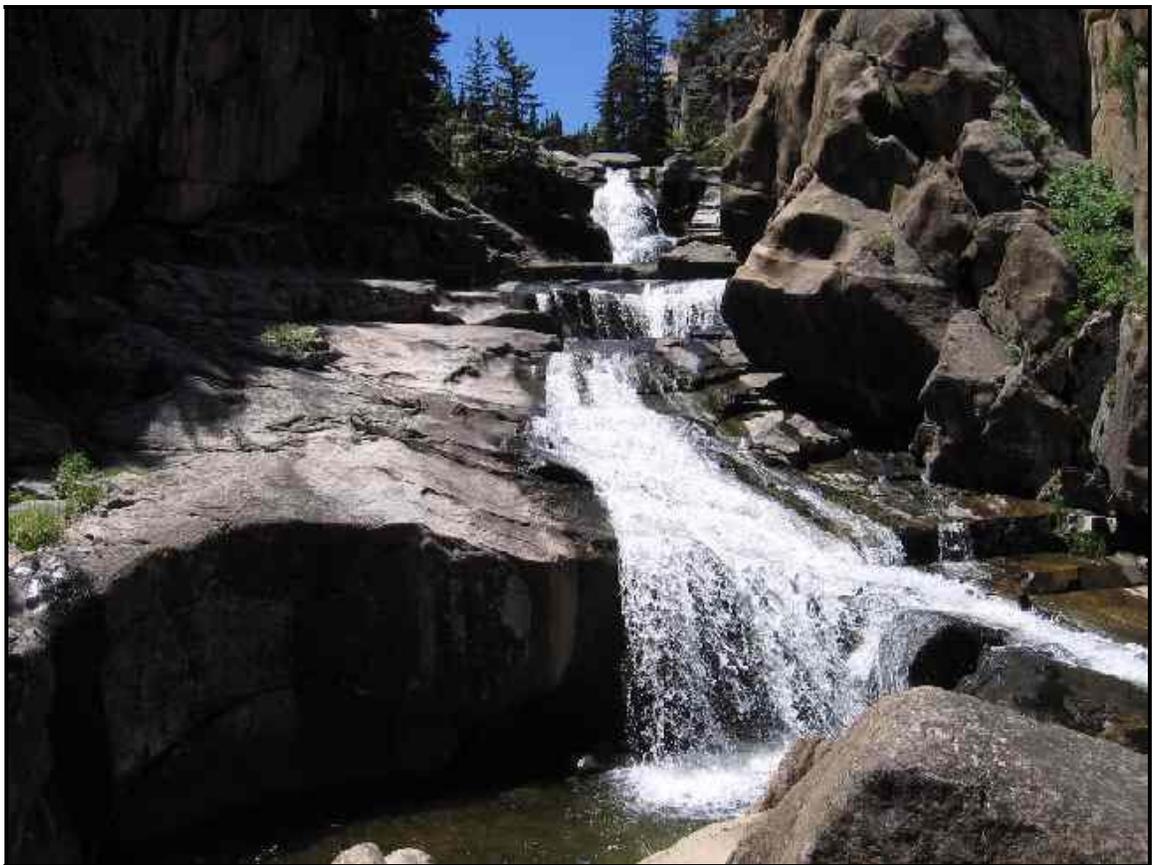


# 2006 ACCOMPLISHMENT REPORT

Bighorn National Forest – Supervisor's Office  
2013 Eastside 2<sup>nd</sup> St.  
Sheridan, WY 82801



**Figure 1.** East Fork Big Goose Creek.

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## INTRODUCTION

The Bighorn National Forest has combined air, minerals and geology, soils, hydrology and fisheries into an integrated unit referred to as the Aquatics Program. The combination of these resource areas has created an integrated blend of specialists and allows for more efficient work. The Aquatics Program consists of three permanent employees.

Program Leader, Dan Scaife, is responsible for overall program direction and administration as well as serving as the forest hydrologist. This position is also the point of contact for issues regarding air, geology and soils. The program leader provides oversight on budget and personnel issues as well.

Lead Fisheries Biologist, Will Young, serves as the primary contact for fisheries issues and provides administrative support to the program leader. This position also serves as a point of hydrological information and expertise for the Forest.

Amy Nowakowski occupies the Trainee Fish Biologist position, as a Student Career Experience Program (SCEP) employee. This position is responsible for overseeing implementation of fisheries and hydrologic projects on the ground and provides some of the day-to-day supervision of seasonal employees. Amy is in the process completing her Master of Science work at Colorado State University and will be converted to Permanent Full Time in June of 2007

In 2006, the seasonal workforce consisted of one GS-04 Fisheries Technician, one GS-04 Hydrologic Technician, and one GS-05 Botany Technician.

This report is intended to give the reader a brief view of the work accomplished by the Aquatics Program during calendar year 2006. Descriptions are intentionally brief and further detail can be obtained by contacting the program leader.

## AIR QUALITY

The Bighorn National Forest continued its long term air quality monitoring program, which began in 1993. The monitoring program is part of a national effort in the western U.S., to determine changes in high elevation lake chemistry from particle deposition from upwind sources of pollution. Two lakes are monitored on the Forest, Emerald Lake and Florence Lake and are sample three times per year, by Wilderness Rangers. Results and interpretations of a preliminary analysis are provided below.

The following paragraph is paraphrased from personal communications with J. Gurrieri, January 2007.

[With regards to the two lakes on the Bighorn NF], there are some significant trends going on. These trends are more significant than the trends in R4. In most lakes in the west  $\text{SO}_4$  is dropping, but in the Big Horn Mountains  $\text{SO}_4$  is increasing significantly.  $\text{NO}_3$  is increasing in the west but Florence Lake has an upward trend that has not been observed before. The lakes appear to be eutrophying, and some effort should be put forth towards looking at changes in the diatom communities of high elevation lakes in the Big Horn Mountains. Similar to other western lakes, cations and anions are increasing causing ANC and pH to increase. This is attributed to drought and more dust in the atmosphere. There is some seasonality in the data, where  $\text{NO}_3$  and  $\text{H}^+$  spike at snowmelt. Lakes that export  $\text{NO}_3$  in the fall, means there is excess  $\text{NO}_3$  in the lake. There doesn't appear to be any serial correlation, meaning 3 samples per year are not excessive.

Many thanks go to the Wilderness Rangers for their previous sample collection efforts and Joe Gurrieri, Regional Geologist, Region 4, for an analysis of the data collected to date.

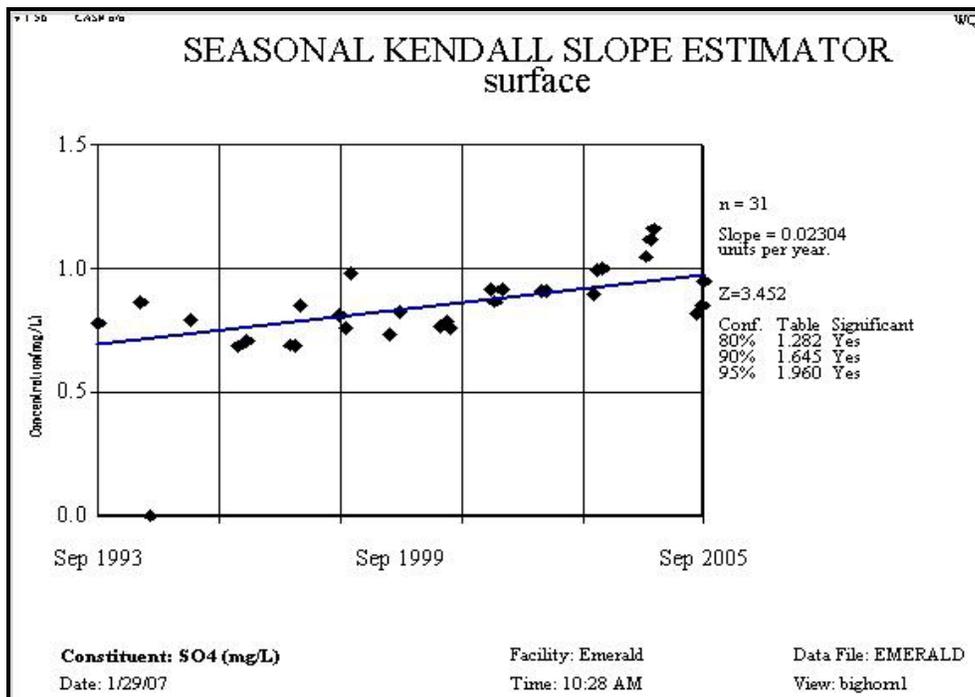


Figure 2. SO<sub>4</sub> trend, Emerald Lake.

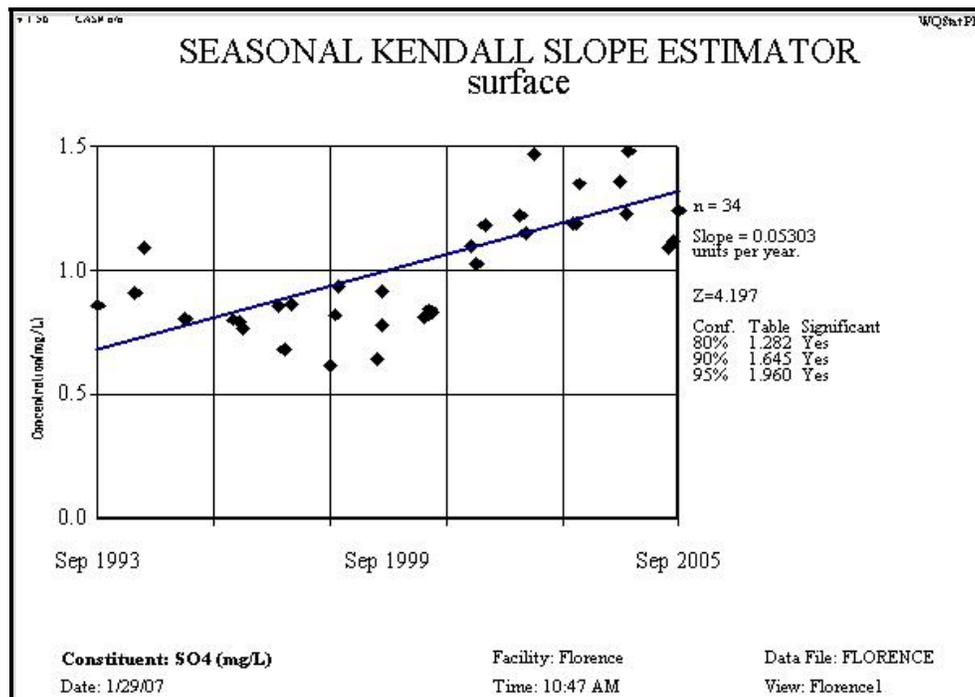


Figure 3. SO<sub>4</sub> trend, Florence Lake.

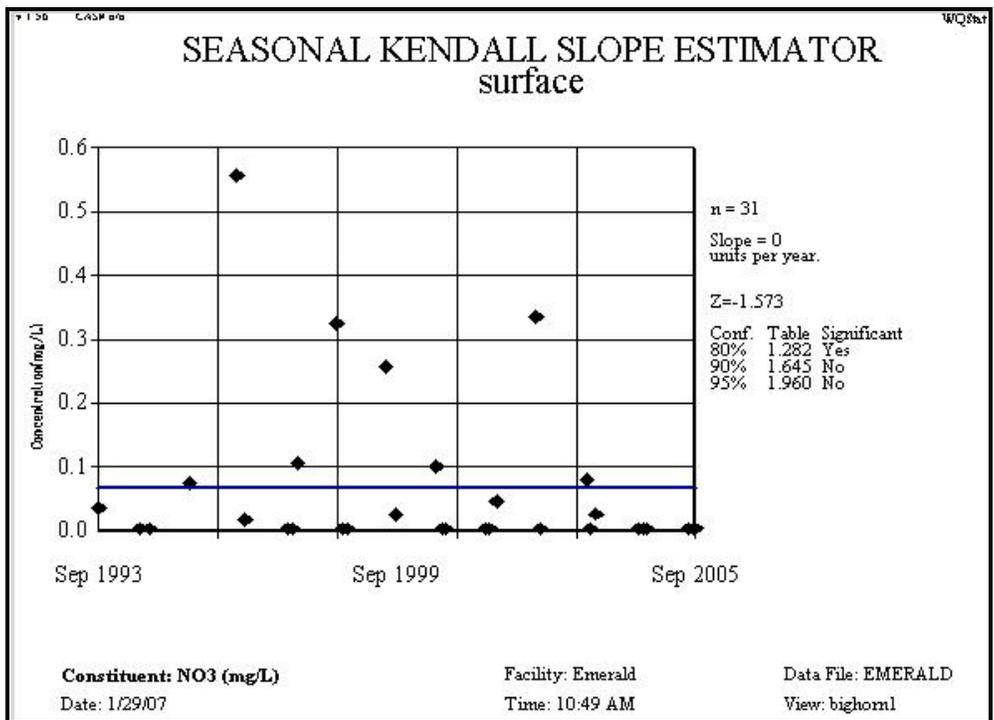


Figure 4. NO<sub>3</sub> trend, Emerald Lake.

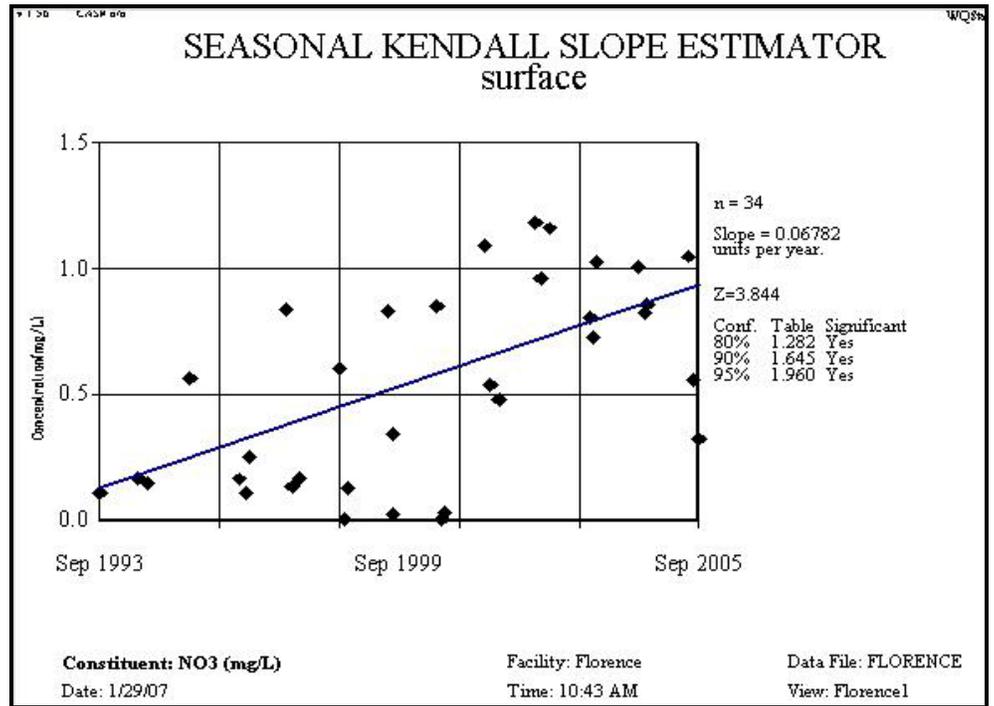


Figure 5. NO<sub>3</sub> trend, Florence Lake.

# FISHERIES

## Dry Medicine Lodge Rehabilitation

Dry Medicine Lodge Creek is one of 18 known fluvial populations of Yellowstone cutthroat trout (*Oncorhynchus clarki bouveri*) on the Forest. Part of the population is isolated above a barrier in the upper half of the stream, without any other fish species present. The Yellowstone cutthroat (YSC) is assumed to be native, due to lack of stocking records for that species. The lower half of the occupied stream contains Yellowstone cutthroat sympatric with brook trout (*Salvelinus malma*). There are a series of impassible cascades above Forest Road #17, which prevents brook trout from invading the upper reaches of suitable habitat.



**Figure 6.** Dry Medicine Lodge Creek sink.

The Wyoming Department of Game and Fish (WG&F) identified Dry Medicine Lodge Creek as a likely candidate for chemical removal of brook trout in 2005. The project was identified as requiring two years to successfully remove brook trout. WG&F fisheries biologists obtained funding in the winter of 2006, to proceed with treatment and worked closely with Bighorn NF personnel during the spring to develop and schedule the treatment. Coordination and openness between the two agencies allowed the project to proceed without setback or delay.

In August, 12 people (9 WG&F and 3 BNF), representing both agencies began implementation. Implementation included electrofishing all waters below the barrier cascades, and applying fish toxicant to the same stretch of water. Prior to electrofishing, all springs and tributaries were located and GPS'd, in addition to obtaining flow rates using dye. The flow rates were used to determine location of chemical drip stations.

Electrofishing with backpack electrofishing units served two purposes. The primary purpose was to remove as

many brook trout as possible before applying chemical, helping to ensure high mortality of any fish left in the treated segment. The second purpose was to capture as many YSC as possible, which were then transplanted in a fishless section of South Trapper Creek. Electrofishing efforts and relocation of fish occurred within the same day.

The intent of transplanting YSC in South Trapper Creek was to establish a new population and provide a genetic reserve. A new population of YSC will provide an additional buffer against extirpation on the Bighorn NF. Additionally, if this population is successful in establishing itself, it could be used in the future as a source of genetically pure YSC for establishing other populations. As genetic science progresses it may become possible to tell if YSC from Dry Medicine Lodge Creek have been isolated from other YSC long enough for genetic drift to occur such that the Dry Medicine Lodge fish have a unique genetic make up.

Following electrofishing, the fish toxicants antimycin and rotenone were applied. Antimycin was applied via drip stations at six locations, while a rotenone sand mix was applied by hand along the margins of the stream and to any seeps or springs. At the point where Dry Medicine Lodge Creek goes subsurface, potassium permanganate ( $KMNO_4$ ) was applied to neutralize any residual toxicants (Figures 6 & 7).



**Figure 7.** Detoxification station on Dry Medicine Lodge Creek.

Block nets were placed above the lower five drip stations and above the detoxification station. The block nets served to capture dying fish and prevent fish from migrating downstream in an attempt to avoid the toxicants. At each block net a live car containing brook trout was placed to serve as "canary" fish.

Due to elevation losses and amount of turbulence, antimycin did not work as well as expected. The chemical did not seem to reach lethal levels until very late in the day and not all canary fish were killed during the first day's treatment. This resulted in a second day of chemical application. The rotenone sand mix appeared to be more effective and it was decided by WG&F biologists to use rotenone at the drip stations instead of antimycin in a follow-up treatment in 2007. Program personnel will assist with the re-treatment in August 2007.

## Miscellaneous

### WG&F Coordination & Relationships

As part of the maintenance and building of working relationships with WG&F employees Aquatics Program personnel assisted with two WG&F fisheries projects off lands administered by the Bighorn NF.

Lead Fisheries Biologist, Will Young, assisted WG&F fisheries biologist and technicians with the setting and pulling of gill nets in Lake DeSmet. The purpose of this netting series is to track the expansion of illegally introduced walleye (*Stizostedion vitreum*).

Aquatics Program seasonal employees assisted WG&F with the chemical treatment of LaBarge Creek, near Pinedale, WY. This project is designed to restore Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) to over 35 miles of headwater and mainstem habitats on the Bridger-Teton National Forest. The

technicians were well regarded by all folks involved and the Program continues to receive comments from numerous WG&F and other FS personnel, thanking us for sending a great crew to help with the project.

### Data Management

The program manager and lead fish biologist developed a series of spreadsheets for fish population estimates and biomass. The spreadsheets are designed to calculate total number per mile and biomass estimates from the data, as well as grouping by fish species. An example of the output is located in Appendix A and can be made available upon request.

## Population Estimates

### North Tongue River

Aquatics Program and other Bighorn NF personnel assisted WG&F with population estimates at six sites within the North Tongue River watershed. Estimates were obtained, from downstream to upstream, at the Burgess, Experimental Pasture, Lower, Bull Creek, Runs, and Moose stations. WG&F has GPS coordinates of the upper and lower ends of these stations.

The following species were captured at the sites; Rainbow, brook, Yellowstone cutthroat, and Snake River finespotted trout (*Oncorhynchus clarki behnkei*). Table 1 summarizes data collected at the five stations and has been reproduced from WG&F annual reports.

**Table 1.** Population data from sampling locations in the North Tongue River.

Station	Species	n	Mean L. (Range) in.	Mean W. (Range) lbs.	Est. #/mi	Est. #/mi >6in	Est. Lbs./mi
Burgess	BKT	4	6.0 (3.7-8.4)	0.11 (0.02-0.22)	51	26	6.2
	RBT	181	6.3 (1.7-12.8)	0.17 (0.02-0.81)	2,338	1,413	397.0
	SRC	15	6.3 (4.2-8.9)	0.11 (0.02-0.21)	231	116	24.8
	YSC	1	9.6	0.29	13	---	2.8
	All trout	201	---	---	2,633	1,555	430.8
Exp. Pastures	BKT	13	7.6 (5.3-9.3)	0.17 (0.06-0.26)	113	104	19.4
	BNT	2	7.9 (3.6-12.1)	0.30 (0.02-0.58)	17	9	5.7
	RBT	198	7.4 (2.8-13.2)	0.19 (0.01-0.85)	1,731	1,305	328.2
	SRC	40	8.2 (4.2-12.5)	0.24 (0.03-0.75)	348	287	83.5
	TRT <sup>1</sup>	48	2.2 (1.6-3.2)	---	---	---	---

Station	Species	n	Mean L. (Range) in.	Mean W. (Range) lbs.	Est. #/mi	Est. #/mi >6in	Est. Lbs./mi
	YSC	26	6.9 (3.5-12.6)	0.16 (0.01-0.69)	226	130	36.4
<b>Exp. Pastures</b>	All trout	327	---	---	2,435	1,835	473.2
<b>Lower</b>							
	BKT	2	8.4 (7.6-9.3)	0.24 (0.18-0.30)	29	---	6.9
	BNT	3	9.1 (2.3-13.1)	0.70 (0.57-0.82)	43	---	30.4
	RBT	102	7.1 (3.0-11.8)	0.18 (0.01-0.60)	1,476	984	266.0
	SRC	32	7.3 (3.5-12.6)	0.19 (0.02-0.68)	463	333	88.0
	TRT <sup>1</sup>	18	2.4 (1.5-2.9)	---	---	---	---
	YSC	19	7.0 (4.0-10.0)	0.16 (0.02-0.41)	275	174	44.0
	YSC AD clip	10	5.3 (4.8-5.8)	0.04 (0.02-0.06)	145	---	5.8
	All trout	186	---	---	2,431	1,491	441.1
<b>Runs</b>							
	BKT	45	6.7 (2.3-11.7)	0.18 (0.01-0.58)	331	173	59.1
	RBT	39	6.8 (2.3-12.8)	0.17 (0.02-0.75)	295	165	49.6
	SRC	84	9.1 (3.5-15.1)	0.37 (0.02-1.31)	604	511	223.6
	TRT <sup>1</sup>	2	2.0 (1.8-2.2)	---	---	---	---
	YSC	184	6.5 (3.8-12.4)	0.12 (0.02-0.70)	525	496	115.9
	YSC AD clip	111	5.3 (3.8-12.4)	0.05 (0.02-0.64)	849	22	42.3
	All trout	465	---	---	2,604	1,367	490.5
<b>Moose</b>							
	BKT	27	3.8 (2.2-9.0)	0.12 (0.02-0.32)	708	107	83.9
	RBT	7	11.8 (6.9-15.7)	0.68 (0.13-1.32)	150	150	102.2
	SRC	14	12.7 (5.5-17.2)	0.91 (0.06-2.17)	300	279	273.4
	TRT <sup>1</sup>	5	1.9 (1.9-2.1)	---	---	---	---
	YSC	16	10.0 (4.6-15.1)	0.42 (0.04-1.19)	343	322	144.2
	All trout	69	---	---	1,501	858	603.7

<sup>1</sup> Young of the year fish that were not positively identified.

### South Tongue River

Aquatics Program and other Bighorn NF personnel assisted WG&F with population estimates at three sites within the South Tongue River watershed. Estimates were obtained, from downstream to upstream, at the

Boy Scout control, Boy Scout, and Dead Swede stations. WG&F has GPS coordinates of the upper and lower ends of these stations.

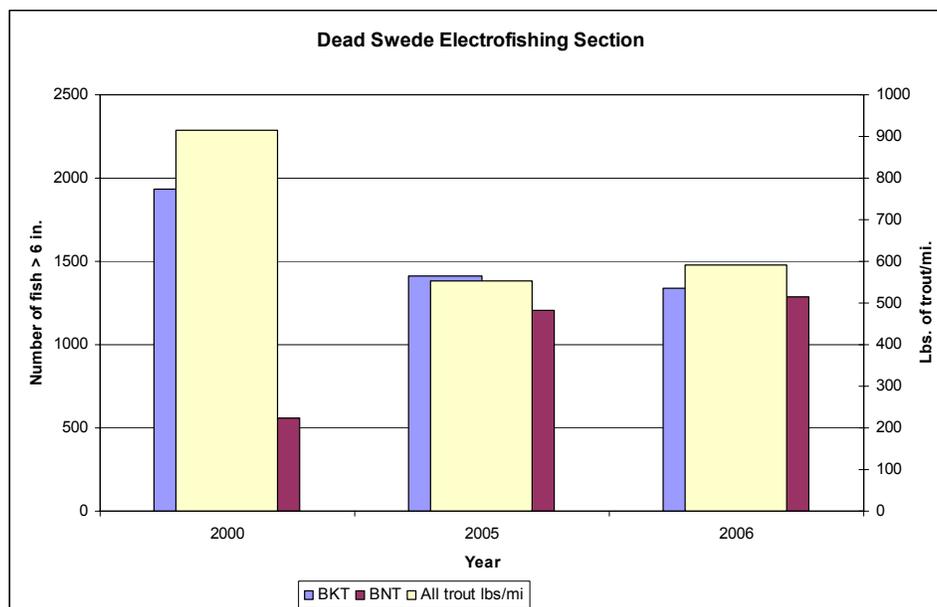
Brook, and brown trout were captured at the sites. Table 2 summarizes data collected at the Dead Swede station.

Table 3 summarizes data collected at the Boy Scout and Boy Scout control sites. The data presented is reproduced from WG&F annual reports.

Figure eight graphically displays estimated number of brook and brown trout greater than 6 inches as well as estimated pounds of all trout species per mile

**Table 2.** Population data from Dead Swede Campground station.

Species	n	Mean L. (Range) in.	Mean W. (Range) lbs.	Est. #/mi	Est. #/mi >6in	Est. Lbs./mi
<b>2000</b>						
BKT	1,118	5.4 (2.0-8.9)	0.07 (0.01-0.25)	10,273	1,936	719
BNT	137	6.7 (1.6-21.1)	0.20 (0.01-4.02)	1,264	556	195
All trout	1,255	---	---	11,537	2,492	914
<b>2005</b>						
BKT	313	5.1 (1.3-8.7)	0.08 (0.01-0.23)	3,138	1,411	251.3
BNT	161	7.4 (2.0-14.5)	0.19 (0.01-1.78)	1,599	1,204	302.9
All trout	474	---	---	4,737	2,615	554.2
<b>2006</b>						
BKT	303	5.4 (2.1-8.3)	0.08 (0.01-0.24)	3,029	1,335	242.3
BNT	166	7.8 (3.5-20.6)	0.21 (0.01-3.24)	1,654	1,285	348.1
All trout	469	---	---	4,683	2,620	590.4



**Figure 8.** Population estimates and biomass of brook and brown trout, > 6" inches.

The Dead Swede population estimate was established to monitor effects of channel rehabilitation activities on fish populations. The South Tongue River was rehabilitated at the Dead Swede campground in 2003 using in-

channel structures and channel reconstruction. The objectives of this restoration were to reestablish hydrologic form and function and to protect the campground from being eroded by the river. The 2000

population estimate is thought to represent the fishery prior to channel reconstruction; however, no control reach was established therefore no conclusions regarding effects of channel modification on fish

populations can be reached. Annual monitoring has shown a shift in species composition from brook trout being the dominant species to nearly equal numbers of brook and brown trout (Figure 8).

**Table 3.** Population data from Boy Scout and Boy Scout Control stations.

Species	n	Mean L. (Range) in.	Mean W. (Range) lbs.	Est. #/mi	Est. #/mi >6in	Est. Lbs./mi
<b>Boy Scout</b>						
BKT	382	5.0 (2.0-8.0)	0.1 (0.02-0.19)	3,466	1,383	783.4
BNT	387	7.2 (1.7-13.5)	0.18 (0.01-1.17)	3,475	2,622	785.5
<b>Boy Scout Control</b>						
BKT	209	5.0 (1.8-7.7)	0.1 (0.06-0.16)	1,506	435	409.9
BNT	355	7.2 (1.6-11.1)	0.19 (0.05-0.43)	2,540	1,891	691.6

When the Boy Scout section of the South Tongue River was identified for channel reconstruction the opportunity presented it's self to locally study the effects of channel reconstruction on fish populations. The Boy Scout reach is approximately 0.5 mile below the Dead Swede Campground. In an attempt to document changes in fish population size and community structure, WG&F biologists and Aquatics Program personnel established two electrofishing stations in the fall of 2005. One within the proposed channel reconstruction zone and one outside of the construction to serve as a control reach. This control reach will allow comparisons to be made between populations occurring in reconstructed channel and channel that has not been rehabilitated.

To avoid the pitfall of the Dead Swede population estimate pre-construction data was collected at the two Boy Scout sites. Population data, serving as baseline, pre-construction data, was collected for the first time in October 2006. This data is summarized in Table 3.

### Wilderness Lakes

Aquatics Program technicians assisted WG&F Fisheries Biologist, Mark Smith, with gill netting in four lakes in the Cloud Peak Wilderness; Fortress, Gunboat, East Marion and Mistymoon lakes. Golden trout (*Oncorhynchus mykiss aguabonita*) were captured in the Fortress Lakes as well as Gunboat Lake. Yellowstone cutthroat trout were captured in East Marion Lake. Brook trout and lake trout (*Salvelinus namaycush*) were captured in Mistymoon Lake.



**Figure 9.** Golden trout from Fortress Lake.

East Marion Lake is stocked with YSC on a biannual basis and sampling indicated stocking rates were appropriate, as fish were found to be in good condition.

Golden trout were stocked in Gunboat and Fortress lakes through the late 1990's, but had not been stocked since the loss of the brood stock. Sampling indicated that natural recruitment has been successful in these lakes.

Mistymoon Lake is not stocked and sampling indicated there is successful recruitment.

### Yellowstone Cutthroat Trout Range-wide Status Update

Aquatics Program personnel assisted efforts to update the range-wide status of Yellowstone cutthroat trout. In April Will Young assisted with updating the GIS layers and data tables used to generate the status report. He entered and edited data in ArcMap and Access databases as well as providing updated information. In December Dan and Will attended the annual meeting of the interagency work group. This meeting presented a summary of the data entered in April as well as coordinating and confirming future meetings to update

the data sets and determine the future efforts of the group.

## HYDROLOGY

### Ditch Bill

Four ditches were reviewed prior to reissuing a special use permit as required by Ditch Bill legislation. Eureka Ditch removes water from Sheep Creek, Peralta Ditch removes water from Cross Creek, Willetts #1 Ditch removes water from the headwaters of West Fork Little Goose Creek, and Big Goose Beaver Ditch diverts water from East Fork Big Goose Creek. All four ditches are for irrigation purposes. No major issues or concerns were found that would require work or retrofitting prior to reissuing the permit.



Figure 10. Inlet of Willetts #1 Ditch.

### Eastside Big Horns Water Rights Investigation

An adjudication of domestic water uses in the Bighorn River basin was completed in 2005. That adjudication included the western portion of the hydrologic divide of the Bighorn NF. Those efforts produced a high quality product for that portion of the Forest, which included improved documentation of discrete uses (non-stock), mapped information of on-site conditions, and spatial data for incorporation into the Forest's electronic database.

Although the previous effort produced a high quality product, the eastern portion the Forest is now inconsistent with the level of information that has been gathered across the Forest. A purchase order, to conduct an investigation of the non-stock uses along the eastern portion of the hydrologic divide, was awarded to a contractor, who began work in the fall of 2006. The cost to evaluate these water uses is estimated at \$1,000 -

\$1,500/water use and is expected to continue over the next 5 years, given available funding. Money has been made available through TIN requests to the Regional Office.

Objectives of the water rights investigation are to:

- Development of an electronic database of discrete water uses (non-stock) for the entire Forest.
- Improve understanding of consumptive water uses on the Forest.
- Meet legal obligations of the Forest Service, with regards to water rights.
- Develop consistency in water rights documentation and spatial data Forest-wide.

### French Creek Ditch

A site visit to the French Creek Ditch was made with Lands and Special Uses personnel. The purpose of the visit was to determine if any work needed for the diversion structure that forces water to the private in holding, Paradise Ranch.

Upon inspection of the diversion it was found that many small side channels feed the small ditch that provides water to the ranch. All of the side channels and the ditch were in good condition. Banks were well vegetated and contained a high proportion of cobble indicating good stability. No work was recommended.

### International Programs - Ethiopia

Dan Scaife had the opportunity to work with a USFS International Programs team and travel to Ethiopia for two weeks in October 2006. The USFS team, consisting of Dan Scaife, and Joe Gurrieri, Regional Geologist for Region 4, was asked by the US Embassy, Addis Ababa Regional Environmental Team to provide technical assistance to the Amhara and Tigray Water Management Bureaus, as a component of a broader Integrated Water Resource Management (IWRM) project that is ongoing in Ethiopia. The assistance focused on improving the capacity of these water bureaus to evaluate and monitor catchment conditions and implement management interventions to address ongoing catchment degradation issues.



**Figure 11.** Village located in Tigray Region watershed.

The objective of this assistance was to support the water bureaus and the IWRM projects with recommendations, strategies, techniques, procedures, necessary resources, and action plans to complete the tasks outlined below. While most of these tasks could not be accomplished in a two week mission, the USFS team provided guidance to local partners for how to accomplish these tasks, and created a partnership where the USFS can continue to support the realization of these objectives in the future. USFS information gathering and exchange included: coordination, planning, and information exchange meetings, field visits for site specific observations, work sessions with local partners, review of existing data and maps, analysis and writing of recommendations for discussion and debate.

### **Little Goose Creek Crossing**

The low water crossing of West Fork Little Goose Creek was modified by engineering personnel, with the assistance of the program leader, in September 2006. The purpose of the modification was to make the crossing safer for vehicles and ATV's. Because of a reservoir failure upstream in the 1969, the crossing had become deep enough to commonly flood out or strand crossing vehicles.

Prior to construction the channel was surveyed. Cross-sections, a longitudinal profile and pebble counts were recorded. This data was used in the design of the crossing. A formal full design package was not assembled due to lack of funding and timing restrictions.

In order to lessen the depth of the crossing several measures were implemented. A large boulder was removed from the channel, which was deflecting the current into the bank and had elevated the water surface by approximately two inches. Following the boulder removal a small J-hook rock structure was installed below the crossing. The intent of the structure was to

help maintain gradient, reduce shear stress on the bank, and stop a headcut if it were to occur. Finally cobble was added to the crossing to elevate the road surface with less erodible material.

The site will be monitored annually for several years in order to determine the stability of the channel following construction activities. The resurveying of cross-sections and the longitudinal profile will aid in determining if additional work is necessary.

### **Long-term Monitoring**

Long-term monitoring sites were established for the purpose of Forest Plan monitoring efforts. In some instances these sites also double as project level monitoring sites. These sites were to be located at low gradient (<3%) reaches towards the outlet of 6<sup>th</sup> level watershed (HUBs). Data collected at each site includes cross sections, longitudinal profile, pebble count, 50 cumulative widths and depths, and greenline. There are 74 6<sup>th</sup> HUBs that contain lands administered by the BNF. Sixty nine of these watersheds have been evaluated, although only 18 have met the criteria that allowed establishment of a site.

Nine sites across the forest were surveyed in 2006. Nearly 2,000 m of channel in 9 longitudinal profiles and 25 cross sections were surveyed, in addition to the pebble counts and 50 cumulative widths. Table 4 provides a brief summary of the type of data collected at the nine sites to date.



**Figure 12.** Cross-section on Shell Creek, Willett monitoring site.

There are six sixth level watersheds to be evaluated in 2007. If suitable sites are found permanent long-term monitoring sites will be established and surveyed. Three existing long-term sites will be re-surveyed in 2007.

**Table 4.** Summary of data collected at nine long-term and two project monitoring sites in 2006.

Site Name	Type	# XS Surveyed	# Long. Pro. Surveyed	Length of Long. Pro. (m)	# Pebble Counts	# 50-W's
Below Rd 17	Project					1
Cattle Bridge	Project	3	1	53	1	1
Cookstove	LTM	1	1	94	1	1
Cub Park	LTM	3	1	200	1	1
Dayton Gulch	LTM	3	1	129	1	1
Exc. West, Outside	Project	3				
Park Reservoir	LTM	3	1	290	1	1
Pine Island	LTM	4	1	488	1	1
Powerline	LTM	3	1	137	1	1
Section 24	LTM	3	1	124	1	1
Two Elk	LTM	3	1	115	1	1
Willett	LTM	4	1	400	1	1
<b>TOTAL</b>		<b>33</b>	<b>10</b>	<b>2030</b>	<b>10</b>	<b>11</b>

## Meadowlark Reservoir Water Withdrawal

Due to extended drought conditions a water call on Meadowlark Lake, for 10 cfs, was received in September for downstream users on Tensleep Creek. This was the third time in a four year period that the Forest has received this request.

Currently the only way to estimate outflow from the dam, was to take a discharge measurement each time the outlet works were adjusted. In order to more accurately estimate the amount of water being discharged from the reservoir for future requests, a permanent cross-section and staff gauge were established below the outlet works. Discharge at several different stages was measured in order to create a rough stage discharge relationship. This relationship was plotted in and future data will be used to refine that relationship.

To further assist in managing water levels in Meadowlark Reservoir staff gauges will be established in 2007 on the streams flowing into the reservoir. These gauges will provide a better picture of flow timing and volume into the reservoir.

## Miscellaneous

### Data Management

In the last two years considerable time and effort has been spent by program personnel entering survey data collected on paper forms into Excel and RiverMorph. The conversion from paper to electronic data has to occur prior to final data quality checking, data control, analysis and reporting can occur. This adds weeks to the process of analyzing and reporting.

In an effort to make surveying and reporting more efficient a series of Excel spreadsheets were developed. The use of the spreadsheets in the field will also reduce the chance of transcription errors. The workbook contains spreadsheets for 4 cross-sections, a longitudinal profile, and 50 cumulative width-depth ratios. The spreadsheets also convert surveys conducted in metric units into English unit surveys. This feature was included because RiverMorph only works with English units. Examples of these spreadsheets are found in Appendix B and can be made available upon request.

## Project Monitoring

Project monitoring sites are sites that are established as part of monitoring identified in a NEPA decision. In some instances these sites also double as long-term monitoring sites. Data collected at each site may include cross sections, longitudinal profile, pebble count, 50 cumulative widths and depths, and greenline.

Three sites were surveyed in 2006 (Table 4). The Cattle Bridge site is located on Hunter Creek and was established to monitor the effects of road relocation on the stream channel. Below Road 17 is located on Mill Creek and 50 cumulative widths and longitudinal profile were measured as part of a planned culvert replacement. Enclosure West, Outside is located on Fool Creek and was surveyed in 2005. The data for three cross sections was lost; therefore the cross sections were resurveyed to replace the lost data. The lost data was later found and it was not necessary to complete a full resurvey.

## **Shutts Flats Trail Reconstruction and Road Decommissioning**

A trail reroute project was completed in the lower South Tongue River watershed in 2006. The old trail was a road that followed the South Tongue River from Shutts Flats upstream for approximately one mile. This road contained numerous wet areas where resource damage occurred on an annual basis. The new trail is located out of the floodplain and is approximately one mile in length. This trail is used by ATV's, bicycles, and foot traffic.

The old trail was closed and decommissioned. Decommissioning efforts included ripping the road bed, installing natural barriers at both ends to deter use, seeding, straw mulching, and rehabilitation, by reestablishing channel shape, of two low water crossings. The low water crossings will be monitored in 2007 following runoff to determine if additional work is necessary to stabilize the banks.

## **Water Quality Monitoring**

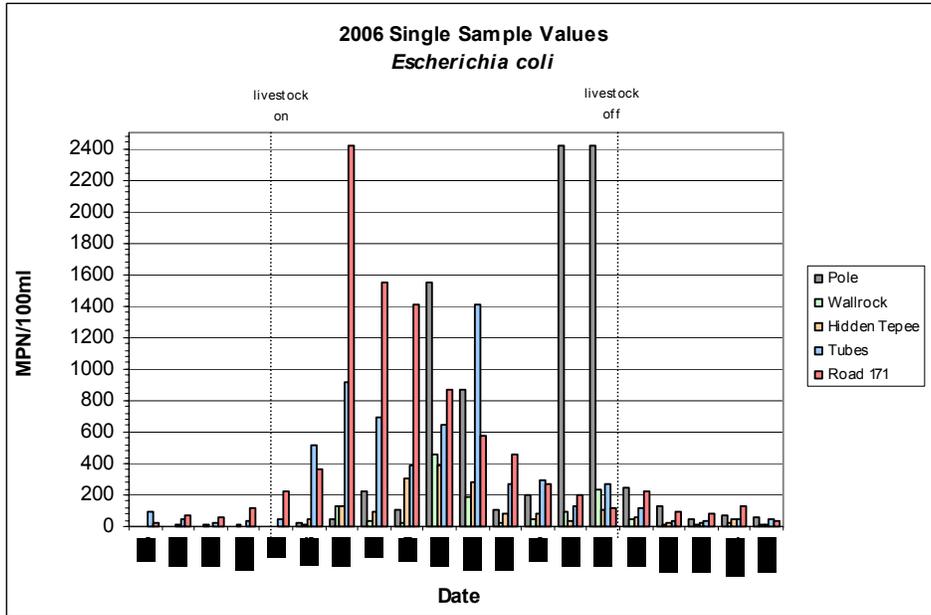
Water quality monitoring was initiated on two streams on the Forest prior to 2006. Five sampling sites were

established in 2003 in the North Tongue River in response to elevated levels of *e. coli* being detected by Wyoming Department of Environmental Quality. One sampling site was established on Granite Creek in 2004 to spot check *e. coli* levels downstream of the Antelope Butte Ski Resort. Both streams are on the Wyoming 303d list of impaired waters, and sampling continued at these sites in 2006. Figure 13 shows the individual results of sampling in the North Tongue River while figure 14 shows the results as geometric means.

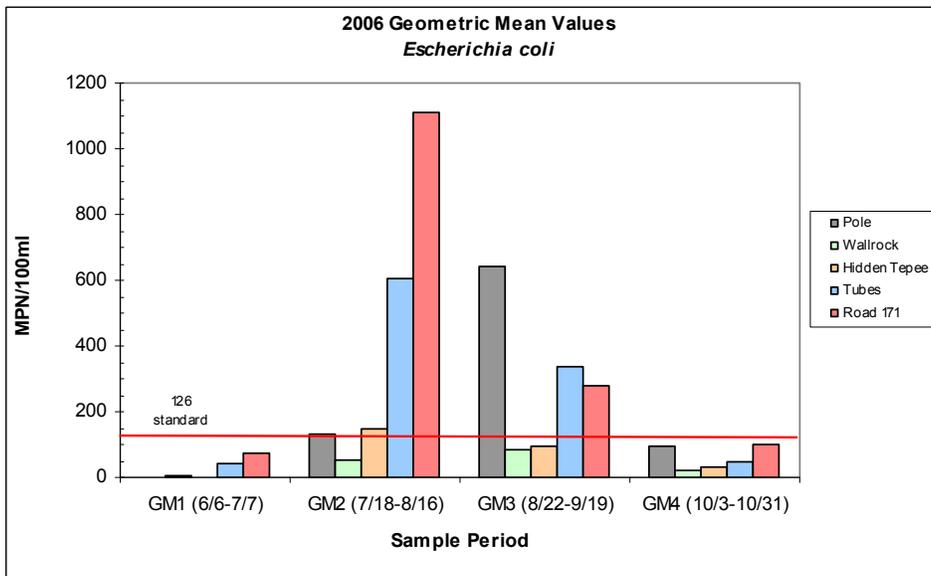
In the North Tongue, individual sample results were higher during the presence of livestock (Figure 13) causing the State water quality standard for primary contact recreation to be exceeded. The State standard is 126 colonies/100 ml determined by a geometric mean of 5 samples within a 30 day period. Sampling resulted in seven instances when the geometric mean was above the 126 MPN/100ml (Figure 14).

Considerable work was done by range personnel and permittees to keep livestock distributed correctly, moving at required times, and utilizing vegetation across the entire pasture instead of focusing on riparian areas. This work included alternative on dates, rotations, and use of riders to move cattle. Efforts like these are beneficial to the North Tongue watershed and will continue into 2007, the final year monitoring for the Tongue River AMP revision.

It should be noted that the Pole sample site was originally selected as a control site, but can no longer be deemed so due to the presence of sheep. This site is above any of the North Tongue allotment pastures; however, it is located within a sheep allotment. Sheep are likely one of the causative agents in the high individual readings and the two geometric mean exceeding the 126 standard.



**Figure 13.** Individual sampling results from North Tongue water quality monitoring in 2006.



**Figure 14.** Geometric means (2006), five sites along the North Tongue River.

In Granite Creek, sampling showed elevated *e. coli* levels in July, August, and September (Figure 15). These individual samples can not be used to determine exceedance of water quality standards because no

geometric mean can be calculated according to protocol. These data are meant to track the presence of *e. coli* on a monthly basis. Additional sampling will occur in 2007.

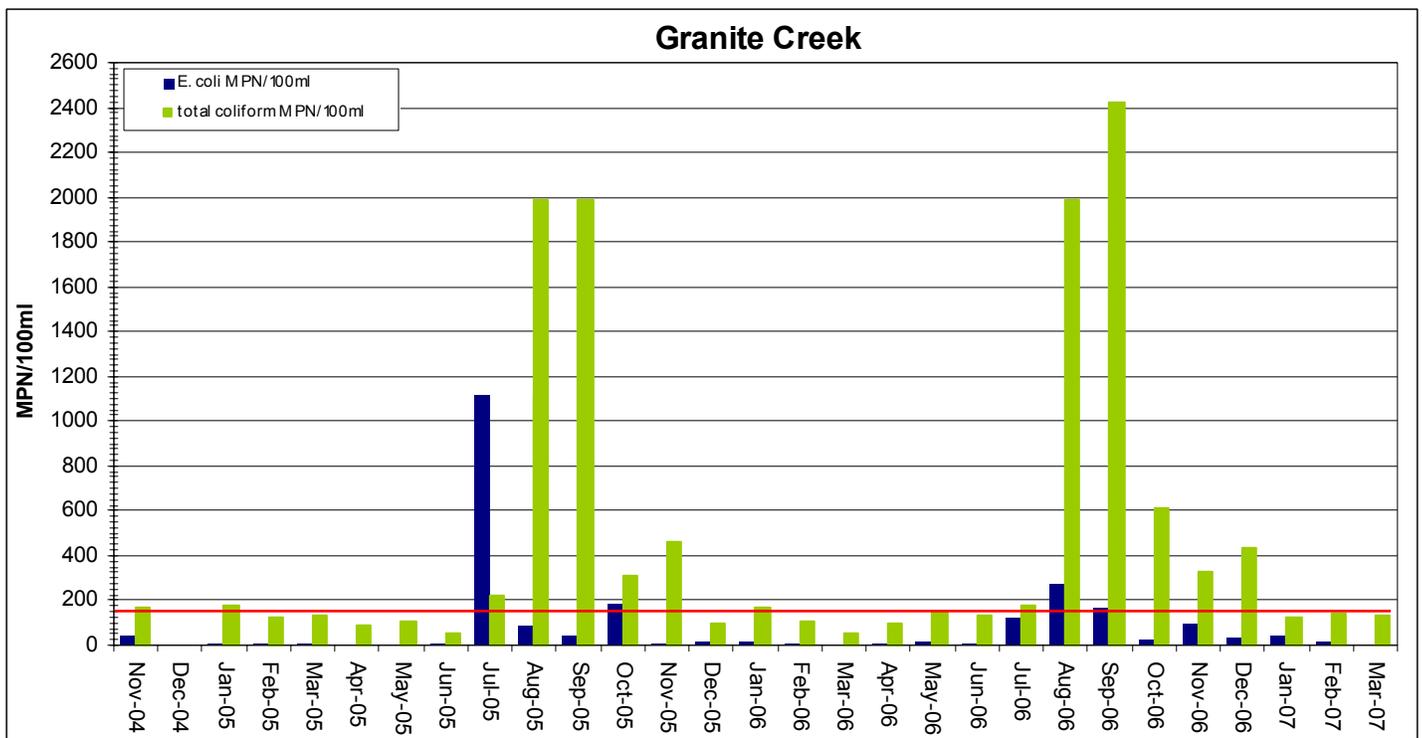


Figure 15. Sampling results from Granite Creek.

## MINERALS AND GEOLOGY

### Dunkin/Labbe Mine

Efforts continued towards the removal of property on the Dunkin/Labbe colloidal clay mine. A claim was filed on the Dunkin/Labbe site in the 1930s, for the extraction of bentonite clay, in the South Paintrock Creek drainage. The original claimant willed the claim to his heirs, who no longer continued to mine the claim, but continue to use it for recreational purposes. In 2001, the claimants were notified that they were in potential trespass on NFS land, as there was no obvious active mining, no Notice of Intent, and no approved Plan of Operation. As little action had taken place in the previous five years, the Aquatics Program worked with Powder River Ranger District and Regional Office personnel and Law Enforcement to resolve the issue through official notifications to the claimant. Resolution through removal of all property on the site is expected to occur in 2007.

## PROGRAM MANAGEMENT

### Best Management Practice's (BMP) Reviews

Two BMP reviews of timber sales were conducted on the Forest this year. Both reviews focused on a post-project review for the Bald Mountain Beetle Infestation and Riley Point Fire salvage timber sales. Range reviews and a review of the Cold Springs timber sale will be conducted in 2007.

No issues were found related to the Riley Point sale with regards to soil and water impacts. The contractor did a good job of scattering slash around temporary roads and the spacing of water bars appears adequate. Vegetation is already evident on the temporary roads and skid trails. Harvesting was allowed within 100 feet of an intermittent stream course, but no heavy equipment entered this water influence zone as directed by the Timber Sale Administrator.

Minor soil displacement was encountered in the review of the Bald Mountain sale, and was estimated at no more than 15% of the project area. Aquatics Program personnel worked closely with the Timber Program during unit boundary layout in order to avoid seeps, wet areas, and stream courses that are common throughout the sale area. These areas were avoided at

an acceptable level. A culvert was identified as being improperly placed along a closed road, used for hauling logs during the sale. The culvert was not installed at the proper grade to match the existing channel. The Timber Sale Administrator was aware of the issue and worked with the contractor to alleviate the problem through reconstruction. A formal review, by the Wyoming BMP audit team will be conducted during the summer of 2007.

## Conservation Education

### Kid's Fishing Day

Aquatics personnel assisted with two community events to promote kid's fishing. The first event was held in June at the Sheridan County Fairgrounds pond and was attended by approximately 100 children and their parents. This event is a cooperative effort between numerous individuals and groups including Wal-mart, WG&F, Trout Unlimited, Tongue River Bait, Bighorn N.F., and Hooked on Fishing International.

The second event was held in July at the Porcupine Ranger Station pond and was attended by approximately 25 children and their parents from the Lovell and Greybull areas. This event is a cooperative effort between WG&F and the Bighorn NF. WG&F stocks several hundred 6 to 8 inch Yellowstone cutthroat trout in the pond several days prior to the event and the Forest provides organization support and prizes.

### SMARTY Bus

Aquatics personnel participated in two interactive events on the SMARTY Bus. On both occasions, aquatic macroinvertebrates were the topic of the presentation. Insects were collected at two sites, the Tongue River at Dayton and Goose Creek near the work center, prior to the presentations. We assumed that the Goose Creek sample would have poorer water quality indicators than the Tongue River sample, because of the higher level of development in the watershed and channelization of Goose Creek for flood control. The poorer water quality would be shown by the presence of more pollution tolerant species.

After a brief introduction the students were encouraged to pick as many bugs out of the samples, in large trays, as they could using forceps. The students were directed to take turns picking and rotated through each sample and questions were answered during that activity. After 30 to 40 minutes, the students were asked questions about what they saw in the samples and if they noticed any difference between the two. Based upon their answers and their ages the presenters then talked about topics ranging from using macroinvertebrates as

indicators of water quality to form and function as well as the food chain.

### Woodland Park School

The Aquatics Program Manager was contacted by teachers from the Woodland Park School, and was asked to make a presentation to 2<sup>nd</sup> graders at Kendrick Park in early November regarding aquatic ecosystems.

It was decided that we would attempt to capture macroinvertebrates, as the students watched from the bank. During this activity we talked about a wide range of subjects and how they related to ecosystems. Topics included how macroinvertebrates fit into aquatic ecosystems and larger ecosystem context, and how the presence of certain species are indicators of water quality and ecosystem health.

## Miscellaneous

### Fire Program Support

The Aquatics Program provided support to the wildland fire and prescribed burning programs both on and off Forest in 2006. On Forest, personnel assisted with prescribed burns and suppression and support of the Tongue fire in August.



**Figure 16.** Prescribed fire in Salt Creek.

Program Leader, Dan Scaife, assisted with prescribed burning in Texas while on a 14-day detail on the Angelina NF. The Program Leader also provided BEAR support for a team on the Nebraska NF, during the Dawes County Complex fire, near Chadron, Nebraska.

Seasonal technicians assisted with wildfire suppression on the Purdy and Little Venus fires, on the Shoshone NF. The lead Fisheries Biologist assisted the Shoshone NF with the Homestead prescribed burn, outside of Lander, WY.

## **NEPA Project Support**

The Aquatics Program provides support to all NEPA projects on the Forest. On a typical project either the Program Leader or Lead Fish Biologist will be assigned to the team and are responsible for representing air, soils, geology, minerals, hydrology, and fishery resources. The following are the projects worked on in 2006.

### **Babione Timber Sale**

The Babione timber sale is located east of Dome Lake and includes portions of the Babione and Antler creek drainages. The project area originally included roadless area south of Weston Reservoir, however; this area was dropped from the project with the reinstatement of the roadless rule. The purposes of this timber sale are:

- Move vegetation distribution toward desired conditions.
- Improve wildlife habitat (elk security).
- Reduce wildfire hazard.
- Produce forest products.
- Manage motorized travel.

This project was initiated in April and field work was conducted throughout the summer. No major issues were found with in the proposed units or with the proposed actions upon initial review. Effects analysis and reporting for the Environmental Assessment (EA) will be completed in 2007.

### **Battle Park Allotment Management Plan Revision**

The Aquatics Program had little activity associated with the Battle Park AMP revision EA in 2006. Fifty cumulative width measurements (50 widths) were taken on Buckskin Ed Creek below the crossing of trail #360. This site coincides with monitoring established by range personnel. Specialist's reports are due in 2007 and a decision is expected to be signed in 2007.

### **Beaver Creek Allotment Management Plan Revision**

2006 saw the initiation of the Beaver Creek AMP revision EA project. Aquatics personnel were involved with preliminary meetings. A majority of the bulk of fieldwork and reporting is expected to occur in 2007.

### **Hunt Mountain Travel Management Plan**

Considerable activity occurred associated with the Hunt Mountain Travel Management Plan EA in 2006. Numerous site visits occurred throughout the summer and fall in addition to working on specialists report.

This project was finished and ready for decision; however, the roadless rule was reinstated and caused the project to be halted. Much of the project area is

located within inventoried roadless and an additional alternative had to be developed that accounted for this. It is expected that the IDT will reconvene early in 2007 to discuss this alternative further and update individual specialist's reports. Upon re-completion of specialist's reports, it is expected a decision will be reached and implemented in 2007.

### **Hunter Trailhead and Campground Relocation**

NEPA was completed in 2006 associated with the relocation of Hunter Trailhead and Campground. The existing facility is located within the riparian zone of Hunter Creek. The revised Forest Plan indicates that facilities should not be located within this zone (Water Influence Zone) and the relocation of the facility to the North alleviates this problem. The new facility is located within one half mile of the existing facility and also involves the decommissioning of several roads and the construction of a new road along a ridge to connect with the Soldier Park road. This project is scheduled for implementation in 2007, but recent decision regarding the Roadless Rule may affect the project.

### **Lily Lake Trailhead Relocation**

This project falls under the Categorical Exclusion (CE) category and involves the relocation of the trailhead northwest approximately one mile and construction of new trail. A site visit was conducted to outline a potential location for the new parking area. The new trailhead is located next to a meadow with a robust population of carex species growing. Recommendations were made to the deciding official on how to prevent or limit ORV use in the meadow. Recommendations included the placing of large boulders and use of natural features such as rock outcrops.

### **Little Bitmore Timber Sale**

The Little Bitmore timber sale is located in the headwaters of Granite Creek, a tributary to Shell Creek. This project was done under the HFRA/HFI CE authority. Approximately 250 acres of timber will be treated with various methods to reduce the risk of wildfire and reduce the threat of insect (pine beetle) damage and spread. Due to very little water and prior entry into the area there were no significant effects found to be associated with the project. The Aquatics program and Wildlife biologist both recommended that this be the last entry into this area for 25 or more years.

### **Piney Allotment Management Plan Revision**

2006 saw the completion of the Piney Allotment Management Plan EA. Personnel collected field data, analyzed data, worked on specialist reports and sections of the draft and final EA. The decision will be signed in

2007 implementing a strategy using adaptive management. As part of the decision a greenline and 50 cumulative width/depths will be the responsibility of the Aquatics Program to monitor. These sites are located on North Piney Creek above the Penrose Guard Station and on Little Piney Creek at Cow Park. These sites are to be monitored on a five year basis.

### **Southwest Fuels Vegetation Management**

The Southwest Fuels project is located on the south edge of the forest in the Canyon and Leigh creek drainages. This project has undergone several revisions due to the reinstatement of the roadless rule and a decision is expected to be signed in 2007. The project involves timber harvest and prescribed fire use.

Aquatics personnel were requested to visit the project area several times to assist with timber unit layout in the summer of 2006. The project area contains several areas where ephemeral streams and wetlands are present. Aquatics personnel provided input to the placement of unit boundaries, buffers and SMZ's.

A pocket guide to help unit layout personnel was developed in conjunction with the timber shop. This guide is intended to help answer questions that may arise during unit layout and is intended for use by hydrologists and experienced timber personnel. It is not to be used by seasonal crews marking boundaries. Direction regarding which buffer or SMZ to use and how to identify wetlands, ephemeral, intermittent, and perennial channels are included. A more detailed version will be refined at a later date.

### **Spanish Point Timber Sale**

The Spanish Point Timber Sale is located in the Dry Medicine Lodge Creek watershed below Forest Road #17. This project was done under the HFRA/HFI CE authority. Approximately 250 acres of timber will be treated with various methods to reduce the risk of wildfire.

Dry Medicine Lodge Creek contains one of the few genetically pure Yellowstone cutthroat trout populations on the forest. A 300' stream buffer was requested and included as one of the design criteria to help protect aquatic habitat. It was decided by Aquatics personnel that this buffer could be adjusted to be closer to the stream after a site visit with the team's wildlife biologist. The site visit found that there were terraces and benches above the stream in several locations (within the 300' zone) that would serve as a buffer. Due to high fuel loadings and concerns about high intensity fire within the riparian zone it was decided that some fuel treatments should be done within the zone. It was recommended to the deciding official that the edge of

the units along the stream be laid out with the help of a hydrologist.

## **Student Career Employment Program (SCEP)**

The SCEP position is occupied by Amy Nowakowski and she is attending Colorado State University to obtain a Master of Science. Amy's project involves characterizing large woody debris in streams that have different practices and levels of land management. In 2006 Amy attended classes in Fort Collins and completed her field work during the summer. She collected data at numerous sites within the South Tongue and Rock Creek watersheds. Amy expects to complete her degree in 2007 and begin working full time for the Aquatics Program.

## **Training**

### **Aquatic Ecosystem Monitoring – NR 16**

Dan Scaife and Will Young attended the Aquatic Ecosystem Monitoring in North Bonneville, WA in May. The intent of this four day training was to provide information on how, where, when, and why to monitor. Lectures also included the use and application of statistics and development of monitoring reports. This training was well organized and provided considerable information, but would best be attended by individuals that have limited experience with establishing, implementing, and reporting associated with monitoring.

### **Stream Simulation**

Dan Scaife and Will Young attended a class in Ogden, UT in March. This five day class focused on assessing and developing road - stream crossings that are passable to all life stages of aquatic dependent organisms at various flows. Class time was spent between lectures and exercises designed to walk an individual through the process of assessing and designing a fish friendly crossing. The class also stressed the need for engineers, hydrologists, and fisheries biologists to work together during the entire process. This training was well organized and would best be attended by individuals that have a strong background in surveying as well as a fundamental knowledge of hydrology, and fisheries biology.

### **I-Web Minerals Module**

Program Leader, Dan Scaife, Tongue RD Recreation Specialist, Cheri Jones, and Medicine/Wheel Paintrock RD Recreation Specialist, Loren Poppert attended the I-Web Minerals Module training in Fort Collins, CO. The

module is used by the District personnel to issue sale permits for mineral materials such as sand and gravel, landscape rock, etc... The Program Leader in the Aquatics Shop has oversight of the Minerals and Geology Program for the Forest and serves as database manager for the module and a point of contact for the District personnel for any mineral material permit issues.

#### **Other Trainings & Professional Meetings**

- Colorado - Wyoming Chapter of American Fisheries Society. Cheyenne, WY.
- Pre-retirement. Cody, WY.
- Yellowstone cutthroat trout interagency working group. Bozeman, MT.

## **OUTYEAR PROJECTS IDENTIFIED**

### **New Projects Identified**

#### **Air Quality Monitoring**

The unique results from monitoring in 2006 lend themselves to further detailed research. Pursuing opportunities to fund and eventually conduct graduate level research relating to air quality and high mountain lakes will occur in 2007.

#### **BMP Reviews**

The Aquatics Program would like to begin BMP implementation and effectiveness reviews on livestock grazing allotments in 2007. A schedule of when and where is to be developed.

#### **Boy Scout**

Minor progress on the Boy Scout channel rehabilitation project is expected in 2007. The Boy Scout project involves the reconstruction of stream channel in the South Tongue River downstream of the Dead Swede campground. Partial funding has been obtained to stock pile construction materials (rocks), but additional funding is necessary to haul all materials to the site. This funding will be pursued from numerous sources.

#### **Meadowlark Reservoir Gauging Stations**

To better understand streams flowing into Meadowlark Reservoir staff gauges will be establish on all streams flowing directly into the reservoir. Stage discharge relationships will be developed from data collected in the Spring, Summer and Fall months.

#### **Surveying**

There are six watersheds left to visit as part of long-term monitoring. They are Painrock - Trout, Long Park, Little Bighorn - Red Canyon, West Fork Little Bighorn, Seven Brothers and North Rock. If suitable locations are found a permanent site will be established and surveyed. A site in the Quartz Creek HUC was established in 2006 and will be surveyed in 2007.

Project level monitoring will comprise the majority of survey work in 2007. Up to 11 sites may be surveyed. Sites in the North and South Tongue rivers need resurveyed as part of the Tongue EIS. A site at Cow Park needs 50-width's and a green line recorded as part of the Piney AMP revision. A site needs to be selected and surveyed each for the Beaver Creek AMP revision and Rock AMP revision.

If all 17 sites were surveyed it would take approximately 35 field days to accomplish. This number was derived by figuring three days for each long-term site and 2 days at each project level site. This assumes a crew of two or three to complete a full survey. The Cow Park site will require one full day due to its remoteness.

# APPENDIX A: Fish population estimate worksheet.

Stream Name:	-
Reach Number/Name:	-
Location:	-
Date:	-
Station Length (feet):	-
Average Station Width (ft):	-
GPS upstream	-
GPS downstream	-
Collected By:	-
Collecting Equipment:	-
Water Temp (deg F):	-
Air Temp: (deg F):	-
Volts:	-
Amps:	-
Method:	-

Species	Number of Fish	Avg length in	Max length in	Min Length in	Avg wt lb (meas.)	Avg wt lb (Ws calc.)	Biomass lb/acre (from meas.)	Biomass lb/acre (from Ws calc.)	Fish/km	Fish/mi
YSC	0	-	-	-	-	-	-	-	-	-
SRC	0	-	-	-	-	-	-	-	-	-
BKT	0	-	-	-	-	-	-	-	-	-
BNT	0	-	-	-	-	-	-	-	-	-
RBT	0	-	-	-	-	-	-	-	-	-
RXC	0	-	-	-	-	-	-	-	-	-
TOTAL	0	-	-	-	-	-	-	-	-	-

Ws = Standard Weight Equation from; Murphy B. and D. Willis, *editors*. 1996. *Fisheries Techniques*, 2nd edition, page 462.

American Fisheries Society, Bethesda, Maryland.

Species	Pop. Est. 2 Pass	Variance 2 Pass	Prob. Cap. 2 Pass	Pop. Est. 3 Pass	Variance 3 Pass	Prob. Cap. 3 Pass	Pop. Est. 4 Pass	Variance 4 Pass	Prob. Cap. 4 Pass
YSC	-	-	-	-	-	-	-	-	-
SRC	-	-	-	-	-	-	-	-	-
BKT	-	-	-	-	-	-	-	-	-
BNT	-	-	-	-	-	-	-	-	-
RBT	-	-	-	-	-	-	-	-	-
RXC	-	-	-	-	-	-	-	-	-
TOTAL	-	-	-	-	-	-	-	-	-

**APPENDIX B:** Examples from the surveying workbook. Spreadsheets contain additional rows and convert from metric to English units.

*Cross-section Example:*

SURVEY REACH FIELD FORM 3: CROSS SECTION - METRIC									
Stream Name:			Date:			Surveyor(s):			
Site Name:			Survey Units:		Metric - meters	Recorder:			
XS-1			Channel Feature:						
#	Station	Descriptor	BS (+)	HI	FS (-)	Elevation	Plant Community	Plant Species	Comments
1	-	BM		50.000	0.000	50.000	-	-	
2	0.00	LEP		-	-	-			
3				-	-	-			
4				-	-	-			
5				-	-	-			
6				-	-	-			
7				-	-	-			
8				-	-	-			
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64				-	-	-			
65				-	-	-			

Cross-section continued.

**Instructions for use Remember to save often**

- 1 Enter stream name in C2.
- 2 Enter Date in G2
- 3 Enter surveyors initials in J2
- 4 Enter site name in C3
- 5 Enter recorder initials in J3
- 6 Enter channel feature being surveyed. Use pool, riffle, glide, run, or other.
- 7 All measurements should be to 3 decimal places. This is all that RiverMorph can handle, so don't record more.
- 8 Enter initial BS reading in D7.
- 9 Start survey at Left End Pin. LEP/Left Bank is determined by facing DOWNSTREAM. XS-1 is the furthest upstream cross section. Number consecutively working downstream.
- 10 Enter station (distance) in column B.
- 11 Use the abbreviations given for descriptor. This is what RiverMorph uses. Record odd things in the comments.
- 12 Enter Descriptor in column C if necessary. Leave blank for streambed or general shots on banks.
- 13 Copy BS reading into column D...unless shooting TP. Then see directions for turn points.
- 14 Enter FS into column F.
- 15 If outside of bankful (BKF) record plant community in column H.
- 16 If outside of bankful (BKF) record plant species in column I...if you know what the dominate 1 or 2 species are. Otherwise leave blank.
- 17 Shoot points that denote features until reaching BKF.
- 18 Calculate BKF width and divide by 20.
- 19 Take shots at this interval between BKF indicators/elevation with additional shots to capture features such as breaks in slope, rocks, point bars, etc.
- 20 Shoot points that denote features until reaching REP.
- 21 End survey at REP.
- 22 Close the loop & calculate error.
- 23 Calculate allowable error.  $0.007 * (\text{square root of } (\text{total distance}/100))$  See bottom of survey page.
- 24 If error is < allowable error you are finished. If error > allowable error check math by hand. If error not found, or still > you need to resurvey the XS.
- 25 Reference Harrelson et al. 1994 for any questions regarding surveying protocol.

**Instructions for turn points See example below**

- 1 Record a distance between the last shot taken and the next shot. Column B. RiverMorph needs this distance to work correctly.
- 2 Record TP in Descriptor column. Column C.
- 3 Shoot and record FS. Enter in column F. Don't move stadia rod between step 3 & 5.
- 4 Move and relevel the level.
- 5 Shoot and record BS. Enter in column B.
- 6 Calculate new HI. (Elevation of TP + new BS = new HI). Or use below.
- 7 Copy new BS reading into column D from this point forward.
- 8 Copy new HI reading into column E from this point forward.
- 9 Repeat if additional turn point(s).

**Turn point example**

Station	Descriptor	BS (+)	HI	FS (-)	Elevation	ant Commun	Plant Species
25.500		2.555	52.555	4.016	48.539	UP	POPR/TAOF
26	TP	2.555	52.555	4.259	48.296		
26	TP	3.025	51.321				
27.500		3.025	51.321	2.732	48.589	UP	TAOF

**Calculations for Turn Points**

Old HI	FS	Elevation	New BS	New HI
		0.000		0.000

Longitudinal Profile

**SURVEY REACH FORM 4: LONGITUDINAL PROFILE - METRIC**

Stream Name: [Redacted] Date: [Redacted] Surveyor(s): [Redacted]  
 Site Name: [Redacted] Survey Units: Metric - meters Recorder: [Redacted]  
 Page 1 BM Elev: 50

#	Station	BS (+)	HI	FS (TW)	FS (WS)	FS (BKF)	Comments
1	-			-	-	-	
2	0.000						
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
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45							
46							
47							
48							
49							
50							
51							
52							
53							
54							
55							
56							
57							

**SURVEY REACH FORM 4: LONGITUDINAL PROFILE - METRIC**

#	Station	BS (+)	HI	FS (TW)	FS (WS)	FS (BKF)	Comments
180							
181							
182							
183							
184							
185							
186							
187							
188							
189							
190							
191							
192							
193							
194							
195							
196							
197							
198							
199							
200							

**Closing the Loop**

Survey Error	50	Allowable Error	0.000
BM Elev. Last Elev.		Distance Surveyed	
50			

**Is survey valid?**      **No**      Note: You will get a No unless you enter values in B217 and G216.

**Instructions for turn points See example below**

- 1 Record a distance between the last shot taken and the next shot. Column B. RiverMorph needs this distance to work corre
- 2 Record TP in Descriptor column. Column C.
- 3 Shoot and record FS. Enter in column F. Don't move stadia rod between step 3 & 5.
- 4 Move and relevel the level.
- 5 Shoot and record BS. Enter in column B.
- 6 Calculate new HI. (Elevation of TP + new BS = new HI). Or use below.
- 7 Copy new BS reading into column D from this point forward.
- 8 Copy new HI reading into column E from this point forward.
- 9 Repeat if additional turn point(s).

**Turn point example**

Station	Descriptor	BS (+)	HI	FS (-)	Elevation	Int Commur	Plant Species
25.500		2.555	52.555	4.016	48.539	UP	POPR/TAOF
26	TP	2.555	52.555	4.259	48.296		
26	TP	3.025	51.321				
27.500		3.025	51.321	2.732	48.589	UP	TAOF

**Calculations for Turn Points**

Old HI	FS	Elevation	New BS	New HI
		0.000		0.000
		0.000		0.000
		0.000		0.000
		0.000		0.000
		0.000		0.000
		0.000		0.000
		0.000		0.000
		0.000		0.000
		0.000		0.000

**SURVEY REACH FORM 7: 50 CUMULATIVE WIDTHS & DEPTHS**

Stream Name:  Date:   
 Site Name:  Survey Units:   
 Surveyor(s):  Recorder:

Survey Increment:      =  
 Transect Length:      =  
 BKF to WS:      =

UPSTREAM					DOWNSTREAM				
#	BKF Width	Depth to Water Surface	BKF Max Depth	W:D ratio	#	BKF Width	Depth to Water Surface	BKF Max Depth	W:D ratio
1					26				
2					27				
3					28				
4					29				
5					30				
6					31				
7					32				
8					33				
9					34				
10					35				
11					36				
12					37				
13					38				
14					39				
15					40				
16					41				
17					42				
18					43				
19					44				
20					45				
21					46				
22					47				
23					48				
24					49				
25					50				

Mean W: #DIV/0! Mean W:D ratio: #DIV/0!  
 Mean D: #DIV/0! Mean BKF max D: #DIV/0!

**Instructions for use Remember to save often**

- 1 Enter stream name in C2.
- 2 Enter Date in H2.
- 3 Enter site name in C3.
- 4 Enter survey units as meters or feet.
- 5 Enter surveyors initials in C4
- 6 Enter recorder initials in H4
- 7 Measure 5 BKF widths and enter into C6, D6, E6, F6, & G6.
- 8 Measure distance between BKF and WS in 5 places and enter into C8, D8, E8, F8, & G8.
- 9 All measurements should be to 3 decimal places. This is all that RiverMorph can handle, so don't record more. Round if you have to.
- 10 Starting in middle of survey reach measure BKF width and max water depth 25 times upstream and 25 downstream. Measurements should be taken at the distance calculated in I6.