

**WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER QUALITY DIVISION
MONITORING AND ASSESSMENT REPORT**

WATERBODY:	Big Sandy River - WYGR14040104 -026
SEGMENT DESCRIPTION:	Extends from the confluence with the Green River upstream to the confluence with the Little Sandy River. (~35 miles).
CLASS:	Class 2AB
DESIGNATED USES:	Drinking water supplies, non-game fisheries, cold-water fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture, and scenic values
1996 305(b) REPORT AND 303(d) LIST:	Listed as partially supportive for aquatic life, cold-water fisheries, agriculture, and agricultural-irrigation uses. Impairments suspected to be caused by siltation, salinity/TDS/chlorides and unknown. Sources of pollutants were reported as municipal point source, rangeland, irrigated crop land, pasture land, highway/road/bridge construction, highway maintenance, and natural sources.
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INTRODUCTION

The Big Sandy River originates in the Wind River Mountains in southeastern Sublette County and flows south/southwest for several miles prior to its confluence with the Little Sandy River. Upstream of this confluence, the Big Sandy River is impounded by Big Sandy Reservoir (Map 1). From the confluence with the Little Sandy River, the Big Sandy River flows southwesterly for approximately 35 miles to its confluence with the Green River. Except for the headwater region, the Big Sandy River watershed is located in the Wyoming Basin ecoregion (Omernik and Gallant, 1987). Segment 26 of the Big Sandy River transverses sandstone (Toe) and marlstone¹ (Tgl) deposits of the marine-formed Green River Formation (USGS, 1985). The naturally low gradient of the river coupled with erodible sandy floodplain soils and sedimentary geologic materials have resulted in a system with an appreciable bed load and a highly mobile sand substrate, for which the Big Sandy River is aptly named. Primary land use in the watershed is livestock grazing. Irrigation diversions and returns are common along the Big Sandy River from Big Sandy Reservoir downstream to the confluence with Bone Draw (Map 1). No NPDES permitted discharge facilities are located in the Big Sandy River watershed.

REPORT OBJECTIVE

The State of Wyoming's 1996 305(b) Report and 303(d) List indicated that the Big Sandy River was partially supportive for aquatic life, cold-water fisheries, agriculture and agricultural-irrigation uses. The Wyoming Department of Environmental Quality (WDEQ) collected physical, biological, and chemical data on the Big Sandy River in September

¹ A rock containing imperfectly consolidated clays and sands as well as calcium and magnesium carbonates.

1998. The purpose of this report is to assess the findings of the 1998 WDEQ assessment and provide a determination of whether designated uses assigned to Big Sandy River are supported.

METHODS AND MATERIALS

All collection, analysis, and evaluation of the Big Sandy River was conducted in accordance with approved assessment procedures as outlined in the following documents:

- _____ 1) Manual of Standard Operating Procedures for Sample Collection and Analysis. (WDEQ/WQD, 2001a).
- _____ 2) Quality Assurance Project Plan (QAPP) for Beneficial Use Reconnaissance Project (BURP) Water Quality Monitoring. (WDEQ/WQD, 2001b).
- _____ 3) A bioassessment method for use in Wyoming stream and river water quality monitoring. (King, 1993).
- _____ 4) Beneficial use reconnaissance project-wadeable stream monitoring methodology. (WDEQ/WQD, 1998).
- _____ 5) Wyoming’s method for determining water quality condition of surface waters. (WDEQ/WQD, 2001c).

ASSESSMENT STATIONS

Descriptive information and data collected on assessment stations of the Big Sandy River (Map 1).

Station ID	Chemical Data	Biological Data	Physical Data	Legal (Sec / T / R)	Latitude	Longitude	Elevation (ft)
WB57 ^a	YES	YES	YES	SWNE of Sec. 12, T24N, R107W	42° 04' 21.29"	109° 28' 01.75"	6540
Bone Draw	YES	NO	NO	SE of Sec. 32, T24N, R107W	NM	NM	6490
WB58 ^b	YES	YES	YES	NWSE of Sec. 31, T24N, R107W	42° 00' 40.24"	109° 34' 48.20"	6470
WB59 ^c	YES	YES	YES	SWNE of Sec. 16, T22N, R109W	41° 53' 07.86"	109° 46' 17.98"	6370

NM = Not measured

^asee Photo 1

^bsee Photo 2

^csee Photo 3

Chemical, physical, and biological data were collected at the above stations between 9/8/98 and 9/10/98.

CHEMICAL DATA

(See Table 1 for complete dataset). Water temperature ranged from 19.3°C at Bone Draw to 21.7°C at WB57. The USEPA (1986) suggests a temperature of 32°C as an upper tolerance limit to maintain a balanced benthic macroinvertebrate structure. Ambient water temperature at all stations, with the exception of stations WB57 and WB59, were at or below the WDEQ/WQD (2001) maximum criteria of 20°C for a cold water fishery. Elevated temperatures, such as those recorded at stations WB57 and WB59, appear to be characteristic of the Big Sandy River according to water temperature data collected at USGS station 09216050 near Eden, Wyoming (Table 2). Between 1975 and 1998, mean water temperatures of the Big Sandy River were generally greatest during the summer months with peaks in May through October that exceeded 20°C.

All pH results were below the upper limit of 9.0 (WDEQ/WQD, 2001). Conductivity increased with distance downstream and ranged from 1283 uS/cm at Bone Draw to 2310 uS/cm at WB59. An increase in conductivity is expected due to an increase in drainage area, geological influences of the watershed, and saline seeps (as noted in the 1998 field observations) along the Big Sandy River. Irrigation return flows may also elevate conductivity.

Dissolved oxygen concentrations ranged from 7.42 mg/L at WB59 to 10.59 mg/L at WB58. With the exception of station WB59, ambient dissolved oxygen concentrations at all other stations were above the acceptable one-day minimum dissolved oxygen criterion of 8 mg/L for a class 2AB drainage (WDEQ/WQD, 2001). Water quality data collected at the United States Geological Survey (USGS) station 09216050 near Eden, Wyoming on the Big Sandy River between 1975 and 1998 (Table 2) indicates that mean ambient dissolved oxygen concentrations are generally greater in the fall, spring, and early summer than in the late summer when the WDEQ Big Sandy River assessment was conducted. Mean dissolved oxygen concentrations for August and September were generally greater than 8 mg/L, though it is not uncommon for dissolved oxygen concentrations to dip below 8 mg/L during these months.

Instantaneous turbidity and TSS values increased with distance downstream. Turbidity at stations WB57, WB58, and WB59 were 4.07, 4.73, and 8.58 respectively. TSS concentrations of 8, 9, and 30 mg/L were measured at stations WB57, WB58, and WB59 respectively. Recent precipitation events relative to the time of the 1998 assessment and irrigation return flows from earthen ditches likely contributed to the turbidity and TSS concentrations observed in the Big Sandy River.

Nitrate-nitrogen and total phosphorous concentrations were either at or below detection (<0.1 mg/L) at all stations.

Generally, for streams that do not directly enter lakes or reservoirs, the recommended target phosphorous concentration considered protective of aquatic life uses is <1 mg/L (King, 1993). Chloride concentrations were 25 mg/L or less at all stations. Sulfate concentrations increased with distance downstream and ranged from 493 mg/L at Bone Draw to 1078 mg/L at WB59. Elevated sulfate concentrations in the Big Sandy River are expected due to the geological influences of the watershed and saline seeps, though irrigation return flows may also elevate sulfate concentrations.

PHYSICAL DATA

Stream substrate composition at stations WB57 and WB59 was primarily sand dominated while the substrate at WB58 was more of a coarse/fine gravel mix (Table 3). Overall, however, segment 26 of the Big Sandy River was characterized as a low gradient system with few riffle complexes present and a channel substrate comprised almost exclusively of sand. Weighted embeddedness (silt cover) scores were 90, 94.5, and 96 for stations WB57, WB58, and WB59 respectively (Table 3). The low embeddedness scores suggest that coarse materials present in the channel substrate are relatively free of fine sediment cover.

Habitat condition at all Big Sandy River stations was evaluated with the slow-water (<10% of stream reach characterized by riffle/run habitats) qualitative assessment procedure (WDEQ/WQD, 2001a). The total qualitative habitat assessment scores for stations WB57, WB58, and WB59 were 91.5, 108.5, and 97.5 respectively (Table 4). Scores for all three stations were >50% of their respective total maximum scores (Table 4).

Items that tended to reduce the score at all three stations were attributed to an absence of complex channel habitat and available cover, a high percentage of sand substrate, low channel sinuosity, and a narrow riparian vegetative zone. The erosive sedimentary geology and soils of the watershed coupled with a naturally low gradient likely explain the high percentage of sand substrate throughout the reach and its influence on habitat characteristics. Deposition of sand may be further exacerbated by upstream flow regulation from Big Sandy Reservoir as well as irrigation withdrawals through a reduction in stream power and sediment transport capability. Low channel sinuosity is expected in a low channel and valley gradient system such as the Big Sandy River. The limited riparian vegetative zone width appears to be controlled primarily by topography. The habitat score at WB58 was somewhat greater compared to WB57 and WB59, due to a higher percentage of coarse substrate in the pools and greater pool variability. The higher scores in the pool substrate and variability categories for WB58 may have been artificially elevated due to the presence of man-made fish structures. Some grazing influences were noted along the Big Sandy River, but they did not appear to be excessive. Despite the influences from Big Sandy Reservoir and irrigation diversions and returns in the system, the riparian zones at each station were relatively stable and the absence of newly deposited mid channel and point bars suggests that the Big Sandy River

is in equilibrium with the sediment and flows being supplied by the watershed. Overall, habitat conditions throughout the segment were improving and herbaceous riparian vegetation was well established and provides adequate support and dissipation of energy during high flows.

BIOLOGICAL DATA

Biometrics developed by Jessup and Stribling (2002) were utilized as a tool to assess the biotic/ecological integrity of the Big Sandy River as a means to determine whether designated uses, such as aquatic life, are being attained. All stations were evaluated with the Wyoming Stream Integrity Index (WSII) developed for the Wyoming Basin ecoregion. WSII scores were rated as 'fair' at stations WB58 and WB59 while WB57 exhibited a 'poor' rating (Appendix A). According to Jessup and Stribling (2002), streams having WSII scores that rate at or above the 25th percentile of reference conditions for a particular ecoregion are rated as 'good' or 'very good' and are deemed supportive of aquatic life uses. Based on the WSII scores and ratings for station WB57, WB58, and WB59, it appears that the Big Sandy River is partially or non-supportive of its aquatic life uses. However, it is believed that the WSII scores and ratings may not accurately reflect the limited biotic potential of the Big Sandy River and therefore may not apply in this particular case considering that this system is different from typical Wyoming Basin reference conditions. A review of the physical characteristics that determine the type of macroinvertebrate community in the Big Sandy River may aid in the understanding of why the potential of the Big Sandy River to support a diverse macroinvertebrate community is limited.

Soils and source materials of the Big Sandy River watershed are highly erosive due to the aridity of the region owing to its high elevation and low annual precipitation. When precipitation events occur, mainly in the form of brief intense storms, substantial overland flows can carry appreciable quantities of sediment from the erosive features of the watershed and deposit it in the streams such as the Big Sandy River. The sand-dominated substrate of the Big Sandy River is largely the result of these flow events that have eroded the sandstone/marlstone strata and sandy alluvial soils of the Big Sandy River watershed.

Because the majority of aquatic macroinvertebrates exhibit a benthic mode of existence, the type of substrate is a major determinant of the distribution and abundance of aquatic biota since it provides habitat space, food, and protection (Ward, 1992). Increases in mean substrate particle size are ultimately associated with increases in physical habitat complexity and bed stability which are important factors in determining the distribution and abundance of benthic macroinvertebrates (Ward, 1992). Sand-dominated channels generally exhibit extremely depauperate benthic macroinvertebrate communities with low diversity and abundance. This is due to sand's high scour potential, instability, and low organic content.

In addition to the type of substrate in a channel, physicochemical conditions of the aquatic environment can also influence the resident macroinvertebrate community. For example, during the summer, physicochemical constituents in the Big Sandy River may elevate considerably because of high rates of evaporation, increased temperatures, and saline seeps along the river. In addition, the marine sedimentary deposits of the watershed can contribute to elevated total dissolved solids, salinity, hardness, and sulfates of the Big Sandy River. Elevated constituent concentrations may also be exacerbated by irrigation withdrawals/returns and releases from Big Sandy Reservoir. The combination of these variables can result in physicochemical conditions that near or exceed the tolerance thresholds of many aquatic biota, thereby preventing the establishment of sensitive taxa in the resident community.

Based on the combined effect of a sand-dominated substrate and the inherent physicochemical conditions, a macroinvertebrate community with diminished species richness and taxonomic diversity is expected in the Big Sandy River. Data collected in 1998 confirm that the macroinvertebrate community of the Big Sandy River is primarily composed of taxa that lack specialized ecological requirements and are considered generalists with broad distribution ranges and tolerances to a wide variety of both physicochemical and substrate conditions (Appendix B). Of the EPT (Ephemeroptera, Plecoptera, and Trichoptera) taxa collected on the Big Sandy River, mayflies were dominated by two taxa (*Acentrella insignificans* and *Tricorythodes minutus*) while two Hydropsychids (*Cheumatopsyche* and *Hydropsyche*) comprised the majority of the caddisfly community, all of which are known to be wide-spread generalists that are tolerant of a wide range of physicochemical and substrate conditions (Merritt and Cummins, 1996; Ward, 1992). The percent composition of stoneflies in the Big Sandy River was less than 1.5%, presumably due to this order's relative intolerance to harsh environmental conditions and inability to utilize sand substrate. Several of the Chironomid (midge) and non-insect taxa collected in the Big Sandy River were also considered to be highly-tolerant generalists.

The macroinvertebrate communities among stations WB57, WB58, and WB59 were overall similar, however, station WB57 exhibited a greater percentage of non-insects and a greater dominance of *Hydropsychid* taxa in the caddisfly community compared to stations WB58 and WB59. The effect of this difference appears to have been enough of an alteration in the community to lower the biotic condition of station WB57 to a 'poor' rating compared to the 'fair' ratings given to stations WB58 and WB59. In light of the similar habitat conditions among stations WB57, WB58, and WB59 and the small difference between WB57's 'poor' WSII score of 38.7 and the WSII score of 40.6 that would result in a 'fair' rating suggests that natural variation in the macroinvertebrate community may ultimately be responsible for the differences in WSII ratings between station WB57 and stations WB58 and WB59.

HISTORICAL/ANCILLARY DATA

According to the Wyoming Game and Fish Department Stream and Lakes Inventory Database, the following species were collected at three locations along the Big Sandy River between 1994 and 1997:

Big Sandy River (SE of Sec. 29, T24N, R107W): Fathead Minnow (*Pimephales promelas*), Flannelmouth Sucker (*Catostomus latipinnis*), Redside Shiner (*Richardsonius balteatus*), Utah Chub (*Gila atraria*), White Sucker (*Catostomus commersoni*), Speckled Dace (*Rhinichthys osculus*), and Brown Trout (*Salmo trutta*).

Big Sandy River (NW of Sec. 29, T23N, R108W): Flannelmouth Sucker, Redside Shiner, Speckled Dace, Fathead Minnow, Utah Chub, White Sucker, Brown Trout, Roundtail Chub (*Gila robusta*), Rainbow Trout (*Onchorynchus mykiss*), Snake River Cutthroat Trout (*Onchorynchus clarki ssp.*), and Bear River Cutthroat Trout (*Onchorynchus clarki ssp.*).

Big Sandy River (SW of Sec. 22, T22N, R109W): Mottled Sculpin (*Cottus bairdi*), White Sucker, Utah Chub, Brown Trout, Rainbow Trout, Bluehead Sucker (*Catostomus discobolus*), Speckled Dace, Flannelmouth Sucker, Fathead Minnow, and Roundtail Chub.

QUALITY ASSURANCE/QUALITY CONTROL

Environmental data from the Big Sandy River was collected in accordance to the methods, procedures, and techniques listed in the Methods section of this report. Station QA/QC reports for each sample station are attached to this report. All physical, biological, and chemical data for 1998 were determined to be complete and accurate.

SUMMARY

Classification - Based on all available information, the Big Sandy River is correctly classified as a class 2AB water. The Wyoming Game and Fish Department Stream and Lakes Inventory database indicated cold-water fishes were present at three locations within segment 026 of the Big Sandy River. Instantaneous water temperatures at all stations on the Big Sandy River were either at or above the maximum 20°C numeric criteria protective of cold-water fisheries in class 2AB waters (WDEQ/WQD, 2001). Dissolved oxygen concentrations at station WB59 were below the minimum numeric criteria of 8 mg/L considered protective for all early life stages of aquatic life in class 2AB waters (WDEQ/WQD, 2001).

The 8 mg/L dissolved oxygen criteria is considered protective of all embryonic and larval stages of cold water fishes such as salmonids. Survey data from the Wyoming Game and Fish Department Stream and Lakes Inventory database indicated rainbow trout, brown trout, and subspecies of cutthroat trout occur in the Big Sandy River, which suggests that conditions in the Big Sandy River are overall conducive to survival and/or recruitment of these salmonids. Brook trout are fall spawners, while rainbow and cutthroat trout generally spawn in the spring and early summer (Baxter and Stone 1995). Data gathered from the USGS station 09216050 near Eden, Wyoming, indicates that in most cases, ambient dissolved oxygen concentrations during the spawning periods for brook, rainbow, and cutthroat trout generally exceed 8 mg/L (Table 2). However, it is also not uncommon for dissolved oxygen concentrations to fall below 8 mg/L during the spawning period (Table 2). Considering the above information, dissolved oxygen concentrations periodically less than 8 mg/L in the late summer, such as at station WB59, do not appear to raise a concern on the ability of the Big Sandy River to support cold-water fisheries uses.

The instantaneous water temperatures in September 1998 for all stations along the Big Sandy River were at or slightly above the maximum 20°C temperature criteria for class 2AB waters considered protective of all life stages of cold water fishes (WDEQ/WQD, 2001). It is important to understand the life history and behaviors of resident cold-water fishes in the Big Sandy River to evaluate the effects of a temperature criteria exceedence on cold-water fisheries uses during September. As noted previously, the three species of trout collected in the Big Sandy River are either spring or fall spawners. In most cases, ambient water temperatures are generally less than 20°C during these time periods, though it is not uncommon for water temperatures to exceed the 20°C criteria on occasion (Table 2). In the presence of temperatures beyond 20°C, many cold-water fishes, such as trout, will migrate long distances to actively seek deeper portions of a lotic system with cooler temperatures. Considering the adaptive behavior of trout to the onset of higher water temperatures and the timing of their reproductive cycles, short duration diurnal exceedences of the 20°C temperature criteria in the peak summer months such as September are not likely to be detrimental to the overall survival and recruitment of cold-water fishes in the Big Sandy River.

Water Quality - Chloride and pH values did not exceed existing numeric criteria protective of class 2AB waters on the dates of sampling. Conductivity and sulfate concentrations increased with distance downstream but this is expected due to the geological influences of the watershed. Irrigation return flows may also elevate conductivity and sulfate in the Big Sandy River. It is suspected that recent precipitation events relative to the time of the 1998 assessment and irrigation return flows from earthen ditches likely contributed to the turbidity and TSS concentrations observed in the Big Sandy River. All other measured water quality parameters did not exceed existing standards protective of class 2AB waters on the dates of sampling.

Habitat Quality - Based on available information, the sand dominated substrate and limited complex habitat morphology can be attributed to the erosive sedimentary formations and sandy floodplain soils in the watershed coupled with low gradient and associated reduced stream power. Deposition of fine sediment in the channel may be exacerbated due to a reduction in the sediment transport capability of the stream as a result of upstream irrigation withdrawals and the impoundment of the Big Sandy River behind Big Sandy Reservoir. Although human influences such as irrigation withdrawals/returns and regulation of flow from Big Sandy Reservoir have altered the flow regime of the Big Sandy River, all available evidence indicates that the Big Sandy River has adjusted to the changes in sediment and flow associated with these influences. This statement is supported by field observations in 1998 that indicated the structural integrity of the banks remains intact, banks are vegetated with a well established riparian zone, and newly formed mid-channel or point bars were absent.

Biotic Quality - Probably no one factor regulates the aquatic macroinvertebrate community of the Big Sandy River more than the presence of a sand-dominated substrate. With each precipitation event, the bed morphology of the Big Sandy River has the potential to change due to the addition of sediment carried via runoff and the mobility of the sand-dominated substrate. The mobility of the sand substrate has the potential to scour the bed as well as resident biota. In addition to changes in bed morphology, direct insolation, saline seeps, and photosynthesis can combine to produce extreme diurnal, seasonal, and annual physicochemical fluctuations. All of these factors combined with a naturally low organic content of a sand-dominated system produce conditions approaching or exceeding the limits of tolerance to many aquatic biota. The result is a depauperate aquatic macroinvertebrate community comprised of taxa tolerant to a wide range of environmental conditions that can withstand stressors that would otherwise eliminate more sensitive taxa from the ecosystem. Considering the overall stability of the habitat, no indication of excessive anthropogenic-related water quality impacts, and the limited potential of this system to support an assortment of complex habitat types along with a diverse macroinvertebrate community, it appears that designated aquatic life uses are supported in the Big Sandy River.

Agricultural Uses - Excessive bank erosion, formation of mid-channel bars and absence of vegetation on point bars can suggest appreciable inputs of fine sediments into a stream system which can impair irrigation activities if present in large quantities. However, at all stations, mid-channel bars were not observed, point bars were re-vegetating, and overall habitat conditions were considered good for this type of sand-dominated system. In addition, the quality of water appears protective of agricultural uses such as livestock watering, etc. Overall, the available evidence suggests that all agricultural uses are supported in the Big Sandy River.

At this time, the weight-of-evidence from the WDEQ 1998 assessment of segment WYGR14040104 -026 suggests the Big Sandy River is supportive of uses assigned to class 2AB waters.

SIGNATURES:

----- Author	----- Date
----- Peer Reviewer	----- Date
----- Monitoring Supervisor	----- Date

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Table 1 - Physicochemical results for Big Sandy River and Bone Draw stations, September 1998, Sweetwater County.

Parameter	WB57	Bone Draw	WB58	WB59
Date	9/8	9/8	9/8	9/8
Time	1600	1500	1345	1215
Temperature C	21.7	19.3	20	20.1
pH	8.78	8.39	8.65	8.3
Conductivity (uS/cm)	1405	1283	1594	2310
Dissolved Oxygen (mg/L)	10.17	8.6	10.59	7.42
Turbidity (NTU)	4.07	7.34	4.73	8.58
TSS (mg/L)	8	9	7	30
Alkalinity (mg/L as CaCO ₃)	170	160	170	200
Sulfate (mg/L)	521	493	661	1078
Chloride (mg/L)	24	7	20	25
Nitrate (mg/L as N)	0.1	0.1	<0.1	<0.1
Total Phosphorus (mg/L)	<0.1	<0.1	<0.1	<0.1
Total Hardness (mg/L as CaCO ₃)	422	462	482	699
Sheen	None	NM	None	None
Color	Lt. Green	NM	Lt. Green	Lt. Green
Odor	Salty-Musky	NM	H ₂ S	None
Dis charge (cfs)	55.06	NM	108.66	108.15
NM = Not measured				

Table 2 - Summary of water temperature and dissolved oxygen data collected from 1975 to 1998 at USGS station 09216050 near Eden, Wyoming.

Water temperature. Values reported in centigrade.												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mean	0.04	0.05	2.4	9.4	13.2	17.9	20.5	17.5	15.2	7.8	2.2	0.1
Maximum	0.5	0.5	9	15	22	27.5	27.5	23.5	23	23.5	8	2
Minimum	0	0	0	3.5	4.5	10	14	12	9	0	0	0
Dissolved oxygen. Values reported in mg/L.												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mean	10.3	-	10.7	9.5	9.2	8.4	7.7	8.2	8.3	11	11.3	10.6
Maximum	11.3	-	11.9	9.9	10	10.8	8.2	9.1	9.3	14.4	12	11.5
Minimum	9.3	-	9.7	8.8	8.4	7	7	7.4	7.4	9.1	10.8	9.2

Table 3 - Mean percent stream substrate composition, weighted embeddedness and water velocity at Big Sandy River stations, September 1998, Sweetwater County.

Substrate Type	WB57	WB58	WB59
Cobble	21.9	13.1	
Coarse Gravel	9.4	46.9	10.6
Fine Gravel	1.9	22.5	14.4
Sand	66.9	17.5	75.0
Silt			
Clay-Hard Pack (solid, slick)			
Organic (fine, black, odor)			
Precipitate			
Weighted Embeddedness	90.0	94.5	96.0
Mean Water Velocity (ft/sec)	1.72	2.34	1.7

Table 4 - Qualitative habitat assessment, pool quality, and biological indicator scores for Big Sandy River stations, September 1998, Sweetwater County.

Habitat Parameters (Max. Score)	WB57	WB58	WB59
Bottom Substrate-Available Cover (20)	5	3	2
Pool Substrate Characterization (20)	7	14	9
Pool Variability (20)	6	12	11
Sediment Deposition (20)	5	7	3
Channel Flow Status (20)	17	16	16
Channel Sinuosity (20)	7	8	10
Channelization/Alteration (20)	16	19	18
Bank Vegetation Protection (10)	9	8	9
Bank Stability (10)	8.5	7	8.5
Disruptive Pressures (Riparian Zone) (10)	8	8.5	8
Riparian Vegetative Zone Width (10)	3	6	3
HABITAT ASSESSMENT TOTAL <10% Riffle/Run (180 possible)	91.5	108.5	97.5
HABITAT ASSESSMENT (Percent of Maximum Score)	50.83	60.28	54.17
Average Pool Quality Score (10)	4	4.25	3.25
Estimated Percentage of Pools in Reach at least 1.5' deep	75	100	100
Biological Indicators*			
Periphyton	1	1	1
Filamentous Algae	2	4	1
Rooted Macrophytes	2	3	1
Floating Macrophytes	2	3	1
Fish	2	2	2
Slimes	0	0	0
* 4-Dominant, 3-Abundant, 2-Common, 1-Rare, 0-Absent			

Appendix A - WSII metric values, scores, and site ratings for Big Sandy River assessment stations, September 1998, Sweetwater County.

Big Sandy River - Upper (WB57) - September 9, 1998		ENTER		5th or 95th %ile
Metric	Scoring formula	METRICS	Score	(as per formula)
Total taxa	100*metric / 95th%ile	36	80.0	45
Ephemeroptera taxa	100*metric / 95th%ile	5	55.6	9
Plecoptera taxa	100*metric / 95th%ile	1	20.0	5
Trichoptera taxa	100*metric / 95th%ile	4	40.0	10
% Plecoptera	100*metric / 95th%ile	1.09	8.4	13
% Trichoptera (no Hydropsychidae)	100*metric / 95th%ile	0.73	2.3	31.3
% non-insects	100*(55 - metric)/(55 - 5th%ile)	14.03	75.2	0.5
% scrapers	100*metric / 95th%ile	13.87	43.6	31.8
BCI CTQa	100*(110 - metric)/(110 - 5th%ile)	94.33	33.1	62.6
Semi-voltine taxa	100*metric / 95th%ile	2	28.6	7
		index score	38.7	
		Sample Rating	good	Western High Plains
			fair	Northwestern Great Plains
			poor	Wyoming Basin
Big Sandy River - Middle (WB58) - September 9, 1998		ENTER		5th or 95th %ile
Metric	Scoring formula	METRICS	Score	(as per formula)
Total taxa	100*metric / 95th%ile	34	75.6	45
Ephemeroptera taxa	100*metric / 95th%ile	6	66.7	9
Plecoptera taxa	100*metric / 95th%ile	1	20.0	5
Trichoptera taxa	100*metric / 95th%ile	6	60.0	10
% Plecoptera	100*metric / 95th%ile	1.47	11.3	13
% Trichoptera (no Hydropsychidae)	100*metric / 95th%ile	1.79	5.7	31.3
% non-insects	100*(55 - metric)/(55 - 5th%ile)	6.86	88.3	0.5
% scrapers	100*metric / 95th%ile	18.89	59.4	31.8
BCI CTQa	100*(110 - metric)/(110 - 5th%ile)	89.71	42.8	62.6
Semi-voltine taxa	100*metric / 95th%ile	3	42.9	7
		index score	47.3	
		Sample Rating	good	Western High Plains
			fair	Northwestern Great Plains
			fair	Wyoming Basin
Big Sandy River - Lower (WB59) - September 9, 1998		ENTER		5th or 95th %ile
Metric	Scoring formula	METRICS	Score	(as per formula)
Total taxa	100*metric / 95th%ile	37	82.2	45
Ephemeroptera taxa	100*metric / 95th%ile	4	44.4	9
Plecoptera taxa	100*metric / 95th%ile	0	0.0	5
Trichoptera taxa	100*metric / 95th%ile	7	70.0	10
% Plecoptera	100*metric / 95th%ile	0	0.0	13
% Trichoptera (no Hydropsychidae)	100*metric / 95th%ile	3.44	11.0	31.3
% non-insects	100*(55 - metric)/(55 - 5th%ile)	3.62	94.3	0.5
% scrapers	100*metric / 95th%ile	14.31	45.0	31.8
BCI CTQa	100*(110 - metric)/(110 - 5th%ile)	93.49	34.8	62.6
Semi-voltine taxa	100*metric / 95th%ile	3	42.9	7
		index score	42.5	
		Sample Rating	good	Western High Plains
			fair	Northwestern Great Plains
			fair	Wyoming Basin

Appendix B - Summary of September 1998 macroinvertebrate collection results and selected biometrics for Big Sandy River stations, Sweetwater County.

	Taxon	WB57		WB58		WB59	
		Abundance	% Composition	Abundance	% Composition	Abundance	% Composition
Nematoda	<i>Nematoda</i>	32	0.36				
Oligochaetae	<i>Enchytraeidae</i>			40	0.33		
	<i>Mesenchytraeus minutus</i>			20	0.16		
	<i>Pristina jenkinsae</i>	32	0.36				
	<i>Uncinatis uncinata</i>	145	1.64				
	<i>Imm. Tubificid w/ cap setae</i>					2	0.19
	<i>Imm. Tubificid w/o cap setae</i>					2	0.19
	<i>Limnodrilus hoffmeisteri</i>	65	0.73	40	0.33		
	<i>Rhyacodrilus coccineus</i>	710	8.03	626	5.05		
	<i>Lumbricidae</i>					2	0.19
Mollusca	<i>Sphaeriidae</i>			40	0.33		
	<i>Physella</i>	81	0.91	40	0.33		
Amphipoda	<i>Hyalella azteca</i>	32	0.36				
Cnidaria	<i>Hydra</i>	16	0.18				
Hydrachnida	<i>Acari</i>	129	1.48	40	0.33	34	3.05
	TOTAL - NON-INSECTS	1243	14.05	848	6.84	41	3.63
Insecta	<i>Ophiogomphus</i>			61	0.49	73	6.49
	TOTAL - ODONATA			61	0.49	73	6.49
	<i>Acentrella insignificans</i>	1017	11.5	2684	21.66	131	11.64
	<i>Baetidae</i>	65	0.73	61	0.49	4	0.38
	<i>Choroterpes</i>	3	0.36	20	0.16		
	<i>Centroptilum</i>			40	0.33		
	<i>Baetis tricaudatus</i>	32	0.36	61	0.49		
	<i>Tricorythodes sp. A</i>					2	0.19
	<i>Tricorythodes minutus</i>	2712	30.66	2543	20.52	191	16.98
	TOTAL - EPHEMEROPTERA	3857	43.61	5408	43.65	329	29.2
	<i>Isoperla</i>	97	1.09	182	1.47		
	TOTAL - PLECOPTERA	97	1.09	182	1.47		
	<i>Brachycentrus occidentalis</i>			61	0.49	2	0.19
	<i>Hydropsyche</i>	65	0.73	848	6.84	24	2.1
	<i>Cheumatopsyche</i>	404	4.56	464	3.75	4	0.38
	<i>Proctoptila</i>	16	0.18				
	<i>Nectopsyche</i>					4	0.38
	<i>Ochrotrichia</i>			20	0.16		
	<i>Oecetis</i>			40	0.33	15	1.34
	<i>Culoptila</i>					2	0.19
	<i>Hydroptila</i>	48	0.55	101	0.81	15	1.34
	TOTAL - TRICHOPTERA	533	6.02	1534	12.38	67	5.92
	<i>Petrophila</i>					6	0.57
	TOTAL - LEPIDOPTERA					6	0.57
	<i>Zaitzevia</i>	97	1.09				
	<i>Optioservus</i>	1211	13.69	2341	18.89	153	13.55
	TOTAL - COLEOPTERA	1307	14.78	2341	18.89	153	13.55
	<i>Stratiomyidae</i>					2	0.19
	<i>Limnophora</i>	16	0.18				
	<i>Hemerodromia</i>					2	0.19
	<i>Tipula</i>	97	1.09	61	0.49	6	0.57
	<i>Hexatoma</i>	97	1.09	20	0.16	2	0.19
<i>Simulium</i>	242	2.74	464	3.75	17	1.53	
TOTAL - DIPTERA	452	5.11	545	4.4	30	2.67	

Appendix B (cont.) - Summary of September 1998 macroinvertebrate collection results and selected biometrics for Big Sandy River stations. Sweetwater County.

	Taxon	WB57		WB58		WB59	
		Abundance	% Composition	Abundance	% Composition	Abundance	% Composition
Insects	<i>Chironomidae-pupae</i>	242	2.74	444	3.58	75	6.68
	<i>Cricotopus Trifascia Gr.</i>	371	4.2	464	3.75	37	3.24
	<i>Cricotopus Bicinctus Gr.</i>					4	0.38
	<i>Cladotanytarsus</i>	65	0.73			58	5.15
	<i>Cricotopus</i>	32	0.36			45	4.01
	<i>Eukiefferiella</i>	113	1.28			4	0.38
	<i>Micropectra</i>			40	0.33	11	0.95
	<i>Orthocladus complex</i>	81	0.91	61	0.49	26	2.29
	<i>Nanocladius</i>	16	0.18				
	<i>Parameiocnemus</i>	194	2.19	61	0.49	62	5.53
	<i>Parakiefferiella</i>					11	0.95
	<i>Polypedium</i>			61	0.49	56	4.96
	<i>Rheotanytarsus</i>	81	0.91				
	<i>Thienemanniella</i>			61	0.49		
	<i>Robackia</i>					17	1.53
	<i>Tvetenia discoloripes grp.</i>	16	0.18	81	0.65	11	0.95
	<i>Thienemanniella Gr.</i>	145	1.64	202	1.63	11	0.95
	TOTAL - CHIRONOMIDAE	1356	15.33	1473	11.89	428	37.98
Selected Biometrics	EPT/Chironomidae		3.31		4.84		0.92
	BCI Qa		94.33		89.71		93.49
	Shannon H (loge)		2.57		2.42		2.85
	Shannon H (log2)		3.71		3.49		4.11
	Evenness		0.72		0.69		0.79
	Simpson D		0.14		0.14		0.08
	HBI		5.04		5.01		5.2
	% 5 Dominant		68.44		72.96		55.34
	% 10 Dominant		81.95		89.42		78.23
	% Multivoltine		24.59		29.84		42.17
	% Univoltine		60.63		50.12		37.6
	% Semivoltine		14.78		20.03		20.23
	Collector-gatherer (%)		65.48		56.38		54.93
	Collector-filterer (%)		8.94		14.34		4.01
	Scraper (%)		13.87		18.89		14.31
Shredder (%)		0		0		0	
Percer-herbivore (%)		0.55		0.97		1.34	
Macrophyte-herbivore (%)		0		0		0	
WSII Metric Score		38.7		47.3		42.5	
WSII Metric Rating		poor		fair		fair	

Photo 1 - Big Sandy River at station WB57. September 1998. Sweetwater County.



Photo 2 - Big Sandy River at station WB58. September 1998. Sweetwater County.



Photo 2 (cont.) - Big Sandy River at station WB58. September 1998. Sweetwater County.



Photo 3 - Big Sandy River at station WB59. September 1998. Sweetwater County.



Photo 3 (cont.) - Big Sandy River at station WB59. September 1998. Sweetwater County.



Map 1 - Big Sandy River and associated monitoring stations. September 1998. Sweetwater County.

