Chapter IV: Reference Conditions

4.1 Introduction

Reconstruction of reference conditions largely depends upon two sources. First, limited records are available giving the impressions of explorers and pioneers as they first saw this region. Although their information was not collected according to the scientific method, it offers valuable firsthand insights into the general distribution of landscape characteristics at the advent of Euro-American settlement. To a large degree, their impressions taken at specific locations can be extrapolated to describe strata within the entire watershed. That is, upland characteristics described at a specific valley location would be expected to be similar to nearby upland valley sites, and would likely be different from the characteristics of valley riparian zones.

The second source is the extrapolation of these impressions based upon geographical, geomorphic, and biological principles. For purposes of this report, the reference conditions are assumed to describe the period immediately prior to European settlement. At that time, geological and climatic influences would be similar to those currently experienced. Given pioneer accounts of the vegetational structure of the watershed, along with scientific studies, we can formulate reasoned deductions related to erosion, hydrology, stream channel, and water quality parameters. Such deductions form a major part in the formulation of the reference conditions described below. They are not to be taken as absolute truth, but rather a reasonable description of assumed watershed condition prior to extensive human impact.

4.2 Erosion

Prior to human settlement, the majority of the Middle Tualatin-Rock Creek watershed was heavily forested, with a large proportion of the watershed in old-growth timber. Such conditions would have provided little opportunity for surface erosion. Most surface erosion would occur in episodic pulses for about 20-40 years following stand replacement fire events. Although intervals between these fire events would vary widely, it is reasonable to believe that low surface erosion rates characterized the watershed about 80-90% of the time (Agee 1993, BLM 1997). Additionally, local increases in surface erosion would have occurred at locations where the tree canopy had been disturbed by large storms, wind, or disease.

Mass wasting processes would also have been episodic, being mainly associated with fires and major storm events. The rate of mass wasting (as well as surface erosion) would have been lower than those presently observed. Although many hillslopes were naturally unstable, they lacked the cuts, fills, and exposed soil surfaces typically associated with roads, residences, and agriculture.

Streambank erosion would probably have occurred at lower rates than those presently observed. Survey data and pioneer accounts from the 1850’s indicate that near-stream areas of the Tualatin subbasin were heavily vegetated (Preston 1851, 1852a, 1852b; Hesse 1994, SD#1 1951). Similarly, most riparian areas would have been covered with dense vegetation, with the exception of the most poorly drained areas of the Wapato Valley. Although natural stream meandering would have resulted in bank erosion, the increased resistance provided by vegetation, roots, and large wood in streams would have slowed this process.

Where erosion did occur, less sediment would probably have been delivered to streams than is presently the case. Due to high relative humidity and lower fuel temperatures, many riparian zones were more resistant to fire than upland sites (BLM 1997). This effect was strongest in lower watershed elevations. Where riparian vegetation and surface cover remained intact, it would have provided resistance to surface flow and encouraged sediment deposition. Substantial wetland areas and floodplains would also have provided opportunity for sediments to settle outside the active channel.

These erosion processes would likely have increased following settlement by Native Americans. The use of fire would have increased the frequency of exposed soils, thus leading to increased surface erosion. The use of nearstream habitats could also have contributed to a higher incidence of streambank erosion. However, the magnitude of such increases is unknown, and appears to be negligible relative to the erosional changes that occurred later with European settlement.

4.3 Hydrology and water quantity

4.3.1 Foothills

In the foothills, it is likely that hydrologic processes were characterized by greater infiltration and less surface runoff than is currently observed. Forested conditions would have led to high rates of interception. Thick layers of forest duff would readily have allowed infiltration. The net effect of increased infiltration on subsurface water supplies is unclear, because forested conditions would also have led to increased rates of transpiration.

Stand replacement fires (both natural and human-caused) would have altered the surface hydrology. Diminished soil infiltration capacity, along with decreased ground cover would have resulted in increased surface storm runoff. Reductions in evapotranspiration rates could have increased the quantity of water available to streams for a number of years following these fires. During this period, increased summer flow would likely have resulted. These flows would gradually diminish as the fire-stricken areas revegetated themselves. Where these stands were replaced with phreatophytic hardwoods, evapotranspiration rates may have been above original levels, resulting in decreased streamflow (Meehan 1991).

Given the low frequency of natural disturbances, it is likely that much less of the watershed was covered with hardwoods than is presently the case. With fewer hardwoods, less evapotranspiration would have occurred, resulting in increased water availability for aquatic life.

4.3.2 Tualatin Plain

The hydrology of the Tualatin Plain was substantially different than that now experienced. In the absence of regulated flow provided by water from Henry Hagg Lake and Barney Reservoir, summer low flows in the Tualatin River mainstem were much lower than those currently encountered. Similarly, winter peak flows downstream of Scoggins Dam were much higher, resulting in a higher frequency and duration of flooding. To a certain degree, the difference in summer low flow would have been compensated by the lack of flow diversion. The effects of diversion are substantial, as illustrated by the following example: In 1895, prior to both flow regulation and most diversion, the depth of the Tualatin River downstream of Hillsboro always exceeded 3 feet (Cass and Miner 1993). In the years immediately prior to creation of Henry Hagg Lake, the river was known to become dry (water rights seminar, Pacific University, October 3, 1998). These extremely low flows were not entirely attributable to flow diversion. In years of severe drought, very low flow conditions prevailed upstream of most diversion points. For example, in September of 1963, the Tualatin River at Little Lee Falls (immediately upstream of Cherry Grove) was diminished to 16 inches wide and a depth of four inches (Nixon and Tupper 1977).

Peak flows would likely have been lower due to retention in floodplains and wetlands. During winter flooding events, water would have been stored for substantial periods of time in these floodplain and wetland areas. In addition to benefits for sediment control and wildlife, these detained waters would have seeped slowly back into the creeks, thus moderating flood peaks and increasing the water available during lower flows. Some of this water would also have become available to replenish subsurface supplies. Additionally, greater in-channel vegetation and large woody debris would have reduced flow velocity and dissipated stream energy during high flows.

Although floodplains and wetlands would have helped to moderate flood peaks, downstream flooding would have been a frequent occurrence. Factors contributing to the flooding of the Tualatin River include the low gradient of the stream, and under reference conditions would have included the congested nature of the channels.

4.3.2.1 Extent of wetlands in the early Middle Tualatin-Rock Creek watershed

Early trapper reports note that most lowland portions of the Tualatin subbasin were wet and swampy (Cass and Miner 1993). Physical factors played the greatest role in creating these wetlands. Flat topography impeded the flow of surface water, while low soil permeability decreased infiltration. Additionally, locally high water tables would rise to the surface in the winter, creating standing pools of surface water (Hart and Newcomb 1965).

Large beaver populations in the Tualatin subbasin significantly contributed to wetland area (Cass and Miner 1993). Beaver dams blocked streams, resulting in decreased water velocity and extensive flooding. The ponds and marshes created by these dams improved water quality by removing sediments and nutrients from the water column. The nutrients stored in the wetlands were subsequently processed to forms more useful to many types of aquatic life (Shively 1993). These shallow wetland areas provided habitats suitable for many amphibian, aquatic and botanical species.

No record exists of the exact extent of wetlands under reference conditions. However, the former extent of lowland wetlands can be estimated by determining the total amount of the watershed underlain by hydric soils. By this measure, about 12,400 acres of the watershed were wetland under reference conditions. About 4% (500 acres) of this wetland area was contained within a “beaverdam” area north of Beaverton Creek. This wetland extended approximately from Cedar Mill Creek to the present location of Highway 219. Based on historical records and soils, it appears that the majority of this wetland would have been seasonally flooded. However, pioneer records refer to part of this wetland as a “lake”, indicating that there were permanently flooded reaches of open water within this wetland (Mac Williams and Mapes 1994).

Several other wetlands were described during 1851 and 1852 surveys. Then, as now, extensive wetlands were present at Jackson Bottom and Fernhill. Additionally, a large wetland area was located along Butternut Creek in sections 23 and 24. Streamside portions of sections 31 and 32 (T1S, R2W) were identified as “mirey swamp”. Large wetland areas are also displayed along the lower reaches of Rock and Cedar Mill creeks.

4.4 Stream Channel

Stream channel characteristics would presumably have been relatively stable prior to the time of human influence. Large inputs of woody debris during major storms were likely to have been relatively stable over time, and would likely have persisted through the periods between disturbances. Sediment would have been input to streams and transmitted through the stream system in pulses corresponding to periods of high landslide rates. The routing of water and sediment through the watershed was controlled by the extent and condition of riparian vegetation, especially in the lower watershed where gradients are lower and the floodplain more developed.

As indicated by early surveys and historical accounts, most stream channels throughout the Middle Tualatin-Rock Creek watershed likely had abundant riparian vegetation (Preston 1851, 1852a, 1852b; Hesse 1994, SD#1 1951). In all but the most poorly drained areas, the natural vegetation would have been riparian forest. Riparian trees and their roots restricted channel width (Shively 1993). Additionally stream channels commonly had jams of woody debris. At times, these log jams were very extensive along the Tualatin River. Jams ranging from 300 to 5,000 feet in length were observed in the valley reaches (Sedell and Luchessa 1982). The abundance of woody debris would have contributed to diverse instream structure. Hydraulic scour adjacent to instream wood would have created pools, resulting in high pool frequency. The large woody elements would also have retained spawning gravels, resulting in a greater amount of high quality spawning habitat than is currently encountered.

More information exists regarding channel planform than cross-sectional geometry. Then, as now, the Tualatin River and the lower reaches of some tributaries displayed a meandering pattern. Although few historical accounts of channel bank height and width exist, the high silt-clay content of channel banks and substrate indicates that then, as now, channels had a low width to depth ratio.

4.5 Water Quality

Water quality prior to human intervention was partially a function of the condition and extent of riparian vegetation. Water quality characteristics would have varied widely across the landscape and over time as a result of the extent of disturbance of the riparian zone.

Under undisturbed conditions, abundant stream canopy on the tributaries would have provided for stream temperatures cooler than those currently experienced[29]. On the Tualatin River mainstem, however, the relationship between reference and current temperatures is more complex. During water temperature modeling based on 1994 climatic conditions, Risley (1997) found that summer water temperatures upstream of Rock Creek under simulated natural conditions would be substantially higher than those currently encountered. Over this reach, water released from Scoggins Reservoir maintains cool water temperatures.

Downstream of Rock Creek, the scenario is reversed, and the simulated “natural” water temperatures are substantially lower than those currently prevalent. However, water temperatures still exceed 17.8 C for a substantial period within the summer months. Although there are no wastewater releases to the river and maximum canopy is assumed by the model, the width of the river exposes substantial surface area to solar heating. Additionally, the river traverses a substantial length of valley upstream of the watershed. This, together with slow water velocity, indicates that water would have had substantial opportunity to heat to ambient levels.

During periods of major disturbance of riparian vegetation from fire or windthrow, water temperatures were elevated. In the periods between those major disturbances, water temperature was suitable for cold-water aquatic life in those areas with adequate riparian vegetation.

It is unclear what the temperature regime would have been for wetland areas, nor for water contributed to streams from these wetlands. Although water stored in wetlands would have received solar heating, most wetland contributions to streamflow would usually have proceeded through subsurface pathways, where temperature would have been moderated by the adjacent soil.

Sediment levels were similarly affected by disturbance events. Where the riparian vegetation was intact, it would tend to restrict sediment delivery to streams, both through binding of soil and detention of sediment-laden runoff. Following disturbance, these factors limiting sediment contributions would be reduced, leading to accelerated sediment contribution to streams.

Nutrient levels in streams are likely to have been low under reference conditions. This is indicated by the low erosion rates, lack of human inputs, and the large amount of wetland storage that is considered to be prevalent at the time. Although some phosphorus would have been contributed through groundwater inputs from sedimentary rocks, valley sediments, and wetlands, surface inputs from erosion and runoff would have been low. For the same reasons, instream concentrations of nitrogen would have been low. Limited amounts of nutrients would have been available from naturally occurring organic detritus. However, contributions of these substances from fertilizers, livestock, sewage and urban runoff would have been absent.

These factors indicate that stream water had relatively high concentrations of dissolved oxygen. Lower water temperatures would have increased stream capacity for oxygen, while reduced inputs of organic waste and nutrients would have reduced the biochemical demand for oxygen.

Contributions of bacteria would have been supplied by wildlife. However, these contributions were probably much lower than those presently attributable to livestock raising and septic systems.

4.6 Aquatic Species and Habitat

4.6.1 Fish

Historical fish habitat information is not available at this time. The amount and condition of fish habitat can be inferred from general vegetation descriptions of the land and estimated human impacts. It can be assumed that prior to extensive settlement, land use conversion, and road construction, fish habitat was in better condition. For example, the prevalence of large woody material in stream channels created diverse instream structure and pools desirable for fish production and survival. Dams, water diversions, and culverts did not impede fish passage. Water quality was generally better except after major fires, landslides, and other large-scale catastrophic events.

Due to the mature state of most of the riparian timber in the watershed, streams received ample contributions of large woody debris. The abundant logjams would have contributed to pool development and instream habitat diversity, which would have been beneficial to aquatic life. Additionally, mature riparian timber provided ample shade for tributary streams. The resulting low water temperatures and high dissolved oxygen levels would have benefited salmonids and many other cold-water aquatic organisms.

Benefits from large woody debris would have extended to streams within the valleys. Although the extent of spawning substrates would probably have been similar to those currently occurring, the increased incidence of LWD-induced pools, as well as lower temperatures, would have provided better salmonid rearing habitat than is now currently available.

Prior to stream clearing and channelization, stream meanders would have provided greater length of total aquatic habitat. Additionally, this habitat would have been more complex. Instream wood provided cover elements for fish, as did tree roots in the banks and hanging vegetation.

It is likely that steelhead were the only native anadromous salmonid species with substantial populations in the Middle Tualatin-Rock Creek watershed during the reference period. Although chinook salmon occasionally migrate along the mainstem of the Tualatin River, it is unlikely that the Tualatin subbasin ever supported a large population of chinook salmon (Ward 1995).

Other streams throughout Western Oregon have documented declining trends for most salmonid species over the last century. This, along with the availability of better habitat, indicates that the watershed's historic populations of cutthroat trout and steelhead were larger than those occurring today. However, historical references to fish populations and habitat within the watershed are difficult to find.

4.6.2 Wetland and riparian dependent species

The relatively large extent of wetland and riparian areas would have provided a high carrying capacity for species dependent on seasonal, shallow wetland habitats. Historical accounts from nearby watersheds indicate that great numbers of waterfowl utilized these habitats (Fulton 1995). Small wetlands created by beavers provided particularly important habitat for pond turtle populations. Trees felled by beavers would have provided habitat for basking, foraging, and refuge (Altman et al. 1997).

These extensive wetland habitats could also have sustained large amphibian populations. Amphibian communities would have consisted of native frog and salamander species. Many of these species, as well as the Western pond turtle, have dwindled since the introduction of the exotic bullfrog.

4.7 Vegetation

4.7.1 General regional characteristics

The watershed lies at the interface between the western hemlock zone and the interior valley zones described by Franklin and Dyrness (1973). Although portions of the watershed are mapped within the western hemlock zone, precipitation is generally below that considered necessary to sustain western hemlock forest. Thus, it is likely that Douglas-fir was a forest dominant prior to human occupation. It is likely that the majority of the Middle Tualatin-Rock Creek watershed was covered by extensive tracts of old-growth forest broken by patches of younger forest, recently burned areas, and wetlands. According to Oliver and Larson (1990), the general structural features of these old-growth stands typically include large, live trees; large, standing dead trees; variation in tree species and sizes; large logs on the forest floor in various stages of decay; and multiple-layered canopies. These stands also have a great deal of horizontal and vertical diversity.

To gain an appreciation of the characteristics of these forests, we can refer to the interim minimum standards for old-growth Douglas-fir described by Franklin et al. (1986). These include:

- Two or more species of live trees with a wide range of sizes and ages.
- Eight or more large (>32 inches diameter at breast height (DBH)) or old (>200 years) Douglas-fir trees per acre; however, most stands have 15 to 45 trees per acre, depending on stand age and history.
- Twelve or more individuals of associated shade-tolerant species per acre, such as western hemlock or western redcedar, that are at least 16 inches DBH.
- More than 15 tons of down logs per acre, including 4 pieces per acre more than 24 inches in diameter and greater than 50 feet long.
- Four or more conifer snags per acre. To qualify for counting, snags must be greater than 20 inches in diameter and more than 15 feet long.

Other features of these old-growth forests include a dense, multiple-layered canopy; decadence in dominant live trees as evidenced by broken or multiple tops and decay; and shade-tolerant species, such as western redcedar, in canopy gaps created through the death of the dominant Douglas-fir trees.

Wildfire, wind, and disease were the primary disturbance agents influencing the development of these stands. Wildfire appears to have been the most significant of these agents (BLM 1997). In western Oregon, these fire events were episodic: they occurred at irregular, generally widely spaced events. Although estimates of fire frequency in western Oregon vary widely, one widely used reference figure estimates an average interval of 230 years between these events (Agee 1993). These fires were typically associated with east wind events (Teensma et al. 1991). These rather infrequent fires, however, were high-intensity, catastrophic, stand-replacement events.

Following Native American settlement, the incidence of fire increased. Although the proportion of the fires attributable to human action is uncertain, it seems likely that human-caused fires dominated the pattern of fire occurrences in the region both before and after European settlement. Lightning was probably not a major cause of fires; especially since fire protection and cause determination began in 1908.

Fire results in both the creation and loss of down wood from the system. Large pulses of down wood have been noted following stand-replacement fire events (Spies et al. 1988). Following fire in an old-growth western hemlock/Douglas-fir forest, there was a 10-fold increase in snags. In addition, the total biomass of down wood increased from 244 tons/acre in the old-growth stand to 565 tons/acre in the newly burned stand (Agee and Huff 1987).

Major wind events associated with winter storms also may have influenced the development of these stands. Windthrown trees add down wood to the forest floor, as well as creating various-sized canopy gaps that support species such as western hemlock and western redcedar. In addition, major windthrow events create conditions for population build-up of the Douglas-fir beetle. Subsequent tree killing by these beetles further adds to the snag and down wood component of these forests as well as creating additional canopy gaps.

Laminated root rot, caused by the fungus *Phellinus weirii*, is widespread and probably had an important influence on the structure of many stands in the watershed. *P. weirii* is a native root pathogen that readily attacks and kills Douglas-fir (Thies and Sturrock 1995). *P. weirii* and similar pathogens creates snags and gaps in the canopy where shrubs, hardwoods, or shade- and disease-tolerant conifer species occupy these various-sized openings. In addition, infection predisposes trees to windthrow. Live infected trees are susceptible to attack and killing by the Douglas-fir beetle. This disease, therefore, is a major source of down wood and snags.

Prior to European settlement, exotic weed species were not abundant on the landscape. There were, no doubt, a few populations of exotic species introduced through animal migration and Native American travel. Many of the exotic species currently within the watershed were brought into the area as ornamentals, to control erosion processes, or entered as seeds or spores on vehicles or clothing.

4.7.2 Vegetational characteristics of the foothills

Prior to European settlement, vegetation characteristics for the Coast Range would have been similar to those described in the previous section. The land would have been mostly forested with timber in the mature/old-growth structural stage. Interspersed in this sea of old-growth were stands of younger timber where stand-replacement fires had occurred.

Fire appears to have played an important role in development of the 1850s era Chehalem Mountain vegetation pattern. An 1852 survey map describes the Chehalem Mountains around Burris and Christensen creeks as being vegetated with "timber principally fir, considerably burnt and fallen with dense undergrowth of hazel, vine maple and fern" (Preston 1852). However, Joseph Gaston, when describing the Chehalem Mountain terrain of the 1830s, indicates that the portion along the Indian (Jason Lee) trail was not brush covered at that time (Gaston 1912).

4.7.3 Vegetational characteristics of the valleys

In the mid-1800s, the Tualatin Plain was a forested region interspersed with wetlands and prairies. These prairies were described by the Hillsboro Argus in 1859 as ranging from two to seven miles in length and one to two miles in width (Bourke and DeBats 1995). They provided valuable grazing and farmland, and were often bordered by riparian forests. One of the largest of these prairies extended from Gales Creek to a region just east of Dairy Creek in a region surrounding the present Highway 8 corridor. This area was described in an 1852 survey map as "rich prairie land" (Preston 1852). Not coincidentally, much of the early settlement occurred within this prairie area. Another prairie, Meek's Prairie, occupied an area within T1R2, sections 7,8, and 18 (Preston 1851).

The remainder of the Tualatin Plain was vegetated with Douglas-fir forest. The 1852 description of the lower Rock Creek area appears to be typical of valley upland forests in the watershed. These forests were described as "timber fir with some western ash, yellow pine, cedar, oak" (Preston 1852). This forest type was characteristic of the region south of the Tualatin River, which was described as "well timbered country".

The Willamette Valley ponderosa pine would likely have been an important component of stands that Euro-American settlers found in the mid-1800's. Unlike the eastern Oregon subspecies, the Willamette Valley ponderosa pine has the ability to thrive under moist soil conditions. Additionally, mature trees develop thick bark that enables them to resist low and moderate intensity fires. Thus, the increased fire frequency that accompanied burning by natives would have resulted in stands of pine and oak adjacent to the prairies (T. Nygren, forester, personal communication 2000).

4.7.4 Wetland vegetation

The vegetation of the wetlands within the watershed would have varied with wetland type and period of flooding. This riparian forest is described for the reach near Cornelius, where 1852 surveys characterized Tualatin Valley bottomland as thickly forested with fir, ash, maple and vine maple, with many swamps thickly wooded with 10- to 20-foot willow (Shively 1993). These surveys also described the floodplain between the Tualatin River and the current location of Rood Bridge Road as having very thick undergrowth.

Likewise, the western portion of the “beaverdam” swamp near Beaverton Creek was described as being dominated by willow, alder, and ash (MacWilliam and Mapes 1984). It is likely that portions of this wetland also had emergent and open water components, as a “lake” bordered the Denney Donation Land Claim on the eastern end of this wetland[30] (Mac William and Mapes 1984).

Other wetland types were also present in the watershed. Cass and Miner (1993) describe marsh grasslands within the prairies. Because of the spread of herbaceous invasive plants, it is difficult to ascertain the dominant species within these marsh communities. Meanwhile, the rolling prairie near West Union was frequently broken by ash-dominated swales (SD #1 1951).

4.7.5 Sensitive plant species

It is difficult to reconstruct the abundance and distribution of sensitive plant species during the reference period. Factors complicating historical information regarding survey and manage species and other sensitive plants are as follows:

- These species were only recently designated as sensitive or endangered. Thus, they would not have attracted special attention from biologists;
- Many of these species were not discovered or described until recently;
- Survey and inventory in the past has predominantly been limited to vascular plants (even vascular plant surveys are very limited);
- Sightings are few and widespread for most plant species, indicating large gaps in range information;
- Only the most rudimentary of ecology data is available for many species; therefore, habitat requirements are essentially unknown for most of these species, historically and presently; and,
- Sighting location information is often general, with little specific information available.

Those species dependent upon old-growth forest habitat, as well as riparian and wetland species, would have had a large area of available habitat relative to current conditions. It is likely, therefore, that these species were more abundant, and more broadly distributed, than is currently the case.

4.7.6 Terrestrial species and habitat

Prior to human settlement, the Middle Tualatin-Rock Creek watershed was made up of larger blocks of later seral stage forests comprised of a wide range of tree sizes, large amounts of down wood, and abundant large snags. This situation undoubtedly provided habitat for those species dependent upon, or which would utilize larger blocks of interior forest old-growth habitat. Species that are presently of concern in the Tualatin subbasin such as the spotted owl, pileated woodpecker, and red tree vole benefited from the historical habitat condition.

The contiguous nature of the landscape pattern facilitated the free movement of these species throughout the watershed and throughout the region. Old-growth habitat conditions extended down into moist riparian areas and shaded the streams, which contained numerous pools as a result of many large logs and debris jams. These riparian areas functioned as corridors for wildlife including amphibians, otter, elk, and cougar.

Abundant habitat suitable for spotted owl existed prior to settlement. The owls benefited from extensive old-growth forest that would have provided many sites for nesting and roosting.

The structure of these forest stands would have provided habitat for other sensitive avian species. Habitat for marbled murrelet would have been abundant in the watershed, as the vast majority of stands would have been in the mature to old-growth stages. These forests would also have provided abundant snags for bald eagle nesting. This, together with abundant fish stocks, would have contributed to bald eagle populations.

Based on settlers accounts, deer, bear, and beaver were common throughout the watershed. As recently as 1886, bear were commonly observed in the Reedville area (Bramel 1996).

The Columbian white-tailed deer (*Odocoileus virginianus*) occupied prairie habitat throughout the Willamette Valley and the valleys of its tributary streams (Verts and Carraway 1998). Shortly after settlement, these deer were extirpated from most of their range in Oregon. Remnant populations are found in Clatsop, Columbia, and Douglas counties. The Columbian white-tailed deer is currently listed as endangered under the federal Endangered Species Act.

4.8 Human

4.8.1 Historical changes in landscape pattern

Human occupancy in the Middle Tualatin-Rock Creek watershed has been a major source of change (Table 4-1). The progression of some of the activities leading to changes in watershed conditions is given below.

4.8.1.1 Human uses prior to European settlement

The Tualatin Indians (also known as the Tuality, or Atfalati), occupied a number of small villages in the Tualatin subbasin. Tribal use appears to have extended throughout the watershed, and numerous accounts abound of Tuality camps and artifacts (e.g. SD #1 1951, Hesse 1994, Laurel Ladies Social Club 1977).

Undoubtedly, Tuality settlement resulted in some changes to watershed conditions. Although these changes are difficult to quantify, they were much smaller than those that ensued following Euro-American settlement. Many tribal activities occurred near bodies of water. This could have resulted in changes to water quality.

It is likely that greatest changes that the Tuality brought to watershed processes were through the use of fire. Evidence exists that the Tuality used fire for agriculture, although not to the same degree as other Oregon tribes (Cass and Miner 1993, Laurel Ladies Social Club 1977). For example, early accounts indicate that such burning regularly took place on the Chehalem Mountains (Laurel Ladies Social Club 1977). During dry, east wind conditions, some of these fires likely became very large and consumed some of the old-growth forest in the area. Where burning frequently occurred, this would have favored species composition toward oaks, shrubs, and herbaceous plants (Agee 1993, Franklin and Dyrness 1973). Besides altering the vegetation of these areas, this burning would have increased surface runoff and erosion.

4.8.1.2 European settlement and agricultural conversion

The first recorded European visit to the watershed was conducted by a group of Hudson’s Bay Company trappers in 1826 (Shively 1993). Fur trappers were also the earliest settlers within the watershed, although they were sparsely distributed. Settlement accelerated with the influx of American settlers in the 1840s. Early settlement in the Tualatin Valley was concentrated east of Dairy Creek, while Forest Grove was settled in the mid 1840s (WCHS 1975, Cass and Miner 1993, Fulton 1995, Bourke and DeBats 1995). The first recorded European settlement of the McFee Creek area occurred in 1848 (Hesse 1994).

During European settlement, the pace of change accelerated. Settlers converted the woodlands and prairies of their land claims to agriculture. At first, most settlement and conversion focused on the prairies within the watershed. When the supply of available prairie land was exhausted, newer settlers attempted to claim farmland from the forests. In many cases, the forests were cut down and the timber burnt onsite, without any attempt made to produce lumber (Hesse 1994).

Early agriculture in the watershed emphasized production of livestock and wheat. Settlers also planted orchards on better-drained lands, with the fruit being used for domestic consumption. Eventually, with the subsistence needs of the settlers met, large scale agricultural operations sprung up. In the 1880s, these included the 840-acre Simeon Reed farm, near Reedville, which was devoted to raising livestock, ryegrass, wheat and oats (Bramel 1996).

Gradually, agriculture within the watershed diversified. In 1906, the town of Orenco was founded on 1,200 acres devoted to the production of nursery crops (Hillsboro Argus, May 13, 1965). By 1922, the Scholls area was well known for walnuts, potatoes, berries, eggs, and prunes (Cass and Miner 1993). Strawberries came soon afterward.

Table 4-1. Timeline of events in the Middle Tualatin-Rock Creek watershed since the 1830s.

Date	Event
1844	Five Oaks area is described as "destitute of timber, except a few ash trees which grew along the margins of the swales".
1848	Peter Scholls settles near McFee Creek. Area is heavy fir timber with hazel underbrush.
1848	Twality tribes continue to camp for several years on land settled by J.D. Rowell. An annual potlatch held near Midway.
1849	Scholl and Rowell build sawmill along Baker Creek.
1850s	"The evergreen blackberry was brought to Oregon". By 1914, it is recorded to grow wild over hundreds of acres.
1858	Extensive drifts and log jams above Harris Bridge. Captains Pease and Sweitzer clear numerous jams between here and Hillsboro.
1860	Small lumber mill by Baker Creek.
1862	McFees settle on McCormick Hill Road near McFee Creek. They soon build a sawmill.
1865	Early estimate of log transport on Tualatin River.
1867	Simeon Reed operates stock farm near Reedville.
1870s	Reedville becomes a freight and passenger center for the Oregon Central Railroad.
1870	First durable bridge built across the Tualatin River at Scholls. At this time, this bridge lies along the main route from Portland to Yamhill County.
1878	Edwin Stanwood builds grist mill at site of Scholl and Rowell sawmill. A dam is built across Baker Creek.
1879	Area around Helvetia scchools appears to already have been logged.
1880s	Extensive use of Chinese labor to clear land. Much timber is burned, rather than milled.Air is filled with dense smoke.
1880	"Every acre of" the 840 acre Reedville farm "not necessary for grazing purposes has been brought to the very highest state of cultivation."
1881	Reedville mill in operation.
1886	David Hagg buys 160 acres south of TV highway near Aloha. Land is "covered with timber and had to be cleared".
1888	Letter states that Tualatin River has become "choked up" since 1880. 23 jams or drifts are noted.
1890	Major flood on Tualatin River.
1890	Creamery started in Helvetia.
1894	Oswego Iron Company clears Tualatin River channel between Lake Oswego Dam and Hillsboro.
1897	D.B. Emerick clears Tualatin between Cornelius and Scholls Bridge.
1900-1920	"Three consecutive sawmills with a large millpond located on McFee Creek and Vanderschuere Road are operated."
Early 1900s	Helvetia has brick factory.
1901	Potter Mill in Bonny Slope is recorded as being in operation.
1902	Julius Christensen buys portion of Burris DLC. They soon start logging their land.
1902	Scholls tile company built. Tile production is discontinued in 1976.
1903	Groner-Rowell company builds sawmill at Scholls Ferry Bridge on Tualatin River. A tile and brick plant is also operated there. Sawmill is closed in 1924.
1903	Logs floated on Tualatin River between McFee Creek and Scholls Ferry. Also, in 1906.
1903	Baseline Timber Company formed. Sawmill built in Cornelius at Emerick Landing.
1905	Fred Groner plants walnuts near Scholls
1909	Railroad is fenced through Aloha "to keep the cattle off the rails."
1912	Washington County buys land for quarry along Burris Creek one mile west of Laurel. Quarry is discontinued in 1940s.
1917	"Two long plank bridges spanned Jackson Bottom"
1917	"Thousands of cords of [fire]wood are brought to Reedville, and stored in ricks between 209th and 229th.
1918	TV Highway constructed between Hillsboro and Beaverton.
Before 1920	Livestock are driven to Reedville to be hauled to Portland stockyards.
1920s	Small patches of strawberries grown around Scholls.
1920	Groner Quarry opened on Hesse Hill, near Scholls. Crushed rock is used to surface Scholls Ferry Road.
1926	Highway 219 graded. Muddy conditions make road nearly impassible in winter.

Table 4-1. Timeline of events in the Middle Tualatin-Rock Creek watershed since the 1830s.

Date	Event
1927	Scholls Ferry Road is paved.
1927	Nutmore farms has 23 acres in potatoes. This is the largest field of certified seed potatoes in Oregon.
1928	Nutmore farms buys 100 acres of timber and clears the land to plant walnuts.
late 1920s	Tie mill operated on Baker Creek just north of Mountain Creek Road.
1930s	Mr. Groner first plants loganberries and black raspberries in the Scholls area.
1931	Bald Peak acquired for a park
1931	Bonny Slope platted by a development company.
1936	Oscar Raines buys land near McFee Creek. He soon builds a sawmill.
1940s	Custom cannery operated near Scholls.
1951	Devastating forest fire recorded in Bonny Slope area. (Three large fires recorded between 1940-1969.)
1955	Scholls Ferry bridge fill floods. Scholls Ferry Road is closed.
1962	Columbus Day storm destroys most remaining walnut trees at Scholls.
1962	Complaint about farms within Reedville School District being sold to speculators for housing tracts.
1962	Tom Garrett, FWS, notes that many young people thoughtlessly shoot song birds and other small forms of wildlife.
1960-2001	Rapid urbanization of subwatersheds comprising Rock Creek, Butternut Creek and their tributaries.
1970	Unified Sewerage Agency formed.
1977-78	Durham and Rock Creek wastewater treatment plants on line.
1988	ODEQ develops Total Maximum Daily Load (TMDL) allocations for phosphorus and ammonia.
Early 1990s	Unified Sewerage Agency adds tertiary treatment to Durham and Rock Creek wastewater treatment plants.
1999	Winter steelhead listed as threatened under the federal Endangered Species Act.
2000	ODEQ develops draft TMDL allocations for temperature, dissolved oxygen, and bacteria, and revises TMDL allocations for phosphorus.

Source: Bramel 1996, Cass and Miner 1993, Farnell 1978, Hesse 1994, Laurel Ladies Social Club 1977, MacWilliam and Mapes 1994, ODEQ 2000, SD #1 1951, Shively 1993, TRWC 1998, WCHS 1975.

With settlement and the introduction of new crops came some species that later became nuisances. According to the Orenco Herald (January 1914) the evergreen blackberry was introduced to Oregon in the early 1850s. By 1914, this blackberry had already invaded extensive areas of burnt land within western Oregon.

The production of wheat necessitated the construction of flour mills. By 1878, a gristmill had been built adjacent to the Scholl and Rowell sawmill on Baker Creek. This was followed by a gristmill in Reedville, which was in production by 1881.

The settlers also accelerated the pace of vegetation change through fire. In Western Oregon, it was estimated that “approximately seven times as much land was burned from 1845 to 1855 as in any of the three previous decades.” (Morris 1934 as cited in USDA and USDI 1997). By 1850, the portions of the watershed lying within the Chehalem Mountains had been recently burned, although the degree to which human activity was responsible for this burnt land is not immediately clear (ODF 1996).

4.8.1.3 Timber operations

Logging activities soon followed Euro-American settlement. Initially, logging was performed to clear homesteads. However, commercial logging began soon afterward. Sawmills were built throughout the watershed. In 1849, Scholl and Rowell built a sawmill on Baker Creek, while the McFees built a sawmill on McFee Creek as early as 1862 (Hesse 1994). On the eastern end of the watershed, the Jones Lumber Company mill was built along Cedar Mill Creek in 1855 (Cass and Miner 1993). Numerous other mills were built in Hillsboro and Cornelius during the late 1800s and early 1900s, and by 1865, major log drives were occurring on the Tualatin River (Farnell 1978). In relatively inaccessible areas, portable sawmills enabled milling of timber near logging sites.

Early transport of logs was most efficiently performed by water. Between 1886 and 1905 numerous log drives occurred along streams within the Middle Tualatin-Rock Creek watershed. Many of these log drives began on the Upper Tualatin, Scoggins Creek, or Gales Creek, with logs destined for the large mills at Hillsboro and Cornelius (Farnell 1978). In the early 1900s, many of these logs were floated the length of the Tualatin, to be shipped to mills in Oregon City. To facilitate the drives, streams would be cleared of obstructions and blocked off from wetlands and secondary channels (Shively 1993).

In the 1870s the Oregon Central Railroad was built. This, along with other railroads, gradually took over the task of transporting timber from the logging sites. Eventually, roads were built through the watershed and trucks became the dominant mode of transportation. Although these modes of transportation had less direct impact to the streams than did the log drives, they created new problems through increased exposed surface area and destabilized slopes. Many of these old railroad grades and logging roads continue to provide sediment to streams. At stream crossings they often provide migratory impediments to fish.

4.8.1.4 Stream cleaning and wetland conversion

In order to reduce flooding and to facilitate log drives, debris jams, beaver dams, and obstructions caused by tree roots were cleared from streams. The first record of stream clearing in the watershed appears to date back to 1858, when Captains Pease and Sweitzer cleared numerous log jams between Harris Bridge (Farmington) and Hillsboro (Farnell 1978). As they returned to Farmington, they noted that a freshet was already undoing their work. Successive efforts were made to clear the Tualatin River of its logjams. An 1888 letter stated that the Tualatin River had become “choked up” since 1880. At that time, 23 jams or drifts were noted on the Tualatin River (Farnell 1978). In 1894, the Oswego Iron Company noted that it had managed to clear the Tualatin River channel between Lake Oswego Dam and Hillsboro.

Although log jams remain on certain portions of the Tualatin River, the majority of the river likely has far less instream large woody debris than under reference conditions. This has made the river more navigable, but at the cost of channel diversity and fish habitat.

The wetlands covering much of the valley floors covered potentially productive agricultural lands, and wetland drainage followed settlement. Several notable wetlands were drained in this manner. One of the largest was the “beaverdam” wetland near Beaverton Creek. In 1882, a drainage district was formed to “complete” drainage of this wetland. Other wetlands that lost significant area due to drainage include Jackson Bottom and Fernhill. Although portions of these wetlands still exist, they are greatly altered in size and function from the reference period. The wetlands near Butternut Creek have mostly been lost to urbanization.

These drainage projects resulted in an extensive loss of wetland habitat. Comparison of hydric soils to current NWI wetland area indicate that as many as 12,300 acres, or 84% of historic wetland area may have been lost due to wetland conversion and drainage. However, it should be noted that the NWI is a conservative measure of current wetland area, and indeed, many lowlands continue to experience ponding and flooding in winter. The largest remaining wetlands are located at Jackson Bottom. The type, function, and condition of the remaining wetlands has been substantially changed. Where many wetlands were typically inundated for four months of the year, by 1953 they were more typically inundated for 60 to 90 days (USACE 1953). Where many wetlands provided forested habitat, most of these seasonally ponded areas now are vegetated with exotic weeds such as reed canarygrass. This has seriously affected the ability of these wetlands to provide their historic hydrologic functions, and has altered the types of wildlife for which they are suited

4.8.1.5 Urbanization

Settlement within the watershed was originally decentralized, consisting of a series of small, agriculturally oriented, villages (Bourke and DeBats 1995). During the 1800s, the small towns of Hillsboro and Forest Grove were the two dominant communities within the watershed. Eventually, the town of Beaverton achieved a similar size to these communities. In the 1900s, settlement tended to accumulate around the Highway 8 corridor. Urban growth accelerated after 1960. Initially, this growth was centered around the eastern portion of the watershed. Where the proximity of Beaverton and Cedar Mill to Portland made these communities attractive for development. Since the 1970s, urbanized growth has spread westward. At present, most growth is focusing on infill in presently urbanized areas.

Urbanization has resulted in increased impervious surface area, which in turn has increased peak flows to streams, increased delivery of pollutants to these streams, and resulted in downcutting of stream channels. Often, development has resulted in diminished area available for wildlife, while the introduction of exotic plant species has been facilitated by urbanization patterns.

4.8.1.6 Roads

The advent of roads created changes in the landscape. Early roads were naturally surfaced and typically followed the courses of paths created by Native Americans. Initial road-related impacts would have been minor, as these roads were infrequently spaced. However, proximity to aquatic habitats may have contributed to stream sedimentation.

Impacts increased as additional roads were created to facilitate access to logging sites and farms. During these early years, there was little concern about the environmental impacts of road placement. Such factors as road steepness, stream crossings, wetland crossings, and culvert placement were left to the engineer’s discretion, and decisions were often dominated by economic considerations.

Early road construction practices also employed little concern for environmental impacts. When building roads along steep slopes, material removed from cuts in the hillslope was often pushed downslope to build up the bank for the driving surface. Additionally, it was not unusual for waste materials to be pushed over the side of the road. Where these materials were deposited adjacent to a waterway, they posed a significant sedimentation threat to the adjacent stream. These materials often entered the stream directly through gravitational and erosional processes. Additionally, the weight of these sidecast materials also destabilized the underlying slope, increasing the landslide risk for many years following construction of the roads.

These road designs usually involved improperly placed and sized culverts. Often these ends of these culverts jutted out over the underlying ground. The water shooting out of these culverts would plunge to the ground below, cutting into the soil and loosening rocks and vegetation, resulting in massive erosion problems. Additionally, fish passage was not a consideration in culvert design and placement.

Roads on steep timberlands were often routed with steep slopes that offered the shortest route to the timber harvest site. This routing took less ground out of the resource base and had less of an impact on groundwater percolation than did more circuitous road designs, but the steepness of the roads could promote raveling, erosion, and sediment runoff.