WATER QUALITY

Characterization

The beneficial uses that are dependent on aquatic resources in the analysis area are: private domestic water supply, industrial water supply, irrigation, livestock watering, anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish, other aquatic life, wildlife and hunting, fishing, boating, water-contact recreation, and commercial navigation (USDI 1994). The water quality parameters that are critical to these beneficial uses are: turbidity, dissolved oxygen, water temperature, nutrients, pesticides/toxics, bacteria/viruses, total dissolved gases, pH, sedimentation, erosion, low flow, debris and structure.

Current Conditions

The 1998 303(d) list designates several reaches South Fork Coos Watershed as water quality limited. Table WQ-1 gives the boundaries and listing parameters for the water quality limited reaches.

Table WQ-1: 1998 303(d) Listed Waterbodies in the South Fork Coos Watershed.

Waterbody	Boundaries	Parameter	Criteria	Supporting Data
Burnt Creek	Mouth to Headwaters	Temperature	Rearing 64°F	1996 data show temperature criteria exceeded: 7 day average max 65.6°F
Cedar Creek	Mouth to Headwaters	Temperature	Rearing 64°F	1996 data from two sites show temperature criteria exceeded: 7day average max 70.5/65.1°F
Tioga Creek	Mouth to Headwaters	Temperature	Rearing 64°F	1996 data show temperature criteria exceeded: 7 day average max 72.7°F
Williams River	Mouth to Headwaters	Temperature	Rearing 64°F	1996 data show temperature criteria exceeded: 7 day average max 72.7°F

Additional South Fork Coos Watershed reaches were considered for listing for reasons of temperature, habitat modification, and sedimentation based on the 1988 non-point source assessment. However, those reaches were not placed on the 303d list in 1998 because either the data are insufficient to support listing at the time, or more recent data indicated the parameters of concern are within acceptable ranges (ODEQ, 2000. http://waterquality.deq.state.or.us/wq/303dlist/303dpage.htm).

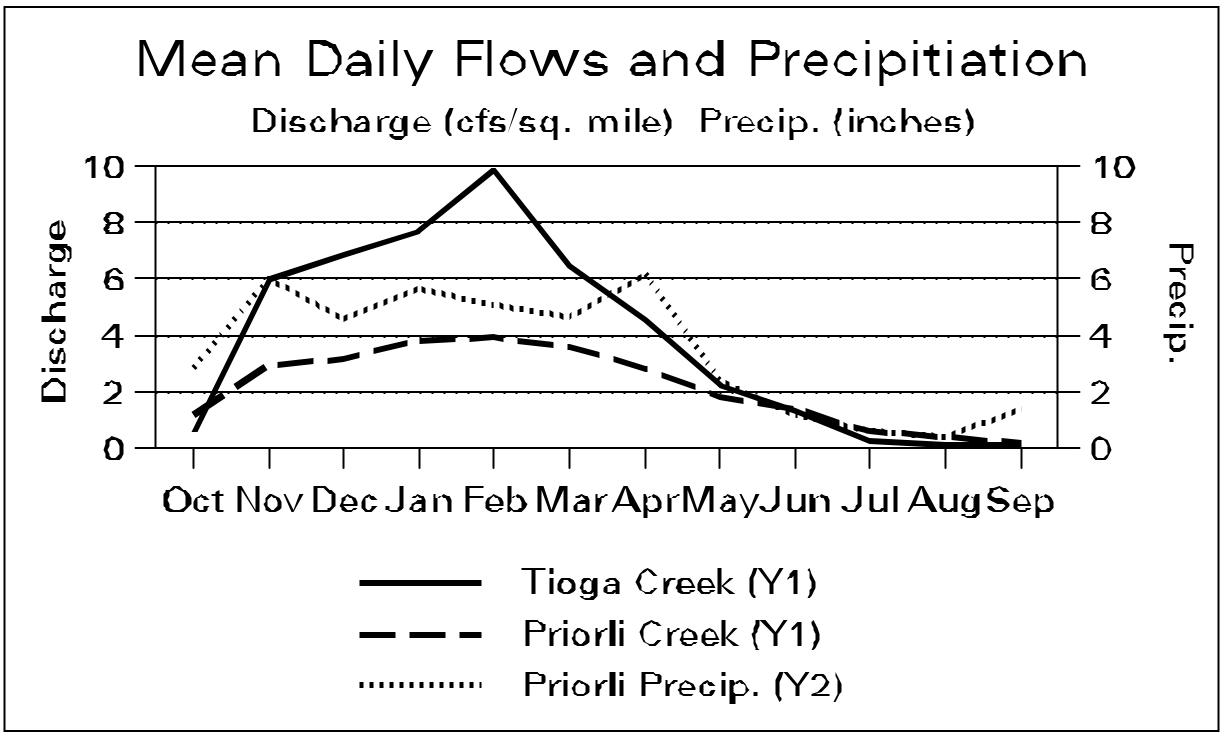
The BLM collected water temperature data at 9 sites during the summers of 1996 and 1997 (Table WQ-2). The BLM also operates gauging stations on Tioga Creek and Priorli Creek, which continuously collect stage and temperature data, and a precipitation gauge at Priorli Creek (Graph WQ-1& Graph WQ-2). The 10-year water temperature record at the Tioga Creek gaging station shows that as steam flow drops in the summer the water temperature rises.

Other sources of water quality data are:

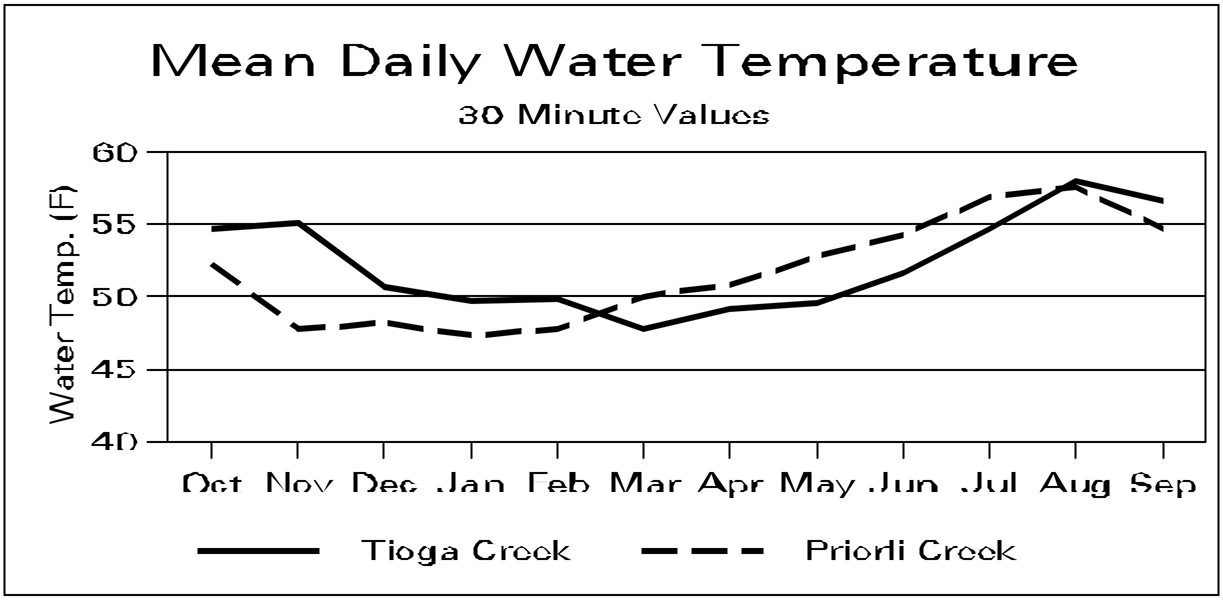
- The EPA STORET database also contains some water quality data on the Coos Subbasin. The most recent data available was collected in 1992.
- The Oregon Department of Fish and Wildlife (ODFW) has conducted habitat surveys on several streams in the Watershed and this information is available through ODFW.
- Oregon DEQ 1988 Oregon Statewide Assessment of Nonpoint Sources of Water Pollution.
- Water supply study for Coos County by CH2M Hill.
- Coos and Coquille Rivers Navigability Studies
- The Oregon DEQ office in Coos Bay.

Table Hyd-1: Water Temperatures Observed in the Summers of 1996 and 1997

Site Name	Legal Description	7-Day Max.	Days >64 F°
Arrow Creek	SESW, Sec 32, T.25S., R.08W.	61.66	0
Cedar Creek 1	NENE, Sec 14, T.26S., R.09W.	70.54	34
Cedar Creek 2	SWNE, Sec 22, T.26S., R.08W.	65.14	8
Coal Creek 1	NENW, Sec 03, T.26S., R.10W.	61.81	0
Coal Creek 2	NENE, Sec 34, T.25S., R.10W.	62.40	0
Cox Creek	NESW, Sec 03, T.25S., R.10W.	59.87	0
Panther Creek	SWSW, Sec 04, T.27S., R.08W.	57.20	0
Tioga Creek	NWNW, Sec 20, T.26S. R.09W.	72.69	46
Williams River	NWNW, Sec 10, T.26S. R.09W.	74.54	64



Graph WQ-1



Graph WQ-2

Access spurs next to Tioga Creek are popular areas for dispersed camping. Many of these campers use recreation vehicles or trailers with self-contained holding tanks, and take their trash with them when they break camp. However, some people still dispose of human waste and garbage in a matter inconsistent with the good back country sanitation practices and contrary to the "leave no trace" philosophy. While this is an aesthetic problem, we do not know if this is causing measurable water contamination.

The Tioga Creek Sediment Budget & Dynamics Investigation, in the Tioga Appendix, describes the changes in sediment from the 1943 to 1992. The conditions and changes described in that document do not fit comfortably in either the current condition or reference condition subsections. None the less, the Sediment Budget & Dynamics Investigation does describe the period of greatest logging and road construction related impacts on water quality in the Tioga Creek tier I Watershed. Formations of bare sandbars during the 1960's suggest that was a period when sediment delivery exceeded the stream's capacity to transport sediment. The 1960s was a time of considerable road building, cat logging and by today's standards little stream protection. Also, the weather during that period was in a wet cycle. The aerial photos from the 1970s and mid 1980s show stream down cutting. This may have been due to the loss of instream CWD and therefore a loss of the channel's ability to store sediment.

Reference Conditions

We do not have direct measurements documenting water quality in the South Fork Coos Watershed from before the conversion of bottom lands to farms or the beginning of large-scale timber harvest operations and extensive road building. Variations in water quality, before Euro-American settlement, can be inferred based on the reference conditions and on going processes described in the Erosion Processes Chapter, Vegetation Chapter, and in the Tioga Appendix: Fire History section. Intense storm events and large fires would have caused periods of elevated sediment levels. Stand replacement fires would have also increased exposure of streams to sunlight elevation water temperature.

<u>Shading of major streams in 1943/1950</u>: Aerial photos taken before logging began in earnest in the more remote parts of the Watershed show the canopy closure above streams, and by that indicate the amount of stream shading. Aerial photos are normally taken around the middle of the day in the summer months because that is when the sun is high in the sky. This provides the best illumination and the shortest

shadows for aerial photography purposes, and incidently also documents the amount of sunlight that reaches the stream during the hottest part of the day during the summer.

Vegetation provided shade on 7th order stream reaches: The surface of the South Fork Coos River is visible for its entire length in the high altitude 1943 aerial photographs. Those aerial photographs show logging and agriculture modifying the stream side vegetation all along the main stem west of Burma Creek by 1943. Later aerial photos show logging and road construction had modified the streamside vegetation for nearly the entire length of the South Fork Coos by 1950.

The 1950 aerial photos cover Williams River from the confluence with Tioga Creek to section 6, T.27S.,R8W. The 1950 photographs indicate this part of Williams River received little overhead shading around midday in July when the photos were taken. The lack of overhead tree shade on the 7th order reach of Williams River, from Tioga Creek to Cedar Creek, is due to the river's width.

Vegetation provided shade on 6th order streams: The 1950 aerial photographs indicate repeated fire in combination with fluvial disturbance, limited vegetation shading of the 6th order reach of Williams River between Cedar Creek and section 6, T.27S.,R8W. The 1943 high altitude aerial photos show a narrow well defined linear gap in the overstory conifers above Williams River where the river flows though section 6. Up stream from section 6, the linear gap ceases being a distinctive feature, and the stand patterns indicating repeated fire give way to well-stocked conifer stands about where Fivemile Creek joins Williams River.

The 1950 aerial photo coverage shows the 6th order reach of Bottom Creek flowing though a narrow flood plain from the south line of section 33, T.25S.,R.9W. to a short distance above where it joins Williams River. The flood plain was sparsely stock with trees. The toe of the slopes next to the flood plain supported closed canopy hardwood stands with scattered conifers that blended into conifer dominated stands on up the slopes. The appearance of the flood plain and streamside trees suggests fluvial disturbances limited overhead shading. The 1943 high altitude photos show a narrow well defined linear gap in the overstory conifers above Bottom Creek along the 6th order reach. The scale of the 1943 aerial photos and the overstory conifer density is such that streamside hardwood stocking levels cannot be assessed. The streamside stands next to Bottom Creek's 5th order tributaries generally have similar structure and stocking levels as observed in the uplands. The area between the two 5th order streams that come together to form the 6th order reach of Bottom Creek was the site of a moderate severity burn.

Coos Bay District-BLM does not have 1:12000 aerial photograph of Cedar Creek taken before the lower reach was logged. The 1943 high altitude photographs show a well defined linear gap in the overstory conifers above the 6th order reach of Cedar Creek downstream from about the center of section 12, T.26S.,R.9W. Those photos show Cedar Creek flowing through a burn area in the eastern part of section 12 of T.26S.,R.9W., and section 7, T.26S.,R.8W. Hardwoods are the predominant streamside trees on the flood plain in the burned area.

We are unable to assess the pre-management canopy condition above the 6th order reach of Tioga Creek because of the road construction next to the lower reaches of Tioga Creek, shortly before the 1950 aerial photos were shot. The upper end of the 6th order reach and the 5th order reach through the northern third of section 1, T27S.,R10W., flows through a flood plain area that had burned a little before 1943. The streamside stand in that area was a mix of young conifers and hardwoods with old-growth snags. From section 1 to midway through section 12, T27S.,R10W., the streamside stand was predominantly hardwood. Tioga Creek was visible in canopy gaps. Those gaps were likely caused by fluvial processes. Near where Tioga Creek crossed the line between section 12 and section 7 in T.27S.,R.9W., is the boundary between a moderate severity burn area and a stand replacement burn area. Tioga Creek reenters a moderate severity burn area near the line between sections 7 and 8. Hardwoods stop being a component of the streamside stands where Tioga Creek flows through section 16 and enters a well-stock old-growth area. For most of the Tioga Creek's upper 5th order reach, the side slopes are well-stocked with old-growth but older trees are generally absent on the narrow flood plains. Tioga Creek is visible through the old-growth where Tioga Creek where there are narrow flood plains.

Vegetation provided shade on 5th order tributaries to the South Fork Coos River: The Daniels Creek flood plain was converted to agriculture in the late 1800s. The 1950 aerial photographs show Daniels Creek protected from direct sunlight where there were narrow strips of riparian trees left along the creek banks. Riparian vegetation is sparse or missing along some reaches.

Cox Creek was roaded and logged before 1943. The pre-logging canopy closure above Cox Creek cannot be determined.

The Coos Bay Office does not have 1950 photo coverage of Fall Creek. The high altitude 1943 photographs show hardwoods dominating the flood plains along the lowest mile of Fall Creek and below Fall Creek's confluence with a 4th order stream in section 20, T.25S.,R.9W. The stream side stands between those 2 hardwood areas have moderate conifer stocking with hardwoods visible in the gaps between the conifers. Narrow linear gaps in the conifer canopy above Fall Creek are visible in places but are discontinuous and generally less obvious than the narrow canopy gaps above the 6th order streams. Stands on the side slopes consist of conifers with younger stands on the south and west aspects due to past fire.

Most of the streamside forest along the 5th order reach of Coal Creek was intact in 1950. These riparian stands along the bottom and at the toe of the slope were predominantly hardwood and moderately stock. Conifers occupied the side slopes. The stream channel was not visible. However, the forest floor was visible thorough numerous gaps and openings in the canopy. Given the stand appearance, Coal Creek likely was shaded by a combination of overstory trees and understory shrubs. The open stand structure next to Coal Creek is likely due to alders dying from old age leaving the longer lived hardwood and conifers. Understory shrub competition precluded establishment of understory trees that could have filled in the canopy gaps.

The streamside forest along the 5th order reach of Mink Creek was intact in 1950. The riparian stands were a mix of moderate to well-stocked with canopy openings. Mink Creek is exposed to direct sunlight though several of the openings. The openings are probably due to a combination of fluvial processes and shrub competition. Hardwoods occupy the bottom and the toe of the slope and conifers are on the side slope.

Vegetation shading of 4th order and smaller streams Canopy cover above smaller streams was observed but not systematically documented while examining the historic shade above the larger streams. Generally the stands next to the smaller streams were fully stocked (75%-100%) with gaps associated with nonforest ground and recent disturbances. Canopy cover was most complete above streams with narrow "V" channels. Canopy gaps that could allow sun light to reach the stream were found where recent debris torrents scoured the channel and where stream channels had an opportunity to meander through small flood plain reaches.

Synthesis and Interpretation

Water temperature: Streams in southwestern Oregon are known for their relatively high summertime temperatures, but it is not clear whether this is related to a latitudinal gradient, high solar radiation loads, low flows, or other related factors (Beschta et. al. 1987). The primary concern with water temperature increases is the potential for detrimental affects on fish and other aquatic organisms. Climate, solar intensity, channel orientation, and elevation influence water temperature. These factors are generally static and unaffected by human activity. Shade and groundwater are also natural factors affecting water temperature. However, these can be influenced by management activities. For example, exposing the stream channel to solar radiation, by removing streamside vegetation, can raise stream temperature. Stream temperature increases of 10^0 F or more have been recorded following removal of streamside vegetation by clearcutting and burning in both the Oregon Cascades and Coast Range (Brown and Krygier 1970; Levno and Rothacher 1969 cited in Adam and Ringer 1994). Water temperatures of larger streams can also increase when clearcutting exposes small tributaries. Shading on a downstream reaches do not significantly lower the water temperature of streams warmed as the result of loss of shade on upstream reaches (Brown 1970). The amount of daily temperature fluctuation is primarily a response to the daily weather patterns. Maximum temperatures normally occur in the late afternoon and minimum temperatures occur just before dawn. Heat added to a stream is not readily dissipated and when temperature increases in headwater streams occur, downstream reaches can also increase in temperature. The heat balance of water in natural systems is regulated by streamflow, water velocity, stream width to depth ratios, and streamside vegetative canopy cover. Solar radiation is the primary factor influencing elevated stream temperatures in the summer, and is largely affected by the degree of interception of this radiation by riparian vegetation (Beschta, et al. 1987).

Increases in stream temperature, in response to increased exposure to sunlight, is inversely proportional to stream volume. Therefore during the summer low flow period, small shallow perennial streams can experience a significant temperature increase following a stand replacement event, like clearcutting or high severity fire(Brown; Krygier 1970). However, surviving vegetation next to small streams and wood debris above the channel can have a moderating influence on stream temperatures follow a stand replacement disturbance. In a study on the H. J. Andrews, Levno and Rothacher (1969 cited in Adams; Ringer 1994) found clearcut logging increased maximum water temperature by 4°F. Subsequent slash burning and stream cleaning increased the maximum water temperature an additional 8-10°F. Following a stand replacement disturbance, riparian vegetation regrowth along small streams (about 10 feet wide) will provide shade levels equivalent to mature stands in 10 years (Summers 1982 cited in Skaugset 1992). Another study showed 50% of a Coast Range stream shaded within 5 years of harvesting and burning (Beschta *et al.* 1987).

Direct solar heating of streams that are too wide to shaded by overhead trees can, in some cases, result in summer time stream temperatures exceeding 64°F even in relatively untouched watersheds (Brown *et al.* 1971). Riparian shade is unlikely to have a significant influence on stream temperatures where the natural low flow stream width exceeds 100 feet (Washington Forest Practice Board 1992). The South Fork Coos exceeds that threshold with a 120-foot low flow width. For comparison, Williams River is about 80-feet wide, and Tioga Creek is about 40-feet wide at the gauging station, and 60-feet wide at the mouth. Conditions on non-fish bearing streams can influence water quality in fish-bearing streams. Brown and co-authors (1971) observed the influence of a tributary's water temperature on a stream is proportional to its discharge. For example, non-fish-bearing tributaries contributing 20% of the flow to a fish-bearing stream will significantly influence water temperature (Caldwell *et al.* 1991 cited in Washington Forest Practice Board 1992). Therefore activities on tributary streams to retain or obtain streamside shade, and to improve contact and exchange between water in the stream channel and ground water (retain deep gravel beds, and reconnect streams with their flood plains) can insure cool water enters the fish bearing tributaries and the main stem streams.

Aerial photographs, taken before timber cutting indicate the 7th order stream reaches and the lower parts of 6th order streams in this Watershed are too wide to be shaded from the midday summer sun by latesuccessional streamside vegetation. The 5th order streams and the upper reaches of 6th order streams were shaded by trees for about 40 to 75% of their lengths. The 5th order and smaller 6th order stream reaches are narrow enough to potentially be fully shaded. However, as these streams migrate across their flood plains, the streambank trees are recruited to the channel leaving canopy gaps. Canopy gap creation alone is not sufficient to stimulate regeneration of replacement trees on sites with well-established shrub competition. Streamside tree regeneration is more likely to be successful where a disturbance (fire or landsliding or alluvial deposition) creates growing space by setting back shrub competition along with gap creation. Topographic maps showed the upper elevations of the stream side hardwood patches, and the narrow well defined linear gaps in the stream side overstory conifer stands to be around 800 feet to 1,200 feet elevation. The linear gaps in the overstory conifer stands were probably due to a combination of hardwoods occupying flood plains and the toe of the slopes (to the general exclusion of conifers), and to stream migration across the flood plains. The aerial photos of 5th and 6th order streams indicate that narrow flood plains were predominantly occupied by hardwoods below about 1,200 feet elevation. Based on the aerial photographs and site visits, narrow active flood plains above 1,200 feet were open or supported shrubs and young trees. In addition to the limiting affects of channel migration on tree longevity, the occupation of the higher elevation narrow flood plains by hardwoods was likely limited by winter cold and snow break. Streamside shrubs were important sources of shade along the narrower low elevation 5th order streams. Patterns visible on the aerial photos indicate that tree regeneration on narrow flood plains following disturbance will result in overhead shading of streams up to 5th order and of the upper reaches of 6th order streams with flood plains. However, fluvial disturbances will in time create canopy gaps above these streams and reduce the relative stocking of conifers on the active flood plains. Based on observation and on the reconstruction of the 1857/1871 vegetation communities along the lower Coos River contained in the Vegetation Appendix, the longevity and thus importance of conifers on the flood plains increases on larger flood plains where natural levees, down cutting/ geologic up lift, and back channels provide greater microtopographic variation.

<u>Sediment</u>: Factors such as gravity, geology, topography, climate, soils, vegetation and land use activities affect sedimentation, or more specifically the sediment cycle. The three closely related processes of erosion, transportation and deposition define the sediment cycle (Everest *et al.* 1987). Deposition is the process most directly related to impacts to water quality. Excessive fine sediments cloud water, choke fish gills, blanket fish spawning areas, smother bottom-dwelling aquatic organisms, and downstream can fill navigation channels and may alter estuary processes. Some amount of fine sediment is necessary for channel development and for providing habitats to some aquatic organisms. The larger material such as gravel, cobble and wood provide the components necessary for creating complex habitats. Sediment associated processes, and interactions are discussed at length in the Erosion Processes chapter.

<u>Habitat Modification</u>: Aquatic habitat is the parameter that has probably been impacted most severely by large-scale timber harvest operations, extensive road building activities, farming and ranching operations, irrigation, and stream cleaning activities. Removing large wood, eliminating or limiting large wood recruitment, confining stream systems and modifying the existing flood plains has simplified the aquatic ecosystems and altered channel characteristics. These issues are discussed more fully in other chapters.

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