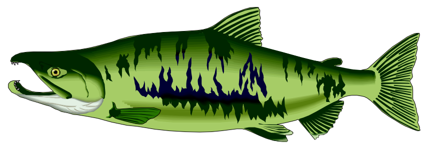
# FLORAS CREEK

# WATERSHED ASSESSMENT



**Prepared for**

The Floras Creek Watershed Council

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# ABSTRACT

The *Floras Creek Watershed Assessment* was prepared for the Floras Creek Watershed Council whose members are dedicated to sustaining the health of their watershed. This document contains detailed information about the Floras Creek watershed and follows guidelines described in the *Governor's Watershed Enhancement Board's 1999 Draft Oregon Watershed Assessment Manual*. Funding was provided by the Oregon Watershed Enhancement Board, Oregon Department of Environmental Quality, United States Bureau of Land Management, Oregon Department of Agriculture, Curry County Soil and Water Conservation District, and Oregon State University Extension Service.

# ACKNOWLEDGEMENTS

The completion of the *Floras Creek Watershed Assessment* was accomplished through the combined effort of private citizens, watershed council members, contracted technical specialists, and local state and federal government agencies. The South Coast Watershed Council would like to thank the following people who generously provided time and energy to improve the quality of this assessment. Additional people helped whose names are not included below. We also acknowledge them.

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# INTRODUCTION & PURPOSE

The *Floras Creek Watershed Assessment* contains technical information about past and present conditions in the watershed. This document updates and expands on information presented in the *South Coast Watershed Action Plan (1995)*. This assessment is a resource to promote better understanding of Floras Creek and its drainage area. The assessment was conducted in response to a need for more detailed information on salmonid fish and their habitat as well as water quality within the watershed. Particular emphasis was placed on private lands within the basin. The *Floras Creek Watershed Assessment* is based on current information and should be periodically updated, as new information becomes available.

The assessment methodology followed guidance provided by the *Governor's Watershed Enhancement Board's 1999 Draft Oregon Watershed Assessment Manual*. In some instances, diversions were made from this manual based on discussions with technical specialists and/or limitations pertaining to the time and scope of the project. The assessment examined historical conditions, ecoregions, channel habitat types, salmonid fish and their habitat, water quality, sediment sources, riparian and wetland conditions, hydrology and water use. Among the components addressed in the Oregon Watershed Assessment Manual that were not included in this assessment was an assessment of channel modifications.

The purpose of this assessment was to compile, summarize and synthesize existing data and information pertaining to Floras Creek's watershed conditions. Near completion of this document an interdisciplinary team, comprised of twelve technical specialists, reviewed the individual components of this assessment. The interdisciplinary team later met to discuss key findings, issues and/or concerns related to each of the assessment components. This information was then synthesized to provide a foundation for the prioritization of projects outlined in the *Floras Creek Watershed Action Plan (August, 2001)*. The action plan is a complementary document that addresses site specific and watershed wide recommendations for achieving restoration, enhancement and protection goals.

# I WATERSHED CHARACTERIZATION

## A INTRODUCTION

Floras Creek, a tributary of the New River basin, drains approximately 51,652 acres or 81 square miles of land. Floras Creek is located primarily in Curry County with a small portion of the East Fork extending into Coos County. It is also the most northern watershed in Curry County and crosses Highway 101 just south of the community of Langlois. Elevations in the watershed range from sea level to approximately 2,786 feet on Edson Butte. Major tributaries include the North Fork, East Fork, South Fork, West Fork, Willow Creek, and Floras Lake. The upper portion of the basin is characterized by steeply sloped forested areas with narrow valleys and tributary streams that have moderately steep to very steep gradient. Grazing, rural residential development and other agricultural uses are dominant in the lower portion of the basin. Streams throughout the lower basin have been diked, ditched, and drained. Flow regimes have been considerably altered in order to confine or reduce the impact of winter flooding and/or to increase areas available for pasture and cranberry production (ODFW 1995). Over 90% of the watershed is in private ownership.

**Note:** Due in part to the very complex nature of the New River basin as well as limitations of time and scope of this project only Floras Creek and its tributaries were assessed. In some cases however, information pertaining to New River was readily available and is therefore presented in this document.

## B SUBWATERSHEDS

The Floras Creek watershed was divided into eight "subwatersheds" for the purpose of this assessment. These subwatersheds generally follow hydrologic boundaries. However, some units include a series of small watersheds that do not drain into a common stream or include segments that are parts of a larger watershed. The delineation of subwatersheds provides a convenient way to refer to areas within the larger watershed.

Delineation of subwatershed boundaries was based on several factors, including major changes in topography, land use and stream size. Subwatersheds were named after the major tributary within the subwatershed so that references to each subwatershed would be consistent throughout all components of the assessment. In cases where no major tributary exists subwatersheds were named according to their relative location within the watershed (e.g. Lower Floras Mainstem subwatershed).

The Middle Floras Mainstem, as referred to in this document, includes the Floras Creek mainstem and small tributaries from the confluence of the North Fork and South Fork to just above Jenny Creek, where the valley begins to open. The Lower Floras Mainstem, as referred to in this document, includes the Floras Creek mainstem and small tributaries from just above Jenny Creek, where the valley begins to open, to its confluence with New River.

**Note:** Since the completion of this assessment an update has been made to improve the accuracy of two subwatershed boundaries including the North Fork and Middle Floras Mainstem. The actual drainage area of the North Fork is now estimated at 8,167 acres (increased from a previous 5,056 acres). Similarly, the actual drainage area of the Middle Floras Mainstem is now estimated at 5,732 acres (decreased from a previous 8,842 acres).

**Table 1 Floras Creek Subwatersheds**

| Subwatershed | Subwatershed Area (square miles) | Subwatershed Area (acres) |
|---|---|---|
| East Fork Floras | 16.4 | 10,497 |
| Floras Lake | 10.4 | 6,636 |
| Lower Floras Mainstem | 7.5 | 4,797 |
| Middle Floras Mainstem | 9 | 5,732 |
| North Fork Floras | 12.8 | 8,167 |
| South Fork Floras | 12.2 | 7,781 |
| West Fork Floras | 5.5 | 3,525 |
| Willow Creek | 7.1 | 4,517 |
| **Totals** | **80.9** | **51,652** |

## C LAND OWNERSHIP AND USE

Land Ownership

Approximately 92% of the land in the Floras Creek watershed is in private ownership. Private lands are divided into industrial and non-industrial lands. Non-industrial private lands account for approximately 69% of the basin whereas industrial private lands comprise about 23% of the total area. Some of the larger industrial private lands in the basin are believed to be owned and/or managed by Al Pierce Timber Co., Sun Studs Timber, Roseburg Forest Products, Georgia Pacific Co., Menasha Corporation, Moore Mill Company, and Crook Estate Land Trust. Non-industrial private lands are divided among a relatively small number of individuals who own moderate tracts of land. However, some non-industrial landowners also actively manage a significant amount of land for timber production.

Public ownership in the watershed is estimated at about 7.5%. Public lands, managed by the Bureau of Land Management (BLM) account for roughly 6% of the basin. County and state lands comprise only about 1.5% of the basin. Table 2 provides a list of land ownership by subwatershed. Map 2 illustrates the geographic distribution of ownerships within the Floras Creek watershed.

**Table 2 Land Ownership by Subwatershed** (acres)

| Subwatershed | BLM | Private Non-Industrial | Private Industrial | County | State | Total Acres |
|---|---|---|---|---|---|---|
| East Fork Floras | 314 | 7,860 | 2,322 | | | 10,496 |
| Floras Lake | | 5,686 | 117 | 691 | 140 | 6,634 |
| Lower Floras Mainstem | 271 | 4,399 | 126 | | | 4,796 |
| Middle Floras Mainstem | 332 | 7,040 | 1,473 | | | 8,845 |
| North Fork Floras | 537 | 3,954 | 418 | | 144 | 5,053 |
| South Fork Floras | 988 | 3,014 | 3,779 | | | 7,781 |
| West Fork Floras | 607 | 748 | 2,171 | | | 3,526 |
| Willow Creek | 59 | 3,123 | 1,335 | | | 4,517 |
| **Total Acres** | **3,108** | **35,824** | **11,741** | **691** | **284** | **51,648** |

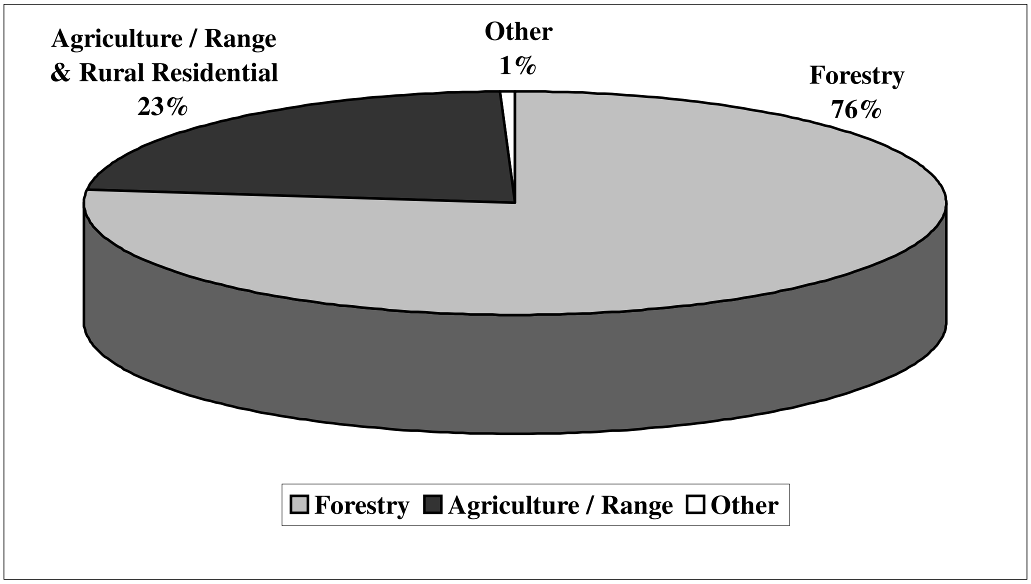
Land Use

Land use in the watershed is divided into two types including (1) forestry and (2) agriculture/range or rural residential. **Note:** Distinguishing between agriculture/range and rural residential was beyond the scope of this assessment and therefore the two are lumped into one land use.

(1) Forestry, the most dominant land use in the watershed, accounts for 76% of the watershed area and includes private industrial and private non-industrial lands in forestry use as well as lands managed by the BLM. Although forestry use is common throughout the entire basin it is most prevalent in the middle and upper portions of the watershed. Much of the forested land was logged within the past forty years and now consists of young timber stands. Some of these areas were left to naturally regenerate resulting in Alder dominant stands (WQMP 2000).

(2) Agriculture/range and rural residential areas account for 23% of the watershed. These lands are located throughout the watershed except in the West Fork and South Fork subwatersheds. Rangelands are primarily managed for livestock grazing whereas agricultural lands are primarily managed for cranberry production. Major types of livestock include sheep and cattle. To a much lesser degree, other types of livestock include llamas, emus, horses, goats, etc. Cranberry production is active in the Lower Floras Mainstem and Floras Lake subwatersheds. Although once common, dairies in the watershed are almost nonexistent. The only dairy in the watershed, located in the Lower Floras Mainstem subwatershed, is not currently in operation.

**Figure 1 Watershed Land Use Summary**




## REFERENCES

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

ODFW 1995. Guide To Project Selection - South Coast Fish Management District. Oregon Department of Fish and Wildlife, November 1995

WQMP 2000. Floras Creek Watershed Water Quality Management Plan. November 2000

# II WATERSHED ISSUES

## A BACKGROUND (GWEB 1999)

The issues to be addressed in a watershed assessment typically arise from local efforts to address concerns that often begin at federal and state levels. Listing of fish populations under the federal Endangered Species Act, for example, immediately focuses attention on evaluating habitat quality or hatchery production in the watershed. Likewise, water quality limited stream segments, listed under authority of the federal Clean Water Act, require that watershed management plans or Total Maximum Daily Loads (TMDLs) be developed at the state or local level.

## B INTRODUCTION

The identification of watershed issues was intentionally conducted early in the process to help direct the watershed assessment. The purpose of identifying watershed issues was primarily to gain an understanding of the Floras Creek Watershed Council's perspective on those practices that may potentially impact salmonid fish habitat and water quality. The watershed council identified critical issues during council meetings held in Langlois on June 1 and October 5 of 1999. The council listed significant land uses within the watershed and their associated impacts to fish habitat and/or water quality. Watershed issues were also identified by technical specialists who reviewed this assessment document. Specific practices were then identified as the primary driver for each issue. The issues addressed reflect both present and legacy practices. Regulatory issues, identified by the project manager, are listed in Table 3.

## C RESULTS

The Floras Creek watershed issues are summarized in two tables: Table 3 Floras Creek Regulatory Issues and Table 4 Floras Creek Watershed Issues.

**Table 3 Floras Creek Regulatory Issues**

| | |
|---|---|
| **Aquatic Resource Issues**<br>(Based on federal and state law) | **Endangered Species Act**<br>coho salmon – threatened<br>steelhead – not warranted<br>cutthroat – not warranted |
| | **Clean Water Act – 303 (d) List (Floras Creek)**<br>Floras Lake – aquatic weeds or algae<br>Willow Creek – temperature (summer) |
| | **Clean Water Act – 303 (d) List (New River)**<br>New River - temperature<br>Bethel Creek - temperature<br>Butte Creek - temperature<br>Fourmile Creek - temperature<br>Morton Creek - temperature |

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

**Table 4  Floras Creek Watershed Issues**

| LAND USE | PRACTICE | ISSUE |
|---|---|---|
| Forestry | I  Timber harvest | 1) Increased run-off and resulting sedimentation/turbidity of mainstem and tributaries<br>2) Reduced quantity of large woody debris in streams<br>3) Reduced LWD recruitment<br>4) Conversion to hardwood dominated riparian areas |
| | *comments:  some areas have not been replanted  (e.g. 1,200 acres on Horner Creek, tributary of the North Fork)* | |
| | | |
| | II  Clearing of large woody debris from streams | 1) Reduced quantity of large woody debris in streams |
| | *comments:  there is a general recognition that more large wood is needed in the creeks (e.g. North Fork)* | |
| Agriculture | I  Conversion of forest/wetland to pasture | 1) Reduced shade and over-hanging vegetation<br>2) Lack of cover<br>3) Change in hydrologic function<br>4) Reduced LWD recruitment |
| | *comments:   some pasture land is reverting back to forest as a result of ailing farm economy* | |
| | | |
| | II  Cranberry production/harvest | 1) Water use<br>2) Chemicals |
| Road Network | I  Past and present construction and maintenance of roads, especially in the upper watershed | 1) Increased run-off and resulting sedimentation/turbidity of mainstem and tributaries<br>2) Fish passage barriers<br>3) Removal of vegetation |
| Mining | I  Mining of quarry rock | 1) Possible sources of sediment input |
| | | |
| | II  Mining of gravel rock | |
| Rural Residential | I  Clearing of vegetation for rural residential development | 1) Reduced shade and over-hanging vegetation |

| LAND USE | PRACTICE | ISSUE |
|---|---|---|
| | | 2) Reduced LWD recruitment |
| **Sport Fishery** | I Violation of regulations/laws (poaching, trespassing, fishing out of season, bag limits, etc.) | 1) Increase in harvest - contributing factor to salmon decline |
| **Commercial Fishery** | I Overfishing in the ocean | 1) Increase in harvest - contributing factor to salmon decline |
| **Predator Control** | I Lack of control of predators from seals, sea lions and waterfowl (cranes, herons, cormorants and mergansers) | 1) Increased predation on juvenile and adult salmonids |

Unshaded Area = Practice or Issue identified by watershed council
Shaded Area = Practice or Issue identified by technical specialist(s)

# III HISTORICAL CONDITIONS

## A INTRODUCTION

This chapter summarizes available information on historic and current land use effects on the natural watershed. While the Floras Creek watershed has been altered and restoration to a pristine condition is not an option, knowledge of historic conditions and the cumulative effects of land use can help guide restoration actions and improve chances for success (HRWA 1999). Documenting how natural, unmanaged streams interacted with the streamside forest allows us to see how far we have deviated from optimum fish habitat requirements (Sedell and Luchessa 1981). This chapter was almost entirely prepared by watershed steward and council member, George Fleming. Information was obtained and interpreted from various historical documents, journals, newspapers, personal interviews, and BLM record and correspondence files. Some dates are approximations.

## B HISTORICAL NARRATIVE

Native American Presence

The Floras Creek watershed has been continuously inhabited for over 8,000 years. Shell midden piles found on the rises above the Floras Creek floodplain indicate centuries of habitation. Various native artifacts found in many locations suggest that the area supported many small and several large villages. The native people experienced a relative abundance of resources and relied on the river and its confluence with the ocean as the source for much of its wealth.

Prior to the arrival of white man, the Qua-to-mah and the people of the lower Coquille gathered annually both to praise as well as harvest salmon that entered the Floras Creek estuary, wherever the river met the ocean. This annual gathering was an important time when Native Americans caught and dried salmon, shellfish, elk, deer, berries and tuberous roots on a subsistence basis. Special significance was given to salmon and much ceremony and ritual surrounded the annual return of the fish. The salmon was sacred in all cultures on the coast. By 1856 all of the native populations had been removed and Euro-American settlement grew steadily in the Floras Creek watershed.

Arrival of Euro-Americans

The first white men to view this bountiful land on foot were the fur trappers. In 1826, Alexander McLeod visited the area from the Hudson Bay Company. He arrived from the North and "found it necessary to hire a native canoe in order to cross a considerable flow to reach the large native village on the northeast shore of Floras Lake". He found the area to be an "extensive swamp or marsh."

In 1828 Jedediah Smith passed the Floras Creek basin on the beach and describes the area as having small pine and makes no mention of different vegetation.

In June of 1851 J.M. Kirkpatrick led a group of eight men north, while escaping native people in Port Orford, and came upon the Floras Creek deflation. He describes,

*"about three o'clock the next day, we came to the edge of what seemed to us a large plain. It looked to be miles in extent, and was covered with a heavy growth of high grass, and proved to be an immense swamp. We now determined to try and cross this swamp and reach the sea after dark and travel all night. We floundered around in this swamp all night, sometimes in water up to our armpits, until after dark we found a little island about an acre of dry land and covered with a thick growth of small fir bushes. Here we laid down and tried to rest and sleep but encountered a new enemy in the shape of clouds of mosquitoes."*

The Oregon Surveyor Generals 1855 map illustrates Floras Creek flowing directly into Floras Lake before emptying directly into the ocean.

<u>Mining (1850-1900)</u>
The first Caucasian settlers arrived to the Floras Creek watershed in 1854. The terraced area of the lower watershed attracted settlers early, mostly because of the gold in the beach sands and the terrace gravel. Three land donation claims were originally made in the lower watershed. One, known as the Swift or Starr ranch was located on the south side of Floras Creek, at the junction of the old beach trail and the inland trail where the present day junction of Floras loop and Floras lake road is. Two or more claims were located just west of present day Langlois, currently known as the Knapp Ranch. One of these was owned by William Langlois and is near the site of the first Langlois store. Several of the Langlois children settled on Floras Creek. The first Langlois store was owned by William's son Frank and partner A.H. Thrift. Another donation claim was farther North of the old trail, just east of New Lake.

Many who came to mine stayed to farm. Gold was not found in the Floras Creek watershed as it was in the Sixes and Elk rivers. Some prospecting happened throughout the watershed in the very early days, but as trappers found with the beaver, no marketable amounts were ever reported.

<u>Fire</u>
*Pioneer Trails of the Oregon Coast* notes that the terrace area was burned over frequently and was by no means completely reforested when the early travelers arrived. The natives often used fire to control brush and create open spaces, thus encouraging the grazing of elk in places convenient for hunting. Some areas in the lower Floras Creek watershed were thought to be managed this way.

The great fire of 1868 reduced much of the coastal forest to ashes and burned many of the homesteads. The fire devastated the local elk population and eliminated much of the low laying timber. Orville Dodge wrote about nearing "Dairyville" as Langlois was originally called.

*"There has been quite an extreme growth of timber along this bench but fire has*

*destroyed the large trees, except in a few places, but a second growth has taken the place of their forefathers and in places the trees seem to reach the sky before their trunks assume a large proportion. In places glades covered with a wild honeysuckle and rhododendrons stretch out for long distances and in June the whole country is a varitable flower garden... Just before arriving at Dairyville, a sawmill is seen at the right of the road and supplies the farmers with lumber... The town nestled at the foot of a hill up which a wagon road branches off that leads to Myrtle Point and is traversed by a daily mail stage and makes the trip in six hours over a considerable mountain."*

The stage roughly followed Langlois Mountain Road and connected the North Fork and East Fork after passing through the town of Hare at the four-mile mark. Small homesteads began to dot the upper valley. Land clearing for pasture and timber was always the first job.

<u>Agriculture (1850-1900)</u>
Farming was the standard. Dairy ranching was the primary occupation of early settlers. Land clearing occurred along the stream banks and bottom-land first. Ditches to drain fertile marsh areas started in those early days and only increased, as settlers needed more land for their growing herds of dairy cattle. Cheese and butter became important products of the lower watershed. Originally a good market for farm products was as close as the troops at Fort Orford and the miners and settlers they were dispatched to protect.

By the 1880's the Floras Creek basin was home to several large dairies. Most surrounded lower Floras Creek. Constant clearing and draining was necessary to provide adequate pasture. Orville Dodge wrote in 1889,

*"A.H. Thrift, whose broad acres of rich bottom lands join the town flat and supports a hundred cows of improved blood... several creameries were in the area... butter and cheese are the chief products of this region known more particularly as the Flores Creek Basin."*

<u>Agriculture 1900 – 1950</u>
Dairy farming was making Langlois famous with the largest dairy farms and a growing cheese industry. Several cheese factories were in the area of Denmark, The Cudahy Packing Co. and one of the earliest whose head cheese maker was Mr. Manning. The Star Cheese Factory, located just west of Langlois and north of Floras Creek, was established in 1925 by Hans Hansen. Hans leased the Star Ranch and milled up to 125 cows. Many other ranchers delivered milk to Hansen as well as other cheese factories. The continued settlement and subsequent changes to the landscape placed a great demand on the watershed. During the 20's and 30's much of the marshland North of Floras Creek was ditched. A.H. Thrift was the first to employ a steam donkey in ditch construction. Bono ditch and Hansen Slough were created as well as the deepening of Floras Creek in an attempt by Joseph Bono and Hansen to create new pasture.

Cranberries were introduced in 1915. A spruce swamp was hand-cleared. Originally berries were dry picked using "native" labor. Later in the century the flooding or "wet pick" harvest methods would be introduced placing a large need for water at the end of the dry season.

The first commercial lilies on the Oregon coast were grown in the Floras Creek basin. The "Ace" Easter Lily was developed by Clark Slocum on a ranch just north of Langlois. He produced lilies from the 30's through the mid 60's.

Timber Harvest & Saw Mills

The upper portion of the watershed contained vast stands of timber. White cedar and Douglas fir were the dominant species. Early logging techniques utilized the stream channel as the main means of log transportation with the trees closest to the creek being the first to go. Few historical records exist of the upper Floras Creek watershed but it may be assumed, to a certain degree, as similar to other coastal streams for which there are records. Huge old growth trees most likely bordered both sides of the streams with large woody debris providing complex in-stream habitat and channel stability. *A Century of Coos and Curry County* stated,

*"A pioneer track used as early as 1859 led out of Langlois over the hills and down Catching Inlet to the Myrtle Point vicinity."*

Several sawmills have been supported by timber from the Floras Creek basin. Adolphsen's Mill on Elk River operated for many years and was the destination for much of the white cedar in the area. O.P. Haagensen operated a mill, as did Jack Tucker. Tucker first operated a sawmill on Langlois Mt. next to the North Fork. Area logs from the North and East Forks supported Tuckers originally. The mill moved to town in the early 50's and became all electric in 1952 when Bonneville Power came to town. Many ranchers were originally loggers converting forest to pasture. The Hildebrands, Mcleods and Isenharts all logged forests of the upper basin. With the introduction of the chainsaw in the 40's and the development of the large D "Cats" most of the forest was harvested and is now in second or third growth in most places. Presently, very little "old growth" exists in the watershed. The closing of Tucker's Mill in the late 1990's marked the last mill closure in the Floras Creek basin.

New River

1889 was the year Dairyville was plotted by A.H. Thrift. The following year a huge flood wiped out several farmers in the lower basin and created a "new river" As the water pushed North parallel to the ocean. By 1897, the out-flow from Floras Lake joined Floras Creek and traveled North for about a mile where it enters the ocean.

By the turn of the century the foredune at the mouth of Floras Creek / New River was manually breached by local ranchers and farmers on a periodic basis. European beach grass was introduced in 1930 in an attempt to stabilize the dune between the creek and the ocean. A 1939 aerial photo showed the outlets of Floras Creek to be separate form those of New Lake and Fourmile Creek. Today, in times of heavy rain, Floras Creek often connects North through the deflation plain to the out-flows of New Lake and Croft Lake where it enters the ocean. The foredune separating New River from the ocean is low and flat and is continually being breached in different locations.

Salmon

There was much competition for the salmon, all methods of harvest were employed but the most efficient were preferred, this being gillnetting. Allen Boice ran a good freight business; a six-horse team was used to haul fish from Sixes River and Floras Creek to the canneries and markets in Bandon. Huge fish were sold along the way for 50 cents each. By 1945 a large sport fishery was developed in Bono ditch, trolling for salmon. Most of New River salmon runs migrated through New Lake and Bono Ditch into Floras Creek. Shore pines were planted on the east side of New River in an attempt to control the channel banks.

Today, efforts to protect, enhance and restore salmon habitat have sparked much interest to understand how our legacy practices may have influenced present day salmon populations and water quality.

## C HISTORICAL TIMELINE

**500 A.D. –** The weather becomes cooler and wetter; conifers rather than savannah oak dominate forests. Sand builds up along the beach in front of the ancient Floras Creek estuary, creating a vast swamp interspersed with shallow lakes. A wave of migration from the north brings new cultural traits and the Athapascan language to the New River area. The Qua-to-mah tribe occupies a territory extending from New River in the north to Humbug Mountain in the south. Major villages are located at the north end of Floras Lake, on the south end of New Lake, at the outlet of New Lake, and west of Croft and Muddy Lakes. Primary economic pursuits are fishing, shellfish gathering, hunting of sea and land mammals as well as waterfowl, and gathering of roots and berries in the New Lake marshes. People live in rectangular plank houses. They hunt with bows and arrows, and worship salmon and sea mammals.

**1600 A.D. –** Spanish, English, and other European explorers begin to visit the south coast of Oregon. The Qua-to-mah obtain metal and glass objects from trade and shipwrecks, but also are exposed to virulent diseases like smallpox. This trade climaxes in the late 1700s, when many European vessels stop at Port Orford in search of sea otter and beaver pelts.

**1603, January –** The Spanish vessel Trey Reyes, captained by Martin Aguilar and Antonio Flores, sails along the southern Oregon coast after being blown off course by a storm. They name “Cape Blanco”; Flores is later attached to “Floras Creek” and “Floras Lake”.

**1700 A.D. –** A major earthquake strikes the region, forcing much of the New River area to subside one to two feet. Floras Creek, which may have previously drained directly into New Lake, carves a new channel and flows west to the ocean before turning north.

**1800 A.D. –** The Coquille and Qua-To-Mah Indians gather at Floras Creek each fall to catch salmon when the river breaches the foredune.

**1826 A.D. –** Alexander McLeod, a trapper for the Hudson's Bay Company, and his men head south on a journey of exploration from the Umpqua to the Rogue River. When he reaches Floras Creek, he observes "passed a small river (named) by the natives "Chiste Etudi." Formed our camp near where our people were lately trapping, on the border of an extensive marsh or swamp."

**1828 –** Jedediah Smith and 18 men travel up the beach in front of the deflation plain of Floras Creek, on their journey up the Oregon coast as they searched for beaver pelts.
**1851, June –** John Kirkpatrick and eight men cross the Floras Creek country during their escape from an Indian siege at Battle Rock near Port Orford. *See Historical Assessment Narrative for interesting quote.*

**1852 –** The U.S. Army establishes a post at Port Orford and begins patrols into the surrounding countryside to control Indian activities. They graze their considerable horse herd on the lush prairies along lower Floras Creek.

**1856, Spring –** All of the Indian tribes from the Coquille to the Chetco River rebel against the invasion of white settlers and miners into their territory. The settlers stay at a fort in Port Orford until the Indians are defeated by the U.S. Army and deported to a reservation in northern Oregon.

**1856 –** At the end of the Rogue Indian War, settlers begin taking out donation land claims between Floras Creek and Bandon. The discovery of gold in California creates a tremendous market for farm produce, including cheese and butter, salted beef and mutton. Farmers haul their goods by wagon to Port Orford or Bandon, where they are loaded on schooners and shipped to San Francisco. Among the earliest settlers were Isham Cox, Chris Long, William Langlois, A.H. Thrift, and Shipman Crouch. Ditching and draining of wetlands begins.

**1865 –** The McClellens establish a ranch at New Lake.

**1868 –** A tremendous forest fire burns between Port Orford and Bandon, destroying most of the settlers' homes and livestock. The extensive elk herds that once grazed on the Floras Creek river bottoms are almost wiped out.

**1873 –** William Gallier establishes the New Lake Dairy on the east side of the lake.

**1876 –** Settlers on lower Floras Creek include the Brocks, Chris Long, William Langlois, William Burris, Jonathan Scott, Edward Burroughs, Al Thrift and The Burnaps.

**1880 –** Frank Langlois and A.H. Thrift form a partnership for the establishment of a store on the Langlois farm a mile west of the present town of Langlois.

**1880 –** The mail route between Bandon and Langlois follows the beach from Bandon to near Croft Lake, where it turns inland and follows the ridge bordering the north side of Conner Creek. From this point, it turns south and follows the present course of Highway 101.

**1881 –** A post office is established at Langlois.

**1888** – Forest Fire

**1889 –** The town of Dairyville (present day Langlois) is platted in 1889 by A.H. Thrift. Thrift's farm is located on the north side of Floras Creek and west of the present town of Langlois. Historian Orville Dodge writes in 1898, "We refer to A.H. Thrift, whose broad acres of rich bottomlands join the town plant and support a hundred cows of improved blood."

**1890 –** A tremendous flood wipes out some farms along Floras Creek, and the floodwaters flow through the deflation plain north of Floras Creek outlet, prompting local ranchers to say that it looks like a new river.

**1893 –** The largest dairy ranch in Curry County, the Starr dairy, milks up to 150 cows daily. This ranch is located north of Willow Creek.

**1897 –** Floras Creek and the outlet of Floras Lake join to form a short river that runs north for about one mile and enters the ocean southwest of New Lake. A short river that enters northwest of New Lake drains New Lake and surrounding marshes. Fourmile Creek is the third outlet shown entering the ocean northwest of Croft Lake. Croft Lake is drained by a narrow channel that flows south into New Lake. These streams are connected by a deflation plain, extending from north of Floras Lake to Laurel Lake, that fills with water each winter. The beach in front of this deflation plain is very flat and is constantly breached in different locations.

**1900 –** Several families of Native Americans obtain allotments in the hills east of New River, along Fourmile and Floras Creeks. They work part-time for local ranchers.

**1900 - 1935 –** Each fall, New River is artificially breached by farmers who supplement their income by gillnetting salmon for sale to local canneries. The location of the breach changes often as adjacent landowners compete to see who can get to the salmon first.

**1903 –** Maps drawn in 1903, 1913, 1932, and 1936 all show New River as a contiguous stream running from Floras lake to the outlet west of Croft lake. However, these maps also show that New River has a second mouth located southwest of New Lake. Throughout most of the year, Floras Creek and the outlet of Floras Lake flow through the southern breach while New Lake drains towards the northern breach. The two systems are connected but only during periods of high winter runoff. Local residents refer to the outlet of New Lake as New River.

**1903 –** Wallace Pomeroy homesteads on the southeast side of New Lake.

**1911 –** Edith Gallier and her family move to the New Lake Dairy. Edith attends school in a one-room schoolhouse at New Lake, where the first eight grades are taught.

**1915 –** One of the earliest cranberry bogs in the Bandon area is built on the east side of Muddy Lake by Henry Eden and Dr. Roland Leep. The spruce swamp is cleared by hand, and a steam donkey is connected to a haul back to obtain sand from dunes east of new River. These bogs are hand picked by local women who are hired each fall, and paid in vouchers that can be redeemed at several Bandon businesses.

**1915 –** Hans Hansen leases the Starr Ranch, and milks 150-175 cows daily. He soon establishes the Langlois Cheese Factory and begins producing blue cheese in 1931. By 1941, the Langlois plant is producing half a million pounds a year.

**1917 –** Joseph Stankeiwicz, a pioneer cranberry grower in the Croft lake area, crosses the McFarlin cranberry vine with wild vines from a marsh at new lake to create the Stankevich variety.

**1930 –** European beachgrass, first introduced to the Oregon coast in 1915, becomes established in the New River area, and a beach ridge begins to form along the coast from Floras Lake to Fourmile Creek.

**1920-1940 –** Farmers attempt to gain new grazing land by draining the marshes south of New Lake. A.H. Thrift is the first rancher to construct a ditch using steam donkey on a sled. Bono Ditch is created, and Hansen Slough and Langlois Creek are straightened and deepened to drain excess water from shallow lakes/marshes, and to provide additional grazing for the large dairy herds of Joseph Bono and Hans Hansen.

**1936** – Forest Fire

**1939 –** Shirley Brown acquires a 220-acre ranch at the mouth of Fourmile Creek, which at this time runs due west into the ocean. He operates a dairy, grazing the area from Croft Lake to Twomile Creek.

**1940 –** Although the beach ridge continues to grow, there are still separate outlets for Floras Creek, New Lake, and Fourmile Creek. A 1939 aerial photograph shows the outlet of Floras Creek to the west of Bono Ditch. The photograph also shows some foredune development near the outlet of New Lake.

**1943 –** Louis Knapp, Jr. purchases the historic 840-acre Thrift Ranch and begins farming it in 1947.

**1945-1955 –** A popular sport fishery develops in Bono Ditch with trolling for coho salmon. Most of the New River salmon run migrates through New Lake and Bono Ditch into lower Floras Creek.  The section of New River west to New Lake carries water only during midwinter.

**1947 –** Gerald Kamph purchases the Joseph Bono property south of New Lake and begins ranching.

**1950 –** Extensive plantings of shore pines are made on the Storm Ranch in an attempt to control shifting sand dunes.  The trees begin to spread and cover much of the terrace bordering the east side of new River.

**1951 –** Lloyd Collins, University of Oregon Archaeologist, records a prehistoric site at the "ocean entrance of New Lake, T. 30S, R. 15W, Sec. 10, NE ¼."  He further notes that the shell midden has been "wave-washed and largely destroyed," indicating the site's proximity to the mouth of the river.

**1954** - A pronounced foredune covered with driftwood and clumps of beachgrass has developed along New River; and Floras Creek, New River and Fourmile Creek are combined to form one system, with the outlet northwest of Croft Lake. The river is very shallow with a sandy bottom and supports little vegetation.

**1955-1975** – An intensive sport fishery develops at the mouth of New River.  Local landowner Jack Storm controls the access to the fishing, and charges a one to two dollar entry-fee.  Several thousand fishermen visit his property each year, and catch large numbers of coho and chinook salmon as well as steelhead.  He artificially breaches the river each fall in front of his property to control the fishery, and to maintain a deep lagoon (10-15 feet deep) at the river's mouth.  In 1970, the Oregon Fish Commission begins stocking Floras Lake with coho smolts, which greatly enhances the New River fishery.

**1960** – The McKenzie family purchases the New Lake Ranch from Fraser and Graham. They begin to dredge channels between New Lake and Bono Lake that greatly reduce the freshwater marshes of the area.  Local fishermen now call the outlet of New Lake "the ditch".  Public access is allowed for hunting and fishing.

**1964 –** The state of Oregon establishes a minimum streamflow of 10 cfs for July and 5 cfs for August and September on lower Floras Creek to protect fishery values.  This validates the state's water right and gives them priority over any other rights filed after 1964, but 18 pre-1964 permits are not subject to shutdown regardless of streamflow.

**1964 –** A major flood occurs at Christmas, inundating much of the farmland around New Lake and lower Floras Creek.  New River is artificially breached near Floras Lake to help alleviate the flooding.  This was an emergency measure that was not carried out for several subsequent years, probably because of Jack Storm.

**1968 –** After renting for several years, Rod McKenzie purchases the Starr Ranch from Buffington and Crook.  He receives permission from the state to channelize portions of

Floras Creek to clarify property boundaries and decrease flooding problems. Hunters and fishermen are granted access to the Starr Ranch, providing some of the best waterfowling along the coast.

**1969 –** The Oregon Beach Bill undergoes final revisions and is implemented. This establishes the states right to a recreational easement west of the vegetation line, which on New River is determined to be along the east bank of the river. The historic artificial breaching of new River may have contributed to this decision by weakening the foredune. This law is vigorously opposed by local landowners, who say they were not notified by the state or allowed any formal comment before the law was enacted. They further contend that the zone line should be on the west, rather than east, side of New River.

**1970, Winter –** Bono ditch becomes clogged with debris after a flood, and New River begins to increase in size and depth. Much of the best fish-rearing habitat between Bono and New Lake is lost, and fish runs, especially of coho, begin a dramatic decline.

**1973, November –** New River is breached near the outlet of Floras Lake for the first time since the Christmas flood of 1964. This breaching is unauthorized and provokes a great opposition from local sportsmen and Jack Storm. BLM representatives attend a hearing at Langlois and help resolve the differences between Storm and the newly organized Floras Creek Water Control district (comprised of local ranchers). The BLM adopts a position supporting the manual breaching of the seawall near Hansen Slough between November and December of each year to help alleviate flooding and yet not interfere with the important fall sport fishery. This breach allows for about one mile of rearing habitat/estuary between the outlet of Floras Lake and the mouth.

**1977, spring –** Alan Haga and other local landowners construct a check dam at the outlet of Floras Lake to maintain the lake level during a severe drought.

**1981-1986 –** Several attempts are made by the Oregon Department of Fish and Wildlife (ODFW) Salmon and Trout Enhancement Program (STEP) to improve salmon passage at a natural barrier (located at approximately river mile 8.0) by dynamiting rocks. The attempts to improve fish passage were apparently unsuccessful.

**1981-1998, winter –** Heavy flooding and high winds precipitate a major move northward by New River. Both the mouth of the river and the river channel move from the NW ¼ of Sec. 3, T. 30 S. on the Storm Ranch to the NW ¼ Sec. 35, T. 29 S., north of Fourmile Creek. This move is consistent with a gradual shifting of the mouth northward since 1950, when the foredune became established. The location of the mouth was somewhat consistent during the 1960's and early 1970's when Jack Storm artificially breached the river each fall near the north line of Section 10. Since Storm sold his ranch, the river is allowed to breach naturally most years, and has slowly carved its way north through the foredune.

**1982 –** the U.S. Fish and Wildlife Service becomes alarmed at the number of Aleutian Geese that are being killed by hunters each fall near New Lake. They close the river to goose hunting and begin monitoring goose migrations each spring and fall.

**1985, August –** While helping Gerald Kamph build the fence at the southern boundary of the Area of Critical Environmental Concern, BLM employees discover that the river has dried up between Hansen Slough and New Lake, causing a considerable loss of salmon and steelhead smolts. The Kamphs complain that several of their cows have died drinking brackish water, indicating a possible saltwater incursion into the water table.

**1986, winter –** New River, which has periodically been breached manually at the south end from 1973 on, is breached again in December. Attempts have usually been made to create the breach just south of Hansen Slough. This allows for the formation of a deep channel running from the outlet of Floras Lake to Hansen Slough, providing excellent fishing opportunities. Although the primary reason for the breaching is to alleviate flooding along lower Floras Creek, this effect is very temporary. The breach usually stays open for only a few weeks before sanding in again.

**1993, March –** The Snowy Plover, a species of concern to the U.S. Fish and Wildlife Service for the last ten years, is formally declared a threatened species. New River, which once supported a nesting population of 15 to 20 Snowy Plovers, now has only one documented nesting pair.

**1998, August** – Coho salmon are listed as “threatened” under the Endangered Species Act.

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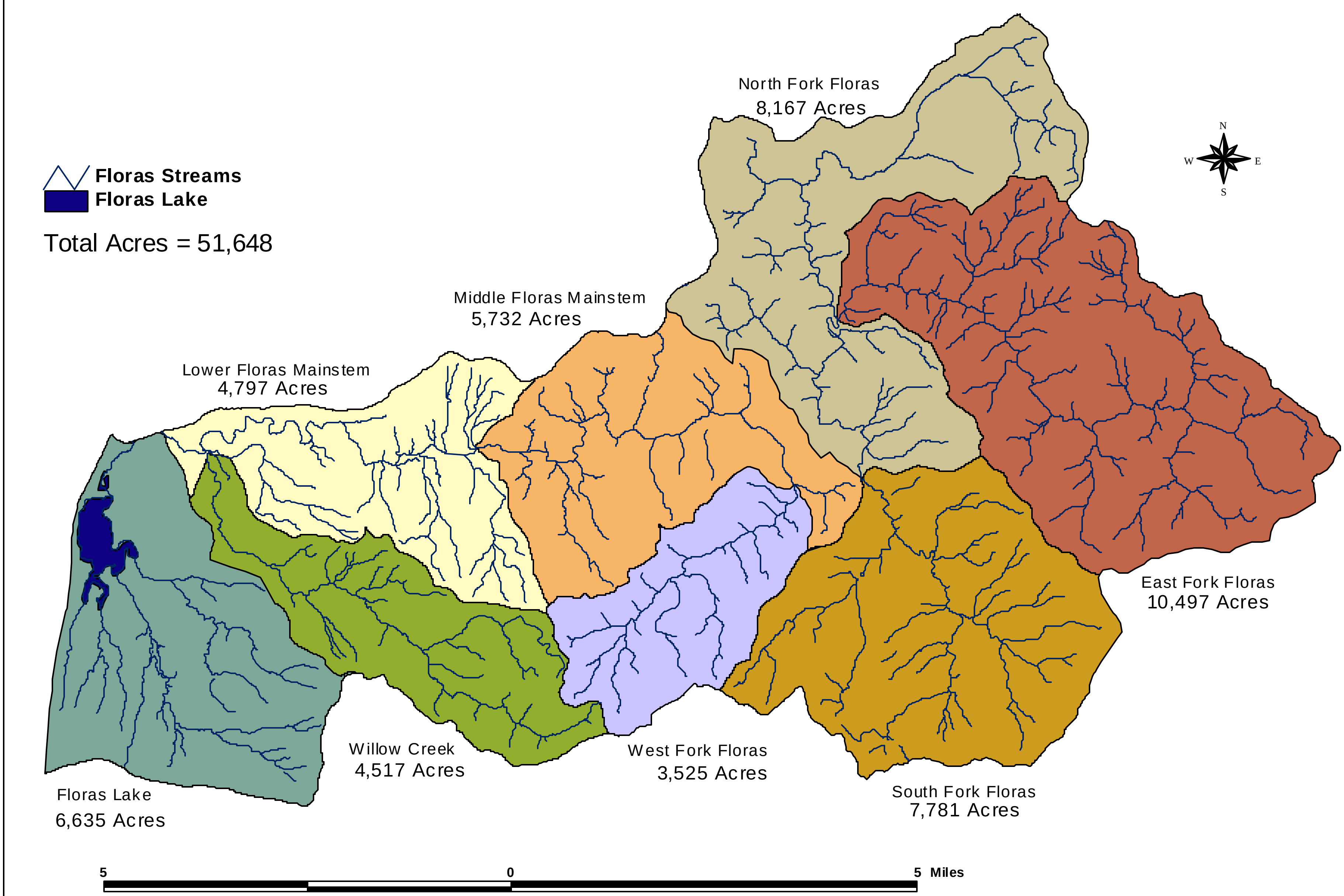
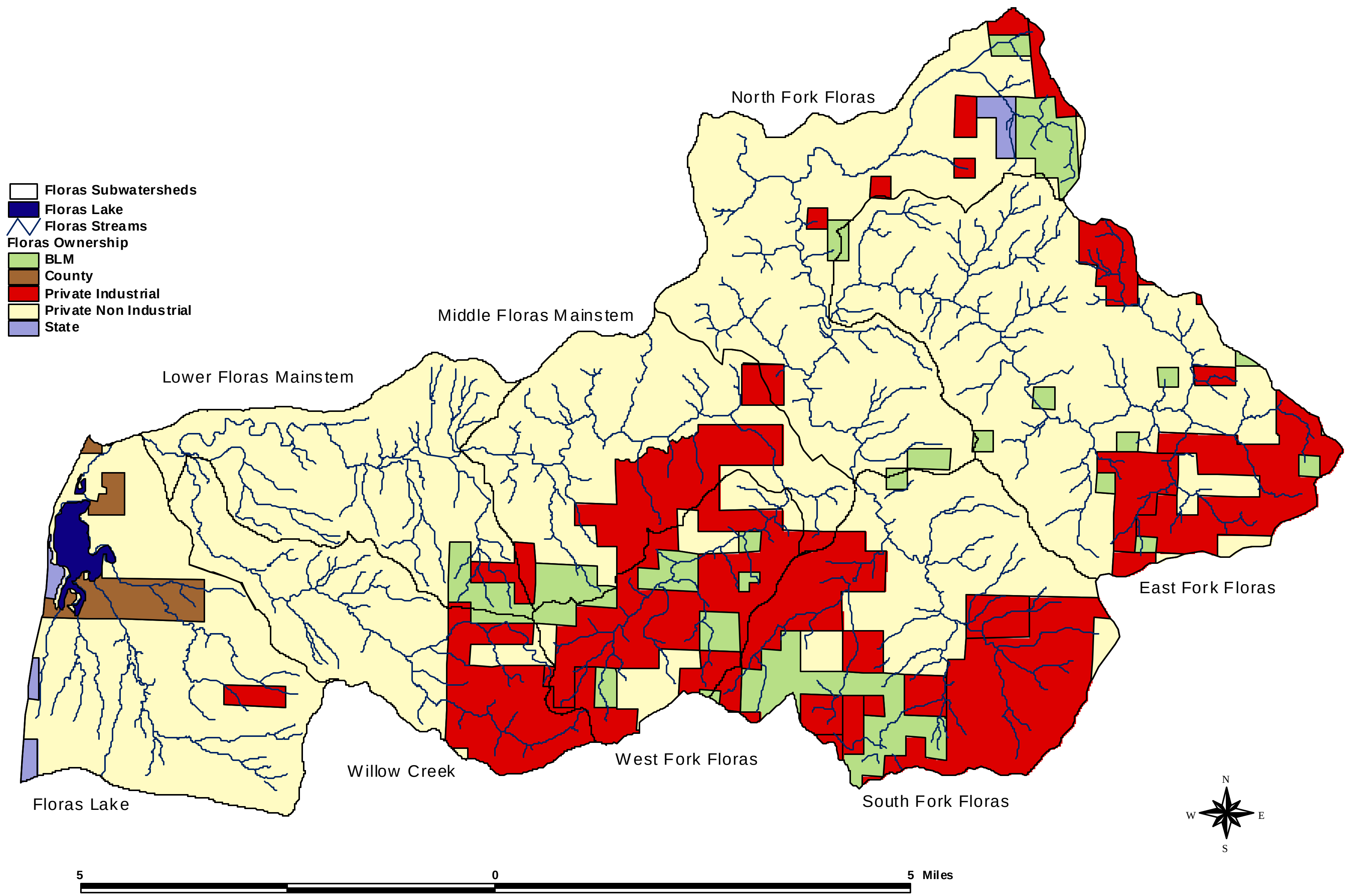
# Floras Creek Subwatersheds



# Floras Creek Ownership



# IV ECOREGIONS

## A BACKGROUND (GWEB 1999 and USEPA, 1996; Omernik, 1987)

The State of Oregon is divided into ecoregions that have been identified based on climate, geology, physiography, vegetation, soils, land use, wildlife, and hydrology. Each ecoregion has characteristic disturbance regimes that shape the form and function of watersheds in the region. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. Ecoregions are directly applicable to the immediate needs of state agencies, including the development of biological criteria and water quality standards, and the establishment of management goals for nonpoint-source pollution. They are also relevant to integrated ecosystem management, an ultimate goal of most federal and state resource management agencies. The following table illustrates the hierarchy of ecoregions characterized for North America. Level I is the coarsest level, dividing North America into nine ecological regions, whereas at Level II the continent is subdivided into 32 classes. Level III contains 98 subdivisions in the continental United States whereas Level IV is a subdivision of Level III. Level IV Ecoregion descriptions provide the most detail and are therefore, the focus of this assessment.

**Hierarchical Scheme of Ecoregions**

| | |
|---|---|
| Level I | 9 Ecological Regions of North America |
| Level II | 32 Ecological Regions of North America |
| Level III | 98 Ecological Regions of North America |
| Level IV | >98 Ecological Regions (Subdivision of Level III) |

(USEPA, 1996; Omernik, 1987)

## B INTRODUCTION

The Floras Creek watershed is situated within one Level-III Ecoregion that is subdivided into two Level-IV Ecoregions. The Level-III Ecoregion is titled the **Coast Range**. A Brief description of this broad ecoregion is provided in the following paragraph. More detailed descriptions of the two Level-IV Ecoregions are provided in the following pages.

<u>Coast Range</u>

The Coast Range contains highly productive, rain drenched coniferous forests that cover low elevation mountains. Sitka spruce forests originally dominated the fog-shrouded coast, while a mosaic of western red cedar, western hemlock, and seral Douglas-fir blanketed inland areas. Today, Douglas-fir plantations are prevalent on this intensively logged and managed landscape. Within the Coast Range exist several Level IV Ecoregions. A portion of the Floras Creek watershed is situated within two of these Level IV Ecoregions. They include the **Coastal Lowlands** and the **Southern Oregon Coastal Mountains**. The Coastal Lowlands include portions of the coastal fringe from Seaside (Oregon) in the north to Gold Beach in the south. The Southern Oregon Coastal Mountains include the southern coastal area from Bandon to Brookings, extending inland from 5 to 20 miles.

**Table 5 Ecoregions by Subwatershed** (acres)

| Subwatershed | Coastal Lowlands | Southern Oregon Coastal Mountains | Total Acres |
|---|---|---|---|
| East Fork Floras | | 10,497 | 10,497 |
| Floras Lake | 6,407 | 229 | 6,636 |
| Lower Floras Mainstem | 2,124 | 2,673 | 4,797 |
| Middle Floras Mainstem | | 5,732 | 5,732 |
| North Fork Floras | | 8,167 | 8,167 |
| South Fork Floras | | 7,781 | 7,781 |
| West Fork Floras | | 3,525 | 3,525 |
| Willow Creek | 1,377 | 3,140 | 4,517 |
| **Total Acres** | **9,908** | **41,744** | **51,652** |

## C DESCRIPTION OF ECOREGIONS

### (1) Coastal Lowlands (19% of Floras Creek Watershed)

Physiography

The Coastal Lowlands are characterized by estuarine marshes, meandering streams, shallow coastal lakes, black-water streams, marine terraces, and sand dunes. Streams are very low gradient and often meander widely. Some streams are directly influenced by the tide while others enter shallow coastal lakes (e.g. Floras Lake) before entering an outlet(s) to another stream or directly into the ocean. Elevation in this ecoregion ranges from sea level to 300 feet.

Geology & Soil

Geology consists predominantly of quaternary marine and non-marine terrace deposits, beach and dune sands, and alluvium. Soils are deep, silty clay loams to sandy loams.

Climate

| Precipitation | Frost Free | Mean Temperature | |
|---|---|---|---|
| Mean Annual (Inches) | Mean Annual (Days) | January Min/Max (°F) | July Min/Max (°F) |
| 60 – 85 | 200 – 240 | 36/50 | 52/68 |

Wind

| | |
|---|---|
| Summer | North winds prevail. East wind events associated with extreme high temperatures (>100° F) and high wind speeds (>35 mph) create extreme fire hazard conditions that may result in catastrophic wildfires |
| Winter | South winds prevail. Extreme high wind events (>100 mph) result in catastrophic wind storms. |

(Wiggins 2001)

Runoff

| | |
|---|---|
| Spring | Partially uniform; rainstorms create periods of higher runoff |
| Summer | Uniform; runoff gradually declines |
| Fall | Mostly uniform; runoff gradually increases; higher runoff during late fall rains |
| Winter | Not uniform; high runoff during rainstorms |

Erosion & Peak Flows
Erosion rate is low due to the low gradient of stream channels. However, the extent of streambank erosion, as a result of channel incision and loss of riparian vegetation, is not addressed by the Level IV Ecoregion description. These are mostly depositional areas. Peak flows (50-year recurrence interval, cfs per square mile) are 150 to 200.

Stream Channel Characteristics

| **Characteristic** | **Gradient** | **Stream Size** | | |
|---|---|---|---|---|
| | | **Small** | **Medium** | **Large** |
| Substrate | Low | Fines | Fines | Fines / Gravel |
| Beaver Dams | Low | Many year-round | Many year-round | Some in summer |

Natural Disturbances
Extreme windstorms capable of toppling large patches of trees occur about every 35 to 100 years. Catastrophic earthquakes capable of causing the coastal fringe to subside 5 to 20 feet occur about every 300 years. Extreme flood events are triggered by high intensity rainfall. High intensity rainfall and steep slopes trigger landslides.

Fires in the Sitka spruce forest, while infrequent, are usually stand replacing; dominant tree species are not fire tolerant. Catastrophic fires occur about every 50 years (Wiggins 2001). Fires are more frequent in Douglas fir/western hemlock forests, although the interval between fires is quite variable. Native Americans and ranchers both used fire to maintain pastures.

Upland & Riparian Vegetation

| | |
|---|---|
| Conifers | Sitka spruce, shore pine, grand fir, Douglas-fir, western hemlock, Port Orford cedar and Monterey Cypress |
| Hardwoods | red alder, big leaf maple, myrtle, and madrone |
| Shrubs | rhododendron, holly, wax myrtle, willows spp., and ceonothus spp. |
| Understory | azalea, ribes spp., iris, sea-watch, huckleberry, salal, ferns, skunk cabbage, rushes, sedges, and grasses |
| Noxious | gorse, blackberry, tansy, scotch broom, European beach grass and thistles spp. |

(Wiggins 2001)

Current riparian conifer regeneration is common in areas with good drainage. Sitka spruce can also regenerate in wetter areas where downed logs create an elevated seed bed. Black cottonwood may be found in riparian areas (Agee 1993).

Potential riparian vegetation may include thickets of wind-stunted shore pine, Sitka spruce, and brush (both native and introduced) sometimes alternating with bare sand. Beaver browsing and dam building may modify some vegetation. In unconfined channels, beaver dams may divide the stream into many channels, creating extensive wetlands.

Land Use
Agricultural land uses include cranberry, blueberry, and organic produce. Rangelands include dairy farms and livestock grazing (sheep, cattle, goats and llamas). Other land uses include rural residential development, tourism, recreation (hunting, fishing, boating, camping, hiking, etc.), forestry, Christmas trees, floral and greenery, rock quarries, light industrial, utility infrastructure (power/communication lines and underground cables, water treatment, etc.) and possibly mining (Wiggins 2001). Many streams in agricultural and residential settings have been diked or channelized.

Other Fog is common in summer.

## (2) Southern Oregon Coastal Mountains (82% of Floras Creek Watershed)

Physiography
The Southern Oregon Coastal Mountains is a mountainous ecoregion with an ocean-modified climate. It is a transitional area between the Siskiyou Mountains and the Coast Range and is underlain by Jurassic sandstone, metamorphosed sediments, granite, and serpentine. Overall, the geology is complex, like that of the Siskiyou Mountains, but its mountains are lower and not as dissected. The distributions of northern and southern vegetation blend together and species diversity is high. Streams are usually high gradient with steep side-slopes. Watersheds in this ecoregion typically have a high stream density due to the high precipitation, moderately steep gradients and fractured geology.

Geology & Soil
Geology is a complex mix of highly-fractured siltstone, shale, sandstone, gray wackie, granite and serpentine. Soils range from very deep to shallow, silt loam to very gravelly loam.

Climate

| **Precipitation** | **Frost Free** | **Mean Temperature** | |
|---|---|---|---|
| Mean Annual (Inches) | Mean Annual (Days) | January Min/Max (°F) | July Min/Max (°F) |
| 70 – 140 | 170 – 220 | 36/52 | 52/76 |

Wind

| | |
|---|---|
| Summer | North winds prevail. East wind events associated with extreme high temperatures (>100° F) and high wind speeds (>35 mph) create extreme fire hazard conditions that may result in catastrophic wildfires |
| Winter | South winds prevail. Extreme high wind events (>100 mph) result in catastrophic wind storms. |

(Wiggins 2001)

Runoff

| | |
|---|---|
| Spring | Partially uniform; rainstorms create periods of higher runoff |
| Summer | Uniform; runoff gradually declines |
| Fall | Mostly uniform; runoff gradually increases; higher runoff during late fall rains |
| Winter | Not uniform; high runoff during rainstorms, especially when snow on ground |

Erosion & Peak Flows

Erosion rate is high due to abundant precipitation, high uplift rates, earthquakes, steep slopes, fractured geology, and high landslide occurrence. Landslides are deep-seated earth flows in lower gradient areas or are shallow landslides (often triggering debris slides) in steep headwater channels. Peak flows (50-year recurrence interval, cfs per square mile) are 300 in northern portion to 550 in southern portion of ecoregion. **Note**: Floras Creek is located in the northern portion of this ecoregion.

Stream Channel Characteristics

| **Characteristic** | **Gradient** | **Stream Size** | | |
|---|---|---|---|---|
| | | **Small** | **Medium** | **Large** |
| Substrate | Low | Gravel | Gravel | Gravel / cobbles |
| | High | Gravel / cobbles | Gravel / cobbles | Cobbles / bedrock |
| Beaver Dams | Low | Some year-round | Few year-round | None |
| | High | Few in summer | None | None |

Natural Disturbances

Fires are more frequent in Douglas fir / western hemlock forests than in their neighboring Sitka spruce forests, although the interval between fires is quite variable. Catastrophic fires occur about 50 years (Wiggins 2001). Large wildfires during late summer and fall once burned large areas within the southern Coast Range. Fires sometimes skipped over streamside areas. Native Americans and ranchers both used fire to maintain pastures. Fire suppression has now eliminated most large wildfires.

Extreme wind storms capable of toppling large patches of trees occur about every 35 to 100 years. Smaller earthquakes capable of triggering landslides occur every decade or so and catastrophic earthquakes occur about every 300 years. Extreme flood events are triggered by high intensity rainfall. High intensity rainfall and steep slopes trigger landslides.

Upland & Riparian Vegetation

| | |
|---|---|
| Conifers | Douglas-fir, western hemlock, white fir/grand fir, Port Orford cedar, incense cedar, Brewer’s spruce, and Sitka spruce |
| Hardwoods | red alder, big leaf maple, myrtle, madrone, tanoak, cascara–buckthorne, Oregon white oak, Oregon ash, and cottonwood |
| Shrubs | ceonothus spp., elderberry, manzanita, hazelnut, wax myrtle, and vine maple |
| Understory | huckleberry, ferns, salmonberry, thimbleberry, skunk cabbage, rushes, sedges, grasses, herbaceous (flowers etc.), fireweed, and poison oak |
| Noxious | gorse, scotch broom, blackberry, tansy, and thistles spp. |

(Wiggins 2001)

Current riparian conifer regeneration is uncommon unless streamside areas are intensively disturbed, followed by control of competing hardwoods and brush. Potential riparian vegetation will vary according to channel confinement. Confined and moderately confined channels may include a narrow band of hardwoods (tanoak, myrtle, red alder) and brush nearest the stream with mainly Douglas fir and hardwoods beyond. Unconfined channels may consist of similar riparian communities although the band of vegetation may be considered moderately wide. Coniferous dominated sites along unconfined channels often occur on infrequently disturbed higher terraces.

Land Use
Forestry, ranching, rural residential development, recreation, rock quarries, greenery, mushrooms and some mining are the predominant land uses (Wiggins 2001).

Other
Irrigation withdrawals result in the partial dewatering of a number of streams during the summer.

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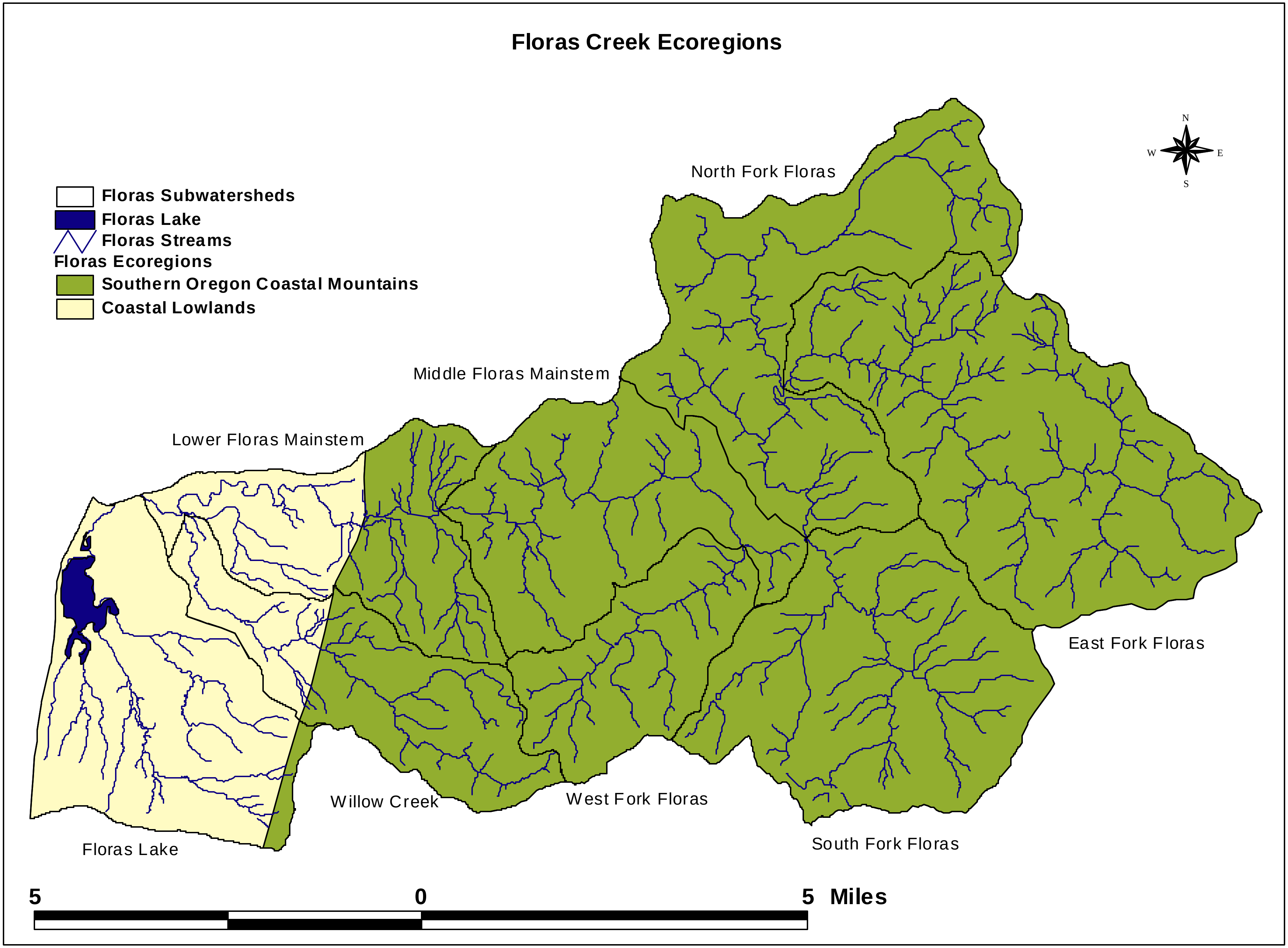
Floras Creek Ecoregions
Floras Subwatersheds
Floras Lake
Floras Streams
Floras Ecoregions
Southern Oregon Coastal Mountains
Coastal Lowlands
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Middle Floras Mainstem
Lower Floras Mainstem
East Fork Floras
Willow Creek
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South Fork Floras
Floras Lake
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# V CHANNEL HABITAT TYPES

## A BACKGROUND (GWEB 1999)

Stream classification systems can be organized on different scales within a watershed: from as large as the entire channel network down to individual pools or microhabitats within those pools. The Oregon Watershed Assessment Manual (OWAM) provides a classification system centered in the middle of this hierarchy and incorporates landscape features such as valley type and stream reach features such as gradient. The variables selected to describe each channel type remain relatively constant within time scales of concern to land management. The scale of channel features is small enough to predict patterns in physical characteristics, yet large enough to be identified from topographic maps and limited field-work.

The following classification system, titled Channel Habitat Types (CHT), is based on several existing stream classification systems including Rosgen and Montgomery & Buffington (Rosgen 1993; Montgomery and Buffington 1993). The CHTs will enable users to make inferences about how land use impacts can alter physical channel form and process and, therefore, fish habitat.

Bankfull Width, Confinement & Modern Floodplain

*Bankfull width* is the width of the channel at the point at which over-bank flooding begins (unless the stream is incised), and often occurs as flows reach the 1.5 year recurrence interval level. *Confinement* is defined as the ratio of the bankfull width to the width of the modern floodplain. *Modern floodplain* is the flood-prone area (Rosgen 1996); it may or may not correspond to the 100-year floodplain.

| Confinement Class | Floodplain Width |
|---|---|
| Unconfined | >4x Bankfull Width |
| Moderately Confined | >2x Bankfull Width but <4xBankfull Width |
| Confined | <2x Bankfull Width |

Management Considerations

It is important to remember that CHTs cannot be managed as isolated segments. Stream reaches in one part of a watershed can be affected by activities taking place in a different part of the watershed, either up-stream, down-stream, or on adjacent land areas.

## B INTRODUCTION

Floras Creek and its tributaries represent a diversity of Channel Habitat Types. Stream channels throughout the basin are almost equally divided into three general types: low gradient confined channels, moderate gradient confined channels and steep gradient confined channels. The low gradient confined channels most commonly characterize the Floras Creek mainstem as well as the mainstems of most of the larger tributaries such as East Fork, North Fork and certain portions of South Fork and Willow Creek. Moderate gradient stream channels typically drain into larger mainstem reaches and are found well distributed throughout the basin. The steep gradient channels are primarily indicative of headwater streams.

Table 6 Channel Habitat Type Attributes provides a comparison of 15 different channel types that potentially occur in a watershed. Each of these stream channels provides unique functions and significant values to both anadromous and resident fish. Eight of these different channel types (listed below) were identified throughout approximately 127 miles of streams in the Floras Creek basin. A description of each Channel Habitat Type is presented in Section E of this component.

1. Low Gradient Confined Channel (LC)
2. Steep Narrow Valley Channel (SV)
3. Moderately Steep Narrow Valley Channel (MV)
4. Moderate Gradient Confined Channel (MC)
5. Very Steep Headwater Channel (VH)
6. Low Gradient Moderately Confined Channel (LM)
7. Moderate Gradient Moderately Confined Channel (MM)
8. Moderate Gradient Headwater Channel (MH)

New River & Estuary Characterization

Floras Creek typically drains into a unique and dynamic body of water known as New River. Depending on the year as well as the season New River may or may not drain into the Pacific Ocean at one or more places along its approximate nine-mile course. As a result, defining the location of the Floras Creek/New River estuary varies from year- to-year and season-to-season Due to the complexity of the New River Basin and the limitations of this assessment the characterization of CHTs was limited to the Floras Creek drainage.

## C METHODOLOGY

1. US Geologic Survey (USGS) maps at the 7.5-minute or 1:24,000 scale were compiled and utilized as base maps for the Floras Creek watershed. Perennial streams and landscape features such as valley type were analyzed for consideration of stream classification. (It was assumed that the perennial streams were the blue-lined streams illustrated on the USGS maps.)
2. Stream reaches were delineated on mylar overlays based on channel gradient and channel confinement. Stream reaches were then evaluated based on valley shape, channel pattern, stream size, position in drainage and dominant substrate.
3. Preliminary CHTs were assigned to each reach using a CHT Guide to Identification (Table 6) as well as CHT Descriptions provided in the OWAM.
4. CHT classifications were verified with field data from the Floras Creek Riparian Shade Assessment and via communication with local landowners.
5. A labeling system was developed for purposes of subwatershed characterization.
6. CHTs were digitized in ArcView and lengths were calculated for each CHT.

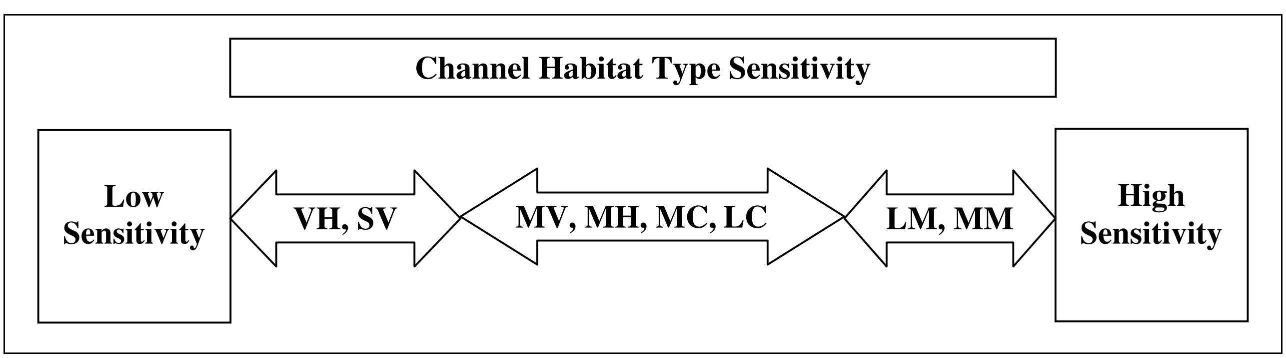
## D CHANNEL SENSITIVITY / RESPONSIVENESS (GWEB 1999)

In general, responsive portions of the channel network are those that lack the terrain controls which define confined channels. Unconfined or moderately confined channels display visible changes in channel characteristics when flow, sediment supply, or the supply of roughness elements such as large woody debris (LWD) are altered. These areas are commonly referred to as response reaches, and usually possess an active floodplain. At the other end of the responsive spectrum would be those channels whose characteristics and form are not easily altered, such as Bedrock canyon.

Differences in gradient, confinement, and bed morphology suggest that different channel types are more or less responsive to adjustment in channel pattern, location, width, depth sediment storage, and bed roughness (Montgomery and Buffington 1993). These changes in channel characteristics will in turn trigger alterations of aquatic habitat conditions. The more responsive or sensitive areas are more likely to exhibit physical changes from land management activities, as well as restoration efforts.

**Channel Sensitivity/Response Descriptions**

| Rating | LWD | Fine Sediment | Coarse Sediment | Peak Flows |
|---|---|---|---|---|
| High | Critical element in maintenance of channel form, pool formation, gravel trapping/sorting, bank protection | Fines are readily stored with increases in available sediment resulting in widespread pool filling and loss of overall complexity of bed form | Bedload deposition dominant active channel process; general decrease in substrate size, channel widening, conversion to planebed morphology if sediment is added | Nearly all bed material is mobilized; significant widening or deepening of channel |
| Moderate | One of a number of roughness elements present; contributes to pool formation and gravel sorting | Increases in sediment would result in minor pool filling and bed fining | Slight change in overall morphology; localized widening and shallowing | Detectable changes in channel form; minor widening, scour expected |
| Low | Not a primary roughness element; often found only along channel margins | Temporary storage only; most is transported through with little impact | Temporary storage only; most is transported through with little impact | Minimal change in physical channel characteristics, some scour and fill |



## E DESCRIPTION OF CHANNEL HABITAT TYPES (GWEB 1999)

### (1) Low Gradient Confined Channels (LC) (32% of Floras Creek's Channels)

LC channels are incised or contained within adjacent, gentle landforms or incised in uplifted coastal landforms. Lateral channel migration is controlled by frequent high terraces or hill slopes along stream banks. They may be bound on one bank by hill slopes and lowlands on the other. They may also have a narrow floodplain in places, particularly on the inside of meander bends. Streambank terraces are often present, but they are generally above the current floodplain. Channels confined by hill slope or bedrock are often stable and display less bank erosion and scour compared to incised channels that are often unstable and confined by alluvial terraces.

High flow events are well-contained by the upper banks. High flows in these well-contained channels tend to move all but the most stable wood accumulations downstream or push debris to the channel margins. Stream banks can be susceptible to landslides in areas where steep hill slopes of weathered bedrock parent materials meet the channel.

***Caution:*** Caution should be used in interpreting channels that have downcut into alluvial material set in a wide flat valley. If streambanks are high enough to allow a floodplain width less than two times the bankfull width, then the stream meets the definition of confined. However, some streams meeting this definition may have recently down-cut, effectively reducing floodplain width as the channel deepens. It is beyond the scope of this assessment to address technical issues such as the rate of channel incision. However, for the purpose of interpreting Channel Sensitivity / Responsiveness, it should be noted that these channels may have transitioned from LM to LC channels.

Channel Sensitivity / Responsiveness

The presence of confining terraces or hill slopes and control elements such as bedrock limit the type and magnitude of channel response to changes in input factors. Adjustment of channel features is usually localized and of a modest magnitude.

| Input Factors | Sensitivity/Responsiveness Rating |
|---|---|
| Large Woody Debris | Low to Moderate |
| Fine Sediment | Low |
| Coarse Sediment | Moderate |
| Peak Flows | Low to Moderate |

Fish Use

**Anadromous** - Important spawning, rearing and migration corridor for chinook, coho, steelhead and sea-run cutthroat trout

**Resident** - Important spawning, rearing and overwintering for cutthroat trout

Riparian Enhancement Opportunities

These channels are not highly responsive, and in channel enhancements may not yield intended results. In basins where water-temperature problems exist, the confined nature of these channels lends itself to establishment of riparian vegetation. In nonforested land, these channels may be deeply incised and prone to bank erosion from livestock. Therefore, these channels may benefit from livestock access control measures.

**(2) Low Gradient Moderately Confined Channel (LM)** (2% of Floras Creek's Channels)

These channels consist of low-gradient reaches that display variable confinement by low terraces or hill slopes. A narrow floodplain approximately two to four times the width of the active channel is common, although it may not run continuously along the channel. Often low terraces accessible by flood flows occupy one or both sides of the channel. The channels tend to be of medium to large size, with substrate varying from bedrock to gravel and sand. They tend to be slightly to moderately sinuous, and will occasionally possess islands and side channels.

Channel Sensitivity / Responsiveness

The unique combination of an active floodplain and hill slope or terrace controls acts to produce channels that can be among the most responsive in the basin. Multiple roughness elements are common, with bedrock, large boulders, or wood generating a variety of aquatic habitat within the stream network.

| Input Factors | Sensitivity / Responsiveness Rating |
|---|---|
| Large Woody Debris | Moderate to High |
| Fine Sediment | Moderate to High |
| Coarse Sediment | Moderate to High |
| Peak Flows | Moderate |

Fish Use

**Anadromous** - Potential spawning and rearing for chinook, coho, steelhead and sea-run cutthroat trout

**Resident** - Potential spawning, rearing and overwintering for cutthroat trout

Riparian Enhancement Opportunities

Like intact floodplain channels, these channels can be among the most responsive of channel types. Unlike floodplain channels, however, the presence of confining landform features often improves the accuracy of predicting channel response to activities that may affect channel form. Additionally, these controls help limit the destruction of enhancement efforts common to floodplain channels. Because of this, LM channels are often good candidates for enhancement efforts.

In forested basins, habitat diversity can often be enhanced by the addition of wood or boulders. Pool frequency and depth may increase, and side-channel development may result from these efforts. Channels of this type in non forested basins are often responsive to bank stabilization efforts such as riparian planting and fencing. Beavers are often present in the smaller streams of this channel type. Fish habitat in some channels may benefit from beaver introduction through side-channel and scour pool development. Introduction of beavers, however, may have significant implications for overall channel form and function, and should be thoroughly evaluated by land managers, as well as biologists, as a possible enhancement activity.

**(3) Moderate Gradient Confined Channel (MC)** (10% of Floras Creek's Channels)

MC streams flow through narrow valleys with little river terrace development, or are deeply incised into valley floors. Hill slopes and mountain slopes composing the valley walls may lie directly adjacent to the channel. Bedrock steps, short falls, cascades, and boulder runs may be present; these are usually sediment transport systems. Moderate gradients, well contained flows, and large-particle substrate indicate high stream energy. Landslides along channel side slopes may be a major sediment contributor in unstable basins.

Channel Sensitivity / Responsiveness

The presence of confining terraces or hill slopes and control elements such as bedrock substrates limits the type and magnitude of channel response to changes management. Adjustment of channel features is usually localized and of a modest magnitude.

| Input Factors | Sensitivity / Responsiveness Rating |
|---|---|
| Large Woody Debris | Low |
| Fine Sediment | Low |
| Coarse Sediment | Moderate |
| Peak Flows | Moderate |

Fish Use

**Anadromous** - Potential steelhead and coho spawning and rearing; may have pockets of suitable chinook habitat depending on site-specific factors

**Resident** - Potential spawning, rearing and overwintering for cutthroat trout

Riparian Enhancement Opportunities

These channels are not highly responsive, and in-channel enhancements may not yield intended results. Although channels are subject to relatively high energy, they are often stable. In basins where water-temperature problems exist, the stable banks generally found in these channels lend themselves to establishment of riparian vegetation. In nonforested land, these channels may be deeply incised and prone to bank erosion from livestock. Therefore, these channels may benefit from livestock access control measures.

**(4) Moderate Gradient Headwater Channel (MH)** (<1% of Floras Creek's Channels)

These channels are similar to LC channels, but occur exclusively in headwater regions. They may be sites of headwater beaver ponds. They are potentially above the anadromous fish zone. These gentle to moderate headwater streams generally have low streamflow volumes and, therefore, low stream power. The confined channels provide limited sediment storage in low-gradient reaches. Channels have a small upslope drainage area with sediment sources limited to upland surface erosion.

Channel Sensitivity / Responsiveness

The low stream power and presence of confining terraces or hill slopes and control elements such as bedrock substrates limit the type and magnitude of channel response to changes in input factors. Adjustment of channel features is usually localized and of a moderate magnitude.

| Input Factors | Sensitivity / Responsiveness Rating |
|---|---|
| Large Woody Debris | Moderate |
| Fine Sediment | Moderate |
| Coarse Sediment | Moderate to High |
| Peak Flows | Moderate |

Fish Use
**Anadromous** - Potential steelhead and coho spawning and rearing; limited chinook
**Resident** - Potential spawning, rearing and overwintering for cutthroat trout

Riparian Enhancement Opportunities
These channels are moderately responsive. In basins where water-temperature problems exist, the stable banks generally found in these channels lend themselves to establishment of riparian vegetation. In nonforested land, these channels may be deeply incised and prone to bank erosion from livestock. Therefore, these channels may benefit from livestock access control measures.

**(5) Moderate Gradient Moderate Confined Channel (MM)** (1% of Floras Creek's Channels)

This group includes channels with variable controls on channel confinement. Altering valley terraces and/or adjacent mountain-slope, foot-slope, and hill-slope landforms limit channel migration and floodplain development. Similar to the LM channels, a narrow floodplain is usually present, and may alternate from bank to bank. Bedrock steps with cascades may be present.

Channel Sensitivity / Responsiveness
The unique combination of a narrow floodplain and hill-slope or terrace controls acts to produce channels that are often the most responsive in the basin. The combination of higher gradients and the presence of a floodplain set the stage for a dynamic channel system. Multiple roughness elements such as bedrock, large boulders, or wood may be common, resulting in a variety of aquatic habitats within the stream network.

| Input Factors | Sensitivity / Responsiveness Rating |
|---|---|
| Large Woody Debris | High |
| Fine Sediment | Moderate |
| Coarse Sediment | Moderate to High |
| Peak Flows | Moderate |

Fish Use
**Anadromous** - Potential steelhead and coho spawning and rearing; may have pockets of suitable chinook habitat depending on site-specific factors
**Resident** - Potential spawning, rearing and overwintering for cutthroat trout

Riparian Enhancement Opportunities
Like floodplain channels, these channels are among the most responsive of channel types. Unlike floodplain channels, however, the presence of confining landform features improves the accuracy of predicting channel response to activities that may affect channel form. Additionally,

these controls help limit the destruction of enhancement efforts, a common problem in floodplain channels. Outcome of enhancement efforts are a bit more uncertain than in LM channels. MM channels, however, are often good candidates for enhancement efforts.

In forested basins, habitat diversity can often be enhanced by the addition of roughness elements such as wood or boulders. Pool frequency and depth may increase as well as side-channel development as the result of these efforts. Channels of this type in nonforested basins are often responsive to bank stabilization efforts such as riparian planting and fencing.

Beavers are often present in the smaller streams of this channel type, and fish habitat in some channels may benefit from beaver introduction through side-channel and scour pool development. Introduction of beavers, however, may have significant implications for overall channel form and function, and should be thoroughly evaluated by land managers as well as biologists as a possible enhancement activity.

### (6) Moderately Steep Narrow Valley Channel (MV) (20% of Floras Creek's Channels)

MV channels are moderately steep and confined by adjacent moderate to steep hill slopes. High flows are generally contained within the channel banks. A narrow floodplain, one channel width or narrower, may develop locally.

MV channels efficiently transport both coarse bedload and fine sediment. Bedrock steps, boulder cascades and chutes are common features. The large amount of bedrock and boulders create stable streambanks; however, steep side slopes may be unstable. Large woody debris is commonly found in jams that trap sediment in locally low-gradient steps.

Channel Sensitivity / Responsiveness

The gradient and presence of confining terraces or hill slopes and control elements such as bedrock substrates limit the type and magnitude of channel response to changes in input factors. Adjustment of channel features is localized and of a minor magnitude.

| Input Factors | Sensitivity / Responsiveness Rating |
|---|---|
| Large Woody Debris | Moderate |
| Fine Sediment | Low |
| Coarse Sediment | Moderate |
| Peak Flows | Moderate |

Fish Use

**Anadromous** - Potential steelhead, coho and sea-run cutthroat spawning and rearing
**Resident** - Potential spawning, rearing and overwintering for cutthroat trout

Riparian Enhancement Opportunities

These channels are not highly responsive, and in channel enhancements may not yield intended results. Although channels are subject to relatively high energy, they are often stable. In basins where water-temperature problems exist, the stable banks generally found in these channels lend themselves to establishment of riparian vegetation. In nonforested land, these channels may be deeply incised and prone to bank erosion from livestock. As such, these channels may benefit from livestock access control measures.

**(7 & 8) Steep Narrow Valley Channel (SV) & Very Steep Headwater (VH)**
(SV = 28% & VH = 7% of Floras Creek's Channels)

These two channel types are very similar and are thus presented together. However VH channels are steeper. SV channels are situated in a constricted valley bottom bounded by steep mountain or hill slopes. Vertical steps of boulder and wood with scour pools, cascades, and falls are common. VH channels are found in the headwaters of most drainages or side slopes to larger streams, and commonly extend to ridge-tops and summits. These steep channels may be shallowly or deeply incised into the steep mountain or hill slope. Channel gradient may be variable due to falls and cascades.

Channel Responsiveness

The gradient and presence of confining terraces or hill slopes and control elements such as bedrock substrates limit the type and magnitude of channel response to changes in input factors. Adjustment of channel features is localized and of a minor magnitude. These channels are also considered source channels supplying sediment and wood to downstream reaches, sometimes via landslides.

| Input Factors | Sensitivity / Responsiveness Rating |
|---|---|
| Large Woody Debris | Moderate |
| Fine Sediment | Low |
| Coarse Sediment | Low to Moderate |
| Peak Flows | Low |

Fish Use

**Anadromous** (SV) - Lower gradient areas provide limited rearing (if accessible)
**Resident** (SV) - Limited resident spawning and rearing
**Resident** (VH) - Very limited rearing

Riparian Enhancement Opportunities

These channels are not highly responsive, and in-channel enhancements may not yield intended results. Although channels are subject to relatively high energy, they are often stable. In basins where water temperature problems exist, the stable banks generally found in these channels lend themselves to establishment of riparian vegetation. This may also serve as a recruitment effort for large woody debris in the basin.

**Table 6 Channel Habitat Type Attributes** *(GWEB 1999)*

| CHT Code | Type | Gradient | Valley Shape | Channel Pattern | Channel Confinement | OR Stream Size | Position in Drainage |
|---|---|---|---|---|---|---|---|
| **ES** | Small Estuarine Channel | 0 to 1% | broad | sinuous single or multiple | unconfined | small-med | bottom, mouth of stream |
| **EL** | Large Estuarine Channel | 0 to 1% | broad | sinuous single or multiple | unconfined | large | bottom, mouth of stream |
| **FP1** | Low Gradient Large Floodplain Channel | 0 to 1% | broad floodplain | sinuous single or multiple | unconfined | large | bottom, low in drainage |
| **FP2** | Low Gradient Floodplain Channel | 0 to 2% | broad, flat or gentle landforms | sinuous single or multiple | unconfined | med-large | middle to lower end of drainage |
| **FP3** | Low Gradient Small Floodplain Channel | 0 to 2% | broad | single or multiple | moderate to unconfined | small-med | variable |
| **AF** | Alluvial Fan Channel | 1 to 12% | where hillslope opens to broad valley | single or multiple spread like a fan | variable | small-med | lower end of small tributaries |
| **LM** | Low Gradient Moderately Confined Channel | 0 to 2% | broad, generally much wider than channel | single w/ occasional multiple channels | variable | variable, usually med-large | variable, often mainstem & low end of main tribs. |
| **LC** | Low Gradient Confined Channel | 0 to 2% | low-mod gradient hillslope w/ limited floodplain | single channel, variable sinuosity | conifined by hillslope/terrace | variable, usually med-large | variable, generally mid to lower in large basin |
| **MM** | Moderate Gradient Moderately Confined | 2 to 4% | narrow valley w/ flood-plain or narrow terrace | single, low to moderate sinuosity | variable | variable, usually med-large | middle to lower portion of drainage |
| **MC** | Moderate Gradient Confined Channel | 2 to 4% | gentle to narrow V-shaped valley, little to no floodplain | single, relatively straight or conforms to hillslope | confined | variable | middle to lower portion of drainage |
| **MH** | Moderate Gradient Headwater Channel | 1 to 6% | open, gentle V-shaped valley | low sinuosity to straight | confined | small | upper, headwater |
| **MV** | Moderately Steep Narrow Valley Channel | 4-8% | narrow, V-shaped valley | single channel, relatively straight | confined | small-medium | middle to upper |
| **BC** | Bedrock Canyon Channel | >4% | canyons, gorges, very steep side slopes | single channel, straight | tightly confined by bedrock | variable | variable |
| **SV** | Steep Narrow Valley Channel | 8 to 16% | steep, narrow V-shaped valley | single, straight | tightly confined | small, small to medium | middle upper to upper |
| **VH** | Very Steep Headwater | >16% | steep, narrow V-shaped valley | single, straight | tightly confined | small, small to medium | middle upper to upper |

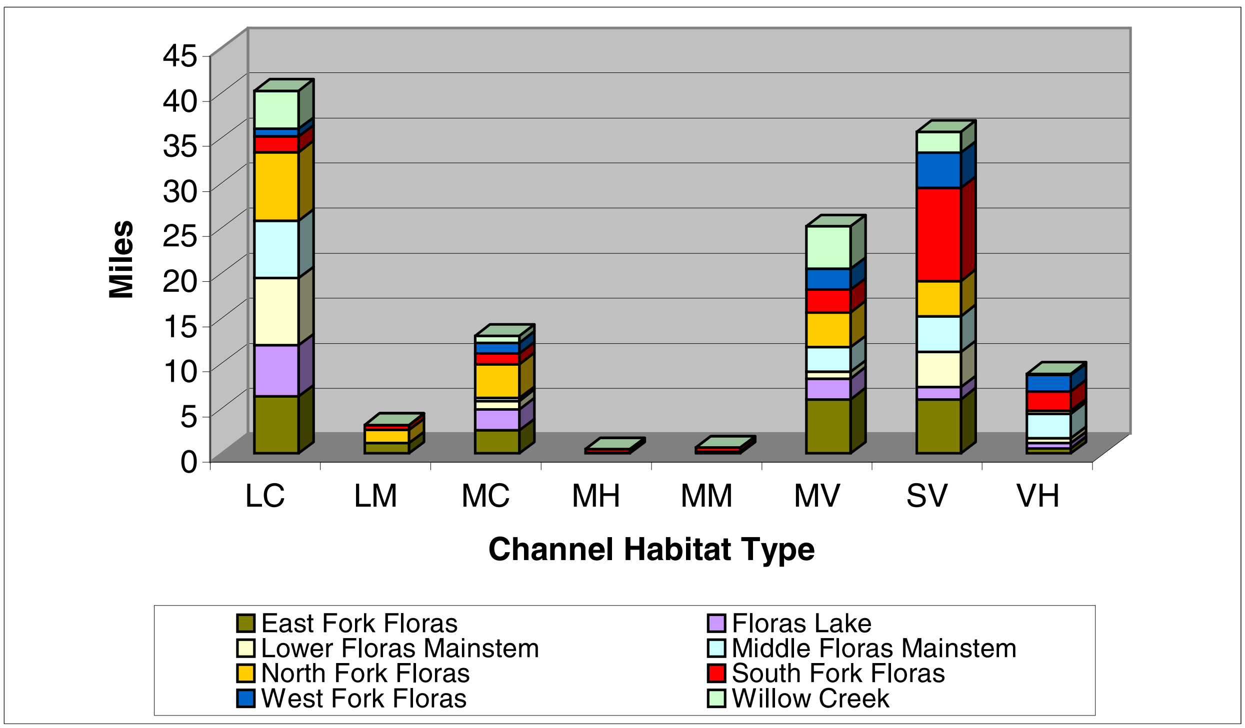
Shaded CHT Codes = Found in Floras Creek

## F RESULTS

**Table 7 Channel Habitat Types by Subwatershed** (miles)

| Subwatershed | LC | LM | MC | MH | MM | MV | SV | VH | Grand Total |
|---|---|---|---|---|---|---|---|---|---|
| East Fork Floras | 6.3 | 1.1 | 2.5 | 0.0 | 0.0 | 6.0 | 6.0 | 0.6 | 22.6 |
| Floras Lake | 5.7 | 0.0 | 2.3 | 0.0 | 0.0 | 2.3 | 1.3 | 0.6 | 12.2 |
| Lower Floras Mainstem | 7.4 | 0.0 | 1.0 | 0.0 | 0.0 | 0.8 | 3.9 | 0.5 | 13.6 |
| Middle Floras Mainstem | 6.4 | 0.0 | 0.3 | 0.0 | 0.2 | 2.7 | 4.0 | 2.7 | 16.4 |
| North Fork Floras | 7.6 | 1.5 | 3.7 | 0.1 | 0.0 | 3.9 | 3.9 | 0.3 | 21.0 |
| South Fork Floras | 1.8 | 0.6 | 1.2 | 0.4 | 0.4 | 2.5 | 10.3 | 2.1 | 19.3 |
| West Fork Floras | 0.8 | 0.0 | 1.2 | 0.0 | 0.0 | 2.3 | 3.9 | 1.8 | 10.0 |
| Willow Creek | 4.2 | 0.0 | 0.8 | 0.0 | 0.0 | 4.7 | 2.4 | 0.1 | 12.3 |
| **Grand Total** | 40.2 | 3.2 | 13.1 | 0.5 | 0.7 | 25.2 | 35.7 | 8.9 | 127.3 |

**Figure 2 Channel Habitat Types by Subwatershed** (miles)



## G KEY FINDINGS

**Table 8 Channel Habitat Type Summary**

| CHT | Channel Description | Percent of Miles | Response to Disturbance | Riparian Treatment Opportunities |
|---|---|---|---|---|
| LM | Low gradient moderately confined | 2 | High | Good candidates |
| LC | Low gradient confined | 32 | Low Mod | Manage livestock access |
| MM | Moderate gradient moderately confined | 1 | High | Good candidates |
| MC | Moderate gradient confined | 10 | Mod | Manage livestock access |
| MH | Moderate gradient headwater | <1 | Mod | Manage livestock access |
| MV | Moderately steep narrow valley | 20 | Mod | Manage livestock access |
| SV | Steep narrow valley | 28 | Low | Few opportunities |
| VH | Very steep headwater | 7 | Low | Few opportunities |

- Of the 127 stream miles evaluated in this assessment, 35 percent are classified as steep (SV) to very steep (VH) narrow valleys. These are typically the small headwater streams in all of the Floras Creek subwatersheds. Channel segments that are accessible to fish offer only limited rearing for anadromous fish and limited rearing and spawning for resident fish, but they can be valuable sources of cool water and large woody debris to downstream fish habitat. The channels are stable, not highly responsive to either disturbance or restoration, but their stable banks support riparian vegetation, making them good candidates for riparian planting or thinning.
- Moderate gradient confined and headwater streams (MC, MH, and MV) comprise 30 percent of the channels, and low gradient confined channels (LC) are 32 percent, for a total of 62 percent. These are typically located in small to medium size streams. MC channels are mostly in the East Fork, North Fork, and Floras Lake subwatersheds; the small amount of MH is in the North and South Forks; and the MV and LC are found in all subwatersheds. Channels are fairly stable, moderately responsive to disturbance, and not highly responsive to restoration activities except for riparian planting or thinning. In nonforested areas, channels may be deeply incised and prone to erosion by livestock, so they may benefit from livestock access control measures.
- A natural barrier to chinook and coho migration is located in the Middle Floras mainstem in MV channel, approximately one mile upstream of the segment boundary with Lower Floras mainstem.
- Floras Creek contains the most LC habitat of all the South Coast Watersheds in this assessment. Fall chinook are found primarily in LC channels in the Lower Floras Mainstem. Coho are prevalent in these channels as well as throughout Floras Lake subwatershed channels and certain tributaries.
- Moderate gradient, moderately confined channels (MM) characterize one percent and low gradient streams that are moderately confined (LM) characterize two percent of the channels. They are in East Fork, North Fork, South Fork, and Middle Floras subwatersheds. These 3 percent of the channel miles are among the most responsive to both disturbance and restoration activities. Habitat diversity can be enhanced by adding structure such as boulders and large wood; banks can be stabilized by planting and fencing.
- Floras Creek had the fewest miles of the MM and LM channel types of the South Coast watersheds in this assessment.

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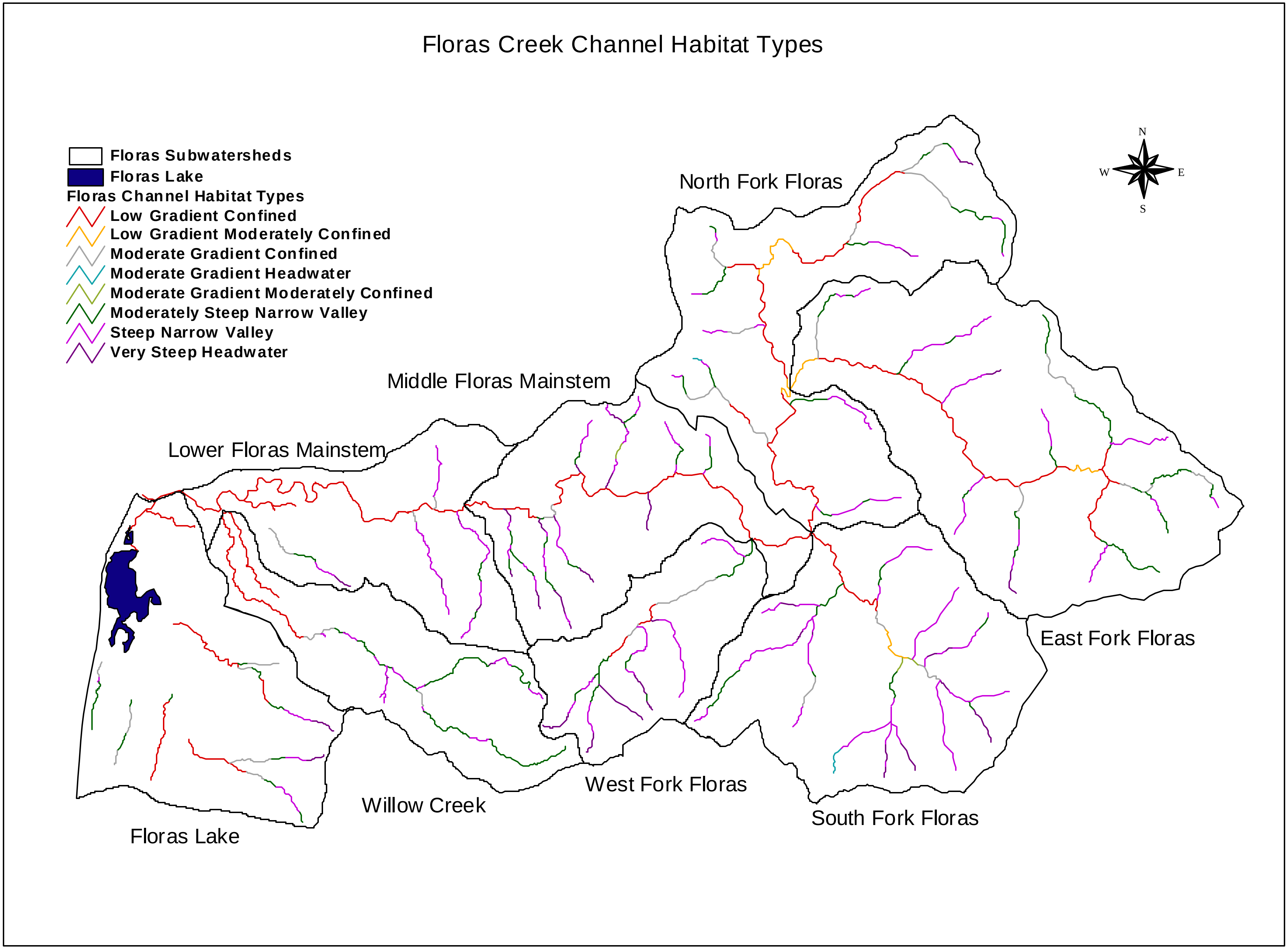

Floras Creek Channel Habitat Types
Floras Subwatersheds
Floras Lake
Floras Channel Habitat Types
Low Gradient Confined
Low Gradient Moderately Confined
Moderate Gradient Confined
Moderate Gradient Headwater
Moderate Gradient Moderately Confined
Moderately Steep Narrow Valley
Steep Narrow Valley
Very Steep Headwater
N
W
E
S
North Fork Floras
Middle Floras Mainstem
Lower Floras Mainstem
East Fork Floras
West Fork Floras
Willow Creek
South Fork Floras
Floras Lake

# VI FISH & FISH HABITAT

## A BACKGROUND

Salmonid Life Cycles (OSU 1998)

Salmonid is the group name for salmon, trout, and char. These fish share a common life history pattern. Many are anadromous, i.e., they spawn in fresh water, migrate to sea as juveniles, grow to maturity, and return to their freshwater stream to reproduce.

Adult salmonids spawn by burying their eggs in nests called redds. Spawning site selection depends on the species, gravel size, and flow pattern of the stream. A common spawning location is the "tail-out" of a pool – the area where a pool becomes shallow before entering a downstream riffle. The eggs remain in the gravel for 45 – 70 days depending on water temperatures. Hatching alevins (fry with yolk sacs for nutrients) remain in the gravel until the yolk sac is absorbed. They then work their way through the gravel and emerge into the stream channel as feeding fry. This is a critical stage for all salmonid species. During this part of their life, fry need adequate food and sediment-free water that contains a lot of oxygen.

Natural mortality of juveniles is high during the first month. Many fry are eaten by birds, amphibians, reptiles, and other fish. Depending on the species, juvenile anadromous salmonids grow 1-3 years before migrating to sea as smolts. Smolts need to adapt from freshwater to saltwater by spending transition time in the estuary. After maturing in the ocean, they return to the stream to spawn.

Life cycles vary greatly from river to river and among species (e.g., winter vs. summer steelhead, spring vs. fall chinook, sea run vs. resident cutthroat trout). Where several salmonid species coexist in a river system, each species has its own schedule for rearing, spawning, and migration, although it is not uncommon for juveniles and adults to occupy the same stream areas throughout the year. Adult anadromous salmonids find their way back from the ocean to the streams where they were born. This life cycle feature is called homing and is one of the least understood yet most wonderful aspects of salmon ecology.

Chinook salmon

Chinook (king) salmon are the largest and longest lived of the Pacific salmon. They average 20-25 pounds as adults, although individuals as large as 100 pounds have been reported. There are two basic life-history patterns of chinook in Oregon – fall and spring. Fall chinook return from the ocean in late-August through December. They spawn in main river channels and low-gradient tributaries. Since chinook are large, they can dig redds deep in the gravel, thus protecting the eggs from channel scouring during winter storms. If an unusually heavy storm does scour the eggs and a year is lost, successive generations can replace the stock because adult chinook spawn from 3-6 years of age. All chinook can spawn once but they then die.

Juvenile fall chinook emerge from the gravel in February or March. They stay in the stream only about 90 days. Peak downstream migration in south coast streams (excluding the Rogue River) is typically early to mid July. They generally spend the next 3-4 months in the estuary and then migrate to the ocean with fall rains. Spring chinook adults return to rivers in the spring and spend the summer in deep pools. They spawn in early fall. The life histories of these juveniles are more variable than those of all chinook.

Coho salmon

Coho (silver) salmon historically were the most abundant salmon on the Oregon Coast. Adults average 6-12 pounds and have a strict 3-year life cycle. Because coho spawn mostly at age 3 with no year class overlap, their survival is susceptible to catastrophic events. If a year is lost, a population is likely to remain depressed for a long time. Coho can recolonize tributaries from highly populated source areas. However, this species can be eliminated from a basin quickly if these source areas deteriorate.

Coho spawn from November to March with two dominant life-history patterns. "Early" coho enter streams on the first major storm of the year, usually in mid-November. If they are successful at spawning, their fry have the advantage of getting the first shot at the food resources. These fry also become the largest individuals, providing additional survival advantage.

Coho are not as large as chinook, they spawn in smaller gravel, and their redds are not as deep as those of chinook. Thus, their redds are likely to be scoured out during winter storms. Therefore, a second stock of "late" coho has evolved to delay spawning until most major winter storms have passed, often as late as March or April. These two groups provide important genetic variation to the species and help coho withstand natural climate variations.

Coho juveniles generally emerge from the gravel from February through April. They prefer to live in pools with slow flow or in beaver ponds. Juveniles remain in the stream for a full year and then migrate to the ocean in April or May. Some coho return as 2-year-old jacks (males), but most return as 3-year-old adults.

Steelhead

Steelhead are seagoing rainbow trout. Adults average 8-12 pounds, and some adults live as long as 7 years. Winter steelhead return from the ocean from November through April, allowing them to move into headwaters of stream during winter flows. Some spawning occurs in May Like salmon, they deposit their eggs in gravel. However, not all steelhead die after spawning. About 30 percent survive to spawn again in the stream of their birth.

Juveniles emerge as late as early July. During the first year they live in riffles and along the edges of stream channels. Therefore, low water conditions can severely affect steelhead. They spend 1-3 years in a stream before migrating to the ocean. This long freshwater residence time also makes them more vulnerable to habitat degradation.

Summer steelhead adults enter river systems from April through August. Unlike winter fish, but like spring chinook, these steelhead need deep, cool pools to reside in until spawning in January or February. The juvenile life history of summer steelhead is similar to that of winter steelhead.

Cutthroat trout

Cutthroat trout have variable life history patterns. Some migrate to the ocean while others remain in the same area of a stream all of their lives. Anadromous and fluvial forms use estuarine, mainstem, and lower portions of the system for adult holding and juvenile rearing, and use small headwater streams for spawning. The resident form of cutthroat are also typically found in headwater areas, but can be found in low gradient backwater areas lower in the system. Cutthroat spawn in the spring or fall, usually in very small tributaries, and the juveniles emerge by June or July. Sea-run cutthroat rarely exceed a length of 20 inches or a weight of 4 pounds. (ODFW, 1995)

Salmonid Spawning Habitat

Successful spawning and development from eggs to fry stages require the following:

- No barriers to upstream migration for adults
- Spawning areas (usually in a riffle or at the tail-out of a pool) with stable gravel, free of fine sediment
- A combination of pools and riffles that provides both spawning areas and places to hide nearby
- A constant flow of clean, well oxygenated water through the spawning gravel

Salmonid Rearing Habitat

Fry are vulnerable to predators and must endure high stream flows and food shortages. They need pools for rearing, temperature regulation, and cover. Good juvenile-rearing habitat exhibits the following characteristics:

- Low to moderate stream gradient (slope) and velocity
- A good mix of pool and riffle habitats
- Clean, oxygenated water and cool stream temperatures
- A variety of bottom types to provide habitat for juvenile fish and food organisms
- Overhanging vegetation, large woody material, and stream cutbanks, which provide protection for juvenile fish and leaf litter for aquatic insect food
- Sufficient nutrients to promote algal growth and decomposition of organic material

As young fish grow, they seek increased summer flow, moving from the edge of a stream to midstream to take advantage of insect drift. In winter, all species seek areas of lower water velocity where they can conserve energy while food and growing conditions are limited.

Salmonid Habitat Use

Although their basic requirements are the same, salmonid species differ in the types of habitat they use. For example, juvenile coho prefer pool areas of moderate velocity in the summer, especially those with slack water current near undercut stream banks, root wads, or logs. In winter, they seek slow, deep pools or side channels, utilizing cover under rocks, logs and debris.

Conversely, juvenile steelhead spend their first summer in relatively shallow, cobble-bottomed areas at the tail-out of a pool or shallow riffle. During winter, they hide under large boulders in riffle areas.

In summer, older steelhead juveniles prefer the lead water of pools and riffles where there are large boulders and woody cover. The turbulence created by boulders also serves as cover. During winter, these steelhead juveniles are found in pools, near streamside cover, and under debris, logs or boulders.

Cutthroat trout habitat requirements are similar to those of steelhead with the exception that they spend the summer in pools. Chinook juveniles tend to rear in large tributaries, and their habitat requirements are different than those of coho. For example, estuarine residence and growth are key elements in a chinook life-history pattern. Coho salmon require backwaters, beaver ponds, or side-channel rearing habitats to survive high winter flows and low summer flows.

<u>Salmonid Limiting Factors</u>
The quantity and quality of spawning and rearing habitat limit the success of spawning and production of smolts. These limiting factors establish the carrying capacity of a stream. Carrying capacity is the number of animals a habitat can support throughout the year without harm to either the organisms or the habitat. Depending upon the limits of available habitat, ocean factors, escapement, etc., salmonid populations fluctuate annually as a result of varying environmental factors (e.g. extreme high and low stream flows, high stream temperatures in the summer, or ice). A stream does not necessarily reach its carrying capacity each year because of these factors.

<u>Salmonid Fish Passage</u>
Stream channel crossings by roads have been the cause of serious losses of fish habitat due to improperly designed culverts. Assessment of migration barriers is important, because anadromous salmonids migrate upstream and downstream during their lifecycles. In addition, many resident salmonids and other fish move extensively upstream and downstream to seek food, shelter, better water quality, and spawning areas. Where these barriers occur, fish can no longer reach suitable habitats. Because of reduced accessible habitat, fish populations may be limited.

Culvert road crossings can create barriers to fish migration in the following ways:

- The culvert is too high for the fish to jump into.
- The water velocity in the culvert is too fast for the fish to swim against.
- The water in the culvert is not deep enough for the fish to swim, or has a disorienting turbulent flow pattern, making it difficult for fish to find their way through.
- There is no pool below the culvert for the fish to use for jumping and resting, so they cannot access the culvert, or there are no resting pools above the culvert, so the fish are washed back downstream.

A combination of these conditions may also impede fish passage. It is not always clear when a culvert blocks fish passage. Some culverts may be velocity barriers during high flows but pass fish successfully during low flows. Other culverts may not be deep enough during summer low flows to pass fish, but fish can pass successfully during higher flows. Large, adult anadromous fish may be able to pass through culverts that are total barriers to smaller juvenile or resident fish. For these reasons it is important to understand what fish species occur in the watershed and when they will be migrating.

Culverts can be round, square, elliptical, or other shapes. Culverts can be made of various materials, including concrete, but metal pipe is the most common material. Because of the variability in culvert type and design, it is often difficult to definitively determine if a culvert blocks fish passage.

Other fish passage concerns can include impoundments, dams, unscreened and screened irrigation pipes and water withdrawals that result in dewatered reaches and/or low flows that restrict migration. Natural barriers, in contrast, are characteristic of a stream's channel morphology and where present, play a vital role in the co evolution of various fish species.

## B INTRODUCTION

Chinook, coho, steelhead and cutthroat are all native to the New River watershed. The historic abundance and distribution of these salmonids, within the watershed, is poorly understood. Historically, coho were more abundant in the New River basin, and likely more abundant than chinook. Contemporary distributions of coho in Floras Creek and New River basins are likely much reduced from the early settlement period due to habitat modification in the low gradient stream reaches (ODFW 2001).

While considerable information exists regarding the contemporary distribution of spawning and rearing of chinook, coho and steelhead, little is known about contemporary cutthroat distributions. Typically, cutthroat utilize all portions of the basin. It is likely that contemporary distributions of chinook and steelhead are not considerably reduced from the period when white settlers in the area began altering pristine habitats (ODFW 1995).

<u>Life History Patterns of Anadromous Salmonids</u>

Table 9 lists the life history patterns of anadromous salmonids in the south coast watersheds including Floras Creek. These characteristics were identified by cross referencing three sources of information: GWEB Oregon Watershed Assessment Manual; Watershed Stewardship, A Learning Guide, Oregon State University Extension Service; and Oregon South Coastal River Basin Fish Management Plan (ODFW Working Draft). Information was then verified through personal communication with ODFW Fish Biologist, Todd Confer, from the Gold Beach District office.

**Table 9 Life History Patterns of Anadromous Salmonids in South Coast Watersheds**

| Species | Adult Return | Spawning Location | Spawning Period | * Eggs in Gravel | Young in Stream | Freshwater Habitat | Young Migrate Downstream | Time in Estuary | Outmigration Period | Time in Ocean | Adult Weight (average) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **COHO** | Oct-Jan | coastal streams, shallow tributaries | late fall-early winter | Oct-May | 1+yrs | tributaries, mainstem, slack water | Mar-June (2nd yr) | few days - several weeks | fall-winter | 2 yrs | 5-20 lb (8) |
| **CHINOOK** | | mainstem large & small rivers | | | | mainstem large & small rivers | | days-months | | 2-5 yrs | |
| **spring** | Jan-Jul | | | Jul-Jan | 1+yrs | | Mar-Jul (2nd yr) | | | | 10-20 lb (15) |
| **fall** | Aug-Mar | | Nov-Jan | Sep-Mar | 3 months | | Apr-July | 3-4 months | Aug-Oct | | 10-40 lb |
| **STEELHEAD** | | tributaries, streams & rivers | Feb-Apr | | | tributaries | | less than a month | | 1-4 years | |
| **winter** | Nov-Jun | | Dec-May | Jan-Jul | 1-3 yrs | | Mar-Jun (2nd-5th yr) | | 1-3 yrs after hatch | | 5-28 lb (8) |
| **summer (Col. R.)** | Jun-Oct | | | Feb-Jun | 1-3 yrs | | Mar-Jun (3rd-5th yr) | | | | 5-30 lb (8) |
| **Coastal Sea Run CUTTHROAT** | Jul-Dec | small tributaries of coastal streams | Feb-May? | Dec-Jul | 1-3 yrs (2 avg.) | tributaries | Mar-Jun (2nd-4th yr) | less than a month ** | 1-3 yrs after hatch | 0.5-1 yrs | 0.5-4 lb (1) |

* The eggs of most salmonids take 3-5 months to hatch at the preferred water temperature of 50-55 F; steelhead eggs can hatch in 2 months.

** Fluvial and immature sea run cutthroat may reside in estuary through the summer

Threatened and Endangered Species

Table 10 lists the threatened and endangered species according to the National Marine Fisheries Service (NMFS) and ODFW. The Northwest Region of NMFS is responsible for marine and anadromous fishes under the Endangered Species Act (ESA). In August of 1998 coho, within the Floras Creek basin, were listed as Threatened. More recently, in April 2001, the status of steelhead was changed from “Candidate” to “Not Warranted”.

**Table 10 Threatened and Endangered Species**

| **Species** | **ESA Status** (1) | **ODFW Status** (2) | **Population Trends** (3) |
|---|---|---|---|
| Chinook | Not Warranted | Not Warranted / Not Reviewed | No +/- trend |
| Coho | Threatened | Not listed | Declining escapement |
| Cutthroat | Not Warranted | Not Warranted / Not Reviewed | Unknown |
| Steelhead | Not Warranted | Not Warranted / Not Reviewed | No +/- trend |

(1) NMFS – NW Region website //www.nwr.noaa.gov/1salmon/salmesa/specprof.htm
(2) Tim Whitesel, ODFW ESA Coordinator
(3) ODFW – Oregon South Coastal River Basin Fish Management Plan, June, 1995 (Working Draft)

Fish Distribution

Fish distribution maps for coho, chinook and winter steelhead were obtained in digital format from the ODFW. Due to the resolution of the scale (1:100,000) distribution of all three species was not available for small streams. All maps reflect distribution only; they do not provide any indication of the relative abundance of each species. Furthermore, all maps are in draft form. The following paragraph was adapted from the fish distribution metadata files (ODFW web site) that correspond to the maps.

Fish distribution maps illustrate areas of suitable habitat (spawning, rearing and migration) currently believed to be utilized by wild, natural, and/or hatchery fish populations. The term "currently" is defined as within the past five reproductive cycles. This information is based on survey data, supporting documentation and best professional judgment of ODFW staff biologists and in some cases, that of staff from other natural resource agencies within Oregon. Areas displayed may not be utilized by a species of fish on an annual basis due to natural variations in run size, water conditions, and other environmental factors. Due to the dynamic nature of this information, it may be updated at any time. This distribution information makes no statement as to the validity of absence in any particular area; no attempt has been made to verify where fish are not present. Historic genetic origin and current production origin have yet to be defined and are not found as attributes of the distribution data at this time.

Distribution of salmonids occurs throughout significant areas of the Floras Creek watershed. However, certain subwatersheds or stream reaches are more prone to provide spawning and summer/winter rearing habitat. Table 11 provides a summary of information that pertains to these important locations.

**Table 11 Important Locations for Spawning and Summer/Winter Rearing**

| Species/Purpose | Location |
|---|---|
| Coho spawning & rearing | Fourmile, Bethel, Butte, and Morton |
| Steelhead spawning & rearing | Distributed throughout basin |
| Chinook spawning | Willow & Floras |
| Chinook rearing | Lower Floras & New River |
| Cutthroat spawning | Throughout upper reaches |

**Source** Floras Creek Preliminary Watershed Assessment, 1995

Spawning Surveys – Peak Counts

Peak counts from spawning surveys provide one measure of fish populations and long term trends in streams and rivers. Spawning surveys on selected rivers range from ½ mile to 2 miles of stream. A trained biologist walks the stream during the peak spawning season (December to January), counting live and dead salmon. Surveys are conducted every 7-10 days. Adverse conditions such as turbidity indefinitely affect the observer's ability to see fish. The numbers listed in Table 12 and Table 13 reflect the peak counts for each spawning season, from 1995 to 2000. Numbers include both live and dead adult fish; jacks are not included.

**Table 12 Chinook Peak Spawning Counts (1995-2000)** (ODFW #21570 & 21569)

| Survey | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|
| Upper & Lower Floras | 59 | * | 31 | 74 | 64 | 122 |
| Willow Creek | 122 | 82 | 57 | 107 | 56 | 24 |

*Continuous high water throughout December and January prohibited counting

**Table 13 Coho Peak Spawning Counts from (1995-2000)**

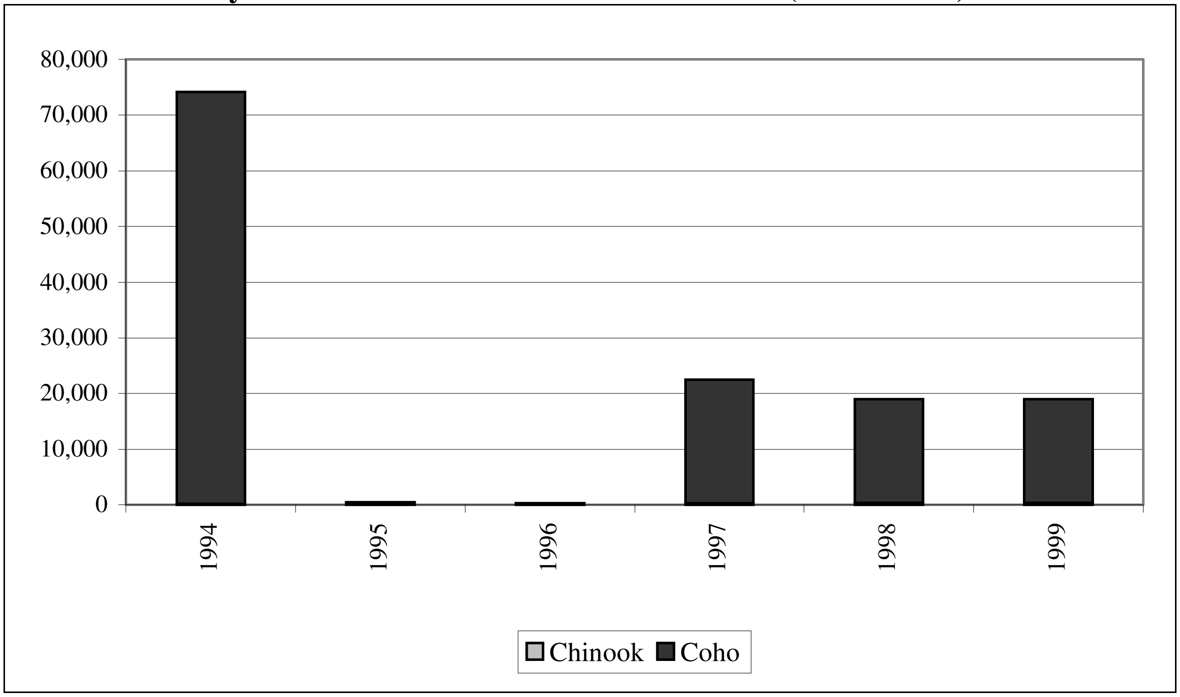
| Survey | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|
| Morton Creek | 24 | 31 | 13 | 25 | NA | 16 |
| Willow Creek | 8 | 20 | 9 | 16 | 5 | NA |

NA = Not Available

Stocking Summary

Chart 3 illustrates the total releases of hatchery fish for each species and each year on record with the local ODFW district office in Gold Beach. Stocking (hatchery release) data was compiled from two sources: ODFW's draft basin plan and the local Salmon and Trout Enhancement Program. The stocking summary is provided to help identify potential interactions between native and stocked species and to assist in determining if hatchery fish have an influence on current population trends. **Note:** Although not present here, stocking data, dating back to 1947, was also available from a third source known as Streamnet.

**Chart 3 Hatchery Releases in Floras Creek & New River (1994 – 1999)**




<u>Migration Barriers</u>
In 1995, a group of displaced fishermen were hired by the South Coast Watershed Council to conduct surveys of culverts in an effort to address fish passage concerns. The compilation of data from these surveys became known as the "Hire the Fishermen" survey. Culverts from this survey, within the Floras Creek watershed, were evaluated to determine adult and juvenile fish passage based on guidance (Robinson 1997) from the Oregon Department of Forestry and Oregon Department of Fish and Wildlife.

Initially, culverts were classified as "Adult Barrier," "Juvenile Barrier," or "Passable" categories. However, according to more recent standards (Robison, et. al., Spring 1999, Oregon Road/Stream Crossing Restoration Guide) outlet drops exceeding one foot in height are expected to restrict adults of some species. As a result, another category was created to represent "Adult Restricted". Additionally, some culvert slope measurements were estimated at 1% with a clinometer. Due to the resolution of these measurements, a degree of uncertainty exists in determining whether these slopes actually met the 0.5% slope criteria. As a result, when slope was the only criteria in doubt, these sites were classified as "Uncertain if Juvenile Barrier". Similarly, in consideration of adult passage, some culverts were estimated at 4% slope. Thus, when slope was the only criteria in doubt, these sites were classified as "Uncertain if Adult Barrier". Finally, the Outlet Drop was determined by estimating pool depth at bankfull flow. The assumption was made that bankfull flow is a better estimate of adult migration conditions than the measured summer flow pool depths.

Culvert conditions were evaluated for juvenile and adult salmonid fish passage. The listed criteria applies only to bare culverts. Few culverts surveyed were embedded or baffled. In both cases these criteria are not minimum values; they describe the conditions in which passage of most fish is blocked. Other conditions may still prevent some fish from passing through a specific culvert.

**Juvenile Fish Passage Criteria**

| | |
|---|---|
| **Slope** | <0.5% |
| **Outlet Drop** | <6 inches, with residual pool 1.5 times deeper than the jump |
| **Inlet Condition** | Diameter > ½ bankfull channel width; no inlet drop |
| **Length** | <100 feet long |

**Adult Fish Passage Criteria**

| | |
|---|---|
| **Slope** | <4% |
| **Outlet Drop** | <4 feet, with residual pool 1.5 times deeper than the jump or 2 feet deep |
| **Length** | <200 feet long |

Culverts, bridges and fords were assessed by the "Hire the Fishermen" survey. Some culverts and bridges have been more recently assessed and are included as well. Stream crossings are labeled by a "Site ID" and an estimated length of potential fish habitat. Potential fish habitat upstream of each culvert was measured, for all "Hire The Fishermen" culverts, to an estimated channel gradient of 16%. Stream channels greater than 16% are considered "Very Steep Headwaters" as described in the Channel Habitat Component of this watershed assessment. Salmonid fish habitat in these very steep headwater channels provides only very limited rearing.

## E KEY FINDINGS

Threatened and Endangered Species

- Coho have been listed as Threatened, according to the Endangered Species Act, since August 1998. No other salmonids are currently listed.

Fish Distribution

- Winter steelhead are well distributed throughout the basin and extend into all subwatersheds.
- Fall chinook are confined to the Lower Floras Mainstem, Willow Creek and a small reach (0.9 mile) of the Middle Floras Mainstem. Chinook distribution ends at a natural barrier situated between Johnson Creek and Clear Creek.
- Coho occupy Floras Lake and some of its tributaries such as Boulder Creek and Swanson Creek. Coho are also found in Willow Creek and throughout the Lower Floras Mainstem and a small reach (0.9 mile) of the Middle Floras Mainstem. Coho distribution ends at a natural barrier situated between Johnson Creek and Clear Creek.
- In the New River basin coho were historically more abundant than present and likely more abundant than chinook. Historical distribution of coho was also larger and has been more affected by habitat modification. However, populations of coho probably

did not exceed several thousand in number. In contrast, the Coquille River had hundreds of thousands of coho historically. (ODFW, 2001)

- **Note:** The coho distribution map included in this assessment erroneously illustrates fish presence in an unnamed tributary to Floras Lake and fails to illustrate fish presence in Swanson Creek. The two streams where coho presence has been observed, in the Floras Lake subwatershed, include Boulder Creek and Swanson Creek. Also not illustrated but observed, are steelhead found in Swanson Creek.

<u>Stocking Summary</u>

- Records indicate that 133,382 coho were stocked in Floras Creek and/or New River from 1994 to 1999. During the same period 1,947 chinook were released into the New River basin.
- Large-scale releases of hatchery fish and transfers between basins have discontinued. During the 1960's and early 1970's a fair amount of experimentation was conducted, involving significant releases of coho and chinook, in order to increase the fisheries. These efforts, for the most part, were unsuccessful. Releases of steelhead and cutthroat persisted for a longer period of time. However, these releases were curtailed and/or discontinued due to concerns about negative interactions with naturally produced fish. Stocks of fish from other watersheds that were released in south coast basins were not particularly well adapted and do not appear to have survived well. Limited genetic analysis indicates that non-indigenous stocks have not persisted in south coast basins since releases were discontinued. (ODFW, 2001)

<u>Migration Barriers</u>

- At approximately river mile 8.0 a natural barrier to adult chinook and coho prevents migration during most years.
- Unnatural barriers to fish migration are mostly in the lower basin with two in the upper basin. Three adult barriers and one considered to restrict, but not block, passage are identified. Three "certain" and two "uncertain" juvenile barriers are identified and three barriers scheduled for repair in 2001 or 2002.

## REFERENCES

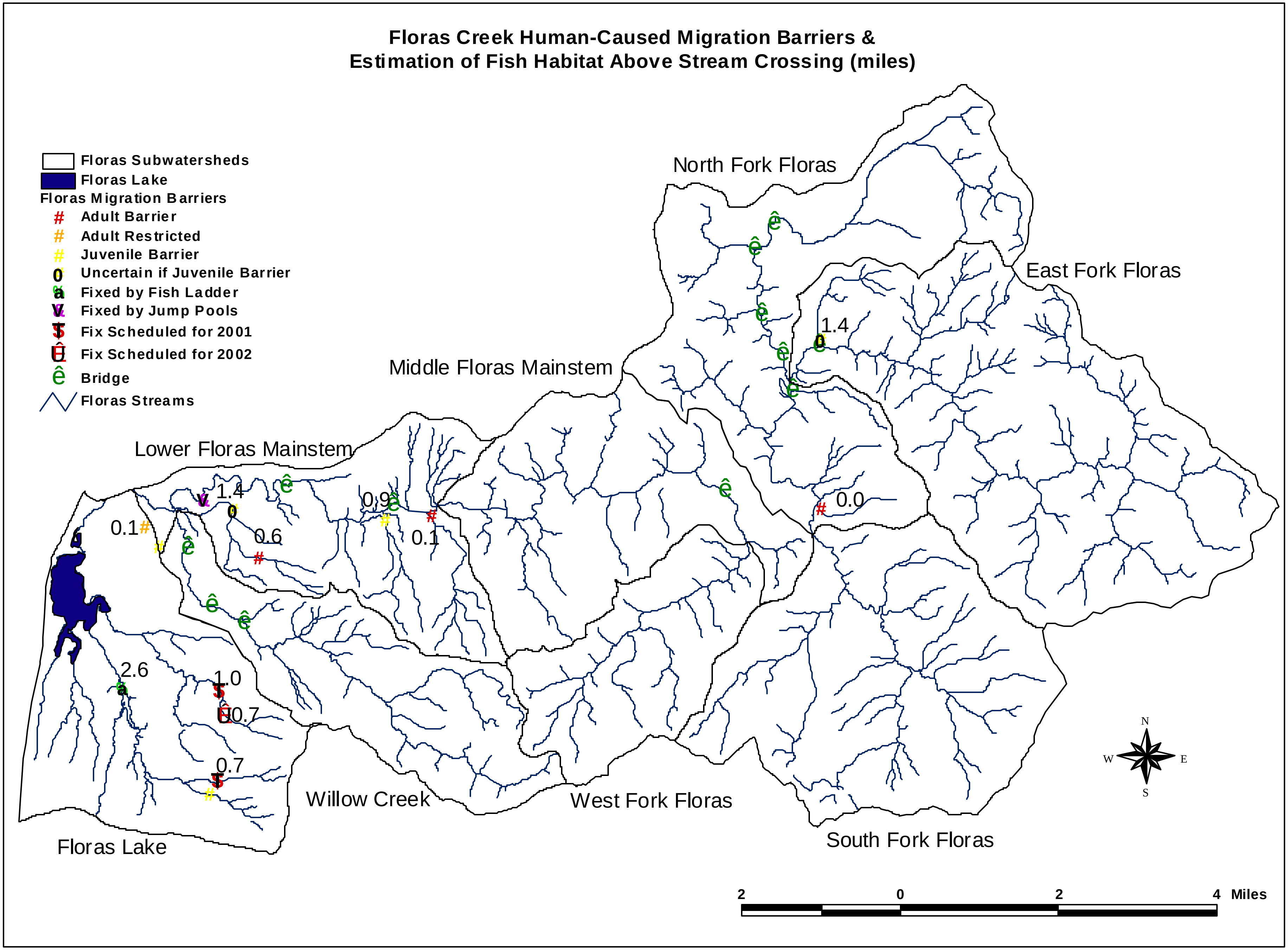

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

ODFW 1995. Oregon South Coastal River Basin Fish Management Plan, Working Draft, June 1995).

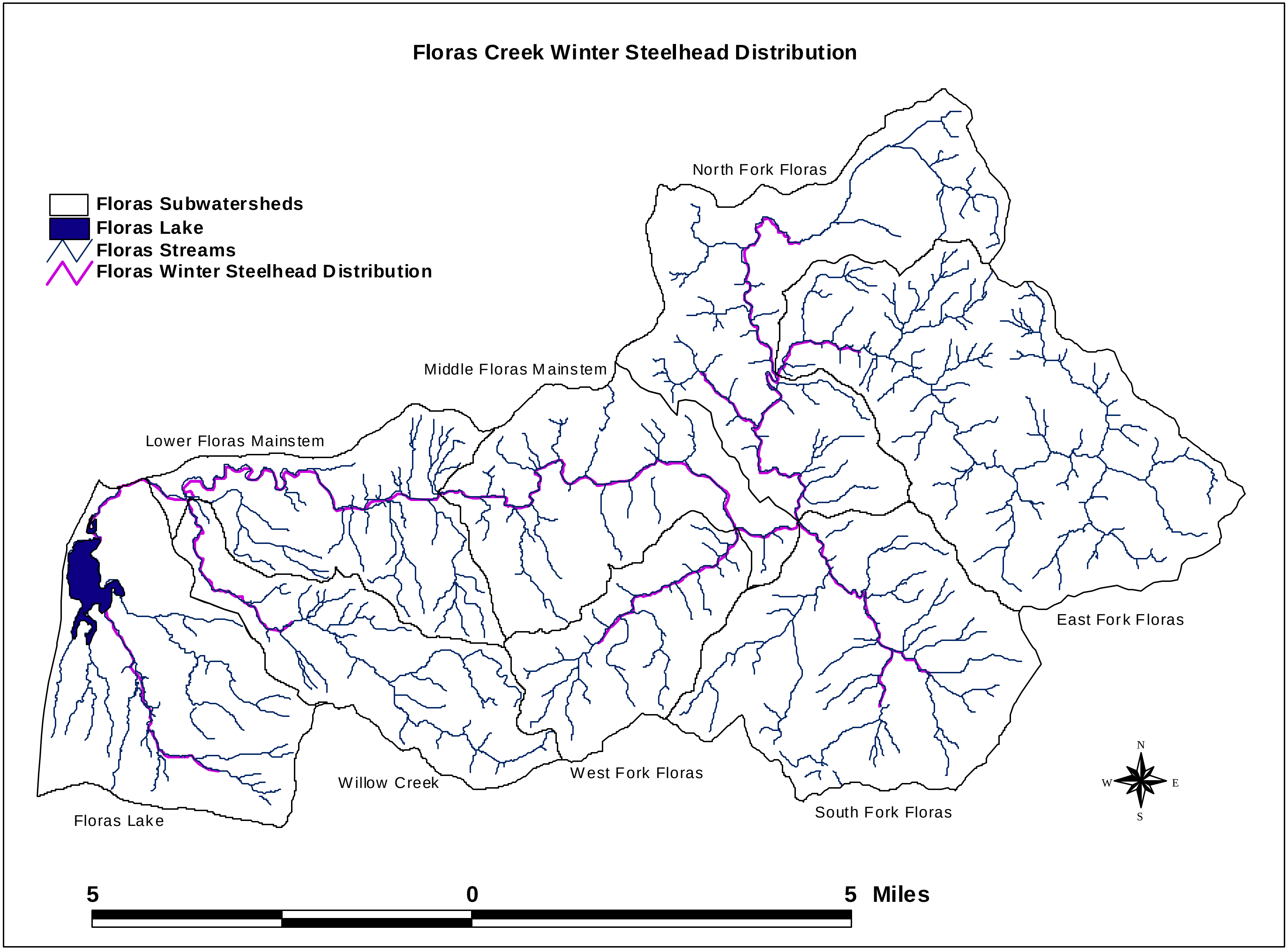
ODFW 2001. Personal communication with Todd Confer, Fish Biologist, Oregon Department of Fish and Wildlife – Gold Beach, Oregon.

OSU 1998. Watershed Stewardship - A Learning Guide, Oregon State University Extension Service, July 1998

Robinson 1997. Oregon Road/Stream Crossing Restoration Guide

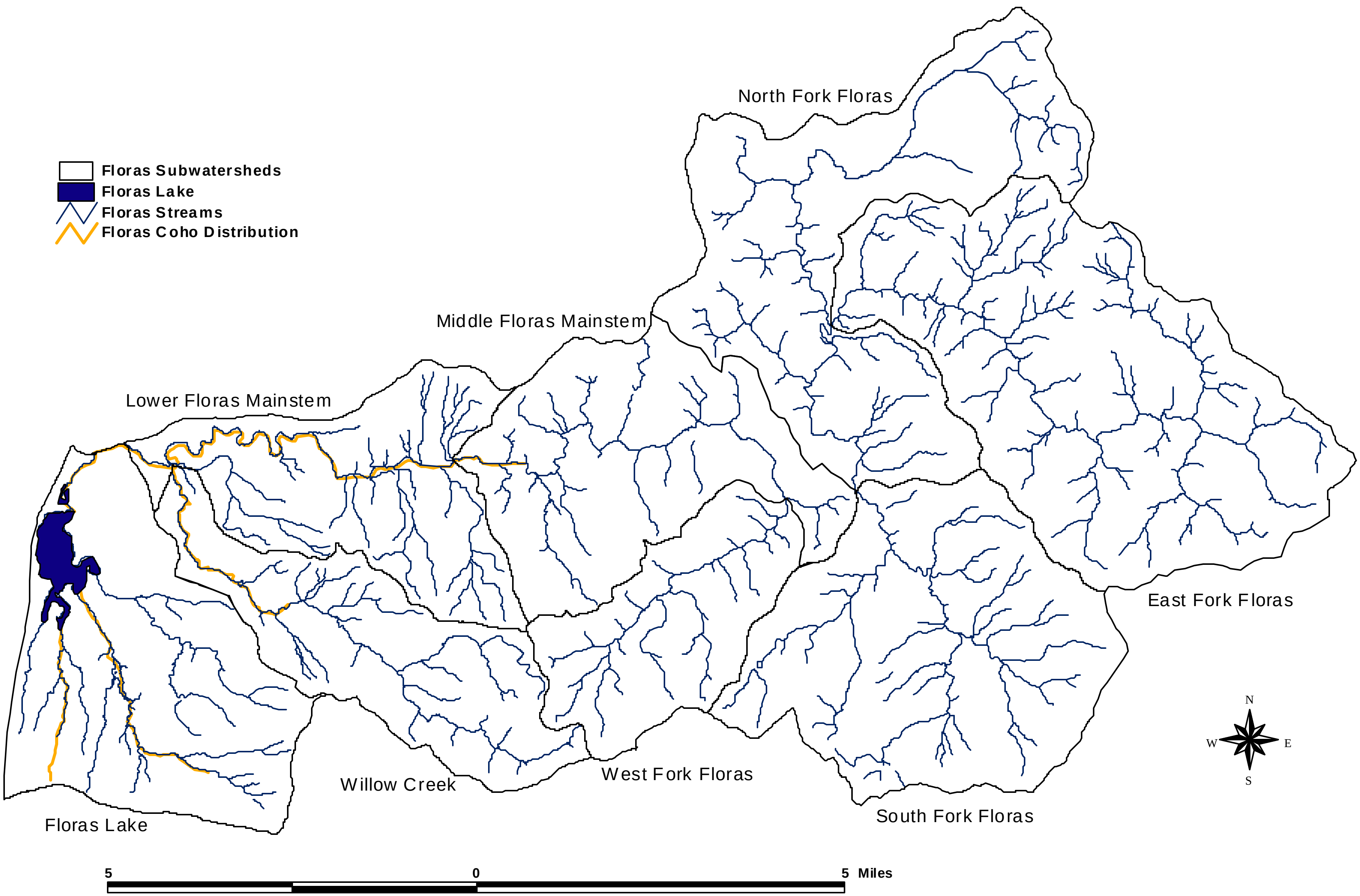


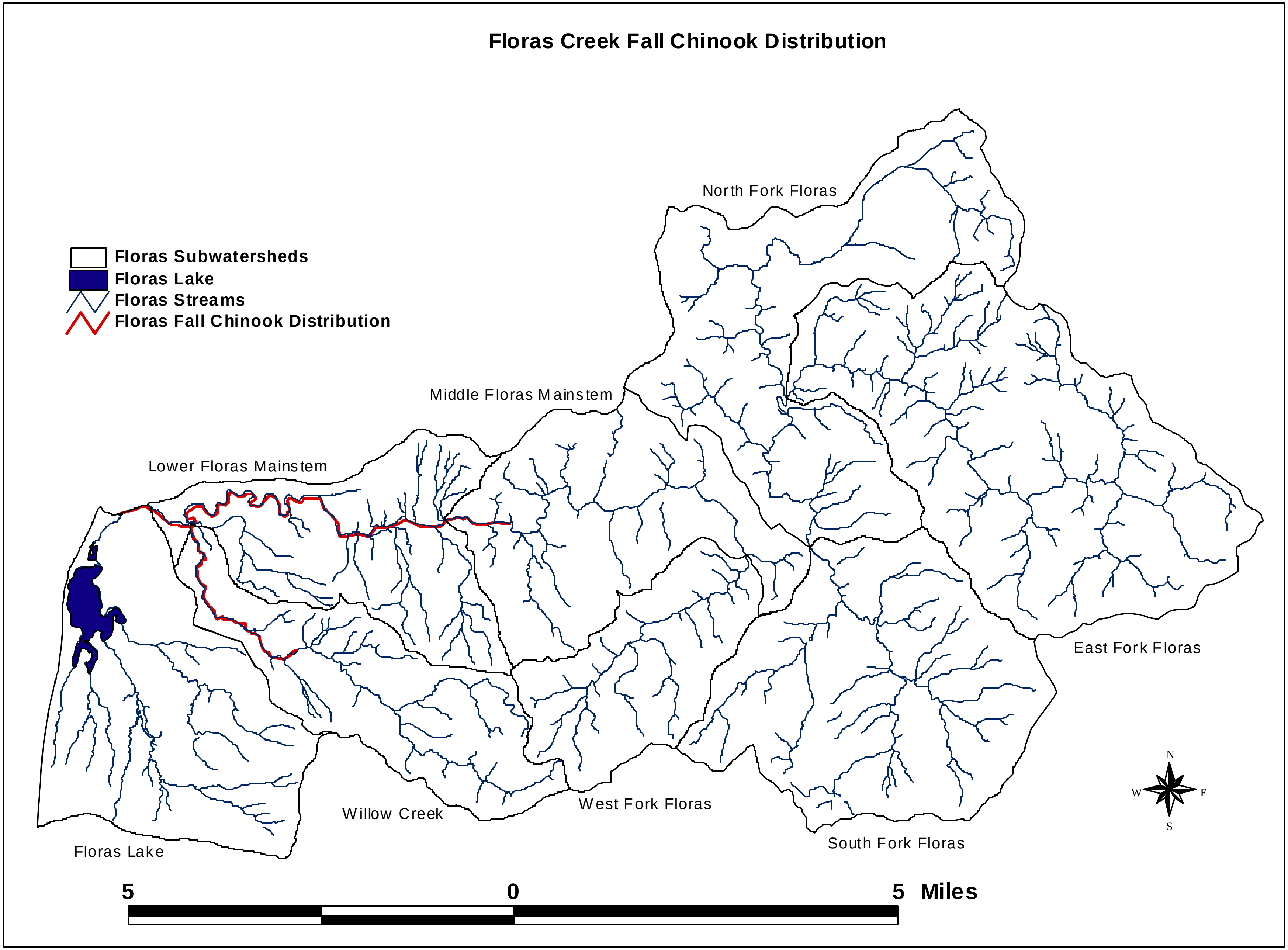
Floras Creek Human-Caused Migration Barriers &
Estimation of Fish Habitat Above Stream Crossing (miles)
Floras Subwatersheds
Floras Lake
Floras Migration Barriers
Adult Barrier
Adult Restricted
Juvenile Barrier
Uncertain if Juvenile Barrier
Fixed by Fish Ladder
Fixed by Jump Pools
Fix Scheduled for 2001
Fix Scheduled for 2002
Bridge
Floras Streams
North Fork Floras
East Fork Floras
Middle Floras Mainstem
Lower Floras Mainstem
Willow Creek
West Fork Floras
South Fork Floras
Floras Lake
1.4
0.0
0.1
1.4
0.6
0.9
0.1
2.6
1.0
0.7
0.7
N
W
E
S
2
0
2
4 Miles



Floras Creek Winter Steelhead Distribution
Floras Subwatersheds
Floras Lake
Floras Streams
Floras Winter Steelhead Distribution
North Fork Floras
Middle Floras Mainstem
Lower Floras Mainstem
East Fork Floras
West Fork Floras
Willow Creek
South Fork Floras
Floras Lake
N
W
E
S
5
0
5 Miles

# Floras Creek Coho Distribution




Floras Creek Fall Chinook Distribution
Floras Subwatersheds
Floras Lake
Floras Streams
Floras Fall Chinook Distribution
North Fork Floras
Middle Floras Mainstem
Lower Floras Mainstem
East Fork Floras
Floras Lake
Willow Creek
West Fork Floras
South Fork Floras
N
W
E
S
5
0
5 Miles

# VII WATER QUALITY ASSESSMENT

## A BACKGROUND (GWEB 1999 and OSU 1998)

A combination of natural watershed processes and the effect of human activities determine water quality at a particular site on a stream or river. All water contains some dissolved chemical elements, particulate matter, and organic matter. The amounts of these substances vary with different watershed conditions. Water quality is described in terms of the beneficial uses of water and the level of quality needed to support those uses. Measures of water quality – the criteria or indicators – provide the connection between the beneficial uses of water and the natural and human sources of watershed inputs.

Beneficial Uses of Water

The streams and rivers in the diverse landscapes of Oregon support different uses of water. To focus the water quality assessment, it is necessary to identify the beneficial uses of water that are important in a watershed as well as those that are specifically identified in the Oregon water quality standards. Beneficial uses determine which water quality criteria apply. For example, assessment for drinking water primarily focuses on the presence of pathogens that can cause disease or chemicals that can contribute to long-term health effects such as cancer risk. Assessment for water that supports fish populations focuses on elements of the stream system such as temperature, dissolved oxygen, metals, nutrients, and chemical contaminants.

Criteria and Indicators

Water quality criteria provide a warning system when activities in a watershed are limiting beneficial uses. Water quality criteria are specifically established in the State Water Quality Standards by major river basin. Water quality indicators are used when the state standards do not specify numerical criteria. Water quality concerns can be grouped into several major categories for analysis: temperature, dissolved oxygen, pH, nutrients, bacteria, turbidity and toxics. Water quality status can also be evaluated indirectly by examining the health of the aquatic community using aquatic invertebrates and fish populations.

Stream Temperature

Cool water temperatures are necessary features of streams that support salmonid fish and the associated aquatic community. Suitable temperature ranges have been evaluated for all life history stages of salmonids – adult migration, spawning, egg incubation, embryo development, juvenile rearing, and juvenile migration. Growth and reproduction are adversely affected when water temperature is outside of the range to which these organisms were adapted.

The biological rationale for temperature criteria is based on laboratory and field studies. Laboratory studies evaluate egg development rate and juvenile survival under constant temperatures. Field studies evaluate the effect of water temperature on adult and juvenile migration behavior and adult spawning behavior. Oregon water quality standards are established to protect fish populations based on sublethal effects on fish, such as susceptibility to disease, inability to spawn, reduced survival rate of eggs, reduced growth and survival rate of juveniles, increased competition for limited habitat and food, and reduced ability to compete with other species. A general numerical standard of 64° Fahrenheit (7-day moving average of maximum temperatures) was established in Oregon on the basis of preventing these sublethal effects. Several documents (Boyd and Sturdevant 1997, Oregon Department of Environmental Quality 1995) have been published by state agencies to help understand the technical basis for the standard, and what managers and land owners can do to meet the standard.

The evaluation criteria for stream temperature is a daily maximum 64° F standard that is applied to the average of the maximum temperatures for the warmest 7 consecutive days (known as the "7-day max"). The daily maximum temperature is determined from readings at hourly or half-hour intervals for each day during the monitoring period, usually mid-June through mid-September. The difference between the coolest and warmest temperature during the warmest 7 consecutive days is known as $\Delta T$. High $\Delta T$ values result from solar exposure, and may be used to indicate reaches where additional shade can limit the sun's ability to warm the stream. Quite strictly, shade does not lower temperature it simply blocks the sun from warming the stream.

<u>Dissolved Oxygen</u>

High dissolved oxygen is a basic physiological requirement of cold-water fishes such as native salmon and trout. Critical dissolved oxygen levels for various life stages have been evaluated in laboratory and field studies. The early larval stages of fish are wholly dependent on the transfer of oxygen within the redd, the salmonid gravel nest. When oxygen is below saturation, salmonid embryos are smaller than usual and hatching is either delayed or is premature. Salmonid juveniles survive in dissolved oxygen less than saturation, but growth, food conversion efficiency, and swimming performance are adversely affected. Water quality criteria are established to provide for the natural fluctuations below saturation while assuring sufficient dissolved oxygen to protect aquatic life. The concentration of dissolved oxygen is a function of many factors: water temperature, surface and intragravel water interchange, water velocity, substrate permeability, and the oxygen demand of organic material. The content of oxygen in water is directly related to water temperature and barometric pressure, and therefore, temperature and pressure (estimated through elevation) must be measured at the same time.

The Oregon Water Quality Standards contain a number of dissolved oxygen criteria. More restrictive criteria are specified for dissolved oxygen during the period that salmonid fish are spawning (11 mg/l). Also, the standards specify a dissolved oxygen concentration (8 mg/l) in the gravel used by spawning fish. For the purposes of this assessment, the evaluation criteria is set at a minimum of 8 mg/l in the water column for cold water fish.

<u>pH</u>

The pH is a measure of the hydrogen ion concentration of water. PH is measured in a logarithmic scale, with pH below 7 indicating acidic conditions and pH above 7 indicating alkaline conditions. PH of water is important in determining the chemical form and availability of nutrients and toxic chemicals. Measurement of pH is especially important in mining areas because there is potential for both generation of heavy metals and a decrease in pH. Metal ions shift to a more toxic form at lower pH value. The pH of waters varies naturally across Oregon due to the chemical composition of the rock type in the watershed and the amount of rainfall. Eastside basins generally will have more alkaline water than westside or coastal basins.

The Oregon Water Quality Standards specify the expected pH range for all basins in Oregon. For the purposes of this assessment, the evaluation criteria is set at 6.5 to 8.5 for all westside basins. It should be recognized that, like dissolved oxygen, pH also varies in streams naturally throughout the day due to the photosynthesis and respiration cycles of attached algae.

Nutrients

Nutrients refer to chemicals that stimulate growth of algae and aquatic plants in water. In fast-moving streams, algae grow attached to the substrate and are called "periphyton." Algae and aquatic plants are a necessary part of the stream ecosystem and act as the primary producers in a stream – processing the sun's energy into food for stream fish. Excess algae and aquatic plant growth, however, becomes a problem in slow moving streams and rivers, and in still waters such as ponds and lakes. The excessive growth can result in low or no dissolved oxygen and interfere with recreation, and certain algae can produce chemicals that are toxic to livestock and wildlife. Phosphorous and nitrogen are the major growth-limiting nutrients in water, and are therefore the focus of a water quality evaluation.

Total phosphorous measures primarily phosphates in the water column and phosphorous in suspended organic material. Total nitrate (commonly measured as nitrite plus nitrate) provides a measure of the majority of nitrogen present in surface waters. Evaluation criteria are based on literature values that have been identified as causing excessive plant growth.

For the purposes of this assessment, the evaluation criteria is set at 0.05 mg/l for total phosphorous and 0.30 mg/l for total nitrates.

Bacteria

Bacteria in the coliform group are used as indicators to test the sanitary quality of water for drinking, swimming, and shellfish culture. Bacteria in the coliform group are found in wastes associated with warm-blooded animals, including humans, domestic animals, and other mammals and birds; these bacteria are indicators of contamination of surface waters by sewage, feedlots, grazing, and urban runoff. The State of Oregon specifies the use of Escherichia coli (E.coli) as the bacterial indicator for water contact recreation, such as swimming, and fecal coliform bacteria as the indicator in marine and estuarine waters for shellfish growing. E.coli is a more specific test for organisms that occur in warm-blooded animals. The fecal coliform procedure tests positive for some bacteria that occur naturally in the environment, but has generally been accepted as a good screening tool.

Fecal coliform bacteria enter streams from many sources associated with human and animal wastes in urban and agricultural watersheds. In rangelands, bacterial contamination occurs primarily from direct deposition of fecal material in streams. Good vegetative cover on the upslope areas and dense riparian vegetation impedes contaminated runoff from reaching streams. Once coliform bacteria enter streams, the majority settles to the bottom and is attached to sediment particles. The stream sediments can act as a reservoir for fecal coliform bacteria; bacteria are resuspended when bottom sediments are disturbed through increased turbulence or animal movement.

For the purposes of this assessment, the evaluation criteria is set at 406 E. coli/100ml in fresh waters and 43 fecal coliform/100ml in marine waters.

Turbidity/Suspended Sediment

Turbidity is a measure of the clarity of water. In most cases, water is cloudy due to runoff of sediment, and therefore turbidity is a useful surrogate for measuring suspended sediment. However, turbidity can also be caused by other sources of suspended material such as algae. Suspended sediment can directly affect fish by damaging their gills and reducing the feeding ability of sight-feeding fish such as salmonids. Suspended sediment is a carrier for other pollutants (nutrients, pesticides, and bacteria) and is therefore a concern for water quality in general. In addition, suspended sediment interferes with recreational uses and the aesthetic quality of water.

Turbidity varies naturally with the soil type in a landscape. The small particle sizes, silts and clays, will stay suspended for long periods and cause turbidity. Soils that break down into sand size fractions will settle to the bottom and result in comparatively low turbidity values. Turbidity in a stream will increase naturally during storm and runoff events. This high variability makes it difficult to establish a simple, meaningful criterion. For the purposes of this assessment, the evaluation criteria is set at 50 NTU. Turbidity at this level interferes with sight-feeding of salmonids and therefore provides a direct indicator of biological effect. *The unit of measure, an NTU (nephelometirc turbidity unit), is based on the original measurement device and has no direct meaning.*

Toxic Contaminants: Organic Compounds, Pesticides, and Metals

The term "contaminants" refers to chemicals that may cause toxicity in aquatic organisms. Due to the lack of data pertaining to toxic contaminants in the Floras Creek watershed no further assessment was conducted.

## B INTRODUCTION

The water quality assessment is based on a process that first identifies the beneficial uses that occur within the watershed (See Table 14). Evaluation criteria that apply to these uses are then identified and finally, water quality conditions are identified by comparison of existing data with these criteria. This conceptual framework is consistent with the guidelines established by the U.S Environmental Protection Agency (EPA) under the authority of the federal Clean Water Act and the water quality programs of the Oregon Department of Environmental Quality (ODEQ). The goal of the federal Clean Water Act, *"to protect and maintain the chemical, physical and biological integrity of the nation's waters,"* establishes the importance of assessing both water quality and the habitat required for maintaining fish and other aquatic organisms.

The requirements for in-stream water quality are based on protection of recognized uses of water. In practice, the sensitive beneficial uses drive the evaluation of water quality and are the basis for establishing best management practices.

Aquatic species, particularly salmonid fish, are often considered the most sensitive beneficial uses in a watershed. Salmonid species are adapted to cold water, high gradient habitats where temperatures are cool and dissolved oxygen is high. Salmonids have highly variable life histories but display similarity in laying eggs in gravels and have fry and juveniles that rear close to where they hatch from the egg. These early life stages are particularly sensitive to changes in water quality. Water quantity affects water quality parameters and subsequently fish, especially during summer low flow conditions. Extracting too much water from a system is just as harmful to fish as are certain water-quality parameters.

Table 14 illustrates the Beneficial Uses that pertain to the Floras Creek watershed. This list was obtained from the ODEQ's web site.

**Table 14 South Coast Beneficial Uses**

| Beneficial Uses | Estuaries & Adjacent Marine Waters | All Streams & Tributaries |
|---|---|---|
| Public Domestic Water Supply (1) | | X |
| Private Domestic Water Supply (1) | | X |
| Industrial Water Supply | X | X |
| Irrigation | | X |
| Livestock Watering | | X |
| Anadromous Fish Passage | X | X |
| Salmonid Fish Rearing | X | X |
| Salmonid Fish Spawning | X | X |
| Resident Fish & Aquatic Life | X | X |
| Wildlife & Hunting | X | X |
| Fishing | X | X |
| Boating | X | X |
| Water Contact Recreation | X | X |
| Aesthetic Quality | X | X |
| Hydro Power | | X |
| Commercial Navigation & Transportation | X | X |

(1) With adequate pretreatment (filtration and disinfection) and natural quality to meet drinking water standards. SA\Table\WH5291.5

Water Quality Limited Streams 303(d) List

The ODEQ is required by the federal Clean Water Act to maintain a list of steam segments that do not meet water quality standards. This list is called the 303(d) List because of the section of the Clean Water Act that makes the requirement. The. EPA has approved ODEQ's 1998 list. (ODEQ web site)

Table 15 illustrates the Water Quality Limited Streams that pertain to New River and Floras Creek. Although this assessment is focused on the Floras Creek watershed, information for New River was readily available and is therefore included in the table. The 7-day maximum temperatures listed below reflect the highest on record as of 1999.

**Table 15 Water Quality Limited Streams**

| Watershed | Tributary | Parameter | Listing Status | 7-day max | Hrs >64 F |
|---|---|---|---|---|---|
| New River | Mouth to Headwaters | Temperature | 303(d) List | | |
| | Mouth to Headwaters | Flow Modification | Need data | | |
| | Butte Creek | Temperature | 303(d) List | | |
| | Bethel Creek | Temperature | 303(d) List | | |
| | Fourmile Creek | Temperature | 303(d) List | | |
| | Morton Creek | Temperature | 303(d) List | 76 in 1999 | 568 |
| Floras Creek | Mouth to Headwaters | Temperature | Need data | 77 in 1997 | 1473 |
| | Mouth to Headwaters | Flow Modification | Need data | | |
| | Mouth to Headwaters | Sedimentation | Need data | | |
| | Willow Creek | Temperature | 303(d) List | 76 in 1994/98 | 844 |
| | Floras Lake | * Aquatic Weeds or Algae | 303(d) List | | |

* Supporting Data from Floras Lake Limnological Survey (PSU, 1995): Extensive growth of Elodea densa, a non-native aquatic plant and a "B" designated weed by Oregon Department of Agriculture, dominates the macrophyte assemblage and interferes with beneficial uses.

Water Quality Criteria Applicable to the Sensitive Beneficial Uses

Evaluation criteria are based on an interpretation of narrative and numeric standards in the Oregon Water Quality Standards. Where numerical criteria are not provided in the state standards, evaluation indicators have been identified based on the literature. Indicators are useful for evaluating water quality conditions, but do not have any regulatory standing.

**Summary of Water Quality Criteria and Evaluation Indicators**

| Water Quality Attribute | Evaluation Criteria | Evaluation Indicator |
|---|---|---|
| Temperature | Daily maximum of 64° (7 day moving average) | |
| Dissolved Oxygen | 8.0 mg/l | |
| pH | 6.5 to 8.5 units | |
| Total Phosphorous | | 0.05 mg/l |
| Total Nitrate | | 0.30 mg/l |
| E. coli | 406 E. coli/100ml (no single sample can exceed the criteria) | |
| Fecal coliform | 43 fecal coliform/ 100ml (not more than 10% of samples) | |
| Turbidity | | 50 NTU maximum |

## C METHODOLOGY

- Water quality conditions were evaluated using available data from the ODEQ's ambient water quality monitoring site at Highway 101 on Floras Creek. (See Table 16 in Appendix.) Data was collected approximately once every three months from 1995 to 2000. To facilitate the compilation of data, two datasets were combined: "Ambient" and "Lasarface". Some water quality data were also obtained by searching an unformatted database known as STORET. *(The Lasarface dataset contains ODEQ's comprehensive records of water quality data. The Ambient spreadsheet was used for calculating the Water Quality Index for 1989 to 1998 but only includes eight water quality parameters.)*
- Flow data from the Oregon Department of Water Resources' gaging station on Floras Creek and Elk River was obtained, where available, to provide a context regarding hydrologic influences in a nearby watershed.
- Water quality data were compared to evaluation criteria or indicators.
- The percent exceedance of criteria was calculated for each water quality parameter.
- An impairment category from the following table was assigned for each parameter.

**Criteria for Evaluating Water Quality Impairment**

| Percent Exceedance of Criteria | Impairment Category |
|---|---|
| (<15%) | **No Impairment**<br>No or few exceedances of criteria |
| (15-50%) | **Moderately Impaired**<br>Criteria exceedance occurs on a regular basis |
| (>50%) | **Impaired**<br>Exceedance occurs a majority of the time |
| Data lacking/insufficient | **Unknown** |

## D RESULTS

### Table 17 Evaluation of Water Quality Conditions

| Statistic | Dissolved Oxygen (mg/l) | pH (SU) | Total Nitrate (mg/l) | Total Phosphorous (mg/l) | Fecal Coliform (MPN) | E. coli (cfu/100 ml) | Turbidity (NTU) |
|---|---|---|---|---|---|---|---|
| **Samples** | 17 | 17 | 18 | 18 | 16 | 6 | 13 |
| **Minimum** | 8.9 | 7.1 | 0.01 | 0.005 | 2 | 2 | 1 |
| **Maximum** | 11.8 | 7.9 | 0.87 | 0.43 | 600 | 280 | 396 |
| **Median** | 10.5 | 7.5 | 0.452 | 0.02 | 22 | 11 | 1.5 |
| **# Exceedance** | 0 | 0 | 10 | 3 | 4 | 0 | 2 |
| **% Exceedance** | **0%** | **0%** | **55.6%** | **16.7%** | **25%** | **0%** | **15.4%** |

### Table 18 Summary of Water Quality Impairment

| Monitoring Site | DO (mg/l) | pH (SU) | Total Nitrate (mg/l) | Total Phosphate (mg/l) | Fecal Coliform (MPN) | E. Coli (cfu/100 ml) | Turbidity (NTU) | Summary of Miles Impaired* |
|---|---|---|---|---|---|---|---|---|
| Floras Creek @ Hwy 101 | None | None | Impaired | Moderately Impaired | Moderately Impaired | None | Moderately Impaired | 4.1 |

** Summary of Miles Impaired: If any box is rated as Moderately Impaired or Impaired, the Summary is rated as Impaired.*

### Table 19 Flow Data from Elk River Gage

| DATE | 4 Days Prior to Sample Date *Flow (CFS) | 3 Days Prior to Sample Date *Flow (CFS) | 2 Days Prior to Sample Date *Flow (CFS) | 1 Day Prior to Sample Date *Flow (CFS) | Sample Date *Flow (CFS) |
|---|---|---|---|---|---|
| 12/12/1995 | 1070 | 1370 | 1310 | 1430 | 3600 |
| 3/5/1996 | 1370 | 1180 | 1210 | 2310 | 2800 |
| 6/18/1996 | 172 | 169 | 165 | 160 | 156 |
| 9/10/1996 | 47 | 46 | 46 | 46 | 45 |
| 6/17/1997 | 154 | 148 | 140 | 133 | 131 |
| 9/10/1997 | 37 | 37 | 36 | 35 | 50 |
| 12/9/1997 | 433 | 391 | 848 | 943 | 730 |
| 3/18/1998 | 650 | 550 | 490 | 437 | 397 |
| 7/14/1998 | 79 | 77 | 75 | 73 | 71 |
| 9/22/1998 | 45 | 45 | 38 | 37 | 36 |
| 1/12/1999 | 391 | 351 | 320 | 322 | 324 |
| 3/16/1999 | 555 | 591 | 837 | 746 | 638 |
| 5/5/1999 | 208 | 538 | 1280 | 1000 | 753 |
| 7/13/1999 | 76 | 75 | 74 | 73 | 72 |

| | | | | | |
|---|---|---|---|---|---|
| 9/15/1999 | 44 | 44 | 44 | 44 | 43 |
| 11/16/1999 | NA | NA | NA | NA | NA |
| 1/25/2000 | NA | NA | NA | NA | NA |
| 3/22/2000 | NA | NA | NA | NA | NA |
| 7/25/2000 | NA | NA | NA | NA | NA |

## E STREAM TEMPERATURE

Many streams in Curry County currently exceed the state's temperature standard and have been subsequently listed as "water quality-limited" on the 303(d) list. In the Floras Creek watershed, Willow Creek, from its mouth to its headwaters, is the only subwatershed officially recognized on this list. However, stream temperature measurements suggest that certain areas of the watershed do not meet the state's temperature standard.

Under the Clean Water Act, water quality management plans are required to lower stream temperatures to meet the standard over time, or to justify setting a new standard to be met. The collection of stream temperature data and corresponding flow data has helped landowners and agencies establish realistic, watershed-specific targets for shade and water temperature. Through the assistance of Oregon State University Extension Service, the Floras Creek Watershed Council completed their water quality management plan in November 2000.

Since 1995, the South Coast Watershed Council has received funding from the Oregon Watershed Enhancement Board and Oregon Department of Environmental Quality to support monitoring for the Oregon Salmon Plan. Standard methods and accuracy checks were used for deploying recording thermometers (thermographs) as described in the *Stream Temperature Protocol* chapter of *Water Quality Monitoring Guide Book*. A Quality Assurance Project Plan provides direction for procedures.

Stream temperature data is collected to assist watershed council members and interested citizens in assessing where to focus efforts on restoring streamside vegetation in order to reduce exposure to the sun. The South Coast Watershed Council has monitored stream temperature and corresponding streamflow in the Floras Creek basin since 1995. Stream temperature monitoring provides baseline data, long-term trend data and educational opportunities. As a result, stream reaches can be prioritized to voluntarily plant or manage vegetation in order to produce adequate shade. Monitoring also allows resource managers to measure the effectiveness of riparian restoration projects.

The following tables represent key characteristics of summarized data compiled by the South Coast Watershed Council's Monitoring Program, BLM and the Oregon Department of Fish and Wildlife. Table 20 illustrates the 7 Day Max Values that represent annual trends from 1994 to 1999. Table 21 illustrates the locations, number of days and associated years that exceed the state's temperature standard. All data was obtained from the Monitoring Program's Stream Temperature Report. In most cases on public lands, resource personnel from the agencies listed above measured the 7-day max values. For more details please contact the South Coast Watershed Council's Monitoring Coordinator.

**Table 20 Annual Trends – 7 Day Max Values** (Degrees Fahrenheit)

| Location | 1999 | 1998 | 1997 | 1996 | 1995 | 1994 |
|---|---|---|---|---|---|---|
| North Fork @ McLeod Rd | - | 65.2° | 64.2° | 67.1° | - | - |
| East Fork @ McLeod Rd | 64.6° | 69.5° | 67.5° | 68.9° | - | - |
| North Fork @ mouth | 69.6° | 71.6° | 74.3° | 73.2° | - | - |
| South Fork @ mouth | 66.8° | 69.6° | 68.1° | 68.7° | - | - |
| Mainstem @ White Elephant Bridge | - | 72.8° | 72.8° | 73.9° | - | - |
| Mainstem @ Mormon Camp | 72.3° | 75.2° | 75.3° | 73.8° | - | - |
| Mainstem @ pump-house | 75.0° | 75.3° | 76.9° | 75.7° | 75.4° | - |
| Willow Creek @ Hwy 101 | 68.9° | 71.0° | 71.8° | 69.1° | 68.4° | 69.4° |
| Willow Creek @ county bridge | - | - | 75.2° | 72.4° | 74.3° | 76.3° |
| Willow Creek near mouth | 73.8° | 75.6° | - | - | - | - |
| Morton Creek @ Hwy 101 | 68.4° | 71.0° | - | - | - | 65.3° |
| Boulder Creek | - | 71.1° | - | 69.0° | - | - |

**Table 21 Days >64° F** (7-day max values)

| Location | 2000 Days > 64° | 1999 Days > 64° | 1998 Days > 64° | 1997 Days > 64° |
|---|---|---|---|---|
| North Fork @ McLeod Rd | 2 | | 21 | 18 |
| North Fork @ mouth | 59 | 69 | 69 | 64 |
| East Fork @ McLeod Rd | | 10 | 39 | 40 |
| East Fork @ Langlois Mountain Rd. | 19 | | | |
| South Fork @ river mile 1.5 | 40 | | | |
| South Fork: Dwyer Creek | 0 | | | |
| South Fork @ mouth | 36 | 40 | 50 | 52 |
| West Fork @ mouth | 0 | | 0 | |
| Mainstem @ White Elephant Bridge | | | 67 | 64 |
| Mainstem @ Mormon Camp | 64 | 74 | 71 | 65 |
| Mainstem @ pump-house | | 85 | 79 | 65 |
| Mainstem @ McKenzie Ranch | | | | 68 |
| Ginny Creek @ mouth | | | | 46 |
| Willow Creek @ Hwy 101 | 48 | 55 | 66 | |
| Willow Creek @ county bridge | 57 | | | |
| Willow Creek near mouth | 63 | 72 | 72 | |
| Mainstem above Willow Creek | 67 | | 58* | |
| Mainstem below Willow Creek | | | 74 | |
| Mainstem above Floras Lake | 71 | | | |
| Boulder Creek below reservoir | | | 69 | |
| Floras Lake outlet | 27 | 78 | | |
| Morton Creek @ Hwy 101 | | 54 | 58 | |
| Morton Creek below Waller's | | 71 | | |

* Bad data thermometer – buried in sand for part of record

## F OREGON WATER QUALITY INDEX (ODEQ 2000)

The Oregon Department of Environmental Quality Laboratory maintains a network of ambient water quality monitoring sites. These sites were selected to provide representative statewide geographical coverage, and to include major rivers and streams throughout the state. There are currently 156 monitoring sites in the network. One site is situated on Floras Creek at Highway 101. ***Note:*** *Water quality data collected at the Floras Creek site is the same data used previously.*

Water quality data collected at these sites, in water years 1989-1998, were included in the Oregon Water Quality Index (OWQI). The index was developed for the purpose of providing a simple, concise and valid method for expressing the significance of regularly generated laboratory data, and was designed to aid in the assessment of water quality for general recreational uses. *(C. Cude, ODEQ)*

The OWQI analyzes a defined set of water quality variables and produces a score describing general water quality. The water quality variables included in the index are temperature, dissolved oxygen (percent saturation and concentration), biochemical oxygen demand, pH, total solids, ammonia and nitrate nitrogens, total phosphorous, and fecal coliforms. OWQI scores range from 10 (worst case) to 100 (ideal water quality).

OWQI results were calculated for each site on all samples taken in Water Years 1989-1998. Seasonal averages were calculated for the summer season (June – September) and fall, winter and spring seasons (October – May). The minimum of these seasonal averages was used for ranking purposes; seasonal variability between river systems was considered.

A classification scheme was derived from application of the OWQI to describe general water quality conditions. OWQI scores that are of less than 60 are considered very poor; 60-79 poor; 80-84 fair; 85-89 good; and 90-100 excellent. To account for differences in water quality between low-flow summer months (June-September) and higher-flow fall, winter, and spring months (October-May), average values for summer and fall, winter, and spring were calculated and compared. Rankings were based on the minimum seasonal averages. Results revealed a summer average score of 87 (good) and a fall, winter, spring score of 64 (poor). No trend analysis was conducted due to insufficient data.

## G KEY FINDINGS

Dissolved Oxygen, pH, Total Nitrates, Total Phosphates, Fecal Coliform, E. coli, Turbidity, & Biological Oxygen Demand

- Seven water quality parameters were evaluated by comparing available water quality data to the Oregon Water Quality Standards. Among the seven, one parameter (Total Nitrates) was rated as impaired; three parameters were rated as moderately impaired (Total Phosphate, Fecal Coliform, and Turbidity); and three were not impaired (Dissolved Oxygen, pH, and E. coli).

- The highest values of Biological Oxygen Demand, Total Phosphorous, Fecal Coliform, E. coli and Turbidity all occurred on the same day (12/12/95). Elk River flow data indicates a flow of 3,600 CFS for this date. When compared to available Elk River flow data for other sample dates it appears likely that this sample was taken during a storm event.
- Evaluation of 13 Turbidity samples, 18 Total Phosphorous samples, and 16 Fecal Coliform samples resulted in Moderately Impaired ratings. However, only two Turbidity samples, three Total Phosphorous samples, and four Fecal Coliform samples exceeded the standard. On 12/12/95, during a likely storm event, all three parameters exceeded the standard.
- Biological Oxygen Demand values are lowest in summer and highest in winter.
- Total Nitrate values are lowest in fall and highest in winter.
- The average time water quality samples were taken was approximately 4:00 PM in the afternoon.

Stream Temperature

- The warmest 7-day maximum temperatures in the Floras Creek watershed have been recorded each year on the mainstem at the pump-house above Highway 101. Associated with these temperatures are relatively large $\Delta T$ values of 10.1º F in 1998 and 10.7º F in 1999. The 7-day minimums are also at or above the 64º F temperature standard.
- From 1996 to 1998, the East Fork's 7-day max was 2-4 degrees warmer than the North Fork's.
- In 1998, the South Fork's 7-day max (69.6º F) was 2 F cooler than the North Fork (71.6º F).
- Along the North Fork, between McLeod road and the mouth, increases in the 7-day max ranged from 6-10 degrees, depending on the year. Also in this reach the East Fork joins the North Fork. In 1998, the East Fork was 69.5º F as it joined the North Fork at 65.2º F.
- Along the mainstem, the 1998 7-day max values between White Elephant Bridge (72.8º F) and Mormon Camp (75.2º F) result in a temperature increase of 2.4º F.
- Mainstem maximum temperatures upstream of Willow Cr. are similar to those at its mouth. However, daily minimum temperatures in Willow are cooler, providing a thermal refuge. In 1999, the 7-day, minimum for Willow Cr. at the mouth was 4 degrees cooler than the value for the Floras mainstem at the pump-house.
- Along Willow Cr., 7-day max temperatures in 1998 decreased from Highway 101 (71.0º F) to the county road bridge (ODFW data; 7-day max NA), and increased again to the mouth (75.6º F). In the reach from the county road bridge to the mouth, surface flow losses to groundwater influenced the temperature increase.
- In 1999, the 7-day max at the Floras Lake outlet (69.2º F) was 5.8º F cooler than the Floras Cr. mainstem value for the pump-house (75.0º F).
- Along Morton Creek, the increase in temperature is accompanied by an increase in streamflow. At the downstream site, the $\Delta T$ of 17.6º F is large and typical of small streams that are exposed to solar radiation. This stream reach is a likely place to detect the effectiveness of riparian fencing and planting projects.

- Along the mainstem and below the gage, year-to-year variability may be affected by differences in flow, water use, and irrigation returns. Values are also lower in years when cloud fronts move through frequently enough to block solar exposure and interrupt the 7 consecutive days of the 7-day max.
- 1999 was generally a cooler year for all of Curry County. Rain in early August increased flows as shown in the Floras gage data.
- A 1.5º-1.9º F 7-day max temperature increase on the mainstem between Mormon Camp and the pump-house occurred in 3 out of 4 years. In 1998, both sites peaked in early August, but at lower flows, the pump-house site was warmer. In 1999, the pump-house was consistently warmer, especially at lower flows late in the season.

<u>Oregon Water Quality Index</u>

- With a minimum score of 64 (poor) for fall, winter, and spring, Floras Creek, at Highway 101, was ranked 129$^{th}$ among a total of 133 for the most impaired water quality sites from around the state.

## REFERENCES

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

OSU 1998. Watershed Stewardship - A Learning Guide, Oregon State University Extension Service, July 1998

ODEQ 2000. Oregon's 2000 Water Quality Status Assessment Section 305(b) Report

## VIII SEDIMENT SOURCES

### A BACKGROUND (GWEB 1999)

Erosion that occurs near streams and on surrounding slopes is a natural part of any watershed. Fish and other aquatic organisms in a region are adapted to deal with a range of sediment amounts that enter streams. The amount of erosion in a watershed and the sediment load in the streams vary considerably during the year, with most sediment moving during the few days that have the highest flows. The most significant land-forming events occur during precipitation or snowmelt events that happen only once every decade or more.

Sediment is delivered and transported to stream channels by a variety of processes. Landslide types vary from rapid, shallow debris slides and flows on steep terrain to slow-moving episodic earthflows covering hundreds of acres. Erosion processes include overland flow, concentrating into rills and gullies as well as streambank erosion.

Effects of sediment on stream channels and aquatic habitat are related to the volume, texture, and rate of delivery (see diagram below), as well as the characteristics of receiving stream channels. Fine particles (sand, organics, and silt) deposited on the streambed may blanket spawning gravels and reduce survival of fish eggs incubating in the gravel. Fine sediment may cover the exposed rock surfaces preferred by aquatic insects, reducing the food supply to fish. Suspended sediments cause turbidity (clouding of water), which prevents fish from feeding. Large deposits of coarse sediments can overwhelm the channel capacity, resulting in pool-filling, burial of spawning gravels, and, in some cases, complete burial of the channel, resulting in subsurface streamflows.

**Channel Response to Bedload Supply** (Lisle USFS)

| **Bedload Supply** → | | |
|---|---|---|
| ← → Incision<br>Bank erosion | Armoring<br>Embeddedness<br>Fines in pools | Braiding<br>Aggradation<br>Bank erosion<br>Pool filling by unsorted bedload<br>Bar construction |
| Morphologic Response | Textural Response | Morphologic Response |

The hardness of the underlying rock and its fracturing as the land is uplifted over long periods of time determine the rate of erosion. These geological processes also influence the pattern and density of streams in a watershed.

In addition to natural levels of erosion, human-induced erosion can occur from roads, landings, rock sources, and other land disturbances. Separating human-induced erosion from natural erosion can be difficult because of the highly variable nature of natural erosion patterns. Furthermore, human-caused erosion may also be highly variable in timing and spatial pattern. While it is nearly impossible to specify when a human-induced change in sediment is too much for a local population of fish and other aquatic organisms to handle, in general, the greater a stream deviates from its natural sediment levels the greater the chance that the fish and other aquatic organisms are going to be affected. Sediment in streams can have a human dimension, too. High sediment levels can increase the cost of treating drinking water, can be aesthetically displeasing, and can decrease fish angling access.

It is important to recognize that much eroding soil will deposit on a hill slope before it reaches the stream. This is good news, since there are a number of things that can be done to fix a site that is eroding before the sediment enters the streams. For example, water draining from a rutted road surface can be delivered onto a well-drained slope where the sediment will be filtered out, and the clean water can flow beneath the ground's surface to the stream.

Road-Related Erosion

The road network is potentially a significant erosion feature. Improperly placed roads can divert sediment-laden water to streams. Poor drainage of roads can lead to gullying and channeling of the road surface. Improper maintenance of inboard ditches can cause saturation of the roadbed, leading to mass wasting.

Road washouts also can occur when a road adjacent to the stream is undercut and a portion of the road drops into the stream, or at stream crossings during a high flow where there was either an undersized or plugged culvert or bridge. In steeper terrain, road washouts can create shallow landslides on unstable fill or cut-slopes failures. Appropriate sizing of culverts and bridges at stream crossings, locating roads away from streams, designing roads properly, and correctly disposing of soil during road construction on steeper slopes can prevent most road washouts.

## B INTRODUCTION

The assessment of sediment within the Floras Creek watershed was focused on the results of two analyses that serve as indicators of sediment related concerns. These indicators include an analysis of road density on steep slopes (>50%) and an analysis of road crossing density. Individually, each indicator can help direct land managers toward areas within the watershed that may warrant further investigation. Collectively, however, these indicators identify the relative risks of sediment impacts for each subwatershed throughout private lands in the basin.

The two indicators considered in this assessment (See Tables 22 & 23) focus on roads. They are designed to characterize past and future sediment delivery potential. These indicators represent processes that cause sediment delivery to stream channels, and should be interpreted with stream channel data, such as substrate and pool depth benchmarks used by ODFW. Data on cobble and dominant substrate at pool tail-outs are also available for channels of various gradients measured at several sites throughout private lands in the watershed. Although natural and harvest-related sediment sources are also present, they offer fewer opportunities for restoration and are therefore not included in this assessment.

**Table 22 Roads on Slopes >50%** (Indicator I)

| |
|---|
| **Process:** Failure of road fills, steep road surfaces and ditches concentrating runoff onto hillslopes. |
| **Comments**: Road failures result when road fill becomes saturated and/or incorporated woody debris decays. Prior to changes in the forest practice rules, roads were constructed by excavating and "sidecasting" road fill on slopes greater than 60%. Current practices call for excavating a "full bench" road and end-hauling the material to a stable landing. Although this indicator does not account for the age of the road, most roads were constructed before the change. Roads with well-maintained drainage systems may minimize the erosion, but large storms may move enough sediment to overwhelm the drainages. |

**Table 23 Road Crossings** (Indicator II)

| |
|---|
| **Process:** Plugging of culverts, leading to wash-outs or diversions down the road and onto unprotected hillslopes. |
| **Comments**: Old forest practice rules required culverts to be sized for storms recurring every 25 years or less. Many of these older culverts cause water to pond during storms, and allow woody debris to rotate sideways and plug the culvert. Culverts that are substantially narrower than the stream channel are also more likely to plug. Crossings located on steeper stream channels are subject to higher stream power mobilizing sediment and wood in the channel, and on hillslopes when diverted. Debris flows are also more likely to be generated on steeper channels. **Note:** *Currently, this indicator has not been refined by considering the stream gradient or the stream junction angle that would factor in the likelihood of continued debris flow run-out. Also, not all culverts that are included in this indicator are likely to plug or fail.* |

Ideally, the sediment indicators could characterize the probability of delivering an estimated volume of sediment with a known range of particle sizes. In reality, we can only infer the processes likely to deliver sediment, and identify locations where the processes are most likely to occur.

## C METHODOLOGY

- Roads on Slopes >50%: USGS 7.5 Minute topographic maps and digital orthophoto quads were interpreted to generate a comprehensive watershed road map in GIS. Old roads were included on the map. Slopes >50% were generated from a slope class map (originally from 10 meter digital elevation models) prepared by the Rogue Valley Council of Governments' GIS department. The length of all roads with slopes >50% were calculated for each subwatershed.
- Road Crossings: USGS 7.5 Minute topographic maps and digital orthophoto quads were interpreted to generate a comprehensive watershed road crossing map in GIS.

Crossings were identified at sites where contours or road configuration indicated the presence of distinct channels. (Larger drainage areas are required to create channels on more gentle slopes.) Old roads were included on the map. Crossings on these old roads may already be washed out, or no longer accessible for restoration, but their effects may be reflected in stream channel conditions below.

- For each subwatershed and each indicator a rating of sediment impacts was assigned based on comparisons of all south coast subwatersheds considered in this assessment. A percentile rating of 0-100 was established to represent the relative risk of each indicator for each subwatershed relative where 0 = lowest possible risk and 100 = highest possible risk. The percentile rating was further divided in the following categories: 0-19 (low); 20-39 (moderately-low); 40-59 (moderate); 60-79 (moderately high) and 80-100 (high).

## D RESULTS

**Table 24 Summary of Sediment Impacts**

| Subwatershed | Non USFS Acres | Roads on Slopes>50% | | | Road Crossings | | |
|---|---|---|---|---|---|---|---|
| | | Total Road Miles | Density/ Sq Mi | Roads on Slopes >50% Percentile | Total # of Crossings | Density/ Sq Mi | Road Crossings Percentile |
| East Fork Floras | 10,497 | 2.60 | 0.16 | 13 | 77 | 4.69 | 21 |
| Floras Lake | 6,635 | 0.03 | 0.00 | 0 | 11 | 1.06 | 0 |
| Lower Floras Mainstem | 4,797 | 0.29 | 0.04 | 3 | 45 | 6.00 | 28 |
| Middle Floras Mainstem | 5,732 | 1.46 | 0.16 | 13 | 76 | 8.49 | 42 |
| North Fork Floras | 8,167 | 1.90 | 0.15 | 12 | 71 | 5.56 | 25 |
| South Fork Floras | 7,781 | 0.39 | 0.03 | 3 | 56 | 4.61 | 20 |
| West Fork Floras | 3,525 | 2.67 | 0.49 | 39 | 22 | 3.99 | 17 |
| Willow Creek | 4,517 | 1.66 | 0.23 | 19 | 35 | 4.96 | 22 |

## E KEY FINDINGS

Density of Roads on Slopes >50%

- With the exception of the West Fork all subwatersheds received low risk ratings of density of roads on slopes >50%. The West Fork received a moderately low risk rating (39%) of density of roads on slopes >50%.

Density of Road Crossings

- The Middle Floras Mainstem received a moderate risk rating (42%) of density of road crossings.
- The subwatersheds that received moderately low risk ratings include the Lower Floras Mainstem (28%), North Fork (25%), Willow Creek (22%), East Fork (21%), and South Fork (20%).
- The West Fork and Floras Lake subwatersheds received low risk ratings of 17% and <1% respectively.

## F OTHER

Although not available at this time, an analysis of roads within 100 feet of stream channels will serve as a third indicator. Data produced by the Rogue Basin Restoration Technical Team should be available in the near future.

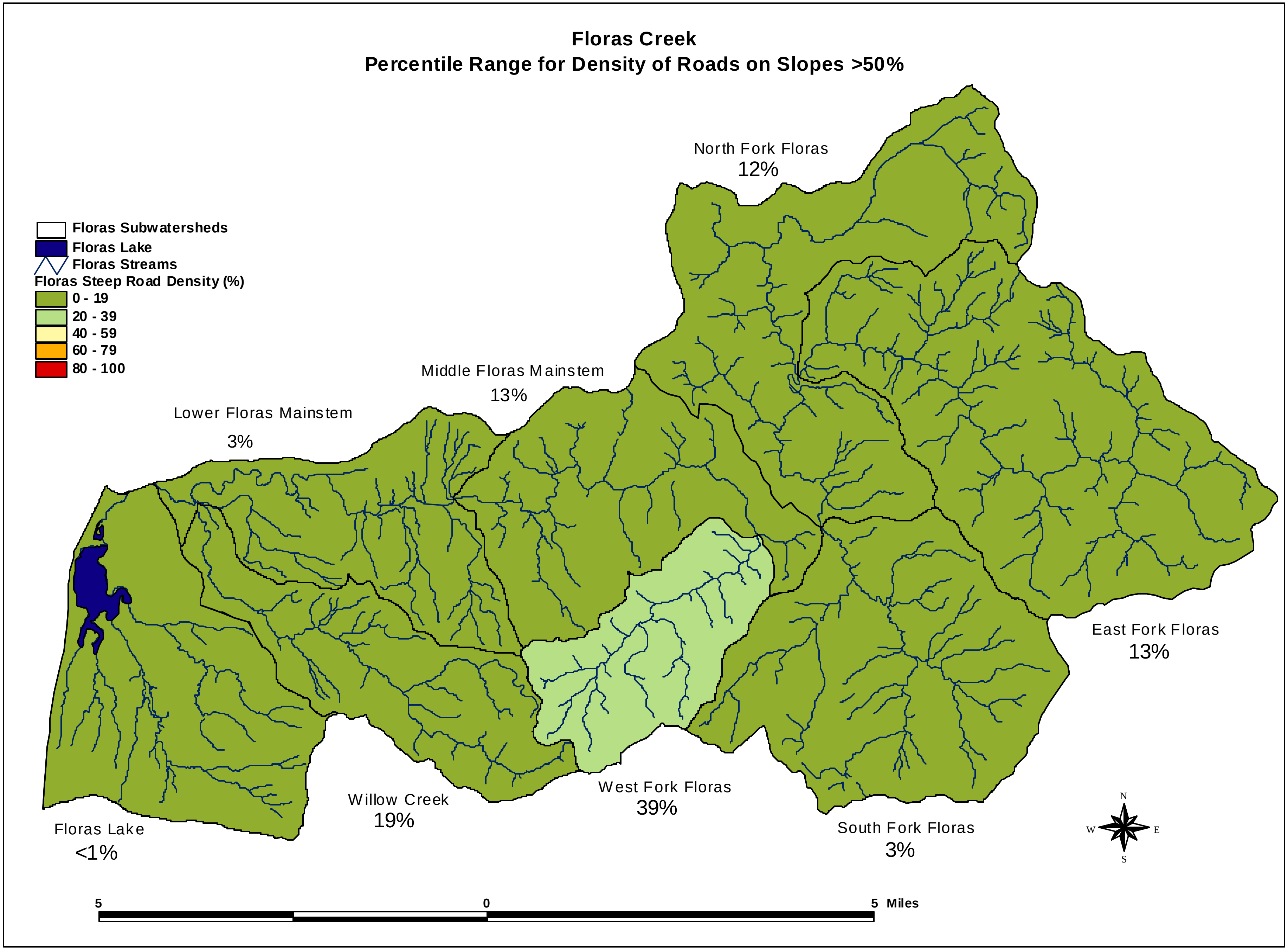
**Roads Within 100 feet of Stream Channels** (Indicator III)

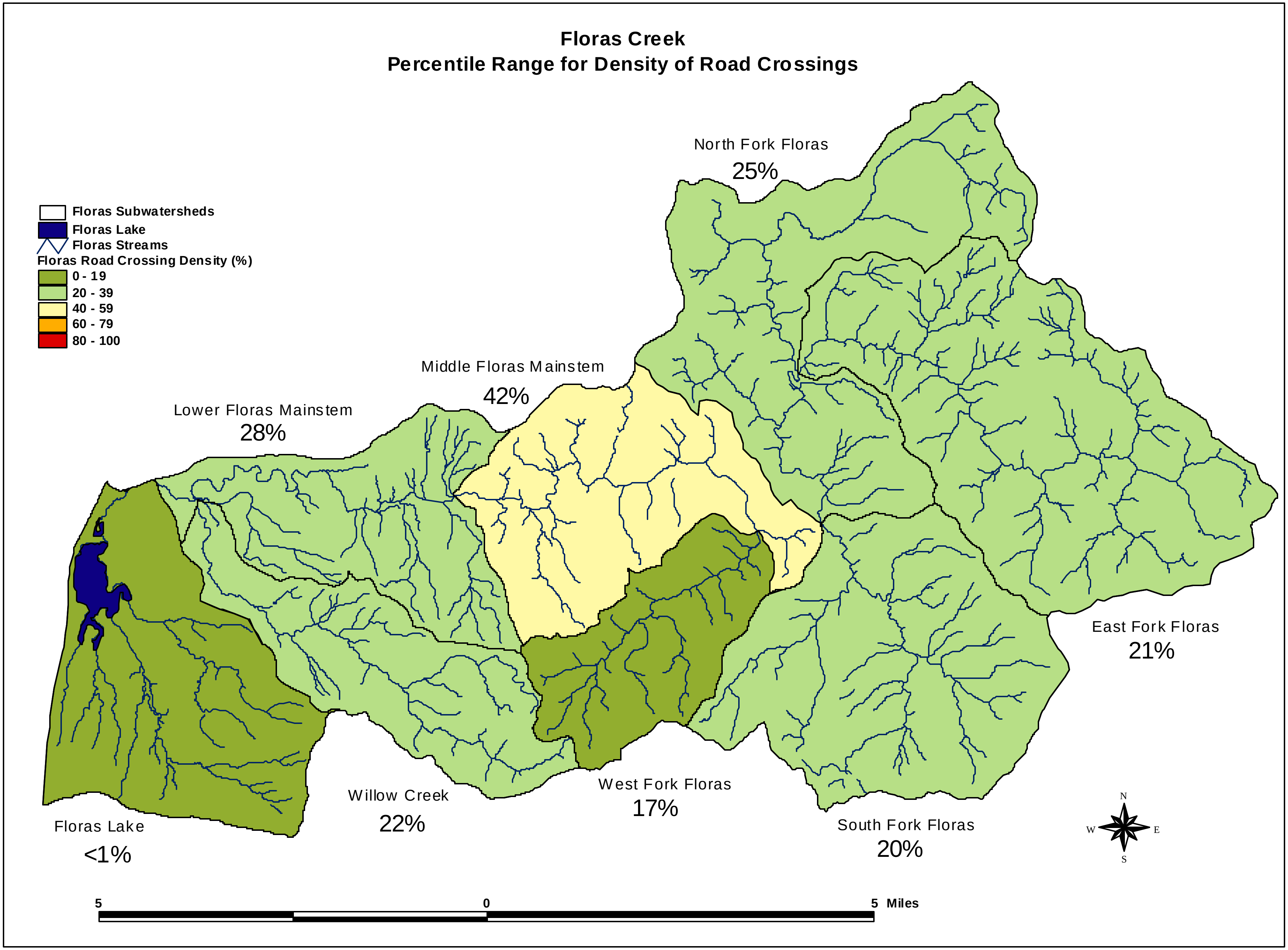
| |
|---|
| **Process:** Ditch erosion delivered directly to streams at crossings and at ditch relief culverts (less opportunity for fines to deposit on slopes), fill failures more frequent in wet toe-slope position and more likely to deliver to channels. Removal of large wood from channels. |
| **Comments**: The amount of fines generated from the road surface and ditch is related to the traffic and season (e.g. wet weather haul), frequency of disturbance including grading, and quality of the surfacing on the road. These factors however are not taken into account by this indicator. |

## REFERENCES


GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

Lisle USFS. Tom Lisle, USFS, Redwood Sciences Laboratory, Arcata, California


Floras Creek
Percentile Range for Density of Roads on Slopes >50%
Floras Subwatersheds
Floras Lake
Floras Streams
Floras Steep Road Density (%)
0 - 19
20 - 39
40 - 59
60 - 79
80 - 100
North Fork Floras
12%
Middle Floras Mainstem
13%
Lower Floras Mainstem
3%
East Fork Floras
13%
West Fork Floras
39%
Willow Creek
19%
South Fork Floras
3%
Floras Lake
<1%
N
W
E
S
5
0
5 Miles



Floras Creek
Percentile Range for Density of Road Crossings
Floras Subwatersheds
Floras Lake
Floras Streams
Floras Road Crossing Density (%)
0 - 19
20 - 39
40 - 59
60 - 79
80 - 100
North Fork Floras
25%
Middle Floras Mainstem
42%
Lower Floras Mainstem
28%
East Fork Floras
21%
Willow Creek
22%
West Fork Floras
17%
South Fork Floras
20%
Floras Lake
<1%
N
W
E
S
5
0
5 Miles

# IX RIPARIAN ASSESSMENT

## A BACKGROUND (GWEB 1999)

A riparian area or zone is a term that is often difficult to define. At its simplest, it is a green area along a body of water such as a stream or river. Riparian areas generally have higher levels of soil moisture than adjacent upland areas, and usually are well-vegetated. A wide variety of hydrologic, geomorphic, and biotic processes determine the character of a riparian zone.

Riparian vegetation influences fish habitat and water quality in a number of ways. Riparian vegetation may act as a filter in some areas, keeping sediment and pollutants out of streams. The roots of riparian vegetation stabilize streambanks by reducing erosion and preventing stream channels from downcutting. Streamside vegetation provides habitat for insects, some of which fall in the water and provide a food source for fish. In addition, vegetative litter is an important source of nutrients to the stream. During high stream flows, riparian vegetation may slow and dissipate the energy of floodwaters, preventing erosion. Although all of these are important functions of riparian vegetation, they are difficult to quantify and are beyond the scope of this assessment. This assessment focuses only on the functions of riparian areas in providing a source of large wood to the stream, and in providing shade for temperature control. Riparian zones that are functioning to provide these two key inputs typically provide many other valuable functions and processes attributed to these dynamic areas.

<u>Large Wood Recruitment</u>

Riparian areas are an important source of large woody debris (LWD) that enters, or is recruited to, the stream channel. LWD, including tree boles, root wads, and large branches, is recruited to the stream by bank erosion, mortality (e.g. disease or fire), or wind throw. Also, trees from both riparian and upland areas may also be carried into the stream by landslides.

In the stream channel, LWD diverts and obstructs flow, thereby increasing channel complexity (i.e., the large wood creates pools and riffles that provide areas of different velocity and depth). This complexity provides cover from predators, creates rearing areas, and develops refuge areas for fish during high stream flows. LWD also creates storage sites for sediment in all sizes of streams. In small headwater streams, wood controls sediment movement downstream. In larger streams, accumulation of sediment behind LWD often provides spawning gravels. LWD plays an important role in stream nutrient dynamics by retaining leaf litter and needles, making these energy supplies available for consumption by aquatic insects that ultimately serve as food for fish.

<u>Riparian Shade</u>

Although other processes besides shading affect heating and cooling of water (such as groundwater inflows), shade can have the largest affect because it counteracts the most important source of stream heating during the summer – solar radiation. Riparian enhancement efforts that provide shade have a high potential to contribute to temperature moderation as well as provide direct benefits to fish and wildlife habitat.

Shade provided by riparian vegetation affects stream temperature by reducing the inputs of solar radiation to the water surface. Although the vegetation itself will radiate heat to the stream, the increase in water temperature due to radiation from this source is very small compared with heating from direct solar radiation. Radiation from vegetation is important, however, because it decreases fluctuation of water temperatures on a daily (or diurnal) basis in forested streams compared with streams that have no canopy cover. The slope and aspect of a site also affect the amount of radiation received. In some areas (e.g. deep canyons) the topography of the land can also provide significant shade.

Role of Ambient Air Temperature

In most streams, evaporation of moisture is a primary mechanism of stream cooling; the heat is used to turn water into vapor. Turbulent streams will cool faster than slow streams with smooth surface conditions, due to the higher evaporation rate. Inputs of cool groundwater are also a significant source of stream cooling in some areas.

Stream temperatures are cooler than the ambient air temperature because of the higher specific heat of the water, and the cooling processes associated with evaporation and the inflow of groundwater. The daily patterns in stream temperature follow the daily change in air temperature. Typically, the maximum daily temperature occurs in the late afternoon and the minimum occurs late at night or early morning.

In many streams in Oregon, late-summer streamflows are lowest when the net heat gain is the greatest, resulting in the warmest water temperatures of the year. This phenomenon reflects the fact that the maximum water temperature is a result of both the net heat received and the amount of water that is heated. Consequently, the maximum annual stream temperatures may be higher in low-flow or drought years even though the stream receives the same level of heating each year.

Stream Order (OSU 1998)

A basic description of stream order is essential to understand the relationship of existing, potential, and potential increase in shade on perennial stream reaches. Stream order is a useful way to classify streams because within a given climatic and geologic region, certain stream orders tend to share many features and processes. The most common stream order classification system is to call the initial channel where a small stream first appears a first-order stream, and then to increase the order with each successive downstream junction with a stream of equal or higher order. Thus, small streams have low order numbers, while large streams and rivers have high order numbers.

## B INTRODUCTION

Riparian vegetation has been removed along streams throughout the Floras Creek watershed for a variety of management practices and also naturally, through streambank erosion. Historically, many riparian zones within the Floras Creek basin contained large conifers that were later harvested. In many cases, alder (*Alnus rubra*) dominant riparian communities have succeeded in the years following these harvests. Conifers typically grow taller and live longer than alders. The act of converting these present-day alder dominant communities back to mixed stands that include conifers (alder conversion) will undoubtedly provide increased shade for the long term.

The removal of riparian vegetation has reduced shade and subsequently increased the amount of sunlight reaching the stream. As noted previously, shade is one of the factors that controls summer stream water temperatures. In-stream flow and groundwater, as well as channel width/depth, and bedrock/substrate heating are other factors to be considered, but are not included in this assessment.

In 1999, an assessment of shade was conducted to estimate the existing and potential shade on perennial streams within the Floras Creek watershed. Existing shade is defined as shade that is currently present as evidenced by aerial photograph interpretation and selected field measurements. Potential shade is defined as the amount of shade that can be produced over time based on the site's potential to grow trees. The results of these two analyses were compared to estimate the potential increase in shade throughout the watershed.

A summary of the riparian assessment is presented in Tables 25 to 28. The Key Findings portion of this assessment highlights significant attributes of each table. **Note:** the Riparian Assessment evaluated riparian zones and streams only on private lands within the Floras Creek watershed.

## C METHODOLOGY

- Topographic maps (USGS 7.5 minute quads) and aerial photos (1997 BLM) were compiled to divide streams into 830 reaches (segments) based on differences in riparian vegetation, orientation (aspect), size and gradient.
- Riparian vegetation was characterized into eight different classes. These classes and their attributes include the following: Mature = coniferous trees >121 feet; High (reproduction) = coniferous trees 91 – 120 feet; Low (reproduction) = coniferous trees 31 to 90 feet; Hardwood = deciduous and evergreen hardwood trees >31 feet; Brush = shrubs < 30 feet; and Pioneer = bare or nearly bare ground.
- Field visits were conducted at 34 sites and included the following measurements: summer low flow width, bankfull channel width, streambank slope, various tree heights, percentage of overhanging vegetation, and shade density. The existing percentage of shade was also measured at each site in the middle of the bankfull channel with an instrument known as the Solar Pathfinder. This device allows the user to estimate the percent of solar radiation shaded by riparian vegetation for any given day of the year. **Note:** *Additional Solar Pathfinder measurements could be used to validate the SHADOW results or to modify assumptions used to date. Although there is a lack of channel data for numerous small streams (not necessarily perennial) in the watershed, these contribute the least flow and require the shortest*

*vegetation to provide shade. Sensitivity analysis for the variables used in SHADOW would help focus attention on those least certain data fields.*

- Existing shade was estimated using a computer spreadsheet program known as SHADOW. SHADOW considered the angle of the sun on August 1st in determining how far a tree projects a shadow across a stream during each hour of the day. For each stream reach, information was obtained from maps, photos, and field measurements to estimate a low flow channel width (wetted width) and existing tree height. SHADOW estimated shade for each stream reach based on its aspect, characterized as diagonal, north-south, or east-west.
- Average channel widths and tree heights were used to create the Existing Shade map overlay. Local conditions differ from assumed conditions and will determine the actual shade along any particular stream reach. Landowners can obtain more specific estimates of Potential Shade for any set of field conditions. SHADOW can also be used to calculate widths of riparian vegetation that are shading in the primary (11:00 AM-1:00 PM) and secondary (before 11:00 AM and after 1:00 PM) zones.
- The process for estimating potential shade was identical to that of estimating existing shade, with the added assumption that a tree can grow to a certain height over time. Upstream of the Highway 101 bridge, it was assumed that trees could grow to a height of 140 feet. Downstream of 101, 80 foot-tall spruce trees were assumed to be the potential height for the site. **Note:** *The application of different tree heights results in a minor change in estimated shade. For example, on a stream with a wetted width of 30 feet and a diagonal aspect, 120 foot-high trees produce 60% shade, while 140 foot-high trees increase shade to 65%.*
- The percentage of existing shade was mapped, in 20% increments, to illustrate the current condition on all perennial streams within the watershed. Similarly, the percentage of increased shade was mapped, in 20% increments, to illustrate the potential condition on all perennial streams within the watershed. Increased shade was determined by subtracting the existing shade from the potential shade.

## D RESULTS

**Note:** These results may not be directly comparable to those from other watersheds.

**Table 25 Miles of Stream by Perennial Stream Reach & Stream Order**

| Perennial Stream Reach | Stream Order | | | | | | Total Miles of Stream (All Stream Orders) |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| North Fork | 4.9 | 10.4 | 6.4 | 6.6 | 2.9 | 4.6 | 35.7 |
| South Fork | 6.1 | 9.4 | 9.4 | 6.7 | 4.0 | | 35.6 |
| East Fork | 3.8 | 10.3 | 15.2 | 2.0 | 6.3 | | 37.6 |
| West Fork | 5.2 | 9.1 | 2.1 | 3.9 | | | 20.3 |
| Willow | 4.4 | 6.2 | 5.5 | 6.0 | | | 22.1 |
| Mainstem | 5.3 | 16.0 | 7.1 | 0.6 | | 13.1 | 42.0 |
| Total Miles | 29.7 | 61.3 | 45.7 | 25.8 | 13.2 | 17.7 | 193.2 |

**Table 26 Average Existing Shade (%) by Perennial Stream Reach & Stream Order**

| Perennial Stream Reach | Stream Order | | | | | | Total Averages for All Stream Orders |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| North Fork | 70 | 63 | 50 | 40 | 57 | 40 | 54 |
| South Fork | 91 | 75 | 62 | 51 | 63 | | 68 |
| East Fork | 76 | 70 | 62 | 53 | 42 | | 62 |
| West Fork | 84 | 68 | 61 | 69 | | | 72 |
| Willow | 92 | 64 | 56 | 31 | | | 59 |
| Mainstem | 68 | 60 | 62 | 0 | | 25 | 50 |

**Table 27**
**Average Potential Shade Increase (%) by Perennial Stream Reach & Stream Order**

| Perennial Stream Reach | Stream Order | | | | | | Total Averages for All Stream Orders |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| North Fork | 30 | 31 | 38 | 40 | 26 | 18 | 32 |
| South Fork | 8 | 20 | 29 | 31 | 17 | | 22 |
| East Fork | 23 | 25 | 28 | 28 | 29 | | 27 |
| West Fork | 14 | 26 | 28 | 11 | | | 20 |
| Willow | 6 | 31 | 32 | 45 | | | 30 |
| Mainstem | 31 | 32 | 30 | 46 | | 26 | 30 |

**Table 28 Riparian Vegetation Classes (miles) by Perennial Stream Reach**

| Perennial Stream Reach | Riparian Vegetation Classes (miles) | | | | | | Percentage of Mature & High |
|---|---|---|---|---|---|---|---|
| | Mature | High (reprod.) | Low (reprod.) | Hardwoods (Alder) | Brush | Pioneer | |
| North Fork | 0.3 | 4.1 | 10.4 | 11.7 | 3.1 | 1.7 | 14 |
| South Fork | 0.5 | 8.4 | 10.7 | 8.3 | 2.0 | 1.0 | 29 |
| East Fork | 1.0 | 4.3 | 13.5 | 9.3 | 2.4 | 1.1 | 17 |
| West Fork | 0.5 | 4.4 | 3.7 | 7.0 | 2.0 | 0.9 | 26 |
| Willow Creek | 0.0 | 2.1 | 2.4 | 8.7 | 3.5 | 2.1 | 11 |
| Mainstem | 0.6 | 7.1 | 5.6 | 10.0 | 9.6 | 6.9 | 19 |

## E KEY FINDINGS

Table 25

- Approximately 193 miles of streams within the Floras Creek watershed were evaluated in this assessment. Of the total stream miles assessed the majority were located along the Floras Mainstem (22% of the total). Other drainages considered in this assessment include: North Fork, South Fork, East Fork, West Fork, and Willow Creek.
- Stream orders in the Floras Creek watershed range form 1$^{st}$ to 6$^{th}$. In order of greatest occurrence the percent of stream orders found throughout the basin are 2$^{nd}$ order (31.7%); 3$^{rd}$ order (23.6%); 1$^{st}$ order (15.3%); 4$^{th}$ order (13.4%); 6$^{th}$ order (9.1%); and 5$^{th}$ order (5.8%).

Table 26

- In general, existing shade percentages are highest in 1st order streams and lowest in 6th order streams. The highest existing shade is 92% on 4.4 miles of 1st order streams in Willow Creek. The lowest existing shade is 0% on 0.6 miles of 4th order streams in the Mainstem area.

Table 27

- The stream reaches in the North Fork have the highest potential shade increase (32%) on average for all stream orders.
- The highest potential shade increase on 1st order streams is 31% on 5.3 miles of Floras Mainstem. The second highest is 30% on 4.9 miles of the North Fork.
- The highest potential shade increase on 2nd order streams is 32% on 16.0 miles of Floras Mainstem. The second highest is 31% on 10.4 miles of the North Fork and 6.2 miles of Willow Creek.
- The highest potential shade increase on 3rd order streams is 38% on 6.4 miles of the North Fork.
- The highest potential shade increase on 4th order streams is 46% on 0.6 miles of the Floras Mainstem. The second highest is 45% on 6.0 miles of Willow Creek.
- The highest potential shade increase on 5th order streams is 29% on 6.3 miles of the East Fork.
- The highest potential shade increase on 6th order streams is 26% on 13.1 miles of the Floras Mainstem.

Table 28

- Mature and high vegetation classes are concentrated along 8.9 miles of the South Fork; 7.7 miles of the Floras Mainstem; 5.3 miles of the East Fork; 4.9 miles of the West Fork and 4.4 miles of the North Fork. These areas are likely sources of large woody debris.
- Willow Creek has the least potential to recruit large woody debris with only 2.1 miles of high vegetation and no mature vegetation.

## F DATA GAPS

- The Floras Creek Riparian Assessment did not include the Floras Lake subwatershed.

## REFERENCES

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

OSU 1998. Watershed Stewardship - A Learning Guide, Oregon State University Extension Service, July 1998

# X WETLANDS

## A BACKGROUND (GWEB 1999 and OSU 1998)

Wetlands are often considered ecological "hot spots." They play a role disproportionate to their size in supporting endangered species and maintaining biodiversity. When considering wetland assessments and associated restoration projects it seems prudent to first understand a regulatory definition of a wetland as used by the U.S. Army Corps of Engineers and the Oregon Division of State Lands: **Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions.**

Wetlands provide a variety of important functions, including water quality improvement, flood attenuation and desynchronization, groundwater recharge and discharge, and fish and wildlife habitat. These functions are described below.

<u>Water Quality Improvement</u>
Wetlands aid in water quality improvement by trapping sediment, and contaminants that may be attached to these sediments. Dense wetland vegetation tends to slow the rate of movement of water, which allows sediments to settle out. Although deposition of sediments is beneficial to downstream resources, excessive sedimentation may have negative impacts on the wetland itself. When a wetland is subjected to ongoing sediment deposition, the bottom elevation of the wetland will change; over time, this will lead to wetland loss. This process is exacerbated by human induced factors that increase sedimentation.

Vegetation within wetlands also can assimilate certain nutrients and some toxins, thereby protecting downstream resources. The anaerobic environment of many wetland soils breaks down nitrogen compounds and keeps many compounds in a nonreactive form. The ability of a wetland to provide this function is limited: At a certain point, toxins can build up to lethal levels in the wetland community and decrease the wetlands capacity to metabolize the nutrients entering from upstream sources. In addition, plant die-back and decay can re-release nutrients or toxins back into the system, although many toxins are actually converted to less harmful forms or bound in sediments.

<u>Flood Attenuation and Desynchronization</u>
Wetlands can help alleviate downstream flooding by storing, intercepting, or delaying surface runoff. Wetlands within the floodplain of a river can hold water that has overtopped river-banks. Floodwater desynchronization occurs when wetlands higher in the watershed temporarily store water, reducing peak flows. The most effective wetlands at providing desynchronization are generally located in the middle elevations of the watershed; these wetland locations are far enough away from the receiving water to create delay, but are low enough in the watershed to collect significant amounts of water.

Groundwater Recharge and Discharge

Wetlands are intimately associated with groundwater, and some wetlands can function to recharge underlying aquifers. Wetlands are sources of groundwater discharge that may help extend streamflows into the drier summer months. In eastern Oregon, restoring wet meadows in stream headwaters has extended the seasonal duration of streamflow.

Fish and Wildlife Habitat

Wetlands provide habitat and food for a variety of aquatic and terrestrial plant and animal species. Many species rely on wetlands for all or a portion of their life cycle. In addition to directly providing habitat, wetlands can directly support fish through some of the functions, discussed previously, that protect water quality and channel stability. Estuarine wetlands provide important feeding and holding areas for out-migrating salmon smolts.

## B INTRODUCTION (GWEB 1999 and OSU 1998)

Wetlands are protected by federal, state, and local regulations. In order to plan for growth and development in a watershed, it is necessary to know where these resources are located. In addition, wetlands can contribute to critical functions in the health of a watershed as mentioned above. Determining the approximate location and extent of wetlands may be essential in solving problems within the watershed.

Purpose

The purpose of the wetland characterization is to gain specific information on the location and attributes of wetlands in the watershed, including size, habitat type, surrounding land use, connectivity, and opportunities for restoration. This process will also assist in determining the relationship between wetlands and problems in the watershed that are identified through other components in this assessment. In addition, this inventory will help watershed councils determine whether it is appropriate or necessary to collect additional data on wetland function.

National Wetlands Inventory and the Cowardin Classification System

The most widely available and comprehensive wetlands information in the United States is the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI). The NWI has located and classified wetlands as well as mapped the entire aquatic ecosystem network. NWI maps contain information on location in the watershed, water regime, vegetation class or subclass, morphology, and sheet versus channel flow. The NWI is based on the Cowardin Classification System, which was published as the *Classification for Wetland and Deepwater Habitats of the United States*. It has four objectives:

1. To describe ecological units whose natural attributes are fairly homogenous
2. To arrange these units in a system that will help people make decisions about resource management
3. To provide information for inventory and mapping
4. To create standard concepts and terminology for use in classifying aquatic ecosystems

A major weakness of the Cowardin system and the NWI is that the descriptions of mapped units often don't relate consistently to ecosystem functions.  Because of the system's reliance on plant types as identifying criteria, wetlands that function very differently often are grouped into the same Cowardin class simply because they have the same vegetation.

Cowardin Classification's five major systems:

1. Marine (ocean): Consists of the open ocean overlying the continental shelf and its associated high-energy coastline.  Marine habitats are exposed to the waves and currents of the open ocean and the water regimes are determined primarily by the ebb and flow of oceanic tides.
2. Estuarine (estuaries): Deepwater tidal habitats and adjacent tidal wetlands that are semi-enclosed by lands but have open, partially obstructed, or sporadic access to the open ocean, and in which open water is at least occasionally diluted by freshwater runoff from the land.
3. Riverine (rivers): Includes all wetlands and deepwater habitats contained within a channel, except: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) areas with water containing ocean-derived salts in excess of 0.5 parts per thousand.
4. Lacustrine (lakes): Includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, mosses, or lichens with greater than 30% areal coverage; and (3) total area exceeds 8 hectares (20 acres).
5. Palustrine (marshes): Includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand.

These systems are divided into subsystems, which reflect water flow regimes (subtidal, intertidal, etc.).  The subsystems are then divided into many different classes, which reflect structural vegetative characteristics (e.g. RB Rock Bottom, UB Unconsolidated Bottom, etc.).  The classification of a mapped wetland is coded by a series of letters and numbers.  The first letter of the code represents the system, the subsequent number represents the subsystem and the next two letters indicate the class.  All Cowardin codes have more than three letters and/or numbers.  These additional characters represent more specific information about each wetland.  Generally, however, the first three letters and numbers of each code are the most important for the purpose of this assessment.  A summary of the Cowardin Classification Codes is provided below.  These codes will be helpful in identifying restoration opportunities within the Floras Creek watershed.

Due to the common occurrence of Palustrine wetlands, specific descriptions of five common classes are provided as follows:

1. EM Emergent: Dominated by rooted herbaceous plants, such as cattails and grass.
2. FO Forested: Dominated by trees taller than 20 feet.
3. OW Open Water: No vegetation evident at the water surface.

4. SS Scrub-Shrub: Dominated by shrubs and saplings less than 20 feet tall.
5. UB Unconsolidated Bottom: Mud or exposed soils.

**Summary of Cowardin Classification Codes**

| System | Subsystem | Class | |
|---|---|---|---|
| M= Marine | 1 = Subtidal | RB Rock Bottom<br>UB Unconsolidated Bottom<br>AB Aquatic Bed | RF Reef<br>OW Open Water/Unknown Bottom |
| | 2 = Intertidal | AB Aquatic Bed<br>RF Reef | RS Rocky Shore<br>US Unconsolidated Shore |
| E= Estuarine | 1 = Subtidal | RB Rock Bottom<br>UB Unconsolidated Bottom<br>AB Aquatic Bed | RF Reef<br>OW Open Water/Unknown Bottom |
| | 2 = Intertidal | AB Aquatic Bed<br>RF Reef<br>SB Streambed<br>RS Rocky Shore | US Unconsolidated Shore<br>EM Emergent Wetland<br>SS Scrub/Shrub Wetland<br>FO Forested Wetland |
| R= Riverine | 1 = Tidal | RB Rock Bottom<br>UB Unconsolidated Bottom<br>AB Aquatic Bed<br>SB Streambed | RS Rocky Shore<br>US Unconsolidated Shore<br>EM Emergent Wetland<br>OW Open Water/Unknown Bottom |
| | 2 = Lower Perennial | RB Rock Bottom<br>UB Unconsolidated Bottom<br>AB Aquatic Bed<br>RS Rocky Shore | US Unconsolidated Shore<br>EM Emergent Wetland<br>OW Open Water/Unknown Bottom |
| | 3= Upper Perennial | RB Rock Bottom<br>UB Unconsolidated Bottom<br>AB Aquatic Bed | RS Rocky Shore<br>US Unconsolidated Shore<br>OW Open Water/Unknown Bottom |
| | 4 = Intermittent | SB Streambed | |
| L= Lacustrine | 1 = Limnetic | RB Rock Bottom<br>UB Unconsolidated Bottom | AB Aquatic Bed<br>OW Open Water/Unknown Bottom |
| | 2 = Littoral | RB Rock Bottom<br>UB Unconsolidated Bottom<br>AB Aquatic Bed<br>RS Rocky Shore | US Unconsolidated Shore<br>EM Emergent Wetland<br>OW Open Water/Unknown Bottom |
| P= Palustrine | | RB Rock Bottom<br>UB Unconsolidated Bottom<br>AB Aquatic Bed<br>US Unconsolidated Shore<br>ML Moss-Lichen Wetland | EM Emergent Wetland<br>SS Scrub/Shrub Wetland<br>FO Forested Wetland<br>OW Open Water/Unknown Bottom |

Source: Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. US Fish and Wildlife Service, FWS/OBS-79-31, Washington DC.

## C METHODOLOGY

1. NWI Maps: NWI maps (scale 1:24,000) were obtained for the majority of private lands within the Floras Creek watershed. These maps were utilized as the base maps for identifying wetlands within the watershed.

2. Wetland ID: Wetland IDs were determined by lumping or splitting individual Cowardin units. The lumping/splitting process was performed on the basis of vegetative and hydrologic similarities, land usage, buffer classification, and restoration potential of adjoining Cowardin units. A Wetland ID (1, 2, 3, etc.) was assigned to each group and labeled on the NWI map. Cowardin Classification Codes characteristic of each wetland were listed in Table 29. (Several Wetland IDs consist of more than one code.) Wetlands beginning with the letter "R" (riverine) were not considered due to the very complex NWI mapping that can occur near stream channels.
3. Color Code: Each Wetland ID was color-coded on the NWI maps to assist in locating a wetland listed on Table 29.
4. Size: The size of each wetland was estimated using a mylar template. The minimum size of a wetland assessed was approximately 1.5 acres. **Note:** A slight margin of error in size estimation was possible.
5. Connectivity: Surface-water connection between each wetland and stream was estimated. A wetland was considered connected if some part had a surface-water connection to a seasonal or perennial surface-water-body, including natural and man-made channels, lakes, or ponds. For terraces alongside major channels that are routinely flooded, the presence of a well-defined channel or depression that lacked vegetation but may potentially lead to a channel constituted a surface-water connection. Similarly, ditched pasture-land also qualified as connected.
6. Subwatersheds: Subwatersheds were identified for each wetland.
7. Buffer: Using aerial photographs, the dominant land use within 500 feet of a wetland's edge was characterized using the following codes: FO = forest or open space, AG = agriculture (pasture, crops, orchards, range land), R = rural (mix of small-scale agriculture, forest, and/or rural residential), or D = developed (residential, commercial, industrial). Where more than one land use exists, the dominant (>50% of the area) was listed.
8. Watershed Position: Using the USGS topographic maps, the watershed was divided into thirds to determine the general location of each wetland within the basin. The position of a wetland was characterized as highest, middle or lowest in position. Elevation changes were considered in determining the watershed position.
9. Degree of Alteration: A degree of alteration (Low, Moderate or High) was assigned to each wetland on the basis of past impacts. Examples of these alterations/impacts include clearing, grading, filling, ditching/draining or diking in or near a wetland.
10. Field Verification: No field verifications were conducted.
11. Comments: Comments were primarily focused on Degree of Alteration. In many cases, key words were used to indicate restoration opportunities including: Protect, Restoration Potential, or Low Restoration Potential. Protect refers to a high value, functioning wetland that should be considered for protection from potential land use impacts. Restoration Potential refers to a site where restoration or enhancement work is feasible, and Low Restoration Potential typically indicates a site that will not likely be restored (e.g. "prime pasture"). Comments also provide some information pertaining to the existing status of the site.

12. <u>Other</u>: Aerial photographs (1997 BLM) were used to assist in determining each wetland's connectivity to stream channel, adjacent land use, and ultimately for the determination of restoration potential and comments portions of the assessment.

## D RESULTS

**Table 29 Floras Creek Wetland Attributes** (See Appendix)

## E KEY FINDINGS

- An estimated 2,346.5 acres of designated wetlands exist in Floras Creek. This acreage consists of 67 Wetland IDs, each comprised of one or more individual wetlands.
- Degree of alteration for the 67 Wetland IDs was rated as follows: 62.7% were rated High; 4.5% were rated Moderate; and 31.3% were rated Low. *Percentages are based on individual Wetland IDs not total acres.*
- Wetland buffers were well distributed: forest/open space accounted for 32.8%; agriculture accounted for 32.8%; and rural accounted for 34.3%. *Percentages are based on individual Wetland IDs not total acres.*
- Wetlands considered connected to other water bodies totaled 64.2% (35.8% of the wetlands were considered not connected). *Percentages are based on individual Wetland IDs not total acres.*
- The two largest wetlands were Wetland IDs' # 20 (660 acres) and #51 (860 acres). These two wetlands account for 64.7% of all wetland acres assessed. Both are buffered by agricultural use and considered to have a high degree of alteration. All other wetlands were equal to or less than 50 acres in size.
- The most common type of wetland within the Floras Creek watershed was Palustrine Emergent. Specifically, two types of Palustrine Emergent wetlands comprise 44.9% of all wetlands assessed. They include PEMA (25.9%) and PEMC (19%). The second most common wetland was Palustrine Scrub/Shrub. Specifically, two types of Palustrine Scrub/Shrub comprise 21.6% of the total wetlands assessed. They include PSSC (12.1%) and PSSA (9.5%). *Percentages are based on individual Wetland IDs not total acres.*
- All wetlands considered in this assessment were located in the lowest watershed position. *See Methodology for explanation of watershed position.*

## F DISCUSSION

The OWEB Watershed Assessment Manual defines the "Restoration Potential" of a wetland based on its degree of alteration. This implies that a wetland considered to have a low degree of alteration, such as a properly functioning wetland, should be rated as low restoration potential. In contrast, a wetland considered to have a high degree of alteration, such as one currently managed for pasture, should be rated as high restoration potential. Although this method is a true characterization of a typical wetland it can be quite misleading because it overlooks certain socioeconomic factors. Often, the most altered wetlands are those that currently serve as prime agricultural lands and, in many cases, may realistically offer only low restoration opportunities.  Therefore, the term "Restoration Potential" has been exchanged for a more accurate term – "Degree of Alteration".

The actual restoration of a wetland should be based on many considerations including opportunities to protect properly functioning wetlands and enhance marginal wetlands as well as the landowner's willingness to convert a pasture back to a wetland.  Ensuring adequate protection for a properly functioning wetland will typically prove more cost effective than restoration of a non-functional wetland.  However, in some cases, the physical and biological benefits associated with restoring a wetland may merit significant costs.

## REFERENCES

GWEB 1999.  Oregon Watershed Assessment Manual.  Governor's Watershed Enhancement Board, July 1999

OSU 1998.  Watershed Stewardship - A Learning Guide, Oregon State University Extension Service, July 1998

# XI HYDROLOGY

## A BACKGROUND (GWEB 1999)

Hydrologic Cycle

The hydrologic cycle describes the circulation of water around the earth, from ocean to atmosphere to the earth's surface and back to the ocean again. Oceans, covering 70% of the earth's surface, play a large role in the movement of water through this cycle. Solar energy evaporates water from the ocean, wind carries the water over the land surface, and water is precipitated by gravity back to the earth. Rain is the most common form of precipitation, but snow, hail, dew, fog, drip, and frost all can bring water into a watershed. Precipitation that reaches the earth can move through three different pathways. Water can:

- Be intercepted by vegetation and evaporated or transpired back to the atmosphere
- Move down-slope on the surface or through soil to a stream system, eventually returning to the ocean
- Be stored in snowpack, groundwater, ponds, or wetlands for a variable period of time

Land Use Impacts on Hydrology

Land use practices can modify the amount of water available for runoff, the routing of water to the streams, the lag time (delay between rainfall and peak streamflow), the flow velocity, or the travel distance to the stream. Land use practices that affect the rate of infiltration and / or the ability of the soil surface to store water are typically most influential in affecting the watershed's hydrology. Using this as an indicator for comparison among the land uses, forest harvesting produces the smallest change in the infiltration rate, thereby producing the smallest impacts to the hydrologic regime of a basin. Forest harvest practices have evolved such that land compaction can be minimized; however, roads and grazing in these watersheds decrease the infiltration rate. In contrast to forest harvest, agricultural practices, rangeland utilization for grazing purposes, and urban development can all involve compaction of the soils and / or paved surfaces, resulting in substantial alteration of the infiltration rate. Agricultural practices and urban development directly involve altering the shape of the drainage system by ditching, channelizing, or using piped stormwater networks which decrease the infiltration and the travel time of subsurface flow to reach the channel. This effect can be much worse in high-flow conditions. While forest harvest practices are not always practiced at sustainable rates, they are temporary conversions of vegetation, and the hydrologic effects diminish as vegetative regrowth occurs. Conversion of lands to agriculture or urbanization produces generally longer-lasting effects. Road construction, associated with all land uses, alters the rate of infiltration on the road surface and replaces subsurface flow pathways with surface pathways resulting in quicker travel time to the channel network.

## B INTRODUCTION

The Hydrologic Condition Assessment is a "screening" process designed to identify land use activities that have the potential to impact the hydrology of the Floras Creek watershed. Alterations to the natural hydrologic cycle potentially cause increased peak flows and/or reduced low flows resulting in changes to water quality and aquatic ecosystems. The degree to which hydrologic processes are affected by land use depends on the location, extent, and type of land use activities. When potential impacts are recognized, best management practices can be followed to minimize some of the potential hydrologic impacts; mitigation will be necessary to address other impacts.

The GWEB Oregon Watershed Assessment Manual provides a set of methods to prioritize those subwatersheds most likely to need restoration from a hydrologic perspective. Because hydrology is such a complex subject, the screening process only deals with the most significant hydrologic process affected by land use (i.e., runoff). The assessment does not attempt to address every hydrologic process potentially affected; the goal is to gain an understanding of the major potential impacts.

<u>General Watershed Characteristics</u>

A Geographic Information System (GIS) analysis was conducted to provide general watershed characteristics pertaining to the Hydrologic Condition Assessment of Floras Creek. The GIS shapefile used in this portion of the assessment is titled "Precipitation, Average Annual", available from the Southwest Oregon Province GIS Data CD Minimum elevations, maximum elevations and maximum elevation locations were determined using USGS 7.5 Minute Quads.

**Table 30 General Watershed Characteristics**

| Subwatershed | Subwatershed Area (square miles) | Mean Annual Precipitation (inches) | Minimum Elevation (feet) | Maximum Elevation (feet) | Maximum Elevation (Highest Peak) |
|---|---|---|---|---|---|
| East Fork Floras | 16.4 | 70 | 480 | 2440 | Calf Ranch Mtn. |
| Floras Lake | 10.4 | 85 | <20 | 1200 | No Name |
| Lower Floras Mainstem | 7.5 | 91.2 | <20 | 2227 | White Mtn. |
| Middle Floras Mainstem | 9 | 86 | 80 | 2227 | White Mtn. |
| North Fork Floras | 12.8 | 70 | 398 | 2185 | Bennet Butte |
| South Fork Floras | 12.2 | 86 | 398 | 2786 | Edson Butte |
| West Fork Floras | 5.5 | 91.2 | 360 | 2536 | Grouselous Mtn. |
| Willow Creek | 7.1 | 91.2 | 20 | 2536 | Grouselous Mtn. |
| **Totals** | **80.9** | | | | |

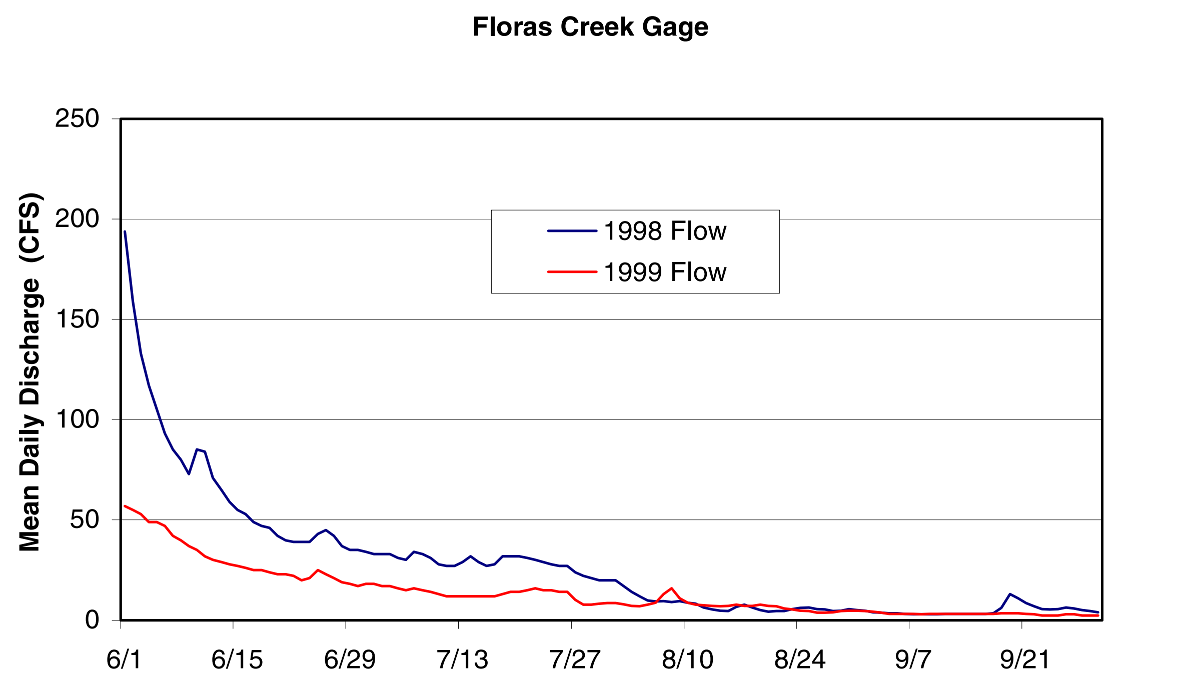
Land Use Summary
A GIS analysis was conducted to determine land use using a shapefile titled "Vegetation", available from the Southwest Oregon Province GIS Data CD. This data was used to characterize land use by lumping several vegetation types into three categories: (1) Forestry and (2) Agriculture/Range and Rural Residential (3) Other (water).

**Table 31 Land Use by Subwatershed**

| Subwatershed | Forestry | | Agriculture/Range & Rural Residential | | Other | | Total |
|---|---|---|---|---|---|---|---|
| | Acres | % | Acres | % | Acres | % | Acres |
| East Fork Floras | 8,467 | 80.7 | 2,029 | 19.3 | | 0.0 | 10,496 |
| Floras Lake | 4,373 | 65.9 | 1,958 | 29.5 | 304 | 4.6 | 6,635 |
| Lower Floras Mainstem | 2,094 | 43.7 | 2,701 | 56.3 | | 0.0 | 4,795 |
| Middle Floras Mainstem | 6,530 | 73.9 | 2,312 | 26.1 | | 0.0 | 8,842 |
| North Fork Floras | 3,893 | 77.0 | 1,163 | 23.0 | | 0.0 | 5,056 |
| South Fork Floras | 7,780 | 100.0 | | 0.0 | | 0.0 | 7,780 |
| West Fork Floras | 3,523 | 100.0 | | 0.0 | | 0.0 | 3,523 |
| Willow Creek | 3,031 | 67.1 | 1,485 | 32.9 | | 0.0 | 4,516 |
| **Totals** | 39,691 | 76.9 | 11,648 | 22.6 | 304 | 0.6 | 51,643 |

Flow Summary
A flow chart was obtained from the Oregon Department of Water Resource's web site illustrating mean daily discharge in cubic feet per second, from June to September 1999/2000. (Station #: 14327137; Station Name: Floras Creek Near Langlois)

**Figure 4 Flow Summary**




Individual Screening Procedures
Three separate screening procedures were developed to evaluate land use impacts on hydrology in the Floras Creek watershed:

**C FORESTRY**
**D AGRICULTURE/RANGELANDS**
**E FOREST AND RURAL ROADS**

## C1 FORESTRY IMPACTS ON HYDROLOGY

The potential effects of forest practices on hydrology include changes in peak flows, water yield, and low flows. There are two primary mechanisms by which forest practices in the Pacific Northwest watersheds impact hydrologic processes: (1) the removal and disturbance of vegetation, and (2) the road network and related harvesting systems.

Removal of vegetation reduces interception and evapotranspiration, both of which allow additional water to reach the soil surface during rainstorms. Additionally, open areas accumulate more snowpack which can potentially produce an increase in water yield.

Forestry-related effects on peak flows may be a function not only of harvest and vegetative cover issues, but also of the type of hydrologic process that occurs in a basin. Increased peak flows, associated with rain on snow events present the greatest likelihood of problems caused by timber harvest. While rain on snow conditions can occur at almost any elevation, given a specific combination of climatic variables, the probability of rain-on-snow enhancement of peak flows differs with elevation and, to a lesser degree, aspect. The highest probability of encountering rain-on-snow conditions occurs at mid-elevations where transient snowpacks develop but not at great depths. The lowest probability occurs in the lowlands, where snowpack rarely occurs and, at the higher elevations, where winter temperatures are too cold to melt snow. The elevation of the lower boundary of the rain-on-snow zone will vary geographically and often by ecoregion.

## C2 METHODOLOGY

**1.** The screen for potential forestry impacts on hydrology was focused on timber harvest. A GIS analysis was conducted to determine total area of transient snow elevation zones by subwatershed. The GIS shapefile used in this portion of the assessment is titled "Transient Snow Elevation Zones", available from the Southwest Oregon Province GIS Data CD. Peak flow generating processes were identified for each subwatershed and characterized as rain or rain-on-snow. Peak flow generating processes within elevation zones of 0' to 2,500' are characterized as rain. In the relatively high elevations snow accumulations are considered transient; snow levels may fluctuate daily, weekly or monthly throughout the winter season. The peak flow generating process in these higher elevations (>2,500') is characterized primarily as rain on snow. However, only occasional storms result in peak flows generated by rain-on-snow conditions (Weinhold USFS).

## C3 RESULTS

**Table 32 Transient Snow Elevation Zones and Peak Flow Generating Processes**

| Subwatershed | Rain Zone | | Rain on Snow Zone | | Total Area (acres) |
|---|---|---|---|---|---|
| | 0' - 2500' (Acres) | % Area | 2500' - 3000' (Acres) | % Area | |
| East Fork Floras | 10,497 | 100 | | 0.0 | 10,497 |
| Floras Lake | 6,636 | 100 | | 0.0 | 6,636 |
| Lower Floras Mainstem | 4,797 | 100 | | 0.0 | 4,797 |
| Middle Floras Mainstem | 8,844 | 100 | | 0.0 | 8,844 |
| North Fork Floras | 5,055 | 100 | | 0.0 | 5,055 |
| South Fork Floras | 7,751 | 99.6 | 30 | 0.4 | 7,781 |
| West Fork Floras | 3,524 | 100 | 0.8 | 0.0 | 3,525 |
| Willow Creek | 4,517 | 100 | | 0.0 | 4,517 |
| **Totals** | 51,621 | 99.9 | 30.8 | 0.1 | 51,652 |

## C4 KEY FINDINGS

- Results indicate that over 99% of the Floras Creek watershed is located within the lowest elevation zone of 0' to 2,500'. Peak flow generating processes in this elevation zone are rain dominant. Elevation zones of the remaining area (<1%) of the watershed are located within the rain on snow zone of 2,500' to 3,500'.
- The GWEB Oregon Watershed Assessment Manual suggests characterizing subwatersheds with more than 75% in the rain category as low potential risk of peak flow enhancement. Since all subwatersheds fall within the rain category a <u>low</u> potential risk of peak flow enhancement was assigned throughout the entire basin.
- Further investigation of peak flow increases based on percent of land in a forested condition >30 years of age needs to be conducted for further analysis.

## C5 DISCUSSION (Stewart 2001)

Peak flows and low flows are the hydrologic processes most significantly impacted by land use activities. By removing more than 30% of a forested landscape the amount and timing of runoff can be altered. This concept is more evident in small local drainages, where some important spawning and rearing of salmonids occur, than at the mouth of a main river.

In addition to land use impacts that cause increased flows from timber harvest, the reduced infiltration capacity of the soil is also a concern. Impervious surfaces and roads are good indicators of urbanization and subsequent impacts to the hydrology of a watershed. However, this is only part of the problem. One needs to determine the percent of land surface compacted during forest harvest. Most literature cites 12% of land in a compacted state to be capable of increasing surface runoff. Many of the south coast watersheds were logged with ground based equipment or cable systems known for poor suspension of logs (Hi-Lead). These harvest systems could have compacted 20-40% of the land surface to a point where infiltration would be impaired and runoff increased.

Compounding the area of harvest and impacts to infiltration from the harvest method, the natural state of the soil in some portions of the watershed is very poor. Hydrologic Soil Group (HSG) ratings C and D have minimum infiltration rates of 1-4 and 0-1 mm/hr. respectively. Converting 0.1 inches of rain/hr. to mm/hr. equals 2.54 mm/hr. One quarter (0.25) inch of rain/hr. exceeds the infiltration capacity of HSG-C by about 50% and HSG-D by over 600%. Given that these soil groups also correspond with areas of high precipitation the runoff effects are naturally high. Harvest removal and compaction further increase this effect.

Further analysis is warranted to look at the level of timber harvest within the watershed. Simply stating that forested areas within rain-dominated areas have a low risk of increasing peak flows is simply untrue. Past practices may still be impacting the routing of water and causing channel modifications or increased sediment routing/turbidity conditions. This would be detrimental to fish habitat and/or fish populations. One suggestion is to obtain and interpret historical photos of the watershed. When viewed on a large scale, specific areas of impact may stand out and provide some indication of historical levels of compaction and timber harvest.

## D1 AGRICULTURAL & RANGELAND IMPACTS ON HYDROLOGY

Agricultural practices have most often been implemented along valley bottoms, floodplains, and other adjacent low-gradient lands. An often long-lasting change in the vegetative cover occurs from the conversion of the landscape from forested woodlands, prairie grasslands, or other natural environs, to agricultural use. Clearing for pasture or crop production has also entailed land-leveling or topographic changes of the landscape. Leveling and field drainage has resulted in the elimination of many wetlands and depressions that previously moderated flood peaks by providing temporary storage. Without wetlands and depressions, surface and subsurface runoff move more quickly to the channel network.

Common channel modifications such as ditches, constructed to drain land, and channel straightening were created to maximize agricultural land use. These practices result in increased velocities of surface and subsurface flows that correspondingly decrease infiltration opportunities. Decreased infiltration produces increased runoff and subsequent decreased baseflows during the low-flow season.

The impact of agriculture on hydrology is dependent on specific practices such as the type of cover and management treatments, as well as the characteristics of the soil being farmed. Practices that change infiltration rates are most likely to change the hydrologic regime. The infiltration rates of undisturbed soils vary widely. Agriculture has a greater effect on runoff in areas where soils have a high infiltration rate compared to areas where soils are relatively impermeable in their natural state (USDA 1986).

The Natural Resources Conservation Service (NRCS) has characterized and mapped the soils throughout the state. As part of the mapping process, soils are classified into one of four hydrologic soil groups primarily as a function of their minimum infiltration rate on wetted bare soil. As part of the NRCS methods (USDA 1986), runoff curve numbers are assigned to areas for each of the combination of three parameters: (1) soil group, (2) cover type, and (3) treatment or farming practice.

**NRCS hydrologic soil group classification (USDA 1986)**

| Low Runoff Potential | Hydrologic Soil Group | Soil Characteristics | Minimum Infiltration Rate (mm/hr) |
|---|---|---|---|
| | A | High infiltration rates even when thoroughly wetted. Deep, well-drained sands or gravels with a high rate of water transmission. Sand, loamy sand, or sandy loam. | 8 – 12 |
| | B | Moderate infiltration rates when thoroughly wetted. Moderately deep to deep, moderately well-drained to well-drained, moderately fine to moderately coarse textures. Silt loam or loam. | 4 – 8 |
| | C | Slow infiltration rate when thoroughly wetted. Usually has a layer that impedes downward movement of water or has moderately fine to fine textured soils. Sand clay loam. | 1 – 4 |
| High Runoff Potential | D | Very low infiltration rate when thoroughly wetted. Chiefly clay soils with a high swelling potential; soils with a high permanent water table; soils with a clay layer near the surface; shallow soils over near-impervious materials. Clay loam, silty clay loam, sandy clay, silty clay, or clay. | 0 – 1 |

Runoff curve numbers are used as part of a simplified procedure for estimating runoff in small agricultural and urban watersheds (USDA 1986). Curve numbers are assigned based on factors such as soils, plant cover, and impervious area. Rainfall is converted to runoff using curve numbers.

Certain soil conditions can make farming difficult, so amending the soil structure by adding organic matter becomes a way in which farmers can maximize the use of their land. This practice can actually change the hydrologic soil group from, say, a C to a B. In this example, it is possible to reduce the runoff rather than increase it. To detect these changes at this screening level of assessments will be difficult. Voluntary actions and implementation of best management practices to improve soil texture and water holding capacity can be a benefit to the farmer as well as to the hydrology of the watershed. Grazing animals impact rangelands in two ways: (1) removal of protective plant material, and (2) compaction of the soil surface. Both of these actions affect the infiltration rate (Branson et al. 1981). Cattle grazing on sparsely forested lands can have similar impacts and should be considered under this heading. In general, moderate or light grazing reduces the infiltration capacity to 75% of the ungrazed condition and heavy grazing reduces the infiltration by 50% (Gifford and Hawkins1979). Soil compaction, which decreases the infiltration rate, correspondingly increases the overland flow or surface runoff.

Impacts associated with the use of range lands can be assessed in a similar manner as agricultural lands. There is no statistical distinction between the impact of light and moderate grazing intensities on infiltration rates. Therefore, they may be combined for purposes of assessment. (Gifford and Hawkins 1979).

## D2 METHODOLOGY

Table 33 (See Below)

1. Using a GIS shapefile titled "Soils" (SWOP CD), hydrologic soil groups were identified in agricultural and rangeland areas in each subwatershed.
2. Using two GIS shapefiles titled "Floras Creek Subwatersheds", available from the South Coast Watershed Council, and "Soils", available from the Southwest Oregon Province GIS Data CD, hydrologic soil groups (HSGs) were identified in agricultural and rangeland areas for each subwatershed.
3. Cover types and treatment practices were identified for the primary hydrologic soil groups of each subwatershed. Cover types and treatment practices were also identified for secondary hydrologic soil groups where HSG accounted for 20% or more of the subwatershed area. **Caution:** Due to the limitations of the available GIS data, no distinction was made between agricultural, rangeland or rural residential areas.

Table 34 (See Appendix)

4. Hydrologic condition classes of good, fair, or poor were determined for each cover type/treatment practice by referring to Table 35 (See Appendix). Hydrologic condition of "Good" was assigned to all HSGs in all subwatersheds based on the criteria of >75% ground cover and lightly or only occasionally grazed.
5. A curve number was selected based on the cover type/treatment practice and hydrologic condition in columns 3 and 4 of Table 34. The selected curve number was then entered in column 5 of Table 34.
6. Background curve numbers were determined from Table 35. The background curve numbers in all cases were based on "woods" in "good" condition. The curve number for the proper hydrologic soil group was then selected and the results were entered in column 6 of Table 34.
7. The 2-year, 24-hour precipitation (i.e., annual maximum 24-hour precipitation with a recurrence interval of 2 years or 50% probability of occurring in any given year) was estimated for each subwatershed. This information was obtained using a GIS shapefiles titled "2-Year, 24-Hour Precipitation", available from the Southwest Oregon Province GIS Data CD. Results were then entered in column 7 of Table 34.
8. Using the current curve number in column 5 and rainfall depth in column 7, runoff depths were identified from Table 36 (See Appendix) for each cover type / treatment combination. Values were interpolated to obtain runoff depths for curve numbers or rainfall amounts not shown. Results were entered in column 8 of Table 34.
9. Using the background curve number in column 6 and rainfall depth in column 7, the runoff depth from Table 36 was identified. Results were identified in column 9 of Table 34.
10. Change in runoff depth from background conditions to current conditions was calculated by subtracting the Background Runoff Depth (column 9) from Current Runoff Depth (column 8). Results were entered in column 10 of Table 34.

Table 37 (See Appendix)

11. The average change from background was calculated (sum of column 10, Table 34, divided by number of HSGs) from all the combinations of cover type / treatment and hydrologic condition. Results were entered in column 3 of Table 37. Percentages from Table 33, column 4 (A, B, C or D) were transferred to column 2 of Table 37.
12. Where more than one hydrologic soil group is dominant in a subwatershed steps 3 through 11 were repeated. Results were entered in column 5, 7, and 9 of Table 37. Percentages from Table 33, column 4 (A, B, C or D) were transferred to column 4, 6, and 8 (respectively) of Table 37.
13. Weighted averages were computed and results entered in column10 of Table 37.
14. Using the subwatershed average change from background (column 3, Table 37) or the weighted average (column 10, Table 37) the potential hydrologic risk was selected and entered into column 11 of Table 37.

**Potential Risk of Agriculture and/or Rangelands**

| Change in Runoff From Background (inches) | Relative Potential for Peak-Flow Enhancement |
|---|---|
| 0 to 0.5 | Low |
| 0.5 to 1.5 | Moderate |
| >1.5 | High |

## D3 RESULTS

**Table 33 Agricultural Land Use and Rangeland Use Summary**

| | Total Area | Agricultural / Range Land Area | | Hydrologic Soil Groups in Agricultural and Grazed Lands | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A | | B | | C | | D | |
| Subwatershed | (Acres) | (Acres) | (%) | (Acres) | (%) | (Acres) | (%) | (Acres) | (%) | (Acres) | (%) |
| East Fork Floras | 10,496 | 2,029 | 19 | 0 | 0 | 272 | 13 | 1,730 | 85 | 27 | 1 |
| Floras Lake | 6,635 | 1,958 | 29.5 | 4 | 0 | 622 | 32 | 800 | 41 | 532 | 27 |
| Lower Floras Mainstem | 4,795 | 2,701 | 56 | 0 | 0 | 597 | 22 | 245 | 9 | 1,862 | 69 |
| Middle Floras Mainstem | 8,842 | 1,326 | 15 | 0 | 0 | 188 | 14 | 1,059 | 80 | 75 | 6 |
| North Fork Floras | 5,056 | 2,149 | 42.5 | 0 | 0 | 1,094 | 51 | 985 | 46 | 65 | 3 |
| South Fork Floras | 7,780 | | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 |
| West Fork Floras | 3,523 | | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 |
| Willow Creek | 4,516 | 1,485 | 33 | 0 | 0 | 413 | 28 | 20 | 1 | 1,049 | 71 |
| **Totals** | 51,643 | 11,648 | 22.5 | 4 | 0 | 3,186 | 27 | 4,839 | 42 | 3,610 | 31 |

**Table 34 Curve Number and Runoff-Depth Summary Table for Primary/Secondary Hydrologic Soil Groups** (See Appendix)

**Table 37 Agriculture/Rangeland Risks of Peak Flow Enhancement** (See Appendix)

## D4 KEY FINDINGS

- Assessment of agricultural and rangeland impacts on hydrology included six out of eight subwatersheds. Two subwatersheds (South Fork and West Fork) were not considered in this assessment due to the lack of agriculture and rangelands in these drainages.
- Agricultural/rangeland use is well mixed throughout the watershed: Lower Floras Mainstem (56.3%); North Fork Floras (42.5%); Willow Creek (32.88%); Floras Lake (29.51%); East Fork (19.33%); and Middle Floras Mainstem (15%).
- Three out of four Hydrologic Soil Groups (HSGs) are found well mixed throughout the agricultural/rangeland areas of the watershed. HSG-B (27.4%); HSG-C (41.5%); HSG-D (31%). Less than 1% of the agricultural/rangeland area of the watershed is comprised of HSG-A.
- Four of the six subwatersheds assessed received "Moderate" ratings of potential risk of peak flow enhancement. They include: Lower Floras Mainstem, Willow Creek, Floras Lake, and Middle Floras Mainstem. East Fork and North Fork Floras received "Low" ratings of potential risk of peak flow enhancement.
- The Floras Lake subwatershed contains approximately 332 acres of cranberry bogs. This accounts for approximately 17% of the agricultural/rangeland area of the subwatershed or about 5% of the total subwatershed area. **Note:** cranberry bog acreage was estimated using 1997 digital ortho-photos.
- All areas in agriculture or range use can be considered in compacted state and elevating percent of runoff.

## D5 DATA GAPS

- Need more information of the soils in Hydrologic Soil Group D. Specifically, information is needed to determine how these soils influence streambank stability, moisture retention and revegetation potential in riparian areas.
- Need a map of soil groups in the New River area. Some areas may have better potential to restore infiltration capacity.

## E1 FOREST AND RURAL ROAD IMPACTS ON HYDROLOGY

Road networks associated with forestry can alter the rate of infiltration on the road surface and potentially change the shape of the natural drainage. The surface of most forest roads is compacted soil that prevents infiltration of precipitation. Forest road networks primarily increase streamflow by replacing subsurface with surface runoff pathways (e.g., roadside ditches) (Bowling and Lettenmaier 1997). Roads can also intercept and divert overland flow and shallow subsurface flow, potentially rerouting the runoff from one small sub-basin to an entirely different subbasin (Harr et al. 1975 and 1979). Roads can potentially impact peak flows during rainfall events, rain-on-snow events, or spring snowmelt; therefore, the determination of percent of basin occupied by roads provides useful information regardless of the way in which peak flows are generated.

Rural roads associated with either agriculture or rangelands can also affect streamflow and will be characterized in a similar manner as forest roads. Roadside ditches are more structured and maintained along rural roads and can significantly extend the stream network density, because their presence is additional to the natural channel. However, if natural channels are altered through straightening or channelizing, the stream network length may decrease. Channelizing streams results in increased velocities and potentially increases erosion rates of the banks and bed.

Roads along stream channels restrict lateral movement and can cause a disconnection between the stream or river and its floodplain. Restricting lateral movement can result in down-cutting of the channel and decreased accessibility of flood waters to over-bank storage, resulting in decreased flood peak attenuation.

## E2 INTRODUCTION

The focus of the road assessment is to determine the quantity of roads within the watershed but does not account for the condition of the roads. A more refined scale to separate out well-built roads that do not accelerate the delivery of water or sediment to the channel from roads that are poorly constructed is beyond the scope of this section. For example, extension of the surface-water drainage network by roadside ditches is often a major influence of increased flows. Roads with proper culvert placement and frequency may alleviate some of these impacts.

The assessment of forest and rural road impacts on hydrology in the Floras Creek watershed is designed to determine what area of the forestry-designated portion of each subwatershed is occupied by roads, as well as by rural roads in agricultural or rangeland areas, and to rate subwatersheds for potential hydrologic impacts. See Tables 38 and 39.

**Potential Risk for Peak-Flow Enhancement**

| Percent of Forested Area in Roads | Potential Risk For Peak-Flow Enhancement |
|---|---|
| < 4% | Low |
| 4% to 8% | Moderate |
| > 8% | High |

## E3 METHODOLOGY

Tables 38 & 39

1. Total watershed area (square miles) and total area of forestry and rural use (acres & square miles) of each subwatershed was determined using GIS analysis. Results were entered in columns 2 through 4 of Tables 38 and 39.
2. Total linear distance of forest roads and rural roads were determined using GIS analysis. Results were entered in columns 5 of Tables 38 and 39.
3. Area of each subwatershed occupied by roads was determined by multiplying column 5 by the width of the road (in miles). The average width for forest roads was assumed

at 25 feet (0.0047 miles). The average width for rural roads was assumed at 35 feet (0.0066 miles). Results were entered in column 6 of Tables 38 and 39.

4. The percent of area occupied by forest and rural roads in each subwatershed was computed. Results were entered in column 7 of Tables 38 and 39.
5. A relative potential for forest and rural road impacts was assigned to each subwatershed. Results were entered into column 8 of Tables 38 and 39.

Table 40

Another way to assess the effects of roads on flow concentration and peak flows is to look at road densities. The mechanism for flow concentration is interception of precipitation by the road surface and groundwater by the cutbanks, both of which drain into the roadside ditch which route the water more quickly to the stream network than soil does. Considering road density as an indicator for how much road-related interception may have altered peak flows, density less than 3.0 miles per square mile is considered low risk for channel network expansion sufficient to increase peak flows; 3.0 to 5.0 miles per square mile is considered moderate risk; and over 5.0 miles per square mile is considered high risk for increasing peak flows. (Risley 2001)

## E4 RESULTS

**Table 38 Forest Road Area Summary**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| **Subwatershed** | **Area (sq. mi.)** | **Forested Area (acres)** | **Forested Area (sq. mi.)** | **Total Linear Distance of Forest Roads (miles)** | **Roaded Area Col. 5 x *Std. Width (sq. mi.)** | **Percent Area in Roads Col. 6/4 x 100** | **Relative Potential for Impact** |
| East Fork Floras | 16.4 | 8,467 | 13.2 | 41.8 | 0.20 | 1.5 | Low |
| Floras Lake | 10.4 | 4,373 | 6.8 | 12.8 | 0.06 | 0.9 | Low |
| Lower Floras Mainstem | 7.5 | 2,094 | 3.3 | 8.3 | 0.04 | 1.2 | Low |
| Middle Floras Mainstem | 13.8 | 6,530 | 10.2 | 20.6 | 0.10 | 1.0 | Low |
| North Fork Floras | 7.9 | 3,893 | 6.1 | 25.0 | 0.12 | 1.9 | Low |
| South Fork Floras | 12.2 | 7,780 | 12.2 | 26.5 | 0.12 | 1.0 | Low |
| West Fork Floras | 5.5 | 3,523 | 5.5 | 14.2 | 0.07 | 1.2 | Low |
| Willow Creek | 7.1 | 3,031 | 4.7 | 13.5 | 0.06 | 1.3 | Low |
| Total | 80.7 | 39,691 | 62.0 | 162.7 | 0.76 | 1.2 | Low |

**Standard Width for Forest Roads = 25 feet (.0047 miles)*

**Table 39 Rural Road Area Summary**

| 1<br><br>Subwatershed | 2<br><br>Area (sq. mi.) | 3<br><br>Rural Area (acres) | 4<br><br>Rural Area (sq. mi.) | 5<br><br>Total Linear Distance of Rural Roads (miles) | 6<br><br>Roaded Area Col. 5 x *Std. Width (sq. mi.) | 7<br><br>Percent Area in Roads Col. 6/4 *100 | 8<br><br>Relative Potential for Impact |
|---|---|---|---|---|---|---|---|
| East Fork Floras | 16.4 | 2,029 | 3.2 | 9.0 | 0.06 | 1.9 | Low |
| Floras Lake | 10.4 | 1,958 | 3.1 | 11.2 | 0.07 | 2.4 | Low |
| Lower Floras Mainstem | 7.5 | 2,701 | 4.2 | 14.5 | 0.10 | 2.3 | Low |
| Middle Floras Mainstem | 13.8 | 2,312 | 3.6 | 9.6 | 0.06 | 1.8 | Low |
| North Fork Floras | 7.9 | 1,163 | 1.8 | 14.1 | 0.09 | 5.1 | Low |
| South Fork Floras | 12.2 | | | | | | NA |
| West Fork Floras | 5.5 | | | | | | NA |
| Willow Creek | 7.1 | 1,485 | 2.3 | 7.6 | 0.05 | 2.2 | Low |
| Total | 80.7 | 11,648 | 18.2 | 65.9 | 0.44 | 2.4 | Low |

**Standard Width for Rural Roads = 35 feet (.0066 miles)*

**Table 40 Road Density Summary**

| Subwatershed | Area Square Miles | Road Miles | Road Density Miles per Square Mile | Probability of Effects on Peak Flows |
|---|---|---|---|---|
| East Fork Floras | 16.4 | 50.7 | 3.1 | Moderate |
| Floras Lake | 10.4 | 24.0 | 2.3 | Low |
| Lower Floras Mainstem | 7.5 | 22.8 | 3.0 | Moderate |
| Middle Floras Mainstem | 13.8 | 30.3 | 2.2 | Low |
| North Fork Floras | 7.9 | 39.0 | 4.9 | Moderate |
| South Fork Floras | 12.2 | 26.5 | 2.2 | Low |
| West Fork Floras | 5.5 | 14.2 | 2.6 | Low |
| Willow Creek | 7.1 | 21.1 | 3.0 | Moderate |
| Total | 80.7 | 228.6 | 2.8 | Low |

## E5 KEY FINDINGS

Table 38 & 39

- The relative potential of impact to hydrology from roads, both in forested and rural areas, was rated Low for all subwatersheds assessed. The relative potential for impact, however, largely depends on the extent of roads identified in the analysis. In this assessment a significant amount of roads were not identified because, at the time, they were not available in GIS format. If this analysis were to be repeated using an updated and more complete road coverage the relative potential of impact on hydrology from roads would only increase. *(This updated road coverage is available as of June 2001.)*

Table 40

- These data indicate that East Fork Floras, Lower Mainstem Floras, Willow Creek, and especially North Fork Floras subwatersheds might be higher priorities for field assessment of road drainage conditions.

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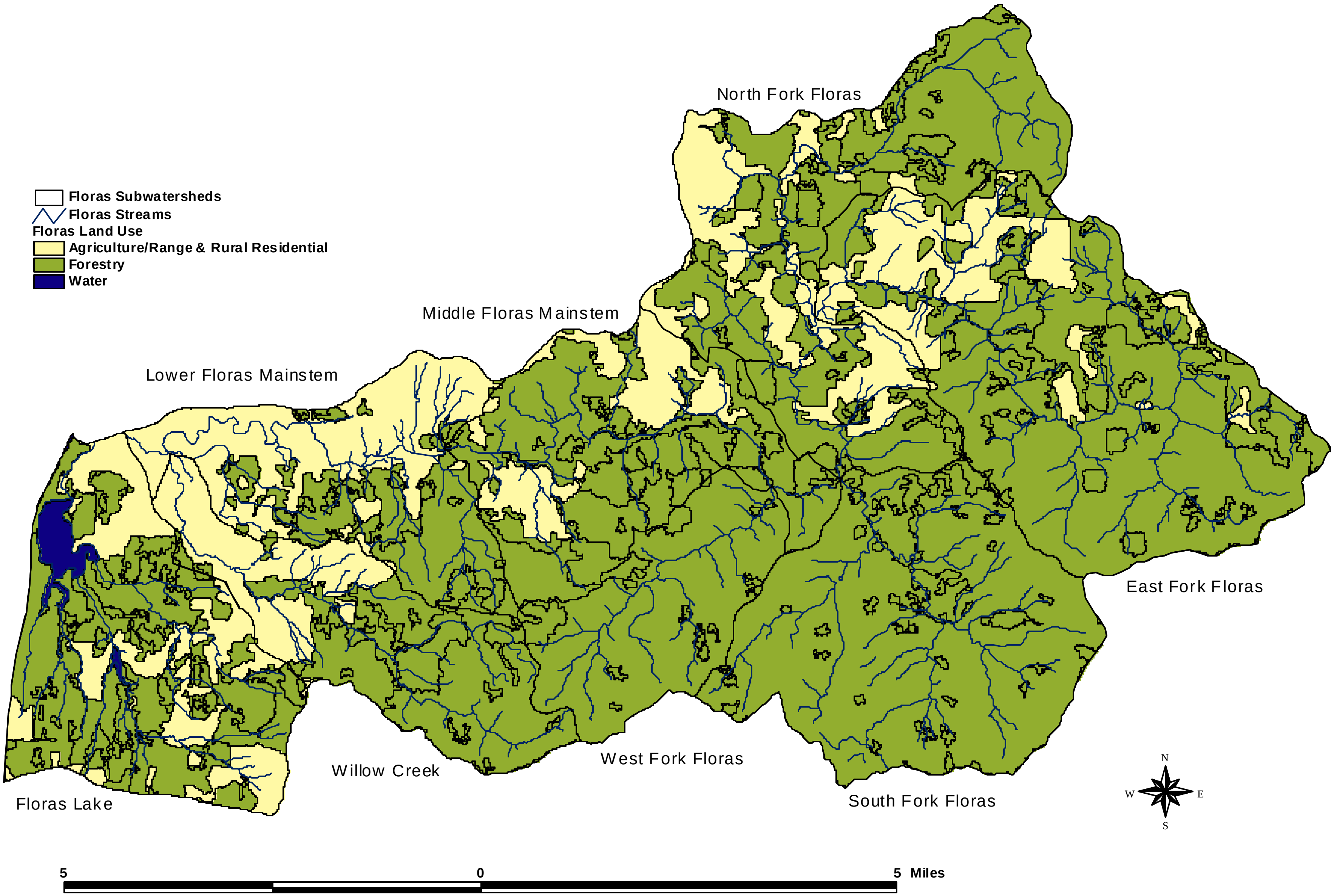
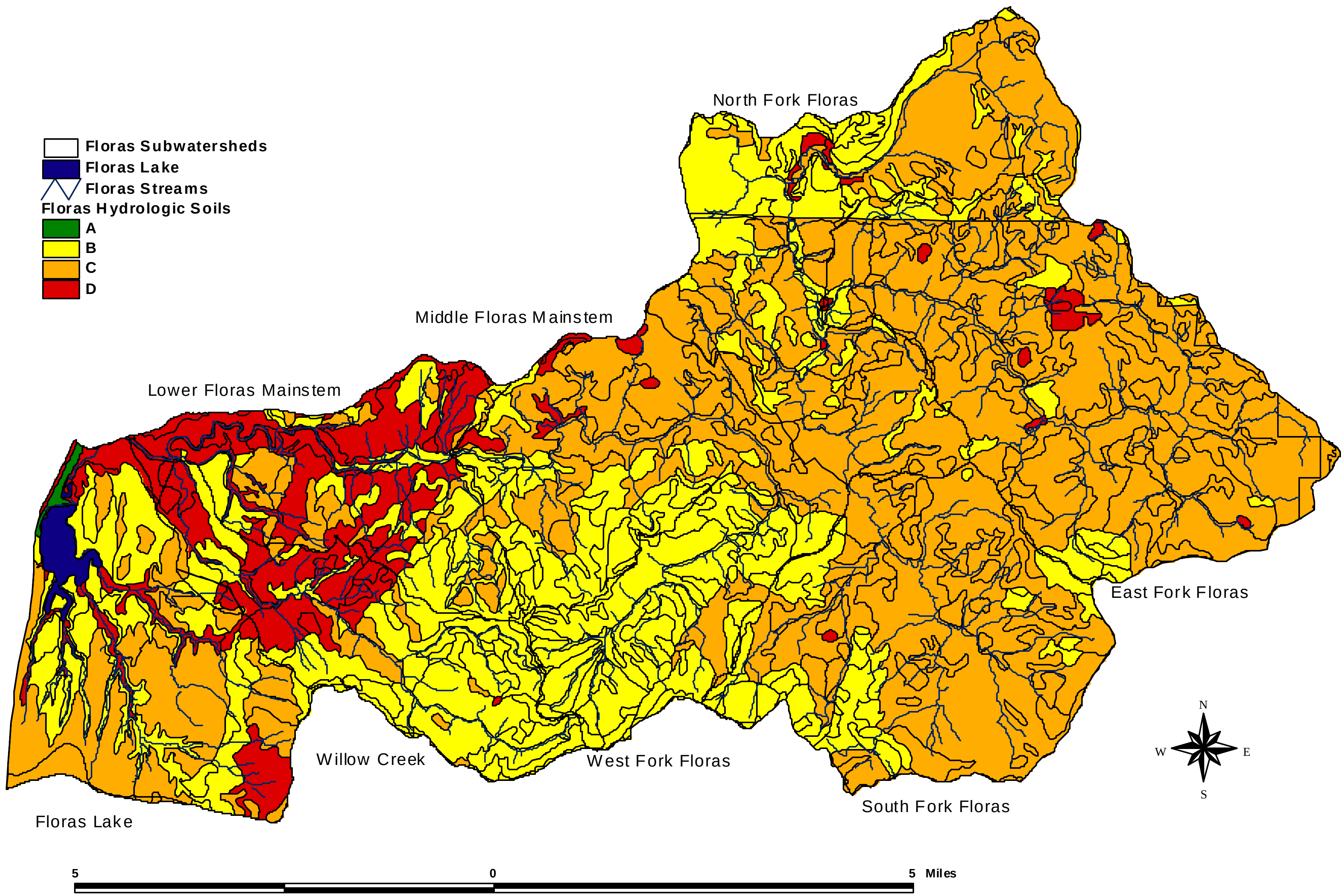
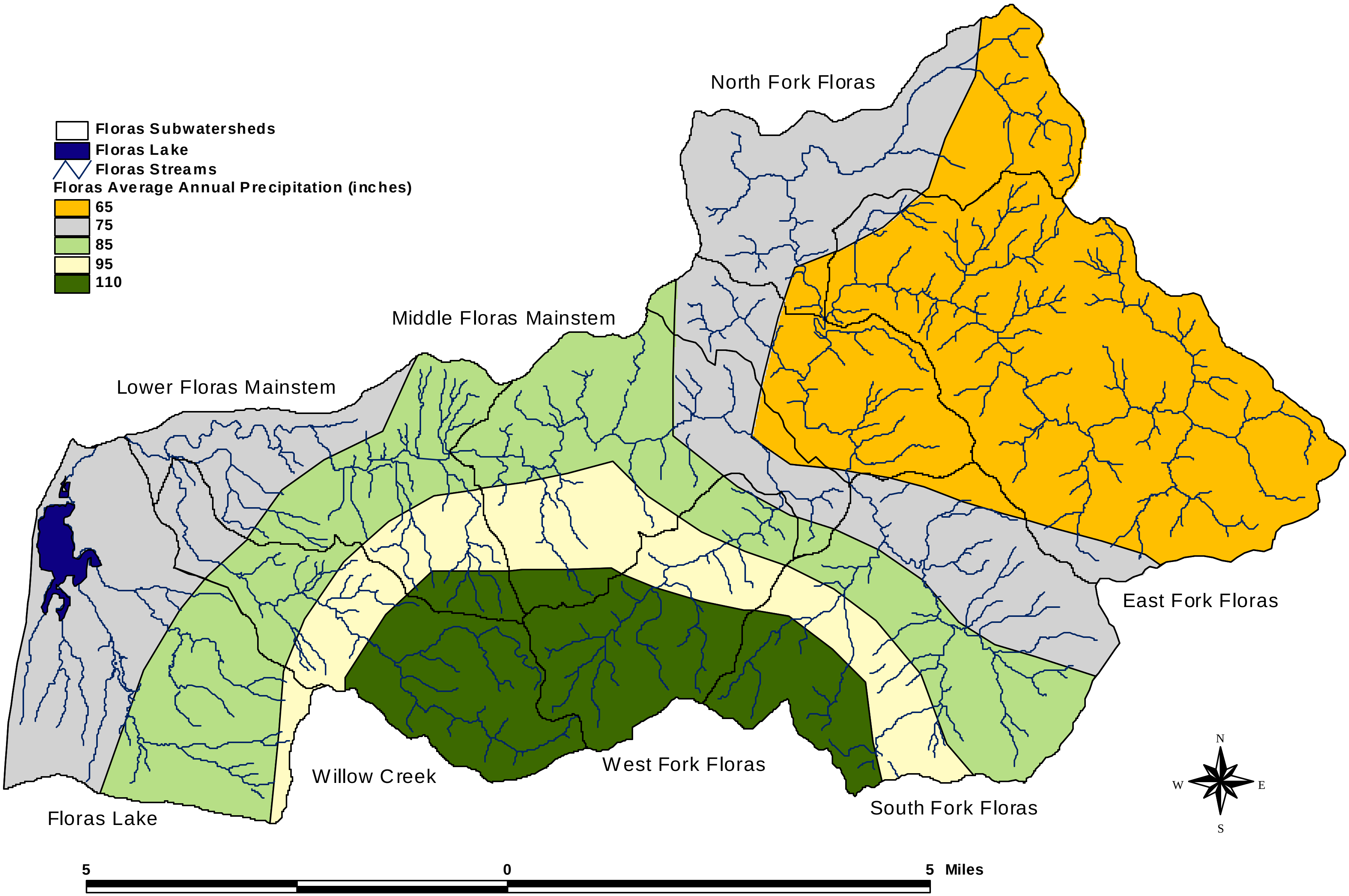
# Floras Creek Land Use



# Floras Creek Hydrologic Soil Groups



## Floras Creek Average Annual Precipitation



# XII WATER USE

## A BACKGROUND (GWEB 1999)

Water Law and Water Use

Any person or entity withdrawing water from a stream or river must have a water right from the Oregon Water Resources Department (OWRD). These water rights are in various levels of use and certification or adjudication. For example, there are certificates, applications for certificates, water rights on record and not being used, and rights not using their entire full entitlement. Each water right has an instantaneous flow amount (the maximum rate at which water can be withdrawn at any point in time), an annual volume restriction (water duty), and a designated beneficial use, including agriculture, domestic, urban, industrial, commercial, fish and wildlife, power, recreation, etc. Water law in the State of Oregon is based on the Prior Appropriation Doctrine or "first in time, first in right," subject to the physical availability of water and the ability to put it to beneficial use without waste. The most senior appropriator (the right with earliest date) has a right to divert water prior to any junior right (a later date). The most senior right is the last one to be shut off from diverting water during low stream flows.

In general, agriculture places the greatest demand on our water resources compared to other uses. Water is required for irrigation of crop lands (e.g., cranberry production), pasture and stock watering. In most cases, the period of high demand for irrigation coincides with the period of low streamflow; crop water requirements tend to peak in August, when streamflows are usually the lowest. Water withdrawals are applied to the crop lands for irrigation, and part of that water is used by the crop (evapotranspiration), a portion percolates to deep ground water, and a portion may be returned to another watershed. The total portion not returned to the river is called consumptive use. The portion of the diversion that returns to the stream system through surface and subsurface avenues at points downstream is called return flow.

Urban water supply can provide for residential, commercial, and some industrial uses. Water is diverted, treated, and then distributed throughout a municipality. Subsequently, the wastewater is delivered to a sewage treatment facility where it is treated to a "primary" or "secondary" level and discharged to a stream or bay at a distinct location. In residential settings, for example, water is not actually consumed but returned to the stream network from wastewater facilities. An exception to this is lawn watering which may infiltrate to groundwater. Lawn-irrigation return flow occurs through subsurface avenues.

National forests, national parks, US Bureau of Land Management lands, Indian reservations, etc., are federal reservations. These entities maintain federal reserved rights for the purposes for which the reservations were established. Their priority date is the date the reservation was created. In many cases, reservations were established in the mid to latter part of the 19$^{th}$ century. Many of the federal reservation rights have been tried in the courts of law, and, more often than not, case law has set precedent of adjudicating (to settle judicially) federally reserved water rights. (Winters Doctrine).

Water Rights

There are three primary types of surface water rights: (1) out-of-stream rights, (2) storage rights, and (3) in-stream rights. Out-of-stream rights are also called “direct flow” or “run of the river” diversions. These rights entail withdrawing water directly from the channel with subsequent application for a specific beneficial use such as irrigation, domestic or urban water supply, industrial use, etc. Storage rights can be for on-stream or off-stream reservoirs. On stream reservoirs capture water as it flows into the reservoir. Water is stored until it is needed for the specified beneficial use, at which time it is released either into the channel and withdrawn downstream or released into the river to the storage site, and subsequent release and conveyance to the point of use. In-stream rights are those that require a designated quantity of water to remain in the stream or river for a specified beneficial use, most often for aquatic resources, wildlife, or aesthetics.

Water withdrawals reduce streamflows, potentially resulting in a negative impact on the biologic resources, particularly during the low-flow season. In recent years, in-stream water rights have become more common as a means of protecting the biologic resources. In-stream water rights did not exist in Oregon prior to 1955. Minimum flows were established by administrative rule in 1955, but they did not carry the full weight of a water right. Between 1955 and 1980, the Oregon Department of Fish and Wildlife conducted basin investigations from which minimum flows were recommended and adopted by rule. In 1987, the legislature changed the administrative rulemaking into an application process for a water right. OWRD holds the water right, but ODFW, Department of Environmental Quality, and State Parks can apply for an in-stream right. Minimum flows were changed into in-stream rights, and the date minimum flows were adopted became the priority date. The in-stream rights can have the value up to but not exceeding the median flow. In-stream rights tend to be junior to the majority of the out-of-stream water rights; this reduces their ability to maintain effective streamflows in the channel. If federal reserved rights for in-stream flows have been adjudicated, they would usually have the most senior right in the basin, because federal reservations were established before the implementation of the Prior Appropriation Doctrine.

Water users with large demands generally have storage rights, because reservoirs provide a more certain supply during low-streamflow conditions. The ability to capture streamflow during the high flows and use it during low flows can be a significant benefit to water users. In some instances, reservoirs are constructed as flood control facilities to provide attenuation of the peak flows and reduce downstream flooding and damage.

Groundwater rights are those attached to the withdrawal of water from a well. With some exceptions, all water users extracting groundwater as the source of supply must have a water right for the legal use of water. There are exempt uses that do not require a right. The most significant of these is rural residential water users; these users are limited to 15,000 gallons per day for noncommercial use and irrigation of less than 0.5 acres.

Groundwater has the potential to influence surface water by what is called hydraulic continuity. Depending on the location of the well and the geology in the area, water withdrawn can have a corresponding effect on the streamflow. In other words, it is possible for the extraction of groundwater to dry up a nearby stream during low flows. Consequently, the State of Oregon manages surface and groundwater rights conjunctively, which means there are times at which groundwater withdrawals will be shut down due to low flows in the channel.

Storage

Man-made storage facilities such as water supply reservoirs, flood control reservoirs, or multipurpose reservoirs impact the peak flows downstream of the impoundment. Each reservoir has its unique operating scheme, and therefore requires more detailed hydrologic investigations, often including release schedules, reservoir routing, etc.

Water Availability

The OWRD has developed a computer model, Water Availability Report System (WARS), which calculates water availability for any of their designated water availability basins (WABs) in the state. Water availability, as defined by the OWRD, refers to the natural streamflow minus the consumptive use from existing rights. It is the amount of water that is physically and legally available for future appropriation. If water is available, additional in-stream or out-of-stream rights may be issued. This value is dynamic and is often updated to account for issuance of new water rights.

The WARs program produces both the 80% exceedance and the 50% exceedance flows, along with the associated water availability under each condition. The 50% exceedance flow is the same as the median flow value. The median flow value means half the time the natural flows are above this value and half the time flows are below this value. The 50% exceedance flows were those used as an upper limit in developing in-stream rights for aquatic species and other in-stream beneficial uses. Water rights for out-of-stream use are issued only when water is available at the 80% exceedance level. (*This assessment considered only water availability at the 50% exceedance flows.)*

Salmonid Fish Considerations

Potential channel dewatering (zero flow in the channel) can present problems for spawning and fish passage. Typically, the spawning period that coincides with the lowest flow begins on approximately September 1 and extends through October. Rearing habitat in the summer also requires flow levels to be maintained. While these are the critical times of the year, flow levels throughout the year need to be maintained to cover all life stages of all species present in a watershed.

Streamflow Restoration Priority Areas

Oregon's Departments of Fish and Wildlife and Water Resources collaborated to develop the Streamflow Restoration Priority Areas (SRPA). This effort was an outcome of the Oregon Plan (1997), which is the broader framework for the Coastal Salmon Restoration Initiative (CSRI). The CSRI mission is to restore coastal salmon populations and fisheries to sustainable levels. Three major factors were identified in CSRI as exacerbating the loss of fish populations: (1) fish resources, (2) fish habitat, and (3) loss of streamflow. The loss of streamflow is the focus of the SRPA analysis.

The identification of priority areas was based on a combination of biological factors and water use. ODFW identified priority areas to enhance fish populations. A rank was assigned to three categories under fisheries: (1) fish resources; (2) habitat integrity; and (3) risk factors such as listing under the Endangered Species Act, in-stream flow protection, or natural low-flow problems. OWRD identified areas in which an opportunity existed to enhance in-channel flows, situations under which water could by saved through conservation, efficiency of use, etc. The criteria for water resources was assigned to two categories: (1) consumptive use by percentage of the median (50% exceedance) streamflow, and (2) number of months an in-stream water right is not met. A priority was established based on the combination of the two resulting factors: "need" (fisheries) and "optimism" (water resources). Determination of the South Coast Flow-Restoration Priorities requires that the "need" rank 3 or 4 and the "optimism" rank 2, 3, or 4. In the need and optimism column, 1 is the lowest rank and 4 is the highest.

| **Basin** | **Flow Restoration** | | |
|---|---|---|---|
| | **Need** | **Optimism** | **Priority** |
| South Coast | 1 or 2 | 1 | No |
| | 3 or 4 | 2,3 or 4 | Yes |

## B INTRODUCTION

Water use is generally defined by beneficial use categories such as municipal, industrial, irrigated agriculture, etc. The Water Use Assessment summarizes the water rights in the Floras Creek watershed and intends to provide an understanding of what beneficial uses these water withdrawals are serving. The assessment of water use is primarily focused on low-flow issues. While low-flow issues can be extremely important, they are difficult to characterize at the screening level. Water use activities can impact low flows, yet the low flows can be enhanced through adopting water conservation measures to keep more water in the stream system.

The basis for the water use assessment is the output from the Water Availability Reports System (WARS) and other data provided by the OWRD. Their system has accounted for consumptive use and presents the best available information at this time.

## C METHODOLOGY

Figure 5 Out-of-Stream Rights and Figure 6 Storage Rights

- Water rights information was obtained from the OWRD Water Rights Information System (WRIS) files. Although not presented in this document, information relevant to the assessment of water use was summarized, sorted and listed by date.
- Two bar graphs, representing Out-of-Stream Rights (CFS) and Storage Rights (Acre Feet), were created from the summary of water rights to illustrate water right allocations in association of use types. Water rights listed in Gallons Per Minute (GPM) were converted to CFS and included in the Out-of-Stream Rights' chart.

Table 41 In-Stream Rights

- In-stream Rights were obtained by request from the OWRD.

Table 42 Minimum Streamflows

- Minimum streamflows measured by Oregon Department of Water Resources during the summer months of 1998 and 1999 were listed.

Floras Creek Points of Diversions (See Map)

- A GIS shapefile illustrating Floras Creek's Points of Diversions was obtained from the OWRD web site and clipped to the Floras Creek watershed. The degree to which each water right, listed in the water rights summary, corresponds with each Point of Diversion is unknown.

Table 43 Water Availability Summary (See Appendix)

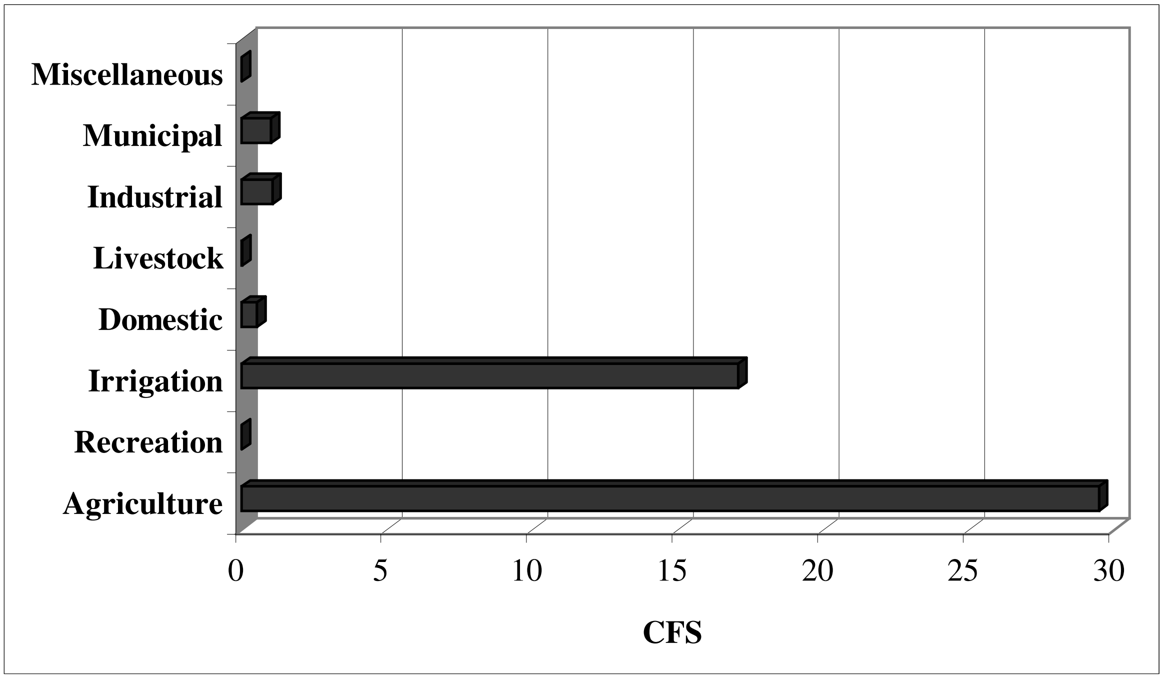
- Water Availability Reports were obtained from the OWRD web site.
- Net water available, at the 50% exceedance level, for each month and for each Water Availability Basin (WAB) within the watershed was listed. **Note:** WABs do not typically correspond to subwatersheds except in the case of Willow Creek.
- For each month and each WAB the "net water available" less than or equal to zero was highlighted to indicate that water is not available at the 50% exceedance level.

Table 44 Streamflow-Restoration Priority Areas (See Appendix)

- Priority WABs, designated as streamflow restoration priority areas, were highlighted for each applicable season.

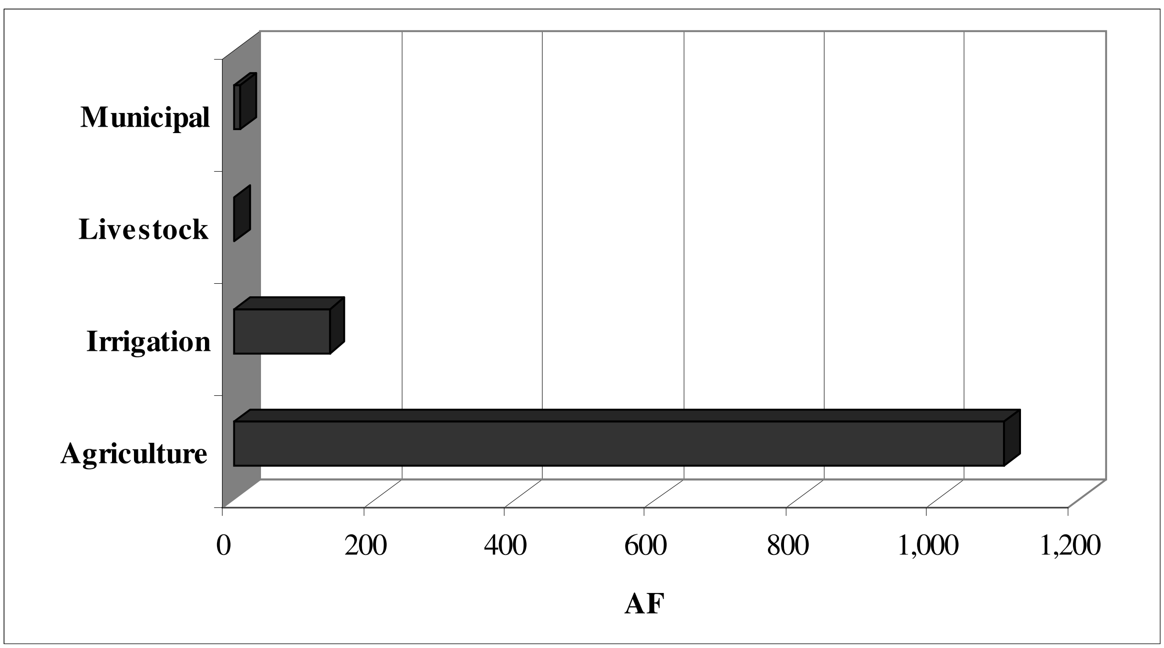
## D RESULTS

**Figure 5 Out-of-Stream Rights***




*Out-of-Stream Rights include all water rights allocated in Cubic Feet Per Second (CFS) and Gallons Per Minute (GPM). Total Out of Stream Rights = 49 CFS.

**Figure 6 Storage Rights****




** Storage Rights include all water rights allocated in Acre Feet (AF). Total Storage Rights = 1,239 AF.

**Table 41 In-Stream Water Rights**

| Stream | Reach (From/To) | Certificate # | CFS July | August | September | Priority Date |
|---|---|---|---|---|---|---|
| Floras Creek | Hwy 101 Bridge / Tidewater | - | 10 | 5 | 5 | 5/22/1964 |
| Floras Creek | Hwy 101 Bridge / Tidewater | - | 10 | 5 | - | 4/1/1980 |
| Willow Creek | RM 5 / RM 0 | 74214 | 8.1 | 5.3 | 4.7 | 11/8/1990 |
| Floras Creek | Willow Cr. RM 2 / RM 0 | 76053 | 36.8 | 21.8 | 14 | 11/8/1990 |
| Fourmile Creek | RM 4.5 / RM 0 | 76054 | 7.1 | 4.4 | 2.6 | 1/29/93 |
| North Fork | Guerin Cr. / Mouth | 74216 | 14.1 | 8.0 | 4.7 | 6/9/1995 |
| South Fork | Dwyer Cr. / Mouth | 74219 | 4.8 | 2.6 | 1.8 | 6/9/1995 |
| Bethel Creek | Unnamed trib. / New Lake | - | 2.5 | 1.5 | 0.8 | 6/9/1995 |
| Butte Creek | Headwaters / Mouth | 74217 | 1.3 | 0.8 | 0.5 | 6/9/1995 |
| Morton Creek | Mill Cr. / Mouth | 74215 | 1.5 | 0.9 | 0.5 | 6/9/1995 |

RM = River Mile

**Table 42 Minimum Stream Flows** (CFS)

| Location | 7/14/99 | 8/11/99 | 8/23/99 | 9/23/99 | 7/6/98 | 8/3/98 | 9/2/98 |
|---|---|---|---|---|---|---|---|
| Floras @County Bridge (gage) | 12 | 7.7 | 5.4 | 2.5 | 30 | 14 | 4.0 |
| Floras below Hwy 101 | 13.7 | 12.3 | 6.9 | 4.0 | 37.4 | 13.0 | 4.5 |

(Measured by Oregon Department of Water Resources)

## E Key Findings

Figure 5

- Two types of water rights (agriculture and irrigation) comprise approximately 95% of all out-of-stream water rights for the Floras Creek watershed. Specifically, Agriculture accounts for about 60% and irrigation accounts for 35%. Many of these rights are associated with cranberry production and/or harvest.
- Total Out of Stream Rights for the Floras Creek watershed = 49 CFS. Water rights allocated after the establishment of the 1964 In-Stream Rights are considered "junior rights"; these rights total 39 CFS. Thus, approximately 80% of all water rights in the Floras Creek watershed may legally be regulated (i.e. prohibited use) if in-stream flow is reduced to 10-5 CFS, the flow that corresponds to the 1964 in-stream rights.

Table 43

- The net water available at the 50% exceedance level, from July to September, is less than or equal to zero for the entire Floras Creek watershed excluding Swanson Creek and Boulder Creek.
- Net water available for Willow Creek is less than or equal to zero during all months of the year.

Table 44

- The “Floras Cr.” Water Availability Basin is considered a summer priority according to the “Needs” and “Optimism” ratings of the ODFW/OWRD Streamflow Restoration Priority Areas. Although Floras Cr. is the only summer priority WAB it includes the following subwatersheds: the Lower Floras Mainstem, Middle Floras

Mainstem, West Fork, East Fork and the North Fork. It does not include Willow Creek or Floras Lake subwatersheds.

<u>Points of Diversion Map</u>

- Points of Diversion indicate a total of 140 diversions are present throughout the Floras Creek Watershed. Of those, 49% are situated in the Floras Lake subwatershed. Similarly, points of diversions in other subwatershed are as follows: 24% in Lower Floras Mainstem; 12% in North Fork, 8% in Willow Cr.; 6% in East Fork; 1% in Middle Floras Mainstem; 1% in South Fork and 0% in West Fork. *(See Map 1)*

## REFERENCES

GWEB 1999. Oregon Watershed Assessment Manual. Governor's Watershed Enhancement Board, July 1999

# XIII WATERSHED SYNTHESIS

The Floras Creek watershed is mostly within the Southern Oregon Coastal Mountain ecoregion, with the bottom quarter nearly all Coastal Lowlands. The watershed has been intensively managed for 175 years and is more than 90 percent privately owned. Dairy farming was extensive in the early 1900's and carries on today, though at a reduced level. Most of the watershed has been logged, with some areas in a second or third rotation. Spruce swamps were cleared for agriculture, and many of the wetlands/floodplains in the watershed have been drained, ditched and channelized. Industrial level cranberry harvest was introduced in 1915 and now represents more than half of water rights in the watershed. The Floras Watershed Assessment does not formally address conditions in the New River Watershed, though certain features are mentioned.

Present and potential sediment sources in the system are identified as the Otter Point formation (landslides) and the high number of stream crossings, especially in the middle Floras Mainstem. Some serpentine soils are present and probably contribute to the sediment load via earthflows and gullies.

Risk of peak flow enhancement due to roads, forestry (rain-on-snow events), and urban development is low. The four sub-watersheds lowest in the system show a moderate risk of peak flow enhancement due to agricultural use and potential runoff. Channel typing in the watershed shows a drastic change in stream function from floodplain controlled, unconfined, sediment collecting reaches, to low gradient confined, sediment transport reaches. Beaver complexes were once probably very common and stable in Floras Creek and New River, especially in the tributaries.

Salmon use in the middle and upper portions of the watershed is limited by a natural barrier. Steelhead and cutthroat are well distributed throughout the watershed. Coho habitat is identified in the Lower Floras, Willow Creek, and Floras Lake subwatersheds, with the best available habitat in Bethel, Butte, and Morton Creeks (near New Lake). Chinook use the lower mainstem of Floras and portions of Willow Creek.

Riparian vegetation in Floras watershed is greatly reduced from its potential. Nearly all sub-watersheds have high potential increases in shade, but Willow Creek, the Mainstem Floras, and the North Fork sub-watershed have the greatest potential. Most sub-watersheds have some high reproduction to mature conifer trees located near the stream channels, showing potential for large wood inputs and providing high quality shade.

Water withdrawals in the Floras Creek watershed are a concern for fish habitat and water quality, both in terms of amount taken and timing. Water users are mostly "self-regulating" and the level of un-permitted or non-compliance use is unknown. Eighty percent of all water rights in the Floras watershed are junior to the in-stream right

Water quality in Floras Creek and its tributaries, both based on water temperatures and chemistry, is rated the lowest of all South Coast streams. Stream temperatures are very high, nearing 80 degrees in the lower mainstem. Water quality is rated as impaired for nitrate levels, and moderately impaired for phosphates, fecal coliform bacteria and turbidity. Heating reaches are identified between White Elephant Bridge and Mormon Camp on mainstem Floras, between McCleod road and the mouth on the North Fork, and between Mormon Camp and the pump-house site, also on the mainstem Floras.

The Lower Floras Creek/New River complex has the most acres of wetlands of any of the South Coast watersheds. More than 2,300 acres are identified within 67 different wetlands. Nearly two-thirds are highly altered and a third are altered very little.

Some of the limiting factors to fish production appear to be: water quality (both temperature and chemistry), altered channels and hydrologic function, greatly reduced stream shade, water use, and sediment transport.

# APPENDIX

## Table 16 Water Quality Data from Oregon Department of Environmental Quality Laboratory

| SOURCE | DATE | TIME | FLORAS FLOW (CFS) | TEMP. (C) | TEMP. (F) | DO (mg/l) | DO (%Sat) | BOD-5 (mg/l) | pH (SU) | NO2+NO3 (mg/l) | Tot. PO4 (mg/l) | FEC. COLI. (MPN) | E. COLI (cfu/100 ml) | TURB. FIELD (NTU) | CHLORO-PHYLL (ug/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ambient | 12/12/95 | 16:30 | | 11.6 | 52.9 | 11.2 | 102 | 2.4 | 7.3 | 0.72 | 0.43 | 600 | 600L | 396 | |
| Ambient | 3/5/96 | 17:40 | | 9 | 48.2 | 11.8 | 102 | 0.9 | 7.4 | 0.57 | 0.23 | 145 | 64J | 55 | |
| Ambient | 6/18/96 | 14:40 | | 17.3 | 63.1 | 10.5 | 109 | 0.5 | 7.6 | 0.21 | 0.005 | 28 | 4J | 1 | 1.9 |
| Ambient | 9/10/96 | 17:05 | | 20.5 | 68.9 | 8.9 | 98 | 0.7 | 7.5 | 0.01 | 0.01 | 2 | 4K | 1 | |
| Ambient | 6/17/97 | 16:55 | | 20.3 | 68.5 | 9.6 | 105 | 0.3 | 7.6 | 0.16 | 0.01 | 16 | 4J | 1 | 0.7 |
| Ambient | 9/10/97 | 19:40 | | 21.3 | 70.3 | 10.3 | 114 | 1 | 7.4 | 0.01 | 0.01 | 12 | 8J | 1 | 0.8 |
| Ambient | 12/9/97 | 16:00 | 369 | 8.6 | 47.5 | 11.7 | 100 | 0.7 | 7.5 | 0.87 | 0.02 | 30 | 18J | | |
| Ambient | 3/18/98 | 16:40 | 178 | 11.7 | 53.1 | 11.1 | 103 | 0.6 | 7.4 | 0.53 | 0.02 | 2 | 2K | | |
| Ambient | 7/14/98 | 16:40 | 32 | 22.5 | 72.5 | 10 | 114 | 0.2 | 7.5 | 0.1 | 0.005 | 46 | 4J | | 1.1 |
| Ambient | 9/22/98 | 16:25 | 7 | 19 | 66.2 | 10.7 | 114 | 1 | 7.7 | 0.01 | 0.005 | 10 | 2J | | 0.9 |
| Lasar | 1/12/99 | 10:28 | | 9.1 | 48.4 | 11.5 | 99 | 2.1 | 7.1 | 0.63 | 0.03 | 30 Est. | 14 Est. | 9 | |
| Lasar | 3/16/99 | 9:00 | | 7.7 | 45.9 | 11.8 | 98 | 1.4 | 7.1 | 0.448 | 0.01 | VOID | VOID | 7 | |
| Lasar | 5/5/99 | 16:40 | | 11.6 | 52.9 | 11.3 | 103 | 1.3 | 7.5 | 0.47 | 0.02 | 34 Est. | 32 Est. | 9 | 0.7 |
| Lasar | 7/13/99 | 15:15 | 12 | 21.5 | 70.7 | 9.4 | 106 | 0.1 | 7.6 | 0.0818 | <0.01 | <2 | 2 Est. | 1 | 0.5 |
| Lasar | 9/15/99 | 17:50 | 3.1 | 18.3 | 64.9 | 10.4 | 110 | 0.8 | 7.9 | 0.0071 | 0.02 | 8 Est. | 6 Est. | 1.5 | 0.8 |
| Lasar | 11/16/99 | 16:20 | 254 | 11.5 | 52.7 | 10.4 | 95 | 0.8 | 7.6 | 0.721 | 0.03 | 350 | 280 | 14 | |
| Lasar | 1/25/00 | 14:55 | 2060 | | | | | 0.7 | | 0.548 | 0.07 | | | | |
| Lasar | 3/22/00 | 16:15 | 214 | | | | | 0.4 | | 0.456 | 0.02 | | | | |
| Lasar | 7/25/00 | 17:30 | | 23.3 | 73.9 | 9.9 | 114 | 0.5 | 7.8 | | | 4EST | 8EST | 1.5 | 0.5 |

**Notes:**

Flow Data from Oregon Department of Water Resources' gaging station on Floras Creek @ county bridge

## Table 29 Floras Creek Wetland Attributes

| Wetland ID | 7.5 Minute Quad | Subwatershed | Size (acres) | Connected to Channel | Cowardin Code | Cowardin Code | Cowardin Code | Cowardin Code | Buffer | Degree of Alteration | Color Code |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Cape Blanco | Floras Lake | 1.5 | N | PEMC | | | | FO | LOW | R |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 2 | Cape Blanco | Floras Lake | 50 | Y | PFOA | PEMC | | | FO | LOW | B |
| | *Comments:* | *Protect - High quality/Connected to Floras Lake Quad* | | | | | | | | | |
| 3 | Cape Blanco | Floras Lake | 4 | N | PSSA | | | | FO | LOW | G |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 4 | Floras Lake | Floras Lake | 1.5 | N | PFOA | | | | FO | LOW | G |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 5 | Floras Lake | Floras Lake | 2 | N | PSSA | | | | FO | LOW | R |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 6 | Floras Lake | Floras Lake | 2.5 | N | PSSB | | | | FO | LOW | G |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 7 | Floras Lake | Floras Lake | 6 | Y | PEMC | PSSC | | | FO | LOW | B |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 8 | Floras Lake | Floras Lake | 18 | Y | PEMC | PSSC | | | FO | LOW | R |
| | *Comments:* | *Protect - Functioning/Extending to Langlois Quad* | | | | | | | | | |
| 9 | Floras Lake | Floras Lake | 1 | Y | M2USP | | | | FO | LOW | R |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 10 | Floras Lake | Floras Lake | 1.5 | Y | PSSC | | | | FO | LOW | G |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 11 | Floras Lake | Floras Lake | 1 | Y | PEMA | PEMR | | | FO | LOW | B |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 12 | Floras Lake | Floras Lake | 24 | Y | M2USP | EIUBL | E2EMP | | FO | LOW | G |
| | *Comments:* | *Protect - Functioning/Ocean Shoreline* | | | | | | | | | |
| 13 | Floras Lake | Floras Lake | 1.5 | Y | PEMH | | | | FO | LOW | R |
| | *Comments:* | *Protect - Functioning/Floras Lake Outlet* | | | | | | | | | |
| 14 | Floras Lake | Floras Lake | 1.5 | Y | PSSC | | | | R | LOW | B |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 15 | Floras/Lang | Floras Lake | 7 | N | PSSC | | | | FO | HIGH | G |
| | *Comments:* | *Restoration Potential - Marginal Pasture* | | | | | | | | | |
| 16 | Floras Lake | Floras Lake | 28 | Y | PEMC | | | | R | LOW | R |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 17 | Floras/Lang | Floras Lake | 22 | Y | PSSA | PEMA | PFOA | | Ag | LOW | B |
| | *Comments:* | *Protect - Functioning/Extending to Langlois Quad* | | | | | | | | | |

## Table 29 Floras Creek Wetland Attributes

| Wetland ID | 7.5 Minute Quad | Subwatershed | Size (acres) | Connected to Channel | Cowardin Code | Cowardin Code | Cowardin Code | Cowardin Code | Buffer | Degree of Alteration | Color Code |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | Floras/Lang | Floras Lake | 35 | Y | PEMA | PSSA | PEMF | | Ag | HIGH | G |
| | *Comments:* | *Restoration Potential - Marginal Pasture/Extending onto Langlois Quad* | | | | | | | | | |
| 19 | Langlois | Floras Lake | 4 | Y | PEMC | PEMF | | | Ag | HIGH | B |
| | *Comments:* | *Restoration Potential - Partially Functioning* | | | | | | | | | |
| 20 | Langlois | Floras Lake/Willow Cr/ Lower Floras Mainstem | 660 | Y | PEMA | PEMF | PEMC | | Ag | HIGH | R |
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 21 | Langlois | Floras Lake | 8 | Y | PSSA | PSSC | | | R | HIGH | B |
| | *Comments:* | *Restoration Potential - Riparian* | | | | | | | | | |
| 22 | Langlois | Floras Lake | 38 | Y | PEMC | PSSC | PROC | PABfb | FO | LOW | G |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 23 | Floras/Lang | Floras Lake | 41 | Y | PSSC | PEMC | PFOC | PUBHh | FO | LOW | R |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 24 | Langlois | Floras Lake | 6 | N | PFOA | | | | FO | HIGH | R |
| | *Comments:* | *Restoration Potential - Riparian* | | | | | | | | | |
| 25 | Langlois | Floras Lake | 10 | N | PEMA | | | | R | HIGH | G |
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 26 | Langlois | Floras Lake | 3 | N | PEMA | | | | R | HIGH | B |
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 27 | Sixes | Floras Lake | 5 | Y | PUBHh | PSSC | | | FO | HIGH | G |
| | *Comments:* | *Protection and Restoration - New Reservoir with some Functionality* | | | | | | | | | |
| 28 | Sixes | Floras Lake | 4 | Y | PUBHh | | | | R | HIGH | R |
| | *Comments:* | *Restoration Potential - Riparian* | | | | | | | | | |
| 29 | Sixes | Floras Lake | 2 | N | PEMC | | | | R | HIGH | B |
| | *Comments:* | *Restoration Potential - Riparian* | | | | | | | | | |
| 30 | Sixes | Floras Lake | 5 | N | PSSA | | | | R | HIGH | G |
| | *Comments:* | *Restoration Potential - Riparian* | | | | | | | | | |
| 31 | Sixes | Floras Lake | 2 | Y | PFOC | | | | FO | LOW | B |
| | *Comments:* | *Protect - Functioning Riparian* | | | | | | | | | |
| 32 | Sixes | Floras Lake | 5 | Y | PFO5Fh | PFOA | | | FO | LOW | G |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 33 | Sixes | Floras Lake | 16 | Y | PSSC | PEMC | PFO5Fh | | FO | MODERATE | R |
| | *Comments:* | *Restoration Potential - Riparian* | | | | | | | | | |
| 34 | Langlois | Floras Lake | 3 | N | PEMA | | | | Ag | HIGH | B |

## Table 29 Floras Creek Wetland Attributes

| Wetland ID | 7.5 Minute Quad | Subwatershed | Size (acres) | Connected to Channel | Cowardin Code | Cowardin Code | Cowardin Code | Cowardin Code | Buffer | Degree of Alteration | Color Code |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 35 | Langlois | Willow Creek | 8 | Y | PEMC | PFOA | PSSA | | Ag | HIGH | B |
| | *Comments:* | *Restoration Potential - Riparian* | | | | | | | | | |
| 36 | Langlois | Willow Creek | 7 | N | PEMA | | | | Ag | HIGH | G |
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 37 | Langlois | Lower Floras Mainstem | 7 | Y | PEMA | PEMC | | | Ag | HIGH | B |
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 38 | Langlois | Lower Floras Mainstem | 2.5 | N | PEMA | | | | R | HIGH | R |
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 39 | Langlois | Lower Floras Mainstem | 12 | Y | PEMA | PEMC | PUBHx | PSSC | R | HIGH | G |
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 40 | Langlois | Lower Floras Mainstem | 10 | Y | PEMFb | PSSC | PFOC | PEMC | R | LOW | B |
| | *Comments:* | *Protect - Functioning* | | | | | | | | | |
| 41 | Langlois | Lower Floras Mainstem | 3 | N | PEMC | PFOA | | | R | HIGH | G |
| | *Comments:* | *Restoration Potential - Marginal Pasture* | | | | | | | | | |
| 42 | Langlois | Lower Floras Mainstem | 11 | N | PSSA | PEMA | | | Ag | HIGH | B |
| | *Comments:* | *Restoration Potential - Riparian* | | | | | | | | | |
| 43 | Langlois | New River/L Floras Mnst | 8 | N | PEMA | PSSA | | | R | HIGH | G |
| | *Comments:* | *Restoration Potential - Marginal Pasture and Riparian* | | | | | | | | | |
| 44 | Langlois | New River/L Floras Mnst | 7 | Y | PEMA | | | | R | HIGH | R |
| | *Comments:* | *Restoration Potential - Riparian* | | | | | | | | | |
| 45 | Langlois | New River | 12 | N | PEMA | PSSA | | | Ag | HIGH | B |
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 46 | Langlois | New River/L Floras Mnst | 26 | Y | PSSC | | | | Ag | MODERATE | G |
| | *Comments:* | | | | | | | | | | |
| 47 | Langlois | Lower Floras Mainstem | 4 | N | PEMC | | | | Ag | HIGH | B |
| | *Comments:* | *Restoration Potential - Fence and Plant Oxbow* | | | | | | | | | |
| 48 | Langlois | New River/Floras Lake | 7 | Y | PEMFb | | | | Ag | HIGH | B |
| | *Comments:* | *Restoration Potential - Marginal Pasture* | | | | | | | | | |
| 49 | Langlois | New River/L Floras Mnst | 50 | Y | PEMA | PEMC | PSSC | | Ag | HIGH | R |
| | *Comments:* | *Restoration Potential - Well defined old trib channel; possibly improve or restore* | | | | | | | | | |
| 50 | Langlois | Lower Floras Mainstem | 4 | Y | PEMC | | | | Ag | HIGH | B |
| | *Comments:* | *Restoration Potential - Fence and Plant Oxbow* | | | | | | | | | |
| 51 | Langlois | L Floras Mnst/New River | 860 | Y | PEMA(C)(Cx) | PUBFx | PFOA | PSSA(C) | Ag | HIGH | G |

## Table 29 Floras Creek Wetland Attributes

| Wetland ID | 7.5 Minute Quad | Subwatershed | Size (acres) | Connected to Channel | Cowardin Code | Cowardin Code | Cowardin Code | Cowardin Code | Buffer | Degree of Alteration | Color Code |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 52 | Langlois | Floras Lake/ New River | 16 | Y | PFOA | PEMC | PEMA | PSSA | Ag | HIGH | B |
| | *Comments:* | *Restoration Potential - old new river channels - some existing veg* | | | | | | | | | |
| 53 | Langlois | Floras Lake/New River | 45 | Y | PEMC | PEMCx | | | Ag | HIGH | R |
| | *Comments:* | *Restoration Potential - marginal pasture with multiple surface channels* | | | | | | | | | |
| 54 | Langlois | Floras Lake/New River | 22 | N | PEMA | | | | Ag | HIGH | B |
| | *Comments:* | *Restoration Potential - smaller unit of marginal pasture* | | | | | | | | | |
| 55 | Langlois | New River/L Floras Mnst | 43 | Y | PEMA | PFOA | | | Ag | HIGH | B |
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 56 | Langlois | Lower Floras Mainstem | 55 | N | PEMA | PEMC | | | R | HIGH | R |
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 57 | Langlois | Lower Floras Mainstem | 2.5 | N | PEMA | | | | R | HIGH | G |
| | *Comments:* | *Residential* | | | | | | | | | |
| 58 | Langlois | Lower Floras Mainstem | 43 | Y | PEMA | PEMAx | | | Ag | HIGH | B |
| | *Comments:* | *Restoration Potential - old channel; possible reveg* | | | | | | | | | |
| 59 | Langlois | Lower Floras Mainstem | 6 | Y | PEMA | | | | R | HIGH | G |
| | *Comments:* | *Restoration Potential - Riparian* | | | | | | | | | |
| 60 | Langlois | Lower Floras Mainstem | 15 | Y | PEMA | | | | R | MODERATE | R |
| | *Comments:* | *Restoration Potential - trib between 60 & 61- riparian enhancement* | | | | | | | | | |
| 61 | Langlois | Lower Floras Mainstem | 12 | Y | PEMA | | | | R | HIGH | G |
| | *Comments:* | *Restoration Potential - oxbow like side channel - fence and plant* | | | | | | | | | |
| 62 | Langlois | Lower Floras Mainstem | 8 | N | PEMA | | | | Ag | HIGH | B |
| | *Comments:* | *Low Restoration Potential - Prime Pasture* | | | | | | | | | |
| 63 | Langlois | Lower Floras Mainstem | 4 | Y | PEMA | | | | R | HIGH | G |
| | *Comments:* | *Restoration Potential - Riparian* | | | | | | | | | |
| 64 | Langlois | Middle Floras Mnst | 2 | Y | PEMB | | | | FO | | R |
| | *Comments:* | *Need Photo to evaluate* | | | | | | | | | |
| 65 | Calf Ranch Mtn | East Fork Floras | 2.5 | Y | PEMA | | | | R | HIGH | B |
| | *Comments:* | *Restoration Potential - two old side channels - riparian* | | | | | | | | | |
| 66 | Calf Ranch Mtn | East Fork Floras | 6 | N | PEMA | | | | R | HIGH | R |
| | *Comments:* | *Numerous small wetlands - possibly reveg - moderate pasture* | | | | | | | | | |
| 67 | Calf Ranch Mtn | North Fork Floras | 6 | Y | PEMA | | | | R | HIGH | R |
| | *Comments:* | *Numerous small wetlands - possibly reveg - moderate pasture* | | | | | | | | | |

## Table 34 Curve Number and Runoff-Depth Summary Table for Primary/Secondary Hydrologic Soil Groups

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| **Subwatershed** | **Primary / Secondary Hydrologic Soil Group** | **Cover Type/Treatment** | **Hydrologic Condition** | **Curve Number** | **Background Curve Number** | **Rainfall Depth (in)** | **Current Runoff Depth (in)** | **Background Runoff Depth (in)** | **Change From Background Col. 8-9** |
| East Fork | C- Primary | Pasture, grassland or range - continuous forage for grazing | Good | 74 | 70 | 6 | 3.28 | 2.81 | 0.47 |
| | D - Secondary | Pasture, grassland or range - continuous forage for grazing | Good | 80 | 77 | 6 | 3.78 | 3.28 | 0.5 |
| | B - Secondary | Pasture, grassland or range - continuous forage for grazing | Good | 61 | 55 | 6 | 1.92 | 1.52 | 0.4 |
| Floras Lake | C- Primary | * Pasture, grassland or range - continuous forage for grazing | Good | 74 | 70 | 7.67 | 5.04 | 4.46 | 0.58 |
| | B- Secondary | * Pasture, grassland or range - continuous forage for grazing | Good | 61 | 55 | 7.67 | 3.33 | 2.78 | 0.55 |
| | D- Secondary | * Pasture, grassland or range - continuous forage for grazing | Good | 80 | 77 | 7.67 | 5.63 | 5.04 | 0.59 |
| | A - Secondary | * Pasture, grassland or range - continuous forage for grazing | Good | 39 | 30 | 7.67 | 1.25 | **0.27 | 0.98 |
| | **** Comment:*** *Additional Cover Type/Treatment includes cranberry production (approximately 211 acres or 10% of HSG C; 41 acres or 6.6% of HSG B and 80 acres or 15% of HSG D) in Floras Lake Subwatershed. Cranberry production can be as impervious as a wetland. Runoff is greatly effected by season and corresponding activity related to cranberry production.* | | | | | | | | |
| | ***** Comment:*** *Background runoff depth not available; interpolated from Table B-4* | | | | | | | | |
| Lower Floras Mainstem | D - Primary | Pasture, grassland or range - continuous forage for grazing | Good | 80 | 77 | 8.67 | 6.57 | 5.95 | 0.62 |
| | B - Secondary | Pasture, grassland or range - continuous forage for grazing | Good | 61 | 55 | 8.67 | 4.1 | 3.49 | 0.61 |
| | C - Secondary | Pasture, grassland or range - continuous forage for grazing | Good | 74 | 70 | 8.67 | 5.95 | 5.33 | 0.62 |
| Middle Floras Mainstem | C - Primary | Pasture, grassland or range - continuous forage for grazing | Good | 74 | 70 | *7.5 | 4.15 | 3.62 | 0.53 |
| | B - Secondary | Pasture, grassland or range - continuous forage for grazing | Good | 61 | 55 | *7.5 | 2.6 | 2.12 | 0.48 |
| | D - Secondary | Pasture, grassland or range - continuous forage for grazing | Good | 80 | 77 | *7.5 | 4.69 | 4.15 | 0.54 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| **Subwatershed** | **Primary / Secondary Hydrologic Soil Group** | **Cover Type/Treatment** | **Hydrologic Condition** | **Curve Number** | **Background Curve Number** | **Rainfall Depth (in)** | **Current Runoff Depth (in)** | **Background Runoff Depth (in)** | **Change From Background Col. 8-9** |
| Middle Floras Mainstem | **** Comment:*** *Rainfall interpolated from Table B-4 was 7.0"* | | | | | | | | |
| North Fork | B - Primary | Pasture, grassland or range - continuous forage for grazing | Good | 61 | 55 | *6.5 | 1.92 | 1.52 | 0.4 |
| | C- Secondary | Pasture, grassland or range - continuous forage for grazing | Good | 74 | 70 | *6.5 | 3.28 | 2.81 | 0.47 |
| | D - Secondary | Pasture, grassland or range - continuous forage for grazing | Good | 80 | 77 | *6.5 | 3.78 | 3.28 | 0.5 |
| | **** Comment:*** *Rainfall based on 6" of rainfall (see Table B-4)* | | | | | | | | |
| Willow Creek | D - Primary | Pasture, grassland or range - continuous forage for grazing | Good | 80 | 77 | 8.5 | 5.63 | 5.04 | 0.59 |
| | B- Secondary | Pasture, grassland or range - continuous forage for grazing | Good | 61 | 55 | 8.5 | 3.33 | 2.78 | 0.55 |
| | C - Secondary | Pasture, grassland or range - continuous forage for grazing | Good | 74 | 70 | 8.5 | 5.04 | 4.46 | 0.58 |
| | **** Comment:*** *Rainfall based on 8" of rainfall (see Table B-4)* | | | | | | | | |

## Table 35: Runoff Curve Numbers for Other Agricultural Lands [1]

| Cover Type | Hydrologic Condition | Curve Numbers for Hydrologic Soil Group | | | |
|---|---|---|---|---|---|
| | | **A** | **B** | **C** | **D** |
| Pasture, grassland, or range -continuous forage for grazing[2] | Poor | 68 | 79 | 86 | 89 |
| | Fair | 49 | 69 | 79 | 84 |
| | Good | 39 | 61 | 74 | 80 |
| Meadow -continuous grass; protected from grazing and generally mowed for hay | --- | 30 | 58 | 71 | 78 |
| Brush -brush-weed-grass mixture with brush the major element[3] | Poor | 48 | 67 | 77 | 83 |
| | Fair | 35 | 56 | 70 | 77 |
| | Good | 30[4] | 48 | 65 | 73 |
| Woods -grass combination (orchard or tree farm)[5] | Poor | 57 | 73 | 82 | 86 |
| | Fair | 43 | 65 | 76 | 82 |
| | Good | 32 | 58 | 72 | 79 |
| Woods[6] - Shaded area can be used as background if the land was originally wooded | Poor | 45 | 66 | 77 | 83 |
| | Fair | 36 | 60 | 73 | 79 |
| | Good | 30 | 55 | 70 | 77 |
| Farmsteads -buildings, lanes, driveways, and surrounding lots | --- | 59 | 74 | 82 | 86 |

1 Average runoff condition and $I_a = 0.2$ S
2 Poor: <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: >75% ground cover and lightly or only occasionally grazed.
3 Poor: <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
4 Actual curve number is less than 30; use curve number = 30 for runoff computations.
5 Curve numbers shown were computed for areas with 50% woods and 50% grass (pasture) cover.
Other combinations of conditions may be computed from the curve numbers for woods and pasture.
6 Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

**Source: USDA Soil Conservation Service, TR55 (2nd edition, June 1986); Table 2-2b, page 2-6.**

## Table 36: Runoff Depth for Selected Curve Numbers and Rainfall Amounts[1]

| | Runoff Depth for Curve Number of…. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainfall | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 98 |
| **1.00** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.08 | 0.17 | 0.32 | 0.56 | 0.79 |
| **1.20** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.07 | 0.15 | 0.27 | 0.46 | 0.74 | 0.99 |
| **1.40** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.06 | 0.13 | 0.24 | 0.39 | 0.61 | 0.92 | 1.18 |
| **1.60** | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.05 | 0.11 | 0.20 | 0.34 | 0.52 | 0.76 | 1.11 | 1.38 |
| **1.80** | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.09 | 0.17 | 0.29 | 0.44 | 0.65 | 0.93 | 1.29 | 1.58 |
| **2.00** | 0.00 | 0.00 | 0.00 | 0.02 | 0.06 | 0.14 | 0.24 | 0.38 | 0.56 | 0.80 | 1.09 | 1.48 | 1.77 |
| **2.50** | 0.00 | 0.00 | 0.02 | 0.08 | 0.17 | 0.30 | 0.46 | 0.65 | 0.89 | 1.18 | 1.53 | 1.96 | 2.27 |
| **3.00** | 0.00 | 0.02 | 0.09 | 0.19 | 0.33 | 0.51 | 0.71 | 0.96 | 1.25 | 1.59 | 1.98 | 2.45 | 2.77 |
| **3.50** | 0.02 | 0.08 | 0.20 | 0.35 | 0.53 | 0.75 | 1.01 | 1.30 | 1.64 | 2.02 | 2.45 | 2.94 | 3.27 |
| **4.00** | 0.06 | 0.18 | 0.33 | 0.53 | 0.76 | 1.03 | 1.33 | 1.67 | 2.04 | 2.46 | 2.92 | 3.43 | 3.77 |
| **4.50** | 0.14 | 0.30 | 0.50 | 0.74 | 1.02 | 1.33 | 1.67 | 2.05 | 2.46 | 2.91 | 3.40 | 3.92 | 4.26 |
| **5.00** | 0.24 | 0.44 | 0.69 | 0.98 | 1.30 | 1.65 | 2.04 | 2.45 | 2.89 | 3.37 | 3.88 | 4.42 | 4.76 |
| **6.00** | 0.50 | 0.80 | 1.14 | 1.52 | 1.92 | 2.35 | 2.81 | 3.28 | 3.78 | 4.30 | 4.85 | 5.41 | 5.76 |
| **7.00** | 0.84 | 1.24 | 1.68 | 2.12 | 2.60 | 3.10 | 3.62 | 4.15 | 4.69 | 5.25 | 5.82 | 6.41 | 6.76 |
| **8.00** | 1.25 | 1.74 | 2.25 | 2.78 | 3.33 | 3.89 | 4.46 | 5.04 | 5.63 | 6.21 | 6.81 | 7.40 | 7.76 |
| **9.00** | 1.71 | 2.29 | 2.88 | 3.49 | 4.10 | 4.72 | 5.33 | 5.95 | 6.57 | 7.18 | 7.79 | 8.40 | 8.76 |
| **10.00** | 2.23 | 2.89 | 3.56 | 4.23 | 4.90 | 5.56 | 6.22 | 6.88 | 7.52 | 8.16 | 8.78 | 9.40 | 9.76 |
| **11.00** | 2.78 | 3.52 | 4.26 | 5.00 | 5.72 | 6.43 | 7.13 | 7.81 | 8.48 | 9.13 | 9.77 | 10.39 | 10.76 |
| **12.00** | 3.38 | 4.19 | 5.00 | 5.79 | 6.56 | 7.32 | 8.05 | 8.76 | 9.45 | 10.11 | 10.76 | 11.39 | 11.76 |
| **13.00** | 4.00 | 4.89 | 5.76 | 6.61 | 7.42 | 8.21 | 8.98 | 9.71 | 10.42 | 11.10 | 11.76 | 12.39 | 12.76 |
| **14.00** | 4.65 | 5.62 | 6.55 | 7.44 | 8.30 | 9.12 | 9.91 | 10.67 | 11.39 | 12.08 | 12.75 | 13.39 | 13.76 |
| **15.00** | 5.33 | 6.36 | 7.35 | 8.29 | 9.19 | 10.04 | 10.85 | 11.63 | 12.37 | 13.07 | 13.74 | 14.39 | 14.76 |

1 Interpolate the values shown to obtain runoff depths for curve numbers or rainfall amounts not shown.

From USDA Soil Conservation Service, TR55 (2nd edition, June 1986) Table 2-1, page 2-3.

**Table 37 Agricutlure/Rangeland Risks of Peak Flow Enhancement**

| 1<br>**Subwatershed** | 2<br>Percent of Ag/Range Area in 1st Hydro Soil Group Table 33 Col. 4 (A, B, C or D) | 3<br>Average Change from Background Table 34 Col. 10 | 4<br>Percent of Ag/Range Area in 2nd Hydro Soil Group Table 33 Col. 4 (A, B, C or D) | 5<br>Average Change from Background Table 34 Col. 10 | 6<br>Percent of Ag/Range Area in 2nd Hydro Soil Group Table 33 Col. 4 (A, B, C or D) | 7<br>Average Change from Background Table 34 Col. 10 | 8<br>Percent of Ag/Range Area in 2nd Hydro Soil Group Table 33 Col. 4 (A, B, C or D) | 9<br>Average Change from Background Table 34 Col. 10 | 10<br>*Weighted Average Change from Background (Cols. 2x3 + 4x5 + 6x7 + 8x9) | 11<br>Potential Risk of Peak Flow Enhancement |
|---|---|---|---|---|---|---|---|---|---|---|
| East Fork Floras | 85.3%(C) | 0.47 | 13.4%(B) | 0.40 | 1.3%(D) | 0.50 | | | 0.46 | Low |
| Floras Lake | 40.9%(C) | 0.58 | 31.8%(B) | 0.55 | 27.2%(D) | 0.59 | 0.2%(A) | 0.98 | 0.57 | Moderate |
| Lower Floras Mnst. | 68.9% (D) | 0.62 | 22.1% (B) | 0.61 | 9.1%(C) | 0.62 | | | 0.62 | Moderate |
| Middle Floras Mnst. | 79.9%(C) | 0.53 | 14.2%(B) | 0.48 | 5.7%(D) | 0.54 | | | 0.52 | Moderate |
| North Fork Floras | 50.9%(B) | 0.40 | 45.8%(C) | 0.47 | 3.0%(D) | 0.50 | | | 0.43 | Low |
| Willow Creek | 70.6%(D) | 0.59 | 27.8%(B) | 0.55 | 1.3%(C) | 0.58 | | | 0.58 | Moderate |

* The weighted change is the additional runoff compared to assumed background level of 2 in/ 24 hr event storm intensity.

## Table 43 Monthly Net Water Available by Water Availability Basin (cfs) (of 50% Exceedence)

| Watershed ID# | Water Availability Basin | WAB Boundary Description | Tributary to | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70891 | 50070000 | Floras Cr | New R | 268.00 | 341.00 | 293.00 | 95.00 | -11.00 | -8.20 | -9.40 | -7.80 | -4.10 | -99.00 | 58.00 | 297.00 |
| 70875 | 50071000 | Willow Cr | Floras Cr | -9.10 | -1.80 | -5.60 | -13.00 | -11.00 | -9.30 | -9.40 | -7.80 | -4.80 | -99.00 | -19.00 | -7.60 |
| 80449 | 50072000 | S Fk Floras Cr | Floras Cr | 14.00 | 27.00 | 21.00 | 0.00 | -11.00 | -8.20 | -9.40 | -7.80 | -4.10 | -99.00 | 0.00 | 17.00 |
| 80445 | 50073000 | N Fk Floras Cr | Floras Cr | 68.00 | 96.00 | 78.00 | -0.02 | -11.00 | -8.20 | -9.40 | -7.80 | -4.10 | -99.00 | -0.01 | 76.00 |
| 31730606 | 50040000 | "Swanson Cr" | Floras L | 15.00 | 18.00 | 15.00 | 7.30 | 2.10 | 2.40 | 1.60 | 1.00 | 0.61 | 0.88 | 7.00 | 15.00 |
| 31730607 | 50050000 | Boulder Cr | Floras L | 16.00 | 19.00 | 17.00 | 7.80 | 1.60 | 2.30 | 1.10 | 0.58 | 0.26 | 0.60 | 6.20 | 16.00 |
| 31730608 | 50060000 | Trib West of Boulder | Floras L | 2.60 | 3.30 | 2.80 | 0.78 | -0.58 | 0.23 | -0.15 | -0.20 | -1.10 | -0.92 | 0.13 | 2.50 |
| 31730615 | 50090000 | Trib West of 5006 | Floras L | 2.80 | 3.40 | 2.90 | 1.30 | 0.31 | 0.19 | -0.06 | -0.09 | -0.04 | 0.01 | 0.48 | 2.80 |

Shaded Area = Water not available at 50% exceedance level

## Table 44 Streamflow Restoration Priority Areas

| Watershed ID | WAB | Stream | Tributary To | SUMMER | | | FALL | | WINTER | | SPRING | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Priority | Needs | Optimism | Needs | Optimism | Needs | Optimism | Needs | Optimism |
| 70891 | 50070000 | Floras Cr. | New R | X | 4 | 2 | 1 | 1 | 1 | 1 | 3 | 1 |
| 70875 | 50071000 | Willow Cr. | Floras Cr | | 4 | 1 | 1 | 1 | 2 | 1 | 3 | 1 |
| 31730607 | 50050000 | Boulder Cr. | Floras L | | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| 80449 | 50072000 | S Fk Floras Cr. | Floras Cr | | 1 | 1 | 1? | 1? | 1? | 1? | 1? | 1? |
| 80445 | 50073000 | N Fk Floras Cr. | Floras Cr | | 1 | 1 | 1? | 1? | 1? | 1? | 1? | 1? |
| 31730606 | 50040000 | "Swanson Cr." | Floras L | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 31730608 | 50060000 | Trib West of Boulder | Floras L | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 31730615 | 50090000 | Trib West of 5006 | Floras L | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Shaded Area = Streamflow Restoration Priority Area and Season