The purpose of Step 4 is to describe the area's known or inferred history prior to recent human influence and natural disturbances. This helps the core team understand what existed in the past and what changes have occurred that may affect current capabilities. Reference conditions are compared with current conditions over the period that the system evolved. The reference conditions step is based on the premise that ecosystems adapt over extended time periods and that the greatest probability for maintaining future sustainability is through management designed to maintain or reproduce natural components, structures and processes. Reference conditions are divided into presettlement and historical time periods. Historical refers to the time period from about 1870 to 1945 and presettlement for the time period prior to 1870.

Erosion Processes

During the presettlement period, soils eroded at very low rates for the most part because management-induced factors contributing to accelerated erosion did not exist. Erosion under these conditions is termed natural or geologic. Soils had lower bulk densities and higher infiltration rates. Water infiltrated the soil to a higher degree and/or flowed naturally over the soil surface without being intercepted, collected and concentrated by roads or irrigation ditches. Soil compaction and displacement did not exist, or only to a minor extent.

Mass wasting was a rare occurrence. It was primarily related to geologic faulting and initial mountain building where steep and unstable slopes were created. Both of these events reduced the natural stability of hillslopes and resulted in rotational slumping or debris avalanches depending on soil/bedrock characteristics. It may also have been related to natural catastrophic events such as unusually intense wildfires followed by intense storms or rain on snow events. This mass wasting occurred over extremely long periods of time and resulted in localized high levels of erosion for several years.

Soil conditions within riparian zones had bulk densities that were low and typically had water tables that were higher than at present. This contributed to lush vegetative growth and stable stream banks.

Natural soil erosion rates are similar to erosion rates in the Dairy/Elder and South Creek watershed (Schumm and Harvey 1982 cited in Fremont National Forest 1998). They are highly variable and range from essentially zero to an average maximum of one mm/yr. One mm/yr equates to about five tons/ac/yr. This could occur under the most extreme natural conditions such as those resulting from a severe intensity wildfire. Generally, losses were much lower and are estimated to have averaged less than 0.5 tons/ac/yr. This estimate is based on climatic conditions as well as physical and chemical weathering from bedrock or consolidated deposits over bedrock. Few soils are produced by bedrock weathering at annual rates greater than one ton/ac (Alexander 1988 cited in Fremont National Forest 1998).

On ponderosa pine sites, low intensity wildfires generally burned at intervals of about 25 to 75 years. These were caused by lightning or were set by aboriginal people or homesteaders to enhance the area for hunting, gathering, livestock grazing or land clearing. Generally, these low intensity fires had minimal impact on the soil surface and erosion rates were not increased to a

significant extent. Occasionally, weather conditions would have permitted higher intensity fires to occur which would have removed variable amounts of organic matter on site and exposed the mineral soil surface to erosional forces. Estimated soil loss rates per acre relating to fire within the major soil groups are shown in Table 36. The calculations were based on a Guide for Predicting Sediment Yields From Forested Watersheds (1981). The figures represent the first year erosion rates following a moderately intense wildfire.

Moderate burns are defined as fires that char the litter or duff but do not alter the underlying mineral soil and consume between 40 and 80% of the plant canopy (Effects of Fire on Soil 1979). The erosion rates shown in the table would be much higher after a severe fire. Severe fires were not a common occurrence.

Table 36. Estimated Erosion Rates Relating to Moderately Intense Wildfire (Tons-1st yr)

Parent Material	Basic Erosion Rate	Geologic Erosion Factor	Erosion Rate
Basalt/And/Tuff	550 t/sq.mi.	.42	0.4 t/ac
Pyro/Tuff Sed	550 t/sq.mi.	.66	0.6 t/ac
Rhyolite	550 t/sq.mi.	1.00	0.8 t/ac
Alluvium	550 t/sq.mi.	1.05	0.9 t/ac
Ash/Pumice	550 t/sq.mi.	.35	0.3 t/ac

Increased erosion rates would have occurred for about four years after the fire and then returned to natural levels by year five. Soil losses the first two years are estimated to be the most significant. Losses during the third and fourth year would be only slightly above the geologic rate due to natural reestablishment of vegetation.

The natural landscape began to change with the advent of settlement which began in the mid to late 1800s. The first white inhabitants had minimal effect on the land as the primary interests were trapping and exploring. The first major impacts were logging and grazing by large herds of sheep. Records indicate that 125,000 cattle months and 463,000 sheep months utilized the Fremont National Forest during the peak grazing years of 1909 and 1910. It is assumed that the Deep Creek watershed received comparable grazing intensity. These impacts, along with associated road building necessary to access timber, began the changes to the landscape which resulted in accelerated erosion. Stream bank erosion was accelerated primarily by a very high grazing intensity, while upland erosion was accelerated by a combination of increased logging, road building and grazing.

Hydrology

A. Base Flow

Low flows that occurred in reference conditions are unknown. Early stream gauge information from the Deep Creek gauging station cannot be used for comparison, because much of the water above the gauging station was diverted during the low flow period for irrigation purposes, and gauging records do not exist prior to this use. Gauging records show that there is always some

flow in Deep Creek at the gauging station. During a Wild and Scenic River review in August 1992, monitoring showed the creek was dry between Limburger Cabin and Camas Creek. It became perennial again at the confluence of Camas Creek. The reference condition of this dry reach is unknown due to changes in the hydrology of Big Valley. It should be noted that 1992 was a low flow year and the status of this reach during normal flow years is unknown.

Lower elevation streams in alluvial depositional areas generally had higher water tables than today and riparian vegetation typically occupied the entire width of the valley bottom. Also, beaver populations were higher prior to trapping that started in the 1800s, particularly in low gradient areas. Beaver dams were more prevalent and helped to maintain the water table. Base flows were enhanced because water was impounded by the dams during spring runoff in adjacent alluvium and released through seepage into the stream channel during low flow periods. Therefore, reference base flows were most likely higher in the Deep Creek watershed below these riparian areas. The magnitude of this change is unknown.

Generally, the high elevation streams were stable and had water tables near the surface. Similar conditions exist in current conditions. Base flows would have changed very little from downcutting at higher elevation areas of the forest due to the naturally rocky substrate of the stream channels and its high resistance to erosion. Low gradient streams were sinuous and had water tables near the surface. Base flows would have been greater in these areas historically, where downcutting has occurred.

Lentic systems are standing water habitat such as lakes, ponds, seeps, bogs and meadows. The large expanse of alluvial deposition shown on Map 4 in the Appendix was most likely meadow area in reference conditions. The historic conditions are unknown, but it is assumed that these areas generally had a high water table with large expanses of willow and beaver populations.

Presently, higher leaf area of white fir and conifer/juniper encroachment in meadow areas has resulted in higher evapotranspiration rates throughout the watershed. This indicates that base flow would have been higher in reference conditions because less evapotranspiration would have occurred. New openings from clearcuts have made little change in the overall openings in the watershed. Also, it is not known if low elevation forest stands were fully occupied due to frequent fires. Stands that were not fully occupied historically would have had excess water available for base flows.

B. Mean Flow

Mean flows in streams are highly variable. Comparison of mean daily flows from the Deep Creek gauging site near Adel, Oregon shows no significant trend in mean daily flows (See Current Conditions-6).

C. Peak Flow

Analysis shows that flows that exceed bankfull (peak flows) occurred less often in reference conditions (Figure 2).

Vegetation

A. Upland (Forest) Vegetation

1. General Description

The historic range of variability of upland forest vegetation on the Fremont National Forest included three major forested types: ponderosa pine, pine associated (mixed conifer consisting primarily of white fir and ponderosa pine) and lodgepole pine. This watershed also has subalpine stands at the upper elevations of Crane Mountain and juniper woodlands in the southeastern portion of the watershed where moisture is a limiting factor for coniferous growth.

Table 37 provides an estimate of the proportion of ponderosa pine, pine associated and lodgepole pine by seral stage during the reference period.

Table 37. Forest-wide Estimates of Ponderosa Pine, Pine Associated and Lodgepole Pine by Structural Condition

	Pine	Pine Associated	Lodgepole Pine
Old	60-80%	40-70%	
Low-productivity			1-3%
High-productivity			1-5%
Late	10-30%	40-70%	50-10%
Mid	5-10%	20-40%	10-30%
Early	1-5%	10-30%	30-90%

Table 38. Canopy Cover (Reference Conditions)*

Cover Group	Acres	% of Area
Nonforest	98,296	55
Shrubs	(1)	0
< 25%	49,208	28
26-55%	24,722	14
56-70%	5,218	3
71+%	508	<1

*Data from Klamath/Lake County 1947 timber type maps. This data is the oldest set available but represents stands mid way in the present twentieth century fire suppression regime.

(1) Shrub data was not separated from nonforest data in this set.

The 1947 timber type GIS coverage for Lake County was utilized to characterize and estimate the historical structural stage and canopy cover for the Deep Creek watershed. The 1947 data was used for a snapshot of structural stage because little harvest activity occurred before this time and no earlier information was available on forest cover. However, it would not reflect conditions prior to intensive grazing which occurred between 1870 and the late 1930s. Also, there could be considerable change in vegetation from almost forty years of fire suppression.

This snapshot must be viewed with caution when it is used to compare current with reference conditions. Structural stage and canopy vary with disturbance cycles and move across the landscape at any point in time. Tables 37 and 38 attempt to display the relative percentage of structural stage and canopy cover condition. Structural stage is generally defined as the age of a stand as expressed in four major groups. Early structural stage is the period of a stand's beginning and is usually seedlings and saplings. The mid stage represents a period during which the stand is growing and the canopy is rapidly closing. It is represented by the terms post and poles. The late stage is when the stand has reached maturity, the canopy has closed and some large old trees characterize the overstory. It is represented by small to large saw timber. The old stage is the time when a stand has large old tree character and begins to develop layers and structure. It is represented by large mature trees that are reaching advanced senility. The stand is regenerating again in smaller patches while retaining the structured layers. Species tend to shift toward more shade tolerant species such as true firs.

a) Ponderosa Pine

Ponderosa pine was historically maintained by frequent, low intensity disturbances in the form of ground fires on a return cycle of 25 to 75 years and insect attacks. Low intensity fires consumed the litter fall and low vegetation. Occasionally, small openings ranging between two to five acres were created in the overall large park like stands where a small group of trees would torch out. The result would be areas of natural regeneration that moved continually across the landscape. When stand-replacing fires occurred, the patch size was large, over two hundred acres on average. Insects would affect mostly the large old pine that were succumbing to old age. The western pine beetle (Dendroctonus brevicomis) was active at an endemic level along with most other insects. Large pine under stress from old age or drought were killed on a regular basis. The resultant mosaic of structural stages was one of smaller patches of seedlings/saplings and post/poles moving across the landscape until stand-replacing events occurred. The total extent of these younger stands was low. The large stand-replacing events occurred on a long return interval but resulted in large to extremely large evenaged patches.

Generally, the encroachment of true fir into ponderosa pine is a function of climate and disruption of the natural fire disturbance regime. On the eastern slopes of Crane Mountain the rain shadow effect of orographic lift extends the ponderosa pine to a higher elevation than in other places on the forest. Generally, sites that are classified as a CW ecoclass on this side of the mountain and are under 6,500 feet in elevation were maintained in a more open predominantly large ponderosa pine tree condition (1947 Timber Typing for Lake County, Fremont National Forest GIS coverage). Below 6,000 feet, ponderosa pine probably was dominate. The proportion of white fir in the overstory probably increased with elevation above 6,000 feet. In the northern part of the watershed drained by Camas Creek, the elevation band is lower and ranges around 6,000 feet.

b) Pine Associated

Pine associated was historically maintained by less frequent, but higher intensity disturbances, mostly in the form of insect attack and fire. It appears true fir, or pine associated type as it was classified, would respond to insect outbreaks that would increase as the density of fir increased. When some maximum carrying capacity was reached, there would be significant mortality of true fir from fir engraver and Modoc budworm. The majority of the mortality would most often be in the white fir, resulting in large fluctuations in the relative dominance of that species in the stands. Fires were generally a stand-replacing event that occurred on long return interval of 75+ years. Fires occurring after an extended fire-free period would likely have been more

intense and were probably the norm in the higher elevation (>6,500 feet) stands with larger proportions of white fir. Fires typically occurred as scattered events over the landscape.

Insect outbreaks occurred when stocking increased and stand density exceeded the upper management zone of SDI. At this point, the stands were so overstocked that the insect population increased rapidly, creating a population explosion. The insect population would follow drought cycles. After drought weakened tree defenses and insect populations increased, white fir mortality increased quickly from fir engraver. Modoc budworm populations are prolific defoliators but do not cause a great deal of mortality during an outbreak. They cause significant growth loss from top kill. The population would rise and fall as the naturally occurring virus that kills the budworm rose shortly after the population increased.

A large fire would likely occur after increased mortality from fir engraver when the dead fuel load dramatically increased. The variability of the frequency and intensity of fire disturbances resulted in a wide range of structural conditions that were maintained for long time periods. Late and old structural conditions could persist as scattered, large blocks for several hundred years.

c) Lodgepole Pine

Lodgepole pine was historically maintained by frequent intense disturbances typified by insect outbreaks followed by a high intensity stand-replacing fire. Lodgepole pine is not as prevalent in this watershed but still occurred in large almost pure stands. At the point where stands reached the state of having late or old structural characteristics, they would become stressed by overstocking and slow growth. They became susceptible to insect attack usually by mountain pine beetle (Dendroctonu ponderosae) followed by a fire. When a stand-replacing event happened, it would consume very large patches. The results would be some remnant trees and small clumps that would provide seed for natural regeneration of large blocks of evenaged trees.

d) Juniper

Western juniper has been part of the landscape of eastern Oregon for thousands of years. Presettlement juniper was considerably less abundant and primarily confined to rocky surfaces or ridges and low sagebrush table lands. Junipers began to expand their range aggressively in this region during the late 1800s (Young and Evans 1981, Eddleman 1987, Miller and Rose 1995). Prior to 1875 fire probably played a major role in limiting juniper distribution. The majority of present day juniper woodlands are less than 100 years old (USDI BLM 1990).

Government Land Office Notes from 1880 for the Chewaucan River drainage on National Forest System land mention little or no juniper presence. In 1895, surveyors described juniper on many occasions as "undergrowth", documenting the early stages of juniper encroachment. Miller (1997) found juniper initiated expansion between 1875 and 1885 in the Chewaucan River Basin. Rate of expansion peaked between 1905-15. Severe drought conditions slowed expansion from 1935-45.

B. Rangeland

The vegetation that was present in presettlement times (1870) is still present today but its composition has changed over time. During presettlement the primary method of disturbance was wildfires. The fire interval for mountain big sagebrush in the intermountain region is 12-25

years (Miller 1998). Fires would remove all the vegetation giving the grass and herbaceous vegetation an advantage for a period of years before the woody species could become established. A mosaic of vegetation types existed with the frequency of fire, either natural or man caused, determining the dominant vegetation in space and time.

With the introduction of livestock around 1870, grazing became the primary means for disturbing vegetation. Grazing removed the fine fuels (grass and forbs) and reduced the chance of fire ignition and spread. This combined with active fire suppression reduced the number and size of fires. The result of this change in fire regime on big sagebrush communities was that the size and amount of big sagebrush increased and the density of juniper increased. The more open grass dominated areas decreased.

Herbaceous understory vegetation has been effected not only by the increase in shrubs and junipers but also by livestock grazing. In the early 1900s, there was no regulation on the number or type of livestock grazing on public land and the result was excessive grazing by cattle, sheep and horses, especially in areas near water sources. This grazing pressure reduced native grasses such as Idaho fescue and bluebunch wheatgrass and allowed to establish and spread introduced species such as Kentucky bluegrass and cheatgrass. Since the early 1940s, the number and type of livestock on public lands has been greatly reduced. This change in management has helped stabilize the plant community and the result is a wide variety of understory grasses, including both desirable and undesirable species.

C. Noxious Weeds

The Forest plan defines noxious weeds as "Undesirable plant species that are unwholesome to the range or to animals" (p. 22). Undesirable and unwholesome are terms that are generally associated with the coming of Euroamerican settlement and grazing of the western range lands. Plants may have existed in the watershed that were unwholesome to animals prior to this time, but it is assumed that they coexisted in the environment within some natural range of variability in response to disturbance. Most noxious weeds are exotic to the reference condition.

Mediterranean sage was probably the first noxious weed in the watershed and it came approximately fifty years ago. Other weeds have come in since then and some in the last five to 10 years.

D. Riparian Vegetation

Little information is available on the presettlement or historical condition of riparian vegetation. Conversations with long time, local residents suggest that riparian zones had a significant black cottonwood component and aspen was much more common. Many of the natural stream courses had a large willow component also.

Riparian vegetation in alluvial meadow areas was historically a willow/beaked sedge association (USDA 1987). This association was probably characterized by the following conditions.

Potential natural vegetation: A sward of beaked sedge occurs under a canopy of Geyer or Booth willow (Geyer willow is found in this watershed). Nebraska sedge and Baltic rush increase in cover on disturbed sites. Tufted hairgrass is present on many plots but is very subordinate to sedges.

Table 39. Floristic Characteristics

Dominants	Range % Canopy Cover	Mean Canopy Cover
Geyer Willow	0-37	15
Tufted hairgrass	0-15	5
Beaked Sedge	0-87	44
Shrubs (Mountain alder and Geyer willow)	25-90	49
Grasses	1-15	7
Sedges	37-90	61
Forbs	15-30	19

Estimated herbage production ranged from 400 to 4,000 lbs/acre dry weight. Beaked sedge is moderately palatable to livestock in late summer. With overuse by livestock, other graminoides and forbs become codominant with beaked sedge.

Field review by Mike Montgomery (1998) identified that mature willow populations in the large meadow areas of the watershed appear to be dominant. Single sprouts and young willows (less than 10 stems) are found less frequently along stream reaches in the meadow areas. However, historic photos show that the overall amount of willows in meadows has increased in the last 30 years. The existing and historic levels of willow have not been quantified, however it is estimated that canopy cover is somewhat below the potential natural levels. Disturbed soil areas along the greenline (six foot riparian area adjacent to the stream channel) are the primary locations where sprouts and young willow become established. As identified above, it is estimated that the potential shrub canopy cover is in the range of 25 to 90% with a mean value of 49%.

Note: Willow will generally not develop on very low gradient streams where cutting action and deposition does not occur. Instead, they will develop as a result of episodic events that cut and scour the channel. The Riparian Ecosystem Classification Project will identify areas that are capable of supporting willow. This will be more site specific than the Riparian Zone Association Guide provided by Kovalchick (1987).

Riparian areas were heavily grazed from about 1870-1940. Many of the riparian areas were downcut especially near the turn of the century before there was any control of livestock. For a description of the effects of this uncontrolled livestock grazing on riparian areas refer to Synthesis and Interpretation-4.

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E. Threatened, Endangered and Sensitive Plant Species

Prior to 1870 (presettlement), ecological processes were considered stable or at least cyclic and functioning within some range of natural variation. Plants became extinct in response to naturally occurring disturbances and change. Therefore, by definition, there were no threatened, endangered or sensitive species occurring as a result of human management activities.

Listed sensitive plants were present in historic times but to what extent is not well documented. The disturbances from grazing, road building, logging, irrigation and water diversions have altered the vegetation community throughout the watershed. Therefore, it could be assumed

these listed plants have been affected but to what extent is not known. Cultural plants were also present and collected in presettlement and historic times and have been impacted by the disturbances listed above. Again, the extent of the impacts is not well documented.

Stream Channel

A. General Discussion

Stream habitat features of pools per mile, large pools, large woody debris, bank stability and fine sediment in spawning substrate are the standards by which stream channels are evaluated in this analysis. These parameters are quantified in the Evaluation of the EIS Alternatives by the Science Integration Team for the Interior Columbia Basin Ecosystem Management Project (ICBEMP 1998). Table 40 summarizes the 50th and 75th percentile for natural and near natural stream data for streams in the northern Great Basin (ERU4).

Table 40. Natural and Near Natural Stream Data

Slope Class	Large Pools Per Mile		Pools Per Mile		Large Wood Per Mile	
	50th	75th	50th	75th	50th	75th
All	0.000	0.003	0.027	0.049	0.019	0.062
<2%	0.000	0.005	0.027	0.053	0.006	0.025
2-4%	0.001	0.004	0.029	0.044	0.020	0.085
>4%	0.000	0.000	0.030	0.051	0.020	0.067

Large pool frequency is the number of pools with a maximum depth greater than 2.6 feet. Large wood is determined using wood that is 20" in diameter on the small end and >35 feet long. The natural or near natural frequency is determined using the above table and the formula number per mile = table value x 5280/average riffle width in feet.

Other evaluation criteria include fine sediment and stream temperature. Fine sediment is determined to be excessive when >30% fine sediment (6.4mm) is in the top four inches of potential spawning substrate material. The maximum water temperature is 17.8ºC using the 7-day moving average of daily maximum temperature.

Reference conditions by stream reach are provided below. These were developed using Table 40 for natural or near natural conditions.

Table 41. Reference Conditions by Stream Reach

Stream Reach	Mean Riffle Width Ft.	Gradient %	Pools >2.6 Ft. 50th	Pools per Mile 75th	Large Wood per Mile 50th	Large Wood per Mile 75th	Large Wood per Mile 50th	Large Wood per Mile 75th
Mud Creek Subshed (01)								
Mud Creek								
1	14	6	0	0	11	19	8	25
2	6	1	0	4	24	47	5	22
Lower Camas Creek Subshed (02)								
Camas Creek								
1(BLM)	27	2.5	.2	.8	6	9	4	17
2(BLM)	24	0.2	0	1	6	12	1	6
3(BLM)	33	3.0	.2	.6	5	7	3	14
Horse Creek Subshed (03)								
Horse Creek								
1	10	5	0	0	16	27	11	35
5	15	5	0	0	11	18	7	24
Burnt Creek Subshed (04)								
Burnt Creek								
2	1	4	.5	2	14	21	10	41
3	9	12	0	0	18	30	12	39
4	10	2	.5	2	15	23	11	45
6	6	1	0	4	24	47	5	22
8	6	5	0	0	26	45	18	59
9	5	1	0	5	29	56	6	26
Upper Deep Creek Subshed (06)								
Deep Creek, South Fork								
1	8	7	0	0	20	34	13	44
2	8	9	0	0	20	34	13	44
3	7	10	0	0	23	39	15	51
Deep Creek, Middle Fork								
1	23	2	.2	.9	7	10	5	20
2	22	4	2	7	51	77	35	150
3	18	5	0	0	9	15	6	20
4	17	2	.3	1	9	13	6	25
5	8	8	0	0	20	34	13	44
6	7	19	0	0	23	39	15	51
Deep Creek, North Fork								
1	13	8	0	0	12	21	8	27

Stream Reach	Mean Riffle Width Ft.	Gradient %	Pools >2.6 Ft.	Pools per Mile		Large Wood per Mile		
			50th	75th	50th	75th	50th	75th
Mosquito Creek								
1	9	5	0	0	18	30	12	39
2	10	16	0	0	16	27	11	35
3	5	4	1	4	31	47	21	89
4	6	10	0	0	26	45	18	59
Dismal Creek Subshed (07)								
Dismal Creek								
2	14	7	0	0	11	19	8	25
3	9	2	.6	2	17	26	12	50
Willow Creek Subshed (08)								
Polander Creek								
2	7	4	.8	3	22	33	15	64
3	7	10	0	0	23	39	15	51
Willow Creek								
1	7	3	.8	3	22	33	15	64
2	7	4	.8	3	22	33	15	64
3	7	1	0	4	20	40	5	19
4	10	1	0	3	14	28	3	13
6	6	11	0	0	26	45	18	59
7	4	4	1	5	38	58	26	112
8	5	20	0	0	32	54	21	71
9	4	9	0	0	40	67	26	88
Lower Deep Creek Subshed (11)								
Lower Deep Creek								
5(BLM)	21	2.3	.3	1	7	11	5	21
6(BLM)	26	0.5	0	1	6	11	1	5
Peddlers Creek Subshed (13)								
Parsnip Creek								
1(BLM)	5	2.0	1	4	31	47	21	90
2(BLM)	3	1.3	0	9	48	93	11	44
3(BLM)	5	2.0	1	4	31	47	21	90
4(BLM)	8	2.0	.7	3	19	29	13	56
5(BLM)	10	9.0	0	0	16	27	11	35
Drake Creek Subshed (14)								
Drake Creek								
1(BLM)	22	1.0	0	1	7	13	1	6
2(BLM)	26	1.0	0	1	6	11	1	5
3(BLM)	18	1.0	0	2	8	16	2	7
4(BLM)	22	2.5	.2	1	7	11	5	20
5(BLM)	20	2.5	.3	1	8	12	5	22

Stream Reach	Mean Riffle Width Ft.	Gradient %	Pools >2.6 Ft. 50th	Pools per Mile 75th	Large Wood per Mile 50th	75th	50th	75th
6(BLM)	6	1.4	0	4	24	47	5	22
Roaring Spring Fork								
1(BLM)	12	1.3	0	2	12	23	3	11
2(BLM)	16	1.2	0	2	9	18	2	8
Gibson Canyon Subshed (15)								
1(BLM)	43	2.4	.1	.5	4	5	3	10
2(BLM)	41	1.4	0	.6	4	7	.8	3
3(BLM)	37	0.6	0	.7	4	8	.9	4
4(BLM)	32	1.7	0	.8	5	9	1	4

B. Geomorphology

Stream morphology varies with respect to geology and valley shape. Streams show similar characteristics depending on location within the watershed. Historically, there were at least three distinct geomorphic features. Geomorphic descriptions that apply to this watershed are obtained from descriptions of similar systems (Rosgen 1996).

1. Valley Floor

Generally, low gradient streams are found in the lower portions of the watershed. These streams had reference conditions of Rosgen type C or E channels. Gradients were less than 2% and were characterized by well developed alluvium floodplains. Stream channels had moderate to high sinuosity with gravel size bed materials. Large open meadow areas had little large wood and were characterized by aquatic sedge species and willow. As the valley floor became steeper, the tendency was for stream channels to become less sinuous and move from E to C type channels. Aquatic sedges, willow, aspen and cottonwood were more common along these areas. Large wood material increased as the stream gradient increased.

2. Narrow Valley/Colluvial Slopes

As stream gradients increased to the range of two to four percent, streams were characterized by Rosgen type B channels. The bed material consisted of gravel material with the channel characterized by a series of rapids with irregular shaped scour pools. Channels were relatively stable and did not contribute a high sediment supply to the stream. Large woody debris was an important component of these streams.

3. Lateral Tributary and Headwaters

These were stream channels that had gradients greater than four percent, were steep, deeply entrenched, with confined channels and coarse depositional materials. These met the Rosgen type A channel conditions. These channels were step/pool or cascading channels, often influenced by organic woody debris that formed debris dams behind which was stored significant amounts of sediment in the pools.

Other factors affecting geomorphology

Beaver dams had a large influence on streams. Beaver dams helped to trap sediment, raise the water table, increase flows throughout the low flow period of the year and influenced aquatic vegetation adjacent to the stream.

Water Quality

A. Fine Sediment

Fine sediment in the stream substrate influences the development and emergence of fry. Successful fry emergence is hindered by excessive amounts of sand and silt in the substrate. General habitat guidelines for incubation of salmonid embryos require less than 25% by volume of fines < 6.4 mm (Reiser and Bjornn 1979). Surface fines less than 20% in spawning substrate are the recommended level in the ICBEMP.

Sieve analysis of potential spawning substrate has been conducted forest-wide in a broad range of geologic types. The ideal level of fines for a particular geologic type has not been identified, however, analysis shows that a level of less than 30% fines is generally attainable in the top four inches of spawning substrate throughout the National Forest. Few sample areas have fine sediment in quantities greater than 30%. Using this forest-wide analysis, and above recommendations, fines less than 20-30% would be considered reference condition.

B. Water Temperature

The Oregon Department of Environmental Quality (ODEQ) criteria is to have a rolling 7 day maximum average at or below 17.8^{o}C. Stream temperatures under historic conditions are unknown. Presently, there are no reference reaches that provide a basis for determining attainable stream temperatures.

Historic management has resulted in changed physical stream channel features and vegetative shading. Historically, many reaches had higher levels of shading from willows, trees and herbaceous vegetation. Also, narrower and deeper stream channels provided higher levels of shading. Nearly every reach has been affected by at least one factor that produces higher stream temperatures. Thus, it is assumed that stream temperatures were lower historically than they are today.

Even though temperatures were probably lower than present, it is not known if State of Oregon standards were achieved in all streams. The effects of beaver dams, exposed water in flooded areas and natural openings in meadows may have resulted in historic temperatures that were above current State standards. The Silver Creek Watershed Analysis showed that the Silver Creek Marsh had temperatures that met State standards when the stream entered the marsh, but exceeded State standards when it left the pristine marsh area.

C. Macroinvertebrates

For macroinvertebrates, reference conditions of good to excellent would indicate optimum water quality and habitat for trout species.

Species and Habitats

A. Terrestrial

1. Threatened, Endangered, and Sensitive Species

a) Northern Bald Eagle (Threatened)

There is no historic information for northern bald eagle habitat or numbers and distribution for the period prior to 1945. Nest/roost habitat was probably more abundant on the forest during this period with higher large tree density, and bald eagle use was probably higher due to the potentially greater prey base (cyclic waterfowl abundances), low road densities and a lower incidence of human use.

b) American Peregrine Falcon (Endangered)

Although peregrine falcons were never studied in southeastern Oregon in depth prior to studies conducted by the Wilderness Research Institute in 1982, peregrines probably nested in Warner Valley during the Pleistocene because the climatic conditions promoted a favorable prey base. During this period ducks and geese flourished along with a variety of other potential prey.

No historical nest sites are known for the watershed. The only historic data for peregrine falcon use comes from anecdotal evidence cited by the Wilderness Research Institute (Boyce and White 1982) which reported that historical accounts from the last 100 years documented several records of nesting peregrines in eastern Oregon. Benjamin Bonneville observed peregrines at Warner Lakes and Morlan Nelson claimed that they nested from Adel north along Fish Creek Rim as late as 1948.

Nesting habitat quantity and quality were probably very similar to what appears today on Fish Creek Rim. Greater waterfowl abundance provided a better prey base. Habitat for prey species and hunting within the forested portion of the watershed was only fair to marginal because the landscape was dominated by forest canopy. Habitat security was probably much greater during the period because road densities, recreational use and logging activity were low.

It has been concluded that climatic changes and pesticide application (causing egg shell thinning) were the major factors contributing to the peregrine decline in southeastern Oregon, as well as the rest of the United States.

c) Western Sage Grouse

No information on historic grouse distribution, lek location or habitat condition is available for the watershed. The only historic grouse information available for the Fremont National Forest is from 1938-1941 when between 400 and 1,600 grouse were estimated to occur on the forest.

In general, the suitability of grouse habitat and grouse numbers most likely gradually declined from 1870-1945 because of human settlement and heavy livestock use on uplands and riparian areas. The cumulative effect of high deer numbers in lower elevation shrublands around 1930-60 exacerbated the decline of habitat conditions for sage grouse. Large numbers of grouse also were probably harvested by early settlers.

d) California Bighorn Sheep

No presettlement or historic data on California bighorn sheep occupancy exists. However, American Indian rock art in the area depicts representations of bighorn sheep and it is believed that bighorns occupied the area during this period. Habitat conditions were probably pristine during the early portion of this time period. However, with the onset of Euroamerican settlement, native bunchgrass communities were immediately altered by the introduction of domestic sheep grazing. Severe overgrazing by domestic livestock from about 1880-1940 probably reduced habitat suitability for bighorns. Less suitable habitat conditions and disease transmission from domestic sheep probably reduced bighorn numbers and distribution.

2. Keystone Species

a) Big Game

Accounts from the journals of John C. Fremont (1846) read that deer were small in numbers and that elk were very rare occurrences. Other historical accounts of the Warner mule deer herds describe herds as small and scattered in the early 1900s. In the late 1930s, the Big Lake wintering herd was estimated at 2,000 animals. After approximately 1930, deer numbers for both herds began to increase until range damage by deer was noted in the mid 1940s. Estimates for numbers of deer in 1944 were 4,000 for the Big Lake wintering herd. Herd numbers peaked in the 1960s. Reasons for the increase are not clear-cut, but factors contributing probably include predator reductions, decreases in animal user months for sheep and cattle, weather variations, protection from hunting and shifts in the fire cycle on summer ranges.

Seasonal distribution of deer was most likely similar to what occurs today as deer traditionally use the same seasonal ranges over time. Snow conditions generally control the elevational distribution of deer spring, fall and winter.

Prior to 1870, deer ranges at low elevations and on south-facing slopes were probably dominated by bunchgrasses with scattered shrubs because of the high recurring frequency of natural low intensity wildfires. Distribution and density of both bitterbrush and curl-leaf mountain mahogany were probably less than what they are currently. Heavy livestock grazing (beginning around 1870) and later fire suppression combined to gradually increase shrub densities on all seasonal ranges. Consequently, browse conditions on winter ranges increased in quantity and quality. By the 1930s and 1940s, however, deer numbers that exceeded carrying capacity on most ranges began to degrade forage conditions. Poor forage conditions on game ranges were noted in early 1940s.

Hiding cover prior to 1870 was probably adequate in most areas above 6,000 feet elevation, and poor over much of the summer range below 6,000 since these areas were dominated by more open ponderosa pine stands. Fire suppression during the twentieth century has led to dense stands of mixed conifer, which increased hiding cover acres.

No assessment information was available on historic elk population numbers or seasonal distribution in the watershed. Annual wildlife reports for the Fremont National Forest between 1926-1933 showed no elk present on the forest, and only 10 present for the period 1943-1945. Up until 1980, elk numbers in Lake County were too few to consider any recreational hunting seasons.

b) Beaver

No assessment of beaver populations prior to 1935 was available, however, beaver were probably more abundant prior to the arrival of settlers. Records show that beaver were transplanted in eight different locations within the watershed between 1937 and 1940. At the same time, native beaver populations were known to exist along Camas, Dismal and Deep Creeks. It can be surmised that heavy livestock grazing from as early as 1870 through 1945 had adverse effects on habitat conditions. Beaver habitat quality and quantity probably declined. Also, trapping activity, which undoubtedly increased in the late 1800s, had a negative impact on beaver populations.

c) Nongame Species

No nongame or neotropical bird assessments are available for the period prior to 1945. However, species dependent on sagebrush that require maintenance of multi-aged sagebrush stands with a diverse grass and forb understory, as well as, riparian area dependent species probably had more suitable habitat conditions before settlement, the introduction of livestock grazing and fire suppression.

3. Management Indicator Species Associated with Late and Old (LOS) Forest Cover

There is no designated LOS forest cover on BLM-administered lands within the watershed.

The abundance, distribution, connectivity and quality of suitable habitat for MI and other species associated with dead wood and LOS forest habitats was probably significantly greater during the period 1900-1947 than exists under current conditions (Table 42). The landscape was dominated primarily by large blocks of late/old structure mixed conifer above 6,000 feet elevation, and large diameter ponderosa pine at lower elevations, with breaks created by insect outbreak and stand-replacement fires. Lodgepole pine structure was much more dynamic. Late/old structure lodgepole probably existed only rarely as large areas of lodgepole were constantly broken down by insect outbreaks every 60 years on average and regenerated by stand-replacement fire about every 80 years.

Average, maximum and range of patch sizes in all forest types were large and most of the patches were high quality interior habitat unaffected by edge or roads. Large diameter live trees, snags and down wood were probably more common on average than what exists presently.

Gaps and fragmentation occurred and normally consisted of burns and natural openings, but overall fragmentation was much less than under current conditions. The contiguous forest matrix facilitated species dispersal, colonization and genetic interchange throughout the entire watershed. It is highly probable that because of more abundant suitable habitat conditions for MI and other species, they were more numerous and widely distributed, especially species associated with open ponderosa pine stand conditions. Exceptions may be the pileated woodpecker and American marten, which have probably benefited from the increase in acres of mixed conifer forest.

Table 42. Current and Historic Range of Structural Stage

Timeframe	Early (acres)	Mid (acres)	LOS (acres)
Current	4,515	41,860	30,084
Historic (Low)	5,070	6,950	29,060
Historic (High)	15,350	14,700	48,400

b) Goshawk

There is no goshawk information available for the period prior to 1945.

Nesting habitat suitability was probably higher historically than under current conditions due mainly to more LOS forest habitat and less habitat fragmentation, roading and disturbance during historic times. Small-scale fragmentation provided by early logging around the forest fringes most likely increased home range effectiveness to a point.

c) Pileated Woodpecker (BLM Sensitive and FS MIS)

There is no pileated woodpecker information available for the period prior to 1945.

Pileated habitat prior to the advent of logging in 1947 was highly suitable in areas above 6,000 feet dominated by mixed conifer. Large blocks of mixed conifer LOS with snag and down log components intact were likely prevalent across much of the forested portion of the watershed.

d) American Marten

There is no American marten information available for BLM-administered lands for the period prior to 1945.

Historical accounts of marten on the Fremont National Forest indicate an estimated 300 marten resided within the forest in any given year during the period 1929-1945. Marten habitat suitability was lowest 100 years ago when ponderosa pine stands were dominated by open, park like conditions and lodgepole stands were normally in an early or mid-seral condition at any given time. Within the past 70 years, the increase in acres of pine associated stands has increased habitat effectiveness for this species.

e) Black-backed/Three-toed Woodpecker

There is no black-backed, three-toed woodpecker information available for BLM-administered lands for the period prior to 1945.

Habitat conditions for black-backed and three-toed woodpeckers at the turn of the century were likely less suitable than what exists today. The lack of large blocks of mature lodgepole pine would have created marginal home ranges for this species on a long-term basis. However, periodic large fires that swept through stands of lodgepole pine would have created short-term foraging bonanzas for these birds, and presumably distribution would have shifted relatively often in response to insect, disease and fire disturbance events. Short-term population eruptions undoubtedly followed these large-scale disturbance events.

4. Dead Wood Habitat Management Indicator Species

a) Primary Excavators

There is no primary excavator information available for the BLM-administered lands for the period prior to 1945.

b) Red-naped Sapsucker

No historical information was available on the occurrence of aspen forest over the landscape. However, it can be speculated that with more frequent, low intensity and larger, high intensity wildfires, lower coniferous stand densities, and higher water tables along riparian areas, the abundance, distribution and successful regeneration of aspen clones was likely greater prior to the era of fire suppression, heavy livestock grazing and high deer numbers during the first half of this century.

More aspen in a diversity of age classes and distribution over a larger area would have provided more available and suitable habitat conditions for aspen associated wildlife species, including the red-naped sapsucker. As aspen distribution decreased across the landscape populations and distributions of aspen associated species also declined.

B. Aquatic

Historically, perennial streams supported populations of native redband trout and dace. The lower reaches of Deep Creek contained Warner suckers and tui chub in the slower water areas. Both trout and suckers moved up Deep Creek from Crump and Pelican Lakes to spawn.

The redband is a unique subspecies adapted to the Warner environments and habitats. Redband trout constitute a significant percentage of the total fish in the Warner Basin. Throughout the eastern Oregon closed desert basins, fish have adapted over time to live in extremely harsh environments characterized by great extremes of water temperature and flow. Thus, the gene pool of fish provide for survival in the arid harsh environment. Warner redband are one of only eight separate desert basin populations of interior native redband trout (Behnke (1992). The Warner Basin is between Catlow Basin to the east, and the Chewaucan and Goose Lake Basins to the west. The Warner redband trout are probably most closely related to redband native to the Goose Lake and Chewaucan River Basins (Behnke 1992).

The introduction of the rainbow trout as early as 1925 has altered many of the unique characteristics of the native redband and the brook trout has competed for limited resources with the redband. How extensive the loss of genetic purity has been is not known nor are the locations of the most pure strains of redbands.

The streams in the watershed make up the majority of flow into the Warner Basin and thus are a significant portion of the redband habitat. The other major tributaries to the Warner Basin that support populations of redband trout are Honey and Twentymile Creeks.

Reference habitat conditions for fisheries have been discussed under reference conditions for stream channel and water quality (Reference Conditions-9).

Generally, overhanging sedges, willows and banks provided shade and cover for salmonids in the open meadow systems. In the upper reaches with Rosgen type A and B channels, higher

percentages of shade and cover were provided by deciduous trees, conifers, willow and other shade tolerant shrub species. Reference riparian vegetation condition is further discussed under Reference Conditions-8.

Historic use of intermittent streams by fish is unknown.

Water withdrawal since the turn of the century has affected the ability of fish to thrive in the streams. Irrigation water withdrawn from Deep, Camas and Parsnip Creeks reduces summer time flows and raises water temperatures.

Human Uses

A. Prehistory

Archaeological evidence of human occupation shows that humans began to move into the area to extract resources about 10,000 years ago. The area of primary focus was Big Valley (private land). Big Valley is a large, protected, well watered valley downstream from the headwaters of the main stem of Deep Creek. As Deep Creek leaves National Forest System lands, it enters Big Valley and then moves on through BLM-administered lands and enters Warner Valley near Adel. Numerous archaeological sites are found in Big Valley.

Archaeological sites found at higher elevations are usually small, seasonal, multi-purpose hunting and gathering sites. To the early inhabitants, the area near Adel was probably a semi-permanent village site. From there they would have moved into the forest and up-country to hunt and gather on a seasonal scheme. For thousands of years these people focused on the abundant resources of the Warner Valley and later in the harvest season, Big Valley. The food resources were similar in both areas. The same plants matured much later in the season in Big Valley as compared to Warner Valley, which gave the local inhabitants a sustainable source of food with abundant periods of production.

The many small upland lithic scatter sites were probably related at times to the few much larger complex habitation sites located in Big and Warner valleys. This scheme of seasonal migration probably continued for 8,000 to 10,000 years or more until the Euroamerican people started to move into the area about 150 years ago. This seasonal gathering of the aboriginal peoples had little to no impact on the landscape. Digging roots in the meadows only increased the meadows productivity and any fires were allowed to burn to manipulate and revitalize the vegetation found across the forests and open lands. Adjacent to these mostly utilitarian sites, there were some sites of ceremonial and/or religious nature. These sites are very sensitive and their physical remains are more subtle than the many lithic scatters found in the area.

There are significant large numbers of archaeological sites known to exist. Research is currently being conducted on many of these sites.

B. History

The Deep Creek watershed was a seasonal hunting and gathering area to the native populations. To the early white settlers, it was an abundant natural resource area for exploitation. The first white people were probably trappers, traders and mountain men looking for gold and beaver. As homesteads began to be built at the lower elevations, the newly introduced cattle, horses, sheep, goats and swine from the central farm locations moved up into the mountains during the summer

months following green up of grasses and other vegetation. People would follow and spend time with their livestock and over time set up line shacks and homesteads in the high elevation areas. By the turn of the century, there were a half dozen places in and around the watershed.

The first visible impacts to the landscape were the overgrazing of sheep and cattle and the beginnings of logging. Lumber markets grew from local to widespread at the end of the reference period.

There are now 20 grazing allotments, but none of these allotments existed 100 years ago. Prior to Euroamerican settlement, there was no livestock grazing except for possible wild horse herds. During the time between the first homesteaders (1870s) and the 1940s when many small homesteads were started within the watershed there was still large areas of public land which served as open range. Many of these areas were grazed on a first come basis and overgrazing was common. Fifty years ago, there were homesteads both active and abandoned scattered throughout the watershed. Following the Taylor Grazing Act in 1934, grazing districts were formed and allotments established. The BLM allotments as we know them now were just beginning to be formed with fence and allotment boundaries being established. From these early allotments current day boundaries have evolved.

Even though the number of grazing livestock peaked in the early decades of this century, not until the end of the reference period was considerable effort made to manage livestock numbers. Reduced stocking levels and the initiation of range improvements were major tasks of the Forest Service at this time. Beginning during the first decade of the century to about 1930, forest-wide sheep numbers went from 120,000 to about 80,000. This effort to reduce sheep numbers forest-wide was also seen in the Deep Creek watershed. Cattle and horse head numbers were also reduced from 26,000 to about 10,000. Although these large numbers of animals had a definite impact on the condition of the forest's grasses and shrubs, it was the long grazing season that had the most detrimental effect. During low snow years, like the 1930s, livestock were basically left on the forest year-round. More typically, season long grazing extended up to eight months. Most improvements from reductions of livestock numbers and length of the grazing season were seen at the lower elevations along the stream courses.

Impacts from this agricultural activity can still be seen today, especially in the condition of some of the stream banks and riparian areas at the lower elevations. Also, plant species composition of the landscape has been altered to some extent by intensive grazing. Grazing, however, does not seem to have had an impact upon the presence of food plants of interest to the American Indian people.

No historic sites of interest are known to exist within the BLM portion of the watershed other than the route of the Oregon Central Military Road. Camp Warner, while important, is located on private property. Portions of the Oregon Central Military Road have been identified with markers placed by the local historical society.