Attachment N

Review of Focus Questions
from
Core Science Report
Dolores River Dialogue

Cold Water and Native Fisheries
Dolores River
below
McPhee Dam

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Figures

Tables

DOLORES RIVER DIALOGUE

BACKGROUND The Dolores River Dialogue ("DRD or Dialogue") is a multi-stakeholder effort aimed at improving the environment of the Dolores River downstream of McPhee Dam, while protecting or enhancing human uses of the Dolores River resource. The dialogue is considering a range of creative alternatives. The practical actions that may result from this effort fall into three categories:1) river channel work (maintenance, restoration, habitat improvement); 2) spill flow management / enhancement; 3) base flow – pool management /operation; and/or 4) some combination of these three strategies. Specific alternatives may include, but are not limited to, re-timing downstream releases, efficiency/infrastructure improvements, interruptible supplies, new storage, new supplies, stream habitat improvements, and weather modification.

The specific objectives and information presented below was gleaned from Dialogue meetings, and reports and include the: Plan to Proceed, Core Science Report, Correlation Report and Hydrology Report.

If the Dialogue is to meet certain objectives the objectives have to be well defined and achievable with agreed upon, measurable goals. Below I present some specific objectives with some measurable goals in regards to the native fisheries and the cold-water sport fishery. The most difficult

Water quality objectives can be linked to baseflows (i.e. temperature) habitat objectives more difficult to link to peak and base flows.

The purpose of this review is to:

1. Update the DRD on the current knowledge and work completed in regards to the cold-water and native fisheries,
2. Review questions outlined in the Core Science Report,
3. Establish specific, measurable goals in regards to the fisheries,
4. Prioritize future research, both literature and field work,
5. Fill in knowledge gaps and goals from the various experts that are working on the fisheries issue.
6. Make recommendations for priorities and experiments

Objectives:

1. Maintain a consistent, cold water fishery (**goal** = 32 pounds of trout/acre/year, self supporting Brown Trout fishery and a stocked Rainbow Trout fishery) in Reach 1.
2. Maintain a reproducing, native fishery in Reaches 3 through 8 (**goal** - self supporting fisheries containing Bluehead Suckers, Flannelmouth Suckers and Roundtail Chubs).

Needs

To maintain a cold water fishery requires:

1. unpolluted water (**measurement**: water quality analysis passes all Colorado State Standards for Cold Water Fisheries),

2. cold water (**measurement**: water temperature not greater than 64.8°F for a period longer than 24 hours measured at Bradfield Bridge at a depth of 1 meter and water temperature *never* reaching 74.8°F measured at Bradfield Bridge at a depth of 1m)
3. sufficient amounts of dissolved oxygen (>6mg/l) **measured** between 0000 and 0700 hours at 1 meter depth measured at Bradfield Bridge at a depth of 1 meter, and,
4. sufficient habitat that includes deep (how deep, how many per linear stream length?) pools, riffles and runs and adequate base flows (what cfs is an adequate base flow?). **Graf's response: These questions are still being debated. Basically understanding of 'reference' streams in the region of similar size suggest that pool depths at least 6 feet at baseflow with sufficient structure would be adequate. One pool every 300-400 feet (concurrent w/ pool-riffle sequencing) would be expected, and this may be present on the more confined reaches that were not historically farmed, mostly on USFS property. The CDOW lands below the bridge were mainly the ag lands, which show a certain measure of disturbance, probably through channelization (to maximize irrigable lands) or through entrenchment that ran concurrent w/ cattle grazing (bank destabilization, downcutting, channel widening, and subsequent lack of enough stream power to re-create meander morphology w/in the newly entrenched channel). Lack of sufficient sediment inputs from the large earthen plug upstream has also hindered channel recovery. As to adequate cfs, the jury is still out, with 50 cfs being sort of base line that still allows upstream/ downstream mobility by fish. (Nehring comment to DG).**

<u>Current Status</u>

- Quality of cold water fishery is currently deemed poor and at risk because the goal of 32 pounds/acre of trout has not been met since 1996 (Figure 1). In October 2008 it was 29 lbs/acre. **Graf's Response. I'm thinking the lbs/ac could be up a bit in 2009. Generally, fish are good quality (body mass index measurements) but age class structure remains poor. Most sampling sites are characterized by a few big fish, a small assortment of 2+ yr fish (5-8 inches), and essentially nothing less than 4 inches. We did pick up quite a few of the Hofer strains of rainbow released last year (these are more WD resistant), which was good news.**

- Water quality in reach 1 is deemed poor because water temperature exceeded the chronic temperature threshold (64.8°f) for more than 24 hours in 1990, 2002, 2003 and reached the acute temperature threshold (74.8°f) in 1990, 2002, and most likely in 2003 and, when measured in 2008, the concentration of dissolved oxygen was less than the criteria of 6mg/l in September 2008 at a flow of 40cfs (Figure 3, Figure 4, and Figure 5).

- Quality of cold-water habitat is currently deemed ????? because of ????? **Graf's Response: I'd say it's marginal, with the worst sites being on CDOW (see comment above re: agricultural lands) and the better, more 'intact' reaches resembling their historic meander patterns w/ adequate pool/riffle spacing and deeper pools. The 'sediment starvation' issue I believe is a real one that hinders the river's ability to maintain clear transitions between pools, glides, runs, and riffles, with much of the channel resembling long, over-wide, shallow runs, and w/out much in the way of**

structure (either large woody debris, overhanging well shaded banks, or large clasts). Large boulders in the channel tend to be somewhat buried by the D50 cobble (~ 75 mm). I think it would not be too much of a stretch to quantify habitat types in the first 12 miles (ie, poor, adequate, (nearly) fully functional) based on aerial photography, in order to get better resolution on the actual miles of stream that might need some more proactive remedial activity (e.g., the D9 solution).

- Quality of native fishery is currently deemed poor and at risk because Bluehead Sucker and Flannelmouth Sucker have declined drastically or have completely disappeared since 1993 (see Jim White Presentation) in reaches 2-8.
- Roundtail Chub populations are considered common (verses abundant or rare, Figure 2).
- Roundtail Chubs are listed as a U.S. Forest Service sensitive species and a species of special concern by the DOW.
- Quality of native fishery habitat is currently deemed poor because of the lack of deep runs, riffles and adequate base flows (With adequate base flows would there then be adequate deep runs and riffles?) **Graf's Response: the numbers I that Anderson gives are a bit unrealistic (300 cfs is optimal) but he also suggests 60 during a spill year, and of course more water (80 cfs) during non-spill years to address the 'deep riffle' needs of natives** and the presence of non-native fish such as smallmouth bass, green sunfish, channel catfish, black bullhead, fathead minnows, carp, brown and rainbow trout (which non-natives do we need to get rid of?). **Graf's Response: Green sunfish, smallmouth bass on top of the list. Black bullhead were a significant component in big gyp during 2002-2005, but grew over years of non-spill and shortage (2001 – 2004) and virtually disappeared after the first big spill in 2005. I haven't seen Dan Kowalski's more recent surveys in Big Gyp to see where that's at now, but more flow definitely = less bullhead. Channel catfish are also a concern, but their population is pretty thin and holding. So far (hold your breath) no white suckers, so that is the best news for the suckers at this time.**
- **RE: roundtails: roundtails are deemed 'common' (as opposed to abundant or rare), according to Jim W. They represent a decent percentage of each catch below the pumps, with some semblance of different age classes represented. Conundrum is these Dolores RTC are literally dwarfish when compared against other roundtails in the region, with maturity (spawning color) observed in 6" fish. Very rare to catch one over 10", while they regularly grow to 12-14" elsewhere. The roundtail was recently petitioned for listing in the lower basin as a 'Distinct Population Segment' (DPS), and USF&WS response was 'warranted so placed it on the 'candidate' 'species list. This essentially says "we agree with the petition but there are higher priorities at this time". The relevance of this is that the same DPS argument could easily be made for these fish in the Upper Co River basin.**

Cold Water Habitat

Knowns

Good cold water habitat includes deep pools, riffles, overhanging banks, in-stream, woody material (i.e. logs and logjams) and overhanging riparian vegetation (a productive, riparian community).

- Productive riparian communities and deep pools are a function of
  1. timing of peak flows,
  2. size of peak flows,
  3. duration of peak flows,
  4. size of base flows (see Science Report), and,
  5. land use practices (*i.e.* grazing practices).
- Amount and timing of water releases from McPhee Reservoir are tied to water rights in McPhee Reservoir (see Hydrology Report).
- Habitat may be enhanced utilizing in-stream habitat improvements (is this really a long-term solution/reality given the costs?) **Graf's Response: See comment re: CW habitat above – it would be possible to prioritize the worst 1-2 miles, and monitor on a few of the other poorer reaches (2-4 miles), and more or less leave the other 6-8 miles untouched.**
- How much water and when water can be released from McPhee Reservoir is governed by climate, weather, water rights power generation, and concern over releasing non-native fish (such as small-mouth bass and white suckers) into the native fisheries over the McPhee Dam spillway.
- Flow releases from McPhee Reservoir between 1986 and 2009 have had minimal, beneficial effects on the productivity of the riparian community (especially in reaches 2 - 8) or in enhancing the quality of both the cold-water and native fish habitats. **Graf's Response: Point must be made that prior to McPhee, there really was no coldwater fishery, so for sure, that has been a project enhancement. Riparian community has benefited from changing land ownership to public management, which essentially removed cattle from the 12-mile reach above Bradfield (there are a few, but riparian damage is negligible). In some sub-reaches, this has allowed the development of a riparian community that was not present before the dam, and encouraged vegetative encroachment (predominantly early seral Coyote willow and sedge) to colonize. Veg encroachment on sediment bars below Disappointment Ck has the opposite effect for the native fishery – it reduces channel capacity and increases competitive stressors on natives. However, peak flow magnitudes have been most impacted further downstream, exacerbating the channel narrowing problem, since reduction in stream power reduce the volume to be moved through the system. I'd expect to see channel aggradation, but to date, this hasn't been studied much. Maybe the Big Gyp site will pick this up, and with it, better meander morphology in the alluvial reach. The opposite could be true, as channel narrowing through encroachment could pinch higher flows in a smaller channel, further degrading the bed and creating greater entrenchment instead of lateral scour and floodplain development. Would be a good thing to explicitly monitor in Big Gyp.**

Biggest impact in post-dam world are the reduced frequency of peak flows, lack of sediment influx in the upper reach (hindering the recovery), and no-spill years, which have direct negative consequences on the trout fishery. Shortage years (reduced project allocation) are frankly, a disaster that should be addressed – this may be the BEST way to use any lease money, and I think would provide the most direct benefits for t he fishery. Note – there have been only two, in 2002 and 2003 in 23 years of project operations. I would predict more on the horizon…

Conclusions (Graf's responses in bold)

The Dolores River below McPhee needs more water for the purpose of increasing the size of peak flows, **(Above Bradfield, probably OK to more or less match what comes in at Dolores)** increasing the duration of peak flows **(Duration is key to moving sediment, but LACK of source sediment in first 12 miles is problematic. Over time, the river should adjust by lateral scour, but in certain reaches, the channel is over-wide under under-powered to be very effective)** and to better manage the timing of peak flows (see Hydrology Report). **Peak timing not so important in this reach, since native cottonwood (Narrowleaf) are mainly root propagators. The timing issue relates mainly to the recession side in terms of drawdown, date of peak, in order to match cottonwood seed set in the lower reaches (4-6 and beyond). We had some notion we could 'leverage' peaks from Disappointment or lower tribs to max cfs in the low river, but the relative benefits and timing issues make this relatively unfeasible in my opinion. (ie, Disappointment peaks at maybe 200 cfs…. And we want a 5000 cfs peak at Bedrock…? That still requires a BUNCH of water going downstream, with very little 'leverage' coming from the lower tribs.) BASEFLOWS remain the biggest concern above Bradfield, with a 'quality' fishery probably developing around 100 cfs, and a baseflow of 78 cfs producing a 'good' sustainable coldwater fishery. (Opinions of our fishery biologists).**

Potential Solutions

1. leased water.

   Unknowns: How much water can potentially be leased and its effect on the size of peak flows **(Negligible, unless it's all realeased at the same time)**, the length and timing of peak flows, the frequency of peak flows and subsequent effects on habitat **I would again re-iterate that any leased water would best be used for baseflow, with the most beneficial effects felt during an allocation shortage. IF lease is an option, I would suggest a separate 'lease water account' with a carryover option to hedge against the shortage years.**

2. Mechanical improvements of habitat **Simply put, this is possible, I think it would help, but it will cost a lot of money to do it well (very rough estimate ~$400,000/mile).**

Temperature

Knowns

- The chronic temperature threshold for trout (64.8°f) was exceeded for several 24-hour periods in 1990, 2002, and most likely in 2003 (Figure 4, Figure 5 and Figure 6).
- The acute threshold for trout (74.8°f) was exceeded several times in 1990, 2002 and most likely in 2003 (Figure 4, Figure 5 and Figure 6).
- The model suggests that neither of these temperature thresholds were exceeded during years other than 1990, 2002, and 2003
- Trout biomass has declined during the normal and wet years between 1993 and 2001 with an increase in trout biomass in 2008 (Figure 1).
- When the fish pool *cannot* be 100% met (summer flows < 75cfs), water temperature is an issue of concern.
- **(instream flow targets?)** *cannot* be 100% met (summer flows < ~~75~~ **78** cfs), water temperature is an issue of concern. **(78 cfs is the CWCB ISF for McPhee to the confluence of the San Miguel River)**
- When the fish pool *can* be met (summer flows >75cfs) temperature is not an issue of concern (Figure 7).
- Acute toxicity due to polluted water does not appear to be an issue given the diversity of benthic macroinvertebrates (bugs) and the lack of deformities in the fish populations (see BMI Report). **NOTE – whirling disease remains an issue, though not specifically water quality (it's habitat – too much slow water and muddy sites for tubifex worms). Hofer strains of rainbow could improve this situation.**

Dissolved Oxygen

- There are high amounts of algae in Reach 1 compared to other streams in the region (
- Figure 8 & Figure 9).
- The amount of algae in Reach 1 is a function of water being released from the deep layers of McPhee Reservoir through the gates and the bypass piping in McPhee Dam (Figure 10 and Figure 11)
- Highly reactive nutrients (orthophosphate, nitrates, nitrites, ammonia) are generated at the bottom of reservoirs because of high pressure and low dissolved oxygen levels and these highly reactive nutrients are released into the Dolores River from McPhee Dam through the gates and the bypass piping.
- From which outlet through McPhee Dam water is released from is governed by: the amount of flow that is required to be released **(requested by the Biology Team)**, concern over releasing non-native fish, and for generating power.
- Low concentrations of dissolved oxygen in Reach 1 is a result of the amount of algae (organic matter decomposition) in Reach 1 (Figure 3).

Unknowns

- Need more data on dissolved oxygen
- Which non-native fish in McPhee Reservoir are we primarily concerned with? **White sucker; green sunfish; smallmouth bass; maybe others (walleye?) – some like bass and sunfish have proven they can persist in the river.**

- Are we still concerned with releasing small-mouth bass from McPhee given that they are already in the Dolores River below McPhee? **Yes, we don't want any more and remediation is a significant part of the downstream sampling/ monitoring CDOW tries to get accomplished during spill years.**
- It is unknown what quantity of highly reactive nutrients are released through the 3rd SLOW into Reach 1 but the quantity is likely much less than what is released through the gates and the bypass piping.
- Winter, low flows are a concern to the over wintering of ???? stages of fish (Nehring)? **Related both to incubation of brown trout eggs – anchor ice presumably would destroy them – and habitat 'concentration' by low flows in too few pools with too little structure. We (CDOW) has not officially re-visited this issue since Nehring's work in ~1993. Unsure to what extent you could have DO issues related to algae growth and decay beneath an ice sheet in the winter, but might be worth investigation.**

Potential Solutions

1. Eliminate releasing water from the bypass pipe during the summer/fall base flows when algae production is greatest.

Non-native fish

Knowns

- Small mouth bass, green sunfish, channel catfish, black bullheads and fathead minnows are the non-native fish currently live in Reaches 3-8.
- No white suckers currently live in the Dolores River downstream of McPhee Reservoir.
- White Suckers live in McPhee Reservoir and are a major concern for the native fishery because of hybridizing with Bluehead and Flannelmouth suckers.
- Water has been consistently released from the SLOW no. 3, the bypass pipeline and the gates in McPhee Reservoir.
- The SLOWs were built for the purpose of maintaining water quality in the Dolores River below McPhee Reservoir.
- The SLOWs were built on a shelf near the dam and the 3rd SLOW, the one where water is primarily released from, is less than 20 feet from the benthos, the habitat where white suckers are primarily found Figure 14 and Figure 15.
- The fact that white suckers are not in the river says something about the design of the SLOWs or the probability of the suckers surviving such a drop, the negative pressure vacuum created by the drop, the turbines or, maybe the suckers don't like being sucked down huge holes and avoid the the SLOWs entirely?
- The chances of eggs or larvae of white suckers entering the SLOWs appears slim as well since the suckers breed in lotic systems and these systems are quite-a-ways from the dam.
- No water has ever been released from the SLOW no. 1 and the SLOW no. 2.
- Flow through the SLOWs supplies normal flows for the power plant, up to 75 CFS. Between operating flows of 25, 50 and 75 and above 75 CFS up to 120cfs, the difference is made up with the By-Pass pipe at the bottom of the reservoir. Greater than 120cfs (max release is 5000cfs) the outlet gates at the bottom of the reservoir are used. The way the

power plant is set up, for emergency bypass, extra water cannot be run through the SLOWs, only 25, 50 & 75 CFS.

- A thermo-cline and oxy-cline develops June through October in McPhee Reservoir that ranges in depths between SLOW no. 1 and SLOW no. 3 (Figure 10 and Figure 11, Figure 12).
- Non-native fish do not venture to depths in the reservoir where they can go through the bypass or the gates.
- A small mouth bass was gill-netted below the level of the 3rd SLOW (Figure 12).
- Other fish live at or below the level of the 3rd SLOW (sonar data) (Figure 12).
- White Suckers are bottom dwellers living off of benthic invertebrates and detritus and are forage fish for predators such as Kokanee, trout, Pike, and bass. White suckers tend to congregate in the bottom waters of cold, oligotrophic (nutrient poor) lakes (Rohde *et. al.* 1994).
- The water in McPhee Reservoir turns over (mixes from top to bottom) every October or November and the temperature and dissolved oxygen clines disappear in the reservoir from November through May (Figure 10 & Figure 11).
- The CDOW completed a study of fish survival out of McPhee reservoir in ??? and there was no indication of survival of non-native fish through the SLOW No. 3 (was the water going through the turbines?).
- There were documented releases of small mouth bass from McPhee to the reaches of the Dolores River below McPhee when water flowed over the spillway in ????

Conclusions

- Temperature and dissolved oxygen are the primary water quality concerns for the coldwater fishery (Reach 1) during the months of July through September.
- It does not appear that releasing non-native fish through SLOW 2 needs to be a concern, especially when the water is going through the turbines in the power plant.
- Water quality in the reaches below McPhee may be improved during the months of July through September by allowing more water to be released through SLOW 2 and SLOW 3 with very little danger of releasing live, non-native fish to the Dolores River below McPhee Reservoir.
- It may be better to release exactly 25, 50 or 75 cfs through the SLOW 3 for power generation than to release any water through the bypass pipe when algae growth is at a maximum (July through September) **QUESTION – is it possible to release water that is not incremental for power through the SLOWs? Ie, if flow request was for 60 cfs, could you run all 60 through SLOW 3 or 50 through SLOW 3 and 10 through SLOW 2? See also question above re: non-incremental flow releases.**

Unknowns:

1. Impact of rate of ramping up and ramping down flows on different life stages of cold water fish in Reach 1.
2. Impact of rate of ramping up and ramping down flows on reproductive success of cold-water fish?

- **We remain uncertain what constitutes 'optimal spawning conditions'. Similar to cottonwood propagation, if we could re-create these every ___ years when**

hydrologic conditions allow, it may be possible to 'manage spawning' through reservoir operations rather than just hoping that random releases will adequately address spawning needs.

Native Fishery

To maintain a native fishery requires unpolluted water, adequate habitat for all life stages including habitat for reproduction, minimal competition and predation from, and no interbreeding with non-natives.

Sufficient habitat for native fisheries includes (need to better quantify):

1. deep riffles,
2. deep runs,
3. backwaters and,
4. side channels,
5. riparian trees.

- Reporting of scouring of pools to bedrock (6-8ft deep) in the spring high flows and refilling of the pool by the end of August from sediment coming from Disappointment Creek (Crocker-Bedford's, (Figure 17)
- Regeneration of cottonwoods and other riparian vegetation has occurred (not quantified) since 1995 at Crocker-Bedfords (Figure 18).

Unknowns

1. The impact of chronic sediment loading from Disappointment Creek and its subsequent impact on habitats (i.e. filling in deep pools and smothering reproductive areas)?
2. Dissolved oxygen, temperature measurements and organic loading from upstream reaches?**Data and literature reviews that need to be completed:**

- Habitat data and information in the Dolores and habitat needs of trout and native fish.

Data needs:

- Nutrient concentrations in McPhee in relation to the thermocline in each season.
- Dissolved oxygen concentrations in the Dolores in different reaches during low flows.

Potential Experiments:

- Habitat: maximize flows (5000cfs) from the dam for as long as possible, measure before and after in-stream habitat variables and changes throughout the year.

- Water quality during summer months: Release water from SLOWs only during summer (July through September) low flow periods. Measure changes in algal biomass in Reach 1.

Recommendation:

- The DRD prioritize water use and experimental use of water between
  1. Rafting,
  2. Cold water fishery in reach 1, or,
  3. Native fish in reaches 2-8.

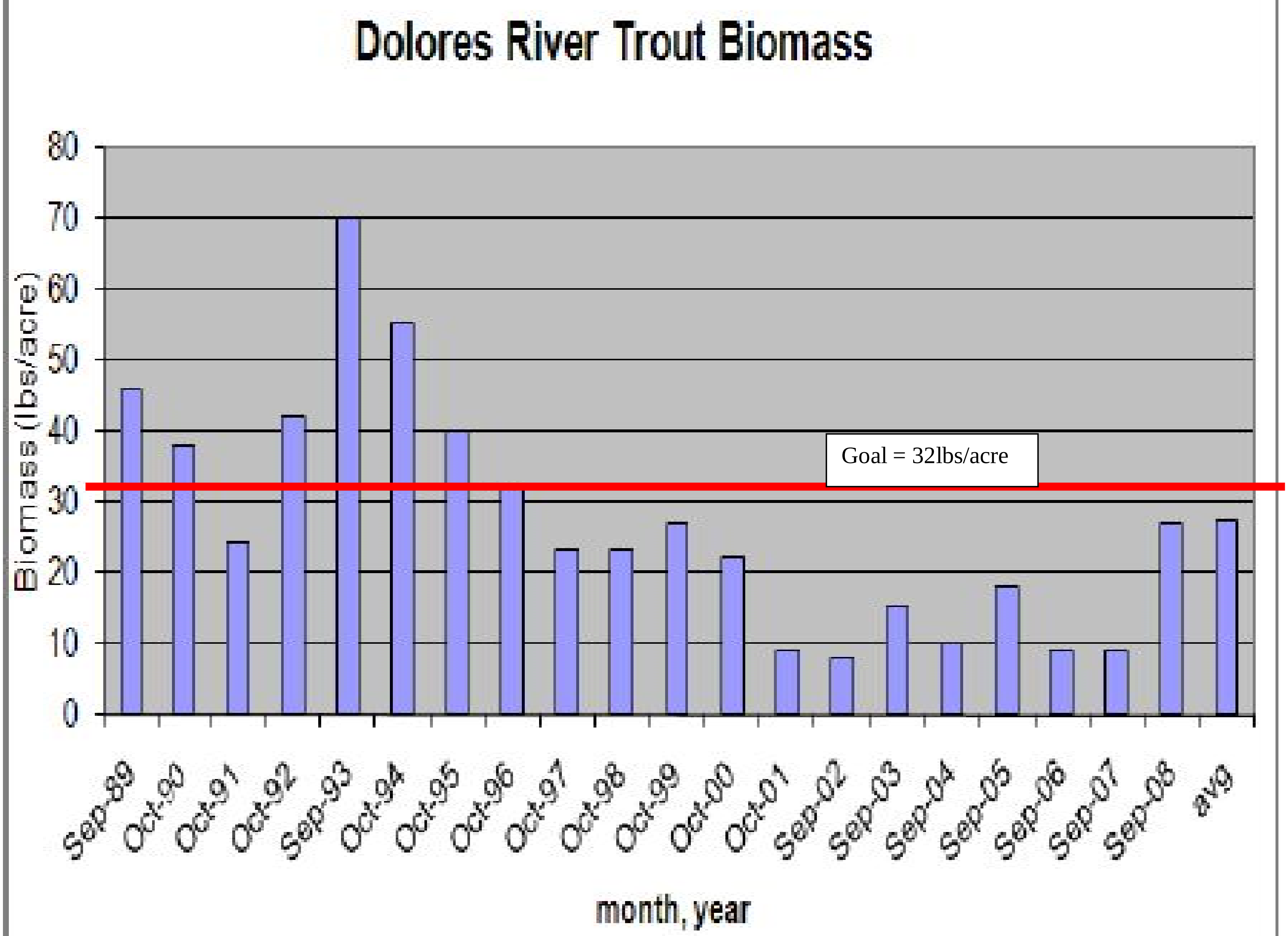

Figure 1. Trout biomass/acre in Reach 1 (Jim White CDOW Data). Goal = 32lbs/acre.

Question - what, if any, operational changes occurred between 1991 and 1993 (increasing trout biomass/acre) that was different from the period 1993 to 2001 (decreasing trout biomass/acre, see figure 5)? **Graf's Responce – Your figure 6 (long term discharge data from McPhee) shows it well – this was when we went from an 'indexed' flow regime (ie, 78 wet, 50 ave, 20 dry) to the 'managed pool'. Since ALL the early years had baseflow of at least 50 cfs, and more often, well over 78 cfs, the change to the managed pool reduced baseflows significantly, which you can see from the figure. There was a brief period in ~ 1989 where the index went to 20 cfs, but it was quickly changed to 50 cfs due to the immediate recognition that 20 cfs would not sustain the fishery.**

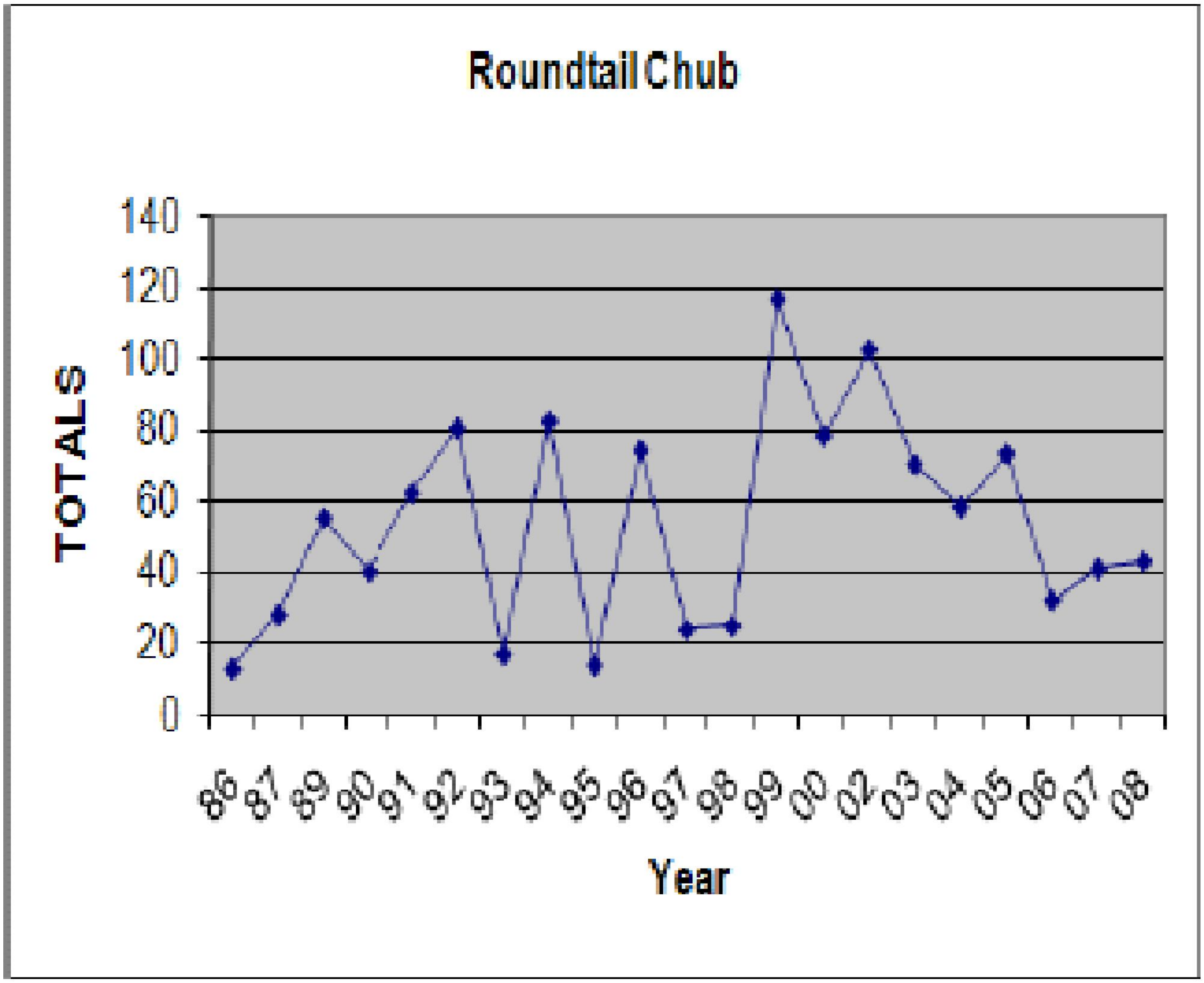

Figure 2. Roundtail Chub @ Dove Creek Pumps?

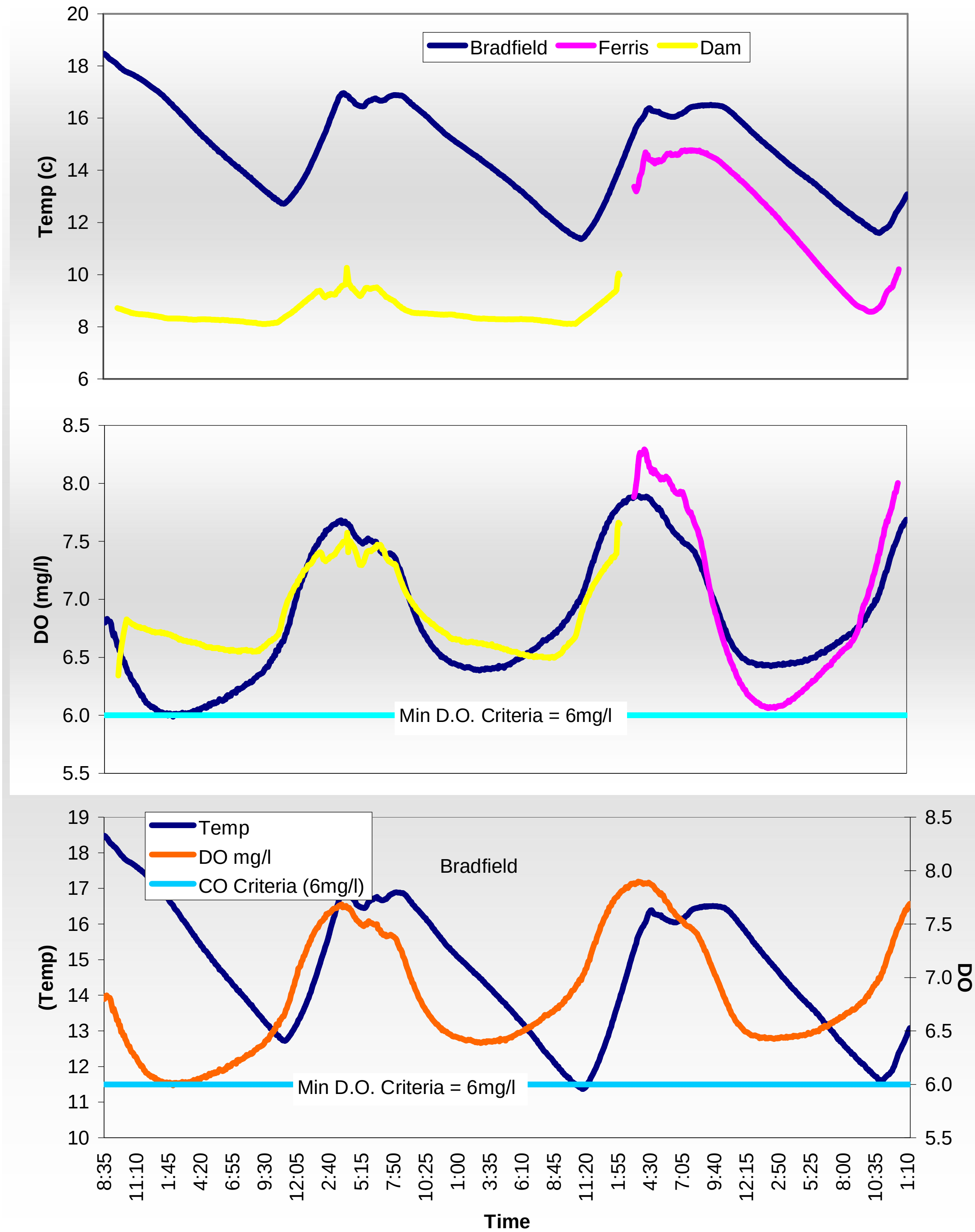

Figure 3. Temperature and dissolved oxygen data obtained with a sonde at 3 sample stations: Below McPhee Dam, Ferris Creek Campground and Bradfield Bridge, September 17-19th 2008. Note the low DO concentrations (5.99mg/l @ Bradfield Bridge and 6.06mg/l @ Ferris Creek Campground and 6.55mg/l @ the Dam measured in the early morning and due to decomposition of organic matter. The State standard for Trout Fisheries is 6mg/l. The chronic temperature threshold for trout (18.22C) was not exceeded during the time period. Discharge from McPhee Reservoir was 40cfs.

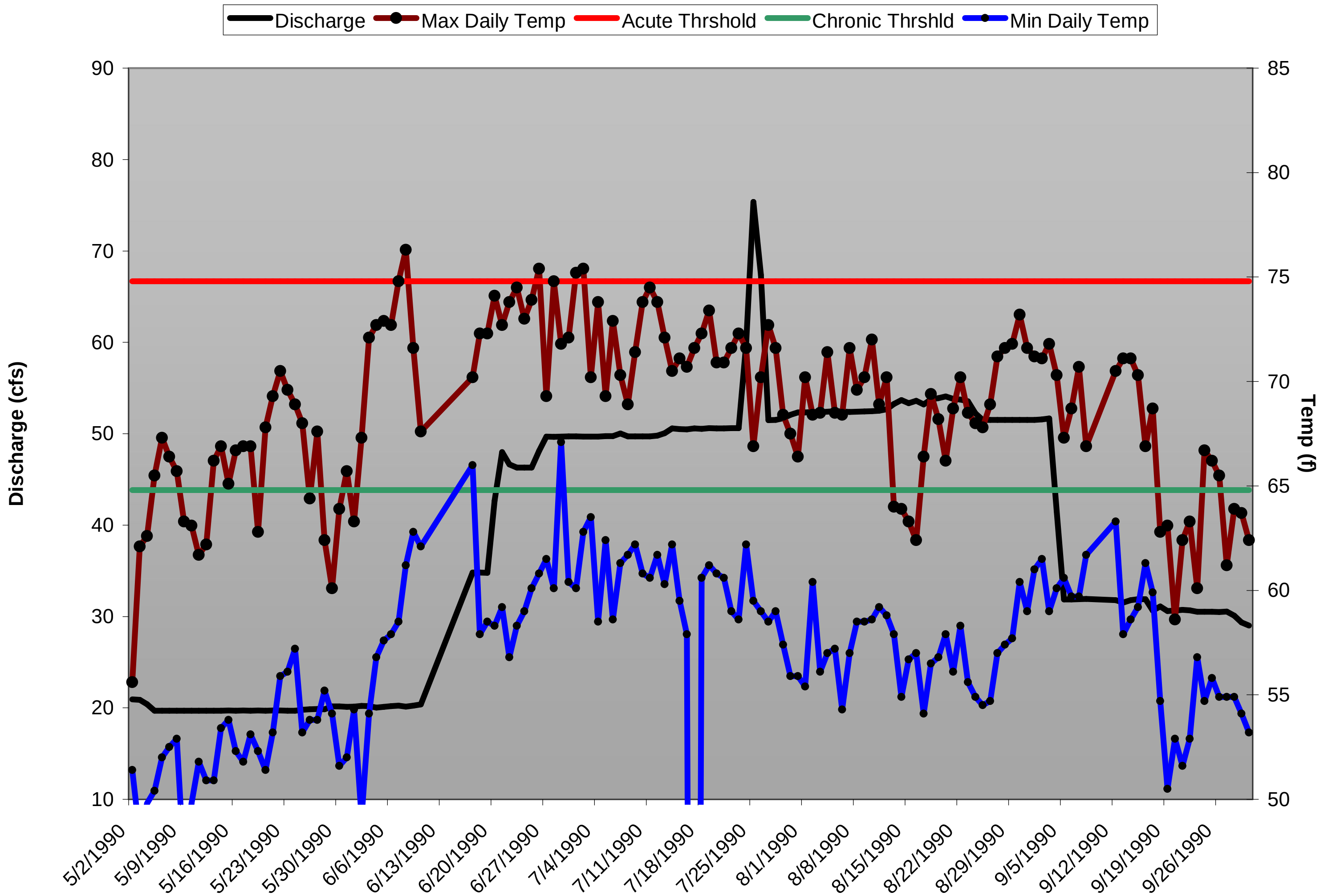

Figure 4. May through September daily maximum and minimum temperature and flow data during the 1990 drought, measured at Bradfield Bridge. Note that the chronic temperature threshold for trout was exceeded twice for periods greater than 24 hours and the acute temperature threshold was exceeded on 5 dates.

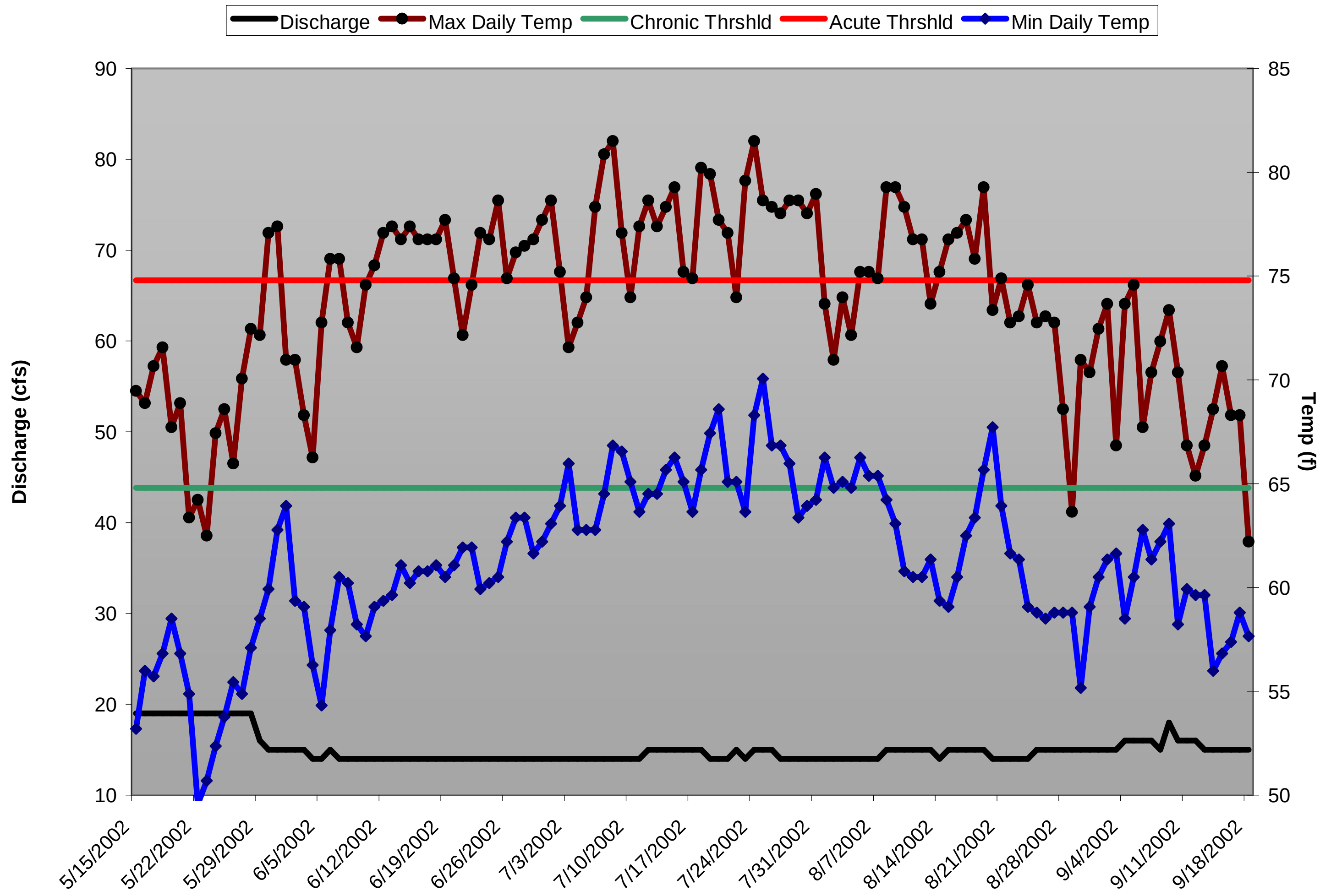

Figure 5. May through September daily maximum and minimum temperature and flow data during the 2002 drought, measured at Bradfield Bridge. Note that the chronic temperature threshold for trout was exceeded several times for periods greater than 24 hours and the acute temperature threshold was exceeded on numerous occasions.

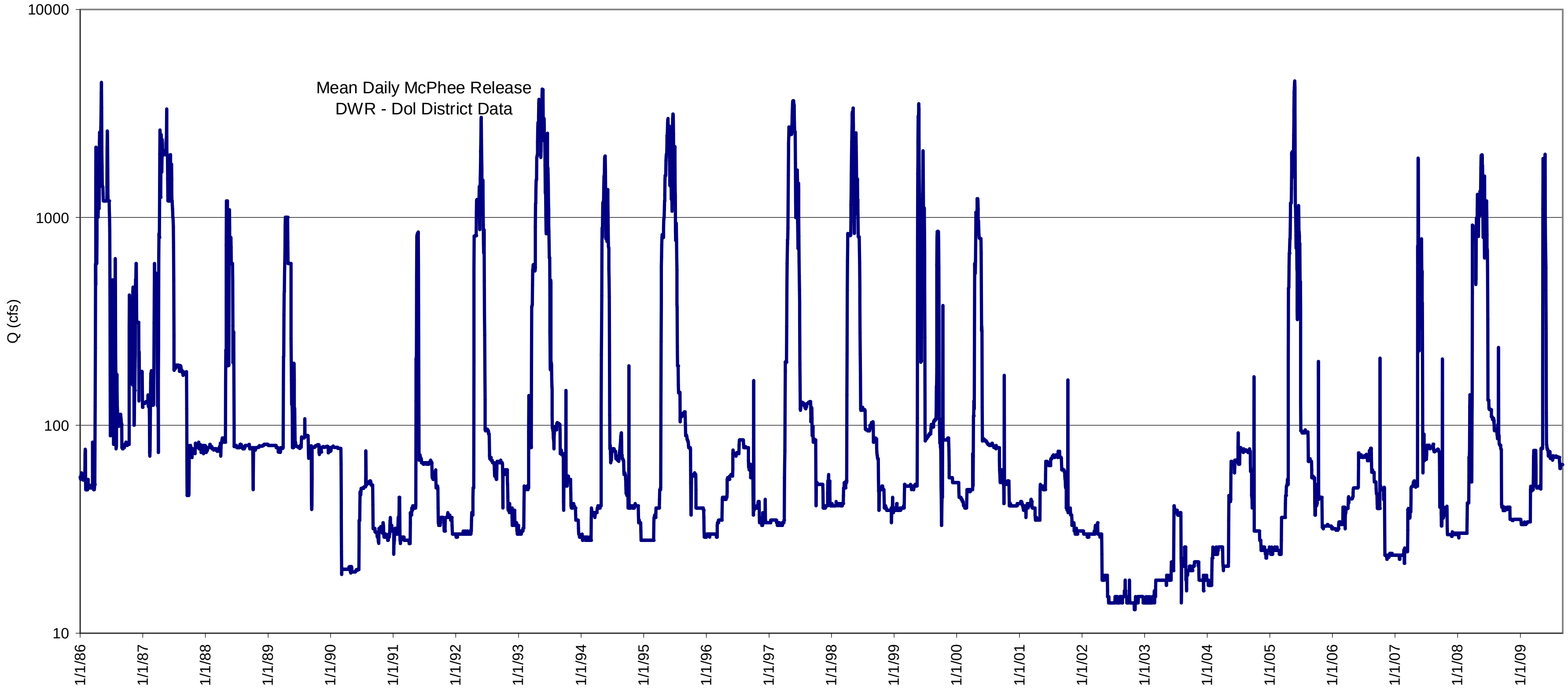

Figure 6. Discharge data from McPhee Reservoir illustrating the low summer/fall flows in 1990, 2002, and 2003.

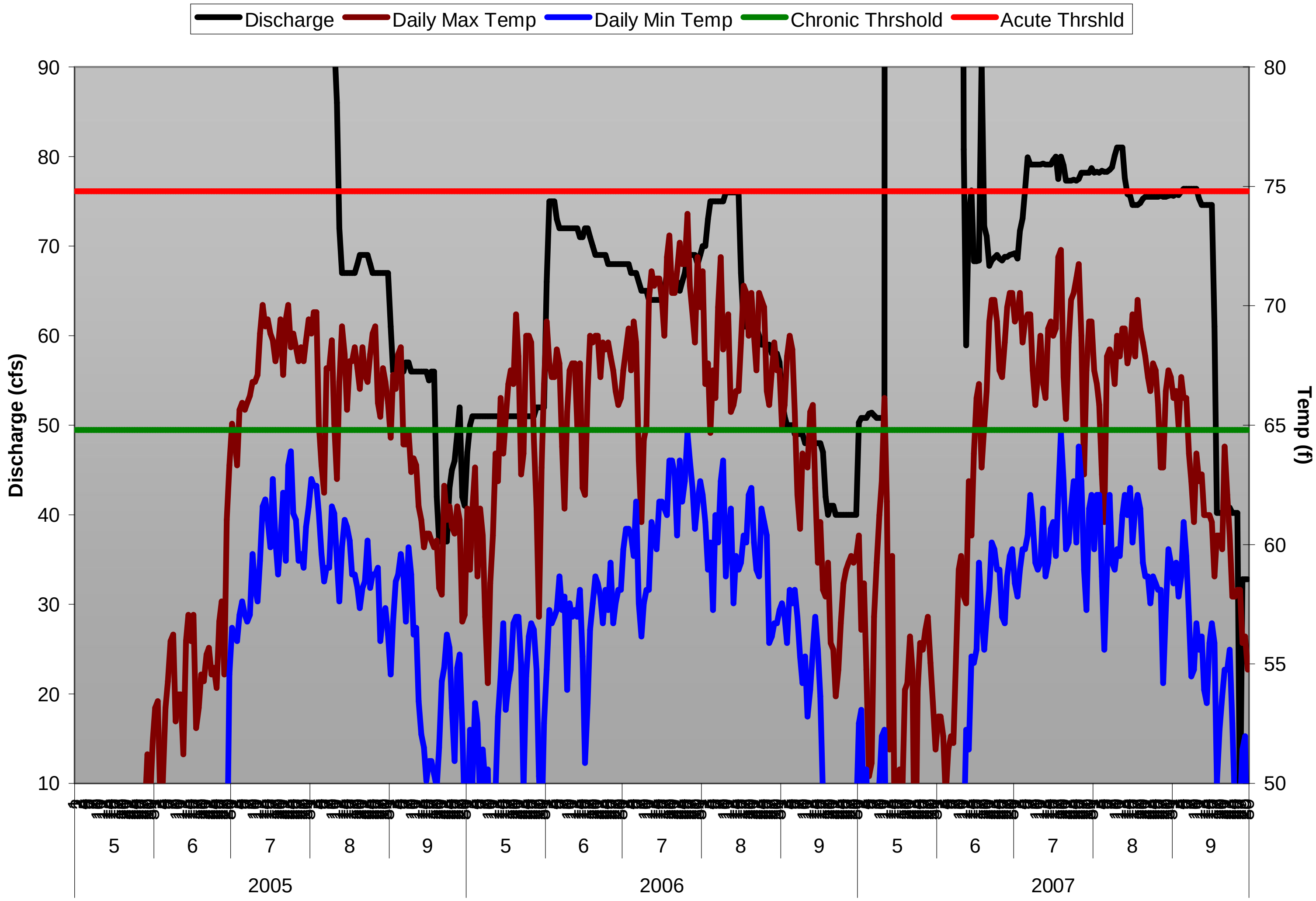

Figure 7. May through September daily maximum and minimum temperature and flow data from 2005, 2006 and 2007 measured at Bradfield Bridge. Note that the chronic temperature threshold for trout was never exceeded for a period of 24 hours and the acute temperature threshold was never exceeded on any date.

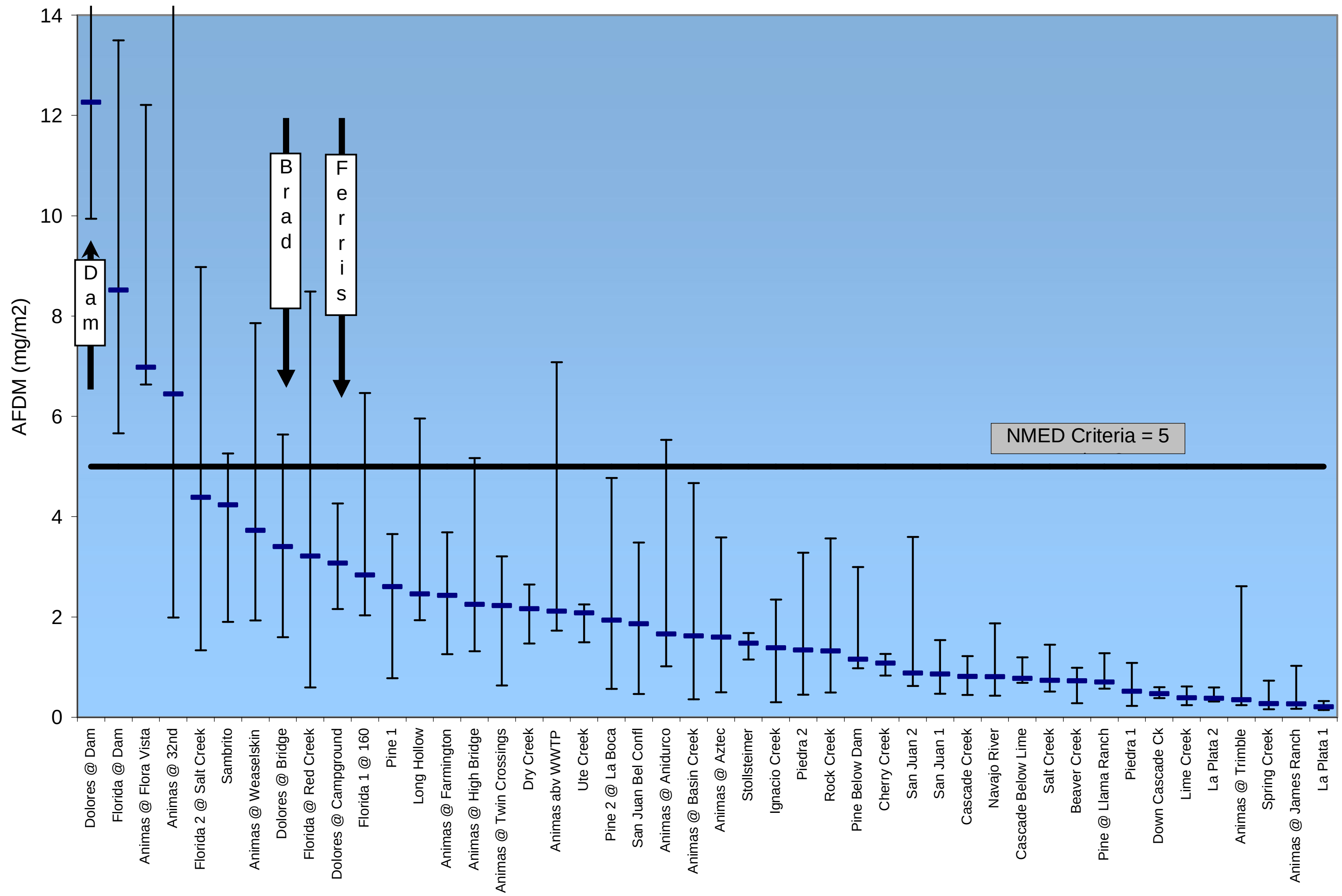

Figure 8. Quantity of organic matter (median ± 75th and 25th percentile) in relation to other streams in the region. Note, the Dolores sites are at the high end of the spectrum. The New Mexico Environment Department has established a regional criteria of 5mg/m2. Colorado is in the process of setting nutrient criteria.

Figure 9. Periphyton in the Dolores below McPhee Dam.

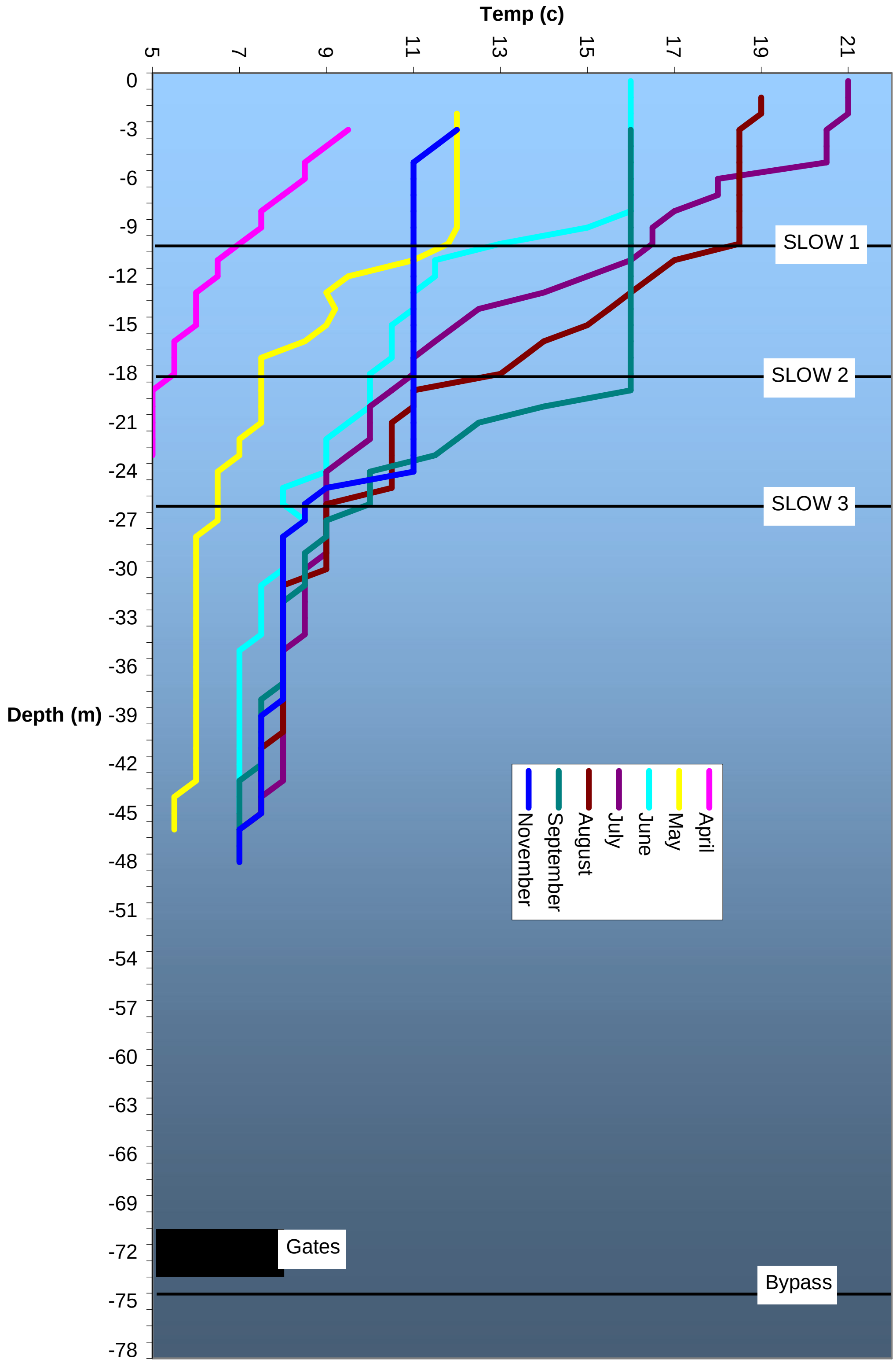

Figure 10. Thermoclines for McPhee Reservoir measured at the dam in 1987 in relation to the SLOWs. Note that the top of the thermocline was between SLOW 1 & 2 for the September and November sample dates and at or above the SLOW 1 for May, June, July and August sample dates and non-existent for April.

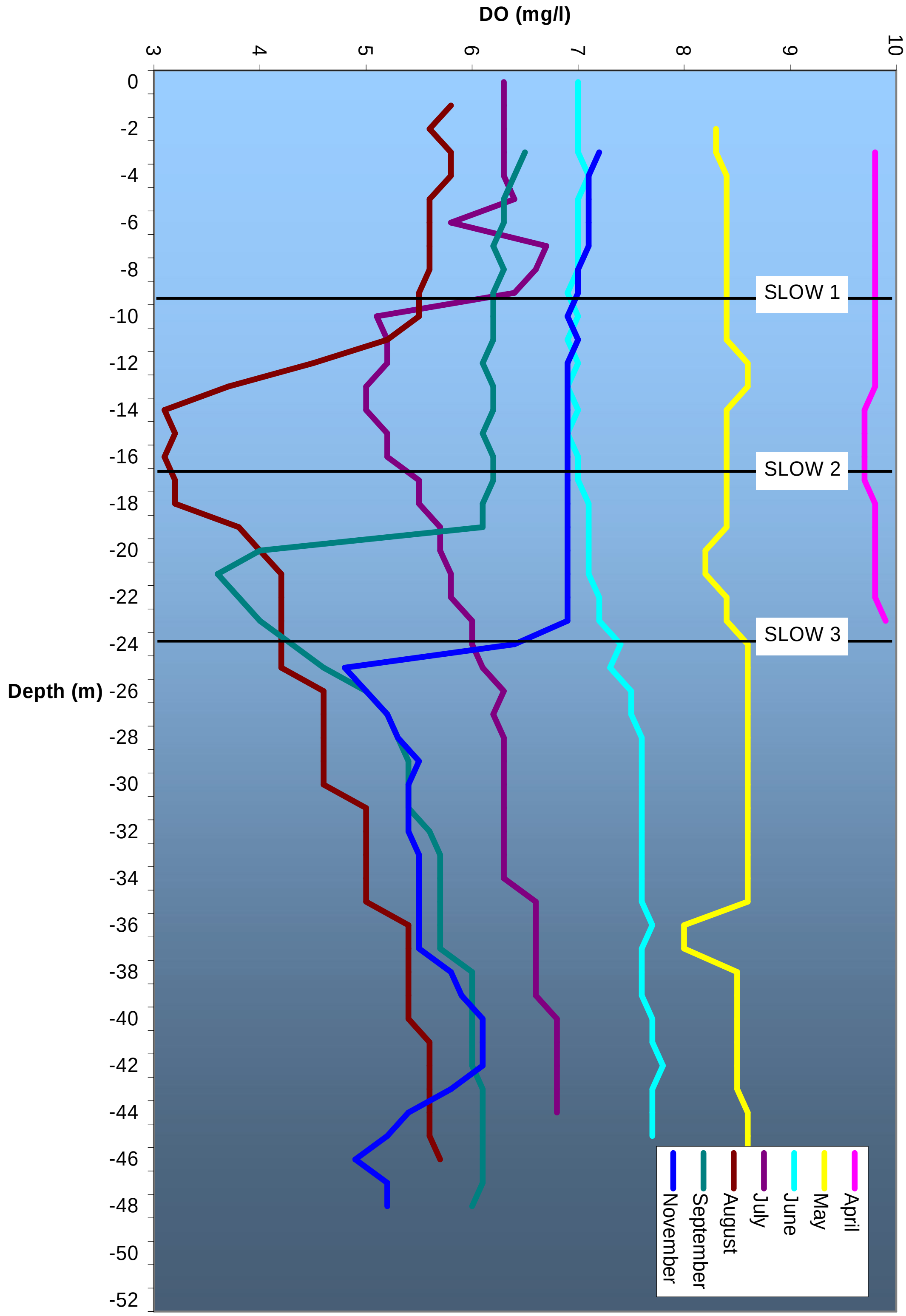

Figure 11. Dissolved oxygen-clines for McPhee Reservoir measured at the Dam in 1987 in relation to the SLOWs. Note that the top of the oxygen-cline was between SLOW 2 & 3 for September and November and between SLOW 1 and 2 for August and at or above the SLOW 1 for July and non-existent for April and May.

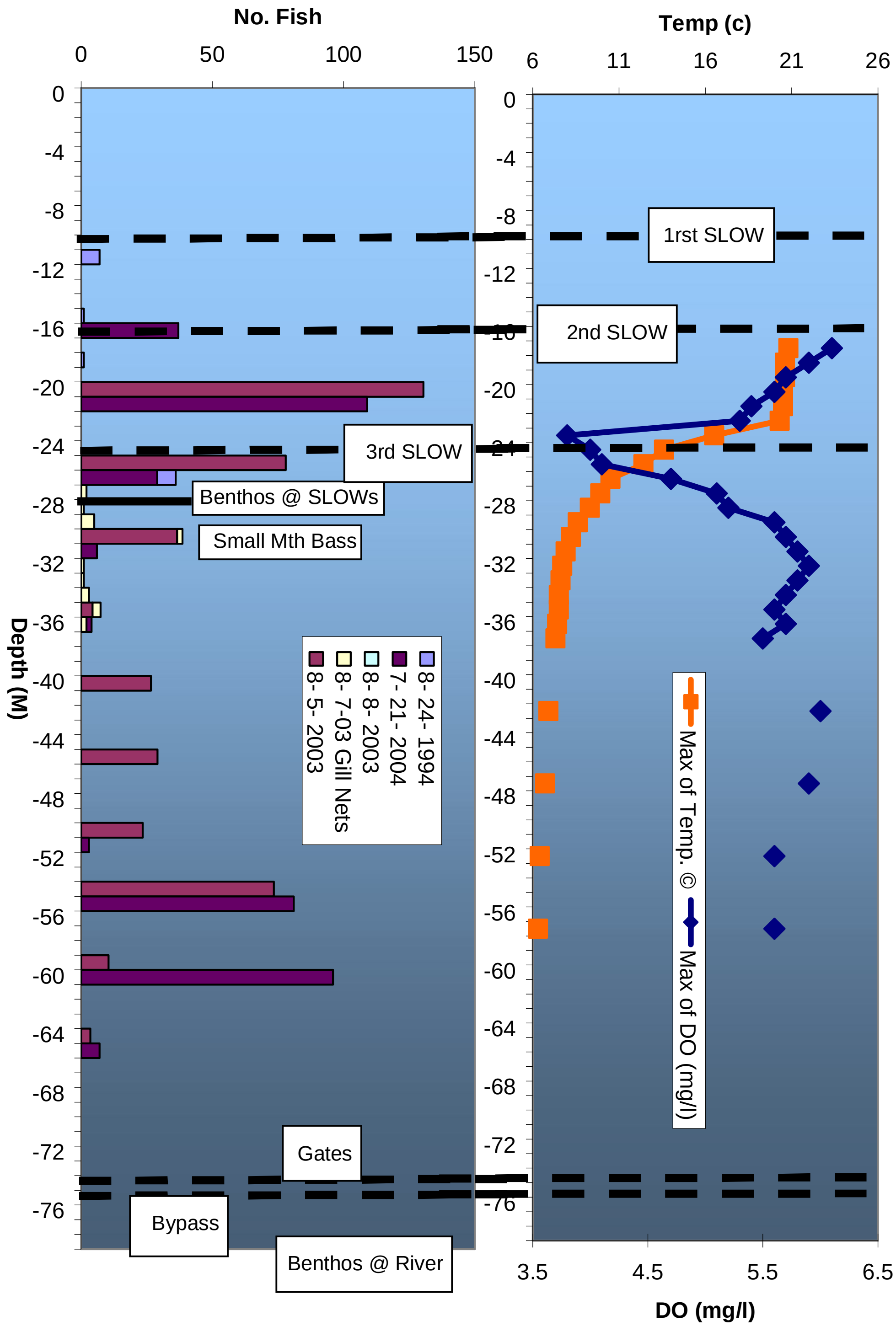

Figure 12. Fish, thermo and oxygen-cline data, August 2003. The 3rd Selective Outlet Work was just below the clines 8-5-03. Sonar data indicates fish living below the clines. Vertical gill nets set for 24 hours caught 20 fish of which 1 was a small mouth bass. The others were Kokanee Salmon, Rainbow and Brown Trout. Reservoir elevation August 5-8, 2003 averaged 15-17.5 meters below full. July 21rst, 2004 it was 9m below full and 8-24-1994 it was 6m below full. All cathe depths are in relationship to the SLOWs.

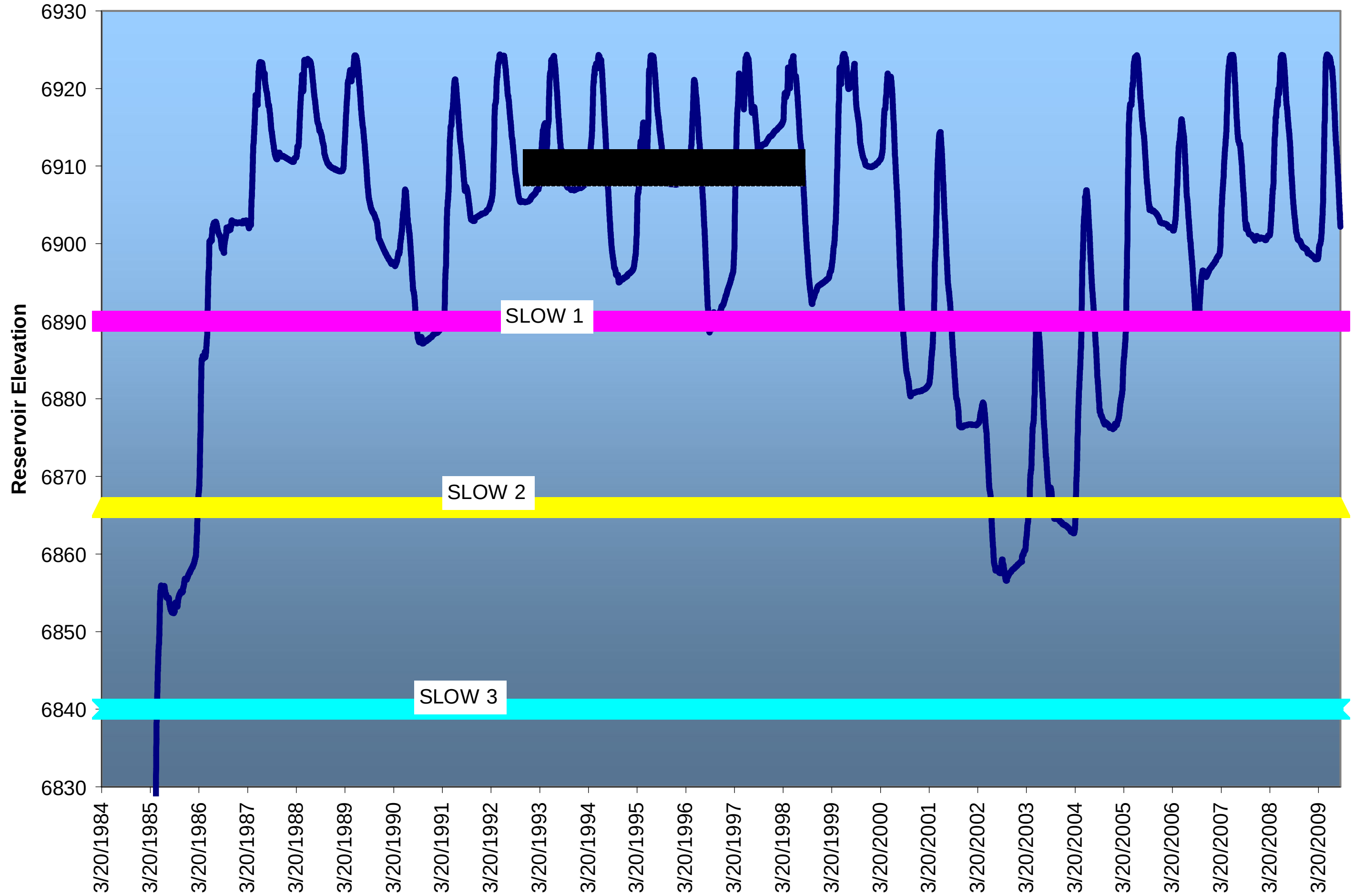

Figure 13. Reservoir Elevation in relationship to the SLOWs. The 3rd SLOW was less than 20 feet below the water surface from July 15th 2002 to February 24th 2003. It is unknown whether or not water was released through the 3rd SLOW during this period although the power plant was not operated.

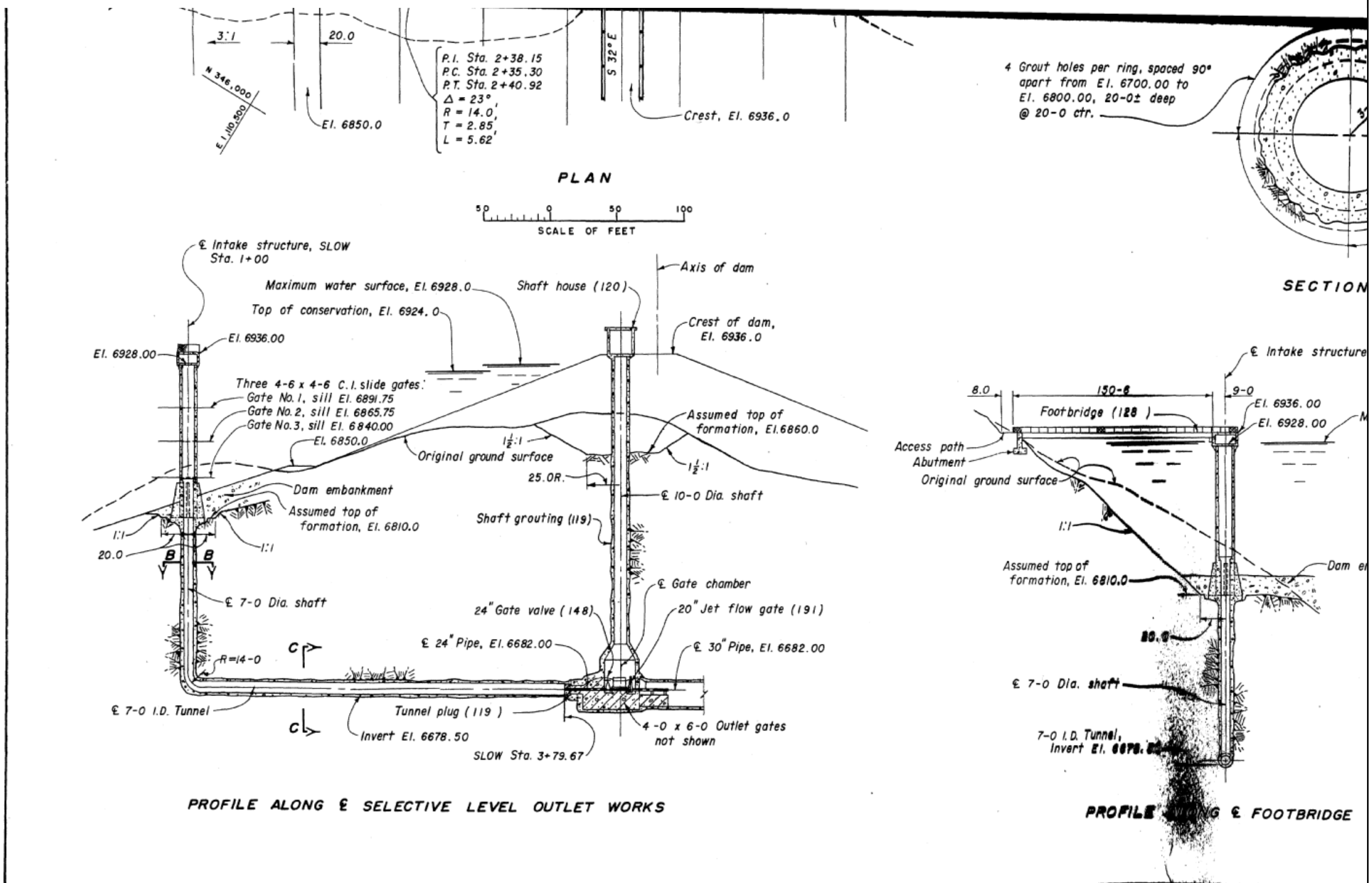

Figure 14. Blue prints for the SLOWs.

Figure 15. Selective Outlet Works showing the 2nd and 3rd outlets. The 1rst outlet faces the dam. Note the proximity of the 3rd SLOW to the benthos.

Figure 16. Gates at bottom of reservoir. Dam has not been constructed.

Figure 17. Native fish habitat. Crocker-Bedford's claim that scouring occurs at this and around this boulder to bedrock bend (leaving a 6-8ft deep hole) but the hole is filled in over the summer from silt out of Disappointment Creek. What is the goal for habitat?

Figure 18. Riparian condition at Cole Crocker-Bedfords. Grazing practices are rotational/rest since 1995. There is regeneration of cottonwoods although not quantified. What is the goal for regeneration?

Water Quality and Base Flow Data Analysis

Below is an analysis of the water quality and flow data available from the USGS Dolores River gauges near Bedrock, CO and Ciscoe, Utah.

My understanding has been that base flows have not been adequate to support a native fishery. The data analysis indicates the opposite may be true. Base flows since the construction of McPhee Reservoir have been greater than they were prior to the construction of McPhee and there are significant differences between pre- and post-dam water quality data as far down as the USGS Gauge at Ciscoe, UT.

The data also supports my suspicion that the operation of McPhee Dam cannot support both a cold-water and a warm-water fishery.

In this analysis I am assuming that native fish populations were healthier prior to the construction of McPhee Dam (Rick Anderson's summary). I am also assuming that the DRD is striving for pre-McPhee populations of native fish and not pre-MVIC populations of native fish. Also, my understanding is that MVIC diverted all the water from the Dolores River at Dolores, CO below a certain discharge value (what is that value and was it throughout the year and are there records?).

As I also understand it, habitat loss below Disappointment Creek is as much or more of a function of sediment deposition from Disappointment Creek than a function of scouring.

My theory: that with the lower base flows prior to the construction of McPhee Dam the sediment from Disappointment Creek was disconnected from the lower reaches of the Dolores River because, at some point in the Dolores, the water in the went below the surface and sediment from Disappointment Creek was filtered out (any observational data to support or refute this theory?).

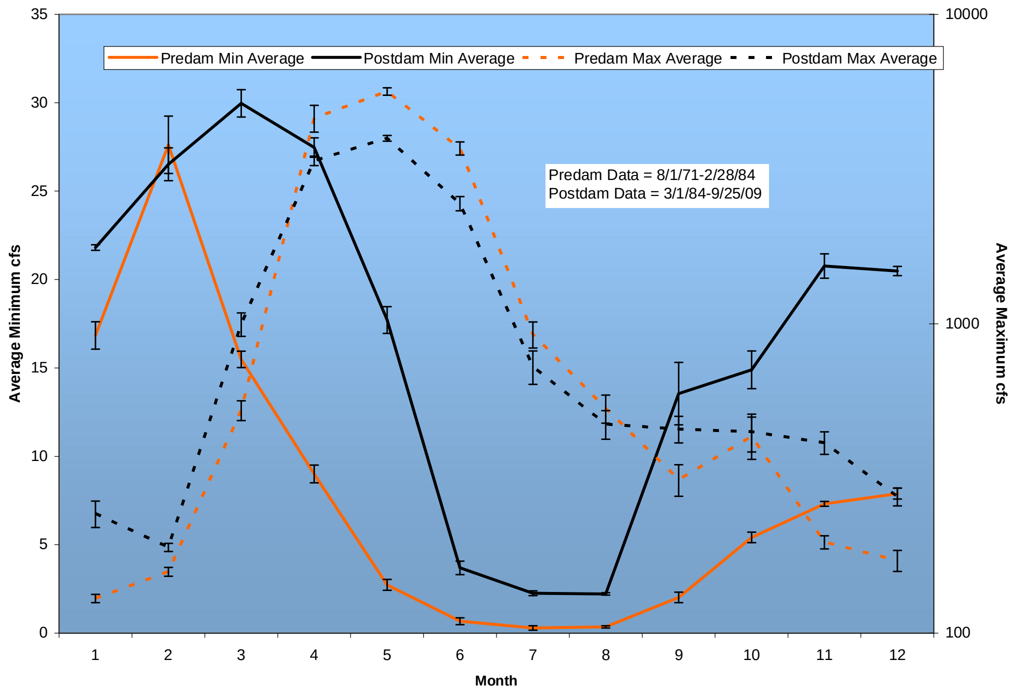

Figure 19. Discharge at the USGS Bedrock Gauge. Average minimum daily flows prior to the construction of McPhee Dam were less than after the construction of McPhee Dam for each month except February. Mean daily maximum flows were less for the months of September and for November through March.

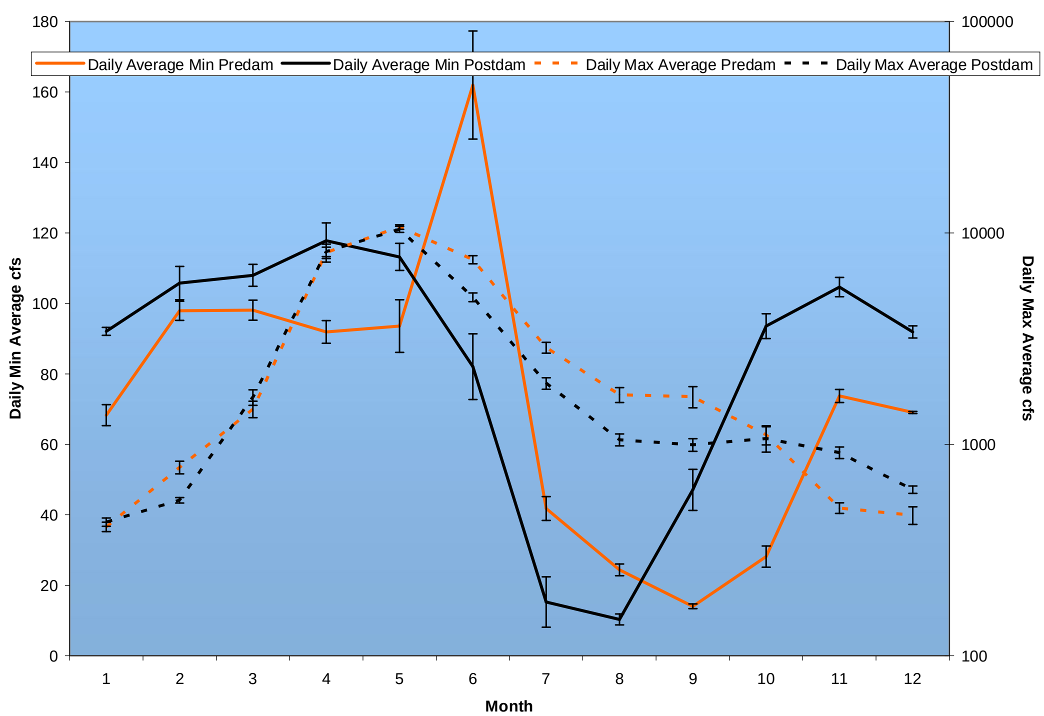

Figure 20. Discharge at the Ciscoe, Utah USGS gauge. Daily mean minimum flows were less prior to the construction of McPhee dam for the months of September through May. Daily mean maximum flows were less for the months of November and December.

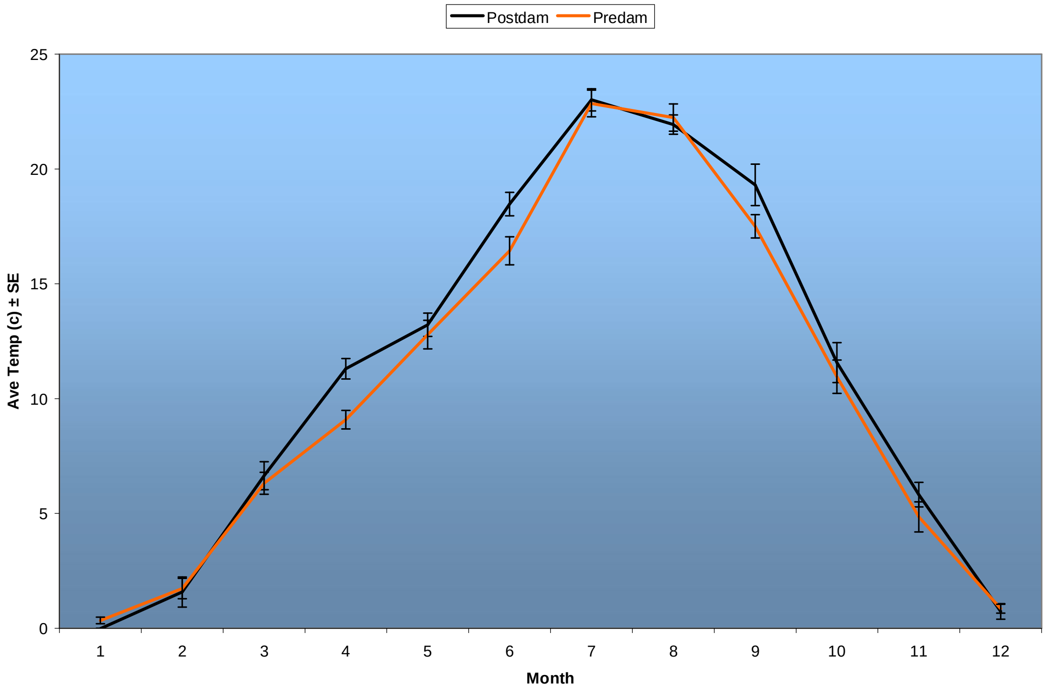

Figure 21. Mean temperature at the Bedrock USGS Gauge (grab samples) prior to the construction of McPhee Dam were less for the months of April, June and September.

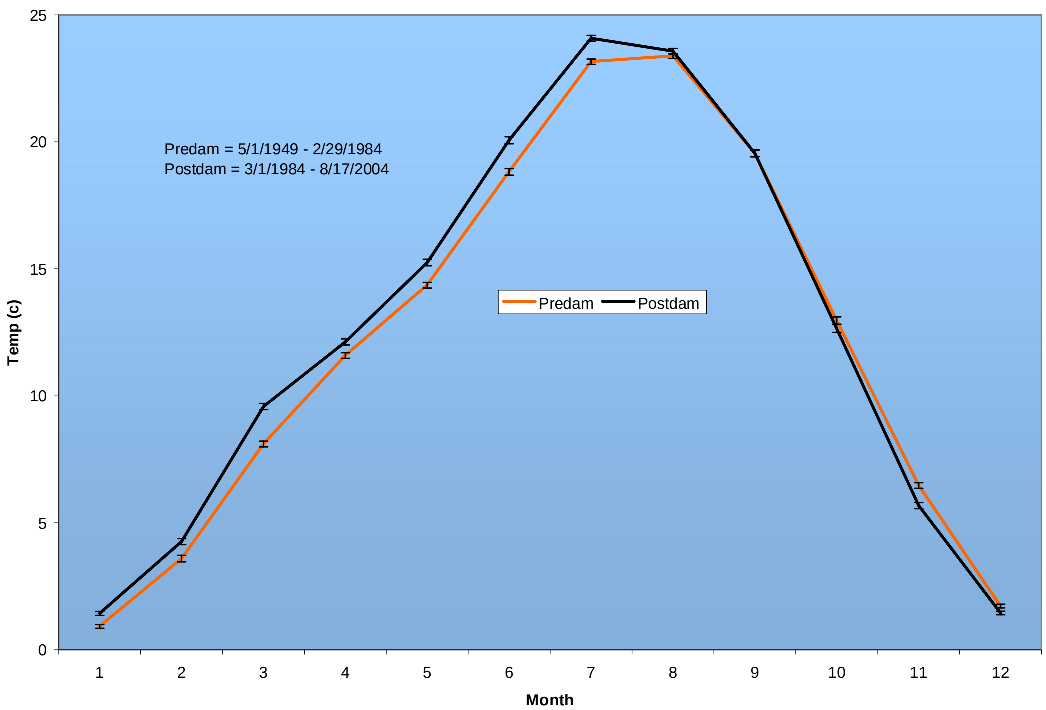

Figure 22. Mean daily temperatures at the Ciscoe USGS Gauge were less prior to the construction of McPhee Dam for each month of the year except for August through December.

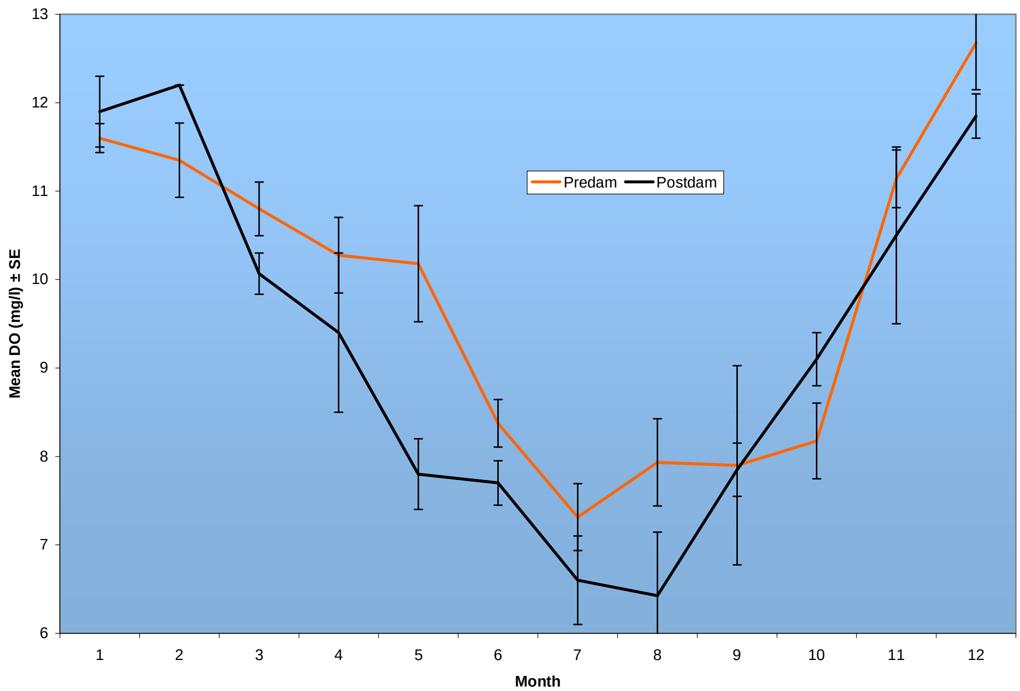

Figure 23. Mean concentration of dissolved oxygen at the Bedrock USGS Gauge (grab samples) were greater prior to the construction of McPhee Dam for the months of March, May, June and August and were independent of the temperature profile (see Figure 3) indicating the effects of respiration of organic matter on DO.

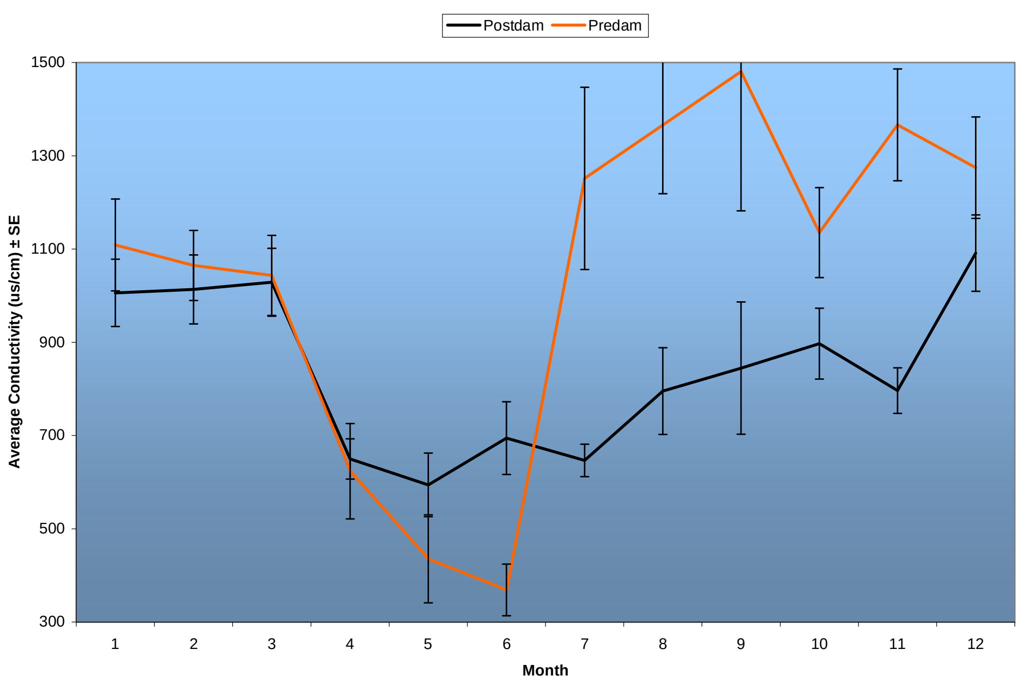

Figure 24. Mean conductivity at the Bedrock USGS Gauge (grab samples) prior to the construction of McPhee Dam was greater for the months of July through November and less for the month of June.

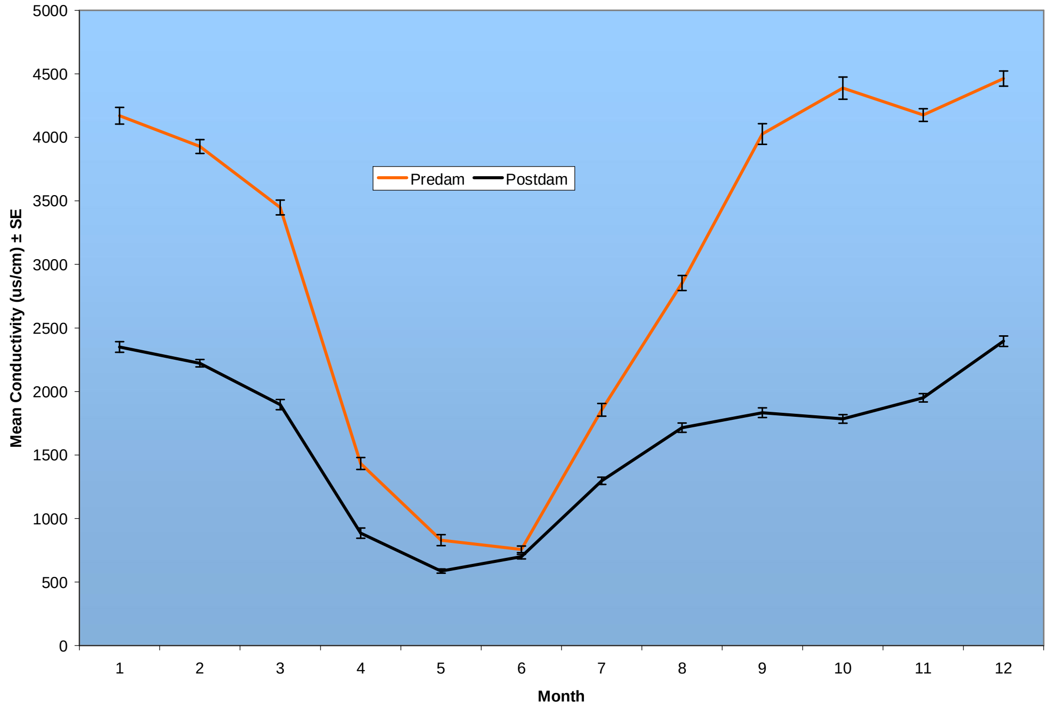

Figure 25. Mean daily conductivity at the Ciscoe, Utah USGS Gauge prior to the construction of the McPhee Dam was greater for each month of the year except June.

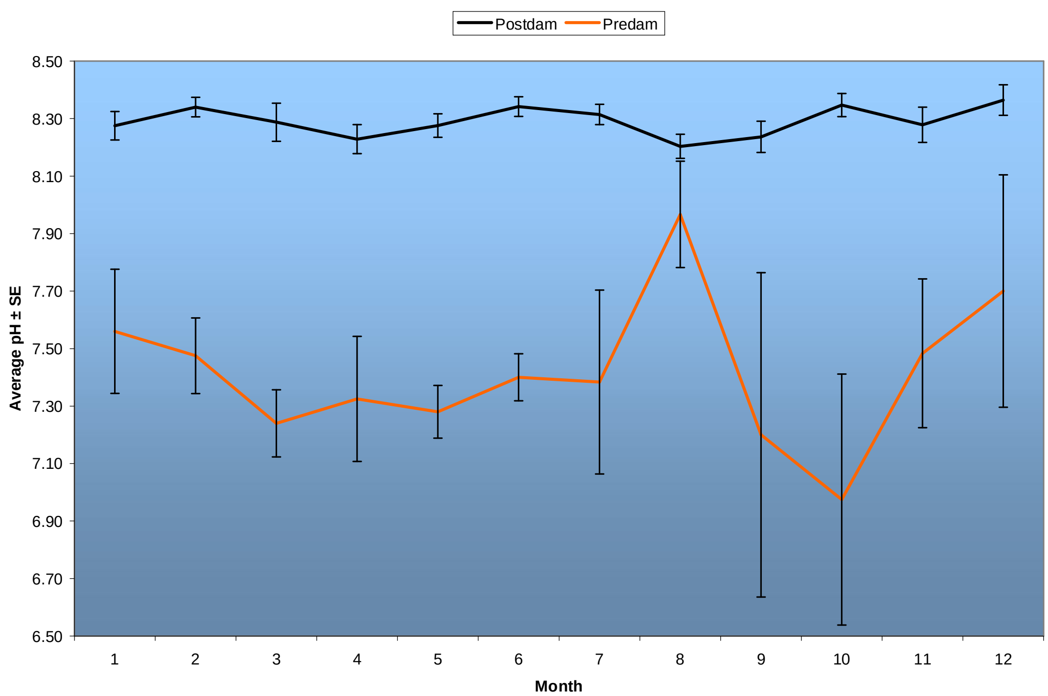

Figure 26. Mean pH at the USGS Bedrock Gauge (grab samples) prior to the construction of McPhee Dam was less for each month of the year with greater variability.

Table 1. Discharge statistics from the Bedrock Gauge.

Max of cfs													
	Mnth Day	1	2	3	4	5	6	7	8	9	10	11	12
Postdam	1	120	150	248	1440	3940	3720	1530	522	391	135	303	365
	2	130	150	237	1720	3730	3540	1960	287	182	262	486	356
	3	120	170	258	2930	3410	3250	2180	257	186	568	336	353
	4	120	190	282	2410	4070	2910	1520	213	201	1700	254	357
	5	140	200	346	2740	4690	2380	1320	343	208	370	430	356
	6	140	180	382	3010	4430	2050	931	229	340	1070	890	379
	7	130	160	368	3120	3860	2030	788	1000	182	1440	502	398
	8	130	160	484	3520	3660	2300	810	280	239	394	502	383
	9	122	160	743	3820	3410	3470	879	360	569	419	490	365
	10	100	160	794	3670	3170	2830	815	328	1140	190	486	350
	11	162	160	844	3630	3310	3030	907	275	655	624	459	328
	12	519	150	791	3510	3550	2900	752	193	564	575	227	227
	13	311	160	704	3430	3620	1890	635	266	569	269	146	190
	14	155	178	768	3220	3660	1730	570	271	675	220	138	200
	15	130	198	1210	2910	3650	1890	472	532	916	203	148	200
	16	120	187	1240	3170	3740	2300	414	335	796	401	177	200
	17	120	189	1250	3580	3790	2570	346	512	708	422	178	200
	18	160	189	1250	3810	3880	2560	274	467	681	422	187	210
	19	380	193	1260	3620	4050	2710	339	464	500	425	307	218
	20	380	224	1320	3570	4230	2940	408	506	350	437	606	216
	21	400	254	1260	3080	3940	3100	643	962	354	428	684	190
	22	390	198	1360	3280	3860	3110	366	722	371	428	490	190
	23	340	201	1400	3800	4480	3020	446	638	595	410	533	205
	24	370	205	1510	4170	4700	2480	397	1440	623	207	679	205
	25	390	205	1400	4030	4890	1800	758	835	309	264	670	196
	26	400	207	1570	3920	5060	1530	613	389	498	307	580	180
	27	408	198	1700	4080	4700	1290	346	260	230	305	384	190
	28	401	249	1470	3760	4110	1400	297	410	178	315	368	180
	29	389	267	1330	3830	4090	1380	261	532	193	244	365	264
	30	205		1440	4120	3850	1260	248	639	301	213	371	640
	31	160		1680		3750		294	222		208		270
Predam	1	103	131	258	2000	6240	6670	2000	394	240	288	233	170
	2	91	120	256	2800	4260	5500	1820	290	152	295	293	142
	3	100	130	268	1800	3500	5050	1620	272	124	290	278	124
	4	110	130	268	1450	3880	3930	1740	250	106	367	260	120
	5	120	130	300	1400	5190	4100	1630	348	114	428	240	114
	6	110	130	290	1500	5810	3950	1470	272	126	235	245	101
	7	110	130	391	1800	4810	3850	1400	340	89	385	285	112
	8	120	140	456	2550	5410	3920	1310	392	80	312	216	134
	9	130	150	449	2300	5900	3800	1280	661	66	172	184	140
	10	120	150	430	2550	6850	4500	1200	456	92	164	174	162
	11	130	150	470	2020	7190	4700	1120	742	152	162	176	182
	12	110	160	570	2600	6450	4600	1090	554	410	150	279	180
	13	120	160	610	3560	6720	4300	860	542	547	142	301	168
	14	120	160	780	3590	6270	4000	730	482	925	148	159	152

	15	130	160	1020	3390	5820	4200	835	446	446	536	187	122
	16	120	140	995	3700	5650	3100	841	1130	461	733	187	109
	17	130	140	775	5160	5650	3120	632	455	510	471	193	120
	18	180	138	682	6580	5580	2540	640	544	461	712	157	150
	19	200	151	630	7440	5740	2730	701	298	494	1870	164	350
	20	140	187	558	6600	6020	3220	473	401	581	1170	178	137
	21	130	180	498	6400	6580	3240	343	464	486	1110	168	134
	22	130	150	526	7750	6540	3050	646	338	371	730	168	136
	23	120	175	446	7880	6210	2940	410	272	332	540	178	140
	24	125	179	455	7300	5240	2940	522	230	280	367	155	156
	25	156	203	416	6270	4460	3200	757	656	230	278	130	148
	26	152	200	385	8000	4870	3000	377	1350	205	231	124	160
	27	148	220	397	7250	4950	2920	422	1020	471	214	126	400
	28	142	223	505	6990	5430	2870	610	1280	398	238	149	349
	29	142	163	505	7790	5740	2480	474	971	248	199	166	283
	30	138		656	8150	5620	2200	389	407	210	240	151	245
	31	136		1030		5950		300	250		212		181
Postdam Max Average		243	189	997	3363	3977	2446	726	474	457	448	413	276
Predam Max Average		129	158	525	4619	5630	3687	924	532	314	432	197	172
Postdam Max Stdev		132	31	482	650	474	712	499	280	247	349	189	103
Predam Max Stdev		22	28	216	2502	857	985	497	309	201	375	53	75
Postdam Max N		31	29	31	30	31	30	31	31	30	31	30	31
Predam Max N		31	29	31	30	31	30	31	31	30	31	30	31
Postdam Max SE		23.70	5.73	86.64	118.69	85.15	130.00	89.65	50.25	45.12	62.77	34.46	18.56
Predam Max SE		3.99	5.17	38.72	456.80	153.97	179.92	89.35	55.52	36.65	67.39	9.63	13.50

Min of cfs

Dam	Mnth Day	1	2	3	4	5	6	7	8	9	10	11	12
Postdam	1	22	21	30	29	25	9.4	2.2	2	2.1	7.4	21	19
	2	22	21	31	30	24	8.5	2.1	2.4	2.1	8	18	19
	3	22	23	29	31	24	7.5	2.3	2.6	2.4	16	17	19
	4	22	23	28	31	23	6.8	2.4	2.5	5.3	26	17	19
	5	22	23	24	30	23	5.9	2.3	2.6	3.1	26	15	20
	6	22	23	24	30	22	5.2	2.3	2.7	2.8	24	15	20
	7	22	22	25	29	23	4.8	2.2	2.7	18	21	15	20
	8	22	22	24	31	22	4.6	1.9	2.7	40	17	15	19
	9	22	23	24	31	19	4.5	1.8	2.3	38	14	25	17
	10	22	23	24	31	15	4.3	1.6	2.1	18	12	27	18
	11	22	25	25	31	13	4	1.7	2.1	12	11	27	19
	12	22	27	30	30	14	3.7	1.7	2.1	30	9.6	27	19
	13	22	26	31	28	21	3.4	1.6	1.9	23	9.3	28	19
	14	22	25	39	27	21	3.2	1.6	1.9	22	9.7	26	20
	15	22	31	40	26	20	2.9	1.8	1.9	21	10	23	21
	16	22	31	37	25	19	2.6	1.8	1.9	19	10	22	21
	17	22	30	34	22	19	2.5	1.8	1.9	15	10	21	21
	18	22	29	34	20	18	2.4	2	1.8	13	10	23	22
	19	22	28	33	26	17	2.3	2	1.4	12	10	22	22

	20	23	28	33	27	16	2.1	2.2	1.7	12	9.6	21	21
	21	23	27	33	27	16	2.1	2.3	2.3	12	10	21	22
	22	23	27	32	27	16	2	2.3	3	11	11	21	22
	23	23	25	31	27	15	1.8	5.5	2.2	9.5	11	21	21
	24	23	24	30	28	14	1.9	3.7	1.9	9.6	12	20	22
	25	21	27	29	27	14	2	2.6	2.1	9.5	21	20	22
	26	21	28	28	23	14	2	3	2.2	9.6	21	20	22
	27	20	29	28	22	14	2	2.6	2	9	21	18	21
	28	20	31	28	26	13	2.3	2.4	2	8.4	21	19	22
	29	20	47	28	26	13	2	2.2	2.4	8.3	21	19	22
	30	21		32	26	12	2.1	2	3.1	8.7	21	19	22
	31	20		31		10		2	2.3		21		22
Predam	1	10	30	23	13	6.3	3.5	0.04	0.07	1.2	2.8	7.4	6
	2	11	24	20	13	7.3	2.7	0.04	0.1	1.2	3.1	6.9	6.8
	3	12	28	19	15	4.6	1.4	0.04	0.4	1.2	3.1	7.1	8.2
	4	12	34	19	13	2.2	0.29	0.46	0.46	0.83	2.9	7.4	8
	5	12	32	17	12	2.7	0.13	0.4	0.22	0.16	2.9	7.4	8
	6	12	30	17	12	2.8	0.09	0.34	0.16	0.47	3.9	7.4	8.2
	7	12	30	18	11	2.4	0.25	0.28	0.46	0.03	3.9	7.4	7.2
	8	13	28	18	12	2.5	0.13	0.16	0.22	0.01	4.2	7.4	7.2
	9	14	28	18	12	1.8	0.09	0.1	0.64	0.01	4.2	7.4	6.9
	10	15	24	17	11	0.23	1.3	0.1	0.39	0.01	4.2	7.4	6.8
	11	15	24	15	10	0.22	2.7	0.1	0.58	0.01	4.2	7.4	8.4
	12	15	26	15	9.7	0.26	2.7	0.08	0.56	0.01	4.4	7.4	6.4
	13	15	26	15	9.1	0.28	2.5	0.08	0.1	0	4.7	7.1	6.7
	14	16	26	15	8.6	3	1.6	0.08	0.07	0.25	5	7.1	6.4
	15	18	24	14	8.4	4.2	0.12	0.07	0	4.2	5.7	7.4	6.2
	16	17	24	14	7.8	3.2	0.1	0.07	0	3.6	5.7	7.4	5.9
	17	17	24	14	7.4	1.7	0.06	0.06	0	3.3	5.7	7.4	6
	18	19	26	14	6.9	0.69	0.06	0.06	0	3	5.7	7.4	7.1
	19	20	26	13	7	1.6	0.05	0.06	0.83	4.7	6	8.2	5
	20	22	26	12	7	1.7	0.05	0.07	0.34	4.4	6	7.4	6.9
	21	22	28	13	6.3	0.36	0.05	0.06	0.46	4.1	6.4	7.1	7.2
	22	20	28	13	6	1.6	0.05	0.06	0.52	3.6	6.4	6.8	8
	23	19	24	14	5.9	2.9	0.05	0.07	0.1	3.1	7.8	7.8	9
	24	20	23	14	6.2	3.2	0.05	0.07	0.07	3.2	7.7	8.5	11
	25	16	22	14	7	3.8	0.05	0.08	0.01	3.2	7.4	8.9	11
	26	14	22	16	6.8	4	0.05	3.8	0.11	3	7.4	8.2	8
	27	20	22	16	5.9	4.2	0.05	1.5	0.02	2.8	7.4	7.8	11
	28	22	22	14	6.5	3.9	0.05	0.1	0.63	3	7.4	5.4	11
	29	24	70	13	7.2	3.9	0.04	0.07	1.2	3.1	7.1	5.4	10
	30	20		12	6.4	4.1	0.04	0.43	0.9	2.9	7.1	6	10
	31	28		14		3		0.1	1.3		7.4		10
Postdam Min Average		22	27	30	27	18	4	2	2	14	15	21	20
Predam Min Average		17	28	15	9	3	1	0	0	2	5	7	8
Postdam Min Stdev		1	5	4	3	4	2	1	0	10	6	4	1
Predam Min Stdev		4	9	3	3	2	1	1	0	2	2	1	2
Postdam Min N		31	29	31	30	31	30	31	31	30	31	30	31

Predam Min N	31	29	31	30	31	30	31	31	30	31	30	31
Postdam Min SE	0.16	0.93	0.77	0.55	0.76	0.38	0.13	0.07	1.77	1.07	0.69	0.26
Predam Min SE	0.78	1.62	0.46	0.50	0.31	0.20	0.13	0.06	0.30	0.30	0.13	0.31

Table 2. Water quality statistics from grab samples at the USGS gauge near Bedrock, CO.

Tempererature	**Ave**		**N**		**StdDev**		**SE**	
Mnth	Postdam	Predam	Postdam	Predam	Postdam	Predam	Postdam	Predam
1	-0.02	0.34	12.00	22.00	0.07	0.68	0.021	0.145
2	1.58	1.73	10.00	24.00	2.08	2.17	0.657	0.443
3	6.64	6.31	17.00	27.00	2.52	2.48	0.612	0.478
4	11.30	9.08	34.00	24.00	2.58	1.98	0.442	0.403
5	13.22	12.79	31.00	33.00	2.83	3.57	0.508	0.621
6	18.47	16.43	30.00	30.00	2.81	3.34	0.513	0.610
7	23.01	22.85	24.00	30.00	2.36	3.19	0.482	0.582
8	21.93	22.24	33.00	23.00	2.44	2.86	0.424	0.596
9	19.31	17.50	13.00	22.00	3.25	2.38	0.901	0.508
10	11.57	10.96	20.00	23.00	3.89	3.49	0.870	0.727
11	5.82	4.85	27.00	24.00	2.79	3.21	0.537	0.656
12	0.74	0.85	14.00	24.00	1.27	0.96	0.340	0.196
Grand Total	12.84	10.86	265.00	306.00	7.76	8.07	0.477	0.461
Conductivity	**Ave**		**N**		**StdDev**		**SE**	
Mnth	Postdam	Predam	Postdam	Predam	Postdam	Predam	Postdam	Predam
1	1005.91	1108.75	11.00	20.00	239.53	440.17	72.222	98.426
2	1013.50	1064.78	10.00	23.00	233.98	360.40	73.990	75.149
3	1028.71	1043.25	17.00	24.00	299.89	420.64	72.735	85.863
4	649.71	623.58	34.00	19.00	251.10	445.58	43.063	102.224
5	594.10	435.46	31.00	28.00	380.67	498.68	68.371	94.241
6	694.47	368.88	30.00	25.00	425.86	276.29	77.751	55.259
7	646.63	1251.52	24.00	25.00	169.95	977.60	34.691	195.521
8	795.33	1365.71	33.00	21.00	534.28	673.29	93.007	146.925
9	844.54	1480.72	13.00	18.00	511.24	1268.39	141.792	298.961
10	897.00	1135.10	20.00	20.00	339.52	432.01	75.919	96.600
11	796.41	1366.36	27.00	22.00	253.34	561.86	48.755	119.788
12	1091.29	1274.55	14.00	22.00	306.26	509.90	81.850	108.711
Grand Total	785.96	1020.18	264.00	267.00	381.86	707.34	23.502	43.288
pH	**Ave**		**N**		**StdDev**		**SE**	
Mnth	Postdam	Predam	Postdam	Predam	Postdam	Predam	Postdam	Predam
1	8.28	7.56	12.00	5.00	0.17	0.48	0.049	0.216
2	8.34	7.48	10.00	4.00	0.11	0.26	0.034	0.131
3	8.29	7.24	16.00	5.00	0.27	0.26	0.066	0.117
4	8.23	7.33	21.00	4.00	0.23	0.43	0.050	0.217
5	8.28	7.28	25.00	5.00	0.20	0.20	0.041	0.092
6	8.34	7.40	24.00	4.00	0.17	0.16	0.035	0.082
7	8.31	7.38	21.00	6.00	0.16	0.78	0.035	0.320
8	8.20	7.97	29.00	9.00	0.23	0.55	0.042	0.185
9	8.24	7.20	11.00	4.00	0.18	1.13	0.054	0.564
10	8.35	6.98	17.00	4.00	0.17	0.87	0.040	0.437

11	8.28	7.48	14.00	6.00	0.23	0.63	0.061	0.259
12	8.36	7.70	14.00	3.00	0.20	0.70	0.053	0.404
Grand Total	8.29	7.46	214.00	59.00	0.20	0.60	0.014	0.079

DO	**Ave**		**N**		**StdDev**		**SE**	
Mnth	Postdam	Predam	Postdam	Predam	Postdam	Predam	Postdam	Predam
1	11.90	11.60	2.00	4.00	0.57	0.33	0.400	0.163
2	12.20	11.35	1.00	4.00	#DIV/0!	0.84	#DIV/0!	0.419
3	10.07	10.80	3.00	5.00	0.40	0.68	0.233	0.303
4	9.40	10.28	2.00	4.00	1.27	0.85	0.900	0.427
5	7.80	10.18	2.00	5.00	0.57	1.47	0.400	0.656
6	7.70	8.38	3.00	4.00	0.44	0.54	0.252	0.269
7	6.60	7.31	2.00	7.00	0.71	1.00	0.500	0.378
8	6.43	7.93	4.00	9.00	1.44	1.48	0.719	0.494
9	7.85	7.90	4.00	3.00	0.60	1.95	0.301	1.127
10	9.10	8.18	2.00	4.00	0.42	0.86	0.300	0.429
11	10.50	11.14	2.00	5.00	1.41	0.73	1.000	0.326
12	11.85	12.68	2.00	4.00	0.35	1.05	0.250	0.527
Grand Total	8.86	9.60	29.00	58.00	2.03	2.00	0.377	0.262

Table 3. Discharge and water quality statistics from daily data gathered at the USGS Gauge near Ciscoe, UT.

Month	1	2	3	4	5	6	7	8	9	10	11	12	Grand Total
Average of Temp													
Postdam	1.43	4.26	9.58	12.12	15.25	20.07	24.08	23.57	19.56	12.66	5.68	1.45	12.80
Predam	0.92	3.58	8.11	11.59	14.37	18.83	23.16	23.39	19.55	12.98	6.47	1.72	13.33
Count of Temp													
Postdam	396	402	480	501	558	454	510	495	444	448	467	488	5643
Predam	440	411	572	625	749	734	735	662	719	676	558	479	7360
StdDev of Temp													
Postdam	1.55	2.43	2.62	2.64	2.95	2.95	2.50	2.31	2.93	3.34	2.55	1.52	8.21
Predam	1.53	2.65	2.61	2.56	2.78	3.21	2.60	1.92	2.99	3.35	2.61	1.65	7.87
SE of Temp													
Postdam	0.08	0.12	0.12	0.12	0.13	0.14	0.11	0.10	0.14	0.16	0.12	0.07	0.08
Predam	0.07	0.13	0.11	0.10	0.10	0.12	0.10	0.07	0.11	0.13	0.11	0.08	0.08
Average of conductivity													
Postdam	2350	2222	1897	885	586	700	1297	1715	1832	1784	1950	2396	1598
Predam	4170	3928	3449	1433	830	757	1855	2853	4026	4388	4176	4463	2939
Count of conductivity													
Postdam	395	402	471	505	557	457	511	493	444	448	471	488	5642
Predam	578	545	704	739	772	779	766	723	743	729	691	658	8427
StdDev of conductivity													
Postdam	830	589	878	895	379	377	628	803	800	702	714	906	947
Predam	1581	1275	1546	1281	1206	731	1393	1582	2231	2363	1319	1519	2091
SE of Conductivity													
Postdam	41.75	29.37	40.46	39.84	16.06	17.62	27.80	36.15	37.97	33.17	32.89	41.03	0.08
Predam	65.76	54.62	58.25	47.12	43.40	26.19	50.34	58.83	81.83	87.51	50.17	59.22	0.08

Min of cfs	Mnth Day	1	2	3	4	5	6	7	8	9	10	11	12
Postdam	1	88.00	90.00	121.00	91.00	103.00	146.00	166.00	6.80	5.00	72.00	110.00	100.00
	2	96.00	90.00	122.00	89.00	98.00	167.00	162.00	6.40	4.60	69.00	112.00	103.00
	3	96.00	92.00	119.00	74.00	101.00	158.00	8.70	6.00	4.20	67.00	115.00	107.00
	4	94.00	98.00	103.00	69.00	105.00	150.00	8.20	5.70	3.80	66.00	112.00	102.00
	5	95.00	95.00	108.00	68.00	100.00	142.00	7.90	5.20	3.20	65.00	105.00	109.00
	6	96.00	87.00	113.00	72.00	88.00	112.00	7.50	8.00	2.80	65.00	101.00	103.00
	7	100.00	79.00	108.00	82.00	80.00	95.00	6.90	31.00	2.40	65.00	104.00	100.00
	8	98.00	72.00	104.00	97.00	82.00	100.00	6.30	27.00	2.00	64.00	102.00	100.00
	9	97.00	67.00	108.00	97.00	102.00	113.00	5.70	17.00	1.70	90.00	118.00	97.00
	10	97.00	67.00	110.00	104.00	117.00	118.00	5.20	18.00	20.00	91.00	125.00	86.00
	11	96.00	66.00	109.00	127.00	112.00	112.00	4.90	15.00	70.00	90.00	124.00	75.00
	12	96.00	79.00	116.00	137.00	107.00	109.00	4.20	34.00	67.00	87.00	123.00	72.00
	13	97.00	89.00	132.00	111.00	108.00	100.00	3.60	8.00	67.00	84.00	122.00	83.00
	14	95.00	123.00	136.00	114.00	106.00	84.00	2.90	7.50	71.00	83.00	123.00	85.00
	15	90.00	127.00	126.00	118.00	107.00	79.00	2.30	6.70	61.00	81.00	124.00	97.00
	16	91.00	128.00	122.00	124.00	111.00	70.00	2.00	6.00	52.00	107.00	120.00	96.00
	17	87.00	132.00	130.00	135.00	124.00	63.00	1.70	5.30	48.00	108.00	116.00	98.00
	18	84.00	132.00	117.00	141.00	138.00	59.00	1.70	4.50	54.00	107.00	111.00	92.00
	19	80.00	134.00	115.00	152.00	129.00	50.00	1.60	3.80	51.00	105.00	108.00	94.00
	20	81.00	137.00	110.00	160.00	157.00	44.00	1.60	3.00	60.00	104.00	99.00	100.00
	21	79.00	123.00	118.00	146.00	164.00	39.00	1.50	2.10	82.00	103.00	91.00	92.00
	22	82.00	116.00	118.00	144.00	137.00	35.00	2.00	1.90	92.00	99.00	88.00	90.00
	23	86.00	109.00	117.00	137.00	163.00	30.00	2.00	1.80	91.00	99.00	86.00	79.00
	24	90.00	106.00	104.00	125.00	129.00	23.00	1.90	24.00	81.00	114.00	86.00	96.00
	25	97.00	103.00	83.00	119.00	130.00	22.00	1.80	18.00	73.00	120.00	79.00	87.00
	26	101.00	112.00	74.00	128.00	115.00	19.00	8.00	13.00	67.00	119.00	89.00	77.00
	27	99.00	125.00	74.00	142.00	99.00	16.00	13.00	8.00	66.00	120.00	87.00	88.00
	28	91.00	119.00	73.00	157.00	98.00	14.00	9.00	7.50	64.00	116.00	86.00	91.00
	29	89.00	170.00	79.00	147.00	99.00	13.00	8.00	7.00	72.00	112.00	83.00	88.00
	30	95.00		91.00	127.00	96.00	180.00	7.40	6.00	74.00	115.00	90.00	79.00
	31	91.00		87.00		104.00		7.20	5.50		113.00		83.00
Postdam Total		79.00	66.00	73.00	68.00	80.00	13.00	1.50	1.80	1.70	64.00	79.00	72.00
Predam	1	70.00	80.00	97.00	104.00	104.00	48.00	32.00	45.00	20.00	14.00	76.00	70.00
	2	70.00	80.00	94.00	114.00	90.00	152.00	26.00	55.00	19.00	20.00	76.00	72.00
	3	80.00	80.00	102.00	107.00	76.00	225.00	23.00	36.00	18.00	16.00	78.00	70.00
	4	74.00	80.00	110.00	102.00	82.00	232.00	27.00	31.00	19.00	18.00	81.00	70.00
	5	70.00	80.00	99.00	100.00	76.00	242.00	41.00	34.00	17.00	20.00	78.00	70.00
	6	75.00	80.00	94.00	94.00	85.00	248.00	60.00	34.00	16.00	20.00	78.00	70.00
	7	78.00	80.00	90.00	91.00	75.00	242.00	84.00	33.00	14.00	20.00	81.00	70.00
	8	80.00	80.00	86.00	114.00	86.00	308.00	74.00	27.00	13.00	18.00	87.00	70.00
	9	70.00	80.00	90.00	107.00	91.00	296.00	70.00	25.00	14.00	18.00	85.00	70.00
	10	60.00	90.00	99.00	101.00	104.00	262.00	70.00	22.00	14.00	18.00	92.00	70.00
	11	50.00	100.00	92.00	104.00	155.00	254.00	50.00	17.00	15.00	21.00	89.00	70.00
	12	40.00	100.00	74.00	95.00	192.00	225.00	42.00	18.00	16.00	18.00	80.00	69.00
	13	35.00	100.00	67.00	92.00	142.00	198.00	31.00	15.00	14.00	20.00	60.00	70.00
	14	35.00	80.00	69.00	92.00	128.00	192.00	24.00	13.00	14.00	19.00	60.00	70.00
	15	35.00	109.00	96.00	88.00	158.00	192.00	17.00	18.00	14.00	18.00	63.00	70.00
	16	40.00	115.00	104.00	92.00	188.00	202.00	16.00	24.00	14.00	20.00	64.00	68.00

	17	50.00	120.00	91.00	98.00	158.00	187.00	16.00	22.00	14.00	22.00	62.00	65.00
	18	60.00	120.00	94.00	99.00	110.00	170.00	15.00	21.00	14.00	23.00	61.00	68.00
	19	70.00	110.00	104.00	96.00	94.00	165.00	18.00	28.00	13.00	25.00	62.00	68.00
	20	75.00	110.00	99.00	110.00	85.00	145.00	61.00	25.00	18.00	23.00	60.00	67.00
	21	80.00	110.00	86.00	122.00	72.00	118.00	55.00	24.00	7.60	25.00	71.00	66.00
	22	85.00	110.00	88.00	100.00	67.00	94.00	60.00	21.00	4.80	27.00	72.00	66.00
	23	85.00	110.00	86.00	76.00	59.00	85.00	51.00	20.00	4.20	25.00	79.00	66.00
	24	85.00	110.00	92.00	64.00	54.00	71.00	42.00	24.00	9.50	44.00	81.00	66.00
	25	85.00	110.00	99.00	55.00	50.00	59.00	39.00	20.00	13.00	37.00	75.00	70.00
	26	80.00	104.00	112.00	55.00	47.00	56.00	37.00	16.00	15.00	33.00	90.00	70.00
	27	80.00	104.00	123.00	65.00	52.00	58.00	34.00	14.00	14.00	34.00	80.00	70.00
	28	80.00	97.00	126.00	65.00	58.00	52.00	51.00	15.00	14.00	35.00	59.00	70.00
	29	80.00	110.00	136.00	71.00	56.00	44.00	51.00	13.00	15.00	73.00	63.00	70.00
	30	80.00		123.00	84.00	56.00	37.00	42.00	25.00	14.00	76.00	69.00	70.00
	31	80.00		119.00		51.00		37.00	21.00		73.00		70.00
Predam Total		35.00	80.00	67.00	55.00	47.00	37.00	15.00	13.00	4.20	14.00	59.00	65.00
Daily Average Min Predam		68.29	97.90	98.10	91.90	93.58	161.97	41.81	24.39	14.04	28.16	73.73	69.06
Daily Average Min Postdam		92.06	105.76	107.97	117.80	113.19	82.07	15.25	10.31	47.09	93.55	104.63	91.90
Stdev Predam		16.65	14.54	15.88	17.72	41.49	84.00	18.83	9.41	3.63	16.70	10.25	1.71
Stdev Postdam		6.15	25.48	17.46	27.65	21.46	51.06	39.83	8.61	32.01	19.49	14.89	9.65
Count Predam		31	29	31	30	31	30	31	31	30	31	30	31
Count Postdam		31	29	31	30	31	30	31	31	30	31	30	31
SE Predam		2.99	2.70	2.85	3.24	7.45	15.34	3.38	1.69	0.66	3.00	1.87	0.31
SE Postdam		1.11	4.73	3.14	5.05	3.85	9.32	7.15	1.55	5.84	3.50	2.72	1.73

Max of cfs	**Mnth Day**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Postdam	1	374	440	750	2730	9410	7840	2820	1270	820	515	648	836
	2	404	440	566	3640	8430	7400	3270	1170	860	515	1240	751
	3	454	450	528	5180	8000	6900	3700	880	944	991	1080	728
	4	428	470	562	5300	8070	6260	3200	853	955	1820	798	751
	5	435	490	606	3930	7830	5370	2550	1020	842	1780	710	752
	6	518	480	712	5540	8950	4900	2210	1120	701	1330	1200	771
	7	483	450	763	5760	8500	5300	1970	936	649	4820	1200	867
	8	462	440	835	6920	8900	5600	2030	1050	607	2240	932	872
	9	430	460	1300	8270	7800	5780	2140	740	686	1390	898	809
	10	383	470	1700	9570	8910	6280	2200	702	1620	1420	833	754
	11	330	480	1290	10000	11100	5290	2250	1060	2340	1090	832	635
	12	322	500	1280	9370	12700	5750	2230	1080	1090	1380	792	569
	13	320	540	1320	9790	12900	4800	2300	860	1030	980	602	499
	14	345	560	1130	9420	12300	3910	2100	758	1140	712	520	500
	15	330	680	1310	9010	13300	3840	2260	722	1030	644	500	583

	16	335	570	1770	8950	13100	3930	2100	761	1460	658	475	610
	17	325	550	1800	9200	12700	4360	1900	740	1140	812	499	594
	18	330	530	1850	9080	12900	5620	1690	710	1070	823	502	576
	19	325	560	1880	10600	12000	5130	1520	790	979	819	575	585
	20	320	580	1970	9260	12300	5040	1640	1040	887	824	1680	575
	21	328	588	2050	7150	12300	5230	1550	1450	929	850	1550	538
	22	344	550	2550	6890	12100	5280	1530	1310	978	832	1290	536
	23	368	560	2770	8510	11800	5120	1230	1130	773	815	1060	516
	24	490	580	2970	9900	11500	5000	1500	1000	1630	777	1050	490
	25	630	634	2720	9320	10900	4140	1560	2730	1100	579	1140	498
	26	615	645	2500	8830	9700	3560	1450	1520	1000	613	1210	451
	27	639	630	2940	9950	9330	3060	1160	1140	891	640	1090	470
	28	615	656	2840	11300	9190	2790	840	870	543	632	841	443
	29	602	797	2140	10700	8800	2730	867	1160	488	624	830	440
	30	587		2080	10300	8920	2890	1110	1190	667	563	838	534
	31	420		2270		8060		1410	825		539		417
Postdam Total		639	797	2970	11300	13300	7840	3700	2730	2340	4820	1680	872
Predam	1	480	500	570	3450	12300	12600	4830	2360	3200	634	400	328
	2	400	1000	680	5050	8140	12000	4490	1910	3010	850	374	336
	3	340	800	1570	4690	7500	10600	4230	1570	2100	726	661	352
	4	320	600	1100	3390	9020	9150	3810	1390	1600	677	620	352
	5	430	491	1000	2610	10200	8040	3830	1260	1280	1400	930	352
	6	440	415	800	3040	10400	8550	3660	1370	4060	572	946	691
	7	410	379	600	3710	10200	8780	3280	2770	4690	604	702	1320
	8	660	400	1180	3940	9080	8250	3140	2230	2910	1520	620	1370
	9	760	530	1790	5050	10200	8400	3650	1890	1570	1560	529	500
	10	657	635	955	4310	11400	7700	3220	1480	1120	1140	444	352
	11	406	796	1420	4930	13400	8040	3000	1230	860	645	404	433
	12	300	932	844	4790	14000	8280	2930	1510	903	462	384	462
	13	300	1090	901	5180	13000	7620	3050	1610	2740	1670	546	424
	14	300	1080	1100	5540	11600	7160	2300	1170	3010	1370	535	415
	15	300	856	1390	5430	10200	7360	2330	1100	1960	675	414	415
	16	308	604	1670	6800	9640	6280	2470	971	1470	1630	414	380
	17	462	512	1540	8000	9810	5500	2560	1870	1120	1130	404	434
	18	433	647	1580	10700	10400	6300	2050	1750	1100	1720	414	492
	19	350	746	1440	13800	10700	5390	1840	1050	1160	2490	394	480
	20	450	746	1280	15500	11400	6270	2620	810	1090	2640	374	444
	21	350	898	1370	16100	11800	6540	1620	1170	1440	2040	384	354
	22	300	962	1550	15100	11200	6370	1520	956	1080	1570	329	344
	23	300	1080	1520	14300	9470	6250	1590	726	904	1100	328	380
	24	300	1210	1190	11900	8970	6250	1710	1100	830	2010	424	390
	25	400	1320	1030	12200	9280	7320	1930	1610	728	690	452	370
	26	560	1350	1250	9320	10100	6480	1610	2820	994	478	625	330
	27	480	1030	1590	9920	10100	6210	2160	2560	820	490	593	300
	28	426	661	3240	9700	11000	5960	4190	2160	1040	600	551	400
	29	323	300	3110	11300	11700	5470	3660	1970	910	469	433	300
	30	367		3050	12300	12100	5280	2920	2270	750	415	361	460
	31	320		3200		12400		2710	4590		415		370
Predam Total		760	1350	3240	16100	14000	12600	4830	4590	4690	2640	946	1370

Daily Max Average Predam		407	778	1468	8068	10668	7480	2868	1717	1682	1109	500	462
Daily Max Average Postdam		429	544	1669	8146	10410	4970	1945	1051	995	1065	914	611
Stdev Predam		118	290	732	4305	1503	1824	934	779	1055	638	158	248
Stdev Postdam		109	86	789	2291	1931	1290	681	381	374	818	315	138
Count Predam		31	29	31	30	31	30	31	31	30	31	30	31
Count Postdam		31	29	31	30	31	30	31	31	30	31	30	31
SE Predam		21	54	131	786	270	333	168	140	193	115	29	44
SE Postdam		20	16	142	418	347	235	122	68	68	147	58	25