SUPPORT OF AQUATIC LIFE USES IN CARELESS CREEK, LODGEPOLE CREEEK, AND THE SOUTH FORK OF LODGEPOLE CREEK BASED ON THE COMPOSITION AND STRUCTURE OF THE BENTHIC ALGAE COMMUNITY

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SUMMARY

In July and August 1999, composite periphyton samples were collected from natural substrates in Careless Creek, Lodgepole Creek, and the South Fork of Lodgepole Creek in the middle and lower Musselshell River drainage of central Montana. Samples were collected following MDEQ standard operating procedures, processed and analyzed using standard methods for periphyton, and evaluated following modified USEPA rapid bioassessment protocols for wadeable streams.

Diatom metrics indicated that **Careless Creek** fully supports its aquatic life uses when compared to biocriteria for prairie streams. A case may be made, however, based on algal floristics, that lower Careless Creek is transitional between cold and warm water aquatic life, and would be more appropriately classified as B-2 rather than C-3. If such were the case, diatom metrics for Careless Creek would be compared to biocriteria for mountain streams and this comparison would indicate moderate impairment from siltation and only partial support of designated uses.

Diatom metrics at the site near the mouth of **Lodgepole Creek** indicated moderate impairment and only partial support of aquatic life uses due to siltation, organic loading, and nutrient enrichment. Nitrogen is the likely nutrient of concern in Lodgepole Creek.

The **South Fork of Lodgepole Creek** had low diatom diversity and species richness for a prairie stream, resulting in a rating of moderate impairment and partial support of aquatic life uses. The low diversity was due mainly to the unusually large numbers of *Achnanthes minutissima* at this site. The abundance of this species here and the presence of other cool-water and pollution sensitive algal taxa, indicate that the stress operating in the South Fork may be natural rather than cultural in origin.

INTRODUCTION

This report evaluates the support of aquatic life uses, and probable causes of impairment to those uses, in Careless Creek, Lodgepole Creek, and the South Fork of Lodgepole Creek in the Musselshell River basin of central Montana. This evaluation is part of a larger assessment that was conducted by staff of the Natural Resources Conservation Service, USDA, and the Montana Department of Environmental Quality (MDEQ).

Evaluation of use support in this report is based on the species composition and structure of periphyton (phytobenthos, benthic algae) communities at 3 sites, one on each stream, that were sampled in July and August of 1999. 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 of streams:

- 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, 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.

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 irrigation intakes, create tastes and odors in drinking water, and cause other problems.

The federal Clean Water Act directs states to develop water

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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).

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 EPA 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.

The purpose of this report is to provide information that will help the State of Montana to determine whether Careless Creek, Lodgepole Creek, and the South Fork of Lodgepole Creek are water-quality limited and in need of TMDLs.

PROJECT AREA AND SAMPLING SITES

The project area is located in the middle and lower Musselshell River drainage of central Montana. Careless Creek heads in the Big Snowy Mountains and flows southeasterly for about 30 miles to where it enters the Musselshell River east of Ryegate in Golden Valley County. Lodgepole Creek heads in western Garfield County and enters the Musselshell River just before its confluence with the Missouri River.

The project area is located in the Northwestern Great Plains Ecoregion, although the headwaters of Careless Creek are in the Middle Rockies Ecoregion (Omernik and Gallant 1987). The surface geology of the Careless Creek and Lodgepole Creek watersheds consists primarily of marine shales, sandstones, and siltstones of the Montana Group (Taylor and Ashley, undated).

Vegetation along lower Careless Creek and in the upper Lodgepole Creek watershed is mixed grassland; river breaks along lower Lodgepole Creek are dominated by an overstory of ponderosa pine and Rocky Mountain juniper (USDA 1976). The main land use in both watersheds is livestock grazing, although water quality in lower Careless Creek is also affected by releases of water from Deadman's Basin Reservoir, an off-stream irrigation water storage reservoir.

Periphyton samples were collected at one site each on Careless Creek, Lodgepole Creek, and the South Fork of Lodgepole Creek in July and August 1999 (Table 1; maps). Elevations at the sampling sites range from 3,600 feet near the mouth of Careless Creek to 2,850 feet on the South Fork of Lodgepole Creek, to 2,300 feet near the mouth of Lodgepole Creek. All three sites are classified C-3 in the Montana Surface Water Quality Standards, although Deadman's Basin Reservoir and Careless Creek above Swimming Woman Creek are classified B-1. Both of these waters are immediately upstream from the reach containing the Careless Creek sampling site.

METHODS

Periphyton samples were collected 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 sample from Careless Creek was collected by Carole Mackin, MDEQ. The samples from Lodgepole Creek and the South Fork of Lodgepole Creek were collected by Warren Kellogg, NRCS.

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 in 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.

After the identification of soft algae, raw periphyton samples were cleaned of organic matter using sulfuric acid, and permanent diatom slides were prepared in a high refractive index mounting medium following *Standard Methods for the Examination of Water and Wastewater* (APHA 1998). For each slide, between 457 and 483 diatom cells (914 to 966 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. Bahls et al. (1984) provide autecological information on important diatom species that live in the Southern Fort Union Coal Region of eastern Montana, including many of the diatom species in Careless Creek and Lodgepole Creek.

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).

One additional metric was calculated for this study: percent of all diatom cells in the family **Epithemiaceae**. This family is represented in streams by two genera, *Epithemia* and *Rhopalodia*, that harbor endosymbiotic nitrogen-fixing bluegreen algae (cyanobacteria) within their cells. A diatom association that contains a large percentage of cells in these genera may indicate nitrogen-limiting conditions, that is, low nitrogen to phosphorus ratios (Stevenson and Pan 1999).

Metric values from study sites were compared to numeric biocriteria developed for streams in the Great Plains Ecoregions of Montana (Table 3) using Protocol I in Bahls (1993). 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, causes, and degrees of pollution (Bahls 1993).

The criteria in Table 3 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.

Protocol II (Bahls 1993) is based on the percentage of change in metric values at study sites when compared to values measured at an upstream control site. Protocol II may be used on relatively short segments of stream where an upstream control site fully supports its aquatic life uses, that is, where it has a rating of "good" or "excellent" biological integrity using Protocol I. Protocol II could not be applied to Careless Creek because a sample was not collected from an upstream control site; it could not be applied in Lodgepole Creek because both sites in this drainage suffered moderate impairment under Protocol I.

For Protocol I, only periphyton samples collected in summer (June 21-September 21) can be compared with confidence to reference stream samples because metric values change seasonally and summer is the season in which reference streams and impaired streams were sampled for the purpose of biocriteria development. (Protocol II can be used at any time of the year.)

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 samples were assigned a unique number compatible with the Montana Diatom Database, e.g., 0379-04. The first part of this number (0379) designates the sampling site (Careless Creek near mouth); the second part of the number (04) designates the number of periphyton samples that have been collected at this site to date 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.

On completion of the project, station information, sample information, and diatom proportional count data will be entered into the Montana Diatom Database. One set of diatom slides will be deposited in the University of Montana Herbarium in Missoula. The other set of slides will be retained by *Hannaea* in Helena.

RESULTS AND DISCUSSION

Results are presented in Tables 4 and 5 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 calculated percent abundances, are attached as Appendix A.

SAMPLE NOTES

Careless Creek. This sample was very silty. The sample also contained macrophytes. Trichomes of *Phormidium* in this sample were very narrow.

Lodgepole Creek. This sample was silty and contained sections of macrophyte stems and leaves. This sample also contained a species of *Phormidium* with very narrow trichomes.

South Fork Lodgepole Creek. The *Chaetophora* in this sample had long setae and compact colonies, which distinguished it from *Stigeoclonium*. This sample contained a species of *Oscillatoria* with narrow trichomes.

NON-DIATOM ALGAE

Careless Creek

The dominant alga in Careless Creek was *Cladophora*, a branched filamentous green that prefers cool, nutrient-rich, flowing waters. Also common here, besides diatoms, were two genera of cyanobacteria: *Calothrix* and *Phormidium* (Table 4).

Lodgepole Creek

Lodgepole Creek and the South Fork of Lodgepole Creek both supported a rich variety of green, blue-green, and euglenoid algae, besides diatoms (Table 4). The green macroalga *Chara* dominated the flora of Lodgepole Creek, while the unbranched filamentous green *Spirogyra* was most abundant in the South Fork, where *Chara* ranked second in abundance.

Chara prefers soft-bottom, low-gradient, hardwater streams. *Spirogyra*, along with *Anabaena* and *Euglena*, which were found in both streams, may indicate elevated concentrations of nutrients. The presence of *Chaetophora* and *Cladophora* in the South Fork (Table 4) indicates cool water temperatures relative to main Lodgepole Creek, where these genera were absent.

DIATOMS

Careless Creek

Careless Creek supported a rich diversity of diatom species (Table 5). Nevertheless, the dominant diatom here was the pollution-tolerant species *Navicula durrenbergiana*, which has been reported from brackish to saline waters in Europe and Israel (Krammer and Lange-Bertalot 1986). In the Southern Fort Union

Coal Region of Montana, this species (misidentified as *Navicula pavillardii*) prefers brackish, sodium sulfate waters, water temperatures between 21 and 30°C, coarse sand substrates, and pH values greater than 8.10; it also tolerates some suspended sediment, turbidity, and chloride (Bahls et al. 1984).

The relative abundance of *Navicula durrenbergiana* and other pollution tolerant diatoms in Careless Creek resulted in a marginal pollution index that indicated minor impairment but still full support of aquatic life uses (Table 5).

The relative abundance of diatoms in the genera *Navicula* and *Nitzschia* resulted in a siltation index value of 45.14 (Table 5). This is a normal but marginal value for least-impaired prairie streams. Careless Creek is classified C-3 at the sampling site, but it is classified B-1 about 10 miles upstream from this point, above its confluence with Swimming Woman Creek (Montana Surface Water Quality Standards 1994). Careless Creek near its mouth has elements of both a cold-water and a warm-water flora, indicating that the stream here might be more appropritatelay classified as B-2. If such were the case, the siltation index would indicate moderate impairment and only partial support of aquatic life.

Careless Creek supported a modest number of cells in the diatom family Epithemiaceae, and the largest relative abundance of diatoms in this family of the three streams addressed in this report (Table 5). This would indicate that, of the three streams, nitrogen would more likely be the limiting nutrient in Careless Creek than in the other two streams.

<u>Lodgepole Creek</u>

Diatom diversity and species richness in Lodgepole Creek were excellent, but a large percentage of pollution tolerant diatoms and a large percentage of diatoms in the genera *Navicula* and *Nitzschia* resulted in pollution and siltation index values that indicated **moderate impairment and only partial support of aquatic life uses** (Table 5).

Nitzschia frustulum was the dominant diatom in Lodgepole Creek. This species is widely distributed in eastern Montana and was the most common diatom in the Southern Fort Union Coal Region, where it tolerates large amounts of suspended sediment and turbidity, although it does best at smaller concentrations (Bahls et al. 1984).

The other major diatom species near the mouth of Lodgepole Creek was *Nitzschia palea* (Table 5). *N. palea* is a facultative nitrogen heterotroph and, in large numbers, a good indicator of elevated concentrations of organic nitrogen. In the Southern Fort Union Region, this diatom prefered fresh to brackish and very hard to extremely hard waters; it was also indifferent to moderate amounts of suspended sediment, turbidity, and chloride (Bahls et al. 1984).

South Fork Lodgepole Creek

The South Fork of Lodgepole Creek had very low diatom diversity and species richness for a prairie stream (Table 5). These low values resulted in a rating of **moderate impairment and partial support of aquatic life uses**.

The low diversity in the South Fork was due in part to the unusual abundance of the pollution sensitive species *Achnanthes minutissima* (Table 5). Although often abundant in mountain streams, *A. minutissima* rarely accounts for more than a few percent of the diatom cells in prairie streams. Its abundance in the South Fork is another indicator of the cool water temperatures that evidently prevailed in this stream prior to sampling. This indicates that at least a portion of the stress that caused the low diversity in the South Fork was natural, rather than cultural, in origin.

Besides *Nitzschia frustulum*, the other major diatom in the South Fork of Lodgepole Creek was *Synedra famelica* (Table 5). In the Southern Fort Union Coal Region of Montana, this diatom prefers brackish, extremely hard waters with large concentrations of sulfate and small amounts of suspended sediment and turbidity (Bahls et al. 1984). Overall, the major diatoms in the South Fork of Lodgepole Creek indicate cool, clear waters of moderate conductivity and low levels of suspended sediment and siltation.

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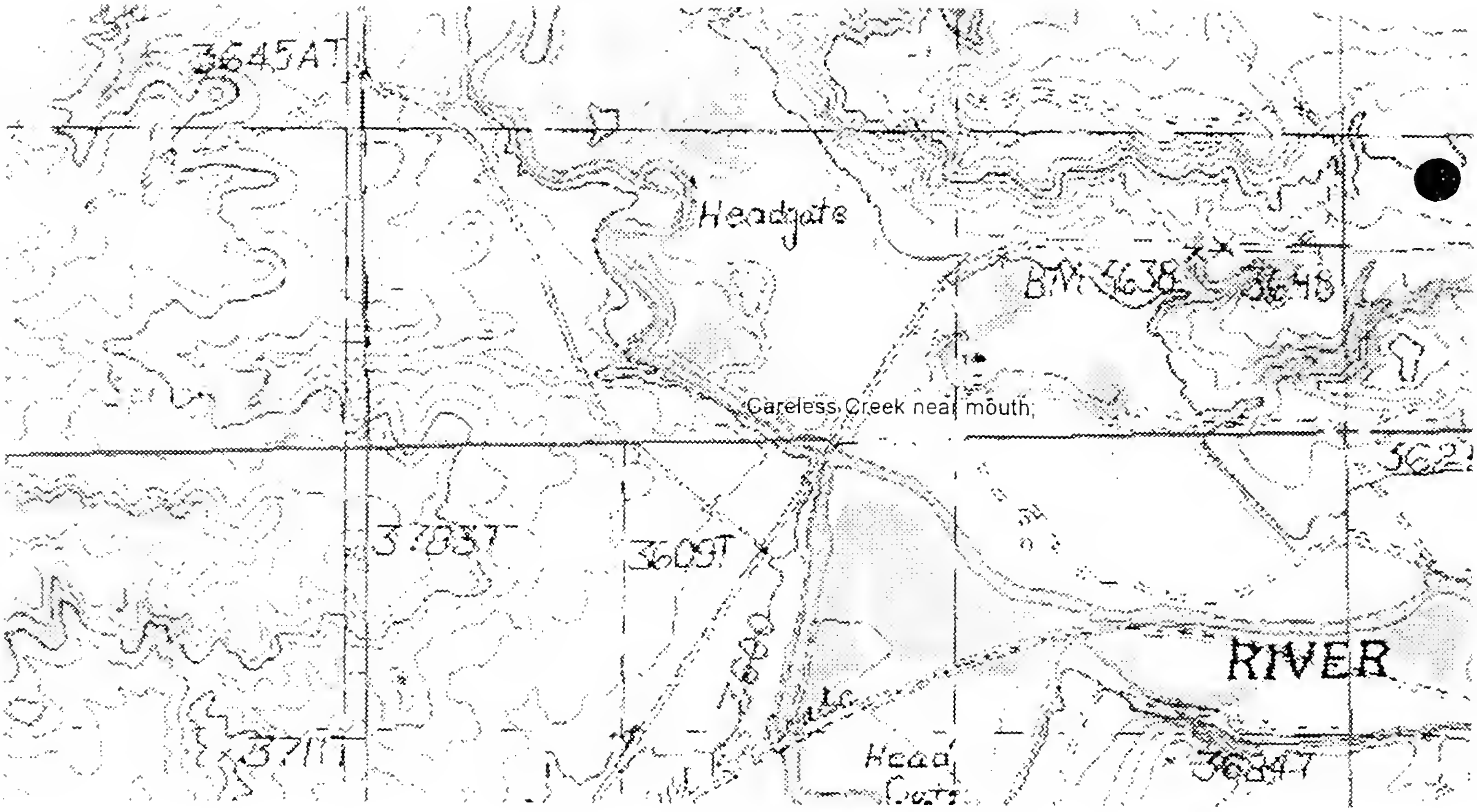
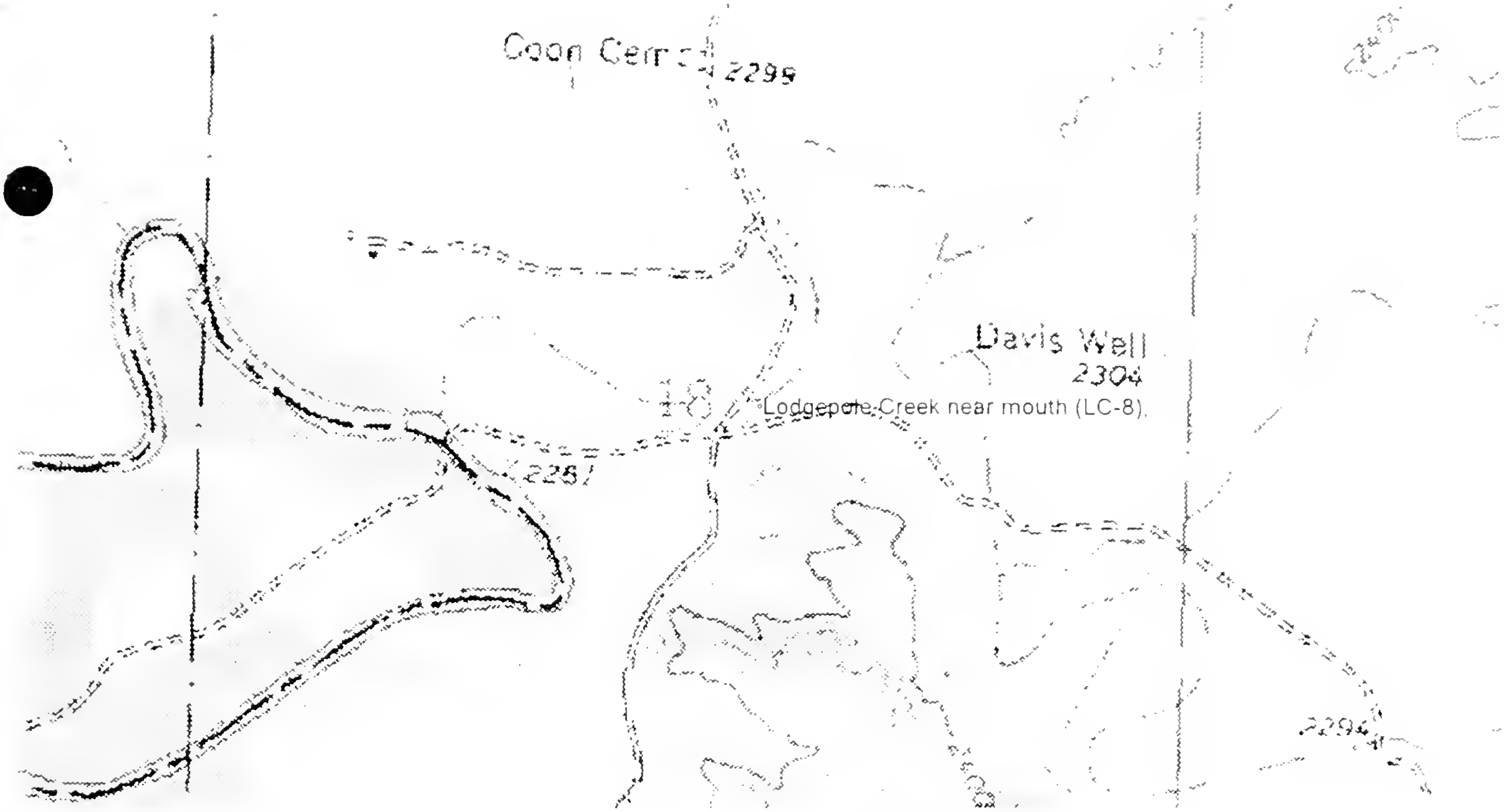


'Ryegate East, MT', Scale 1" = 0 189Mi 305Mt 1,000Ft, 1 Mi = 5 279", 10 cm = 120Mt



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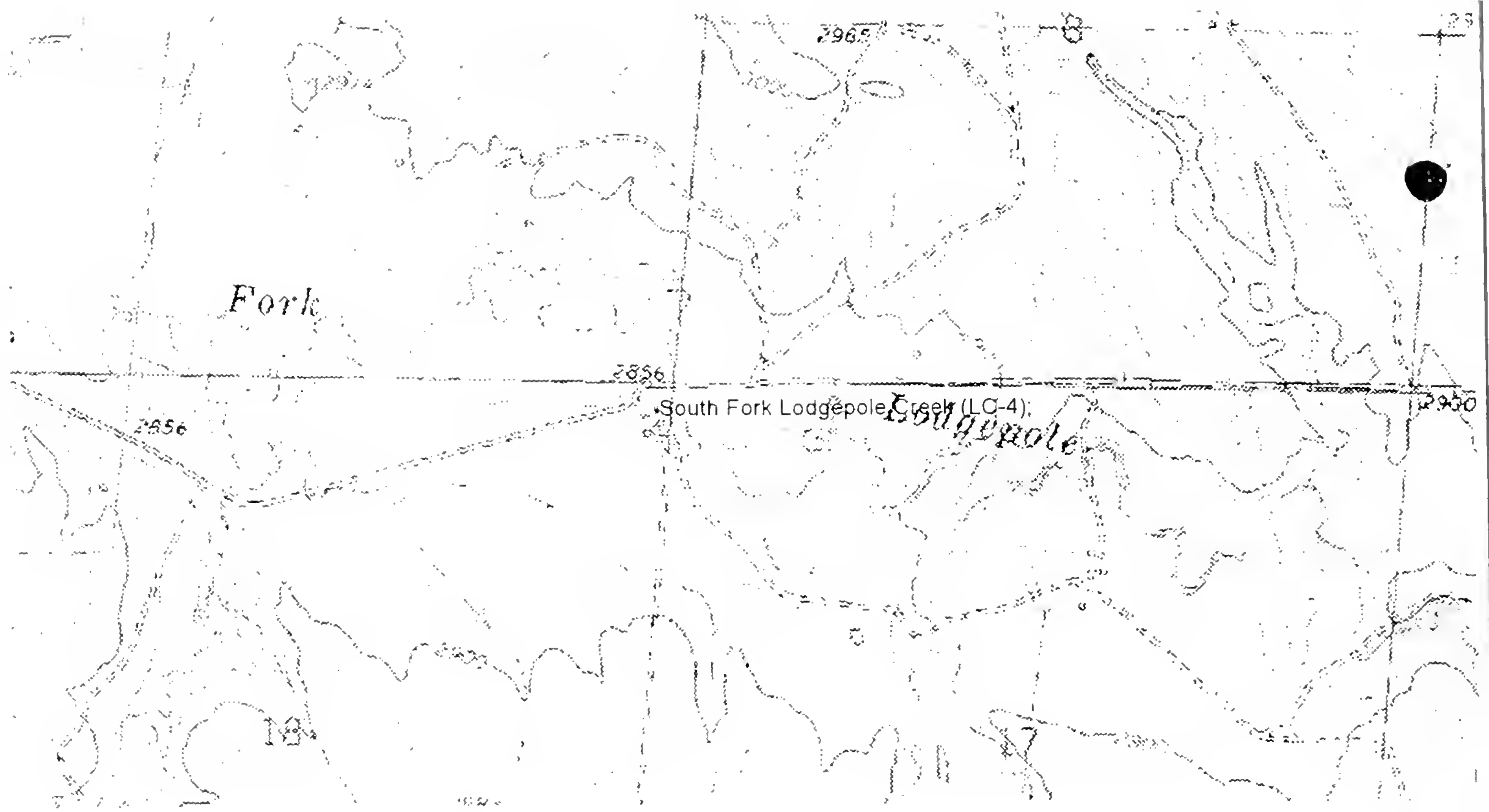

'Searl Coulee, MT', Scale 1" = 0.253Mi 406Mt 1,333Ft, 1 Mi = 3.959", 10 cm = 160Mt

Table 1. Location of periphyton sampling stations on Careless Creek, Lodgepole Creek, and the South Fork of Lodgepole Creek, MDEQ station codes, sample numbers in the Montana Diatom Database, legal descriptions, latitudes and longitudes, and sample dates.

Location	Station Code	Sample Number	Legal Description	Latitude/ Longitude	Sample Date
Careless Creek near mouth	----	0379-04	T07NR20E35CD	48 18 58 109 11 10	08/23/99
Lodgepole Creek near mouth	LC-8	1875-01	T18NR30E18DB	47 19 17 107 55 48	07/29/99
South Fork Lodgepole Creek above County Road	LC-4	1874-01	T16NR32E18AA	47 09 24 107 41 37	07/28/99

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

[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] This is a composite numeric expression of the pollution tolerances assigned by Lange-Bertalot (1979) to the common diatom species.

[3] Computed as the sum of the percent abundances of all species in the genera *Navicula*, *Nitzschia*, and *Surirella*. These are common genera of predominantly motile taxa that are able to maintain their positions on the substrate surface in depositional environments.

[4] Computed as the percent abundance of *Achnanthes minutissima*. This attached taxon typically dominates early successional stages of benthic diatom associations and resists chemical, physical and biological disturbances in the form of metals toxicity, substrate scour by high flows and fast currents, and grazing by macroinvertebrates.

Table 3. 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 4. Estimated relative abundance of algal cells and rank by volume of diatoms and genera of non-diatom algae in periphyton samples collected from Careless Creek, Lodgepole Creek, and the South Fork of Lodgepole Creek in 1999. R = rare, U = uncommon, C = common, VC = very common, A = abundant, VA = very abundant.

Taxa	Careless Creek	Lodgepole Creek	South Fork Lodgepole Creek
Chlorophyta (green algae)			
Chaetophora			VC(4)
Chara		A(1)	VC(2)
Characium		R	
Cladophora	VA(1)		C(5)
Closterium	R		U(9)
Cosmarium	R		R
Oedogonium		VC(2)	
Spirogyra			VA(1)
Euglenophyta (euglenoid algae)			
Euglena		U(7)	R
Chrysophyta (golden algae)			
Diatoms	VC(2)	VC(3)	A(3)
Cyanophyta (cyanobacteria)			
Anabaena		U(8)	C(8)
Calothrix	C(3)	C(4)	C(7)
Lyngbya	U(5)	C(5)	
Oscillatoria			VC(6)
Phormidium	C(4)	C(6)	R
Spirulina		U(9)	

Table 5. Percent abundance of major diatom species[1] and values of selected diatom association metrics for periphyton samples collected from Careless Creek, Lodgepole Creek, and the South Fork of Lodgepole Creek in 1999. Underlined values indicate full support of aquatic life uses with minor impairment; **bold values** indicate partial support of aquatic life uses with moderate impairment; all other values indicate full support of aquatic life uses and no impairment based on the ecoregional reference stream approach (Protocol I in Bahls 1993) and criteria for wadeable prairie streams in Table 3.

Species/Metric (Pollution Tolerance Class)	Careless Creek	Lodgepole Creek	South Fork Lodgepole Creek
Achnanthes minutissima (3)	6.03	0.62	48.69
Fragilaria vaucheriae (2)	11.02		
Navicula durrenbergiana (1)	14.97	0.41	
Nitzschia frustulum (2)	3.53	17.60	21.12
Nitzschia palea (1)	3.64	10.77	0.44
Synedra famelica (2)			11.16
Number of Cells Counted	481	483	457
Shannon Species Diversity	4.88	4.42	**2.37**
Pollution Index	2.18	**1.69**	2.35
Siltation Index	45.14	**75.26**	30.55
Disturbance Index	6.03	0.62	48.69
Number of Species Counted	67	49	**21**
Percent Dominant Species	14.97	17.60	48.69
Percent Abnormal Cells	0.00	0.00	0.00
Percent Epithemiaceae	2.81	1.34	0.00
Similarity Index[2]		16.00	25.02

[1] A major diatom species is here considered to be one that accounts for 10.0 percent or more of the diatom cells that were counted at one or more stations in a sample set.

[2] The similarity index between Careless Cr. and the South Fork of Lodgepole Cr. was 12.67.

Sample	Genus/Species/Variety	PTC	Count	Percent
037904	Achnanthes minutissima	3	58	6.03
037904	Amphipleura pellucida	2	12	1.25
037904	Amphora pediculus	3	2	0.21
037904	Cocconeis pediculus	3	3	0.31
037904	Cocconeis placentula	3	57	5.93
037904	Cyclotella bodanica	3	2	0.21
037904	Cyclotella meneghiniana	2	1	0.10
037904	Cymbella affinis	3	19	1.98
037904	Cymbella caespitosa	2	21	2.18
037904	Cymbella microcephala	2	15	1.56
037904	Cymbella minuta	2	17	1.77
037904	Cymbella muelleri	2	4	0.42
037904	Cymbella silesiaca	2	12	1.25
037904	Cymbella sinuata	3	12	1.25
037904	Diatoma tenue	2	19	1.98
037904	Diploneis puella	2	10	1.04
037904	Entomoneis paludosa	2	1	0.10
037904	Epithemia sorex	3	23	2.39
037904	Epithemia turgida	3	2	0.21
037904	Fragilaria atomus	3	21	2.18
037904	Fragilaria construens	3	18	1.87
037904	Fragilaria vaucheriae	2	106	11.02
037904	Gomphonema minutum	3	2	0.21
037904	Gomphonema olivaceum	3	32	3.33
037904	Gomphonema parvulum	1	5	0.52
037904	Gyrosigma spencerii	2	2	0.21
037904	Mastogloia elliptica	2	2	0.21
037904	Mastogloia smithii	2	4	0.42
037904	Navicula capitata	2	0	0.00
037904	Navicula capitatoradiata	2	18	1.87
037904	Navicula caterva	2	6	0.62
037904	Navicula circumtexta	1	0	0.00
037904	Navicula cryptotenella	2	5	0.52
037904	Navicula cuspidata	2	1	0.10
037904	Navicula durrenbergiana	1	144	14.97
037904	Navicula erifuga	2	3	0.31
037904	Navicula gregaria	2	4	0.42
037904	Navicula halophila	1	3	0.31
037904	Navicula notha	2	0	0.00
037904	Navicula omissa	1	0	0.00
037904	Navicula peregrina	2	0	0.00
037904	Navicula reichardtiana	2	7	0.73
037904	Navicula schroeterii	2	14	1.46
037904	Navicula slesvicensis	2	3	0.31
037904	Navicula vandamii	2	5	0.52
037904	Navicula veneta	1	2	0.21
037904	Navicula viridula	2	0	0.00
037904	Nitzschia acicularis	2	2	0.21
037904	Nitzschia angustata	2	0	0.00
037904	Nitzschia angustatula	2	2	0.21
037904	Nitzschia apiculata	2	4	0.42
037904	Nitzschia aurariae	1	2	0.21
037904	Nitzschia capitellata	2	2	0.21
037904	Nitzschia dissipata	3	73	7.59
037904	Nitzschia filiformis	2	6	0.62
037904	Nitzschia frustulum	2	34	3.53
037904	Nitzschia gracilis	2	14	1.46
037904	Nitzschia incognita	2	2	0.21
037904	Nitzschia inconspicua	2	2	0.21
037904	Nitzschia levidensis	2	4	0.42

Sample	Genus/Species/Variety	PTC	Count	Percent
187501	Achnanthes minutissima	3	6	0.62
187501	Bacillaria paradoxa	2	0	0.00
187501	Caloneis bacillum	2	2	0.21
187501	Chaetoceros muelleri	1	28	2.90
187501	Cyclotella meneghiniana	2	2	0.21
187501	Cymbella pusilla	1	34	3.52
187501	Cymbella silesiaca	2	4	0.41
187501	Diploneis puella	2	76	7.87
187501	Entomoneis alata	2	1	0.10
187501	Entomoneis paludosa	2	4	0.41
187501	Epithemia adnata	2	3	0.31
187501	Gyrosigma macrum	2	1	0.10
187501	Mastogloia elliptica	2	7	0.72
187501	Mastogloia smithii	2	59	6.11
187501	Navicula capitata	2	6	0.62
187501	Navicula caterva	2	27	2.80
187501	Navicula cincta	1	0	0.00
187501	Navicula circumtexta	1	18	1.86
187501	Navicula durrenbergiana	1	4	0.41
187501	Navicula erifuga	2	27	2.80
187501	Navicula goersii	2	18	1.86
187501	Navicula gregaria	2	5	0.52
187501	Navicula omissa	1	2	0.21
187501	Navicula pygmaea	2	2	0.21
187501	Navicula salinicola	1	14	1.45
187501	Navicula slesvicensis	2	2	0.21
187501	Navicula tenelloides	1	6	0.62
187501	Navicula vandamii	2	18	1.86
187501	Navicula veneta	1	44	4.55
187501	Navicula viridula	2	0	0.00
187501	Nitzschia amphibia	2	3	0.31
187501	Nitzschia apiculata	2	2	0.21
187501	Nitzschia aurariae	1	2	0.21
187501	Nitzschia calida	2	3	0.31
187501	Nitzschia compressa	1	3	0.31
187501	Nitzschia filiformis	2	41	4.24
187501	Nitzschia frustulum	2	170	17.60
187501	Nitzschia hungarica	2	0	0.00
187501	Nitzschia incognita	2	2	0.21
187501	Nitzschia liebetruthii	3	18	1.86
187501	Nitzschia microcephala	1	76	7.87
187501	Nitzschia palea	1	104	10.77
187501	Nitzschia paleacea	2	46	4.76
187501	Nitzschia pusilla	1	4	0.41
187501	Nitzschia reversa	2	36	3.73
187501	Nitzschia sociabilis	2	4	0.41
187501	Nitzschia solita	1	12	1.24
187501	Nitzschia valdestriata	2	6	0.62
187501	Rhopalodia acuminata	1	5	0.52
187501	Rhopalodia gibba	2	1	0.10
187501	Rhopalodia operculata	1	4	0.41
187501	Surirella brebissonii	2	2	0.21
187501	Synedra fasciculata	2	2	0.21
187501	Synedra pulchella	2	0	0.00

Sample	Genus/Species/Variety	PTC	Count	Percent
037904	Nitzschia liebetruthii	3	6	0.62
037904	Nitzschia palea	1	35	3.64
037904	Nitzschia paleacea	2	2	0.21
037904	Nitzschia perspicua	1	1	0.10
037904	Nitzschia recta	3	2	0.21
037904	Nitzschia valdestriata	2	4	0.42
037904	Nitzschia vermicularis	2	1	0.10
037904	Pleurosigma delicatulum	2	1	0.10
037904	Rhoicosphenia curvata	3	33	3.43
037904	Rhopalodia brebissonii	1	0	0.00
037904	Rhopalodia gibba	2	2	0.21
037904	Surirella brebissonii	2	14	1.46
037904	Surirella minuta	2	7	0.73
037904	Synedra acus	2	1	0.10
037904	Synedra ulna	2	14	1.46

Sample	Genus/Species/Variety	PTC	Count	Percent
187401	Achnanthes minutissima	3	445	48.69
187401	Amphora veneta	1	45	4.92
187401	Cyclotella meneghiniana	2	6	0.66
187401	Cymbella sinuata	3	1	0.11
187401	Entomoneis paludosa	2	6	0.66
187401	Gomphonema gracile	2	11	1.20
187401	Gomphonema parvulum	1	18	1.97
187401	Navicula capitata	2	2	0.22
187401	Navicula cincta	1	1	0.11
187401	Navicula circumtexta	1	1	0.11
187401	Navicula gregaria	2	2	0.22
187401	Navicula pelliculosa	1	2	0.22
187401	Navicula veneta	1	52	5.69
187401	Nitzschia aurariae	1	4	0.44
187401	Nitzschia frustulum	2	193	21.12
187401	Nitzschia liebetruthii	3	2	0.22
187401	Nitzschia palea	1	4	0.44
187401	Nitzschia perspicua	1	2	0.22
187401	Nitzschia supralitorea	2	6	0.66
187401	Surirella brebissonii	2	8	0.88
187401	Synedra famelica	2	102	11.16