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Memo

To:	WRIA 35 Planning Committee		
From:	Jory Oppenheimer, Kari Vigerstol	Project:	WRIA 35 Level II – Water Quality
CC:	Ben Floyd, HDR/EES, John Koreny, HDR/EES		
Date:	June 23, 2005	Job No:	22592

RE: ASOTIN CREEK FECAL COLIFORM – ASSESSMENT OF EXISTING DATA

1.0 INTRODUCTION

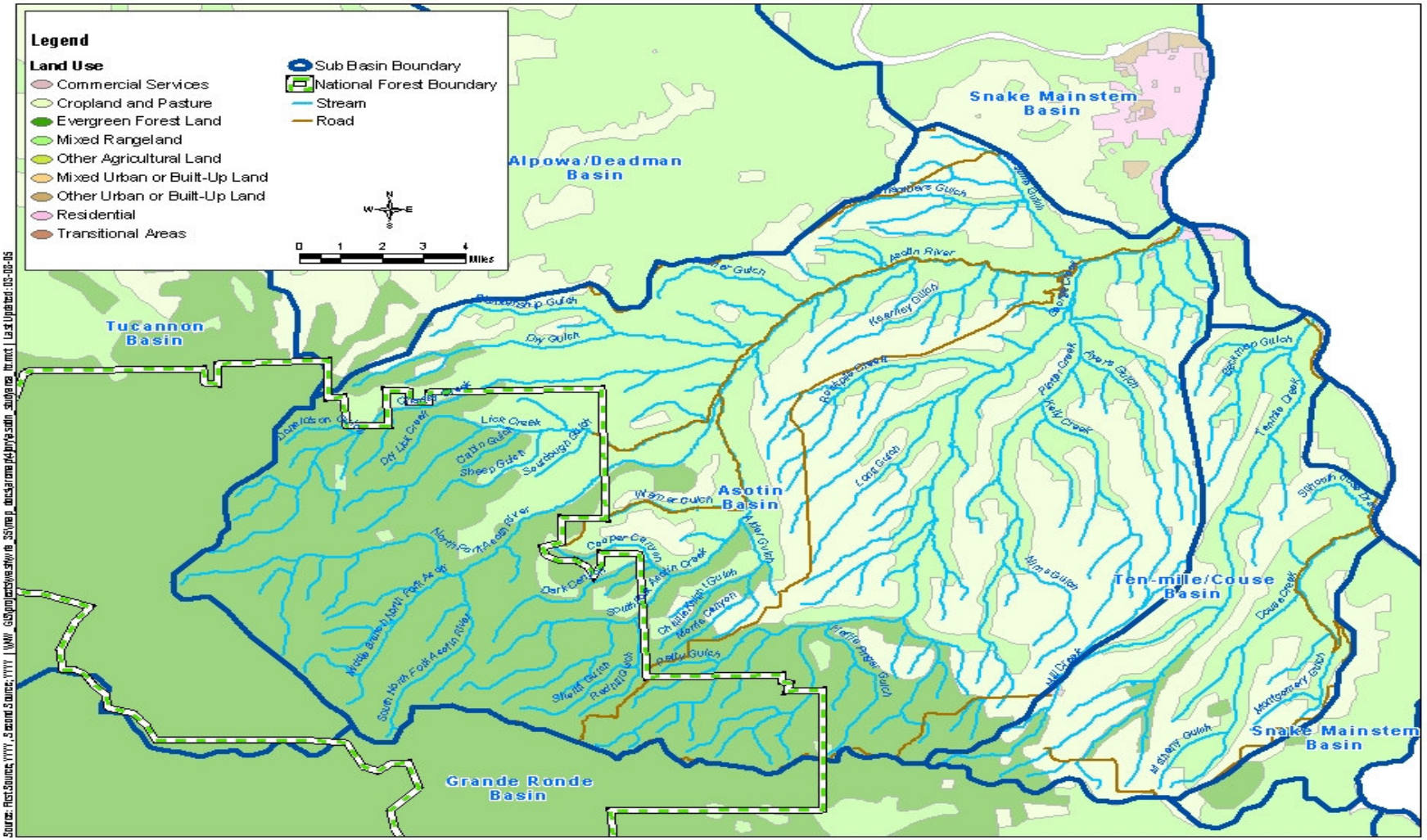
This technical memorandum describes our assessment of fecal coliform levels in Asotin Creek based on our review of existing data, land use information, and comparison to water quality standards. The primary purpose of this assessment was to determine whether sources of fecal coliform to the creek from the residential areas located near the creek's mouth, agricultural areas located upstream of the residences, or a combination of these two potential sources. The main topics addressed in this memorandum include:

- Summary of existing data
- Fecal coliform standards for Asotin Creek
- Basis for 303(d) listing of Asotin Creek
- Results of the assessment of existing fecal coliform data
- Conclusions
- Recommendations

2.0 PROJECT STUDY AREA

Asotin Creek is located in Asotin and Garfield counties. The creek headwaters are located in the Blue Mountains at an elevation of 6200 feet and the mouth of the creek is located in the town of Asotin as the creek enters the Snake River at an elevation of 800 feet (WSU 2000). The Asotin Creek watershed is approximately 208,000 acres, 43% of which enters the creek from George Creek and the remainder draining from the North and South Forks, Lick Creek, Charley Creek and other local inflow locations (HDR/EES 2005). The study area is shown on Figure 1.

Pasture and rangeland, cropland, and forestland are the predominant land uses within the Asotin Creek subbasin (Stovall, 2001). Forests occupy about 30% of Asotin Creek watershed, located primarily in the creek's headwater areas. Most of the forestland is part of the Umatilla National Forest and is managed by the USFS for timber, livestock grazing, recreation, mining, and natural resources. Further downstream agriculture dominates with 43% of the watershed in pasture and rangeland and 26% in agricultural production with crops such as winter wheat and spring barley (HDR/EES 2005). There are 142 farm and ranch operators that own or lease agricultural lands in the subbasin (Stovall, 2001). Residential areas represent a small portion of the watershed, with single-family homes and trailers next to Asotin Creek between about river mile 0.5 (just upstream of the highway 129 bridge) and river mile 1.6.



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Asotin Creek Study Area
FIGURE 1

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3.0 EXISTING WATER QUALITY DATA

Table 1 summarizes the water quality monitoring for fecal coliform in Asotin Creek and its tributaries. The monitoring stations are shown in Figure 2.

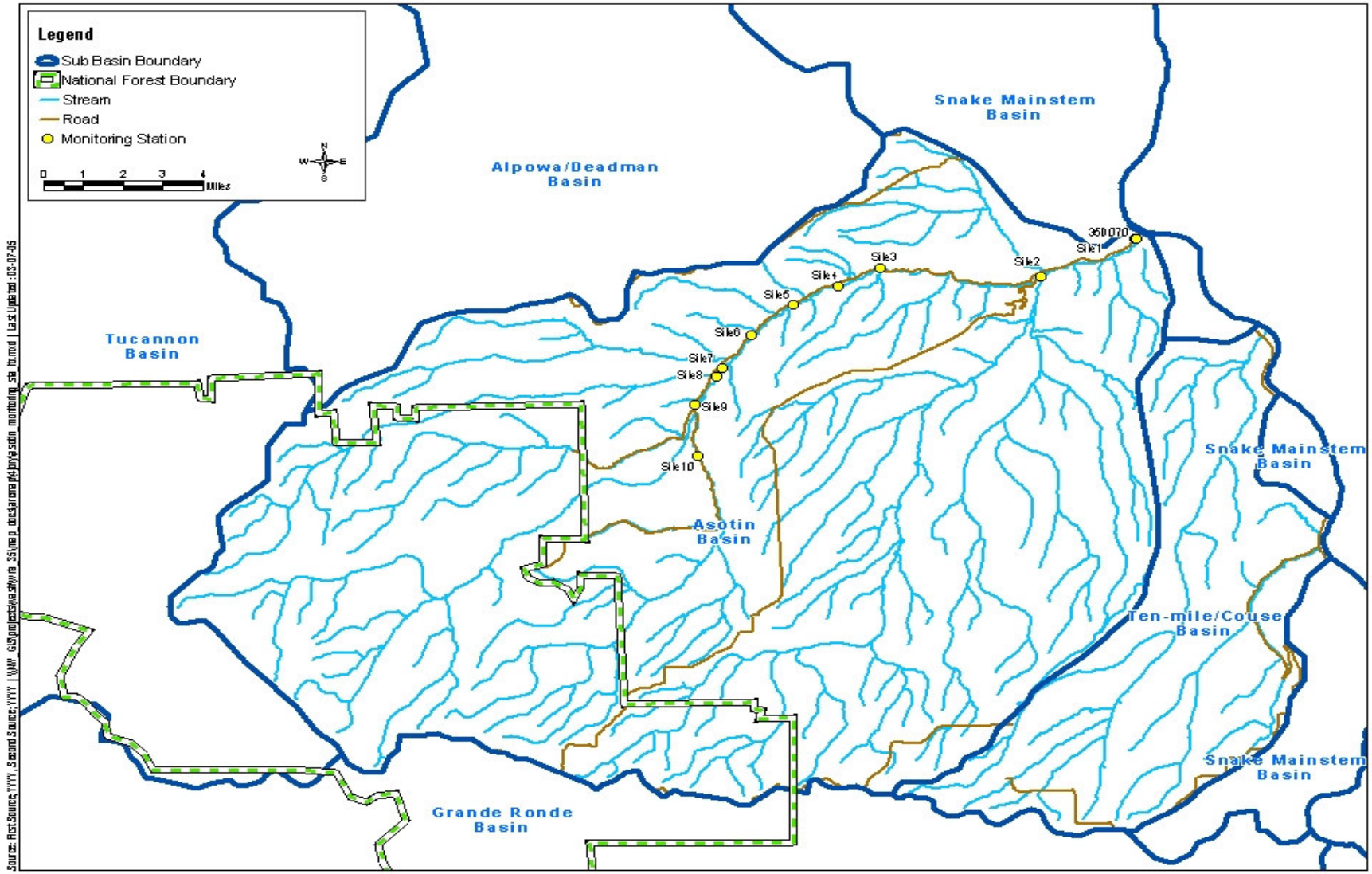
The Washington Department of Ecology (Ecology) operates one station near the mouth of the creek at Asotin that has been sampled monthly for various water quality parameters and flow over four separate water years since 1977 (Ecology 2005).

The Asotin Creek Water Quality Monitoring Project was a joint effort between the Asotin County Conservation District and Washington State University (WSU) to monitor water quality in Asotin Creek between 1997 and 1999 (WSU 2000). Eight stations were located along the Asotin Creek's main stem, with additional stations at the mouths of South Fork Asotin Creek and George Creek. Most stations were sampled monthly, with four stations sampled twice a month (Figure 2). Parameters sampled included total suspended sediments, temperature and fecal coliform.

Table 1.
Summary of Water Quality Monitoring
Programs in Asotin Creek and its Tributaries

Station	Agency	Period of record	River Mile	Location
35D070	Ecology	1977, 1993, 1997, 2002	0.4	2nd Street, Asotin
Site 1	WSU	1997 -1999	0.2	Asotin City Park
Site 2	WSU	1997 -1999	3.1	George Creek
Site 3	WSU	1997 -1999	7.8	Below Koch's
Site 4	WSU	1997 -1999	9.1	Headgate Park
Site 5	WSU	1997 -1999	10.5	Above Thiessen's
Site 6	WSU	1997 -1999	11.9	Below Hood's
Site 7	WSU	1997 -1999	13.2	Below Blankenship's
Site 8	WSU	1997 -1999	13.5	Below Charley Creek
Site 9	WSU	1997 -1999	14.6	Downstream of North and South Forks
Site 10	WSU	1997 -1999	16.2	South Fork

In addition, WSU conducted water quality sampling from 1990 to 1993 at ten sites, eight along the main stem of Asotin Creek and one each on the North Fork and George Creek (Moore, 1993). The Asotin County Conservation District also had three sites on the main stem and South Fork that were sampled between 1996 and 1997 (WSU 2000).



Asotin Creek Monitoring Stations

FIGURE 2

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4.0 FECAL COLIFORM STANDARDS FOR ASOTIN CREEK

The Surface Water Quality Standards for Washington State designate Asotin Creek as a Class A (excellent) waterbody (WAC 173-201A)[1]. The fecal coliform standards for Class A waters includes two parts[2]. The first part, a geometric mean, is similar to an average. The standards are based on the geometric mean of all the samples collected over a year (or season). The water quality standard for Class A waters is less than 100 colony forming units (cfu)/100 ml for the geometric mean of all the samples collected.

The second part of the fecal coliform standard requires that 10 percent of the samples collected over the year (or season) are less 200 cfu/100 ml. For example, if 10 samples are collected during a year, not more than one sample should be above 200 cfu/100 ml.

5.0 BASIS FOR 303(d) LISTING

Asotin Creek is listed as an impaired water body for fecal coliform on Ecology's 1998 and 2002/2004 303(d) lists. The rationale for the 303(d) listing of Asotin Creek is summarized in Table 2. The 303(d) listing prepared in 1998 is the most current approved by EPA. Ecology will likely submit a revised 303(d) list (2002/2004) to EPA for approval as part of the 303(d) program under the provisions of the Federal Clean Water Act in April 2005 (Ken Koch, Ecology, personal communication, 2005).

Table 2.
Rationale for 303d Listing for Asotin Creek

303(d) List	Stream segment ID #	Basis for listing
1998	KP78KL	3 excursions beyond the criterion out of 12 samples (25%) at Ecology ambient monitoring station 35D070 (RM 0.4) between 9/91 and 9/96.
2002/2004	16975	Geometric mean of 9 samples collected in 1993 (at Station 35D070) was 149/100 ml and 3 samples (33%) exceeded the percentile criterion

Source: Ecology's 303(d) list web page.

Asotin Creek was placed on Ecology's 2002/2004 303(d) list due to exceedences in 1993 near the mouth of the creek as it enters the Snake River. Monitoring conducted at this station (Station 35D070) by Ecology indicated that fecal coliform levels did not exceed the fecal coliform standard in 1996 and 1997 (Figure 3).

More recent monitoring conducted by Ecology and the fecal coliform data collected by WSU were not assessed for 303d listing. Fecal coliform sampling conducted by Ecology indicates that the fecal coliform standards were not exceeded near the mouth of Asotin Creek in 2001/2002. The

[1] This 1997 version of the surface water quality standards was revised in 2003 by Ecology. However, the 2003 version is currently under review by EPA. The fecal coliform criteria are the same for both versions of the standards

[2] *As stated in the 1997 version of the Surface Water Standards (WAC 173-201A) for Class A waters - "Fecal coliform organism levels shall both not exceed a geometric mean value of 100 colonies/100 mL, and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceeding 200 colonies/100 mL."*

geometric mean of the 12 monthly samples was less than 100 cfu/100 ml (i.e., 43 cfu/100 ml), with only 8 percent of the samples (1 of 12 samples) were above the 200 cfu/100 ml criterion.

Figure 3 shows the fecal coliform data collected by Ecology near the mouth of Asotin Creek. The graph shows that with the exception of 1993, fecal coliform levels were below standards. The red line in the graph indicates the 100 cfu/100 ml geometric mean criterion which applies to the geometric mean of all the samples collected for the year. It is not considered an exceedence of the standard if individual samples have fecal coliform concentrations greater than 100 cfu/100 ml.

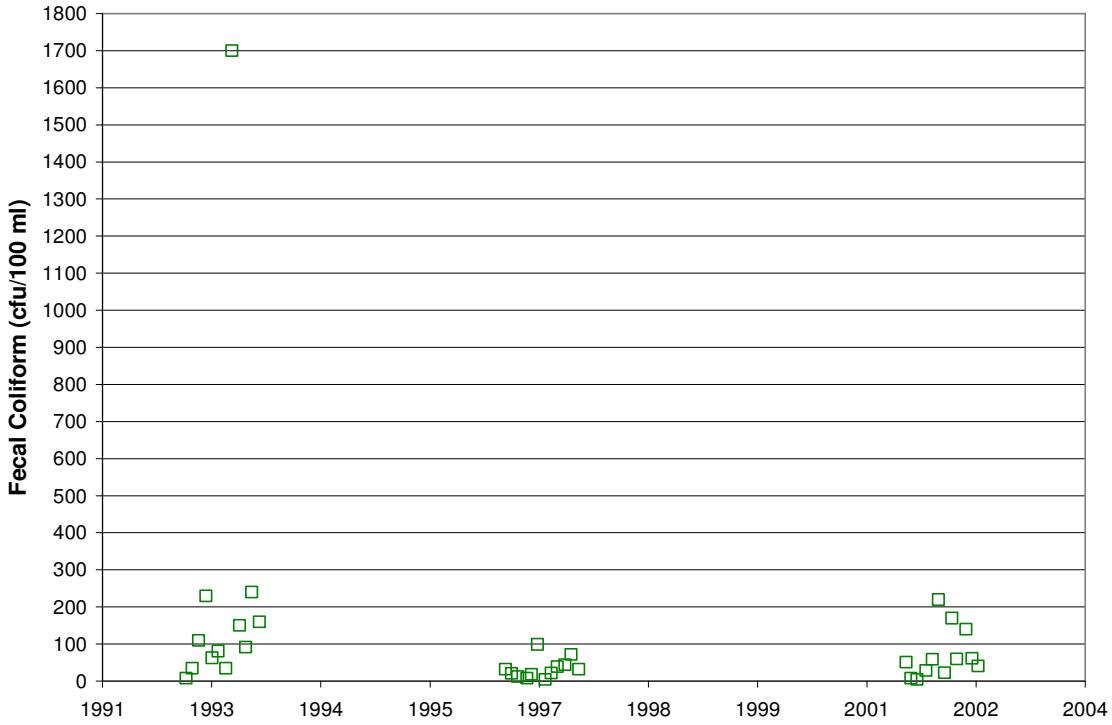


Figure 3 Fecal coliform data collected by Ecology near the mouth of Asotin Creek (Station 35D070)

The high fecal coliform value of 1700 cfu/100 ml in the summer of 1993 was associated with very high turbid water - a total suspended concentration of more than 1000 mg/L. Streams with high turbidity sometimes have high fecal coliform concentrations, because the bacteria adsorb onto particles and it is relatively difficult to get accurate fecal coliform results in highly turbid waters.

6.0 RESULTS OF ASSESSMENT OF EXISTING DATA

The existing fecal coliform data were assessed to:

- Determine the change in fecal coliform concentrations along Asotin Creek, from the upstream station to the creek's mouth station.
- Characterize the differences in fecal coliform concentrations and loading at the Asotin Creek station located just upstream of the residential area, the mouth of George Creek, and at the mouth of Asotin Creek. The purpose of this assessment was to isolate the sources of fecal coliform downstream of agricultural areas and upstream and downstream of the residential areas.

6.1 Sources of Fecal Coliform Loads in the Entire Asotin Creek Watershed

First, we assessed the fecal coliform data collected between 1997-1999 by WSU to evaluate the sources of fecal coliform in the entire watershed. Figure 4 is a graph of the median concentrations of fecal coliform collected by WSU between 1997 and 1999 at the 8 main stem Asotin Creek plotted by river mile. The graph shows that there is a gradual increase in fecal coliform concentrations in Asotin Creek from the furthest upstream station at river mile 16.2 (Station 10) to the mouth of the creek at river mile (Station 1). These results indicate that:

- Various sources in the watershed are contributing to increasing fecal coliform levels in the creek. The sources are diffuse as indicated by the gradual increase in median fecal coliform levels.
- Fecal coliform concentrations remain relatively low with a median of concentration of less than 60 cfu/100 ml at the Asotin Creek's mouth.
- George Creek fecal coliform concentrations are slightly higher than the fecal coliform concentrations measured in Asotin Creek.

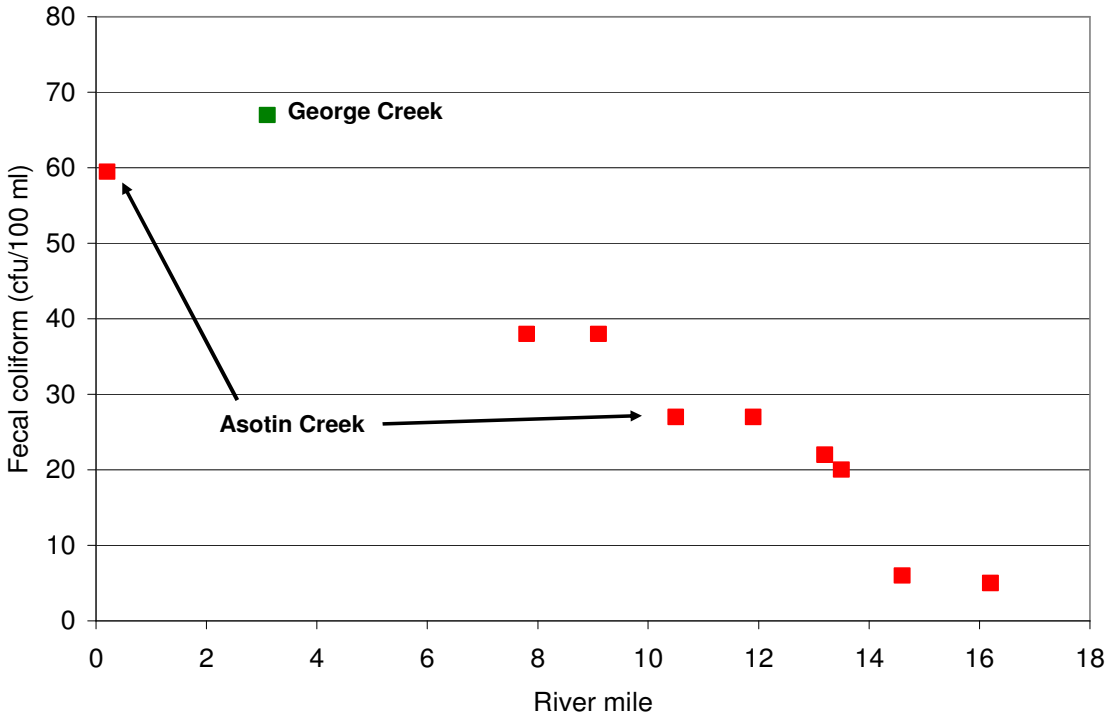


Figure 4 Median fecal coliform concentrations (1997-1999) measured in Asotin and George creeks (Source: WSU 2000)

6.2 Sources of Fecal Coliform Loads in the Lower Portion of the Asotin Creek Watershed

We evaluated the data in the lower portion of the watershed to isolate fecal coliform sources based on land uses. Nearly all the residential areas next to the creek extend to about RM 1.6, downstream of the confluence of George and Asotin Creeks (RM 3.8). Therefore, we assessed the data to determine differences between fecal coliform concentrations at stations upstream and downstream of the residential areas of the watershed.

The contribution from various sources is based on the combination of the fecal coliform concentration and the flow. This is termed the fecal coliform load, which is the concentration of fecal coliform multiplied by the amount of water.

Methods of Analysis

To assess whether septic systems were a significant fecal coliform source to Asotin Creek, we evaluated if there was a substantial increase in fecal coliform concentrations between the George Creek/Asotin Creek confluence (just downstream of Station 2) and the mouth of the Asotin Creek (Station 1). This assessment was completed using the data collected by WSU between 1997 and 1999 (WSU 2000). A large increase in fecal coliform concentrations at Station 1 compared with the concentrations just downstream of the George Creek/Asotin Creek confluence would indicate a significant source of fecal coliform in this reach of the Asotin Creek.

We assessed data from the following stations:

- Station 3 - representing fecal coliform levels as the result of upstream agricultural areas in Asotin Creek
- Station 2 – representing fecal coliform levels as the result of upstream agricultural areas in George Creek
- Station 1 – representing the fecal coliform levels from a combination of upstream agricultural areas and the residential area just upstream of Station 1.

The station locations are shown on an orthophoto (Figure 5).

Fecal coliform concentrations at Station 1 were measured, while the fecal coliform concentrations just downstream of Station 2 had to be estimated from the combined loads of George and Asotin Creeks. The fecal coliform loads from George Creek and Asotin Creek were estimated by multiplying the fecal coliform concentrations with the flow. The calculated combined load was used to estimate the fecal concentration just downstream of the George Creek/Asotin Creek confluence

Results

1. Comparison of George and Asotin Creek Fecal Coliform Loads - The relative loads of fecal coliform indicate that, on average, George Creek contributes about 57 percent of the fecal coliform loads to Asotin Creek, compared with 43 percent from Asotin Creek upstream of the George Creek confluence. (Note: Due to the lack of flow data, the flow estimates were based on drainage areas. The flows in George Creek are significantly lower than Asotin Creek, so that this loading result should be verified with actual discharge data from Asotin and George creeks).

2. Residential Area Fecal Coliform Loads

As Figure 6 indicates, the estimated fecal coliform concentrations downstream of the George Creek/Asotin Creek confluence are generally higher than the measured concentrations at Station 1 during the fall and winter. This indicates that there maybe a loss of fecal coliform in this section of the creek, which may be the result of settling of suspended sediments during this period. It is also possible that the loss of fecal coliform between Stations 1 and 2 is the relatively lower fecal coliform concentrations in Asotin Creek as compared with George Creek.

The results during the summer are less conclusive. In 1998, the measured fecal coliform concentrations at Station 1 are higher than the estimated concentrations downstream of the George Creek/Asotin Creek confluence, which may indicate that septic systems were a source of fecal coliform during this period (Figure 6). However, fecal coliform concentrations at these two stations were similar in the summer of 1999, indicating that septic systems were not a significant source at this time. These results should be verified with actual flow measurements from George and Asotin creeks.

3. Relative Drainage Areas

Because the fecal coliform concentration in Asotin Creek depends on both the concentration and flow entering the river from upstream sources, it is less likely that septic systems are a significant source to Asotin Creek. The drainage area entering Asotin Creek just downstream of the George Creek watershed represents more than 96 percent of the watershed. The amount of water from septic systems represents a relatively small amount of water.

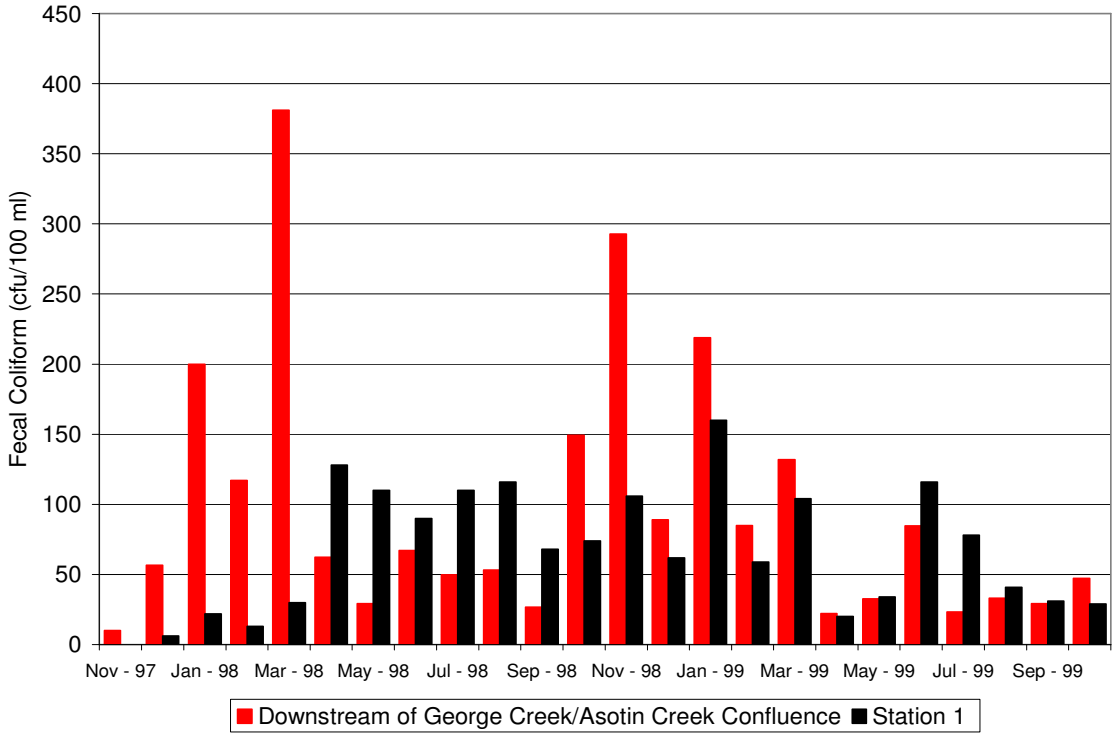
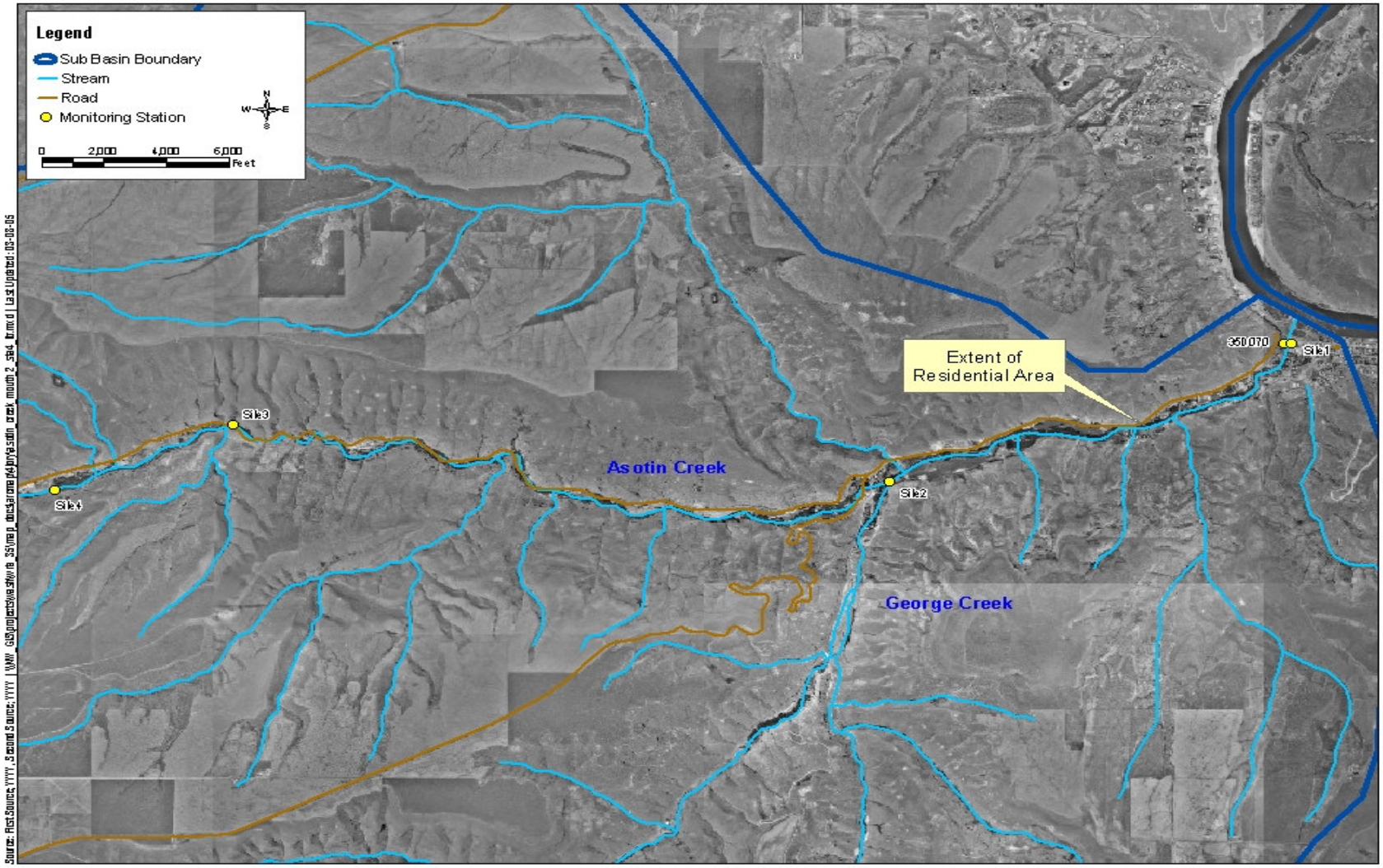


Figure 6 Comparison of fecal coliform concentrations in Asotin Creek between 1997 and 1999.

6.3 Seasonal Differences

Of the three stations, only George Creek showed seasonal differences, with highest fecal coliform concentrations in the winter (see figures A-1 through A-3 in Attachment A). Neither Asotin Creek station showed strong seasonal differences.



Orthophoto of Asotin Creek Between Mouth and WSU Station 4

FIGURE 5

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7.0 CONCLUSIONS

The results of our review of existing fecal coliform data, watershed characteristics, and land use indicate that:

- There is a gradual increase in Asotin Creek fecal coliform concentrations from upstream to the mouth of the creek. This indicates that there are various diffuse sources of fecal coliform concentrations in the watershed
- George Creek contributes relatively more fecal coliform loads to Asotin Creek, compared with the watershed upstream of Asotin Creek/George Creek confluence. These conclusions should be verified with flow and fecal coliform data from both creeks.
- Septic systems do not cause significant increases in Asotin Creek fecal coliform concentrations in the fall and winter. Septic systems may be a small source of fecal coliform concentrations in the summer, although results are inconclusive. Given the relative flows from upstream areas, it seems less likely that septic systems represent a significant source of fecal coliform to Asotin Creek. These conclusions should be verified with flow and fecal coliform data from both creeks.
- Recent fecal coliform concentrations measured by Ecology at the mouth and by WSU indicate that fecal coliform levels were generally below standards.

8.0 RECOMMENDATIONS

- Submit the 2001/2002 fecal coliform data and this technical memorandum to Ecology for consideration during the 2006 303(d) list assessment and WRIA 35 TMDL scoping. Recent data indicate that fecal coliform levels are below standards.
- Collect additional fecal coliform and flow data between stations 1 and 3 to confirm the changes in fecal coliform concentrations in this reach of the river. Fecal coliform loading estimates discussed in this memo were based on the assumption that flow rates in George and Asotin Creeks are proportional to their drainage areas. Flow and fecal coliform measurements should be measured to verify the estimated loading rates.
- Continue water quality monitoring and water quality protection and improvement projects (to reduce fecal coliform and sediments loads), particularly in the George Creek drainage basin. Although fecal coliform levels are below standards, concentrations are still above the levels measured upstream of agricultural areas.
- Continue with efforts to reduce the effects of agricultural land use on water quality.

9.0 REFERENCES

Ecology. 2005a. 2002/2004 303(d) list web page: http://www.ecy.wa.gov/programs/wq/303d/index.html

Ecology. 2005b. River and Stream Water Quality Monitoring Website at http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html#4.

Ecology. 2002. Water Quality Program Policy 1-11. September 2002.

HDR/EES. 2005. WRIA 35 Middle Snake Watershed Level 1 Assessment Report. Prepared for the WRIA 35 Planning Unit. January 2005

Koch, Ken, Ecology (personal communication).

Moore, B.C. 1993. Asotin Creek Water Quality Monitoring: 1990 to 1993, A Report to the Asotin Conservation District. Washington State University, Department of Natural Resources.

Stovall, S. 2001. Draft Asotin Creek Subbasin Summary.

WSU. 2000. Asotin Creek Watershed Water Quality Monitoring Final Report. WSU Center for Environmental Education. Prepared for Asotin County Conservation District. 9 pages plus figures and appendices.

Attachment 1
Graphs of Fecal Coliform Monthly Concentrations
Collected at Select Stations in Asotin and George Creeks

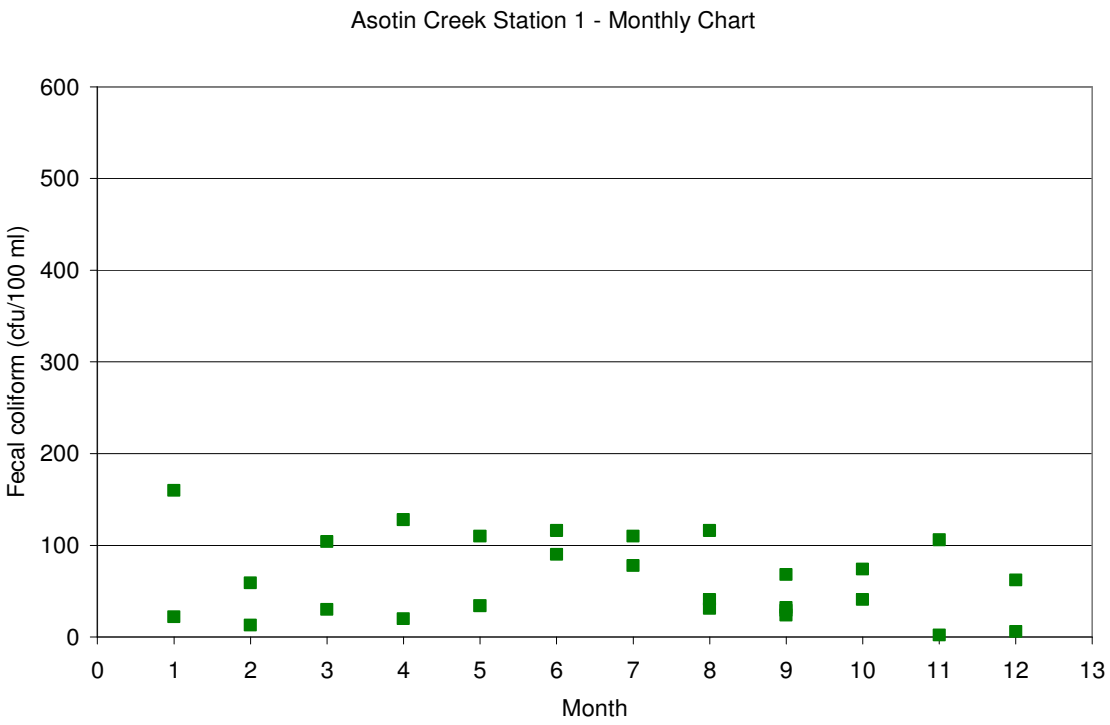

Figure A-1 Monthly concentrations of fecal coliform measured between 1997-1999 in Asotin Creek – Station 1

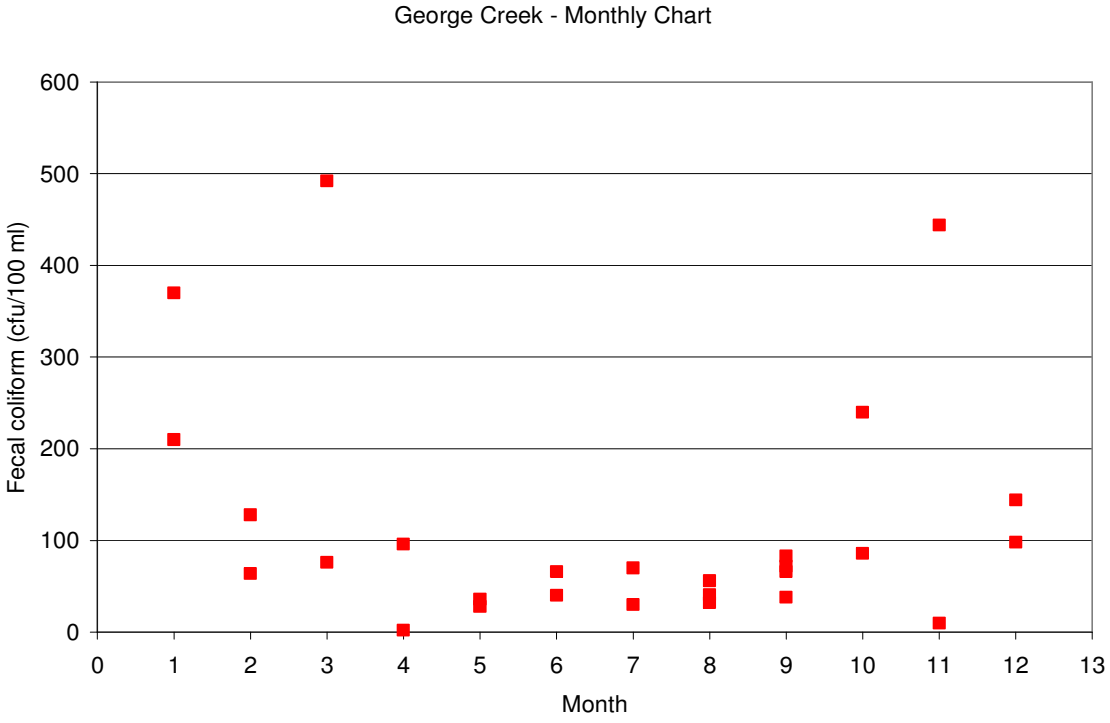

Figure A-2 Monthly concentrations of fecal coliform measured between 1997-1999 at the mouth of George Creek – Station 2

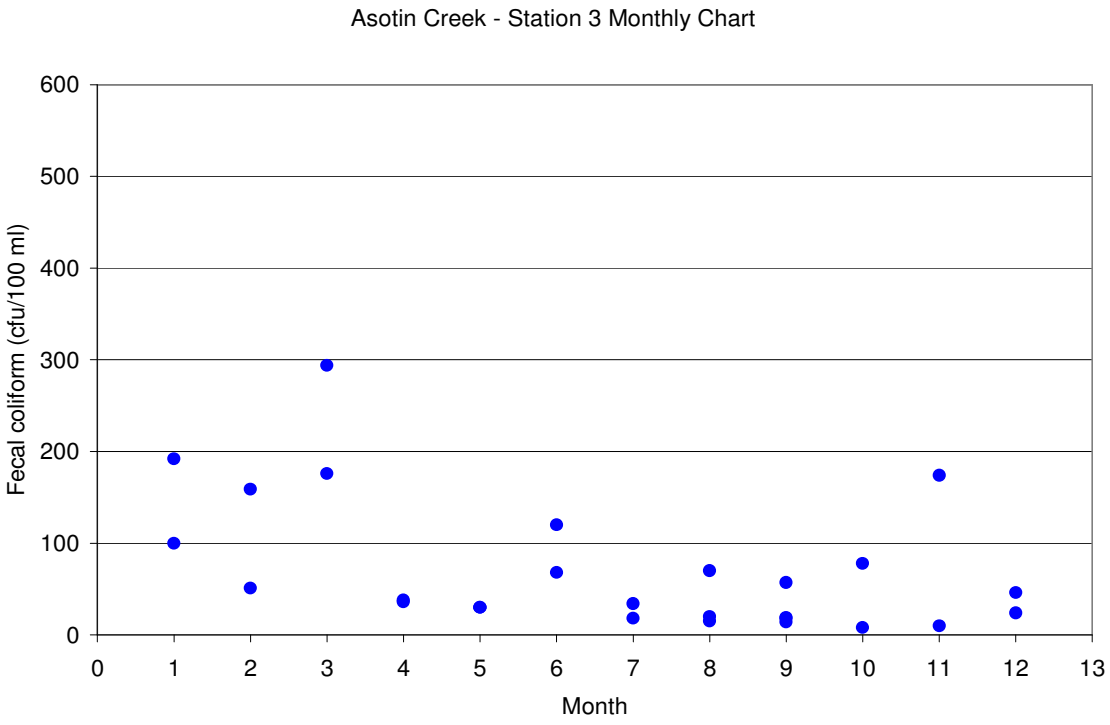

Figure A-1 Monthly concentrations of fecal coliform measured between 1997-1999 in Asotin Creek – Station 3