Final Report

319(h) Phase 6

Water Quality Improvement Work in Shasta Valley

Great Northern Corp.
PO Box 20
Weed, Ca 96097

Submitted to:

US Fish and Wildlife Service
1829 So. Oregon St.
Yreka, Ca 96097

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Other land use activities include limited timber harvest, and a history of gold mining, now largely abandoned.

Urbanization is limited. Incorporated areas include Yreka (pop. 7100), Montague (pop. 1300), and Weed (pop. 3000), along with smaller unincorporated urban and sub-urban areas. Total population in the Shasta watershed is approximately 16,500.

Socially, high levels of unemployment (generally 10-20%), loss of timber related jobs, and ongoing marginal profitability in the agricultural sector all are worrisome, and contribute to community distress. Conversely, low crime rates, good climate, minimal traffic congestion, abundant public land for recreation and good major transportation routes make the area attractive.

Road travel into and out of the area is accomplished primarily on Interstate 5 which runs north-south through the center of the Shasta Valley, and to a lesser extent by Highways 3, 89, 96 and 97.

Most of the identified impairments of the natural environment revolve around water quality and quantity for salmon. To a lesser extent, air quality is also becoming an issue, a result of wind blown particulates in summer, and smoke from home heating with wood in winter.

The Shasta River has been identified by a variety of studies or documents as having a very high priority for watershed improvement work. These include:

1. California Unified Watershed Assessment: Category I (Impaired) Priority Watershed, needing to improve water temperatures and levels of dissolved oxygen.
2. California Regional Water Quality Control Board (North Coast District): Identified as impaired for beneficial uses in the areas of Temperature and Dissolved Oxygen.
3. Viewed as critically important to salmon restoration in the *Long-Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program* Klamath River Basin Fisheries Task Force, January 1991. Finds improvements needed in land uses including irrigation, livestock, and timber harvest in order to improve water quality.
4. Lower portions of Shasta identified as "Area of Critical Environmental Concern" in *Redding Resources Management Plan*, US Department of the Interior, Bureau of Land Management, Redding Resource Area, California, June 1993. Calls for management for benefit of anadromous fish.
5. Described by the Pacific Fishery Management Council as: "The Shasta River is the most important chinook salmon spawning stream in the upper Klamath River." Annual *Review of Ocean Salmon Fisheries*, all years, 1978 to present. Pacific Fisheries Management Council, Portland Oregon. 1978-2000.
6. The *Shasta Watershed Restoration Plan*, Shasta CRMP 1997 identifies high water temperatures, low dissolved oxygen, excessive fine sediment, low water levels, reduced spawning and rearing habitat, and a need to address ground water usage before it becomes critical. For upland areas recommends implementation of RMAC process. Overall describes need to develop improvement measures for above problems consistent with ongoing economic survival of private landowners.

A variety of other reports exist describing specific conditions in the Shasta Valley. Collectively all investigations into resource needs of the Shasta Valley tend to call for: 1. Improvements in all phases of irrigation to reduce water withdrawals and subsequent tailwater return, 2. Erosion reduction to minimize fine sediment impacts on spawning gravel, 3. Measures to reduce livestock impacts on riparian zones of streams.

Abstract: Clean Water Act 319(h) funds were used for a variety of water quality improvement projects and activities in the Shasta Valley in 2000. These included: livestock exclusion fences, beaver protection on large trees, water quality data collection and management, working with local high school students on restoration site monitoring and water quality issues, partnering with AmeriCorps members working with students, and preparing and providing additional maps and information for the Klamath Resources Information System. Funds originally allocated to the Shasta Valley were supplemented with additional 319(h) funds originally allocated for similar water quality work in the Modoc National Forest, but unable to be used there.

Introduction:

This report describes the water quality improvement work completed under a grant from the California Water Quality Control Board under section 319(h) of the Federal Clean Water Act of 1972. All work was done in the Shasta Valley in Siskiyou County, California during 2000.

Description of Study Area:

Because of its geology, vegetation and climate, the Shasta Watershed should be thought of as part of the Great Basin, with conditions similar to those typical of Eastern Washington, Eastern Oregon, Northern Nevada, and those parts of California East of the Sierras. It totals just under 800 square miles, and is part of the larger Klamath Basin.

General Location of Project

It is an area of frequent winds, high evaporation rates, limited rainfall and sunny days. Because of its elevation (2300-3500 feet or higher) the growing seasons are short, limiting the crops which can be grown. Distance to markets and lack of infrastructure further limit agricultural activities that can be profitably pursued.

Much of the perimeter Shasta Watershed is steep, dry, and frequently volcanic ground. Because the terrain is so dry and rugged, it has been relatively little impacted by human activities over the last 150 years.

The flat, central portions of the Shasta Valley present a very different picture. Here despite the fact that it contains areas of as little as 5 inches of precipitation per year, agricultural activities predominate. Most ground is dedicated to cow-calf beef production including dryland grain and grazing, irrigated and sub-irrigated pastures, and grass and to a lesser extent alfalfa hay. Additionally, there are limited areas of small orchards, truck gardens, strawberry bedding plants, potatoes, garlic and lavender.

Wherever possible, irrigation is used, either from surface water from the Shasta River or its tributaries, or from ground water. Irrigation with surface water is generally accomplished via wild or controlled flooding. Irrigation using ground water is almost invariably done with sprinklers.

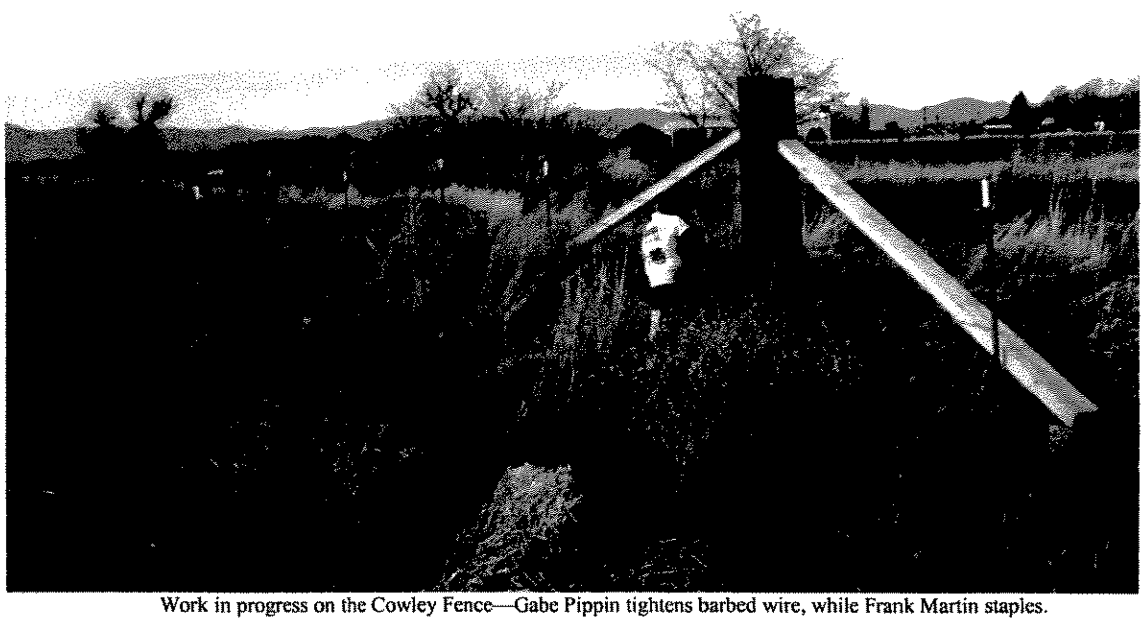
Methods and Materials:

This grant funded a wide variety of activities. Each will be discussed individually. Funds utilized included $22,750 originally allocated to the Shasta Watershed, and an addition of $4,569 in funds originally allocated to the Modoc NF which became available in approximately November of 2000.

1. Livestock control fencing:

The owners of the Fiock and Cowley Ranches were willing to allow livestock exclusion fencing to be built along the portions of the Shasta and Little Shasta River where they flowed through their properties. On the Cowley ranch, 319(h) funds were matched with approximately $52,018 in California Coastal Salmon Recovery Program funds and added 2,433 feet of fencing to a project that will now add a total of 12,000 feet of livestock exclusion fencing along the Little Shasta River. On the Fiock Ranch, 319(h) funds were used to add an additional 2000+ feet of fencing to the existing 7600 feet of livestock exclusion fencing along the Shasta River on their property.

The fence constructed on the Cowley Ranch utilized 8.5 and 9-foot railroad ties for all corners and line posts. All posts were set three to four feet into the ground. Line posts were placed a maximum of every 72 feet. Six-foot heavy-duty steel fence posts (1.33 lbs./foot) were used throughout, with five strands of four-point barbed wire. Three crossing lanes will be provided to allow moving livestock from one side of the stream to the other, and to allow access to a limited area for stockwatering.



Work in progress on the Cowley Fence—Gabe Pippin tightens barbed wire, while Frank Martin staples.

This fence is in an area that has shown the strong potential for good natural recruitment of trees in past years. With livestock excluded for a minimum of ten years, we expect natural tree recruitment to result in substantial stabilization of the soil and banks, along with shading of the Little Shasta River.

During the fall of 2000, fall chinook salmon were seen moving through this area and spawning nearby. The owner of a neighboring ranch who is in his 60's stated that he can never remember seeing salmon there before. While the restoration work to date has not been directly responsible for this, our ongoing outreach has resulted in his new awareness of fisheries and water quality issues. The habitat which will exist as a result of the Cowley fence and other adjoining projects will be used by fall chinook, steelhead, and possibly coho. Water quality in the Little Shasta, Shasta and Klamath Rivers will be benefited.

On the Fiock Ranch, a different style of fencing was used used. Over 2,150 feet were constructed, using corners made of 3" scd. 80 pipe, set in 12" holes, belled at the bottom and filed with concrete. Line posts are similar, set every 72 feet. Five strands of 4-point barbed wire and heavy-duty posts were used throughout. One water access area to the Shasta River was left open.

Fall Chinook salmon were spawning intermittently the length of the Fiock project in 2000. Protection of the stream banks, most of which still have significant riparian growth will be vital to the ongoing restoration effort on the Shasta. Most of the salmon and steelhead production of the Shasta River must pass through this stretch of the river, increasing its importance.

2. Protect existing trees:

While it is uncertain just what the original riparian zone looked like along the Shasta River, there is no doubt that many areas that once had large trees shading the river have lost those trees through the combined effects of beaver, cattle and time. In addition, recruitment of new trees seems to be severely limited by changes to the natural hydrograph resulting from irrigation needs for water and the presence of Dwinnell Dam upstream. In this environment, it is essential to retain the large trees that are still alive, while at the same time supplementing natural recruitment with plantings of local native stock. As part of this ongoing effort, 30-60 foot tall willows and alders along a 1/2 mile stretch of the Webb property on the Shasta were loosely wrapped with 2" x 4" fencing to a height of three to four feet to prevent loss to gnawing by beavers. This work was coordinated by paid staff, with much of the labor provided by volunteers.

Angel and Olana Gomez wrap large willows to prevent gnawing by beavers.

Approximately 65 trees were wrapped, assuring that this portion of the Shasta will remain shaded, and that the aquatic community will continue to be fed by the annual leaf fall. Beavers were actively working in the area where the trees were being protected.

3. Work with schools to monitor project effectiveness:

The Shasta CRMP has an ongoing working relationship with several schools to measure stream cross section profiles at several locations throughout the Shasta Valley. This year cross section work was done at the Meamber Ranch by Discovery High School students.

Setting up new cross sections is a multi step-process. It is begun by selecting several sites in the excluded area that are typical of the stream reach that has been fenced, or will be likely to show measurable change. Heavy-duty T posts are driven upside down at the starting and ending point of each cross-section. By placing them upside down they stand out as unusual, reducing the likelihood that they will be inadvertently removed for use elsewhere. It is our standard practice to denote monitoring sites with upside down T posts.

Once the starting and ending points are marked, reference stakes are driven into the ground about 1.5 feet away from each end point stake and in line with the cross section to be measured. Those stakes are 2-3 foot long pieces of heavy-duty T posts that are driven nearly flush with the ground. In that position they are extremely unlikely to be removed, and even if lost can often be relocated with a metal detector.

A preliminary stringline height is selected at one end of the cross section, and marked on the upside down T post with a felt pen. An engineering autolevel is set up and used to establish an identical horizontal height on the upside down T post at the opposite end of the cross section. Once a reasonable height is established on both ends, a hacksaw is used to notch the upside down T posts at identical heights. Once cut, the heights are re-checked, and if necessary adjusted by additional driving of the posts.

At that point, a string line can be tied to one upside down T post, then pulled tightly to the opposite T post. Braided nylon line works best for this purpose. It is attached at each end in the newly cut notch in the upside down T post, assuring that each end is on a perfectly level plane. (This method ignores sag in the string, but provides results that are comparable from year to year, and is a process the students can understand.)

Next a fiberglass tape measure is stretched below the string line, and also tied off to the upside down T posts. Measurements are then made from the string to the top of the reference stake, and then periodically from the string to the ground. The horizontal distance (which can be read from the tape), and the height of the string above the ground are both recorded. In addition, notes are made of vegetation characteristics, stream substrate, and any other observations deemed important.

Discovery High School Students stretch fiberglass tape in preparation for measuring stream cross section on Meamber Ranch.

Once all field data is collected, the horizontal and vertical dimensions can be entered into a spreadsheet, then depicted in a standard Cartesian graph. Similar data from this site for multiple years can be entered on one graph, showing change over time.

Cross Section work with Discovery High School

Discovery High School is a small alternative high school (associated with Yreka High School) for those students who for various reasons aren't able to fit in well in an ordinary high school environment.

In addition to other water quality monitoring work they do independently, students from Discovery HS have helped with gathering stream cross section data on the Meamber Ranch on the Shasta River since 1996. This September they continued that program, taking three replicate measurements at four cross sections on that property over the course of two field days. Supervision was provided by their teacher, Kevin Velarde, and CRMP staff member Dave Webb.

Procedures in the field involved dividing into two teams of three to four students and one adult. String lines and tapes were deployed as described above, and students rotated through each aspect of the work--field measurements, data recording, and field quality control. Adults avoided undue influence on the proceedings in order to allow the students to gain experience at carrying out a detailed process.

Two students volunteered to enter the field data, but have not yet finished the task. In order to maximize the educational value of the process, it is important to let the students complete the process and review the data. Should completion of data entry prove problematic, the CRMP Coordinator will finish the task from the field data sheets.

4. Other school assistance:

The Shasta River served as the focal point of a graduate student field trip from Southern Oregon University during the summer of 2000, where 12 Natural Resources oriented students learned about the challenges and opportunities faced by landowners working to protect and improve water quality.

Southern Oregon University Grad Students inspect tailwater recovery system originally funded with 319(h) funds.

In 1995 319(h) funds were used to purchase a computer for use in development of the Klamath Resources Information System (KRIS). Over time, the computer has become somewhat obsolete, and the CRMP replaced it with a newer computer last year. However, it is still a good, dependable machine, suitable for a variety of work. It is currently on loan to an AmeriCorps volunteer who is working on a variety of water quality and fisheries projects with the students in the Shasta Valley.

5. Other Water Quality Monitoring:

Other monitoring was done with the combined efforts of employees of Resources Management Inc. and USFWS. Using a CRMP supplied YSI Dissolved Oxygen 55D Meter, they provided labor to collect minimum dissolved oxygen data at 4 sites for much of the summer. Procedure consisted of energizing the meter, driving to the first site at roughly 4:00 am calibrating the instrument, then lowering the probe off the edge of a road bridge into the water. Temperature and dissolved oxygen were recorded. Data was later entered into spreadsheets and graphed. Preliminary discussion of findings was done at the CRMP meeting in December, with more detailed presentation of data planned for a future meeting.

6. KRIS development and implementation:

The Shasta CRMP has been a strong proponent of the Klamath Resources Information System since its inception. We were able to provide the photographic images and project data that were the core of its early development, and information from the Shasta River is also a significant part of the web site for KRIS.

KRIS development has been a long process, much longer than was originally envisioned. Until it reached a public release stage it could not be readily used for restoration planing, documentation and dissemination. The production release of the first KRIS CD in 1998 marked a major milestone in reaching those goals. Since that time, we have distributed numerous copies of it to interested individuals, government officials, the Siskiyou County public library, and landowners. By so doing, we have been able to create a shared database that can be referred to when discussing historic trends, project proposals, restoration needs, etc.

With the listing of Coho, and the designation of critical habitat, the easy ability to refer to data and documents has been especially helpful when working with the newly hired Siskiyou County Natural Resources Planner. We frequently find ourselves planning and discussing fisheries issues by phone, and I regularly refer to the KRIS CD for background data and supporting documentation. Were it not available we would be spending an inordinate amount of time making and mailing copies of difficult to secure documents, or trying to describe locations or processes much easier understood via a photograph. We expect this usage will continue to expand in the future, and as a result we are devoting additional staff time to updating and expanding the KRIS coverage available for the Shasta Valley.

Specific collaboration this year included providing additional photographs, extensive review and editing of many Shasta Valley related KRIS coverages, preparation of a variety of maps, and suggestions for changes. This is an ongoing process.

In addition, we processing both current and historic water quality data for eventual inclusion in KRIS, with the goal of helping put in perspective the water quality issues in the Shasta Valley. Data processed included electronic data from 1994 through 2000 at a variety of sites throughout the Shasta Valley. This data had been assembled electronically by the Shasta CRMP, but needed very extensive re-formatting, export, consolidation and clean-up before it could be reliably usable.

8. KRIS Computer:

The KRIS dB portion of KRIS was released to the public in 1998. The Shasta CRMP transferred the computer originally provided for use with the KRIS to the office of the Shasta Valley Resources Conservation District (RCD) in Yreka in 1998 so that members of the public could more easily access it, with assistance planned to be provided by the RCD staff. It remained there for most of 1999. Among the people given training in the use of KRIS, were Andy Eagan, Nancy Salluci (both RCD employees), Jim DePree, Siskiyou County Natural Resources Planner, and Angel Gomez and Peter Townley, CRMP employees.

Peter Townley used the KRIS computer and software for his work as the RCD District Manager through part of 2000, preparing grant funding requests for fisheries and water quality improvement projects, preparing maps, reports and planning documents. In early summer he switched to a newer computer provided by the Shasta CRMP, and loaned the KRIS computer to Nubez Jordan, an AmeriCorps volunteer, who has been working in the Shasta Watershed with students on a variety of water related projects.

Results and discussion of accomplishments:

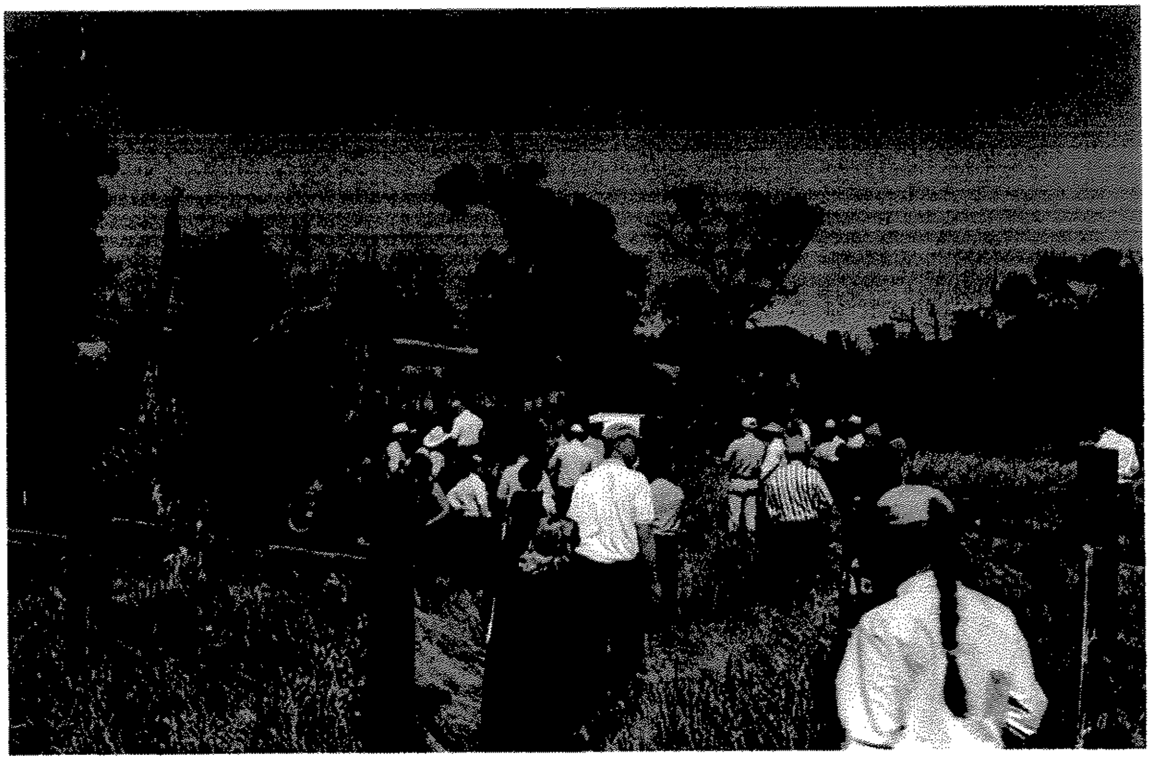
The physical products that resulted from this grant were fairly easy to quantify:

Well over three-quarters of a mile of additional livestock exclusion fencing was constructed.
Triple replicate stream cross section measurements were made on 4 sites on the Meamber Ranch.
65 mature trees were protected from beavers.
Dissolved oxygen data was collected from 4 sites from June through October.
Additions and improvements were made to the KRIS system.
A computer with the KRIS program installed was made available to an AmeriCorps volunteer to use in working with students in the Shasta Valley.
Historic temperature data assembled by the Shasta CRMP was prepared for eventual inclusion in KRIS.

The real gains were less tangible. In part as a result of livestock exclusion fencing under construction on the Cowley Ranch, an adjoining landowner is now investigating fencing an additional 3 miles of the Little Shasta or its tributaries on his ranch. People living along the river are increasingly aware of the presence of salmon and steelhead, and are watching for them.

On the main Shasta, the history (since 1996, all with the help of 319(h) funds) of stream cross section measurements on the Meamber Ranch made it a focus of the annual Siskiyou County Cattlemen's tour.

There, the benefits and costs of river protection were openly discussed at length, graphs and photographs displayed, and the concepts of river protection were strongly endorsed by state level officials within the organization.



Ranchers and farmers at the annual Siskiyou County Cattleman's tour discuss change over time along the Shasta River on the Meamber Ranch.

Collection of season-long dissolved oxygen data provided the basis for an in-depth discussion of irrigation impacts to the river, and the need to aggressively address irrigation tailwater return. TMDLs for the Shasta will be established in 2005. That process is likely to be difficult, and getting an early start on awareness and preventative measures continues to be critical to successfully returning the Shasta to a healthy state.

The KRIS continues to be the best and essentially only mechanism for disseminating both water quality and fisheries data and general information on the Shasta and other portions of the Klamath Basin. It is facilitating an awareness that is translating into growing opportunities to secure restoration funding for the area.

Summary and Conclusions:

Over the past seven years, 319(h) funds have proven to be invaluable in furthering the water quality and fisheries restoration work being done in the Shasta Valley. Flexibility and a reliance on local focus have been the hallmarks of the program, and have been a major factor in the programs ongoing success.

Restoration work takes many varied forms. The work done with funds provided for use in the Shasta Valley through the 319(h) grant process reflect that fact.

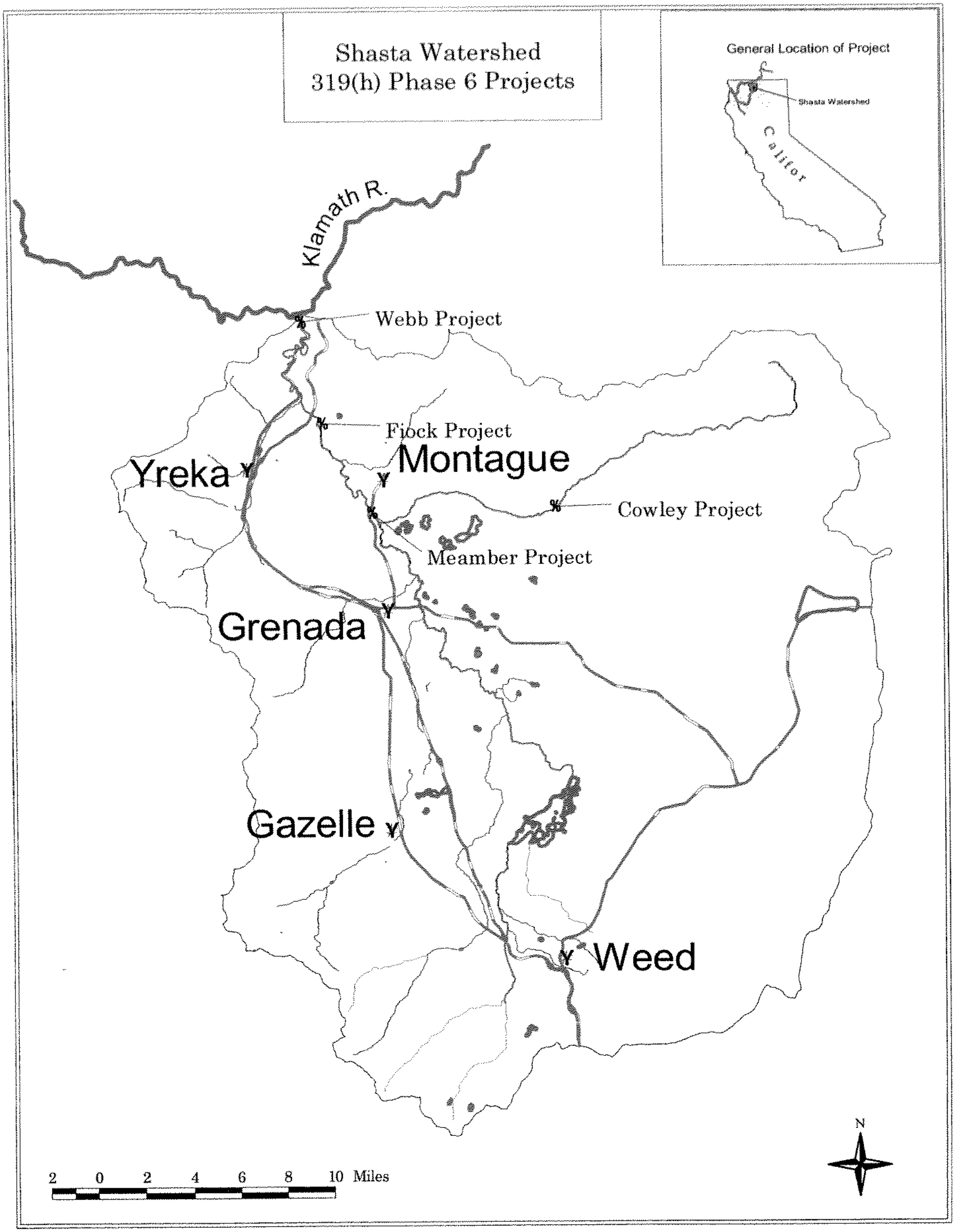
The physical projects-- livestock exclusion fencing and tree protection--speak well for themselves. The need they address is clear-cut, and the results begin to accrue immediately.

The value and importance of ongoing monitoring is less apparent, but no less important. Exposing the local agricultural community to the details of the dissolved oxygen problem in the Shasta will allow them to assimilate the issues, and respond appropriately, something that probably would not have been possible if nothing were apparently being done until the setting of TMDLs in 2005.

The KRIS is now a product ready to take on a life of its own. The USFWS is filling its role as the caretaker of the system, assembling data, suggesting protocols and preparing for future releases. The programming that underlies it has been refined, re-refined and re-refined further. It is now up to those of us who need common access to restoration critical data, and who need a vehicle to distribute that information to add to and improve it.

Appendices

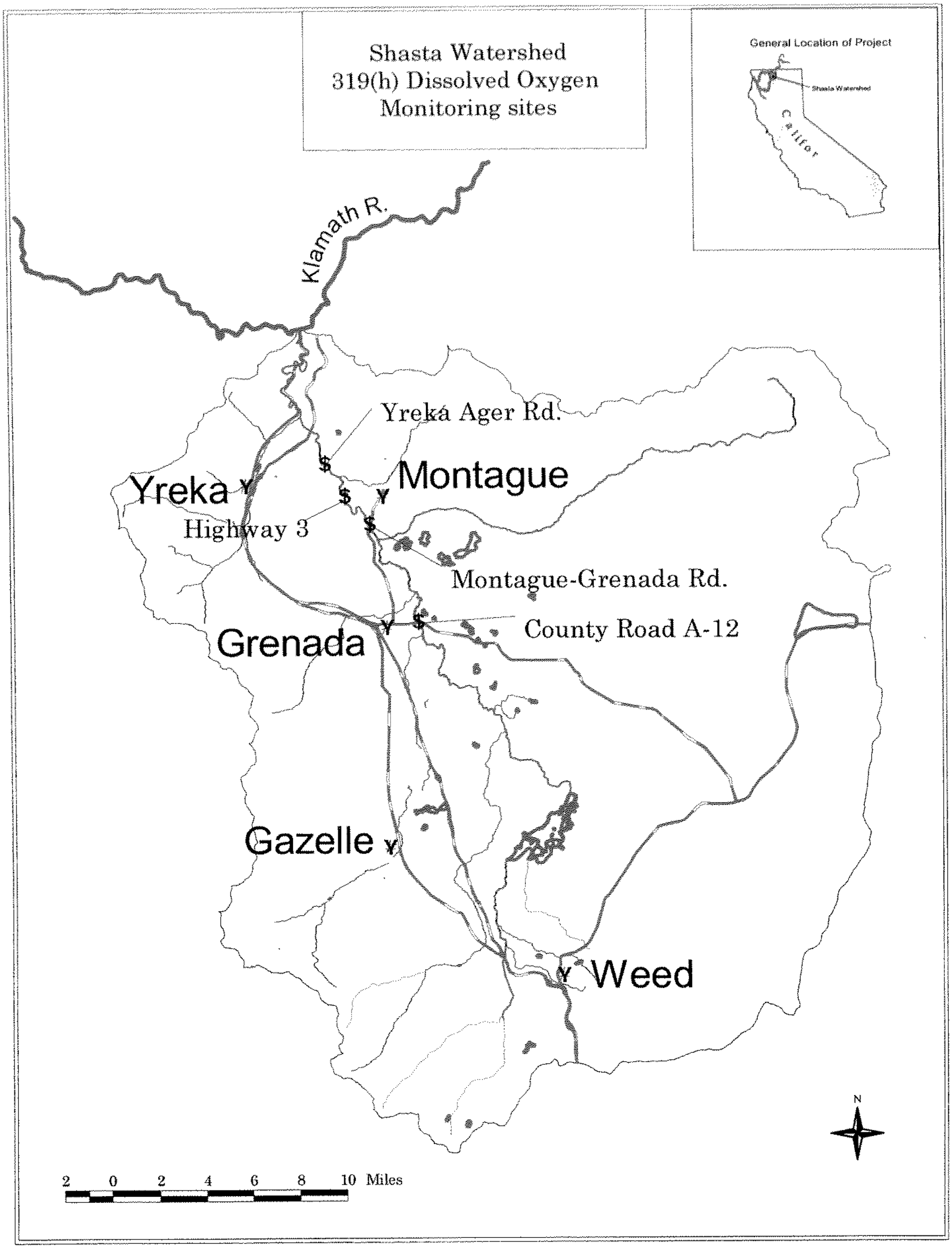
Map of project locations: Cowley, Fiock, Meamber, and Webb Properties.
Dissolved Oxygen data from four locations in Shasta Valley in 2000.
Map showing locations of dissolved oxygen data collection.
Inventory of water temperature data prepared for KRIS.
Samples of graphs used in temperature data clean-up.
Description of cost share and/or matching funds used.



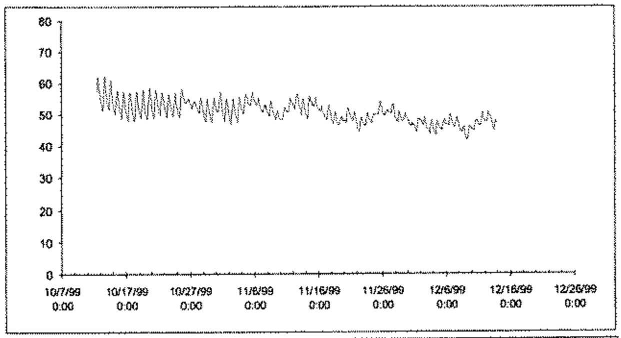
Shasta Watershed
319(h) Phase 6 Projects
General Location of Project
Shasta Watershed
Califor
Klamath R.
Webb Project
Fiock Project
Yreka
Montague
Cowley Project
Meamber Project
Grenada
Gazelle
Weed
2 0 2 4 6 8 10 Miles
N

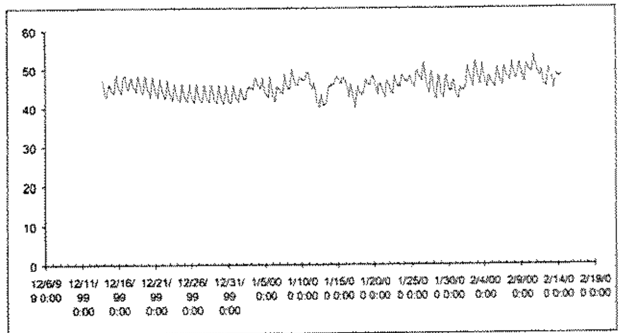
Shasta River Dissolved Oxygen Data, Summer 2000

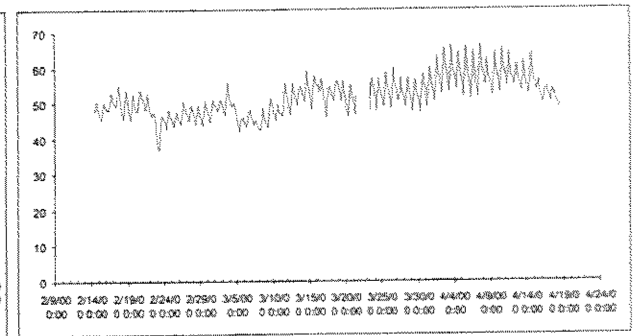
Location	Date	Time	WaterTemp(C)	% Saturation	Mg/L
A 12	05/24/00	5:00	19.8	74.0	6.8
A 12	05/27/00	4:16	18.6	77.3	7.2
A 12	06/03/00	4:16	17.5	80.9	7.7
A 12	06/08/00	4:15	15.7	78.9	7.8
A 12	06/18/00	4:20	19	76.5	7.1
A 12	06/22/00	4:00	19.4	75.5	6.9
A 12	06/27/00	4:15	18.9	75.6	7.0
A 12	07/05/00	4:12	15.5	83.1	8.3
A 12	07/11/00	4:22	18	84.5	8.0
A 12	07/18/00	4:37	18.2	77.9	7.3
A 12	07/24/00	4:15	18.4	76.6	7.2
A 12	08/02/00	4:40	18.9	75.2	7.0
A 12	08/09/00	4:33	18.4	79.6	7.5
A 12	08/16/00	4:45	16.3	75.9	7.4
A 12	08/25/00	4:30	16.4	74.6	7.3
A 12	08/29/00	4:05	19.5	74.1	6.8
A 12	09/06/00	4:40	13.8	74.1	7.7
A 12	09/12/00	6:00	15.8	66.6	6.6
A 12	09/18/00	5:57	15.5	66.0	6.6
A 12	09/27/00		14.1	73.6	7.6
A 12	10/06/00	4:30	13.3	77.1	8.1
Hwy 3	05/23/00	5:15	20	49.7	4.5
Hwy 3	05/26/00	5:07	18.4	59.0	5.5
Hwy 3	06/02/00	4:32	17.8	60.0	5.7
Hwy 3	06/07/00	4:20	18.3	54.6	5.1
Hwy 3	06/17/00	4:40	19.5	60.5	5.5
Hwy 3	06/20/00	4:05	19.6	65.2	6.0
Hwy 3	06/26/00	4:35	21.7	48.8	4.3
Hwy 3	07/03/00	4:41	18.3	49.7	4.7
Hwy 3	07/10/00	4:35	19.3	66.4	6.1
Hwy 3	07/17/00	4:24	20.7	64.1	5.7
Hwy 3	07/23/00	4:35	20.5	56.9	5.1
Hwy 3	08/01/00	4:45	22.1	34.4	3.0
Hwy 3	08/06/00	4:33	20.9	52.1	4.6
Hwy 3	08/13/00	4:47	19.9	44.7	4.1
Hwy 3	08/24/00	4:31	18.2	68.7	6.5
Hwy 3	09/05/00	4:30	14.7	69.0	7.0
Hwy 3	09/11/00		16.3	55.4	5.4
Hwy 3	09/17/00	5:52	17	48.8	4.7
Hwy 3	09/26/00	4:30	13.6	72.0	7.5
Hwy 3	10/04/00	4:46	13.6	76.9	8.0
Montague Grenada Rd	05/24/00	5:17	19	66.0	6.1
Montague Grenada Rd	05/27/00	4:29	18.7	68.0	6.3
Montague Grenada Rd	06/03/00	4:35	17.9	71.7	6.8
Montague Grenada Rd	06/08/00	4:35	16.6	64.5	6.3
Montague Grenada Rd	06/18/00	4:40	18.7	72.4	6.8
Montague Grenada Rd	06/22/00	4:30	20.4	69.0	6.2
Montague Grenada Rd	06/27/00	4:35	21.1	64.9	5.8
Montague Grenada Rd	07/05/00	4:45	17.5	73.8	7.1
Montague Grenada Rd	07/11/00	4:49	19.6	71.6	6.6
Montague Grenada Rd	07/18/00	4:55	20	73.7	6.7
Montague Grenada Rd	07/24/00	4:45	20.9	72.9	6.5
Montague Grenada Rd	08/02/00	5:00	22.1	67.9	5.9
Montague Grenada Rd	08/09/00	4:50	21.3	67.0	5.9
Montague Grenada Rd	08/16/00	5:03	18.3	67.0	6.3
Montague Grenada Rd	08/24/00	4:45	18.3	74.6	7.0
Montague Grenada Rd	08/29/00	4:45	19.2	70.8	6.5
Montague Grenada Rd	09/06/00	5:00	15.3	73.9	7.4
Montague Grenada Rd	09/12/00	6:12	17.8	75.1	7.1
Montague Grenada Rd	09/18/00	6:13	17.2	60.4	5.8
Montague Grenada Rd	09/27/00	5:00	13.3	77.5	8.1
Montague Grenada Rd	10/06/00	5:00	12.1	77.1	8.3
Yreka Ager Rd	05/23/00	4:45	20.3	55.7	5.0
Yreka Ager Rd	05/26/00	4:38	19	59.2	5.5
Yreka Ager Rd	06/02/00	4:15	17.8	65.1	6.2
Yreka Ager Rd	06/03/00	4:50	18.7	63.7	5.9
Yreka Ager Rd	06/07/00	4:00	18.2	63.8	6.0
Yreka Ager Rd	06/17/00	4:20	19.6	64.5	5.9
Yreka Ager Rd	06/20/00	3:35	19.9	68.5	6.2
Yreka Ager Rd	06/26/00	4:15	22.1	57.8	5.0
Yreka Ager Rd	07/03/00	4:14	19.5	65.7	6.0
Yreka Ager Rd	07/10/00	4:15	19.3	69.0	6.4
Yreka Ager Rd	07/17/00	4:45	20.5	67.5	6.1
Yreka Ager Rd	07/23/00	4:10	21.2	65.3	5.8
Yreka Ager Rd	08/01/00	4:25	23.5	50.8	4.3
Yreka Ager Rd	08/06/00	4:18	22.3	56.2	4.9
Yreka Ager Rd	08/13/00	4:32	20	60.3	5.5
Yreka Ager Rd	08/24/00	4:11	18.3	71.0	6.7
Yreka Ager Rd	08/28/00	4:15	19.8	60.9	5.6
Yreka Ager Rd	09/05/00	4:15	14.8	75.3	7.6
Yreka Ager Rd	09/11/00	5:50	16.9	68.4	6.6
Yreka Ager Rd	09/17/00	5:33	17.4	62.4	6.0
Yreka Ager Rd	09/26/00	4:10	13.7	77.0	8.0
Yreka Ager Rd	10/04/00	4:30	14	77.1	7.9

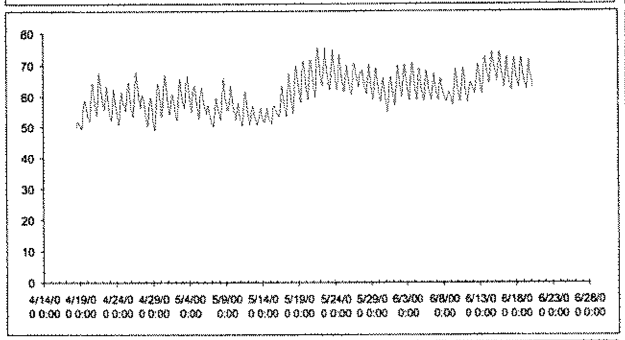

Shasta Watershed
319(h) Dissolved Oxygen
Monitoring sites
General Location of Project
Klamath R.
Yreka Ager Rd.
Yreka
Montague
Highway 3
Montague-Grenada Rd.
Grenada
County Road A-12
Gazelle
Weed
N
2 0 2 4 6 8 10 Miles

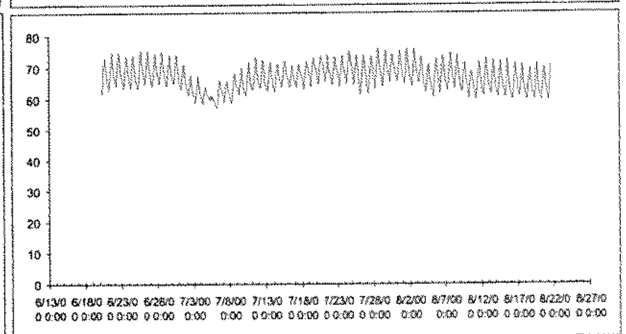
Stream Temperature Shasta River. Top 6 graphs are all the data in consecutive sets. Graph 7 is all the data in one graph. The remaining graphs are selected subsets to show patterns.

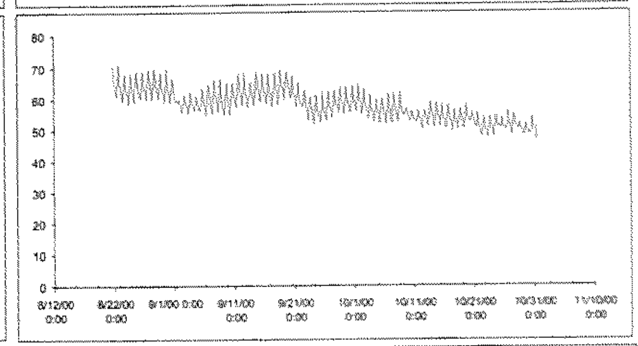


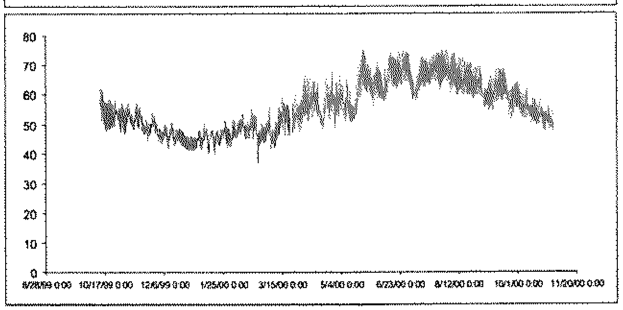


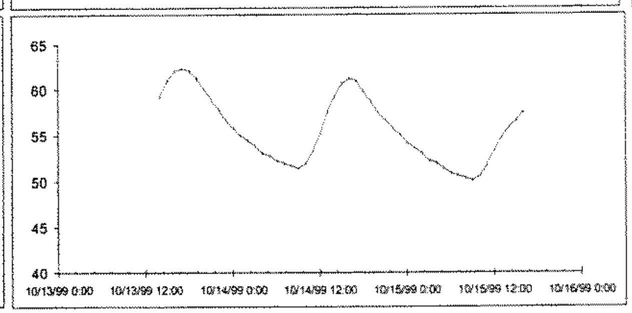


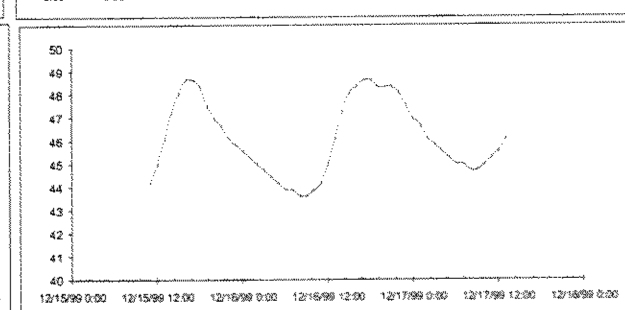


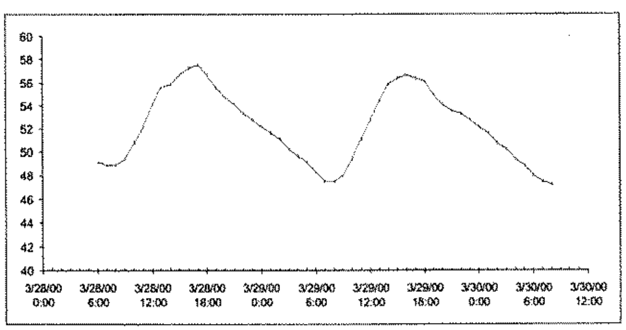


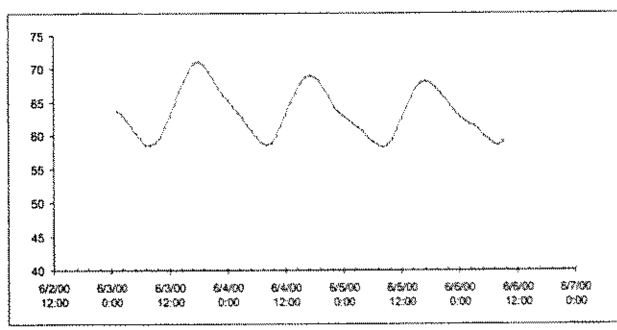


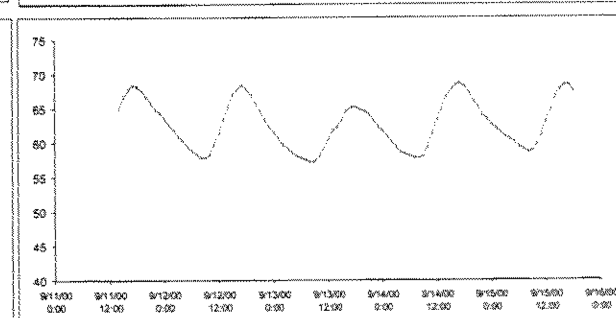












Louie Rd 2000. Deleted outlier at 3/21.

Shasta River Temperature Prepared for KRIS Distribution

Site	year	extent
Anderson Grade Rd Bridge	1994	6/26 to 11/22
Anderson Grade Rd Bridge	1995	3/6 to 11/21
Anderson Grade Rd Bridge	1996	3/21 to 10/20
Anderson Grade Rd Bridge	1997	3/11 to 11/10
Anderson Grade Rd Bridge	1998	4/10 to 11/4
Anderson Grade Rd Bridge	1999	8/18 to 12/31
Anderson Grade Rd Bridge	2000	1/1 to 10/22
DWR Weir / Montague Grenada Rd	1993	6/9 to 6/25
DWR Weir / Montague Grenada Rd	1994	7/15 to 11/22
DWR Weir / Montague Grenada Rd	1995	6/6 to 11/21
DWR Weir / Montague Grenada Rd	1996	3/20 to 10/18
DWR Weir / Montague Grenada Rd	1997	3/23 to 11/6
DWR Weir / Montague Grenada Rd	1998	4/10 to 11/3
DWR Weir / Montague Grenada Rd	1999	3/18 to 10/12
DWR Weir / Montague Grenada Rd	2000	3/23 to 10/31
Edgewood Rd nr Airport	1996	6/12 to 8/25
Edgewood Rd nr Airport	1997	6/9 to 11/5
Edgewood Rd nr Airport	1998	4/10 to 11/3
Edgewood Rd nr Airport	1999	3/18 to 12/31
Edgewood Rd nr Airport	2000	1/1 to11/13
Grenada Irrigation Dist Dam	1994	7/14 to 11/22
Grenada Irrigation Dist Dam	1995	6/6 to 11/21
Grenada Irrigation Dist Dam	1996	3/24 to 8/5
Grenada Irrigation Dist Dam	1997	3/12 to 11/5
Grenada Irrigation Dist Dam	1998	5/29 to 11/3
Grenada Irrigation Dist Dam	1999	3/18 to 10/13
Grenada Irrigation Dist Dam	2000	3/23 to 5/9
Highway A-12 Bridge	1993	6/9 to 6/30
Highway A-12 Bridge	1994	3/28 to 11/24
Highway A-12 Bridge	1995	2/28 to 11/21
Highway A-12 Bridge	1996	6/6 to 10/21
Highway A-12 Bridge	1997	3/21 to 11/4
Highway A-12 Bridge	1998	4/10 to 11/3
Highway A-12 Bridge	1999	3/17 to 10/12
Highway A-12 Bridge	2000	3/23 to 11/1
Highway 263 Bridge	1993	6/24 to 7/15
Highway 263 Bridge	1994	4/6 to 11/22
Highway 263 Bridge	1995	3/6 to 11/21
Highway 263 Bridge	1996	3/24 to 10/21
Highway 263 Bridge	1997	3/11 to 11/5
Highway 263 Bridge	1998	4/7 to 11/3
Highway 263 Bridge	1999	3/18 to 12/31
Highway 263 Bridge	2000	1/1 to 10/6
Highway 3 Bridge	1994	3/28 to 6/30
Highway 3 Bridge	1995	3/6 to 11/28
Highway 3 Bridge	1996	3/21 to 10/21
Highway 3 Bridge	1997	3/21 to 11/5
Highway 3 Bridge	1998	8/18 to 11/3
Highway 3 Bridge	1999	3/21 to 12/31
Highway 3 Bridge	2000	1/1 to 10/31
Hole in the Ground	1999	4/7 to 10/12
Louie Rd Bridge	1994	7/17 to 9/9
Louie Rd Bridge	1995	5/17 to 8/15
Louie Rd Bridge	1996	3/25 to 10/12
Louie Rd Bridge	1998	4/6 to 11/4
Louie Rd Bridge	1999	3/18 to 12/31
Louie Rd Bridge	2000	1/1 to 10/31
Mouth of Shasta	1997	3/21 to 11/6
Mouth of Shasta	2000	1/1 to 10/5
Parks Cr Nr. Mouth	1997	6/10 to 10/31
Parks Cr Nr. Mouth	1999	4/8 to 10/12
Parks Cr Nr. Mouth	2000	5/8 to 8/27
Riverside Drive Crossing	1994	3/26 to 8/30
Riverside Drive Crossing	1995	2/28 to 9/10
Riverside Drive Crossing	1996	3/22 to 6/20
Riverside Drive Crossing	1997	6/11 to 10/31
Riverside Drive Crossing	1998	5/20 to 11/3
Riverside Drive Crossing	1999	3/19 to 12/31
Riverside Drive Crossing	2000	1/1 to 5/9
Yreka Ager Rd	1994	3/26 to 11/22
Yreka Ager Rd	1995	3/6 to 11/21
Yreka Ager Rd	1996	3/28 to 10/20
Yreka Ager Rd	1997	3/12 to 11/4
Yreka Ager Rd	1998	4/8 to 11/3
Yreka Ager Rd	1999	3/18 to 10/12
Yreka Ager Rd	2000	3/22 to 11/1

Volunteer contributions and matching funds:

Meeting the goals of this grantincluded the following volunteer hours and/or cash contributions:

1. Collection of dissolved oxygen data by the combined efforts of Resources Management Inc. and USFWS personnel, labor and mileage, $2,900.

2. In measuring stream cross sections, 32 student field hours @ $8.00/hr = $256, plus one adult @ $30/hr. for 5 hours = $150, plus one adult processing data for 12 hours @ $30/hr= $360, totaling $766.

3. Wrapping trees to prevent beaver damage, 18 person hours at $20/hr. = $360.

4. Lost grazing from the two livestock exclusion areas—2.6 acres @ $15/acre/month for 8 months/year for 10 years = $3117.

5. DFG cash match on the Cowley Fence, $52,018.

Total volunteer contributions and match: $59,161