BOARD OF SUPERVISORS

October 17, 2005

Sharon Stohrer
State Water Resources Control Board
1001 I Street, 14th Floor
Sacramento, CA 95814

Dear Sharon:

Please accept this letter and the enclosed documents as the comments of Plumas County regarding the scope and content of the EIR for the water quality certification for the Upper North Fork Feather River Hydroelectric Project (FERC Project 2105).

As you know, Plumas County has been an active participant in the 2105 relicensing process and is one of the parties to the partial settlement agreement that was signed last year. The settlement agreement reflects collaboration and compromise on a number of important issues – protecting and enhancing all of the designated beneficial uses of Lake Almanor, while also improving conditions in the North Fork of the Feather River below the lake. In developing and analyzing alternatives for the EIR, we request that the State Board recognize and preserve the progress of the settlement agreement to the greatest extent possible.

We recognize that water temperature in the North Fork is an important question in this relicensing and that it was not resolved in the settlement agreement. Plumas County has vocally opposed earlier proposals for a "thermal curtain" at Prattville that would attempt to siphon cold water from Lake Almanor, and we continue to be concerned with proposals for cold water releases from Canyon Dam that could alter the lake's ecosystem. After years of negotiation and scrutiny, we are convinced that the most practical approach to addressing the impacts of Project 2105 in the Seneca and Belden reaches is to make compensating improvements elsewhere in the North Fork system.

It may be possible to make marginal temperature improvements in the North Fork below Canyon Dam, but only by jeopardizing Lake Almanor and Butt Valley Reservoir and imposing significant reductions in power generation. However, Pacific Gas & Electric Company should not be given a pass on reasonable mitigation efforts. PG&E should contribute to watershed restoration and enhancement – but in areas where the investment will provide the greatest return. That is the reason Plumas County has advanced the Watershed Restoration and Improvement Alternative focused on the East Branch of the North Fork. We hope the State Board will embrace that alternative as the primary and preferred alternative in the EIR.

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Finally, at the scoping meeting in Chester on September 27, we were informed the State Board could take up to two years to complete this EIR. We hope the EIR will be finished much sooner than that, considering that the original 2105 license expired a year ago and that with each passing year we postpone important environmental, recreational, and economic enhancements that have already been agreed upon as elements of the final license. Following the intentions of the CEQA guidelines and federal regulations, we request that the State Board adopt a one-year timetable to complete the EIR and make every effort to stick to that timetable.

Thank you for your consideration of our comments. Plumas County looks forward to continuing our collaborative relationship as we all move forward with this process.

Sincerely,

William N. Dennison

William N. Dennison
Chair, Board of Supervisors

County of Plumas

Project 2105 EIR Scoping Comments

The County of Plumas appreciates the opportunity to provide scoping comments to the State Water Resources Control Board (SWRCB) for the EIR on the water quality certification for the Upper North Fork Feather River Hydroelectric Project (FERC Project 2105). Our primary concerns relate to the contemplated thermal curtains at Prattville and in Butt Valley Reservoir and the EIR's full consideration of the alternative we propose for watershed restoration efforts.

Plumas County strongly opposes the thermal curtain. For the reasons stated below, and based on the many more arguments presented at the September 27 scoping meeting, the SWRCB should determine that the thermal curtain alternative is fundamentally flawed and it should be described in the EIR as an unreasonable alternative and eliminated from further consideration. Instead, Plumas County proposes a Watershed Restoration and Improvement Alternative ("Watershed Alternative") to provide compensatory mitigation in other parts of the North Fork system, as set forth in Attachment 2. The County has reviewed available information for other alternatives and believes that the Watershed Alternative is superior to other alternatives presented. We hope that the SWRCB will arrive at the same conclusion after thoroughly evaluating the Watershed Alternative as part of the EIR.

The County appreciates the SWRCB's commitment to conduct a detailed evaluation of all the reasonable alternatives. We support an independent analysis, but wish to express concern over the potential schedule. At the scoping meeting attendees were informed that the EIR process could take as long as two years. Plumas County would like to remind the SWRCB that CEQA guidelines suggest that the EIR should be completed within one year. Also, according to federal regulations, the 401 Water Quality Certification decision must be made within one year of submittal of a complete application. This would imply that the EIR process should be completed prior to the September 2006 anniversary date of PG&E's submittal of a complete 401 application. Delaying the 401 decision beyond next September would cause further harm to the County as the County already has had to endure a two-year delay for environmental, recreational, and economic improvements agreed to in the April 2004 Settlement Agreement.

Finally, it is important that the EIR recognize the efforts and progress of the relicensing processes to date. Collaborative groups have been wrestling with the North Fork water management questions for years, and the products of their collective efforts are the settlement agreement and new license for the Rock Creek/Cresta Project 1962 and the partial settlement agreement for Project 2105. Any alternatives analyzed in the EIR need to consider the relationship between the contemplated alternatives and the settlement agreements.

In support of the general observations and requests outlined above, Plumas County offers the following specific comments.

Elimination of Thermal Curtain Alternative

Plumas County opposes solutions to certain water temperature and fishery problems, such as the thermal curtain in Lake Almanor, that provide limited benefits in one area while potentially

harming our citizens' quality of life and negatively impacting our environment and recreation-based economy elsewhere.

Based on preliminary review of a number of proposals that attempt to reduce water temperatures in the North Fork, including the thermal curtain, it is evident that a great deal of money could be spent without producing significant benefits. Even under some of the most ambitious proposals, it appears there will be periods of time when it is impossible to meet 20˚C temperature standards in the North Fork Feather River (NFFR) without significantly diminishing the cold water pool and degrading the cold water fisheries in Lake Almanor and Butt Valley Reservoir. There may even be periods of time when it is impossible to meet cold water temperatures in the NFFR without causing seasonal harm to the fishery in the Seneca reach.

Rather than devoting significant resources to even more examination of the thermal curtain schemes, the 2105 EIR analysis should focus on the mix of alternatives that provides the most environmental benefit in the NFFR with the least environmental impact to other water bodies.

With respect to those other alternatives mentioned in the Notice of Preparation, the proposal to construct mechanical water chillers at reach-specific locations is the only alternative besides the thermal curtain that would create significant new structures. Based on the preliminary information that has been advanced, it does not appear that chillers provide enough benefit to justify the cost of construction and operation, their negative environmental impacts, and the visual degradation to the North Fork Canyon. Perhaps chillers have a place in the Poe reach, but such a massive and unsightly installation would need to be designed and screened to fully mitigate visual impacts.

1962 and 2105 Settlement Agreements

Plumas County and its citizens have participated in good faith to arrive at the settlement agreements for Projects 1962 and 2105, and the commitments agreed to in those negotiations need to be honored to the greatest extent possible. The CEQA analysis should disclose how all alternatives under consideration will affect the existing 1962 and 2105 settlement agreements. Effects on the agreements should be a significant factor in determining "reasonable and feasible" temperature modification alternatives for the NFFR. Specifically, the CEQA analysis of alternatives should analyze and disclose:

- impacts to the summer water temperatures, summer lake levels, and cold water fishery of Lake Almanor and Butt Valley Reservoir
- how the temperature modification alternatives may affect the existing agreement for reservoir operations at Buck's Lake
- how temperature modification alternatives may affect the existing schedule of Western Canal water deliveries from Lake Almanor to Lake Oroville
- impacts to hydropower generation

The system-wide impacts of the chosen temperature modification alternatives should be displayed in a fashion that allows the public to visualize the impacts and tradeoffs between different river reaches and lakes – by each alternative and as clearly as possible. The impacts

and tradeoffs need to be displayed for the full range of conditions under consideration. At a minimum, this means

- showing water temperatures, air temperatures, flows in cfs, and residence times for water passage through different reaches of the NFFR system at different flows and temperatures during June, July, and August
- displaying water temperatures at both the top and bottom of each stream or lake reach where possible
- clearly labeling settlement agreement flows within the analysis
- clearly identifying all thresholds of significance

The blended climate/water temperature/discharge characterization of normal, cold-wet, hot-dry periods currently used by PG&E may be the best way to delineate and display a range of conditions for analysis. However, the CEQA analysis should independently evaluate and determine the most transparent method for characterizing and comparing temperature modification alternatives throughout the NFFR system.

The CEQA analysis should begin with daily mean water temperatures for normal years at a 50 percent to 90 percent exceedance in June, July, and August, and then, if needed, analyze dry and critically dry years at various exceedances. This analysis will help the public understand the effect of weather on controllable factors such as stream flow releases. The CEQA document should describe both pre-project and existing project conditions in terms of summer water temperatures and adult trout populations in the NFFR based on best available information. Any sources of information used in the CEQA analysis should be described as professional judgment, monitoring data, computer simulations, etc. with the range of accuracy or confidence clearly disclosed, by information source.

Shoreline Erosion

Shoreline erosion has and is continuing to have an adverse effect on environmental and social resources in the Lake Almanor environs. To mitigate for these effects, Plumas County requests that the SWRCB evaluate shoreline erosion in the EIR and impose conditions in the 401 Water Quality Certification that protect environmental and social resources around Lake Almanor. At a minimum, the SWRCB should require that PG&E update the shoreline erosion control plan in consultation with the SWRCB, resource agencies, and Plumas County. The County believes that PG&E's proposed erosion control plan included as part of the Shoreline Management Plan does not adequately address erosion sites that are adversely affecting resources, including Maidu cultural resources.

Plumas County recommends that the SWRCB include two conditions to protect Lake Almanor resources: a shoreline management plan and a shoreline erosion plan. FERC's recent issuance of a license for Portland General Electric's (PGE) Pelton Round Project provides a good example of the license/article 401 conditions recommended by the County. Both license conditions are included as Attachment 4 to these comments.

Article 428 of PGE's license requires a shoreline management plan. During the settlement negotiations, Plumas County and PG&E successfully negotiated a shoreline management plan

with which both could live. Plumas County asks that the SWRCB require PG&E to update the shoreline management plan to include a shoreline erosion plan acceptable to Plumas County and the SWRCB. Because the shoreline management plan did not receive sufficient public scrutiny, the County requests that PG&E present the plan to the public and solicit input on the plan.

Article 429 of PGE's license requires the licensees (the Warm Springs Indian Tribe is a co-licensee) to file a shoreline erosion plan within one year that 1) discusses the conditions and probable causes of shoreline erosion; 2) describes agreed upon actions, but not limited to what is already in the license article; and, 3) provides that all the actions conducted under the shoreline erosion plan be developed and implemented with a Shoreline Management Working Group. Within three years, the licensees are required to rehabilitate a number of erosion sites. The licensees are required to survey the shoreline area and prepare a baseline survey that maps resources that are affected by erosion (water quality, fish habitat, terrestrial habitat, or tribal reservation lands). Annual monitoring is required thereafter to monitor existing erosion and identify and map new erosion sites. At each erosion site the licensees are to establish a re-locatable topographic survey transect. An annual report is to be produced that describes soil erosion control measures. In developing erosion control measures, the licensees are to give preference to soft erosion control techniques. The County recommends that an identical condition be included in the SWRCB's 401 Water Quality Certification.

As an additional shoreline erosion issue, during the settlement negotiations PG&E reiterated its right to erode areas that were conveyed to PG&E via the Red River and Clifford Deeds. However, the SWRCB is charged with protecting the environmental and social resources affected by the project, and in particular water quality and beneficial uses. A side agreement between PG&E and the previous owners of the Clifford and Red River deeds cannot preempt either FERC or the State Board's responsibility to protect environmental resources. As the licensee, it is PG&E's responsibility to remedy erosion problems that are damaging to environmental resources. Plumas County proposes to work with PG&E and the SWRCB to update PG&E's erosion plan to identify areas of eroding shoreline that are affecting terrestrial, water quality, fishery, cultural, recreational and socio-economic resources around Lake Almanor.

Supplemental Materials

The following items are presented as attachments to the comments of Plumas County:

Attachment 1 – Thermal Curtains and Watershed Restoration (CD)
(PowerPoint presentation with voiceover)
Attachment 2 - Watershed Restoration and Improvement Alternative
Appendix A – Description of Projects with Benefits and Costs
Appendix B – Watershed Data Archive
Appendix C - East Branch Water Quality and Fishery Monitoring Plan
Appendix D – Water Rights Notification Process
Appendix E – Last Chance Protocol and Lake Almanor Habitat Map (CD)
PowerPoint from Feather River Coordinated Resource Management Group (CD)
The Feather River CRM – 20 Years of Watershed Restoration (DVD)
Attachment 3 - Upper Feather River Integrated Regional Water Management Plan (CD)
Attachment 4 – Shoreline management and erosion provisions from Portland General Electric.

Attachment 2

Project 2105 EIR Scoping Comments

Watershed Restoration and Improvement Alternative

Introduction

The County of Plumas requests that the State Board analyze the Watershed Restoration and Improvement Alternative ("Watershed Alternative") presented below as part of the EIR for the water quality certification for FERC Project 2105. The Watershed Alternative provides for off-site mitigation in the East Branch of the North Fork Feather River, where mitigation benefits can be achieved in greater magnitude, at less cost, and without the redirected impacts of many of the mitigation alternatives being proposed within the Project 2105 boundary. Mitigation opportunities in the East Branch can produce water temperature and other water quality benefits in the North Fork and provide attendant habitat improvements – all in ways that are consistent with regional water management plans. The Watershed Alternative is offered as a stand-alone alternative or to be used in combination with other prudent alternatives.

Plumas County has a longstanding commitment to improving the economic and environmental health of the Upper Feather River watershed – more than seventy percent of which lies within the County's jurisdiction – for the benefit of County residents and visitors and for more distant beneficiaries. Plumas County has consistently advocated a collaborative and watershed-based approach for balancing beneficial uses in the North Fork Feather River. As stated in the Integrated Regional Water Management Plan for the Upper Feather River:

> *It is apparent to most decision-makers in the watershed that piecemeal planning constrains the range of potential solutions to the region's most pressing conflicts. By building on the wealth of hands-on watershed restoration experience, project-scale monitoring, and institutional capacity it will become possible to expand water management and planning to larger scales when water management conflicts require larger scale solutions.*

In the context of the relicensing of FERC Project 2105 and the management of the North Fork, Plumas County opposes solutions to certain water temperature and fishery problems, such as the thermal curtain in Lake Almanor, that provide limited benefits in one area while potentially harming our citizens' quality of life and negatively impacting our environment and recreation-based economy elsewhere.

Based on preliminary review of a number of proposals that attempt to reduce water temperatures in the North Fork, it is evident that a great deal of money could be spent without producing significant benefits. Even under some of the most ambitious proposals, it appears there will be periods of time when it is impossible to meet 20˚C temperature standards in the North Fork Feather River (NFFR) without significantly diminishing the cold water pool and degrading the cold water fisheries in Lake Almanor and Butt Valley Reservoir. There may even be periods of time when it is impossible to meet cold water temperatures in the NFFR without causing seasonal harm to the fishery in the Seneca reach.

Instead, other alternatives may provide comparable downstream benefits with more adaptive management flexibility and fewer redirected impacts. From a review of currently available data, three degrees of coldwater improvements in the Rock Creek/Cresta Reach of the NFFR in normal water years may be achieved in a number of ways. In particular, the East Branch of the North Fork is a significant source of hot water for the river and presents a mitigation opportunity for the North Fork system that is begging to be seized. For that reason, Plumas County is proposing the Watershed Alternative for off-site, compensatory mitigation in the East Branch, as detailed in the following pages.

Watershed Alternative

After extensive review and years of participation in the collaborative licensing processes, Plumas County has concluded that off-site mitigation is the most feasible and effective way to address the irreversible and continuing loss of coldwater habitat for trout resulting from hydro-modification of the NFFR system. Trout have lost access to historic coldwater refugia and spawning habitat in the main channel and the tributary streams of the NFFR. These impacts are permanent and cannot be adequately mitigated by any practical means. PG&E's hydroelectric dams block trout from migrating up and down the NFFR to seek suitable coldwater habitat. Without fish ladders, the continuing blockage of fish passage cannot be mitigated on-site, in the NFFR. Creating further detriment, the Rock Creek, Cresta and Poe reservoirs warm NFFR water beyond temperatures that would have occurred under free flowing river conditions.

Plumas County supports efforts by the Department of Fish and Game, the Plumas National Forest, the 1962 ERC, and others who are working to improve fish spawning habitat and coldwater conditions and other protections (such as increased warden presence) for the improvement of the coldwater fishery in the NFFR Canyon. To complement those efforts, Plumas County proposes the Watershed Alternative - offsite compensatory mitigation for 2105 and the cumulative impacts of the other PG&E projects on the North Fork. The Watershed Alternative is offered as a stand-alone alternative or to be used in combination with other alternatives.

The Watershed Alternative confronts the dilemma of incremental improvements in water quality and the coldwater fishery in the NFFR being achievable only by degrading the coldwater fishery and summer water quality in Lake Almanor. The Basin Plan's designated beneficial uses for Lake Almanor should not be impaired by efforts to improve preexisting conditions in the NFFR – conditions that have existed for nearly a century and that pre-date State Board Resolution 68-16 and the federal Clean Water Act by more than 50 years.

Instead, the Watershed Alternative should be used to improve stream reaches elsewhere in the North Fork watershed as off-site, compensatory mitigation for not achieving the last marginal and costly increments of coldwater fishery and temperature improvements in the NFFR. Plumas County supports improving coldwater fisheries and summer water quality throughout the North Fork system, including Lake Almanor and Butt Valley Reservoir. However, degrading Lake Almanor for a final increment of benefit in the NFFR is not "worth it" at any price, even if such a trade-off is technically feasible.

The Watershed Alternative was initially set forth in an August 1, 2005, document prepared for the 2105 Licensing Group collaborative. The latest version of the document is attached as Appendix A and includes a detailed description of Plumas County's proposed projects and their estimated costs and benefits. The following sections of this document further describe aspects of the 17 proposed restoration projects in four subwatersheds of the East Branch of the North Fork, including their environmental benefits and the linkages to Project 2105.

Watershed Alternative and NOP Feasibility Criteria

The State Board's Notice of Preparation (NOP) for the EIR sets forth criteria for evaluating the feasibility of alternatives, and that evaluation will inform the decision on which alternatives to include and analyze in the EIR. The sections below address aspects of the Watershed Alternative in the context of the evaluation criteria stated in the NOP.

Temperature Moderating Benefits to the Affected NFFR Reaches

The entire Watershed Alternative is based upon the premise that for any given level of effort and expenditure, temperature benefits and corresponding habitat improvements can be achieved in a much greater magnitude in the vast, free-flowing expanses of the East Branch of the North Fork than in the highly modified and flow-controlled reaches of the river system from Canyon Dam to Bid Bend. Therefore, the Watershed Alternative does not directly affect temperature in the reaches from Canyon Dam to the confluence with the East Branch, but it does provide significant compensatory benefits in the East Branch as well as some benefit in the North Fork below the confluence.

The North Fork canyon within the 2105 project boundary is unique, and there are no comparable mitigation opportunities in the region. However, within the larger North Fork system, there are canyon stream reaches in the East Branch that are comparable to the river sections within the 2105 boundary, although they are smaller and interspersed with alluvial valleys. Degraded conditions in those valleys provide mitigation opportunities that will improve water quality and biological connectivity in the canyon reaches. Given the biological and hydrological connection between the North Fork and its East Branch, the EIR analysis should include the potential for mitigation of cumulative effects in the watershed through off-site mitigation.

Jim Wilcox is the Program Manager for the Feather River Coordinated Resource Management Group. In his professional judgment, which is based on 20 years of watershed restoration experience in the Upper Feather River Basin, full implementation of the Watershed Alternative would delay the onset of temperature exceedances in the NFFR by two weeks in a normal year and provide water temperature improvement throughout the summer. Although the East Branch contributes a relatively small portion of the total North Fork summer flow, it is a significant source of hot water. Unlike the river reaches from Canyon Dam to Big Bend, there are numerous opportunities in the East Branch system for the restoration of natural conditions and processes that will in turn reduce hot water. If Project 2105 is operated at historic capacity from mid-July through August, the temperature influence of the East Branch is minimal, but that influence increases commensurately with any reductions in power production.

Cost of Implementation Versus Predicted Benefits

Based on PG&E's 4-D report, a two-week delay in the need to reoperate the 2105 hydro-electric system at Lake Almanor, Butt Valley Reservoir, and Belden equates to an avoided cost of about $1 million per year that would otherwise be lost in power generation in the month of July. Depending on the term of the new license, savings would be on the order of $30 to $50 million in today's dollars. The Watershed Alternative is estimated to cost $30 million over the same period, and Plumas County proposes to augment PG&E's contributions with funds from other sources. Therefore, the Watershed Alternative warrants analysis for cost reasons alone.

In contrast to the other temperature modification alternatives under consideration, the benefits of the Watershed Alternative are realized year-round and provide much broader environmental enhancements. The Watershed Alternative improves habitat for riparian, wetland, and aquatic species on 80 stream miles of the East Branch and provides meadow floodplain restoration to 6,000 acres. In comparison, there are less than 40 stream miles in the main stem of the North Fork.

Implementing the Watershed Alternative in combination with reasonable and feasible temperature modification measures in the NFFR Canyon addresses up to three times more riverine and coldwater fish habitat than a "no project" alternative. Improving up to 120 miles of river in the main stem and the East Branch can enhance biological connectivity in the whole North Fork system – which is one of the goals of the Integrated Regional Water Management Plan for the Upper Feather River.

Incidental Environmental Effects

The local Feather River Coordinated Resource Management Group (Feather River CRM) has implemented over 40 stream bank erosion control and meadow re-watering projects since 1985 on public and private lands in the Upper Feather River Basin. Project monitoring combined with modeling-based predictions (Linda Bond, 1997; Rick Kattlemen, 1987) suggest that meadow and stream restoration in combination with upland vegetation management could reduce downstream flood peaks by five percent for the first 24 to 36 hours of a severe winter storm, while enhancing summer base flows by seven percent. Measurements of flood events (when possible) have shown that 50 cfs discharges in channels are associated with 5cfs flows on adjoining floodplains during the same flood period (Kossow-Cawley, 1987). Dr. Bond estimates that restoring groundwater storage in the 200,000 acres of degraded meadows in the Upper Feather River Basin would increase late season surface water yields by 100,000 or more acre feet in normal and wet years. In 1999, Dr. Jeff Romm, an economist at UC Berkley, conducted a cursory survey of the value of restoring natural watershed processes in the Feather River watershed and concluded that "in certain conditions, riparian and meadow restoration can actually enhance water storage more efficiently than dam augmentation."

Based on professional judgment by the FR-CRM staff and based on data that has been collected by the FR-CRM (see Appendix A), the Watershed Alternative could mitigate water temperatures by 3˚C to 9˚C or more in June, July, and August in specific stream reaches of the East Branch.

When compared to other temperature modification alternatives under consideration by the State Board, the Watershed Alternative could provide as much as three times the peak stream temperature mitigation, depending on the characteristics of particular stream reaches in the East Branch. In most cases, water temperatures of 20˚C could be achieved in June, July, and August of normal years within 10 years of initiating restoration treatments. PG&E's July, 2005, 4-D report states that trout useable wetted habitat would increase by an average of about 5 percent and a maximum of about 15 percent in the NFFR as a result of a variety of temperature modification alternative measures. We recognize that these estimates are preliminary and may be revised upward. We predict that the Watershed Alternative will increase trout habitat by 10 percent to 30 percent or more, as measured by the National Forest Stream Condition Inventory (SCI) protocol. (See Appendix C for more information on the SCI protocol).

Scientific Basis for Watershed Improvement Alternative

Watershed-wide erosion identified in a 1989 study conducted by the Soil Conservation Service (now called the Natural Resources Conservation Service) is one symptom of an overall loss of watershed function. Other symptoms include increased flood peaks and flood damage frequency, water quality impairments (nutrients and temperature, as well as sediment), and the ongoing loss of aquatic and terrestrial habitats. The primary physical process resulting in these symptoms is channel incision in the meadows and valleys of the upper two-thirds of the watershed (Clifton, 1994). Once initiated, incision/stream bank erosion continues until a new channel base level is reached. On many of the larger channel systems this erosion and channel widening and deepening process has reached depths of 14 to 16 feet and widths of 300 feet or more, far beyond the range of natural with/depth ratios in healthy streams. The incised channel continues widening by eroding the stream banks below the protective rooting depth of the native meadow sod. As the incising channel capacity increases more stream flow is captured, further severing the stream from the naturally evolved flood plain. In many areas of the watershed virtually no flood flows now access the historic flood plains. The concentration of stream flows and the desertification of the original riparian vegetation community further weakens stream banks, creating ongoing cycles of erosion, dewatered meadow aquifers, peak summer heating temperatures, and the continued loss of coldwater fish habitat.

After the winter precipitation and runoff season ends, surface water flow derives almost entirely (80% or more) from groundwater and tributary flows (Benoit). In healthy systems, fully recharged groundwater aquifers feed surface flows throughout the summer. Some models estimate that shallow meadows completely drain groundwater into streams in one to three year's time, depending on each previous year's precipitation (Loheide). Mature riparian and aquatic vegetation, and defined and self-maintaining pools and riffles (ideally at a 1:1 ratio), maintain cooler stream temperatures and provide cold water refugia for fish, even during prolonged peak heating spells during the four to five month summer droughts that are common to this watershed.

Project-Level Impacts of Restoring Watershed Function to East Branch Streams

The Indian Creek Watershed Study (Soil Conservation Service, 1993, pp. 37-38) predicts a 2.3˚F reduction in summer stream temperatures from a 25 percent increase in riparian shading and a 3.9˚F decrease in summer stream temperatures from a combination of 25 percent increase in

riparian cover and a 50 percent decrease in stream width in Indian and Genesee Valleys. Genesee and Indian Valleys are the largest and lowest elevation valleys in the East Branch. Other experts have documented 2 to 4 or more degrees F cooler water in stream pool bottoms (Flint, Theiss, Kavvas: personal communications). A possible outcome from successful stream rehabilitation could be as much as 8-15˚ F cooling of stream waters at the bottoms of pools three feet and deeper that are overhung by at least 25 percent riparian vegetation. This outcome would be achievable within 10 years, depending on vegetation recovery and post-project vegetative management. As an example, monitoring of the recently completed Last Chance Creek meadow rewatering and stream rehabilitation project has documented a 10˚F reduction in stream temperatures from the top of the project area to the downstream end of the project (4 miles) in June 2004, the first year after reconstruction (Wilcox).

Reconnecting restored stream channels to re-watered floodplains would add longer influxes of 50˚ to 58˚F groundwater to summer baseflows, with an unknown but potentially significant additional cooling downstream. The 1994 project at Big Flat demonstrated a 30-day extension of perennial flow in ephemeral Cottonwood Creek from groundwater accretion after completion of the project. Groundwater temperatures in the gravels in the rewatered reach were 50˚ to 58˚ F (Wilcox, Seagraves). The Big Flat project on one mile of Cottonwood Creek produced a trout increase of 1,000 rainbow trout per mile, post-project, compared to zero trout per mile in the pre-project condition (Mink). This project achieved such dramatic gains in coldwater fishery populations through a combination of habitat and water quality improvements. A low width (2-4')-depth (4'-6') sinuous channel with undercut banks was constructed and the 47-acre adjoining floodplain was re-watered. Groundwater inflow from uplands and the adjoining meadow was reconnected to the stream channel so that groundwater accretion to the channel was prolonged. Stream temperatures were maintained by the low width-depth ratio. Wetland vegetation development in combination with grazing management has improved coldwater trout habitat during a longer period of the summer (Mink).

In the "Red Clover Demonstration Project Research Summary Report (1985-1995)", the following information is presented. "These results show that substantial heating of the stream occurs upstream of the demonstration area. They also show that the ponds were deep enough to provide pockets of water that were considerably cooler …. 20˚C was exceeded 71-98% of the days near the surface of the pond (3 foot depth) compared to 0-55% of the days at the bottom (8 foot depth). Exceedance of 22˚C near the surface occurred on 31-74% of the days compared to 0-16% at the bottom of the pond." Surface stream temperatures upstream of the project reached 27.5˚C and 29.7˚C during the same July-August, 1989-1993 period. And it is important to note that the ponds were completely unshaded. The authors conclude that "Lowering water temperatures throughout Red Clover Creek would require substantial channel narrowing and development of riparian cover, possibly in combination with increased base flows from groundwater" (Seagraves, 1995, pp. 8-10).

In the Red Clover Demonstration Project, as in the NFFR, lack of spawning habitat, intense competition for coldwater refugia (with non-game fish species), and selective predation (including poaching) are important causes of decreased rainbow trout abundance and reproductive success, along with water temperatures. Lack of spawning habitat in the Red Clover Project led directly to the innovative "pond and plug" meadow rewatering design as an

alternative to traditional instream check dam installations. As the now-preferred way to rewater meadows and to reconnect streams and floodplains, "pond and plug" restoration treatments plug the eroding gully with fill collected from off-stream pond development. A small narrow sinuous stream channel is allowed to develop, or is reconstructed, on top of the re-watered and pond filled floodplain. In this way, pool-riffle stream features are reestablished and spawning habitat is enhanced because ponds do not replace free flowing streams, as they do in instream check dam designs. Instead, off-stream ponds replace the old gullies, and a free-flowing stream redevelops down the low point of the meadow.

Project Prioritization in the Watershed Alternative

According to a recent report from the State Board:

> Much of the upper Feather River watershed has been affected by 140 years of intensive human use. Mining, grazing, timber harvesting, wildfire, and railroad and road construction have all contributed to watershed degradation, which is down cutting and widening of tributary streams, causing erosion/sedimentation, increased water temperature, and other adverse impacts on water quality, fisheries, and aquatic habitat.
>
> Watershed Management Initiative, State of the Watersheds Report, Feather River Subwatershed, 2002, pp. 10-14.

All of the proposed project areas in the Watershed Alternative exhibit the legacy watershed degradation attributes described by the State Board. The following conceptual framework is the scientific basis for the project prioritization that is presented in the tables in Appendix A:

- Inadequate cold water in lakes and streams limits water quality in the summer and fall.
- Excessive stream bank and road-related erosion from flood flows limits water quality during the winter and spring.
- Restoring groundwater recharge through enhancing floodplain and flood-way processes lessens erosive flood forces in stream channels.
- Restoring groundwater recharge in meadows and forested uplands prolongs base flows in streams through enhanced groundwater influxes to streams during the summer-fall drought.
- Integrating surface water and groundwater management for better drought and flood management provides an opportunity to increase cold water in lakes and streams during the summer-fall drought period.

Priority 1 projects are mostly "meadow re-watering projects" which means that the project includes reconnecting the stream to its natural meadow floodplain and to the groundwater aquifer that is associated with the historic meadow-floodplain. Priority 1 meadow re-watering projects create significant seasonal and permanent wetland habitat and recreate summer-long groundwater influxes to streams as rewatered aquifers naturally drain downslope and downstream during the summer-long drought. Because groundwater temperatures range from 50˚ to 58˚ F, floodplain aquifers provide a significant source of cooler summer water to streams both within and downstream of a restored stream reach.

Priority 2 projects are mostly "geomorphic reconstruction projects" that are installed in confined, eroding stream channels with narrow floodplains that have formed within eroding gullies in meadows. For a variety of reasons, it is no longer feasible to reconnect the stream to its historic floodplain meadow. Rehabilitation of the stream and riparian system must be confined within the eroding gully. Rehabilitation work in stream systems that are unconnected to their historic meadows and floodplains is inherently more risky than work in natural stream and floodplain-meadow systems. Entrenched or incised streams, as they are called, carry larger volumes of floodwaters within their stream channels rather than spreading higher flood flows across wide floodplain meadows. Concentrating flood flows within a narrower cross-sectional area of the erosion-caused gully exponentially increases the erosive force of flood waters. In addition, streambank vegetation in entrenched or incised channels tends to be less vigorous, because incised channels are more isolated from groundwater inflows during the summer growing season. More stream power combined with weaker vegetative protection creates the potential for higher failure risks and longer recovery times for incised streams.

Restoration projects have generally been implemented in a downstream direction from the headwaters, so that the benefits from upstream projects accrue to future projects downstream. Downstream, the stream systems and alluvial valleys become larger, and current watershed stresses such as urbanization, water diversions, stream channelization, and flood control become larger factors in restoration designs. The rehabilitation of the upstream watershed has the potential to help seed lower river reaches with excess productivity from increased populations of the macroinvertebrate, fishery and riparian communities. During the months of primary water temperature concern (July and August), the restored reaches upstream could act as areas of refuge along with the cooler tributary streams.

The tables in Attachment 3 summarize the Watershed Alternative in as much detail as is available at this time. The Priority 1 reaches identified are located in three subwatersheds: Last Chance, Red Clover, and Indian Creeks. Last Chance and Red Clover are at the upper end of the East Branch watershed. Lower Indian Creek is the next subwatershed downstream. The Priority 1 reaches vary from one to ten stream miles in length, and include 70 to 1,000 acres of adjoining meadow-floodplain. The Priority 2 reaches are located in the Spanish Creek and upper Indian Creek subwatersheds. These reaches vary from three to seven miles in length and affect 90 to 1,000 acres of floodplain and meadow. Water from each of these reaches eventually flows into the East Branch and North Fork Feather River.

Project Risks and Benefits

In the best of circumstances, benefits can be fully realized in three to five years in meadow re-watering projects of unconfined systems (Priority 1) and in eight to ten years in confined stream reaches (Priority 2). The duration of benefits is probably up to a 45-year magnitude flood event for mature Priority 2 projects in confined systems, and may be up to a 75-year or greater magnitude flood event for mature Priority 1 projects in unconfined stream systems.

The timing of benefits and costs is most dependent on the time interval between project implementation and the next peak flood event and whether the treated stream is entrenched or

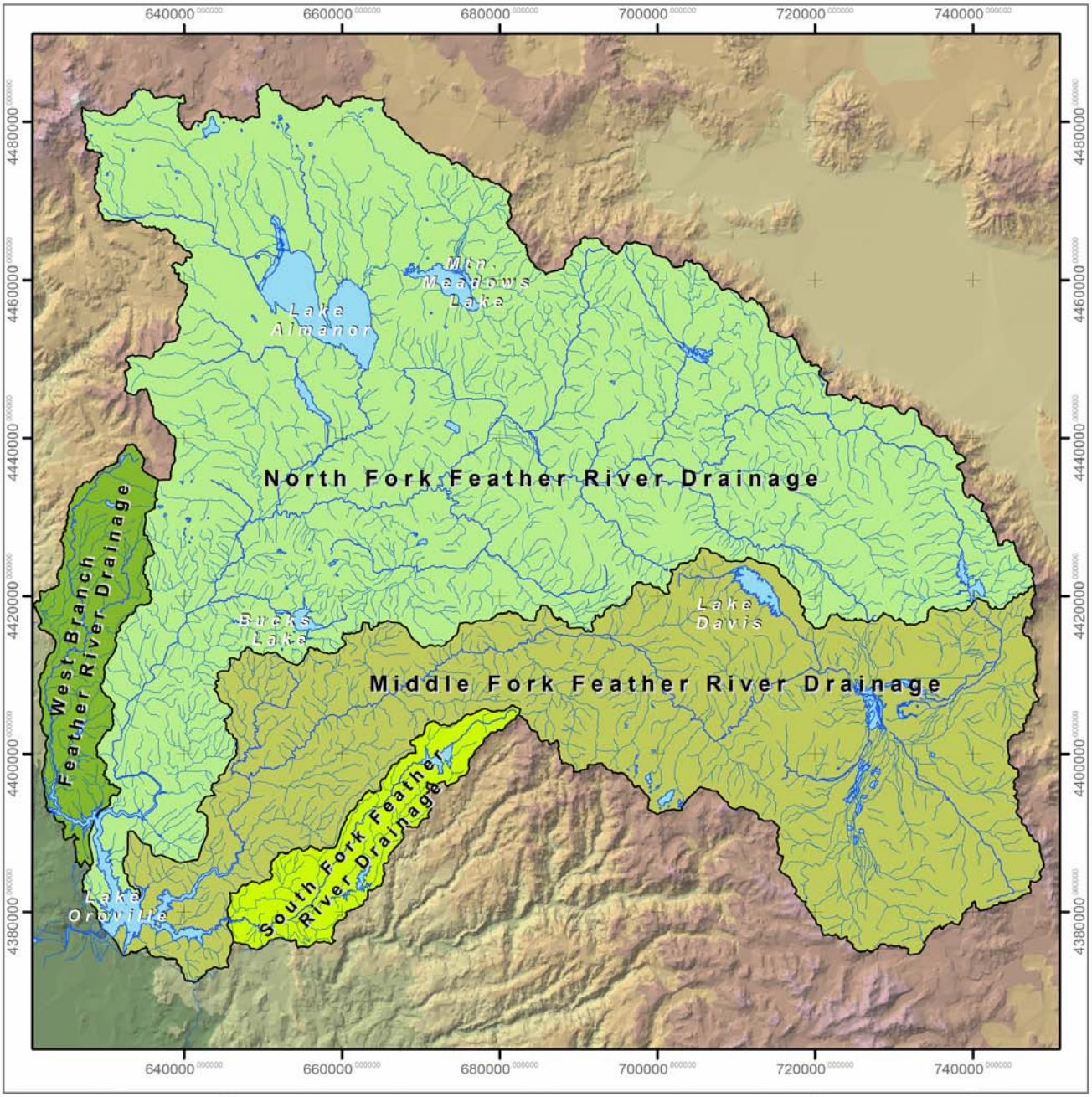
unconfined and grazed or ungrazed. A 100-year flood occurring in the first runoff season after the installation of a Priority 2 project in a confined system creates a risk of significant damage because vegetation has not had enough time to become established. Priority 1 unconfined systems, protected by the energy dispersal of the floodplain, have a much lower (10%-20%) risk of substantial damage from a 100-year flood in the first year after construction and revegetation.

Whether a peak flood event is the last high flow event of a runoff season or the first event in a series of high water events in a season also affects the risks for damages in any given year. If a project has the next summer growing season to recover from the damage of the last winter flood event, there will be less risk of damage from future flood events. For example, the Wolf Creek geomorphic reconstruction project in Greenville, which was constructed in 1989, has demonstrated that vanes are a streambank treatment in confined systems that were capable of withstanding the 1997 flood velocities eight years after construction and revegetation. Pre and post-project photos are presented below.

Wolf Creek Vane Project

As a final note, the predicted benefits presented in Appendix A are based on the professional judgment of the FR-CRM staff. The FR-CRM and its subcontractors include professional hydrologists, fishery and wildlife biologists, botanists, and soil scientists with decades of professional experience in the upper Feather River Basin. Monitoring data reflects the project priorities and performance criteria for individual projects. Early FR-CRM projects focused on erosion control, often in seasonal, second and third order streams. Ephemeral streams were discharging disproportionate sediment loads into downstream perennial stream reaches.

It is important to note that all projects are voluntary, with full landowner cooperation, and designed to achieve maximum onsite and downstream benefits. Appendix D describes downstream effects for other water rights holders resulting from the projects, and also provides an example of the FR-CRM's experience in coordinating these types of projects with other affected parties.



Legend

- Streams
- Lakes and reservoirs
- Rivers

Major River Drainages

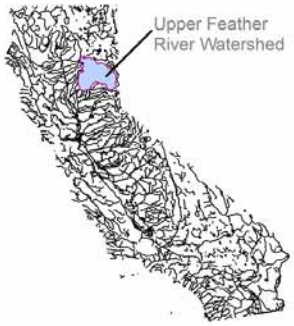
- Middle Fork Feather River
- North Fork Feather River
- South Fork Feather River
- West Branch Feather River

FIGURE 4.9

UPPER FEATHER RIVER MAJOR RIVER DRAINAGES

Watershed base map depicting the major river drainages of the North, Middle, South, and West Branch Feather River. The water from each major river drainage flows into Lake Oroville.

N



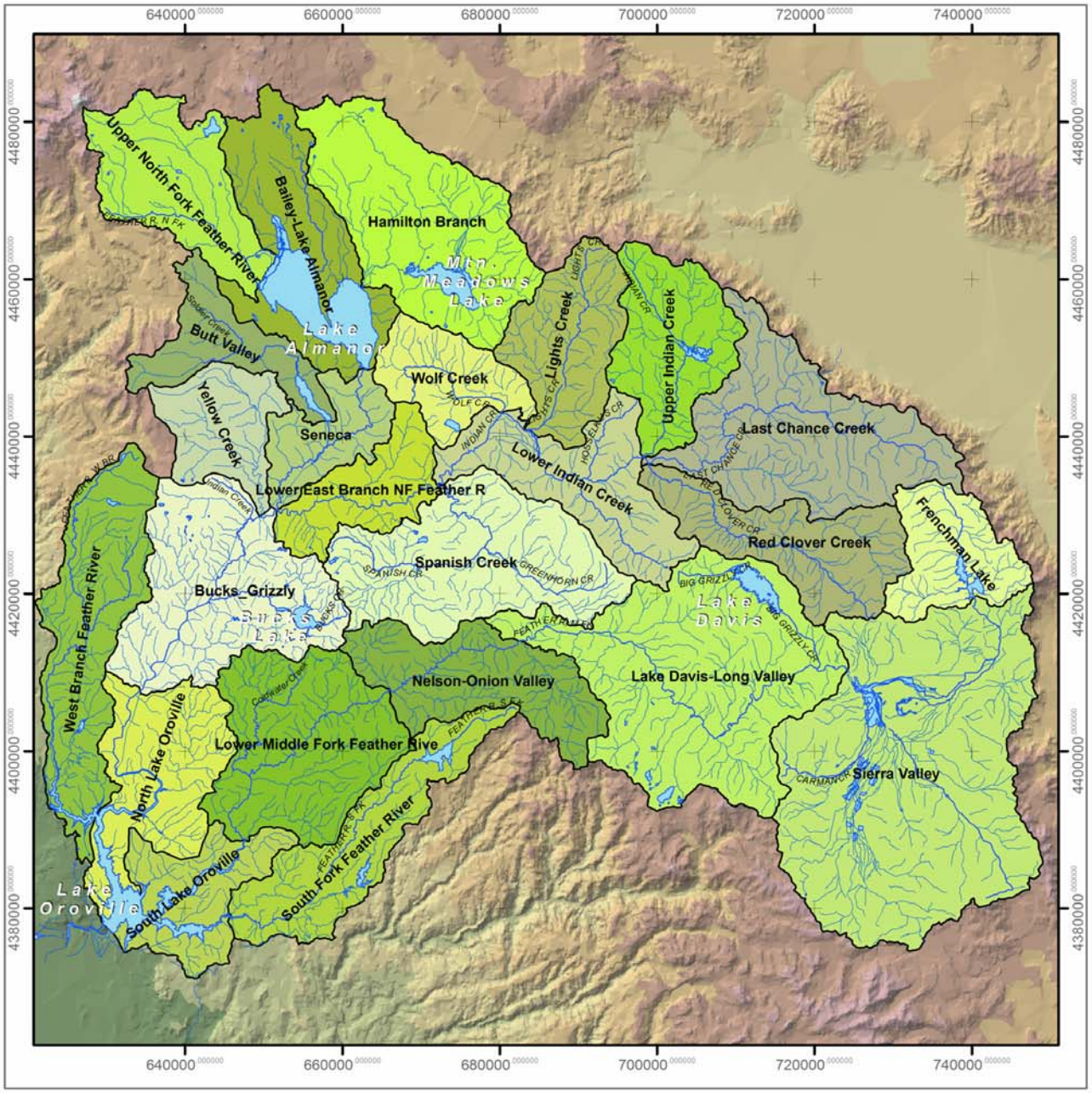


FIGURE 4.8

UPPER FEATHER RIVER SUBWATERSHEDS

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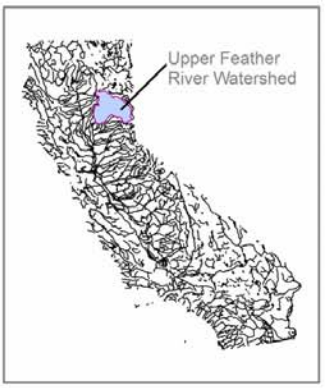
Subwatershed base map depicting smaller hydrologic catchments within the greater watershed.

GIS Metadata Information
Subwatershed delineation shapefile:
California Spatial Information Library CASIL



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All studies referenced and quoted in this report are available on the FR CRM website at www.Feather-River-CRM.org under “Publications.”

Appendix A

Watershed Restoration and Improvement Alternative

Description of Projects with Benefits and Costs

The Watershed Alternative is a proposal to fund the implementation of coldwater watershed improvement via projects as well as appropriate aquatic resources and water quality studies throughout the upper North Fork Feather River (NFFR) watershed, including the East Branch (EB) and other tributaries. The Plumas County Flood Control and Water Conservation District (PCFC&WCD) will implement projects in cooperation with Feather River Coordinated Resource Management (FR-CRM) and other groups (e.g. Plumas Water Forum, Resource Conservation Districts). The projects will be designed to address stream temperature improvement and additional beneficial uses as described in the Central Valley Regional Water Quality Control Board Basin Plan including cold freshwater habitat, domestic and agricultural water supply, recreation, and hydropower generation. The activities initiated under this alternative will include ongoing prioritization for both public (including NFS lands) and private lands and may include those identified as priority projects to address on-going temperature and sediment issues in the North Fork Feather River in existing studies and planning documents such as FR-CRM MOU (1985) and Feather River Watershed Management Strategy (2004). The activities will be consistent with guidance included within the Integrated Regional Water Management Plan (Plumas County, July 2005).

Potential projects identified at this time for implementation in the first fifteen years of the license are included on the list below, and include effectiveness monitoring throughout the term of the license. During the implementation phase, monitoring of existing and constructed projects will provide a feedback loop to maximize the effectiveness of projects as they are implemented. This alternative will include the following actions:

- Implement priority restoration projects as identified in existing plans for the watershed or identified in the future by the implementing authority. Foster and support innovative restoration projects.

- Develop a monitoring plan that addresses project effectiveness and contributes to increased understanding of stream temperature dynamics and coldwater sources during late summer months. The monitoring plan will also track the sustainability of implemented projects and identify any maintenance needs. Consider utilizing thermal imaging technology (helicopter flights currently used) to establish baseline stream temperatures, identify cold and warm water sources and provide periodic review of benefits derived. Continuous recording thermographs will be installed at key areas throughout the watershed to build on the existing FR-CRM network. The monitoring plan will include an aquatic resources and habitat monitoring component on a sub-watershed scale to complement other monitoring efforts in the watershed.

- Maintain or modify implemented projects if necessary to establish self-sustainability.

- Develop a central data archive as a repository to collect information that is currently maintained by various entities and to utilize information more efficiently, track activities, and monitor results (see Appendix C). This information will assist in determining real

and potential effects in the EB and the NFFR, and the downstream effects of restoration projects on water temperature and aquatic productivity in the watershed.

- Utilize information from selected stream restoration projects to aid in future project design considerations.

- Identify and implement as appropriate on-site and off-site projects that reduce temperature, reduce sedimentation, and improve aquatic habitat. This may include culvert modification, fish ladder installation, and other measures to improve access to cold-water refugia.

Assumptions:

- This alternative assumes that all reasonable on-site alternatives to reduce daily mean water temperatures to 20 degrees C in the NFFR within the FERC 2105, 1962, and 2107 project boundaries have been identified. Actions (except for construction of the Prattville Curtain) included in the FERC 1962 license to address temperature will be implemented.

- Modeled and measured daily mean water temperature will exceed the 20 degrees C goal in the NFFR within the project boundaries at certain times even with implementation of any of the previously evaluated 24 water temperature reduction alternatives either singularly or in combination.

- Portions of the NFFR and EB watersheds can be restored to improve cold-water habitat.

- It is possible to bring alluvial valley and canyon streams in Plumas County much closer to their natural function to provide cold-water habitat and cold-water supply.

- The Union Pacific Railroad, CalTrans, and other landowners will be invited to become active participants in the watershed restoration activities, especially regarding fish passage into coldwater tributary channels in the NFFR Canyon.

- It is unknown what synergistic effect upper watershed restoration activities would have on temperatures within the lower Belden, Rock Creek-Cresta and Poe reaches. Long-term monitoring of these actions may show a reduction of EB thermal input to the NFFR system. On-going project monitoring in the watershed has shown local water temperature improvements resulting from restoration (see table below showing monitoring results from 1985-2005)

- Funding will be escalated for inflation through the term of the license.

Rationale:

- Water-temperature modeling efforts have shown the EB to be a primary source of warmer water into North Fork project waters between the confluence with the NFFR and Belden Powerhouse.

- Available information (Integrated Regional Water Management Plan, July 2005) prioritizes the following specific sub-watersheds within the NFFR watershed as suitable and cost-effective for restoration: Last Chance; Red Clover; Spanish Creek; Lower Indian; Upper Indian; Lake Davis-Long Valley; and Sierra Valley. (See table below for proposed projects and estimated costs and benefits).

- Potential for leveraging other funding sources (see table below of Historic Funding Sources).

- Headwater areas can more readily be fully restored to proper fluvial and floodplain function (less land use restrictions). Restoration can result in reduced peak run-off and extend the natural hydrograph to help reduce downstream water temperature in the East Branch and increase natural base flows.

- Opportunities to work in mid-watershed valleys to maintain headwater temperature and other beneficial uses (e.g. Indian, American, Genesee valleys) will require the interest of willing landowners. While landowner interest has been slowly but steadily evolving, the pace is expected to increase markedly above existing levels due to new (2004) Clean Water Act Agricultural Waiver compliance regulations.

- The EB includes priority sub-watersheds associated with large floodplains and valleys as identified in the Feather River Watershed Management Strategy (Monterey Agreement, 1994).

- Biological connectivity – Rehabilitation of the upstream watershed has the potential to help seed lower river reaches with excess productivity from increased macroinvertebrate, fishery, and riparian communities.

- Other water quality improvement benefits include reduced sedimentation and turbidity.

Other Considerations:

- Potential for salmonid fish passage actions that might necessitate additional enforcement personnel to address poaching (relates to measurement criteria to be used to evaluate effectiveness of upstream restoration activities)

- Supports implementation of Central Valley RWQCB Agricultural Waiver Compliance Program

Implementation Strategy:

The alternative would have a 'front-loaded' schedule to initiate restoration activities during the first 15 years after issuance of a new project license (FERC No. 2105) and allow adequate time to monitor long-term synergistic responses within the NFFR watershed and provide valuable information for use during future NFFR relicensings.

Conclusions:
The potential benefits of the NFFR Watershed Restoration Alternative are significant and include but are not limited to improving stream health, water quality and other beneficial uses in both upper watershed and lower project waters. The NFFR Watershed Restoration Alternative also includes compiling information from multiple agencies' stream restoration projects and the potential to leverage outside funding for expanded project implementation and management. To be fully successful, this alternative requires a long-term commitment of resources, which will be guaranteed through FERC enforcement of license articles. The Proposed alternative warrants additional analysis and consideration.

Projects Completed and Benefits Monitored 1985-2005*

Stream Name/Phase Project Type	Total Treated Miles/Acres	Total Cost/ Completion Date	Fishery Benefits[1]	Temperature Benefits[2]	Other Benefits Observed	Comments
Last Chance Valley Cottonwood/Big Flat Meadow re-watering	1.0/47	$100,000 1995	Pre-restoration: no trout observed Post-restoration: 1,280 trout per mile	Estimated 2˚C water temp decrease in treated area in 1998	Downstream spring flow duration extended. Terrestrial and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity; decreased erosion	
Last Chance Valley-Clarks Creek Phase I Meadow Re-watering	1.0/56	$75,000 2001	No data available	No data available	Terrestrial and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity; decreased erosion	Project implemented during drought
Last Chance Creek- Stone Dairy Meadow re-watering	0.6/22	$56,000 2001	No defined channel for fish habitat	No data available	Decreased erosion; increased water storage. Terrestrial and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity.	Intermittent drainage
Last Chance Creek Mainstem Phase I (CalFed) Meadow re-watering	7.0/800	$980,000 2004	Fish population in Last Chance Creek watershed steady decline in three sampling efforts between 1997-2005; unknown causal factors. No post-restoration data available	Measured 10.7ºF water temp decrease for 4.8 miles in June 2004; 1.7ºF water temp decrease in daily maximum at Jordan Flat June-July 2005; 4.5ºC water temp	Decreased erosion; increased water storage. Terrestrial and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity.	Water temperature monitoring difficult due to ephemeral channels. Last Chance Ck. is still recovering from project construction completed in 2004. Additional restoration to continue in 2005.

Stream Name/Phase Project Type	Total Treated Miles/Acres	Total Cost/ Completion Date	Fishery Benefits[1]	Temperature Benefits[2]	Other Benefits Observed	Comments
				decrease at Alkali Flat.		
Red Clover Creek Demonstration Project Check dams	1.0/70	$172,000 1985	Pre-restoration: no trout observed Post-restoration: 4-32 trout observed in pools behind check dams	No data available	Waterfowl habitat improved; 588 waterfowl in project acre; 23 waterfowl in control area	Lack of spawning habitat is a limiting factor. Accurate sampling in ponds problematic. Coldwater refugia created by deep ponds behind check dams and immediately downstream
Red Clover Creek- Bagley Creek Meadow re-watering	0.3/15	$9,000 1997	No data available	No data available	Decreased erosion; increased water storage. Terrestrial and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity.	
Indian Creek- Boulder Creek Meadow re-watering	0.6/30	$22,000 1997	No data available	No data available	Decreased erosion; increased water storage. Terrestrial and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity.	
Indian Creek -Ward Creek Meadow re-watering	1.0/165	$220,000 1999	No data available	No data available	Decreased erosion; increased water storage. Terrestrial and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity. Increased waterfowl and deer populations.	
Indian Creek- Hosselkus Creek, Phase I /II	0.75/65	$156,000	Not applicable	Measured 4.5˚C water	Increased water storage; Terrestrial and riparian	Ephemeral stream channel – no fish habitat

Stream Name/Phase Project Type	**Total Treated Miles/Acres**	**Total Cost/ Completion Date**	**Fishery Benefits[1]**	**Temperature Benefits[2]**	**Other Benefits Observed**	**Comments**
Meadow re-watering		2001/2006		temperature decrease thru 1400' of treated area on June 27, 2005	vegetation and wildlife habitat improved; increased riparian and meadow productivity.	
Indian Creek - Wolf Creek Phases I-III (through the town of Greenville) Geomorphic channel reconstruction and re-vegetation	2.5/70	$600,000 1990-1999	Pre-restoration: no trout captured Post-restoration: no trout captured in 2001 or 2003	Pre-restoration: No data available Post-restoration: daily water temp increase <1ºF in one mile of treated area through Greenville	Terrestrial and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity.	Lack of trout capture may be result of urban setting. A temperature increase of less than 1˚F is a significant improvement where vegetation response has been very slow
Spanish Creek - Greenhorn Creek (Farnworth property) Geomorphic channel reconstruction and re-vegetation	0.75/20	$150,000 1991	Pre-restoration: 2 trout captured in 408' of project area.	No data available	Decreased erosion; increase in recreational fishery; Terrestrial and riparian vegetation and wildlife habitat improved;	

[*]Data provided on this table are from various monitoring files housed by FR-CRM, PG&E, DWR, DFG and antidotal observations.

[1]Fishery benefits are based on results of electro-fishing, and are highly variable due to other variables such as flow, precipitation, and air temperatures.

[2] Monitoring efforts on these projects were largely limited to one year pre-project and one year post-construction measurements to confirm conformance to construction specifications. Long-term, consistent monitoring will be necessary to measure water temperature improvements in meadow re-watering projects (see Appendix C). Water temperature improvements appear to be expressed when additional groundwater stored as a result of the project begins to augment the surface water, downstream of the actual project work. Detecting change may require more sampling points both within and downstream of the project area to capture water temperature changes.

Priority 1 Project Reaches: Estimated Costs[1] and Anticipated Benefits[2]

Stream Name/Phase Project Type	Total Area to be Treated – Miles/Acres	Estimated Costs/ Completion Date	Anticipated Fishery Benefits	Anticipated Water Temperature Benefits	Other Benefits Anticipated	Comments
Last Chance Creek/Mainstem Phase II Meadow Re-watering	9.0/800	$2,800,000 2007 thru 2009	Trout fishery expected to increase, with most benefits taking up to 5 years	Maximum daily temperatures expected to decrease by up to 10°F at Doyle Crossing	Increased water storage; Terrestrial, aquatic, and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity; decreased erosion.	Improvement in temperature will be due to increased off channel water storage and delayed summertime release
Last Chance Creek/Clarks Creek Phase II Meadow Re-watering	1.0/70	$100,000 2009	No change in fishery is expected	Decrease of 1-2°F at confluence of Clarks and Last Chance creeks;	Increased water storage; Terrestrial, aquatic and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity.	Improvement in temperature will be due to increased off channel water storage and delayed summertime release
Last Chance Creek/Mainstem Phase III Meadow Re-watering	10.0/1000	$3,000,000 2009 thru 2011	Increased trout fishery	Decrease of daily maximum water temps. By up to 5°F	Increased water storage; Terrestrial, aquatic and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity.	This area not as impaired as Mainstem Phase II, so smaller temp. benefits anticipated
Red Clover Creek/Phase I Meadow Re-watering	3.5/375	1,100,000 2005 thru 2006	Pre-restoration: one trout observed in 2004; 9 trout observed in 2005 Anticipate increased trout fishery;	Pre-restoration: daily maximum water temp increase of 6.3ºF measured in treated area from 6/15-8/31, 2005 Post-restoration: No data available Anticipate decreased water	Increased water storage; Terrestrial, aquatic and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity; decreased erosion.	Project construction planned to begin in 2006

Stream Name/Phase Project Type	Total Area to be Treated – Miles/Acres	Estimated Costs/ Completion Date	Anticipated Fishery Benefits	Anticipated Water Temperature Benefits	Other Benefits Anticipated	Comments
			aquatic ecosystem improvement	temperatures in same area		
Red Clover Creek/Phase II Meadow Re-watering	2.0/200	$400,000 2008 thru 2010	Anticipate increased trout fishery	Decrease of 1-3°F through project reach.	Increased water storage; Terrestrial, aquatic and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity; decreased erosion.	
Red Clover Creek/Dixie Creek Phase I Meadow Re-watering	1.0/90	$75,000 2005 thru 2007	Improve aquatic habitat, including trout.	Little or no change	Increased water storage; Decreased erosion. Terrestrial, aquatic and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity	Relatively small project; primary goal is to stop headcut moving upstream
Red Clover Creek/Dixie Creek Phase II Meadow Re-watering	5.0/150	$750,000 2011 thru 2013	Unknown fishery; general aquatic habitat should improve	Expected to decrease due to increased riparian vegetation	Increased water storage; Terrestrial, aquatic and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity; decreased erosion.	Limited benefits expected due to small size of watershed
Red Clover Creek/Dixie Creek Phase III Meadow Re-watering	7.0/1000	$1,050,000 No construction date identified	Expect cumulative fishery benefits from all three phases	Decrease in maximum daily temp. of 10-15ºF at Notson Bridge from all three phases of project	Increased water storage; Terrestrial, aquatic and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity; decreased erosion.	
Indian Creek/Genesee Valley	6.0/200	$2,400,000 2006 thru 2012	Expect improved trout biomass of	Up to a 10ºF decrease in maximum daily	Increased water storage; Terrestrial, aquatic and riparian vegetation and wildlife habitat	

Stream Name/Phase Project Type	**Total Area to be Treated – Miles/Acres**	**Estimated Costs/ Completion Date**	**Anticipated Fishery Benefits**	**Anticipated Water Temperature Benefits**	**Other Benefits Anticipated**	**Comments**
Geomorphic channel and revegetation			30% above Flournoy Bridge from 2003 levels (2,350 ml/100 yds) and 100% at Taylorsville (365 ml/100 yds)	temperatures from all Last Chance and Red Clover projects through Genesee Valley	improved; increased riparian and meadow productivity; decreased erosion.	
Indian Creek/Indian Valley Geomorphic channel and revegetation	7.0/170	$2,800,000 2008 thru 2015	Anticipate increased trout fishery	Maintenance of the 10-15°F decrease accomplished by upstream restoration projects	Increased water storage; Terrestrial, aquatic and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity; decreased erosion.	
TOTALS	**50/3780**	**$13,525,000**				

[1] All costs are estimates in today's dollars. Costs reflect only survey, design, permitting and construction expenses.
[2] Anticipated benefits are based on professional judgment and past experience with similar projects.

Priority 2 Project Reaches: Estimated Costs[1] and Anticipated Benefits[2]

Stream Name/Phase Project Type	Total Area to be Treated – Miles/Acres	Estimated Costs/ Completion Date	Anticipated Fishery Benefits	Anticipated Water Temperature Benefits	Other Benefits Anticipated	Comments
Spanish Creek – American Valley Geomorphic channel and revegetation	7.0/170	$2,800,000 2007 thru 2009	Expect to improve trout fishery by 30% above 2003 level (115 ml/100 yds)	Decrease maximum daily temp by up to 5ºF after vegetation becomes established (5 years)	Decrease sedimentation; increased terrestrial, riparian wildlife habitat	Trout improvement difficult to establish; fishing pressure an issue at this site; Benefits will be limited to near-channel area
Spanish Creek – Meadow Valley Geomorphic channel and revegetation	7.0/170	$2,800,000 2006-2010	No change predicted	Limited or no change (1-2°F decrease)	Decrease sedimentation; increased terrestrial, riparian wildlife habitat	Presence of foothill yellow-legged frogs may limit restoration at this site. Benefits will be limited to near-channel area
Spanish Creek – Greenhorn-Chandler Geomorphic channel and revegetation	5.0/150	$1,250,000 2011 thru 2014	Anticipate increased trout fishery	Decrease in maximum daily temp of 3-8°F from historic temps of 76 and 77°F (2003 and 2001, respectively)	Decrease sedimentation; increased terrestrial, riparian wildlife habitat	Benefits will be limited to near-channel area
Indian Creek/Lights Creek, Indian Valley Geomorphic	5.0/1000	$1,500,000 No construction date identified	Anticipate increased trout fishery	Decrease in daily maximum temp of 10-15°F from historic temps of 84-86°F	Terrestrial, aquatic and riparian vegetation and wildlife habitat improved; increased	Project may be required to comply with RWQCB

Stream Name/Phase Project Type	**Total Area to be Treated – Miles/Acres**	**Estimated Costs/ Completion Date**	**Anticipated Fishery Benefits**	**Anticipated Water Temperature Benefits**	**Other Benefits Anticipated**	**Comments**
channel or meadow re-watering				(2000-2003)	riparian and meadow productivity; decreased erosion.	standards.
Indian Creek/Cooks Creek, Indian Valley Geomorphic channel or meadow re-watering	4.0/400	$1,000,000 No construction date identified	Anticipate increased trout fishery	Unknown	Terrestrial, aquatic and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity; decreased erosion.	Project may be required to comply with RWQCB standards.
Indian Creek/Wolf Creek, Indian Valley Geomorphic channel and revegetation	3.0/90	$1,250,000 No construction date identified	Anticipate increased trout fishery however, expect fisheries to be limited by Greenville urban runoff	Predict maintenance of upstream temp or slight increase (<1 ^{o}F) through this reach	Terrestrial, aquatic and riparian vegetation and wildlife habitat improved; increased riparian and meadow productivity; decreased erosion.	Benefits will be limited to near-channel area
TOTALS	**31/1980**	**$10,600,000**				

Administration Budget

Activities	Funding Per Year	Period
FR-CRM		
Project coordination, monitoring, and education	$125,000	Years 1-15
Project coordination, monitoring, and education	$75,000	Year 16 onward
Maintenance (5% of 1st Priority Total)	$16,906	Year 1 onward
Total		
Plumas County Flood Control District		
Project development, contract administration, project oversight, and coordination and planning with IRWM Partners and other entities.	$65,000 $35,000	Years 1-10 Year 11 onward

- All costs are in today's dollars. All costs are complete, "stand-alone" costs.
- Education is primarily landowner-oriented and in support of local school science programs. Education may also include the occasional production of publications and professional papers.
- The 5% maintenance costs are to fix problems from major flood events and first-winter problems that can occur before the vegetation becomes vigorous enough to protect stream banks and floodplains during the wet season. Little problems become bigger and more costly to fix later.

Historic Funding Sources

Funding Source	Funded 1990-05	% Of Total Funding
Federal Agencies		
USDA-United States Forest Service	$467,650	7%
USDA-Natural Resources Conservation Service	$82,500	1%
Environmental Protection Agency	$15,000	<1%
Bureau of Reclamation	$980,000	14%
State Agencies		
California Department of Forestry & Fire Protection	$105,000	2%
State Water Resources Control Board	$3,422,104	49%
California Department of Water Resources	$920,500	13%
Central Valley Regional Water Quality Control Board	$109,000	2%
California Department of Fish & Game	$100,000	1%
California Department of Transportation	$100,000	1%
California Department of Parks and Recreation	$39,930	<1%
UC Cooperative Extension	$2,100	<1%
County & Local Public Agencies		
Plumas County	$234,263	3%
Plumas County Community Development Commission	$1,900	<1%
Quincy Community Services District	$3,800	<1%
Plumas Unified School District	$1,600	<1%
Feather River College	$1,600	<1%
NorCal Nevada Resource Conservation and Development	$9,500	<1%
Private Groups		
Pacific Gas & Electric	$352,000	5%
Landowners	$7,710	<1%
Sierra Pacific	$15,000	<1%
Collins Pine	$10,000	<1%
Total	$6,981,157	98%

Appendix B

Watershed Data Archive

Plumas County has pursed stream restoration in the higher segments of the Feather River watershed to promote cooler water temperatures and improve water quality and fish habitat. The County believes that the thermal and other ecological improvements can be maintained as stream flow travels down the East Branch to its confluence with the North Fork Feather River, providing at least two additional weeks of target temperatures in the summer. However, to fully analyze the County's proposal and evaluate the potential for off-site mitigation, existing data should be compiled in a central archive. To fully inventory and organize monitoring data from over 20 years of upper watershed improvement work, an ambitious data management system is required. Plumas County, which encompasses more than 70 percent of the Upper Feather River watershed, is willing to initiate such an effort.

A central archive of data would bring together all existing and available studies and display them in a more consistent and publicly accessible manner. This Upper Feather River watershed data archive will be aimed at showing linkages between upper watershed improvement projects and the potential thermal and biological benefits to the downstream waters of the East Branch of the North Fork Feather River and the North Fork Feather River below its confluence. Selection of potential study and restudy areas and retrospective monitoring areas and questions will be better served by this proposed data archive. This growing base of shared information would help water managers in the NFFR practice coordinated adaptive management where and when it is desirable. This increased water management coordination is one of the goals of the Upper Feather River Integrated Regional Water Management Plan.

Since the advent and institutionalization of GIS technology, it has become much easier to correlate and integrate distinct geospatial data sets to provide new and useful insights into the interaction of many geographic phenomena (e.g., land use effect on water quality, population density effect on economic development). Now that GIS is widely utilized the focus has shifted to the challenges associated with integrating these systems and managing the volumes of data that are created. Thus, the need has arisen to build what has come to be called a geospatial data infrastructure (GDI). Such infrastructures have been described as information highways linking environmental, socio-economic and institutional databases, and providing for the flow of information from local to national levels and eventually to the global community (Coleman and McLaughlin 1997). Some examples of GDIs are the California Spatial Information Library (CASIL), California Environmental Resource Evaluation System (CERES) and Sierra Nevada Ecosystem Project. Each of these GDIs incorporate regional, state, and national data from several agencies and provide that data to a greater populous.

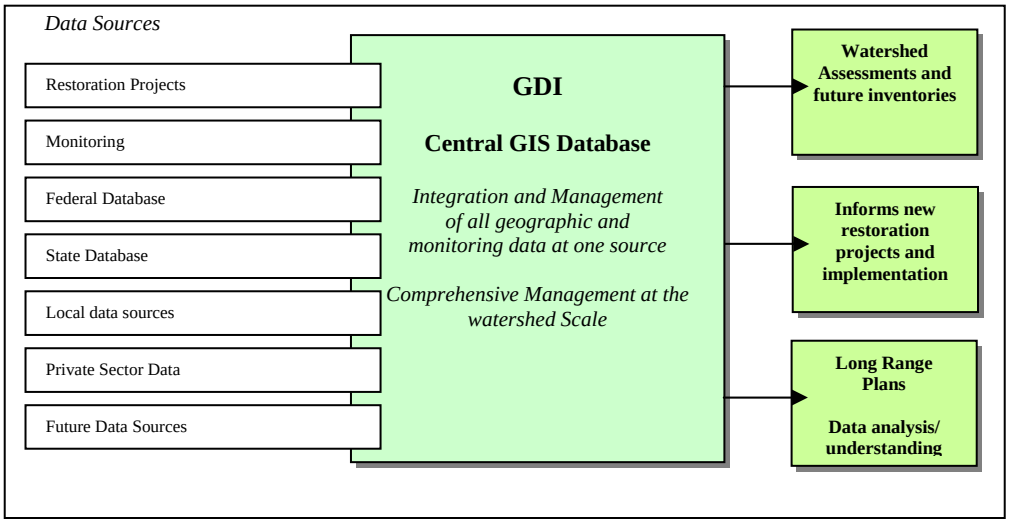
The Upper Feather River Watershed includes a large geographic area that is managed by multiple agencies, governments, private corporations and land owners, resource groups, and interested non-governmental organizations. Each of these entities creates geospatial data pertaining to their specific land holdings. Data creation by many groups means that there is a significant existing data set pertaining to the Upper Feather River Watershed. One problem with this existing data set is that it exists in unrelated and separate locations. For example, the

existing data sets are not available to greater Upper Feather River Watershed community members, nor are they integrated in a meaningful and useable context. Each entity has specific objectives for its data, and once those objectives are met, that data, often, are never used again. Another common problem with resource use data is that it is not readily shared. Usually the data creating entity is the only user of that data. This lack of coordination can lead to misunderstanding between groups, increased project costs due to redundant data gathering efforts, and an overall lack of knowledge of the resource in question due a deficiency of available data. Thus, the need for a Geospatial Data Infrastructure (GDI) has arisen within the Upper Feather River Watershed. As well, the implementation of a GDI would facilitate data sharing, reduce redundant data collection efforts, improve management decisions by providing up-to-date data, and improve efficiency for all organizations by providing a forum for data sharing.

Common Problems and Results with GIS Not Being Linked Through a Geospatial Data Infrastructure

Common Problem	Common Result
Proprietary formats – data used by only one agency	Multiple copies of data to be managed – redundant data creation
Project / program specific data	Additional effort to process & manage data
Different map projections & datum's	Inhibits information exchange & interoperability
Not GIS ready	Poor understanding of data
Spatial & attribute data not linked	Additional cost to manage data and less robust GIS
Insufficient (or no) metadata	Inconsistent data
Inconsistent data quality	Higher risk for error
Poor decision making	No enterprise-wide data standards

A spatial server is an application that extends the relational database to handle spatial data types, thus increasing the efficiency of the database by allowing it to store and manage complex spatial data along with tabular (non-spatial) data. ArcSDE, created by ESRI, is an example of a spatial server. The third component of a GDI is GIS software. The most common GIS software is ArcGIS created by ESRI. Retrieving and manipulating data and producing maps are managed using the GIS software. Connecting to the database can be done over the web or via a restricted local network, although allowing web access enables a greater community to share the data. Beyond these three necessary components networked geospatial databases require data handling facilities, which entail a place to house the computer equipment and an administrator to manage the data, perform maintenance and update the database as new data are made available. GDIs are not simple programs that run with little human interaction. They require institutional, organizational, technological, human, and economic resources. These required components underpin the design, implementation, and maintenance of mechanisms that facilitate the sharing, access to, and responsible use of the geospatial data.



GDI schematic

The GIS data clearinghouse links past and future restoration projects and planning efforts.

Phase I Proposal

Plumas County staff would initiate the watershed archive project by meeting with resource managers in the upper Feather River Basin to obtain an understanding of the volume and quality of potentially available water related information. Available data could include unpublished data from public agencies that resource managers are interested in sharing, and unpublished reports and studies as well as published data, reports and studies by the agency. Available data also could include data, reports and studies from private entity resource managers that they were volunteering to make available to the public.

The product of this effort would be a bibliography of relevant information and a library of electronic and hard copy reports, studies and data sets. It is estimated that this effort would take about a year of 1/4 time commitment by one person and cost an estimated $25,000, including travel and supplies. Plumas County would provide fully equipped office space and staff support and oversight.

Subsequent data management and coordination phases would be developed as part of the conclusions and recommendations from this preliminary effort and would be coordinated through the Integrated Regional Water Management partner agencies, including Plumas County, the Plumas County Flood Control and Water Conservation District, the Plumas National Forest, and the Sierra Valley Groundwater Management District. Future phases could include the development of interactive Geographic Information Systems linked through a Geospatial Data Infrastructure but we believe that it is pre-mature to propose that level of data management at this time.

Appendix C

East Branch Water Quality and Fishery Monitoring Plan

As an optional component for the Watershed Alternative, the County of Plumas suggests a water quality and fishery monitoring program to document project effectiveness.

Historically, due to limited project funding, monitoring performed by the Feather River Coordinated Resource Management Group (FR-CRM) has been largely limited to documenting for grantors and regulators that restoration projects are installed as designed and permitted – essentially "project compliance monitoring." One to two years of data before and after the project is usually sufficient for documenting permit compliance. However, that limited monitoring is generally not enough to measure other project-related effects. Therefore, project effectiveness monitoring is proposed as a broader monitoring exercise to track other important aspects of the project, such as predicted benefits of summer stream temperature moderation and adult trout habitat improvement.

Environmental improvements usually need time to mature. For example, based on FR-CRM staff reflections on past meadow rewatering projects, it takes a minimum of three years for dewatered aquifers to refill under normal water year conditions. It takes anywhere from two to ten years for riparian vegetation to become vigorous enough to effectively shade streams and to effectively reduce streambank erosion. Trout recruitment is slow to colonize what are, in effect, isolated reaches of improved habitat in largely degraded stream systems. Restored stream reaches, because of their scarcity, can also get disproportionate fishing and hunting pressure. Fish and game species tend to concentrate in these islands of improved habitat once they are rediscovered.

The highest monitoring level proposed is on the scale of the whole East Branch of the North Forth Feather River. Project effectiveness and ambient monitoring can be integrated with watershed modeling to predict and track project responses on the scale of the full East Branch system and through a broad range of climatic conditions. This level of monitoring would be important for a better understanding of groundwater and surface water interactions and for evaluating the importance of groundwater for cold water refugia in streams during peak summer heat waves.

The monitoring plan needs to offer different levels of monitoring, depending on the kind if information desired. The data set that we have today reflects its "project compliance" monitoring purpose. In this attachment we propose different monitoring intensities with estimated budgets. We propose expanding monitoring beyond project compliance monitoring in phases, until the desired level of project effectiveness monitoring is reached.

Project Description

The Feather River CRM has been conducting watershed-wide ambient water quality and trout monitoring since 1999, under contract with the Central Valley RWQCB. The FR-CRM's

network of sites dovetails with Plumas and Lassen National Forest monitoring efforts, so that a comprehensive and comparable data set is available for the entire watershed, on both public and private lands. In order to monitor watershed health across jurisdictional boundaries, the Feather River CRM initiated a watershed monitoring program that dovetails with the existing Forest Service watershed monitoring program, which primarily uses the Stream Condition Inventory (SCI) Protocol (USFS Region 5 1998). As a protocol that monitors stream condition, it also monitors key fish habitat parameters. The suite of protocols in SCI can also be used separately to monitor certain aspects of habitat. The entire SCI suite was developed by the Forest Service as a monitoring indicator of large-scale watershed health. The protocol is designed for use in alluvial "response reaches" of relatively small watersheds, where upstream watershed conditions are likely to trend toward stable or unstable conditions by erosional and/or depositional processes.

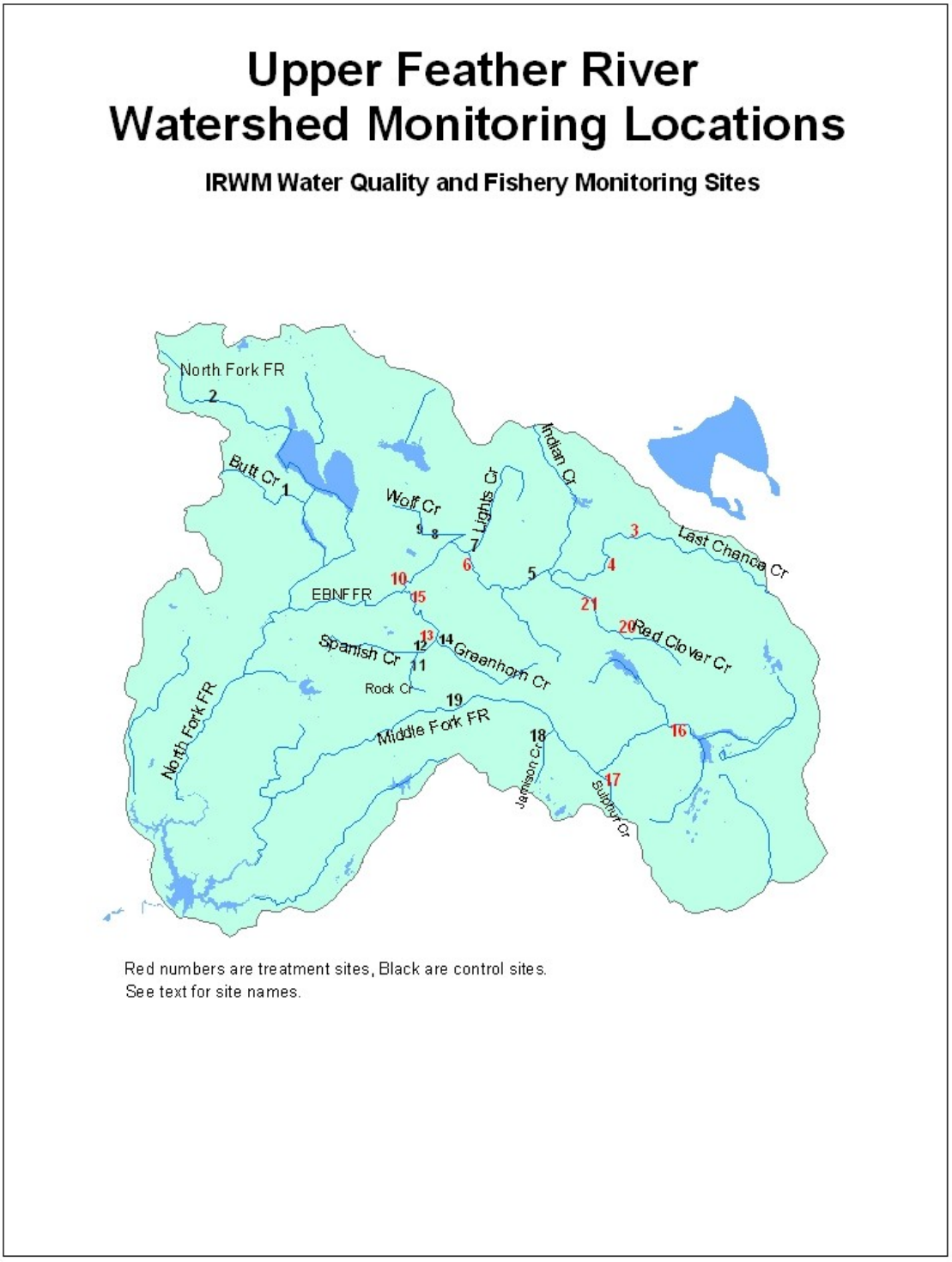
The Forest Service does not currently include fish population monitoring as part of the SCI protocol, but the Feather River CRM includes a multiple pass depletion method of fish population estimate with SCI surveys, as well as some water quality testing. The Forest Service conducts SCI surveys at each site on a five-year rotation. The CRM began with a two-year rotation for six years, and plans to continue also at five-year intervals. There are 36 Plumas National Forest Service "SCI sites" and 18 CRM "Monitoring Reach" sites. Using the same monitoring methodology for ambient monitoring and for project effectiveness monitoring facilitates the comparison and integration of monitoring data.

In the future it is proposed that all stream restoration projects include coldwater fish habitat monitoring and water temperature and flow monitoring elements. In addition it is proposed that selected past projects be resurveyed to monitor long term trends using the SCI suite plus stream temperature profiles and trout population data. In the future more of the SCI protocol data such as air temperature, stream width-depth ration, streamflow, and streamshading will accompany all project and ambient data presentations. Project monitoring is proposed to become fully integrated with ambient watershed monitoring.

Ambient watershed water quality monitoring was prioritized in the SWRCB's State of the Watersheds - Feather River Basin, December 2002 report. This multi-level proposed monitoring program includes testing some monitoring recommendations in the Feather River CRM's final report to the SWRCB on the first two years of the ambient watershed monitoring program (SWRCB Agreement # 00-115-150-0: 2003.) Monitoring for cold water strata in stream pools, inventorying salmonid habitat condition, and assessing salmonid habitat potential will be added to ambient watershed water quality monitoring and project monitoring.

This program would fund 4 years of measurements at 18 of the FR-CRM sites at 5 year intervals (the 36 FS sites are funded within the Forest Service). As of 2005, the FR-CRM has collected three years of baseline funding (1999, 2001, and 2003), which includes water quality and fishery monitoring in addition to the Forest Service SCI protocols. Baseline data include continuously recorded flow data from eight FR-CRM gage stations throughout the watershed, some with data from as far back as 1999, with the most recent station installed on Sulphur Creek in fall 2004. All data are available on the Monitoring Program page at feather-river-crm.org.

The following map shows all of the FR-CRM Monitoring Reach and Continuous Recording Gage Station sites.



Seven of the sites are multi- purpose sites for both ambient monitoring and also serving as baseline information for Priority 1 or 2 restoration projects, or as trend information for rotating project re-surveys. Eleven sites are primarily "single purpose" ambient monitoring or control sites. (The table below displays site names and data types as an example.)

This larger scale monitoring will complement ongoing immediate pre-project and post-project effectiveness monitoring included in each project budget and workplan, and will also help determine which parameters in the long-term monitoring program reveal measurable effects on a watershed scale.

Pre and post project data and programmatic monitoring data will be also used as model inputs for an extension of the Last Chance Creek Watershed Modeling Project down the East branch of the North Fork of the Feather River (EBNFFR) to the confluence of the EBNFFR with the NFFR in the Feather River Canyon, approximately 100 miles downstream. The water cooling effects of riparian vegetation (through transpiration and shading) and groundwater influxes to streams will also be evaluated through field measurements in combination with infra-red aerial photo monitoring. The CVRWQCB's ambient watershed monitoring program will be significantly enriched by the monitoring information generated by implementating integrated ambient and project monitoring.

Monitoring Locations and Data Types

Site Name & Map Number	Data Type	Treatment or Control?	Temperature Study Site?
1. Butt Cr	SCI	C	
2. North Fork Feather abv Lake Almanor	SCI	C	
3. Last Chance at Doyle X-ing	Gage Station	T	
4. Last Chance blw Murdock X-ing	SCI	T	Y
5. Indian Cr at Flournoy Bridge	SCI & Gage	C	Y
6. Indian Cr at Taylorsville	SCI & Gage	Distant T	Y
7. Lights Cr	SCI & Gage	C	
8. Wolf Cr Town Park	SCI	C	
9. Wolf Cr Main St Bridge	Gage	C	
10. Indian Cr abv Spanish	SCI	Distant T	Y
11. Rock Cr	SCI	C	
12. Spanish at Gansner Park	Gage	C	Y
13. Spanish abv Greenhorn	SCI	T	Y
14. Greenhorn Cr	SCI	C	Y
15. Spanish abv Indian	SCI	Distant T	Y
16. Middle Fork at Beckwourth*	SCI	T	

17. Sulphur mouth & Bridge*	SCI & Gage	T	
18. Jamison*	SCI	C	
19. Middle Fork abv Nelson Cr*	SCI	C	Y
20. Red Clover at Chase Br	SCI	T[1]	Y
21. Red Clover at Notson Bridge [1] For Red Clover CALFED Project	Gage	T[1]	

This proposal also includes new efforts, focused on increasing our understanding of cold water refugia for trout in this watershed. At ten of the monitoring reaches, additional hobotemp sensors would be placed in pool tops and bottoms, for a total of 30 pools to be measured for thermal stratification.

• What is the long-term trend of fish populations in the watershed? Continued multiple-pass depletion electroshock monitoring at the 17 Feather River CRM SCI Monitoring Reaches. Data would be compiled at the end of the monitoring cycle, and would include data from other fishery monitoring entities such as DWR at the reservoirs, the Forest Service, and the Department of Fish and Game.

• What is the long-term trend of fishery habitat in the watershed, and in response to IRWM projects? Continued five-year cycle SCI (watershed health and water quality) protocol monitoring at the 18 Feather River CRM Monitoring Reaches.

Continued operation of the CRM's ten continuous recording flow and temperature stations. (station operation is funded through December 2006).

Additional temperature stratification monitoring of selected pools would be measured to determine whether or not pool depth provides cooler water temperatures. This would be an additional protocol to the existing monitoring regime:

Three pools in ten Monitoring Reaches (including both projects and controls), with a depth of at least twice that of the adjacent habitats, would be measured for temperature differences at the surface and at the pool bottom, and snorkeled for fish presence. Data analysis would be stratified by channel size. This protocol would begin to answer questions concerning whether or not temperature-stratified pools exist at these sites, what other channel and habitat attributes contribute to stratification, and whether or not trout use mainstem alluvial valley pools for base flow habitat.

Following is a list of the SCI parameters to be measured, with a brief explanation of their use:
• Monumented cross-sections- used to calculate erosion or deposition rates, and changes over time in bankfull cross-sectional area.
• Water quality constituents such as metals, nutrients, and physical characteristics- Provides a direct measurement of water quality for beneficial uses.

• Water and air temperature - a measurement of aquatic habitat quality, and provides an indirect measurement of riparian area management, i.e. stream shading.
• Entrenchment - used to analyze how readily high flows can access the flood plain
• Width:depth ratio, shore depth, bank stability, bank angle- used primarily to characterize stability and fish habitat quality trends, such as overhanging bank.
• Longitudinal gradient- helps provide context for interpreting other parameters
• Wolmann pebble counts - size of bed material, and changes in size over time, are a key influence in channel stability.
• Pool tail fines - Pool tails are prime habitat for spawning trout as well as aquatic insects; percent fines is a habitat quality parameter.
• Large woody debris- Important component of fish habitat cover.
• Percent shade - strong influence on water temperature.
• Pool:riffle ratio and pool depth - excessive sediment from land management in the watershed can fill pools.
• Aerial photography - provides a visual comparison of an area over time that complements the numeric data.
• Estimate fish populations- cold water fisheries are a defined beneficial use of water according to the CVRWQCB Basin Plan.
• Aquatic insect sampling and analysis- numerous indices based on insect communities can indicate changes over time in watershed health.

Budget:
Full 18 Monitoring Reach repeat should be completed every five years, at an approximate cost of $70,000/per year, including water quality testing. Infra-red aerial monitoring will be used to complement the FR-CRM's ambient monitoring program. Please see the FR-CRM powerpoint attachment to see an example of this monitoring protocol. In addition rotational project re-monitoring will be used to track longer-term project responses, large event responses, and the new groundwater, pool stratification, and trout population monitoring protocols beyond first year after project implementation. This proposed programmatic monitoring budget totals $709,000 over the life of the program. (Immediate pre-and post project compliance monitoring is already included in project implementation costs).

Monitoring Costs and Schedule

Item	Year 1	Years 2, 4,7, 9, & 12	Years 6, 11 & 16
*18 Monitoring Reach full SCI protocol.	$70,000		$70,000
*Infra-red aerial photo water temperature baseline & trend monitoring @ $1000/mile including	$81,000		$81,000

fieldwork that field verifies temperature and photo-color correlations			
Data Management & Reporting	$5,000	$5,000	$5,000
Rotating Project/event Monitoring	$4,000 project re-survey	$4,000 project re-survey	
Rotating stream pool/groundwater temperature stratification study	$6,000	$6,000	
Rotating trout population survey	$4,000 project re-survey	$4,000 project re-survey	

In addition, the current watershed and aquifer modeling (that is described in a separate attachment about the Last Chance Phase 1 Project). could be extended downstream to the confluence with the NFFR. This highest level of monitoring would cost an additional $500,000. This level of integrated watershed monitoring and public domain modeling would be helpful for characterizing the aquifer/groundwater characteristics in the alluvial valleys of the EBNFFR. By simulating aquifer-stream flow interactions, we would begin developing the capability to extrapolate project level water flow and temperature effects downstream, under a variety of climactic and management scenarios. If the modeling level is included, the cost in today's dollars for this proposed integrated watershed monitoring and modeling program for the EBNFFR is $1,200.000 in today's dollars. This expenditure represents approximately 4% of overall program costs.

Appendix D

Hosselkus Creek Project
Notification to Indian Creek Decree Water Rights Holders
June 1, 2005

Project Description

The Hosselkus Creek project is a cooperative, multi-jurisdictional project between the Neff Family Ranch and the USDA- Plumas National Forest, Mt. Hough Ranger District (MHRD) with assistance from the Feather River Coordinated Resource Management (FRCRM) group. The project is funded by Plumas County using Monterey Agreement Water Forum funds.

The 2300-foot project would include channel and meadow restoration on Hosselkus Creek that has become deeply incised into the meadow. Approximately 1460' of the project is on lands administered by the MHRD. This degraded situation is symptomatic of meadow/channel conditions throughout the Indian Creek watershed. It has resulted in an ongoing and synergistic cycle of continuing degradation symptoms: conversion of protective meadow vegetation to sparse annual grasses and forbs, increased erosion from gully walls, loss of riparian vegetation, increased water temperatures and fluctuations, excessive in-stream sedimentation, degraded fish and wildlife habitat, etc. This action is an extension of the Hosselkus Creek Phase I Project implemented in 2002. The Phase I project was also multi-jurisdictional between the Neff Ranch and MHRD.

The treatment technique proposed in this project is called "pond and plug." This technique consists of obliterating the gully by replacing it with a series of earthen plugs and borrow pits (ponds which fill with groundwater). The excavation of the ponds provides the fill material for the plugs (see Figure 2). The flow that was within the gully is re-directed into a channel at the elevation of the meadow. Existing remnant channels are used wherever possible. However, construction of geomorphically-designed channels is sometimes necessary. The design is based on functional fluvial geomorphic processes, and has been previously implemented in numerous locations in the Indian Creek watershed, including the Phase I project. The technique was chosen here because it best meets the project objectives by restoring the functionality of the system, and has been proven to perform well, while requiring minimal long-term maintenance.

The ponds, which are situated within the gully, serve two functions. The primary function of the ponds is to provide the fill material for the gully plugs. The volume of material removed from the ponds is dictated by how much volume is needed for the plugs. An ancillary benefit of the ponds is wildlife habitat enhancement. Ponds are constructed with irregular shapes, depths, and (when feasible) islands and other wildlife components, such as perches. Because the ponds are part of the obliterated gully, surface water elevation in the ponds are generally connected only to ground water, not channel flow. Shallow groundwater levels in the Phase I project area typically fluctuate more than 15' from spring to mid-summer as the valley drains.

The plug elevations and widths are designed to reduce the risk of head-cutting and surface erosion during major overland flows. To minimize the footprint of project activities, all heavy equipment stays within the confines of the work area, and material transport generally does not exceed 300 feet. Vegetation that would be buried or drowned is removed, stockpiled, and re-planted at key points on the plugs, pond sides, or new channel where structure or support is needed.

Project Rationale & Benefits

The Feather River CRM has provided restoration project assistance to numerous landowners, public and private for almost 20 years. The evolution of our understanding of the issues facing the Feather River watershed, flooding, water quality (temperature, sediment and nutrients) and water supply reliability, has led to the direction of restoring fully functional floodplains wherever possible. General science has recognized the importance of functional floodplains for improving all of the above issues.

The meadows and valleys throughout the Feather have evolved to buffer the watershed from extremes of flood/drought and sediment/nutrient pulses from the uplands. These alluvial features spread and slow flood waters while trapping sediments and nutrients. The meadows also served as a sponge, absorbing winter and early spring flows in the porous soils, then releasing this water back into the channel through the streambanks as flows diminish into the summer.

The FRCRM has monitored a number of projects similar to the proposed Hosselkus Creek Phase II restoration, including Hosselkus Phase I. This data graphically shows the change and timing of change in shallow meadow water levels, streamflow and water temperatures from these restored meadow systems.

Figure #1 below displays the detention and release measured at Clarks Creek, which was constructed in 2001. The percentage values displayed above each annual peak level are the percent of normal precipitation for that water year. Analysis of this data reveals that the time of meadow soil saturation within 1' of ground level increased from an average of 8 days pre-project to 223 days post-project annually. Saturation to the near-surface now occurs in early winter rather than early spring. The initiation of water release is now early summer rather than mid spring. This meadow still fully releases its stored water by late summer. Streamflow from the early winter saturation point is pass-through until inflows into the meadow diminish in early summer, triggering release of soil storage. Gross recharge water available post-project over pre-project conditions in the 56 acre meadow totals 49 acre-feet using a field (water holding) capacity coefficient of .25 for sandy loam soils (USDA, 1955). As the data show, this storage is less affected by seasonal precipitation variation than the pre-project condition.

Figure #3 displays the changes occurring on Hosselkus Creek resulting from the Phase I project. The '0' line at the top of the graph is ground level. Monitoring Well # 1 is at the top of the valley and was un-affected by the original restoration work. Well #3 was near the upstream end of the Phase I work and shows some influence from the work. Well #5 is at the lower end of the valley and is fully influenced by the original work. Restoring the connection between the channel and floodplain, while reducing the erosion stress on the stream channels, allows high flows to infiltrate the upper levels of the meadow temporarily. These flows are then released later in the spring/early summer as enhanced baseflow. As the graphs show, the post project meadow soil water is higher in the spring while draining back down to pre-project levels by mid-summer.

Table #1 below displays the temperature influence of the groundwater recharge to the stream channel. These measurements were taken when surface stream flow had ceased for the season in the Hosselkus Creek Phase I project reach. Measurements were taken at the point of flow cessation upstream of the project, at the bridge where groundwater from the project area resumes surface flow and above/below the influence zone of the tributary aquifer on Indian Creek. These temperature response are consistent with monitoring that from other project areas. Cumulatively projects or this type have potential to significantly improve water temperature concerns throughout the Feather River watershed.

Photo #1 shows the existing condition downcut condition in the Phase II Reach. Photo # 2 shows the Phase I reach restored in 2002..

Table 1- Hosselkus Temperature Comparison:

Temperature Data collected on June 27, 2005. Weather mostly cloudy. Air temperature = 24.3C.

Location	Time	Degrees Centigrade	Fahrenheit
Hosselkus Cr abv the project	1355	23.5	74.3
Hosselkus Cr at bottom of project	1250	18	64.4
Hosselkus Cr at mouth	1240	21	69.8
Indian abv Hosselkus	1315	20	68
Indian blw Hosselkus	1230	19	66.2

Figure #4 illustrates the flow changes that have resulted from similar restoration in Big Flat Meadow on Cottonwood Creek. Streamflow in 1995 ended on June 6 despite being the wettest precipitation year on record.

Summary:

The meadow restoration projects implemented and being planned are intended to fully restore the water quality and baseflow augmentation functions of the naturally-evolved watershed. It was these attributes which historically made the Feather River one of the most desirable, reliable water supply river systems in California. All projects receive ongoing monitoring of some indicator of watershed function to ensure that they are performing as expected. These projects receive broad scientific, professional and governmental support because of the broad range of water resource benefits illustrated below.

Figure #1- Project Map

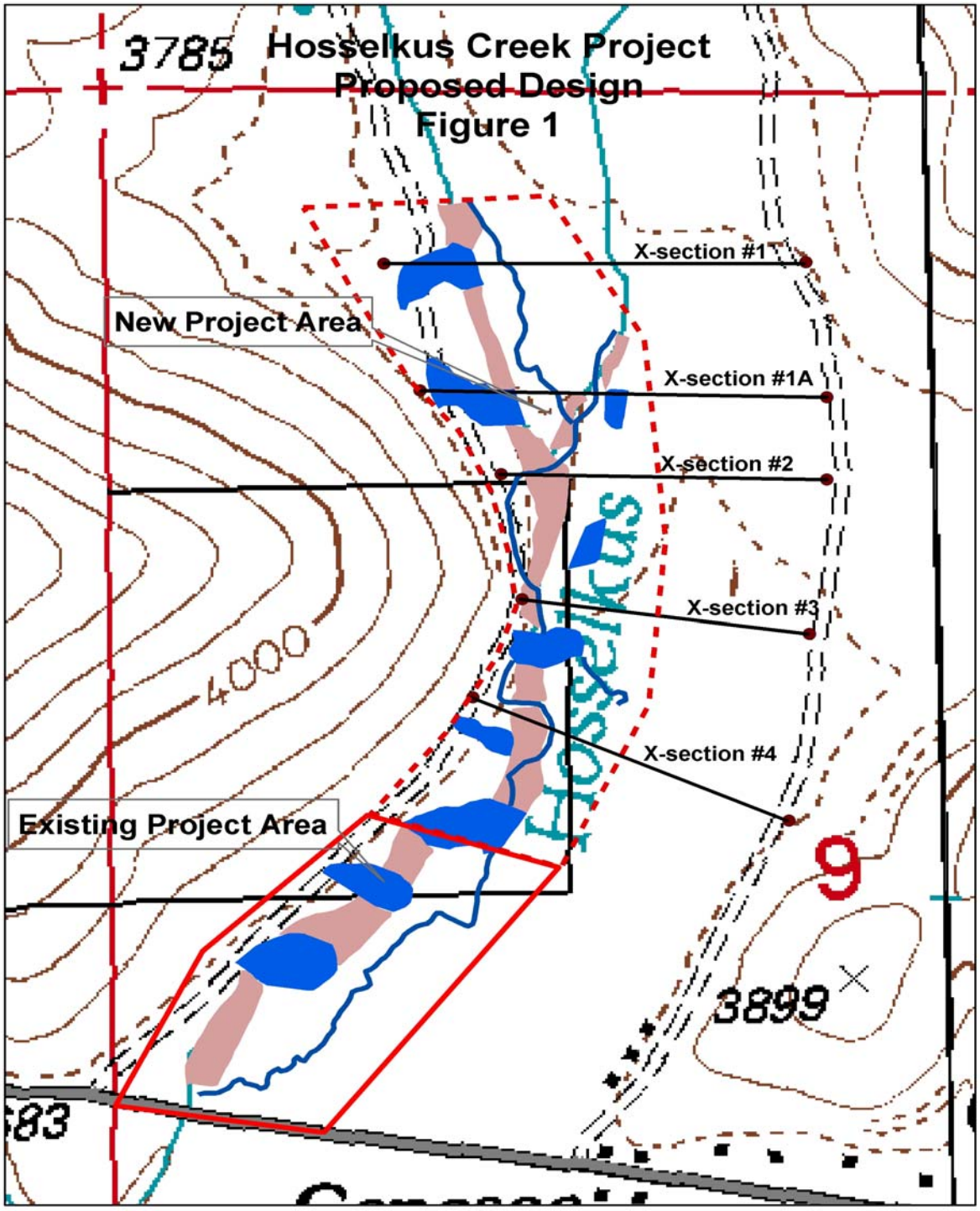


Figure #2: Clarks Creek Groundwater Data

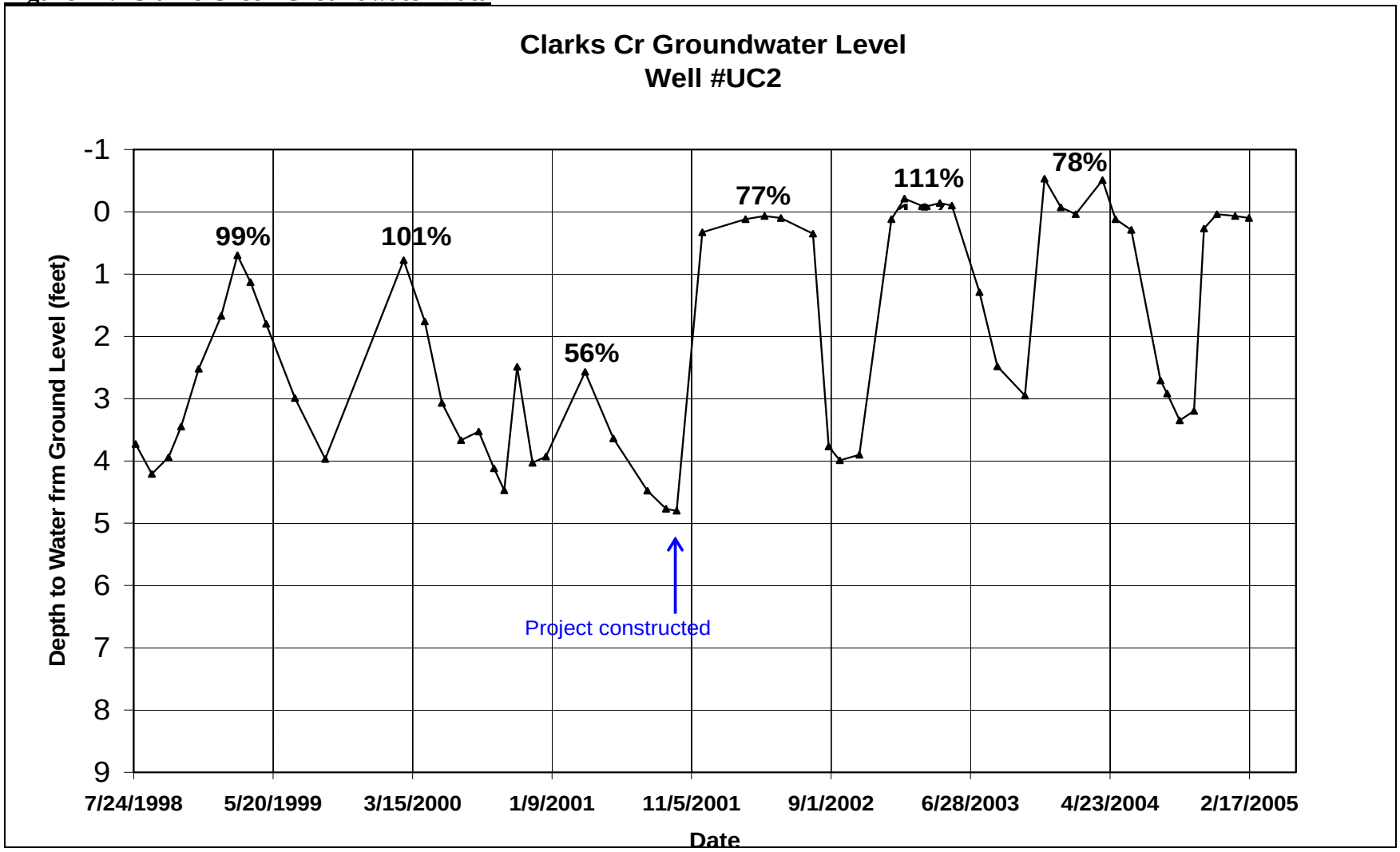
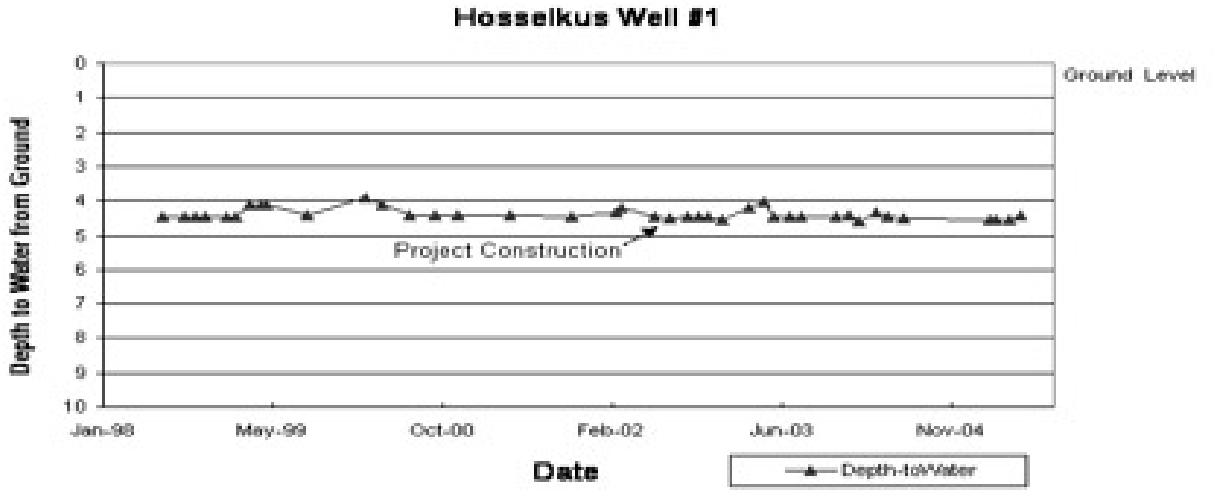
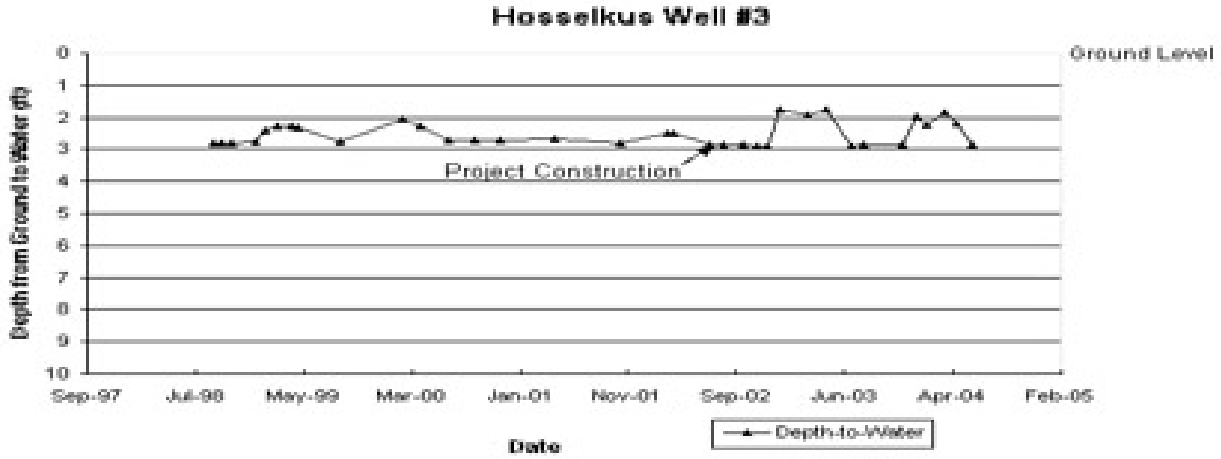


Figure #3- Hosselkus Groundwater Wells





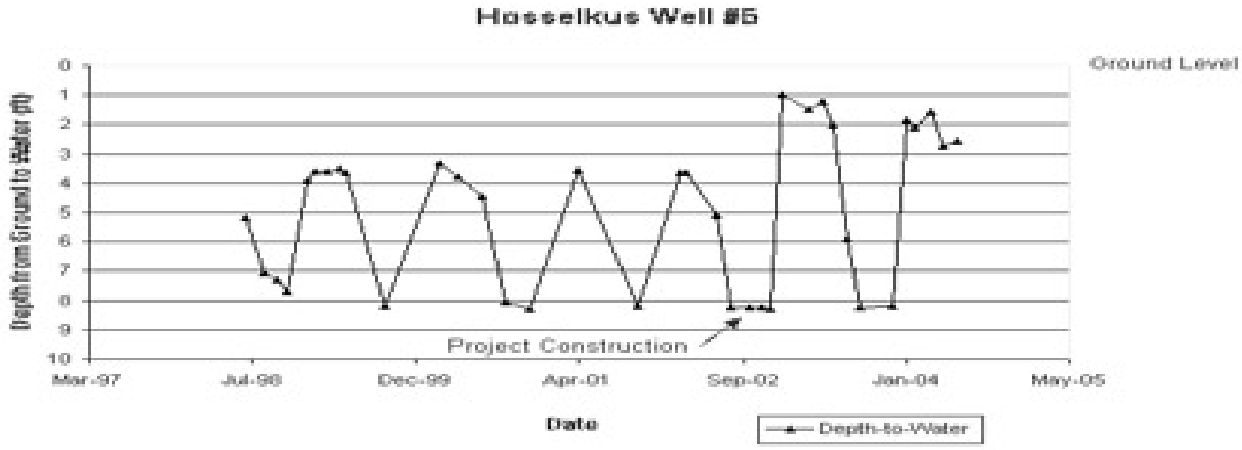


Figure #4- Streamflow Enhancement Cottonwood Creek

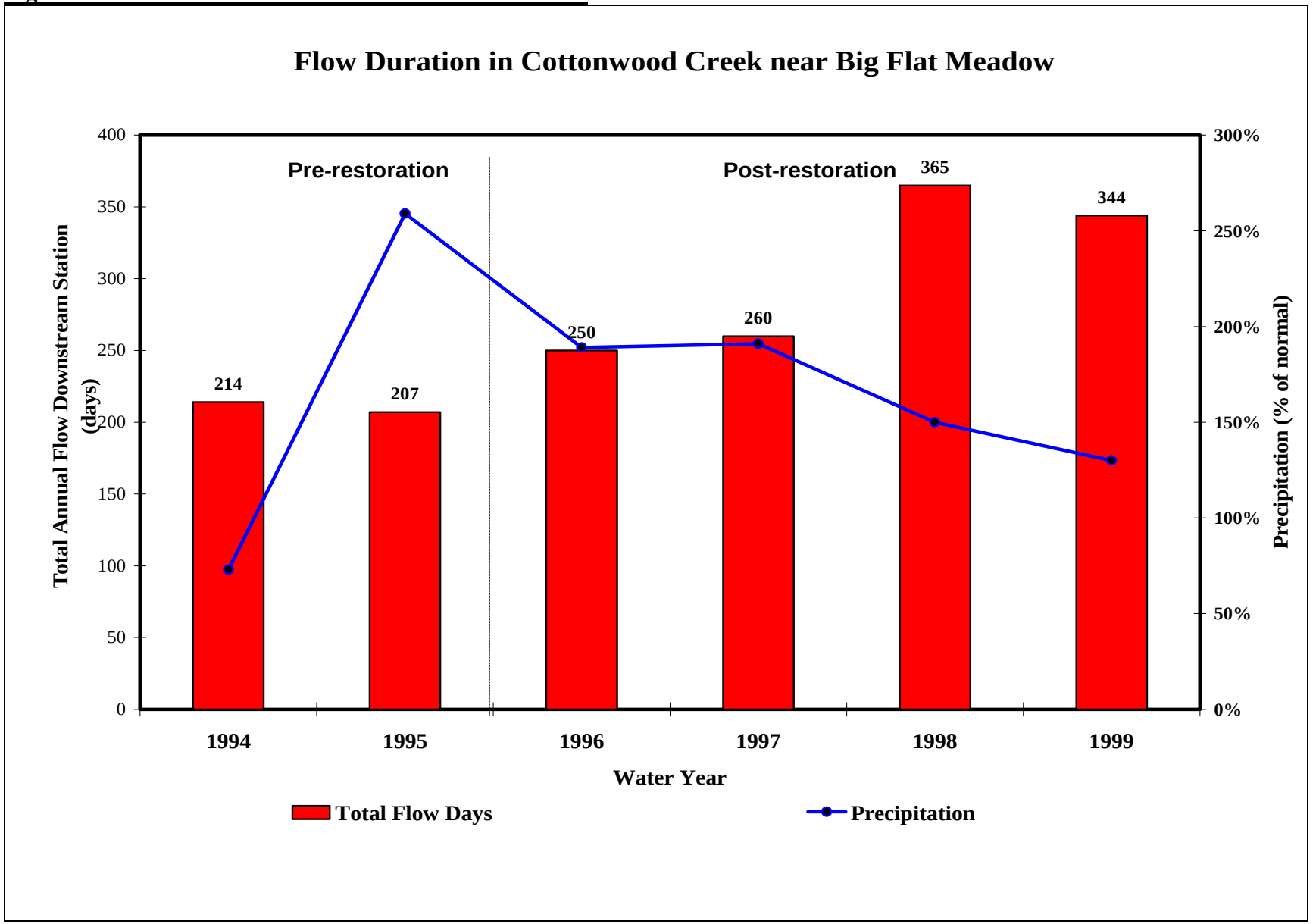


Photo #1- Hosselkus Phase II

Photo #2- Hosselkus Phase I, restored in 2002

Attachment 4

Provisions from Portland General Electric License

Article 428. ***Shoreline Management Plan.*** Within one year of license issuance, the licensees shall, after consultation with the Shoreline Management Working Group established pursuant to Article 402, file for Commission approval a Shoreline Management Plan (SMP) for the Pelton Round Butte Project. The SMP shall include standards and guidelines for new shoreline development, installation of new docks, and modification of existing docks.

The licensees shall include with the SMP, an implementation schedule, documentation of consultation, copies of comments and recommendations on the completed SMP after it has been prepared and provided to the Shoreline Management Working Group, and specific descriptions of how the Working Group's comments are accommodated by the SMP. The licensees shall allow a minimum of 30 days for the Working Group to comment before filing the plan with the Commission. If the licensees do not adopt a recommendation, the filing shall include the licensees' reasons, based on project-specific information.

The Commission reserves the right to require changes to the SMP. Implementation of the SMP shall not begin until the SMP is approved by the Commission. Upon Commission approval, the licensees shall implement the SMP, including any changes required by the Commission.

Article 429. ***Shoreline Erosion Plan.*** Within one year of license issuance, the licensees shall, in consultation with the Shoreline Management Working Group established pursuant to Article 402, file for Commission approval, a Shoreline Erosion Plan to monitor and control stream and impoundment shoreline erosion at the Pelton Round Butte Project. The plan, at a minimum, shall include the following objectives and measures listed below.

(1) The following objectives of the plan shall be to:

(a) Discuss the conditions and probable causes of, as well as potential measures for, shoreline erosion;

(b) Describe agreed upon actions, including, but not limited to the measures described herein; and

(c) Provide that all actions conducted under the shoreline erosion plan shall be developed and implemented in consultation with the Shoreline Management Working Group established pursuant to Article 402.

The licensees shall develop the plan using the annotated outline in Section E-V11 – Land Management and Use of the Final Joint Application Amendment, and any other applicable information, in consultation with the Shoreline Management Working Group.

(2) Within three years of license issuance, the licensees shall commence rehabilitation at, but not limited to, the following existing erosion sites:

(a) Chinook Island;

(b) Indian Park Campground;

(c) Juniper Canyon;

(d) Big Canyon;

(e) Dispersed sites on the east bank just south of Round Butte dam;

(f) Shoreline of the cove at Perry South Campground and along Spring Creek;

(g) Shoreline upstream of the Upper Deschutes Day-Use Area;

(h) Pelton Park;

(i) Bureau of Land Management Beach east of the Three Rivers Marina; and

(j) shoreline and access road at Monty Campground.

(3) The licensees shall conduct, or provide for an entity to conduct, a baseline survey of the project area to identify, map, and assess existing erosion sites that are project-related and are significantly affecting terrestrial habitats, fish habitats or water quality; or that, if the site is located on the Confederated Tribes of the Warm Springs Reservation, is causing or is likely to cause significant loss of shoreline. For each erosion site identified, the licensees shall include a re-locatable topographic survey transect, notes on sediment types, vegetative condition or fish or wildlife habitat existing on the site, photographic documentation, and an analysis of the probable causes of the erosion.

(4) Beginning in the first year following license issuance, and after consultation with the Shoreline Management Working Group, the licensees shall conduct annual monitoring of the project area to monitor existing erosion sites and identify and map any new project-related erosion sites. This annual monitoring shall follow the pattern and standards established by the baseline survey performed above and shall include the opportunity for the Shoreline Management Working Group to accompany the licensees' survey crew in the field. Information that is unchanged from any prior year's survey shall be noted, but need not be repeated. Annual monitoring of sites shall occur until documentation of stable or improved conditions, after which additional monitoring can be changed based on consultation with the Shoreline Management Working Group and Commission approval. Annual monitoring shall also include an assessment of ongoing mitigation activities.

(5) No later than March 31 of each year after Commission approval of the Shoreline Erosion Plan, the licensees shall file with the Commission an annual report, prepared after consultation

with the Shoreline Management Working Group, which identifies soil erosion control measures; describes annual maintenance of erosion control sites; identifies any other soil erosion control measures including those undertaken during emergency situations; describes coordination with other resource management plans, such as the Cultural Resources Management Plan required by Article 429 of this license; and documents consultation. Any proposed changes in the treatment or monitoring status of the erosion control site shall include the rational for such changes.

(6) Further, the licensees shall monitor identified erosion sites following (i) any event at the Round Butte development where the outflow exceeds inflow by more than the maximum turbine flow, (ii) any drawdown of Lake Simtustus resulting in 7 or more feet of reservoir elevation change in a 24-hour period, or (iii) other events that could rapidly change the shoreline condition.

(7) The licensees shall develop site-specific measures for the erosion sites listed in (2) above, and for any project-related erosion sites identified during the baseline survey or subsequent annual monitoring. The licensees shall give preference to "soft" erosion control techniques including, bioengineering, planting and seeding of appropriate native riparian species, sediment replenishment, or anchored woody debris, but may, when necessary, utilize "hard" erosion control, including use of geotextiles, rock armoring, or other hard surfaces. The licensees shall develop the site-specific measures after consultation with the Shoreline Management Working Group.

The licensees shall include with the plan, an implementation schedule, documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the Shoreline Management Working Group, and specific descriptions of how the Working Group's comments are accommodated by the plan. The licensees shall allow a minimum of 30 days for the Working Group to comment before filing the plan with the Commission. If the licensees do not adopt a recommendation, the filing shall include the licensees' reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan shall not begin until the plan is approved by the Commission. Upon Commission approval, the licensees shall implement the plan, including any changes required by the Commission.