Bear-Evans Creek Stream Resource Inventory

Technical Report WR-82-2

METRO

Water Quality Division
1982

Municipality of Metropolitan Seattle

BEAR-EVANS CREEK

STREAM RESOURCE INVENTORY

Technical Report WR-82-2

Metro Water Quality Division

TABLE OF CONTENTS

		Page
APPENDICES		iii
LIST OF FIGURES		iv
LIST OF TABLES		v
ACKNOWLEDGMENTS		vi
ABSTRACT		vii
CHAPTER 1	INTRODUCTION	1
CHAPTER 2	SUMMARY OF THE AVAILABLE DATA	3
	Description of the Stream and Its Basin	3
	Stream Biota	13
	Water Use	15
CHAPTER 3	DESCRIPTION OF EVALUATION APPROACH	18
	Evaluation Criteria	18
	Comments on the Appropriateness of the Criteria	19
	Data Limitations	21
CHAPTER 4	EVALUATION OF SUITABILITY OF EXISTING STREAM CONDITIONS TO SUPPORT IDENTIFIED BENEFICIAL USES	22
	Physical Features Related to Flood/Erosion Potential	22
	Riparian Corridor for Wildlife/Water Quality Protection	24
	Salmonid Production	26
	Water Quality for use as Water Supply	27
	Recreational Opportunities	28
	Summary	29
CHAPTER 5	IDENTIFICATION OF ADDITIONAL DATA NEEDED FOR THE EVALUATION OF EXISTING STREAM CONDITIONS	30
REFERENCES		32

APPENDICES

		Page
A.	PERIOD OF RECORD FOR METRO'S BEAR-EVANS CREEK WATER QUALITY SURVEYS AND PARAMETERS	36
B.	CONCENTRATIONS OF SEVEN CHEMICAL PARAMETERS AT SIX SITES IN BEAR-EVANS CREEK	
	B.1. ANNUAL COMPARISON	38
	B.2. SEASONAL COMPARISON	39
C.	SALMON SPAWNING GROUND DATA FOR BEAR-EVANS CREEK AND ITS TRIBUTARIES	42
D.	CRITERIA FOR EVALUATING A STREAM AS TO:	
	D.1. FLOOD AND EROSION POTENTIAL	45
	D.2.a. SUITABILITY FOR SALMON AND TROUT	46
	D.2.b. MAXIMUM TRACE METALS CONCENTRATION FOR THE PROTECTION OF FRESH WATER AQUATIC LIFE	47
	D.3. SUITABILITY OF RIPARIAN CORRIDOR FOR WILDLIFE HABITAT AND PROTECTION OF WATER QUALITY	48
	D.4. SUITABILITY FOR WATER SUPPLY	49
	D.5. SUITABILITY FOR SWIMMING AND BOATING.	50
E.	TASK AND LABOR REQUIREMENTS TO FILL DATA NEEDS	51

LIST OF FIGURES

		Page
2.1	BEAR-EVANS CREEK DRAINAGE BASIN	3b
2.2	USGS MEAN MONTHLY DISCHARGE FOR EVANS CREEK FOR 1957 to 1976 COMPARED WITH INSTANTANEOUS DISCHARGES DURING METRO'S WATER QUALITY SAMPLING (1972-1981)	9a
2.3	LOCATION OF METRO'S PAST AND PRESENT WATER QUALITY STATIONS ON BEAR-EVANS CREEK	11a
2.4	SPATIAL AND TEMPORAL COMPARISONS (1979-1981) OF SIX PARAMETERS AT SIX SITES IN THE BEAR-EVANS CREEK BASIN	12b
2.5	SALMON UTILIZATION OF BEAR-EVANS CREEK BY SPECIES AND AREA	14a
2.6	PROBABLE USES OF WATER RIGHTS GRANTED IN BEAR-EVANS CREEK BASIN	15a
4.1	SUMMARY OF THE SUITABILITY OF BEAR-EVANS CREEK TO SUPPORT VARIOUS USES	29a

LIST OF TABLES

		Page
2.1	WASHINGTON DEPARTMENT OF ECOLOGY CHARACTERISTIC USES TO BE PROTECTED FOR FRESHWATER	3a
2.2	1980 LAND USE ESTIMATES FOR THE BEAR-EVANS CREEK BASIN	4a
2.3	PHYSICAL SURVEY DATA FOR BEAR-EVANS CREEK AND SEVERAL TRIBUTARIES	4b
2.4	SEASONAL COMPARISON OF 14 WATER QUALITY PARAMETERS FOR STATION 0 AT THE MOUTH OF BEAR-EVANS CREEK	12a
2.5	TOXICANTS IN BEAR-EVANS CREEK INTERSTITIAL STREAM WATER	13a
2.6	FISHERIES SURVEY DATA FROM A LIMITED BASIN SURVEY . . .	14b
2.7	SUMMARY OF BEAR CREEK BENTHOS DATA FOR TWO MAINSTEM SITES AND FOUR TRIBUTARY SITES	14c
2.8	TOTAL ALLOTTED VOLUMES FOR THE MOST COMMON USES MADE OF WATER WITHDRAWN FROM BEAR-EVANS CREEK . . .	15b
4.1	SUMMARY OF USES OF BEAR-EVANS CREEK AND THEIR CONFIRMATION THROUGH THIS STUDY	22a
4.2	NUMBER OF TIMES THAT MEASUREMENTS OF FOUR PARAMETERS AT SIX STATIONS ON BEAR-EVANS CREEK DID NOT MEET VARIOUS CRITERIA	26a
4.3	NUMBER OF TIMES THAT MEASUREMENTS OF SIX METALS AT SIX STATIONS ON BEAR-EVANS CREEK DID NOT MEET VARIOUS CRITERIA	26b

ACKNOWLEDGMENTS

This document is the result of the combined efforts and talents of many people. The cooperation and input of all those involved with this project is greatly appreciated by the authors.

Documentation Preparation:	Alan Johnson (Project Manager), Bob Brenner, Rob Morrice, Dale Anderson, Pat Magnuson, Sarah Hubbard, Peggy Burbank - Metro Water Quality Division
Other Agency Input:	Tim Flint, Jim Ames, Millard Deusen, Joe Robel - Washington Department of Fisheries
	Bob Pfeifer, Ted Mueller - Washington Department of Game
	Dave Garland - Washington Department of Ecology
Typing:	Barbara Badger - Metro Water Quality Division
	Metro Word Processing Center

ABSTRACT

The purpose of the Bear-Evans Creek Stream Resource Inventory (SRI) is to provide a synthesis of the available information on the present condition of the stream's physical, biological and chemical features. Specifically, this document is intended to serve as a technical resource document for developing basin specific water quality management plans. It is also intended to serve as an information source for other agency, jurisdiction, public and private sector use.

The 32,000 acre Bear-Evans Creek drainage basin has moderate to steeply sloped uplands that drain into a broad floodplain. Currently, 82.5 percent of the basin is forested or classified as open space.

In general, both Bear and Evans Creeks are fairly wide, shallow streams that have low gradients. The canopy varies from small amounts of deciduous trees that provide little shade to thick growths of deciduous and coniferous trees that provide excellent shade. Portions of both streams flow through wet, marshland areas in which the streambank is sometimes undefined. The riparian corridor is primarily green belt with some single family residences.

Bear-Evans Creek is generally a cool, clear, well oxygenated stream. The water is slightly alkaline with a low buffering capacity. Bear-Evans Creek has been assigned a Class AA rating by the Department of Ecology. The most commonly identified water supply uses were for domestic water supply (single-family), fish propagation and irrigation. Irrigation comprises the largest portion of the allotted withdrawal volume.

Sockeye and coho are the most numerous of the three species of salmon found in many streams of the basin. Annual returns of 16,000 to 22,000 adult sockeye have been recorded. There is also a fair number of cutthroat trout and a few steelhead present.

In the evaluation of the suitability of the present conditions to support the various uses, Bear-Evans Creek was generally rated as good. The primary factors which caused the few low ratings were high fecal coliform counts (Water Use and Recreation), shallow water depth (Recreation) and channel scour and high fines content of the substrate (Salmonid Production).

Four data needs were identified in the evaluations of Bear-Evans Creek. They are physical survey data for several small tributaries, information on the present status of the fishery resource in these same tributaries, further recreational use data and confirmation of the present water withdrawals for domestic use.

CHAPTER 1

INTRODUCTION

The determination of existing and future water quality conditions is a fundamental element of any water quality management program. This information, especially when it defines the limitations of existing instream water uses, is needed so that decisions on the design and implementation of effective water quality management systems can be made by the public and the resource management agencies. The purposes of this report are, first, to provide a synthesis of the available information on the present condition and use of Bear-Evans Creek and, second, to evaluate the suitability of the creek to support various desired uses. This report is primarily intended to serve as a technical resource document for the development of basin-specific water quality management plans. A prediction of future stream conditions is not included in this document as this will be evaluated in a separate effort.

This report is one of a series of stream resource inventories (SRI's) prepared by Metro. While this document is intended primarily for Metro's water quality management activities, it is also intended to serve as a reliable information source for other agency, jurisdiction and private sector use. Much of the data for this report is from Metro's water quality monitoring and physical stream surveys. Some of the data summaries are updates of Uchida's "A Profile of Water Quality in the Cedar-Green River Basins" (1978). Other input was provided by personnel from the Washington State Departments of Ecology (DOE), Fisheries (WDF), Game (WDG), the United States Geological Survey (USGS) and the local jurisdictions of each stream basin. Correspondence concerning corrections, additional information or updates of data cited herein would be appreciated by the authors.

The format for the remainder of this report is as follows:

- Chapter 2 summarizes and documents the available data on Bear-Evans Creek and its use. Little data interpretation is intended or presented in this section.

- Chapter 3 describes how the stream is evaluated using the existing data. It defines the criteria used in the evaluation procedure, the appropriateness of the criteria, and the general limitations of the data used.

- Chapter 4 evaluates the suitability of the stream to support various desired uses.

- Chapter 5 summarizes the additional data or information needed for the evaluation. Included in this section are estimates of the effort required to obtain this information.

CHAPTER 2

SUMMARY OF THE AVAILABLE DATA

The Washington State Department of Ecology, which has responsibility for managing the water resources of the state, has classified all surface waters into five classes: Lakes, AA (extraordinary), A (excellent), B (good) and C (fair). Each class of water has specific characteristic uses. These uses include but are not limited to water supply, fish and wildlife habitat, and general recreational and aesthetic enjoyment (Table 2.1). This chapter summarizes the available information on the present existing conditions and uses of Bear-Evans Creek, a class AA water. The first section of this chapter, "Description of the Stream and Its Basin," describes the physical features of the basin, the stream, the riparian corridor and the quality of the stream water. The section on "Stream Biota" discusses the fish and other aquatic organisms found in the stream. Finally, the human uses of the stream, specifically water supply and recreation, are examined in the section on "Water Use."

DESCRIPTION OF THE STREAM AND ITS BASIN

Basin Description

The 32,000 acre Bear-Evans Creek drainage basin is located northeast of Lake Sammamish and extends north into Snohomish County east of Woodinville. The topography of the basin is characterized by moderate to steeply sloped uplands that drain into a broad floodplain, wetlands or lakes (Uchida, 1978).

Two major streams, Bear and Evans, exist in the basin (Figure 2.1). Bear Creek with a main stem of 12.4 miles, drains approximately 9,000 acres. Bear Creek has four large tributaries: Mackey Creek (2.6 miles); Cottage Lake Creek (6.7 miles); Seidel Creek (2.8 miles) and Struve Creek (1.8 miles). Evans Creek, which is 8.2 miles in length, drains approximately 8,000 acres. There are four lakes in the basin: Cottage (63 acres), Paradise (18 acres), Crystal (39 acres) and Leota (10 acres).

Much of the drainage of these two streams lies within a flat, wide valley. There are large sections of cleared land interspersed with areas of third growth timber, deciduous trees

Table 2.1. Washington Dept. of Ecology Characteristic Uses[1] to be Protected for Freshwaters (DOE, pers. comm., 1982)

USES	WATER COURSE CLASSIFICATION AA Extraordinary	A Excellent	B Good	C Fair
Water Supply				
domestic	X	X		
industrial	X	X	X	X
agricultural	X	X	X	
Stock Watering	X	X	X	
Fish				
salmonid migration	X	X	X	X
salmonid rearing	X	X	X	
salmonid spawning	X	X		
salmonid harvesting	X	X	X	
other fish migration	X	X	X	X
other fish rearing	X	X	X	
other fish spawning	X	X	X	
other fish harvesting	X	X	X	
Shellfish				
clam, oyster & mussel rearing	X	X	X	
clam, oyster & mussel spawning	X	X	X	
clam, oyster & mussel harvest.	X	X		
crustaceans & other shellfish rearing	X	X	X	
crustaceans & other shellfish spawn.	X	X	X	
crustaceans & other shellfish harvest.	X	X	X	
Wildlife Habitat	X	X	X	X
Recreation				
primary contact recreation	X	X		
sport fishing	X	X		
boating	X	X		
aesthetic enjoyment	X	X		
Recreation				
secondary contact recreation	X	X	X	X
sport fishing	X	X	X	X
boating	X	X	X	X
aesthetic enjoyment	X	X	X	X
Commerce and Navigation	X	X	X	X

[1]Uses listed for each class are "...included but not limited to."

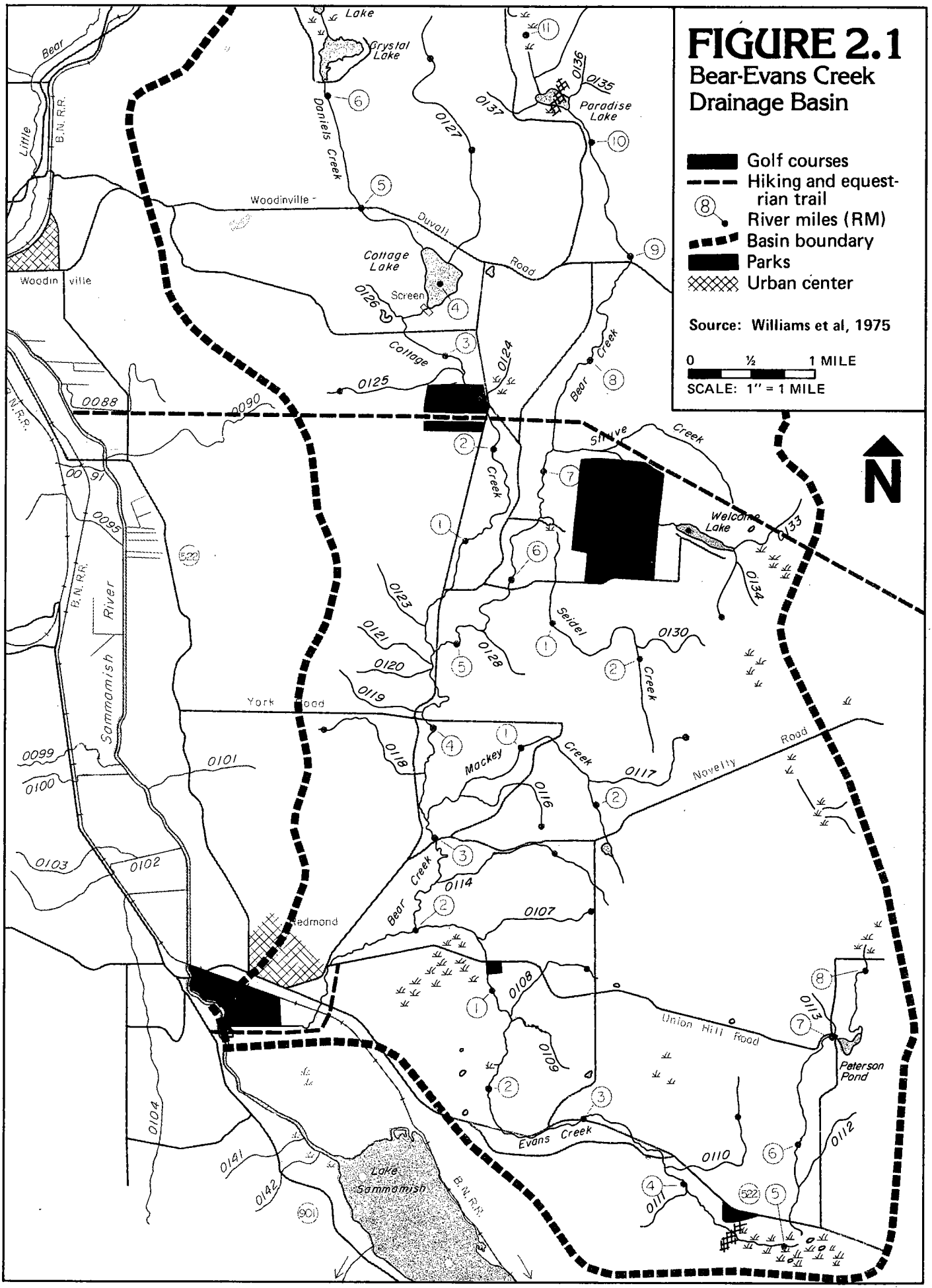


FIGURE 2.1
Bear-Evans Creek
Drainage Basin
Golf courses
Hiking and equestrian trail
River miles (RM)
Basin boundary
Parks
Urban center
Source: Williams et al, 1975
0 ½ 1 MILE
SCALE: 1" = 1 MILE
N
Crystal Lake
Paradise Lake
Daniels Creek
Woodinville
Duvall Road
Cottage Lake
Screen
Cottage Creek
Bear Creek
Shrive Creek
Welcome Lake
Seidel Creek
Sammamish River
York Road
Mackey Creek
Novelty Road
Bear Creek
Redmond
Union Hill Road
Peterson Pond
Evans Creek
Lake Sammamish
B.N.R.R.
Little Bear
0088
0090
0091
0095
0099
0100
0101
0102
0103
0104
0107
0108
0109
0110
0111
0112
0113
0114
0116
0117
0118
0119
0120
0121
0123
0124
0125
0126
0127
0128
0130
0133
0134
0135
0136
0137
0141
0142

and brush. The more fertile lands of the watershed have undergone rapid development and residential growth within the last 10 years.

Three governmental jurisdictions exist in the basin. Approximately 29 percent of the basin is in Snohomish County with the remainder in King County. The jurisdictions with drainage responsibility include King County (70 percent), Snohomish County (29 percent and Redmond (1 percent). The estimated population of the basin in 1980 was 18,038 (PSCOG, unpublished data, 1981).

Currently 82.5 percent of the basin is forested or classified as open space (Table 2.2). The remainder of the basin is agricultural (5.4 percent), low density housing (5.4 percent) and streets (4.4 percent).

Stream Description

Bear Creek

Bear Creek originates in Paradise Valley immediately north of Paradise Lake. It flows in a southwesterly direction for 12.4 miles before joining the Sammamish River at RM 12.2 near Redmond (Williams, et al., 1975).

In general, Bear Creek is a fairly wide, shallow stream with a low gradient (Table 2.3). The average width of Bear Creek varies from 4 to 25 feet in summer and 5 to 30 feet in winter. The creek is evenly divided between pool, run and riffle areas that vary in depth from 5 to 0.1 foot respectively. The canopy varies from small amounts of deciduous trees which provide little shade, to thick growths of deciduous and coniferous trees that provide excellent shade. The instream cover consists of overhanging branches and grasses, natural stream debris, and undercut banks.

Except for several scattered areas near RM 9.0, and 6.5 to 7.0, much of the upper reaches of the stream (RM 10.3 to 8.0) flows through wet, marshland areas in which the streambank is sometimes undefined. Beaver dams are common near the headwaters. The substrate varies from areas of muck and high fines to graveled riffles. The riparian corridor is primarily greenbelt with some single family residences. Near RM 8.0, part of the stream has been diverted through a private residence to form a pond and garden area.

Table 2.2 1980 Land Use Estimates for the Bear-Evans Creek Basin. (PSCOG, 1980 Unpublished Data)

LAND USE	ACREAGE	% OF TOTAL ACREAGE
Residential:		
Low Density	1,729	5.4
Medium Density	32	0.1
High Density	34	0.1
Commercial	364	1.1
Industrial	46	0.1
Streets	1,421	4.4
Open Space	3,730	11.7
Agricultural:		
Cultivated	416	1.3
Pasture	1,304	4.1
Forest	22,642	70.8
Inland Waters	277	0.9
TOTAL	32,000	100

ESTIMATED PERCENT IMPERVIOUS SURFACE - 8.0% (Harper-Owes, 1981)

Table 2.3. Physical Survey Data for Bear-Evans Creek and Several Tributaries. Data from Metro's 1981 Small Streams Surveys.

STREAM	STREAM REACH	RIVER MILE	ESTIMATED DISCHARGE (CFS)[3]	SUMMER WIDTH Average/Range (FT)	WINTER WIDTH Average/Range (FT)	POOL DEPTH Average/Range (FT)	RIFFLE DEPTH Average/Range (FT)	POOL: RIFFLE: RUN (%)	SUBSTRATE[2] B:R:G:S (%)	GRADIENT[4] (%)	SHADE[4] (%)	COVER (%)	RIPARIAN LAND USE
Bear	Golf Course to	0.0-0.3	20	12 10-15	15 12-20	No Pools	1 0.8-1.5	0:65:35	All riprap	0	35	50	Golf course/ Greenbelt
	Union Hill Road to	0.3-1.2	15	25 18-35	28 20-30	4-76	No riffles	20:0:80	Muck	0	50	30	Agriculture /Pasture
	NE 95th to	1.2-2.7	15	25 18-30	28 20-35	2 1-4	0.5 .2-.7	80:5:15	0:t:50:50	0.32	30	65	Light residental/ Farming
	NE 106th to	2.7-3.4	15	16 18-30	25 15-45	2.0 1.8-5	0.3 .3-.5	45:5:50	t:5:70:25	0	30	55	Light farm/ livestock grazing
	NE 116th to	3.4-4.1	15	12 6-30	15 7-40	3 1.5-4	0.3 .2-.4	45:10:45	0:0:75:25	0.67	15	55	Light residental
	Avondale Road to	4.1-4.8	15	16 10-30	30 25-50	2.5 1.4-5.0	0.6 .4-.8	15:5:80	t:5:90:5	0	20	60	Light residental
	NE 133rd to	4.8-6.0	15	18 10-30	22 15-50	2.5 1.-4.	0.3 .1-.6	40:15:45	0:0:80:20	0.39	75	60	Green belt/ pasture/ light residental
	NE 140th	6.0-6.5	15	15 10-20	18 15-25	3 2-5	0.2 .2-.5	30:30:40	0:10:50:40	0.95	80	30	Light residental

Table 2.3. Physical Survey Data for Bear-Evans Creek and Several Tributaries. Data from Metro's 1981 Small Streams Surveys. (Cont.)

STREAM	STREAM REACH	RIVER MILE	ESTIMATED DISCHARGE (CFS)[3]	SUMMER WIDTH Average/Range (FT)	WINTER WIDTH Average/Range (FT)	POOL DEPTH Average/Range (FT)	RIFFLE DEPTH Average/Range (FT)	POOL: RIFFLE: RUN (%)	SUBSTRATE[2] B:R:G:S (%)	GRADIENT[4] (%)	SHADE[4] (%)	COVER (%)	RIPARIAN LAND USE
Bear Cont.	to Near Bear Ck. Road	6.5-7.0	15	18 6-25	22 10-40	2 1.-3.5	0.4 .2-.6	35:55:10	0:t:85:15	0.95	30	25	Light residental
	to Near NE 175th	7.0-8.0	15	18 10-25	25 15-30+	1.5 1-2	0.3 .2-.5	35:30:35	t:5:80:15	0.47	75	60	Light residental
	to Woodenville Rd.	8.0-9.0	15	20 10-20	25 15-25	2 .5-2.0	0.5 .2-.7	25:20:55	0:15:70:15	1.42	80	40	Light residental
		9.0-9.5	15	? 14-? Swampy	? 14-?	1.3 .8-1.5	0.2 .1-.4	30:20:50	t:5:60:35	0.95	70	50	Greenbelt/ light residental
Evans 08.106		5.1-5.4	2	6 3-10	10 6-40	1 .7-1.5	0.3 .2-.5	20:70:10	t:40:45:15		70	90	Greenbelt/ open spaces
		5.4-7.0	3	3 2-6	10 8-30	1 .5-1.7	0.2 .1-.3	50:50:0	5:5:80:10		90+	80	Greenbelt/ open spaces
08.018		0-.4	3-5	3 2-7	5 3-15	1 .8-1	0.2 .2-.4	5:95:0	0:0:70:30		10	20	Med. den. residental Agriculture (pasturage)
		.6-.4	3-5	3 2-7	5 3-15	1 .8-1	0.2 .2-.4	5:95:0	t:15:70:15		60	40	"
		.6-1.1	3-5	7 4-15	8 6-40	1 .8-1.3	0.4 .1-.6	t:70:30	10:35:40:15		90	40	Greenbelt

Table 2.3. Physical Survey Data for Bear-Evans Creek and Several Tributaries Data from Metro's 1981 Small Streams Surveys. (Cont.)

STREAM	STREAM REACH	RIVER MILE	ESTIMATED DISCHARGE (CFS)[3]	SUMMER WIDTH Average/Range (FT)	WINTER WIDTH Average/Range (FT)	POOL DEPTH Average/Range (FT)	RIFFLE DEPTH Average/Range (FT)	POOL: RIFFLE: RUN (%)	SUBSTRATE[2] B:R:G:S (%)	GRADIENT[4] (%)	SHADE[4] (%)	COVER (%)	RIPARIAN LAND USE
08.0110		0-.4	3	4 3-10	6 4- ? Large swamp	1 .7-2.5	.4 .2-.5	10:90:0	0:20:65:15		20	35	Low den. residental and green-belt
		.4-.7	3	4 4-8	10 6-15	.9 .5-2	.3 .1-.5	20:80:0	0:10:75:15		85	70	Greenbelt/ low den. residental
Cottage Lake 08.0122	NE 128th to	0.0-0.3	3	10 6-20	12 8-30	1.5 1-2.5	.25 1.-.4	20:20:60	t:t:60:40	0	25	25	Light residental
	Avon-dale Road to	0.3-0.5	3	8 7-10	9 8-12	2.0 1.5-3.0	None	20:t:80		2.37		90	Greenbelt
	Near Jct. Avon-dale & Bear Ck. Rd. to	0.5-2.3	3	12 8-20	20 15-40	1.5 8-4.0	.3 .1-.5	25:25:50	t:5:70:25	1.05	10to70	20to75	Light residental/ Sm. farms
	NE 155th	2.3-2.7	3	8 6-10	10 8-15	.8 .7-1	.3 .2-.5	5:80:15	t:10:50:40	1.18	0	10	Golf course

Table 2.3. Physical Survey Data for Bear-Evans Creek and Several Tributaries Data from Metro's 1981 Small Streams Surveys. (Cont.)

STREAM	STREAM REACH	RIVER MILE	ESTIMATED DISCHARGE (CFS)[3]	SUMMER WIDTH Average/Range (FT)	WINTER WIDTH Average/Range (FT)	POOL DEPTH Average/Range (FT)	RIFFLE DEPTH Average/Range (FT)	POOL: RIFFLE: RUN (%)	SUBSTRATE[2] B:R:G:S (%)	GRADIENT[4] (%)	SHADE[4] (%)	COVER (%)	RIPARIAN LAND USE
Cottage Lake Cont.	to NE 165th	2.7-3.6	3	12 10-35	16 12-45	1.2 1-2	0.2 .1-.4	20:35:45	t:5:55:40	0	35	25	Light residental/ some livestock
		4.3-5.2	2-3	8 2-15	12 5-18	1 1-1.5	0.1 .1-.3	20:5:75	0:t:80:20		55	45	Low density residental/ greenbelt
		5.2-5.3	2-3	5 1.5-13	8 3-20	.7 .3-1.5	0.2 .1-.3	50:50:0	0:5:80:15		5	30	Agriculture - Pasture
		5.3-6.0	1-2	4 1-6	7 7-15	.6 .5-1	0.1 .1-.3	40:40:20	t:t:80:20		90	60	Low density residental/ greenbelt
08.132		0.0-0.91	3	8 4-12	10 6-18	1 18-1.5	0.3 .2-.5	5:95:0	5:25:55:15		95	90	Greenbelt
Struve 08.0131		0-.5	5	5 3-12	10 5-16	1 .8-2.0	0.2 .1-.3	40:60:0	0:20:70:10		90	90	Greenbelt
		1.5	3	1.5 1-2	2 1.5-3	.8 .6-1	0.2 .1-.3	70:30:0	0:0:70:30		90	90	Greenbelt

At RM 5.4, a large area of the stream corridor is being developed. The stream banks have been cleared or rip-rapped and soil has been bulldozed into the stream channel. There were also several pipes draining into the stream in this section.

At RM 4.8 the creek enters a section in which a few pools are as much as five feet in depth. Several private car and foot bridges cross the creek. Intermittent boulder rip-rap is found throughout this section.

Immediately downstream of RM 4.0 the stream appears to have been channelized. There is very little canopy and a high percentage of fine material in the substrate. At RM 3.4, pasture areas which extend to the stream's edge leave very little vegetative bank protection. There is intermittent rip-rap along the bank with almost continuous undercutting of the unprotected banks.

Although the stream corridor from RM 2.7 to the mouth is primarily agricultural and pasture, the stream also flows through a large mobile home court near RM 2.0 and a golf course at RM 0.7. There is little canopy or cover in this reach, especially near the mouth of the stream. The stream in this reach is primarily a run (average depth 2 feet) in which the substrate has a high percentage of fine material (as much as 100 percent fines near the mouth). Because of the unfenced pastural areas, livestock move freely into and through the stream from RM 2.7 to 1.2. There is extensive bank cutting in this same reach.

Evans Creek

Because of the inaccessibility of the marshy, low-land areas, Metro has limited physical survey data for Evans Creek. The following description is from Williams et al. (1975):

> "Evans Creek originates five miles east of Redmond on Union Hill. It flows south from heavily forested hillsides through a narrow canyon with steep gradients of 200 feet per mile to the valley floor where it abruptly turns northwest until it joins Bear Creek at RM 2.0. The lower 2.5 miles of Evans Creek lie in open Sammamish Valley terrain. Evans Creek Valley contains many farms and has some commmercial use. Cascades, rapids and small falls with large boulders, rubble and fallen trees predominate in the canyon. A gentle gradient is evident below the swampy area at

RM 5.0. Stream widths vary from 4 to 7 yards as it meanders through pasturelands with brush and blackberry vines along the stream banks. Good riffle-pool stability is evident with long glide areas. Bottom materials are gravel with occasional patches of aquatic vegetation."

The culvert under Highway 202 (Redmond-Fall City Road) may be a possible barrier to upstream fish passage. On the downstream end of the culvert there is a 2.5 foot drop onto a shallow pool.

Cottage Lake Creek

Cottage Lake Creek, which originates in a marshy area near Little Lake and Crystal Lake about 1.5 miles north of the Woodinville-Duvall Road, flows southerly for 6.7 miles before joining Bear Creek at RM 4.9. Above Cottage Lake the stream is also known as Daniels Creek.

From RM 6.0 to 4.3, Daniels Creek varies in width from 1 to 15 feet in summer and 3 to 20 feet in winter. The stream is composed primarily of pools and riffles of less than one foot in depth. The substrate is mostly gravel (80 percent).

Cottage Lake Creek varies in width from 6 to 20 feet in the summer and 8 to 45 feet in the winter. The pools average 1.5 feet in depth and the riffles 0.3 feet. This stream has a gentle gradient, with a good distribution of pool, riffle and glide areas. The bottom composition varies from 25 to 40 percent fines, 50 to 70 percent gravel, and 5 to 10 percent rubble along the stream's length.

The canopy along the stream corridor ranges from areas of dense growth of deciduous and coniferous trees (western red cedar primarily) to areas with little or no canopy. The instream cover correspondingly ranges from 10 to 25 percent in the cleared areas to 75 percent in the other areas. The best areas of canopy and cover were found from RM 6.0 to 5.3 and from RM 2.7 to 0.5. The stream between RM 0.5 and 0.3 is primarily contained in a deep channel with an exposed hardpan substrate. The stream is completely covered by thick brush which grows across the channel. Near the mouth (RM 0.3 to 0.0), the stream channel is extensively rip-rapped with rock, metal, barrels and old tires.

The stream corridor varies from marshland near the headwaters to pasture, light residential, wooded greenbelt and a golf course near the mouth.

Unnamed (08.0108)

This 1.1 mile tributary joins Evans Creek at RM 1.3. The upper half of this small stream is a series of cascades where the water flows over larger rocks (greater than 1.5 feet in diameter) and logs into many small braided channels. A possible fish passage barrier--a 36 inch diameter culvert with a steep incline and high water velocity--exists where the stream crosses under Union Hill Road. There is a moderate amount of bank failure in this section.

From RM 0.4 to 0.6, the stream is crossed by several small bridges and many fences. Some riparian cover has been cleared and approximately 80 feet of the bank has been rip-rapped. Near RM 0.4, as the stream flows through a pasture area with very little riparian cover, the substrate becomes very silty (30 percent) and soft. The channel on this lower reach appears to be barely adequate to contain present peak flows.

Unnamed (08.0110)

From RM 0.0. to 0.4, the streambed of this 1.3 mile tributary to Evans Creek is quite uniform: moderate rubble (20 percent), gravel (65 percent) and low fines (15 percent). Even though the lower half of this reach is a scrub/shrub wetland that is probably inundated periodically, the channel is well defined. The stream, which averages four feet in width in summer and six feet in winter, is predominantly a riffle in this area. Considerable algae, moss and submerged plants have been observed in the channel.

Upstream (near RM 0.7), the silt and rubble in the substrate jams increase. Instream cover is provided by overhanging branches, grasses and several debris jams.

Struve Creek

Struve Creek is a 1.8 mile tributary that joins Bear Creek at RM 7.2. Only the first half-mile of this stream was surveyed; an additional spot check was made near the headwaters (RM 1.5). The stream width varies from 1 to 12 feet in summer, and from 1.5 to 16 feet in winter. It is a shallow stream with a substrate that is mostly gravel

(70 percent). The stream has 90 percent shade and cover that is provided by thick bank vegetation. Instream cover consists mostly of overhanging brush and debris (logs). Periphytic algae has been observed on the substrate.

Unnamed (08.0132)

Approximately half of this two mile tributary, which is the outlet of Welcome Lake, was surveyed. As with other streams in the area, it is a moderately wide, shallow stream. The reach surveyed was predominantly a riffle that was mostly gravel (55 percent) with some rubble (25 percent) and boulders (5 percent). The overhanging brush provides a high percentage of both shade and cover.

From 1979 to 1981, a total of 16 Hydraulic Project Approvals (HPA's) for 11 instream project types were issued for the streams in the Bear-Evans basins (M. Deusen, WDF, 1982, unpublished data). The projects included four culvert installations, three pond constructions and two bank protections. HPA's, which are issued by the Departments of Fisheries and Game, are required for all projects that occur within the ordinary high water mark of the stream (RCW75.20.100).

The USGS maintained two gauging stations on the Bear-Evans drainage basin; one station was near the mouth of Evans Creek (near station B), second was near station J on Bear Creek (see Figure 2.3--Water Quality for station location). Both gauging stations have since been discontinued.

The gauging station on Evans Creek operated almost continuously from 1955 to 1976. During that time, the average annual discharge was 23.1 cubic feet per second (cfs). The monthly mean discharge for this same period ranged from a minimum of 5.9 cfs on August 1967 to a maximum of 76.3 cfs in March 1972 (USGS, 1982, unpublished data). The maximum and minimum discharges were 222 cfs and 3.9 cfs (USGS, 1980).

The Bear Creek gauging station was operated from 1945 to 1949 and 1978 to 1980. During this time, the maximum and minimum discharges were 196 cfs (February 1949) and 3.1 cfs (August 1946).

Most of Metro's instantaneous flow measurements for 1979 to 1981 are lower than the USGS monthly mean flows for 1957 to 1976 (Figure 2.2). The instantaneous flows for November through April are generally lower because of physical difficulties in measuring instantaneous flows during this high flow period.

As is typical of a stream that drains a relatively natural, undeveloped basin, Bear Creek responds slowly to precipitation. Hydrographs are slow to rise and often take several days to return to base flow conditions after a storm event (Richy, 1982). Also typical of this type of basin, runoff occurs primarily as interflow and groundwater seepage.

Riparian Corridor

The riparian vegetation along a stream is important as habitat for wildlife, for shading and cooling the water for fish use and for stabilization of the stream bank.

Bear Creek

From RM 9.5 to 6.5 Bear Creek is a greenbelt interspersed with residences and pastures. The canopy consists of deciduous and coniferous trees which provide 30 to 75 percent shade. The vegetative bank cover is 70 to 100 percent.

From RM 6.5 to 4.8 the canopy is mostly deciduous trees with a few conifers. This area has some greenbelt in addition to the few residences and pastures found in the upstream section. At approximately RM 5.4 a section of the corridor is being cleared and the stream banks rip-rapped. This section is quite swampy in which the bank cover is a thick growth of shrubs and grasses. From RM 4.8 to 4.1 the creek's canopy is patchy (50 percent) and is made up of deciduous and coniferous trees. The banks are covered with blackberry bushes and grasses. The land use is low density residential and pastures.

From RM 4.1 to the mouth the canopy is made up of deciduous trees that are also quite patchy. There is also much less shade provided (15 to 30 percent) than in upstream sections. The vegetative bank cover is generally 70 to 90 percent except where livestock have access to the stream (RM 1.5). The bank cover is made up of blackberry bushes, shrubs and grasses. The creek flows through low density residential areas, pasture lands, a few cultivated fields (RM 2.9 and 1.6), one commercial area (RM 0.7), an undeveloped grassland (RM 0.5), and a golf course (RM 0.3) before it enters the Sammamish River.

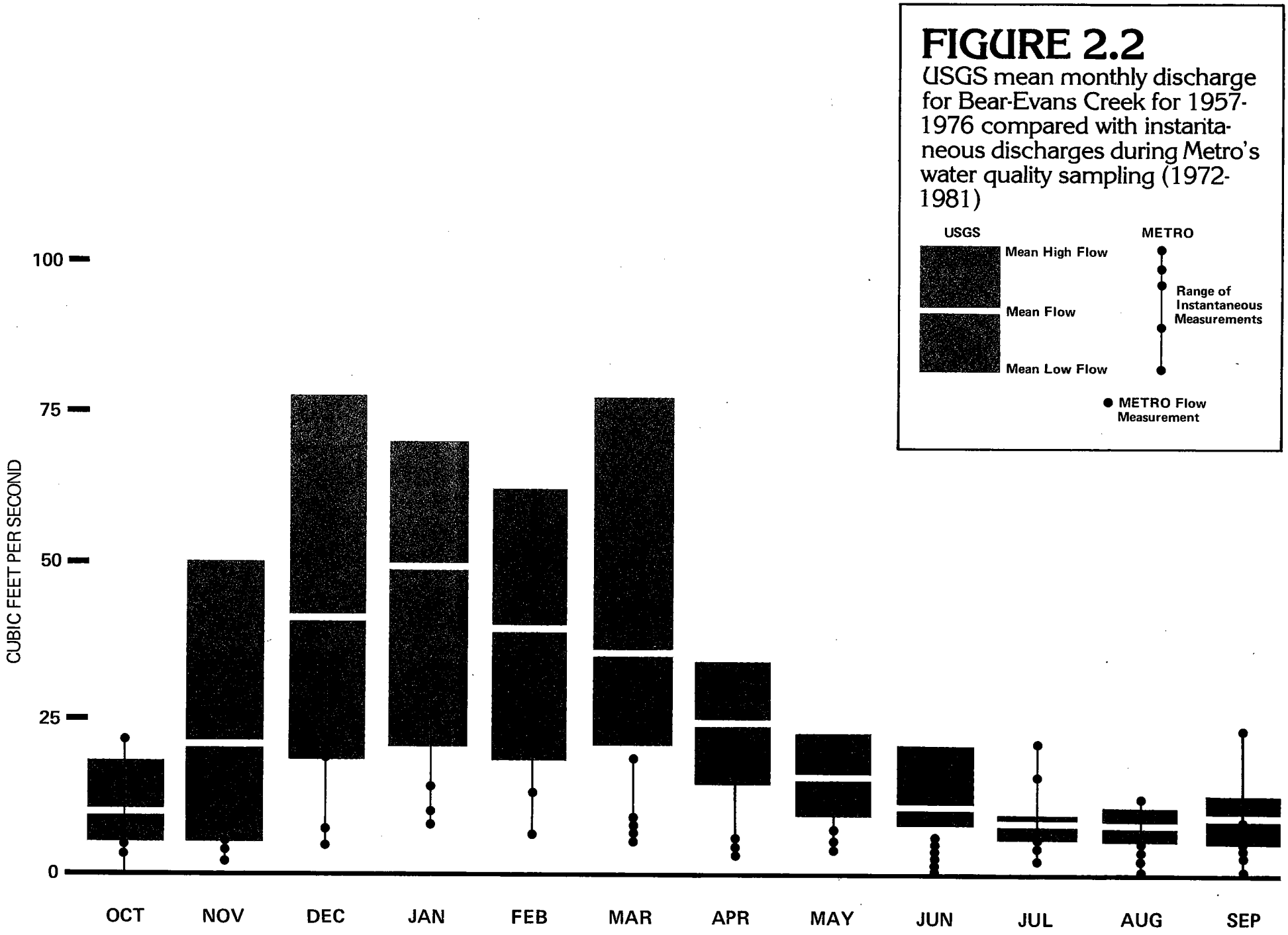


FIGURE 2.2
USGS mean monthly discharge for Bear-Evans Creek for 1957-1976 compared with instantaneous discharges during Metro's water quality sampling (1972-1981)

Evans Creek

The upper portions of Evans Creek have 90 percent shade that is provided primarily by coniferous trees. The vegetative bank cover is 50 to 70 percent. Because the stream flows through a steep ravine the land used as a greenbelt or open space. From RM 5.6 to 2.3, the corridor is a scrub-shrub wetland. The canopy is made up of deciduous trees which provide shade for 45 percent of the stream. The vegetative bank cover is a thick growth of grasses and shrubs. At RM 2.3 the creek is bordered by a short stretch of woods before the corridor becomes another wetland area. The land use throughout this entire stretch is low density residential and pastureland. At RM 0.8 the corridor is occupied by a small area of light industry.

Cottage Creek/Daniels Creek

Near RM 6.0 Daniels Creek enters a small ravine that has 90 percent shade and 60 percent cover. In spite of the high percentage of shade, there are occasional open spaces in which the plants are moderately dense. At RM 5.5 the stream enters a small marsh area. While the shade in this area is provided by both coniferous and deciduous trees that are approximately 40 to 60 feet in height, vine maples provide most of the cover. The riparian land use is low density residential and greenbelt.

From RM 5.3 to 5.2 there is very little shade or cover. Although the land along this reach of stream was used as a pasture, there is no indication of present use. At RM 5.2 the stream again flows through a low density residential area where there is moderate shade and cover. Near the lake there is a decrease in shade and an increase in cover. The shade is provided by deciduous trees less than 40 feet in height.

The entire corridor of Cottage Creek is a low density residential area interspersed with pastures and a short section of golf course from RM 2.7 to 2.3. The canopy from RM 3.6 to 2.7 is deciduous and coniferous trees. The bank is covered with various vines, including evening nightshade, grasses and shrubs. Through the golf course there are no trees and little bank cover. Although the canopy is patchy from RM 2.3 to 0.5, the thick growth of deciduous and coniferous trees provides good shade in places. The bank cover is 70 to 90 percent dense in this section. From RM 0.5 to 0.3 there are very few trees; a thick growth of blackberry bushes, however, lines the banks. From RM 0.3 to 0.0 there are

again some deciduous and coniferous trees lining the banks (25 percent). The vegetative bank cover is 90 percent density.

Unnamed (08.0108)

The riparian corridor along this stream varies from greenbelt and agricultural areas to low and medium density residential areas. The stream shade correspondingly varies from 90 percent in the upper half of the stream to 10 percent near the mouth. The riparian vegetation was a mixture of half coniferous and half deciduous trees from RM 1.1 to 0.6, and mostly deciduous trees from RM 0.6 to 0.0. The plant density on the bank varied from 70 to 90 percent in the upper reach to greater than 90 percent in the lower reach.

Unnamed (08.0110)

The riparian corridor along the first portion of this stream (RM 0.0 to 0.4) varies from a scrub-shrub wetland near the mouth to areas that are mostly grassed. The low amount of shade (20 percent) was provided by deciduous trees. From RM 0.4 to 0.7, the stream shade increases to 85 percent as the trees are a mixture of coniferous and deciduous. The plant density on the bank is very thick (greater than 90 percent) all along the stream.

Struve Creek

The deciduous and coniferous vegetation that grows along Struve Creek provides a high percentage of both shade and cover. Upstream of RM 1.5 the stream is almost completely overgrown. Although there is some recent construction and development near the mouth of the stream, the riparian corridor is primarily a greenbelt.

Unnamed (08.132)

Similar to neighboring Struve Creek, this small tributary also has a high precentage of shade and cover provided by a mixture of deciduous and coniferous trees. The riparian corridor is a greenbelt in which there is evidence of recent construction activities.

WATER QUALITY

Since 1971, Metro has monitored water quality in Bear-Evans Creek basin at various sites and parameter arrays to meet different monitoring objectives (Figure 2.3, Appendix A).

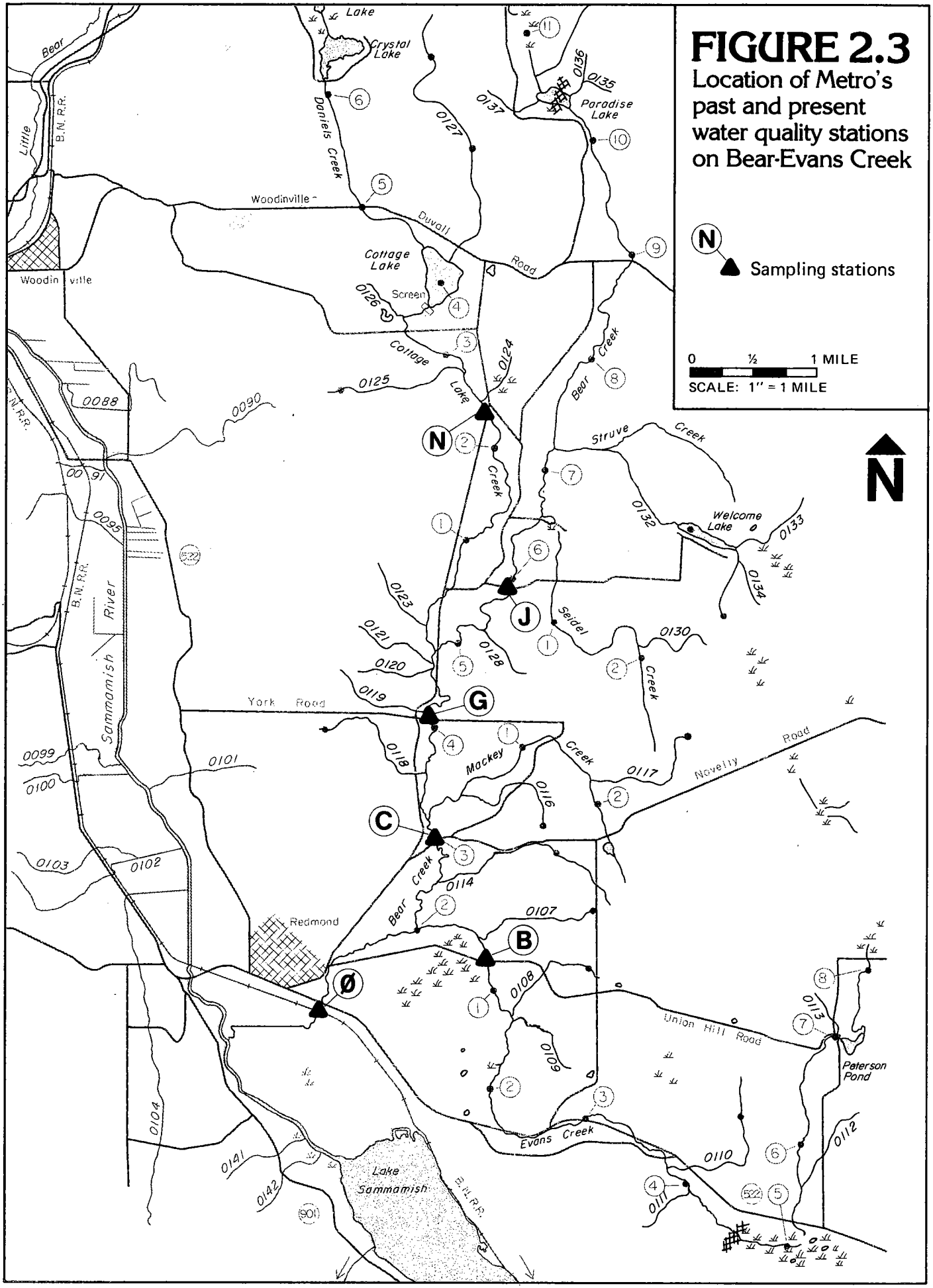


FIGURE 2.3

Location of Metro's past and present water quality stations on Bear-Evans Creek

Because of these differences, the discussion of the spatial and temporal nature of the water quality will center on 1979-81 data since it provides the most continuous data for the largest number of sites.

Generally, Bear-Evans Creek is a cool, clear, well oxygenated stream (Table 2.4). The water fluctuates from slightly acidic to slightly alkaline and has a low buffering capacity. Spatially, the differences in water quality within the basin are particularly evident in levels of fecal bacteria and ammonia (Figure 2.4). For Bear Creek stations, concentrations of these parameters were highest at station 0 and lowest at station J. High fecal coliform concentrations were also found at stations C and G which are located downstream of pastoral areas.

Seasonal differences in the water quality of Bear-Evans Creek are evident on several parameters. The differences in temperature and conductivity reflect natural climatic variance. This seasonal difference is also reflected in nutrient concentrations; the dry season concentrations of ammonia and nitrate/nitrite were only 40 to 45 percent of the wet season concentrations. This change in concentration, which has also been documented by Perkins, et al. (1980), may be related to the seasonal uptake of these nutrients by plants (Hynes, 1972).

The bacterial counts for Bear-Evans Creek also had contrasting seasonal changes. While the dry season median fecal coliform counts were approximately 70 percent greater than the wet season counts, the dry season median fecal streptococcus counts were only 50 percent of the wet season counts. The reason for this contradiction is unknown.

The concentrations of trace metals in Bear-Evans Creek were usually at or below the analytical detection limit. (See Chapters 3 and 4 for further discussion.)

Metro has received few reports of or requests for assistance with chronic water quality concerns in the Bear-Evans basin. The few calls that have been received (less than 10 per year) were concerned with temporary erosion and sedimentation associated with the increasing urbanization of the basin.

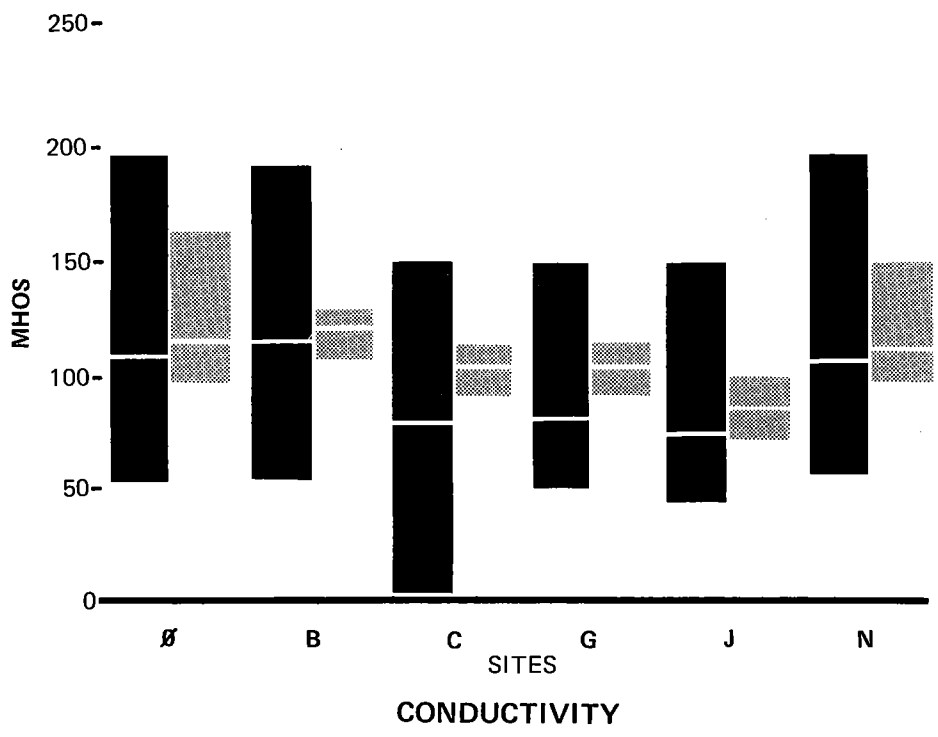
Table 2.4. Seasonal Comparison of 14 Water Quality Parameters for Station 0 at the Mouth of Bear-Evans. Data from Metro's 1979-1981 Small Streams Surveys.

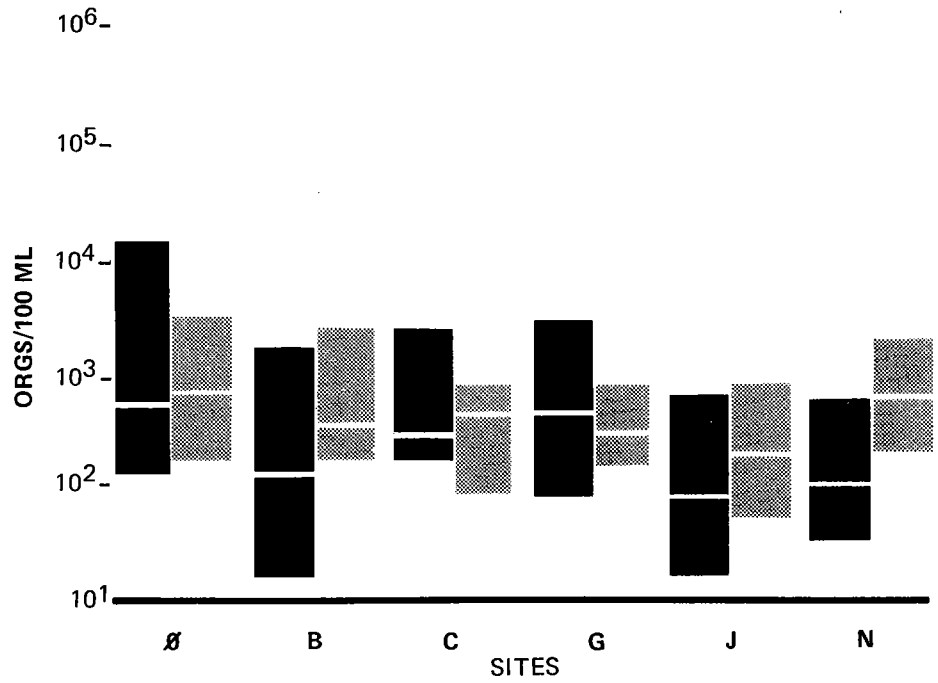
PARAMETER	WET SEASON[1] Mean/Median	Min.-Max.	# of Samples	DRY SEASON[1] Mean/Median	Min.-Max.	# of Samples
Temperature (Centrigade)	7.8/7.8	1.0-14.3	21	14.6/14.8	13.2-16.3	12
Dissolved Oxygen (MG/L)	10.4/10.5	7.5-13.5	21	9.5/9.7	5.5-10.8	12
Dissolved Oxygen (% Saturation)	87.0/92.1	69.7-98.5	21	93.5/95.9	54.3-104.9	12
Ammonia (MG/L)	.093/.072	.015-.342	24	.024/.018	.001-.094	14
Nitrate (NO_3) & Nitrite (NO_4) (MG/L)	.786/.792	.379-1.456	22	.326/.310	.195-.432	14
Ortho-Phosphorus (MG/L)	.050/.044	.004-.182	24	.040/.038	.031-.062	14
Total Phosphorus (MG/L)	.164/.082	.047-1.683	23	.073/.068	.040-.132	14
Fecal Coliforms (ORGS/100 ML)	1325/500	169-13,000	24	912/625	180-2500	14
Fecal Streptococcus (ORGS/100 ML)	55,453/4100	33-1,000,000	23	959/805	160-2800	14
pH	7.1/7.2	7.6-6.5	24	7.1/7.5	6.5-7.9	14
Conductivity (Mirco Mhos)	100/93	54-190	24	114/110	96/166	14
Alkalinity (MG/L as Ca CO_3)	26/23	10-36	12	44/44	41-46	4
Flows (CFS)	52/54	19-97	10	30/23	18-58	8
Total Suspended Solids (MG/L)	13.2/12/5	3.1-33	24	5.1/4.0	2.0-11.0	14

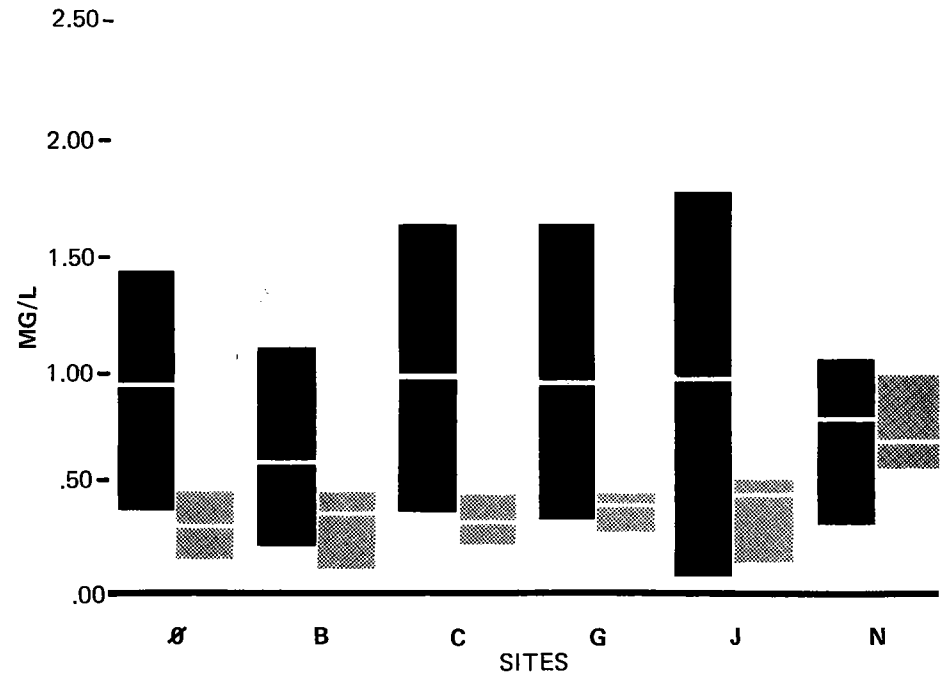
[1]Wet Season = Oct. - May
Dry Season = June - Sept.

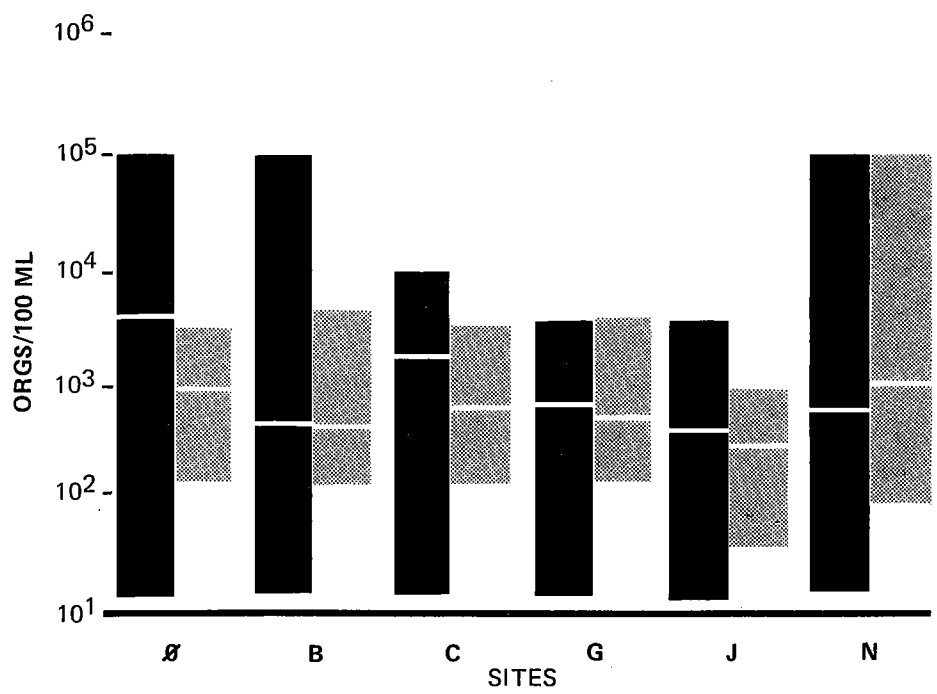
FIGURE 2.4

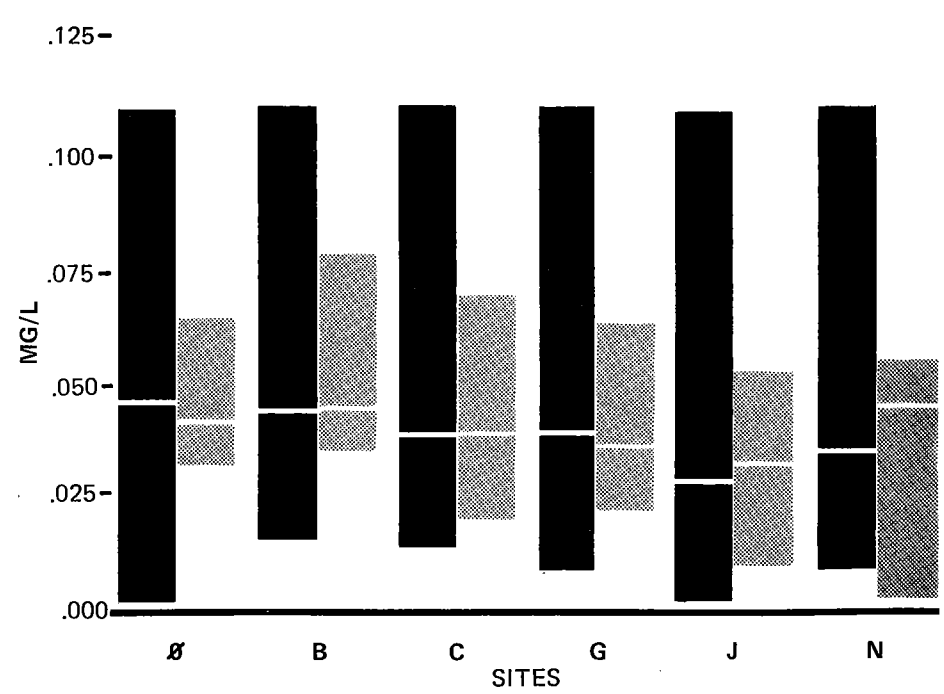
Spatial and temporal comparisons of six parameters at six sites in the Bear-Evans Creek Basin. Data from Metro's 1979-1981 small streams survey (see Appendix B.)

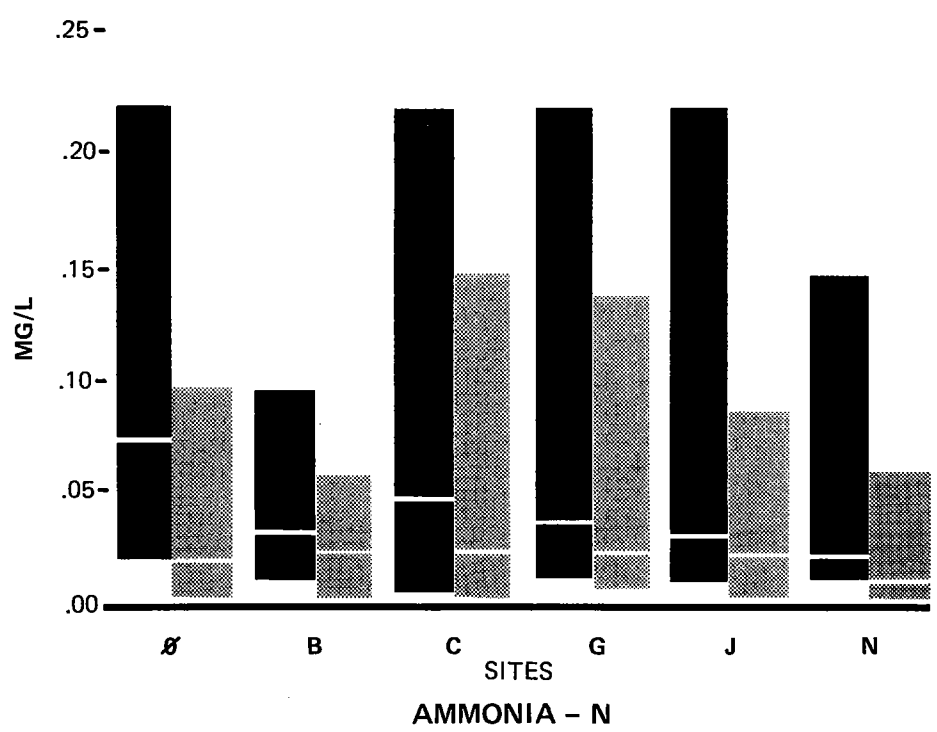












Information on the quality of intersitial water is reported by Richey (1982) and Scott et al. (1982). The concentration of dissolved oxygen in the intragravel water varied with time; the minimum value of 0.88 mg/l was recorded in August 1982, and the maximum value of 7.95 mg/l in December 1982. Variations in pH ranged from 6.5 to 7.7 with the minimum and maximum values occurring in May and September respectively. Intragravel water temperatures did not appear to differ from surface water temperature at sunrise.

Analyses for 13 metals and more than 100 trace organic compounds found very low or undetectable concentrations in the intersitial water of Bear Creek (Table 2.5). It appears that the majority of the chemical compounds that were detected are loosely bound to fine sediment particles and not in soluble form (Richey, 1982; R. Moore, Metro, per. comm.). Thus, when silt and organic debris particles are accounted for, the levels detected are comparable to natural background levels (R. Moore, Metro, per. comm.)

Other extensive water quality information, which includes data on organic carbon, sediment and watershed yields for several constituents, is reported by Richey (1982).

STREAM BIOTA

Fish

The following information on the fisheries of Bear-Evans Creek is from Uchida (1978):

> "Records of the fishery in Bear-Evans Creek dates back to 1925 when the County Game Commission constructed a wooden weir across the stream to take eggs from silver trout (kokanee salmon). Plants of silver, steelhead, cutthroat and rainbow trout were made as early as 1933. Cutthroat and steelhead plants were culminated after 1933 and 1939, respectively. The last recorded plants of rainbow and silver trout were made in 1976 and 1962. Coho salmon were planted in the Bear-Evans Creek in 1943 and periodically augmented with juvenile fish plants until 1970. Fall chinook salmon were planted in 1964 and in 1977.
>
> In 1956, large runs of coho salmon and silver trout, a fair run of cutthroat and very few steelhead trout were reported (Ajwani, 1956). Bear-Evans Creek was at that

Table 2.5. Toxicants in Bear-Evans Creek Interstitial Streamwater

All values are concentrations in ppb=μg/ℓ. Comparison is made with the federal water quality criteria. "Less than" (<) values represent detection limits for undetected parameters; NCA=no criterion available; NA=not analyzed for. (Galvin and Moore, 1982).

ppb= μg/ℓ	8/7/81 (Dry Season)	3/16/82 (Wet Season)	Water Quality Criteria Freshwater Acute	Water Quality Criteria Freshwater Chronic
Metals				
Antimony	<2	<1	NCA	NCA
Arsenic	4	46	440	NCA
Beryllium	<0.1	0.5	NCA	NCA
Cadmium	0.2	3.6	0.6[a]	0.005[a]
Chromium (total)	1	78	NCA	NCA
Copper	2.4	230	5.0[a]	5.6
Lead	1	120	24[a]	0.09
Mercury	<0.4	<0.5	4.1	0.20
Nickel	<7	27	540[a]	28
Selenium	<3	<2	260	35
Silver	<0.2	<0.5	0.3[a]	NCA
Thallium	<0.5	<1	NCA	NCA
Zinc	12	460	85[a]	47
Cyanides	10	NA	52	3.5
Organics				
Benzene	<1	<1	NCA	NCA

[a]Criterion calculated using a water hardness value of 20 mg/ℓ.

time regarded as the largest producer of coho salmon and one of the largest producers of silver trout in the state for its size."

Sockeye and coho salmon are the most numerous of the three species of salmon found in the system (Figure 2.5., Appendix C). Returns of 16,000 to 22,000 adult sockeye were recorded in Bear Creek from 1977 to 1979 (Deusen, 1982). In 1976-1977, the return of adult coho to Bear-Evans was estimated at 5,000 fish (Uchida, 1978). Salmon spawn throughout the system from September to February, depending on the species. In addition to the mainstream, several tributaries--Cottage Lake, Struve and Unnamed (Rutherford - 08.0110)--appear to be especially important salmon spawning areas.

The present status of the fishery throughout the basin, particularly the trout fishery, is not well documented. Scott et al. (1982) state that at present, Bear Creek supports a "fair abundance of cutthroat and very few steelhead and chinook." Although they surveyed a limited area (RM 7.4 to 8.9), Scott et al. present a considerable amount of information collected in intensive fishery surveys on Bear Creek from 1979 to 1981. In other preliminary data from a limited basin survey, coho juveniles were the most numerous fish found in most of the tributaries (Table 2.6). The only stream in which rainbow trout were found in any number was Cottage Lake Creek.

Benthos

Although there were a large number of taxa of benthic invertebrates found in the samples from Bear Creek (20 to 35 taxa per sample), the dominant organisms at most sites were mayflies (Baetidae, Heptageniidae and Ephermerellidae) (Table 2.7). Mayflies were dominant in 13 of 18 samples collected. Other organisms that were dominant or abundant were caddisflies (Hydropsychidae), stoneflies (Nemoridae), blackflies (Simulidae), and midges (Chironomidae). This diverse make-up and distribution among the different taxa in Bear Creek was also observed by White and Martin (1976) and Pederson (1981). The reason for large increases in the numbers of organisms and mean total weight in 1981 is unknown.

Freshwater clams (Margaritifera margaritifera) were abundant a short distance upstream from station J. The clams were most concentrated along the edges of sandbars where the water velocity was relatively low and the surface of the streambed was free of sand.

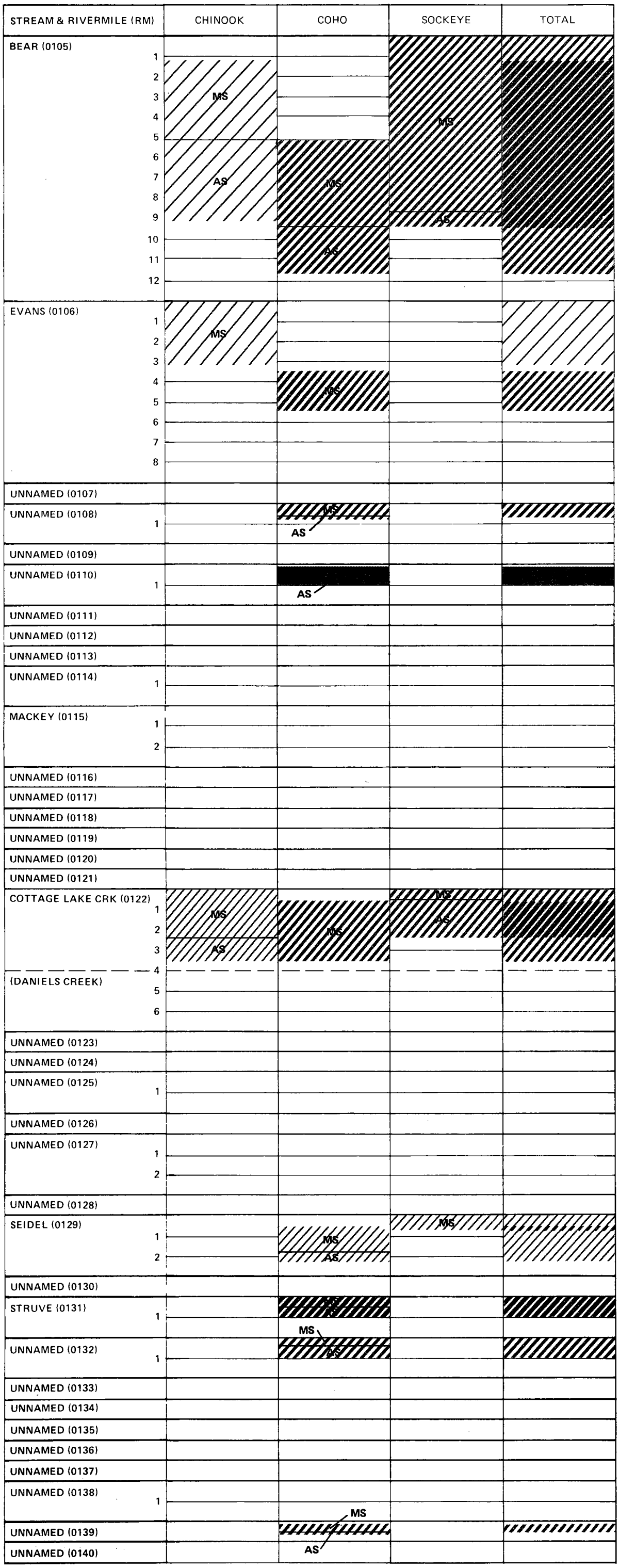


FIGURE 2.5

Salmon utilization of Bear-Evans Creek by species and area* (Sources: Egan, 1978, 1980)

Spawning areas: median number of fish/mile

25-100 | 10-25 | 5-10 | >5

MS = Major spawning area
AS = Additional spawning area

Blank indicates either no fish observed or reach not surveyed.
*For more detail on salmon spawning, see Appendix C.

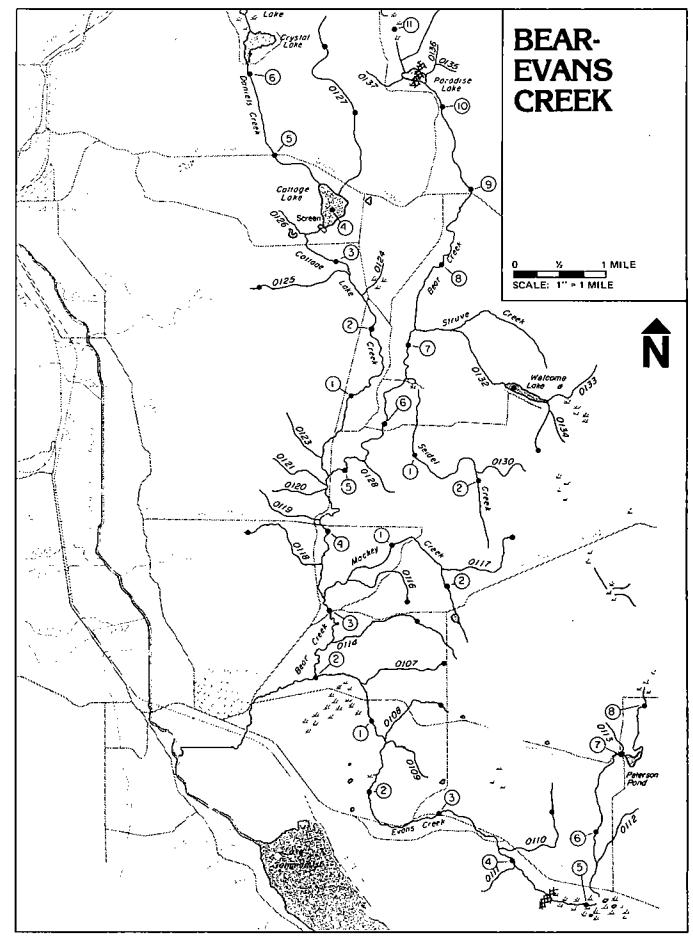


Table 2.6. Fisheries Survey Data From A Limited Basin Survey. All Information From Metro Electrofishing Surveys (Unpublished Data, July, 1982)

Stream	Survey Site (RM)	Coho Salmon Total Number Captured	Coho Salmon Median Length/ Range (MM)	Cutthroat Salmon Total Number Captured	Cutthroat Salmon Median Length (MM)	Stream Length Surveyed (Feet)
Bear	4.1	6	74 70-97	12	55.5 40-156	
Bear	5.9	11	68 58-81	11	53 37-140	100
Mackey	0.6	49	74 51-94	22	120 36-179	150
Cottage Lake	2.6	31	77 35-188	5	151 118-176	100
				(1) 19	142 67-188	
Daniels	5.5	318	50 35-129	27	100 57-232	300
Siedel	0.2	54	63 39-96	29	50 33-201	150
Struve	0.2	93	56 46-78	23	54 35-147	150
Unnamed 09.0110	0.2	145	55 37-84	10	124 110-250	150

(1) Rainbow trout

TABLE 2.7. SUMMARY OF BEAR CREEK BENTHOS DATA FOR TWO MAINSTEM SITES AND FOUR TRIBUTARY SITES. DATA FROM METRO'S 1979-1981 SMALL STREAMS SURVEYS.

YEAR	SITE	NUMBER OF TAXA	ORGANISMS PER SQ. FOOT	MEAN EPT* DRY WT. (MG/SQ.FT.)	MEAN TOTAL DRY WEIGHT (MG/SQ.FT.)	PERCENT EPT* (BY WEIGHT)	NUMERICALLY DOMINANT TAXON
1979							
	MAINSTEM						
	0	25	665	60	134	45	BAETIDAE
	C	23	648	54	70	77	HYDROPSYCHIDAE
	G	22	587	28	34	84	HEPTAGENIIDAE
	J	23	612	41	54	77	NEMOURIDAE
	TRIBUTARIES						
	B	23	1425	27	40	67	BAETIDAE
	N	20	499	48	80	60	BAETIDAE
1980							
	MAINSTEM						
	0	31	683	12	78	15	CHIRONOMIDAE
	C	32	624	31	60	51	BAETIDAE
	G	27	553	16	25	66	HEPTAGENIIDAE
	J	29	436	36	47	76	BAETIDAE
	TRIBUTARIES						
	B	34	365	44	72	62	CHIRONOMIDAE
	N	27	504	31	46	66	BAETIDAE
1981							
	MAINSTEM						
	0	32	1600	1060	2030	52	BAETIDAE
	C	35	660	540	710	76	HEPTEGENIIDAE
	G	25	2702	2480	5240	47	SIMULIDAE
	J	24	2282	1593	2553	62	BAETIDAE
	TRIBUTARIES						
	B	35	2070	1300	1723	75	EPHEMERELLIDAE
	N	30	496	293	553	53	BAETIDAE

* EPHEMEROPTERA, PLECOPTERA, TRICHOPTERA - INSECT ORDERS CONSIDERED TO BE INDICATIVE OF RELATIVELY UNPOLLUTED WATERS.

Periphyton

Although a periphyton survey in 1977 found a diverse, well balanced population of algae at station J, Diatoma vulgare, a diatom indicative of nutrient loading (Patrick and Reimer, 1966), was dominant at stations C, G and N (Brenner and Morrice, 1978). In 1979, Syndera ulna, another diatom indicative of nutrient loading, was dominant at station C (Brenner, 1980). Samples from the mouth of Evans Creek (station B) were dominated both years by Closterium, a desmid.

During a "spot check" of the basin in 1977 filamentous green algae was apparent on the substrate of most of the tributaries (Brenner and Morrice, 1978). The algae, identified as a species of Ulothrix, was apparent in the mainstem only below the confluence of Bear and Evans Creek.

Macrophytes

Aquatic plants were noted at many of the sample sites. At the Cottage Creek station (N), mats of buttercup (Ranunculus sp.) and watercress (Rorippa nasturtiun-aquaticum) grew in the shallow water near the site. At stations G, C and O, the most apparent plant was waterweed (Elodea sp.).

WATER USE

Water Supply

The most common uses of surface water withdrawals identified for Bear-Evans Creek were for single-family domestic supply, fish propagation and irrigation (Figure 2.6). Although only 73 DOE water right permits have been issued, a total of 102 probable uses have been identified (DOE, 1982, unpublished data). This is indicative of the multiple uses of water withdrawn from a single withdrawal site.

Of the three most commonly identified uses, irrigation comprises the largest portion of the total allotted withdrawal volume followed by single-family domestic water use (Table 2.8). A critical concern associated with the DOE definition of single-family domestic water supply is the potential use of the withdrawn water as a potable water supply. This potable use is confirmed by DOE personnel prior to the issuance of the water right (D. Garland, DOE, pers. comm.). Of the 11 permits for domestic water withdrawal from the

STREAM & RIVERMILE (RM)		NUMBER OF PERMITS WHICH INCLUDE EACH USE									Number of Permits Issued
		Domestic	Fish Prop.	Irrigation	Power	Comm./ Indust.	Stock Water	Wildlife Prop.	Rec. & Beautif.	Fire Protection	
BEAR (0105)				4							4
	1										
	2	2		3	1						4
	3	2		3			1				4
	4	2		1							3
	5			1							1
	6	1	1	4							6
	7	1		2							2
	8	1	1	2			1				4
	9	2	1	1			1		1	1	4
	10										
	11										
	12										
EVANS (0106)		1	1	2		1	2				4
	1					1					1
	2	1	2	2			1		1		3
	3			1							1
	4										
	5										
	6										
	7										
	8										
UNNAMED (0107)			1						1		1
UNNAMED (0108)											
	1										
UNNAMED (0109)											
UNNAMED (0110)											
	1										
UNNAMED (0111)											
UNNAMED (0112)											
UNNAMED (0113)											
UNNAMED (0114)		2	1	2							3
	1	1	1	2							3
MACKEY (0115)		1		1			1				1
	1	2		2							3
	2										
UNNAMED (0116)			1								1
UNNAMED (0117)											
UNNAMED (0118)											
UNNAMED (0119)											
UNNAMED (0120)											
UNNAMED (0121)											
COTTAGE LAKE CRK (0122)		6		2						1	8
	1			1							1
	2	3		2			1				5
	3			2							2
	4										
(DANIELS CREEK)											
	5										
	6										
UNNAMED (0123)											
UNNAMED (0124)											
UNNAMED (0125)											
	1										
UNNAMED (0126)											
UNNAMED (0127)											
	1										
	2										
UNNAMED (0128)		1		1							1
SEIDEL (0129)		1		1							1
	1										
	2										
UNNAMED (0130)											
STRUVE (0131)											
	1										
UNNAMED (0132)			1						1		1
	1										
UNNAMED (0133)											
UNNAMED (0134)											
UNNAMED (0135)											
UNNAMED (0136)											
UNNAMED (0137)											
UNNAMED (0138)											
	1										
UNNAMED (0139)											
UNNAMED (0140)											
TOTAL		30	11	42	1	2	8	0	4	3	72

FIGURE 2.6

Probable uses of water rights granted in Bear-Evans Creek Basin (DOE, 1982)

Total instantaneous withdrawal volume (CFS) for permits issued

3 <1.0

6 1.0+

Because water withdrawn under each permit may have multiple uses, the total number of uses often exceeds the total number of permits issued. See text for further discussion.

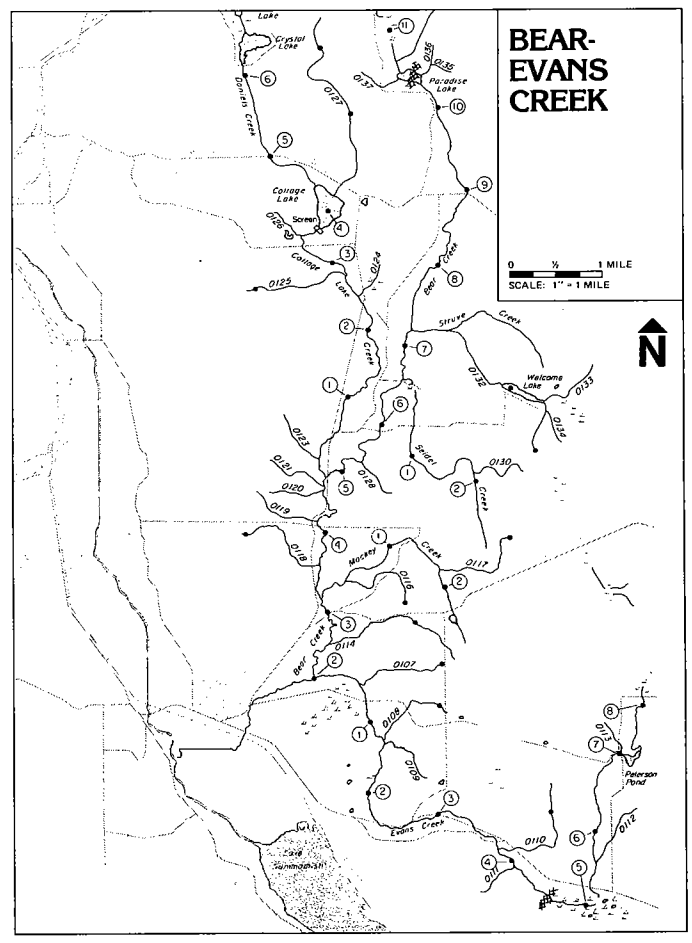


Table 2.8 Total allotted volumes for the most common uses made of water withdrawn from Bear-Evans Creek. (WA Dept. of Ecology, 1982)

Probable[1] Use of Maximum Allowable Instantaneous Withdrawal (cfs)[2]				
WATER BODY	DOMESTIC	IRRIGATION	FISH PROPAGATION	OTHERS[3]
Bear	0.320	6.455	0.240	0.600
Evans	0.240	0.600	0.420	2.920
Cottage Lake Creek	0.105	1.415	0	0.020
Other Tributaries	0.405	0.535	0.160	0.130

[1]Uses were confirmed by Dept. of Ecology upon issuance of permit and may not reflect present water useage.

[2]Maximum instantaneous withdrawal amounts may cover more than one permitted use. Withdrawal volumes shown here have been attributed to only one use rather than divided amongst permitted uses.

[3]Other uses include power, commercial/industrial, stock watering, wildlife propogation, recreation and beautification.

mainstem of Bear Creek, six were issued between 1944 and 1953. Similarly, seven of the 10 domestic water withdrawal permits for Cottage Lake Creek were issued before 1963. It is uncertain whether or not this potable use still occurs.

The total allotted water withdrawal from Bear-Evans Creek is 12.89 cfs (6.79 from Bear; 3.81 from Evans; 1.52 from Cottage Lake Creek; and 0.76 from other tributaries). This allotted value is less than half of the calculated 7-day--10-year low flow value of 28 cfs. This theoretical value indicates that there is a 10 percent probability that in any given year, there will be a seven day period in which the mean daily discharage of Bear-Evans Creek will be 28 cfs or less. This value was estimated by multiplying the Bear-Evans drainage by the ratio of a 7-day--10-year low flow for Evans Creek to its drainage area.

The actual number and volume of water withdrawal from Bear-Evans Creek is probably greater than what is indicated in this discussion. While all surface water withdrawals are supposedly limited to those authorized by DOE, unauthorized withdrawals probably also occur (D. Garland, DOE, pers. comm.). As of September 5, 1979, Bear-Evans Creek and its tributaries were closed to further authorized withdrawals by DOE's Instream Resources Protection Program (WAC 173-508-020). Although Metro's stream survey should theoretically be able to document some of the water withdrawals identified in Figure 2.6, it is difficult to do in practice. The following water withdrawals were identified by the most recent stream survey:

Withdrawal Type/Use Observed	Tributary (River Mile)
1 Pump/Irrigation	Bear (2.7 - 3.4)
3 Pumps/Unknown	Bear (4.1 - 4.8)
? Pumps/Irrigation	Bear (6.0-6.5)
3 Pumps/Unknown	Bear (7.0 - 8.0)
Diversion/Ornamental Garden	Bear (7.0 - 8.0)
Diversion/Fish Ponds	Bear (8.0 - 9.0)
2 Pumps/Unknown	Cottage (0.0 - 3.0)
2 Pumps/Unknown	Cottage (0.3 - 0.5)
Diversion/Pond	Cottage (0.5 - 2.3)

Recreational Opportunities

The recreational use of Bear-Evans Creek is thought to be minimal. Some fishing and viewing does occur; other uses that may occur but were not documented include wading, swimming and kayaking. As for many of the streams in the area, the opportunity for recreational use of Bear-Evans is restricted by limited public access.

Access to the stream for viewing occurs at street crossings, parks and trails. Park access is limited to two very small parks, both of which are located adjacent to Evans Creek. There are two public golf courses on the stream: one at the confluence of Bear Creek and the Sammamish River and one on Cottage Lake Creek. Additional access is provided by two recreational trails. These are a county bike route that parallels the mouth of the creek between the Sammamish River; and Union Hill Road, and the Tolt Pipeline equestrian and hiking trail which crosses Cottage, Bear, Struve and unnamed tributary to Welcome Lake (08.0133).

Fishing for game fish (primarily trout) in Bear-Evans Creek is permitted during the appropriate season; the taking of salmon and steelhead, however, is not permitted (WDF, 1980; WDG, 1981). There was only a limited amount of identified data which documents fishing in Bear Creek. Over a 16-year period (1959 to 1967 and 1972 to 1979), a limited check of fishermen revealed that a total of 133 cutthroat trout were caught by 945 anglers (Pfeifer, 1980). Most of the fishing occurs near the mouth of the creek.

According to members of the Outdoor Access Coalition (L. Moyer, pers. comm.), there is apparently little interest in or use of streams like Bear-Evans for canoeing or kayaking. There may be some boating use by non-organized groups; again, information to document this use could not be located.

CHAPTER 3

DESCRIPTION OF THE EVALUATION APPROACH

EVALUATION CRITERIA

The evaluation of the suitability of a water body to adequately support the desired use of that resource is dependent on two key factors: 1) The criteria by which the data are judged, and 2) the inherent limitations of the data that are being evaluated. The following discussion explains the criteria used in our evaluations, comments on the appropriateness of some of the criteria, and explains the general limitations of the available data. The criteria are listed in detail in Appendix D.1 through D.5.

The evaluation of the suitability of the stream to support various desired uses is presented in terms of either poor, fair, good, excellent, acceptable, marginal or unacceptable. These ratings refer to the criteria revelant to each stream characteristic or use as outlined in Appendices D.1 through D.5. The suitability of each stream reach was rated by comparing the data discussed in Chapter 2 with the criteria listed in Appendix D. In some cases, the data from the tables and discussion of more than one section of text may be required. From this comparison, a composite value or overall rating was given to each stream reach for which data was available. The evaluation was not strictly quantitative in that some professional judgement was used to weight certain parameters more than others.

In the physical features section, the physical criteria pertain to the stream's flood potential; in particular, its channel capacity, channel stability and susceptability to bank erosion (Appendix D.1). The criteria used evaluating the physical characteristics of the stream are based on criteria originally devised by Pfankuch (1978) and later adapted by Metro (Brenner, 1979). In the stream biota section, the criteria relate to the stability and quality of the habitat for salmonid spawning and rearing (Appendix D.2). Wildlife habitat (primarily small game animals and birds) and the protection of water quality through the bank stabilization and filtering properties of vegetation were evaluated in the riparian corridor criteria (Appendix D.3). In the water supply section, the criteria relate to the suitability of surface water for domestic or agricultural use (Appendix D.4). The criteria used in evaluating the chemical and microbiological characteristics are primarily from

DOE State Water Quality Standards established in 1978 in WAC 173-201. Finally, the recreational criteria relate to the suitability of the stream for swimming and boating (Appendix D.5).

COMMENTS ON THE APPROPRIATENESS OF THE CRITERIA

The criteria used in this inventory to evaluate the suitability of a particular stream to support its identified beneficial uses have been adapted and revised for use by Metro from several sources. As such, the criteria may not have universal acceptance by the many professionals on the various water resource fields. Some of the criteria do warrant comments as to their appropriateness in this evaluation.

Drainage studies to determine flood or erosion prone areas along stream corridors are often based on mathematical models. A large portion of the input to these models is computer analysis of stream physical data. These studies may be limited if the accuracy of the input data or the resultant predictions are not confirmed by field observation. The data used in this evaluation is based entirely on field observation. Although this evaluation is limited in predicting future flood prone areas, it may be more accurate in identifying areas in which flooding and erosion presently occur. These include areas of bank erosion, channel scour, and areas that require bank protection materials (rip-rap). If future predictions of flood prone areas are desired, the data used in this evaluation may serve as the data base for some form of computer analysis.

Although the effects of sediment on stream biota are well documented (Iwamoto et al., 1978; DOE, 1981), criteria for evaluating these effects are not. Criteria, which vary from the use of turbidity standards to various quantities of fine material in the substrate, are well discussed in the above referenced documents. The percentage of fine material in the streambed was used in this evaluation because at the present time, it seems to be the standard most widely accepted. Although there have been recent proposed changes in this reporting methodology (Lotspeich and Everest, 1981), these changes have not yet been widely adopted. Evaluations in this report of the percentage of fine material in the substrate are based on visual estimates provided by Metro's physical surveys rather than the more commonly used freeze core data. This is based on work by Johnson (1981), who found no significant difference between the two methods.

The rationale for the use of criteria regarding metals concentration in order to protect aquatic life appears in many publications (Federal Register, 1980; Environmental Protection Agency, 1978; National Academy of Sciences, 1974; and McKee and Wolf, 1963). Most of the criteria are based on laboratory experiments where acute and chronic biological effects are documented at specific concentrations of dissolved metal species. For others, a safety factor is applied to the experimental concentrations to define the criteria concentrations. In the latter case for some metals (lead, copper, chromium, cadmium, mercury and nickel), the safety factor reduced the criteria concentration level below the detection limit of Metro's laboratory instrumentation used at the time of sample collection (Appendix D.2.b and D.4). It is questionable whether these experiments and the resultant criteria can be extrapolated to actual receiving water conditions. This concern is partially addressed by adjusting criteria using formulae which include receiving water characteristics that modify the toxicity of metals. For the present evaluation, the authors have used the most recent federal criteria. Ideally, criteria for protecting aquatic life should be predicated on biological monitoring. At present, this approach has been conducted only on a limited scale.

The evaluation approach in determining the microbiological suitability of surface water to support various beneficial uses has been debated for years (Stevenson, 1953; Cabelli, 1976; Dufour, 1981). At issue is which indicator organism to monitor and how to use the data in evaluating the public health risks. At present, fecal coliforms are the most widely accepted indicator organism, primarily because of its analytical cost effectiveness. The technical link of fecal coliforms to public health risk is based on the correlation of fecal coliform counts to the incidence of Salmonella, an enteric pathogen (Cabelli, 1976).

Adoption of a fecal coliform "standard" has varied between agencies and with the desired use of the water. Public swimming beaches in the Seattle area, for instance, are usually not closed to swimming unless the fecal coliform counts exceed 1,000 organisms per 100 mililiters (org/100mls). The Environmental Protection Agency sets 200 org/100ml as its criteria for contact recreation. The Department of Ecology has taken a more conservative approach for Class AA and A waters by setting criteria at 50 and 100 org/100 ml, respectively. The Department of Social and Health Services has set drinking water standards for potable water at 20 org/100ml. In this evaluation, the authors have used the DOE fecal coliform criteria. Ideally, the use of microbiological organisms in water quality evaluations should reflect the actual degree of risk to public

health. Recent microbial monitoring data from the Green River and Lake Washington watersheds (Brenner, 1979; Brenner and Anderson, 1982) have frequently exceeded these conservative criteria, often by considerable amounts. At present, there have been no epidemiological studies which relate these more conservative local standards to public health effects.

DATA LIMITATIONS

In preparing any type of analysis or assessment, it is important to know the limitations of the data base used. These limitations define the "bounds" in which the conclusions of the analysis reside. Extrapolation of conclusions from the data beyond the bounds mentioned below, should be done carefully. In our assessments, the two main sources of data are Metro's stream survey and small stream monitoring.

Metro's stream survey data, used in the assessments of the physical, stream biota, riparian corridor and recreational uses, are from physical surveys conducted once per year, usually during the low flow period of June through September (Brenner, 1979). Trained observers make visual observations on 10 physical parameters as they walk the stream course. Some of the data, specifically the data on land use in the riparian corridor and percent canopy, may not cover a standard length on each side of the stream (50 feet for example). The "depth" of observations, i.e., distance back from the stream's edge which the observer can see, varies from stream to stream. Stream surveys have not been conducted during winter months or periods of high flow.

Most of Metro's recent water quality monitoring data are from monthly grab samples collected between 8 a.m. and 2 p.m., usually at the mouth of the stream (B. Brenner, Metro, pers. comm.). Because the samples generally represent non-storm, low-flow, daylight conditions, the "worst case" water quality conditions may not be reported. The concentrations of dissolved oxygen, nitrates, ortho-phosphate and pH, for example, can fluctuate considerably during a 24-hour period when large amounts of algae are present. A few storm grab samples have been collected, but the entire hydrograph in most cases has not been sampled making it difficult to assess the impact on water quality from storm runoff.

CHAPTER 4

EVALUATION OF SUITABILITY OF EXISTING STREAM CONDITIONS TO SUPPORT IDENTIFIED BENEFICIAL USE

This chapter uses available data on existing stream conditions to evaluate the stream's suitability to support various desired uses. As stated in Chapter 2, the general characteristic uses of a stream include, but are not limited to, water supply, fish and wildlife habitat, and general recreational and aesthetic enjoyment (Table 2.1). As part of a water resource planning effort, Metro added to this list and attempted to quantify which uses might logically occur and to what degree (Table 4.1). Although the basis for the degree of each use was defined qualitatively, the authors believe this is an important data input in the development of basin-specific water resource management plans. Before major actions are taken to improve stream conditions, it is important that these uses be further confirmed and quantified to provide reasonable assurance that cost-effective benefits will be realized.

The evaluation of the suitability of the stream to support various desired uses is presented in terms of either poor, fair, good, excellent, acceptable, marginal or unacceptable. These ratings refer to the criteria relevant to each stream characteristic or use as outlined in Appendices D.1 through D.5.

PHYSICAL FEATURES RELATED TO FLOOD/EROSION POTENTIAL

Bear Creek

The physical features of Bear Creek are rated as good. RM 12.4 to 9.5 is primarily an inaccessible swampy area which make up the headwaters. While there is little evidence of bank failure from the headwaters to RM 7.0, the channel capacity is frequently exceeded. Bank erosion is moderate and channel stability is rated good to fair with some sloughing evident. From RM 7.0 to 3.4 the stream is rated as good. Bank failure is infrequent and channel stability is good although some scour and deposition is occurring. The bank erosion potential varies from slight to moderate; there is some intermittent cutting at out curves and constrictions. The physical nature of the stream from RM 2.7 to 0.0 is rated as good. Bank failure is moderate with some raw banks and areas of extensive bank

Table 4.1 Summary of Uses of Bear/Evans Creek and their Confirmation through this Study.

USE CATEGORY	DOE CHARACTERISTIC USES (CLASS AA & A WATERS)	METRO BENEFICAL USES	1981 ESTIMATES DEGREE OF USE ● Major O Minor	SUMMARY RESULTS OF THIS STUDY: Confirmation of Use or Disuse	Degree of Use	Reach
FISH & SHELLFISHING	Salmonid spawning	Salmonid spawning	●	Yes 1944-1979	0-335 Median Fish/Mile	Bear RM 0.0-11.5;Evans RM 0.0-3.0;3.5-5.5 Cottage RM 0.0-3.5 & other tributaries
	rearing	rearing	●	Yes 1944-1979	- -	
	migration	migration	●	Yes 1944-1979	0-335 Median Fish/Mile	
	Other Fish Spawning	Other Fish Spawning	NA	Unconfirmed		
	rearing	rearing	NA	Unconfirmed		
	migration					
	Clam, oyster, mussel spawning rearing; Crustaceans & Other Shellfish spawning rearing	Shellfish rearing	o	Yes 1981	Freshwater clams	Bear, Site J
HARVEST	Sport Fishing	Sport Fishing; Sport Shellfishing	o	Cutthroat 1959-1979; Unconfirmed	Relatively low catch per unit effort	Bear Creek Mouth
	Salmonid Harvesting; Other Fish Harvesting	Commercial Fishing	NA	NA	Prohibited by law	
	Clam, oyster, mussel Harvesting; Crustaceans & Other Shellfish Harvesting	Commercial Shellfishing	NA	NA	Prohibited by law	

USE CATEGORY	DOE CHARACTERISTIC USES (CLASS AA & A WATERS)	METRO BENEFICIAL USES	1981 ESTIMATES DEGREE OF USE ● Major O Minor	SUMMARY RESULTS OF THIS STUDY: Confirmation of Use or Disuse	Degree of Use	Reach
WATER SUPPLY	Domestic & Potable	Potable	NEM	Yes 1939-1976*	30 withdrawals	Bear RM 2.0-10.0; Evans RM 0.0-3.0;Cottage RM 0.0 -3.0 and other tributaries
		Domestic	NEM			
	Irrigation (Agricultural)	Agriculture	●	Yes 1922-1975 1936-1976	43 withdrawals-Irrigation 8 withdrawals-Stock watering	Bear RM 0.0-10.0; Evans RM 0.0-4.0; Cottage RM 0.0 -4.0 and other tributaries
	Stock Watering					
	Propagation	Fish Hatchery	NA	Yes** 1948-1981	11 diversions	Bear RM 6.0-10.0; Evans RM 0.0-3.0; & other tribs.
	Industrial/Commercial/Power	Industrial	NA	Yes 1930-1964	3 withdrawals	Bear RM 2.0-4.0; Evans RM 0.0-2.0
	Other					
WILD-LIFE	Wildlife Habitat	Wildlife	●	Unconfirmed	Beaver dams	Bear headwaters
RECREATION	Primary Contact	Swimming	o	Unconfirmed		
	Secondary Contact	Wading	o	Unconfirmed		
		Scuba Diving	NA	NA		
	Boating	Powerboating	NA	NA		
		Sailing	NA	NA		
		Waterskiing	NA	NA		
		Canoe/Row/Kayaking	NA	None likely	See Chap. II Rec. Oppor.	
	Aesthetic	Viewing	●	Yes 1982	No quantification. Potential of golf courses, parks, trails and road crossings	Bear RM 0.0-0.6; Evans RM 0.8-4.5;Cottage RM 2.4-2.6; and Trib. 0132 RM 0.2-0.8; and scattered other locations

NA=Not appropriate

NEM=No estimate made

*For all water supply: DOE permit for use confirmed, but actual withdrawal for use is unconfirmed.

**No public fish hatchery exists on Bear-Evans Creek

USE CATEGORY	DOE CHARACTERISTIC USES (CLASS AA & A WATERS)	METRO BENEFICIAL USES	1981 ESTIMATES DEGREE OF USE ● Major O Minor	Confirmation of Use or Disuse	Degree of Use	Reach
COMMERCIAL SHIPPING	Commerce & Navigation	Commercial Navigation	NA	NA		
	Log rafting and storage	Log Storage	NA	NA		
WATER & WASTE DISPOSAL		Stormwater receiver	●	Yes 1982		
		CSO's & Emergency Outflows	NA	NA		
		Wastewater Assimilation	NA	NA		
		Deepwater Disposal	NA	NA		

cutting. The channel capacity is good. The bank erosion potential is slight even though seasonal high flows breach banks.

Evans Creek

The physical features of Evans Creek from RM 7.0 to the mouth are rated fair to excellent. From RM 7.0 to 5.4, the stream flows through a steep ravine. Although the channel capacity is good, there is significant bank cutting and scour (30 to 50 percent) in places. At RM 5.4 (Highway 522), the stream enters the valley bottom and the stream conditions improve. There is, however, extensive deposition where the gradient decreases. From RM 5.4 to 0.0 the physical features of Evans Creek are rated excellent. There is no indication of bank failure throughout this entire reach. The soil erosion and cutting potential is slight and rated excellent because of the gentle slopes (less than 2 percent) and riparian vegetation. Because the water table is seasonally near the surface, the channel capacity is frequently exceeded.

Cottage Lake

The physical features of Cottage Lake Creek (including Daniels Creek), were rated good to excellent. As Daniels Creek (RM 6.0 to 4.3), the stream is rated excellent. Although some flooding occurs in marsh areas near RM 5.8 the channel capacity is adequate; there is no evidence of bank failure, obstructions or channel scour.

Cottage Lake Creek is rated good from RM 3.6-0.0. The channel has a moderate to slight erosion and bank failure potential. Channel stability is also good with only 10 percent of the channel effected by scouring.

Unnamed (08.0108)

The physical features of this small stream were rated poor to excellent. From RM 1.1 to 0.6, there is a moderate amount of bank failure with some intermittent cutting (up to 12 inches in height). Channel scour is more than 50 percent in some places.

From RM 0.6 to 0.4, conditions improve considerably. There is no evidence of bank failure or cutting; less than 5 percent of the channel was scoured. Channel capacity, however, may be somewhat limited in places.

Unnamed (08.0110)

Throughout the surveyed reach (RM 0.0 to 0.7), this stream was rated as good. There is little evidence of bank failure, cutting or deposition. Channel scour varied from less than 5 percent to 30 percent. From RM 0.4 to 0.7, there is some cutting which resulted in raw banks that were 12 to 24 inches in height.

Struve Creek

The physical features of Struve Creek are rated as good. Although there is no evidence of bank failure, there is some intermittent cutting and channel scour. There is also some new deposition observed in this stream.

Unnamed (08.0132)

Similar to Struve Creek, this stream is also rated as good. There is some intermittent cutting at out curves; channel scour was 5 to 30 percent. There is also some deposition observed in this stream.

RIPARIAN CORRIDOR FOR WILDLIFE AND WATER QUALITY PROTECTION

Bear Creek

Survey information on the riparian corridor is limited to RM 9.5 to 0.0. The corridor from RM 9.5 to 5.4, which is rated good, consists of scattered single family residences and plant cover (coniferous trees and vegetative bank protection) which exceeds 75 percent. From RM 7.0 to 5.4 the deciduous trees, however, become the primary canopy and pastures are more prevalent. From RM 5.4 to 4.1, land clearing is occurring. The canopy is becoming more discontinuous; this section, which is quite swampy with thick ground cover and scattered single family residences, is rated fair.

The riparian corridor from RM 4.1 to 0.0 is rated fair because of the reduction in plant cover (15 to 30 percent) and developed open space. These open spaces consist of pastureland, cultivated fields and a golf course.

Evans Creek

The corridor from RM 7.0 to the mouth is rated as good. There is extensive plant cover with a few interspersed single family residences, farms and pastures bordering the

wetlands adjacent to Evans Creek. Although some industry and light commercial areas are approaching the corridor near RM 0.8, the vegetative buffers have been preserved.

Cottage Lake

The riparian corridor of Daniels Creek varies from greenbelt, low density residential, to old pasture areas. The corridor from RM 6.0 to 4.3 is rated fair to good. The vegetative bank cover ranges from 50 to 70 percent. The trees are a mixture of deciduous and coniferous species; in some areas the trees are 40 to 60 feet tall. The riparian corridor of Cottage Lake Creek consists of scattered single family and fenced, buffered pastures. The entire length of the corridor, with the exception of RM 2.7 to 2.3--which is the golf course (developed open space with no buffer strip), is generally rated good.

Unnamed (08.0108)

The riparian corridor of this tributary is rated as good. From RM 1.1 to 0.6, the corridor is a natural greenbelt area that has a 70 to 90 percent plant density. Downstream (RM 0.6 to 0.0) the plant density in the corridor increases to more than 90 percent, but the land use changes to medium density residential area that is interspersed with pasture.

Unnamed (08.0110)

The riparian corridor of this tributary is rated good to excellent. Throughout the surveyed reach (RM 0.0 to 0.7), the plant density on the banks is greater than 90 percent. From RM 0.0. to 0.4, the trees are mostly deciduous; from RM 0.4 to 0.7, they are a mixture of deciduous and coniferous trees. The corridor is primarily a greenbelt with scattered residential areas.

Struve Creek

The riparian corridor of Struve Creek is rated good. The vegetative bank cover varies from 70 percent to more than 90 percent; the trees are a mixture of both coniferous and deciduous. The land use is greenbelt.

Unnamed (08.0132)

The vegetative bank cover of rose bushes, devils club, with a mixture of deciduous and coniferous trees along RM 0.0 to 0.9, is rated as good (70 to 90 percent cover). The corridor land use is a greenbelt.

SALMONID PRODUCTION

The suitability of the physical habitat of Bear-Evans Creek for salmonids is rated excellent to poor. Although there appears to be no major water quality limitations, the dissolved oxygen (d.o.) concentration is occasionnally less than excellent. Of the 197 d.o. samples collected, 42 (21 percent) were in the good category and 13 (7 percent) were rated fair (Table 4.2). During the "dry" period of the year, four of the 48 samples (7 percent) were rated poor. Because the samples are collected on a monthly basis, it is not known how long these lower d.o. concentrations existed instream.

It is difficult to fully evaluate the concentrations of trace metals because, as discussed in Chapter 3, of the limitations in sampling frequency and analytical detection limits. The concentration of several trace metals, however, did occasionally exceed the acute criteria for the protection of freshwater life (Table 4.3). The concentrations of cadmium, chromium, copper and lead exceeded the criteria in one or two of the samples at several different sites. Most of these higher concentrations seem to occur during the wet season.

In Bear Creek, the high percentage of fine material in the substrate and the lack of cover may limit fish spawning and rearing particularly in the reach from RM 4.8 to the mouth. In general, 14 percent (1.3 miles) of the substrate from RM 9.5 to the mouth is rated excellent, 39 percent (3.7 miles) is rated good to fair, and 47 percent (4.5 miles) is rated poor. Specifically, the substrate from RM 9.5 to 9.0 is rated poor; most of RM 9.0 to 4.1 is rated good to fair; and most of RM 4.1 to the mouth is rated poor.

Because of the limited accessibility of Evans Creek, only the substrate RM 7.0 to 5.1 was rated. In this reach, the substrate is rated as fair for salmonid spawning. Although the fines content is only moderate (10 to 15 percent), 30 to 50 percent of the substrate is subject to channel scour. The culvert under Highway 202 (Redmond-Fall City Road) may be a possible barrier to upstream fish passage. Further evaluation is limited by lack of recent survey data for this stream.

TABLE 4.2. NUMBER OF TIMES THAT MEASUREMENTS OF FOUR PARAMETERS AT SIX STATIONS ON BEAR-EVANS CREEK DID NOT MEET VARIOUS CRITERIA. DATA FROM METRO'S 1979-1981 SMALL STREAMS SURVEYS.

SITE	SEASON	PARAMETER														
		DISSOLVED OXYGEN NUMBER <				TEMPERATURE NUMBER >				FECAL COLIFORMS NUMBER >					PH NUMBER	
		9.5	8.0	6.5	4.0	16	18	21	24	GMFC*	20	100	200	400	<6.5	>8.5
MAINSTEM																
0	WET	4/21	1	-	-	0/21	-	-	-	633	24/24	24	23	16	0/24	-
	DRY	3/12	1	1	-	1/12	-	-	-	690	14/14	14	13	10	0/14	-
	ANNUAL	7/33	2	1	-	1/33	-	-	-	600	38/38	38	36	26	0/38	-
C	WET	4/21	2	-	-	0/21	-	-	-	361	23/24	22	19	11	0/24	-
	DRY	3/12	1	1	-	0/12	-	-	-	380	14/14	14	13	7	0/14	-
	ANNUAL	7/33	3	1	-	0/33	-	-	-	395	37/38	36	32	18	0/38	-
G	WET	3/21	1	-	-	0/21	-	-	-	384	24/24	22	20	12	0/24	-
	DRY	3/12	1	1	-	0/12	-	-	-	373	14/14	14	13	5	0/14	-
	ANNUAL	6/33	2	1	-	0/33	-	-	-	385	38/38	36	33	17	0/38	-
J	WET	2/21	1	-	-	0/21	-	-	-	68	23/24	8	2	1	0/24	-
	DRY	9/12	1	1	-	1/12	-	-	-	172	14/14	12	6	1	0/14	-
	ANNUAL	11/33	2	1	-	1/33	-	-	-	110	27/28	20	8	2	0/38	-
TRIBUTARIES																
B	WET	4/21	2	-	-	0/21	-	-	-	114	23/24	12	6	3	0/24	-
	DRY	2/12	1	-	-	0/12	-	-	-	442	14/14	14	13	8	0/14	-
	ANNUAL	6/33	3	-	-	0/33	-	-	-	210	37/38	26	19	11	0/38	-
N	WET	3/20	-	-	-	0/21	-	-	-	166	24/24	15	6	4	0/24	-
	DRY	2/12	1	-	-	0/12	-	-	-	513	14/14	14	13	9	0/14	-
	ANNUAL	5/32	1	-	-	0/33	-	-	-	205	38/38	29	19	13	0/38	-

* GEOMETRIC MEAN - FECAL COLIFORMS

** X/Y: X=NUMBER OF MEASUREMENTS NOT MEETING CRITERIA: Y=NUMBER OF MEASUREMENTS MADE (ALL SUBSEQUENT COLUMNS CONTAIN ONLY X); - = ZERO.

TABLE 4.3. NUMBER OF TIMES THAT MEASUREMENTS OF SIX METALS AT SIX STATIONS ON BEAR-EVANS CREEK DID NOT MEET VARIOUS CRITERIA. DATA FROM METRO'S 1979-1981 SMALL STREAMS SURVEYS.

	CADMIUM NUMBER > .6*	10	CHROMIUM NUMBER > .29	21	COPPER NUMBER > 5.6	500	IRON NUMBER > 300	1000	NICKEL NUMBER > 13	28	LEAD NUMBER > 0.1	24
O (MOUTH OF BEAR-EVANS CREEK)												
WET	1/20	1	2/24	1	2/24	-	14/14	-	0/18	-	4/24	1
DRY	0/14	-	0/14	-	0/14	-	1/ 7	-	0/14	-	0/13	-
TOTAL	1/34	1	2/36	1	2/38	1	15/21	-	0/32	-	4/37	1
B (MOUTH OF EVANS CREEK)												
WET	2/20	2	1/24	1	2/24	-	15/15	-	2/19	1	2/24	1
DRY	0/14	-	0/14	-	0/14	-	5/ 8	-	0/10	-	0/14	-
TOTAL	2/34	2	1/38	1	2/38	-	20/23	-	2/29	1	2/38	1
MAINSTEM SITES												
C												
WET	0/18	-	2/22	-	1/22	-	11/12	-	0/17	-	3/22	1
DRY	0/14	-	1/14	-	0/14	-	1/ 8	-	0/10	-	0/14	-
TOTAL	0/32	-	3/36	-	1/36	-	12/20	-	0/27	-	3/36	1
G												
WET	0/20	-	2/24	1	2/24	-	9/14	-	0/19	-	1/24	-
DRY	9/14	-	0/14	-	0/14	-	1/ 8	-	0/10	-	0/14	-
TOTAL	9/34	-	2/36	1	2/38	-	10/22	-	0/29	-	1/38	-
J												
WET	0/20	-	3/24	-	1/24	-	8/15	-	0/19	-	2/24	1
DRY	0/14	-	0/14	-	0/13	-	0/ 7	-	1/ 9	-	2/13	2
TOTAL	0/34	-	3/38	-	1/37	-	8/22	-	1/28	-	4/37	3
TRIBUTARIES												
COTTAGE LAKE CREEK												
WET	1/20	1	1/24	-	2/24	-	8/18	-	0/19	-	3/24	2
DRY	0/14	-	0/14	-	1/14	-	0/ 8	-	0/10	-	1/14	-
TOTAL	1/34	1	1/38	-	3/38	-	8/26	-	0/29	-	4/38	2
DETECTION LIMITS:	4		20-40		10		10		20		6-40	

* ALL CRITERIA VALUES ARE EXPRESSED AS UG/L.

** X/Y: X=NUMBER OF MEASUREMENTS NOT MEETING CRITERIA; Y=NUMBER OF MEASUREMENTS MADE (ALL SUBSEQUENT COLUMNS CONTAIN ONLY X); - = ZERO.

The physical habitat of Daniels Creek is rated as excellent. The stream has a very stable substrate and a high percentage of shade and cover. Although the percent of fine material in the substrate is somewhat marginal (15 to 20 percent), spawning apparently occurs successfully; during Metro's stream survey, numerous salmon fry were observed throughout Daniels Creek.

The substrate in Cottage Lake Creek is generally rated as poor. Forty-seven percent or 1.6 miles of the substrate from RM 3.6 to the mouth had fines content of 40 percent. The remaining 53 percent or 1.8 miles (specifically RM 2.3 to 0.5), while rated poor, appears only marginally so. The estimated 25 percent fines in this reach is only 5 percent above the upper limits of the "fair" rating.

The habitat of the other tributaries (08.0108, 08.0110, Struve and 08.0132) is rated as good to excellent. As with Daniels Creek, these streams generally have a stable substrate and a high percentage of shade and cover. Although the content of fines in the substrate is marginal in areas (20 to 30 percent), most of the substrates are rated good. Salmon fry and trout were observed in all of tributaries and were especially numerous in stream 08.0110.

Complete evaluation of the suitability of Bear-Evans Creek for salmonids is limited by lack of physical data for several tributaries. This evaluation is also limited by the lack of data on the present extent of spawning and rearing of salmonids in the tributaries.

WATER QUALITY FOR USE AS WATER SUPPLY

Generally, the water quality of Bear-Evans Creek met DOE class AA standards (Table 4.2). The exceptions to this were dissolved oxygen concentrations (discussed in Salmonid Production) and fecal coliform counts. Both spatially and temporarily, the fecal coliform counts exceeded nearly all of the use criteria on a majority of the samples. Only station J met the criteria for livestock watering and agricultural use during both the wet and dry season; stations B (Evans Creek) and N (Cottage Lake Creek) met these same criteria during the wet season.

As mentioned earlier, the limitations with sampling frequency and in analytical detection limits restricts the evaluation of the levels of trace metals. The water supply criterion

for nickel, for example, is less than the detection limits of Metro's analytical equipment at the time of sampling. In spite of this, some general comments can be made. Except for iron, concentrations of most of the metals were less than the criteria (Table 4.3). In only four samples (three nickel and one lead) did concentration of a trace metal exceed potable water supply criteria. The concentration of iron, especially the samples from the wet season, frequently exceeded the potable water standards. Because the criteria for iron relates primarily to aesthetics such as water taste, these concentrations do not pose a threat to human health.

Evaluation of the potential risk to human health is limited by the lack of data on the number of households presently using the creek as a potable water supply. As mentioned in Chapter 2, most of the water rights for domestic withdrawal were issued prior to 1963.

RECREATIONAL OPPORTUNITIES

Bear Creek

The recreational use of Bear Creek for boating and swimming from RM 12.4 to 7.5 is rated marginal to not acceptable. The limiting factors are water depth (less than 1 foot average depth) and limited access. From RM 7.5 to 0.0 recreational use is rated acceptable to marginal. Water depth in pools is occasionally greater than 3 feet and access is available from bridges and public right-of-ways.

Except for station J, the water quality of Bear Creek is rated unacceptable for contact recreation because of dry season median fecal coliform counts in excess of 200 organisms/100 ml.

Evans Creek

The recreational use of Evans Creek for boating and swimming from RM 7.0 to 0.0 is rated marginal to not acceptable. The primary limiting factor is the marshy condition of the stream course, and an average water depth of less than 1 foot. Bridge crossings provide the only access to the creek.

The water quality of Evans Creek for recreation is rated unacceptable for contact recreation because of dry season median fecal coliform counts in excess of 200 organisms/100 mls.

Cottage Lake Creek

The recreational use of Cottage Lake and Daniels Creek for boating and swimming from RM 6.0 to 0.0 is rated marginal to not acceptable. The limiting factors are water depth (less than 1 foot average depth) and access. With the exception of some limited access at bridge crossings, Tolt Pipeline Trail crossing and the public golf course, the entire corridor is private land.

The water quality of Cottage Lake Creek is rated unacceptable for contact recreation because of dry season median fecal coliform counts in excess of 200 organisms/100 ml.

The recreational use of the other surveyed tributaries (08.0108, 08.0110, Struve and 08.0132) is rated as marginal to unacceptable. The primary limiting factor in all of these streams is the shallow average depth and limited access.

SUMMARY

In evaluating the suitability of present stream conditions to support various uses, Bear-Evans Creek and its tributaries were generally rated as good (Figure 41). The primary factors which caused the few low ratings were high fecal coliform counts (Water Use and Recreation), shallow water depth (Recreation) and channel scour and high fines content of the substrate (Salmonid Production). As mentioned in the text, some of the evaluations are limited by the lack of available data for portions of Bear-Evans Creek. Chapter 5 contains estimates of the effort required to obtain the information needed to complete or extend these particular evaluations.

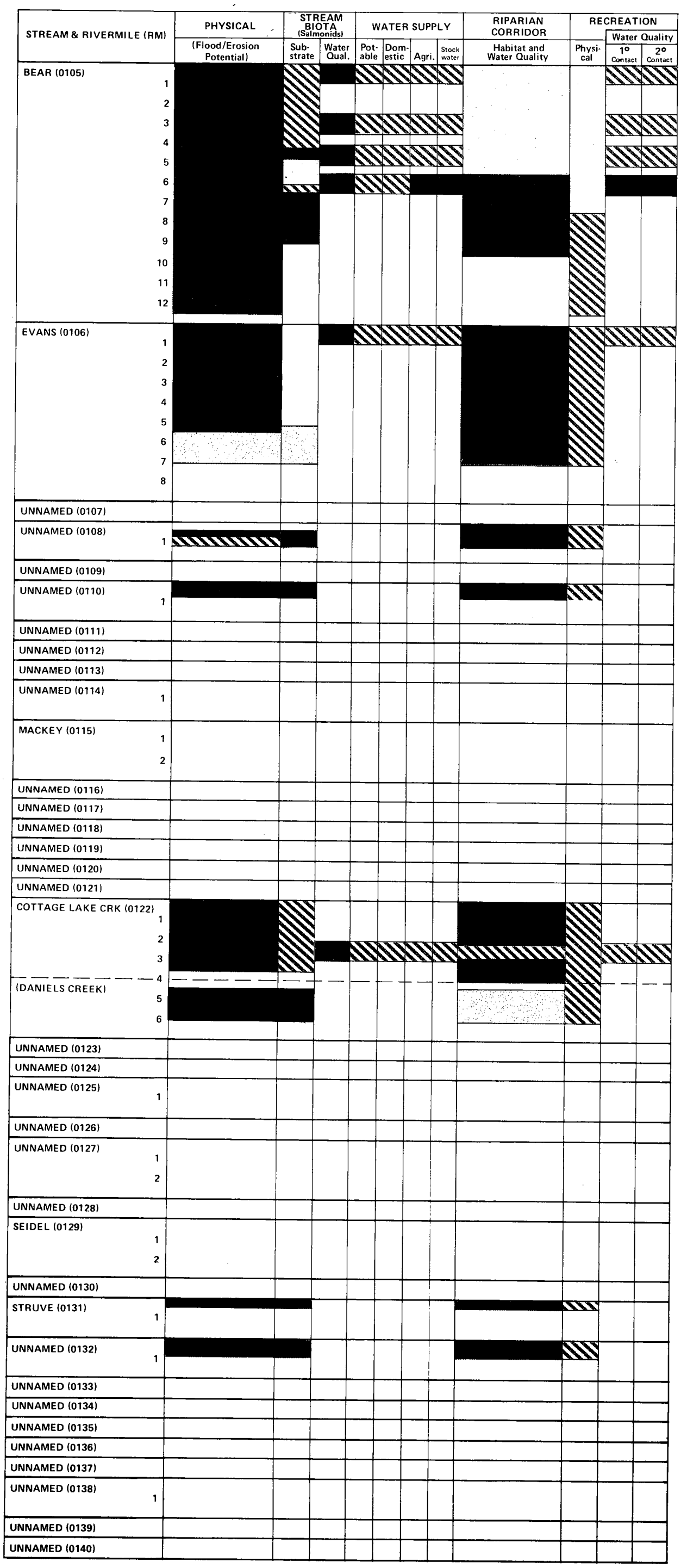


FIGURE 4.1

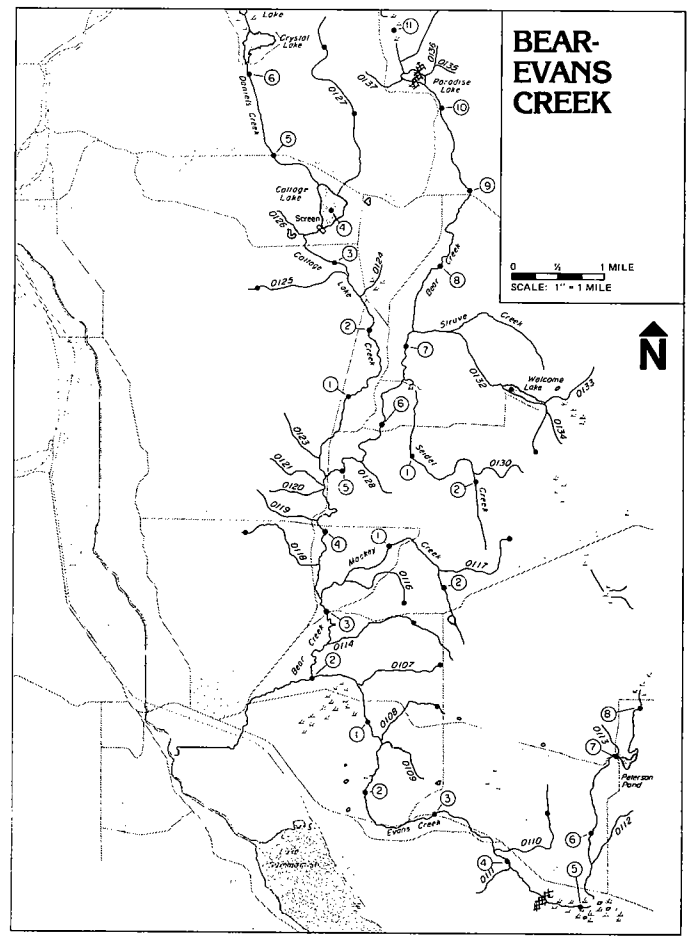
Summary of the suitability of Bear-Evans Creek's to support various uses

Rating scale for each characteristic -- see criteria in Appendix D.

PHYSICAL	STREAM BIOTA	WATER SUPPLY	RIPARIAN CORRIDOR	RECREATION
EXCELLENT (Low Potential)	EXCELLENT	ACCEPTABLE	EXCELLENT	ACCEPTABLE
GOOD	GOOD	UNACCEPTABLE	GOOD	MARGINAL
FAIR	FAIR		FAIR	UNACCEPTABLE
POOR (High Potential)	POOR		POOR	

1° = Primary; 2° = Secondary

Some reaches may only have data from a station or spot check. Blanks indicate no data. See text for further discussion.



CHAPTER 5
IDENTIFICATION OF ADDITIONAL DATA NEEDED FOR THE EVALUATIONS OF EXISTING STREAM CONDITIONS

Four data needs were identified in the evaluation of Bear-Evans Creek. They are physical survey data for several small tributaries, information on the present status of the fishery resource in these same tributaries, further recreational use data, and confirmation of present water withdrawals from Bear-Evans for domestic use. It will require an estimated 385 to 550 labor hours to fill these data needs.

The physical data is needed to complete the evaluations of the physical, stream biota and riparian corridor sections. While most of the basin has been surveyed, data for several small tributraries is incomplete. A standard survey of 15 miles of stream would require approximately 75 labor hours.

A survey of the present fishery resource in unsurveyed tributaries of Bear-Evans Creek would be used to document the fish species present, their distribution within the stream basin, and their general levels of abundance. This information is needed to help confirm the extent of use of these tributaries for salmonid spawning and rearing. This one-time survey would require between 80 and 120 labor hours.

Because the physical surveys described above and in Chapter 2 are normally performed between 8 a.m. and 5 p.m. on a weekday, it is unlikely that a comprehensive picture of recreational or other use throughout the basin can be obtained. An alternate method for collecting such data would be to conduct a survey of residents and the recreational facilities in the basin as to their use or what use they have observed. The preparation, distribution, collection and analysis of such a survey would require between 120 and 200 hours assuming a mail-out/mail-back method.

Confirmation of the present water withdrawals from Bear-Evans Creek is needed to determine how many households are withdrawing untreated water for potable use. Because of the high fecal coliform counts, there may be a potential health threat to these households. Further studies, which would depend on the number and location of households withdrawing water for domestic use, would be needed to help identify the

source of the coliform bacteria if effective abatement actions are to be pursued. The labor hours required for this confirmation and source identification survey would vary from 50 to 100 hours depending on the extent of the survey.

A more detailed description of the individual task and labor hours required to fill each of data needs listed above is contained in Appendix E.

REFERENCES CITED

Brenner, R. N. 1979. Small streams survey interim report. Report for the Municipality of Metropolitan Seattle. Seattle, Washington. 88 p.

Brenner, R. N. and D. E. Anderson. 1982. 1980 Small streams survey report. Report for the Municipality of Metropolitan Seattle. Seattle, Washington. 85 p.

Brenner, R. N. and R. J. Morrice. 1978. Routine streams survey interim report. Report for the Municipality of Metropolitan Seattle. Seattle, Washington. 49 p.

Cabelli, V. J., H. Kennedy and M. A. Levin. 1976. Pseudomonas aeruginosa - fecal coliform relationship in estaurine and fresh recreational waters. Journal Water Pollution Control Federation 48(2):367-376.

Department of Ecology. 1978. Washington State water quality standards. (WAC 173-201) Olympia, Washington. 32 p.

Department of Ecology. 1981. The use of sediment as a water quality criterion: a discussion paper. Olympia, Washington. 18 p.

Department of Social and Health Services. 1978. Rules and regulations of the state board of health regarding public water systems. Olympia, Washington. 48 p.

Deusen, M. 1982. Washington Department of Fisheries. Letter to D. Wilson, Metro. May 10, 1982.

Dufour, A. P. 1982. Fresh recreational water quality and swimming associated illness. U. S. Environmental Protection Agency, Health Effects Research Laboratory, Microbiology Branch, Cincinnati, Ohio. Unpub.

Egan, R. 1978. Salmon spawning ground data report. Progress report no. 51. Washington Department of Fisheries. Olympia, Washington. 484 p.

Egan, R. 1980. Salmon spawning ground data report. Progress report no. 109. Washington Department of Fisheries. Olympia, Washington. 145 p.

Environmental Protection Agency. 1978. Quality criteria for water, U. S. Government Printing Office. Washington, DC. 256 p.

Federal Register. 1980. Part V Environmental Protection Agency notice of water quality criteria documents. 45(23):79318-79341.

Galvin, D. and R. Moore. 1982. Toxicants in urban runoff. Report for Municipality of Metropolitan Seattle. Seattle, Washington.

Harper-Owes. 1981. Development and evaluation of a predictive capability to assess water quality impacts from urbanization in King County streams and rivers. Report prepared for the Municipality of Metropolitan Seattle. Seattle, Washington. 124 p.

Hynes, H. B. N. 1972. The ecology of running waters. University of Toronto Press, Toronto. 555 p.

Iwamoto, R. N., E. O. Salo, M. A. Madej and R. L. McComas. 1978. Sediment and water quality: a review of the literature including a suggested approach for water quality criteria. U. S. EPA, Region 10. Rpt. EPA 910/9-78-048. 151 p.

Johnson, A. 1981. A comparison of visual estimation with freeze cores for evaluating streambed substrates. Unpublished manuscript. Municipality of Metropolitan Seattle. Seattle, Washington. 9 p.

Lotspeich, F. and F. Everest. 1981. A new method for reporting and interpreting textural composition of spawning gravel. USDA Pacific Northwest Forest and Range Experiment Station Research Note PNW-369. 11 p.

McKee, J. E. and H. W. Wolf. 1963. Water quality criteria. The Resources Agency of California, State Water Quality Control Board, Publication No. 3-A. 344 p.

National Academy of Sciences. 1974. Nutrients and toxic substances in water for livestock and poultry. Report of Subcommittee on Nutrient and Toxic Elements in Water. Washington, DC.

Patrick, R. and C. W. Reimer. 1966. The diatoms of the United States. Academy of Natural Sciences, Philadelphia.

Pederson, E. R. 1981. The use of benthic invertebrate data for evaluating impacts of urban stormwater runoff. Masters Thesis, University of Washington, Seattle, Washington. 106 p.

Perkins, M. A., et al. 1980. Ecological impacts of storm water runoff in urban streams. Preliminary status report, January 1, 1979 to May 31, 1980. FRI-UW-8013. Fisheries Research Inst., University of Washington. Seattle, Washington. 36 p.

Pfankuch, D. J. 1978. Stream reach inventory and channel stability evaluation. USDA Forest Service Northern Region. Missoula, Montana. 25 p.

Pfeiffer, B. 1980. Sea-run cutthroat status report in District Two of Region Four. In: Sea-run Cutthroat Status Report. Fisheries Management Division, Washington Department of Game, Olympia, Washington.

Richey, J. 1982. Effects of urbanization on a lowland stream in western Washington. Doctoral Thesis. University of Washington, Seattle, Washington. 248 p.

Scott J., C. Steward and Q. Stober. 1982. Impacts of urban runoff on fish populations in Kelsey Creek, Washington. Fisheries Research Institute Rpt. FRI-UW-8204. University of Washington, Seattle, Washington. 377 p.

Stevenson, A. H. 1953. Studies of bathing water quality and health. American Journal of Public Health, Vol. 43:529.

Uchida, B. 1978. A profile of water quality in the Cedar/Green River basins. Tech. Appendix No. 5. Report for Municipality of Metropolitan Seattle. Seattle, Washington. 350 pp.

U. S. Department of Agriculture - Soil Conservation Service. 1973. Soils Survey - King County Area, Washington. U. S. Government Printing Office, Washington, DC. 100 p.

United States Geological Survey. 1980. 1979 Water resources data for Washington. Vol. 1. Western Washington. Water Resources Division, Tacoma, Washington. 433 p.

Washington Department of Fisheries. 1980. 1980-81 sport fishing regulations: salmon, shellfish and other food fish. Olympia, Washington.

Washington Department of Game. 1981. 1981 Washington game fish seasons and catch limits. Olympia, Washington.

White, S. and D. Martin. 1977. A baseline study of the benthic community in small streams. Report for Municipality of Metropolitan Seattle. Seattle, Washington. 83 p.

Williams, R.W., R.M. Laramie and J.J. Ames. 1975. A catalog of Washington streams and salmon utilization. Washington Department of Fisheries, Volume I, Olympia, Washington. 704 p.

APPENDICES

A. PERIOD OF RECORD FOR METRO'S BEAR-EVANS CREEK WATER QUALITY SURVEYS AND PARAMETERS.

B. CONCENTRATIONS OF SEVEN CHEMICAL PARAMETERS AT SIX SITES IN BEAR-EVANS CREEK.

C. SALMON SPAWNING GROUND DATA FOR BEAR-EVANS CREEK AND ITS TRIBUTARIES.

D. CRITERIA FOR EVALUATING A STREAM AS TO:

D.1. FLOOD AND EROSION POTENTIAL.

D.2.a. SUITABILITY FOR SALMON AND TROUT.

D.2.b. MAXIMUM TRACE METALS CONCENTRATION FOR THE PROTECTION OF FRESH WATER AQUATIC LIFE.

D.3. SUITABILITY OF RIPARIAN CORRIDOR FOR WILDLIFE HABITAT AND PROTECTION OF WATER QUALITY.

D.4. SUITABILITY FOR WATER SUPPLY.

D.5. SUITABILITY FOR SWIMMING AND BOATING.

E. TASK AND LABOR REQUIREMENTS TO FILL DATA NEEDS.

Appendix A (Continued). Key to Abbreviations of Parameters

MET	HG	Mercury
	CU	Copper
	CR	Chromium
	CD	Cadmium
BIOLOGICAL	PEN	Periphyton (Cell Volume)
	BEN	Benthos
	PEPH	Periphyton - Phaeophyton
	PECH	Periphyton - Chlorophyll A
	CHLA	Chlorophyll A
	FS	Fecal Strep
	FC	Fecal Coliform
	TC	Total Coliform
CHEMICAL	SAL	Salinity
	COND	Conductivity
	CHLR	Chlorinity
	CLRES	Chlorine Residual
	BOD	Biochemical Oxygen Demand
	%SAT	% Saturation
	DO	Dissolved Oxygen
	ALK	Alkalinity
	PH	pH
	O&G	Oil & Grease
	PEST	Pesticides
	PCBS	PCB's (Polychlorinated Biphenyls)
PHYSICAL	STRM	Streamwalk
	WSPD	Wind Speed
	WDIR	Wind Direction
	STAF	Staff Height (Gauge)
	FLOW	Flow
	SSOL	Settled Solids
	SUSP	Suspended Solids
	TURB	Turbidity
	TRAN	Transparency
	TEMP	Temperature
	SOLR	Solar Radiation
	CLOD	Cloud Cover
NUTRIENTS	HYPO	Hydrolyzable Phosphorus
	TOPO	Total Phosphate
	OPO	Ortho-Phosphate
	NH3	Ammonia
	NO2+NO3	Nitrate and Nitrite
	ORGN	Organic Nitrogen
	TKN	Total Kjeldahl

APPENDIX B.1.
CONCENTRATIONS OF SEVEN PARAMETERS
SIX SITES ON BEAR-EVANS CREEK
FOR THE YEARS 1979 THRU 1981

		TEMPERATURE	DISSOLVED O2	AMMONIA	NITRATE	ORTHO-PO4	FECAL COLIFORM	FECAL STREPT
0484	NUMBER	33	33	38	36	38	38	37
	MEAN	10.27	10.06	0.07	0.61	0.05	673*	1766*
	MEDIAN	10.70	10.12	0.04	0.49	0.04	600	1100
	MINIMUM	1.00	5.50	0.00	0.19	0.00	109	33
	MAXIMUM	16.30	13.50	0.34	1.46	0.18	13000	999998
C484	NUMBER	33	33	38	36	38	38	37
	MEAN	10.01	10.18	0.06	0.69	0.04	368*	540*
	MEDIAN	10.50	10.13	0.03	0.58	0.04	395	640
	MINIMUM	1.00	5.90	0.01	0.29	0.01	20	30
	MAXIMUM	16.00	13.62	0.39	1.66	0.15	2600	9900
G484	NUMBER	33	33	38	36	38	38	37
	MEAN	9.88	10.30	0.05	0.67	0.04	380*	549*
	MEDIAN	10.10	10.22	0.03	0.54	0.03	385	660
	MINIMUM	1.00	6.20	0.00	0.27	0.01	87	30
	MAXIMUM	15.70	13.71	0.34	1.71	0.15	2400	4600
J484	NUMBER	32	33	38	36	38	38	37
	MEAN	10.04	10.18	0.04	0.57	0.03	95*	264*
	MEDIAN	10.45	9.96	0.02	0.42	0.03	110	290
	MINIMUM	0.10	6.40	0.00	0.06	0.00	20	23
	MAXIMUM	16.70	13.78	0.26	1.75	0.14	670	4300

* INDICATES THAT THE GEO-MEAN CALCULATION WAS USED.

APPENDIX B.1. (Cont.)
CONCENTRATIONS OF SEVEN PARAMETERS
SIX SITES ON BEAR-EVANS CREEK
FOR THE YEARS 1979 THRU 1981

		TEMPERATURE	DISSOLVED O2	AMMONIA	NITRATE	ORTHO-PO4	FECAL COLIFORM	FECAL STREPT
B484	NUMBER	33	33	38	36	38	38	37
	MEAN	9.68	9.95	0.03	0.52	0.05	188*	435*
	MEDIAN	10.00	10.22	0.02	0.42	0.04	210	480
	MINIMUM	2.90	6.60	0.00	0.18	0.01	20	20
	MAXIMUM	15.00	12.43	0.10	1.07	0.16	1700	14000
N484	NUMBER	33	32	38	36	38	38	37
	MEAN	9.98	10.42	0.03	0.65	0.04	251*	610*
	MEDIAN	10.80	10.66	0.02	0.62	0.04	205	620
	MINIMUM	3.20	7.30	0.00	0.13	0.00	47	30
	MAXIMUM	14.00	12.55	0.14	1.08	0.15	2000	48000

* INDICATES THAT THE GEO-MEAN CALCULATION WAS USED.

APPENDIX B.2. SEASONAL COMPARISONS OF EIGHT WATER QUALITY PAPAMETERS AT SIX STATIONS IN BEAR-EVANS CREEK. DATA FROM METRO'S 1979-1981 SMALL STREAMS SURVEYS.

SITES	LEGEND	PARAMETER			
		FECAL COLIFORMS ORGANISMS / 100 ML		FECAL STREPTOCOCCUS ORGANISMS / 100 ML	
		WET	DRY	WET	DRY
MAINSTEM					
0	N=	24	14	23	14
	MEAN (MED)	1325(500)	912 (625)	55K (4100)	959 (805)
	RANGE	109-13000	180-2500	33-1000K	160-2800
C	N=	24	14	23	14
	MEAN (MED)	552(345)	416 (430)	1702(1100)	826 (565)
	RANGE	20-2600	200-800	30-9.9K	140-3K
G	N=	24	14	23	14
	MEAN (MED)	509 (400)	408 (365)	1267(800)	899 (600)
	RANGE	87-2.4K	150-840	30-4.6K	160-4K
J	N=	24	14	23	14
	MEAN (MED)	99 (59)	206 (165)	810 (420)	340 (265)
	RANGE	20-590	50-670	23-4.3K	40-850
TRIBUTARIES					
B (EVANS)	N=	24	14	23	14
	MEAN (MED)	216 (104)	522 (445)	1433(480)	995 (480)
	RANGE	20-1.4K	170-1.7K	20-140K	160-3.4K
N (COTTAGE LAKE)	N=	24	14	23	14
	MEAN (MED)	292 (120)	640 (505)	1399(560)	5099(910)
	RANGE	47-600	160-2K	30-100K	73-48K

APPENDIX B.2.(CONTINUED) SEASONAL COMPARISONS OF EIGHT WATER QUALITY PAPAMETERS AT SIX STATIONS IN BEAR-EVANS CREEK. DATA FROM METRO'S 1979-1981 SMALL STREAMS SURVEYS.

SITES	LEGEND	CONDUCTIVITY		TEMPERATURE DEGREES CENTIGRADE		DISSOLVED OXYGEN PPM	
		WET	DRY	WET	DRY	WET	DRY
MAINSTEM							
0	N=	24	14	21	12	21	12
	MEAN (MED)	100 (93)	114 (110)	7.8 (7.8)	14.6(14.8)	10.4(10.5)	9.5(9.7)
	RANGE	54-190	96-166	1.0-14.3	13.2-16.3	7.5-13.5	5.5-10.8
C	N=	24	14	21	12	21	12
	MEAN (MED)	83 (82)	100(100)	7.5 (7.1)	14.2(14.8)	10.6(10.8)	9.2 (9.6
	RANGE	8-148	90-110	1.0-14.5	12.5-16.0	7.6-13.6	5.9-10.9
G	N=	24	14	21	12	21	12
	MEAN (MED)	85 (80)	98 (100)	7.4 (7.0)	14.2(14.4)	10.8(10.1)	9.5 (9.7
	RANGE	49-159	89-115	1.0-14.2	12.5-15.7	8.0-13.7	6.2-10.0
J	N=	24	14	21	12	21	12
	MEAN (MED)	75 (67)	87 (86)	7.2 (6.8)	14.8(15.3)	10.8(10.9)	9.2 (9.4
	RANGE	46-145	75-98	.1-14.7	12.9-16.7	7.5-13.8	6.4-10.0
TRIBUTARIES							
B	N=	24	14	21	12	21	12
(EVANS)	MEAN (MED)	109(100)	119(120)	7.7 (7.6)	13.1(13.0)	10.2(10.4)	9.6 (9.8
	RANGE	54-189	105-130	2.9-13.4	12.2-13.4	7.1-12.4	6.6-10.8
N	N=	24	14	21	12	20	12
(COTTAGE	MEAN (MED)	103 (98)	112(110)	8.0 (8.0)	13.4(13.5)	10.7(10.7)	10.0(10.
LAKE)	RANGE	59-196	95-150	3.2-14.0	12.2-14.5	8.7-12.6	7.3-11.1

APPENDIX B.2.(CONTINUED) SEASONAL COMPARISONS OF EIGHT WATER QUALITY PAPAMETERS AT SIX STATIONS IN BEAR-EVANS CREEK. DATA FROM METRO'S 1979-1981 SMALL STREAMS SURVEYS.

SITES	LEGEND	PARAMETERS					
		AMMONIA PPM		NITRATE + NITRITE PPM		ORTHO-PHOSPHOROUS PPM	
		WET	DRY	WET	DRY	WET	DRY
MAINSTEM							
0	N=	24	14	22	14	24	14
	MEAN (MED)	.093(.072)	.024(.018)	.796(.792)	.326(.310)	.050(.044)	.040(.038)
	RANGE	.015-.342	.001-.094	.379-1.456	.194-.432	.004-.182	.031-.062
C	N=	24	14	22	14	24	14
	MEAN (MED)	.071(.040)	.028(.018)	.886(.916)	.369(.370)	.044(.038)	.038(.038)
	RANGE	.010-.389	.006-.138	.335-1.664	.286-.439	.013-.152	.022-.069
G	N=	24	14	22	14	24	14
	MEAN (MED)	.066(.036)	.030(.021)	.864(.870)	.376(.387)	.043(.036)	036(.034)
	RANGE	.010-.339	.004-.130	.313-1.714	.274-.446	.010-.148	.024-.063
J	N=	24	14	22	14	24	14
	MEAN (MED)	.046(.026)	.021(.014)	.810(.871)	.194(.172)	.034(.027)	.027(.028)
	RANGE	.005-.256	.001-.080	.179-1.746	.061-.418	.001-.139	.009-.053
TRIBUTARIES							
B	N=	24	14	22	14	24	14
(EVANS)	MEAN (MED)	.032(.024)	.018(.015)	.636(.586)	.334(.331)	.051(.040)	.050(.046)
	RANGE	.010-.096	.001-.055	.237-1.070	.181-.421	.014-.165	.036-.080
N	N=	24	14	22	14	24	14
(COTTAGE	MEAN (MED)	.044(.024)	.015(.009)	.717(.766)	.534(.560)	.041(.036)	.036(.041)
LAKE)	RANGE	.005-.143	.002-.050	.291-1.079	.132-.699	.008-.151	.005-.056

APPENDIX C

Information used in developing Appendix C was obtained from the Washington Department of Fisheries' Salmon Spawning Ground Data Reports (Egan, 1978; 1980). Because of some limitations in the data used in this Appendix, some explanation is needed.

The median values listed in Appendix C are for all the values listed for each stream, regardless of the date or river mile location of the survey. These counts are somewhat theoretical in that they are "standardized counts." The spawning ground surveys often cover different stream lengths; these can vary from less than one mile to more than several miles. To allow for comparison between counts, the actual number of fish observed during each survey is converted to a fish per mile count. Five fish in 0.5 mile, for example, equates to 10 fish per mile.

The medians are listed only to help demonstrate the relative salmon usage in each stream. The comparison between median values of different streams should be done carefully if at all. The lack of data or indication of limited use may not always reflect the actual salmon usage. The accuracy of each survey and consequently the median, depends on several elements: time of year when the survey was conducted, stream area surveyed, the number or frequency of the surveys, and the condition of the stream at the time of the survey, i.e., its clarity, water depth, etc. Especially important in determining the confidence in a particular median is the number of data entries from which that median was derived. As the number of data entries increases, more confidence can be placed on the median. Information and data for direct comparisons between streams or stream reaches should be obtained from personnel of the Harvest Management Division of the Department of Fisheries. The area primarily observed and the time of year primarily observed were estimated from visually scanning the data. These columns identify the location (RM) and month(s) in which most of the salmon were observed during the listed surveys.

Appendix C. Salmon Spawning Ground Data for Bear/Evans Creek and Its Tributaries. Original data from Egan (1978; 1980).

STREAM	SALMON SPECIES	NUMBER OF SPAWNERS FISH/MILE MEDIAN (RANGE)	AREA PRIMARILY OBSERVED OF CONCENTRATION (RANGE)	TIME OF YEAR PRIMARILY OBSERVED CONCENTRATION (RANGE)	SURVEY YEARS PRIMARY (RANGE)	TOTAL NUMBER OF DATA ENTRIES
Bear 08.0105	Sockeye	22.1 (0-2451.1)	0.0-8.9 (0.0-9.5)	Sept.-Oct. (Sept.-Dec.)	76 (44-79)	89
	Coho	20.0 (0-1493.3)	5.0-9.5 (0-11.6)	Nov.-Dec. (Sept.-Jan.)	76-77 (44-79)	210
	Chinook	3.3 (0-205.0)	1.3-4.9 (0-9.0)	Oct.-Nov. (Sept.-Dec.)	76 (73-78)	101
Evans 08.0106	Sockeye	0	0-1.4	Sept.	76	2
	Coho	14.0 (0-2160.0)	3.5-5.4 (0-5.4)	Jan.-Feb. (Nov.-Feb.)	76-77 (76-79)	131
	Chinook	0 (0-2.5)	0-3.0 (Same)	Oct.-Nov. (Same)	76 (76)	5
Unnamed 08.0108	Coho	13.0 (0-76.6)	0-0.5 (0-0.7)	Nov.-Dec. (Nov.-Jan.)	77 (76-77)	22
Unnamed (Rutherford) 08.0110	Coho	335.0 (0-860)	02.-0.6 (0-0.8)	Dec.-Jan. (Nov.-Feb.)	77 (76-78)	39
Unnamed 08.0114	Coho	0 (0-1.6)	0.1-0.7 (0-0.7)	Jan. (Nov.-Jan.)	77	3
Unnamed 08.0121	Sockeye	10.0	0-0.5 (Same)	Oct. (Same)	76	1
	Chinook	34.0 (5.4-37.7)	0.5-2.3 (0-3.4)	Oct. (Same)	76 (76)	3

Appendix C. Salmon Spawning Ground Data for Bear/Evans Creek and Its Tributaries. Original data from Egan (1978;1980). (Cont.)

STREAM	SALMON SPECIES	NUMBER OF SPAWNERS FISH/MILE MEDIAN (RANGE)	AREA PRIMARILY OBSERVED OF CONCENTRATION (RANGE)	TIME OF YEAR PRIMARILY OBSERVED CONCENTRATION (RANGE)	SURVEY YEARS PRIMARY (RANGE)	TOTAL NUMBER OF DATA ENTRIES
Cottage Lake 08.0122	Sockeye	10.0 (0-486.6)	0-0.6 (0-2.3)	Sept.-Oct. (Same)	76 (76)	6
	Coho	16.0 (0-61.6)	0.5-3.4 (0-3.4)	Oct.-Dec. (Oct.-Jan.)	76 (74-77)	55
	Chinook	7.6 (0.68.0)	0-2.3 (0-3.5)	Oct.-Nov. (Sept.-Dec.)	76 (74-77)	32
Seidel 08.0129	Sockeye	5.0 (Same)	0-0.6 (Same)	Dec. (Same)	76 (76)	1
	Coho	5.0 (0-117.5)	0.4-0.8 (0-2.1)	Dec. (Nov.-Jan.)	77 (76-77)	32
Struve 08.0131	Coho	48.7 (0-195.0)	0-0.4 (0-1.0)	Nov.-Dec. (Nov.-Jan.)	77 (76-78)	20
Unnamed 08.0132	Coho	11.5 (0-56.6)	0-0.3 (0-0.9)	Nov.-Dec. (Nov.-Jan.)	77	10
Unnamed	Coho	10.0 (0-285)	0.1-0.3 (0-0.4)	Dec. (Nov.-Jan.)	76 (59-77)	33

APPENDIX D.1. Criteria for evaluating the stream's flood and erosion potential (except as noted, criteria adapted from Pfankuch, 1978)

PARAMETER	EXCELLENT	GOOD	FAIR	POOR
Channel Capacity	Ample for present flows plus some increases. Peak flows contained. Width/depth ratio <7.	Adequate. Overbank flows rare. Width/depth ratio 7-15.	Barely contains present peaks. Occasional over bank floods. Width/depth ratio 15-25.	Inadequate. Overbank flows common. Width/depth ratio >25.
Cutting	None or little evident. Infrequent raw banks less than 6" high generally.	Some. Intermittently at out curves and constrictions. Raw banks may be up to 12".	Significant. Cuts 12"-24". Root mat overhangs and sloughing evident.	Almost continuous cuts, some over 24" high. Failure of overhangs evident.
Channel Stability	Less than 5% of channel affected by scouring and deposition. Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	5-30% of channel affected Few obstructions present, are newer, less firm. Some scour and cutting @ constrictions, out curves and where grades steepen. Some deposition in pools.	30-50% of channel affected. Obstructions moderately frequent & moderately unstable. Bank cutting signficant. Deposition often filling pools, sloughing evident.	More than 50% of channel affected. Frequent obstruction causing almost continuous cuts. Extensive deposition. Bottom in state of flux or change nearly year long.
Bank Failure	No evidence of past or any potential for mass wasting into channel.	Infrequent and/or very small. Mostly healed over. Low future potential.	Moderate frequency & size, w/some raw spots eroded by water during high flows.	Frequent or large causing sedimentation nearly year long or eminent danger of same
Bank Erosion potential (1)	Slight/none	Moderate	Severe	Very Severe

(1) As characterized by soils maps and description from USDA/SCS (1973).

APPENDIX D.2.a

Criteria for evaluating the suitability of the stream for salmon and trout. Water quality criteria from Department of Ecology's water body classification (1978). Physical criteria, except where noted, adapted from Pfankuch (1978).

PARAMETER	EXCELLENT	GOOD	FAIR	POOR
Water Quality				
Dissolved Oxygen (mg/ℓ)	>9.5	>8.0	>6.5	>4.0
Temperature (°C)	<16.0	<18.0	<21.0	<24.0
pH	6.5-8.5			
Physical Habitat				
Percentage Fines[1] (<2mm)	0-10%	11-15%	16-20%	>20%
Substrate Consolidation or Particle Packing	No packing evident. Loose assortment, easily moved.	Mostly loose assortment with no apparent overlap.	Moderately packed with some overlapping.	Tightly packed and overlapping or bedrock
Channel Stability	Less than 5% of channel affected by scouring & deposition. Rocks and old logs firmly embedded. Flow pattern w/out cuting & deposition. Pools and riffles stable.	5-30% of channel affected. Few obstructions present newer, less firm. Some scour and cutting at constrictions, outcurves and where grades steepen. Some deposition in pools.	30-50% of channel affected. Obstructions moderately frequent & moderately unstable. Bank cutting significant. Deposition often filling pools. Sloughing evident. Fish passage difficult.	More than 50% of channel affected. Frequent obstructions causing almost continuous cuts. Extensive deposition. Bottom in constant flux or change. Fish passage improbable to impossible.

[1]From D. King, Washington Dept. of Fisheries, pers. comm.

APPENDIX D.2.b. Maximum trace metals concentrations for protection of freshwater aquatic life (Federal Register, 1980)[a]

Type of Exposure	METAL (μG/ℓ) Zinc	Lead	Copper	Chromium	Cadmium	Iron	Mercury	Nickel
Chronic (24-hour avg. concentration)	47.0	0.9	5.6	0.29[b]	0.005	1000.0	0.20	28.0
Acute (Max. conc. not to exceed)	85.0	24.0	5.0	21.0[b]	0.6	N/A	4.1	540.0
Metro's limit of detection at time of data collection	5-6	6-40	10	20-40	4	10	0.2	20

[a]Values corrected for local water hardness (assumed to be 20 mg/ℓ as $CaCO_3$)

[b]Chromium criteria are for hexavalent ion only; most analyses, including Metro's detection limit values, are for total chromium.

APPENDIX D.3. Criteria for evaluating the suitability of the riparian corridor for wildlife (small game) habitat and protection of water quality.

PARAMETER	EXCELLENT	GOOD	FAIR	POOR
Riparian Vegetation	Trees, shrubs and other vegetation combine to cover more than 90% of ground. Openings in canopy small and evenly dispersed. Deep, dense root mat present.	Plants cover 70-90% of ground. Shrubs, small trees (alder) more prevalent than larger trees. Openings in canopy common. Deep root mat not continuous.	Plant cover from 50-70% Trees few, small shrubs common. Canopy thin, discontinuous. Root mats shallow.	Less than 50% of ground covered. Trees essentially absent. Shrubs exist in scattered clumps. Root mats shallow and discontinuous.
Nature of Riparian Corridor	Undeveloped, open space of forest or natural vegetation.	Scattered single family, recreational areas, fenced pastures or cultivated fields with riparian buffer strips.	Continuous single family and occasional multifamily, recreational areas, fenced pasture, or cultivated fields with little riparian buffer strips.	Continuous multifamily,or industrial, commerical, unfenced pasture or cultivated fields with no riparian buffer strips.

APPENDIX D.4. Criteria for evaluating the suitability of streams for water supplies.

WATER USE	FECAL COLIFORMS 100mls	pH	METALS (μg/ℓ) Zinc	Lead	Copper	Cadmium	Chromium	Iron	Mercury	Nickel
Potable (untreated)[1]	≤20	N/A	5000	50	1000	10	50	300	0.144[2,5]	13.4[2,5]
Domestic[3]	≤100+≤10% > 200	6.2-8.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Agricultural[3]	≤200+≤10% > 400	6.2-8.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Stock Watering[4]	≤200+≤10% > 400[3]	N/A	25,000	100	500	50	1000	1000	10	1000

[1] Department of Social and Health Services (1978)

[2] Federal Register (1980)

[3] Standard for the least stringent water body classification (DOE, 1978) which includes this as a characteristic use.

[4] National Academy of Sciences (1974).

[5] Concentration below Metro's limit of detection at time of data collection (Appendix B.2b)

APPENDIX D.5. Criteria for evaluating the suitability of the stream for swimming and boating.

PARAMETER	ACCEPTABLE	MARGINAL	NOT ACCEPTABLE
Average Water Depth	Greater than 3'	1' to 3'	Less than 1'
Access to stream	Park or other public lands	Limited access from street ends, bridges, occasional public land adjoining creek.	Private land, no access
Water Quality[1]			
1. Primary Contact Recreation (swimming)	Meets standard for class AA waters for contact recreation. (pH 6.5-8.5, fecal coliform geometric mean $\leq$ 50/100mls)	Occasionally exceeds standard for class A waters for contact recreation. (pH 6.0-8.6 fecal coliform geometric mean 50-100/100mls)	Habitually exceeds standard for class A waters for contact recreation. (pH $<$6.0 - $>$8.6, fecal coliform geometric mean $>$100/100mls)
2. Secondary Contact Recreation (wading, boating)	Meets standard for class A waters. Fecal coliform geometric mean $\leq$ 100/100mls	Meets standard for class B waters. Fecal coliform geometric mean 100-200/100mls.	Exceeds standard for class B waters. Fecal coliform geometric mean $>$200/100 mls.

[1] Water quality criteria derived from Dept. of Ecology standards for protected uses of freshwater.

APPENDIX E. TASK AND LABOR REQUIREMENTS TO FILL DATA NEEDS

The tasks and estimated labor hours listed below are provided only as general guidelines for planning and scheduling purposes.

1. Physical survey of approximately 15 miles of Bear-Evans Creek and its tributaries. The physical data is needed to complete the evaluations of the physical, stream biota, riparian corridor and recreation sections.

   A. Stream surveys @ 3 hours/mile would require:

Stream	Reach to be Surveyed (R.M.)	Total Miles	Estimated Labor Hours
	Several tributaries including Struve and Mackey Creeks	15	45.0
B.	Equipment prep/maintenance/maps etc.		8.0
C.	Data analysis/write-up @ 45 min/mile		12.0
D.	Travel time to/from sites	8.0	
		TOTAL	73.0
		(Rounded 75 hours)	

2. To better survey the recreational use of Bear-Evans Creek, a mail-out/mail-back questionnaire would be used to gain information about use of the stream by the local residents. Since much of this use probably occurs in the evenings or on the weekends, it would not be observed during a stream survey.

	Task	Estimated Labor Hours
A.	Develop and produce questionnaire	40 to 80
B.	Administer questionnaire. Includes mailing and tallying returns.	20
C.	Analyze results and prepare report.	60-100

3. A survey of the present fishery resource in Bear-Evans Creek would be used to document the fish species present, their distribution within the stream basin, and their general levels of abundance. This information is needed to help confirm the extent of use of Bear-Evans Creek for salmonid spawning and rearing.

A.	Electrofishing at 20 sites (unsurveyed tributaries) @ 1 to 2 hours per site 20-40 hours x 2 people =	40-80 hrs.
B.	Equipment prep-maintenance	8
C.	Total travel time	8
D.	Data analysis/write-up	24
	TOTAL	80-120 hrs.

4. Confirmation of 30 existing domestic water rights for Bear-Evans Creek is needed to determine how many households are withdrawing untreated water for potable use. Because of the high fecal coliform counts from Bear-Evans Creek, there may be a potential health threat to these households. Further studies, which would depend on the number and location of households withdrawing water for domestic use, would be needed to help identify the source of the coliform bacteria if effective abatement actions are to be pursued.

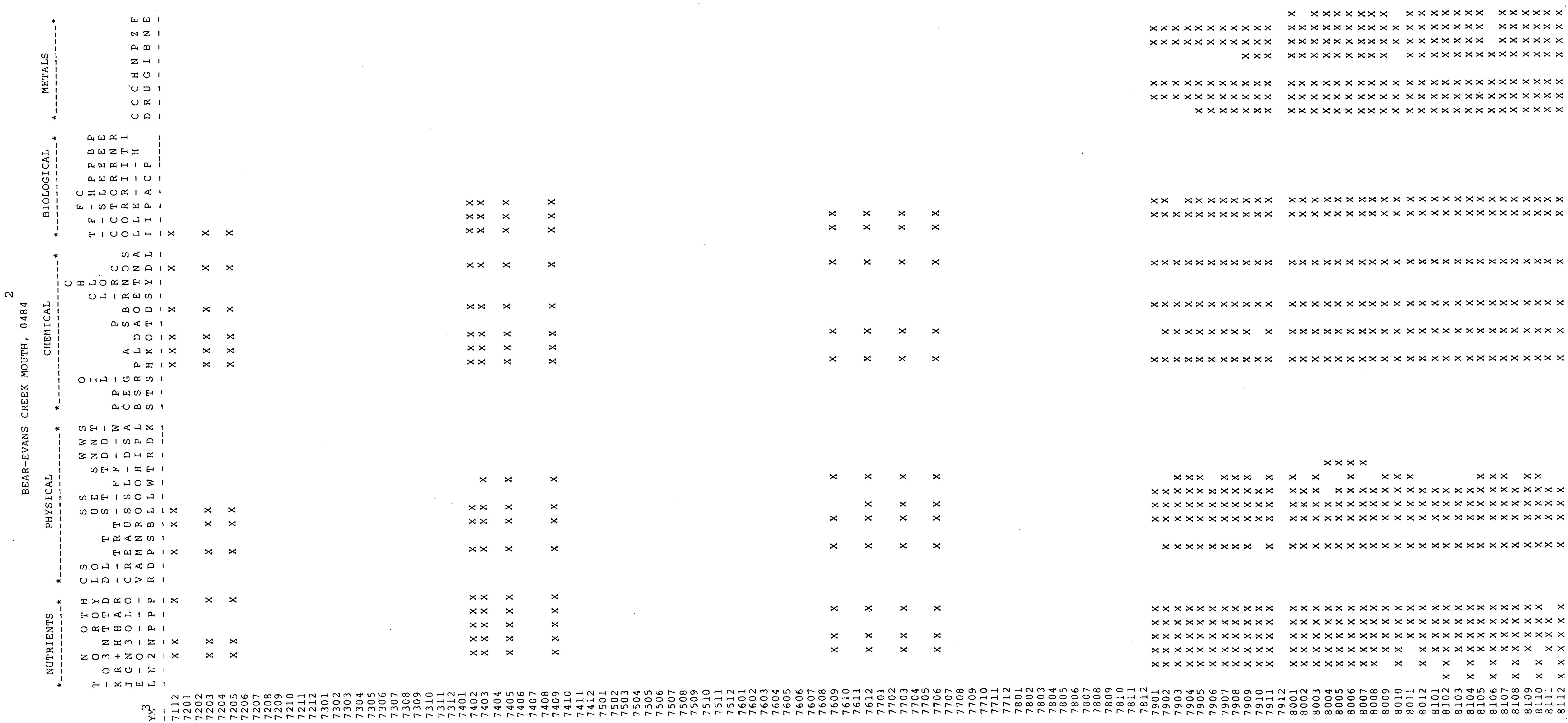
Phase I - Confirmation of Water Rights

A.	Meet with DOE personnel	1 to 2 hours
B.	Analyze DOE water right records with DOE personnel	4 to 8 hours
C.	Prepare contact list	1 to 2 hours
D.	Contact citizens (assume 1 to 2 hour/contact)	24 to 48 hours
E.	Update SRI (reporting)	20 to 40 hours
	TOTAL	50 to 100 hours

Phase II - Minimum effort required to identify single contamination source - 3 day survey

A.	Collect 24 samples	24 hours
B.	Lab analysis	12 hours
C.	Reporting	24 hours
	TOTAL	60 hours

APPENDIX A. Period of record for Metro's Bear-Evans water quality surveys and parameters. (Metro, unpublished data). Data for Station 0 only.[1]



[1] Summary of Metro's Bear-Evans Creek water quality surveys is as follows:

Sample Dates	Number of Sites	Frequency
October 1972 to Sept. 1973	2	Semi-monthly
October 1973 to Dec. 1974	14	Monthly & Semi-monthly
1975 to mid-1978	6	Quarterly
1979 to present	6	Monthly

[2] See key to abbreviations on following page.

[3] YM = Year and month starting with 1971, December.