A Department of Ecology Report

# Bunker/Deep Creek Water Quality Data Report, 1994-1995

WASHINGTON STATE DEPARTMENT OF ECOLOGY


## Abstract

Water quality monitoring results are described for several sites in the Deep Creek watershed where nonpoint source best management practices (BMPs) are being installed. The 1994-95 pre-BMP monitoring results show that the major water quality problem during the wet season is high turbidity. Deep Creek was not sampled during the dry season, but dry season sampling of Bunker Creek showed high levels of organic nitrogen and ammonia suggesting sources of animal waste.


## Introduction

This report transmits the results for the 1994 dry season sampling of Bunker Creek and the 1994-95 wet season sampling of Bunker and Deep Creeks. The purpose of the monitoring is to gather pre-BMP data on several sites in the Deep Creek basin and the mouth of Bunker Creek. Results are shown in Tables 1 and 2. Sampling sites are shown in Figure 1. All sampling was conducted as described by the Quality Assurance Project Plan (QAPP) (Sargeant, 1994).

## Best Management Practices

In the lower reaches of Deep Creek, Lewis Conservation District obtained CFRP funds to install over 2.5 miles of riparian fencing, and 8.5 acres of stream corridor revegetation (Boomer, 1996). Fencing projects are located at approximately river mile (RM) 1.5 and from RM 2.4 to RM 4.5 (Brummer, 1996). In the upper reaches of Deep Creek the CFRP and DNR funded BMPs to target erosion control: treatment included 38 miles of abandoned trail restoration and road restoration; 6 miles of drainage upgrade; erosion control treatments such as culvert replacement and sedimentation traps; and streambank revegetation (Ireland, 1995).

## Dry Season Sampling

During the 1994 dry season, a site near the mouth of Bunker Creek (BCM 0.5) was sampled. Sampling was planned for Deep Creek as well, but sampling was canceled due to low flows. Bunker Creek temperatures exceeded the Class A water quality standard of 18°C during one out of four sample events. Fecal coliform levels met water quality standards.

Total phosphorus levels were slightly elevated ranging from 0.129 to 0.131 mg/L. Phosphorus concentrations above 0.10 mg/L in flowing waters may stimulate algal growth (EPA, 1986).

Dissolved oxygen (D.O.) levels were low, ranging from 3.1 to 4.5 mg/L. None of the dry season D.O. samples met the Class A water quality criterion for D.O. of 8.0 mg/L. Although biochemical oxygen demand (BOD) samples were below detection limits, ammonia levels were elevated, suggesting an uncontrolled source upstream.


by Debby Sargeant


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# TABLE 1

## BUNKER\DEEP CREEK FIELD DATA

| FIELD DATA | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Station creek mile | Date | Time | Temp ° C | | pH | COND µmho /cm | | Discharge cfs | D.O. mg/L (dry season) meter | Winkler |
| DCM 4.5 | 3/9/95 | 13:35 | 7.9 | | 6.8 | 57 | | 17.2 | | |
| DCM 4.5 | 3/14/95 | 12:45 | 8.4 | | 7.7 | 53 | | 52.0 | | |
| DCM 4.5 | 3/22/95 | 9:54 | 6.8 | | 6.3 | 52 | | 43.5 | | |
| | | | | | | | | | | |
| DCM 3.9 | 11/14/94 | 14:26 | 7.0 | | 7.5 | 97 | | 2.6 | | |
| DCM 3.9 | 12/27/94 | 12:30 | 8.7 | | 8.3 | 55 | E* | 225 | | |
| DCM 3.9 | 1/10/95 | 12:35 | 6.4 | # | 6.4 | 60 | | 13.1 | | |
| DCM 3.9 | 1/25/95 | 15:15 | 5.4 | | 7.1 | 65 | | 11.5 | | |
| DCM 3.9 | 1/29/95 | 11:24 | 7.3 | | 7.8 | 62 | E | 9.6 | | |
| DCM 3.9 | 2/16/95 | 12:20 | 4.2 | | 7.6 | 65 | | 7.9 | | |
| DCM 3.9 | 2/21/95 | 10:45 | 7.9 | # | 6.4 | 60 | | 67.7 | | |
| DCM 3.9 | 3/9/95 | 13:10 | 8.0 | | 6.9 | 55 | | 22.3 | | |
| DCM 3.9 | 3/14/95 | 13:25 | 8.5 | | 7.4 | 62 | | 61.2 | | |
| DCM 3.9 | 3/22/95 | 10:33 | 6.8 | | 6.7 | 52 | E | 48.9 | | |
| | | | | | | | | | | |
| DCM 3.6 | 11/14/94 | 14:55 | 7.1 | | 7.2 | 100 | | 2.2 | | |
| DCM 3.6 | 12/27/94 | 12:55 | 8.7 | | 7.8 | 55 | E* | 260 | | |
| DCM 3.6 | 1/10/95 | 12:05 | 6.4 | # | 6.5 | 54 | | 13.9 | | |
| DCM 3.6 | 1/25/95 | 14:47 | 5.3 | | 7.1 | 67 | | 10.8 | | |
| DCM 3.6 | 1/29/95 | 11:30 | 7.4 | | 8.0 | 64 | E | 9.8 | | |
| DCM 3.6 | 2/16/95 | 12:55 | 4.3 | | 7.6 | 68 | | 8.3 | | |
| DCM 3.6 | 2/21/95 | 11:40 | 8.0 | # | 6.3 | 56 | | 78.7 | | |
| DCM 3.6 | 3/9/95 | 12:35 | 8.0 | | 7.1 | 58 | | 25.6 | | |
| DCM 3.6 | 3/14/95 | 14:00 | 8.7 | | 7.5 | 56 | | 67.4 | | |
| DCM 3.6 | 3/22/95 | 10:43 | 6.9 | | 6.9 | 56 | E | 62.8 | | |
| | | | | | | | | | | |
| DCM 2.4 | 11/14/94 | 15:40 | 7.4 | | 7.0 | 125 | | 4.5 | | |
| DCM 2.4 | 12/27/94 | 13:10 | 8.7 | | 7.7 | 60 | E* | 220 | | |
| DCM 2.4 | 1/10/95 | 11:30 | 6.3 | # | 6.5 | 66 | | 19.0 | | |
| DCM 2.4 | 1/25/95 | 14:10 | 5.2 | | 7.1 | 67 | | 12.6 | | |
| DCM 2.4 | 1/29/95 | 11:47 | 7.4 | | 7.9 | 68 | E | 14.4 | | |
| DCM 2.4 | 2/16/95 | 13:39 | 4.4 | | 7.7 | 70 | | 11.8 | | |
| DCM 2.4 | 2/21/95 | 13:00 | 8.3 | # | 6.2 | 60 | | 97.0 | | |
| DCM 2.4 | 3/9/95 | 12:02 | 7.8 | | 7.9 | 61 | | 35.4 | | |
| DCM 2.4 | 3/14/95 | 14:40 | 8.8 | | 7.8 | 58 | | 86.3 | | |
| DCM 2.4 | 3/22/95 | 11:00 | 6.9 | | 7.1 | 55 | E | 79.6 | | |
| | | | | | | | | | | |
| BCM 0.5 | 8/30/94 | 16:50 | 18.6 | | 7.0 | 145 | | 0.1 | 4.2 | |
| BCM 0.5 | 8/31/94 | 10:45 | 16.3 | | | 147 | | 0.1 | | 4.52 |
| BCM 0.5 | 9/14/94 | 8:27 | 14.9 | | 7.0 | 137 | | 0.2 | 3.2 | 3.10 |
| BCM 0.5 | 9/14/94 | 13:35 | 15.9 | | 6.9 | 136 | | 0.2 | 3.7 | 4.00 |
| BCM 0.5 | 11/14/94 | 16:18 | 7.2 | | | 95 | | 29.6 | | |
| BCM 0.5 | 12/27/94 | 13:37 | 8.9 | | 7.7 | 45 | | ** | | |
| BCM 0.5 | 1/10/95 | 10:35 | 5.8 | # | 6.7 | 60 | | 85.7 | | |
| BCM 0.5 | 1/25/95 | 13:32 | 4.5 | | 7.1 | 60 | | 66.5 | | |
| BCM 0.5 | 1/29/95 | 12:05 | 7.3 | | 8.0 | 56 | | 69.1 | | |
| BCM 0.5 | 2/16/95 | 14:20 | 3.9 | | 7.7 | 55 | | 60.2 | | |
| BCM 0.5 | 2/21/95 | 14:00 | 8.4 | # | 6.4 | 49 | E* | 740 | | |
| BCM 0.5 | 3/9/95 | 11:20 | 7.5 | | 7.9 | 54 | | 145.9 | | |
| BCM 0.5 | 3/14/95 | 15:25 | 8.7 | | 7.7 | 47 | E* | 670 | | |
| BCM 0.5 | 3/22/95 | 11:19 | 6.7 | | 7.4 | 50 | E* | 610 | | |

# Post calibration of meter showed meter reading from 0.4 to 0.5 low compared to known standard. Data is considered valid, but biased from 0.4 to 0.5 low.

E Field estimate\gauge reading.

* Flow curve estimate may not be reliable due to very high flows.

** High flows in Chehalis River caused back up at mouth of Bunker Creek, unable to give estimate of discharge.

# TABLE 2

## BUNKER\DEEP CREEK LABORATORY DATA

| LABORATORY DATA | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station creek mile | Date | Time | Turbidity NTU* | | BOD5 mg/L (dry season) | | NH3 mg/L | | NO2/3 mg/L | Organic Nitrogen ** | TPN mg/L | Total Phos. mg/L | | Fecal Coliform cfu/100 mL* | | |
| DCM 4.5 | 3/9/95 | 13:35 | 20 | | | | | | | | | | | | | |
| DCM 4.5 | 3/14/95 | 12:45 | 20 | | | | | | | | | | | | | |
| DCM 4.5 | 3/22/95 | 9:54 | 15 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| DCM 3.9 | 11/14/94 | 14:26 | 5.9 | | | | < | 0.010 | 0.352 | 0.132 | 0.494 | | | 4 | | |
| DCM 3.9 | 12/27/94 | 12:30 | 160 | | | | | 0.022 | 0.970 | 0.458 | 1.45 | | | 190 | | 110 |
| DCM 3.9 | 1/10/95 | 12:35 | 9.4 | | | | < | 0.010 | 0.690 | 0.074 | 0.774 | | | 5 | | |
| DCM 3.9 | 1/25/95 | 15:15 | 5.6 | | | | < | 0.010 | 0.718 | 0.000 | 0.713 | | | 2 | | |
| DCM 3.9 | 1/29/95 | 11:24 | 8.3 | | | | | 0.044 | 0.564 | 0.013 | 0.621 | | | 13 | | 7 |
| DCM 3.9 | 2/16/95 | 12:20 | 6.8 | | | | < | 0.010 | 0.552 | 0.056 | 0.618 | | | 7 | | 4 |
| DCM 3.9 | 2/21/95 | 10:45 | 26 | | | | < | 0.010 | 0.880 | 0.130 | 1.02 | | | 4 | | |
| DCM 3.9 | 3/9/95 | 13:10 | 22 | 22 | | | < | 0.010 | 0.609 | 0.182 | 0.801 | | | 5 | | 4 |
| DCM 3.9 | 3/14/95 | 13:25 | 22 | | | | < | 0.010 | 0.789 | 0.104 | 0.903 | | | 8 | | |
| DCM 3.9 | 3/22/95 | 10:33 | 14 | | | | | 0.022 | 0.815 | 0.121 | 0.958 | | | 15 | | 12 |
| | | | | | | | | | | | | | | | | |
| DCM 3.6 | 11/14/94 | 14:55 | 5.9 | | | | < | 0.010 | 0.415 | 0.085 | 0.510 | | X | 13 | | 19 |
| DCM 3.6 | 12/27/94 | 12:55 | 150 | | | | | 0.022 | 1.16 | 0.428 | 1.61 | | | 70 | | |
| DCM 3.6 | 1/10/95 | 12:05 | 9.5 | | | | < | 0.010 | 0.811 | 0.070 | 0.891 | | | 21 | | |
| DCM 3.6 | 1/25/95 | 14:47 | 5.9 | | | | < | 0.010 | 0.858 | 0.016 | 0.884 | | | 6 | < | 1 |
| DCM 3.6 | 1/29/95 | 11:30 | 15 | | | | | 0.014 | 0.675 | 0.057 | 0.746 | | | 19 | | |
| DCM 3.6 | 2/16/95 | 12:55 | 6.9 | | | | < | 0.010 | 0.672 | 0.065 | 0.747 | | | 4 | | |
| DCM 3.6 | 2/21/95 | 11:40 | 28 | 26 | | | < | 0.010 | 1.05 | 0.280 | 1.34 | | | 3 | < | 3 |
| DCM 3.6 | 3/9/95 | 12:35 | 45 | | | | < | 0.010 | 0.813 | 0.160 | 0.983 | | | 15 | | |
| DCM 3.6 | 3/14/95 | 14:00 | 23 | | | | | 0.049 | 0.914 | 0.127 | 1.09 | | | 10 | | 7 |
| DCM 3.6 | 3/22/95 | 10:43 | 14 | 13 | | | | 0.036 | 0.934 | 0.120 | 1.09 | | | 15 | | 11 |
| | | | | | | | | | | | | | | | | |
| DCM 2.4 | 11/14/94 | 15:40 | 11 | | | | < | 0.010 | 0.392 | 0.114 | 0.516 | | | 120 | | |
| DCM 2.4 | 12/27/94 | 13:10 | 150 | | | | | 0.047 | 1.19 | 0.823 | 2.06 | | | 125 | | 125 |
| DCM 2.4 | 1/10/95 | 11:30 | 12 | 11 | | | < | 0.010 | 0.783 | 0.083 | 0.876 | | | 31 | | 17 |
| DCM 2.4 | 1/25/95 | 14:10 | 6.2 | | | | < | 0.010 | 0.840 | 0.000 | 0.824 | | | 8 | | |
| DCM 2.4 | 1/29/95 | 11:47 | 12 | | | | < | 0.010 | 0.667 | 0.071 | 0.748 | | | 31 | | |
| DCM 2.4 | 2/16/95 | 13:39 | 8.7 | 8.6 | | | < | 0.010 | 0.647 | 0.051 | 0.708 | | | 31 | | 40 |
| DCM 2.4 | 2/21/95 | 13:00 | 36 | | | | < | 0.010 | 1.06 | 0.270 | 1.34 | | | 11 | | |
| DCM 2.4 | 3/9/95 | 12:02 | 32 | | | | < | 0.010 | 0.694 | 0.186 | 0.890 | | | 83 | | |
| DCM 2.4 | 3/14/95 | 14:40 | 28 | | | | | 0.021 | 0.894 | 0.125 | 1.04 | | | 14 | | |
| DCM 2.4 | 3/22/95 | 11:00 | 19 | | | | | 0.026 | 0.932 | 0.112 | 1.07 | | | 18 | | |
| | | | | | | | | | | | | | | | | |
| BCM 0.5 | 8/30/94 | 16:50 | | | < | 2 | | 0.043 | 0.036 | 0.239 | 0.318 | 0.131 | | 130 | | |
| BCM 0.5 | 8/31/94 | 10:45 | | | < | 2 | | 0.042 | 0.043 | 0.350 | 0.435 | | | | | |
| BCM 0.5 | 9/14/94 | 8:27 | | | < | 2 | | 0.096 | 0.031 | 0.384 | 0.511 | 0.129 | | | | |
| BCM 0.5 | 9/14/94 | 13:35 | | | < | 2 | | 0.049 | 0.029 | 0.286 | 0.364 | 0.129 | | 88 | | 58 |
| BCM 0.5 | 11/14/94 | 16:18 | 6.5 | 6.5 | | | < | 0.010 | 0.209 | 0.113 | 0.332 | | | 31 | | 23 |
| BCM 0.5 | 12/27/94 | 13:37 | 80 | | | | | 0.021 | 0.694 | 0.325 | 1.04 | | | 195 | | |
| BCM 0.5 | 1/10/95 | 10:35 | 11 | | | | < | 0.010 | 0.453 | 0.133 | 0.596 | | | 87 | | 100 |
| BCM 0.5 | 1/25/95 | 13:32 | 6.9 | | | | | 0.031 | 0.518 | 0.063 | 0.612 | | | 14 | | 13 |
| BCM 0.5 | 1/29/95 | 12:05 | 10 | | | | | 0.041 | 0.379 | 0.075 | 0.495 | | | 45 | | 35 |
| BCM 0.5 | 2/16/95 | 14:20 | 9.8 | | | | < | 0.010 | 0.357 | 0.169 | 0.536 | | | 89 | | |
| BCM 0.5 | 2/21/95 | 14:00 | 27 | | | | < | 0.010 | 0.677 | 0.216 | 0.903 | | | 20 | | 23 |
| BCM 0.5 | 3/9/95 | 11:20 | 31 | | | | < | 0.010 | 0.389 | 0.184 | 0.583 | | | 540 | | |
| BCM 0.5 | 3/14/95 | 15:25 | 28 | 27 | | | | 0.017 | 0.603 | 0.160 | 0.780 | | | 92 | | 84 |
| BCM 0.5 | 3/22/95 | 11:19 | 15 | | | | | 0.027 | 0.620 | 0.134 | 0.781 | | | 23 | | |

* Second column details lab results for field replicates samples.

** The organic portion of nitrogen is calculated by subtracting NH3 and NO2/3 from Total Nitrogen.

< Less than the reported result.

X High background count, count may be an underestimate.

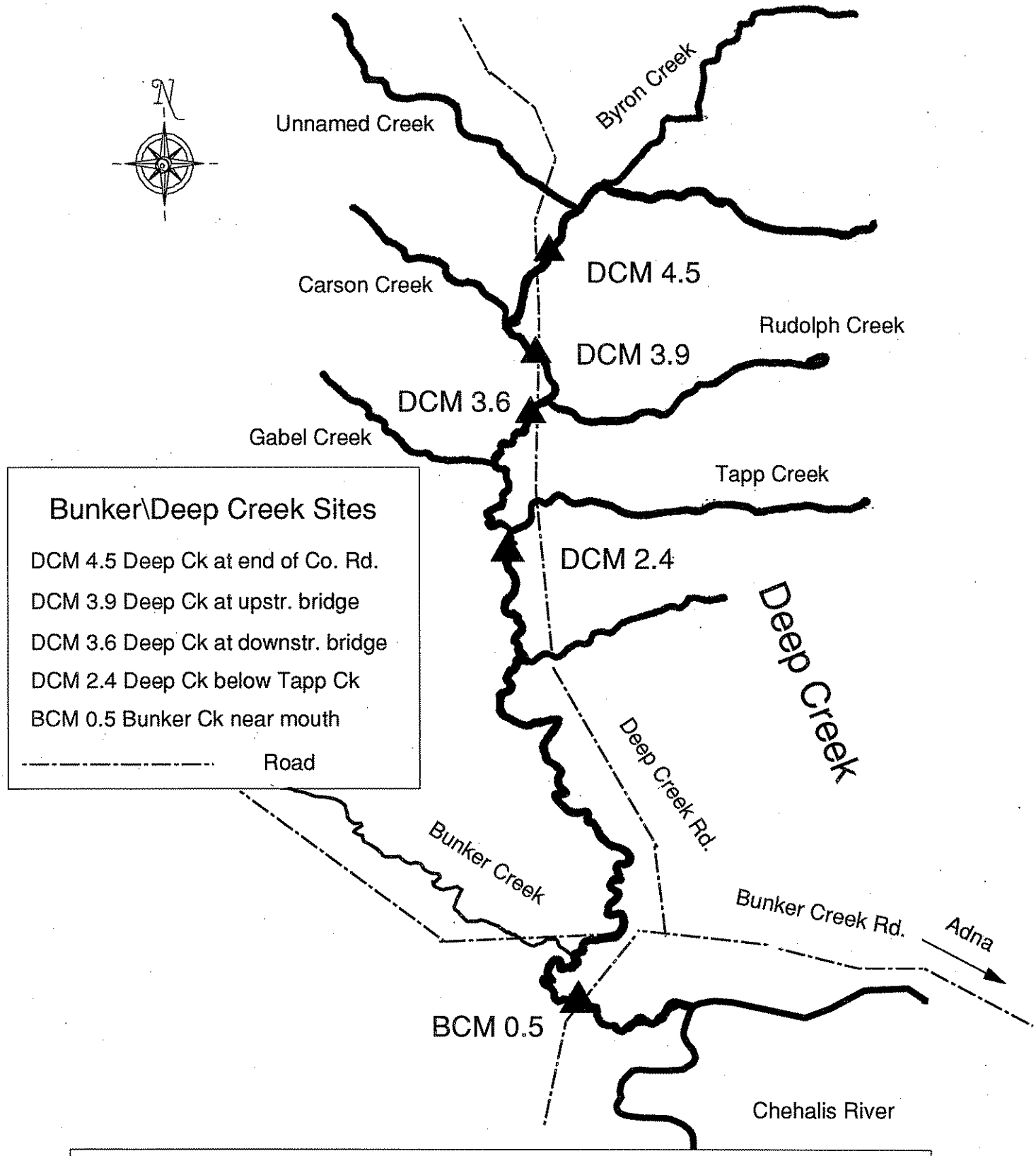


Figure 1 Bunker and Deep Creek Sampling Sites.

Dry season ammonia levels were elevated ranging from 0.042 to 0.096 mg/L. Though these levels meet the water quality standards, they do not meet the Bunker Creek dry season ammonia target of <0.010 mg/L, as recommended in the Upper Chehalis River Dry Season total Maximum Daily Load Study (Pickett, 1994).

A comparison of dry and wet season sampling results for Bunker Creek shows that during the dry season, conductivity levels were higher than in the wet season. During the dry season, nitrogen was mostly in organic form with elevated ammonia, while in the wet season nitrogen was mostly in the form of nitrate\nitrite. Figure 2 shows inorganic\organic nitrogen levels found during the wet and dry season at Bunker Creek. This could indicate dry season pollutant loading of an organic nitrogen source, such as direct animal access to the stream or failing on-site septic systems. Higher wet season flows dilute the dry season sources, but also increase the transport of nitrates, which are highly soluble. The results can also be explained by a lack of nitrification that converts ammonia to nitrate. The lack of nitrification could be due to low dissolved oxygen, the absence of nitrifying bacteria, or the proximity to the source.

## Wet Season Sampling

Winter sampling of Bunker and Deep Creeks showed high turbidity levels at all sampling sites (Figure 3). Using the upstream station as background, the water quality standard for turbidity was not met for the Deep Creek sites during three of the ten sampling events. The station at Deep Creek Mile (DCM) 2.4 had higher turbidity levels that the station at DCM 3.9 during nine out of ten sampling events. This indicates the presence of upland sources or bank erosion between DCM 3.9 and 2.4.

Turbidity levels increase with higher flows. This is especially true for the Deep Creek sampling sites. High turbidity levels during higher flows is consistent with findings in the USFWS Chehalis River Basin Fishery Resources survey (Wampler *et al.*, 1993) that documented bank erosion and sediment deposition from DCM 3.9 upstream to near the headwaters of Deep Creek. During sampling of Deep Creek, eroding banks and fine sediment deposition at the sampling sites were observed.

During the wet season, temperature, pH, fecal coliform, and ammonia met water quality standards.

## Conclusions

Turbidity is a major problem throughout the Deep Creek Basin. High levels of organic nitrogen and ammonia suggest animal waste sources that are not yet controlled. The presence of dry season loading suggest an animal access problem. Data support continued work on livestock access to address both ammonia and turbidity problems.

Since the major water quality problem during the winter months in Deep Creek is high turbidity levels, I recommend focusing on sediment-related laboratory parameters. The 1995 addendum to the QAPP (Sargeant, 1995) describes the 1995-96 sampling plan. For winter 1995-96, laboratory parameters will be reduced to turbidity and total suspended solids.

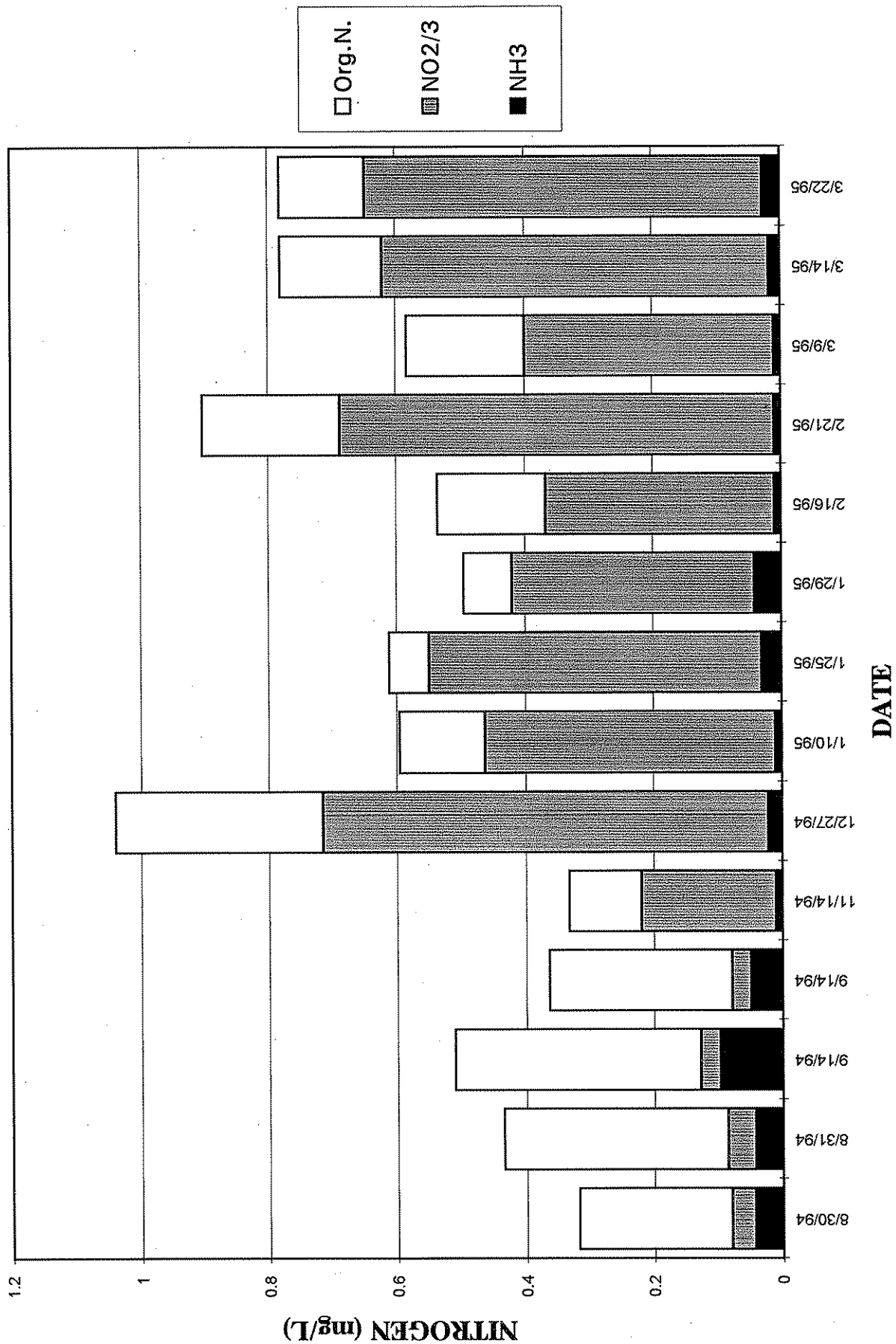


**Figure 2. Summer and Winter Nitrogen Levels at Bunker Creek 1994\95.**

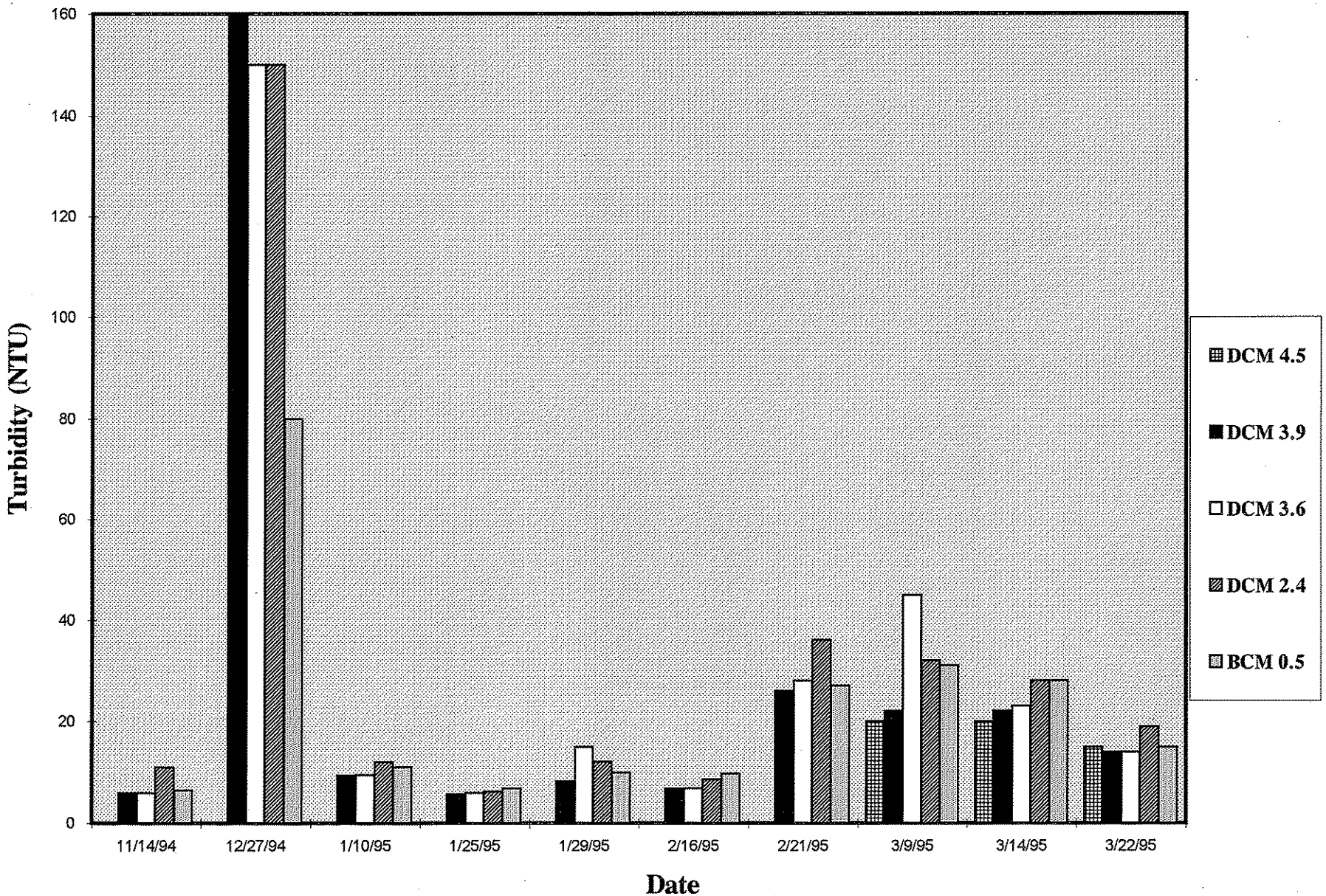


**Figure 3. Turbidity**

**Sample Results for Bunker and Deep Creek for winter 1994-95.**

Future dry season sampling plans will be determined when results from the 1995 dry season sampling have been analyzed.

A detailed analysis of the data for Bunker and Deep Creeks is planned for the final report in 1998, after several years of data have been collected.

## References


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