Willamette River Water Quality 2008

Photo: Erin Popelka

Willamette Valley Climate Information

Season and elevation are the main climatic drivers within the Willamette Basin. Annual precipitation in the basin is generally greatest between October and March, with July and August typically being the driest months (less than 5% of total annual precipitation). The mountain ranges bordering the western and eastern side of the basin force clouds up and over, causing precipitation to fall as either rain or snow. This orographic effect results in relatively high precipitation on the peaks, and relatively low precipitation within the valley, particularly for valley areas within a peak's "rainshadow". For example, Marys Peak, bordering the Willamette Valley in the central Coast Range and the range's highest peak, receives 150 inches of rain annually; Corvallis, a town a few miles to the east of Marys Peak and on the valley floor, receives around 43 inches of annual precipitation. **(1)**

The Oregon Water Quality Index (OWQI)

The Oregon Water Quality Index (OWQI) is defined as a set of water quality variables that produce a numerical score of water quality. Ten is the worst score and 100 is the ideal score. The variables used to compose the score are temperature, dissolved oxygen (DO), biochemical oxygen demand (BOD), pH, total solids (TS), ammonia and nitrate, total phosphorus (TP), and E. Coli (fecal coliform prior to 2002). There are currently 144 monitoring sites within the Willamette stream network, but budget constraints have caused the number of monitoring sites to fluctuate.

The results shown in the table below were calculated from samples taken between 1997 and 2006 by the Oregon Department of Environmental Quality. When sufficient data is collected, a site is analyzed for significantly increasing or decreasing trends, at an 80% or greater confidence level **(2)**. In general, water pollutants are diluted during the wet season due to increases in precipitation and stream discharge. Each of the 2006 OWQI scores are shown on the cover map located along their associated sampled stream shown as a thick blue river line.

●	44 - 50	●	71 - 80
●	51- 60	●	81- 90
●	61 - 70	●	91 - 100

Numerical ratings: Below 60 - Very Poor; 60 – 79 Poor; 80 – 84 Fair; 85 – 89 Good; 90 – 100 Excellent; NT – No Trend.

This table lists various monitoring stations, their river mile, and the OWQI since 2001, with trend information since 1997. They are highlighted by river. **(2)**

Monitoring Station	River Mile	2001	2003	2006	Trend since 1997
Yamhill R. at Dayton	5	70	71	77	NT
Swan Island Channel midpoint	0.5	78	80	81	NT
Willamette R. at SP&S RR Bridge	7	79	79	82	-2.9
Willamette R. at Hawthorne Bridge	13.2	80	82	85	NT
Willamette R. at Canby Ferry	34.4	84	86	86	NT
Willamette R. at Newberg Bridge	48.6	83	85		2
Willamette R. at Wheatland Ferry	71.9	86	87	88	NT
Willamette R. at Salem	84	86	87	89	NT
Willamette R. at HWY 20 (Albany)	119.3	86	87	88	NT
Willamette R. at HWY 34 (Corvallis)	131.4	87	88	89	NT
Willamette R. at HWY 99E (Harrisburg)	161.2	89	90	91	NT
Willamette R. at HWY 126 (Springfield)	185.3	92	93	93	1.4
Tualatin R. at Rood Bridge	39	73	76	80	-3.3
Tualatin R. at HWY 210	26.9	62	65	62	-22.5
Tualatin R. at Elsner Road	16.2	65	66	63	-19.5
Tualatin R. at Boones Ferry Road	8.6	56	59	57	-18
South Yamhill R. at HWY 99W	16.5	79	81	83	NT
South Santiam R. at HWY 226	7.6	92	93	92	NT
South Fork McKenzie R. at NF Road 19	3.9	95	95		-1.7
Pudding R. at HWY 99E	8.1	60	64	66	NT
Pudding R. at HWY 211	22.4	53	57	60	NT
North Yamhill R. at Poverty Bend Road	4.5	75	77	82	-2.8
North Santiam R. at Green's Bridge	2.9	93	93	94	NT
North Santiam R. at Gates School Road	39	93	93	93	NT
North Santiam R. at Coopers Ridge Road	63.8	94	95	95	NT
Mollala R. at Canby	3	89	89	90	NT
Mohawk R. at Hill Road	1.6	86	87		NT
Middle Fork Willamette R. at Jasper Bridge	8	94	94	93	2
McKenzie R. at McKenzie Bridge	68.1	95	95	94	NT
McKenzie R. at HWY 126	89	94	95		NT
McKenzie R. at Hendricks Bridge	24	93	94	94	NT
McKenzie R. at Coburg Road	7.1	92	93	92	-1.6
Mary's R. at HWY 99W (Corvallis)	0.2	84	86	85	NT
Long Tom R. at Stow Pit Road (Monroe)	4.7	76	78	77	-2.5
Johnson Creek at SE 17th Avenue	0.2	28	29	30	NT
Fanno Creek at Bonita Road	2.3	62	62	62	-6.7
Columbia Slough at Landfill Road	2.6	32	37	44	17.3
Coast Fork Willamette R. at Mt. Pisgah Park	3	85	84	86	NT
Clackamas R. at Memaloose Road	35.7	91	92	95	NT
Clackamas R. at McIver Park	22.6	95	95	95	NT
Clackamas R. at High Rocks	1.2	90	91	92	NT
Calapooia R. at Queens Road	3	74	78	82	3.3
Blue R. at Blue River Drive	0.3	95	95		NT
Beaverton Creek at Cornelius Pass Road	0.3	55	53	54	NT

Changes in the River Channel and Floodplain

The natural course of a river changes over time, typically during high-flow events. As meanders get cut off, oxbow lakes form that are visible as wetlands or water bodies. Since the establishment of large permanent population centers beginning in the mid-1800s, the Willamette River channels and adjacent floodplains have been vastly altered. With permanent settlements came revetments, levees, and dikes along the Willamette River corridor to counter the effects of bank erosion. Resulting undercut banks, due to increased stream erosion as meanders propagate downstream, created a loss of valuable farm land in many areas.

Stream sediment carried within the river channel increases during a flood event due to both the increased flow velocity (carrying capacity) and the increased amount of surface runoff during the peak precipitation events. As the Willamette's water levels overtop the bank and the water velocity decreases as the flood waters flow onto the floodplain, fine grained clay soil particles are deposited. Soils on the valley floor are composed of these nutrient-rich floodplain deposits that date back to before habitation.

Peak Flows (in cubic feet per second) of Major Floods at the Albany Gauge

1861	1890	1943/1945	1964	1996
340,000	291,000	210,000	180,000	117,000

Albany has the longest flow gauge record on the Willamette River. The greatest flood on record occurred in 1861 and covered an area of more than 320,000 acres, providing a delineation for the 100-year flood plain. High-level flood events have historically occurred every 1 to 4 years, with other major floods occurring in 1881, 1890, 1901, 1903, and 1907. After the construction of United States Army Corps of Engineers (USACE) flood-control dams and bank stabilization features, the water levels during flood events were not nearly as elevated in the upper Willamette as they were during the 1800s. The years 1943, 1946, 1948, 1996, and 1997 all recorded flood levels that did cause property damage, but they in no way compared to the floods before the dams were built. **(3)**

Major Dams in the Willamette Basin:

Flood Control initiated by the Willamette Project operated by the United States Army Corps of Engineers (USACE)

▪ USACE Dams

Thirteen major dams were constructed by the USACE between the years 1941 and 1969 through what was called the Willamette Project. Beginning in 1935, the Willamette Project's purpose was to "propose the greater utilization of the natural resources of this watershed for the economic and social betterment of its inhabitants and of newcomers who may settle there" (1935, Oregon State Planning Board).

Flood control is performed by storing snowmelt and winter precipitation in large reservoirs which are accessed for irrigation, recreation, and hydroelectric generation. Controlling water flow from the 12 major tributaries into the Willamette River drastically reduces the peak levels of high flow reached during the winter months and allows for greater agricultural expansion and urban development within closer proximity to the river.

These USACE dams act as a control on river flow, drastically decreasing winter flooding and increasing summer base-level flow within the Willamette River. In addition, eight of the thirteen dams are suited for hydroelectric power production (with number of turbines): Hills Creek Dam (2), Lookout Point Dam (3), Dexter Dam (1), Cougar Dam (2), Foster Dam (2), Green Peter Dam (2), Detroit Dam (2), and Big Cliff Dam (1).

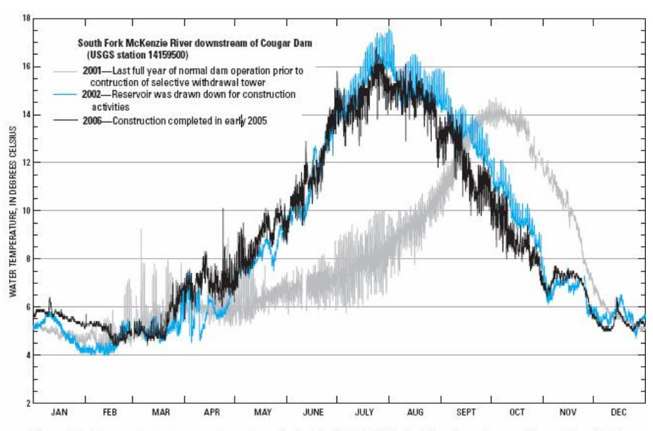

Figure 12. Seasonal water temperature patterns in the South Fork McKenzie River downstream of Cougar Dam in 2001, 2002, and 2006.

These dams have been found to alter the temperature of the downstream reaches by releasing cold water from the base of the dam thus changing the seasonal variations in river temperatures. These prolonged shifts in stream temperature affect the instinctive nature of salmon populations that return to the area to spawn. In order to upgrade the dams so that they are not threatening the continued existence of the threatened and endangered species that occupy the streams, various efforts have been attempted or proposed. For example, since early 2005 Cougar Dam has in place a selective withdrawal tower that promotes 'natural' water temperatures by selectively withdrawing water from a reservoir depth at the same temperature as the receiving stream. **(1)**

Over 350 other small dams have also been installed in the basin primarily for agricultural irrigation purposes. **(1)** By their nature, dams alter stream morphology and interrupt the passage of migratory fish species. Removing old dams that are no longer needed is a great way to increase the natural rhythm of the stream, as well as to create a safer environment in the case that the dam would fail due to high flow. For example, Marmot Dam on the Sandy River was decommissioned and removed in October 2007. The Little Sandy Dam, on the Little Sandy River, is scheduled to be removed in the summer of 2008. In the long term, the streambed will return to its natural state, and summertime stream temperatures below the dam site are expected to decrease. The Sandy and Little Sandy Rivers provide access and habitat for anadromous fish and other aquatic organisms. **(17)**

Red-tailed hawk circling above the fields at Snag Boat Bend.
Photo: Richard P. Hughes

Major Point Source Permittees with Mixing Zones in the Willamette River (16)

▲ Major Mixing Zones

1. Kellogg Creek Water Pollution Control Plant
11525 SE McLoughlin Blvd. Milwaukie, OR 97222. (503) 794-8050
River Mile: 18.7 **Receiving Water:** Willamette River
Mixing Zone Length: 200 ft. **Mixing Zone Width:** 99 ft
Limited Effluents: CBOD5, TSS, pH, total residual chlorine, E. Coli, ammonia. **Monitored Effluents:** BOD5, CB)D5, TSS, NH3-N, pH, chlorine residual, Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn, Cyanide, total phenols, bioassay, E. Coli, water temperature, molybdenum and priority pollutants.
Violations: 11/14/2007- Violating a technology-based effluent limitation: $3,400.

2. Oak Lodge Sanitary District
13750 SE Renton Av. Milwaukie, OR 97222-8089. (503) 653-1653
River Mile: 20.1 **Receiving Water:** Willamette River
Mixing Zone Length: 600 ft. **Mixing Zone Width:** 300 ft.
Limited Effluents: CBOD5, TSS, BOD5, E. Coli, pH
Monitored Effluents: BOD5, CBOD5, TSS, NH3-N, pH, E. Coli, chlorine residual, Nh3-N, temperature, bioassay, priority pollutants
Violations: 9/23/2005 - District Permit Exceeded for E Coli. Class 2 Violation; 12/4/2006 - Causing pollution of waters of the state: $16,800; 6/30/2003 - Reducing the quality of waters below State water quality standards: $5,400; 8/1/2002 - 6000 gallons of raw sewage into Willamette River Pump Station #1; 5/5/2000 - Unpermitted Discharge of Wastewater.

3. Tri-City Water Pollution Control Plant
15941 S Agnes Ave. Oregon City, OR 97045. (503) 557-2823
River Mile: 25.5 **Receiving Water:** Willamette River
Mixing Zone Length: 300ft. **Mixing Zone Width:** 275ft.
Limited Effluent: fecal coliform, pH, total residual chlorine, TSS, CBOD5.
Monitored Effluent: BOD5, CBOD5, TSS, NH3-N, pH, fecal coliform, chlorine residual, nutrients, Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Zn, Cyanide, total phenols, toxics removal, whole effluent toxicity.

4. Blue Heron Paper Company
419 Main Street Oregon City, OR 97045-1809. (503) 650-4211
River Mile: 26 **Receiving Water:** Willamette River
Mixing Zone Length: 32.8 ft. **Mixing Zone Width:** 9.8 ft.
Limited Effluents: pH, TSS, oil and grease, temperature.
Monitored Effluents: TSS, pH, temperature
Violations: 5/5/2004 - Causing pollution of waters of the State: $3,000.

5. West Linn Paper Company
4800 Mill Street West Linn, OR 97068. (503) 557-6500
River Mile: 27.4 **Receiving Water:** Willamette River
Mixing Zone Length: 65 ft. **Mixing Zone Width:** 235 ft.
Limited Effluents: BOD5, TSS, pH, turbidity, temperature
Monitored Effluents: BOD5, TSS, pH, turbidity, temperature, Fe, whole effluent toxicity, priority pollutant scan
Violations: 9/9/2007 - During routine operation of emptying a chest, the increased flow overwhelmed the wet end effluent sump and overflowed to the mill sump, which reached the Willamette River. Class 2 Violation.

6. Blue Heron Paper Company
419 Main Street Oregon City, OR 97045-1809. (503) 650-4211
River Mile: 27.5
Receiving Water: Willamette River
Mixing Zone Length: 246 ft.
Mixing Zone Width: 377.2 ft.
Limited Effluents: Temperature, Turbidity.
Monitored Effluents: color, whole effluent toxicity, mercury, cadmium, copper, lead.
Violations: 4/17/2004 - Wastewater discharge into Willamette River. Class 2 Violation; 12/28/2003 - Discharge of sulfuric acid.

Three children enjoy Riverfront Commemorative Park in Corvallis.
Photo: Erin Popelka

7. City of Canby
1480 NE Territorial Canby, OR 97013. (503) 266-4021 ext.248
River Mile: 33
Receiving Water: Willamette River
Mixing Zone Length: 100 ft. **Mixing Zone Width:** 51.5 ft.
Limited Effluents: CBOD5, TSS, pH, E Coli, ammonia
Monitored Effluents: BOD5, CBOD5, TSS, pH, E. Coli, NH3-N, Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn, Cyanide, Total Phenols, bioassay, priority pollutant testing.

8. City of Wilsonville
9275 SW Tauchman Rd. Willsonville, OR 97070. (503) 682-4092
River Mile: 39 **Receiving Water:** Willamette River
Mixing Zone Length: 150 ft. **Mixing Zone Width:** 37 ft.
Limited Effluents: CBOD5, BOD5, TSS, E. Coli, pH
Monitored Effluents: CBOD5, BOD5, TSS, E. Coli, pH, temperature, NH3-N, Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn, Cyanide, bioassay

9. City of Newberg
2301 Wynooski Road, Newberg, OR 97132. (503) 537-1252
River Mile: 49.7 **Receiving Water:** Willamette River
Mixing Zone Length: 165 ft. **Mixing Zone Width:** 75 ft.
Limited Effluents: CBOD5, TSS, E. Coli, pH, total residual chlorine
Monitored Effluents: CBOD5, NH3, TSS, hardness, pH, temperature, E. Coli, total residual chlorine, Nutrients, total phosphorus, Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn, Cyanide, iron, Priority Pollutants

10. City of Salem
555 Liberty St. SE Salem, OR 97301. (503) 588-6211
River Mile: 78.4 **Receiving Water:** Willamette River
Mixing Zone Length: 160 ft. **Mixing Zone Width:** 140 ft.
Limited Effluents: CBOD5, TSS, E.Coli, pH, total residual chlorine
Monitored Effluents: CBOD5, NH3-N, TSS, hardness, pH, dissolved oxygen, E. Coli, pH, chlorine residual, temperature, Nutrients, Metals, Cyanide, Iron, Whole Effluent toxicity, Priority Pollutants
Violations: 10/27/2005 - Reducing the quality of below State water quality standards: $7,800; 2/28/2001- Notice of Civil Penalty Assessment NPDES-Permit Requirements: $1,440; 11/2/2000- Raw sewage overflow. Class 1 Violation.

11. Wah Chang
1600 NE Old Salem Road Albany, OR 97321. (541) 926-4211
River Mile: 115.5 **Receiving Water:** Willamette River
Mixing Zone Length: 10,000 ft. **Mixing Zone Width:**Width of Truax Creek
Limited Effluents: Cr, Cu, Cyanide, Pb, Ni, Zn, Titanium, TSS, Ammonia Nitrogen, Thiocyanate ion, Methylisobutyl ketone, oil and grease, total residual chlorine, acute toxicity, pH. **Monitored Effluents:** total organic carbon, ammonia nitrogen, thiosyanate ion, methylisobutyl ketone, oil and grease, total residual chlorine, Cr, Cu, Cyanide, Pb, Ni, Zn, Titanium, TSS, Conductivity, Bioassay, molybdenum, radium-226, pH and temperature.
Violations: 6/18/2001- Notice of Civil Penalty Assessment, acutely toxic waste water dismissed: $21,600; 1/25/2000- Mutual Agreement and Order Penalty NPDES-Permit Requirements: $4,800; 12/1/2000- Notice of Civil Penalty Assessment NPDES-Waste Discharge Limits: $20,000; 11/1/1999- Notice of Civil Penalty Assessment NPDES-Waste Discharge Limits: $23,000.

12. Weyerhaeuser
2812 Old Salem Rd. NE Albany, OR 97321. (541) 812-3400
River Mile: 116.5 **Receiving Water:** Willamette River
Mixing Zone Length: 500.0 ft. **Mixing Zone Width:** 60ft.
Limited Effluents: BOD5, TSS, pH. **Monitored Effluents:** BOD5, TSS, color, temperature, pH, Zn, TDS, NH3-N, TKN, NO2- Nitrogen, NO3- Nitrogen, T. Phosphorus, acute/chronic bioassay.
Violations: 6/30/2006 - Schedule A,A.1 of permit contains a maximum daily discharge limitation for B.O.D. of 3,500 lbs. On June 20th you discharged 3,950lbs. of B.O.D. This exceeded the permit limitation by 13%. Class 3 Violation.

13. City of Albany
310 Waverly Dr. NE, Albany, OR 97321. (541) 917-7600
River Mile: 118 **Receiving Water:** Willamette River
Mixing Zone Length: 150.0 ft. **Mixing Zone Width:** 15ft.
Limited Effluents: CBOD5, TSS, E. Coli, pH, total residual chlorine
Monitored Effluents: CBOD5, Ammonia-N, TSS, E. Coli, pH, temperature, chlorine residual, nutrients, Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn, bioassay. **Violations:** 1/15/2008 - The daily max. T.S.S. loading reported for the January composite sample was 8053 lbs. The effluent flow at the time of discharge was 14.63 MGD. Well above the dilution factor of 2. Class 2Violation; 1/15/2008 - The level of E. Coli reported for the Jan. 2 grab sample was >2450 COL/100 ML. The reported value exceeds the permit limitation by a factor of 6.0; 5/23/2006 - A1.A of permit contains a daily maximum discharge limitation of 2,900lbs of T.S.S.. On May 23, 2006 you discharged 3,330lbs of T.S.S. This exceeds the permit limitation by 14%: $5,080; 12/30/2001 - Exceeding total chlorine discharge concentration. Class 3 Violation.

14. City of Corvallis
1304 NE Second St. Corvallis, OR 97330-6219. (541) 766-6916
River Mile: 130.8 **Receiving Water:** Willamette River
Mixing Zone Length: 310 ft. **Mixing Zone Width:** 130 ft.
Limited Effluents: CBOD5, TSS, E. Coli, pH, total residual chlorine
Monitored Effluents: CBOD5, Ammonia-N, TSS, E. Coli, pH, chlorine residual, nutrients, Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn, Cyanide, Bioassay, temperature. **Violations:** 11/28/2001 – Exceeding E.Coli discharge permit limits. Class 2 Violation.

15. Fort James Operating Company/ Pope & Talbot, Inc.
30470 American Drive Halsey, OR 97348. (541) 369-1589
River Mile: 147 **Receiving Water:** Willamette River
Mixing Zone Length: 300 ft. **Mixing Zone Width:** 137 ft.
Limited Effluents: BOD5, TSS, pH, pentachlorophenol, trichlorophenol**Monitored Effluents:** flow, pH, BOD5, TSS, temperature, ammonia, phosphorus, Cu, Zn, WET testing, trichlorophenol, pentachlorophenol. **Violations:** 11/13/2006 – Discharged 5,129 lbs of BOD. This is a violation of schedule A, A.1 of NPDES permit NO. 101114, which allows a daily maximum discharge of 500 lbs. of BOD. This amount exceeds the allowable discharge by 3%. Class 3 Violation; 5/8/2006 - Schedule A,1.A. of permit contains a maximum daily discharge limitation for TSS of 6,750 lbs. On May 8th you discharged 19,579 lbs of TSS. This exceeds the permit limitation by over 50%. Class 1 Violation.

16. Metropolitan Wastewater Commission Eugene
410 River Avenue Eugene, OR 97404. (541) 682-8611
River Mile: 178 **Receiving Water:** Willamette River
Mixing Zone Length: 220 ft. **Mixing Zone Width:** 120 ft.
Limited Effluents: CBOD5, TSS, E. Coli, pH, total chlorine residual, excess thermal loading, NH3.
Monitored Effluents: CBOD5, TSS, E.Coli, pH, total chlorine residual, temperature, ammonia, nutrients, bioassay, Ag, As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Se, Zn, total cyanide, priority pollutant, effluent flow, organics.
Violations: 6/1/2006 - Schedule A of NPDES permit allows a monthly average effluent concentration of 10MG/L for TSS. During the month of May, your average TSS concentration was 12 MG/L, which exceeded permit limitation by 20%.

Other Major Violations of NPDES Permits Documented by the DEQ

Industrial

1. Smurfit Newsprint Co.
427 Main St. Oregon City, OR 97045. (503) 742-9100
Violations: 6/27/2000 - Notice of Civil Penalty Assessment NPDES—Permit Requirements: $96,280; 6/13/1999 - Exceeding permit discharge limitations.

Storm Water

1. Oregon Department of Transportation
355 Capital St. NE. Salem OR 97301-3871. (888) 275-6368
Violations: 9/5/2007, 9/11/2007 Lane Gettings Creek rest area, I-5, MP 178.2, exceeding the maximum daily flow for onsite wastewater treatment system. Class 2 Violation.

2. Willamette Industries, inc/Weyerhauser:
1300 SW. 5th Av. Portland, OR 97201. (503) 273- 5603
Violations: 5/30/2001, 6/12/2001: Exceeding permit discharge limitations Class 1, Class 2, and Class 3 Violations.

3. Oregon Metallurgical Corporation
530 34th Ave. SW Albany, OR 97332-3828. (541) 967-9000
Violations: 10/1/1999, 11/1/1999, 12/1/1999, 12/6/1999, 3/1/2000: Violations for exceeding permit discharge limitations. Class 2 Violations.

Municipal

1. Woodburn, City
2815 Molalla Rd. Woodburn, OR 97071. (503) 982-5280
Violations: 12/15/2006—Failure to maintain pH range by 1PH Unit of less established in an NPDES permit. Class 3 Violation.

2. Sweet Home, City (Sewage Treatment Plant)
201 Pleasant Valley Rd. Sweet Home, OR 97386. (541) 367-4846
Violations: 11/17/2006—Failed to comply with Schedule A-Effluent Limitations. Failing to comply the conditions of NPDES permit.

3. Monmouth, City
151 West Main St. Monmouth, OR 97361. (503) 838-2173
Violations: 11/15/2007—The City had an E.Coli sample that was reported as being 1300 Oreganisms/100ML. This exceeds the permit limitations by less that 5-times the effluent limit which is defined by OAR 340-012-0055.; 12/9/2002—Failure to comply with total Coliform Limits. Class 2 Violation.

4. City of Adair (Sewage Treatment Plant)
6030 NW William Carr Avenue, Adair Village, OR 97330. (541) 745-5507
Violations: 10/11/2007- Failure to obtain DEQ approval prior to discharge; 1/15/2006 - Fecal Coliform;, Fecal and TSS for Feb. O6; TSS for March 06, and Fecal for April 06.

Definitions for Effluent Acronyms:

CBOD5 – Carbonaceous Biochemical Oxygen Demand;
TSS – Total Suspended Solids;

NH3 – Ammonia;	Mo – Molybdenum;
Ag - Silver;	Hg – Mercury;
As – Arsenic ;	Ni – Nickel;
Cd - Cadmium;	Pb – Lead;
Cr – Chromium;	Se – Selenium;
Cu – Copper;	Zn – Zinc.

Disclaimer:

The Corvallis Environmental Center and the Institute for Water and Watersheds used many information sources on this poster, and we've done our best to properly and correctly use data from them. Remember, however, that the data, related information, and graphics are for illustrative purposes only, may not have come from legal documents, and are not intended to be used for legal purposes.

Although the poster has gone through an extensive review process, the Corvallis Environmental Center and the Institute for Water and Watersheds can give no warranty, express or implied, as to the accuracy, reliability, utility, or completeness of this information. Only the original data source can do that. Thus, please use this map for general education purposes—its intended use.

Total Maximum Daily Load (TMDL)

The Oregon Department of Environmental Quality (ODEQ) is responsible for setting pollutant levels within Oregon's streams and water bodies. When a stream or water body is found to be over the threshold limit for a given parameter, the stream or water body is placed onto the 303(d) list of impaired water bodies, as stated within the Clean Water Act. By placing a stream or water body onto the 303(d) list, the TMDL process is initiated in order to establish effluent limits that will bring the stream or water body back to its acceptable level. The TMDL process is iterative, meaning that many variables are involved within numerous complicated equations to evaluate each factor and establish realistic loading capacities. The loading capacity of a water body is defined as the maximum amount of a pollutant that the water body can carry without violating water quality standards set by the ODEQ. The four factors built into TMDL loading capacity are: 1) point source waste load allocations, 2) the non-point source load allocations, 3) the natural background load allocations, and 4) a safety buffer built in to decrease the possibility of surplus pollutants. Many of the pollutants do not dissipate entirely before additional pollutant discharges are contributed to the stream. Computer modeling is used to analyze the effects of river flow on the transportation of effluent from its entry into the water body. Once the initial TMDL is created by the DEQ, it must then by approved by the Environmental Protection Agency (EPA) before further action is taken. Once the TMDL is approved by the EPA for a specific parameter within a region or subbasin, all of the 303(d) streams within that region or subbasin in violation for that specific parameter are delisted and considered water-quality limited. If a de-listed stream is found to be in violation when the next 303(d) list is created is will be placed back onto the 303(d) list so that changes to the TMDL can be made. **(1)**

The Tualatin subbasin was the first subbasin to have an approved TMDL. In 2001, EPA approved Tualatin's TMDL, thus no 303(d) streams were listed in the 2002 303(d) list. In 2006, a few streams in the Tualatin subsisting were put back onto the 303(d) list for pesticides and toxics. The Tualatin subbasin TMDL is considered one of the most mature in the Willamette Valley.

The entire Willamette Basin TMDL has been approved and covers mercury, bacteria, and temperature for all of the subbasins. The Tualatin, Yamhill, and the Mollala-Pudding subbasins are not included for any other parameters within the Willamette Basin TMDL. Both the Yamhill and the Mollala-Pudding subbasins will have TMDLs completed in 2008 to cover all other parameters besides mercury. **(1)**

TMDLs created and approved within the Willamette Basin

1. Tualatin Subbasin --08/07/2001 -- *temperature , bacteria, dissolved oxygen, settleable volatile solids, ammonia, chlorophyll a, pH, phosphorus*
2. Willamette Basin --09/29/2006 -- *temperature, bacteria, mercury, dissolved oxygen, dieldrin, dichlorodiphenyltrichloroethane, turbidity*

In order to keep track of where, what kind, and how much of each pollutant type enters the waterways, the DEQ is responsible for permitting point source discharge permits called NPDES permits. The National Pollution Discharge Elimination System (NPDES), as created in the Clean Water Act, gives the state of Oregon the responsibility of permitting point-source discharge permits to anyone discharging into surface water. These permits vary depending on the type of facility, the amount of discharge, and the concentration of the discharge.

In order to enact basin wide changes in accordance with the approved TMDL, the DEQ assigns Designated Management Agencies (DMAs) the task of creating and upholding Implementation Plans to lower non-point pollution levels. These Implementation Plans include a management strategy to reduce pollutant loading, a timeline for reaching goals through performance monitoring, as well as proof of compliance with state land use requirements. DMAs are federal, state, or local government agencies that have legal authority such as: cities, counties, the U.S Forest Service, the U.S. Bureau of Land Management, and the USACE. The DMAs are responsible for upholding the non-point source allocations and must submit reports to the DEQ annually. More than 100 jurisdictions in the Willamette Basin are designated as DMAs to enact the changes made in the 2006 TMDL. **(8) (9) (10)**

Point Source Discharge:

● Sewage Treatment Plants ▲ Major Mixing Zones

ODEQ assigns two different types of storm water permits based on both the size of the community and the location within an urban area as defined by the US Census Bureau. The Phase 1 Municipal Separate Storm Sewer System (MS4) permits are issued to the largest communities with a population of greater than 100,000. There are six Phase 1 permits in the Willamette Basin, covering portions of the Portland metropolitan area and the cities of Salem and Eugene. Phase 2 MS4 permits are issued to jurisdictions within urbanized areas with populations of 50,000 or greater, which are not already part of the Phase 1 permit program. These permits cover portions of the Portland metropolitan area, Salem, and Eugene urban areas and the entire Corvallis urbanized area.

It is currently common practice for permits to include a built-in 'Regulatory Mixing Zone' within the receiving body of water. A mixing zone, varying in size from 5 to 300 feet, is defined as the area of a stream where wastewater discharge from a facility enters the water body at pollution levels exceeding current water quality standards. The size of the "zone" varies based on how concentrated the wastewater discharge is, current water quality standards, location of the discharge in relation to critical habitat or drinking water intakes, and size or flow of the receiving water body. Not all permitted facilities have mixing zones. The permitted mixing zone dischargers along the Willamette River are fined heavily when exceedences above their allowable discharge occur.

Amended into the Clean Water Act is an action termed 'civil lawsuit.' These 'civil lawsuits' allow for the public to notify the ODEQ of potential NPDES violations who in turn notify the facility of a pending lawsuit against them. Heavy fines are imposed on violators through this process of compliance that often times would have gone unnoticed. One major struggle with effectively maintaining the TMDL process is that it takes a long period of time – from several years to several decades before management practices become fully effective. **(1) (7) (9)**

Major TMDL parameters within the Willamette Basin

Temperature

Altered stream temperatures occur downstream of major dam operations, areas where there has been loss of stream side vegetation, and at point sources where water is dumped after being used to cool factory devices. Elevated stream temperatures, in the 23°C - 26°C (73°F - 79° F) range, are routinely observed in the Upper Willamette subbasin. These elevated temperatures cause death of coldwater fish species during exposure times lasting a few hours to one day. The most common and widespread cause of thermally induced fish mortality is attributed to interactive effects of decreased or lack of metabolic energy for feeding, growth or reproductive behavior, increased exposure to pathogens (viruses, bacteria and fungus), decreased food supply (impaired macro-invertebrate populations) and increased competition from warm water tolerant species. This mode of thermally induced mortality, termed 'indirect' or 'sub-lethal', is more delayed, and occurs weeks to months after the onset of elevated temperatures (18° C to 23°C or mid-60°F to low-70°F). **(11)**

Bacteria and E.Coli

Bacteria can carry pathogens and cause gastrointestinal problems in humans, causing impairment or harm to human health. The 30-day log mean of 126 *E. coli* organisms per 100 milliliters criterion was used as the target concentration in the TMDL for determining the loading capacity of a waterbody. This criterion most directly relates to illness rates and potential impacts on the beneficial use of water for recreation. There is currently an excess bacterial load to the Willamette River that results in occasional violations of water quality standards in the upper basin, and frequent violations in the lower basin. This excess load results from nonpoint source urban and agricultural runoff, waste water treatment plants in the middle and upper reaches of the river, and from direct discharges of Combined Sewage Overflows in the lower reach. **(12)**

Mercury

Mercury (Hg) and other toxics can increase health risks or even cause outright harm to human health. The Oregon Department of Human Services (DHS) has issued multiple fish consumption advisories for mercury in the Willamette Basin advising people of the health risks associated with eating fish caught from the Willamette River and the Dorena and Cottage Grove Reservoirs. The Black Butte abandoned mine site, located in the headwaters of the Coast Fork Willamette River above the Cottage Grove Reservoir, represents a likely source of mercury to downstream waterbodies particularly the Cottage Grove Reservoir. **(13)**

Dissolved Oxygen

Dissolved oxygen (DO) is a key element of water quality that is necessary for supporting aquatic life. Many pollutants in wastewater put an oxygen demand on the natural supply of dissolved oxygen. This is called biochemical oxygen demand, or BOD, and is used to measure how well a sewage treatment plant is working. If the effluent from the sewage treatment plant has a high content of organic solids or ammonia, it will demand more oxygen from the water and leave the water with less oxygen to support fish and other aquatic life. **(14)**

Pesticides or Toxics

A pesticide is any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any pest. However, pesticide also refers to herbicides, fungicides, and various other substances used to control pests. NPDES permits are not required for an application that may leave residuals because a pesticide is not a pollutant at the time of discharge—only after it has served its intended purpose. In Oregon, more than 11,000 pesticide products are registered, which include 771 active ingredients. The effects due to the combination of pesticides in streams are of great concern since little is known about their combined effects. **(15)**

Turbidity

A measure used to represent the clarity of water, turbidity is affected by both inorganic and organic solids. For regulatory purposes, turbidity is quantified in terms of Nephelometric Turbidity Units (NTU). The primary external source of turbidity causing solids are storm water-related inflows. Other secondary sources of turbidity causing solids are multiple types of point and nonpoint sources such as surface water runoff events and stream bank erosion due to the removal or reduction of stream side vegetation. Turbidity can decrease primary productivity by smothering, abrading, or shading photosynthesizing organisms. Excessive fine particulate material can deposit and adversely impact macroinvertebrate lifeforms by filling in habitat space and reducing oxygen supply. Excessive fine particulate material may also harm fish and amphibian communities by covering respiratory surfaces, smothering eggs, trapping emerging newly hatched fry, and decreasing visual feeding efficiency. **(14)**

Riparian and Wetland Habitats in the Willamette Valley

Historically in the Willamette Valley, wetland prairies were widespread within the Willamette River's floodplain and managed by the native Kalapuya. They practiced prescribed late summer burning, which thinned out vegetation for hunting and farming over larger areas of the river floodplain.

Backwater wetland slough located within the historic Willamette River channel at the Snag Boat Bend Unit operated by the Finley National Wildlife Refuge. Photo: Richard P. Hughes

Since the population boom in the Willamette Valley beginning in the mid 1800s, agricultural practices have demolished once-abundant wetland prairies into a rare wetland type representing about 1% of the original wetland prairie ecosystem. Currently, wetland prairies are defined as lands with water levels ranging from saturated soils to no more than 6 inches of surface water during the growing season, with drier soil during the summer months. **(4)**

Many plant species adapted to this environment are now in extreme risk of extinction and have been placed onto the State or Federal Threatened/Endangered Species List which offers habitat protection under the Endangered Species Act. **Plants include:** *Willamette Valley daisy, Bradshaw's lomatium, Golden paintbrush, Howellia, Kincaid's lupine, Nelson's sidalcea, White rock larkspur, Peacock larkspur, Wayside aster, White-topped aster*. **Animals include:** *Oregon chub, Chinook salmon (spring run), Steelhead (winter run), Coho salmon (Lower Columbia River ESU), Fender's blue butterfly* **(5).**

In order to conserve what is left of the upland and wetland prairies, as well as to create new prairies from oversaturated agricultural land, the Willamette Valley National Wildlife Refuge complexes are actively restoring native prairies by seeding with native plant species and placing controls on the wetland hydrologic systems within their refuge boundaries. Outside of the National Wildlife Complexes, there is a wetland mitigation system developed by the federal government that forces developers to recreate the wetlands that are destroyed during development with the goal of 'no net loss' of wetlands in mind.

The definition of a wetland adopted by the USACE: "The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." **(18)**

There are 12 major riparian corridors that feed the Willamette River. The water quality in these riparian areas is critical to the overall water quality of the Willamette River. Flow volume within the mainstream of the Willamette is much lower in the southern section than in the northern due to the large contributions of surface water and groundwater from these riparian areas. Agricultural development has led to the loss of vegetative buffering alongside these tributary streams. The decrease in shade cover, once supplied by riparian vegetation, has led to increases in water temperatures during times of prolonged sunlight. Shade modeling techniques have been developed in order to estimate the naturally occurring water temperatures within tributary reaches. The Long Tom River is one of the first rivers within the basin to have riparian cover reestablished after extensive studying through the USGS. **(6)**

Non-Point Source Pollution

Agricultural and forestry land use practices have historically been prone to over-development since the Mid 1800s. The Oregon Department of Agriculture (ODA) is responsible for regulating agricultural activities that affect water quality as stated in the Agricultural Water Quality Management Act (SB1010). Senate Bill 1010 specifies that farmers must develop overall water quality management plans to limit surface water degradation. These plans are reviewed on a biennial basis so that necessary changes can be made to uphold Total Maximum Daily Load (TMDL) regulations.

Pesticides Used in the Willamette Valley in 2007

Pesticide Name	Use	Pounds Applied	% of total
-Copper naphthenenate	Wood preservative	2,751,374	29%
-Glyphosate	Herbicide	983,472	10%
-Duiron	Herbicide	447,320	5%
-2,4-D	Herbicide	345,737	4%
-Pendimethain	Herbicide	314,712	3%
-All others	Various	4,803,870	50%

Source: Pesticide Use Reporting System 2007 Annual Report; Oregon Department of Agriculture

Examples of best management practices that protect water quality on agricultural lands include:
1. Conservation tillage;
2. Manure, pasture, and nutrient management;
3. Plant cover crops on sloping lands or erosion-sensitive areas;
4. Provide streamside buffer of site appropriate vegetation;
5. Irrigate pasture or crops according to soil moisture and plant water needs to prevent soil erosion and excess nutrient loss;
6. Construct farm road fords appropriately; install water bars or rolling dips to divert runoff to roadside ditches;
7. Apply pesticides according to label instructions.

Pesticide, nutrient loading, and sedimentation are the most common causes of direct surface water degradation from agricultural lands. Grass seed crops cover approximately 450,000 acres within the Willamette Valley. Farmers have historically used large quantities of agricultural chemicals and intensive soil disturbance practices to control diseases and weeds to achieve high seed yields. Confined Animal Feeding Operations (CAFO) have been significant contributors of bacteria and ammonia to the surface water as non-point source pollution. The ODA and DEQ have teamed together to issue NPDES permits for CAFOs in hopes of regulating the contaminated runoff. **(7)**

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About Us

Since 1994, the Corvallis Environmental Center's mission has been to provide learning opportunities to Corvallis-area residents and businesses, providing tools to pursue ecologically, socially, and economically sustainable practices. This map is one example of that dedicated work.

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The Institute for Water and Watersheds is Oregon's federally-designated water resources research institute. It coordinates water and watershed activities at OSU, connects students, staff, and faculty with stakeholders and statewide water issues, and pursues solutions to the water and related environmental problems of Oregon, the Pacific Northwest, and the world by assembling research teams from a broad spectrum of disciplines.

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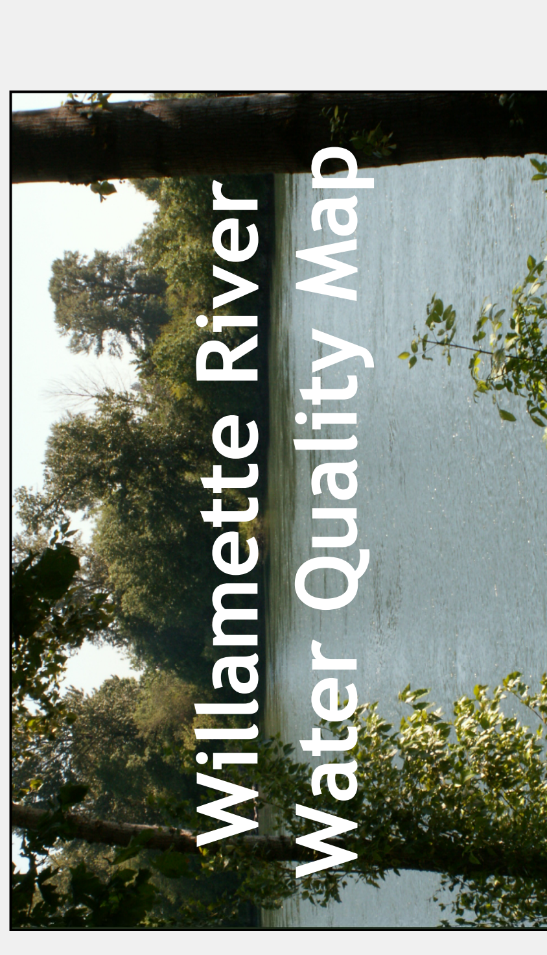
What you can do...

- **Support organic farming.** Eat fruits, vegetables, eggs, meat, and grains grown without pesticides.
- Use organic fertilizer on your lawn.
- Control garden pests with earth-friendly alternatives.
- Plant drought-tolerant and native plants to minimize water needs.
- Cut your grass 2.5"-3" high to reduce evaporation.
- Use low-flow showerheads, faucets, and appliances.
- **Fix water leaks!**
- Turn off the faucet when you wash your hands, clean dishes, or brush your teeth.
- Install a rainwater collection system for watering your lawn and irrigating your garden. Minimize the use of household chemicals, especially chlorine-containing cleaners.
- Beware of gasoline or oil leaks in your motorized equipment. Fix any problems immediately!
- **Recycle**—especially batteries that can leach heavy metals into the Willamette River.
- **Drive as little as possible**—walk, bike, or take public transportation instead.
- **Volunteer** at the Corvallis Environmental Center and other environmental groups.
- Support legislation and policies that protect and restore the Willamette watershed. Write letters to the editor of your local newspaper, supporting environmentally sound solutions to local river issues.
- Talk with your neighbors, friends, family, council-members, and senators about river issues.
- Use a shut-off nozzle on your hose. Running hoses can waste 5 gallons a minute!
- **Buy reusable** instead of disposable.
- **Donate** to local environmental non-profits, like the Corvallis Environmental Center!

...to be part of the solution!



Willamette River Water Quality Map

Created by the Corvallis Environmental Center with generous support from the Institute for Water and Watersheds at Oregon State University.