BIOLOGICAL INTEGRITY OF ANTELOPE CREEK AND POTTER CREEK BASED ON THE COMPOSITION AND STRUCTURE OF THE BENTHIC ALGAE COMMUNITY

Prepared for:

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SUMMARY

In early August 2000, periphyton samples were collected from one station each on Antelope Creek and Potter Creek north of Livingston, Montana for the purpose of assessing whether these streams are 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.

Both streams flow through the semi-arid sagebrush steppe of the Shields River Valley, and Potter Creek does so for its entire length. In addition, Potter Creek heads at a relatively low elevation compared to other streams in the area. For these reasons, diatom metrics were compared to biocriteria for both mountain streams and prairie streams.

An unusually large percentage of motile diatoms indicated that Potter Creek was moderately impaired by sediment when judged against criteria for mountain streams. However, when compared to sedimentation criteria for prairie streams, Potter Creek was assessed as borderline but unimpaired. Potter Creek also had a larger than normal percentage of teratological cells which may have been caused by toxic ammonia generated by internal organic loading.

Diatom metrics indicated no impairment or only minor impairment in Antelope Creek. Both streams showed signs of nutrient, especially nitrogen, enrichment. These included large numbers of *Nitzschia palea* and small percentages of diatoms in the family Epithemiaceae, both indicators that nitrogen was not limiting to algal growth in either stream. The two streams had about half of their diatom assemblages in common.

INTRODUCTION

This report evaluates the biological integrity, support of aquatic life uses, and probable causes of impairment to those uses, in Antelope Creek and Potter Creek, both tributaries of the Shields River. The purpose of this report is to provide information that will help the State of Montana determine whether these streams are 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 in early August 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 northern Park County in southcentral Montana. Antelope Creek heads on the eastern slopes of Battle Ridge (el. 7,531 feet) and flows easterly for about 10 miles to where it enters the Shields River just north of Clyde Park, Montana (pop. 302). Antelope Creek begins in the Middle Rockies Ecoregion and ends in the Montana Valley and Foothill Prairies Ecoregion of North America (Woods et al., 1999).

Potter Creek heads on the low divide (el. 5,350 feet) that separates the Shields River watershed from the Sixteenmile Creek drainage. Potter Creek flows south for about 15 miles to where it enters the Shields River north of Wilsall, Montana. For much of its length, Potter Creek parallels U.S. Highway 89. The Potter Creek watershed is entirely within the Montana Valley and Foothill Prairies Ecoregion (Woods et al. 1999).

The surface geology of the project area is complex and includes volcaniclastic deposits of the Livingston Group, Cretaceous sandstones and shales of the Montana group, Paleocene continental deposits, and Tertiary intrusives (Renfro and Feray 1972). Vegetation is mixed conifer forest in the headwaters of Antelope Creek and mixed grassland along lower Antelope Creek and throughout the Potter Creek catchment (USDA 1976). Although both creeks are classified B-1 in the Montana Surface Water Quality Standards, they flow for a good portion of their lengths through sagebrush steppe habitat that is typical of eastern Montana.

Periphyton samples were collected at one site on each stream in early August 2000 (Table 1). The Antelope Creek site (Map 1) is located just above the mouth of the stream at an elevation of about 4,900 feet. The Potter Creek site (Map 2) is located just north of the Wilsall Airport at an elevation of about 5,100 feet.

METHODS

Periphyton samples were collected by Patrick Newby of the 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 of cells 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, 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 413 and 428 diatom cells (826 to 856 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 Antelope Creek and Potter Creek were compared to numeric biocriteria or threshold values developed for streams in the Rocky Mountain and Great Plains Ecoregions of North America (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., 1999-01. The first part of this number (1999) designates the sampling site (Antelope Creek near mouth); the second part of this number (01) 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. 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

Antelope Creek. At least two species of *Spirogyra* were present in this sample.

Potter Creek. Most of this sample was composed of vascular plant stems and leaves. The *Cladophora* in this sample was senescent and covered with epiphytes; *Oedogonium, Protoderma, Stigeoclonium,* and *Phormidium* were present only as epiphytes on *Cladophora*.

NON-DIATOM ALGAE

Green algae and chrysophycean algae, including diatoms, were present in both Antelope Creek and Potter Creek, and blue-green algae were present in Potter Creek but noticeably absent from

Antelope Creek (Table 5). Diatoms and green algae have a competitive advantage over nitrogen-fixing cyanobacteria when a waterbody is enriched with nutrients. This may help to explain the absence of blue-green algae in Antelope Creek.

The siphonaceous chrysophyte *Vaucheria* dominated the sample from Antelope Creek and the filamentous green alga *Enteromorpha* was abundant here (Table 5). Both of these algae are typical of spring-fed streams that have a steady supply of cool water.

Stigeoclonium was common in the sample from Potter Creek (Table 5). This genus is a good indicator of nutrient enrichment (Palmer 1977). *Anabaena* was one of three nitrogen-fixing cyanobacteria in Potter Creek. Under certain conditions, *Anabaena* can produce waterblooms that release neurotoxins into the water. These toxins can be lethal to livestock, pets, and wildlife. However, *Anabaena* was not abundant enough in Potter Creek to pose a problem for livestock producers.

DIATOMS

The major diatom species in Antelope Creek and Potter Creek included ones that are both sensitive to and tolerant of organic pollution (Table 6). Both streams supported relatively large percentages of *Nitzschia palea*, which is a nitrogen heterotroph that is typical of the zone of heavy organic loading (Lowe 1974).

Diatom metrics generated from the Antelope Creek periphyton sample indicated good to excellent biological integrity and full support of aquatic life uses (Table 6). Siltation, disturbance, toxicity, and organic loading were minor problems. Antelope Creek had good biological integrity when compared to biocriteria for both mountain and prairie streams. It shared about half of its diatom flora with Potter Creek (similarity index = 48.50%).

The siltation index for Potter Creek indicated only fair biological integrity, moderate impairment, and partial support of aquatic life uses for a mountain stream (Table 6). The siltation index for Potter Creek indicated full support but borderline impairment when compared to biocriteria for a prairie stream.

An unusually large percentage of teratological cells (1.64%) was observed in the sample from Potter Creek, resulting in a rating of fair biological integrity, moderate impairment, and partial support of aquatic life uses (Table 6). Since the criteria for abnormal cells are the same for mountain streams and prairie streams, the fair rating applies in both cases.

A number of factors are known to cause abnormalities in diatom cells, including heavy metals (McFarland et al. 1997). Salinity and ammonia are other possible causes. Salinity is not the likely cause of teratological cells in Potter Creek because most of the major diatom species that are present (Table 6) indicate fresh to only slightly brackish water. Heavy metals are also an unlikely cause. Deformities caused by heavy metals have been reported only from poorly buffered, circumneutral waters (McFarland et al. 1997).

In summer, with decreased flows, higher temperatures, and decompositon of algae and aquatic macrophytes, a certain amount of internal organic loading may occur in low gradient streams. Some of the abnormalities observed in Potter Creek may have been caused by ammonia generated from this internal organic loading. Thus, the percentage of deformed cells observed in Potter Creek in August may be within the normal range for such low gradient streams.

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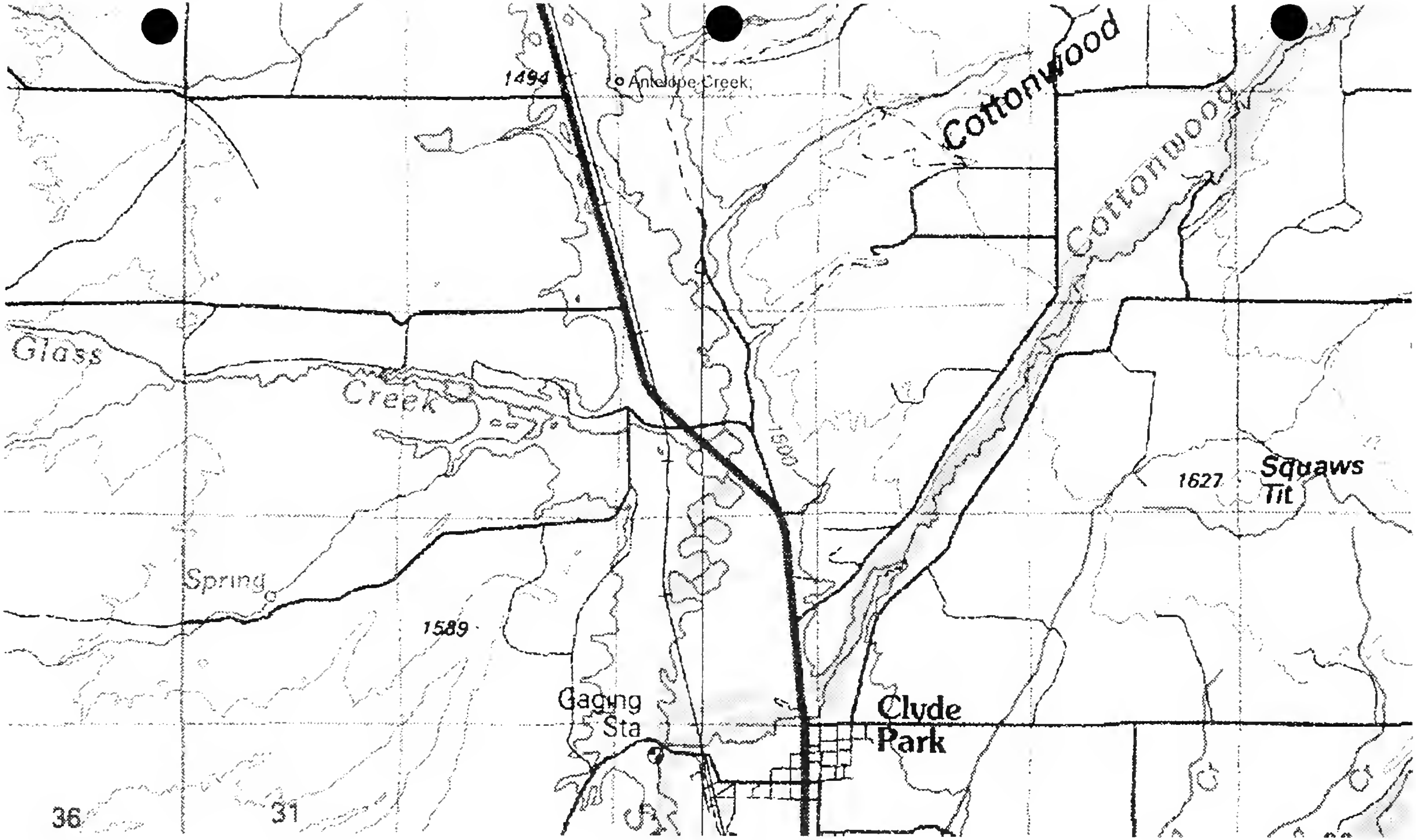
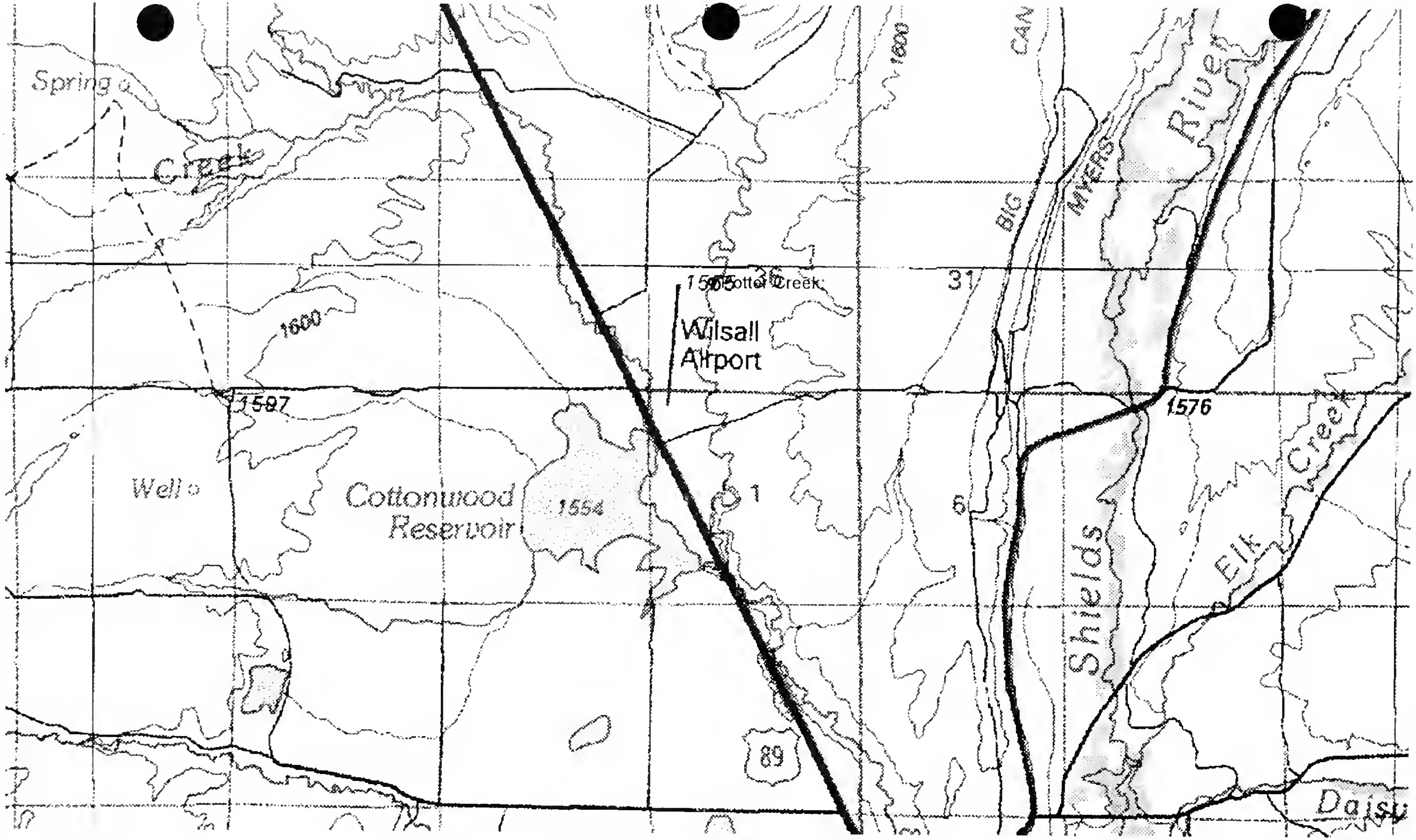


MAP 1

'Livingston 100K; MT'; Scale: 1" = 0.635Mi 1,022Mt 3,354Ft, 1 Mi = 1.574", 1 cm = 403Mt



MAP 2.

'Ringling 100K; MT'; Scale: 1" = 0.635Mi 1,022Mt 3,354Ft, 1 Mi = 1.574" , 1 cm = 403Mt

Table 1. Location of stations on Antelope Creek and Potter Creek that were sampled for periphyton in August 2000: Station codes, sample numbers in the Montana Diatom Database, latitudes and longitudes, and sample dates.

Location	Station Code	Sample Number	Latitude/ Longitude	Sample Date
Antelope Creek near mouth below Hwy. 89 north of Clyde Park	Station 1	1999-01	45 55 52/ 110 37 17	8/11/00
Potter Creek near mouth north of Wilsall	Station 1	1998-01	46 03 15/ 110 40 49	8/10/00

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 Antelope Creek and Potter Creek on August 10 and 11, 2000.

Taxa	Relative Abundance and (Rank)	
	Antelope	Potter
Chlorophyta (green algae)		
Ankistrodesmus	rare (7)	
Cladophora	common (5)	frequent (2)
Closterium		occasional (7)
Enteromorpha	abundant (3)	
Oedogonium	common (6)	common (6)
Protoderma		common (5)
Spirogyra	abundant (2)	
Stigeoclonium		frequent (4)
Chrysophyta (golden algae)		
Bacillariophyceae (diatoms)	abundant (4)	abundant (1)
Vaucheria	dominant (1)	
Cyanophyta (cyanobacteria)[1]		
Anabaena		occasional (8)
Oscillatoria		occasional (9)
Phormidium		abundant (3)

[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 Antelope Creek and Potter Creek on August 10 and 11, 2000.

Species/Metric (Pollution Tolerance Class)[3]	Percent Abundance/Metric Values[2]			
	Mountain Criteria		Plains Criteria[4]	
	Antelope	Potter	Antelope	Potter
Achnanthidium minutissimum (3)	31.23	5.72		
Cocconeis placentula (3)	9.56	6.89		
Cymbella affinis (3)		12.38		
Diatoma vulgaris (3)		5.37		
Gomphonema minutum (3)	6.90	3.97		
Gomphonema parvulum (1)	8.11	1.29		
Navicula capitatoradiata (2)	1.33	5.96		
Nitzschia frustulum (2)	1.09	5.61		
Nitzschia palea (1)	16.83	20.79		
Cells Counted	413	428		
Total Species	54	55		
Species Counted	46	53		
Species Diversity	3.65	4.35	<u>3.65</u>	
Percent Dominant Species	<u>31.23</u>	20.79	<u>31.23</u>	
Disturbance Index	<u>31.23</u>	5.72	<u>31.23</u>	
Pollution Index	<u>2.24</u>	<u>2.28</u>	<u>2.24</u>	
Siltation Index	<u>33.41</u>	**49.77**		
Percent Abnormal Cells	<u>0.61</u>	**1.64**	<u>0.61</u>	**1.64**
Percent Epithemiaceae	0.36	0.00		
Similarity Index	48.50			

[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] <u>Underlined values</u> 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
199901	Achnanthes lanceolata	2	4	0.48
199901	Achnanthidium minutissimum	3	258	31.23
199901	Amphora inariensis	3	2	0.24
199901	Amphora montana	2	0	0.00
199901	Amphora pediculus	3	9	1.09
199901	Aulacoseira granulata	3	1	0.12
199901	Cocconeis placentula	3	79	9.56
199901	Cyclotella atomus	2	2	0.24
199901	Cyclotella meneghiniana	2	7	0.85
199901	Cymatopleura solea	2	0	0.00
199901	Denticula kuetzingii	2	3	0.36
199901	Diatoma tenue	2	2	0.24
199901	Encyonema minutum	2	2	0.24
199901	Encyonema silesiacum	2	13	1.57
199901	Fallacia pygmaea	2	4	0.48
199901	Fragilaria vaucheriae	2	4	0.48
199901	Gomphonema mexicanum	2	8	0.97
199901	Gomphonema minutum	3	57	6.90
199901	Gomphonema olivaceum	3	6	0.73
199901	Gomphonema parvulum	1	67	8.11
199901	Gomphonema truncatum	3	0	0.00
199901	Navicula capitatoradiata	2	11	1.33
199901	Navicula cincta	1	1	0.12
199901	Navicula cryptotenella	2	2	0.24
199901	Navicula gregaria	2	24	2.91
199901	Navicula lanceolata	2	14	1.69
199901	Navicula menisculus	2	1	0.12
199901	Navicula reichardtiana	2	6	0.73
199901	Navicula subminuscula	1	1	0.12
199901	Navicula tripunctata	3	2	0.24
199901	Navicula trivialis	2	0	0.00
199901	Navicula veneta	1	6	0.73
199901	Nitzschia acicularis	2	2	0.24
199901	Nitzschia amphibia	2	2	0.24
199901	Nitzschia capitellata	2	2	0.24
199901	Nitzschia dissipata	3	0	0.00
199901	Nitzschia dubia	2	2	0.24
199901	Nitzschia frustulum	2	9	1.09
199901	Nitzschia linearis	2	1	0.12
199901	Nitzschia microcephala	1	0	0.00
199901	Nitzschia palea	1	139	16.83
199901	Nitzschia paleacea	2	4	0.48
199901	Nitzschia perminuta	3	1	0.12
199901	Nitzschia solita	1	19	2.30
199901	Reimeria sinuata	3	1	0.12
199901	Rhoicosphenia curvata	3	13	1.57
199901	Surirella brebissonii	2	11	1.33
199901	Surirella minuta	2	16	1.94
199901	Synedra rumpens	2	2	0.24
199901	Synedra ulna	2	0	0.00
199901	Tabularia fasciculata	2	2	0.24
199901	Tryblionella apiculata	2	3	0.36
199901	Tryblionella calida	2	1	0.12
199901	Tryblionella hungarica	2	0	0.00

Sample	Genus/Species/Variety	Pollution Tolerance Class	Count	Percent
199801	Achnanthes lanceolata	2	4	0.47
199801	Achnanthidium minutissimum	3	49	5.72
199801	Amphora inariensis	3	1	0.12
199801	Amphora pediculus	3	9	1.05
199801	Amphora veneta	1	0	0.00
199801	Cocconeis placentula	3	59	6.89
199801	Cyclotella meneghiniana	2	5	0.58
199801	Cymbella affinis	3	106	12.38
199801	Diatoma vulgaris	3	46	5.37
199801	Diploneis puella	2	5	0.58
199801	Encyonema auerswaldii	2	7	0.82
199801	Encyonema silesiacum	2	8	0.93
199801	Fragilaria construens	3	4	0.47
199801	Fragilaria vaucheriae	2	4	0.47
199801	Gomphoneis eriense	3	1	0.12
199801	Gomphonema minutum	3	34	3.97
199801	Gomphonema olivaceum	3	10	1.17
199801	Gomphonema parvulum	1	11	1.29
199801	Gomphonema pumilum	3	29	3.39
199801	Melosira varians	2	1	0.12
199801	Navicula capitata	2	0	0.00
199801	Navicula capitatoradiata	2	51	5.96
199801	Navicula cincta	1	1	0.12
199801	Navicula cryptotenella	2	11	1.29
199801	Navicula goersii	2	2	0.23
199801	Navicula gregaria	2	5	0.58
199801	Navicula menisculus	2	9	1.05
199801	Navicula reichardtiana	2	8	0.93
199801	Navicula subminuscula	1	2	0.23
199801	Navicula tripunctata	3	6	0.70
199801	Navicula trivialis	2	1	0.12
199801	Navicula veneta	1	6	0.70
199801	Nitzschia acicularis	2	2	0.23
199801	Nitzschia alpina	3	3	0.35
199801	Nitzschia amphibia	2	1	0.12
199801	Nitzschia dissipata	3	40	4.67
199801	Nitzschia fonticola	3	11	1.29
199801	Nitzschia frustulum	2	48	5.61
199801	Nitzschia gracilis	2	9	1.05
199801	Nitzschia heufleriana	3	1	0.12
199801	Nitzschia inconspicua	2	3	0.35
199801	Nitzschia linearis	2	2	0.23
199801	Nitzschia palea	1	178	20.79
199801	Nitzschia paleacea	2	12	1.40
199801	Nitzschia perminuta	3	4	0.47
199801	Nitzschia solita	1	3	0.35
199801	Reimeria sinuata	3	1	0.12
199801	Rhoicosphenia curvata	3	23	2.69
199801	Sellaphora pupula	2	1	0.12
199801	Surirella brebissonii	2	5	0.58
199801	Surirella minuta	2	2	0.23
199801	Synedra acus	2	1	0.12
199801	Synedra ulna	2	8	0.93
199801	Thalassiosira weissflogii	2	2	0.23
199801	Tryblionella apiculata	2	1	0.12