BIOLOGICAL INTEGRITY OF SPRING CREEK, TETON COUNTY, MONTANA BASED ON THE COMPOSITION AND STRUCTURE OF THE BENTHIC ALGAE COMMUNITY

Prepared for:

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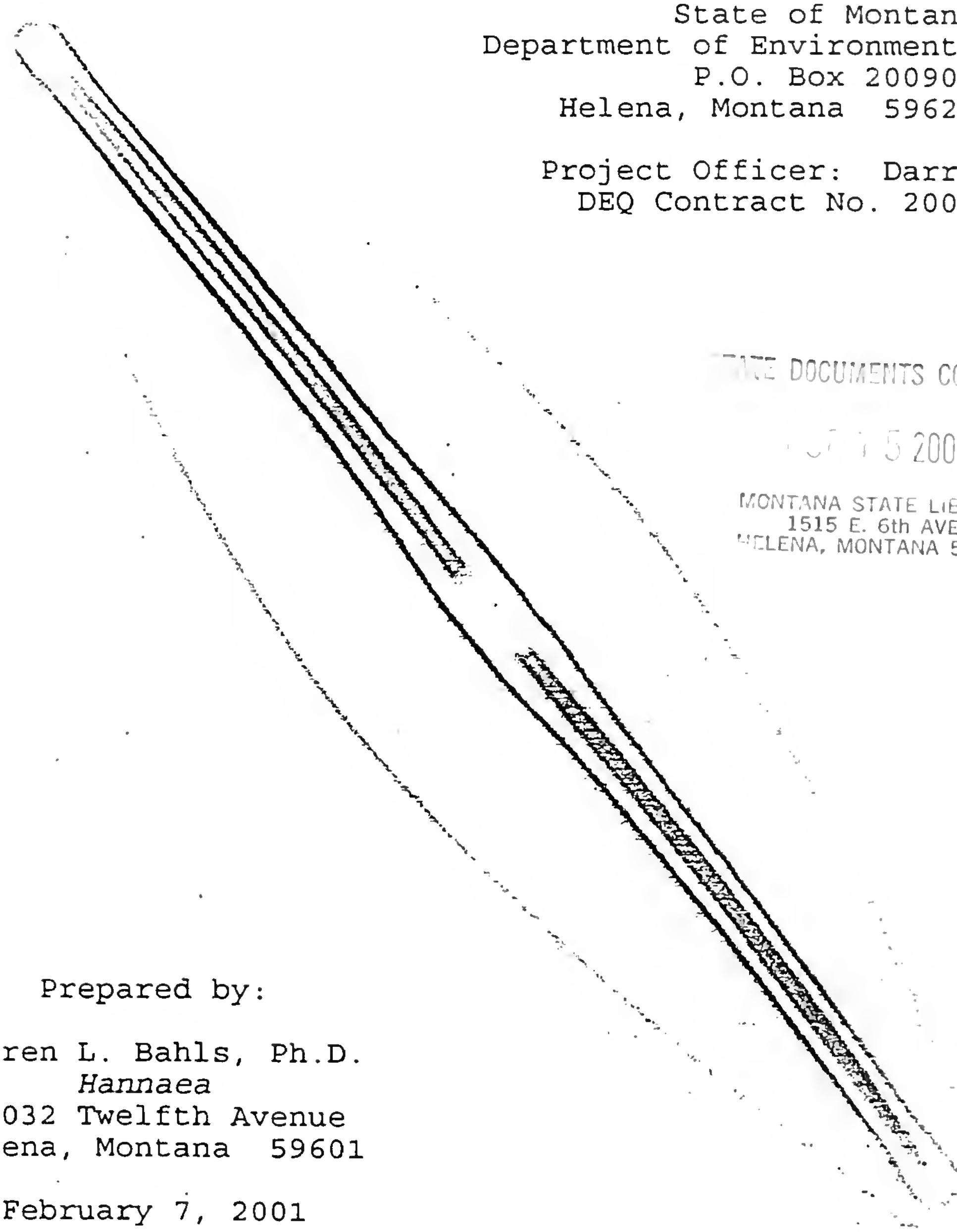

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SUMMARY

On August 1, 2000, periphyton samples were collected from two stations on Spring Creek above Choteau, Montana for the purpose of assessing whether the creek is water-quality limited and in need of TMDLs. The samples were collected following DEQ standard operating procedures, processed and analyzed using standard methods for periphyton, and evaluated following modified USEPA rapid bioassessment protocols for wadeable streams.

The Spring Creek watershed straddles the boundary between the Northwestern Glaciated Plains and the Montana Valley and Foothill Prairies Ecoregions and is classified B-2. For these reasons, Spring Creek metrics were compared to criteria for both mountain streams and prairie streams. Also, Spring Creek has every indication of being a spring brook of the Teton River, with which it is closely associated hydrologically.

Spring Creek supported a rich non-diatom flora composed of 17 genera. Dominance by diatoms and green algae and low numbers of cyanobacteria indicate an ample supply of nutrients, including nitrogen. A decline in the number of non-diatom genera at the downstream station (S-3) may be due to competition with aquatic mosses at this site.

The large number of *Achnanthes minutissima* at S-3 resulted in a rating of moderate impairment and partial support of aquatic life uses. The reasons for this rating were borderline values for percent dominant species and the disturbance index. The disturbance at S-3 is probably natural in origin and caused by grazing by macroinvertebrates (e.g., snails).

All other diatom metrics indicated good to excellent biological integrity, little or no impairment, and full support of aquatic life uses at both sites.

INTRODUCTION

This report evaluates the biological integrity, support of aquatic life uses, and probable causes of impairment to those uses, in Spring Creek above Choteau, Montana. The purpose of this report is to provide information that will help the State of Montana determine whether Spring Creek is water-quality limited and in need of TMDLs.

The federal Clean Water Act directs states to develop water pollution control plans (Total Maximum Daily Loads or TMDLs) that set limits on pollution loading to water-quality limited waters. Water-quality limited waters are lakes and stream segments that do not meet water-quality standards, that is, that do not fully support their beneficial uses. The Clean Water Act and USEPA regulations require each state to (1) identify waters that are water-quality limited, (2) prioritize and target waters for TMDLs, and (3) develop TMDL plans to attain and maintain water-quality standards for all water-quality limited waters.

Evaluation of use support in this report is based on the species composition and structure of the periphyton (benthic algae, phytobenthos) community at two stream sites that were sampled on August 1, 2000. The periphyton community is a basic biological component of all aquatic ecosystems. Periphyton accounts for much of the primary production and biological diversity in Montana streams (Bahls et al. 1992).

Plafkin et al. (1989) and Stevenson and Bahls (1999) list several advantages of using periphyton in biological assessments:

- Algae are universally present in large numbers in all streams and unimpaired periphyton assemblages typically support a large number (>30) of species;

- Algae have rapid reproduction rates and short life cycles, making them useful indicators of short-term impacts;

- As primary producers, algae are most directly affected by physical and chemical factors, such as temperature, nutrients, dissolved salts, and toxins;

- Sampling is quick, easy and inexpensive, and causes minimal damage to resident biota and their habitat;

- Standard methods and criteria exist for evaluating the composition, structure, and biomass of algal associations;

- Identification to species is straightforward for the diatoms, for which there is a large body of taxonomic and ecological literature;

- Excessive algae growth in streams is often correctly perceived as a problem by the public.

- Periphyton and other biological communities reflect the *biological integrity*[1] of waterbodies; restoring and maintaining the biological integrity of waterbodies is a goal of the federal Clean Water Act;

- Periphyton and other biological communities integrate the effects of different stressors and provide a measure of their aggregate impact; and

- Periphyton and other biological communities may be the only practical means of evaluating impacts from non-point sources of pollution where specific ambient criteria do not exist (e.g., impacts that degrade habitat or increase nutrients).

Periphyton is a diverse assortment of simple photosynthetic organisms, called algae, and other microorganisms that live attached to or in close proximity of the stream bottom. Most algae, such as the diatoms, are microscopic. Diatoms are distinguished by having a cell wall composed of opaline glass--hydrated amorphous silica. Diatoms often carpet a stream bottom with a slippery brown film.

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[1] *Biological integrity* is defined as "the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within a region" (Karr and Dudley 1981).

Some algae, such as the filamentous greens, are conspicuous and their excessive growth may be aesthetically displeasing, deplete dissolved oxygen, interfere with fishing and fish spawning, clog water filters and irrigation intakes, create tastes and odors in drinking water, and cause other problems.

PROJECT AREA AND SAMPLING SITES

The project area is located in Teton County near the town of Choteau, Montana (pop. 1,586). Spring Creek heads about a mile east of Eureka Reservoir at an elevation of 4,100 feet. It then flows southeast through Choteau to where it enters the Teton River near the Freezeout Lake Wildlife Management Area, about 15 miles from its source.

The Spring Creek watershed is located on the boundary of the Northwestern Glaciated Plains Ecoregion and the Montana Valley and Foothill Prairies Ecoregion (Woods et al. 1999). The surface geology consists of Cretaceous shales of the Colorado Group overlain in places by Quaternary gravel deposits (Renfro and Feray 1972). Vegetation is mixed grassland (USDA 1976).

Periphyton samples were collected at two sites on August 1, 2000 (Map 1, Table 1). The upper site (S-2) is at an unnamed road crossing downstream from U.S. Highway 89. The lower site (S-3) is located upstream from Choteau. The two sites bracket a three-mile reach of Spring Creek that runs east of and parallel to U.S. Highway 89. Elevation at the sampling sites is about 4,000 feet above mean sea level.

Land use in the Spring Creek watershed is mostly livestock and wildlife grazing with some residential and commercial development. Spring Creek is classified B-2 in the Montana Surface Water Quality Standards.

METHODS

Periphyton samples were collected by Darrin Kron, Water Monitoring Section, MDEQ Monitoring and Data Management Bureau, following standard operating procedures of the MDEQ Planning, Prevention, and Assistance Division.

Using appropriate tools, microalgae were scraped, brushed, or sucked from natural substrates in proportion to the rank of those substrates at the study site. Macroalgae were picked by hand in proportion to their abundance at the site. All collections of microalgae and macroalgae were pooled into a common container and preserved with Lugol's solution.

The samples were examined to estimate the relative abundance and rank by biovolume of diatoms and genera of soft (non-diatom) algae according to the method described by Bahls (1993). Soft algae were identified using Dillard (1999), Prescott (1978), Smith (1950), and Whitford and Schumacher (1984). These books also served as references on the ecology of the soft algae, along with Palmer (1977).

After the identification of soft algae, the raw periphyton samples were cleaned of organic matter using sulfuric acid, and permanent diatom slides were prepared using Naphrax, a high refractive index mounting medium, following *Standard Methods for the Examination of Water and Wastewater* (APHA 1998). Between 434 and 439 diatom cells (868 to 878 valves) were counted at random and identified to species. The following were used as the main taxonomic and autecological references for the diatoms: Krammer and Lange-Bertalot 1986, 1988, 1991a, 1991b; Patrick and Reimer 1966, 1975. Lowe (1974) was also used as an ecological reference for the diatoms.

The diatom proportional counts were used to generate an array of diatom association metrics (Table 2). A metric is a characteristic of the biota that changes in some predictable way with increased human influence (Barbour et al. 1999).

Metric values from Spring Creek were compared to numeric biocriteria or threshold values developed for streams in the Rocky Mountain and Great Plains Ecoregions of Montana (Tables 3 and 4). These criteria are based on metric values measured in least-impaired reference streams (Bahls et al. 1992) and on metric values measured in streams that are known to be impaired by various sources and causes of pollution (Bahls 1993).

The criteria in Tables 3 and 4 distinguish among four levels of impairment and three levels of aquatic life use support: no impairment or only minor impairment (full support); moderate impairment (partial support); and severe impairment (nonsupport). These impairment levels correspond to excellent, good, fair, and poor *biological integrity*, respectively.

Quality Assurance. Several steps were taken to assure that the study results are accurate and reproducible.

Upon receipt of the samples, station and sample information were recorded in a laboratory notebook and the samples were assigned a unique number compatible with the Montana Diatom Database, e.g., 2006-01. The first part of this number (2006) designates the sampling site (Spring Creek below Highway 89); the second part of this number (01) designates the number of periphyton samples that have been collected at this site for which data have been entered into the Montana Diatom Database.

Sample observations and analyses of soft (non-diatom) algae were recorded in a lab notebook along with station and sample information provided by MDEQ. A portion of the raw sample was used to make duplicate diatom slides. After completing the diatom proportional count, the slide used for the count will be deposited in the University of Montana Herbarium in Missoula. The other slide will be retained by *Hannaea* in Helena.

On completion of the project, station information, sample information, and diatom proportional count data will be entered into the Montana Diatom Database.

RESULTS AND DISCUSSION

Results are presented in Tables 5 and 6, which are located near the end of this report following the Literature Cited section. Spreadsheets containing completed diatom proportional counts, with species' pollution tolerance classes (PTC) and percent abundances, are attached as Appendix A.

SAMPLE NOTES

S-3. This sample consisted mostly of aquatic mosses.

NON-DIATOM ALGAE

Diatoms were the most abundant algae at both sites on Spring Creek (Table 5). Green algae ranked second in abundance and cyanobacteria were a distant third. *Audouinella*, a red alga, was rare at S-3, but absent at S-2. Dominance by diatoms and green algae and low numbers of cyanobacteria usually indicate an ample supply of biologically-available nutrients, including nitrogen.

Spring Creek supported a rich non-diatom flora consisting of 17 genera: 14 genera were observed at S-2 and 8 genera were observed at S-3. Green algae accounted for most of these genera. The average number of non-diatom genera observed in least impaired plains streams was 13 (range 9-19) (Bahls 1993).

The most abundant non-diatom algae at S-2 were *Chaetophora* and *Zygnema* (Table 5). *Chaetophora* prefers cold, running waters. *Microspora*, which ranked second in biovolume to diatoms at S-3, also prefers cool water, but is more often found in slack water habitats, like pools and ditches (Smith 1950).

Competition with aquatic mosses at S-3 may help to explain the smaller number of algal genera observed here. Aquatic mosses are perennial plants that indicate a constant supply of cool water, which is consistent with the nature of a spring creek. Since Spring Creek closely parallels the Teton River for much of its length (Map 1), it likely receives much of its flow from this parent stream. Spring Creek also receives water from Eureka Reservoir via seepage from an irrigation canal that runs parallel to and upslope from the creek (Darrin Kron, MDEQ, personal communication, February 6, 2001).

DIATOMS

All but one of the seven major diatom species in Spring Creek were sensitive to organic pollution (Table 6). Dominance by sensitive diatoms is reflected in the relatively high pollution index values at both stations. These are particularly high for prairie streams and indicate little organic loading.

A unique feature of the Spring Creek diatom assemblage is dominance by species of *Fragilaria*. Diatoms in this genus are usually unattached and tychoplanktonic, indicating relatively low turbulence and slow current velocities.

Both sites on Spring Creek had excellent species richness, even for a prairie stream (Table 6). Diatom species diversity was excellent for a prairie stream at S-2 and good at S-3.

The large number of *Achnanthes minutissima* at S-3 resulted in a rating of moderate impairment and partial support of aquatic life uses. The reasons for this rating were borderline values for percent dominant species and the disturbance index.

Achnanthes minutissima is an opportunistic "weed" species that is among the first to colonize recently disturbed areas (Barbour et al. 1999). Disturbance may be caused by physical scour, chemical toxicity, or macroinvertebrate grazing. If this Spring Creek is typical of most spring creeks, it supports an abundance of grazing fauna, including snails. In the absence of fast currents and heavy metals or other toxics in Spring Creek, the disturbance indicated at S-3 is probably biological and natural in origin.

Siltation index values were very low, especially for a prairie stream (Table 6). No abnormal cells were encountered in the diatom proportional counts, indicating the probable absence of toxics or physiological stressors. The percentage of cells in the family Epithemiaceae was low to moderate, indicating low to moderate levels of inorganic nitrogen.

The two sites shared only about 32 percent of their diatom assemblages. Since there is no evident tributary or surface discharge in the reach between these sites (Map 1), their quite different floras may result from intervening springs (Agency Spring?) or zones of upwelling water originating from the Teton River. Spring Creek has all the characteristics of a spring brook of the Teton River.

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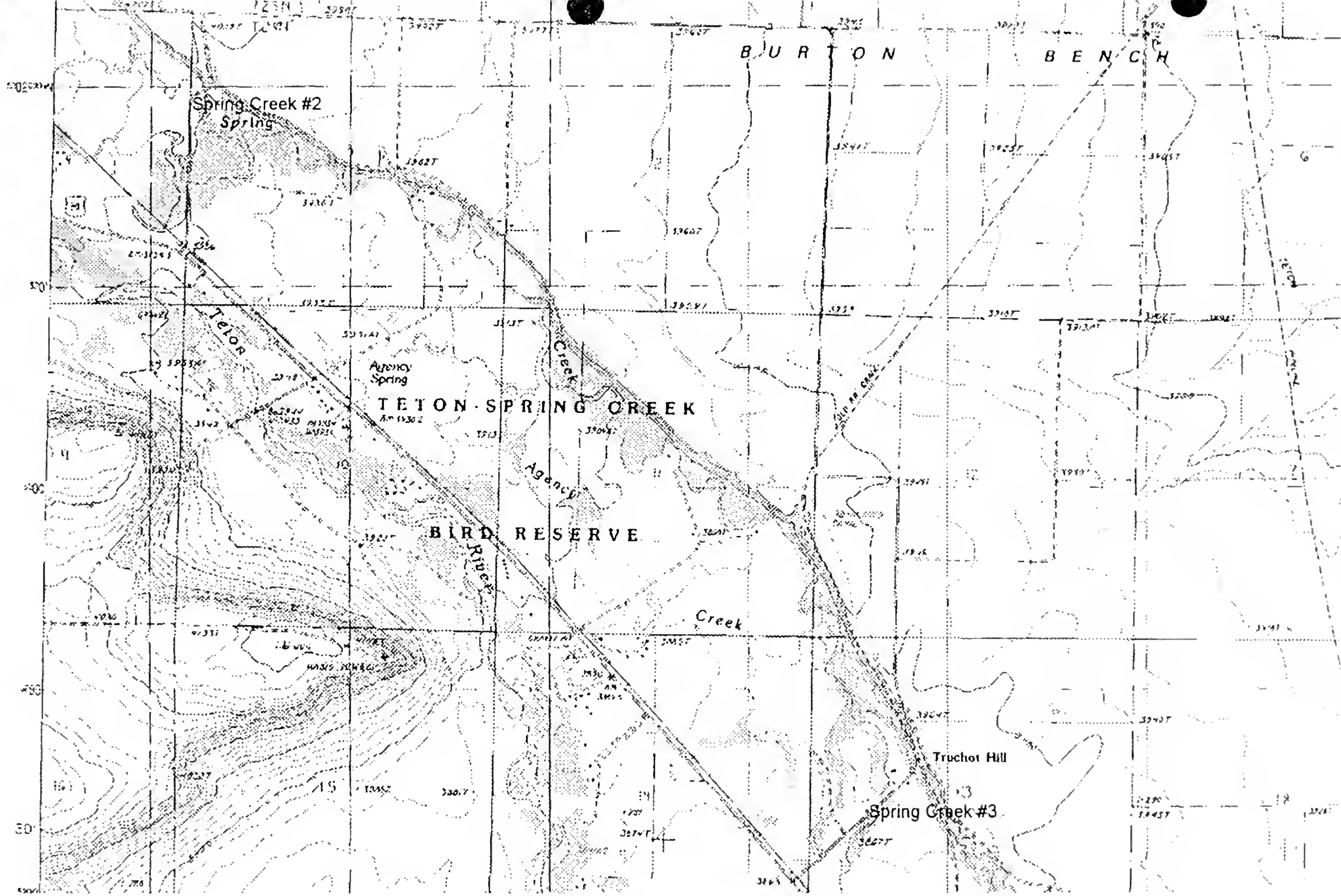

Map 1

'Choteau, MT'; Scale: 1" = 0.447Mi 719Mt 2,359Ft 1 Mi = 2.238" 10 cm = 283Mt

Table 1. Location of periphyton stations on Spring Creek sampled August 1, 2000: Station codes, sample numbers in the Montana Diatom Database, and latitudes and longitudes. Stations are listed in order from upstream to downstream.

Location	Station Code	Sample Number	Latitude/ Longitude
Spring Creek below U.S. Highway 89	S-2	2006-01	47 51 57 N 112 14 27 W
Spring Creek above Choteau	S-3	2007-01	47 50 05 N 112 11 41 W

Table 2. Diatom association metrics used to evaluate biological integrity in Montana streams: reference, range of values in Montana streams, and expected direction of metric response to increasing anthropogenic perturbation or natural stress.

Metric	Reference	Range of Values	Expected Response
Shannon Species Diversity	Bahls 1979	0.00-5.00+	Decrease[1]
Pollution Index[2]	Bahls 1993	1.00-3.00	Decrease
Siltation Index[3]	Bahls 1993	0.00-90.0+	Increase
Disturbance Index[4]	Barbour *et al.* 1999	0.00-100.0	Increase
No. Species Counted	Bahls 1979, 1993	0-100+	Decrease[1]
Percent Dominant Species	Barbour *et al.* 1999	5.0-100.0	Increase
Percent Abnormal Cells	McFarland *et al.* 1997	0.0-20.0+	Increase
Similarity Index	Whittaker 1952	0.0-80.0+	Decrease
Percent Epithemiaceae	Stevenson & Pan 1999	0.0-80.0+	Decrease
Percent Aerophiles	Johansen 1999	0.0-100	Increase

[1] Shannon diversity and species richness may increase somewhat in naturally nutrient-poor mountain streams in response to slight to moderate increases in nutrients or sediment.

[2] Composite numeric expression of the pollution tolerances assigned by Lange-Bertalot (1979) to the common diatom species.

[3] Sum of the percent abundances of all species in the genera *Navicula*, *Nitzschia*, and *Surirella*, plus the species *Cymbella sinuata*.

[4] Percent abundance of *Achnanthes minutissima*.

Table 3. Criteria for rating levels of biological integrity, environmental impairment or natural stress, and aquatic life use support in wadeable **mountain** streams of Montana using selected metrics for benthic diatom associations. The lowest rating for any one metric is the overall rating for the study site.

Biological Integrity/ Impairment or Natural Stress/Use Support	Diversity Index (Shannon)	Pollution Index	Siltation Index	Disturbance Index	Number of Species Counted	Percent Dominant Species	Percent Abnormal Cells	Similarity Index[1]
Excellent None/Full Support	>2.99	>2.50	<20.0	<25.0	>29	<25.0	0.0	>59.9
Good/Minor Full Support	2.00-2.99	2.01-2.50	20.0-39.9	25.0-49.9	20-29	25.0-49.9	>0.0-<1.0	40.0-59.9
Fair/Moderate Partial Support	1.00-1.99	1.50-2.00	40.0-59.9	50.0-74.9	10-19	50.0-74.9	1.0-9.9	20.0-39.9
Poor/Severe Nonsupport	<1.00	<1.50	>59.9	>74.9	<10	>74.9	>9.9	<20.0

[1] The Similarity Index or Percent Community Similarity (Whittaker 1952) may be used to compare a study site to an unimpaired upstream control site on the same stream. This metric measures the degree of floristic similarity between diatom associations at the two sites and is the sum of the smaller of the two percent abundance values for each species that is common to both sites. Adjacent riffles on the same stream, without intervening tributaries or environmental perturbations, will generally have at least 60% of their diatom floras in common (Bahls 1993). PCS may also be used to guage the relative amount of impairment or recovery that occurs between adjacent study sites: >59.9% = very similar floras, no change; 40.0-59.9% = somewhat similar floras, minor change; 20.0-39.9% = somewhat dissimilar floras, moderate change; <20.0% = very dissimilar floras, major change.

Table 4. Criteria for rating levels of biological integrity, environmental impairment or natural stress, and aquatic life use support in wadeable **plains** streams of Montana using selected metrics for benthic diatom associations. The lowest rating for any one metric is the overall rating for the study site.

Biological Integrity/ Impairment or Natural Stress/Use Support	Diversity Index (Shannon)	Pollution Index	Siltation Index	Disturbance Index	Number of Species Counted	Percent Dominant Species	Percent Abnormal Cells	Similarity Index[1]
Excellent None/Full Support	>3.99	>2.25	<50.0	<25.0	>39	<25.0	0.0	>59.9
Good/Minor Full Support	3.00-3.99	1.76-2.25	50.0-69.9	25.0-49.9	30-39	25.0 49.9	>0.0-<1.0	40.0-59.9
Fair/Moderate Partial Support	2.00-2.99	1.25-1.75	70.0-89.9	50.0-74.9	20-29	50.0-74.9	1.0-9.9	20.0-39.9
Poor/Severe Nonsupport	<2.00	<1.25	>89.9	>74.9	<20	>74.9	>9.9	<20.0

[1] The Similarity Index or Percent Community Similarity (Whittaker 1952) may be used to compare a study site to an unimpaired upstream control site on the same stream. This metric measures the degree of floristic similarity between diatom associations at the two sites and is the sum of the smaller of the two percent abundance values for each species that is common to both sites. Adjacent riffles on the same stream, without intervening tributaries or environmental perturbations, will generally have at least 60% of their diatom floras in common (Bahls 1993). PCS may also be used to guage the relative amount of impairment or recovery that occurs between adjacent study sites: >59.9% = very similar floras, no change; 40.0-59.9% = somewhat similar floras, minor change; 20.0-39.9% = somewhat dissimilar floras, moderate change; <20.0% = very dissimilar floras, major change.

Table 5. Relative abundance of cells and rank by biovolume of diatoms and genera of non-diatom algae in periphyton samples collected from Spring Creek near Choteau, Montana on August 1, 2000.

Taxa	Relative Abundance and (Rank)	
	S-2	S-3
Chlorophyta (green algae)		
Ankistrodesmus	occasional (13)	common (3)
Bulbochaete	occasional (9)	
Chaetophora	abundant (2)	
Closterium	occasional (11)	occasional (7)
Cosmarium	rare (15)	
Microspora		common (2)
Mougeotia	common (7)	rare (6)
Oedogonium	frequent (4)	
Pediastrum	occasional (12)	
Protoderma	occasional (10)	
Scenedesmus	occasional (14)	occasional (9)
Spirogyra	frequent (5)	
Zygnema	abundant (3)	
Chrysophyta (golden algae)		
Bacillariophyceae (diatoms)	abundant (1)	abundant (1)
Rhodophyta (red algae)		
Audouinella		rare (8)
Cyanophyta (cyanobacteria)[1]		
Calothrix	occasional (8)	occasional (5)
Merismopedia		common (4)
Rivularia	common (6)	

[1] Formerly known as blue-green algae.

Table 6. Percent abundance of major diatom species[1] and values of selected diatom association metrics for periphyton samples collected from Spring Creek near Choteau, Montana on August 1, 2000.

Species/Metric (Pollution Tolerance Class)[3]	Percent Abundance/Metric Values[2]			
	Mountain Criteria		Plains Criteria[4]	
	S-2	S-3	S-2	S-3
Achnanthes biasolettiana (3)	3.69	6.61		
Achnanthes minutissima (3)	10.71	50.91		
Cymbella microcephala (2)	9.56	3.08		
Diploneis oblongella (3)	0.12	5.92		
Fragilaria brevistriata (3)	11.64	2.05		
Fragilaria construens (3)	19.70	2.39		
Fragilaria leptostauron (3)	8.18	2.16		
Cells Counted	434	439		
Total Species	62	59		
Species Counted	59	52		
Species Diversity	4.28	3.34		3.34
Percent Dominant Species	19.70	**50.91**		**50.91**
Disturbance Index	10.71	**50.91**		**50.91**
Pollution Index	2.70	2.85		
Siltation Index	11.87	9.34		
Percent Abnormal Cells	0.00	0.00		
Percent Epithemiaceae	0.23	2.28		
Similarity Index	32.56			

[1] A major diatom species is here considered to be one that accounts for 5% or more of the cells in one or more samples of a sample set.

[2] Underlined values indicate good biological integrity, minor impairment, and full support of aquatic life uses; **bold values** indicate fair biological integrity, moderate impairment, and partial support of aquatic life uses; all other values indicate excellent biological integrity, no impairment, and full support of aquatic life uses when compared to diatom criteria for mountain and plains streams in Tables 3 and 4.

[3] 3 = sensitive to pollution; 2 = tolerant of pollution; 1 = most tolerant of pollution.

[4] Only metric values that exceed diatom biocriteria for plains streams are shown.

APPENDIX A: DIATOM PROPORTIONAL COUNTS

Sample	Genus/Species/Variety	Pollution Tolerance Class	Count	Percent
200601	Achnanthes biasolettiana	3	32	3.69
200601	Achnanthes laevis	3	1	0.12
200601	Achnanthes lanceolata	2	7	0.81
200601	Achnanthes minutissima	3	93	10.71
200601	Amphipleura pellucida	2	5	0.58
200601	Amphora inariensis	3	2	0.23
200601	Amphora libyca	3	1	0.12
200601	Amphora montana	2	2	0.23
200601	Amphora pediculus	3	36	4.15
200601	Amphora thumensis	3	2	0.23
200601	Anomoeoneis vitrea	2	2	0.23
200601	Caloneis alpestris	3	2	0.23
200601	Cocconeis pediculus	3	2	0.23
200601	Cocconeis placentula	3	5	0.58
200601	Cymbella amphicephala	3	2	0.23
200601	Cymbella brehmii	3	3	0.35
200601	Cymbella cymbiformis	3	0	0.00
200601	Cymbella microcephala	2	83	9.56
200601	Cymbella silesiaca	2	5	0.58
200601	Denticula kuetzingii	3	1	0.12
200601	Diatoma moniliformis	2	19	2.19
200601	Diatoma vulgaris	3	2	0.23
200601	Diploneis oblongella	3	1	0.12
200601	Fragilaria brevistriata	3	101	11.64
200601	Fragilaria capucina	2	3	0.35
200601	Fragilaria construens	3	171	19.70
200601	Fragilaria lapponica	3	8	0.92
200601	Fragilaria leptostauron	3	71	8.18
200601	Fragilaria pinnata	3	41	4.72
200601	Fragilaria vaucheriae	2	0	0.00
200601	Gomphonema acuminatum	3	2	0.23
200601	Gomphonema pumilum	3	4	0.46
200601	Navicula acceptata	2	2	0.23
200601	Navicula capitatoradiata	2	5	0.58
200601	Navicula cryptotenella	2	9	1.04
200601	Navicula difficillima	3	2	0.23
200601	Navicula exilis	2	1	0.12
200601	Navicula gregaria	2	0	0.00
200601	Navicula minima	1	6	0.69
200601	Navicula radiosa	3	6	0.69
200601	Navicula reichardtiana	2	2	0.23
200601	Navicula subrotundata	3	2	0.23
200601	Navicula trivialis	2	1	0.12
200601	Navicula viridula	2	1	0.12
200601	Neidium ampliatum	3	1	0.12
200601	Nitzschia alpina	3	2	0.23
200601	Nitzschia angustata	2	3	0.35

Sample	Genus/Species/Variety	Pollution Tolerance Class	Count	Percent
200601	Nitzschia bacillum	3	3	0.35
200601	Nitzschia dissipata	3	10	1.15
200601	Nitzschia fonticola	3	5	0.58
200601	Nitzschia gracilis	2	12	1.38
200601	Nitzschia lacuum	3	6	0.69
200601	Nitzschia linearis	2	10	1.15
200601	Nitzschia palea	1	14	1.61
200601	Nitzschia sociabilis	2	1	0.12
200601	Pinnularia microstauron	2	1	0.12
200601	Rhopalodia gibba	2	1	0.12
200601	Synedra acus	2	27	3.11
200601	Synedra nana	3	6	0.69
200601	Synedra parasitica	2	6	0.69
200601	Synedra rumpens	2	6	0.69
200601	Synedra ulna	2	8	0.92

Sample	Genus/Species/Variety	Pollution Tolerance Class	Count	Percent
200701	Achnanthes biasolettiana	3	58	6.61
200701	Achnanthes flexella	3	6	0.68
200701	Achnanthes laevis	3	3	0.34
200701	Achnanthes lanceolata	2	3	0.34
200701	Achnanthes minutissima	3	447	50.91
200701	Amphipleura pellucida	2	3	0.34
200701	Amphora pediculus	3	0	0.00
200701	Caloneis bacillum	2	1	0.11
200701	Cocconeis pediculus	3	0	0.00
200701	Cocconeis placentula	3	9	1.03
200701	Cyclotella distinguenda	2	11	1.25
200701	Cymbella affinis	3	2	0.23
200701	Cymbella amphicephala	3	7	0.80
200701	Cymbella cesatii	3	11	1.25
200701	Cymbella cistula	3	0	0.00
200701	Cymbella cymbiformis	3	3	0.34
200701	Cymbella hebridica	3	6	0.68
200701	Cymbella microcephala	2	27	3.08
200701	Cymbella silesiaca	2	10	1.14
200701	Denticula kuetzingii	3	18	2.05
200701	Denticula tenuis	3	2	0.23
200701	Diploneis oblongella	3	52	5.92
200701	Eunotia arcus	3	6	0.68
200701	Fragilaria brevistriata	3	18	2.05
200701	Fragilaria capucina	2	0	0.00
200701	Fragilaria construens	3	21	2.39
200701	Fragilaria lapponica	3	5	0.57
200701	Fragilaria leptostauron	3	19	2.16
200701	Fragilaria pinnata	3	1	0.11
200701	Gomphonema bohemicum	3	4	0.46
200701	Gomphonema parvulum	1	3	0.34
200701	Gyrosigma spencerii	2	1	0.11
200701	Navicula capitata	2	0	0.00
200701	Navicula cincta	1	1	0.11
200701	Navicula cryptocephala	3	1	0.11
200701	Navicula cryptotenella	2	6	0.68
200701	Navicula laevissima	3	18	2.05
200701	Navicula nipponica	3	4	0.46
200701	Navicula pelliculosa	1	4	0.46
200701	Navicula pupula	2	2	0.23
200701	Navicula radiosa	3	0	0.00
200701	Navicula reichardtiana	2	2	0.23
200701	Navicula tripunctata	3	1	0.11
200701	Navicula veneta	1	1	0.11
200701	Navicula wildii	2	8	0.91
200701	Nitzschia bacillum	3	9	1.03
200701	Nitzschia dissipata	3	11	1.25

Sample	Genus/Species/Variety	Pollution Tolerance Class	Count	Percent
200701	Nitzschia gracilis	2	2	0.23
200701	Nitzschia heufleriana	3	0	0.00
200701	Nitzschia linearis	2	7	0.80
200701	Nitzschia palea	1	1	0.11
200701	Nitzschia perminuta	3	1	0.11
200701	Nitzschia pura	2	2	0.23
200701	Nitzschia recta	3	1	0.11
200701	Reimeria sinuata	3	2	0.23
200701	Stauroneis smithii	2	1	0.11
200701	Synedra famelica	2	3	0.34
200701	Synedra rumpens	2	12	1.37
200701	Synedra tenera	2	10	1.14