WASHINGTON STATE DEPARTMENT OF ECOLOGY

A Summary of Water Quality Data Collected in the Wilson/Cherry Sub-basin, April – October 1999

Abstract

Water quality data were collected from April through October 1999 in the Wilson and Cherry Creek sub-basin as part of the upper Yakima River suspended sediment and organochlorine pesticide total maximum daily load (TMDL) assessment. Sites were located on tributary branches within the sub-basin in various land use types.

Water samples were analyzed for total suspended solids (TSS), turbidity, and fecal coliform bacteria. Some samples also were analyzed for Escherichia coli bacteria, Klebsiella bacteria, or a suite of 107 pesticides. Turbidity and basic loading, as well as TSS and fecal coliform bacteria, for each site were calculated for each site.

Canal water and headwater streams entering the sub-basin generally met Class A water quality criteria. Water quality became highly degraded in most of the streams and return drains before they crossed south of the Vantage Highway. Some tailend water from canal systems also had poor water quality. Turbidity values, suspended sediment concentrations and loads, and fecal coliform bacteria significantly increased in range and agricultural areas of the sub-basin, especially in the Cherry Creek watershed. Urban areas appeared to have less impact on these contaminants during the April to October monitoring period.

Correlations investigated were not reliable to predict fecal coliform loads or counts from TSS or turbidity values. The 1999 concentrations of 2,4-D, dicamba, and MCPA appeared to have increased since 1995. Diazinon was not detected as it was in 1995, and atrazine and bromacil concentrations appeared to be of similar or lower concentrations than in 1995.

The resulting summary and comparison of TSS, turbidity, fecal coliform, and pesticides should help water quality managers focus their continuing water quality improvements in the Wilson and Cherry Creek sub-basin.

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Introduction

This report summarizes and briefly evaluates data collected in 1999 from the Wilson and Cherry Creek watershed as part of the upper Yakima suspended sediment and organochlorine pesticide total maximum daily load (TMDL) assessment. The original purpose of the data collection was stated in the Washington State Department of Ecology (Ecology) TMDL quality assurance project plan (Dickes and Joy, 1999). The selected objectives of that plan addressed in this report are the following:

1. Evaluate suspended sediment in the Kittitas Valley for the major drainages and land uses.
   - Evaluate the major sources of suspended sediment loading from the Kittitas Valley entering the Yakima River via Wilson Creek.
   - Coordinate with ongoing data collection in the basin by the Kittitas Conservation District and the Kittitas Reclamation District.
   - Estimate suspended sediment transport from various land use types during the irrigation season.

2. Evaluate fecal coliform bacteria in the Kittitas Valley.
   - Evaluate fecal coliform 303(d) listings for Wilson Creek and Cooke Creek based on dominant land use.
   - Provide baseline fecal coliform data for other drainages in the Valley.

3. Evaluate water column concentrations for pesticides in the Cherry Creek basin.
   - Screen for presence of previously identified pesticides.

This report does not make specific recommendations for TMDL targets for individual creeks and drains in the Wilson/Cherry sub-basin. This evaluation only indicates which branches within the sub-basin have TSS concentrations and loads, turbidities, and fecal coliform counts and loads that should be the focus of implementation work to meet the Wilson Creek TMDL targets (Joy, 2002), and bacteria water quality criteria. A comparison of 1999 to 1995 pesticide results, other than DDT metabolites and dieldrin, is also presented.

The data presented in this report should be helpful for several ongoing activities related to water quality managers in the Kittitas Valley. Streams, canals, and drains with water quality problems are identified. Basic loading and statistical calculations are presented that may be of use for the bacteria TMDL currently under development by Ecology's Central Regional Office Water Quality Program (Bohn, 2002). Monitoring activities by federal, state, and local agencies may benefit from the data presented, and the data provide another comparison point for recommended pesticide, turbidity, and TSS TMDL monitoring in 2006 (Joy, 2002).

Data Sources

Data for this evaluation were gathered from several cooperating sources. The coordinated monitoring effort in the sub-basin was outlined in the original quality assurance (QA) project plan for the upper Yakima River basin TMDL (Dickes and Joy, 1999). Since then, the data collected in 1999 has been posted on agency web-sites or presented in reports. The following is a list of most of the source data:

- Kittitas County Conservation District (KCCD) report: Kittitas Water Quality and Water Conservation Project (Lael, 2000)
- Kittitas Reclamation District (KRD)/ Kittitas County Water Purveyors (KCWP): http://www.elltel.net/krd/KCWP.htm
- Washington State Department of Ecology Upper Yakima TMDL project (Ecology):
  - Select Project: Upper Yakima TMDL: http://www.ecy.wa.gov/eimreporting/Export.htm
  - Data Summary report (Joy and Madrone, 2002): http://www.ecy.wa.gov/biblio/0203032.html
- USBR Yakima Hydromet data: http://mac1.pn.usbr.gov/yakima/yakwebarcread.html

Monitoring sites were selected to create a broad coverage of waterways in the sub-basin as they entered the rangeland and agricultural areas (Figure 1). Each of the three cooperating agencies had a particular emphasis in its monitoring network.

1. The KCCD focused on agricultural lands and practices in the Cherry Creek system that are significant sources of elevated sediments and nutrients (Lael, 2000).
2. The KRD sites covered irrigation delivery systems under the district's responsibility.
3. Ecology's network covered several types of land uses and waterways consistent with the purposes outlined previously in the Introduction.

All three water quality monitoring programs (KCCD, KRD/KCWP, and Ecology) were operating under QA project plans that were reviewed and approved by the Washington State Department of Ecology in 1999. Lael (2000) and Joy (2002) addressed quality assurance for their respective monitoring data. Turbidity and TSS results from samples collected by all three agencies at the same time at two sites in the sub-basin are compared in Table 1. Fecal coliform samples collected by paired combinations of the agencies at the same two sites are also compared in Table 1. The coefficient of variation (standard deviation divided by the mean) was calculated for each set of replicate samples. The root mean square errors of the coefficient of variations were all within an acceptable range for combining data for a general evaluation.

Wilson/Cherry Sub-basin Monitoring Sites 1999

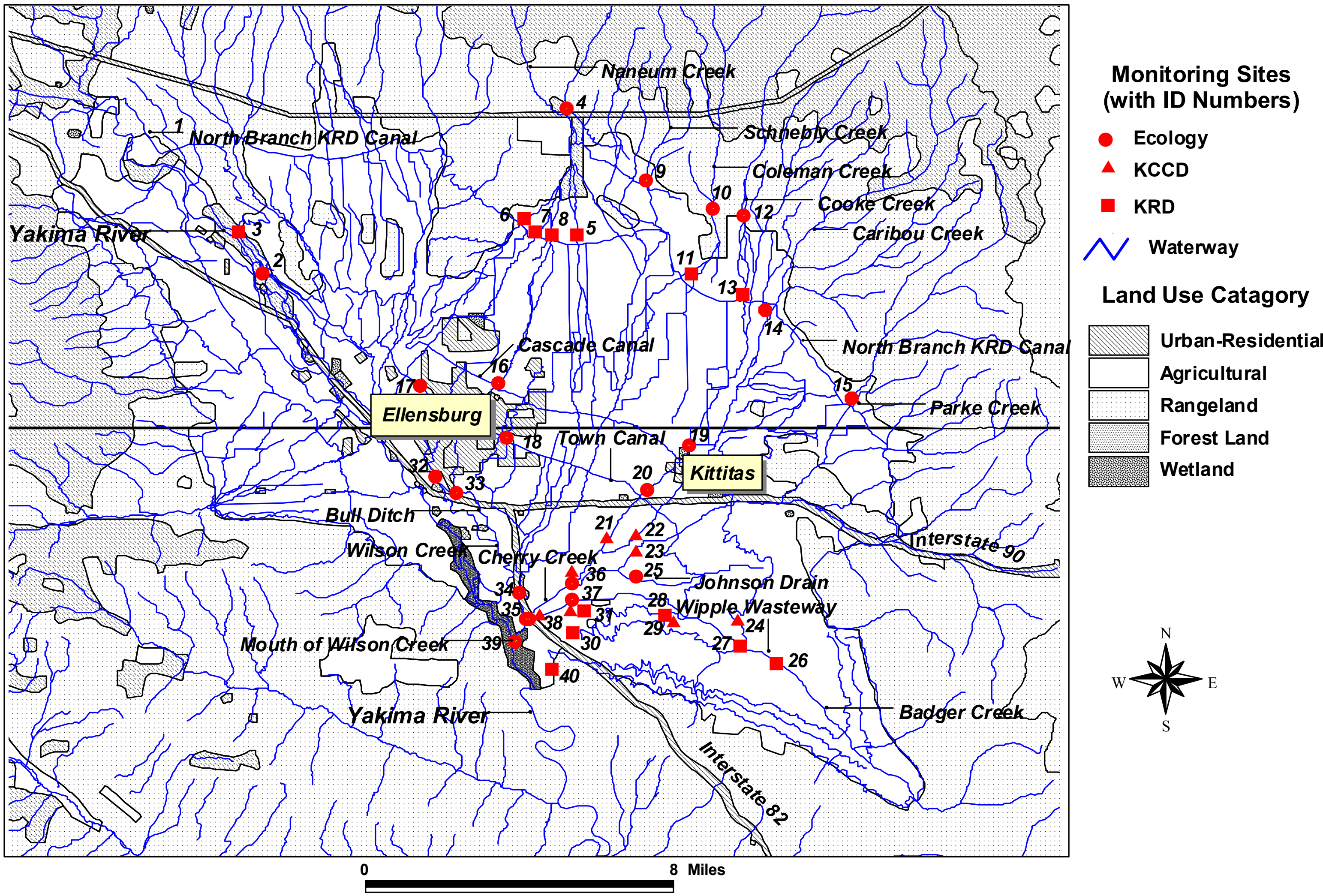

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Table 1. Side-by-side sampling at two sites in the Wilson/Cherry sub-basin in 1999 by three monitoring agencies: Kittitas County Conservation District (KCCD), Washington State Department of Ecology (Ecology), and Kittitas Reclamation District (KRD). Coefficient of variation between sample results are calculated.

		Turbidity (NTU)					**log (NTU) Turbidity**				
		KCCD	Ecology	KRD	cv 2way	cv 3way	KCCD	Ecology	KRD	cv 2way	cv 3way
Cherry Creek at Moe Road	4/19/99	53	60		0.008		1.7235	1.7782		0.0005	
Wipple Wasteway at Moe Road	4/19/99	23	28		0.016		1.3692	1.4472		0.002	
Cherry Creek at Moe Road	5/4/99	30	45		0.084		1.4728	1.6532		0.007	
Wipple Wasteway at Moe Road	5/4/99	16	15		0.002		1.2014	1.1761		0.0002	
Cherry Creek at Moe Road	5/19/99	17	29		0.125		1.2405	1.4624		0.013	
Wipple Wasteway at Moe Road	5/19/99	11	15	15.1	0.050	0.031	1.0374	1.1761	1.1790	0.008	0.005
Cherry Creek at Moe Road	6/14/99	9.0	20		0.286		0.9552	1.3010		0.047	
Wipple Wasteway at Moe Road	6/14/99	12	17		0.065		1.0719	1.2304		0.009	
Cherry Creek at Moe Road	7/14/99	23	9.3		0.357		1.3598	0.9685		0.057	
Wipple Wasteway at Moe Road	7/14/99	10	8		0.027		1.0043	0.9031		0.006	
Cherry Creek at Moe Road	8/9/99	9.4	19		0.227		0.9741	1.2788		0.037	
Wipple Wasteway at Moe Road	8/9/99		25	23.9				1.3979	1.3784		
Cherry Creek at Moe Road	8/24/99	9.6	12		0.025		0.9814	1.0792		0.005	
Wipple Wasteway at Moe Road	8/24/99	5.2	9.9		0.198		0.7126	0.9956		0.055	
Cherry Creek at Moe Road	9/8/99	6.5	13		0.222		0.8129	1.1139		0.049	
Wipple Wasteway at Moe Road	9/8/99	3.0	9.2	7.4	0.514	0.237	0.4786	0.9638	0.8716	0.226	0.112
Cherry Creek at Moe Road	10/4/99	8.8	10		0.008		0.9435	1.0000		0.002	
Wipple Wasteway at Moe Road	10/4/99	8.3	9.1	7.9	0.005	0.005	0.9175	0.9590	0.8993	0.001	0.001
Cherry Creek at Moe Road	11/3/99	10	12		0.013		1.0083	1.0792		0.002	
Wipple Wasteway at Moe Road	11/3/99	2.5	2.7	2.5	0.066	0.002	0.4025	0.4314	0.3997	0.069	0.002
					34.8%	**26.2%**				**17.7%**	**17.3%**
				42.1%	percent w/cv less than 20%					**68.4%**	percent w/cv less than 20%

		TSS (mg/L)					**log (mg/L) TSS**				
		KCCD	Ecology	KRD	cv 2way	cv 3way	KCCD	Ecology	KRD	cv 2way	cv 3way
Cherry Creek at Moe Road	4/19/99	179	153		0.012		2.2529	2.1847		0.0005	
Wipple Wasteway at Moe Road	4/19/99	69	72	70	0.001	0.0005	1.8388	1.8573	1.8451	0.0001	0.00003
Cherry Creek at Moe Road	5/4/99	123	146		0.015		2.0899	2.1644		0.0006	
Wipple Wasteway at Moe Road	5/4/99	50	46		0.003		1.6990	1.6628		0.0002	
Cherry Creek at Moe Road	5/19/99	78	92		0.014		1.8921	1.9638		0.0007	
Wipple Wasteway at Moe Road	5/19/99	37	38	30	0.000	0.016	1.5682	1.5798	1.4771	0.00003	0.0013
Cherry Creek at Moe Road	6/14/99	49	45		0.004		1.6902	1.6532		0.0002	
Wipple Wasteway at Moe Road	6/14/99	40	38		0.001		1.6021	1.5798		0.0001	
Cherry Creek at Moe Road	6/28/99	32	36		0.007		1.5051	1.5563		0.0006	
Wipple Wasteway at Moe Road	6/28/99	35	37		0.002		1.5441	1.5682		0.0001	
Cherry Creek at Moe Road	7/14/99	61	49		0.024		1.7853	1.6902		0.0015	
Wipple Wasteway at Moe Road	7/14/99	23	24		0.001		1.3617	1.3802		0.0001	
Cherry Creek at Moe Road	8/9/99	47	42		0.006		1.6721	1.6232		0.0004	
Wipple Wasteway at Moe Road	8/9/99	57	53	50	0.003	0.004	1.7559	1.7243	1.6990	0.0002	0.0003
Cherry Creek at Moe Road	8/24/99	37	33		0.007		1.5682	1.5185		0.0005	
Wipple Wasteway at Moe Road	8/24/99	26	25		0.001		1.4150	1.3979		0.0001	
Cherry Creek at Moe Road	9/8/99	45	34		0.039		1.6532	1.5315		0.0029	
Wipple Wasteway at Moe Road	9/8/99	21	25	16	0.015	0.048	1.3222	1.3979	1.2041	0.0015	0.0056
Cherry Creek at Moe Road	10/4/99	23	21		0.004		1.3617	1.3222		0.0004	
Wipple Wasteway at Moe Road	10/4/99	22	17	22	0.033	0.020	1.3424	1.2304	1.3424	0.0038	0.0025
Cherry Creek at Moe Road	11/3/99	29	34		0.013		1.4624	1.5315		0.0011	
Wipple Wasteway at Moe Road	11/3/99	2	4	5	0.222	0.174	0.3010	0.6021	0.6990	0.2222	0.1510
					13.9%	**20.9%**				**10.4%**	**16.4%**
				95.5%	percent w/cv less than 20%					**95.5%**	percent w/cv less than 20%

		Fecal Coliform (cfu/100 mL)				**Fecal Coliform log (cfu/100 mL)**			
		KCCD	Ecology	KRD	cv 2way	KCCD	Ecology	KRD	cv 2way
Wipple Wasteway at Moe Road	4/19/99	230		220	0.001	2.3617		2.3424	0.00003
Cherry Creek at Moe Road	5/4/99	500	680		0.047	2.6990	2.8325		0.0012
Wipple Wasteway at Moe Road	5/4/99	700	300		0.320	2.8451	2.4771		0.0096
Wipple Wasteway at Moe Road	5/19/99	130		70	0.180	2.1139		1.8451	0.0092
Cherry Creek at Moe Road	6/28/99	700	630		0.006	2.8451	2.7993		0.0001
Wipple Wasteway at Moe Road	6/28/99	300	190		0.101	2.4771	2.2788		0.0035
Wipple Wasteway at Moe Road	8/9/99	800		1000	0.025	2.9031		3.0000	0.0005
Cherry Creek at Moe Road	8/24/99	800	400		0.222	2.9031	2.6021		0.0060
Wipple Wasteway at Moe Road	8/24/99	300	220		0.047	2.4771	2.3424		0.0016
Wipple Wasteway at Moe Road	9/8/99	800		100	1.210	2.9031		2.0000	0.0679
Wipple Wasteway at Moe Road	10/4/99	140		50	0.449	2.1461		1.6990	0.0270
Wipple Wasteway at Moe Road	11/3/99	23		6	0.687	1.3617		0.7782	0.1487
					52.4%				**15.1%**
				25.0%	percent w/cv less than 20%			**83.3%**	percent w/cv less than 20%

Water Balance

Art Larson of Ecology's Stream Hydrology Unit estimated the 1999 water balance for the Wilson/Cherry sub-basin from mid-April through mid-November (Larson, 2001). He used gage data collected by KCCD, KRD, USBR, various irrigation districts, and Ecology. Five streams and four canals were used to estimate water delivered to the sub-basin (Table 2).

Table 2. Estimated quantities of water supplied to the Wilson/Cherry Creek sub-basin from mid-April to mid-November, 1999.

Source	Average Discharge (cfs)	Seasonal Supply (acre-ft)
Naneum Creek	120	52,000
Schnebly Creek	0.7	285
Coleman Creek	20	8,600
Cooke Creek	11	4,800
Caribou Creek	6	2,700
Parke Creek	0.2	85
Stream Sub-total	158	68,470
North Branch KRD	638	235,000
Cascade Canal	83	30,500
Town Canal	104	38,500
Bull Ditch	24	9,000
Canal Sub-total	849	313,000
Total	1007	381,470

* Streams are calculated with a period of 214 days and canals with 184 days.

Streams contributed heavily early in the season, and canals took over later in the season. The water supplied by the canals is approximately 4.5 times the amount from stream sources over the course of the irrigation season. Both sources were at their lowest volumes shortly after mid-October.

Once available, the water was routed through the sub-basin and used for operational spills or irrigation deliveries, or was lost to groundwater. Larson estimated that approximately 91% of the water supplied was delivered for irrigation, much of which is not used directly by the crops. Operational spills and leaks to groundwater from unlined delivery canals account for about 9% of the volume entering the valley.

The primary collection and discharge point for the remaining surface water to the Yakima River is Wilson Creek at Canyon Road. Approximately 53% of the water entering the sub-basin left as surface water at this site. Cherry Creek and Wilson Creek join immediately upstream of this terminal discharge and supply equal volumes (Table 3). Discharge monitoring conducted in 1999 indicates that most of the discharge at Cherry Creek at Thrall Road was accounted for in upstream contributions from Wipple Wasteway and Cherry Creek. However, 27% of the season discharge at Wilson Creek at Thrall Road was unmonitored upstream. Some surface or groundwater returns from Bull Ditch or Wilson Creek areas were missed. The Naneum Creek return site near Fiorito Ponds accounted for 50% of the discharge monitored at Wilson Creek at Thrall Road (Table 3).

Table 3. Estimated average daily seasonal (mid-April to mid-October) discharge at terminal sites monitored in the Wilson/Cherry sub-basin in 1999.

Creek or Drain	Average Discharge (cfs)
Wilson Creek Branch -	
Wilson Creek at Umptanum Rd.	50
Wilson Creek at Comfort Inn	10
Naneum Creek at Fiorito Pond	140
Wilson Creek at Thrall Road	275
Cherry Creek Branch -	
Cherry Creek at Moe Road	150
Wipple Wasteway at Moe Road	110
Cherry Creek at Thrall Road	260
Wilson Creek at Canyon Road	540

Water Quality

The primary water quality parameters measured in the sub-basin were turbidity, TSS, and fecal coliform bacteria. Samples were collected at varying frequency, depending on the agency responsible. Ecology sites were sampled every other week during the irrigation season between April 20 and October 17. Kittitas County Conservation District (KCCD) and the Kittitas Reclamation District (KRD) sampled along a similar schedule between March 24 and November 13.

Turbidity

The upper Yakima suspended sediment and organochlorine pesticide TMDL set interim and final turbidity targets for the mouth of Wilson Creek and other tributaries based on an estimated background turbidity distribution (Joy, 2002). The estimate was based on turbidity values collected in 1999 from some of the sites higher in the Wilson/Cherry sub-basin (Naneum, Caribou, Coleman, and Schnebly). The background and target distributions for Wilson Creek at Canyon Road during the irrigation season are as follows:

- A background distribution of turbidities with a median of 2.6 NTU and a 90th percentile of 7.5 NTU.
- An interim distribution of turbidities that allows up to a 10 NTU increase over background. In 1999 the allowable distribution was estimated to have a median of 11.6 NTU and a 90th percentile of 18.6 NTU.

- A final distribution of turbidities that allows up to a 5 NTU increase over background. In 1999 the allowable distribution would have a median of 8.2 NTU and a 90th percentile of 13.2 NTU.

Statistics calculated for turbidity data at 1999 sites on branches within the sub-basin were summarized and compared to Wilson Creek target values (Table 4). There was a general increase in turbidities in the downstream sites, especially in the Cherry Creek branch of the sub-basin. Wilson Creek streams and drains serving agricultural areas were more turbid than the urban-residential portions. Local agencies implementing the TSS and turbidity TMDL may want to focus efforts on agricultural practices along the lower reaches (south of the Vantage Highway) of Cooke, Caribou, Naneum, Wilson, and Cherry creeks (Table 4).

Total Suspended Solids

The TSS concentrations were highly correlated to turbidity values in the 1999 irrigation season (Figure 2). TSS concentrations at sites higher in the basin were better correlated with turbidity than at sites lower in the basin. This follows the pattern observed in the mainstem and tributary sites in the TMDL study: sites with fewer irrigation operations upstream had better correlations between TSS and turbidity than those in heavily irrigated areas.

TSS concentrations and flows were monitored in several locations in the sampling network, so that sample distribution statistics and TSS loads could be calculated. Some differences in sampling frequency, procedures, and analytical techniques among the cooperating agencies can influence statistics and load differences between sites. For example, several KRD sites were not sampled until May, and some Ecology sites dried up by June. The average seasonal TSS loads were estimated using the Beales ratio equation. The median concentration, 90th percentile concentration, and average seasonal loads for all sites with available data are shown in Table 5. Sub-basin input and output loads are shown in Table 6.

TSS concentrations increased along the downstream gradient, especially in drains south of the Vantage Highway. The statistics in Table 5 show that the highest median concentrations were at Cooke Creek and Parke Creek at South Ferguson Road (>60 mg/L TSS). The highest 90th percentiles occurred at the Cascade Irrigation District (CID) tailend site, Cooke Creek and Parke Creek at South Ferguson, and Cherry Creek at Moe Road. The highest recorded concentration was 222 mg/L from the CID tailend. Most of the maximum TSS concentrations at sites in the sub-basin occurred early in the season (April – June), but the CID tailend site maximum concentration occurred in mid-July.

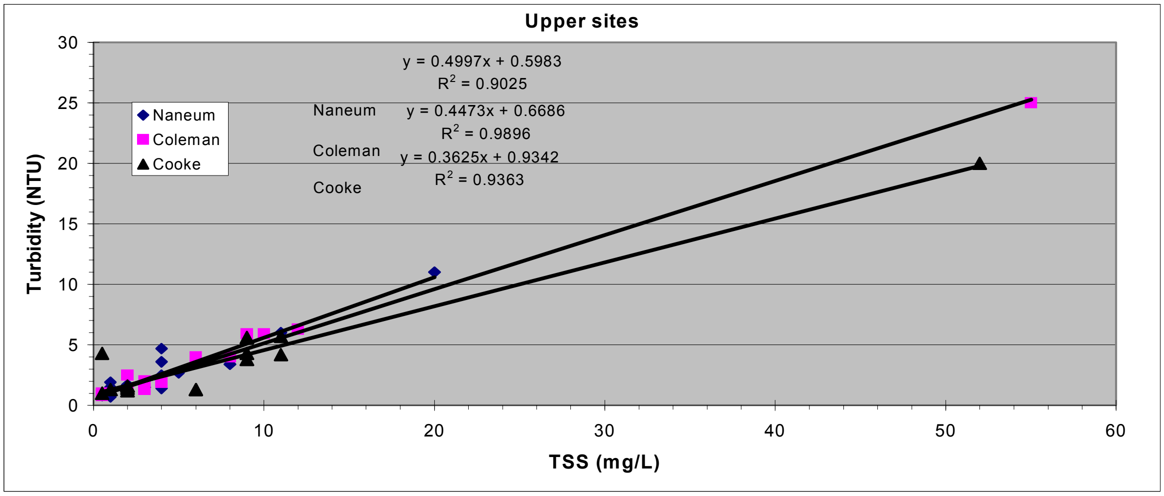
The maximum average seasonal TSS load occurred at the mouth of Wilson Creek (Wilson Creek at Canyon Road) and represents the cumulative load from the sub-basin, except for the KRD turbine spill site that has a separate confluence with the Yakima River. The estimated average TSS load to the Yakima River (71 tons/day) represented a five-fold increase over estimated average input loads (14.5 tons/day) to the sub-basin (Table 6). Average loads increased significantly at major return drain and creek sites already mentioned as having elevated turbidity and TSS concentrations.

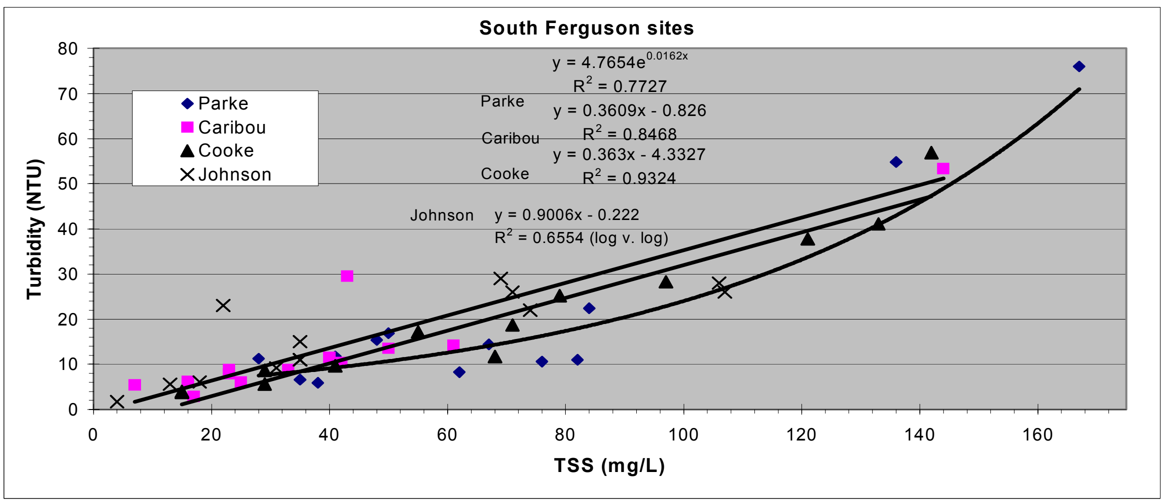
Table 4. Turbidity statistics at sites in the Wilson/Cherry sub-basin sampled in 1999 by the Washington State Department of Ecology (Ecology), Kittitas Reclamation District (KRD), Kittitas County Conservation District (KCCD), and the U.S. Bureau of Reclamation (USBR).

Site	Number of samples	Turbidity Statistics		Agency / Map Site ID
		Median	90th Percentile	
Easton Headworks – KRD canal	10	1.4	3.8	KRD / 1
Cascade Canal (CID) at Yakima R.	14	2.2	**17**	Ecology / 2
Ellensburg WC at Yakima R.	11	1.7	10.8	KRD / 3
Naneum Creek at Naneum Rd.	14	1.8	5.3	Ecology / 4
Naneum Creek at North Branch	11	2.6	5.9	KRD / 5
Whiskey Creek at North Branch	11	2.8	5.1	KRD / 6
Mercer Creek at North Branch	11	3.2	7.1	KRD / 7
Wilson Creek at North Branch	11	3.6	6	KRD / 8
Schnebly Creek at Fairview Rd.	3	2.2	13	Ecology / 9
Coleman Creek at Coleman Rd.	14	2	6.2	Ecology / 10
Coleman Creek at North Branch	10	2.5	6.7	KRD / 11
Cooke Creek at Coleman Rd.	14	1.6	5.3	Ecology / 12
Cooke Creek at North Branch	6	4.2	8	KRD / 13
Caribou Creek at Erickson Rd.	14	2.7	6.3	Ecology / 14
Parke Creek at Parke Cr. Rd.	5	1.6	8	Ecology / 15
Wilson Creek at Sanders Rd.	14	5.4	**19**	Ecology / 16
Town Canal (EWC) at Hannah Rd.	14	4.4	9.1	Ecology / 17
Town Canal at East 3rd	14	5.2	9.2	Ecology / 18
Cooke Creek at No. 81 Rd.	14	7.7	**14.4**	Ecology / 19
Cooke Creek at Fairview Rd.	14	**9.8**	**20.8**	Ecology / 20
Cooke Creek at Ferguson Rd. S.	13	**18**	**40.4**	KCCD / 21
Caribou Creek at Ferguson Rd. S.	13	**8.8**	**26.4**	KCCD / 22
Parke Creek at Ferguson Rd. S.	13	**12**	**48**	KCCD / 23
Cascade Canal at Thrall Road	13	**10.8**	**25.4**	KCCD / 24
Johnson Ditch at Ferguson Rd. S.	14	**18.5**	**29**	Ecology / 25
Badger Creek above Wipple WW	11	**9.4**	**13.3**	KRD / 26
Wipple Wasteway at CID	11	**8.8**	**14**	KRD / 27
Wipple Wasteway at EWC return	11	**10.3**	**15.2**	KRD / 28
Ellensburg WC at Thrall Road	13	6.1	11.6	KCCD / 29
CID tailend	11	**35**	**90**	KRD / 30
EWC tailend	11	**8.8**	**17**	KRD /31
Wilson Creek at Umptanum Rd.	14	5.9	8.3	Ecology / 32
Wilson Creek at Comfort Inn	14	7.4	11	Ecology / 33
Naneum Creek at Fiorito Pond	14	**14**	**34.3**	Ecology / 34
Wilson Creek at Thrall Rd.	19	**9.7**	**23.6**	Ecology, USBR / 35
Cherry Creek at Moe Rd.	28	**13**	**47**	KCCD, Ecology / 36
Wipple Wasteway at Moe Rd.	32	**10**	**24**	KRD,KCCD, Ecology /37
Cherry Creek at Thrall Rd.	15	**15**	**27**	KCCD, USBR / 38
Wilson Creek at Canyon Rd.	14	**15.5**	**25**	Ecology / 39
KRD Turbine Spill	11	7.2	**13.4**	KCCD / 40

Site ID numbers refer to Figure 1.
Shaded values exceed the interim TMDL targets set for Wilson Creek. **Bolded** values exceed final targets (see text).

Figure 2. Relation of total suspended solids (TSS) concentration and turbidity values at several sites in the Wilson/Cherry sub-basin based on data collected from April through October, 1999.





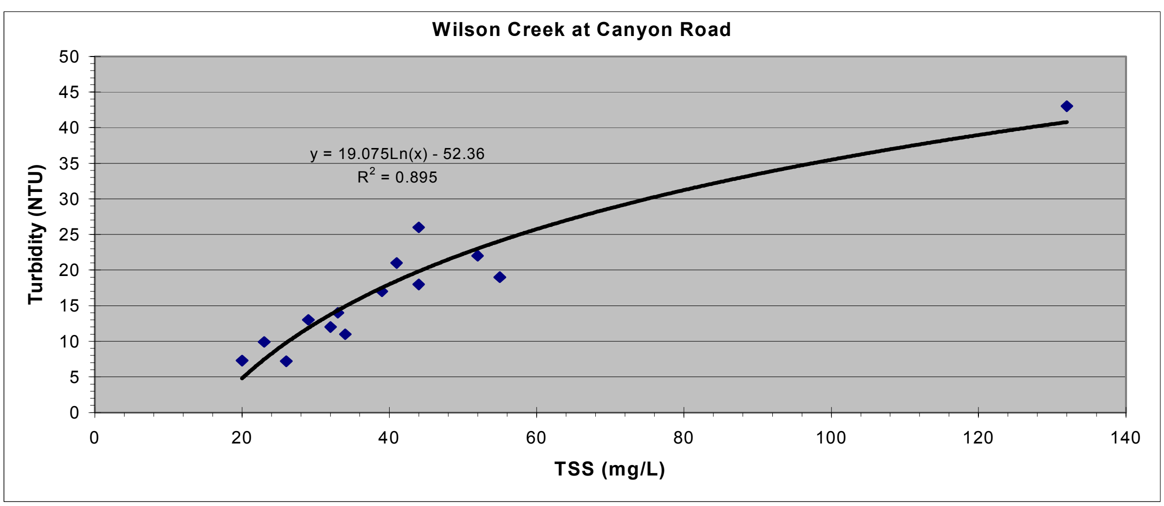


Table 5. Total suspended solids (TSS) statistics and estimated irrigation season loads (April to October) at sites in the Wilson/Cherry sub-basin sampled in 1999 by the Washington State Department of Ecology (Ecology), Kittitas Reclamation District (KRD), Kittitas County Conservation District (KCCD), and the U.S. Bureau of Reclamation (USBR).

Site	Number of samples	TSS Statistics		Estimated TSS Load (tons/day)
		Median	90^{th} Percentile	
Easton Headworks – KRD canal	12	1	2	2.2
Cascade Canal (CID) at Yakima R.	15	5.5	33	2.7
Ellensburg WC at Yakima R.	13	4	17.6	2.7
Naneum Creek at Naneum Rd.	15	4.8	10.1	3.4
Naneum Creek at North Branch	12	4	8	0.5
Whiskey Creek at North Branch	13	4	9	0.6
Mercer Creek at North Branch	12	3.5	10	0.4
Wilson Creek at North Branch	12	4.5	10	0.7
Schnebly Creek at Fairview Rd.	3	2	25	0.06
Coleman Creek at Coleman Rd.	14	3.5	11.4	0.9
Coleman Creek at North Branch	11	2	12	0.2
Cooke Creek at Coleman Rd.	14	4	11	0.8
Cooke Creek at North Branch	7	7	16	0.6
Caribou Creek at Erickson Rd.	14	3.5	17.4	0.8
Parke Creek at Parke Cr. Rd.	4	3	8	0.01
Wilson Creek at Sanders Rd.	14	8	35	1.1
Town Canal (EWC) at Hannah Rd.	14	7	11	2.7
Town Canal at East 3^{rd}	14	9	16	2.9
Cooke Creek at No. 81 Rd.	14	18.5	31.7	1.8
Cooke Creek at Fairview Rd.	14	20.5	53.5	3.1
Cooke Creek at Ferguson Rd. S.	13	68	130	6.8
Caribou Creek at Ferguson Rd. S.	13	33	59	-
Parke Creek at Ferguson Rd. S.	13	62	126	-
Cascade Canal at Thrall Rd.	13	27	45.8	-
Johnson Ditch at Ferguson Rd. S.	14	35	93	3.0
Badger Creek above Wipple WW	13	16	38	1.2
Wipple Wasteway at CID	13	20	30	4.0
Wipple Wasteway at EWC return	13	22	30	5.4
Ellensburg WC at Thrall Rd.	13	9	21	-
CID tailend	12	39	191	0.9
EWC tailend	13	12	24	0.4
Wilson Creek at Umptanum Rd.	14	10	15	1.5
Wilson Creek at Comfort Inn	14	11.5	24	0.6
Naneum Creek at Fiorito Pond	14	29	51.4	12.4
Wilson Creek at Thrall Rd.	19	17	49	25
Cherry Creek at Moe Rd.	27	45	132	30
Wipple Wasteway at Moe Rd.	33	27	63	11
Cherry Creek at Thrall Rd.	18	44	99	45
Wilson Creek at Canyon Rd.	19	36.5	54	71
KRD Turbine Spill	11	7	14	-

Table 6. Estimated suspended sediment (as TSS) and fecal coliform seasonal average loads in 1999 from source waters (input) to the Wilson/Cherry sub-basin, and discharged from the sub-basin through the major branches (output) to the Yakima River (Wilson Creek at Canyon Road).

Source (Input)	Suspended Sediment Load (tons/day)	Fecal Coliform Load (count/100 mL x cfs)
Naneum Creek	3.4	2,700
Schnebly Creek	0.06	-
Coleman Creek	0.9	700
Cooke Creek	0.8	300
Caribou Creek	0.8	1,500
Parke Creek	0.01	50
Stream Sub-total	6.0	5,300
North Branch KRD	2.2	4,500
Cascade Canal	2.7	-
Town Canal	2.7	20,700
Bull Ditch	0.9	-
Canal Sub-total	8.5	25,200
Estimated Input Loads	14.5	30,500

Creek or Drain (Output)	Suspended Sediment Load (tons/day)	Fecal Coliform Load (count/100 mL x cfs)
Wilson Creek Branch -		
Wilson Creek at Umptanum Rd.	1.5	25,900
Wilson Creek at Comfort Inn	0.6	2,500
Naneum Creek at Fiorito Pond	12.4	42,000
Wilson Creek at Thrall Road	25	83,000
Cherry Creek Branch -		
Cherry Creek at Moe Road	30	83,000
Wipple Wasteway Moe Road	11	28,000
Cherry Creek at Thrall Road	45	175,000
Wilson Creek at Canyon Road	71	est. 260,000*

* Fecal coliform samples were not collected at Canyon Road; the load is the sum of Cherry Creek and Wilson Creek loads upstream.

As input sources, the average TSS load from Naneum Creek (at Naneum Road) was the same order of magnitude as the average loads from the canals (Table 6). Naneum Creek delivered most of its TSS load early in the season; the maximum measured TSS load was 36 tons/day on April 19. The larger tributaries (e.g., Coleman, Cooke, and Caribou creeks) and irrigation canals delivered maximum loads of 6 to 13 tons/day on dates in April to June.

The sum of the estimated TSS loads from Wilson Creek at Thrall Road and Cherry Creek at Thrall Road closely matches the load for Wilson Creek at Canyon Road (Table 6). The Cherry Creek branch delivered almost twice the daily average load that Wilson Creek branch delivered during the irrigation season. Following these branches farther upstream, a major portion (50%) of the Wilson Creek TSS load came from Naneum Creek at Fiorito Pond, below the junction of lower Naneum Creek, Coleman Creek, and Bull Ditch (Figure 1). This is not unexpected since the water balance showed a similar contribution in water volume. About 42% of the TSS load estimated for Wilson Creek at Thrall Road could not be accounted for in the sites monitored upstream. One or more tributaries to Wilson Creek may have been missed in the monitoring network. Up the Cherry Creek branch, Cherry Creek at Moe Road contributed nearly three times the TSS load to the Cherry Creek at Thrall Road site as Wipple Wasteway at Moe Road (Table 6). The two branches accounted for 91% of the estimated TSS load for the Cherry Creek at Thrall Road site. Cooke Creek at S. Ferguson and Johnson Drain together may contribute about a third of the TSS load to Cherry Creek at Moe Road. Discharge data were not available for the Caribou and Parke creek sites at S. Ferguson to complete the TSS load balance for Cherry Creek at Moe Road.

Fecal Coliform Bacteria and Other Indicators

Fecal coliform, E. coli, and percent Klebsiella samples were collected at several sites in the sub-basin by the cooperating agencies. As with the other parameters, the numbers of samples collected at each site and the time span over which the samples were collected varied. Therefore, comparisons between sites may not accurately portray all loading patterns in the sub-basin.

Fecal coliform results were summarized and compared to the two parts of the Washington State Class A freshwater quality criteria:

- Shall not exceed a geometric mean of 100 colonies/100 mL, or
- Shall not have more than 10% of the samples used to calculate the geometric mean exceed 200 colonies/100 mL.

The geometric mean and 90th percentile for samples collected at sites in the sub-basin are shown in Table 7. The calculated 90th percentile rank provides a sample distribution value to compare to the second part of the state criteria. Review of the original data confirmed that all sites with a 90th percentile of more than 200 colonies/100 mL criterion also had more than 10% of their samples over 200 colonies/100 mL. This is not always true with some fecal coliform sample distributions. The estimated fecal coliform loads for sites with fecal coliform counts and discharge data are also shown in Table 6.

Only five of the 37 sites with sufficient data met both parts of the Class A criteria (Table 7). All five sites were source waters at the forest edge or irrigation supply canal water near the head of their respective systems. The sanitary quality of most creeks became degraded below Class A criteria at their crossing the Main KRD canal, and grew more degraded towards the mouth of Wilson Creek. Therefore, all the sites south and west of the KRD main canal should be included in any TMDL assessment and given load allocations. The highest counts were recorded by KRD and KCCD at the EWC and CWD canals along Thrall Road (5,000 colonies/100 mL), and at Parke Creek at South Ferguson Road (7,000 colonies/100 mL). The Cascade Canal at Thrall Road also had the highest geometric mean concentration (Table 7).

In most cases, it appears that sources of fecal coliform bacteria in the sub-basin are only generally associated with sources of TSS and turbidity during the irrigation season. Fecal coliform counts did not appear to directly correlate with TSS or turbidity at any one site, or when compared collectively basin-wide. The general downstream trend in poorer water quality was similar for fecal coliform as it was for turbidity and TSS, but fecal coliform counts did not predictably rise and fall with changes in turbidity and TSS.

Keeping in mind that fecal coliform bacteria are highly variable and not very conducive to mass balance analysis, the following statements can only be generalizations. Fecal coliform loads increased in the downstream direction (Table 6). Fecal coliform samples were not collected at the mouth of Wilson Creek (at Canyon Road), so the average load to the Yakima River from April through October can only be estimated from Cherry Creek and Wilson Creek at Thrall Road as approximately 260,000 colonies/100 mL*cfs. The impact of the Wilson/Cherry sub-basin bacteria load on the Yakima River theoretically could be characterized as follows:

> *If the Yakima River at Irene Reinhardt bridge had a fecal coliform count that met Class A criteria (e.g., 50 colonies/100 mL as a seasonal geometric mean), the average fecal coliform load from Wilson Creek would increase the seasonal average count downstream in the Yakima River to 110 colonies/100 mL. The increase would create a fecal coliform Class A criteria violation.*

Similar to the TSS loading, the Cherry Creek branch of Wilson Creek appeared to have contributed about two-thirds of fecal coliform load. Wipple Wasteway and Cherry Creek at Moe Road loads accounted for 64% of the load at Thrall Road. As with the TSS load distribution, Cherry Creek contributed about three times the fecal load as Wipple Wasteway (Table 6). Similarly, the site at Naneum Creek at Fiorito Ponds contributed about 50% of the fecal coliform load to Wilson Creek at Thrall Road.

Escherichia coli (E. coli) and percent Klebsiella analysis were performed on a small subset of the fecal coliform samples collected by Ecology (Table 8). The samples were collected in the later part of the irrigation season or shortly afterwards (late-September to November). The samples represented a wide range of fecal coliform densities, and were collected from waterways in various land use areas.

In a majority of cases, the fecal coliform and E. coli results were identical. These results suggested that a majority of the colonies detected in the fecal coliform analysis were E. coli from the guts of warm-blooded animals rather than soil organisms like Klebsiella. The E. coli and Klebsiella results at sites lower in the basin appeared to have greater variability than at sites higher in the basin. For example, E. coli may have been less dominant in two samples collected from Cherry Creek at Moe Road. Also, two samples collected from Cooke Creek at No. 81 Road had quantifiable percentages of Klebsiella, but the samples appeared to be dominated by E. coli. Ribo-typing techniques or other bacteriological analyses could be helpful to isolate and identify various sources of the fecal coliform where they are not most obvious.

Table 7. Fecal coliform statistics and estimated irrigation season loads (April to October) at sites in the Wilson/Cherry sub-basin sampled in 1999 by the Washington State Department of Ecology (Ecology), Kittitas Reclamation District (KRD), Kittitas County Conservation District (KCCD), and the U.S. Bureau of Reclamation (USBR).

Site	Number of samples	Fecal Coliform		Estimated Fecal Coliform Load (cfu/100 mL * cfs)
		Geometric Mean	90th Percentile	
Easton Headworks – KRD canal	11	4.8	10	4,533
Ellensburg WC at Yakima R.	12	6	19.8	
Naneum Creek at Naneum Rd.	8	6	32	804
Naneum Creek at North Branch	11	69	160	2,674
Whiskey Creek at North Branch	12	**263**	**1,820**	3,702
Mercer Creek at North Branch	11	**319**	**1,100**	8,062
Wilson Creek at North Branch	11	**102**	**370**	4,639
Schnebly Creek at Fairview Rd.	1			
Coleman Creek at Coleman Rd.	8	13	67	710
Coleman Creek at North Branch	10	**153**	**533**	924
Cooke Creek at Coleman Rd.	8	70	**258**	288
Cooke Creek at North Branch	6	**161**	**910**	4,481
Caribou Creek at Erickson Rd.	8	**181**	**1,014**	1,540
Parke Creek at Parke Cr. Rd.	3	**111**	174	48
Wilson Creek at Sanders Rd.	8	**458**	**909**	8,170
Town Canal (EWC) at Hannah Rd.	8	83	**364**	20,662
Town Canal at East 3rd	8	**122**	**265**	15,900
Cooke Creek at No. 81 Rd.	8	**687**	**2,660**	15,661
Cooke Creek at Fairview Rd.	8	**451**	**1,920**	16,502
Cooke Creek at Ferguson Rd. S.	13	**381**	**1,200**	19,841
Caribou Creek at Ferguson Rd. S.	13	**465**	**1,580**	
Parke Creek at Ferguson Rd. S.	13	**496**	**1,620**	
Cascade Canal at Thrall Rd.	13	**1,387**	**2,300**	
Johnson Ditch at Ferguson Rd. S.	8	**287**	**1,498**	17,873
Badger Creek above Wipple WW	12	**338**	**753**	10,498
Wipple Wasteway at CID	12	**267**	**656**	25,276
Wipple Wasteway at EWC return	12	**371**	**990**	43,081
Ellensburg WC at Thrall Rd.	13	**629**	**2,660**	
CID tailend	12	**378**	**2,770**	4,689
EWC tailend	12	**276**	**572**	4,037
Wilson Creek at Umptanum Rd.	8	**538**	**1,370**	25,908
Wilson Creek at Comfort Inn	8	**148**	**512**	2,476
Naneum Creek at Fiorito Pond	8	**158**	**448**	41,918
Wilson Creek at Thrall Rd.	8	**235**	**592**	82,998
Cherry Creek at Moe Rd.	21	**436**	**1,100**	83,429
Wipple Wasteway at Moe Rd.	25	**205**	**760**	28,043
Cherry Creek at Thrall Rd.	13	**509**	**1,100**	174,813
Wilson Creek at Canyon Rd.				
KRD Turbine Spill	11	**177**	**800**	

Bold values exceed Class A water quality criteria (see text). Missing loading data indicate absence of discharge data.

Table 8. Escherichia coli (E. coli) and Klebsiella analyses performed on fecal coliform samples collected from sites in the Wilson/Cherry sub-basin in 1999 by Ecology.

Site	Date	Fecal Coliform (cfu/100 mL)	E. coli (cfu/100 mL)	% Klebsiella
Wilson Creek at Sanders Rd.	22-Sep-99	870	870	
Wilson Creek at Sanders Rd.	19-Oct-99	190	190	
Wilson Creek at Sanders Rd.	17-Nov-99	85	85	
Wilson Creek at Umptanum Rd.	22-Sep-99	1100	1100	
Wilson Creek at Umptanum Rd.	19-Oct-99	510	380	
Wilson Creek at Umptanum Rd.	17-Nov-99	130	110	
Wilson Creek at Comfort Inn	19-Oct-99	15	15	
Wilson Creek at Comfort Inn	17-Nov-99	13	13	
Cooke Creek at Cooke Creek Rd.	22-Sep-99	300	300	1 U
Cooke Creek at Cooke Creek Rd.	19-Oct-99	43	43	1 U
Cooke Creek at Cooke Creek Rd.	17-Nov-99	9	9	1 U
Cooke Creek at No. 81 Rd.	22-Sep-99	900	900	4
Cooke Creek at No. 81 Rd.	19-Oct-99	85	85	1 U
Cooke Creek at No. 81 Rd.	17-Nov-99	23	23	14
Cooke Creek at Fairview Rd.	22-Sep-99	730	670	
Cooke Creek at Fairview Rd.	19-Oct-99	46	46	1 U
Cooke Creek at Fairview Rd.	17-Nov-99	35	27	1 U
Cherry Creek at Moe Rd.	22-Sep-99	1100 J	310	
Cherry Creek at Moe Rd.	19-Oct-99	310 J	310 J	
Cherry Creek at Moe Rd.	17-Nov-99	69	40	
Caribou Creek at Erickson Rd.	22-Sep-99	1800 J		1 U
Caribou Creek at Erickson Rd.	19-Oct-99	54		1 U
Caribou Creek at Erickson Rd.	17-Nov-99	48		1 U
Johnson Drain at S. Ferguson Rd.	17-Nov-99	92	76	1 U

J = estimated from non-ideal plate count; U = not detected

Nitrogen-Containing and Organophosphorous Pesticide Scans

Samples were collected during three runs at two sites and analyzed for a suite of nitrogen-containing and organophosphorous pesticides. The two sites were Cherry Creek at Moe Road (Map ID 36) and Wipple Wasteway at Moe Road (Map ID 37). The samples were collected, along with the samples for dieldrin and DDT metabolite analyses, in June, August, and October of 1999. The 107 target analytes are listed in the appendix table.

After extraction under normal Manchester Laboratory protocols, samples were analyzed using gas chromatography with atomic emission detection (GC/AED) following EPA SW-846 Method 8085. Confirmation of detected pesticides was performed using gas chromatography with ion-trap mass spectrometry (GC/ITD), or comparisons of elemental ratios of hetero-atoms to empirical formulas.

The pesticides detected at each site are shown in Table 9. Eight pesticides were detected in samples from Wipple Wasteway, and ten were detected in Cherry Creek. All eight of the pesticides detected in Wipple Wasteway were detected in Cherry Creek except azinphos (Guthion). Bentazone, hexazinone, and simazine were only detected in Cherry Creek. Most of the results were qualified as estimates, and none of the results exceeded known criteria.

USGS also collected samples from Wilson and Cherry creeks in August 1999 (Ebbert and Embrey, 2002). The Cherry Creek sample collected by USGS at the Thrall Road site (Map ID 38) contained atrazine, deethylatrazine, EPTC, simazine, and terbacil. All were also detected by Ecology except for EPTC, a thiocarbamate pesticide Ecology did not analyze for.

Table 9. Pesticides detected in samples collected from Cherry Creek and Wipple Wasteway at Moe Road. All values are ug/L, whole water.

Cherry Creek at Moe Road			
Sample Date	Parameter	Value	Qualifier
6/14/99	2,4-D	0.075	
6/14/99	Atrazine	0.024	J
6/14/99	Atrazine Desethyl	0.013	J
6/14/99	Bentazon	0.12	
6/14/99	Bromacil	0.011	J
6/14/99	Dicamba I	0.016	J
6/14/99	Hexazinone	0.003	NJ
6/14/99	MCPA	0.027	J
6/14/99	Simazine	0.004	NJ
6/14/99	Terbacil	0.009	J
8/9/99	2,4-D	0.18	
8/9/99	Atrazine	0.039	
8/9/99	Bentazon	0.3	
8/9/99	Bromacil	0.008	NJ
8/9/99	Dicamba I	0.052	J
8/9/99	MCPP (Mecoprop)	0.027	J
8/9/99	Simazine	0.006	NJ
8/9/99	Terbacil	0.3	
10/4/99	2,4-D	0.36	
10/4/99	Atrazine	0.012	J
10/4/99	Atrazine Desethyl	0.015	J
10/4/99	Bentazon	0.04	J
10/4/99	Dicamba I	0.13	J

Wipple Wasteway at Moe Road			
Sample Date	Parameter	Value	Qualifier
6/14/99	2,4-D	0.14	
6/14/99	Atrazine	0.033	J
6/14/99	Atrazine Desethyl	0.012	J
6/14/99	Bromacil	0.0087	J
6/14/99	Dicamba I	0.021	J
8/9/99	2,4-D	0.25	
8/9/99	Atrazine	0.024	
8/9/99	Azinphos (Guthion)	0.006	J
8/9/99	Bromacil	0.01	NJ
8/9/99	Dicamba I	0.091	
8/9/99	Terbacil	0.059	J
10/4/99	2,4-D	0.046	J
10/4/99	Atrazine	0.011	J
10/4/99	Atrazine Desethyl	0.006	J
10/4/99	Dicamba I	0.006	J
10/4/99	MCPA	0.17	J

J: The analyte was positively identified. The associated numerical result is an estimate.

NJ: There is evidence that the analyte is present. The associated numerical result is an estimate.

In 1995 Davis et. al. (1998) detected a total of ten pesticides in four samples collected at the mouth of Cherry Creek (Table 10). The 1995 samples were analyzed for a broad spectrum of 161 pesticides. All of the detected pesticides in 1999 were also part of the analytical suite for samples collected in 1995.

Table 10. Analytical results from whole water samples collected from Cherry Creek at Thrall Road by Ecology in 1995. All values ug/L. (Davis et. al., 1998).

Sample Date	Parameter	Value	Qualifier
1995-03-24	2,4-D	0.025	J
	Dacthal	0.100	J
	MCPA	0.066	J
	MCPP	0.025	NJ
1995-06-26	Diazinon	0.024	J
	Disulfoton sulfone	0.011	J
	2,4-D	0.079	
	Bromacil	0.069	J
	Bromoxynil	0.011	J
	MCPA	0.010	NJ
1995-07-31	2,4-D	0.089	
	Atrazine	0.035	J
	Dicamba	0.021	J
1995-09-25	2,4-D	0.037	
	Atrazine	0.008	J
	Dicamba	0.0098	J
	MCPA	0.015	J

J: The analyte was positively identified. The associated numerical result is an estimate.

NJ: There is evidence that the analyte is present. The associated numerical result is an estimate.

The 1999 and 1995 pesticide detections have 2,4-D, atrazine, bromacil, dicamba I, MCPA, and MCPP in common. Concentrations and loads of the first five pesticides were estimated for Cherry Creek at Thrall Road from the 1999 Moe Road data for Cherry Creek and Wipple Wasteway. These estimates are compared to 1995 concentrations and loads from similar monthly periods in Table 11. Based on these data, there were significant increases in 2,4-D, dicamba, and MCPA loads in Cherry Creek. Atrazine loads did not appear to change, and bromacil loads had decreased. Changes in crop rotation and water use during the two survey periods could have caused some of the differences.

Table 11. A comparison of pesticide concentrations and loads for Cherry Creek at Thrall Road from samples collected in 1995 and 1999 by Ecology. The 1999 values are based on estimates from results collected from two branches of Cherry Creek at Moe Road.

Survey Date		Flow	2,4-D		Bromacil		Atrazine		Dicamba I		MCPA	
Month	Year	cfs	ug/L	g/day	ug/L	g/day	ug/L	g/day	ug/L	g/day	ug/L	g/day
June 26	1995	71	0.079	13.7	0.069	12.0					0.01	1.7
June 14	1999	300	0.092	67.5	0.01	7.3	0.026	19.1	0.017	12.5		
July 31	1995	145	0.089	31.6			0.035	12.4	0.021	7.4		
August 9	1999	282	0.222	153.1	0.009	6.2	0.03	20.7	0.076	52.4		
September 25	1995	349	0.037	31.6			0.008	6.8	0.0098	8.4	0.015	12.8
October 9	1999	385	0.151	142.1			0.011	10.4	0.047	44.2	0.17	160.0

Conclusions

The Wilson/Cherry sub-basin is complex because of its hydrology and varied land uses. During the irrigation season, water is used intensively, and water quality problems are evident throughout the sub-basin. Canal water entering the sub-basin and headwater streams generally meet Class A water quality criteria. Turbidity, suspended sediment, fecal bacteria, and pesticide results suggest water quality becomes highly degraded in most of the feeder streams and return drains before they cross south of the Vantage Highway. Some tailend water from canal systems also has poor water quality.

Turbidity values and suspended sediment concentrations and loads significantly increased in agricultural areas of the sub-basin. The Wilson Creek branches serving agricultural areas were more turbid than the urban-residential portions. Cherry Creek TSS loads were twice that of Wilson Creek. Water quality managers should focus on practices in the Cherry Creek branch and branches above Naneum Creek at Fiorito Ponds to meet turbidity TMDL targets for Wilson Creek at Canyon Road.

Fecal coliform concentrations in most streams from the forested northern drainages and incoming canal water met Class A water quality criteria. Fecal coliform counts did not meet water quality criteria as water from these sources crossed into livestock and agricultural land uses at the North Branch KRD canal, and generally became more contaminated towards the mouth of Wilson Creek. Only five of the 37 sites in the sub-basin with sufficient bacteria data met both parts of the Class A criteria. TSS and turbidity were only generally associated with fecal coliform, since both tended to increase towards the mouth of Wilson and Cherry creeks. However, no reliable correlations were found to predict fecal coliform loads or counts from TSS or turbidity values.

Pesticide screening results in 1999 suggests there have been increases in 2,4-D, dicamba, and MCPA since 1995. The effects of these pesticides on the aquatic system, alone or combined, are not well known. Diazinon was not detected as it was in 1995, and atrazine and bromacil concentrations appeared to be of similar or lower concentrations than in 1995.

References

Bohn, G., 2002. Personal communication. Central Regional Office, Washington State Department of Ecology, Yakima, WA.

Davis, D., A. Johnson, and D. Serdar, 1998. Washington State Pesticide Monitoring Program: 1995 Surface Water Sampling Report. Publication No. 98-300. Environmental Investigations and Laboratory Services Program, Washington State Department of Ecology, Olympia, WA. 22 pgs.

Dickes, B., and J. Joy, 1999. Upper Yakima River suspended sediment total maximum daily load quality assurance project plan. October 7, 1999. Environmental Assessment Program, Washington State Department of Ecology, Olympia, WA. 17 pgs.

Ebbert, J., and S. Embrey, 2002. Pesticides in Surface Water of the Yakima River Basin, Washington 1999-2000 – Their Occurrence and an Assessment of Factors Affecting Concentrations and Loads. Water-Resources Investigations Report 01-43211. U.S. Geological Survey. 49 pgs.

Joy, J., 2002. Upper Yakima River Basin Suspended Sediment and Organochlorine Pesticide Total Maximum Daily Load Evaluation. Publication No. 02-03-012. Environmental Assessment Program, Washington State Department of Ecology, Olympia, WA. 75 pgs.

Joy, J. and A. Madrone, 2002. Data Summary: Upper Yakima River Basin Suspended Sediment and Organochlorine Pesticide TMDL Evaluation. Publication No. 02-03-032. Environmental Assessment Program, Washington State Department of Ecology, Olympia, WA. 32 pgs.

Lael, A., 2000. Kittitas Water Quality and Water Conservation Project. Kittitas County Conservation District, September 2000. Ellensburg, WA. 31 pgs. + appendices.

Larson, A., 2001. Hydrologist. Unpublished findings. Stream Hydrology Unit, Environmental Assessment Program, Washington State Department of Ecology, Olympia, WA.

Appendix

Analytes sought in the 1999 pesticide screening samples collected from Cherry Creek and Wipple Wasteway by Ecology.

2,3,4,5-Tetrachlorophenol
2,3,4,6-Tetrachlorophenol
2,4,5-T
2,4,5-TB
2,4,5-TP (Silvex)
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,4-D
2,4-DB
3,5-Dichlorobenzoic Acid
4-Nitrophenol
Abate (Temephos)
Acifluorfen (Blazer)
Alachlor
Ametryn
Atraton
Atrazine
Atrazine Desethyl
Azinphos (Guthion)
Azinphos Ethyl
Benefin
Bentazon
Bolstar (Sulprofos)
Bromacil
Bromoxynil
Butachlor
Butylate
Carbophenothion
Chlorothalonil (Daconil)
Chlorpropham
Chlorpyriphos
Coumaphos
Cyanazine
Cycloate
Dacthal (DCPA)
Demeton-O
Demeton-S
Di-allate (Avadex)
Diazinon
Dicamba I
Dichlobenil
Dichlorprop
Dichlorvos (DDVP)
Diclofop-Methyl
Dimethoate
Dinoseb
Dioxathion
Diphenamid
Disulfoton (Di-Syston)
Diuron
EPN
Eptam
Ethalfluralin (Sonalan)
Ethion
Ethoprop
Fenamiphos
Fenarimol
Fenitrothion
Fensulfothion
Fenthion
Fonofos
Hexazinone
Imidan
Ioxynil
Malathion
MCPA
MCPP (Mecoprop)
Merphos (1 & 2)
Metalaxyl
Methyl Chlorpyrifos
Methyl Paraoxon
Methyl Parathion
Metolachlor
Metribuzin
Mevinphos
MGK264
Molinate
Napropamide
Norflurazon
Oxyfluorfen
Parathion
Pebulate
Pendimethalin
Pentachlorophenol
Phorate
Phosphamidan
Picloram
Profluralin
Prometon (Pramitol 5p)
Prometryn
Pronamide (Kerb)
Propachlor (Ramrod)
Propazine
Propetamphos
Ronnel
Simazine
Sulfotepp
Tebuthiuron
Terbacil
Terbutryn (Igran)
Tetrachlorvinphos (Gardona)
Treflan (Trifluralin)
Triadimefon
Triallate
Tribufos (DEF)
Trichlopyr
Vernolate