2005 WRK Volunteer Monitoring Report

Background: With equipment borrowed from the Oregon Department of Environmental Quality, Willamette Riverkeeper facilitates a Volunteer Water Quality Monitoring program on the mainstem of the Willamette River. Approximately 28 volunteers, trained by WRK staff, monitor 20 sites spanning approximately 100 river miles. Volunteers test for physical characteristics including dissolved oxygen, temperature, conductivity, turbidity, and *E.coli*. The data collected from January 2005 to November 2005 are presented below.

Disclaimer: It is important to remember the selection methods used for this data. For one, samples were taken once monthly. If weather is unusually extreme one day and completely different the next our results for a month can look very different depending on the day we sampled. If some people are sampling at the beginning of the month and others at the end, results can be very different. This occurs on a diurnal level as well. We try to limit this source of error by doing all our sampling between the 10^{th} and 20^{th} of each month and between 11 AM and 7 PM on the sampling day.

Secondly, sample sites used in this report are stretched along 100 river miles. Conditions for any month will be quite different at Roger's Landing (RM 50) and Kelly Point (RM 1). This makes pooling our data a somewhat suspicious maneuver. We will claim that our data represents a broad look at these 100 miles of river and not at a specific location along those 100 miles. Saying that makes me feel like a politician. Parameters were also broken down by site (Figures 7 through 24) to illustrate this difference.

Finally, note that sample size varies considerably from month to month (see column "number" in below tables). Ideally, sample size would be identical for each month.

Averages along a 100 mile stretch

Figures 1 through 6 represent averages for each parameter by month. Month is represented numerically. The green diamonds in each graph are centered on the mean and their shape implies the error. If they are tall and skinny, there is more error. If they are short and wide, there is less error. Standard error describes the accuracy of the average based on the sample size. Each black dot in each column represents a single sample. The blue line connects the averages for each month. The gray line across the middle of the graph demonstrates the overall mean.

Tables 1 through 6 detail the averages for each month. The column labeled 'number' lists the sample size for each month. For example, Table 1 explains that there were 13 temperature readings taken by volunteers for the month of February. The column labeled 'mean' lists the average for each parameter for each month. For example, Table 1 explains that the average temperature for February is 7.15 ºC (rounded up). If the sample size is small, the average is less representative of actual conditions. The column labeled 'std error' gives an error value based on sample size and the spread of the data. As standard error increases, accuracy decreases. Don't worry about those last two columns. Statistically, all parameters vary significantly with month aside from E.coli.

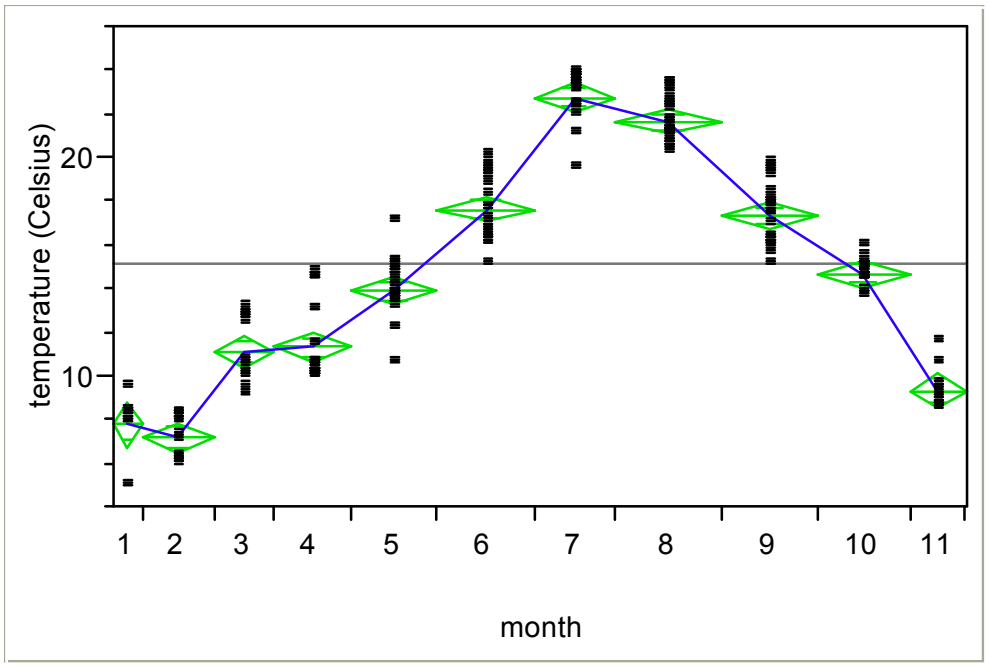

Figure 1: Oneway Analysis of temp By month
As we would expect, temperatures are lowest at mid-winter and highest in july. The July average temperature of 22.8°C violates the DEQ standard and is hazardous to fish and other aquatic organism health. The small plateau around march and april can be accounted for by the cold, wet spring we experienced.

Table 1: Means for temperature

Month	Number	Mean	Std Error	Lower 95%	Upper 95%
1	6	7.8000	0.52243	6.768	8.832
2	14	7.2214	0.34201	6.546	7.897
3	12	11.1250	0.36942	10.395	11.855
4	15	11.3467	0.33042	10.694	11.999
5	17	13.9047	0.31037	13.292	14.518
6	19	17.6684	0.29358	17.089	18.248
7	16	22.8125	0.31992	22.181	23.444
8	21	21.6714	0.27925	21.120	22.223
9	19	17.3947	0.29358	16.815	17.975
10	18	14.7333	0.30163	14.138	15.329
11	11	9.3545	0.38584	8.592	10.117

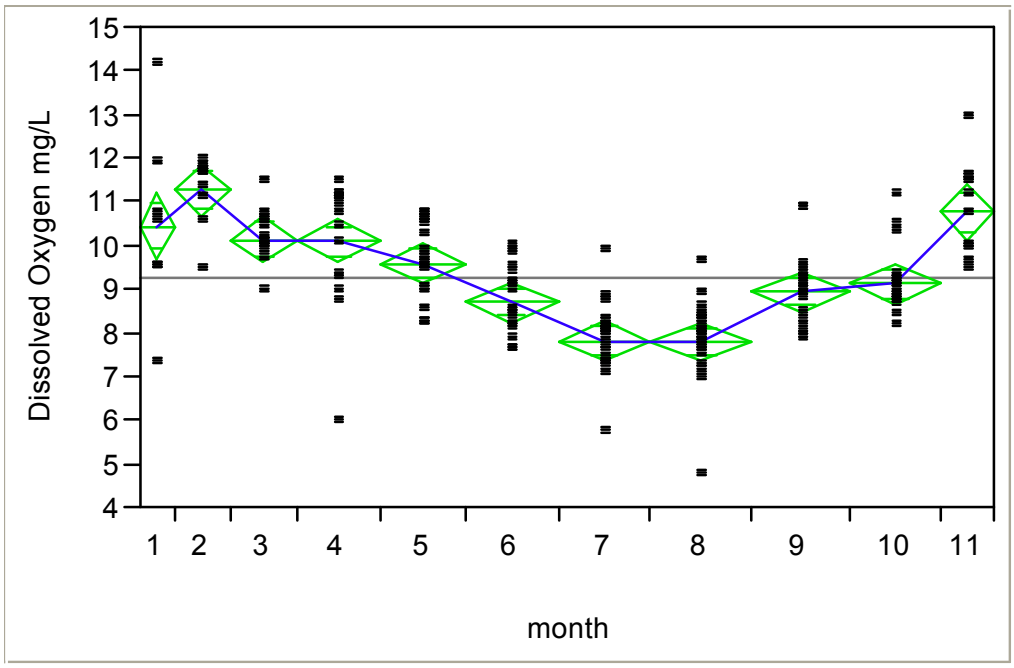

Figure 2: Oneway Analysis of D.O. By month
As expected, Dissolved Oxygen is almost directly inverse to temperature. Colder water has a greater capability to hold dissolved oxygen. Although the low point displayed for the month of April may be due to volunteer error, the two points at 6 and below for july and august probably represent true conditions. At D.O. levels under 6 mg/L fish and other aquatic organisms can become greatly stressed and undergo mass fatality.

Table 2:Means for Dissolved Oxygen

month	Number	Mean	Std Error	Lower 95%	Upper 95%
1	7	10.4771	0.37351	9.739	11.215
2	11	11.2900	0.29796	10.701	11.879
3	13	10.1654	0.27408	9.624	10.707
4	16	10.1219	0.24705	9.634	10.610
5	17	9.6124	0.23968	9.139	10.086
6	18	8.7278	0.23292	8.268	9.188
7	18	7.8428	0.23292	7.383	8.303
8	20	7.8005	0.22097	7.364	8.237
9	19	8.9642	0.22671	8.516	9.412
10	18	9.1517	0.23292	8.692	9.612
11	10	10.7880	0.31250	10.171	11.405

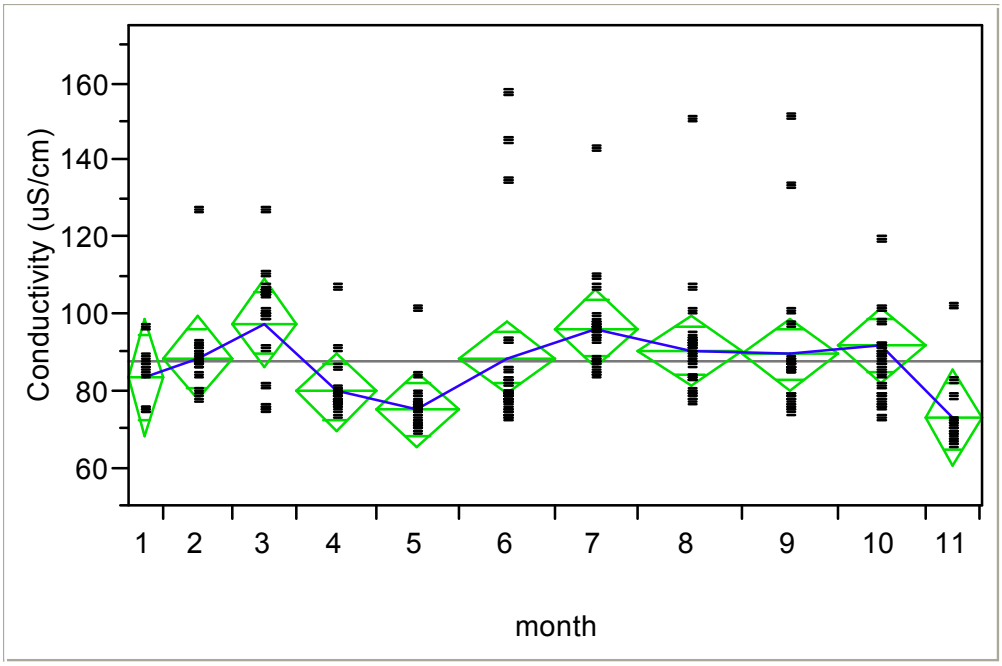

Figure 3: Oneway Analysis of Conductivity By month
Conductivity is an electrical measurement of the amount of ions in the water. Ions come from salts and chemicals that dissolve in water. All fertilizers and other chemicals on land are pulled into the river with run-off from rain water. However, they are also diluted by large volumes of water. The shape of the graph from February through may is unusual and a result of our strange winter/spring weather. After dry January, February, and March there was little water to dilute chemicals in the Willamette. Heavy rains from mid-March through May increased dilution and brought conductivity down. As the weather dried up for the summer, levels rose again. Fall rains will bring conductivity levels down.

Table 3: Means for Conductivity

month	Number	Mean	Std Error	Lower 95%	Upper 95%
1	7	83.5714	7.8317	68.105	99.04
2	14	88.7643	5.5378	77.828	99.70
3	13	97.7231	5.7469	86.374	109.07
4	16	79.8687	5.1802	69.639	90.10
5	17	75.3824	5.0255	65.458	85.31
6	19	88.6526	4.7537	79.265	98.04
7	17	96.4588	5.0255	86.534	106.38
8	21	90.6762	4.5216	81.747	99.61
9	19	89.6737	4.7537	80.286	99.06
10	18	92.0000	4.8839	82.355	101.64
11	11	73.3909	6.2475	61.053	85.73

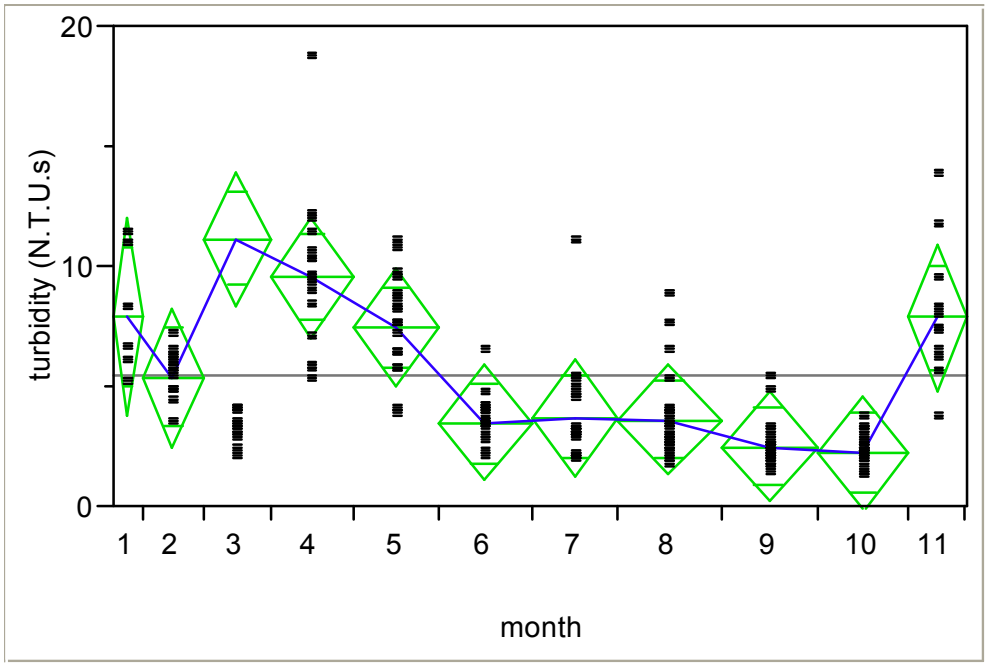

Figure 4: Oneway Analysis of turbidity By month

Turbidity is directly effected by water volume and precipitation. This is why we see peaks at march and November. Some of the data for march is off the chart, accounting for the elevated mean. This data was taken towards the end of the month. Heavy rains after an unusual dry spell resulted in readings of 52 N.T.U. ! The large difference between this reading and the others for march illustrates the need for sampling dates as close together as possible.

Table 4: Means for Turbidity

month	Number	Mean	Std Error	Lower 95%	Upper 95%
1	6	7.9717	2.0698	3.8833	12.060
2	12	5.4258	1.4636	2.5349	8.317
3	13	11.2200	1.4061	8.4425	13.998
4	16	9.5825	1.2675	7.0789	12.086
5	17	7.4982	1.2296	5.0694	9.927
6	18	3.5372	1.1950	1.1768	5.898
7	17	3.7318	1.2296	1.3029	6.161
8	20	3.6600	1.1337	1.4207	5.899
9	19	2.5232	1.1631	0.2257	4.821
10	18	2.2972	1.1950	-0.0632	4.658
11	11	7.8973	1.5286	4.8778	10.917

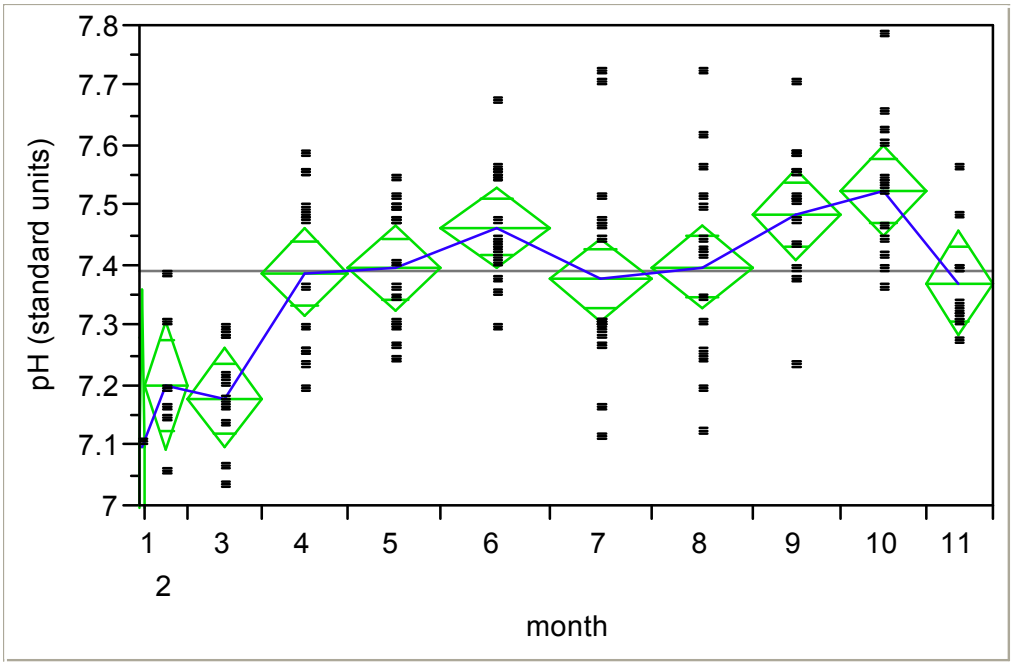

Figure 5: Oneway Analysis of pH By month

This graph doesn't seem to present an obvious pattern. Perhaps this is due to sampling error?

Table 5: Means for pH

month	Number	Mean	Std Error	Lower 95%	Upper 95%
2	6	7.20333	0.05365	7.0970	7.3097
3	10	7.18100	0.04155	7.0986	7.2634
4	12	7.39083	0.03793	7.3156	7.4660
5	13	7.39692	0.03644	7.3247	7.4692
6	15	7.46600	0.03393	7.3987	7.5333
7	14	7.37857	0.03512	7.3090	7.4482
8	14	7.40000	0.03512	7.3304	7.4696
9	12	7.48833	0.03793	7.4131	7.5635
10	12	7.52500	0.03793	7.4498	7.6002
11	9	7.37222	0.04380	7.2854	7.4591

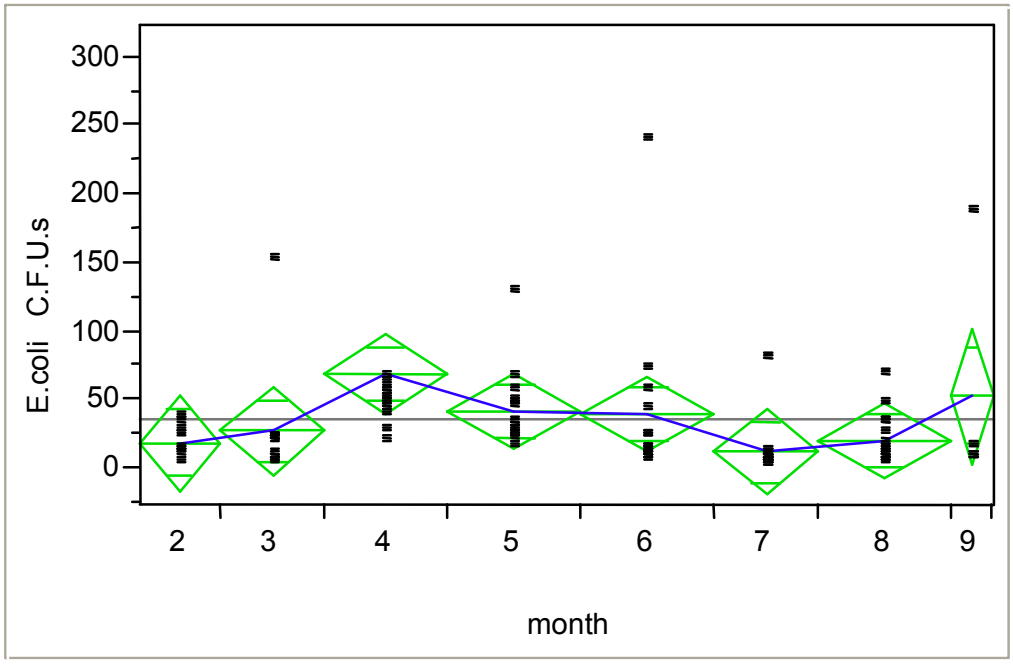

Figure 6: Oneway Analysis of E.coli By month
E.coli levels correspond to heavy rainfall that causes overflow of Portland's CSO pipes. Several outliers may indicate sewage spills or one day storms that caused overflow on a single sampling day. Additional high outliers exist but are not visible on this graph (above 300 C.F.U.s).

Table 6: Means for E.coli

month	Number	Mean	Std Error	Lower 95%	Upper 95%
2	8	18.9000	17.495	-15.952	53.75
3	10	27.2400	15.648	-3.933	58.41
4	12	68.9000	14.285	40.443	97.36
5	13	42.2846	13.724	14.944	69.63
6	13	39.5615	13.724	12.221	66.90
7	10	12.2400	15.648	-18.933	43.41
8	13	20.6231	13.724	-6.717	47.96
9	4	52.9750	24.742	3.686	102.26

Individual site results

Figures 7-24 detail WQ results at each site. The chart on the left displays temperature (red), dissolved oxygen (green), and turbidity (blue). The chart on the right displays conductivity (otherwise known as specific conductance or EC25). Please note that the x and y-axis are not the same from site to site due to sometimes drastically different results at some sites and dates of sampling. If you plan on testing water quality next year, keep the chart for your site for the purpose of comparison. If you recently began testing at your site, there is too few data to generate a chart for your site (sorry Salem folks!).

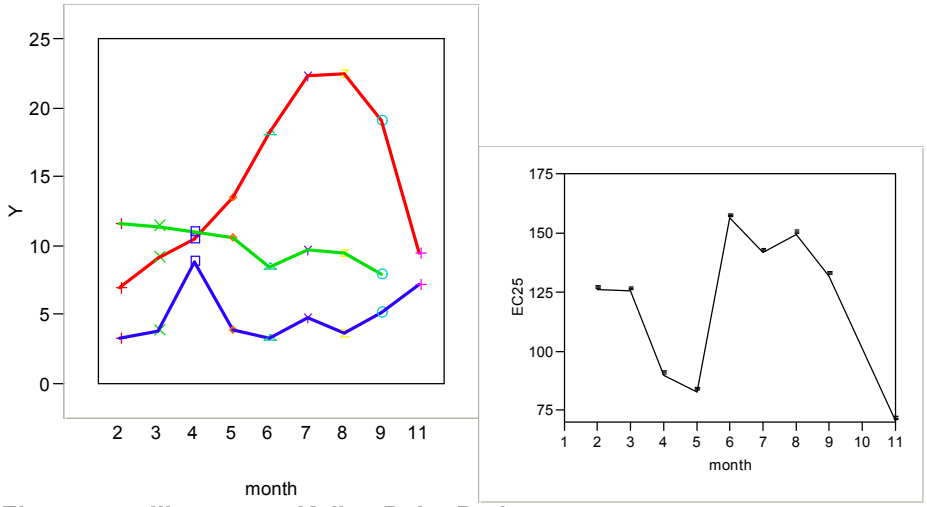

Figure 7: willamette at Kelley Point Park

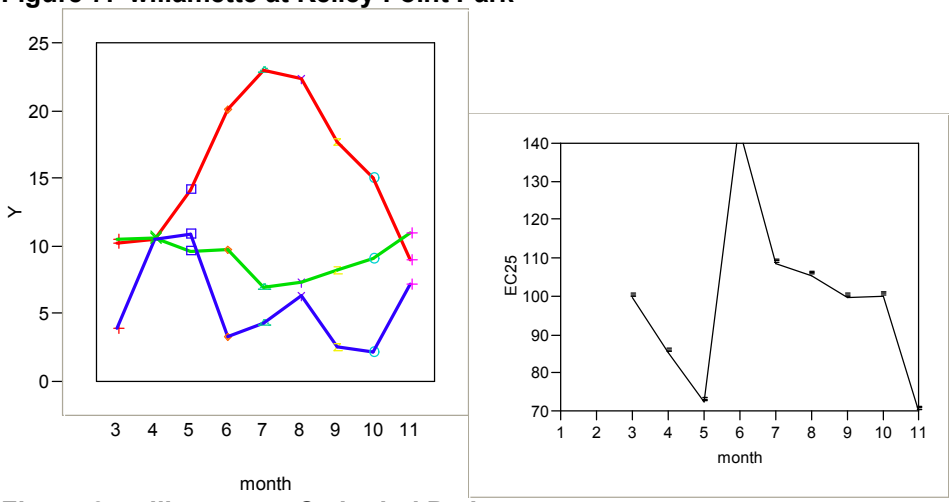

Figure 8: willamette at Cathedral Park

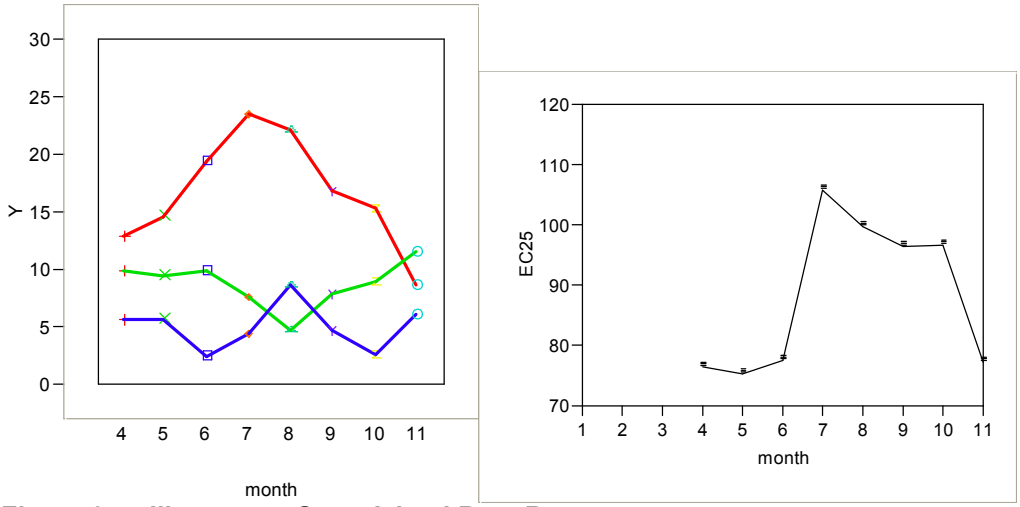

Figure 9: willamette at Swan Island Boat Ramp

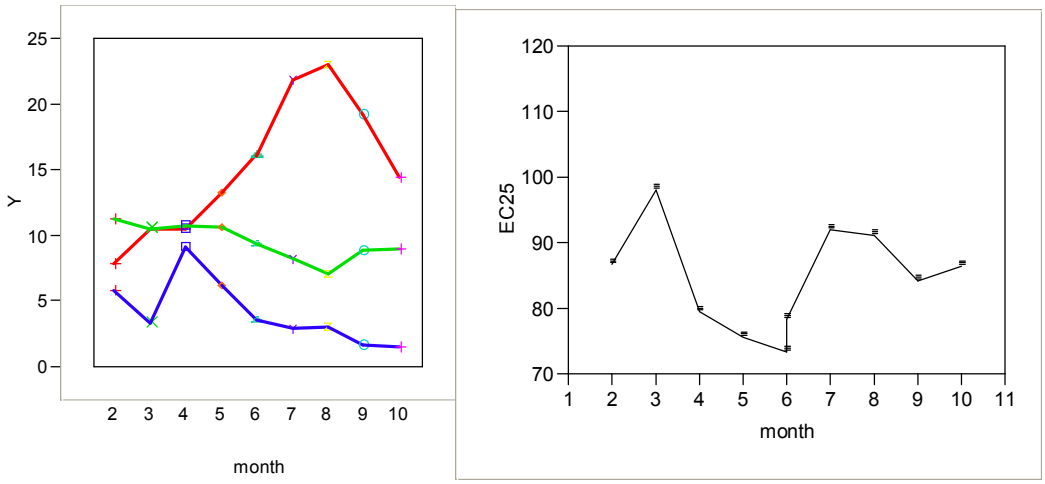

Figure 10: willamette @ N end of floating esplanade dock (CSO 40)

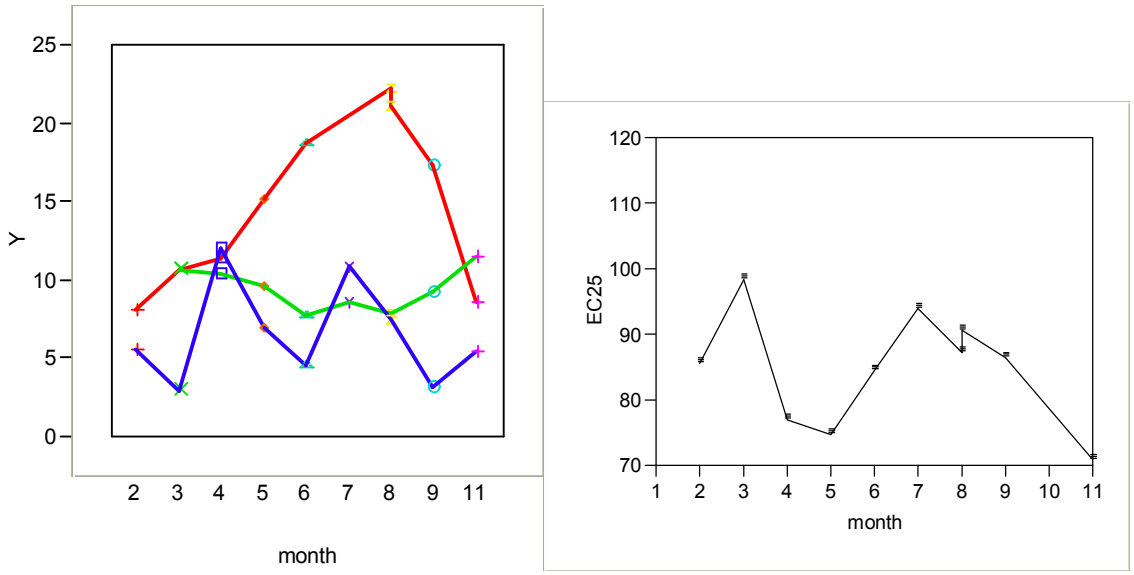

Figure 11: willamette 1-2 mi. U-S of Ross Island Lagoon entrance (Holgate channel-Holgate CSO)

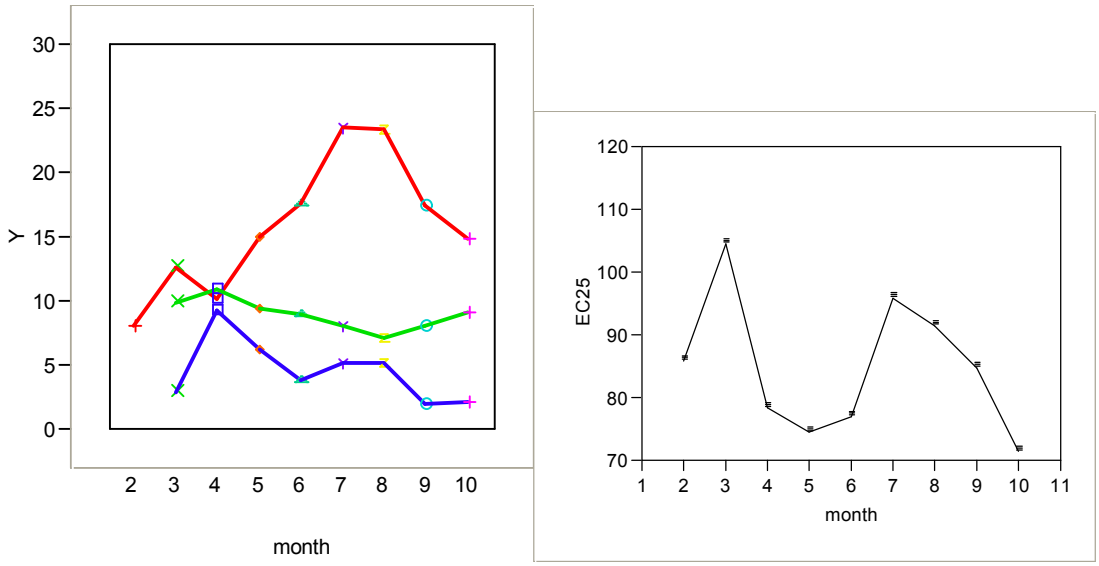

Figure 12: willamette .25 mi D-S of Sellwood Bridge

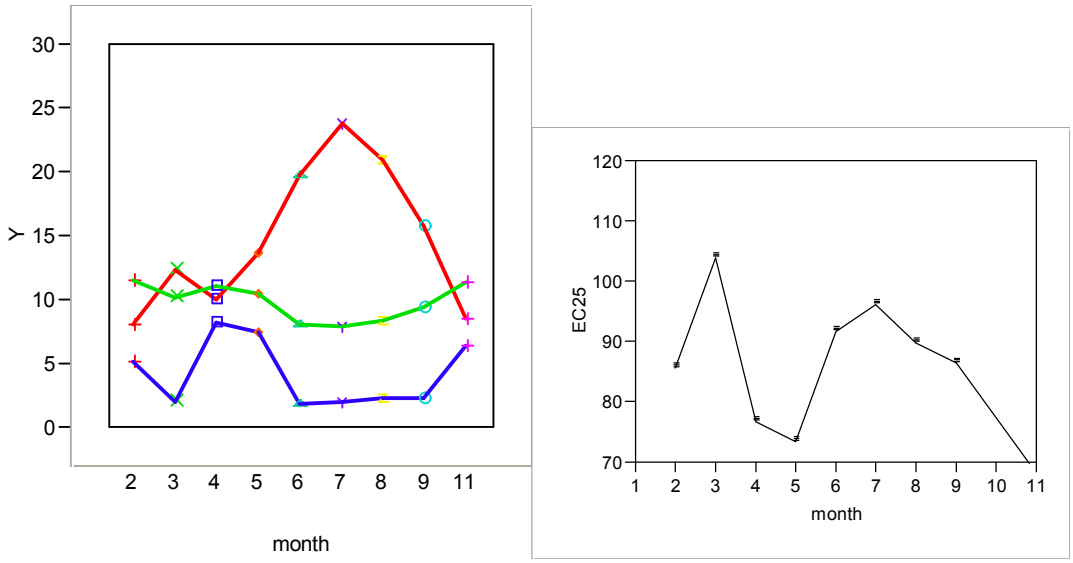

Figure 13: willamette @ Jefferson Street Boat Ramp

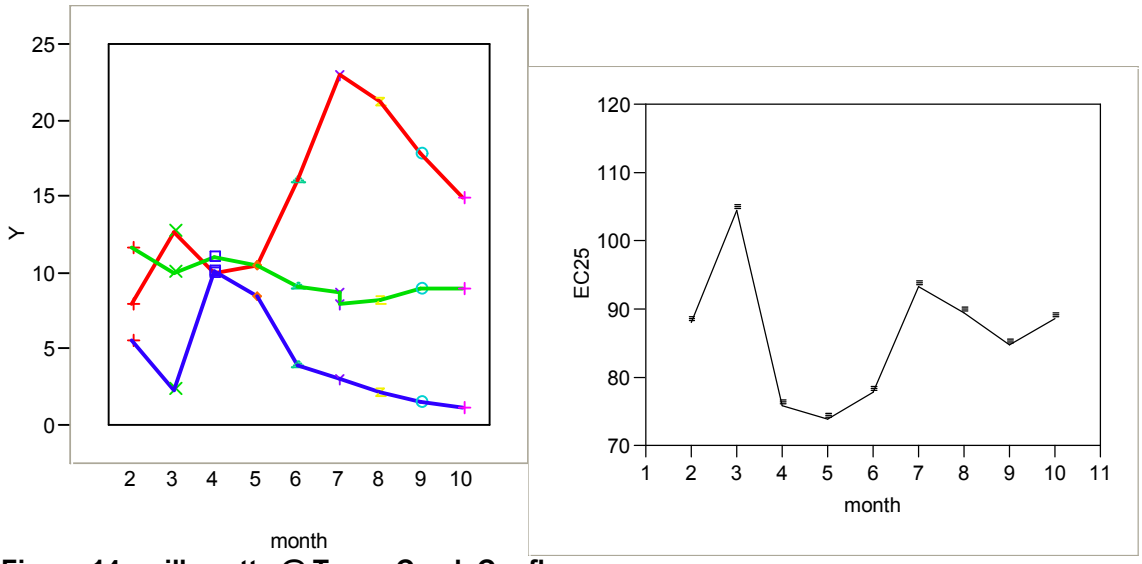

Figure 14: willamette @ Tryon Creek Confluence

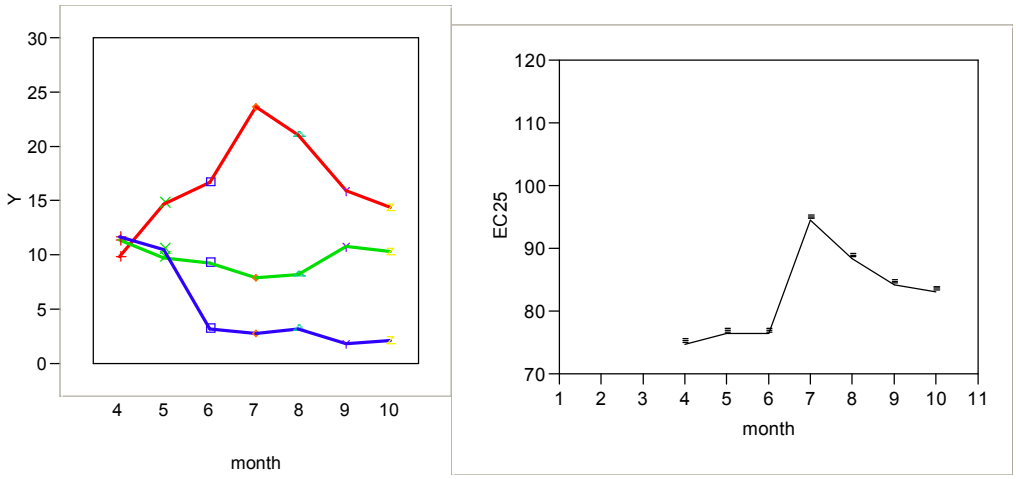

Figure 15: willamette @ Lake Oswego Creek

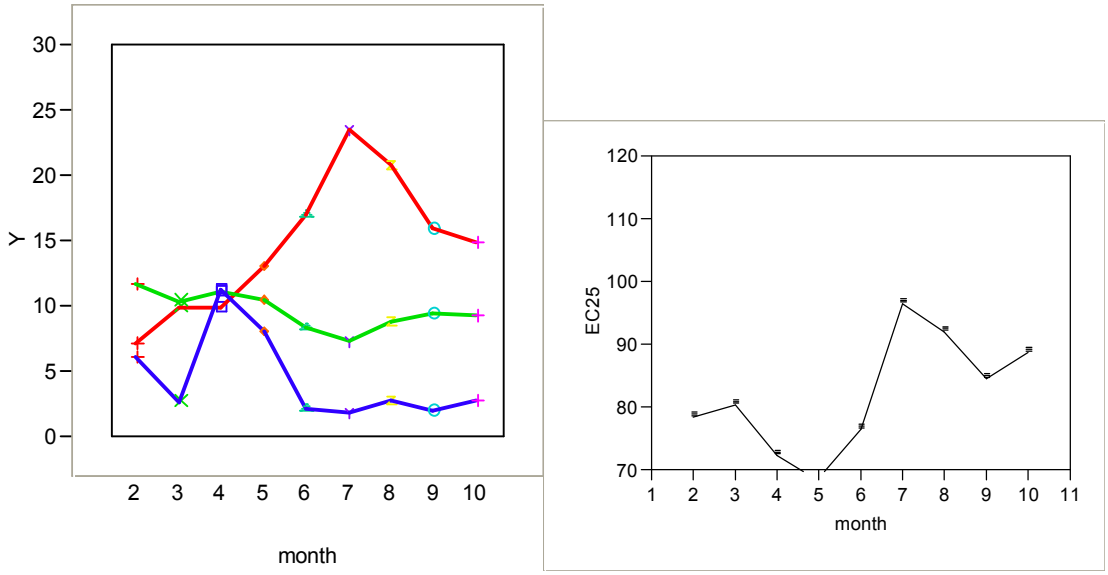

Figure 16: willamette @ clackamas river confluence

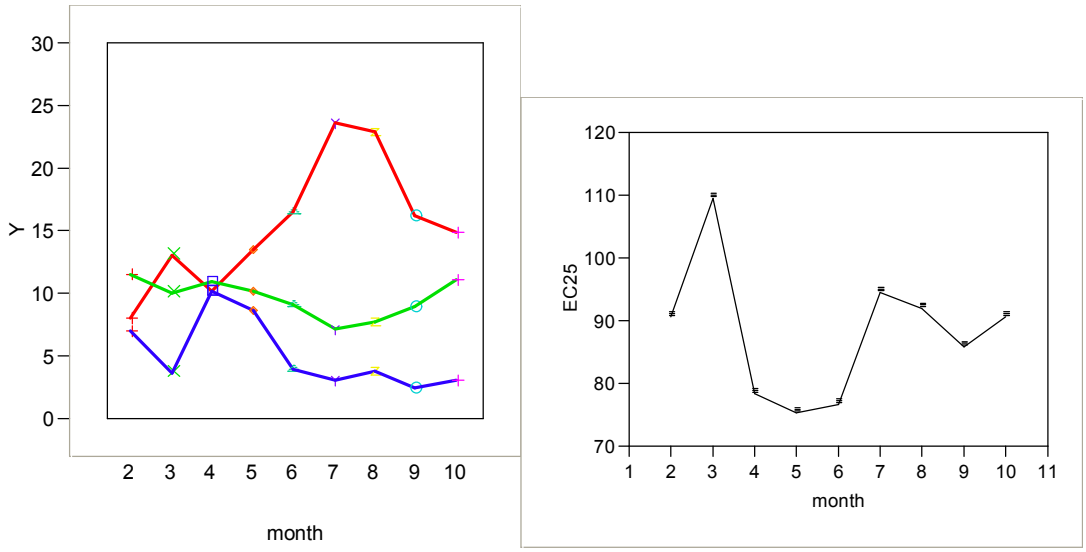

Figure 17: willamette @ willamette falls

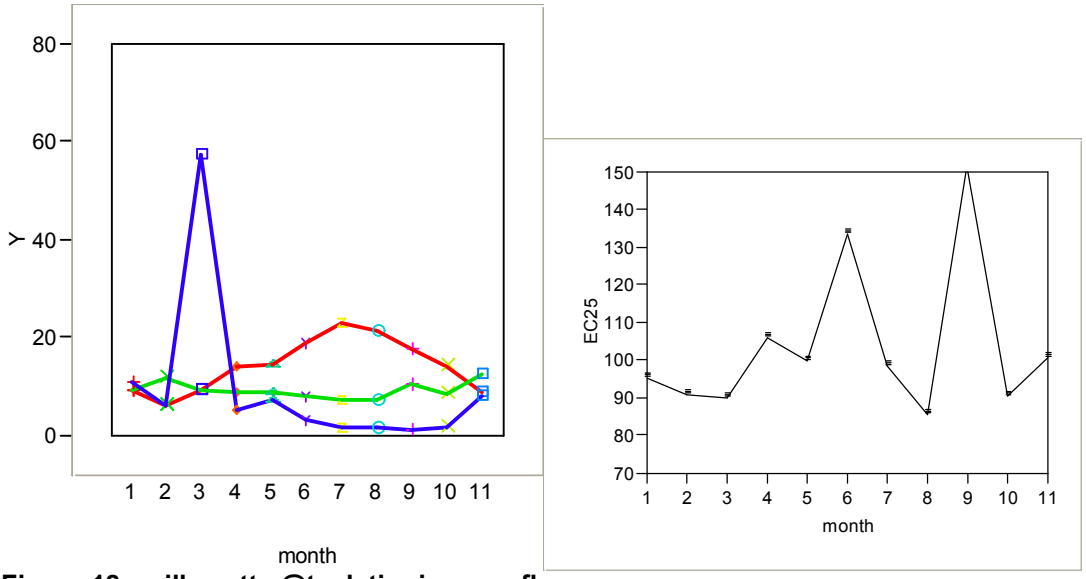

Figure 18: willamette @tualatin river confluence

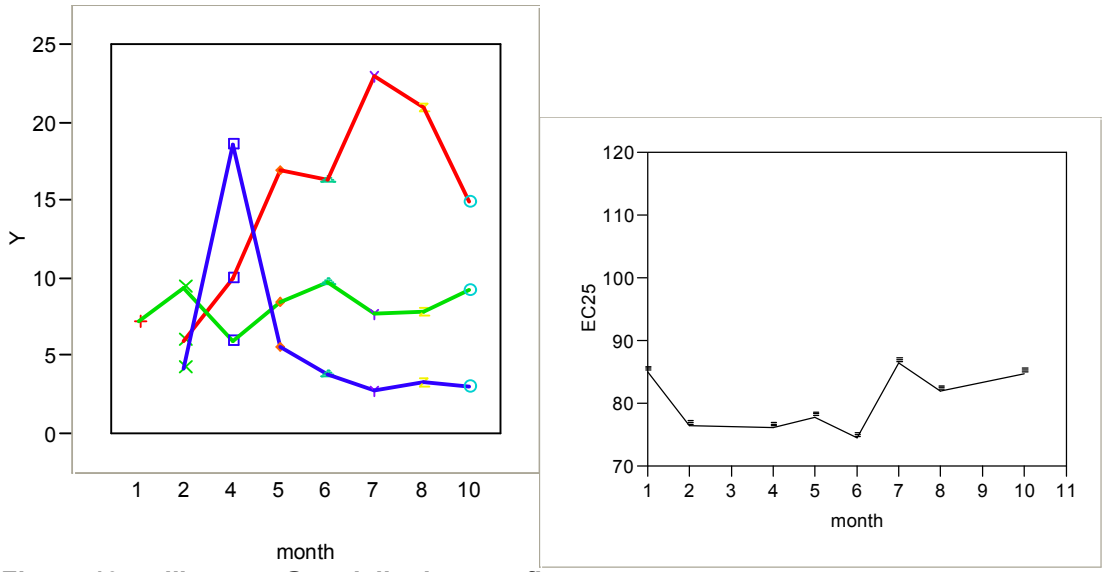

Figure 19: willamette @ molalla river confluence

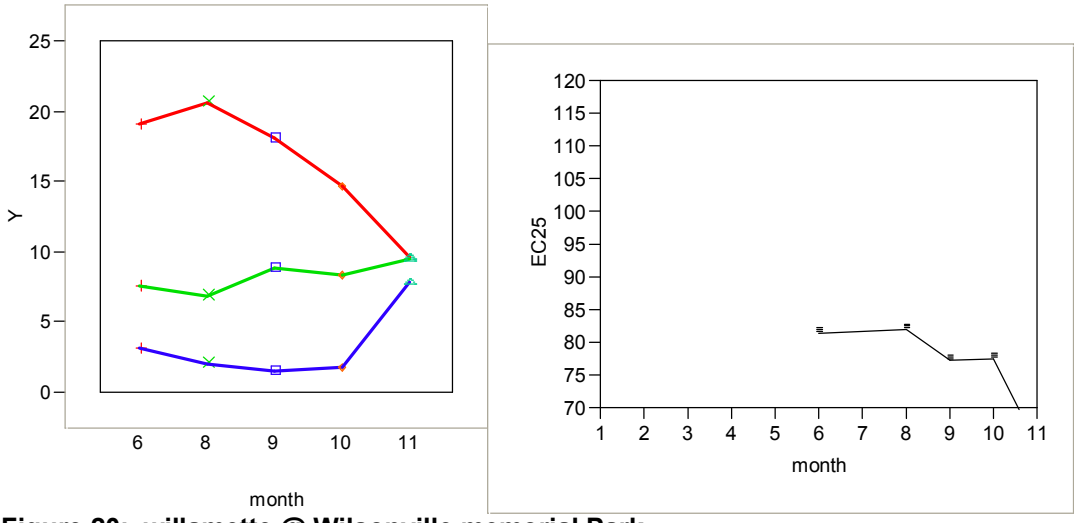

Figure 20: willamette @ Wilsonville memorial Park

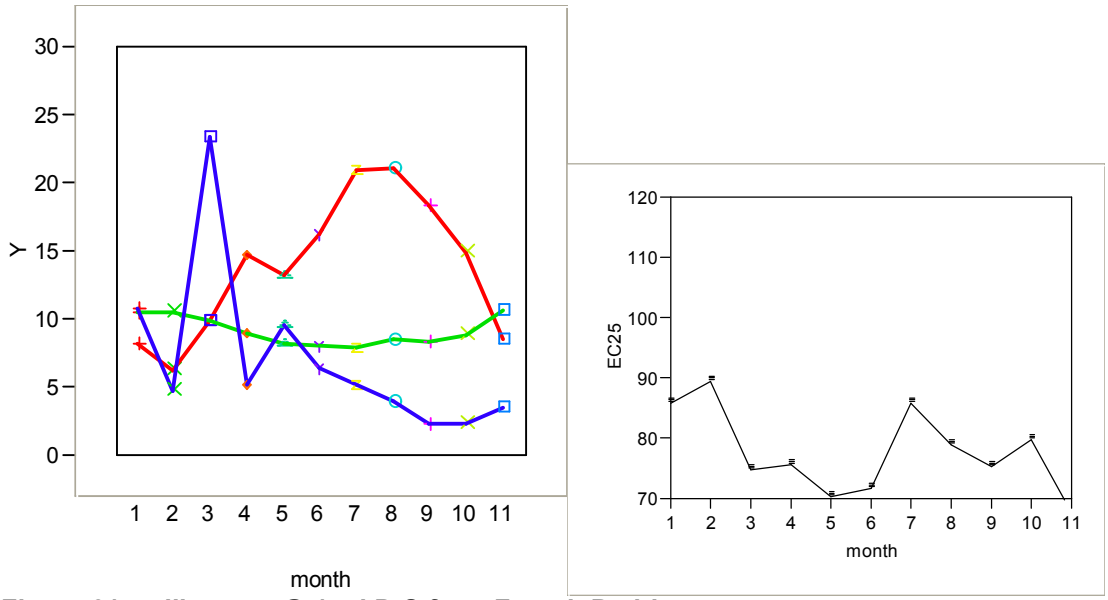

Figure 21: willamette @ 1 mi D-S from French Prairie

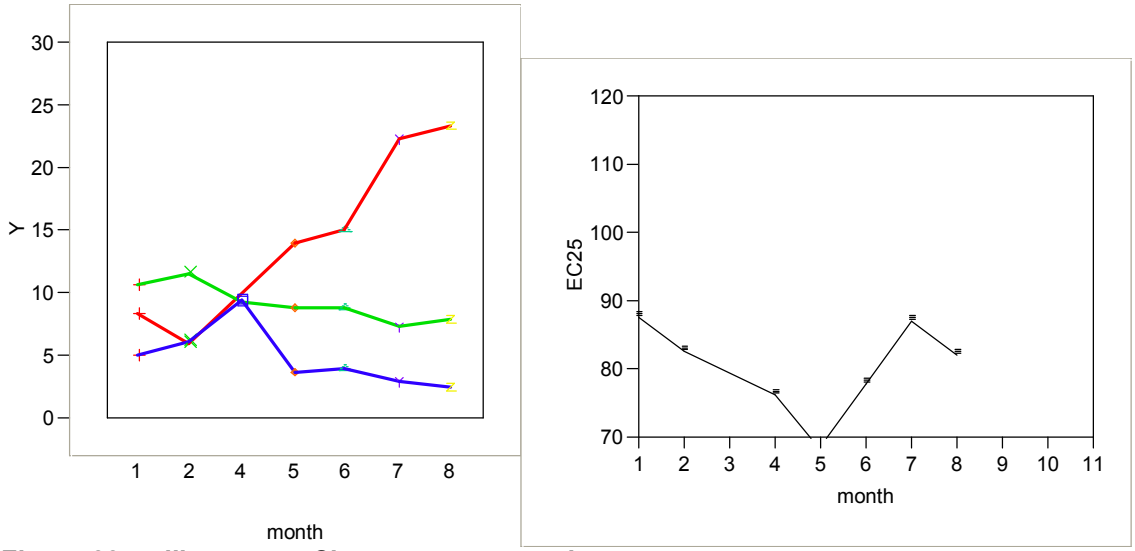

Figure 22: willamette at Champoeg state park

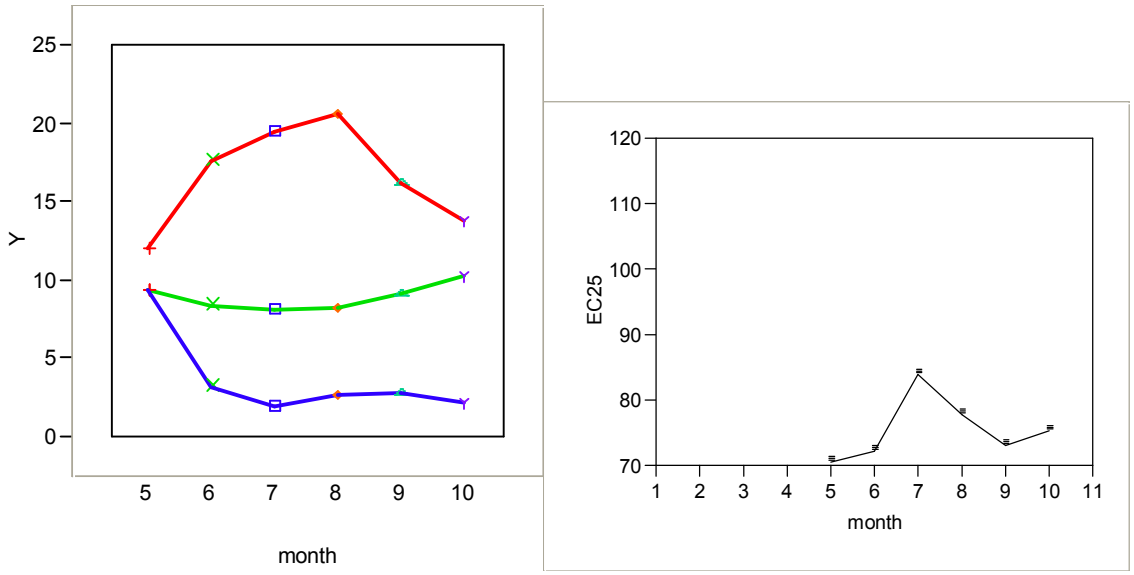

Figure 23: willamette @ Smurfit Newsprint

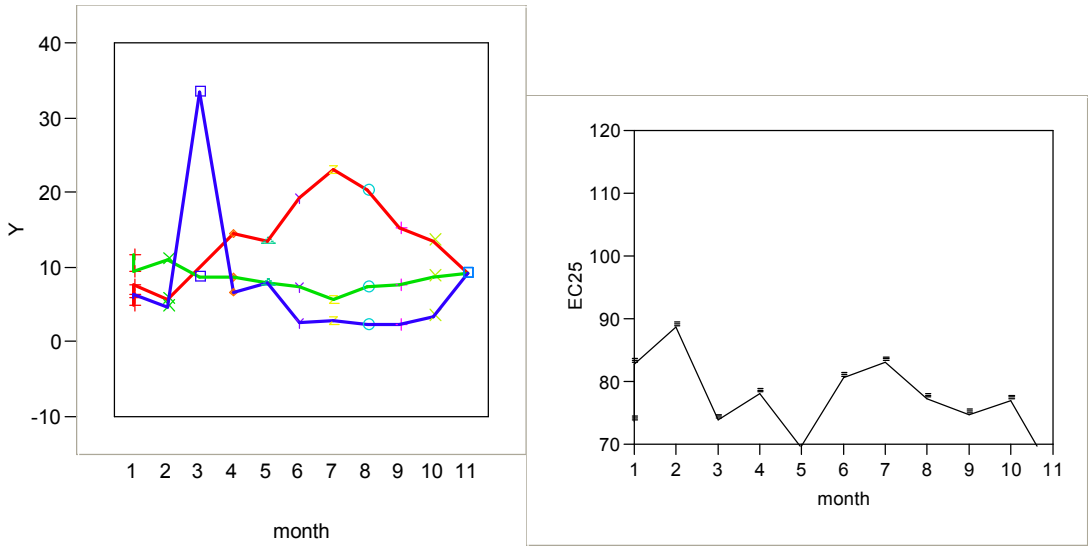

Figure 24: willamette @ Roger's Landing