budworm mortality (Camas Ecosystem Analysis 1995). Where the fire underburned through stands, many overstory and understory trees survived; however, damage from the fire is common among these remaining trees. Bole and crown scorch, as well as root damage, are resulting in tree mortality (especially among thin-barked or shallow-rooted tree species) and are causing severe stress in trees that survived the fire. These fire-stressed trees are at significantly higher risk to insect attack, and some mortality from insects (primarily bark beetles) has been observed in portions of the fire area (although not to the extent occurring within the Summit Fire to the southwest). With the increased amount of susceptible trees supporting a rising insect population, there is a greater risk of damage to the healthy green trees within and outside the fire area. Also, several stands have scattered remnant, large, old ponderosa pine over a sapling/pole-sized understory that is densely stocked with a

[2] Live trees comprise 10% or less of the overstory canopy cover.

[3] The term "fire severity" is used in this document to describe the effects of the fire on the landscape, while the term "intensity" describes how hot the fire burned.

[4] For Douglas-fir, grand fir, and lodgepole pine, stands that have 56% or more canopy cover are considered overstocked. For ponderosa pine, stands with 41% or more canopy cover are overstocked (based on Cochran and others 1994).

species mix not suited to site conditions. These large pines are important components for structural diversity and are at risk of dying due to heavy competition for space, water, and nutrients.

Water and Soil

The analysis area consists of most of the subwatersheds partially or totally burned in the Tower Fire. This includes the Lower Cable (33A), Lower North Fork Cable (33B), South Fork Cable (33C), Upper North Fork Cable (33D), Texas Bar (35B), NFJD/Turner (35C), NFJD/Otter (35D), and NFJD/Oriental (35E), Winom Creek (95A), Big Creek (95B), Lower Hidaway (96A), and Upper Hidaway (96B) subwatersheds (see Map 1). These subwatersheds cover 88,658 acres, 83 percent of which are composed of Federal lands that are managed by the Forest Service (see Table 3.1 and Figure 3.1). The Upper Grande Ronde/Fly (85D) Subwatershed, which had 32 acres, burned, and the Bridge/Pine Subwatershed (34A and 34B), which had 126 acres burned, were excluded from the analysis area because the area burned was small and contained no proposed activities.

Table 3.1: Land Ownership within the Analysis Area.

Subwatershed #	Subwatershed Name	Total Area (acres)	Nat'l Forest (acres)	BLM (acres)	State (acres)	Private (acres)
33A	Lower Cable	5,946	1,247	457	0	4,241
33B	Lower North Fork Cable	5,639	4,543	711	0	384
33C	South Fork Cable	6,051	5,852	179	0	19
33D	Upper North Fork Cable	6,639	6,639	0	0	0
35B	Texas Bar	6,297	5,715	0	33	548
35C	North Fork John Day/Turner	5,425	2,777	0	220	2,428
35D	North Fork John Day/Otter	8,723	7,330	0	0	1,392
35E	North Fork John Day/Oriental	7,019	7,019	0	0	0
95A	Winom Creek	6,384	6,384	0	0	0
95B	Big Creek	11,333	11,333	0	0	0
96A	Lower Hidaway Creek	10,288	6,166	42	0	4,078
96B	Upper Hidaway Creek	8,913	8,913	0	0	0
Total		**88,658**	**73,918**	**1,389**	**253**	**13,090**

The entire analysis area is within the North Fork John Day Sub-Basin. Pearson Ridge divides the area so that watersheds 35 and 95 drain south directly into the North Fork John Day River, while watersheds 33 and 96 drain northwestward into Camas Creek (which flows into the NFJD River approximately 6 miles downstream of the analysis area). Tower Mountain, which is at the headwaters of Hidaway and Big creeks, is the highest point in the analysis area and has an elevation of 6,780 feet. The lowest point is at the outlet of the Texas Bar Subwatershed, which has an elevation of about 3,000 feet.

Past activities such as timber harvest, road construction, livestock grazing, and mining have affected the existing condition of the watersheds. Recent harvest records show that logging has occurred on 8,719 acres (11.8%) of the 73,918 acres of National Forest System lands within the analysis area (Figure 3.1). This amount includes the post-fire harvest that occurred under the timber sales enjoined by the Big Tower lawsuit. The overall road density (open and closed roads) within the analysis area is 2.4 miles per square mile[5] (seeTable 3.2 for details per subwatershed). Livestock grazing has occurred throughout the analysis area since the turn of the century and placer mining has occurred in several area streams and is still active in three locations adjacent to the burn. The residual effects of these activities are discussed under each applicable section below.

[5] This is not to be confused with the Forest Plan management objective of 2.0 mi/mi^2, which applies to open roads only.

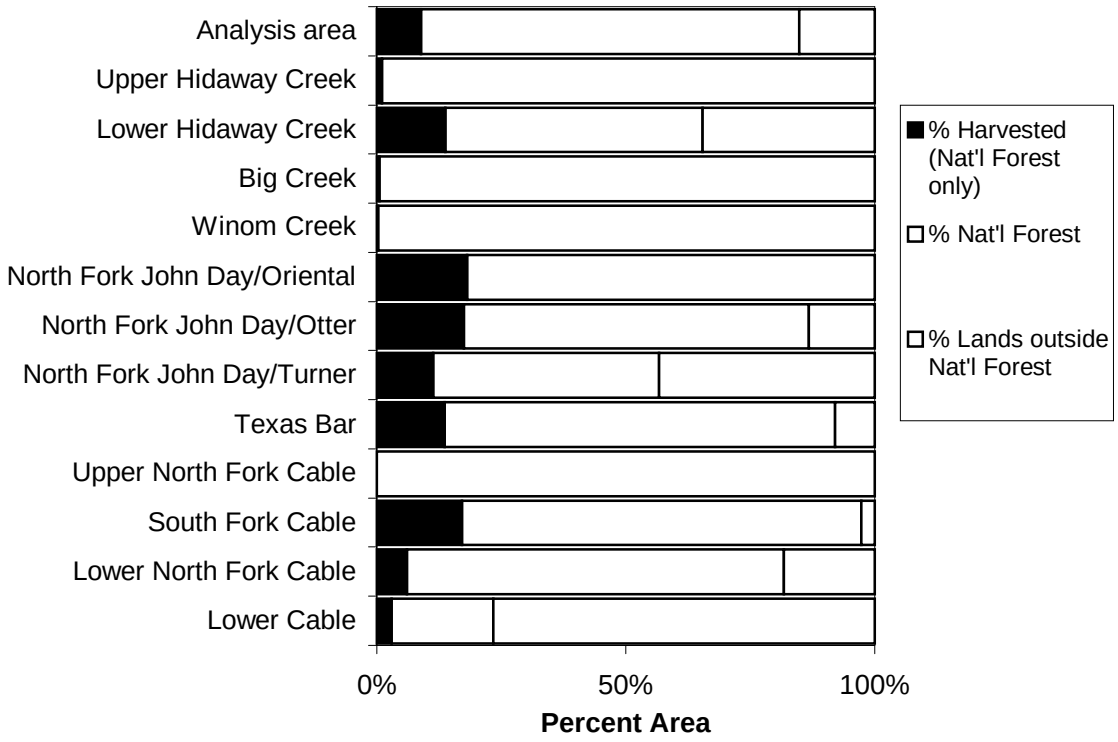

Figure 3.1: Existing harvest of National Forest System Lands within each subwatershed.

The Tower Fire burned 46 miles of streams severely[6], 96 miles of streams moderately, and 180 miles of streams lightly (see Table 3.3 for specifics to each stream). The Tower Fire also burned adjacent to about 1½ miles of the North Fork John Day River with a low severity. The effects of this are summarized in following sections; refer to the Tower Fire Ecosystem Analysis (1997) for further details.

[6] These are based on definitions for burn severity associated with Burned Area Emergency Rehabilitation and are as follows:

Low - Soil surface litter and humus have not been destroyed by fire. Some down woody material is present, tree boles are scorched less than 30% of their length, there is little or no crown scorch, and understory shrubs are mostly (>50%) unburned.

Medium - Soil surface litter and humus have been destroyed by fire and the A-horizon has had intensive heating. Very little down woody material is present, tree boles are scorched to the base of the crown or higher, less than 50% of the tree crown is scorched, and understory shrubs are mostly (>50%) burned.

High - Soil surface litter and humus have been completely destroyed by fire and the A-horizon has had intensive heating. Down woody material is absent, tree boles are fully scorched, tree crowns are leafless or greater than 50% of the crown is scorched, and understory shrubs and ground cover vegetation are absent.

Table 3.2: Roads and past harvest within National Forest portion of the analysis area.

Subwatershed	Total System Roads					Timber Harvest[2]	
	Miles	Total Road Density[1] (mi./sq. mi.)	% of Sub-watershed[1]	Crossing per Mile of Stream	Road Crossings Density (count/sq. mile)	Percent of sub-watershed Entered[3]	Percent of RHCA Entered[3]
33A Lower Cable	8.8	4.5	1.3	0.4	7.7	3	20
33B Lower North Fork Cable	23.5	3.3	0.9	1.2	6.1	22	25
33C South Fork Cable	16.3	1.8	0.5	0.8	3.0	22	15
33D Upper North Fork Cable	14.1	1.4	0.4	0.7	3.1	3	3
35B Texas	40.5	4.5	1.3	2.4	11.7	43	27
35C Turner	14.5	3.3	0.9	1.5	9.9	26	35
35D Otter	26.4	2.3	0.7	1.3	6.1	27	15
35E Oriental	37.8	3.4	1.0	1.8	8.2	41	22
95A Winom	4.5	0.4	0.1	0.5	2.0	0	0
95B Big	17.0	1.0	0.3	0.3	1.2	0	0
96A Lower Hidaway	48.5	5.0	1.4	1.7	9.2	25	47
96B Upper Hidaway	26.0	1.9	0.5	0.8	2.8	8	6
Total	**278.1**	**2.4**	**0.7**				

[1]This assumes a 15-foot road width.
[2]Various harvest prescriptions, 1979-1998. Computed for National Forest land only
[3] Source: NFJD District GIS queries for steelhead & bull trout consultation

Table 3.3: Burn severity by subwatershed (as classified by the Tower Fire Burned Area Emergency Rehabilitation Report).

Subwatershed #	Name	Total (ac)	Low (ac)	Low (%)	Moderate (ac)	Moderate (%)	High (ac)	High (%)	Total (ac)	Total (%)
33A	Lower Cable	5,946	649	11	166	3	0	0	815	14
33B	Lower NF Cable	5,639	2,254	40	868	15	1	0	3,123	55
33C	South Fork Cable	6,051	1,935	32	2,771	46	1,158	19	5,863	97
33D	Upper NF Cable	6,639	3,404	51	1,699	26	1,537	23	6,639	100
35B	Texas Bar	6,297	2,153	34	2,053	33	701	11	4,907	78
35C	NFJD/Turner	5,425	1,427	26	593	11	0	0	2,020	37
35D	NFJD/Otter	8,723	1,760	20	2,143	25	73	1	3,976	46
35E	NFJD/Oriental	7,019	1,900	27	2,373	34	492	7	4,765	68
95A	Winom Creek	6,384	3,709	58	926	15	1,727	27	6,361	100
95B	Big Creek	11,333	5,017	44	854	8	172	2	6,043	53
96A	Lower Hidaway	10,288	39	0	0	0	0	0	39	0
96B	Upper Hidaway	8,913	4,839	54	1,185	13	82	1	6,107	69
Total		**88,658**	**29,085**	**33**	**15,632**	**18**	**5,943**	**7**	**50,660**	**57**

Watershed Hydrology/Stream Flow

Hydrologic functioning within the analysis area has been affected in several ways, both by past management activities and by the fire. Changes in vegetation, soil compaction, subsurface water flows, and stream structure have increased annual water yields, stream baseflows, and stream peak flows. A U.S. Geologic Survey gauging station is located on Camas Creek 18.7 river miles upstream of the confluence with the North Fork John Day River. The station collects water from 77,440 acres, of which about 25 percent comes from the Hidaway Watershed (which is within the analysis area). Based upon streamflow measurements collected between 1914 and 1990, the mean annual water yield at the Camas station is 69,300 acre-feet, which is equal to 10.77 inches[7] water distributed over the entire watershed (USGS 1991). Table 3.4 illustrates estimated pre-fire water yield from each watershed in the analysis area, based on the assumption that the water yield recorded by the Camas Creek gauging station is representative of the entire analysis area. Water yield increases with decreasing watershed area because less water percolates into the aquifer. The analysis area watersheds have less area than that of the Camas Creek gauging station, so yields were likely under predicted.

Past harvest, road construction, and grazing reduced vegetation across much of the analysis area, with mining and developed and dispersed camping decreasing vegetation in localized areas. The effects of the Tower Fire have superseded the hydrologic effects of past reductions in vegetation, so only reductions outside of the burn would currently be causing an effect. Reductions in vegetation have decreased vegetative consumption of water (called transpiration) and interception of precipitation, and may be causing increases the soil water content, base flows, and annual water yield. The increased soil water content reduces the amount of precipitation required to saturate the soil and produce runoff.

Table 3.4: Estimated annual water yield prior to the Tower Fire

Creek Name	Annual Water Yield (acre-feet)
Camas Creek Gauging Station	69,300
Big Creek*	34,829
Cable Creek	21,787
Hidaway Creek	17,233
Oriental Creek	6,270
Winom Creek	5,730
Texas Bar Creek	5,652

*Of the creeks exiting the analysis area, Big Creek has the highest estimated annual water yield, though half of the watershed is outside of the analysis area.

Coniferous trees, with their evergreen foliage and deep root system, have greater transpiration rates than grasses or forbs, so their removal has had the largest effect on base flows and annual water yields. Timber harvest over the last 20 years covered approximately 19 percent of the National Forest System Lands within the analysis area, though only 2.7 percent has occurred outside of the burn (see Table 3.2 and Table 3.5). An estimated 7 percent of private lands within the fire have been logged during that same time, with an unknown amount outside of the burn. Stand regeneration prescriptions were the most common treatments used on National Forest System Lands, which resulted in harvest of most or all trees and burning of the remaining vegetation and slash.

Research suggests that only small magnitude peak flows are higher after timber harvesting (Standiford and Ramacher, 1981). In the High Ridge Evaluation Area on the Umatilla National Forest, the only statistically significant change found after the first timber harvest entry occurred in just one of the three

1 [7]Approximately one-third of the precipitation leaves the watershed as streamflow, the remainder is either lost as evapotranspiration into the atmosphere or percolation into the groundwater aquifer.

watersheds treated. After 43 percent of this watershed was clearcut, there was a 13 percent decrease in the magnitude of events having a peak discharge rate greater than 0.004 cubic feet per second (Helvey et al. 1995). However, after a second treatment that harvested the remaining timber in this and one other watershed using ground-based equipment, the peak discharge rate of events greater than 0.004 cubic feet per second increased by 18 and 26 percent. Overall, there was a small but statistically significant (p=0.05) increase in the average annual water yield on these two watersheds after the second entry. No change in peak discharge or annual water yields was detected in the other watershed, which was only partially cut (Helvey et al. 1995). The author concluded that in this case, harvest had a minor influence on annual water yield. In a study on the H. J. Andrews Experimental Forest (which is situated on the west slopes of the Cascade Mountains), no difference in peak discharge rates greater than 4.51 liters/second/hectare were measured between two regeneration-type logged watersheds and an unlogged watershed (Harr et al. 1982). The average annual water yield increased by 30 percent after clearcutting and 22 percent after a shelterwood cut during a 4-year period. Water yield increases extended into the low flow period, but the increase in base stream flow could not be quantified due to flow variations (Harr et al. 1982). At a larger scale, peak annual discharge increased by 21 percent after lodgepole pine was clearcut from approximately 30 percent of the 8,373-acre Camp Creek Watershed in south central British Columbia (Cheng 1989). This study also showed a 13 percent average increase in base flows. This watershed was a high elevation watershed with a snowmelt-dominated hydrograph. Because of this, logging also caused the peak discharge to occur 13 days earlier in the spring due to increased exposure of the snow pack to solar radiation. Considering this information, stream base flow increases attributable to recent timber harvesting would be minor and undetectable, except in the Hidaway Watershed where about 9 percent of the watershed outside of the burn was logged.

In some areas, water infiltration into the soil has been reduced by soil compaction, which was caused by grazing, dispersed and developed camping, and use of heavy machinery in road construction and timber harvest. Such compaction reduced the soil pore space available for water storage and can take decades or longer to recover naturally. Harvest and grazing have changed a great deal in the last 20 years, and standards in the 1990 Forest Plan (including amendments #10 and #11, which added standards to protect anadromous fish and riparian vegetation) now limit the amount of compaction and vegetation removal, particularly in riparian areas. Effects of past management have also been mitigated in some areas through subsoiling (which breaks up soil compaction) of abandoned roads and harvest skid trails and landings, and through planting of riparian vegetation.

Road construction has additionally affected watershed hydrology by bringing subsurface flows to the surface where cut banks and inslope ditches occur. Several studies indicate that average peak flows may show a statistically significant increase after about 12 percent of the watershed area is composed of roads or other compacted area (Harr 1975). However, King and Tennyson (1984) measured a variable, but statistically significant, change in discharge rates after a smaller percentage of watersheds were affected by road construction. They showed a statistically significant increase of 30.5 percent in moderate discharge rates when 1.8 percent of one watershed was roaded, and a statistically significant decrease of 29.4 percent in low discharge rates in small watersheds that had 4.1 percent of the area composed of roads. Four other watersheds that had 3.0 percent, 3.9 percent, 2.6 percent, and 3.7 percent of the area in roads did not show statistical changes in the discharge rate. This study in north central Idaho only collected two years of post-road construction data, so the small data set was too small to make more statistically significant conclusions. Currently there are 278 miles of system roads within the Forest Service portion of the analysis area (Table 3.2). The worst-case estimate of road density (which includes abandoned roads) for a given watershed within the analysis area is less than 3 percent, so roads have likely had little affect on annual water yield by themselves.

Grazing, mining, dispersed camping, and past harvest along perennial streams removed riparian vegetation and instream wood, which are important for maintaining stable streambanks. Streambank stability relates to the capacity of the channel to carry and store water. For example, unstable streambanks can collapse into channels, reducing the volume of water that the channel can contain, while stable streambanks are adjusted to both base and peak flows.

The Tower Fire superseded management-related reductions in vegetation, especially within the moderate and high burn severity areas (42% of the burned area). Where these severities occurred, most of the

above ground vegetation was consumed, decreasing the interception rate to an estimated 2 percent and increasing the net precipitation that reaches the soil by approximately 20 percent (Dunn and Leopold, 1980). An estimated 45 percent of the existing tree cover experienced complete or near complete mortality, converting the area into a very early seral state dominated by grass/forb vegetation. The resulting reduction in transpiration on a watershed scale means that more moisture remains within the soil profile at the end of each growing season. These soils more quickly become saturated during the rainy season, producing earlier surface flows and greater peak discharge rates. Soil water infiltration is gradually recovering as grasses and forbs become reestablished, however, higher soil moisture contents will persist because grass/forb vegetation does not have a deep root system able to utilize the entire soil profile.

Loss of vegetation has caused sealing of soil surface pores (due to the impact of raindrops on bare soil), which has reduced water infiltration into the soil. In addition, a 1997 study by Robichaud (from the Forest Service Intermountain Research Station) revealed that granitic soils within the Tower Fire had developed a hydrophobic layer[8] where the fire burned intensely. Where this water repellant layer has developed, the potential for generating overland flow had been further increased, but repellency is typically broken down by the third year after the fire. Sealing of soil surface pores has been somewhat mitigated in the Tower Fire area by Burned Area Emergency Rehabilitation seeding, which quickly established grass cover within high severity burned areas of the Oriental and Texas Bar subwatersheds.

There are no gauging stations within or close downstream of the burned watersheds, so changes to watershed hydrology could not be measured. Therefore, published research was relied upon to predict the likely effects of the fire on baseflow, total annual yield, peak discharge, and water quality. Research following a 1970 wildfire on the Entiat Experimental Forest in north-central Washington provides the best comparison with the Tower Fire analysis area, due to the similarity in vegetation and climate. After the Entiat burn, Klock and Helvey (1976) measured an autumnal soil moisture content increase of 50 percent that persisted for the duration of the five year study. Annual water yields increased by 50 percent during the first year after fire in watersheds ranging from 1,169 to 1,384 acres (Helvey 1972), and mean annual yield increased 275 percent between the second and seventh year after the fire (Helvey 1980). Other researchers working in watersheds with different vegetation and climate regimes have shown annual yield increases between 60 percent and 1000 percent from burned watersheds (Wright 1976; Campbell et al. 1977). Based upon research from the Entiat watersheds, it is likely that the annual yield of watersheds within the analysis area has doubled, and this is expected to last for up to 10 years until tree cover is reestablished. Research following the Tillamook Fire in the Coast Range of Oregon showed that baseflows from two large watersheds increased by 16 to 20 percent between July and September during the first 16 years after the fire (Anderson 1976 in Tiedemann 1980). The Tower Fire has also likely affected stream baseflows, with the greatest increase likely occurring within the Winom and Cable drainages due to the large portion of each drainage burned (see Table 3.3). Measurements made in Arizona ponderosa pine and Douglas-fir forests during summer thunderstorms showed that peak discharge rates following wildfires were between 5 and 58 times greater than pre-fire rates (Rich 1962, and Campbell 1977). However, the shallow soils and higher intensity rainfall in the Arizona forests tend to make those watersheds have a flashier response than watersheds within the Tower analysis area.

Because of the fire, past logging only continues to affect annual water yields, baseflows, and peak discharge rates where regeneration-type harvest has occurred outside of the fire boundary. The entire burn affected 57.1 percent of the analysis area while timber harvesting outside of the burn affected 2.7 percent. The only subwatershed that was more affected by timber harvest than by the fire is the Lower Hidaway Subwatershed, in which just 39 acres burned. While the contribution of roads to changes in discharge rates would be not be measurable because they comprise such a small area within the analysis area subwatersheds (ranging from 0.1% to 1.4% of a subwatershed), their effects would be cumulative with those of the Tower Fire.

[8] The burning of litter and organic matter during a high intensity fire can cause waxy substances to coat soil particles, forming a partial barrier to the downward movement of water.

Table 3.5: Area in an early vegetation stage as a combined result of the Tower Fire and past harvest.

Subwatershed #	Name	Total Area (ac)	Harvest outside Tower Fire 1987-97 (ac)	(%)	Burned (moderate & high severity) (ac)	(%)	Total (ac)	(%)
33A	Lower Cable	5,946	0	0	166	3	166	3
33B	Lower North Fork Cable	5,639	152	3	869	15	1,021	18
33C	South Fork Cable	6,051	0	0	3,928	65	3,928	65
33D	Upper North Fork Cable	6,639	0	0	3,235	49	3,235	49
35B	Texas Bar	6,297	42	0	2,754	44	2,796	44
35C	North Fork John Day/Turner	5,425	335	6	593	11	928	17
35D	North Fork John Day/Otter	8,723	159	2	2,216	25	2,375	27
35E	North Fork John Day/Oriental	7,019	0	0	2,865	41	2,865	41
95A	Winom Creek	6,384	0	0	2,652	42	2,652	42
95B	Big Creek	11,333	6	0	1,026	9	1,032	9
96A	Lower Hidaway Creek	10,288	1,650	16	0	0	1,650	16
96B	Upper Hidaway Creek	8,913	54	0	1,268	14	1,322	15
	Total	**88,658**	**2,398**	**3**	**21,572**	**24**	**23,970**	**27**

Water Temperature

When considering stream water temperatures, much of the analysis area is constrained by the local climate and the aspect and elevation of terrain (see Tower Fire Ecosystem Analysis for details). High summer temperatures, which coincide with the period of low rainfall and stream flow, cause stream water temperatures within the area to increase to high levels. These climatic effects are more pronounced in the lower elevations of the analysis area. South facing drainages, especially at lower elevations, tend to be even drier and hotter than other terrain features.

Besides the natural limitations discussed above, pre-fire stream surveys showed a low percent of stream vegetative canopy cover and low pools per mile throughout most of the analysis area[9]. This was the result of several management activities. Past livestock management practices reduced the riparian vegetative canopy through grazing of riparian hardwood vegetation. This has been minimized in recent years through implementation of Forest Plan standards using techniques such as increased fencing and riding to move cattle away from streams.

In the past, regeneration-type harvest units spanned perennially flowing streams, which also reduced the stream canopy cover. Research of the effects of riparian logging in the H. J. Andrews Experimental Forest (western Oregon) showed water temperature increases between 0 and 1.2^{o} F per 300 feet of channel after clearcutting. The High Ridge watersheds in 1976 experienced an increase in maximum water temperatures of 7° F and 13° F degrees after logging in watersheds 1 and 4 respectively, but only a small increase was recorded after clearcutting Watershed 2 (Helvey et al. 1995). In the Coast Range of Oregon, the July-September average maximum water temperature increased between 5° F and 14° F after the forest adjacent to a small stream was clearcut (Brown and Krygier 1967), and clearcutting with burning along a small stream increased maximum water temperatures between 16°F and 18° F (Brown and Krygier 1970). Changes in the application of harvest (such as the implementation of PACFISH and

[9] Streamside vegetation shades the stream from solar radiation, which helps to maintain cool water temperatures, while pools provide deeper water, which is more difficult to heat.

the Screens in the early 1990's) now protect riparian vegetation in order to maintain stream shade and other benefits.

Roads affected water temperature by reducing riparian canopy cover, intercepting subsurface water flow and exposing it to the warm atmosphere, and/or diverting surface water onto the exposed roadbed where drainage was poor. Dredge mining along 9 miles of the North Fork John Day River also affected water temperature by reducing stream shade (although restoration of the floodplain has occurred in recent years and stream shade is now recovering). As a result of climatic factors and management activities, water temperatures in Hidaway, Cable, and Big creeks and the North Fork John Day River frequently failed to meet the Oregon State water quality standard of 64° F during the summer months, prompting the State of Oregon to list them as water quality limited (Oregon Department of Environmental Quality 1996).

Due to the amount of area affected, the Tower Fire currently has the greatest influence on streamside shade and water temperatures. Researchers have shown marked increases in water temperatures following wildfires (Tiedemann et al. 1979). Helvey (1972) measured a 10° F increase in the maximum stream water temperature during the first summer after a wildfire in northeastern Washington, and subsequent years of monitoring showed maximum water temperatures increased by as much as 22° F (Helvey 1976). The Tower Fire destroyed most vegetation that has regenerated since logging or other management activities, setting back the shade recovery process. About 46 miles of stream burned with high severity and 96 miles burned with moderate severity, removing all adjacent vegetation. In these areas, the fire has superseded the effects of harvest.

Water temperatures have been collected on streams within the analysis area since 1992, and additional monitoring sites were installed after the fire. Table 3.6 compares water temperatures for streams in the analysis area before and after the fire; however, changes in water temperatures were not tested for statistical significance due to the short length of record and natural variation in temperature resulting from weather.

Sites located several miles downstream from the burn have not shown a detectable increase in the seven-day maximum temperature, because high temperature water flowing from the burned area is cooled by water coming from unburned tributaries, springs, and ground water infusion. The largest increases in water temperature occurred at sites that were located near or within the burned area. The marked increase in temperature on Oriental Creek the second year after the fire resulted from the May 1998 flood that modified the structural characteristics of the creek and riparian area. North Fork Cable Creek and Hidaway Creek also showed an increase in temperature after a flood in May of 1997. Both floods destroyed riparian vegetation that shaded the creek downstream from the burn and removed material from the bottom of smaller tributaries that otherwise covered the subsurface flow. In other parts of these streams, deposited sediment increased channel width/depth ratios, which increased exposure of stream surface areas to atmospheric temperature fluctuations. Oriental Creek will likely be placed on the State's 303(d) list, if increased temperatures persist.

Overall, much of the riparian hardwood vegetation burned in the fire has resprouted and streamside shade appears to be recovering rapidly, although the recovery period may require decades. In addition, fire-induced increases in base streamflow could lessen water temperature increases because the greater amount of water takes more energy to heat. Stream water temperatures could decrease to or below pre-fire levels within 10-20 years.

Table 3.6: Seven-day maximum water temperatures (in degrees Fahrenheit) within the analysis area.

Location	Subwatershed	1992	1993	1994	1995	1996	1997	1998	1999	2000
Big @ mouth	Big	--	65	72	--	72	74	71	71	74
Big @ Forest Road 52	Big	--	68	--	--	--	60	65	66	69
Cable @ mouth	Lower Cable	76	73	78	74	~ 74	75	77	76	76

Location	Subwatershed	1992	1993	1994	1995	1996	1997	1998	1999	2000
N Cable @ mouth	Lower N. Fork Cable	--	--	--	66	68	71	--	68	70
S Cable @ mouth	S. Fork Cable	--	66	--	66	68	72	73	70	73
Hidaway @ Chimney Rock Trail	Upper Hidaway	--	--	--	59	60	66	64	63	63
Hidaway @ mouth	Lower Hidaway	72	71		78	75	77	78	75	77
Hidaway @ Forest Boundary	Lower Hidaway	--	--	70	--	69	71	71	--	--
Oriental @ mouth	NFJD/ Oriental	66	60	--	58	61	66	75	72	--
Oriental @ Forest Road 5507	NFJD/ Oriental	--	--	--	--	--	71	76	72	--
Otter Ck @ mouth	NFJD/Otter	62	58	--	58	--	60	62	59	62
Texas Bar @ mouth	Texas Bar	--	61	65	~62	--	68	66	65	68
Winom @ Forest Road 52	Winom	--	65	~68	~65	~67	74	69	75	70
Winom @ mouth	Winom	--	--	--	--	--	--	67	64	67

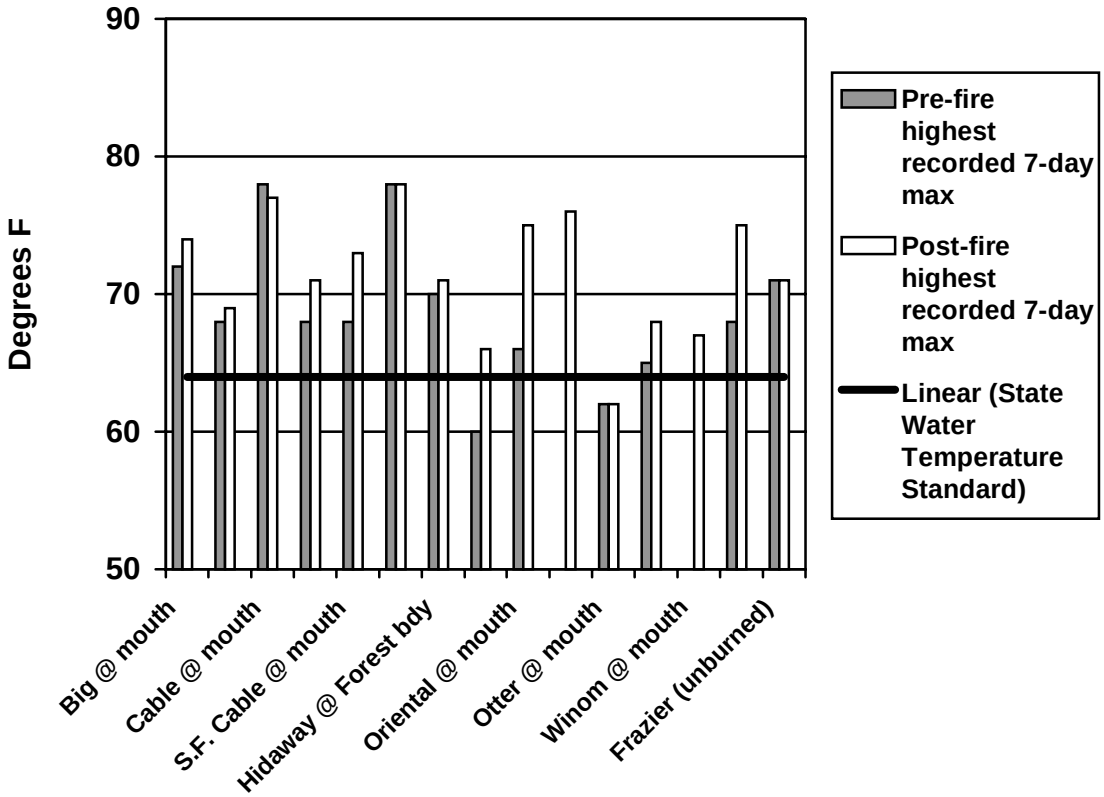

Figure 3.2: Highest 7-day maximum average water temperature[10] between 1992 and 2000 for streams within the analysis area.

Soil Erosion and Sedimentation

In general, soils within the analysis area are highly productive but susceptible to erosion when the vegetative cover is disturbed and bare soil is exposed to the forces of wind and water. Over half of the Oriental Subwatershed and over a quarter of the Winom and Big subwatersheds consist of coarse textured, granitic soils that are deep and productive, but highly susceptible to surface erosion and have a high potential for mass movement. This geology tends to yield the highest amount of sediment and is most susceptible to soil disturbing activities. Soils in the Lower Cable, Lower North Fork Cable and Lower Hidaway subwatersheds are largely composed of soils that are shallow, rocky, and have low productivity. However, these soils also tend to have low erosion rates, be resistant to mass wasting, and stream flow transport of sediment tends to exceed the rate that sediment enters the drainage network. Landslide deposits dominate the middle elevations of the Texas Bar Subwatershed. These deposits are typically unstable, as witnessed in 1998 when an isolated storm resulted in a 5-acre landslide into Texas Bar Creek (directly adjacent to a slide that occurred an estimated 100 years ago). No roads or timber harvest had occurred within the proximity of either landslide, so they do not appear to be related to management activities. Cable and Hidaway creeks transport a relatively large bedload of coarse gravel derived from the meta-sedimentary bedrock.

It is not known how current soil erosion and sedimentation rates quantitatively differ from historical rates, but some observations about changes can be made. Prior to Euro-American settlement, periodic fires

[10] Seven-day moving average of daily maximum temperature measured as the average of the maximum daily temperature of the warmest consecutive seven-day period. Data from 1992 - 2000. Data for some years was not available for some stations.

frequently consumed vegetation that protected the soil from erosion. Although the past century of fire suppression would have slowed erosion, other management activities would have caused erosion. For instance, roads can account for 90 percent of the management-induced soil erosion, though only a percentage of the sediment gets transported to the stream system. Erosion related to construction of roads typically produces a relatively high amount of fine sediment initially, which declines to a persistent low level within several years. Extremely large amounts of sediment can enter streams from mass wasting of road fill material or hill slopes undercut by roads. Failures of culverts during floods can introduce large quantities of sediment from the road fill into streams. Timber harvest and grazing also have contributed to management-induced erosion, which has varied depending upon the amount of vegetation removed and area compacted, particularly within riparian zones and on steep slopes. Since 1990, standards prescribed in the Forest Plan have reduced such management-related erosion by placing limits on soil disturbance. The District Motorized Access and Travel Management Plan has also reduced management-related erosion by closing or obliterating unnecessary roads. In some areas, activities to suppress the Tower Fire (such as the construction of tractor fire lines) affected the rates of infiltration and soil erosion, primarily through the compaction of soil and removal of vegetative cover.

Mining also continues to produce sediment. Vegetation still has not totally reclaimed hydraulic mining sites that were abandoned over 100 years ago. These occur primarily within granitic geology, over 300 feet away from the North Fork John Day River. Raveling of several, steep, exposed slopes is occurring, though off-site movement of sediment appears to be minor. Dredge mining of the North Fork John Day River (conducted in the 1940's and 1950's) has greatly affected floodplain function and water quality. Much of the alluvial material in the ten-mile reach between Big and Texas Bar creeks was excavated, sieved for gold, and piled behind the dredge. Little vegetation established on the gravelly dredge tailing piles. Also, the channel was straightened in the dredging process and the tailing piles isolated the river from its floodplain, resulting in a high-energy channel that was eroding adjacent hill slopes. The North Fork John Day River Dredge Mine Restoration Project (implemented between 1993 and 1998) mitigated these effects by spreading the dredge tailings across the valley bottom, which allowed the river to re-establish a functioning floodplain. Since the completion of the project, larger runoff events have deposited silt and seeds of riparian vegetation on the newly reestablished floodplain, initiating recovery of riparian vegetation. Deposition of silt on the floodplain during the next several decades would cause a net reduction in the sediment moving down the North Fork John Day River.

A change in sediment yield resulting from management activities is difficult to assess due to the high spatial and temporal variability. Monitoring on the Umatilla Barometer Watershed showed that annual sediment yield varied by an order of magnitude during an 8-year period (Harris and Clifton 1999). Intensive monitoring of sediment yield also was conducted in the High Ridge Evaluation Area prior to and following the second ground based logging treatment. Watersheds 1 and 2 were clearcut and a shelterwood prescription conducted on Watershed 4. Unfortunately, the changes in sediment yield cannot be compared to determine statistical significance because the one pretreatment year of data does not account for natural temporal variation. During the first year after logging (including harvest within riparian areas), sediment yield from Watershed 1 increased 750 percent from the previous year and Watershed 2 increased 515 percent, but Watershed 4 experienced a 34 percent decrease in sediment yield (Helvey et al. 1995). Watershed 3, which was untreated, increased 168 percent. The authors concluded that logging-related soil movement probably caused the pulse of sediment from Watersheds 1 and 2. A comparison of sediment yields from the logged and unlogged watersheds showed that during the year prior to logging, sediment yields from watersheds 1 and 2 were 5.5 and 7.4 times greater than Watershed 3, respectively. During the 5-year period after logging, sediment yield from watersheds 1 and 2 was 2.6 and 9.8 times greater than the unlogged watershed, respectively. With only one year of pretreatment data it is not possible to conclude how much spatial variability in sediment yield existed before logging occurred. Also, watersheds 1, 2 and 4 were logged 7 years prior to the initiation of sediment monitoring, so these watersheds may have experienced some effect prior to monitoring. Six to 11 years after treatment sediment yield was 10 percent (watershed 1) and 51 percent (watershed 2) lower than the amount from the untreated watershed. The authors concluded that the decrease in sediment yield resulted from the dense riparian vegetation that became re-established within the riparian area after the forest canopy was removed and that much of the loose material was scoured from the stream during the previous years of elevated sediment levels.

In addition to management-related erosion, the Tower Fire has increased soil erosion and sedimentation for several years (see Figure 3.3). Much of the ground vegetation and organic litter, which protected the soil surface from erosion, was consumed over the 21,574 acres that burned with high and moderate fire severities. As discussed earlier, this caused changes in transpiration, precipitation interception, snow distribution, and infiltration of water into the soil, which increased overland flow and, thus, erosion. In addition, the fire consumed much of the streamside vegetation and some large, in-stream, woody material, increasing peak discharge rates and accelerating stream bank erosion. Fortunately, the roots of many riparian plants growing within the wet soil adjacent to perennially flowing streams were not killed and new shoots have re-sprouted. The Burned Area Emergency Rehabilitation attempted to mitigate erosion by seeding high severity burned areas and felling dead trees along the contour in steep areas to trap eroding soil. The combination of the Tower Fire and past management within the fire boundary has had a cumulative effect on water quality, but the amount attributable to each disturbance is difficult to identify.

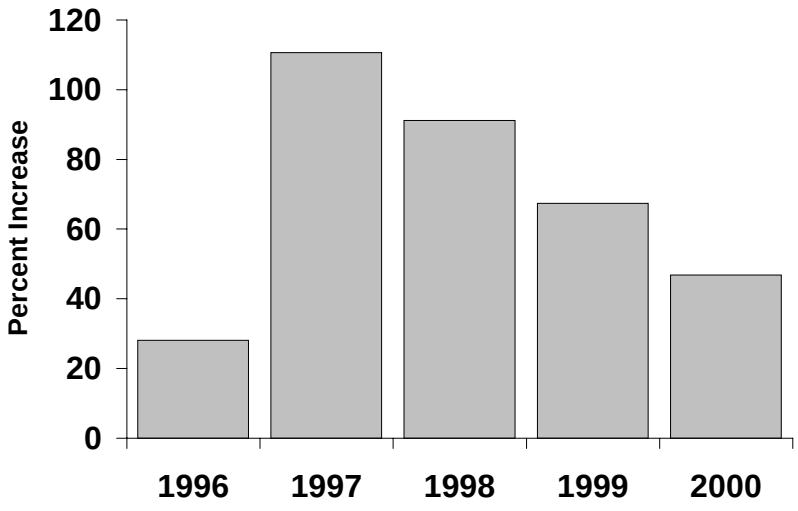

Figure 3.3: Modeled sediment yield increase above background levels for entire analysis area.

Rainfall intensity, which plays an important role in the rate of soil erosion, is low in this area. However, several isolated, high intensity thundershowers have occurred within the Tower burn since the wildfire. These high intensity storms, in combination with fire-induced reductions in the water infiltration rate, have resulted in high runoff events and heavy pulses of sediment. A high intensity rainfall on May 29, 1997, in the roadless portion of the Upper North Fork Cable and Upper Hidaway subwatersheds, resulted in rilling of upland soils, debris flows, high stream bedload movement, and scour of streams down to bedrock.

Another storm occurred on May 6, 1998, within the Oriental Subwatershed. Again, rainfall intensity exceeded the infiltration rate resulting in overland flow that eroded numerous rills on the burned hill slopes. The primary difference in the effects of these two events was that road crossings in the Oriental Subwatershed affected the down stream movement of sediment. Soil, woody debris, and rock were transported downstream where culverts at road crossings became plugged. Water backed up behind the plugged culverts, eventually flowing over the top of the roads, eroding new channels around the culverts. The largest plugged culvert (60 inch diameter) was at the Forest Road 5507 crossing of Oriental Creek, and the road fill, which was approximately 35 feet deep, was overtopped and washed out. However, the effect of sediment eroded from the road fills during the culvert failures was small compared to effect that the culverts had on fluvial processes. Over 10,000 cubic meters of bedload and over one hundred logs were detained behind the Forest Road 5507 fill after the culvert inlet was plugged, but only several hundred cubic meters of road fill (which contained high levels of coarse sand and gravel) were transported downstream. The road fill trapped most of the bedload moving through the system, and, relieved of its burden, the stream scoured additional alluvium from the downstream channel. At the monitoring site, channel cross-sectional volume increased by 40 percent as the flood downcut three feet into the alluvial canyon bottom (Umatilla NF 1998). Over a dozen other culverts, including the Forest Road 5506 crossings at Oriental and Sheep Creeks, responded similarly to the Forest Road 5507 crossing of Oriental Creek but at a much smaller scale.

Emergency flood repairs were completed in August of 1998 to prevent further erosion by removing the remaining road fill from the valley bottom, reconstructing the channel, and seeding the disturbed area with native grasses to stabilize the soil. Motorists driving up Forest Road 5506 to the Big Creek Trailhead have created a ford of Oriental Creek upstream of the washed-out culvert. Vehicles have driven over riparian vegetation that has re-sprouted since the flood, caused rutting, and exposed soil along a 100-foot section of the creek. Use of the crossing has also caused a small increase in the suspended sediment within the stream.

The high sediment loads observed in the Tower Fire area are similar to measurements presented in published research articles. Helvey (1980) showed that the annual sediment yield from the burned, but unlogged, Fox Watershed increased by at least 1,700 percent during the first 5 years after the wildfire when compared to the four pre-fire years. Helvey stated that the bedload transport was not fully accounted for. Campbell (1977) measured sediment yield rates between 1 and 1,254 kg/ha/yr after a wildfire in a northern Arizona ponderosa pine ecosystem, while comparable unburned watersheds generated 0-3 kg/ha/yr. Based upon these studies, it is likely that sediment yield from the burned watersheds within the analysis area have increased by two orders of magnitude. Also, the increased sediment yield is not uniformly distributed across the landscape either temporally or spatially, but is primarily the result of isolated, high intensity rainfall events.

Soil Productivity

Nitrogen and sulfur are two of the primarily nutrients that limit plant growth within the analysis area. This is primarily due to the soil limitations and the effects of periodic fire. Fire suppression allowed these nutrients to increase, but this has likely been offset in some areas by past timber harvest that removed or burned all aboveground biomass (up to 2,798 acres within the analysis area). Harvests that have occurred since the implementation of the Forest Plan (396 acres) have left an amount of effective ground cover dependent upon the erosion hazard (see Forest Plan page 4-80), so loss of these nutrients due to timber harvest has been greatly reduced.

Nitrogen and sulfur have low volatilization temperatures, so the high temperatures of the Tower Fire greatly reduced the amount of these nutrients over a widespread area, particularly on the 2,696 acres that

burned with high severity. Although the amount of nitrogen and sulfur lost during the Tower Fire is unknown, Welch and Klemmendson (1975) measured a 20 percent reduction in total nitrogen during a wildfire in a ponderosa pine ecosystem. Nutrients still remain in small tree branches and needles where they were not fully consumed in the fire. While tree boles do not contribute much in way of nutrients, they do contribute to soil productivity by providing large carbon stores, protecting against soil erosion, and functioning as micro sites for water storage, vegetation re-establishment, insects beneficial to the soil (such as ants), and fungi refugia. Even so, the ability of coarse woody debris to function in some of these capacities will be delayed because decomposition of wood is slow within the local dry environment and charring of the wood further retards decay. In addition to remaining dead material, Ceanothus (a fire-dependent, nitrogen fixing plant found throughout the analysis area) is re-sprouting within the burned area and will contribute to the nitrogen content of the soil.

Fish & Aquatic Habitat

The Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin classifies the North Fork John Day River Sub-basin[11] as Category 2 (moderate aquatic integrity). In that context, ratings from the Scientific Assessment databases show pre-fire aquatic habitat integrity for most of the Tower Fire area as low or medium compared to the remainder of the John Day River Basin. Also, over half of the fire area occurs within the C-7 "Special Fish Management Area", which is to be managed to *"...maintain and enhance water quality and produce high levels of anadromous fish habitat..."* (Forest Plan 1990)

The Tower Fire contains 322 miles of streams, of which 42 miles are Class 1 (anadromous fish bearing), 11 miles are Class 2 (resident fish bearing), 65 miles are Class 3 (perennial, non-fish bearing), and 204 miles are Class 4 (seasonally intermittent) (see Map 3). In addition to the streams listed by the State of Oregon as water quality limited due to temperature (see Water & Soil section), Hidaway Creek and the main stem, north, and south forks of Cable Creek are also listed as water quality limited due to habitat modification.

Past management activities within the analysis area have included timber harvest, livestock grazing, recreation, dredge and placer mining, and construction and use of roads associated with these activities. Table 3.2 on page 5 of this chapter summarizes some measures of management activities. Based on this information, it appears that on National Forest System land the Texas Bar and Oriental subwatersheds have experienced the most intense management, although Lower Hidaway has experienced more intense management within its Riparian Habitat Conservation Areas.

Reference Conditions

Fish habitat components were surveyed in most of the subwatersheds before the fire using Hankin and Reeves protocol.

Large Wood: Frequency of large wood in fire area streams were adequate based on PACFISH objectives, but compared to Blue Mountain Reporting Unit 50th percentiles (ERU 6, McKinney et al. 1996), large wood frequency appeared to be lower than desired.

Pool Frequency: Pool frequencies before the fire were generally low as compared to either PACFISH objectives or the Blue Mountain Reporting Unit 50th percentiles (ERU 6, McKinney et al. 1996). However, the quality of existing pools was good, since all reaches fell below the PACFISH specified maximum width to depth ratios.

Sediment / Substrate Embeddedness: Fine-grained sediment (sand or silt, $\leq$ 6mm) was the dominant or subdominant substrate in 12 of 29 reaches surveyed, which is an indicator of lower quality habitat. Three of the reaches (two on North Fork Cable and one on South Fork Cable)

[11] The North Fork John Day River sub-basin includes private, state and federal lands and covers parts of three national forests (Umatilla, Malheur, and Wallowa-Whitman) and one Wilderness (the North Fork John Day Wilderness). The sub-basin has seen a wide variety of management activities, including ranching, mining, timber harvest, recreation, water withdrawals, and road construction associated with these activities. There are also several small towns within the sub-basin.

were low gradient (≤ 2%) streams where accumulation of fine sediments might be expected. However, nine of the higher gradient reaches (one on Texas Bar Creek, one on Camp Creek, three on Hidaway Creek, and three on an unnamed tributary in the North Fork John Day/Otter subwatershed) also experienced accumulations of fine sediments. Texas Bar Subwatershed contains one of the highest total road densities and the most harvest (see Table 2.3 on page 4-5), which may explain why the high gradient reach in this stream experienced an accumulation of fine sediments. However, very little harvest has occurred in the Upper Hidaway Subwatershed (which contains three of the high gradient reaches) and total road density is low. This could indicate that the higher proportions of fine sediment are simply a natural condition of this subwatershed, derived from the soil and rock types present, or it might mean other management activities not so readily quantified (such as cattle grazing) could be involved.

Another indicator of habitat quality is streambed "embeddedness[12]". Streams with embeddedness over 35 percent have lower quality juvenile spawning, rearing and over wintering habitat. The lowered quality results from increased fine sediments, which fill spaces between substrate particles reducing hiding and escape cover and spawning gravel quality. Seven stream reaches (associated with South Fork Cable, Camp, Oriental, and Hidaway creeks and an unnamed tributary in North Fork John Day/Otter subwatershed) had more than 35 percent embeddedness prior to the Tower Fire.

Temperature: Only Hidaway Creek at the Chimney Rock Trail and the mouth of Otter Creek consistently met PACFISH or Oregon standards for water temperature prior to the Tower Fire; both of these temperature stations were in roadless areas.

Post-Fire Conditions

The Tower Fire burned all of the Upper North Fork Cable and Winom subwatersheds and a substantial part of the South Fork Cable (97%), Texas Bar (78%), Upper Hidaway (69%), and North Fork John Day/Oriental (68%) subwatersheds (refer to Map 1 and Tower Fire Ecosystem Analysis). Because of the fire, aquatic habitat conditions have deteriorated since survey data was collected.

Large Wood: Casual observation has indicated that considerable new wood has been added to most streams as a result of the fire, particularly in areas that burned with high or moderate severities. On Oriental Creek, a strong localized storm in the spring of 1998, together with after-effects of the Tower Fire, caused a severe flood that moved much of the in-channel wood up onto the floodplain or downstream, greatly reducing wood frequency. A 1998 post-flood survey of this creek revealed that Oriental Creek does not now meet PACFISH objectives for wood frequency, and water temperatures appear to have ranged higher than before the fire.

Pool Frequency: Since large, in-channel, woody debris can function as a pool-forming element, the fire could result in increased pool frequency over time as snags fall and persist in stream channels and sediment stabilizes (Gresswell 1999).

Sediment/Substrate Embeddedness: Fire severity ratings were based on effects of the fire on the soil, so by definition, portions of watersheds rated as experiencing high fire severity have had more soil damage than other areas, and their streams are especially susceptible to sedimentation from hill slope soil erosion (Beschta 1990; McNabb and Swanson 1990). Parts of most streams in the fire area fit this description, although only a small amount of the Hidaway and Big Creek drainages were so affected (Table 3.6). Areas that were logged before the fire may be even more susceptible to erosion (Marston and Haire 1990).

Substrate particle size distribution has changed since the fire in those reaches monitored (Tower Fire Ecosystem Analysis 1997). Reaches that burned with high severity have shown a shift of particle sizes to smaller sand-size classes. In biological terms, this probably means a decrease in aquatic habitat quality, with associated stress to fish populations.

[12] Embeddedness is the percent of the cobble (or if not present, then gravel) that is buried by sediment (silt and sand).

Table 3.7: Lengths of streams subject to substantial habitat alteration due to the Tower Fire.

SUBWATERSHED (MAJOR STREAM)	**Miles in Moderate Severity Burn**	**Miles in High Severity Burn**	**Total of High Plus Moderate Severity**
33A (Lower Cable Creek)	0.9	0.0	0.9
33B (North Fork Cable Creek)	6.6	0.0	6.6
33C (South Fork Cable Creek)	17.9	7.1	25.1
33D (Upper North Fork Cable Creek)	10.5	12.9	23.4
35B (Texas Bar Creek)	12.1	5.5	17.6
35C (NFJD & minor tributaries – Turner Creek)	3.0	0.0	3.0
35D (NFJD & minor tributaries – Otter Creek)	16.7	1.0	17.7
35E (NFJD - Oriental Creek)	13.0	4.2	17.2
95A (Winom Creek)	4.0	14.4	18.4
95B (Big Creek)	5.1	0.6	5.7
96A (Lower Hidaway Creek)	0.0	0.0	0.0
96B (Upper Hidaway Creek)	6.0	0.1	6.1
Totals	**95.8**	**45.8**	**141.7**

An extensive debris flow in 1997 introduced a large amount of sediment into Cable Creek, which may have substantially altered substrate particle size distribution. Although this stream has not been surveyed following the fire and debris flow, similar events in other areas of the inland Northwest have resulted in simplification of higher gradient channels, but increased complexity of downstream, lower gradient channels (Rieman et al, 1995). Observations during field visits suggest that although some reaches have been further degraded through additional sediment introduction, other stream segments have benefited from delivery of coarse materials that contribute to habitat complexity.

All three tributary streams on upper Hidaway Creek had a fine-textured substrate (sand) before the fire. Together with other habitat component deficiencies, this indicates that habitat quality, although not severely degraded, may have been below optimal. Then in 1997, a storm localized over a tributary in the upper part of the subwatershed and eroded a large amount of sediment, which then moved downstream and changed aquatic habitat conditions. Together, these circumstances have created a stream condition that could be sensitive to additional sediment.

A landslide on Texas Bar Creek after the fire introduced large amounts of sediment that blocked the stream and eroded the fine-textured stream bank.

Riparian vegetation and shade: High and moderate intensity fire killed much of the riparian vegetation, causing decreases in habitat conditions. Of the major streams within the fire boundary, only Big Creek escaped extensive tree mortality over its riparian area. Where riparian vegetation was killed, streams became more vulnerable to increases in summer water temperature due to increased exposure to solar radiation, particularly in reaches within headwaters (Amaranthus, Jubas & Arthur, 1989; Beschta, 1990; Helvey, 1972). High water temperatures cause stress to fish, resulting in mortality at the extreme.

Loss of low growing riparian vegetation immediately adjacent to the stream also reduced escape and hiding cover for fish. Nearly 3 years after the fire, however, regrowth of shrubs from surviving rootstocks has restored some of this cover and shade. Addition of considerable amounts new wood in most streams will partially compensate for loss of live vegetative hiding cover. Shrubs were planted on Oriental and Texas Bar creeks in 1997 and 1998 and will soon begin contributing shade to these streams.

Temperature: Increases in water temperature have occurred at most monitoring sites that were located near or within the burned area (Table 3.6 on page 3-11 and Figure 3.2 on page 3-12).

Bankfull Width to Depth Ratio: Within and downstream of the fire, so much sediment has been moving through the system that channel width/depth ratios have increased since the fire (Rick van der Zweep, personal communication). Stream channels are also less stable laterally and will remain so until sufficient vegetation grows to stabilize stream banks.

Water Chemistry: Streams with substantial lengths in areas burned with high severity often experience alterations in water chemistry, including increased amounts of some nutrients (Rieman and Clayton 1997; Brown 1989; Minshall, Brock and Varley 1989). The combined effects of increased sunlight and nutrients should actually enhance aquatic productivity over pre-fire conditions (Minshall and Brock 1991), although it should also alter the species balance (Minshall, Brock, and Varley 1989). Observations of streams affected by the Tower Fire appear to substantiate these expectations.

Fish Populations

The analysis area (which is larger than the fire area) contains approximately 106 miles of fish bearing streams (out of 540 miles total, see Map 1). These include: North and South Fork Cable, Hidaway, Texas Bar, Oriental, Winom, and Big creeks, along with some unnamed tributaries and the North Fork John Day River. Fish presence was based primarily on stream surveys conducted during summer low flow conditions, when intermittent or ephemeral streams may have been partially dry. Fish distribution is believed to be more extensive at other times when flows are higher and more reaches are accessible to fish. Fish access to upstream habitat has been restricted in some areas due to improperly designed road crossings of streams.

The fire burned with high severity along substantial portions of South Fork Cable, North Fork Cable, Texas Bar, Oriental, Winom, and Sheep creeks, apparently extirpating fish from at least several stream segments in South Fork Cable, Oriental, and Texas Bar creeks. While most of the fire along Hidaway Creek burned with low severity, there was a fish kill associated with an accidental retardant drop into the creek, which extended approximately 0.9 miles below the fire[13]. Because of site remoteness and shortage of time and personnel, the high severity areas along Winom Creek were not systematically sampled after the fire. However, members of the Burned Area Emergency Rehabilitation team observed dead fish in Winom Creek immediately after the fire (personal communication, Christine Hirsch 1996).

District personnel surveyed South Fork Cable, Oriental, and Texas Bar creeks in the five years following the fire. Of the areas sampled within the fire perimeter in 1996, redband and brook trout were only observed in South Fork Cable Creek. In subsequent years (1997-2000), fish were observed at all sample locations in all years (except Oriental Creek in 1998, which was not sampled).

Management Indicator Species

These are species selected by the Forest Plan to represent the welfare of other species using the same habitat. The habitat requirements of the selected indicator species are presumed to represent those of a larger group of species. Steelhead trout and redband trout were selected to represent stream habitats.

"Threatened" and "Endangered" Species

These species are managed under the Endangered Species Act to ensure that they do not become extinct.

Mid-Columbia steelhead trout ("Threatened") occur in all of the fish-bearing streams within the analysis area except Winom, Meadow, and upper Big creeks. This species is an anadromous form of redband trout, which requires stream and riparian habitat to be in good condition for successful spawning and juvenile rearing. Factors of importance are water temperature, water quality, timing and quantity of peak stream flows, and physical instream and riparian habitat.

[13] The upper 0.38 miles of the kill zone were sampled and a total of 2000 to 3000 resident rainbow and juvenile steelhead trout were estimated to have been lost within the entire kill zone, along with an unknown number of sculpins. No bull trout or chinook salmon were noted within the fish kill area (Clifton and Hirsch 1996).

Steelhead trout can briefly survive water temperatures upwards of 75° F, but prefer extremely cool water of 50° F to 55° F (Bell 1986, Beschta et al. 1987). Spawning ground surveys conducted by Oregon Department of Fish and Wildlife for the past 40 years have shown that steelhead redds per mile are on a decline in the John Day River basin (Unterwegner and Gray 1996). National Marine Fisheries Service has designated critical habitat for listed steelhead as all waters within the range of the ESU below longstanding naturally impassable barriers (e.g. waterfalls) and certain dams.

Columbia River bull trout ("Threatened") use the North Fork John Day River, including the portion of the river adjacent to the burn (ODFW, unpublished) as migratory and possibly winter habitat. They have been reported in lower Big Creek (Buchanan, Hanson and Hooton 1997) and may have inhabited Hidaway Creek in the past (Buchanan, Hanson and Hooton show them as "probably extirpated" in that stream). No sightings of bull trout have been substantiated within the fire area since 1990 when one individual was identified. Bull trout require temperatures in the range of 39° F to 50° F for optimal juvenile growth and less than 54° F for optimal adult population density (Buchanan and Gregory 1997). The U.S. Fish and Wildlife Service has not designated critical habitat for bull trout. Bull trout are known to hybridize with eastern brook trout (*Salvelinus fontinalus*). An introduced species, brook trout have been identified in Hidaway, South Fork Cable, Winom, and Big creeks. Multiple visual sightings and subsequent sampling by Forest Service personnel imply that many survived the fire. Brook trout are of particular concern since they hybridize with bull trout, reducing bull trout production and potentially leading to displacement of bull trout. The presence of strong populations of brook trout in some tributary streams may prevent or at least inhibit bull trout from colonizing them.

Region 6 "Sensitive" Species

The Pacific Northwest Regional Forester has identified these species as needing special management to prevent their being placed on Federal or State threatened or endangered species lists.

Redband trout occur in all of the fish-bearing streams within the analysis area (according to species definitions from Behnke 1992 and Oregon Department of Fish and Wildlife). This species is a close relative to the rainbow trout and has many of the same habitat requirements. They inhabit freshwater streams with steady flowing currents and cool water temperatures. Riffles and pools are a necessary part of the stream habitat (Lagler et al. 1962). Lagler further states that the gravel substrate found in riffles is necessary for spawning habitat.

Spring chinook salmon, in its native, wild form, use the North Fork John Day River, Oriental Creek, lower Big Creek, and lower Hidaway Creek for spawning and/or rearing habitat. Hidaway Creek is the last remaining tributary to Camas Creek (which drains into the North Fork of the John Day River) that still supports spring chinook salmon. Two adults were observed in 1990, one carcass was found in 1992, and a pool sampled during a stream survey in 1992 contained juvenile chinook. No spawning activity was observed in Hidaway Creek in 1993. Chinook spawning populations in the North Fork John Day River have fluctuated widely during the past five years (ODFW, unpublished annual reports). Preferred water temperatures for spring chinook salmon are 45 ^{o} F to 58 ^{o} F degrees, and spawning temperatures are between 42 ^{o} F and 57 ^{o} F degrees, while the upper lethal limit is 77 ^{o} F (Beschta et al. 1987).

Fish Species of Concern

Pacific lamprey is considered a species of concern for this area by the U.S. Fish and Wildlife Service. Lamprey are known to occur in the North Fork John Day River as far as the mouth of Oriental Creek.

Recreation

Dispersed Recreation

Average Recreation Visitor Days[14] for the analysis area (excluding OHV use) is 22,000. Some of the popular activities in the area include camping, big game hunting, OHV riding, mushroom picking, mountain bike riding, snowmobiling, and sightseeing. The Blue Mountain Scenic Byway is a major travel route through the analysis area, via Forest Road 52.

There are an estimated 200 dispersed campsites within the burned area (based on monitoring tags). Most are located adjacent to roads, and the fire made a number of them unusable or undesirable for camping, causing users of those sites to be displaced from their favored location. Burned sites contain charred debris, hazardous dead trees, and lack definition, causing use to spread out. The lack of site definition in particular has resulted in slowed recovery of burned vegetation and an increase in erosion and sediment delivery to streams.

The analysis area occurs primarily in the Ukiah Big Game Management Unit of Oregon Department of Fish and Wildlife. Approximately, 4,000 rifle permits are issued each year for deer and elk hunts in the Ukiah Unit. At least 25-30 percent of the hunters with permits in this management unit hunt within the Tower Fire area. Hunting season typically begins in October and extends through November. An outfitter/guide for hunting is permitted within the northern portion of the burned area, and has been operating in this area for 10 years. On the average, the operation provides services for eight to 12 people per year at an average cost of $1,200 per person per hunt. A Plan of Operation was not submitted for the 1999 season; therefore, this activity will not occur until a new plan is approved. The area is also popular for wildlife viewing, with the North Fork John Day Wilderness in the eastern portion of the analysis area and Bridge Creek Wildlife Area to the west.

[14] A Recreation Visitor Day equals 12 hours, which may be aggregated continuously, intermittently, or simultaneously by one or more persons.

Heavy commercial mushroom harvesting activity occurred in the analysis area during 1997 because of anticipated increases due to the Tower Fire. As a result, dispersed campsites, trails and trailheads sustained overcrowding, vandalism, littering, resource damage (i.e. rutting, destruction of vegetation by off-road driving), and user conflicts. Traditional recreational users of the area were displaced in 1997 as commercial mushroom pickers occupied trailheads and dispersed campsites, often for the entire summer. These problems were largely resolved in 1998 as a result of designated camps for commercial mushroom pickers (located outside of the burned area) and a greatly reduced mushroom harvest. The entire Tower Fire area has been closed to commercial mushroom harvest since1999 based on terms set forth in the Big Tower lawsuit judgment.

Developed Recreation

There are three developed campgrounds with trailheads and three additional trailheads within the burned area (see discussions below). There are numerous hazard trees surrounding and within these sites.

Winom Creek Campground and Trailhead serves as the southern termini of the Winom-Frazier Off Highway Vehicle (OHV) Complex. The campground features seven group and individual campsites, accessible restrooms, two group shelters, and trailhead parking. Campground use typically occurs between June 1 and November 30. The Tower Fire burned a portion of the campground and trailhead and, as a result, use has decreased moderately due to the altered landscape (which is blackened with areas of little to no vegetation). Rehabilitative work done to date includes replacement of a burned picnic table, planting of seedlings in the western portion of the campground, and felling of immediate hazard trees.

Big Creek Meadows Campground and Trailhead is a small campground and trailhead facility featuring four campsites, a vault toilet, trailhead parking, and a wooden fence defining the entrance point into the North Fork John Day Wilderness. Two of the campsites are located immediately adjacent to Big Creek and the parking area is not graveled, which has caused some rutting to occur.

Oriental Campground and Trailhead has seven campsites, two vault toilets, and trailhead parking. Two campsites, one vault toilet and the trailhead were damaged in a 1998 flood. In April of 1999, recreation employees noted that the concrete vault appeared to sustain cracks, which will require replacement or closure of the toilet. This flood also damaged the road crossing of Oriental Creek, which has severely restricted access to the Oriental Creek Trailhead and another popular wilderness entrance, Big Creek Trailhead, located a few miles beyond. Currently, a user-made ford allows for limited high-clearance crossing of Oriental Creek. Due to these conditions, recreational use of the trailhead is minimal and use of the campground is below average.

North and South Winom Trailhead is a three-vehicle parking facility to access the wilderness. The bulletin board, trail signs, and entrance fence were replaced after they were destroyed in the Tower Fire.

Round Meadows Trailhead is a three-vehicle parking facility for OHV trail-users. The trail signs were replaced after they were destroyed in the Tower Fire.

Three Culverts Trailhead provides OHV parking for five full-sized vehicles and dispersed camping. The vegetation and signing were damaged in the Tower Fire.

Pearson Recreation Residence tract (five summer homes) and **Pearson Guard Station** administrative site (two cabins) are located within the fire area. The guard station's associated pit toilet and portions of the water system need to be replaced. Three of the privately owned residences, along with numerous outbuildings, a gate, and a fence were burned in the Tower Fire. Of the three destroyed homes, only one is being replaced. There are numerous hazard trees surrounding this site as well.

There are approximately 60.7 miles of trails for hiking, equestrian, or motorized use (see OHV Trails section for discussion of motorized use). There are 20 miles of ungroomed snowmobile trail within the

burn and the area is part of the trail system noted in the District's proposed winter recreation plan. Forest Road 5226 in particular receives moderate use for snowmobiling.

A yearly mountain bike race has occurred in the northern portion of the fire area, and adjacent National Forest and private lands for the past several years. There are generally two to three courses with varying degrees of difficulty serving over 200 participants. However, in 1999, this event did not occur because a Plan of Operations was not submitted for this activity.

A portion of the North Fork John Day Wilderness also occurs within the burned area. About 75 percent of the affected area burned with low severity, 10 percent burned with medium severity, and 15 percent burned with high severity. This blackened the landscape and left little to no vegetation in the high severity areas. Recreation use within this portion of the wilderness is primarily associated with trail use and occurs largely during the big game hunting seasons. Horseback riding, hiking, hunting and sightseeing are popular activities for wilderness users.

OHV Trails

The Winom-Frazier Off-Highway Vehicle (OHV) Complex is one of the six access strategies identified in the North Fork John Day Motorized Access and Travel Management Plan. The Tower Fire burned over 53 percent of this OHV complex, which contains 92.5 miles of trail. The 13 trails affected by the fire include: Whoop-De-Doo (#3045), Round Meadows (#3155), Cut-Across (#3158), Roundaway (#3046), Hidaway (#3154), Chimney Rock (#3167), Cable Creek (#3152), Lost (#3150), Short Cable (#3024), Lookout Creek (#1853), Umapine (#1950), River (#3158), and Tower Loop (#3040).

This complex was designed to provide a variety of loop riding opportunities that accommodate a range of skill levels and modes of travel (three- and four-wheelers and motorcycles). The Whoop-De-Doo, Round Meadows, Cut-Across, Tower Loop, Lost, Umapine, and River trails and 2.9 miles of the Chimney Rock Trail are rated as "easy" and provide opportunities for all modes of travel. The Hidaway Trail and 2.6 miles of the Chimney Rock Trail are rated as "more difficult", while the Roundaway, Cable Creek, Short Cable, and Lookout trails are rated as "most difficult"; all of which are signed "not recommended for 4-wheeler use". The peak season of use is May through September and all trails receive medium to high use during this period. Several trails connect various portions of the complex, including a portion that is managed by the La Grande Ranger District of the Wallowa-Whitman National Forest, however, there is currently no "easy" access or designated 4-wheeler access connecting the Frazier (north portion) and Winom (south portion) trails. Four-wheelers have been accessing these trails via roads open to full-sized vehicles or by way of the Roundaway Trail, ignoring the signed recommendation. The northern portion of the Roundaway Trail is very steep with a 12 to 16 inch managed trailbed and has been rerouted due to past instability problems.

Most of the trails are in good condition, however, there are some localized problem areas on the Round Meadows, Cut Across, and River trails, and numerous hazard trees border many of them. The approach to the Cut-Across Trail crossing of Forest Road 52 is down an abrupt, steep bank with limited space for machines to stop prior to the heavily used road. Directly adjacent to the Round Meadows Trail crossing of Forest Road 52 there is a small dispersed campsite and vehicle turnout. This occurs at a bend in the road and impairs visibility for OHV users and motorists. A segment of the River Trail crosses a wet area associated with an adjacent spring. Although this portion of the trail is located on an old roadbed, it does not drain well, and rutting of the trailbed is occurring.

Roadless Area

The Tower Fire encompassed most (16,305 acres out of 17,000) of the South Fork-Tower Roadless Area (which abuts the northern edge of the North Fork John Day Wilderness). The area is bounded on the northwest by Forest roads 5450 and 5445, on the northeast by Forest Road 5226, and on the south by Forest Road 52. This area was inventoried for study as a potential wilderness during the RARE II process and was allocated to non-wilderness use by the RARE II decision in January 1979. The Forest Plan then scheduled this area to be developed consistent with the principal management allocations of C7, C1, and A3 (refer to Management Direction section in Chapter 1 for definitions).

Elevation varies from 4,200 feet on the northwest side to 6,700 feet north of Tower Mountain. Topography is diverse with a number of very gentle ridge tops separated by the moderately deep canyons of Hidaway, North Fork Cable, and South Fork Cable creeks. Forest types prior to the fire were mixed conifer and white fir, interspersed with lodgepole pine on the gentle benches, giving way to subalpine fir at the higher elevations. Of the 16,305 acres burned in the Tower Fire, 54 percent burned with low severity, 32 percent burned with medium severity, and 14 percent burned with high severity.

The recreation opportunity spectrum[15] is divided with 48 percent in a roaded modified condition, 32 percent in a roaded natural condition, and 20 percent in a semi-primitive motorized condition. Approximately 19.8 miles of OHV trail occur within the roadless area. Due to the long, narrow shape of the roadless area and its topography, the opportunities for a feeling of solitude and primitive experience do not really exist within the area (Forest Plan FEIS Appendix C 1991). Roads and timber harvest activities to the north, west and southwest present nonconforming sights and sounds to nearly the entire roadless area. This has been amplified by the removal of forest vegetation by the Tower Fire.

Wild and Scenic River

The Oregon Omnibus Wild and Scenic Rivers Act of 1988 placed the North Fork John Day River into the National Wild and Scenic Rivers system, to be managed according to the Wild and Scenic Rivers Act of 1968. A management plan was developed and analyzed, with a Decision Notice and Finding of No Significant Impact signed in June 1993. A River Management Plan was developed and incorporated by amendment into the Umatilla and Wallowa-Whitman Forest Plans to provide protection and/or enhancement of the “outstandingly remarkable values” of the North Fork John Day River. These outstandingly remarkable values are: scenery, cultural, recreation, fisheries, and wildlife. Overall, approximately 54.1 river miles are designated as Wild and Scenic: 11.0 miles on the Wallowa-Whitman National Forest and 43.1 miles on the Umatilla National Forest.

Sections of the river were designated by the Act of 1988 as “Wild”, “Scenic”, or “Recreational” to define the level of development along the river. Above the Tower Fire area, two segments of the river are designated as “Wild” and one segment as “Recreational”. The river segment within the fire area is designated “Scenic”, with the remaining downriver segment designated as “Recreational”. The following are the development levels associated with each term:

> ***Wild:*** free of impoundments and generally inaccessible except by trail, with watersheds and shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.
>
> ***Scenic:*** free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.
>
> ***Recreational:*** readily accessible by road or railroad, may have some development along the shoreline, and may have undergone some impoundment or diversion in the past

Only the segment within the Tower Fire area and downstream of it would be affected by proposed activities. The segment that occurs within the fire area is approximately 10.5 miles long, encompassing

[15] This is a measure of recreation experience opportunities based on the extent to which the natural environment has been modified, the type of facilities provided, the degree of outdoor skills needed to enjoy the area, and the relative density of recreation use. The three classes that apply to the South Fork-Tower Roadless Area are defined as follows:

> *Semi-primitive Motorized* - The area is characterized by a predominantly natural or natural-appearing environment of moderate to large size. Concentration of users is low. The area is managed with minimum on-site controls and restrictions (i.e. signs). Motorized use is permitted.
>
> *Roaded Natural* - The area is characterized by predominantly natural-appearing environments with moderate evidence of the sights and sounds of humans. Interaction between users may be moderate to high. Resource modification and utilization practices are evident, but harmonize with the natural environment. Conventional motorized use is allowed.
>
> *Roaded Modified* - A considerably modified, natural-appearing environment characterizes the area with considerable evidence of the sights and sounds of humans. Interaction between users may be low to moderate. Resource modification and utilization practices are evident and seldom harmonize with the natural environment. Conventional motorized use is allowed. The area is managed to meet modified and maximum modified visual quality objectives.

an area 1,320 feet wide on each side of the river from Big Creek to Texas Bar Creek. The segment downstream of the Tower Fire is approximately 8.3 miles long, from Texas Bar Creek to the river's confluence with Camas Creek. The area of consideration for this segment is generally 1320 feet from the river on the southern portion and out to section lines along the northern portion.

The existing conditions of these segments are described based on the outstandingly remarkable values for which the river was designated. The outstandingly remarkable values of fisheries and wildlife are described at the analysis area scale under associated sections in this document and will not be repeated here. The remaining outstandingly remarkable values of scenery, recreation, and cultural are described below.

Scenery: The Wild and Scenic River corridor runs generally east to west, and can be characterized as a narrow canyon with steep hillsides containing a diversity of landforms and vegetation. Scenery along the river corridor range from open ponderosa pine stands to dense fir stands, and wide stretches of river to narrow canyons with rock walls.

The north and south sides of the river differ greatly in vegetative composition, as well as in the variety of past human activities. The south side of the river has less evidence of past logging activity, and consists of heavily stocked mixed conifer and fir stands. Tree species include white fir, Douglas-fir, western larch, ponderosa pine, and small amounts of lodgepole pine. Size and age classes tend to be narrow and uniform, with limited regeneration under the closed canopies. A few of the stands are more open, where logging has occurred or where ponderosa pine stands have been maintained. There are areas along the river where fir species have been severely impacted by spruce budworm defoliation and bark beetle infestations. This has resulted in sparse crowns and dead trees.

The north side of the river consists primarily of open areas, from open ponderosa pine stands to grassy scab rock slopes and rock walls. There are some mixed conifer stands on the flats adjacent to the river and within the riparian areas along the hill slope. Some of the stands on this side of the river have been partial-cut in the past, though this activity is relatively old and not readily apparent. Tree regeneration occurs in the openings, with an intermediate story of young to mature pine. There are also some scattered old growth pines. Overall, there is more diversity of age and size classes on this side of the river than the south side.

Other visual characteristics found within the corridor include rock outcrops, grass-sedge meadows, two historic structures associated with mining activity, one historic homesite, forest camps, and two developed campgrounds. Past mining activity included a gold dredge, which operated in the river in the 1930's and 1940's. Large tailing piles from this activity are still evident, though some areas have been restored.

State Highway 395 and Forest Roads 5500 and 5506 run parallel to the river and provide access to the area. Four bridges also cross the river within this area. Below the project area, there are sections of privately owned land, as well as the Bridge Creek Game Management Area, which is owned and administered by the Oregon Department of Fish and Wildlife.

Recreation: The North Fork John Day River corridor provides a wide variety of recreational opportunities, including hunting, fishing, horseback riding, camping, gold panning, hiking, water play, sight seeing, cross-country skiing, and snowmobile travel. Trails leading to and from the river provide scenic and challenging hiking and horseback riding opportunities. Heaviest use occurs in the summer and fall seasons, primarily associated with camping, fishing, and upland and big game hunting. Oriental Campground and numerous dispersed campsites are located within the corridor. These sites are used throughout the summer and fall months, especially during the big game hunting and fishing seasons. During the spring runoff, rafts, canoes, and kayaks float the last few miles of the designated portion of the river. This form of recreation is currently modest, probably due to the very short season.

Cultural: Evidence exists that the southern Plateau Indians used the North Fork John Day River corridor. In particular, ancestors of the Confederated Tribes of the Umatilla Indian Reservation are said to

have used this area heavily in prehistoric times for hunting, fishing, camping, root digging, and berry picking. Surveys on federal land have identified several historic sites.

Gold mining is a long and well-established activity along the North Fork John Day River, and continues on a smaller scale today. Mining was the primary activity that first brought substantial numbers of people to the Blue Mountains in the 1860's, and evidence of this "gold rush" still exists along the river. Gold occurs in the placer sand and gravel deposits along the river. Many of the mounds of hand-stacked boulders and thousands of feet of ditches and flumes are testimony to the 1860's gold rush that produced an estimated $5,000,000. Additional evidence of this rich history includes various structures for habitation and use, mines, prospect holes, and other related developments. The majority of this activity occurred upriver from the fire area, but some evidence of past and present mining activity occurs within the burn.

Visual Quality

Two areas within the burn were identified in the Forest Plan as a viewshed (management allocation A3): the Blue Mountain Scenic Byway (Forest Road 52), and the North Fork John Day River (designated a Wild and Scenic River by Congress). Forest Plan guidelines for this allocation states "*landscapes containing negative visual elements will be rehabilitated.*" Other areas where visual quality is important are the Pearson Guard Station and Recreational Residence Tract, the Winom-Frazier OHV Complex, and the Big Creek and Oriental campgrounds. The Tower Fire catastrophically altered the visual quality of these areas. Live vegetation is slowly returning along the scenic byway and in the Pearson area, and portions of the Winom Creek Campground and associated trailheads. While the results of the fire are natural appearing, most people do not consider them visually appealing. Large areas surrounding these features are devoid of live trees, with the dead snags visually dominant. Color and texture have become uniform and the scale is out of proportion with visual patterns adjacent to the fire area. It will be decades before trees regain visual prominence, although the black charring on the landscape is becoming obscured where grasses and forbs have reestablished.

Wildlife Habitat

While the Tower Fire overshadowed the effects of many past activities by changing wildlife habitat structure and composition over a large portion of the analysis area, some activities still have a residual effect within the burn. Timber and fuelwood harvest reduced tree densities and down wood in many areas, which the fire has further decreased. Livestock grazing and fire suppression changed species and structural compositions, while installation of range improvements (fences, water developments, etc) still affects distribution of livestock and wildlife. Road construction increased human disturbance of wildlife and increased vulnerability of big game to hunting. This has been intensified by the near total consumption of vegetation by the fire across large areas.

Analysis for all habitats within the entire burn indicates the area would support 142 wildlife species for the next 15-20 years (Tower Fire Ecosystem Analysis 1997). Overall, wildlife habitat in the analysis area has generally changed to a very early serial stage that will be dominated by grasses, shrubs, and forbs for many years. In these areas, standing dead trees provide a low level of cover from weather, predators, and human disturbances. Microhabitats of green forest patches and individual live trees remain, as well as a rich edge habitat between the burned area and adjacent forest. Since the fire, understudy communities of grasses and shrubs are regenerating and developing across much of the burn, and tree seedlings have been planted on approximately 5,900 acres. Lightly burned areas which sustained partial mortality include ponderosa pine stands on the south and southwest edge of the burn and mixed conifer on roughly the northeast half of the burn, primarily in wilderness. Other habitat remaining includes dead trees, down wood, rock outcrops, talus slopes, meadows, springs, and open water. These areas sustained some burning, but not to the degree of forested stands due to less ground vegetation, coarse woody debris, and canopy cover.

Riparian

Wetland habitat (riparian, meadows, springs, etc.) occurring in the analysis area was also burned with varying fire intensities. Currently, meadows and springs contain a moderate to high density of grasses and forbs and appear to be recovering at an acceptable rate. Intensively burned riparian habitats (portions of Cable, Texas Bar, Oriental, Winom, and Sheep creeks) lost most vegetation; while grasses and shrubs are growing well, few conifers or hardwoods are evident. It may take more than 10-15 years for wildlife riparian habitat to reestablish in these areas (Tower Fire Ecosystem Analysis 1997). The remaining riparian areas generally have low to moderate densities of grasses and shrubs regenerating.

Old Growth

Seven old growth areas occur partly or wholly within the Tower Fire (stand #1021, #1043, #1001, #1053, #1191, #0991, and #1083), of which five were designated in the Forest Plan as C1-Dedicated Old Growth (see Map 2). The fire burned 1,300 acres of these stands, 35 percent of which experienced moderate and high fire severities killing most trees. Four stands were wholly burned with varying severities and are no longer functioning as old growth. Three stands were only partially burned and experienced low fire severity. There are also three stands allocated as C2 - Managed Old Growth (stand #2177, #2198, and #2208). The majority of these stands burned with low severity. The Camas Ecosystem Analysis identified a portion of the burned area as an integral part of its proposed old growth-riparian network. Field reconnaissance of several stands that burned with low severity revealed that there has been delayed mortality in a large portion of these stands. These areas no longer function as old growth or connectivity for the network. As directed in the Forest Plan, new C1 and C2 management units have been identified to replace existing units destroyed by a catastrophic event (see Map 1).

Dead and Down Habitat

Currently, dead standing tree (snag) densities are high with numerous size classes present in areas that have not been salvage harvested or 3.4 to 5.4 snags per acre in the larger size classes (depending on the ecological setting) in the areas salvaged under sales associated with the Big Tower EA (Gobar 1996). Snag size and density are likely larger on average in old growth, riparian areas, wilderness, and roadless areas where no previous timber management has occurred.

Snags across the analysis area will eventually fall, because of the increased exposure to wind and the increasing amount of rot occurring at the base of trees. Given the age, structure, and composition of stands before the fire, the majority of the snags in the area are generally less than 16 inches in diameter at breast height. These small dead trees are expected to fall within three to five years following mortality because their small size succumbs quickly to basal rot and wind throw (USDA 1998). Snags larger than 18 inches in diameter at breast height are expected to remain standing 10 or more years depending on their size, soundness, and exposure to high winds (Gobar 1996, Tower Fire Ecosystem Analysis 1997). Stands with high levels of mortality will experience a low to zero snag density at some future time.

Down wood densities in the area are currently low and generally do not meet Forest Plan objectives due to the combined effects of past harvest and the fire. Down wood is beginning to increase as snags fall, which are primarily from the smaller diameter classes (less than 16 inches diameter at breast height). Snags less than 14 inches diameter at breast height generally do not meet the size class and length criteria for down wood (12 inch diameter at the small end and greater than 6 feet in length) as described in Forest Plan Amendment #11 (USDA 1995). However, sites with larger burned trees will eventually meet down wood standards.

Management Indicator Species

These are species selected by the Forest Plan to represent the welfare of a larger group of wildlife species presumed to share the same habitat requirements. Rocky Mountain elk were selected to represent general forest habitat and winter ranges, pileated woodpecker for dead/down tree habitat in mature and old growth mixed conifer stands, northern three-toed woodpecker for dead/down tree habitat in mature and old growth lodgepole pine stands, pine marten for mature and old growth stands at elevations, and the primary cavity excavator guild for snag and down tree habitat. Not all Forest Plan

management indicator species will occur in the analysis area because post-fire conditions do not provide suitable habitat for some of the species. Habitat in the fire area remains suitable for Rocky Mountain elk, northern three-toed woodpecker, and some primary cavity excavators (black-backed woodpecker, downy woodpecker, hairy woodpecker, Lewis's woodpecker, and northern flicker).

Rocky Mountain elk are common within the analysis area, which has historically been an important migration corridor. The analysis area includes a portion of the Bridge Creek State Wildlife Area, an important winter range used extensively by elk. Telemetry data gathered by the Oregon Department of Fish and Wildlife indicated more elk locations within the Cable Creek drainage and fewer locations within the rest of the analysis area south of Cable Creek (Tower Fire Ecosystem Analysis 1997). Pre-fire observations by Oregon Department of Fish and Wildlife personnel indicate that elk migrate through the Oriental Basin and Texas Bar Creek drainages, but at a faster rate than within the roadless area to the north of Forest Road 52. (This helps explain the fewer telemetry locations within the analysis area). Summer and winter forage for elk (which consists of grass and shrub dominated habitat) has increased because of the fire, and is expected to improve in quantity and quality as the area continues to regenerate. As a result, spring and fall elk migration is expected to continue through the area, although migration patterns may change as elk adjust to the burned conditions. Movement through the area will most likely occur at a quicker pace and shift to areas that reduce exposure.

The cover component for elk was severely reduced by the Tower Fire, eliminating satisfactory cover[16] within the burned area. A limited amount of marginal cover[17] still exists inside the fire on sites that did not burn, or that burned with low severity. Once established, conifers could take up to 30 years to grow in sufficient size (greater than 10 feet) and quantity (greater than 40 percent canopy closure) to obtain an adequate "marginal cover" component as identified in the Forest Plan. The desired condition in the Forest Plan is 30 percent of an area occurring in a cover condition (marginal and satisfactory cover combined). Areas that do meet Forest Plan guidelines for satisfactory or marginal cover occur outside the fire area in the adjoining subwatersheds.

Before the fire, elk calving was very limited and occurred in the northern portion of the analysis area. Calving habitat could now be more widespread throughout the burn, although it will likely be unsuitable for the first few years after the fire. Sites that were structurally altered by the fire or that have been subjected to disturbances from post-fire activities could be less desirable for calving.

Roads increase human disturbance of elk (which increases animal stress), as well as increasing their vulnerability to hunting. Current open road densities are generally less than two miles per square mile within all subwatersheds in the analysis area (Table 3.8). Open road density within the fire boundary exclusive of wilderness and roadless area is 1.8 mi/mi^2. This is within the Forest Plan management objective of a Forest-wide, average open road density of 2.0 mi/mi^2.

Table 3.8: Open road density on National Forest System Lands.

Subwatershed	Open Road Miles	Square Miles	Open Road Density
33A Lower Cable	0.1	2.0	0.05
33B Lower N. Fork Cable	7.6	7.0	1.1
33C South Fork Cable	8.2	9.0	0.9
33D Upper N. Fork Cable	3.4	10.4	0.3
35B Texas Bar	12.3	9.0	1.4

[16] The Forest Plan defines satisfactory cover as "cover used by animals to ameliorate the effects of weather." For elk, this consists of stands of coniferous trees 40 feet or more in height with an average crown closure of 70 percent or more.

[17] According to the Forest Plan, marginal cover contains trees that are 10 or more feet high with an average canopy closure of at least 40 percent and generally capable of obscuring at least 90 percent of a standing elk from the view of humans at a distance of 200 feet.

35C NFJD/Turner	8.5	4.3	2.0
35D NFJD/Otter	15.0	11.5	1.3
35E NFJD/Oriental	16.0	11.0	1.5
95A Winom	4.5	10.0	0.5
95B Big	12.6	17.7	0.7
96A Lower Hidaway	16.0	9.6	1.7
96B Upper Hidaway	7.0	14.0	0.5
Subwatershed Total	**111.2**	**115.5**	**0.9**
Total within Tower Fire	**63.3**	**79.0**	**0.8**
Total within Tower Fire Area excluding Wilderness and Roadless areas	**63.3**	**34.7**	**1.8**

Northern three-toed woodpecker occurs within the analysis area and is expected to increase its presence due to its attraction to large stands of dead trees, which are now prolific within the analysis area.

Primary cavity excavators do not all benefit from post-fire conditions because many of these species depend on live, green trees and uncharred logs for habitat. Those primary excavators that are expected to do well for the next 15-20 years are the hairy woodpecker, black-backed woodpecker, Lewis's woodpecker, downy woodpecker, and the northern flicker. These species tend to prefer large, dead, standing trees to construct cavities for nesting and roosting. In addition, they forage primarily on dead standing trees, on down logs, and on the ground.

Pileated woodpecker and American marten typically use late and old stand structures of mixed conifer species, which will not be available within the burned area for many years (Tower Fire Ecosystem Analysis 1997). Pileated woodpecker will not likely inhabit the burned area unless closed canopy nesting and roosting areas are close by, while American marten is not expected because it prefers moist forest types with developed riparian areas and high down wood densities (which were destroyed by the fire). These two species may occasionally pass through the area, and could return to the area when suitable habitat is restored. It could take 20-60 years for the marten and 80-150 years for the pileated woodpecker to occupy breeding habitat within the fire area.

"Threatened" and "Endangered" Species

These species are managed under the Endangered Species Act to ensure that federal actions do not result in a downward population trend. The sections of chapters 3 and 4 that deal with threatened, endangered, proposed, and species listed on the Regional Forester's Sensitive Species List constitute the Terrestrial Wildlife Biological Evaluation for the proposed projects. Based on local studies, surveys, and monitoring, as well as published literature regarding distribution and habitat use, the following Threatened, Endangered, Proposed, and Sensitive wildlife species have the potential to occur in or adjacent to the fire area: northern bald eagle, Canada lynx, gray wolf, peregrine falcon, and spotted frog.

Northern bald eagles (Threatened) are known to winter along the North Fork of the John Day River from December through March, mostly within one mile of the North Fork John Day River and on the ridgeline south of the river (Tower Fire Ecosystem Analysis 1997). Yearly mid-winter eagle counts and other monitoring indicates that typically five to ten bald eagles use the river corridor between Highway 395 and Oriental Creek (15 miles from Highway 395). The eagles perch diurnally on prominent ridgeline snags a half to one mile south of the river and the analysis area. During the winter of 1991/1992, a possible "communal" night roost was located on private land approximately two miles upriver from Highway 395 (approximately four miles from Texas Bar Creek). A maximum of eight birds used the roost during that period; however, this roost is

thought to be opportunistic since no communal roosting has been observed since. No resident bald eagles are known to occur, however potential nesting habitat is available along the river.

Canada lynx (Threatened) have not been documented within the Tower analysis area or on the District since the 1920's, although several recent but unconfirmed sightings have been reported in the Blue Mountains. Potential lynx habitat occurs within the Tower Fire area, but this habitat was almost completely burned in 1996. Surveys were completed in 1999 and 2000 according to Forest Service protocol. No lynx were detected in 1999, and results for 2000 are pending. The Tower Fire area is included in the Meadow Creek Lynx Analysis Unit, which contains approximately 59,431 acres of potential lynx habitat (based on potential vegetation). Potential lynx habitat that burned within the Tower Fire is currently classified as "unsuitable[18]". Despite the loss from the Tower Fire, 51 percent of the lynx habitat in the entire Lynx Analysis Unit is currently in suitable condition (Table 3.10). In 15-20 years, abundant foraging[19] and denning[20] habitat will likely develop as large burned trees fall and lodgepole pine trees grow tall enough to provide cover above the snow.

Table 3.9: The status of lynx habitat in the Meadow Creek (#8) Lynx Analysis Unit.

Habitat Status	LAU Total	Lynx Habitat	Unsuitable Habitat		Suitable Habitat			
					Denning		Foraging	
	Acres	Acres	Acres	%	Acres	%	Acres	%
Existing Condition	104,549	59,431	29,110	49	3,287	6	27,034	45

Gray wolf (Endangered) A radio-collared gray wolf dispersed to the Blue Mountains from Idaho in March 1999, and was captured for relocation to Idaho on the District. Another wolf was killed in October 2000 near Ukiah, and other wolves have been reported in the Blue Mountain region. The Idaho wolf population has been increasing steadily, and dispersion into the Blue Mountains will likely continue. The Blue Mountains offer relatively high prey densities, large tracts of publicly owned land, and low human populations. All of these factors make it highly probable that a wolf population will eventually once again inhabit the area.

Region 6 "Sensitive" Species

The Pacific Northwest Regional Forester has identified these species as needing special management to prevent being placed on Federal or State endangered species lists. An updated fish and wildlife sensitive species list was released in November of 2000. The following sensitive species have the potential to occur or are documented within or near the analysis area.

Peregrine falcons have been observed foraging across the District and near the analysis area, although not during the breeding season. Surveys in 1992, 1993, and 1997 at potential nest sites failed to detect any peregrine falcons on the District. Potential nesting habitat is greater than ten miles from the analysis area, generally too far for foraging falcons.

California wolverines have not been observed and are not known to occur within the analysis area. Several snow track surveys have been conducted across the District and within the

[18] Potential lynx habitat was determined based on guidance found in the Lynx Conservations Assessment and Strategy (USDA 2000), and the Lynx Science Report (Ruggerio et al. 1999). Potential habitat on the North Fork John Day Ranger District is primarily subalpine fir and lodgepole pine plant associations, and cool moist grand fir associations at or above 5,000 feet. "Unsuitable habitat" is defined as an area that is capable of producing lynx foraging or denning habitat, but which currently does not have the necessary vegetation composition or structure (USDA et al. 2000).

[19] Foraging habitat that supports primary or alternate prey consists of dense trees or shrubs that are tall enough to protrude above average snow levels (USDA et al. 2000).

[20] Denning habitat for birthing and rearing of young is defined as an area having large amounts of down woody debris either in older mature forest, or in regenerating stands > 20 years old (USDA et al. 2000).

analysis area in the past decade, and no wolverines or their tracks have been found. Natal denning habitat does not occur within the analysis area, and the nearest potential for such habitat is greater than 15 miles south of the analysis area. Wolverines may pass through or skirt the edge of the fire to take advantage of wintering ungulate populations.

Columbia spotted frog suitable habitat occurs along Cable Creek, Texas Bar Creek, Oriental Creek, Sheep Creek, and the wet meadows and springs throughout the analysis area. A *Rana* species, presumed to be a spotted frog, was observed in Long Meadows (Cable Creek) drainage in the early fall of 1997.

Species of Concern

The U.S. Fish and Wildlife service requested that the District consider the following wildlife species of concern: northern goshawk, Pacific fisher, olive-sided flycatcher, and several bat species.

Northern goshawk were present in the analysis area before the Tower Fire, but none have been documented since the fire. Two goshawk nest territories were known in the Texas Bar and Oriental drainages; however, both nests have been unoccupied since 1995. The Texas Bar nest site burned at low and moderate fire severities, killing 50 percent of the overstory and all of the understory in the post-fledging area. The Oriental Basin nest site and post-fledging area burned at high and moderate severities, consuming the entire understory and overstory. A limited amount of potential goshawk habitat remains along the south end of the analysis area, and outside the fire boundary in adjoining subwatersheds.

Pacific fisher have not been reported on the Umatilla National Forest. They typically use mid to low elevation, moist forests. Fisher are currently known in the Rocky Mountains and Cascade Mountains, and it is possible that the Umatilla Forest would be used as a dispersal route between these two areas.

Olive-sided flycatcher may be in decline throughout the West according to breeding bird surveys conducted over many decades (Csuti et al. 1997). This flycatcher is particularly known to use tall snags left over from fires, and forest with a more open canopy. Listed as “common” for the North Fork John Day District (Tower Fire Ecosystem Analysis 1997), it likely occurs in the Tower Fire area during the breeding season.

Bat species considered as species of concern for this area by the U.S. Fish and Wildlife Service include: pale western big-eared bat, small-footed myotis, long-eared myotis, long-legged myotis, and Yuma myotis. The pale western big-eared bat was formerly referred to as the Pacific western or Townsend’s big-eared bat. The pale subspecies occurs east of the Cascade crest, and the Pacific subspecies occurs west of the Cascade crest. Big-eared bats have not been observed within the fire area, and a field assessment of bat habitat did not reveal any potential maternity roost or hibernacula sites. However, the fire area has not been specifically surveyed for bat presence (mist-net or bat detection devices). Potential habitat within the larger analysis area consists of mine adits for colonial roosts and hollow trees, snags, or rock crevices for temporary day or night roosts for individuals. Known suitable habitat occurs within 20 miles, near the town of Granite, where abandoned mines could provide this type of habitat. Surveys conducted near Granite in 1994 with a Bat Detector revealed the possible presence (80-90 percent certainty) of a big-eared bat.

The long-legged and long-eared myotis are considered relatively abundant, but the Yuma myotis is relatively scarce in eastern Oregon, and very little is known about the small-footed myotis (Verts and Carraway 1998). All of these bat species could occur within the Tower Fire area.

Economics/Social

The use of forest resources has contributed to the quality of life for many residents who live near the Umatilla National Forest and the North Fork John Day Ranger District. The affected area or impact zone consists of Grant, Morrow, Umatilla, Union, Wallowa and Wheeler counties in Oregon and Asotin, Garfield, Columbia and Walla Walla counties in Washington. These counties are encompassed within the

Pendleton and Spokane Bureau of Economic Analysis regions. Several communities such as Heppner, Ukiah, Fossil, and Enterprise are geographically isolated from the closest larger cities such as Pendleton, Walla Walla, and La Grande (Reyna et al. 1998). Agriculture, manufacturing (particularly wood products), and food processing are important sources of employment and income in this region. Grant County, for example, has a low level of economic diversity, a high dependence on federal timber and forage, and a low resiliency for change. Reliance on timber and forage from federal lands is moderate to high in several counties in the impact zone (Haynes et al. 1997). Many communities in the impact zone are closely tied to the Forest through work and recreation. These communities are directly influenced by changes in the timber supply produced from the Forest and by the Forest supply of firewood, small sales, game animals, scenic resources, and recreational opportunities. Timber harvest has contributed to the economic and employment health of the local communities and cumulatively to regional areas.

Costs over and above revenues collected on timber sales (such as those associated with area improvements) were historically funded by trust fund accounts such as the Salvage Sale Fund and Knudsen-Vandenburg fund, and from budget appropriations. Forest balances in these trust funds have declined sharply in the past few years due to lower levels of harvest and subsequently fewer collections for the trust funds. The ability of the Forest to cover future costs dependent on the trust funds or to receive appropriated dollars is unknown.

Non-Forest Vegetation

Before the Tower Fire, 705 vascular plant species had been documented in botanical surveys within the fire zone (none of which occurred solely within the area impacted by the fire). The overall ratio of native species to introduced species was 87.5 percent to 12.5 percent; the greatest departure from this occurring among grasses (65% native versus 36 percent introduced) (Tower Fire Ecosystem Analysis 1997).

Past exclusion of fire not only affected forest vegetation (see that section), it also reduced herbage production due to dense overstories of trees that blocked sunlight. This affected both big game and livestock forage, and especially reduced the abundance of shade-intolerant species. Because of such reductions and the severity and scale of the fire, reproductive material of shade intolerant species (seeds, etc.) was largely destroyed resulting in the probable extirpation of an estimated 22 species from the fire zone (including the western white pine discussed earlier). This was strongly evident in the south and west-trending riparian corridors (particularly along Texas Bar and Oriental creeks). Refer to the Tower Fire Ecosystem Analysis for further details or to Urban, 1994, for the methods used to identify plant species potentially at risk of local extirpation.

Region 6 “Sensitive” Species

The Pacific Northwest Regional Forester has identified these species as needing special management to prevent being placed on Federal or State endangered species lists. An updated plant sensitive species list was released in May of 1999. The fire area has been completely covered by botanical surveys. The following sensitive species have the potential to occur or are documented within or near the analysis area.

Botrychium minganense A small population of four plants was identified within the fire perimeter (Tower Fire Ecosystem Analysis 1997). The location of this population is important because it occurs at 3,800 feet, well below the lowest typical elevation in this physiographic province.

Carex crawfordii and ***Carex interior*** are sedges that grow in moist or wet areas. These species were not tracked by plant surveys prior to their listing as “Sensitive” in 1999; therefore, specific location data for these plants is not available.

Silene spaldingii This species is listed as “Sensitive” and is being considered by the Fish and Wildlife Service for listing as “Threatened” under the Endangered Species Act. This species occurs in the northeastern corner of the Pomeroy Ranger District, far to the north. Silene

spaldingii primarily occurs in open areas of deep Palousian soils, often on north aspects. There is no potential habitat present within or adjacent to the fire area.

Species of Concern

The U.S. Fish and Wildlife service requested that the District consider the following plant species of concern: *Astragalus collinus* var. *laurentii, Calochortus longebarbatus* var. *longebarbatus, Botrychium crenulatum, Mimulus jungermanniodes,* and *Rorippa columbiae.*

Astragalus collinus* var. *laurentii The only *A. collinus* on the Umatilla National Forest is *A. collinus* var. *collinus*, found only on the Pomeroy Ranger District far north of the burn. According to Hitchcock et. al. "*Vascular Plants of the Pacific Northwest", A. collinus* var. *laurentii* is found only in Morrow County. The associated habitat is basaltic grasslands and sagebrush deserts.

Calochortus longebarbatus* var. *longebarbatus Extensive surveys for this plant have been conducted on the North Fork John Day District. It has not been found south of Frazier Guard Station to the south, though plants have been found sporadically to the north of this landmark. The plants are highly susceptible to grazing and have only been found on the District in areas protected by fencing or natural obstacles such as woody debris or rocks. The associated habitat is damp meadows along small perennial or seasonal streams and in meadow pockets, usually at the forest (typically lodgepole pine)/meadow ecotone or out into the meadow area.

Botrychium crenulatum Only one population has been found on the North Fork John Day District and it occurs approximately 9 miles south of the Tower Fire. This species tends to grow in the wettest extreme of habitat for all *Botrychium* species. Meadows and riparian areas within the burn have been extensively surveyed for Botrychium species, and the survey timing would have been optimal for finding *Botrychium crenulatum* in ungrazed areas, if it were present. Potential habitat exists within the fire perimeter.

Mimulus jungermanniodes The nearest population occurs along the Umatilla River, west of the town of Reith. Potential habitat could exist on cliff faces at the very southeast corner of the Tower Fire. There have been some surveys, but the sheer steepness of the terrain has made thorough searches unsafe.

Rorippa columbiae The nearest populations occur in Lake County, in ditches, large playas, or along the edges of ephemeral lake margins or small springs or seeps. It commonly grows in alkali soils in vernally wet areas on flat topography. There is no such habitat in the Tower Fire area.

Noxious Weeds

Fourteen weed species have been documented within the fire area, one of which was first found in the area in the early fall of 1998 (yellow starthistle). These are displayed in Table 3.10. Two additional species that are listed as noxious in the state of Washington, flannel mullein and oxeye daisy, are present within the burn. However, the North Fork John Day Ranger District has never considered these species to be problematic and, therefore, has never attempted to record their occurrences or to treat them.

Table 3.10: Noxious weed occurrence within the Tower Fire.

Noxious Weed Species	Treatment Prioritization Category	# of sites w/i fire	Population size		*REMARKS*
			Gross Acres	Plants Per Acre	
Centaurea diffusa (diffuse knapweed)	New Invader/ Established	8	22	3	Spread by animals, wind, vehicles
Centaurea biebersteinii (spotted knapweed)	New Invader/ Established	6	22	8	Spread by animals, wind, vehicles
Centaurea nigra (black knapweed)	Potential Invader	0			Apparently successfully eradicated (single plant was manually extracted in 1996)
Centaurea solstitialis (yellow starthistle)	New Invader/ Established	1	1	No plants found in 2000	One plant found near fencing project on Texas Bar Creek in October of 1998
Potentilla recta (sulfur cinquefoil)	New Invader/ Established	Plants within the Tower Fire, but not inventoried. Known populations mostly on private land in southwest fire area.			Has high potential for displacing meadow and riparian vegetation; spread can usually be traced to contaminated livestock feeds and/or feces
Senecio jacobaea (tansy ragwort)	New Invader/ Established	1	1	No plants found in 2000	Infestations usually coincide with hunter's camps; source is contaminated straw or livestock feeds
Linaria vulgaris (yellow toadflax)	New Invader	1	20	20	A creeping perennial; difficult to control because of extensive rhizomes; occupies moist to dry soil types; displaces desirable grasses; spread by water, animals, vehicles
Hypericum perforatum (common St. John's wort)	Established	5	30	300	Increasing along roads and rangelands
			Inventory not complete, may be double this amount		
Cirsium arvense (Canada thistle or Canadian thistle)	Established	1	5	200	Established slowly; difficult to control because of rhizomes; prolific seed producer; seeds dispersed by wind/water in late summer and fall
		Inventory not complete, occurs in patches throughout the Forest.			

Noxious Weed Species	Treatment Prioritization Category	# of sites w/i fire	Population size		REMARKS
			Gross Acres	Plants Per Acre	
Cirsium vulgare (bull thistle)	Established	Not inventoried, occurs throughout the Forest including the Tower Fire			Common in harvest units; persistent for about two years; not considered problematic by District silviculturists
Ventenata dubia (Ventenata grass)	Established	Not known in Tower Fire, but large population on Bridge Creek Flats so may be small populations on west side of fire			Increasing by spreading from roadside ditches to grasslands; unpalatable to livestock and wildlife

Most of these noxious weed species thrive in full sunlight in disturbed soils where native species have been diminished or displaced. Conversely, hound's tongue and common burdock will tolerate shaded habitats. With the exception of common cocklebur, virtually all of the noxious weeds within the burn occur along roads. The highest risk of infestation and establishment (by knapweeds, yellow starthistle, and ventenata grass) occurs in the "Hot, Dry Grassland" plant association group[21] and the "Dry Grassland" potential vegetation group[22]. Because of the structure of the bunchgrass-type rangelands found in the analysis area, noxious weeds can invade unvegetated spaces between the "bunches" of bunchgrass. The second highest risk of infestation and establishment (St. John's wort, sulfur cinquefoil, and especially knapweeds) is the "Hot, Dry" plant association group within the "Dry Forest" potential vegetation. From the roadsides and rangeland infestations, these species can invade the relatively open understories in this vegetation type. Hound's tongue and sulfur cinquefoil are probably the only two species that would invade shaded habitats of the "Moist Forest" vegetation group.

In many areas, the fire consumed the soil cover, creating a seedbed for potential noxious weed invasion. This is compounded by the fact that past ground disturbance and increased vehicular access have allowed for establishment of some noxious weeds within the analysis area. Where vegetation has re-established, risk of invasion has been reduced since vegetation acts as a barrier against most noxious weeds.

Fire Management/Air Quality

Historically, warm dry sites (ponderosa pine and western larch stands) experienced wildfire in the form of low intensity underburns that occurred at an interval of three to ten years, while the cool moist and cold dry sites (mixed conifer and fir stands) experienced high intensity stand replacement fires every 100 to 300 years. Map 8 illustrates distribution of stands predicted to have historically been in either low intensity or high intensity fire regimes. The map groups the three fire regimes found within the fire area[23] into two general categories, low and high intensity. Low intensity areas are based on those stands determined to be warm, dry upland forest (fire regime 1). High intensity areas are based on those stands determined to be cool, moist upland forest (fire regime 3) or cold, dry upland forest (fire regime 5). While scale differences do exist between fire regimes 3 and 5, they were mapped together because both experience high fire intensities.

[21] A "plant association group" is that set of plants which tend to grow together under specific environmental conditions such as moisture, aspect, elevation, etc. if left undisturbed.

[22] A "potential vegetation group" is a combination of closely related plant association groups used in coarse scale analyses such as the Interior Columbia Basin Ecosystem Management Plan.

[23] In all cases, the base Geographic Information System map was constructed from the Existing Vegetation Layer for the Umatilla National Forest. From this layer, potential vegetation classes were determined (i.e. Warm, Dry Upland Forest). Each potential vegetation class was then assigned to a fire regime, based upon current knowledge and research in the Blue Mountains (Agee 1993, Hayerdahl 1996, USDA 1996).

The frequent fires on warm, dry sites reduced air quality in the Intermountain West on a regular basis; such decreases were generally small, but of long duration due to low fuel loads that burned over long periods. This reduction in quality varied depending on fuel conditions, air stability, and dispersion conditions during these low intensity events. The stand replacement fires that occurred in the cool moist and cold dry sites generated, acre for acre, much more smoke than did the low intensity burns, but occurred infrequently.

Fire exclusion and selective logging (which removed ponderosa pine and Douglas-fir) in some of the lower elevation stands changed many of the historically ponderosa pine/western larch stands to mixed conifer/fir stands with dense understories. Analysis of the subwatersheds within the fire area indicates there have been 159 fires within the past 28 years. The majority of the fires were less than 0.1 acres in size, while the largest recorded fire, the Tower fire in 1996, burned in excess of 51,000 acres. Table 3.11 shows a breakdown of fire numbers by size from 1970 to 1998.

Table 3.11: Fire History within the analysis area*

Size Class	Acres	Number of fires
A	0-0.25	110
B	0.26-9.9	31
C	10.0-99.9	12
D	100-299.9	3
E	300-999.9	1
F	1000-4999.9	1
G	5,000 or more	1

* Review indicates that some fires are absent from the database.

Post-fire fuels conditions vary greatly within the analysis area due to differing fire severities and stand types across the landscape. High severity fire affected 5,942 acres, while moderate severity fire affected 15,632 acres and low severity fire affected 29,243 acres[24]. In the high severity fire zone, most of the fuel complex was consumed, whether upland or riparian habitat, with a total absence of live tree crowns and ground vegetation and little down woody debris remaining. In the moderate severity zones, >50 percent of the understory shrubs were burned and tree crowns were scorched with >50 percent of them killed. Larger, burned, downed wood remains in this zone, but no fine organic material is evident. Where fire resulted in low severity, a large quantity of fuel remains with live, lightly scorched tree crowns, unburned down woody material, and a detectable layer of fine organic material. In these areas, many of the perennial plants have recovered and shrubs are aggressively resprouting.

In ponderosa pine/mixed conifer stands that experienced low fire severity, the majority of fine surface fuels (≤3 inches diameter) were consumed, as were some of the larger fuels. Tree boles and crowns were scorched to varying degrees depending upon tree size and fire intensity. Overall, the majority of the larger trees (>9 inches diameter at breast height) survived the fire.

Some true fir/lodgepole pine stands also experienced a low intensity understory burn, however, these trees are thinner barked and more susceptible to fire. As a result, large portions of the standing trees

[24] Burned Area Emergency Rehabilitation definitions for burn severity are as follows:

Low - Soil surface litter and humus have not been destroyed by fire. Some down woody material is present, tree boles are scorched less than 30% of their length, there is little or no crown scorch, and understory shrubs are mostly (>50%) unburned.

Medium - Soil surface litter and humus have been destroyed by fire and the A-horizon has had intensive heating. Very little down woody material is present, tree boles are scorched to the base of the crown or higher, less than 50% of the tree crown is scorched, and understory shrubs are mostly (>50%) burned.

High - Soil surface litter and humus have been completely destroyed by fire and the A-horizon has had intensive heating. Down woody material is absent, tree boles are fully scorched, tree crowns are leafless or greater than 50% of the crown is scorched, and understory shrubs and ground cover vegetation are absent.

have since died due to trunk damage or insect activity. The majority of the fine surface fuels were consumed, although generally to a lesser degree than seen in the ponderosa pine stands.

In stands of all types that burned at moderate or high intensities, the majority of the trees are currently dead, and most of the fine and large surface fuels were consumed. In addition, much of the needle mass in the overstory was also consumed, effectively removing the vertical component of the fuel profile and eliminating the potential for future crown fires in these stands (until they regenerate).

Transportation System

There are approximately 278 miles of system roads (open and closed) on National Forest System lands within the subwatersheds affected by the Tower Fire. Of this total, 111 miles are open to the public and 167 miles are closed to the public but maintained for administrative access (such as fire suppression, fence maintenance, etc.). The District Motorized Access and Travel Management Plan, which was signed in 1990, discusses in detail management objectives and access needs for this area.

The Tower Fire has resulted in a reduction in vegetative soil cover, which has increased erosion. Such erosion is affecting roads by filling in ditches and culverts diverting water directly onto road surfaces. This is causing rutting of the roadbed and adds to sediment loads in adjacent streams (see detailed discussion under Water and Soil section). In places, cutbanks and fills have become unstable, increasing maintenance needs. The fire also killed or damaged many trees adjacent to roads, which now pose a safety hazard for motorists.

In addition, a storm in 1998 caused Texas Bar and Oriental creeks to flood. At a number of road crossings along those two creeks, hail, burned debris, and sediment combined to block drainage through culverts, cause water to flow down roads and completely eroding the road fill in some locations. Three primary roads (Forest roads 5506, 5507, and 5510) access this area, which receives moderate to high recreation use. All three roads received some level of damage, with Forest Road 5507 receiving the most damage. Emergency repairs were made immediately following the storm to prevent further damage to roads and streams, but access to Oriental Basin has been severely degraded.

Forest Road 5507 is a high standard road having a wide surface with many turnouts. It has good sight distance and has no problem handling two-way traffic. It contains ditches and the surface of the road is native material, which results in minor rutting when wet. The cutslopes are granitic sand, which does not revegetate easily and is highly erodible. This is causing a maintenance problem and requires frequent cleaning of the ditches and crossdrains. No problems with mass failures have occurred on this road in the past.

Forest Road 5510 is a low standard, single lane road with poor sight distance and often requiring backing when oncoming traffic is met. The road is both ditched and out-sloped. The road surface is native material, which results in minor rutting when wet. The surface also has a problem with potholes. The cutslopes vary—some are granitic, while others are a meta-volcanic/rhyolite tuff/volcanic ash combination with lots of 12 to 18-inch boulders that come loose and roll down into the road as the cutslopes weather. These cuts do not revegetate easily and are highly erodible, causing a constant maintenance problem. The ditches and crossdrains require frequent cleaning. The unstable cuts and large, loose boulders combined with a narrow road on very steep side slopes make this road a hazard to drive unless maintained several times a year. When the road is snow or ice covered, the narrow outslope sections become extremely hazardous. The road has a history of mass failures and currently has two areas where the fill side of the road has slumped off. Many old slumps are visible above and below the road, which could cause trouble in the future. This road is currently restricted as a haul route by the Umatilla National Forest Road Use Rules.

Forest Road 5506 is a high standard road for the first 5.9 miles. This portion of the road has some problems with raveling cutslopes and has one active slump on the cutslope, which is causing a continuing ditch maintenance problem. This section has a crushed rock surface and has two narrow corners, but in most areas, it can handle two-way traffic. The last section of this road is very low standard from milepost 5.9 to Big Creek. This section is not recommended for passenger cars or trailers. It is very narrow with few turnouts, poor sight distance, and very few places to turn around. In many places, this section of the

road is right on the edge of the North Fork John Day River, and has had some failures due to high water levels washing out the lower side of the road. Most of the side drainage crossings are fords or small pipes that plug and overflow, requiring frequent cleaning. Forest visitors heavily use this road because it provides access to the river corridor in the Wilderness, the Wild and Scenic River corridor, several campgrounds, a trailhead, and many dispersed campsites. Because of the low standard of this segment, very little maintenance is required.

Cultural Resources

All of the National Forest System Lands outside the Wilderness and the roadless area were surveyed from 1986 to 1993 and 19 heritage properties were located. The area was re-surveyed after the fire with a cursory site inspection of known properties and high probability sites in 1997, and a large, systematic re-inventory of high probability areas in 1998. These surveys resulted in the identification and documentation of six additional cultural properties. The properties include both historic (17 sites) and prehistoric (8 sites). Several of the historic sites are associated with early gold prospecting within the North Fork John Day River drainage and consist of waste rock tailings related to placer mining and a dredge that operated around the middle of the century. Historic sites that are not associated with mining relate to early Forest Service administrative improvements including: stock driveways, telecommunication lines, livestock salt log and watering troughs, two foundations, two trash concentrations, a ditch, and the historic Pearson Guard Station. All of the prehistoric sites consist of small, discrete, low-density lithic scatters that are not diagnostic of age or cultural affiliation. The predominant artifact on these sites is the waste flake indicative of stone tool manufacturing or maintenance that suggests short-term camping associated with upland resource utilization. Occasional projectile points and ground stone implements also occur at many of the sites and indicate that activities associated with hunting and vegetal procurement took place.

In 1974, Robert Suphan compiled an ethnographic report pertaining to the sociopolitical organization and land use patterns of the Umatilla Indians that occupied the Blue Mountains of northeast Oregon. Suphan used material published by several ethnographers and information gathered from Umatilla, Cayuse, and Walla Walla Indians who participated in oral interviews and field survey trips undertaken in 1941. The participants identified subsistence areas used by their ancestors before establishment of the reservation. Five subsistence areas used for hunting, fishing, berry collection, and root gathering were identified within the Tower Fire perimeter. Three sites are located along Cable Creek, one at Long Meadow, and one along Winom Creek. It is unclear if the three sites along Cable Creek are on National Forest System Lands. Based on published accounts (Fowler 1992; Murphey 1959) of plants used as foods by Native Americans, 56 culturally significant food plant species occurred in the Tower Fire area prior to the burn. Of these, two species (*Lewesia* rediviva - bitterroot and *Orobanche* fasciculata - clustered broomrape) may have been locally extirpated as a result of the fire. Both occurred in very limited abundance before the fire (Tower Fire Ecosystem Analysis 1997).