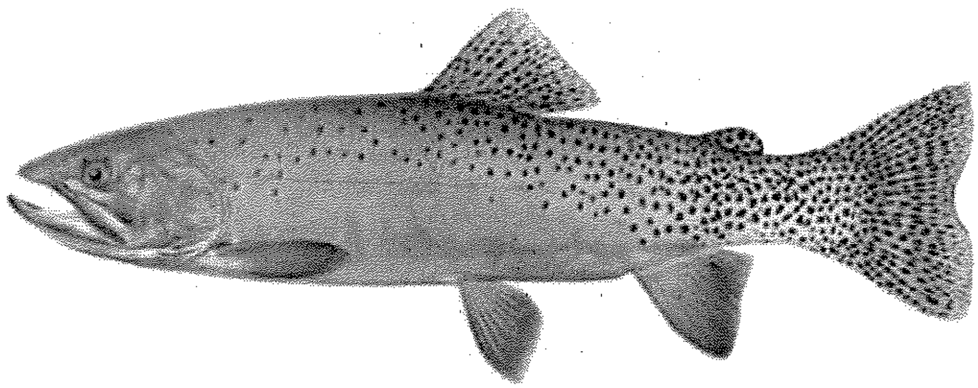
Sekokini Springs Natural Rearing Facility

Master Plan



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Improvements to the Sekokini Springs Natural Rearing Facility were funded by the Bonneville Power Administration through the Hungry Horse Dam Fisheries Mitigation Program. BPA purchased the facilities (previously a private trout farm) on land owned by the U.S Forest Service, and funded the installation of a gravity water routing system, spring caps to protect the small hatching facility against disease contamination, and new siding for the hatchery building.

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The Independent Scientific Review Panel (ISRP) provided thoughtful guidance during the development this Master Plan, the Hatchery genetics Management Plan and our long-term plans for Research, Monitoring and Evaluation.

Executive Summary

Westslope cutthroat trout (WCT) populations in the Flathead Subbasin have declined in recent decades due to a loss of spawning and rearing habitat, hybridization with rainbow trout, genetic introgression with Yellowstone cutthroat trout, and competition with introduced species. The current distribution of WCT in Montana has been reduced to less than 39 percent of its total historic range, and genetically pure populations are estimated to remain in only 9 percent of their native range in Montana (Shepard et al. 2003). WCT are listed as a Fish Species of Special Concern by the state of Montana and a sensitive species by Region I of the U.S. Forest Service. Additionally, although recently determined by the U.S. Fish and Wildlife Service to lack sufficient evidence for listing, in 1997, WCT were petitioned for coverage under the Federal Endangered Species Act, as amended.

In an effort to aid in the recovery of genetically pure WCT populations in the Flathead River drainage and to increase the abundance of WCT in their historic range, the Bonneville Power Administration purchased the existing Sekokini Springs facility (formerly used as a private rainbow trout farm on land owned by the U.S. Forest Service), to raise wild WCT and release their progeny. This proposed WCT natural rearing facility at Sekokini Springs is part of the Hungry Horse Mitigation Program, and would be operated by Montana Fish, Wildlife & Parks (MFWP) to conserve local populations of genetically pure WCT and restore genetic diversity throughout the Flathead Watershed. MFWP plans to restore wild WCT within their historic range using a variety of tools including habitat protection and restoration, fish passage improvements, removal and replacement of nonnative fish populations, modified dam operation strategies, harvest regulations, direct translocation of wild trout and the appropriate use of artificial propagation in an isolation facility.

In addition to providing background information about WCT in the Flathead Subbasin, this Master Plan describes methods by which MFWP intends to accomplish WCT recovery using a variety of techniques to increase their abundance while promoting genetic diversity. The Sekokini Springs site would provide created ponds and channels for rearing genetically pure donor fish whose progeny would be released to targeted restoration streams and lakes in the Flathead Subbasin. The site would also provide an isolated water source to contain wild trout for inspection for fish pathogens and genetic purity. Mature male WCT have been held in isolation at Sekokini Springs for collection of milt for infusion into the state's existing WCT broodstock (MO12). Wild trout may also be held for inspection in preparation for direct translocations to restored stream habitats. An additional component of the proposed facility would include an educational center intended to promote public awareness and the conservation of native species, particularly the WCT. As part of this educational component, fish viewing windows and gazebos would be installed to allow observations of fish in a setting designed to mimic their natural environment.

Chapter 1. Introduction

This project is part of the Hungry Horse Mitigation Program (HHMP) funded by Bonneville Power Administration (BPA). In 1991, Montana Fish, Wildlife, & Parks (MFWP) and the Confederated Salish and Kootenai Tribes (CSKT) (MFWP and CSKT 1991) prepared the Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam (Mitigation Plan). This Mitigation Plan provided the Northwest Power and Conservation Council (NPCC; formerly named Northwest Power Planning Council) with documentation of fisheries and habitat losses associated with construction and operation of Hungry Horse Dam (HHD) and an adaptive strategy to mitigate for those losses. It addressed six specific program measures identified in the 1987 Columbia Basin Fish and Wildlife Program and subsequent program amendments. NPCC approved the loss statement, including annual fisheries losses of 250,000 juvenile bull trout (*Salvelinus confluentus*) and 65,000 migratory westslope cutthroat trout (WCT, *Oncorhynchus clarki lewisi*) from Flathead Watershed populations. In addition, an estimated 175,483 adfluvial WCT juveniles were lost in tributary reaches of the Hungry Horse Reservoir (HHR) and Flathead Lake due to construction and operation of the dam (Table 1-1 and Table 1-2). The Mitigation Plan also identified 77 miles (124 kilometers (km)) of critical, low gradient spawning and rearing habitat in streams that were inundated and lost when HHR filled.

Table 1-1. Estimated Number of Adfluvial Cutthroat Juveniles Lost (standing stock) by Stream Order and Gradient Categories (for gradients less than six percent) in tributary reaches inundated by Hungry Horse Reservoir (lost to all spawning adults and rearing juveniles).

Stream order	Gradients (%)	Number of reaches	Length (meter)	Average number of WCT per 100m (mean)	Total calculated loss (# of fish)
2	0.4 - 1.8	4	4,770	22.7	1,083
2	2.2 - 2.6	2	4,004	56.9	2,278
2	2.8 - 3.6	5	5,370	77.6	4,167
2	4.0 - 5.8	8	5,108	31.6	1,614
3	0.6-0.6	1	8,692	22.3	1,938
3	2.6-3.8	9	9,384	25.4	2,384
3	4.3-5.9	5	4,096	43.4	1,778
4	0.9-0.9	1	3,956	5.2	206
4	2.0-3.5	4	12,874	13.5	1,738
Total		39	58,254		17,186

Source: Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam (1991)

Table 1-2. Estimated Number of Adfluvial Cutthroat Juveniles Lost (standing stock) by Stream Order and Gradient Categories (for gradients less than six percent) in Tributary Reaches above full pool (includes upper South Fork drainage) lost to spawning and rearing fish from Flathead Lake but available to spawners from Hungry Horse Reservoir.

Stream order	Gradients (%)	Number of reaches	Length (meter)	Average number of WCT per 100m (mean)	Total calculated loss (# of fish)
2	1.5-1.5	1	877	22.7	199
2	2.2-2.3	4	9,739	56.9	5,541
2	2.8-3.8	7	13,905	77.6	10,790
2	3.9-5.9	32	79,047	31.6	24,979
3	0.7-1.0	2	10,916	22.3	2,434
3	1.1-1.4	2	9,898	38.9	3,850
3	1.7-2.2	8	51,918	62.9	32,656
3	2.6-4.0	20	86,468	25.4	21,963
3	4.1-5.9	20	62,865	43.4	27,283
4	0.3-0.6	8	38,963	5.2	2,026
4	1.1-1.3	5	40,337	24.0	9,681
4	1.7-4.8	13	68,778	13.5	9,285
5	0.6-0.8	3	53,220	14.3	7,610
Total		125	526,931		158,297
Grand Total Table 1-1 and 1-2					175,483

Source: Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam (1991)

The *Hungry Horse Dam Fisheries Mitigation Implementation Plan* (Implementation Plan) was developed by MFWP and CSKT, adopted by the NWPPC in 1994, and funded by BPA. The Implementation Plan describes specific measures to protect and enhance resident fish and aquatic habitat affected by Hungry Horse Dam that do not require changes in Hungry Horse Dam Operation. Fisheries losses are to be mitigated using a mix of techniques, 1) habitat improvement, 2) fish passage improvements, 3) hatchery upgrades, fish production and planting, and 4) offsite mitigation using these same techniques (MFWP and CSKT 1991 and 1993). HHMP completes projects to address items 1, 2 and 4 and cooperates with state and federal hatcheries to address item 3. Additional measures requiring operational changes were addressed separately (Marotz et al. 1996, 1999; Marotz and Muhlfeld 2000). The NPCC approved the mitigation and implementation plans and amended their Columbia Basin Fish and Wildlife Program (Measure 10.3A, NWPPC 1994).

A decision tree in the Implementation Plan directs the cooperating agencies to experiment with artificial propagation of native species to facilitate species restoration. The Flathead Subbasin Plan (CSKT and MFWP 2004) recommended experimental culture of WCT at Sekokini Springs. The site offers a unique combination of a small hatchery facility and outdoor pond and stream habitat suitable for rearing native WCT in a controlled naturalized environment.

The mitigation plans used a technique developed by Zubik and Fraley (1986) to estimate the number of recruits expected from various restored or reconnected streams, based on measurements from relatively pristine streams, stratified by stream order and gradient. Natural recruitment from reestablished wild spawning runs can be estimated based on stream order and gradient, or confirmed directly through migrant trapping. MFWP documented spawning redds above previous fish barriers (after impassible culverts at road crossings were repaired) and observed trends in fish standing stocks associated with stream habitat restoration projects. Annual recruitment from completed mitigation projects was estimated to be 5122 juveniles (Knotek et al. 1997). Ascribing a percentage of measurable improvements to habitat or hatchery actions will continue to be an educated guess. Habitat and hatchery actions compliment each other and MFWP has not yet verified how many new recruits resulted from past habitat and passage projects or hatchery outplanting.

1.1 The Purpose of the Master Plan

The purpose of the Sekokini Springs Natural Rearing Facility and this Master Plan is to aid in the recovery of genetically pure WCT populations in the Flathead Subbasin by increasing the number and abundance of WCT populations, while maintaining genetic diversity within their historic range. Sekokini Springs was designed to provide rearing habitat for wild donor stocks whose progeny (as eyed eggs or juveniles) will be released into targeted restoration streams and lakes. The site also provides an isolated water source to contain wild WCT for inspection for fish pathogens and genetic purity. Wild male WCT have been held in isolation for collection of milt for infusion into the existing state broodstock (MO12) to introduce additional genetic variation and reduce domestication. The educational component of the project will promote the conservation of native species and provide the public with information on the overall mitigation program.

Westslope cutthroat populations have declined due to loss of spawning and rearing habitat, hybridization and introgression with rainbow trout (*O. mykiss*; RBT) and Yellowstone cutthroat trout (*O. clarki bouvieri*; YCT) and competition with introduced species (MFWP and CSKT 1991; Hitt 2002; Leary et al. 1998). The species is listed as a Fish Species of Special Concern in Montana. In 1997, WCT was petitioned for listing under the Federal Endangered Species Act of 1973, as amended (ESA). The U.S. Fish and Wildlife Service (USFWS) determined, at the time of petitioning, that listing was not warranted. However, in 2002, the USFWS was court-ordered to reevaluate this finding (see Section 2.1.1 for more details). The most recent status review indicated that WCT in Montana currently occupy 39 percent of their historic range and non-hybridized populations occupy nine percent of their former range (Shepard et al. 2003). This

Master Plan describes our plans to mitigate for damages caused by the construction and operation of Hungry Horse Dam (HHD) and to aid in the restoration of WCT populations to help eliminate the need to list WCT under ESA in the future. The long-term research, monitoring and evaluation plan (Chapter 8) contains strategies for evaluating the effectiveness of the facility and its products.

1.2 History of Sekokini Springs Facility

Sekokini Springs was formerly a private trout farm that propagated RBT for purchase by private pond owners. The site was not secure and unintentionally released RBT into the Flathead River where they hybridized with native WCT populations. Evidence suggests that RBT escaped intermittently for nearly 40 years (B. Marotz, MFWP, personal communication, January 24, 2003). The HHMP first leased the site and removed all RBT from the facility. After removing trout from the water source and performing a comprehensive analysis for fish diseases, the State fish health specialist listed the Sekokini Springs water source as safe from fish pathogens to allow for experimental culture of WCT. The onsite facilities were purchased by BPA on the U.S. Forest Service (USFS) property and a no-cost special use permit was secured by MFWP to use the site for experimental culture of WCT.

Experimental hatching and rearing of WCT took place from 1997 through 1999 by personnel from the USFWS Creston National Fish Hatchery (CNFH). In 2001, approximately 90,000 eyed eggs (M012 WCT) were transferred from the Washoe Park Trout Hatchery to Sekokini Springs where they were hatched and reared. Approximately 40,000 fingerling WCT (designated pure strain M012 brood source) were reared to assess the water source at Sekokini Springs (B. Marotz, MFWP, personal communication, 2003). The water source follows a natural annual flow and temperature regime that successfully raised WCT with an exceptional condition factor (Don Edsall, USFWS, personal communication). Fish were reared with automatic feeders and limited human interaction, and were outplanted to a closed-basin lake (Rogers Lake). Trout have not reproduced naturally in the single, small tributary to Rogers Lake, so there was no offset to annual fish losses. Instead, the Rogers lake project replaced harvest opportunity that was lost due to the construction and operation of Hungry Horse Dam. Fishing greatly improved in Rogers Lake (MFWP state-wide creel census). In 2003 and 2004, wild WCT were held in isolation at Sekokini Springs to screen for fish pathogens before collecting milt for infusion into Montana's captive WCT broodstock held at Washoe Park State Fish Hatchery. These experiments demonstrated that it was possible to isolate and rear westslope cutthroat trout indoors at Sekokini Springs.

1.3 Program Goals and Benefits

Initially, our goal is to successfully rear and spawn (replicate) a wild, genetically pure donor population from the Flathead watershed, a major tributary of the Columbia River whose drainage encompasses 5,399,040 acres (13,576 km^2) in northwest Montana (Deleray et al.1999).

Unlike other state hatcheries, the experimental facility at Sekokini Springs can isolate wild fish (including those considered for translocation) while they are tested for genetic purity and fish pathogens. The facility was designed to isolate and rear up to four wild donor populations to maturity for spawning. Progeny would then be used to reestablish wild populations in their historic habitats within the Flathead watershed that are presently vacant or reconditioned by removing introduced or hybridized/introgressed populations. This program differs from typical captive broodstock facilities because new donor fish will be collected from wild populations annually, reared to maturity in natural habitat, and spawned to create F1 progeny for outplanting. Once a new population has been reestablished and becomes self-sustaining, additional populations from a variety of donor populations throughout the Flathead Subbasin will be replicated and outplanted within their original watersheds. This goal is consistent with recommendations for genetic conservation of WCT (Leary et al. 1998) that suggests the translocation of fish or gametes from genetically pure populations from either the same drainage or "within-drainage" population, or a population inhabiting habitats most similar to those of the water body being restored. In addition to providing pure genetic sources, the Sekokini Springs facility has the capacity to isolate and hold wild WCT being inspected for direct translocation and wild males for milt collection used to infuse wild genetic material into the state's MO12 captive broodstock.

MFWP plans to evaluate the success of fish plants from Sekokini Springs and document any wild spawning runs that are successfully initiated. Success can be measured through juvenile population estimates, migrant counts, micro-elemental signatures in otoliths and scales, genetic sampling and angler surveys. If Sekokini Springs is used to reestablish westslope cutthroat trout in lakes, fish leaving the lakes to downstream waters and fish spawning in the lake inlets and outlets would offset a portion of the approved losses of naturally reproduced WCT.

The Independent Scientific Review Panel (ISRP) asked that we identify what portion of the approved losses would be attributed to mitigation activities (hydro, habitat, hatchery) and identify the portion assigned to Sekokini Springs. The percentage of offsets attributable to each mitigation strategy can only be approximated. In the mitigation plans, MFWP estimated that modifying Hungry Horse Dam operations could mitigate approximately half of the losses. The remaining half of the losses would be mitigated through habitat restoration, fish passage improvements and by restoring wild spawning runs. The cooperating agencies did not propose to mitigate the annual loss of 65,000 naturally reproduced WCT recruits using hatchery plants alone. Instead, wild spawning runs would be enhanced using habitat enhancement and fish passage improvements to promote natural recolonization. Where wild WCT have been extirpated, populations would be reestablished through direct fish translocations where possible and appropriate. Where large numbers of WCT are required to reestablish WCT populations in the contiguous Flathead Watershed, artificial propagation techniques would be used to replicate wild donor populations to maintain genetic diversity. This was the impetus for renovating the Sekokini Springs facility. Existing state and federal hatcheries would establish new WCT populations in closed-basin lakes for offsite mitigation and certain onsite waters where hatchery outplants are compatible with restoration goals. If HHMP achieves its mitigation goals, the relative contribution of Sekokini Springs to conserving Montana's westslope cutthroat trout would be significant. Conserving westslope cutthroat trout in the Flathead Subbasin would secure approximately 45% of the remaining core genetic legacy for the species in Montana. The South Fork Flathead alone represents about 10% of the westslope cutthroat habitat in Montana and represents 50% of the remaining large, connected metapopulations. Depending on future use of the facility, Sekokini Springs has the potential to offset as much as 25% of the approved cutthroat loss.

1.4 Relationship to Other Plans, Programs and Projects in the Region

Renovation of the Sekokini Springs facility is a component of BPA project 199101903, which addresses fishery losses caused by the construction and operation of Hungry Horse Dam in the Flathead Basin. This project implements habitat restoration, fish passage improvement, off-site mitigation and monitoring pertaining to Hungry Horse Mitigation and includes enhancement and restoration at numerous tributaries in the basin. Projects under the Hungry Horse Mitigation Plan are coordinated to accomplish overall goals of the Flathead Subbasin Plan, adopted as part of the NPCC's Columbia Basin Fish and Wildlife Program. Objectives are designed to complement or co-sponsor work of associated projects and address specific problems limiting native fish stocks, including WCT, in the Flathead Basin. Mitigation projects by MFWP and CSKT have parallel charges and have worked cooperatively on several objectives during recent years. In association with this effort, BPA project 199101901 included both stream restoration projects and monitoring of waterbodies within the Flathead Basin to verify responses of native fish communities, including WCT, to Hungry Horse Dam mitigation measures.

In 1995, USFS and MFWP jointly developed the Fish, Wildlife and Habitat Management Framework for the Bob Marshall Wilderness Complex and in 1997 added the Fish and Wildlife Decisions Supplement (USFS & MFWP 1997). This framework provides guidelines for fish and wildlife management and conservation programs in the wilderness. Among the specific issues identified in the document are: management of threatened, endangered and sensitive species, fish stocking, and chemical treatment to control exotic fish, and fish spawn taking.

In 1999, eight state and federal agencies developed and signed the Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout in Montana (Conservation Agreement, MFWP 1999a), which provided a framework for cutthroat conservation strategies in Montana. Primary among the conservation objectives is that:

> ...all genetically pure populations are to be provided the protection necessary to ensure their long-term persistence...

In 1999 MFWP launched comprehensive plan to conserve westslope cutthroat in the South Fork Flathead by removing exotic trout from lakes that were genetically contaminating downstream populations and risked hybridizing with pure populations throughout the South Fork drainage. MFWP published the "South Fork Flathead Watershed Westslope Cutthroat Trout Conservation

Program" (Grisak 2003). From 1999-present, MFWP, BPA and USFS have been developing a plan and EIS to implement this project (EIS 2005). The EIS discusses methods by which 21 lakes will be chemically treated to eliminate non-native trout and introgressed WCT from historical WCT habitat. Progeny of within-drainage WCT populations produced at the proposed Sekokini Springs facility would be outplanted into several of these lakes, in addition to several streams, upon confirmation that the lakes are devoid of non-native trout or introgressed WCT. Two issues that complicate completely removing all fish from the outflow streams. First, the rugged terrain makes access to some outflow streams difficult. Secondly, bull trout (ESA listed threatened) reside in the lower portions of many of the outflow streams. Fish toxins must be neutralized before entering habitat occupied by bull trout during fish removal projects. For these reasons, MFWP can only remove as many exotic trout as possible and rely on genetically pure fish stocked in the headwater lakes to re-populate downstream systems.

The Flathead River Native Trout Project is currently using radio-telemetry to identify seasonal location and movements of lake trout (*Salvelinis namaycush)*, bull trout, and WCT in the drainage. Personnel are building on the previous database to produce a biological layer to overlay on the physical framework of the Instream Incremental Flow Methodology (IFIM) study. Physical aspects of the IFIM project were directly contracted by BPA (project 199502500). This project evaluates the effects of flow fluctuations from the HHD on fish habitat, predator prey interactions, sediment deposition and fish migrations. Coordination with biological sampling is essential to complete the river model. Concurrent with population monitoring in the Flathead River tributaries, personnel are evaluating RBT and cutthroat trout interactions. Since 1999, MFWP has initiated graduate projects in cooperation with the University of Montana to examine interactions between RBT and cutthroat trout (genetic introgression, overlap in timing and location of spawning, etc.). The results of these studies indicate that hybridization between RBT and WCT is progressing upstream in tributaries within the Flathead River system and will be utilized in identifying appropriate recipient streams from Sekokini Springs. (Hitt 2002, Boyer 2006).

Integrated Rule Curves (IRCs) developed for the Flathead subbasin have influenced flood control and power operations at Hungry Horse Dam. IRCs are used as a tool to balance the requirements of hydropower generation and flood control with the needs of resident and anadromous fish.

MFWP often benefits from the StreamNet project 3874700 Geographic Information Services (GIS) Unit. This GIS support group integrates Geographic Positioning System (GPS) locations and provides layers for land ownership, land use, species distribution, etc. that assist in creating detailed watershed maps. These maps are essential in planning projects and have allowed detailed analysis of the Flathead System and native trout species.

Because CSKT manages the south half of Flathead Lake and tribal lands encompass the lower Flathead Drainage, MFWP and the USFWS cooperate on several inter-jurisdictional projects with the tribe. These include all monitoring, Subbasin Planning, and management activities involving Flathead Lake and certain tributary streams. Dayton Creek restoration is one ongoing project that has been collaboratively designed with CSKT and several other groups. In the preliminary watershed assessment, MFWP completed basinwide fish distribution and abundance surveys, installed thermographs, completed maps using MFWP's GIS support system, and made some of the initial landowner contacts.

Hungry Horse mitigation incorporates cost-share agreements and collaborative relations with other agencies. For example, the US Bureau of Reclamation's (BoR) Technical Assistance Program provided engineering support for the design of Sekokini Springs, the Hay Creek and Crossover Wetlands projects. MFWP also collaborated with the USFS on culvert improvements on HHR tributaries, the Griffin Creek fencing project, and the chemical rehabilitation of Lion Lake. In the Emery Creek restoration project, MFWP teamed with the Flathead National Forest, Trout Unlimited, the National Fish & Wildlife Foundation and Flathead Common Ground (a consensus building group made up of environmental, timber management, multiple-use, and agency representatives). Fish passage and stream restoration on Paola Creek was a cooperative project with the USFS and the National Fish & Wildlife Foundation. Other groups that have routinely cooperated on projects include local conservation districts, Montana Conservation Corps, Montana Department of Natural Resources and Conservation, and the U of M Flathead Biological Station. The Flathead Biological Station has collected useful water quality, invertebrate, and other ecological data throughout the Flathead Lake and River system. MFWP has funded student and faculty research through the University of Montana and Montana State University.

1.5 How to Use the Master Plan

The NPCC has specific requirements for the contents of a Master Plan (Table 1-3). Specifically, the NPCC requires discussion regarding the program goals and objectives, expected benefits, impacts, alternatives, historical information and other information deemed necessary for program proponents and reviewers to make decisions.

Table 1-3. Requirements for NPCC Master Plans

In accordance with Section 7.4B of the Fish and Wildlife Program (NWPPC 1994) this Master Plan addresses: •project goals; •measurable and time-limited objectives; •factors limiting production of the target species; •expected project benefits (e.g., gene conservation, preservation of biological diversity; fishery enhancement, and/or new information); •alternatives for resolving the resource problem; •rationale for the proposed project; •how the proposed production project will maintain or sustain increases in production; •the historical and current status of anadromous and resident fish in the subbasin; •the current (and planned) management of anadromous and resident fish in the subbasin; •consistency of proposed project with Council policies, National Marine Fisheries Service recovery plans, other fishery management plans, watershed plans and activities; •potential impact of other recovery activities on project outcome; •production objectives, methods and strategies; •brood stock selection and acquisition strategies; •rationale for the number and life-history stage of the fish to be stocked, particularly as they relate to the carrying capacity of the target stream and potential impact on other species;

•production profiles and release strategies;
•production policies and procedures;
•production management structure and process;
•related harvest plans;
•constraints and uncertainties, including genetic and ecological risk assessments and cumulative impacts;
•monitoring and evaluation plans, including a genetics monitoring program;
•conceptual design of the proposed production and monitoring facilities, including an assessment of the availability and utility of existing facilities;
•cost estimates for various components, such as fish culture, facility design and construction, M&E, and O&M.
•the ISRP requested a long-term RM&E plan as part of this Master Plan.

1.6 Where to Find More Information

- U.S. Department of Agriculture (USDA) Forest Service Special-Use Permit for Sekokini Springs Facility issued to the Montana Fish, Wildlife and Parks (Appendix A)
- Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*) in Montana (MFWP 1999)
- Draft Flathead Subbasin Summary (CSKT and MFWP 2001) and Flathead Subbasin Plan (CSKT and MFWP 2004)
- Water Temperature and Temperature Units, Sekokini Springs Natural Fish-Rearing Project – Progress Report: July 23, 1997 – March 31, 1998 (Appendix C)
- Montana Fish, Wildlife & Parks Hatchery and Genetic Management Plan – Resident Fish Edition for the Sekokini Springs Natural Fish Rearing Facility (Appendix J)
- Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam (MFWP and CSKT 1991)
- Hungry Horse Dam Fisheries Implementation Plan (MFWP and CSKT 1993)
- Hungry Horse Dam fisheries mitigation 1992-93 biennial report (MFWP et al. 1994)
- 1993-94, 1995, and 1996 kokanee stocking and monitoring reports (Deleray et al. 1995, Hansen et al. 1996, Carty et al. 1997)
- Hungry Horse Mitigation: aquatic modeling of the selective withdrawal system at Hungry Horse Dam, Montana (Marotz et al. 1994)
- Model development to establish integrated operational rule curves for Hungry Horse and Libby Reservoirs, Montana (Marotz et al. 1996)
- Fish passage and habitat improvement in the upper Flathead Basin (Knotek et al. 1997)
- Fish and habitat monitoring in the upper Flathead Basin (Deleray et al. 1999),
- Seasonal distribution and movements of native and non-native fishes in the upper Flathead River system (Muhlfeld et al. 2000)
- Status Review for Westslope Cutthroat Trout in the United States (USFWS 1999)
- South Fork Flathead Watershed Westslope Cutthroat Trout Conservation Program (Grisak 2003)
- Hybridization Between Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*) and Rainbow Trout (*O. mykiss*): Distribution and Limiting Factors (Hitt 2002)

- Mitigation for the construction and operation of Libby Dam: Annual Report 2000 (Hoffman et al. 2002).
- Determination of Fishery Losses in the Flathead System Resulting From the Construction of Hungry Horse Dam (Zubik and Fraley 1986)
- Genetic Conservation of the Westslope Cutthroat Trout in the Upper Missouri River Drainage (Leary et al. 1998)

Information from these and other pertinent documents is summarized in the Master Plan.

1.7 Organization of the Chapters

This Master Plan contains the information necessary for the NPCC, program proponents and others to make informed decisions regarding the proposed Sekokini Springs Natural Rearing Facility program.

- Chapter 2 describes the need for the program
- Chapter 3 describes the proposed alternative and alternatives considered
- Chapter 4 contains a description of the current and planned production procedures and policies for the program
- Chapter 5 contains life history and other technical information for Flathead River westslope cutthroat trout
- Chapter 6 describes the factors limiting natural production of Flathead River westslope cutthroat trout
- Chapter 7 contains the risk management plan
- Chapter 8 contains the long-term research, monitoring and evaluation plan
- Chapter 9 contains the references used to prepare this document
- Chapter 10 contains a list of acronyms and a glossary
- Appendices provide technical support documents for the proposed program

Chapter 2. Need for the Project and Consistency with Existing Plans and Agreements

2.1 Need for Action

Principal tributaries of the mainstem Flathead River are the North Fork Flathead, Middle Fork Flathead, South Fork Flathead, Stillwater, Whitefish, and Swan Rivers (Figure 1). Hungry Horse Dam was completed in 1952 on the South Fork Flathead River 5.3 miles (8.5 km) above the confluence with the mainstem of the river and is operated for flood control and power production. Seventy-seven miles (124 km) of high quality, low gradient spawning and rearing habitat were lost due to inundation when Hungry Horse Reservoir filled (Zubik and Fraley 1986). The dam eliminated access to about 42 percent of the traditional spawning grounds in the South Fork for westslope cutthroat and bull trout. Reservoir fluctuations and unnatural dam discharges further eliminated wetland habitat and left reservoir and river shorelines barren of riparian vegetation.

In total, habitat degradation and fish passage barriers have eliminated nearly 60 percent of the habitat once available to native westslope cutthroat and bull trout in the Flathead watershed upstream of Flathead Lake (Fraley et al. 1989). The HHMP goal is to partially mitigate these habitat losses by protecting remaining habitat, and by restoring and reconnecting damaged habitats. In certain areas, there is a need to reestablish pure populations of WCT in the restored habitat.

As part of the Hungry Horse Dam mitigation program, the Sekokini Springs Natural Rearing Facility was designed as a multiphase project to promote the conservation of native, genetically pure WCT and to preclude potential listing under the ESA. The goal of the project is to preserve the genetic integrity and wild behavioral traits of WCT from the Flathead Subbasin and to aid in the restoration of WCT in their historic range within the Flathead Subbasin. Sekokini Springs offers an isolated water source to hold wild trout for inspection, prior to use in restoration activities with in the Flathead Drainage. Genetically pure WCT from donor populations within the Flathead Watershed will be reared to maturity in created natural rearing habitat at the site to preserve behavioral traits and provide gametes for creating and releasing F1 (first generation) progeny in selected waters where the species has been impacted or extirpated. The site will also conserve remnant populations that are threatened by nonnative species or environmental damage.

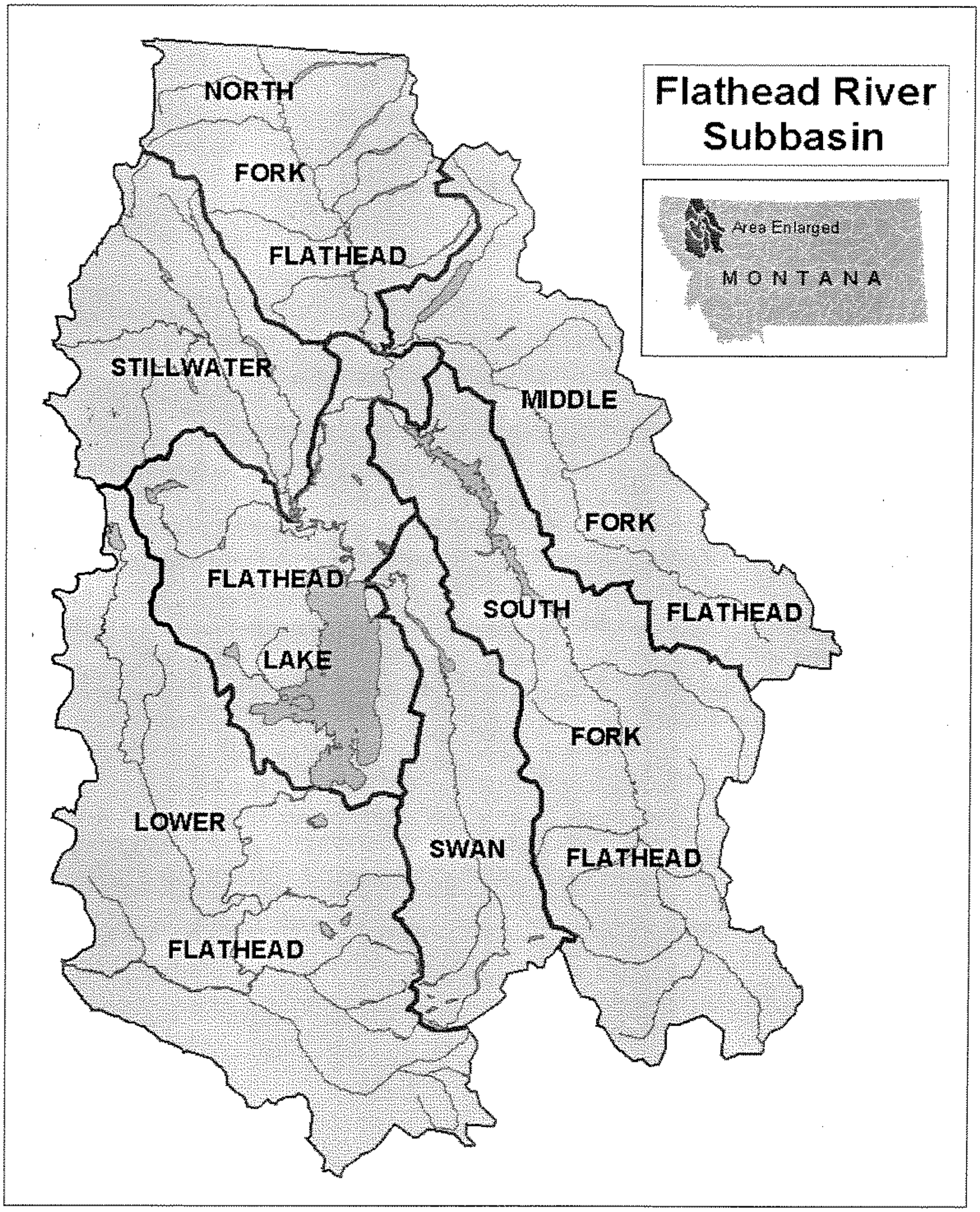


Figure 1. Location of the Flathead River Subbasin and Major Tributaries

2.1.1 Status of Westslope Cutthroat Trout in Montana

In Montana WCT populations occupy a small percentage of their historic range (MFWP and CSKT 2000; Liknes and Graham 1988; Shepard et al. 2003) primarily due to hybridization and competition with introduced salmonids (Allendorf and Leary 1988). The species has been listed as a Fish Species of Special Concern in Montana and a sensitive species by Region I of the USFS. WCT are designated as a category S2 Species of Special Concern in Montana, meaning that the species is imperiled because of rarity or because of other factors demonstrably making it very vulnerable to extinction throughout its range.

In 1997, WCT was petitioned for listing under the ESA. In 1998, the USFWS determined that listing was not warranted at the time of petitioning. In response to an October 2000 lawsuit filed by petitioners claiming the USFWS was arbitrary and capricious in its "not warranted for listing" decision, on March 31, 2002, a federal court ordered that the USFWS must re-evaluate its "not warranted" finding within 12 months, with specific consideration of the threat posed by hybridization (Grisak 2003). The re-evaluation of whether or not to list the WCT was published August 7, 2003 (FR 68 46989-47009). The reconsidered findings included a new status review for the species (Shepard et al. 2003) and that concluded the WCT is actually more abundant in its historic range than indicated in the 1999 status review. Genetically non-hybridized WCT currently occupy 9 percent of their historic range in Montana (Shepard et al. 2003). Therefore, the USFWS determined, again, that the WCT is not warranted for listing at this time.

Genetic testing performed on WCT in different basins within Montana included numerous samples from the Missouri River and Columbia basins. The University of Montana Genetics lab analyzed 177 samples, which demonstrated that the species is genetically diverse throughout its entire range. Testing revealed little genetic variation between WCT from the Missouri and Columbia basins. Leary et al. (1998) found that most (64.95 %) of the total amount of genetic variation was attributed to genetic differences among fish within samples, 33.8 % to differences among samples within basins, and only 1.3 % to genetic differences between samples from the Columbia and Missouri River basins. Dunning and Knudsen (2004) assessed the genetic relationships among westslope cutthroat trout in the upper Flathead River system and found that samples from the South Fork were significantly differentiated from those of the North and Middle Forks. Geneticists concluded that, from a conservation perspective, each stream population is unique.

The discrete nature of freshwater habitats may lower genetic variability within populations of fish and increase allele frequency divergence among drainages (Avise and Smith 1977; Gyllensten 1985). In addition, Rieman and Clayton (1997) have suggested that complex life histories and high levels of genetic divergence between drainages may be the evolutionary result of periodic disturbances such as drought and fire. Therefore, the degree of population subdivision is likely to have conservation implications for species (Leary et al. 1993; Knudsen et al. 2002; Spruell et al. 2003).

The distribution of genetic variation within a species is a function of the opposing forces of gene flow and genetic drift. Populations exchanging a greater number of migrants will have higher intrapopulation genetic diversity and reduced differentiation between populations (Allendorf and Phelps 1981). Leary et al. (1988) examined samples from across the range of *O. c. lewisi* and found one-third of the total amount of genetic variation detected at 32 protein loci to be attributable to differences among populations (F_{ST} = 0.33). Similarly, Taylor et al. (2003) examined 8 microsatellite loci in 36 *O. c. lewisi* populations in southeastern British Columbia and found extensive population subdivision (F_{ST} = 0.32). This pattern of population subdivision in WCT is consistent even at relatively small spatial scales. For example, Boyer (2006) found significant allele frequency divergence among 14 nonhybridized WCT populations in the North Fork Flathead River (F_{ST} = 0.08) and Dunning and Knudsen (2004) reported similar results in 13 populations from the Middle and South Forks of the Flathead River (F_{ST} = 0.14). These results demonstrate limited gene flow among populations and suggest that *O. c. lewisi* likely possess local adaptations at small spatial scales.

In summary, surveys of genetic variation within and among populations of *O. c. lewisi* indicate that any one population will not represent the range of allelic diversity contained within the evolutionary lineage of this taxon. Furthermore, highly divergent populations, or populations fixed at some loci for rare alleles, likely possess local adaptations necessary for long-term persistence (Allendorf and Leary 1988; Leary et al. 1995). These findings have important implications for future reintroduction efforts and management of *O. c. lewisi* at the landscape scale. Conservation of this species will, therefore, require the persistence of many populations throughout its geographic range in order to retain genetic diversity in *O. c. lewisi* (Allendorf and Leary 1988).

Local Adaptation

Local adaptation is a well-documented phenomenon and is important for long-term persistence and evolution of species (Servidio 2004; Broggi et al. 2005; Reginos and Cunningham 2005). Two conditions are necessary for the evolution of local adaptations: reproductive isolation (or low levels of gene flow) and variation in selection pressures (Wright 1951). Gene flow into a population can disrupt the effects of natural selection, thereby imposing a limit on local adaptation (Lenormand 2002). However, low amounts of gene flow are necessary to counteract the deleterious effects of inbreeding while still allowing for adaptive divergence among populations (Mills and Allendorf 1996).

Gene flow occurs at low levels among populations of WCT as evidenced by significant allele frequency divergence among spatially proximate populations and the presence of geographically rare alleles found at high frequency within local populations (Allendorf and Leary 1988). Additionally, WCT exhibit various life histories and inhabit dynamic environments that likely impose differing selection pressures on local populations. These conditions provide ample opportunity for the evolution of local adaptation in WCT.

Hybridization may disrupt local adaptations through intrinsic and extrinsic outbreeding depression. Intrinsic outbreeding depression results from genetic or chromosomal incompatibilities between the two hybridizing taxa and leads to the disruption of coadapted gene complexes. For example, epistatic interactions occur when the genotype at one locus controls the phenotypic expression of genotypes at other loci. Introgression of foreign alleles would be expected to disrupt these coadapted gene complexes resulting in reduced hybrid fitness (Dobzhansky 1970; Shields 1982). Evidence for intrinsic outbreeding depression has been demonstrated experimentally in crosses between RBT and WCT where hybrid fry exhibit reduced growth and survival (Leary et al. 1995). Similarly, Leberg (1993) demonstrated that offspring produced from mating genetically divergent stocks of mosquitofish (*Gambusia holbrooki*) had reduced growth rate and size compared to control groups.

Alternatively, reduced fitness may result from interactions with environmental factors (i.e., extrinsic outbreeding depression). Local adaptation is well documented in many plant and animal species and can be disrupted by hybridization, whereby locally adapted gene complexes are lost due to recombination (Templeton 1986). For example, Philipp and Whitt (1991) found that hybrids between northern largemouth bass (*Micropterus salmoides salmoides*) and Florida largemouth bass (*M. s. floridanus*) had reduced survival and growth when raised in Illinois ponds resulting from reduced tolerance to cold water temperatures. Additionally, Goldberg et al. (2005) documented decreased disease resistance in outbred strains of *M. salmoides*.

In general, interspecific hybridization between WCT and introduced RBT and YCT is of greater concern than intraspecific hybridization between divergent populations of WCT. Nevertheless, widespread translocations of WCT derived from a common broodstock (M012 or otherwise) can significantly alter the genetic structure of indigenous recipient populations. The greater the level of local adaptation, the more difficult it will be to replace a local population with transplants from non-local populations. From a conservation genetics perspective, the best strategy to minimize the negative effects of outbreeding depression and preserve locally adapted WCT populations is to transplant individuals directly descended from within the drainage of transfer.

Nonnative species or environmental damage in some locations threatens remnant populations of genetically pure WCT, creating a need to conserve the genetic integrity and diversity of the species. Hybridization poses an especially difficult set of issues in conservation biology and, currently, there is no formal policy for dealing with hybrids under the Endangered Species Act. A recent decision by the U. S. Fish and Wildlife Service (USFWS 2003) includes hybrids as WCT in the unit considered for listing. More specifically, populations with the arbitrary amount of 20% or less admixture from RBT or YCT and individuals with the morphological characteristics of WCT are to be considered WCT. These decisions are based on the assumption that "natural populations conforming morphologically to the scientific taxonomic description of WCT are presumed to express the behavioral, ecological, and life-history characteristics of WCT" (USFWS 2003). Furthermore, headwater populations of WCT are presumed to be secure from future introgression. Both the documented increase in hybridization in the Upper Flathead River in the last 20 years (Hitt et al. 2003) and the high rate of straying from hybridized populations is in sharp contrast to the dispersal behavior of WCT and indicates that remaining WCT populations are not secure from future introgression (Boyer 2006). Thus, current policy fails to preserve WCT by protecting sources of future introgression (Allendorf et al. 2004; Allendorf et al. 2005; Boyer 2006).

MFWP determined the current distribution of native WCT, nonnative fish species and known populations of genetically introgressed (hybrid) cutthroat trout (Dunning and Knudsen 2004; Leary 2002; Rumsey and Cavigli 2000; Sage 1993).

2.1.2 Status of Westslope Cutthroat Trout in the South Fork Flathead River

The distinct population structure of westslope cutthroat trout in the South Fork Flathead River has been mapped (Figures 2 and 3). The South Fork Flathead River upstream of Hungry Horse dam represents approximately half of the remaining interconnected habitat containing core populations in Montana and is considered a stronghold for nonhybridized WCT. This drainage contains a nearly native fish assemblage, with the exception of 21 mountain lakes in eight tributary drainages that were stocked prior to 1950 and now contain nonnative rainbow trout or genetically introgressed populations with nonnative rainbow and Yellowstone cutthroat trout. Handkerchief Lake supports a popular fishery for a transplanted, self-sustaining population of arctic grayling. Hybridization is expanding downstream from headwater lakes in the South Fork Flathead River drainage (Grisak 2003; EIS 2005).

Lake rehabilitation has been initiated as one way to remove this threat to pure native stocks. Although the State's captive brood stock is available to reestablish WCT in many areas, sources of genetically pure WCT from various wild donor populations within the Flathead Subbasin are desired to replace certain genetically distinct populations. Geneticists agreed, however, that if site-specific stocks were not available, stocking pure WCT from the Flathead Subbasin would have a better influence on downstream populations than would occur if non-native fish or hybrids are allowed to expand over time.

In February 2005, MFWP fisheries convened a focus group with personnel from the U of M genetic lab to discuss cutthroat genetics and restoring populations. The team agreed that, because no geographical pattern exists in the genetic samples, each stream represents a unique population. Even stocks from a nearby stream or closely associated on a genetic dendrogram cannot be considered an appropriate "within-drainage" stock. The most conservative genetic conservation approach, therefore, would be to use donor populations directly from the stream where a new population is being restored. However, these genetic differences have not been related to any local adaptations, growth or ability to survive. All of the identified stocks persist in diverse lentic and lotic habitat conditions, and wide range of stream orders and gradients. Also, all 21 headwater lakes in the South Fork Flathead that were proposed for treatment to remove nonnative fish had been previously stocked ("swamped") with Montana's captive broodstock (M012) westslope cutthroat trout in an attempt to overwhelm nonnative stocks.

Montana's M012 WCT stock was mainly founded using donor populations from the South Fork Flathead River, and a few donor populations from the Clark Fork River. This generic brood stock was developed for use in waters where we cannot recover stocks using fish from the same stream. The westslope cutthroat trout breeding plan calls for infusing wild genes from donor populations each decade to increase genetic diversity. M012s are currently the only source of westslope cutthroat trout that has a long history of sampling for genetic purity and fish pathogens. Geneticists, state biologists and hatchery managers agreed that the risk of outbreeding depression presented by the M012 stock is far less harmful to native populations than the existing populations of hybrids or nonnatives that are escaping downstream from headwater lakes or expanding upstream. Regardless, the long-term goal is to maintain the maximum genetic diversity and to avoid homogenizing the unique populations in the South Fork due to genetic outbreeding as populations are restored.

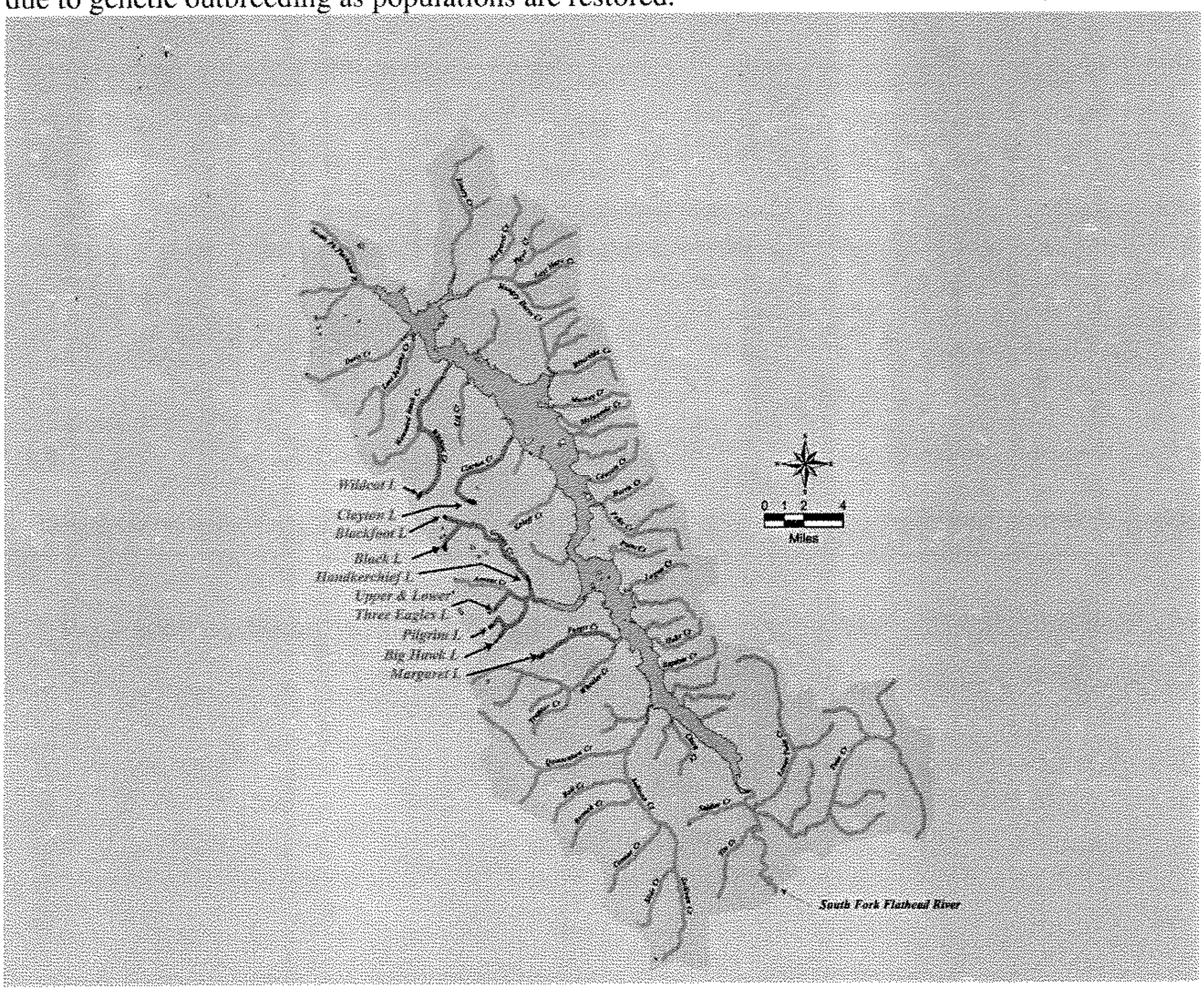


Figure 2. Current distribution of hybrid trout (red) and genetically pure westslope cutthroat trout (green) in lakes and tributaries flowing into Hungry Horse Reservoir, Montana.

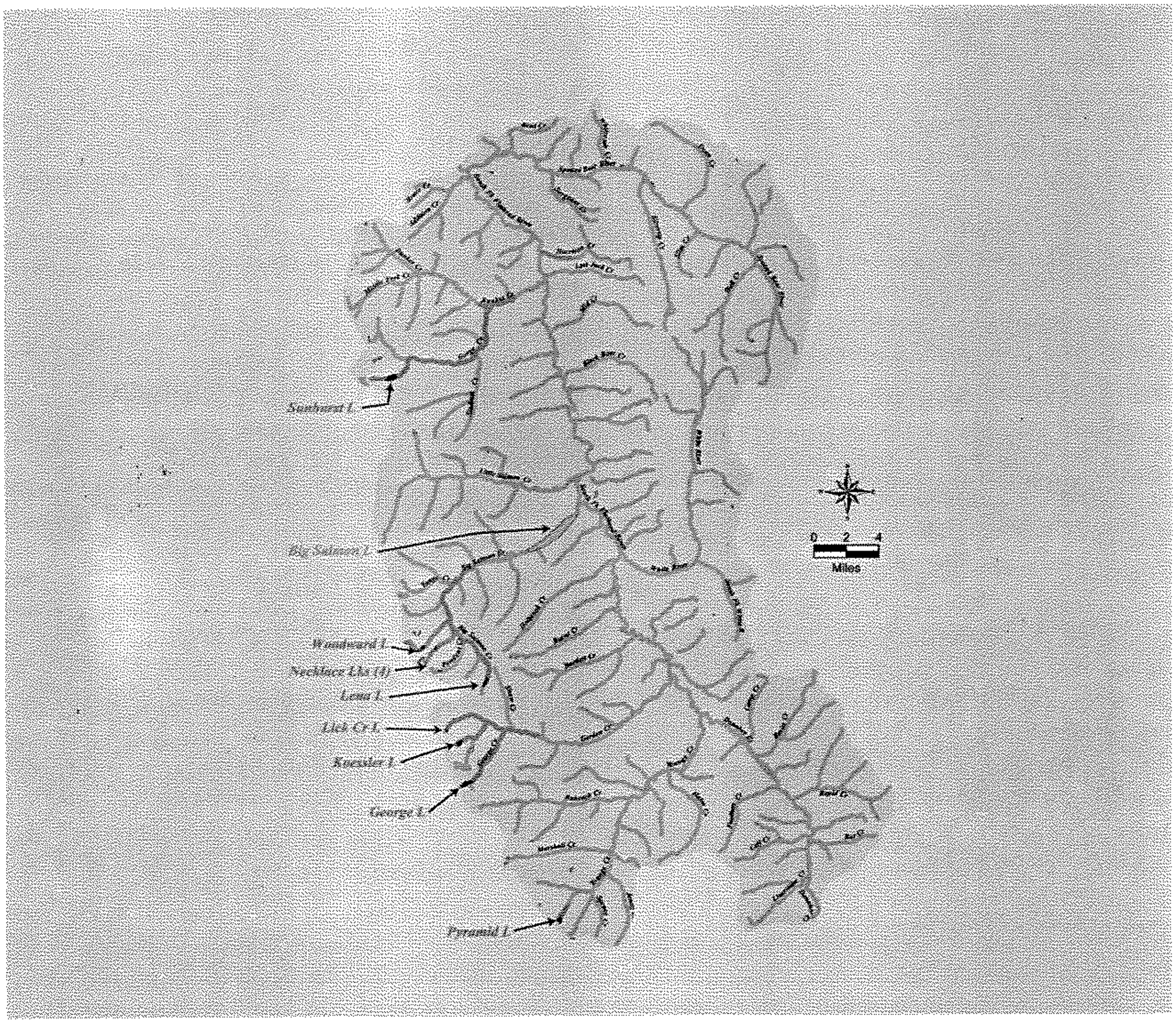


Figure 3. Current distribution of hybrid trout (red) and genetically pure westslope cutthroat trout (green) in the South Fork Flathead River headwaters.

Given the large number of waters in the Flathead Subbasin, MFWP does not have the hatchery facilities or funding required for developing within-drainage stocks in all locations. The team agreed that the M012 brood are genetically compatible in many locations, but not all. Genetic samples were analyzed to determine which populations were distinct from the M012 brood. Leary (2002) concluded: "*Since substantial genetic differences exist between the M012 fish and the westslope cutthroat trout populations in Big Salmon Lake, Gordon Creek, and Danaher Creek, and the supposed middle Wheeler Creek population, continued introduction of M012 fish into these drainages genetically does not represent the best conservation approach. This practice could potentially result in significant genetic changes in the downstream populations.*

Whether or not these changes will negatively affect the viability of the downstream populations is unknown, but the possibility that they may negatively impact viability exists. Thus, from a genetics perspective a less risky conservation strategy would be to use westslope cutthroat trout either collected directly, or descended from those collected directly, from each of these drainages as the source of fish for introductions within each respective drainage".

The Youngs Creek drainage is also genetically distinct, but contains two lakes (Devine and Marshall Lakes) that were previously stocked with M012s. Because Pyramid Lake can be accessed by trail in less than a day's hike and may need to be stocked repeatedly after treatment to maintain the recreational fishery, many members of the Technical Committee thought that M012s might be the most economical source for future plants. However, biologists have not compiled scientific evidence to support the contention that the Pyramid Lake needs to be stocked repeatedly, and the current population may be self-sustaining at the current harvest level. For this reason, a portion of the team thought that MFWP should develop a donor source from Youngs Creek to plant Pyramid Lake. Local stocks from the streams below the lakes could also be developed to supplement the existing M012s in Devine and Marshall Lakes.

Big Salmon Creek contains rainbow trout (from Necklace Lakes) that are escaping into Big Salmon Lake. Most agreed it would be prudent to treat this rainbow source as soon as possible to reduce the risk of further hybridization. MFWP does not currently have a within-drainage source to restore populations in the Big Salmon headwaters and plans to reestablish the lake populations using M012 cutthroat. In 2006, HHM plans to assess the genetic composition of fish populations in the drainage to identify potential donor sources. If Sekokini Springs can be renovated to a develop within-drainage stock, it may be possible to defer the treatment of headwater lakes until within-drainage stocks are available.

The team agreed that chemical treatment of lakes in the Gordon Creek drainage (George, Lick and Koessler lakes) could be delayed until MFWP can produce a within-drainage source from Gordon Creek to reestablish the lake populations and preserve the unique genetic stock throughout the drainage. Sekokini Springs would be used to replicate pure westslope cutthroat trout from Gordon Creek over the next decade.

The need to thoroughly screen prospective donor populations for genetic purity and fish pathogens emphasizes the importance of developing experimental facilities like Sekokini Springs. The Sekokini Springs facility would allow managers to develop up to four within-drainage stocks for restoring westslope cutthroat trout in the Flathead Subbasin. We acknowledge that Sekokini Springs does not have the capacity to rear individual genetic stocks indefinitely. Once the recipient waters have recovered, the stock would be replaced with fish for another restoration project. Limited resources will require that basin-wide recovery actions use a mixture of strategies, including stocking MO12 cutthroat and direct translocation of live fish where appropriate.

2.1.3 WCT status in the North and Middle Forks of the Flathead River drainage

Nonhybridized populations of WCT exist in the headwaters of the North and Middle Forks of the Flathead River (Hitt et al. 2003; Muhlfeld et al. 2004; Boyer 2006). These river systems contain resident, fluvial, and adfluvial WCT life history forms (Muhlfeld et al. 2004). Genetic inventories revealed that hybridized/introgressed populations in headwater lakes are threatening pure WCT populations (Figures 4 and 5).

The introduction of nonnative RBT and, to a lesser extent, YCT has resulted in widespread hybridization in the upper Flathead River drainage (Hitt et al. 2003; Boyer 2006). Unintentional introductions of RBT from the formerly privately owned Sekokini Springs Trout Farm likely occurred downstream of the North Fork and Middle Fork confluence. Consequently, sources of hybridization in these drainages primarily exist at lower elevations, resulting in an upstream vector of RBT invasion (Hitt et al. 2003; Boyer 2006). The spread of hybridization results from exceedingly high rates of straying from hybrids (Boyer 2006) and is not effectively limited by environmental factors such as stream temperature and gradient (Hitt et al. 2003). These results indicate that hybridization is a progressive upstream threat and, in the absence of physical barriers to dispersal, remaining populations of WCT are not secure from future introgression (Boyer 2006).

2.1.5 Biodiversity and Productivity

As part of the Flathead Subbasin Planning process, fisheries and land management authorities assessed the quality of habitat throughout the watershed. The group used the Quality Habitat Assessment model (QHA) and data on the historic and current distribution of WCT and genetic purity. WCT have declined within their historic range in the Flathead River and its tributaries due to habitat degradation, barriers to fish migrations and negative interactions with nonnative fish species. Remaining populations of genetically pure WCT tend to occur in areas that are cold, nutrient poor, and isolated from nonnative fish species by natural or man-caused barriers.

From a conservation perspective, the scope of the invasive species issue is of considerable scale. Introduced fishes have impacted nearly every major watershed in the United States (Courtenay et al. 1984) and the rate of introductions has increased dramatically in the last 50 years (Fuller et al. 1999). Once established, the introduced taxa are often impossible to remove from the environment and may become invasive, causing unpredicted effects on native biota.

Hybridization can be a significant consequence of species introductions where nonindigenous species hybridize with rare or endangered species, threatening their persistence (Rhymer and Simberloff 1996). The genomic extinction of rare taxa is often a direct result of human-caused

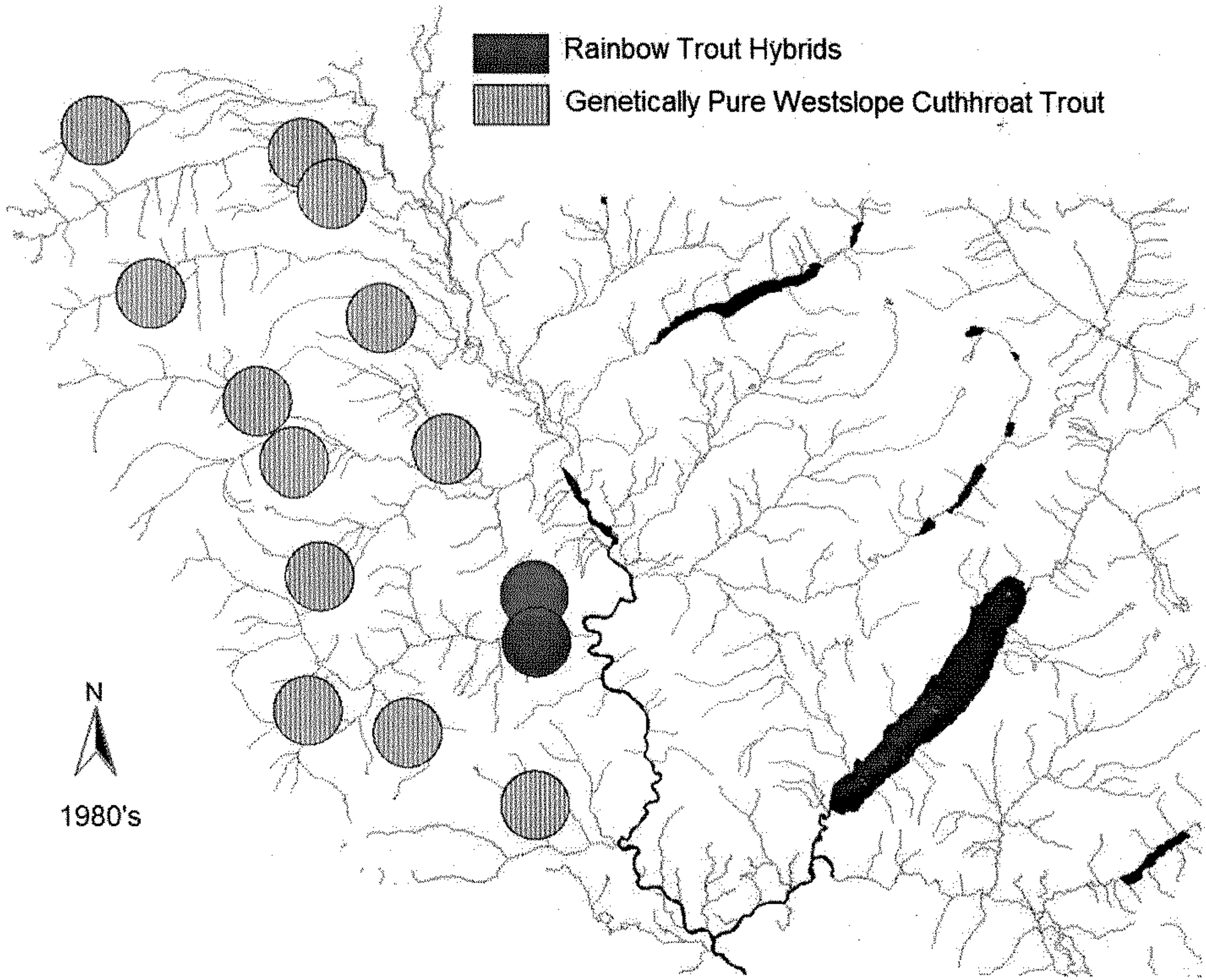


Figure 4. Rainbow x cutthroat hybrids were discovered in one North Fork Flathead River tributary during 1984 (from Huston 1988).

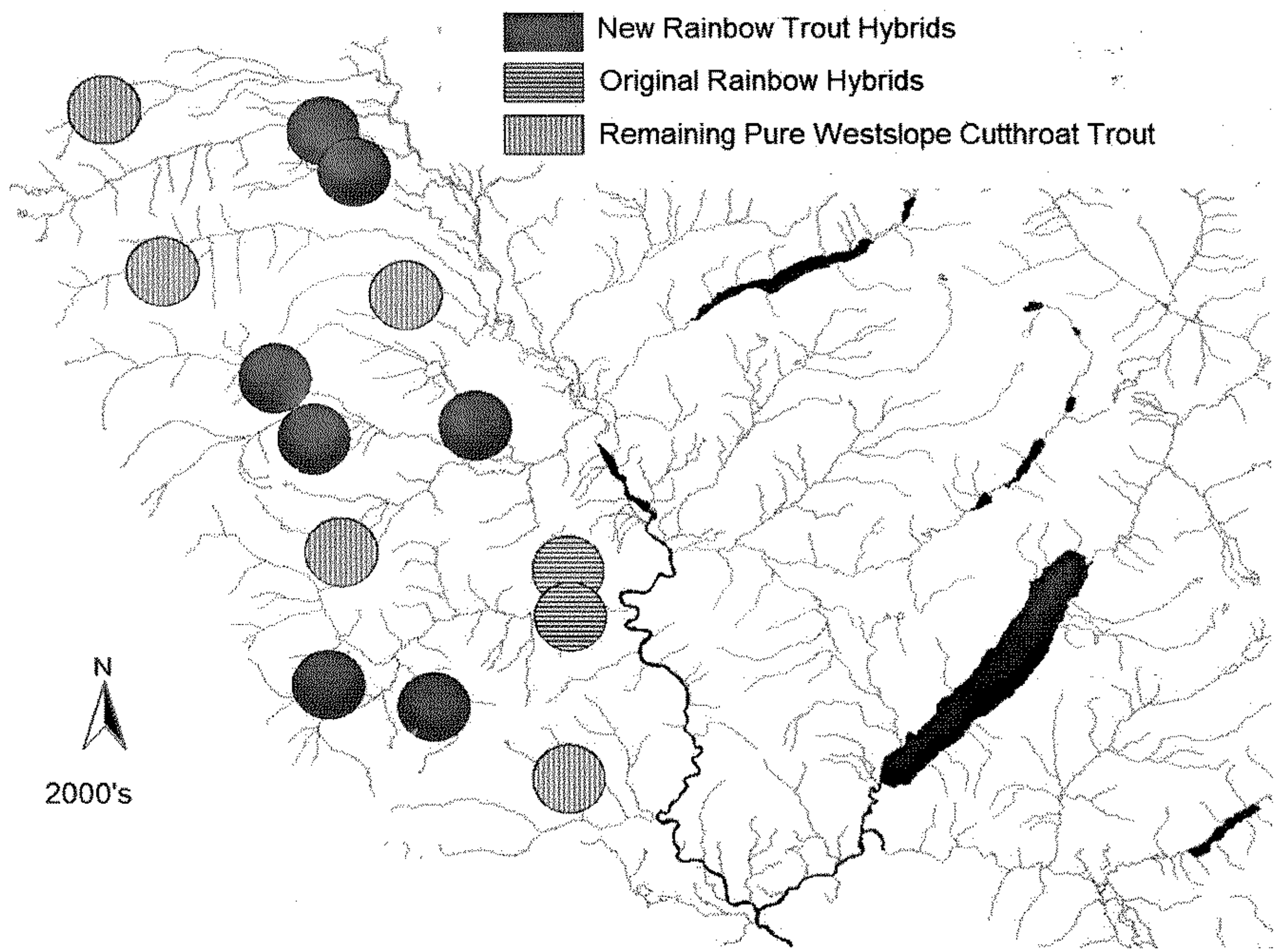


Figure 5. Expansion of hybrid trout populations in the North Fork Flathead River Montana (from Hitt 2003).

introduction of exotic species into novel environments (Allendorf et al. 2001). In North America, species introductions were found to be a factor in 68 percent of fish extinctions; hybridization, resulting from introduced species, was linked to 38 percent of extinctions (reviewed in Miller et al. 1989).

2.1.5 Residents of Montana Harvest Needs

In addition to the need for preservation of natural resources, including rivers and native species, sport fishing is vital to Montana's economy. Results from the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation indicate that anglers, 16 years old and older spent over $292 million on fishing expenses in Montana during 2001 (U.S. Department of Interior et al. 2003). Based on 1997 angling estimates, the recreational fishery is worth $4.65 million in direct expenditures to the local economy (MFWP and CSKT 2000). Nonresident anglers made over two-thirds of those expenditures. That spending, in turn, resulted in a total economic impact of an estimated $300 million, providing an estimated 5,800 Montana residents with jobs. Additionally these revenues provide necessary funds for educational programs that encourage an understanding of aquatic riparian ecosystems for all citizens (MFWP brochure). Although Montana's current angling policy for wild WCT is one of catch and release, anglers continue to fish for this species, contributing to the fishery-related economy in the form of equipment sales and rentals, fish licenses, etc.

In addition to economic and educational values that fisheries provide for Montana residents, fishing and hunting are part of the lifestyle of residents and are cultural activities that need to be preserved.

2.1.6 The Confederated Salish and Kootenai Tribe's Need

The southern half of Flathead Lake lies within the Flathead Reservation of the CSKT, a sovereign nation, composed of members from the Salish, Pend d'Oreille, Kalispel and Kootenai Indians. Native fish have been historically significant to the survival of the native people in the Flathead Nation, and are an integral part of their spiritual and cultural lives.

Although CSKT harvest would likely benefit from increased WCT production, the facility is outside of CSKT reservation borders and the Tribe would not participate in facility management. The CSKT is a collaborator on the Hungry Horse Mitigation Plan, and has been consulted during the initial planning of this project.

2.1.6.1 Fish to Fulfill Treaty Rights

The Hellgate Treaty guaranteed the Tribes the "exclusive right of taking fish in all streams running through or bordering" the Reservation. Several court decisions have affirmed the Tribes' jurisdiction over fisheries management in the portion of Flathead Lake that lies within Reservation boundaries.

2.2 Existing Plans, Agreements and Best Available Science

2.2.1 Goals and Objectives for the Hungry Horse Mitigation Program

The goal of the HHMP is to mitigate fisheries losses attributable to the construction and operation of Hungry Horse Dam. Council approved fisheries losses include 65,000 juvenile WCT annually, to be restored using a combination of habitat restoration, dam operation changes, harvest management and experimental hatchery techniques.

2.2.2 Consistency with Conservation Agreement for WCT

The goal for this project, the restoration of WCT in historic ranges of the Flathead River Subbasin using genetically pure indigenous stocks, is consistent with the Westslope Cutthroat Trout Conservation Agreement [1999, Memorandum of Understanding (MOU)], which states the following:

> *The management goal for westslope cutthroat trout in Montana is to ensure the long-term, self-sustaining persistence of the subspecies within each of the five major river drainages they historically inhabited in Montana (Clark Fork, Kootenai, Flathead, upper Missouri, and Saskatchewan), and to maintain the genetic diversity and life history strategies represented by the remaining local populations.*

A primary objective of the MOU is to protect all genetically pure (100 percent of tested individuals, through genetic analysis, show no evidence of hybridization or introgression with other species or subspecies) WCT populations to ensure the long-term persistence of the species within their native range. Within the Flathead River Subbasin, the native range of WCT consists of at least two geographically separate interconnected metapopulations, each occupying at least 50 miles (80.5 km) of connected habitat (MFWP 1999). The goal of the MOU is to ensure that population aggregates persist, with at least one of the local populations remaining viable for a period of more than 10 years (2-3 generations of fish). Once a population becomes viable, monitoring at a frequency of at least once every 10 years must be done to document its persistence. According to the Conservation Agreement, each tributary that supports WCT, regardless of length, is considered a population.

2.2.3 Consistency with Landscape Approach to Artificial Production

The Sekokini Springs facility will focus on rearing WCT in an environment that incorporates elements of the natural environment and that attempts to maintain wild behavioral traits while preserving the genetic integrity of various populations throughout the Flathead Subbasin. Several components of the facility reflect the theoretical concepts presented in a recent publication by Williams et al. (2003) entitled "Integrating artificial production with salmonid life history, genetic, and ecosystem diversity: a landscape perspective." The paper presents ways of managing artificial production activities from an ecosystem approach, integrating the needs of the target species during and after release from the production facility. The Sekokini facility is in line with the Landscape Approach (LA) in that its design and rearing environment is consistent with the surrounding ecosystem and its attributes. For example, rearing units have been designed as ponds, with natural substrate and cover in the littoral zone that mimics the natural environment. The site has stream environments upstream and downstream of the rearing ponds that will be restored to conditions in local reference streams. In addition, natural feed will be used to supplement diets, overhanging vegetation will mimic riparian shading habitat, and artesian spring sources provide an annual thermal regime that is similar to WCT streams in nature. These methods will attempt to minimize domestication, producing fish that are as genetically and ecologically similar to wild WCT as possible.

In line with recommendations of the LA, the Sekokini Springs natural rearing facility is not a traditional broodstock production facility in which fish are mass-produced, and the success of the facility will not be measured on the number of fish that are released. Only limited numbers of fish will be reared at the facility, each lot representing a unique genetic strain from wild donor populations throughout the Flathead Subbasin. Once fish (or eyed eggs) are stocked, in numbers not surpassing the natural carrying capacity of streams that are targeted for WCT recovery, MFWP intends to monitor the success of these stockings based upon the reproductive success of outplanted juveniles using microelemental signatures in scales and otoliths (Wells et al 2003; Muhlfeld et al 2005) or DNA microsatellite techniques (Boyer 2006). Detailed information on this research is presented in the RM&E plan (Chapter 8).

The Sekokini Springs facility will operate congruously with WCT restoration actions undertaken by the HHMP and fish populations replicated at the facility will be released into habitat historically occupied by WCT. These habitats include areas recovered through habitat and passage improvements or through the eradication of non-native species. Facility managers and the MFWP will continue to perform genetic studies on WCT in Flathead Subbasin streams to determine the most appropriate locations for recovery and enhancement of 100% pure WCT populations.

Chapter 3. Proposed Alternative and Other Alternatives

3.1 Criteria Used to Develop and Screen Alternatives

During initial project development, including the formation of goals and objectives for the WCT restoration program, co-managers, including members from MFWP, USFWS, and CSKT, determined that the following criteria are key ingredients to establishing a facility that will meet the needs of recovery efforts for the WCT:

- Facility must have access to an isolated groundwater source that varies in temperature over the year (to allow for fish pathogen-free incubation, rearing and otolith marking)
- Facility must have the option of natural-rearing to produce a parental generation that closely resembles naturally-reared counterparts; natural rearing includes substrate and cover that mimics the natural environment, natural thermal exposure and photoperiod, low density rearing and natural supplemental feed
- Facility must allow for educational opportunities that allow viewing of WCT in a natural setting

3.2 Alternatives

Three alternatives were considered for meeting the program needs:

- Use of the Washoe Park Trout Hatchery - State's MO12 captive broodstock
- Develop the Sekokini Springs site (Proposed Alternative)
- Use direct translocation of wild fish to reestablish new populations

3.2.1 Use of the Washoe Park Trout Hatchery - State's MO12 Captive Broodstock

A new hatchery building and public education center, consisting of an aquarium with a "living stream," has made the Washoe Hatchery (shown in Figures 6 and 7) one of the leading aquaculture educational facilities in the state. The hatchery has variable water temperatures from two spring water sources and from two wells with different water temperatures, and has the capability of mixing the water sources to get a wide range of temperatures. With the exception of a natural-rearing environment, the Washoe Park Trout Hatchery meets the screening criteria for the proposed program, although it is located over 200 miles (322 km) from the Flathead Subbasin. Although natural rearing techniques are not currently utilized at the existing facility, it is likely that facilities could be modified, if necessary, to meet screening objectives. The facility currently does not have the capacity to isolate unique genetic strains from specific donor populations in the Flathead Watershed.

The genetic composition of captive WCT broodstock (MO12) reared at the Washoe Park Trout Hatchery was established with the first spawn of captive WCT in 1983/84 (Grisak 2003). The parental stock included 4,600 genetically pure WCT collected from 12 streams in the South Fork Flathead and 2 tributary streams to the Clark Fork River. On-going genetic testing of the MO12 stock confirms that it is genetically variable and has no introgression. While genetic diversity is high, the MO12 stock had not been infused with wild gametes until 2003 and the existing strain had probably adapted somewhat to the hatchery environment.

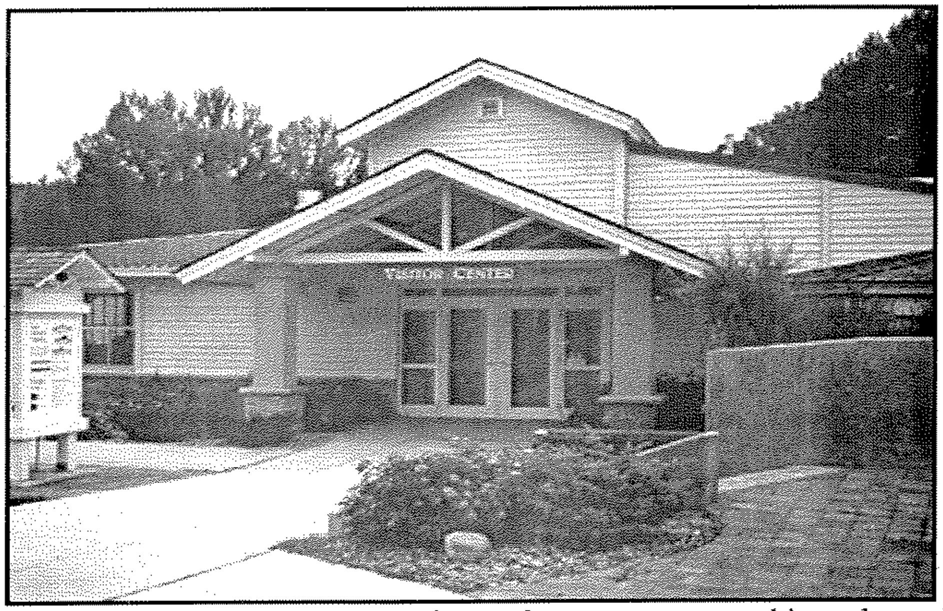


Figure 6. Washoe Park Trout Hatchery (photo source: www.bigstack.com).

Leary et al (1998) suggest that MO12 broodstock could be used to supplement populations throughout the state if wild gametes are introduced into the broodstock. Wild trout cannot be transported to this facility by state policy, so gametes or milt are the preferred options for infusion of new genetic material (M. Sweeney, MFWP, personal communication, March 4, 2003). In 2003, MFWP used Sekokini Springs as an isolation facility (separate water source) to collect milt from wild males in Quintonkon and Deep Creeks (South Fork Flathead River) for infusion into the Montana captive broodstock (MO12) held at Washoe Park Trout Hatchery. Although these source populations have a history of pathogen-free status through disease testing, all male fish were sacrificed for additional disease testing after milt was collected. This milt collection strategy occurred again in 2004 and will be continued intermittently throughout the life of the Sekokini Springs project, when co-managers determine there is a need for additional infusion of wild genes into the state's captive broodstock.

Although geneticists have designated the MO12 broodstock as suitable for use in WCT restoration throughout the state of Montana, especially in waters previously planted with MO12s, geneticists also recognize the value of replicating genetically distinct WCT populations to preserve diversity across the historic range (B. Marotz, MFWP, personal communication, March 5, 2003). As identified in the Conservation Agreement (MFWP 1999) each tributary that supports WCT regardless of length constitutes a population, and all genetically pure populations are to be protected. Since our long-term goal is to retain as many unique genetic stocks as possible, researchers must continue to develop within-drainage donor populations. Exclusive use of the MO12 stock will not achieve this objective.

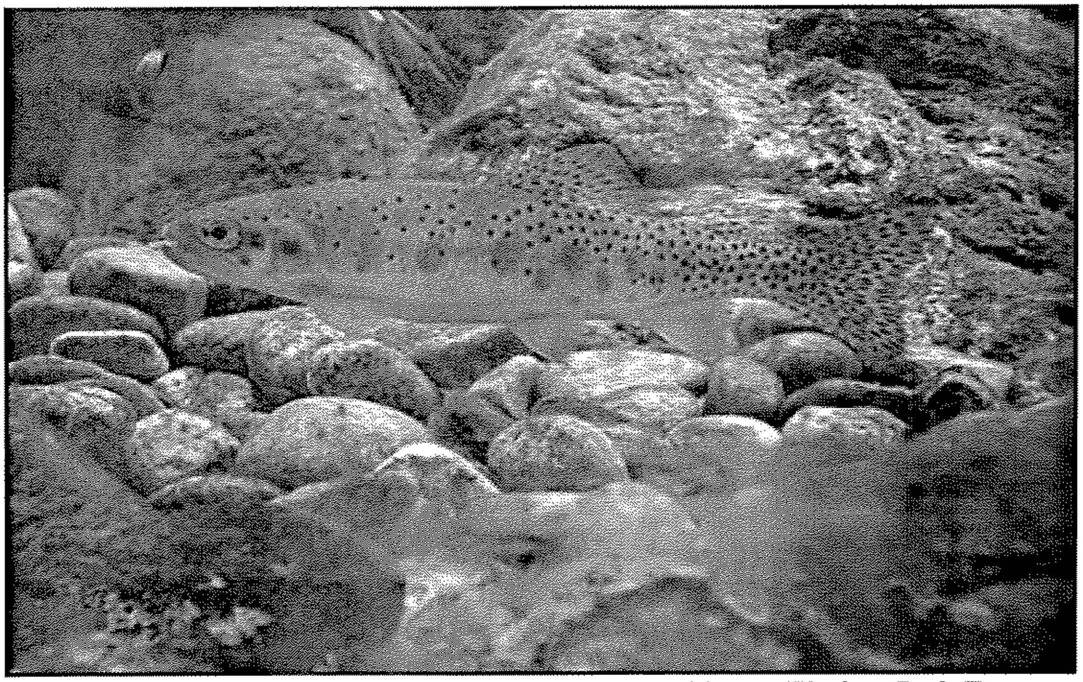


Figure 7. Westslope cutthroat trout in natural habitat at Washoe Park Trout Hatchery (photo source: www.bigstack.com).

3.2.2 Use Sekokini Springs site (Proposed Alternative)

The Sekokini Springs facility will be used to establish varying sources of genetic material to restore populations with different genetic characteristics than the MO12 stock. Donor fish and F1 juveniles will be reared to avoid domestication using a variety of techniques including: native substrate, floating cover, submerged structures, and natural feed supplementation. Sekokini Springs would allow researchers to carefully screen potential donor populations and replicate sufficient numbers to restore genetically compatible stocks in selected waters. The intent is to produce fish that are as similar to their wild counterparts as possible. The Sekokini Springs facility will be innovative by incorporating natural rearing environments and, to the extent possible, natural prey items, to maintain wild traits and enhance WCT populations by rearing multiple unique genetic populations over time.

3.2.3 Direct translocations

Direct translocation of fish from donor populations represents an important strategy for restoring westslope cutthroat trout populations where feasible. Restoration of westslope cutthroat trout is time sensitive because available donor populations are threatened by habitat loss or negative interactions with nonnative fish species. Direct translocation can be accomplished far sooner than could be achieved by renovating Sekokini Springs, which has been in the planning stage for eight years. The primary differences between direct translocations and experimental culture are 1) the number of fish available for restoring populations in new waters, 2) the duration of fish planting operations required to reestablish the new population and 3) the level of assurance that fish to be planted are genetically pure and free of pathogens.

Direct translocation may provide a sufficient quantity of fish to reestablish a stream population, or given enough years, to repopulate a rehabilitated lake. If however, a chemical treatment of a lake was not 100% successful in removing nonnative fish or hybrids (say 95% successful), the original population could rebound unless the water is treated a second time, or the population is immediately restored using pure cutthroat trout. Failure to detect fish after lakes are poisoned does not prove that no fish survived. Therefore, our strategy for reestablishing populations in treated lakes is to rapidly reestablish the population with pure westslope cutthroat trout to dominate any remaining hybrids (Grisak 2003; EIS 2005). MFWP plans to stock M012 westslope cutthroat trout to restore populations where appropriate or use replicated populations from wild donor sources. Artificial production techniques at Sekokini Springs would benefit cutthroat restoration by providing sufficient numbers of up to four within-drainage stocks to reestablish pure populations after nonnative fish species or hybrids are eliminated.

The potential for harming the donor population must be considered when removing wild fish for direct translocation or experimental culture. The number of fish available for removal is therefore limited. Sekokini Springs provides a unique opportunity to replicate a specific donor stock by collecting limited numbers of gametes or juveniles over several years and raising them to maturity in a controlled environment for spawning. Outdoor rearing in naturalized habitat at the facility was designed to maintain wild behavioral traits when donor fish are reared to maturity. A larger number of F1 progeny can be obtained, with less risk to wild donor populations, for restoring populations within the original drainage.

Holding donor fish in PVC tubes or live boxes in their original location while they are certified genetically pure and free of pathogens may be possible in easily accessible locations. However, this technique would be extremely difficult to apply in remote locations such as the Flathead River headwaters, where access is limited to primitive transportation methods (hiking, livestock etc.). MFWP has determined that it would be more practical to collect fish and hold them in an isolation facility such as Sekokini Springs for critical examination.

In Montana, live fish cannot be transported to government hatcheries and may only be held in experimental facilities. Sekokini Springs would be an experimental facility in western Montana for this purpose, providing a controlled environment to isolate wild fish considered for translocation while they examined for genetic purity and fish pathogens. It is extremely important that fisheries managers do not inadvertently move hybridized individuals to recipient waters.

3.3 Proposed Alternative

The proposed alternative will modify the existing hatchery facilities at the Sekokini Springs site for use as a WCT experimental rearing and isolation facility. This Master Plan proposes to restore habitat at Sekokini Springs by replacing abandoned ponds, culverts and many erosion channels with a single thread stream channel, rearing ponds and wetlands. This restored natural habitat would be used to rear westslope cutthroat trout to maintain wild behavioral traits. Modification of the existing facilities will make it possible to meet the goals of this project, including assisting with the conservation of WCT. The program goal for the Sekokini Springs

Natural Rearing Facility is to provide genetically pure WCT following the within-drainage approach for stocking of restored or newly reconnected habitats. Anticipated production numbers for the Sekokini Springs program are presented in Table 3-1. To assess the potential for the Sekokini Springs facility to successfully rear WCT, experimental trials were conducted with the MO12 stock of WCT in 1997-1999 and 2001. The result of experimental rearing of WCT has successfully demonstrated, over several seasons, that the water sources at Sekokini Springs are suitable for an experimental rearing program.

Table 3-1.Anticipated Production of Westslope Cutthroat Trout at Sekokini Springs by Life-stage.

Production Stage Criteria	Parameter	Number
Number of juveniles to collect per population	up to 1,000	
Juvenile survival to spawn	67%	
Fish health sampling	60	
Number of juveniles surviving to spawn	630	
Ratio of males to females	1:1	
Number of females	315	
% spawn at age 3	37%	115
% spawn at age 4	59%	185
% spawn at age 5	63%	200
Fecundity per female		
age 3	500	57,500
age 4	1,000	185,000
age 5	1,200	240,000
Number of green eggs produced	482,500	
Green to eyed egg survival	65%	
Total eyed egg production per population	313,625	
Eyed egg distribution by Stocking Program		
RSI's	25%	78,406
Artificial Redds	20%	62,725
Smolt Release	55%	172,494
Number of eyed eggs surviving to fry		
RSI's	60%	47,044
Artificial Redds	10%	6,273
Smolt or Imprint fingerling release program	75%	129,371
Number of fry surviving to 4 inch smolt for release	85%	109,965
Assumptions: Production for each population will occur over 3 years assuming fish will mature between age 3 and 5. Fecundity based on MO12 for age 3 and 4 (Sweeney 2003 pers. comm.), age 5 estimated. Ratio males to females based on MO12 (Sweeney 2003 pers. comm..). Age at maturity estimated based on combination of MO12 observations and wild population information (Gresswell 1988). Survival to spawn based on MO12 (Sweeney 2003 pers. comm.). Egg, fry and smolt survival based on MO12 (Sweeney 2003 pers. comm.).		

The Sekokini Springs site was chosen for the native species recovery program because the site offers a unique combination of spring water sources that are free of fish pathogens, land area for developing natural habitat for onsite restoration work, areas for incorporation of educational components, and existing infrastructure. Sekokini Springs can provide an isolation facility (separate effluent management) to hold wild fish until they can be tested for fish pathogens and genetic purity. The site contains four artesian springs of two distinct water temperatures that afford the opportunity for rearing native trout under varying water temperature regimes and for otolith marking.

Initially, one genetic strain of pure WCT will be collected, reared and spawned for reintroduction to habitats that are currently being restored and rehabilitated to remove non-native brook trout (Haskill Creek Project).

3.3.1 Sekokini Springs Site Investigations and Conceptual Design

Site Characteristics

The Sekokini Springs site is located in Flathead County about 10 miles (16.1 km) northeast of Columbia Falls, Montana (T. 31 N., R. 19 W., Sec. 17, Hungry Horse, Montana Quadrangle). The site is located on 10.446 acres of USFS managed land in the northern part of Flathead County between Bad Rock Canyon just east of Columbia Falls and the town of West Glacier. Access to the site is from the west by the North Fork and Blankenship Roads and from the east by State Highway 2 and Blankenship Road (Figure 8). State Highway 2 is the primary route to Glacier National Park with upwards of 1 million people per year traveling through the area to the park. An easement allows accessthrough an adjacent landowner's property for approximately 0.1 miles (0.15 km), and then enters the project property managed by the USFS.

This site has been extensively modified by past land use practices and private trout farm operations for over 40 years, as supported by a Department of Agriculture water right held for the site dated February 14, 1955. The previous owner constructed the existing system of ponds, outlet structures, piping and linear ditches to support trout farm operations. Existing site improvements consist of nine excavated earthen ponds, two sediment ponds, a hatchery building and associated infrastructure. Several of the existing ponds are presently drained, while others maintain a relatively stable water surface elevation controlled by wooden outlet structures.

Land Ownership

A Special-Use Permit has been issued to the MFWP for the purpose of "maintaining and operating a fish hatchery with the necessary approved buildings: including the residence contained within the hatchery building, water transmission lines, and internal road system." This permit will expire on December 31, 2007. MFWP has a recorded easement for the access road across the private property dated April 22, 1998 (Appendix A). The site included in the special use permit does not have frontage on the Flathead River. The current permit excludes the strip of land between the river and the site acreage. This permit will be revised to include the site usages as proposed in this Master Plan.

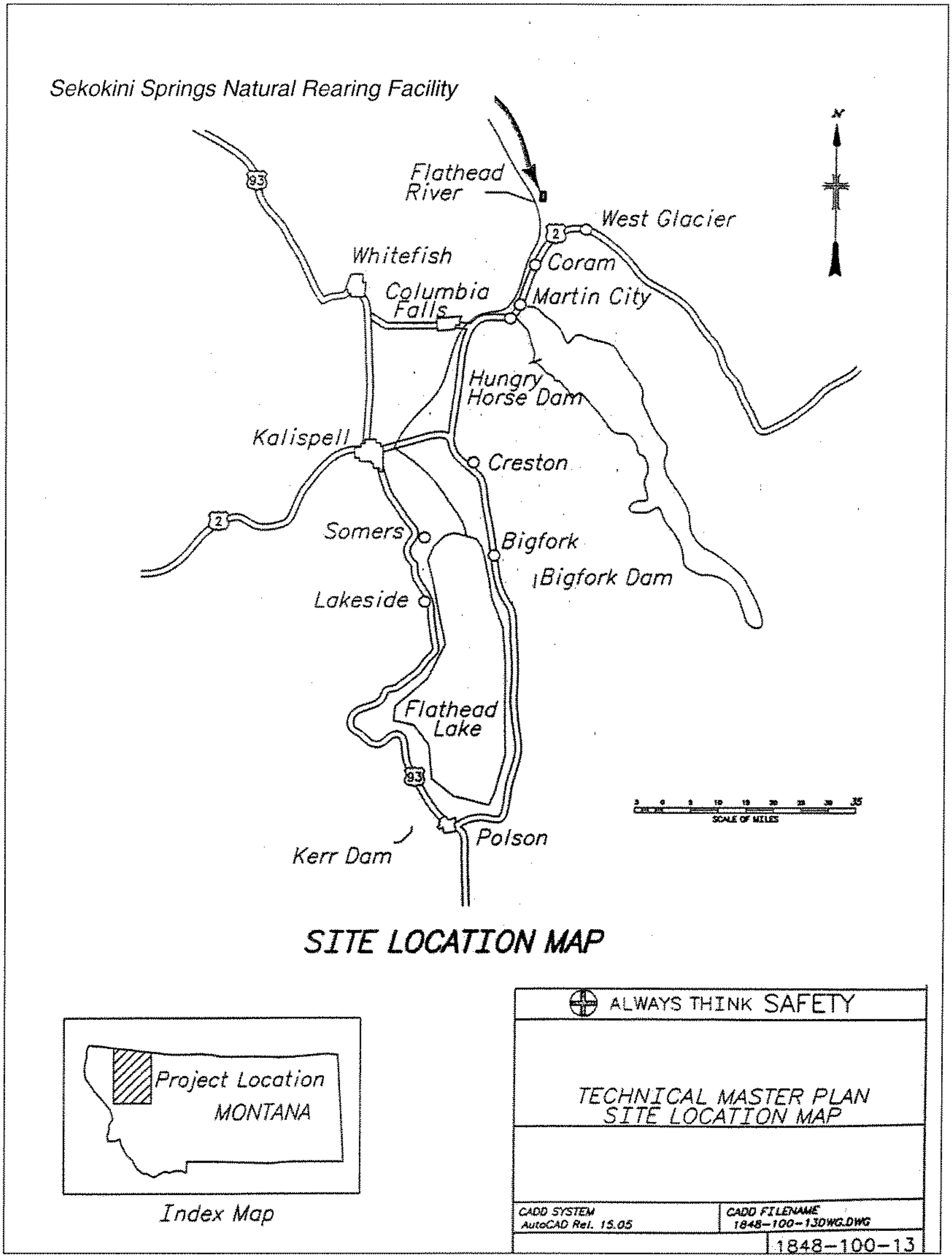


Figure 8. Sekokini Springs Site Location Map

River Designation

The Flathead River corridor is designated as a wild and scenic river under the 1968 federal Wild and Scenic Rivers Act. There are three levels of protection for rivers under the law. Rivers or sections of river may be designated as wild, scenic, or recreational areas. This particular reach of the river is protected as a recreational river corridor, which affords protection but still allows for site improvements to be made as long as there is minimal visual impact. An informal meeting was held with the USFS on the site and there were no objections voiced concerning visual impacts.

Groundwater Supply and Current Use Pattern

Four natural springs occur on the subject property. Springs 1, 2 and 3 are located near the existing hatchery building and the fourth spring is located in the northwest corner of the site (Figure 9A & 9B). Geologic studies conducted in support of the proposed project indicate that the general trend of both surface and groundwater flows appears to be from the kettle lakes (glacially formed, deep, spring fed lake) located northeast of the site at elevations 3,265 to 3,256 feet (ft), towards the Flathead River located along the southwest side of the subject property at 3,100 ft in elevation. The on-site springs daylight at an approximate elevation of 3,200 ft. Springs 1, 2 and 3 have been capped using pre-cast concrete collector boxes with valves and overflow pipes. Springs 1-3 have been captured into spring boxes, and plumbing from the springs to the hatchery building has been installed. A naturally eroded bypass channel carries the remainder of flows to the settling pond and then through pipes to erosion channels that lead to the Flathead River. Spring 4 will be utilized to feed the constructed creek reach (Profile 2) from a point where the stream channel heads down gradient to the river (Figure 9A).

The combined flows from springs 1-3 vary seasonally between 0.75 and approximately 6 cubic ft per second (cfs). Water flow for the proposed facilities from springs 2 and 3 are estimated at 4 cfs. Estimated flow from spring 4 ranges from .25 to 2.0 cfs. Once the facility is operational, flows from the springs will be routinely monitored.

Water quality samples taken on November 1, 2001, showed that all measured parameters are below levels known to be harmful to fish (Appendix B).

Water temperatures for the four springs that flow onto the site were measured between July 23, 1997 and March 31, 1998 (Appendix C). Springs 2, 3 and 4 showed seasonal fluctuation, with high temperatures in July/August and declining throughout the sampling period (Figure 10). Springs 1 and 4 demonstrated less seasonal fluctuation in temperature than springs 2 and 3, which follow an annual temperature regime similar to surface waters. Spring 1 was the most stable with only a 3 degree (F) fluctuation recorded. Spring 1 did show a warming trend from July into January that did not occur in the other spring sources (Figure 10).

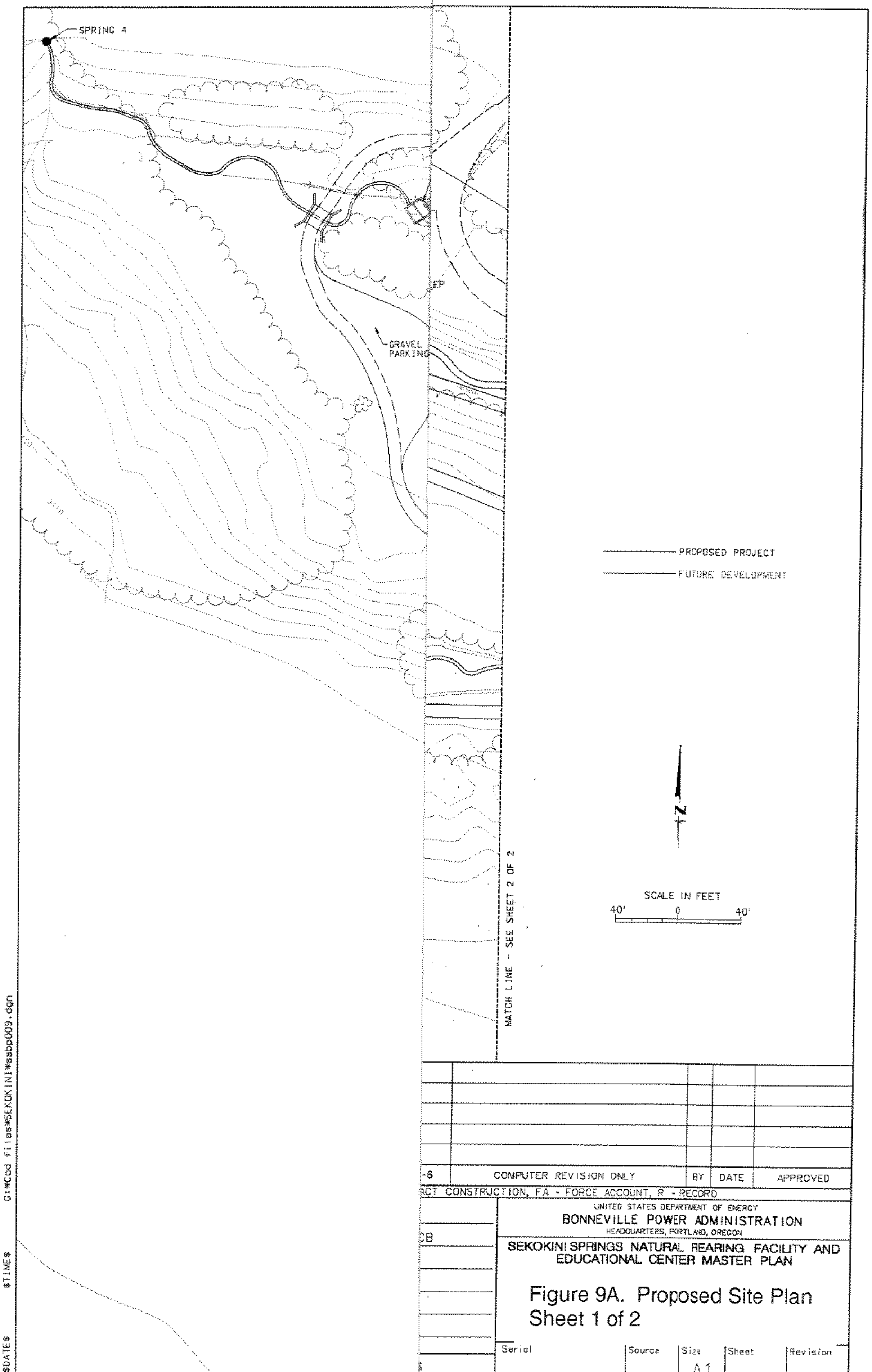
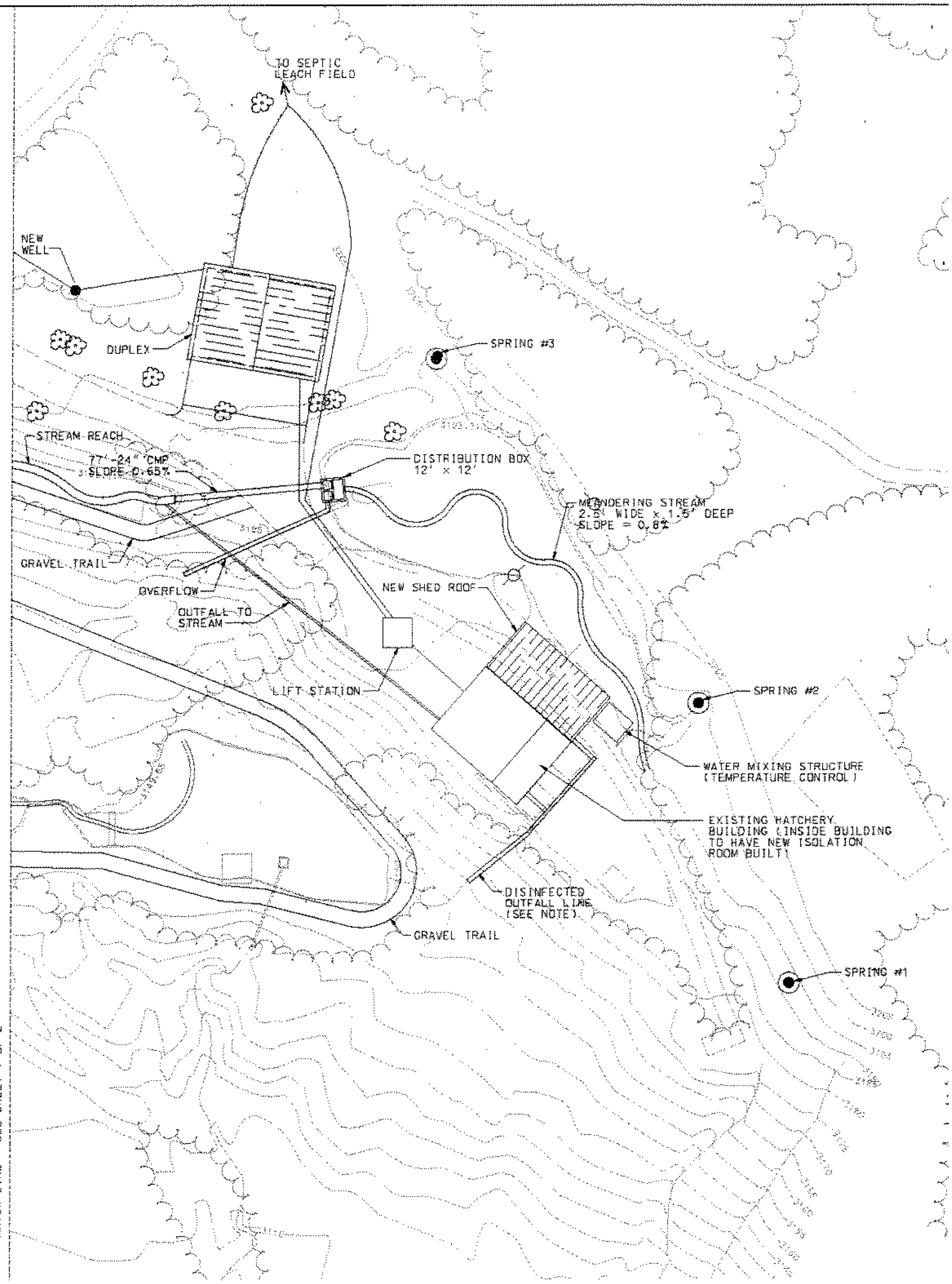


Figure 9A. Proposed Site Plan
Sheet 1 of 2



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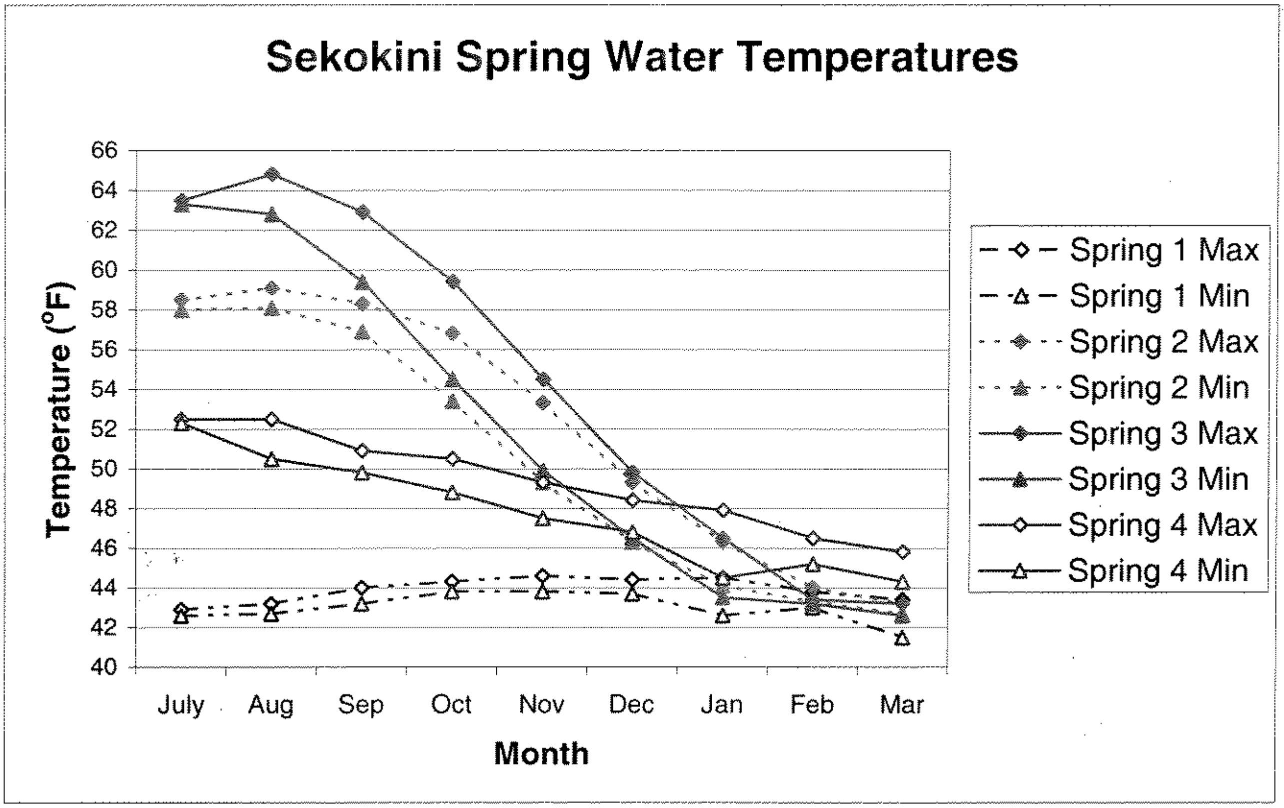


Figure 10. Sekokini Springs Maximum and Minimum Mean Daily Water Temperature Data by Month - taken between July 23, 1997 and March 31, 1998.

Water rights at Sekokini Springs are held by the Department of Agriculture, dated February 14, 1955.

Topographic and Geological Considerations

Glacial features such as moraine ridges, kettle lakes, and pothole topography are located northeast and upslope from the site. The site occurs at the southern end of a primarily flat, elongated river terrace about three-quarters of a mile long and one-half mile wide and is located approximately 80 to 100 ft above the present river level. The topography of the site consists of a series of river terraces (benches) that have been cut into older glacial debris. Slope angles range from 25 to 50 degrees. Generally the slopes are stable.

The geologic units exposed at the site consist of a thin veneer of forest soil covering a shallow thickness of alluvium overlying a great thickness of glacial debris. The soil is composed of silty fines, fine sand, and organic matter. The alluvium is composed of an unconsolidated, heterogeneous mixture of hard subrounded to rounded sand, gravel, and cobbles deposited by the river. The alluvium was derived in part from reworked glacial debris and in places may be up to 50 ft thick (Johns 1963). The glacial debris is composed of a heterogeneous mixture to crudely layered clay to silty, bouldery glacial till and thinly bedded, fine-grained lacustrine deposits. The thickness of the glacial debris could be several hundred feet at the site.

A BOR geologist conducted general site-specific geologic studies during the summer of 1999 and a short report was issued to MFWP and others. That report indicated general acceptability of the site for the proposed work and is attached in Appendix D. An additional geotechnical investigation on use of the site and evaluation of the global stability of the site and subsurface conditions in the vicinity of the planned structures was prepared by NTL Engineering and Geoscience (2003) and is attached in Appendix E. The NTL report suggested the use of impermeable liners in ponds and stream channels to prevent surface water infiltration that could increase saturation and downslope movement.

Vegetation

The subject property is situated at an elevation of approximately 3,200 ft. Habitat types found on the site include upland coniferous forest, forest openings, forested wetland and riparian/floodplain areas. A majority of the site has been previously disturbed by hatchery construction and maintenance activities. Disturbed areas have been colonized by many non-native, weedy species.

USFS botanists have conducted four separate site surveys to determine the potential extent of threatened, endangered and sensitive plant species. Site surveys were conducted on June 8, 1994, September 15, 1999, June 22, 2000 and July 10, 2002 (Waggy and Mantas 2002a; 2002b). No sensitive plant species were observed in areas proposed for project activities. However, three sensitive species, mountain moonwort (*Botrychium montanum*), poor sedge (*Carex paupercula*) and kidney-leaved violet (*Viola renifolia*), are known to occur within five miles of the subject property. Waggy and Mantas (2002a) noted that construction of the Sekokini Springs facility "may impact individuals and habitat but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species" regarding poor sedge and kidney-leaved violet. Determination of proposed action impacts to moonwort (*Botrychium*) species may require additional surveys due to the difficulty in surveying for this species group and the uncertainty of their habitat requirements (Waggy and Mantas 2002a). In addition to the sensitive plant surveys, a subsequent biological assessment was prepared for two federally-threatened plant species, water howellia (*Howellia aquatilis*) and Spalding's catchfly (*Silene spaldingii*). The USFS determined in their biological assessment that these species and their required habitat types are not present in the project area and that the proposed project would have no effect on the listed plant species or potential habitats (Waggy and Mantas 2002b).

A detailed noxious weed management plan was prepared by the USFS, with assistance from MFWP. Noxious weeds were present in large numbers in previously disturbed areas around the ponds and buildings. A noxious weed control program is being implemented according to the Flathead County Weed District in compliance with provisions of the USFS special use permit.

Wetland Characterization

Wetlands are unique ecological systems that are transitional between terrestrial and aquatic environments. Wetlands are defined as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Jurisdictional wetlands are subject to Section 404 of the Clean Water Act as administered by the U.S. Army Corps of Engineers.

Preliminary wetland determinations were made using vegetation, hydrology, and soils conditions observable at the time of the site visit (November 5th and 6th, 2002). Formal wetland delineation was not performed as part of the investigation. Previous site alterations with regard to utilization of spring flows and associated pond construction have resulted in the formation of wetland conditions throughout much of the site. All of the existing ponds and channels are characterized by wetland plant communities, although in some of the ponds hydrophytic (wetland) plant species are limited to the perimeter of the pond.

An additional wetland was noted in the central portion of the site, in an area that was relatively undisturbed by trout farm operations. This forested wetland is located between the proposed rearing ponds and the existing, high gradient overflow channel located just west of the hatchery building. Pools of standing water and saturated soils were noted within this area during the site investigation. This area is considered to have a higher potential for sensitive plant species than much of the rest of the site (Waggy and Mantas 2002a). The project was designed to minimize the amount of wetland impacts and potential impacts to sensitive plant species in this forested wetland.

Threatened and Endangered Species

The Sekokini Springs site is used at certain times by grizzly bears which are listed under the ESA. Bald eagles, currently listed as threatened under the ESA, also frequent the site. No ESA listed fish species occur at the site. A survey for ESA-listed plant species occurred in the summer of 2002 (Waggy and Mantas 2002b). Results of this survey indicate that no ESA-listed species or required habitat types are present in the project area and that the proposed project would have no effect on the listed plant species or potential habitats in the vicinity of the project.

3.3.2 Evaluation of Existing Facility

The existing facility consists of a pre-engineered metal building containing incubation and rearing units, nine natural earth trout ponds, and two sediment ponds. Several structures, including living quarters, one open-sided wood storage shed and four cement fish tanks were removed. The pond system has not been fully utilized in recent years. Several of the existing ponds are drained and terrestrial vegetation has become established in the area. Some ponds have partially filled with sediment and most pond structures have crude outlets using dam boards for water level control. All of these structures are in poor condition or have failed. The sediment ponds are fitted with concrete outlet controls that have screened culverts leading to erosion channels draining toward the Flathead River.

The existing steel building was built in 1979 and is 42 ft wide by 60 ft long with 16-foot walls and a concrete floor. Forty feet of the building is used for rearing fish and the remainder, formerly a living area, is being converted to office and storage space. The hatchery area has a 12-foot by 12-foot fiberglass overhead door and one standard steel door for walk through access. The building has been restored with new metal siding and roof, and the interior walls are insulated. This area has not been fully wired or plumbed. Outside of the main buildings, on each side of the overhead door, are two metal sheds with concrete floors attached to the main structure. Both sheds are 10 ft by 15 ft with a ceiling height of about 10 ft. The shed on the northeast corner is accessed from the main building and was used as an incubation room. The shed on the southeast corner is accessed by a steel walk through door on the outside and is used for storage.

The state hatchery division has donated fourteen fiberglass tanks and associated plumbing to replace the original four cement fish tanks that were pre-fabricated septic tanks with outlets on the bottom for drainage. The tanks were plumbed to allow mixing of the flow from spring sources 1, 2 and 3, so that water temperatures can be varied inside the hatchery building.

Upgrades of the existing facility are not complete. Additional improvements to electrical wiring and communications systems (phone and computer) must be made to accommodate the proposed WCT program.

3.3.3 Conceptual Design

The proposed alternative will modify existing structures and construct new facilities and rearing habitat for a conservation-based production program for genetically pure mainstem Flathead River WCT (Figure 9A and 9B). A number of site elements have been identified as "Future Development", these mainly include the stream-channel improvements that will create habitat within the water conveyance channels (Figure 9A&B highlighted in green). Two portions of the trail system and viewing windows are also included as "Future Development". Some of the proposed site improvements may be completed through separate efforts and funding. These "future" elements of the site development were selected as they are considered not essential to establishing fish rearing on-site, but are a component of the educational facilities that are necessary to meet the objectives of this project.

The proposed alternative will require:

- Construction of new incubation facilities in the existing hatchery building
- Modification and conversion of two existing earthen ponds into four donor fish and juvenile rearing ponds
- Construction of a concrete pad near the rearing ponds for a spawning area
- Construction of educational trails, and associated interpretive signage, that are compliant with the Americans with Disabilities Act (ADA)
- Construction of a trap/fish barrier at the outfall stream reach to prevent fish from escaping into the Flathead River or entering the facility from the river (approved by USFS - Wild and Scenic River designation, requiring Special Use Permit modification)
- Construction of an education facility, parking area and USFS approved vault privy
- Construction of a new duplex for personnel, including a drinking water supply well and septic field, sited per input from USFS
- Upgrade electrical service to site, if necessary
- Installation of a pre-fabricated storage facility
- Addition of a new shed roof extension

- Construction of a water control structure on an existing drained pond to restore wetland conditions
- Installation of a false attraction weir within the kettle for each brood pond to aid in collecting mature fish for spawning

Future Development components:

- Construction of an overlook on the lower stream at an oxbow bend
- Creation of two viewing structures, one on an upper stream riffle pool section and another at the two level viewing gallery
- Construction of a wetland area access path and viewing platform
- Construction of a natural-type stream habitat, beginning near the existing hatchery building and ending at the Flathead River; the alignment will minimize site disturbance and the stream bed will be lined with an impermeable material, as necessary, to prevent seepage

Facility Components

Spring Collectors and Associated Piping

The three spring collectors installed in April 2001 consist of 4-foot diameter precast concrete sections similar to sewage manholes. The average height of the structures is about 6 ft. They have a 4-inch thick concrete lid with a steel manhole cover and ring for access and cleanout. The spring water is collected through a series of 3/4 inch holes in the side of the structure. There are a total of about 80 holes to collect the spring flow. The outflow leaves through two pipes. The first is located about 18 inches off the floor and is 6-inches in diameter. The 6-inch diameter pipe supplies flow to the hatchery building and will be used intermittently. The second outlet is located about 4 ft off the floor of the structure and is 8-inches in diameter. This pipe is only about 15 ft in length on average and delivers all flow not required by the hatchery back to the existing channel created by the original spring.

The piping runs from three enclosed spring collectors to the hatchery building. All pipes are 6-inch diameter and buried at a depth of 4 ft to allow winter operations. The piping goes under the foundation of the building and comes up through the floor near the northeast corner of the building.

No aeration or degassing of the spring water is likely necessary based on the successful demonstration of rearing WCT at the Sekokini Spring site. Dissolved oxygen (DO) levels will be monitored to insure that natural aeration is occurring on-site.

Residence, Office Space, and Maintenance Buildings

A duplex residence is proposed for hatchery personnel. The duplex will be accessed from an existing road and positioned to overlook the hatchery building. The location was selected for security at the site and visual distance from the river corridor. The residence will be sided with rustic earth tones with asphalt shingles to blend with the natural surroundings. The home will be heated with propane and constructed to incorporate passive solar technology. A domestic well is proposed to serve potable water to the residence and the hatchery building. The well may also be piped to a spigot at the educational facility to provide a source of potable water. The placement of the septic system will be located at a sufficient distance from surface and ground waters.

Office space is available within the existing hatchery building. Up to four separate offices may be included at the site. The total number will depend on the extent and type of work going on in the hatchery building throughout the year. The hatchery building will include a bathroom. Septic service for the hatchery building will be via a lift station to the septic tank and leach field installed for the residence. A wet lab may be included if it is needed for research activities.

Maintenance and storage facilities will be required at the site. Current plans call for some storage at the hatchery building, potentially a prefabricated storage shed, and additional limited storage under one of the gazebos. All storage areas will be designed for bear-proof food storage. The maintenance portion of the building will likely be a pole type structure for storage of vehicles, lawn mowers, and bulky spare parts.

Incubation Facilities

Standard incubation trays that allow for egg lot segregation will be utilized. Eggs from up to four females may be held in one tray. These trays will be supplied by a combination of water from Springs 1 – 3, depending upon the temperature desired for incubation. Spring 1, the coldest spring with an average temperature around 43° F (6.1°C), will be used for otolith marking to aid in the identification of individuals for program Monitoring and Evaluation (M&E) activities, and to blend with springs 2 and 3 which are warmer. Eggs will be treated with formalin to prevent fungal infections. Discharge of incubation water will be piped out of the incubation room, and discharged subsurface. This procedure should effectively disinfect the incubation effluent and preclude the introduction of fish pathogens to surface water sources.

Indoor Rearing

Indoor rearing facilities will need to meet a number of requirements. Since wild fish will be brought on station to obtain gametes for the MO12 broodstock, or to replicate donor populations, an isolation area is needed to contain wild fish until disease testing is completed. Wild fish must remain physically separated form other fish held at the site, in a separate water source. The hatchery building will be divided and fitted with rearing tanks and discharge piping to an external percolation gallery. The remainder of the indoor rearing area will be utilized to hold mature fish for spawning or to rear F1 progeny prior to stocking.

Fourteen fiberglass tanks (2 x 14 feet) are available in the hatchery building. These are plumbed to allow mixing of the flow from spring sources 1, 2 and 3, so that water temperatures can be varied during rearing. These tanks will be utilized for fry rearing.

The circular tanks will be installed in the isolation area and in the "rearing" area of the hatchery building. Isolation tanks will be utilized to hold wild WCT that are collected from donor populations each year while they are inspected for fish pathogens and genetic purity, prior to translocation or to collect wild gametes. The effluent from these tanks being utilized in the isolation area will be discharged subsurface away from the created stream system and ponds to avoid any potential contamination of the other rearing areas. Indoor rearing tanks will be used to rear wild trout that have passed inspection and F1 progeny prior to outplanting.

Donor Fish Conditioning Ponds and Juvenile Rearing Pond

Four ponds are proposed for the Sekokini Springs facility. These ponds would be used to rear fish that have passed inspection in the isolation facility, to maturity for spawn collection. Each pond would contain different collection-year groups of the same genetic stock, or up to four separate genetic stocks.

The water supply for the rearing ponds would be provided from springs 1-3. Spring 4, the coldest of the springs, surfaces adjacent to the lower bench and flows southwest could be used to regulate summer water temperatures if needed. When Spring 4 is not needed to supplement ponds, flow will be directed to the lower stream reach. The flow available from the upper three springs averages about 3.0 cfs but varies seasonally by + or - 50 percent. It might be necessary at times to use up to 80 percent of the water from the upper springs to adequately supply the conditioning/rearing ponds.

Water supply for the ponds will be routed from the created stream channel (Profile 1) to a screened diversion structure. The diversion structure will prevent upstream or downstream movement of fish. Each pond will be fed independently through a piping array from the diversion structure. This water supply distribution will ensure that fish pathogen transmission will not occur between ponds from the water supply. The distribution system will also allow controlling the water supply to individual ponds when some are not being used at full capacity, or are off-line for cleaning or maintenance.

Ponds may be irregularly shaped and will have variable side slopes (3:1 and 4:1), or configured with some or all near vertical sides (helps to limit predation) created through the use of "ecology" blocks, possibly graded with a benched area to provide a variety of depths, mimicking natural environments. A concrete channel may be installed to run through the middle of the ponds to allow for more effective cleaning. Simulating a natural environment will encourage the development of "wild" behavioral traits similar to their naturally-reared counterparts. The goal of utilizing semi-natural rearing is to produce healthy natural-type donor fish, and juveniles that are as similar to wild fish as possible.

One component of semi-natural rearing is the use of natural substrate, consisting of gravels, rock or cobble that match the color of the substrate of streams to which the fish will be released. The Sekokini Springs facility will use rearing ponds that are lined with an impermeable layer, and substrate that mimics that of natal streams. The use of natural or artificial woody debris, floating and submerged logs and large rocks for cover will be incorporated. A portion of the pond, roughly 25%, will be deeper and devoid of obstacles. When it is required that fish be removed from the ponds, the water level will be drawn down forcing the fish into the deeper area where the lack of in-water structures will allow them to be netted or otherwise captured. Predation netting may be installed over the ponds if losses to aerial predators are excessive. In addition, other methods may be necessary to prevent predation by small mammals, such as river otters. Electric fencing may become necessary if otters become a problem.

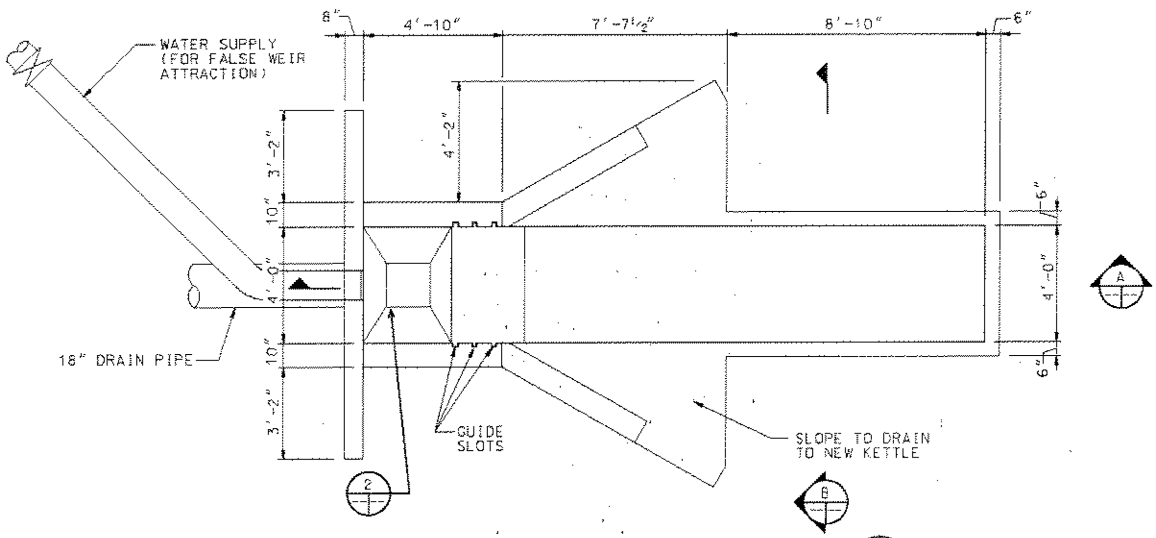
Because grizzly bears frequent the area, all food storage must be in sealed "bear-proof" containers.

Natural Feed Cultivation Pond

Commercial fish feed will likely be used for primary feeding, but it is desired to introduce other natural foods to simulate natural foraging behavior and provide natural nutritional sources. To provide supplemental feeding of fish with macroinvertebrates, an on-site food cultivation pond is proposed. Insects and macroinvertebrates can be seined and placed into ponds for natural food supplementation.

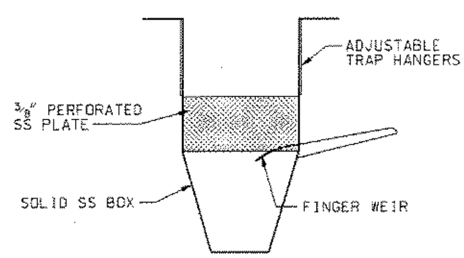
On-site Donor Fish Collection

Upon maturation, likely at ages 3-5, donor WCT will be ready for spawning. Migratory behavior will be stimulated by the use of a false attraction weir at the kettle for each pond (Figure 11). This weir will act to simulate a current and attract fish to a trap structure within the kettle. Kettles may also provide another method of collection. The water level in the ponds can be drawn down and fish collected in the kettle for sorting. Mature fish will be moved from the kettle to either temporary holding tanks located adjacent to the ponds where they will be held until spawning. A concrete pad will be constructed adjacent to the fishponds for use as a spawning area. A temporary shelter may be placed on the pad during spawning operations.



PLAN

SCALE IN FEET



NOTE:

DURING ADULT TRAPPING, KETTLE WILL HAVE TEMPORARY TRAPPING CAGE HUNG FROM TOP OF THE CONCRETE WALLS.

TEMPORARY ADULT TRAP

SCALE IN FEET

FISHPRO A DIVISION OF HDR		BONNEVILLE POWER ADMINISTRATION SEKOKINI SPRINGS NATURAL REARING FACILITY AND EDUCATIONAL CENTER MASTER PLAN KETTLE PLAN AND DETAIL	FIGURE 11
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Outfall Trap/Fish Barrier Structure

The trapping/barrier structure will be constructed with a concrete foundation and a structural steel frame. The trap will be located near the bottom of the proposed type-A channel leading from the bench to the Flathead River. The structure will be located behind a screen of trees so that it is not visible from the mainstem Flathead River to comply with the Wild and Scenic River Act requirements. The primary purpose of this structure is to provide a barrier to prevent the escape of WCT from Sekokini Springs into the Flathead River and to prevent potential upstream migration of adults of all species from the river into the facility. It is anticipated that nonnative rainbow trout and hybrids residing in the Flathead River will be attracted to the outflow from Sekokini Springs. The outflow channel downstream of the trap will be constructed of large native cobble substrate unsuitable for spawning.

The primary component of the structure will be a trap box and v-notch weir. The structure will occupy less than a 20-foot by 20-foot area straddling the constructed stream. The trap box will be large enough to hold fish safely for about 24 to 48 hours and would be checked regularly by MFWP personnel.

Stream Channels

Base stream channels will be constructed in Phase 1 of the project. The stream habitat enhancement features will be created in the "Future Development" phase. The stream channel design process employed the principles and practices of Rosgen's "Applied River Morphology," (1996). The Rosgen method emphasizes stream classification into eight categories from "A" to "G" based on channel slope, shape and patterns, with further sub-classifications of "1" to "6" determined by the size of materials making up the channel substrate. Once classification has been established, the Rosgen design method requires that the stream channel be compatible with local terrain and materials. Rosgen designs use naturally occurring sediments, stone, vegetation and woody debris for channel configuration, stream bank protection, hydraulic control and habitat creation. The stream channel areas will serve as educational displays with viewing windows to observe fish and aquatic habitat. These stream displays along with accompanying signage will educate the public in the importance of WCT and other native aquatic species, the value of the aquatic environment and the need to maintain various forms of habitat.

The stream channel types chosen for Sekokini Springs are "A and E" type and will occur in one of four Profiles. A and E stream types were chosen because of locally available materials for streambed composition (river cobbles and glacial till) and to mimic local streambed composition. Generally, A-type channels occur in steeper gradients and E-type channels occur in areas of broad meanders with shallow slopes. Additionally, sections of the stream channels are proposed to disconnect the rearing facility from the Flathead River to serve as a "no fish zone" where WCT escapees can be collected, and fish are prevented from entering the facility from the river.

- Profile One will contain A3 and E3 channels up to the control structure near the proposed donor/juvenile fishponds and the wetland demonstration area. This Profile will provide habitat for WCT that will function as educational exhibits, showing the species in a more natural setting. These fish will not be utilized as broodstock.

- Profile Two will contain A3 channels to the outfall/trap structure.

- Profile Three will contain a variety of E-type channels, and a short section of A3 as the stream channel moves down slope to a lower terrace.

- Profile Four will be the designated "no fish zone" where escapees from the rearing ponds will be collected. The channel type for Profile 4 will likely be an E-type channel.

The A-type channels on the steeper slopes (4% to 7.9%) will have a slight meandering pattern, and will have a step-pool configuration, with a pool occupying each step down. In a step-pool arrangement, pool length is proportional to pool width, based on the steepness of the channel slope. Each pool will have a weir-like rock structure on the downstream end that will control the water level in the pool. The rock structures will be placed on geotextile fabric to provide enhanced stability and to help control flow through the structures. The stream sections with high gradients will have resting pools. The resting pools have been designed to be twice the size of other pools in a section.

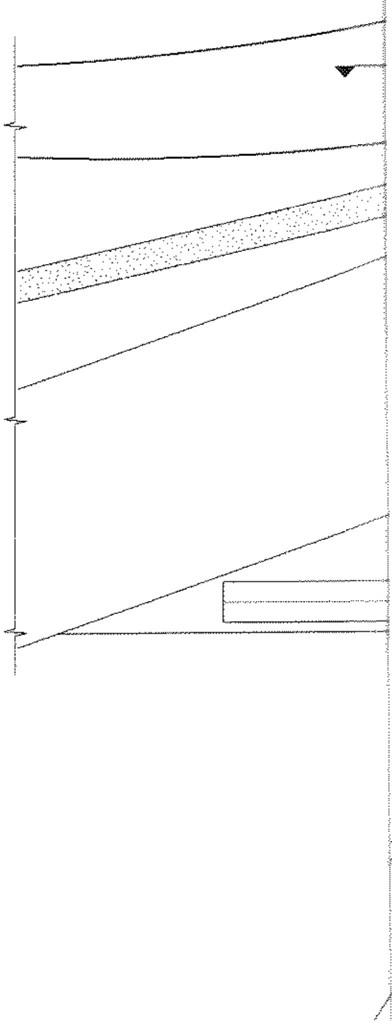
The E-type channels on the flatter slopes are typified by broad meanders, typically traversing a bed width of 15 to 20 ft on slopes from 0.6% to 1.4%. Water will move more slowly through these sections, and it may be desirable during final design to add fish habitat structures for diversity and aesthetics.

The substrate type of "3" for all fish bearing stream channels was chosen based on the geology report, composition of other streams in the area, and economics. The geology report listed river deposits and glacial till as the predominate materials at Sekokini Springs, so channels would have a high proportion of cobble sized material to other constituents and would mimic existing terrain. In the Rosgen method, degraded streams are restored to a state similar to others in the area. While the Sekokini Springs stream will be newly created, mimicking local streams will help to create a natural appearance and provide appropriate habitat. Finally, most of the streambed materials will have to be excavated elsewhere and hauled to the site. Costs from a local gravel company showed higher rates for sand and small gravels than for cobbles. Profile Four will be composed of substrate type "6", a silt/clay dominated area.

A fish trap will be installed on the outflow from the Sekokini facility to prevent fish from entering or leaving the site. The structure will be placed at the downstream end of Profile 2 approximately 120 ft from the margin of the Flathead River. Downstream of the trap structure discharge water will flow in a created naturalized outlet stream. Because of the Wild and Scenic Status and Recreational River Designation, the trap structure will be "hidden" from view and only native materials will be used to create a natural stream outlet to the river. The channel will be constructed of river rocks and other local materials and will be built during low water to a point at about the normal high water line during August/September. No in-water work is proposed for the outfall structure. A path 4 to 6 ft wide will be maintained along the constructed stream to allow foot access to the river confluence. After floods and other weather-related events, a certain amount of hand maintenance will likely be required at the mouth of the stream.

Viewing Windows

We propose two fish viewing windows, installed below the waterline, that would serve as educational tools for observation of WCT in a natural setting (Figures 9A &9B). To increase viewing opportunities, a plunge pool or some other high quality habitat will be located near the windows to encourage WCT use of the immediate areas. One window will be located along Profile One. The other window will be located at the confluence of Profiles Two and Three. Figure 12 depicts a conceptual plan for the viewing windows.



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UNITED STATES DEPARTMENT OF ENERGY
BONNEVILLE POWER ADMINISTRATION
HEADQUARTERS, PORTLAND, OREGON

OKINI SPRINGS NATURAL REARING FACILITY AND EDUCATIONAL CENTER MASTER PLAN

Figure 12. Fish Viewing Window

Source	Size	Sheet	Revision
	A1		

Wetlands and Wetland Viewing Platform

Existing ponds located to the west of the rearing/donor fish ponds will be maintained to serve as wetland demonstration and education areas. Removal of noxious weeds and functional enhancement will be necessary to rid the ponds of exotic species that have invaded the wetlands' perimeters. Water levels should be maintained within these areas to assure that wetland plant species are provided with adequate water for their survival.

A wetland-viewing platform is proposed adjacent to Profile 4 to allow viewing of an extensive skunk cabbage-dominated wetland and fringe wetlands. The platform would be accessed via a walkway that spans the fish escape barrier at the "no fish zone." This platform would serve as an additional educational component to enhance visitors' understanding of the local environment and to better understand the complexity and interaction of terrestrial and aquatic habitats.

To decrease costs associated with this structure, the local Boy Scouts have volunteered to provide materials and labor (B. Marotz, MFWP, personal communication, January 24, 2003).

Trails, Public Access and Educational Facilities

Public access is an important component of the facility and it is expected that nearly all areas of the site will be available to the public. The "footprint" for the proposed trail system and interpretive sites is shown in Figures 9A & B. The trails will follow existing access roads and berms along the constructed stream channels. The paths will be constructed of packed, crushed gravel or roadmix to allow all weather access. The high slope of most of the site will make handicapped access to all of the site difficult, however, a large portion of the facility will be made available to all the public in accordance with ADA and other pertinent regulations mentioned elsewhere in this Master Plan. The trails will begin at the upper bench area across the access road from the spring distribution box. The trail will follow the stream channel down slope to the lower bench where the ponds will be constructed. A viewing window is planned along this upper stream reach. An alternate trail connecting to an existing road/path will be constructed downstream of the viewing window. This trail will provide a gentler slope to allow ADA access to the lower area. A path and viewing platform extending towards the forested wetland area will also be constructed. Where the stream channel forms an oxbow and begins the decent down slope to the river another viewing window with two gazebo structures is planned. This area is anticipated to be a gathering place where interpretive talks can be conducted. These same trails will also provide maintenance access to the various stream sections. Interpretive signs and informational materials will be spaced around the site featuring various topics such as the WCT conservation program, lifecycle of fish, habitat restoration, water conservation, wetlands, geology, and the characteristics of streams.

Construction of the viewing windows and gazebos will occur in the "Future Development" phase, following the hatchery building and base stream channel construction. Prior to construction of the trail systems, specific plans will be made available to the USFS for review and comment. Designs for trails and handicapped facilities will be done under the supervision of or reviewed by accessibility specialists at BOR or by others on contract to BPA or MFWP.

An educational facility will be provided in a new building near the access road. This structure will face the access road and present an attractive, natural facade of stripped log construction with a cathedral ceiling. The building will be sized to accommodate approximately 75 people, with an open-sided design, and will be outfitted with picnic tables. Vault privies will be provided adjacent to the proposed educational facility. Other infrastructure will include parking, outdoor lighting around the building, and signage at the site and on the main access roads. All these improvements will conform to USFS guidelines.

Material Sources

The creation of the stream channel habitat will require a substantial amount of fill material. Fortunately, some adequate fill material will be generated on site and can be stockpiled in designated areas for later use or placed directly where required. These materials will be typical of that used for construction of embankments or roadbeds. The fill material should be free of organic debris. Top treatment can consist of agricultural loams as well as sands or silts. The existing sloughs will need to have all deposited sediments and organics removed prior to placement of fill materials. This organic material can be used to top-treat disturbed areas that will be stabilized with vegetation. River rock and bedding gravel required for construction of the streambed above the liner will be purchased from local suppliers.

3.3.4 Probable Opinion of Cost, Construction Schedule and Budgeting

An opinion of probable costs for construction of the facilities is shown in Table 3-2. Some repairs and remodeling to the hatchery building have already been accomplished by MFWP.

Construction Schedule

The proposed Sekokini Springs Natural Rearing Facility is to be funded and constructed over a period of 5 years. Modifications to existing structures were completed in 2001 and 2002. Annual construction efforts are described in Table 3-3. These efforts have been programmed based upon the priority of need and available funding for MFWP to successfully complete the mission of the project. The highest priority is to remodel the hatchery building, developing water conveyance channels and construct the ponds so that fish rearing can be initiated. The "Future Development" phase to create stream channel habitat and viewing windows will occur as funding is available. Should funding be accelerated, higher prioritized elements of the project may be completed sooner than scheduled.

Table 3-2. Initial Opinion of Probable Construction Costs.

Item	Notes	Phase 1	Future Development
Site Work		$60,500	
Utilities		$15,000	
Duplex Residence	1	$288,250	
Educational Facility	1	$41,000	
Vault Privies	2	$22,000	
Hatchery Modifications	1	$50,000	
Temperature Control / Mixing Structure	1	$20,000	
Base Channel Improvement, Profile "1"		$159,451	
Additional Channel, Profile "1" Development Budget			$92,600
Base Channel Improvement, Profile "2"		$58,305	
Additional Channel, Profile "2" Development Budget			$208,107
Base Channel Improvement, Profile "3"		$40,916	
Additional Channel, Profile "3" Development Budget			$49,873
Base Channel Improvement, Profile "4"		$4,421	
Additional Channel, Profile "4" Development Budget			$5,672
Larger Ponds		$200,000	
Smaller Ponds		$130,000	
Piping		$250,000	
Total Construction Costs		$1,339,843	$356,252
Contingency (25%)		$334,961	$89,063
Total Construction with Contingency		**$1,674,804**	**$445,315**
Design and permitting @ 15%		$251,221	$66,797
Construction Management @ 7%		$117,236	$31,172
Subtotal Additional Costs		**$368,457**	**$97,969**
Project Cost Phase 1		**$2,043,261**	
Project Cost Future Development			**$543,284**

Notes:
1 - Cost figure provided by Montana Wildlife & Parks Department of Fish
2 - Cost figure provided by US Forest Service

Table 3-3. Construction Schedule for Proposed Sekokini Springs Natural Rearing Facility

Year	Construction Action	Details of Action	Action Function	Completed
2007	Hatchery building modifications	• Add extended roof over driveway • Finish office walls • insulate exterior walls • repair internal walls • rewire offices • equip with phone, fax and intercom • install wet lab, kitchen and lavatory (pending approval of septic lift station, tank and drainfield)	• improvements will allow use of facility during construction • overall, improvements are necessary to house hatchery manager and personnel	Internal and External wall work complete
2007	Modify two existing ponds to create four rearing ponds	• drainage designed to allow the surface elevation at each of four ponds to be controlled independently • four ponds will be completed and stabilized with native vegetation • the stream channel will be equipped with a bi-directional fish barrier to prevent WCT from escaping and Flathead River fish from entering ponds	• allows for rearing of unique genetic stocks of pure WCT • allows for rearing of donor stocks and juveniles to be planted for WCT recovery	
2007	Create water source for ponds and stabilize streambed at former head pond	• construct the base channels for spring water supply stabilized within existing meander pattern	• provide water to the four rearing ponds • stabilization necessary to prevent blow outs and sedimentation	
2007	Restore linear ponds	• Under dry conditions, linear ponds extending down slope from the upper bench would be restored to stream channels • Create Rosgen type A channel with cascade • Channel would continue down slope to connect to the four ponds • Stabilize bank along stream course and create fish viewing window	• Provides natural-looking pond connection • Allows convenient site for fish-viewing window #1	

2007	Develop hatchery building outflow pipe to stream channel and separate isolated discharge to external subsurface infiltration gallery	• Outflow pipe will connected to the stream channel to utilize overflow or water from pathogen free rearing • Disposal of waste water from isolation incubation or rearing	• Will allow outfall of water from indoor rearing to be utilized in the rearing ponds • Will reduce the potential of introduction of fish pathogens from wild sources	
2008	Improve existing trail	• The existing trail provides construction access to the channel. Trail will be improved incrementally as the channel is being restored	• Allows for access to the lower bench and ponds	
2008	Construct storage facility		• Provides secure outdoor storage for maintenance equipment, etc.	
2008	Upgrade electrical service	• To the hatchery building	• Allows for year-round use	
2009	Construct residence	• Designed to blend with the scenery • Will include latest energy-saving technology	• Allows for on-site personnel year-round	
2009	Upgrade electrical service	• To the residence, if necessary	• Prepares for occupancy by Hatchery Manager and Facility Curator	
2009	Construction of waste septic disposal system		• For the office and proposed hatchery residence(s)	
2009	Drill a domestic well and install water piping	• Near proposed residence	• For the office and proposed hatchery residence	
Future Development				
2010	Install initial interpretive exhibits	• Featuring water conservation, native fish recovery, on-site wildlife and botanical features	• Allows for educational opportunities	
2010	Complete educational facility	• Develop parking area, restrooms and classroom	• Enhances educational opportunities • Allows for site tours by school groups and the public	

2010	Restore non-hatchery streams	• Create Rosgen stream channels in waters downstream of the rearing ponds • Creation of new channels within existing linear ponds on the bench • Creation of a new channel to the Flathead River	• Creation of Rosgen type E stream course with a type A cascade • Protects wetlands and natural appearance • Allows for natural-looking stream channel surrounding rearing ponds to Flathead River and restores hydrologic connection to river	
2010	Creation of fish-viewing area #2 and gazebos	• Viewing area will have two levels to allow viewing fish from above and below the water level	• Allows for educational opportunities and fish viewing	
2010	Creation of a type E channel to connect to type A that flows into the Flathead River	• Constructed inside the existing linear ponds in preparation for connection with the proposed type A Rosgen channel to the Flathead River	• Protects /expands existing wetlands • Captures water below ponds for connection to water from Spring 4	
2010	Creation of the type A Rosgen channel to connect to the Flathead River	• Constructed from the last of the existing type E channel down slope to connect to the Flathead River • This section of the channel will include the fish barrier/trapping facility	• Type A channel accommodates steep terrain • Fish trap would prevent fish escapes from the facility and monitor fish accessing the effluent stream from the river	
2011	Repair erosion gullies	• Rehabilitate gullies created by past blowouts of ponds	• Reduces chances of erosion and sedimentation to newly constructed streams	
2011	Finalize improvements to trails	• Add educational signage and exhibits • Allow wheelchair access and educational opportunities	• To allow for foot access to the streams and ponds • To comply with ADA regulations	
2007-2011	Revegetate impacted areas with native vegetation	• planted with native riparian vegetation	• allows for a more natural landscape and lower maintenance	
2010-2011	Complete interpretive exhibits	• Featuring water conservation, native fish recovery, on-site wildlife and botanical features	• Allows for educational opportunities	

4.1 Program Components

The proposed Sekokini Springs facility will incorporate two conservation strategies into the program. The first component is the collection of juveniles from donor streams for production of an F1 population to be outplanted into restoration streams and lakes. The second component is the collection of milt from wild spawners for infusion of genetic material into the state's existing WCT captive broodstock (MO12 stock). These components are described below.

Juvenile Donor Stock Collection- Creation of F1 Generation from Local Stock Conservation Strategy

There are two options for collection of a donor stock at the Sekokini Springs facility. The preferred option is to collect juvenile WCT from local streams that have been genetically tested and determined to contain WCT that are 100 percent genetically pure. The donor populations would also be required to have a history of fish pathogen testing, and a negative record for pathogens of concern. The alternate option is to collect gametes from wild spawners.

If juvenile collection does not allow for the appropriate number of donor fish required for the program, the alternative option, collecting gametes from wild spawners, may be considered. Because the program necessitates collection every year and access issues make gamete collection difficult, juvenile collection is preferred for the establishment of a within-drainage stock. The pros and cons of collecting juveniles vs. gametes are listed in Table 4-1.

Table 4-1. Donor Stock Collection: Juvenile vs. Gamete Collection Strategies

Life Stage at Collection	Pros	Cons
Gametes from spawning adults	• State code prohibits transfer of fish to hatcheries (gametes only for genetic infusion) • Adults can be collected throughout spawning run, increasing genetic diversity	• Only available in uppermost reaches • Access issues (snow) during spawning period • May impact donor population due to handling stress and harrassment • May not be efficient collection method since WCT get ripe at different periods • Longer time frame to obtain F1 generation
Juveniles	• May be reared to maturity at Sekokini Springs and cross fertilized to increase genetic diversity • Sekokini Springs is an experimental facility, not a state hatchery, so wild juveniles can be imported for rearing • Opportunity to cull a subset of desired individuals • Access is not an issue since wild juveniles can be collected all summer • Less impact to donor population from collection actions	• More costly to rear juveniles to maturity • Potential for domestication – won't affect genotype, but may affect wild behavioral traits.

Milt Collection - Infusion of New Material into MO12 Stock Conservation Strategy

The Sekokini Springs facility will be used to hold wild male spawners for milt collection for infusion into the state's MO12 captive broodstock. The infusion of new genetic material into the captive broodstock is considered to be an important component of WCT conservation to increase the genetic diversity of the state's stock (Leary et al. 1997, 1998; Grisak 2003). Because the transfer of live fish to hatcheries is prohibited in the state of Montana, milt is the best option for infusion. Milt is preferred for this activity since it is the easiest to obtain and the collection is less disruptive to wild runs. The collection of gametes is a difficult task, as shown in Table 4-1. This activity will take place only when genetic infusion is deemed necessary by managers of the MO12 stock, and not on an annual basis.

Infusion of new genetic material into the MO12 stock, although part of this Master Plan, is separate from establishing the within-drainage stocks. The Sekokini Springs facility was utilized in 2003 to infuse wild gametes into the MO12 broodstock for the first time since the stock was established in 1983 – 1984.

4.2 Rationale for Choosing Donor Stocks

The recommendations of the WCT Technical Committee would be followed for conservation of WCT into presently unoccupied historic habitats, or restored habitat. The following is an excerpt from Leary et al. (1998):

> *Based on the assessment of genetic variation by Leary et al. (1997), the WCT Committee suggests that any genetically pure source of WCT could be used* (for restoration), *as long as it is capable of providing at least 50 fish, ideally at least 25 females and 25 males (Allendorf and Ryman 1987). Since there is presently a relatively high level of uncertainty concerning which donor sources might be best adapted for any particular environment, we suggest that either of the following two alternatives are viable and, if tried, their success needs to be monitored and evaluated:*
>
> 1) *Translocation of fish or gametes from existing populations which are abundant enough to withstand loss of at least 50 fish...translocated gametes should be incubated at the restoration site to maximize the potential for local adaptation. Translocation could be used to replicate a WCT population as a genetic reserve. Translocations would likely occur from either the nearest population [based on genetic dendrograms of stock relatedness] or a population inhabiting habitats most similar to the proposed restoration site.*
> 2) *A captive WCT brood could be used for restoration, provided that this captive brood has an appropriate amount of genetic diversity.*

Based on these recommendations, possible donor populations that contain 100% genetically pure WCT were identified and tested for reportable fish pathogens. Donor fish would be collected yearly to reestablish populations in restored habitats. The donor population will be monitored to assure that juvenile (or gamete) collection does not impact that population. Our goal is not to create a captive broodstock, but instead to replicate genetically unique stocks. Juvenile WCT, collected as donor fish, would be held until maturity to provide a source of F1 gametes (eyed eggs) or fingerlings.

4.3 Donor Fish Collection

The following discussion details collection methods for the program.

4.3.1 Collection Sites and Descriptions

Juvenile Donor Stock Collection- Creation of F1 Generation from Local Stock Conservation Strategy

Preliminarily, the following streams have been identified as juvenile donor fish collection locations (Figure 13):

- Haskill Creek
- Gordon Creek
- Youngs Creek
- Danaher Creek

Haskill Creek - Haskill Creek is a 8 mile (12.9 km) long tributary of Whitefish River, which flows from the north into the Flathead River. Both brook trout (*Salvelinus fontinalis;* BKT) and WCT are considered common residents from river mile 0 to 7.2 (Rkm 0 to Rkm 11.6), with WCT common throughout the remainder of the tributary. Haskill Creek is classified as moderate in terms of fisheries resource values. Haskill Creek is currently the focus of a WCT recovery effort to "rescue" a remnant pure population of WCT that has been invaded by BKT (MFISH 2002). Haskill Creek can be accessed by road, so is conveniently used for experiments on of BKT removal and conservation aquaculture.

Gordon Creek - Gordon Creek, a tributary to the South Fork Flathead River, is approximately 18.7 miles (30.1 km) in length and contains eight tributaries, including Elk, Gabe, Cardinal, Shaw, George, Doctor, and Lick creeks, as well as an unnamed tributary. Bull trout are abundant below Rkm 23.5, with incidental occurrence from river mile 14.6 to 16.5 (Rkm 23.5 to 26.6). Mountain whitefish are common below river mile 5.9 (Rkm 9.5) and rare upstream. Westslope cutthroat trout are abundant through river mile 14.0 (Rkm 22.5), with WCT x YCT hybrids present upstream to river mile 16.5 (Rkm 26.6). Through river mile 16.5 (Rkm 26.6), Gordon Creek was classified as outstanding in terms of fisheries resource value (MFISH 2002). Three mountain lakes, Koessler, Lick and George contain hybrid trout that are scheduled for removal during the next 10 years by MFWP under the South Fork Flathead Watershed Westslope Cutthroat Conservation Project (cite Grisak 200?; FEIS 2006; RODs etc). MFWP is committed to reestablishing pure WCT in the lakes after nonnative trout are eradicated. Our goal is to replicate donor populations from within the same drainage to populate the lakes. Details are provided later in this document.

Youngs Creek – Youngs Creek, a tributary to the South Fork Flathead River, is approximately 21.4 miles (34.5 km) in length and contains 14 tributaries. The creek is located in the Bob Marshall Wilderness area. Bull trout are abundant seasonally in the lower 17.9 miles (28.8 km).

Mountain whitefish are common in the lower 6.1 miles (9.8 Rkm) and rare in the upstream reach to mile 14.6 (23.5 Rkm). Westslope cutthroat trout are abundant, year-round residents throughout the lower 17.7 miles (28.5 km) of the creek. An isolated genetically pure population of westslope cutthroat trout (designated an A1 donor population) has been located above a barrier in Youngs Creek. The entire creek is classified as outstanding in fisheries resource value (MFISH 2002). Pyramid Lake in the Youngs Creek drainage contains hybrid trout that are scheduled for removal by MFWP during the next 10 years. After fish are eradicated from the lake, MFWP is considering repopulating the lake using within-drainage sources.

Danaher Creek - Danaher Creek, a tributary to the South Fork Flathead River, is approximately 21.1 miles (34 km) in length and contains 12 tributaries. The creek is located in the Bob Marshall Wilderness area. Bull trout and mountain whitefish are common through river mile 8.9 (Rkm 14.3) and rare throughout the upstream length of the creek. Slimy sculpin are also common in the lower reaches of the creek. Westslope cutthroat trout are abundant, year-round residents throughout the creek. The entire creek is classified as outstanding in fisheries resource value (MFISH 2002). The headwaters arise in a large meadow (type E channel) with high densities of juvenile WCT.

In addition to these creeks, other potential donor populations (containing 100 percent genetically pure WCT populations) are presented in Appendices G-J. Figure 14 depicts streams that are known to contain genetically pure WCT. For initial program start up, only one stream would be used for juvenile collection for the first three years. This will ensure that all fish in the rearing ponds are from the same genetic stock. Upon maturation and spawning of the first set of collected juveniles, ponds will become available for an additional donor sources.

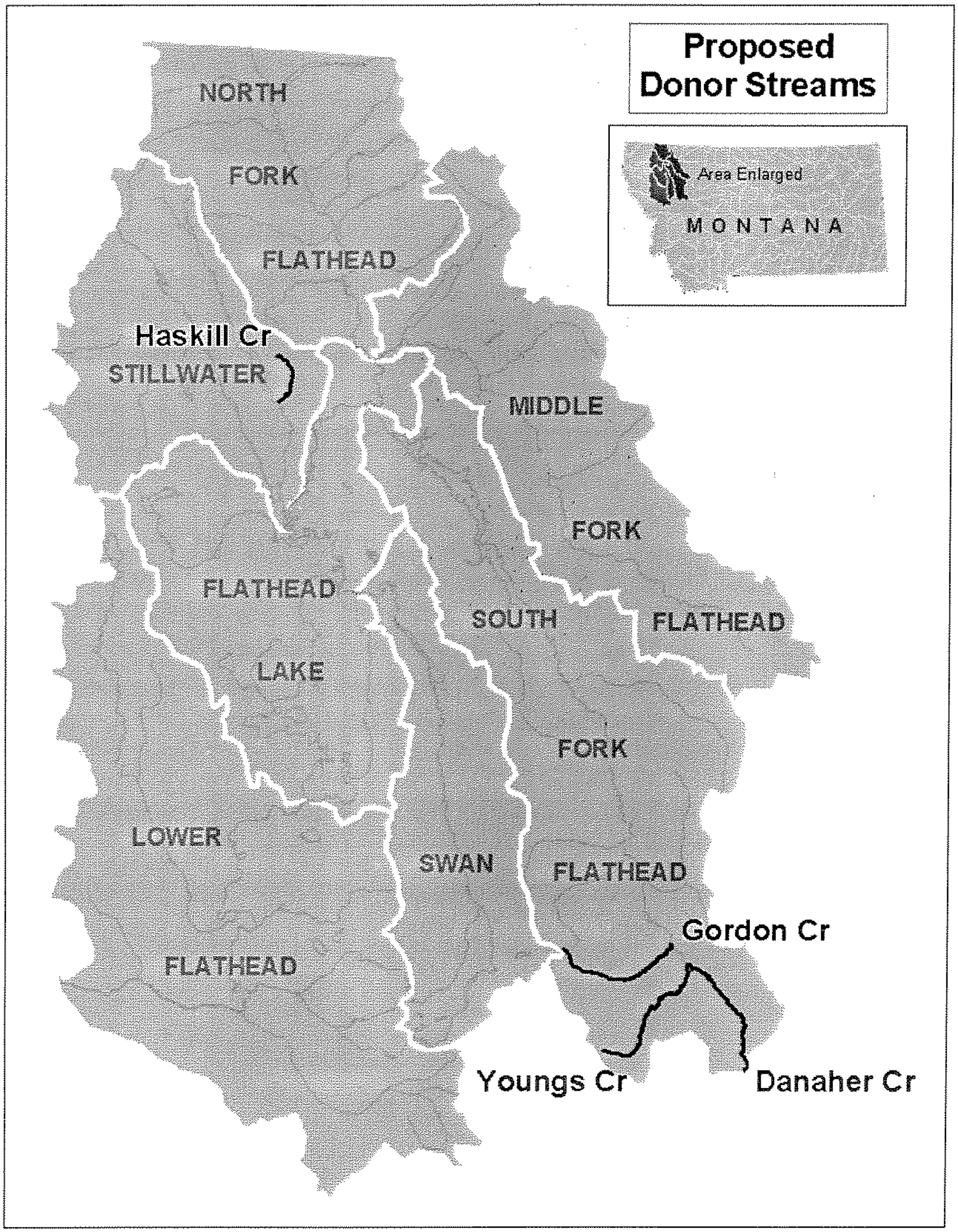

Figure 13. Locations of Potential Donor Streams: Haskill, Danaher, Youngs and Gordon Creeks.

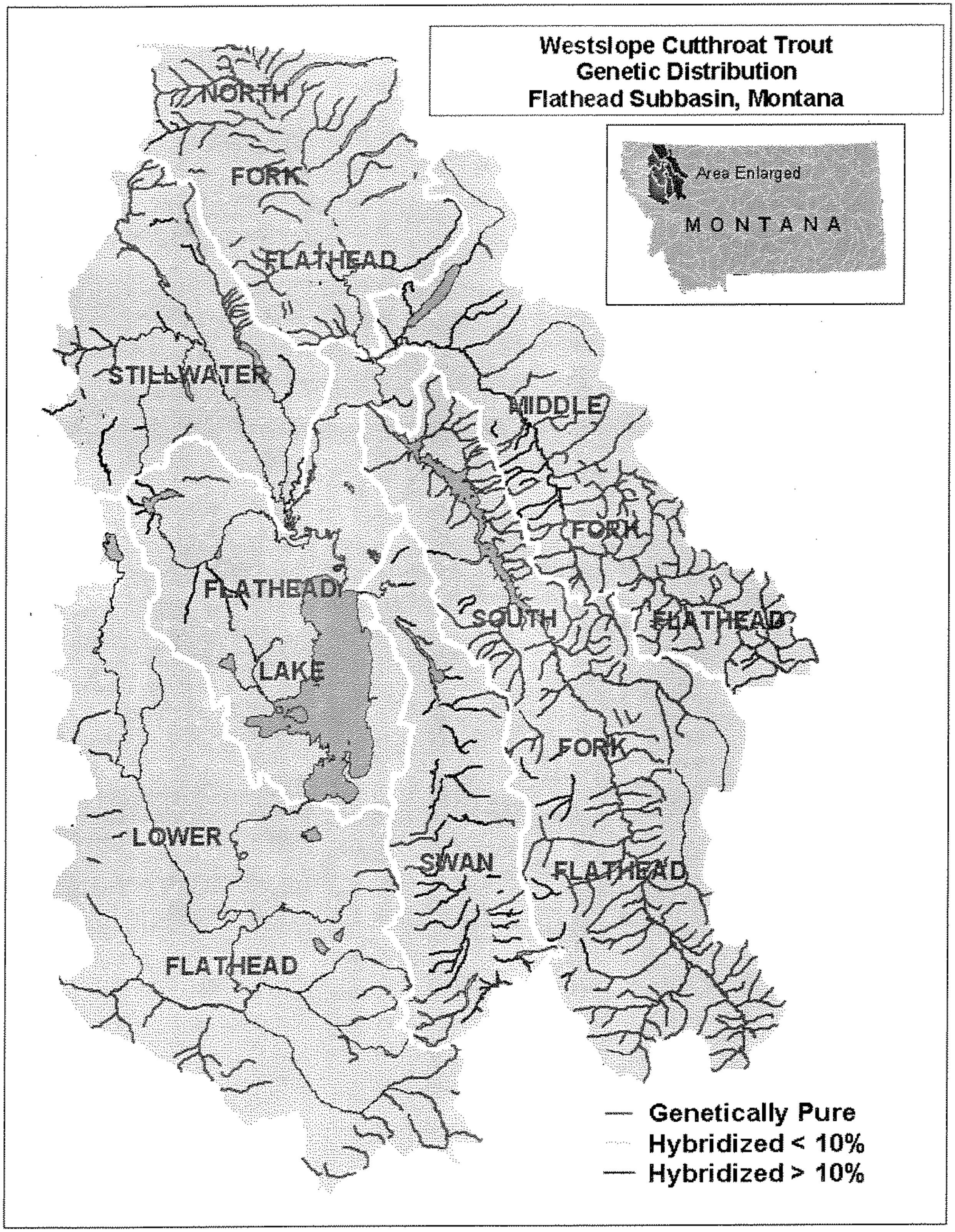

Figure 14. Location of Genetically Pure and Hybridized WCT Populations in the Flathead Subbasin.

Milt Collection - Infusion of New Material into MO12 Stock Conservation Strategy

MFWP and co-managers collected milt from wild spawning males found in genetically pure populations in Deep and Quintonkon Creeks, both tributaries to the South Fork Flathead in 2003 (Figure 15). Wild spawners were collected and spawned in an isolation facility in the hatchery building at Sekokini Springs. In the future, gametes from female spawners may also be collected.

Quintonkon Creek - According to the Montana Fisheries Information System (MFISH; 2001), Quintonkon Creek is a tributary to Sullivan Creek, which then drains into the South Fork Flathead. Quintonkon Creek is approximately 9.5 miles (15.3 km) in length with three tributaries: Rock Creek at river mile 2.1 (Rkm 3.4), Posy Creek at river mile 5.0 (Rkm 8.0) and Red Owl Creek at river mile 5.8 (Rkm 9.3). WCT occupy the entire stretch of the creek. Due to the presence of WCT and bull trout, the entire stretch of river is considered a NPCC Fisheries Protected Area with an outstanding fisheries resource value (NWPPC 1994; MFISH 2001). Within the first 5 river miles (8 Rkm), the WCT population has been characterized as having both resident and fluvial/adfluvial populations with abundant numbers of individuals. From river mile 5 to 9.5 (Rkm 8.0 to 15.3), the WCT population is characterized as abundant, with year-round residents occupying the reach. MFWP collected population data in 1987. This collection effort determined that the creek's habitat quality was good and population estimates suggest a density of 29 individuals per 492 ft (150m). Stream channel data indicate that bank vegetation is primarily in the form of coniferous trees with fair subsurface cover (MFISH 2001).

During 1983 and 1984, as part of the effort to establish the state's M012 WCT captive broodstock, 150 and 365 WCT, respectively, were collected from Quintonkon Creek.

Deep Creek – Deep Creek is a second order tributary of the South Fork Flathead River. It is approximately 4.8 miles (7.7 km) in length with one tributary, Ruby Creek, located at river mile 2.4 (Rkm 3.8) (MFISH 2002). Data from 1986 (Zubik and Fraley 1986) indicate a WCT density of 51.1 juveniles per 328 ft (100 m). Portions of Deep Creek salmonid habitat were impacted by the Hungry Horse Reservoir. It is believed that WCT occupy the entire stretch of the creek.

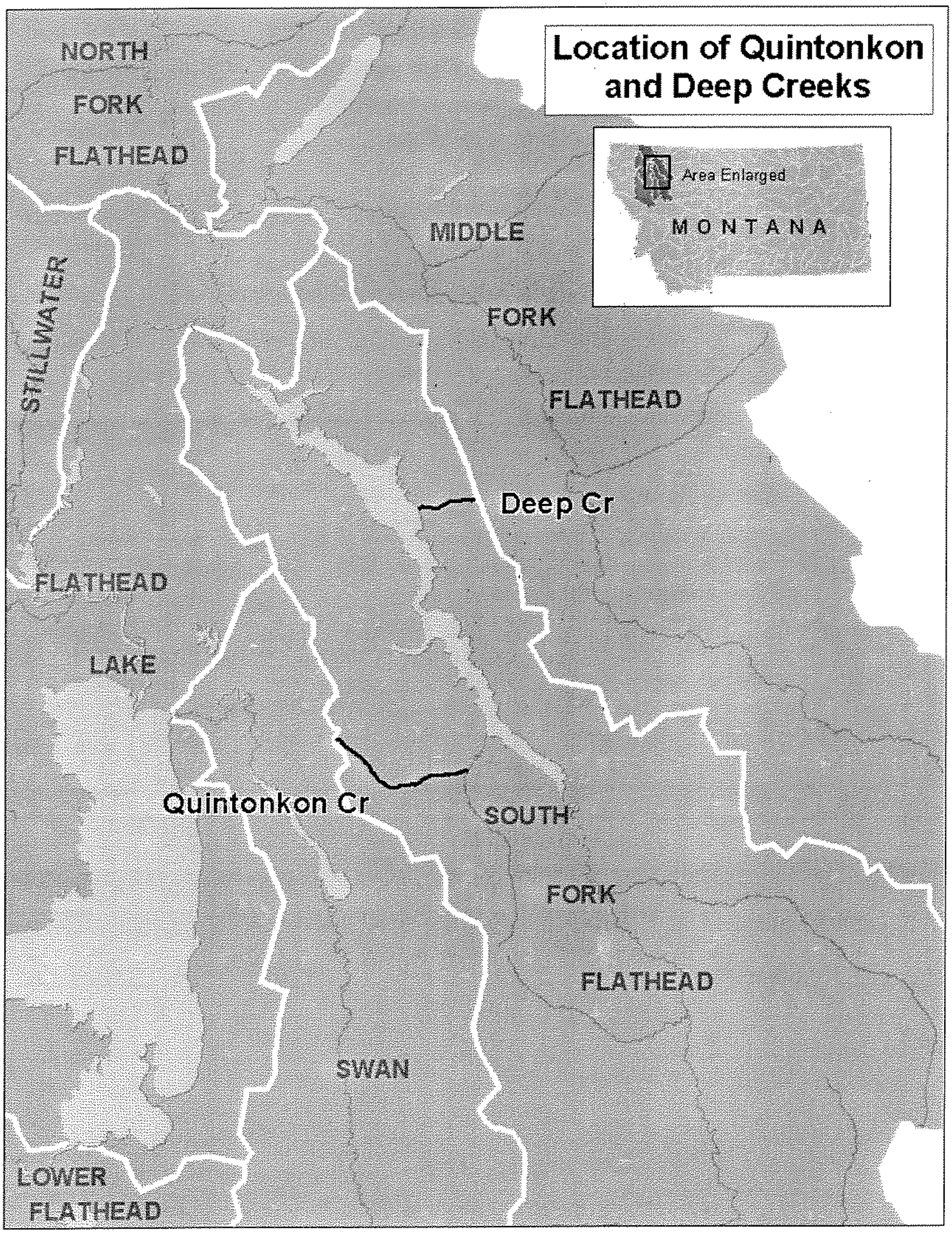

Figure 15. Location of Deep and Quintonkon Creeks

4.3.2 Genetic Information

General Information on WCT Genetics

Genetic testing performed on WCT in different basins within Montana included numerous samples from the Missouri River and Columbia basins. Testing revealed little genetic variation between WCT from the Missouri and Columbia basins (Leary et al. 1998). Instead, most (64.95 %) of the total amount of genetic variation detected was attributed to genetic differences among fish within samples, 33.8 % to differences among samples within basins, and only 1.3 % to genetic differences between samples from the Columbia and Missouri River basins.

Genetics of Flathead River

Juveniles will be collected from genetically pure WCT populations in headwaters of the North, Middle and South Forks of the Flathead River, with the exception of Haskill Creek, which is a tributary to the Whitefish River. Identification of non-hybridized populations will be based on biochemical genetic techniques. Discussion of the individual drainages and genetic composition of populations within those drainages follows discussion of the North, Middle and South Forks of the Flathead River.

North Fork Watershed

The North Fork Flathead River watershed encompasses 609,280 acres (243,742 hectares), of which 47.1% is USFS land, 44.6% is National Park Service (NPS) land, 3.1% is owned by the state of Montana, and 5.2% is either private or owned by other public entities (USFWS 1999). In the watershed, stocks of genetically pure WCT occupy 67.4 miles (108.4 km),. within 27 stream reaches. Stocks that are 99.9 to 90.0% pure occupy 69.2 miles (111.4 km); stocks that are <90% pure occupy 37.5 miles (60.3 km); and stocks in the remaining 311+ miles (500+ km) of stream reaches remain untested for genetic composition (USFWS 1999; Shepard et al. 2003). Within the watershed, Marnell et al. (1987) identified the following lakes and associated tributaries as genetically pure: Akokala, Cerulean, Quartz, Lower Quartz, Middle Quartz, and Trout. These findings have been confirmed by recent genetic analyses, with the exception of Trout and Cerulean creeks, which have not been recently tested. In addition to these streams, recent data indicate that Bowman Creek, Canyon Creek, Dead Horse Creek, Depuy Creek, Huntsberger Lake, Moran Creek, Nasukoin Creek, Red Meadow Lake, Tepee Creek and Yakinikak Creek also have populations that are genetically pure. Additionally, portions of the following waterbodies are genetically pure: Big, Coal, Colts, Cyclone, Hay, Kletomus, Logging, McGinnis, Moose, and Skookoleel creeks (MFWP unpublished data, 2003; Appendix F).

Among the total 444 miles (714.5 km) of stream occupied by WCT stocks, 266 miles (428.1 km) of stream have stocks that are considered abundant; stocks in the remaining 178 miles (286.5 km) of stream are considered rare. Of the total linear amount of stream habitat known to be occupied by WCT in the North Fork Flathead River watershed, 81.9 % lies on lands administered by federal agencies (USFWS 1999). Data from the Interior Columbia River Basin Ecosystem Management Project (ICBEMP) indicate WCT stocks are strong or predicted strong in four hydrologic unit codes (HUCs); depressed or predicted depressed in 31 HUCs; and absent or predicted absent in the one remaining HUC. Within that portion of the watershed that lies in Glacier National Park, genetically pure WCT naturally inhabit 10 lakes that have a total surface area of 2,407 acres (963 hectares) (Marnell 1988).

Middle Fork Watershed

The Middle Fork Flathead River watershed encompasses 727,680 acres (291,072 hectares) (USFWS 1999). Land ownership in the Middle Fork Flathead watershed is 51.1 % USFS, 46.0 % National Park Service, and 2.8 % private and other public entities (USFWS 1999). In the watershed, stocks of genetically pure WCT occupy 55.6 miles (89.4 km); stocks that are 99.9 to 90.0% pure occupy 15.8 miles (25.5 km); stocks that are <90% pure occupy 9.6 miles (15.5 km); and stocks in the remaining 435 + miles (700+ km) of stream (131 stream reaches) remain untested genetically (USFWS 1999; Shepard et al. 2003). Within the watershed, Marnell et al. (1987) identified the following lakes and associated tributaries as genetically pure: Avalanche, Lincoln, Lower Howe, Lower Isabel, Snyder, Upper Howe, and Upper Isabel. However, recent genetic testing indicates that Lincoln Creek is no longer pure. The remainder of genetically pure streams, as determined by Marnell et al., have not been recently tested. Recent genetic analysis also indicates the following waterbodies contain genetically pure WCT: Bear, Challenge, Cox, Ole, Park, Pinchot and Tunnel creeks, and Almeda, Bergsicker, Cup, Dickey, Elk and Scott lakes (MFWP unpublished data 2003; Appendix G).

Among the total 471 miles (758 km) of stream occupied by WCT stocks, 246 miles (395.9 km) of the stream have stocks that are considered abundant; stocks in the remaining 225 miles (362.1 km) of stream are considered rare. Of the total linear amount of stream habitat known to be occupied by WCT in the Middle Fork Flathead River watershed, 94.1 % lies on lands administered by federal agencies (USFWS 1999). Data from the ICBEMP indicate WCT stocks are depressed or predicted depressed in 41 HUCs and absent or predicted absent in the one remaining HUC. Within that portion of the watershed that lies in Glacier National Park, genetically pure WCT naturally inhabit 10 lakes that have a total surface area of 2,940 acres (1,176 hectares) (Marnell 1988).

South Fork Watershed

The South Fork Flathead River watershed is considered to be the last remaining stronghold of WCT in Montana (Leary et al. 1997) and encompasses 1,077,760 acres (431,104 hectares; USFWS 1999). Land ownership in the South Fork Flathead watershed is 97.5 % USFS and 2.5 % private and other public entities (USFWS 1999). The upper two-thirds of the South Fork Flathead drainage lie entirely within the Bob Marshall Wilderness Area. In the watershed, stocks of genetically pure WCT occupy 218 miles (350.5 km) in 89 stream reaches; stocks that are 99.9 to 90.0 % pure occupy 54.5 miles (87.7 km); stocks that are < 90.0 % pure occupy 10.6 miles (17.0 km); and stocks in the remaining stream reaches remain untested genetically (USFWS 1999; Shepard et al. 2003). Among the total 609 miles (980.1 km) of South Fork drainage occupied by WCT stocks, 559 stream miles (899.6 km) have stocks that are considered abundant; stocks in the remaining 50 miles (80.5 km) of stream are considered rare. Of the total linear amount of stream habitat known to be occupied by WCT in the South Fork Flathead River watershed, 97.4 % lies on lands administered by federal agencies (USFWS 1999). Data from the

ICBEMP indicate WCT stocks are strong or predicted strong in 51 HUCs and depressed or predicted depressed in the remaining 22 HUCs.

Appendix H presents the results of genetic analyses of the South Fork drainage, including those waterbodies that were identified to contain 100 percent genetically pure WCT populations (MFWP unpublished data, 2003).

Genetics and Fish Health Status of Donor Stock Streams

<u>Juvenile Donor Stock Collection- Creation of F1 Generation from Local Stock Conservation Strategy</u>

Appendix I presents genetic analysis data for streams throughout the North, Middle and South Forks of the Flathead River. Waterbodies identified to contain 100 percent pure WCT may be used for WCT collection. At this time, Haskill and Gordon creeks have been identified as specific streams from which juvenile WCT will be collected for donor stock.

One-hundred percent genetically pure WCT occupy only a portion of Haskill Creek, primarily in the upper-most reaches. As shown by genetic analysis, the genetic purity of WCT in the lower reaches of the creek is approximately 98.2 percent, with the remaining 1.2 percent contributed by RBT (B. Marotz, MFWP, personal communication, May 6, 2003; MFISH 2002). Currently, managers plan to recover the genetics of the remaining pure population for reestablishment after limiting factors, including the presence of BKT and degraded habitat, have been eliminated. Preliminary plans are to "rescue" the pure WCT, rearing juveniles at Sekokini Springs while restoration activities proceed. Upon completion of BKT removal and the establishment of barriers to prevent re-invasion by BKT and RBT, F1 progeny would be released back into Haskill Creek (B. Marotz, MFWP, personal communication, May 6, 2003). Juvenile trout collection must occur within one year after the donor population is tested for reportable fish pathogens. Wild juvenile fish will be held in isolation and tested for genetic purity.

Westslope cutthroat trout from Youngs and Danaher creeks were analyzed allozymically in 1989 and found to be 100 percent pure (MFISH 2002). Disease sampling indicated that the creeks were free from reportable pathogens (B. Marotz, MFWP, personal communication, May 6, 2003). Because these creeks have been tested for fish pathogens and contain pure WCT, they will be targeted as donor streams, following Haskill Creek.

Gordon Creek WCT were analyzed allozymically in 1989 and found to be 100 percent pure (MFISH 2002). Deoxyribose nucleic acid (DNA) testing performed in 2001 for Gordon Creek WCT confirmed that fish within the lower portions of this stream are 100 percent pure WCT (MFISH 2002). Fish health testing will be completed prior to juvenile collection.

South Fork Flathead tributaries of Youngs, Danaher and Gordon creeks have been reported to contain fish that are significantly different from the existing MO12 state broodstock (R. Leary letter to B. Shepard Montana Cooperative Fishery Research Unit dated May 16, 2002). Fish from these creeks could therefore be used to establish unique donor populations at Sekokini Springs. Collecting these fish from these wilderness locations will require transport by packhorses or helicopter (with the permission of the USFS).

Milt Collection - Infusion of New Material into MO12 Stock Conservation Strategy
Quintonkon and Deep creeks, both located within the South Fork Flathead were utilized in 2003 for the collection of milt from wild spawners. Fish pathogen testing indicated both creeks were free of pathogens of concern. The parental stock was tested for genetic purity and the wild milt was used successfully to fertilize MO12 eggs of the state's broodstock.

Quintonkon Creek - According to 1983 electrophoretic genetic testing results conducted independently by Huston and Leary, the WCT population is considered 100% genetically pure (MFIS 2001). Allozymic and DNA testing confirming these results was funded by MFWP in 2002 (B. Marotz, MFWP, unpublished data, May 6, 2003).

Deep Creek – According to 2003 allozymic and DNA genetic analysis by Robb Leary, Deep Creek has been identified as containing 100 percent pure WCT (B. Marotz, MFWP, personal communication, May 6, 2003; MFISH 2003).

4.3.3 Collection Methodologies

Juvenile Donor Stock Collection- Creation of F1 Generation from Local Stock Conservation Strategy

Juveniles will be randomly selected from previously described donor populations through electrofishing or downstream trapping. The timing of collection would be based on access, and likely would occur in July and August when the weather would allow access to collection streams.

Capture of juveniles can be accomplished when spawning adults are absent from the stream, thus eliminating immediate risk to the spawning population. Juveniles would be transported to Sekokini Springs in an insulated hatchery tank with oxygenation. Incremental removal of a subset of the natural population will provide a random selection of individuals while protecting the remaining wild population.

Milt Collection - Infusion of New Material into MO12 Stock Conservation Strategy

Mature male spawning WCT would be collected from Quintonkon and Deep creeks through electrofishing methods. Individuals collected from Quintonkon would be transferred via helicopter, while individuals collected from Deep Creek would be transferred via haul truck to be held and spawned at Sekokini Springs. Those individuals would likely be sacrificed following spawning activities.

For the collection of milt to infuse into the MO12 stock, the program goal is to collect up to 60 mature males from each donor stream. This can be accomplished over several years to avoid removing more than 50 percent of spawning males each year. In the future, if gametes from males and females are collected, the program goal is to obtain gametes from at least 25 females and 25 males, collected over the spawning period. No more than 25 percent of the females would be removed from the donor population in any given year.

4.3.4 Proposed Number of Juveniles Collected

No more than 25 percent of the juvenile population in a given reach will be collected for donor stock. If the number of juveniles within a population decreases, as evidenced through monitoring and evaluation procedures (population estimation through electroshocking assessments), less fish will be removed, or collection will cease. A precipitous decline (>25%) in a donor population from one year to the next would necessitate a cessation of juvenile collections. It is likely that fish from adjacent stream reaches will occupy the collection reach, so lasting impacts to the donor populations are not anticipated (B. Marotz, MFWP, personal communication, May 6, 2003). Once a given donor population has been successfully used to plant an appropriate recipient stream(s) or lake(s), that donor stream will no longer be used for juvenile collections. Juveniles will then be collected from the next donor stream on the list.

The specific number of juvenile donor fish to be collected is dependent upon several factors, one of which is the estimated mortality rate of wild donor fish as they acclimate to conditioning ponds. The estimated mortality rate was assumed to be similar to that which occurred during the establishment of the state's existing MO12 captive broodstock. To establish that stock, approximately 4,600 fish were collected, of which approximately one-third of the wild fish died before they attained sexual maturity in the hatchery environment (Grisak 2003). Based on these numbers, the mortality rate for captured wild juveniles is estimated to be approximately 33%. The fish collected for the MO12 stock were not separated by age class or size and were reared in conventional concrete raceways and fed commercial feed (M. Sweeney, MFWP, personal communication, March 4, 2003). At Sekokini Springs, fish will be reared in earthen ponds at low densities and the use of supplementary natural food will occur. It is hoped that the mortality rate experienced by the MO12 program, or less can be obtained. If this occurs, fish collection numbers would be reduced in subsequent years.

Other factors that contribute to the number of juveniles to be collected include the relative abundance of juvenile WCT within the donor populations (Table 5-4), the carrying capacity of the proposed recipient streams and known survival percentages of various life-stages of reared WCT.

It is estimated that up to 1,000 individual juveniles (ages 1 and 2) will be removed from a given donor population/genetic stock each year (based on a percentage of the population estimated through electrofishing estimates, not to exceed 25 percent of the donor population).

4.3.5 Juvenile/Adult Holding

Juvenile Donor Stock Collection- Creation of F1 Generation from Local Stock Conservation Strategy

Approximately sixty individuals, or a number determined by the MFWP fish health specialist to be sufficient, from each lot will be sacrificed for disease testing before the fish are moved from the isolation facility (circular holding tanks in the hatchery building) to the outdoor ponds.

If disease testing results are positive for a reportable fish pathogen, fish will be removed from the facility and all equipment will be sanitized. The source population will be removed from the list of possible donor populations.

Juveniles collected for donor stock will be reared to maturity within the rearing ponds. Because wild WCT demonstrate variable growth rates among individuals in a population, collected juveniles would not be separated by size. Such a separation could lead to "hatchery grading" or the inadvertent selection for specific traits (B. Marotz, MFWP, personal communication, May 6, 2003). Feeding will be a combination of commercial fish feed and natural feed. Demand feeders will be utilized to minimize the interaction with humans.

Milt Collection - Infusion of New Material into MO12 Stock Conservation Strategy

Adults collected for milt collection will be held in an isolation facility within the hatchery building.

4.4 Sekokini Springs Facility Operations

4.4.1 Spawning

Juvenile Donor Stock Collection- Creation of F1 Generation from Local Stock Conservation Strategy

Collected juveniles will be reared to maturity within ponds that hold each collection year/genetic stock. Upon maturation, a false attraction weir (incorporated within the kettle structure), or kettle will be used to collect maturing adults from the conditioning ponds (Figure 11). A false weir will provide a migration path for the mature component of the population. These fish, following their instinct to migrate to spawning areas, will ascend the weir and be collected in the trap area. An alternative method for adult collection will be to draw down the pond and collect fish within the kettle and sorted for ripeness. These fish will then be spawned adjacent to the ponds (a temporary spawning shelter will be placed on the concrete pad provided for this action). Mature fish will not be transferred to the hatchery building.

Each females will be live-spawned with sperm from two males, one as a primary source and one as a "back up" to fertilize each egg lot. The number of family groups will be maximized based on the number of mature trout. Sixty fish will be sacrificed after spawning and fish pathogen samples will be collected.

The following priorities have been established by facility managers for the use of semen during fertilization:

- Fresh semen (milt) would be used whenever possible. Recycled males may be used when low numbers of broodstock are available. Hormone injections of gonadotrophin may be used on males 7-10 days prior to the date females are expected to be ripe.
- Cryopreservation may be necessary if male and female wild adults do not become ripe simultaneously.

Prior to fertilization, each male's sperm would be checked for motility immediately before combination of gametes. Surplus milt would be cryopreserved and held for future use, or sent to a hatchery for infusion into the MO12 broodstock.

Milt Collection - Infusion of New Material into MO12 Stock Conservation Strategy

Adults collected for milt collection will be captured randomly during the migration period. Fish would be transported to Sekokini Springs for holding until they spawn. Milt will be collected from ripe males and transported in individual containers with oxygen and on ice to the hatchery facilities producing the MO12 stock.

Milt from excess males for the F1 Generation Conservation Strategy may be infused into the State's MO12 captive broodstock upon approval of the State Hatchery Manager and Fish Health Specialist (B. Marotz, MFWP, personal communication).

4.4.2 Disposition of Donor Fish (Post Spawning)

Juvenile Donor Stock Collection- Creation of F1 Generation from Local Stock Conservation Strategy

Once collected donor juveniles have matured and spawned, spawned-out fish will be transferred to isolated fishing ponds, placed in the created stream channels at the site, used for fertilizer or donated to food banks. Transfer to isolated fishing ponds and the created channels must ensure that there will be no escape or accidental release of these fish. Non-controlled release of fish could result in hybridization of those individuals with RBT or introgression with genetically non-pure WCT individuals, which is counterproductive to program goals. Carcasses will not be returned to natal streams for nutrient enhancement.

Milt Collection - Infusion of New Material into MO12 Stock Conservation Strategy

Adults collected for milt extraction will be sacrificed and tested for pathogens and hybridization (B. Marotz, MFWP, personal communication, May 6, 2003) to ensure that fish pathogens are not transported to the captive populations and the associated hatcheries.

4.4.3 Incubation and Release Strategies at Sekokini Springs

Incubation will involve the use of tray type stack incubators, located within the hatchery building. Incubation trays can be divided and have the capacity to hold eggs from up to four adult pairs under segregated conditions. Trays will be supplied primarily by fish pathogen-free spring water from Springs 2 and 3, each of which averages about 60°F (15.6°C), and from the cold water from Spring #1, which provides water averaging 44°F (6.7°C). Variable temperatures available from the spring sources will allow for otolith marking.

Fertilized eggs will be disinfected during water hardening with an iodophor solution. No detrimental effects to WCT eggs have been demonstrated from this practice with exposure levels up to 125 mg/L for 30 minutes during water hardening (Pravecek and Barnes 2003). Eggs will be treated with formalin to prevent fungal infection.

Anticipated egg survival rates from green egg to eyed eggs, and eyed eggs to fry at the Sekokini Springs facility will be based on those experienced at the Washoe Park Trout Hatchery. Survival from green egg to eyed egg was 65-75%, and eyed egg to fry was 75-85% (J. Pravecek, MFWP, personal communication, February 24, 2003).

It is hypothesized that a spike in thyroxin hormone is associated with the time in which juvenile salmonids store the long-term memory required to imprint to their natal water source, enabling individuals to return to their natal tributaries as adults (Scholz et al. 1992; Dittman et al. 1996). The imprinting mechanism in WCT is poorly understood, although preliminary measurements indicate that thyroxine spikes occur around hatch and during swim-up (Tilson et al. 1994). The authors recommended that the study be repeated with more frequent sampling during incubation and continued through smoltification. It is thought that another spike may occur at smoltification.

In order to test which of these hormone spikes are important to the homing of WCT, two types of release strategies will occur in the program. F1 progeny will be outplanted as eyed eggs or as imprint fingerlings (juveniles released prior to the age at which they would emigrate from their natal tributary). Individuals from both strategies will be otolith-marked or scale-marked for future identification. Otolith marks may be created using thermal treatment (Schroder et al. 1996) or stabile elements (Snyder et al. 1992; Thresher 1999; Gillanders 2001; Wells et al. 2003). A few fish from each treatment will be sacrificed upon emergence to assure marks can be detected. Similar research on MFWP's Libby Mitigation program showed that otolith marks applied by cold temperature must be repeated several times to produce identifiable marks. Other otolith marks using strontium chloride or barium appear to be more easily identifiable.

Fish from both release strategies will be sampled annually in the rearing tributary using electrofishing population census to monitor age-specific survival and growth. Fish recaptured at larger size during subsequent surveys will be marked again using Passive Integrated Transponder (PIT) tags. Migrant traps and PIT tag detectors will be used to compare age and size at emigration from each source. Provided that the study fish survive in sufficient numbers to detect as spawning adults, we plan to install remote PIT tag detection stations to assess the degree of homing, or straying, of each release strategy to determine which thyroxine hormone spike, or both, are important to the homing mechanism in this species.

Incubation Through Early Rearing at Sekokini Springs

The first of these strategies will involve incubation, hatch and early rearing at the Sekokini Springs facility. Eggs will be incubated, hatched and subsequently placed into an on-site rearing pond and held until they are outplanted as fingerlings into a recipient stream. It is believed that these fish will experience one hormone spike at Sekokini Springs as swim-up fry and one as they emigrate from their "new natal water". It is anticipated that these fish will not smolt at Sekokini Springs since they will be released prior to the age of emigration.

Fry will be removed from incubator trays 5 days before swim-up and placed in fiberglass troughs (10 ft by 1 ft by 0.5 ft) receiving 8 gallons per minute (gpm) from the same water source. After fish are on feed and they reach roughly 1 inch (25 mm) in length, they will be moved to the outdoor rearing pond. This will occur in approximately July. A majority of the pond area will be designed to simulate "natural fish habitat" with the use of natural woody debris (overhead and submerged), overhead cover, a deeper pool area, and large rocks for cover.

Incubation to Eyed-Egg Stage at Sekokini Springs

The second rearing strategy will be to incubate eggs on-site to the eyed egg stage. Otolith marking may occur during this period. Standard shocking methods will be used to cull non-viable eggs, and eyed eggs will be transferred to Remote Site Incubators (RSIs) or artificial redds to be located within the target streams. The resulting fish will be introduced to their "natal" streams as eyed eggs, producing a fish that experience two hormone spikes in the wild.

The use of RSIs for WCT incubation in a Montana stream was successful, with 70 to 75 percent survival rates (Hoffman et al. 2002). Because RSIs will be "outplanted" during late spring/early summer, there should be no potential for freezing of the systems. Eyed eggs will incubate in the recipient stream water and fry will emerge directly from the RSI. It is anticipated that the fry will rear in the recipient stream for up to four years (most WCT emigrate by age three) before emigrating from their natal tributary.

Substrate within target streams for artificial redds should contain a low percentage (<30 %) of fine sediments based on evidence from Weaver and Fraley (1993) which showed "a significant inverse relationship between fry emergence success, as measure by fry emergence traps, and the percentage of substrate materials less than 6.35 mm in diameter.". Artificial redds will be constructed mechanically or hydraulically to create an egg pocket where eyed eggs are deposited, gently buried and allowed to emerge naturally.

4.4.4 Outplanting into Restoration Streams

All fish planted from Sekokini Springs will be identifiable (e.g. scale and otoliths microchemistry, genetic characteristics, fin clips or tags). Because there is limited information on appropriate stocking densities into streams and tributaries (M. Sweeney, MFWP, personal communication, March 4, 2003), fish from Sekokini Springs will normally be released to recovery streams at a density not to exceed the maximum density of wild trout in a comparable stream habitat type, stream order, gradient and flow range (Zubik and Fraley 1986). Experiments to examine stocking densities and determine the appropriate stocking levels may occur. Target streams to be stocked include previously fishless and degraded habitats within the historic range of WCT that have been recently recovered, or vacant habitats that have been blocked to fish passage by man-made obstacles. To be considered for stocking, all target streams must be absent of WCT, YCT and RBT, or isolated from wild spawners to minimize the expansion of introgressed or hybridized stocks in the Flathead Watershed.

As currently proposed, fish will be released into streams shown in Table 4-2. Figure 16 shows the location of potential restoration streams in the Flathead Basin. In addition to these streams, Logan Creek may receive outplants once BKT and RBT have been successfully eradicated.

Table 4-2. Potential Restoration Streams and Characteristics

Target Restoration Creek	Characteristics[1]
Abbott Creek	• Tributary of Flathead River (mainstem) • 4.5 miles, resident WCT in all • Contains two tributaries: South Fork Abbot Creek at River Mile (RM) 0.89 and Abbot Creek Trib #1 at RM 1.81 • Moderate fisheries resource value • 1994-95 data indicated genetically pure; 2000 data indicate new introgression • RBT introgression is moving upstream in this system (Hitt 2002) • MFWP currently removing a RBT hybrid swarm[2] • Upstream barrier installed in 2003 to block RBT spawning
Haskill Creek (also a donor stream)	• Tributary of Whitefish River – also will serve as donor stream upon complete eradication of BKT; Genetically pure WCT may be transferred to areas from which BKT and RBT are to be removed[2] • 8.0 miles of stream with resident WCT concentrated from RM 4.3 to 5.4 • Moderate fisheries resource value • 2001-02 Paired Interspersed Nuclear DNA Element (PINE) genetic testing from 25 WCT from RM 4.8-4.9 indicates 1.8% introgression with RBT
An unnamed tributary located across the Flathead River from Sekokini Springs	• Radio tagged RBTxWCT hybrids observed ascending tributary during spawning period • Although tributary has marginal fisheries value, it is a potential source of RBT and hybrids • Risk evaluation ongoing
Swanson Creek (trib to Shepard Creek)	• USFS currently removing BKT and attempting to establish wild runs of WCT[2]
Gooderich Bayou	• Spring source tributary to Flathead River • Source of naturalized run of RBT and RBTxWCT hybrids • Upstream barrier installed fall 2003 to prevent RBT spawning • Genetically pure WCT adults planted above barrier 2003 remained in spring slough habitat • Scheduled for annual plant of 250 pure WCT, will assess natural reproduction

[1] MFISH 2001
[2] B. Marotz, MFWP, personal communication, May 6, 2003

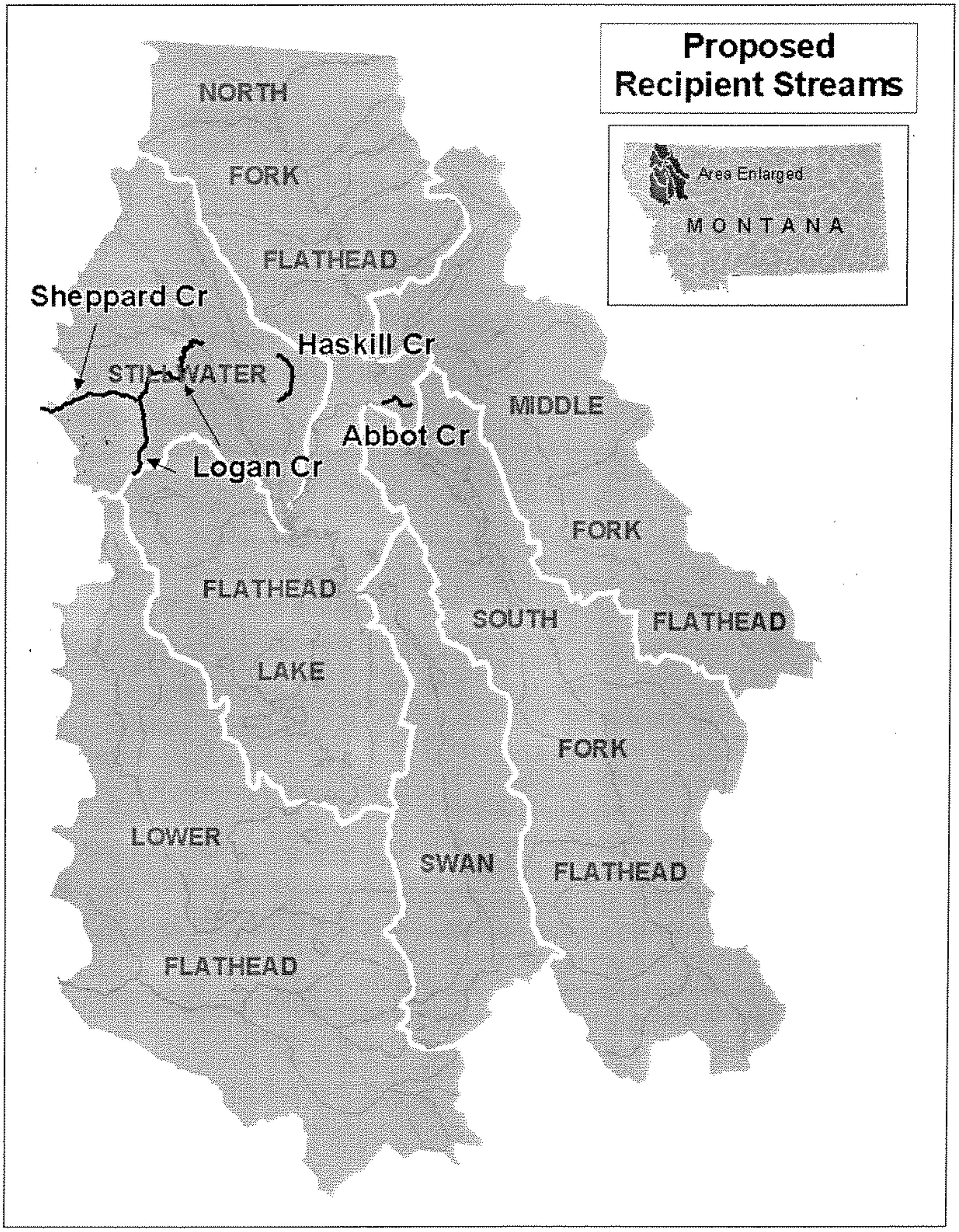

Figure 16. Location of Potential Restoration Streams

Additional sites within the Flathead River basin will be chosen for target releases as the program progresses. Experimental BKT removal programs may create restoration opportunities for WCT introduction in the future. Target streams should be as similar as possible to donor streams in terms of habitat, gradient, order and aspect to ensure the suitability of recipient streams to WCT.

In addition to the proposed restoration streams, in conjunction with the *South Fork Flathead Watershed Westslope Cutthroat Trout Conservation Program* (Grisak 2003), gametes and juvenile fish produced at Sekokini Springs may be used to aid in the restoration of genetic reserves in closed basin lakes. One component will involve replicating pure populations to restore populations where non-native fish or genetically introgressed populations were removed. Another component will infuse wild genes to lakes previously planted with MO12 WCT.

Imprint planting (F1 progeny outplanted as fingerlings prior to the age at which they would emigrate from their natal tributary) is consistent with the 1991 Hungry Horse Dam Mitigation Plan. The plan suggests the experimental planting of hatchery juveniles and eggs to test the relative success in the following order of priority:

- Imprint planting in blocked areas that will be reopened
- Imprint planting in habitat improvement sites
- Supplementation of juveniles or eggs in areas with low populations (MFWP and CSKT 1993) Note: Supplementation of existing WCT populations was subsequently discontinued. Instead, MFWP is attempting to increase low populations using passage and habitat improvements. MFWP still considers genetic "swamp-out" of hybridized populations using introductions of genetically pure WCT potentially beneficial under certain situations in headwater lakes (Huston 1998).

Imprint planting can initiate spawning runs in areas that do not contain a wild or naturally spawning population of fish (Miller et al. 1990).

In order to maintain existing genetics of natural populations within these systems, no fish from the Sekokini Springs facility will be introduced into waters containing genetically pure populations, classified by Leary et al. (1990) as A1 populations. A1 populations are those that are rated 100 percent genetically pure based on electrophoretic testing of at least 25 individuals from the population. The ultimate goal is to use members of the A1 population for donor stock collection.

4.4.5 Rationale for Number and Life History Stage at Release

With the exception of one stream-stocking event that occurred after a fire in a tributary system (M. Sweeney, MFWP, personal communication, March 4, 2003), the state of Montana has not and does not presently stock streams with WCT. Therefore, there is no model to predict the number of fish needed to be released into target streams to achieve a self-sustaining population. To determine the number of eggs and yearlings to outplant, co-managers relied on data from Zubik and Fraley (1986). These researchers developed a method to estimate the number of juveniles present in streams based on habitat, stream order and gradient (Table 4-3). These estimates have been used to predict stocking densities for outplanted eggs and juveniles as shown in Table 4-3. Proposed annual fish release levels (maximum number) by life stage and location are shown in Tables 4-4 and 4-5.

Table 4-3. Mean WCT estimates per 100m of stream for juveniles greater than 75mm by stream order and gradient categories for tributary reaches to the North, Middle and South Forks of the Flathead River (Zubik and Fraley 1986).

Stream Order	Gradient (%)	Mean Estimate
2	1.2 - 1.9	22.7
2	2.0 – 2.7	56.9
2	2.8 – 3.8	77.6
2	3.9 – 6.9	31.0
2	7.0 – 12.3	18.8
3	0.5 – 1.0	22.3
3	1.1 – 1.6	38.9
3	1.7 – 2.2	62.9
3	2.3 – 4.0	25.4
3	4.1 – 5.3	43.9
3	5.4 – 17.0	19.2
4	0.4 – 1.0	5.2
4	1.1 – 1.6	24.0
4	1.7 – 4.2	13.5
5	0.2 – 1.8	14.3
Mean		31.9

Historically, MFWP has stocked WCT artificial redds in closed-basin lake systems. These redds are usually stocked with approximately 1,500 eggs per redd and the number of redds per stream varies according to the number of naturally-occurring redds within a healthy stream of the same order. The usual range of artificially-created redds has been between 30 and 60 per reach. Using electroshocking sampling, the number of resulting juveniles can be estimated and future plants adjusted to achieve desired densities.

The use of RSIs for WCT incubation within Montana has been shown to be successful with 70 – 75% survival rates (Hoffman et al. 2002). Because RSIs will be "outplanted" during late spring/early summer, there should be no potential for freezing of the systems. RSIs will be stocked at up to 10,000 eggs per container, although lower densities are preferred.

Table 4-4. Proposed WCT Stocked/Release from the Sekokini Spring Natural Rearing Facility.

Location	Life Stage	Stocking/ Release Method	Maximum Number	Release Date	Where released (RM)
Abbot Creek (Once RBT removed)	Eyed Eggs	RSI's		May	
		Artificial Redds	100,000		3-5
	Fingerlings	Direct Release	2,000	June – July	3-5
Haskill Creek (Once RBT/BKT removed)	Eyed Eggs	RSI's	20,000	May-June	6-8
		Artificial Redds	20,000	May	6-8
	Juveniles	Direct Release		June – July	6-8
Unnamed tributary to Flathead River (Survey ongoing)	Eyed Eggs	Artificial Redds	20,000	May-June	1-1.5
	Juveniles	Direct Release		June – July	1-1.5
Swanson Creek (once BKT removed)	Eyed Eggs	Artificial Redds	20,000	May-June	1.0
	Juveniles	Direct Release	400	June – July	0.5-1
Gooderich Bayou	Juveniles and spent adults	Direct Release	250 annually	Aug-Sept	1.0
Restored or reconnected tributary habitat	Fingerlings	Direct Release	50,000 (as available)	June – July	Treatment area
Mountain Lakes South Fork Flathead WCT Conservation Project	juveniles	Direct Release	100 per acre	July-Sept	Lake center

Table 4-5. Proposed within-drainage WCT stocking from Sekokini Springs to selected mountain lakes to be rehabilitated by the South Fork Flathead River Westslope Cutthroat Conservation Project.

First Year Post-Treatment					Second Year	Third Year	
Stock Year	Lake	2" YOY	4" (age I+)	8" (age II+)	2" YOY	2" YOY	Future Stocking
2012	Pyramid	1,000	1,000	200	1,000	1,000	3-yr rotation as needed
2014	Koessler	8,000	8,000	500	8,000	8,000	Cease after self-sustaining
2014	Lick	2,000	2,000	300	2,000	2,000	Cease after self-sustaining
2016	George	12,000	12,000	500	12,000	12,000	Cease after self-sustaining

Experimental stocking of mountain lakes with within-drainage stocks requires replication of donor populations from the same watersheds in the Bob Marshall Wilderness. Pyramid Lake would be planted with F1 progeny of wild fish from Youngs Creek. The remaining three lakes would receive progeny of donor populations developed from Gordon Creek. Monitoring of the populations is described in Chapter 8, long-term RM&E plan.

4.5 Fish Health Management

The Fish, Wildlife and Parks fish health management project has tested fish reared at the Sekokini Springs site for pathogens since 1995. Annual inspections for the period 1995-1998 were conducted on fish held by the previous owner of the facility. The most recent inspection at this facility was conducted March 25, 2002. In this inspection 60 cutthroat trout and 60 Arctic grayling (*Thymallus arcticus)* being reared at Sekokini Springs were tested for bacterial and viral pathogens, in addition to *Myxobolus cerebralis*, the parasite responsible for whirling disease (MFWP lab number 020027). No pathogens were detected during this inspection. No pathogens of concern were detected during any of these inspections. All lab results are available from the MFWP fish health laboratory in Great Falls (Contact Jim Peterson, MFWP Fish Health Coordinator).

4.5.1 Stocking Inspection Requirements

Annual fish health inspections will be conducted at the Sekokini Springs facility, as they are at all Montana state fish culture facilities. However, instead of lot-by-lot testing conducted during a single inspection, periodic testing will be done at various times of the year depending on what fish are present at the facility. For example, young-of-the-year wild fish collected from wild populations will be tested at 4 inches in length. They will be tested again at sexual maturity. Fingerlings in the hatchery building will be tested prior to stocking.

Fish health inspections will include testing for all salmonid pathogens of concern as specified in the Administrative Rules of Montana (ARM 12.7.502). These pathogens include the following eight disease organisms:

*Infectious Hematopoietic Necrosis Virus (IHNV)
*Infectious Pancreatic Necrosis Virus (IPNV)
*Viral Hemorrhagic Septicemia Virus (VHSV)
**Oncorhynchus masou* Virus (OMV)
**Renibacterium salmoninarum*
**Aeromonas salmonicida*
**Yersinia ruckeri*
**Myxobolus cerebralis*

No fish may leave the Sekokini Springs facility until testing is completed, a fish-pathogen -free status is determined and a fish health inspection report is issued. Inspections will be conducted by the MFWP fish health project. Testing will be conducted using procedures established by the American Fisheries Society (AFS), Fish Health Section (FHS) in the AFS/FHS Bluebook, Suggested Procedures for the Detection and Identification of Certain Finfish and Shellfish Pathogens, 2003 Edition.

If a pathogen of concern is detected during any fish health inspection at the Sekokini Springs facility, the facility will immediately be placed under quarantine as specified in the MFWP Fish Health Policy. A meeting of the MFWP Fish Health Committee will be convened in order to develop an appropriate course of action. Actions may include removal of infected fish or disinfection of the entire facility, depending upon the pathogen detected and the risk to the facility and Montana's fishery resources. MFWP's Fish Health Policy will be followed regarding initiation and removal of a quarantine.

4.5.2 "Importation" Requirements – fish/eggs into Sekokini Springs Facility

All fish and eggs transported from any stream, lake, fish culture facility or any source to the Sekokini Springs facility must be from a source which has a history of pathogen testing and found free of the salmonid pathogens of concern (See additional discussion under Pathogens of Particular Interest below). Little, if any, health history exists for many of the waters from which wild cutthroat trout or eggs will be collected. Therefore, it is likely very little will be known about the health status of stocks selected for donor sources. Limited health testing will be conducted on fish from each donor source prior to collection of fish, regardless of the known health history of the water. Testing will be limited in many waters due to the availability of suitable fish for testing. MFWP will attempt to sample a suitable number of fish from each donor population to obtain a reasonable confidence of detecting fish pathogens, if they are present. Generally, MFWP will attempt to sample a minimum of 60 fish, 4 inches or larger. A sample size of 60 fish will result in a 95% confidence of being able to detect a fish pathogen, assuming as few as 5% of the fish in the population are infected with the pathogen (AFS/FHS Bluebook, attribute sampling table.) If 60 fish are not available due to limited population size, less fish may be tested. A donor stream will not be selected unless a minimum of 15 four inch or larger fish can be health tested and determined pathogen-free prior to collection of fish for transfer to Sekokini Springs. Fifteen fish is not enough to establish reasonable confidence of pathogen detection. However, this number is felt to provide an idea of the pathogen risk associated with donor waters. If no pathogens are detected, fish may be moved from the donor water to the Sekokini Springs facility.

MFWP prefers collecting fish from donor streams for which an established health history over several years is available. However, few of these waters exist. The risk inherent to moving live fish increases with fish from waters with little or no health history.

In the case of eggs taken to the facility, the parent stock from which the eggs are collected must have been pathogen tested prior to the eggs being taken to Sekokini Springs. These eggs must be held in isolation in the Sekokini incubators until results of the parental health inspection are received indicating no pathogens of concern were detected. Effluent from the incubators will be piped out of the building and run into the ground. No effluent from egg incubation will be allowed to enter any of the Sekokini ponds. The eggs will remain in the incubators until the health testing from the adults is completed. If a pathogen is detected in the health samples collected from the adult fish from which eggs were collected, the eggs will be destroyed before they hatch. Note that the level of testing of adults will be determined at the time of spawning based on the number of fish in the donor stream. Generally, a minimum of 60 fish, or 100% of the contributing adults from which eggs are collected, will be tested at the time of egg collection.

There will be many times when juvenile fish may have to be collected for transport to Sekokini Springs from a source which can not be adequately health tested. However, regardless of the health history of the donor fish, all wild fish collected and taken to the Sekokini Springs facility will be held in tanks, which are isolated from all other fish at the facility until they are a minimum of four inches. At four inches, a representative 60-fish sample will be health tested. If no pathogens of concern are detected in these samples, the fish may be moved to the lower rearing ponds. In addition, there may be times when eggs will be collected for transport to

Sekokini Springs from sources where adequate testing of the parent stock is not possible. In these cases, the fish or eggs must be held in isolation at the facility, until such time that adequate health testing can be conducted on the fish (four inch minimum size.) A minimum sample of 60 fish, representative of the collection lot, must be tested and determined to be pathogen of concern negative prior to transfer to the rearing ponds.

While no pathogens of concern have ever been detected at the Sekokini Springs facility, it must be emphasized that the potential to import pathogens exists every time fish or eggs are collected from a wild source and transported to the facility. For this reason inspection of representative fish from all donor sources, and annual inspections of the Sekokini Springs facility is essential.

4.5.3 Pathogens of Particular Interest:

Viral pathogens of concern are IHNV, IPNV, VHSV and OMV. Fish or eggs will not be collected from any donor population where any of these viruses are known to occur. If any virus is detected in fish after being taken to the Sekokini Springs facility, the facility will be placed under quarantine and the fish will be destroyed.

Myxobolus cerebralis. The whirling disease parasite has been present in Montana waters since 1994 and is present in the Flathead River drainage, having been detected in the Swan River and several tributaries to the Swan River, and in Mission Creek and Crow Creek, below Flathead Lake. The parasite has not been detected in the upper Flathead River or any of the main forks of the Flathead River above Flathead Lake. However, as of printing of this plan, the parasite has been detected in over 120 different waters in Montana, and it is expected to continue to spread (J. Peterson, MFWP, personal communication, 2004).

Renibacterium salmoninarum is the bacteria which causes bacterial kidney disease (BKD). This bacteria is known to occur in many waters across Montana. It has resulted in fish losses at fish hatcheries, but clinical disease has not been observed in the wild. It is important to discuss in the Master Plan because this bacteria may be present at low levels in donor fish, from which eggs will be collected for transport to Sekokini Springs. It is also of interest because this bacterial fish pathogen is known to be transmitted with eggs. MFWP requires *R. salmoninarum* testing of all stocks from which eggs are collected. Testing required by MFWP is the fluorescent antibody test (FAT). While other testing methods may be more sensitive than the FAT test, MFWP relies on the FAT procedure to detect medium and high range infections. Fish which test positive for *R. salmoninarum* using the FAT test will not be considered as egg sources for Sekokini Springs.

Aeromonas salmonicida and *Yersinia ruckeri* (type 1). *Aeromonas salmonicida* is known to occur in various waters in the Flathead drainage. Donor stocks are tested for these bacterial pathogens. Live fish infected with either of these pathogens will not be allowed to enter Sekokini Springs. Since these bacterial pathogens are not known to be egg-transmitted, properly disinfected eggs from parents infected with either of these organisms may be transported to Sekokini Springs with approval of the MFWP Fish Health Coordinator. All eggs which are taken into the Sekokini Springs facility must be thoroughly disinfected with iodophor disinfectant prior to entering the facility. Eggs will be water hardened in an iodophor solution at the time of fertilization. A 100 mg/L solution of povidone iodine will be used for this process.

Eggs will be water hardened in this solution for 30 minutes. This will be done at the time and place of fertilization. External disinfection of eggs will be conducted prior to eggs entering the Sekokini Springs hatchery building. It is anticipated this will be done in the parking lot behind the building. External egg disinfection will be conducted at a concentration of 100 mg/L for 10 minutes. At times, green eggs may need to be collected for fertilization at Sekokini Springs. These eggs will also be water hardened in iodophor as described above. If this process takes place inside the hatchery building, special care must be taken to avoid contamination of the hatchery facility.

4.5.4 Gamete Collection for Westslope Broodstock Development - Infusion of New Material into MO12 Stock Conservation Strategy

One of the primary objectives of the Sekokini Springs project is collection of gametes for incorporation into the MO12 WCT broodstock. In order to accomplish this, wild fish may be taken to Sekokini Springs for egg or sperm collection. Prior to collecting these fish from the wild, health testing will be conducted as described above for wild fish collection. Once at the facility, these wild fish will be treated the same as wild fish brought to the facility for rearing. They will be taken to the wild fish tanks, where gametes will be collected. After collection of gametes, these fish will be sacrificed for health and genetic testing.

4.5.5 On-site Fish Health Monitoring

The MFWP Fish Health Coordinator shall be responsible for determining sampling protocol and time of inspection. The MFWP Fish Health Coordinator will schedule all inspections at the facility with the Sekokini Springs facility manager. Fish health inspections conducted prior to collection of fish or eggs from wild sources will be coordinated with the MFWP Fish Health Coordinator, regional staff responsible for management of waters from which fish will be collected, and the Sekokini Springs facility manager. Collection and transfer of fish in specific situations, which do not meet the requirements of this section, must be approved by the MFWP Fish Health Committee prior to transfer.

The following on-site inspections will be conducted:

- Wild fish brought to Sekokini Springs will be health tested at 4 inches (60 fish)
- Mature spawning fish at Sekokini Springs will be health tested at the time of spawning (Minimum of 60 fish or 100% of spawning adults)
- Fingerlings will be health tested prior to being stocked back into the wild (60 fish)
- Other testing at Sekokini Springs may be conducted as necessary.

An on-site fish culturist will monitor fish health at the facility. All fish health problems or unusual symptoms or mortality will be immediately reported to the MFWP Fish Health Coordinator. Fish health management will be consistent with MFWP fish health policy, Pacific Northwest Fish Health Protection Committee (PNFHPC) Model Program, Integrated Hatchery Operations Team (IHOT) policies, and Montana laws (87-3-209), ARM 12.7.502-12.7.504. Equipment used at the hatchery will be disinfected with chlorine, iodophor or other approved disinfectant between uses.

4.6 Captive Broodstock Option

Although Montana's captive M012 broodstock is available to reestablish WCT in many areas, a source of genetically pure WCT from "within-drainage" wild sources within the Flathead watershed is needed to replace certain populations locally. There are no plans to maintain a captive broodstock at the Sekokini Springs facility.

4.7 Hatchery Monitoring and Evaluation Activities

MFWP is under contract to complete investigations in support of the Hungry Horse Mitigation Program. Activities to assess WCT populations, and the eggs or fish provided by the Sekokini Springs facility, are presented in Chapter 8, long-term RM&E plan.

A Hatchery Genetic Management Plan is presented in Appendix J.

4.7.1 Fish Culture Monitoring

Fish culture monitoring activities will consist of documenting facility operational practices including evaluation of the following:

- Monitoring fish health
  - collection of mortalities (saved for biological analysis)
  - daily observation of behavior
- Fish rearing records (as can be collected without excessive handling to the fish)
  - survival by life stage
  - growth rates
  - feed consumption
  - feed conversion
  - condition factor
- Document release data
  - location
  - number
  - size at time of release

5.1 Description of the Flathead River System

The Flathead Subbasin is located in northwestern Montana and the southeastern corner of British Columbia, Canada. The subbasin is the most northeastern drainage of the Columbia River and encompasses almost six million acres (two million four hundred thousand hectares). Tributaries originate in Glacier National Park, the Bob Marshall Wilderness, and Canada. The mouth of the river is located at Paradise, Montana. The mainstem Flathead River begins at the confluence of the North and Middle Forks near Coram, Montana and flows southerly for 55.4 miles (89 km) where it enters the north end of Flathead Lake. This river is a sixth–order stream and flows predominantly through agricultural and forested lands of the Flathead Valley. The Sekokini Springs facility is located along the mainstem Flathead River, upstream of its confluence with the South Fork (Muhlfeld et al. 2000; Figure 17).

Within the U.S.'s portion of the subbasin, approximately 1.9 million acres (760,000 hectares) are protected and approximately 210 miles (338 km) of river are federally designated as Wild and Scenic with a recreational Outstandingly Remarkable Values (ORV; Table 5-1; CSKT and MFWP 2001). The Sekokini Springs site is located within an area classified as a recreational ORV under the Wild and Scenic Act.

Table 5-1. Flathead River Subbasin National Wild and Scenic Rivers

Flathead River Segment	Location	River Mile (River kilometer)	Classification
North Fork	U.S./Canada border to Camas Bridge	40.7 (65.5)	Scenic
	Camas Bridge to Middle Fork	17.6 (28.3)	Recreational
Middle Fork and Upper Mainstem	Headwaters to Bear Creek	46.6 (74.9)	Wild
	Bear Creek to South Fork	54.1 (87.0)	Recreational
South Fork	Headwaters to Spotted Bear River	51.3 (82.5)	Wild
	Spotted Bear River to Hungry Horse Reservoir	8.8 (14.1)	Recreational

Source: Flathead River Subbasin Summary (2001); Zackheim 1983

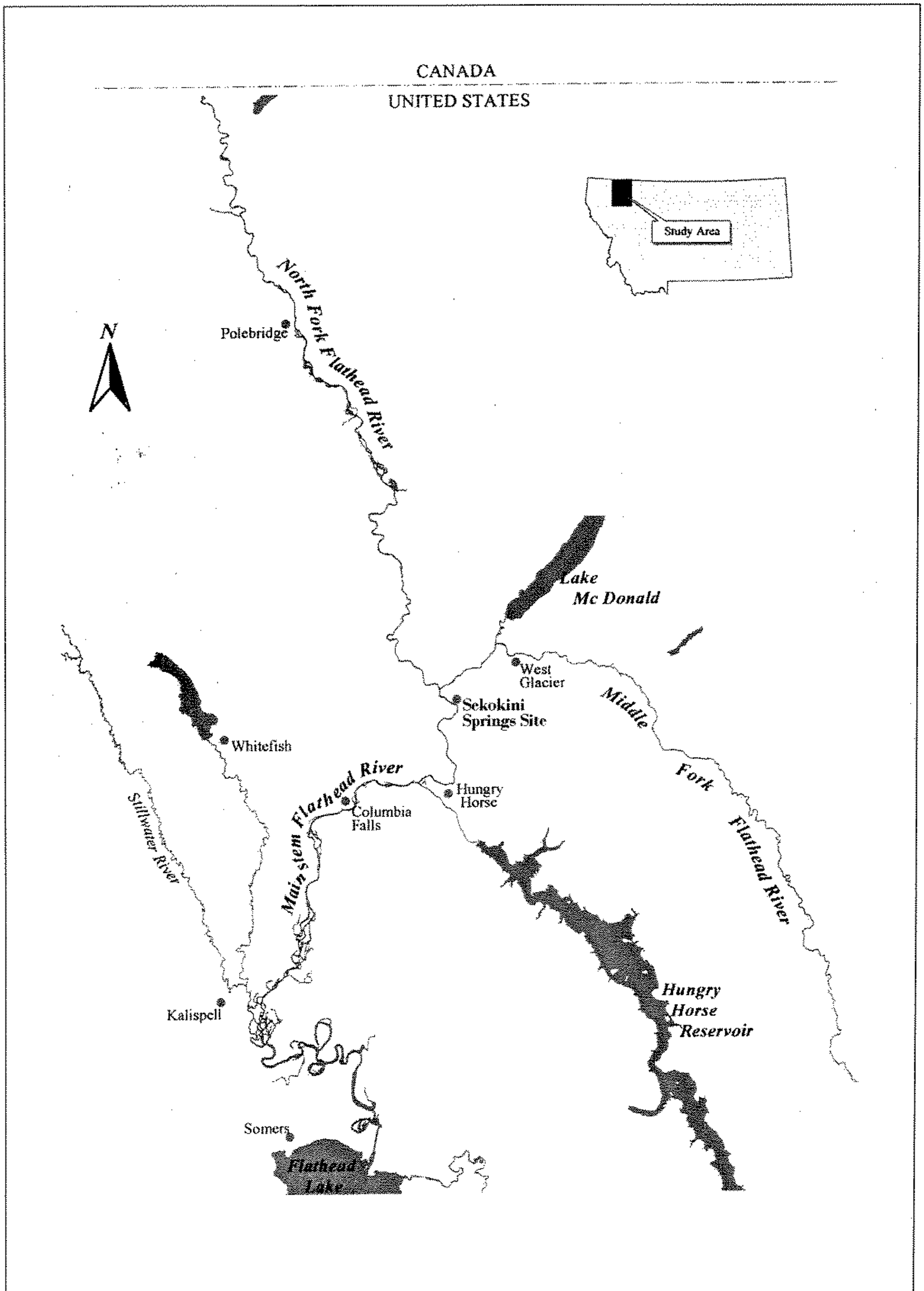

Figure 17. The Upper Flathead River Drainage Area including Flathead Lake and the Mainstem, North, Middle, and South Forks of the Flathead River.

There are ten native species and twelve introduced species in the Flathead system (Fraley et al. 1989; Montana Fisheries Information System, Helena 2003). Table 5-2 lists native species and Table 5-3 lists exotic fish species and the dates they were introduced.

Table 5-2. List of Native Fish Species currently found in the Flathead System

Common Name	Scientific Name
Bull trout	*Salvelinus confluentus*
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*
Mountain whitefish	*Prosopium williamsoni*
Pygmy whitefish	*Prosopium coulteri*
Longnose sucker	*Catostomus catostomus*
Largescale sucker	*Catostomus macrocheilus*
Northern pikeminnow	*Ptychocheilus oregonensis*
Peamouth	*Mylocheilus caurinus*
Redside shiner	*Richardsonius balteatus*
Sculpin spp.	*Cottus spp.*

Sources: Hanzel 1969; Alvord 1991; Deleray et al. 1999

Table 5-3. List of Non-Native Fish Species Currently Found in the Flathead System

Common Name	Scientific Name	Date Introduced
Lake trout	*Salvelinis namaycush*	1905
Lake whitefish	*Coregonus clupeaformis*	1890
Kokanee	*Oncorhynchus nerka*	1916
Yellow perch	*Perca flavescens*	1910
Northern pike	*Esox lucius*	1960s
Arctic Grayling	*Thymallus arcticus*	1927
Rainbow trout	*Oncorhynchus mykiss*	1914
Brook trout	*Salvelinus fontinalis*	1913
Yellowstone cutthroat trout	*Oncorhynchus clarki bouveiri*	1924
Largemouth bass	*Micropterus salmoides*	1898
Pumpkinseed sunfish	*Lepomis gibbosus*	1910
Black bullhead	*Ameiurus melas*	1910

Sources: Hanzel 1969; Alvord 1991; Deleray et al. 1999; Fraley et al. 1989

Note: In addition, Fathead Minnow (*Pimephales promelas*) was discovered in Beaver Lake circa 1999 and are now a self sustaining population. One illegally introduced female walleye (*Stizostedion vitreum*) was captured and removed from a Flathead River slough by MFWP personnel in 2000 (apparently stocked in late 1990's). Black crappie (*Pomoxis nigromaculatus*) were illegally introduced to Blanchard Lake circa 1997 and are now self reproducing.

5.2 Life History and Population Biology of Westslope Cutthroat Trout

Westslope cutthroat trout are a subspecies of interior cutthroat trout (*Oncorhynchus clarki*) that were historically the dominant trout in western Montana, central and northern Idaho, and a small portion of northwestern Wyoming (Liknes and Graham 1988). WCT are native to the Flathead drainage, which is one of the most important remaining strongholds for the species (Deleray et al. 1999). In many of the headwater streams, WCT are the only fish present. Westslope cutthroat trout using the mainstem of the Flathead River have diverse life history strategies, which makes it difficult to assess the status of populations because individual fish of one life history are generally not visually distinguishable from those of another life history. Determining population status for this species is difficult due to the timing of seasonal migrations and overlapping habitat use by representatives of the different life histories.

Three life history strategies are exhibited by WCT in the Flathead watershed: resident, fluvial, and adfluvial. The resident form completes its entire life cycle solely in headwater tributaries to all three Flathead River forks (Deleray et al. 1999). Migratory forms of WCT grow to maturity in the river (fluvial) or lake (adfluvial) before returning to their natal streams to spawn (Liknes and Graham 1988; Fraley et al. 1989).

Fluvial fish spawn in tributaries where the young live for up to four years. Approximately 60% of WCT emigrate from their natal tributaries to Hungry Horse Reservoir at age III (May et al. 1988). After emigrating from their natal tributary, fluvial fish reside in the Flathead River. Fluvial WCT are found primarily in the mainstem of the South Fork above Meadow Creek Gorge, and portions of the Middle Fork.

Adfluvial fish, like the fluvial form, spawn in tributaries where the young live for up to four years and then migrate to Flathead Lake or Hungry Horse Reservoir. Adfluvial WCT generally occur in the lower South Fork of the Flathead up to Meadow Creek Gorge and in the Middle and North forks of the Flathead River. Additionally, adfluvial WCT use the mainstem river and North and Middle Forks as a migratory corridor. Adults migrate to and from spawning tributaries from early winter through summer, while juveniles migrate from rearing streams toward Flathead Lake or Hungry Horse Reservoir from early summer through winter (Shepard et al. 1984; Liknes and Graham 1988). As winter approaches, some WCT begin long downstream migrations to avoid unsuitable temperatures. Where adequate overwintering habitat is available, some WCT exhibit a sedentary behavior. These sedentary fish are often young juveniles that are small enough to find suitable habitat within the gravels of a streambed (Muhlfeld et al. 2000; Liknes and Graham 1988).

5.2.1 Timing

Westslope cutthroat trout males attain sexual maturity beginning at age 2 and are usually all mature by age 4. Females begin to mature at age 3 and most are mature by age 5 (Downs et al. 1997). WCT within the Flathead River basin attain sexual maturity at age 4 and older (Liknes and Graham 1988). Resident and migratory WCT spawn in May and June in small and intermediate-sized tributaries. Juvenile WCT emerge from the spawning redds in June and July, depending on time of spawning and water temperature. Most of the migratory WCT leave the tributaries as juveniles at two or three years of age, primarily during June and July.

Repeat spawning varies greatly in Montana, from 0.7% of the spawning population in Youngs Creek (May and Huston 1975) to 24% of the spawners in Hungry Horse Creek (Huston 1972).

5.2.2 Distribution

Within the Flathead River basin, approximately 5,582 miles (8974 km) (33.9%) of the estimated 16,466 miles (26,472 km) of historic stream habitat have been surveyed for WCT. Among those stream miles surveyed, WCT have been documented in 4,174 miles (6711 km) of the stream (74.8%) (USFWS 1999). Liknes and Graham (1988) suggest that WCT are still present in 85% of their historic range in the Flathead River basin. Spawning is likely in all tributary headwaters that are accessible to the species. The Middle Fork of the Flathead River downstream from the wilderness boundary contains mostly adfluvial cutthroat. The Middle Fork upstream of the wilderness boundary and possibly the North Fork from Polebridge to the Canadian border contain primarily fluvial cutthroat (Fraley et al. 1989).

Estimates of juvenile WCT densities from the North, Middle and South Forks of the Flathead River are shown in Appendix K. Population estimates for juveniles >2.95 inches (75mm) for donor streams is shown in Table 5-4.

Table 5-4. The reach, stream order, gradient and juvenile WCT estimates (> 2.95 inches (75mm)) for Specific Reaches of Donor Stock Collection Streams (Milt and Juvenile Collections Combined).

Drainage	Stream	Reach	Stream Order	Gradient (%)	WCT Juveniles per 100m
South Fork	Deep Creek[1]	1	2	9.6	51.1
	Youngs[1]	1	3	0.8	22.3
	Quintonkon[1]	2	3	2.3	27.2
	Gordon Creek[1]	1	4	0.4	4.9
	Danaher Creek[1]	1	5	0.7	19.6
Whitefish River (tributary to Flathead)	Haskill	Unknown	Unknown	Unknown	Unknown

[1] Zubik and Fraley 1986

5.2.3 Age Composition

Shepard et al. (1984) estimated maximum ages of 7 for WCT inhabiting waters of the Flathead River/Lake subbasin. Age composition likely varies from year to year within the Flathead River. Pooled scale information from all forks of the River (251 samples analyzed) indicates that WCT from one to six years of age exhibit the mean lengths shown in Table 5-5, which correspond with age:

Table 5-5. Westslope cutthroat trout lengths and corresponding age classes

Mean length In inches (mm)	Estimated age
2.2 (55)	1
3.9 (100)	2
5.7 (146)	3
7.6 (194)	4
9.9 (251)	5
11.9 (301)	6

Source: Shepard et al. 1984

Downs et al. (1997) stated that length is a better predictor of sexual maturity than age in WCT. Using the age-to-length ratios presented in Table 5-5, estimated cutthroat trout numbers from a 1986 South Fork study indicate that approximately 86 percent of the population was less than 10.5 inches (254 mm) in length. This suggests that most fish in the South Fork are less than four years old. Mid-sized, 10.5 to 12.0 inches (254 – 305 mm, or age 4 and 5 fish) WCT comprised roughly 10 percent of the population, while large fish (> 12 inches (305 mm)) averaged only four percent of the population (Deleray et al. 1999). Estimates from the Middle Fork in 1994 indicate that small fish (< 10 inches (254 mm)) comprised approximately 98 percent of the total population for that year (Deleray et al. 1999). Snorkel estimates from the 1990s are consistent with those findings. The majority of fish within the Flathead River system appear to be less than four years of age (Deleray et al. 1999). These findings focused only on river and tributary systems where young adfluvial fish hold and rear until they emigrate to lakes. Therefore, these studies give no indication as to adult survival and abundance.

5.2.4 Sex Ratio

Spawning populations of WCT tend to have a high ratio of females to males. Studies from three Montana waters and one Idaho stream yielded a 3.4:1 ratio of females to males (Liknes and Graham 1988). However, in isolated headwater populations in Montana, Downs et al. (1997) documented an average of 1.3 males per female. Washoe Park Trout Hatchery in Anaconda reported that sex ratios of WCT are typically 1:1 (P. Suek, MFWP, personal communication, 2003).

5.2.5 Fecundity

Fecundity is associated with age and size where larger fish tend to produce more eggs.
Estimated average fecundity of Flathead River naturally produced WCT appears to be approximately 500 eggs per female (fecundity increases in the hatchery setting as shown from WCT at the Washoe Park Trout Hatchery, Anaconda, MT. J. Pravecek, MFWP, personal communication, 2003). Year 3 females have an average fecundity of 500 – 700 eggs per female and year 4 fish have an average fecundity of 1,000 – 1,200 eggs per female (J. Pravecek, MFWP, personal communication 2003). Published accounts suggest that WCT fecundity is slightly higher than for other subspecies and varies from 1,000 to 1,500 eggs for females with a mean length of 14 inches (355 mm) and mean weight of 1.1 pounds (0.5 kg) (Roscoe 1974; Liknes and Graham 1988).

5.2.6 Egg Incubation

WCT require an average of 1,100 accumulated daily temperature units (DTU) to develop into free-feeding fry (Lake Chelan Emergent Fry Study. Chelan County PUD. 2000). Eggs deposited from May through June will produce emergent fry in June through July, depending on the time of spawning and water temperatures. Washington Department of Fish and Wildlife (WDFW) biologists (2002) suggest an optimum incubation temperature of 55°F (12.7°C).

5.2.7 Juvenile Rearing

Juvenile WCT rear in natal streams and generally emigrate downstream at age 2 or 3 (Shepard et al. 1984). According to Liknes and Graham (1988), age 1 outmigrants may also be abundant downstream of spawning tributaries. Shepard et al. (1984) suggest that some juvenile WCT may move out of natal streams, overwinter in adjacent rivers, and then migrate to a lake. Juvenile emigration may also occur at early ages during the fall (Bjornn and Mallet 1964; May and Huston 1974, 1975), which may indicate a lack of overwintering habitat in upstream tributaries. Those juveniles that do not move from natal areas for overwintering may move into crevices in the substrate (Liknes and Graham 1988).

5.3 Historical and Current Fisheries Management

5.3.1 Historical Harvest Management

MacPhee (1966) found that WCT are highly vulnerable to angling, which is thought to be a contributing factor to their decline. Over time, angling limits for WCT have become much more restrictive. Downs et al. (1997) state that mature males, in particular, are especially susceptible to angling, which may explain skewed sex ratios. Angling for cutthroat trout is catch-and-release, except for the Middle Fork Flathead and the Great Bear Wilderness, and South Fork tributaries and lakes upstream of Hungry Horse Reservoir and the Bob Marshall Wilderness, where it is legal to harvest three fish less than 12 inches. (Table 5-6). Since the early 1970s, additional harvest management protection has been afforded to WCT as managers developed a policy of not planting exotic fish species in areas where they would compete with native species. One exception to this is kokanee salmon that have been planted throughout the Flathead River system until the mid-1990s. Additionally, since 1982, a policy has restricted the use of non-native fish in private ponds connected to the Flathead Lake and River system (MFWP and CSKT 2000).

Table 5-6. Historic and Current Angling Limits for Westslope Cutthroat Trout in the Flathead Lake and River System

Year	WCT Catch Limit
1959	10, or 10 pounds and 1 fish
1982	5
1984	5 (only 1 over 14 inches (356 mm) in River)
1986	5 (only 1 over 14 inches in River)
1990	2 in Lake, 5 (only 1 over 14 inches in River)
1992	2 in Lake, 5 (only 1 over 14 inches in River)
1994	2, only 1 over 14 inches
1996	2, only 1 over 14 inches
1998	Catch and Release only (except where wilderness limits apply and lakes other than FHL)

Source: MFWP and CSKT 2000

Tribal Harvest Management

The Tribes' *Fisheries Management Plan for the Flathead Indian Reservation,* adopted in 1987 and amended in 1993, is guided by three basic assumptions: (1) the Tribes are committed to managing their fisheries resources using the services of a professional staff and employing professional management techniques; (2) the Tribes wish to manage their fish stocks to provide fish for food, recreation, or Tribal commercial purposes consistent with their potential habitat; and (3) the Tribes wish to manage fisheries to maintain the current species composition found in reservation waters. An exception is where bull trout and pure strain WCT are found, they will have priority over non-native species. The plan also describes tribal policy on the introduction of non-native aquatic organisms, stocking, and procedures for developing regulations and management strategies.

State of Montana Harvest Management

Currently, there is no allowable harvest in the contiguous Flathead River system. The state of Montana has implemented a mandatory catch and release regulation for WCT in the Flathead River system. Wild runs established by this project in Flathead River tributaries will be protected by the mandatory catch and release.

Harvest of WCT (5 daily and 10 in possession) is currently allowed in lakes and standard Montana regulations apply to lake systems. These regulations do not include Flathead Lake where WCT harvest is catch and release only. Proposed regulations for the 2004 through 2007 fishing season limit the catch of WCT to three daily and in possession for streams, rivers, lakes and reservoirs in the Western District, within which the Flathead Subbasin occurs. However, proposed regulations in Flathead Lake still maintain catch and release only for WCT.

The offspring of wild WCT reared at Sekokini Springs will primarily be used to initiate wild spawning runs in restored or reconnected habitat. Once spawning runs are established, harvest will be controlled through fishing regulations. Most onsite areas are regulated for mandatory catch and release fishing, until such time as populations increase enough to sustain harvest.

Surplus fish will be reared to maturity and then outplanted in closed-basin lakes to provide angler harvest as part of Montana's Family Fishing program. Additionally, surplus fish could be outplanted into lakes being chemically rehabilitated as part of the WCT conservation program. This strategy will speed the recovery time of rehabilitated lakes, and provide recreational fishing opportunities immediately after treatment.

5.4 Production Management

5.4.1 Early Production Efforts

Historically, the MFWP first attempted to establish a WCT brood program in 1952 with fish captured from Big Salmon Lake and reared at the Jocko River State Trout Hatchery, the Hamilton Hatchery and Libby Hatchery. This attempt proved unsuccessful because biologists believed these fish were WCT-RBT hybrids. A second attempt occurred in 1954 when fish were taken from various Hungry Horse Reservoir tributaries and initially reared at the CNFH and then transferred to the Anaconda hatchery. After several hatcheries were closed, the remaining broodstock were stocked and the programs ended. In 1965, the Jocko River hatchery reared fish from Hungry Horse Creek and Emery Creek. Hatchery practices likely caused a loss of genetic variation within these stocks and they proved undesirable (Leary et al. 1990).

5.4.2 HHMP Program Overview

The goal of the HHMP is to mitigate fisheries losses attributable to the construction and operation of Hungry Horse Dam. Council approved fisheries losses include 65,000 juvenile WCT annually, to be restored using a combination of habitat restoration, dam operation changes, harvest management, and experimental hatchery techniques. The objectives of the Sekokini Springs facility are, therefore, consistent with the HHMP.

5.4.3 Westslope Cutthroat Reintroduction and Supplementation Program

The present broodstock was founded in 1983, mainly from fish collected from the South Fork Flathead River tributaries above Hungry Horse Dam and two populations in the Clark Fork drainage. These stocks were found to be genetically pure and are reared in several hatcheries throughout the state, in association with various tribal, state and federal agencies. These facilities include the Flathead Lake Salmon Hatchery, Murray Springs Trout Hatchery, Jocko River Trout Hatchery and the CNFH. The MFWP maintains the captive WCT M012 broodstock at Washoe Park Trout Hatchery in Anaconda, MT and rearing facilities throughout the state. Stocking efforts aim at providing and improving recreational fishing and meeting Tribal obligations.

6.1 Types of Limiting Factors

Limiting factors within the Flathead River subbasin vary depending on the location of the waterbody within the subbasin. Limiting factors that are applicable to portions of the Flathead River subbasin include the following:

- Altered Hydrograph
- Floodplain Alterations – includes bank instability and floodplain restrictions
- Non-native Species Interactions
- Fragmentation of Habitat
- Human/Wildlife Conflicts
- Sedimentation
- Temperature Changes
- Artificial Production

6.1.1 Altered Hydrograph

Hydropower-related discharge fluctuations on the South Fork and upper mainstem of the Flathead River have resulted in a wider zone of water fluctuation, or varial zone (nearshore habitat), which has become biologically unproductive (Hauer et al. 1994). Reduction in natural spring freshets due to flood control has reduced the hydraulic energy needed to maintain the river channel and periodically resort river gravels. Collapsing riverbanks caused by intermittent flow fluctuation and lack of flushing flows have resulted in sediment buildup in the river cobbles, which is detrimental to insect production, fish reproduction, food availability, and security cover. Changes in the annual hydrograph for the lower Flathead River cause the normally vegetated varial zone to become abnormally inundated. This does not allow riparian vegetation to exist where it normally would. The area between the high and low water levels has become a largely unvegetated varial zone dominated by silt, cobbles and rock. Deciduous and mixed deciduous/coniferous vegetation has moved toward a conifer-dominated vegetative community due to the curtailment of naturally high flows during spring runoff, for flood control, and abnormal flow fluctuations caused by electricity generation. Studies have also shown that constant fluctuation in water levels and flows have not allowed a stable enough situation for vegetation to become established (Mackey et al. 1987; Mack et al. 1990, Hansen and Suchomel 1990).

6.1.2 Floodplain Alterations

Channelization, road fill, bank armoring and other encroachments along stream segments have narrowed channels and limited meander inside floodplains. This has created shorter channels, steeper gradients, higher velocities, loss of bank storage and aquifer recharge capacity, streambed armoring, and channel entrenchment. In impacted stream reaches, even minor flood events have often resulted in significant channel deterioration. Erosion has increased, and the number of pools and the extent of riparian cover has decreased. The changes have lowered the quality and quantity of fish and wildlife habitat.

6.1.3 Non-Native Species Interactions

Non-native species now threaten the diversity and abundance of native species and the ecological stability of ecosystems in the subbasin. Illegal (intentional) and unintentional introductions of non-native fish species have set up negative inter-species competition with native fish. Non-native RBT and YCT have also hybridized with native WCT. The introduction of RBT and YCT, and predation by nonnative lake trout in Flathead Lake has had adverse effects on native WCT.

6.1.4 Fragmentation of Habitat

Fish migrations have been blocked by human caused barriers, including road culverts, dewatered stream reaches, dams, and irrigation diversions (Morton 1955; Read et al. 1982; Weaver et al. 1983). These blockages fragment river reaches and result in less habitat available to fish that utilize affected stream reaches.

6.1.5 Human/Wildlife Conflicts

Increasing numbers of humans in sensitive wildlife habitats has led to an increasing number of human/wildlife conflicts. For example, humans continue to introduce non-native fish and other nuisance aquatic species that impact native species restoration efforts, and illegal harvesting of WCT most likely occurs in many areas. Land use practices, including road and house construction, irrigation withdrawals and recreational uses of river systems has also contributed to declines in WCT population abundance.

6.1.6 Sedimentation

Logging activities, road building, residential development, and agricultural practices have increased the amount of fine sediments entering streams. Fine sediments accumulating in spawning substrates reduce egg-to-fry survival (Weaver and Fraley 1993). In some areas sedimentation has reduced natural reproduction to the point that it is insufficient to fully seed available rearing habitat with juvenile fish. Pools and rearing habitat have become clogged with sediment, reducing the productive capacity of the stream. Indirect effects of sediment include loss of invertebrate populations due to loss of habitat and food sources. This loss is significant because aquatic insects compose a large percentage of the WCT diet, especially during spring and early summer, before terrestrial insects and zooplankton become the dominant prey.

6.1.7 Temperature Changes

The removal of riparian vegetation, especially trees and overhanging shrubs, has changed stream water temperatures, making the water warmer in the summer and colder in the winter. These changes have interfered with fish migration, spawning and survival, and have generally degraded the quality of stream habitats for native fish and other aquatic life. This, in turn, has affected the food base for the many wildlife species that feed on aquatic organisms.

6.1.8 Artificial Production

Currently, Montana's hatchery system does not supply fish to rivers and streams. The Sekokini Springs facility will enable propagation of genetically unique strains for initiating "wild" spawning runs in streams scheduled for native species restoration where native WCT have been extirpated and replicate stocks that are threatened by habitat degradation or nonnative fish species after limiting factors are eliminated.

The progeny of wild fish produced by this program will be available for stocking certain lakes that are proposed for treatment by the South Fork Flathead Watershed Westslope Cutthroat Conservation Project. Nonnative rainbow trout and genetically introgressed cutthroat trout populations will be removed using rotenone or antimycin and replaced with genetically pure westslope cutthroat trout from the state's captive M012 brood stock or within-drainage stocks reared at Sekokini Springs.

The closed-basin lakes that are planted through this program provide alternative fisheries to meet public demands for harvest and partially offset fishing bans or reduced limits enacted for native species recovery. This program may indirectly benefit native species recovery by redirecting harvest away from sensitive recovery areas in the contiguous Flathead watershed.

6.2 Habitat Studies, Assessments and Planning Efforts

Habitat studies and planning efforts were addressed in Section 1.4. The state of Montana has initiated a modified IFIM project on the Flathead River to calibrate simulations of hydraulic conditions (stage/discharge and velocities, etc.) and fish habitat from HHD to Flathead Lake at various discharges from HHD (Muhlfeld et al. 2000). An optimization program is scheduled for development to allow managers to assess tradeoffs between the requirements of reservoir and riverine biota, when conflicts occur between reservoir operation and river flow limits. MFWP and CSKT monitor the effects of dam operation in HHR and the Flathead River and its tributaries. Daily flow data can be examined using the IFIM model to determine the area of the channel affected by dam operation. Radio telemetry was used to study habitat selection by fish species and life cycle phase. Results were used to calibrate the IFIM model to assess species-specific and lifecycle effects.

Numerous fish passage and habitat projects have been completed in the Flathead River subbasin. These include the establishment of an extensive monitoring program, installation and operation of selective withdrawal at HHD, offsite lake rehabilitation and the development of IRCs for HHD. IRCs are used as a tool to balance the requirements of hydropower generation and flood control with the needs of resident and anadromous fish. Highlights include work on Hay Creek, where more than 11.2 miles (18 km) of bull trout and WCT spawning/rearing habitat was reconnected to the North Fork Flathead River by redefining the channel in a braided reach that was subject to seasonal dewatering. Hay Creek flows reached the North Fork during the fall bull trout spawning period in 1995-98. Seven fish passage projects in tributaries to HHR, proposed since 1954, were completed in 1997. In total, these projects expanded available adfluvial WCT spawning and rearing habitat in HHR by 11.5 miles (18.5 km). Adfluvial WCT have spawned upstream of all culverts that were replaced or improved through 1997. Bull trout colonization has also been documented in 6 of 7 streams upstream of the former barriers.

Several components of the Taylor's Outflow project were completed in 1994-98, including reconstruction of 1.9 miles (3 km) of spawning and rearing habitat and connection (fish passage) to the mainstem Flathead River. Projects at Taylor's Outflow, Big Creek, and in the HHR drawdown zone have helped to develop biotechnical approaches for riparian restoration. In 1998, construction was completed at the Crossover Wetlands site, a pilot project designed to increase productivity in the reservoir drawdown zone.

A stream naturalization project in the lower portion of Emery Creek was completed in the fall of 2000. Cooperators included MFWP, USFS, National Fish & Wildlife Foundation and Trout Unlimited. The stream was degrading due to road encroaching on the floodplain which caused bank erosion, channel braiding and prevented transport of alluvium. The project restored the structural and functional integrity of the stream channel and will provide spawning habitat and much needed deep water habitats necessary for overwintering young trout.

Offsite, lake chemical rehabilitations have been extremely successful in establishing popular fisheries, creating genetic reserves, directing fishing pressure away from recovering stocks, and eliminating sources for new illegal introductions. Fishing pressure on Lion Lake (treated in 1992) nearly doubled after treatment and has the highest pressure per acre of 509 lakes in northwestern Montana. Devine Lake treatment removed the threat posed by introduced BKT on native trout populations in the wilderness. Similar success has occurred on recent rehabilitation projects at Bootjack, Murray, Dollar, and Little McGregor Lakes. In 1999 Hubbart Reservoir and Hidden lakes were also treated to remove an illegally introduced and stunted perch population. The lake was stocked with RBT and kokanee salmon in 2000. In this case, RBT were used because the species can recolonize Hubbart reservoir from Bitterroot Lake upstream. Downstream trout movement is effectively eliminated by the dam and lethal water temperatures in the discharge stream, so there is no threat to native fish species. Angling records indicate Hubbart Reservoir can provide upwards of 3000 angler days per year when at peak production.

In 1999, Hungry Horse Mitigation launched a program to reduce the threat of competition and hybridization that non-native species pose to the Flathead's native trout constituent. High altitude lakes in the North, Middle and South Fork drainages were inventoried and a database was developed to track stocking history, angler use, genetic composition, etc. Lakes having exotic fish populations were prioritized and the restoration program commenced with the treatment of two lakes. Following public review and comment of the Montana Environmental Policy Act Environmental Assessment, Whale Lake in the North Fork Flathead drainage was treated and thus eliminated the only known exotic trout population in that drainage that lies outside of Glacier National Park. Likewise, Tom-Tom Lake in the South Fork drainage was treated. The project is expected to continue by treating 2-3 lakes per year until this threat is reduced or eliminated. A 10-year program to eliminate the sources of hybrid fish in the South Fork Flathead drainage is currently the subject of a draft environmental impact statement (DEIS) by BPA (Grisak 2003).

A summary of habitat improvement projects that have been completed or are proposed to be implemented in the Flathead River basin are listed in Table 6-1.

Table 6-1. Habitat Improvement Projects in the Flathead River Subbasin

Project Name	Project Description	Project Goal	Location	Project Participants
Elliot Creek Enhancement	Artificial spawning channel and WCT stocking ; attempt to eradicate BKT	Provide additional WCT spawning and rearing habitat	Elliot Creek flows into the Flathead River upstream of Flathead Lake	MFWP
Big Creek Sedimentation Control	Sedimentation control; riparian revegetation	Improve former WCT spawning and rearing habitat	Big Creek, a tributary to the North Fork Flathead River	MFWP, USFS, American Timber Co., F.H. Stolze Land and Lumber Co.
Hay Creek Enhancement	Sedimentation control, riparian enhancement	Reconnected habitat that was blocked by subsurface flow to open spawning channels; reduce fine sediments; increase streambank stability	Hay Creek, a tributary to the North Fork Flathead River	MFWP, BOR, and private landowners
Taylor's Outflow Restoration	Habitat improvement, instream and riparian; Passage improvements; attempt to eradicate BKT	Installed fish ladder to allow fish passage to provide additional WCT spawning and rearing habitat; improved habitat in degraded creek	Taylor's Outflow, a small creek that flows into the Flathead River near Columbia Falls	MFWP, private landowners
HHD Fisheries Mitigation Program	Culvert replacements and sediment source surveys	Improve fish passage for bull trout and WCT	Streams: Felix, Murray, Harris, N. Logan, McInernie, Margaret, Riverside	MFWP, BOR, USFS
Slash Pile Installation in HHR	Install slash piles by anchoring pine tree tops	Measure benthic insect production and availability to WCT	HHR	MFWP
HHR Revegetation and Riparian Enhancement	Riparian enhancement	Improve water quality, reduce erosion, increase insect production, establish healthy native plants	HHR	MFWP
Willow Survival Experiments	Native willow enhancement	Determine if HHR drawdown zone can be revegetated with water tolerant plants	HHR and Emery Bay	MFWP, BOR, USFS
HHR off-site Mitigation	Attempted eradication of non-native fish species	Improve WCT habitat, reduce competition with BKT	Lion Lake, Rogers Lake, Bootjack Lake	MFWP
Coolwater Fisheries Enhancement	Increase shoreline and submerged cover	Increase habitat availability for cool water fish species	Echo Lake, Halfmoon Lake	MFWP, local sportsmen groups, Burlington Northern
Fish Passage in Paolo and Tunnel creeks	Remove or replace culverts	Improve fish passage	Paola and Tunnel creeks, tributaries to Middle Fork Flathead	MFWP
Sullivan Creek Drainage	Sediment source survey	Improve water quality	Sullivan Creek watershed	MFWP, USFS

Hungry Horse Wetlands Project	Restore/create wetland habitat	Increase aquatic invertebrate production	Upper end of HHR	MFWP, BOR, USFS
Dayton Creek Habitat Improvements	Habitat improvements	Reduce bank instability problems; increase average depth and increase pool and riffle habitat to increase WCT habitat	Dayton Creek, tributary to Flathead Lake	MFWP, CSKT
Griffin Creek Fencing Project	Install fences	Improve habitat by eliminating grazing in riparian zone	Griffin Creek, stream in Stillwater River drainage	MFWP
Lake Rehabilitation	Eradicate fish non-native species	Increase habitat available to WCT and bull trout	Skyles Lake, Spencer Lake, Murray Lake, Dollar Lake, Little McGragor Lake and Hubbar Reservoir	MFWP
Stoner Creek Improvement	Habitat and fish passage improvement	Improve habitat for WCT	Stoner Creek, tributary to Flathead Lake	Kerr Mitigation Coop
Whale Lake Rehabilitation	Eradicate non-native fish species	Provide increased habitat for WCT	Whale Lake, tributary to the North Fork Flathead	MFWP
Tom-Tom Lake Rehabilitation	Eradicate non-native fish species	Provide increased habitat for WCT	Tom-Tom Lake, tributary to the South Fork Flathead River	MFWP
Emery Creek Improvements	Reconstruct 2 km of stream that had been channelized by road, re-vegetate streambanks	Increase streambank stability to reduce sedimentation and improve WCT habitat and migration corridor.	Emery Creek, a tributary to Hungry Horse Reservoir	MFWP, USFS, Trout Unlimited, National Fish and Wildlife Fund
CSKT Focus Watershed Program	Habitat improvement projects	Provide increased habitat for bull trout and WCT	Dayton Creek, east and south forks of Valley Creek, Marsh Creek, Post Creek, Mission Creek, DuCharme Creek, the Little Bitterroot River and Jocko River	CSKT in coordination with the Flathead Basin Commission, Bull Trout Restoration Team, Conservation Districts of Lake, Lincoln, Sanders and Flathead counties; NRCS, Montana Watercourse, Montana Watershed Inc.

Source: Knotek et al. 1997; Fredenberg et al. 1999.

Chapter 7 Risk Management Plan

7.1 Demographic Risk

Demographic risk is defined as the risk of extinction due to factors that contribute to population growth and decline. These factors include smolt-to-adult return rates, birth and death rates, and immigration and emigration rates. Smaller populations have higher risks of extinction because chance plays a greater role in determining individual survival and breeding success. Based on habitat degradation, genetic introgression and hybridization with other species in addition to declining population trends, managers of WCT in Montana have determined that the Flathead River WCT populations are at moderate risk of extirpation.

Protecting donor populations

Our plan is to remove no more than 25% of juveniles (age I through IV, approximately 70 to 180 mm TL) from donor populations in any given stream reach. Because access is limited to many areas during winter, juveniles would be collected during summer. Collections would be scheduled after the spawning period to reduce risk to spawning adults. Collections would not be "one time only" as the ISRP stated, but would continue for several years to assure that progeny represent the genetic diversity in the donor stock. Collecting fish over time and distance (longitudinal stream reach) reduces the risk of capturing many siblings from a few spawning events. Population estimates using the extinction method would be completed during juvenile collections and in subsequent years to determine if removing 25% of the juveniles impacts populations in the affected stream reach. Our rationale was that compensatory responses and fish recruitment from adjacent stream reaches would lessen the effects on the donor population. If the number of juveniles decreases within a population, as evidenced through electrofishing population estimates the following year, less fish would be removed, or fish collection would cease. A precipitous decline (>25%) in a donor population from one year to the next would necessitate a cessation of juvenile collections.

If juvenile fish collections fail to achieve our objectives in a given location, we proposed to collect milt and/or eggs from adult spawners. Collection of gametes would require trapping and handling spawners, which could interrupt natural reproduction. Impacts to spawning adults could be reduced by partially spawning females, then releasing them to spawn naturally. Access to remote streams is limited by snow during the spawning period making gamete collection logistically difficult. Males and females become fertile at different times, so males would have to be held captive in the stream until females ripen, or female maturation would have to be manipulated using hormone injections. This would require personnel at the site during the entire spawning period. If this strategy must be used, MFWP would first estimate the number of spawners in the donor population using electrofishing and/or migrant trapping to determine how many adults can be safely removed. Spawning runs with less than 25 spawning pairs would be left to spawn naturally. The program goal is to collect up to 60 mature males from each donor stream for milt collection. This can be accomplished over several years to avoid removing more than 50 percent of spawning males each year. In the future, if gametes from males and females are collected, the program goal is to obtain gametes from at least 25 females and 25 males, collected over the spawning period. No more than 25 percent of the females would be removed from the donor population in any given year.

Protecting non-target organisms during fish eradication operations

Fish eradication projects will be performed by HHM, separately from the Sekokini Springs project.

Antimycin and rotenone were selected for chemical fish removal because the toxins break down rapidly after treatment and effects on non-target organisms are short-term and temporary (Grisak 2003a; AFS 2000; Chandler and Marking 1982). MFWP has investigated the performance of and the effects of rotenone and antimycin on native amphibians and WCT by laboratory assay (Grisak et al. 2005 In press). This research produced response curves for both 24-hour and 96-hour exposures. The 24-hour LC50 values are listed in table 1. Antimycin has been extensively tested to measure its effect on non-target organisms. Schnick (1974) prepared a compendium of study results on non-target organisms and concluded that laboratory studies, field trials and case histories from reclamation projects revealed that vertebrates, phytoplankton or aquatic plants exposed to antimycin at fish killing concentrations demonstrated no adverse effects either short term or long term. Late fall treatments are advantageous because most amphibians have metamorphosed and left the water, or have entered winter dormancy.

Table 1. Comparison of 24-hour LC50 values (+ 95% CI) for long-toed salamanders, Columbia spotted frogs, tailed frogs and westslope cutthroat trout after exposure to rotenone or antimycin.(from Grisak et al. 2005 *In prep*).

Species	*Life stage*	*Antimycin (ug/L)*	*Prenfish (mg/L)*	*Rotenone (ug/L)*
Long-toed salamander	**Larvae**	**225 (150-300)**	**0.10**	**5**
	Adult		**8.0 (6.6-9.8)**	**400 (330-490)**
Columbia spotted frog	**Adult**	**>250**	**41.5 (33.9-50.9)**	**2100 (1695-2545)**
Tailed frog	**Tadpole**	**77.6 (66.3-90.7)**	**0.04 (0.03-0.05)**	**2 (1.5-2.5)**
Westslope cutthroat trout	**Fry**	**<1.0**	**<0.25**	**<12.5**

To reduce impacts to bull trout or pure WCT populations downstream fish removal projects, MFWP devised strategies to neutralize fish toxins upstream of sensitive non-target fish populations (Grisak 2003a).

Chapter 8. Long-term Research Monitoring and Evaluation Plan

Montana Fish, Wildlife & Parks (MFWP) and the Confederated Salish and Kootenai Tribes (CSKT) are implementing the Hungry Horse Mitigation Program designed to offset fisheries losses attributable to the construction and operation of Hungry Horse Dam. As part of this Program, we are taking action to protect and restore westslope cutthroat trout (*Oncorhynchus clarki lewisii*) in the Flathead Watershed. MFWP proposed renovating an existing hatchery at Sekokini Springs into natural rearing facility to assist in genetic conservation of the species. On February 4, 2005, the Independent Scientific Review Panel (ISRP) provided a preliminary review (ISRP 2005-4) of MFWP's Master Plan and Hatchery Genetic Management Plan (HGMP) for the *Sekokini Springs Natural Rearing Facility and Educational Center,* Hungry Horse Mitigation Project (project 199101903). The ISRP acknowledged that the renovation and implementation of Sekokini Springs as a hatchery conservation facility would be a proactive step to bolster populations of westslope cutthroat trout and help avoid potential listing under the Endangered Species Act. The ISRP stated that the science related to Sekokini Springs and its role in westslope cutthroat trout conservation in the Flathead Subbasin was, for the most part, sufficiently sound. ISRP asked for additional information, an updated Master Plan and a long-term Research, Monitoring and Evaluation (RM&E) Plan. MFWP therefore compiled related RM&E actions to be carried out by Hungry Horse Mitigation and the Mainstem Amendment Monitoring Project (project 200600800). This document describes ongoing and planned RM&E to evaluate artificial propagation of genetically pure westslope cutthroat trout at Sekokini Springs and the success of fish released into restored habitat.

Biological Justification

In 1999, a Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout in Montana (Conservation Agreement) was developed and signed by Montana Fish, Wildlife & Parks, U.S. Fish and Wildlife Service, Bureau of Land Management, Forest Service, Natural Resources Conservation Service, Montana Department of Environmental Quality, Montana Department of Natural Resources and Conservation, Westslope Cutthroat Trout Technical Committee, Montana Chapter of American Fisheries Society, and Montana Wildlife Federation. The goal of the Conservation Agreement is to ensure the long term, self sustaining persistence of the species within each of the five major river drainages they historically inhabited in Montana, and to maintain the genetic diversity and life history strategies represented by the remaining local populations. The agreement lists five objectives to achieve this goal; primary among them is to protect all genetically pure westslope cutthroat trout populations.

Renovation of the Sekokini Springs Natural Rearing Facility was recommended in the Flathead Subbasin Plan for conserving westslope cutthroat trout populations in the Flathead watershed. Sekokini Springs was designed by MFWP in collaboration with CSKT, HDR FishPro and US Bureau of Reclamation technical assistance program. Goals in Subbasin Objectives 1 and 2 for westslope cutthroat trout, directed cooperating agencies to: 1) evaluate effects of introduced fishes on westslope cutthroat trout and implement tasks to minimize negative effects; 2) conserve and monitor genetic diversity and gene flow among local populations; 3) incorporate conservation of genetic and behavioral attributes of westslope cutthroat trout into recovery and management plans; 4) conduct a genetic inventory to complete the genetic baseline (untested areas) and to monitor genetic changes throughout the range of westslope cutthroat trout; 5) experiment with micro-elemental signatures in fish scales and otoliths to determine the natal stream of origin; 6) maintain long-term viability of conservation populations and establish wild populations where native stocks have been extirpated; 7) develop genetic management plans and guidelines for appropriate use of transplantation and artificial propagation (e.g. Sekokini Springs Master Plan, HGMP and this RM&E Plan); and 8) suppress or eradicate introduced species that compete with, hybridize with, or prey on genetically pure westslope cutthroat trout. Objective 3 directed cooperating agencies to upgrade hatchery practices…to minimize the risk of further inadvertent introduction of non-native species in the Flathead Subbasin and implement control of nonnative fishes. Objective 4 directed cooperating agencies to appropriately utilize rotenone or antimycin to remove non-native species or introgressed populations and detoxify ichthyotoxins upstream of sources of bull trout. The Hungry Horse Mitigation Program is working to complete these objectives.

Molecular Genetic Detection of Hybridization

Monitoring and evaluation activities for the facility will include genetic monitoring to verify the genetic makeup of fish collected. To differentiate WCT from RBT, YCT or introgressed forms, genetic sampling may involve protein electrophoresis, paired interspersed nuclear DNA element – Polymerase Chain Reaction (or PINE marker) method or various mitochondrial DNA marker techniques. Samples would be analyzed by the Montana Wild Trout and Salmon Genetics Laboratory at the University of Montana, Missoula or another suitable laboratory.

Advances in molecular genetic methods have greatly improved the ability to detect hybridization and characterize patterns of introgression. Molecular detection of hybridization is frequently based on multiple diagnostic loci that are fixed or nearly fixed for different alleles in hybridizing taxa (Ayala and Powell 1972). Diagnostic loci are the most reliable marker type for hybrid detection and have been used extensively for describing hybrid zones (Szymura and Barton 1986), measuring barriers to genetic exchange between species (Sage et al. 1986), and identifying nonintrogressed populations for conservation efforts (Dowling and Childs 1992).

Several classes of diagnostic molecular markers exist for identifying hybridization between cutthroat trout subspecies and rainbow trout. Historically, allozyme electrophoresis has been used to detect hybridization between cutthroat trout and rainbow trout (Leary et al. 1987; Allendorf and Leary 1988); however, this technique requires lethal sampling and immediate storage of samples at very cold temperatures. The advent of polymerase chain reaction (PCR) resolved this issue, allowing for amplification and long-term storage of DNA fragments from nonlethal tissue samples. Subsequently, PCR-based Paired Interspersed Nuclear Element analysis (PINE; Smithwick 2000; Spruell et al. 2001) was developed and is commonly used to detect hybridization between most cutthroat trout subspecies and rainbow trout. The primary shortcoming of this technique is the dominant expression of PINE fragments that limits the utility of this method strictly to determining presence or absence of hybridization. Recently, however, Boyer (2006) described seven diagnostic microsatellite loci for detecting hybridization between WCT and RBT. The high level of polymorphism and codominant Mendelian inheritance pattern at microsatellite loci make this marker type ideal for fine-scale population genetic studies. Codominant diagnostic markers allow all genotypes to be distinguishable, making it possible to categorize individuals by the type of hybrid cross and assess the likelihood that some individuals in the population are nonhybridized. Currently, the University of Montana Conservation Genetics Laboratory is expanding the utility of this method by identifying diagnostic microsatellite loci between WCT and YCT. These additional loci will be valuable for detecting YCT introgression in drainages where this subspecies has been transplanted.

Hybridization in individuals and populations is identifiable by the presence of alleles from both parental taxa at diagnostic loci. However, it is important to note that loci that appear to be diagnostic may not be diagnostic for all populations of a taxon. For example, an allele typically characteristic of RBT or YCT may occur in some WCT populations as a result of mutation rather than hybridization (i.e., homoplasy). The high mutation rate at microsatellite loci increases the likelihood of homoplasy at typically diagnostic loci. However, it is possible to detect homoplasy by examining several diagnostic loci. Hybridization is expected to result in approximately equal rates of introgression throughout the genome. Therefore, a high frequency of a diagnostic allele at a single locus is likely evidence of homoplasy and not hybridization (Forbes and Allendorf 1991*a*). Additionally, we may assess the likelihood that a novel allele (i.e., one that has not been previously identified in either taxon) indicates either hybridization or intraspecific genetic variation based on the number of base-pair repeats.

In summary, the development of diagnostic microsatellite loci is an important advancement in methodology for detecting and describing patterns of hybridization. Additionally, microsatellites are valuable molecular markers for a wide range of population genetic studies including estimation of migration among populations, detecting regions of the genome under selection, and parentage assignment. As molecular genetic techniques continue to advance, so will our ability to answer biological questions that will aid in the conservation of WCT.

Research and Collaboration Opportunities

The Sekokini Springs Natural Rearing Facility will provide an exceptional opportunity to address important questions pertaining to hybridization, local adaptation, and captive breeding of threatened and endangered species. Research and collaboration with The University of Montana, Flathead Lake Biological Station, and Montana State University can enable opportunities for graduate students and provide an efficient means of conducting research and promoting the facility.

Questions remain about local adaptations in aboriginal WCT populations that have not been experimentally tested. Local adaptations have not been related empirically to genetic differences between divergent populations. It also remains unknown if the genetic differences observed among the streams are the result of adaptation to local environmental pressures or resulted from a cataclysmic population reduction, such that streams contain descendants from a small founding population. Long-term monitoring of genetic changes in re-established WCT populations provides an opportunity to link genetics to observations of growth, fecundity, survival and phenotypic traits.

Related Mitigation Actions

The Hungry Horse Mitigation (HHM) is cooperating with the Bonneville Power Administration and US Forest Service to complete an EIS for the South Fork Flathead Watershed Westslope Cutthroat Trout Conservation Project (FEIS). This proposed 10+ year restoration project would protect westslope cutthroat trout in the strongest core area in Montana by removing nonnative fish species and hybrids from mountain lakes in the South Fork Flathead headwaters. This project would treat two or three lakes per year with rotenone or antimycin, and within 12 months, replace the lake populations with genetically pure westslope cutthroat trout.

Nonnative trout suppression is also occurring in selected tributaries to the mainstem Flathead River. MFWP is tracking the expansion of rainbow trout in the mainstem Flathead River and the North and Middle Forks of the Flathead. Rainbow trout are expanding from a few primary sources. To control or reduce nonnative species expansion, barriers have been installed in selected streams to prevent spawning by rainbow trout while native cutthroat are restored (Muhlfeld et al. 2004; Grisak et al. 2003, 2004).

HHM has also reconnected spawning habitat blocked by human caused barriers in native fish core areas (Knotek et al. 1997). Our long-term goal is to restore wild runs of native trout using habitat restoration, fish passage and experimental aquaculture. Sekokini Springs would facilitate these ongoing efforts by providing an isolated, controlled environment for conserving wild populations. Where introduced species are containable, HHM uses physical means (e.g. electrofishing, trapping and/or piscicide treatment) to suppress nonnatives. All non-native species (e.g. RBT) or apparently hybridized or introgressed individuals collected during M&E efforts will be held for transport to a closed-basin "put and take" children's fishing pond called Dry Bridge Slough on South Woodland Drive, Kalispell, Montana.

Micro-elemental research (Muhlfeld et al. 2005) is being used to determine the natal stream of origin of individual fish. The technique shows promise as a nonlethal sampling tool that requires the removal of one scale (more than one are actually removed) from each fish. Research on microelemental signatures in fish scales began in 2001. This non-lethal technique proved reasonably accurate for identifying a fish's natal stream of origin (Wells et al. 2003; Muhlfeld et al. 2005). Combined with genetic samples, these two layers of evidence should increase accuracy manifold. The implications to research and management seem clear; trout are pre-marked by elements in their natal environment. Juvenile fish captured within an unspecified amount of time after emigration can be related back to their natal tributary.

Questions remain about the stability of elemental marks in fish scales as fish mature. Trout scales are gelatinous and contain proportionately less minerals per mass than otoliths. Scales consist of a matrix of collagen fibrils and mucus with plates and prismatic crystals of calcium in the form of hydroxyapatite (Wells et al. 2003; Yoshitomi et al. 1997). As fish scales grow, calcified structures form in plates on the exterior and spikes penetrate the collagen-mucus matrix in the scale interior (Schönbörner et al. 1979). Unlike otoliths that are ossified in concentric layers and, once formed, remain isolated from metabolic processes, minerals in scales can apparently change over time. We suspect that the fish can reabsorb calcium from the scales to meet metabolic needs, perhaps associated with maturation. If so, the technique would have to be used within an unspecified time after fish emigrate from their natal tributaries. To determine when to use the technique, the persistence of microelemental signatures in fish scales must be measured as trout mature. MFWP plans to remove scales (or otoliths) from recaptured PIT tagged fish to empirically determine the persistence of elemental markers (Sr stable isotopes) after fish leave their natal streams. Migrant class (age at which fish emigrate from tributaries) can be determined using growth checks on scales, or through known intervals between the time of marking and subsequent emigration. Once these are known, recently emigrated fish can be used for future assessments to determine the relative contribution from various streams, or changes in recruitment resulting from various mitigation actions.

Donor Populations

HHM is implementing actions that will require drainage-specific broodstocks of WCT for restoration. Montana's westslope cutthroat brood stock at Washoe Park State Fish Hatchery is currently the only certified source of WCT for use in restoration. This stock (called M012) was established from donor populations throughout the South Fork Flathead and Clark Fork rivers and has a long history of genetic purity and fish health. University of Montana geneticists have approved M012 for restoration in most waters within their historic range statewide. In fact, M012 cutthroat have been stocked in all of the lakes proposed for restoration (Grisak 2003a). However, four stocks of non-hybridized WCT that are genetically distinct from the M012s have been identified within the watersheds where the 21 mountain lakes are scheduled for chemical rehabilitation using piscicides (Grisak 2003a; EIS 2005). Unique stream populations remain in the Big Salmon, Gordon, Youngs and Wheeler drainages.

Long-term and widespread stocking of M012 westslope cutthroat into these drainages could result in significant genetic changes to these populations; within-drainage stocks would be preferable, if available (Leary 2002). "Within-drainage" stocks are genetic variants in individual streams within the 6th code HUC. Development of within-drainage stocks may facilitate genetic conservation in certain waters in the Bob Marshall Wilderness and Jewel Basin Hiking Area where endemic stocks are unique. The cutthroat trout technical committee agreed that where aboriginal populations differ from M012, the most conservative strategy for restoring unique stocks would be to use WCT either collected directly, or descended directly, from each stream as the source of fish for restoring populations in lakes within each drainage. Where feasible and genetically appropriate , such stocks will be developed to maintain local adaptations and genetic diversity as westslope cutthroat trout are restored within their historic range.

MFWP collected additional genetic samples during 2005 to assess the current status of populations in Gordon and Youngs Creeks. In the Gordon and Youngs Creek drainages, non-lethal fin clips were obtained from approximately 30 fish per sampling location for microsatellite analysis. A disjunct population from Big Salmon Creek, established in North Biglow Lake in 1962, was also sampled in 2005 (N=52) to assess the feasibility of developing a donor population to restore headwater lakes in the Big Salmon drainage. The Wheeler Creek data was derived from a small sample (N=9) in 2001, and the current status is uncertain.

In some stream reaches, new populations can be initiated by direct translocation of fish. For lake restoration projects where greater numbers are needed to meet objectives, we proposed experimental propagation to avoid impacting the donor populations. Sekokini Springs would provide an isolation facility to "replicate" wild donor populations by rearing juvenile fish to maturity for spawning or by collecting wild gametes to restore new self-sustaining populations in selected drainages in the Flathead Subbasin. Up to four within-drainage stocks of native westslope cutthroat trout could be reared to maturity to produce F1 progeny for restoring populations. Based on previous propagation trials at Sekokini Springs, MFWP anticipates producing a sufficient quantity of wild WCT progeny to swamp (overwhelm with a higher proportion of pure WCT) remaining hybrids in reclaimed lakes.

Wild fish or gametes must first be tested for genetic purity and fish pathogens before being transplanted. Sekokini Springs has been used as an isolation facility to hold wild fish for testing and for experiments using stream-specific or "within-drainage" stocks. The site was also used by MFWP to collect wild gametes for infusion into the M012 brood at Washoe Park State Fish hatchery in Anaconda. The proposed outdoor rearing ponds and stream habitats at Sekokini Springs were designed to maintain wild behavioral traits in wild westslope cutthroat trout reared at the facility.

Criteria for Selecting / Certifying Donors

Prospective donor populations are sampled (60 fish) to determine genetic purity and to screen for fish pathogens.

As donor populations are examined for use, personnel will compile reference information for successfully replicating populations at Sekokini Springs. The population structure, mating protocol, behavior, growth, phenotype and genetic characteristics found in each wild source population will be used as a template for the F1 progeny of wild fish that are artificially reared for restoration activities.

Collecting Juveniles while protecting Donor Populations

Negative demographic effects to the donor population must be considered when removing fish or gametes from a prospective donor population. Our plan is to remove no more than 25% of juveniles (age I through IV, approximately 70 to 180 mm TL) from donor populations in any given stream reach. Our rationale was that compensatory responses and fish recruitment from adjacent stream reaches would lessen the effects on the donor population. Collections of juvenile fish would continue for several years to assure that progeny represent the genetic diversity in the donor stock. Collecting fish over time and distance (longitudinal stream reach) reduces the risk of capturing many siblings from a few spawning events. If the number of juveniles decreases within a population, as evidenced through electrofishing population estimates the following year, less fish would be removed, or fish collection would cease. A precipitous decline (>25%) in a donor population from one year to the next would necessitate a cessation of juvenile collections.

Donor streams will be monitored to determine whether removing 25 percent of juveniles impacts the population. Donor populations would be monitored by HHM using electrofishing apparatus and mark-recapture or extinction method population estimates using standard electrofishing techniques in established stream reaches prior to and after juvenile collections. Initially, donor streams will be sampled annually to assess trends in juvenile densities and annual variation. The reach boundaries would be documented with GPS coordinates and blocked with nets during the population estimate. Adfluvial populations will be sampled before or after the spring spawning run to avoid migratory fish. Because access is limited to many areas during winter, juveniles would be collected during summer. Fish density (fish / 150 m stream length) will be used to estimate the length of stream required to provide the appropriate number of juveniles for collection. The timing of samples will be consistent seasonally. Comparison with subsequent estimates during the same month the following year would provide a measure of possible impacts caused by fish removal.

Some proposed donor streams are designated index streams that are monitored annually as part of a juvenile population assessment conducted by MFWP. Past data from the index streams provide a measure of natural annual variation. When fish populations decline beyond the known annual variation in reference streams, juvenile collections will be terminated until survey results indicate that the population has rebounded to previous levels. Annual sampling of donor populations will be used to assess rates of population recovery after juvenile collections cease. Sampling in a given stream will end after the population rebounds to previous levels. We acknowledge that annual "snap shot" population estimates are variable in the absence of fish removal operations, so results will provide only trend information over time.

During monitoring and evaluation efforts (and collection activities), extreme care will be taken when applying electrofishing for collection of WCT. Dwyer et al. (2001) applied three methods of electroshocking to juvenile WCT to analyze effects from this method of fish collection. Fish were sampled 110 and 250 days post treatment. It was found that juvenile WCT (mean weight of 172 grams) exposed to electroshocking were negatively affected, as measured by weight gain and presence of spinal injuries. The authors express the need for caution when sampling small populations, where individuals may be of great importance, using electroshocking equipment (Dwyer et al. 2001). MFWP has responded by using Smith-Root electrofishing systems specifically designed to reduce injury in fish by using 300 volt pulsed DC at 30 Hz frequency at a pulse rate of 8 ms.

Collecting gametes

If juvenile fish collections fail to achieve our objectives in a given location, we propose to collect milt and/or eggs from adult spawners. Collection of gametes would require trapping and handling spawners, which could interrupt natural reproduction. Impacts to spawning adults could be reduced by partially spawning females, then releasing them to spawn naturally.

Access to remote streams is limited by snow during the spawning period making gamete collection logistically difficult. Males and females become fertile at different times, so males would have to be held captive in the stream until females ripen, or female maturation would have to be manipulated using hormone injections. This would require personnel at the site during the entire spawning period. If this strategy must be used, MFWP would first estimate the number of spawners in the donor population using electrofishing and/or migrant trapping to determine how many adults can be safely removed. Spawning runs with less than 25 spawning pairs would be left to spawn naturally. The program goal is to collect up to 60 mature males from each donor stream for milt collection. This can be accomplished over several years to avoid removing more than 50 percent of spawning males each year. In the future, if gametes from males and females are collected, the program goal is to obtain gametes from at least 25 females and 25 males, collected over the spawning period. No more than 25 percent of the females would be removed from the donor population in any given year.

Demographic and Genetic Management of Drainage-Specific Broodstocks

The most conservative approach to restore trout populations and maintain local adaptations requires developing within-drainage stocks to reestablish populations in certain waters in the Bob Marshall Wilderness and Jewel Basin Hiking Area. A primary objective of reintroduction programs is to maintain the genetic characteristics of the population so as to maximize the probability of successful reintroduction into the wild. Two major types of deleterious genetic change can occur during captivity: loss of genetic variation through genetic drift, and adaptation to captivity through natural selection. The ultimate success of the reintroduction effort depends on the ability to adequately address these issues.

The Sekokini Springs Natural Rearing facility would provide an isolation facility to replicate wild, within-drainage donor populations for restoration actions in selected drainages in the Flathead Subbasin. Up to four within-drainage stocks of native westslope cutthroat trout could be reared to maturity to produce F1 progeny for restoring populations. Sekokini Springs has also provided a controlled environment for collecting wild gametes for infusion into Montana's westslope cutthroat trout brood stock (called M012s).

Sekokini Springs also provides a controlled environment to isolate wild fish considered for translocation while they examined for genetic purity and fish pathogens. It is extremely important that fisheries managers do not inadvertently move hybridized individuals to recipient waters.

The proposed outdoor rearing ponds and stream habitats at Sekokini Springs were designed to maintain wild behavioral traits in wild, genetically pure westslope cutthroat trout brought to the facility.

Natural Prey Items

Mortality associated with bringing wild juveniles into aquaculture from the donor population is a serious issue. Past experience developing the M012 stock demonstrated difficulties in transportation and when wild fish transitioned to hatchery feed. We propose to provide temperature control and aeration while transporting wild trout or gametes. Once in isolation, we plan to experiment with natural food and methods for supplemental feeding. The outdoor habitat was designed to produce aquatic insects. The surface of the ponds will trap terrestrial insects from the surrounding landscape. Additional natural food could be harvested in the wetland pond, which will have one area with an unobstructed, gravel substrate where amphipods and insect larvae can be seined. The University of Montana's Flathead Lake Biological Station has also offered expertise for culturing aquatic insects.

Eliminate Grading

Human handling and artificial rearing presents a risk of inadvertent selection in fish derived through aquaculture. We proposed to produce only F1 progeny of wild fish, rather than developing a captive brood stock. Labor intensive to collect new spawners and/or gametes for each stocking event This short period in captivity should reduce artificial selection. We can further reduce the risk of hatchery grading by collecting wild fish over an extended stream reach or gametes over the course of the spawning period. Collections would occur over several years to assure genetics of the F1 cohort represent the donor population (Stockwell and Leberg 2002). Rearing fish in naturalized, outdoor habitat with natural food items should also reduce domestication.

Disease Prevention

Unlike other state hatcheries, the experimental facility at Sekokini Springs can isolate wild fish (including those considered for translocation) while they are tested for genetic purity and fish pathogens. Juvenile fish or gametes from donor populations will be isolated in a separate water source until they are tested for genetic purity and fish pathogens.

Approximately sixty individuals, or a number determined by the MFWP fish health specialist to be sufficient, from each lot will be sacrificed for disease testing. Thirty fish from this same sample will be tested for genetic purity before the fish are moved from the isolation facility (holding tanks on a separate water source) to the outdoor ponds.

Monitoring Donor Population Trends in Recipient Waters

When Sekokini Springs becomes fully operational, MFWP plans to monitor the success of fish plants and document any wild spawning runs we successfully initiate. Success can be measured through juvenile population estimates, migrant counts, micro-elemental signatures, genetic sampling and angler surveys.

HHM conducts population estimates (Extinction method or Peterson mark – recapture) using electrofishing, snorkel surveys and spawning redd surveys. Redds constructed by spring spawning trout are difficult to identify due to runoff conditions making counts less accurate. Nonetheless, redd counts provide evidence of natural reproduction and trends in adult escapement. Lakes are evaluated using gill net surveys to enumerate the number of fish per net, species relative abundance and provide samples for analysis (age/growth, genetics, population structure, etc.). Populations are also sampled using hook and line sampling and angler creel census.

Genetic samples from the refounded population will be compared over time to the original donor population to assess changes due to novel environmental pressures in the new location (Stockwell and Leberg 2002). Continued translocations from downstream populations to headwater lakes may be necessary to avoid potential impacts to downstream populations due to one-way gene flow.

MFWP is implementing treatments using rotenone and antimycin where total eradication of the targeted fish species is possible and likely to succeed. Where nonnatives are containable, HHM uses physical means to suppress nonnatives. For example, rainbow trout captured in Flathead River tributaries are relocated to closed-basin lakes for family fishing opportunities.

The Hungry Horse Mitigation (HHM) is cooperating with the Bonneville Power Administration and US Forest Service to complete an EIS for the South Fork Flathead Watershed Westslope Cutthroat Trout Conservation Project (FEIS). This proposed 10-year restoration project would protect westslope cutthroat trout in the strongest core area in Montana by removing nonnative fish species and hybrids from 21 mountain lakes in the South Fork Flathead headwaters. This project would treat two or three lakes per year with rotenone or antimycin and, within 12 months, replace the lake populations with genetically pure westslope cutthroat trout.

HHM tracks the expansion of rainbow trout in the mainstem Flathead River and the North and Middle Forks of the Flathead River. Rainbow trout are expanding from a few primary sources. Nonnative salmonids inhabit Flathead Lake, Flathead River and selected tributaries. The headwaters of the North and Middle Forks still contain sources of pure westslope cutthroat trout (Hitt 2002; Hitt et al. 2003).

Nonnative fish species and hybrid populations are expanding from headwater lakes in the South Fork Flathead River upstream of Hungry Horse Reservoir.

Barrier installation/Removal

To control or reduce nonnative species expansion, barriers have been installed in selected streams to prevent spawning by rainbow trout while native cutthroat are restored (Muhlfeld et al. 2004; Grisak et al. 2003, 2004). HHM has also reconnected spawning habitat blocked by human caused barriers in native fish core areas (Knotek et al. 1997). Future research should evaluate the efficacy of these management actions by assessing the extent to which barriers elevate straying rates and the spread of hybridization and whether reestablishing habitat connectivity promotes the spread of introgression.

Repopulating Streams

Remote Site Incubators (RSI's) were used successfully by MFWP's Libby Dam Mitigation Program to increase the number of westslope cutthroat trout rearing in Young Creek, west of Eureka, Montana. Results showed that RSI's provided increased juvenile rearing and recruitment while damaged spawning habitat is repaired (Dunnigan et al. 2003).

Post Reintroduction Monitoring

Releases from Sekokini Springs will be monitored over time to determine which strategy is most cost effective for reestablishing a wild population. Successful restoration of wild spawning runs in tributaries to the Flathead River can be assessed by migrant trapping, redd surveys and population estimation before and after fish/egg stocking into restored or reconnected habitat. Upstream spawning migrations into restored and reconnected streams will be sampled using migrant traps or remote PIT tag detectors. Spawners will be examined for physical tags or microelemental signatures in calcified fish tissues (Wells et al. 2003). MFWP is also researching a non-lethal sampling methodology that uses DNA analysis of fin tissue and minerals incorporated in fish scales to determine their natal stream or origin (Muhlfeld et al. 2005). Spawning success will be assessed through standard redd counts. Progeny will be assessed using 492 ft (150 m) electrofishing reaches and standard population estimates. Success can be measured through juvenile population estimates (Peterson mark-recapture; Ricker 1975; Zar 1996), migrant counts, micro-elemental signatures, genetic sampling and angler surveys.

Fish release strategies (eyed-egg, imprint fingerling or juvenile) can be evaluated in natal streams using electrofishing population census to monitor age-specific survival and growth. Electroshocking apparatus will be configured to avoid damage to native fishes (Dwyer et al. 1993; Dwyer and Erdahl 1995). Fish recaptured at larger size during subsequent surveys will be marked again using Passive Integrated Transponder (PIT) tags. MFWP estimates abundance and survival of cutthroat trout populations by examining juvenile outmigration and adult escapement at major spawning and rearing streams by use of migrant traps (i.e., screw and box traps) and PIT tags. Bi-directional migrant traps and remote PIT tag detection weirs will be installed near the mouths of spawning and rearing streams to capture and tag juvenile emigrants and adult spawners during spring, summer, fall, and possibly winter (depending on snow and ice conditions). Also, we will use a systematic survey to locate PIT tags each time a population estimate is performed throughout each study stream to quantify movements and to locate missing fish (Morhardt et al. 1999). All captured trout will be anesthetized with MS-222, abdominally implanted with individual PIT tags, and examined for marks including PIT tags. Additionally, scales and tissue samples will be collected from each fish to estimate size and age-class structure, fish growth, and scale chemistry (Wells et al. 2003; Muhlfeld et al. 2005) and molecular genetics signatures (Kanda and Allendorf 1991).

Provided that the study fish survive in sufficient numbers to detect as spawning adults (cutthroat trout typically spawn at 5-7 years of age; Shepard et al. 1984; Liknes and Graham 1988; Fraley and Shepard 1989), we plan to assess the degree of homing, or straying, of each release strategy to determine which thyroxine hormone spike is important to the homing mechanism in this species. Quantification of juvenile return rates as determined by recapturing spawning adults in subsequent years will provide an estimate of subadult survival in the river and lake system and the potential factors (density dependent and independent) influencing age-specific survival.

Long term marks, including pit tags, pigment dyes, and stable isotope marks on calcified tissues must be used to assess the origin of returning adults. Condition factor and incremental growth from scales and/or otoliths will be used to describe the health of individual fish relative to the proposed rearing strategies i.e.: eyed egg (RSIs or artificial redds), or fingerling imprint plants. Otoliths and scales will be used to determine age at emigration and subsequent growth increments. Total length and girth will be measured to determine condition factor.

Use the Weisberg (1986) method to back-calculate fish length using annuli and growth increments from individual fish. This technique compares growth increments from various age fish within each year with a composite growth rate at age from all samples. Annual variation in growth rates can then be attributed to environmental conditions that fish experience during a given year. The method described by Weisberg (1986) will be used to back-calculate fish length at age using scale and otolith annuli from individual fish. Growth increments from individual salmonids age III to VI will be compared, by yearclass, with a composite growth rate at age from all samples. We will estimate growth rates by back-calculating fish length at age using annuli and growth increments (Weisberg 1986; Weisberg and Frie 1987).

Public Outreach

MFWP is informing the public about the threats caused by Nuisance Aquatic Species. HHM has installed TIS systems on travel corridors to the Flathead alerting recreationists to the threat of nuisance aquatic species and ways to avoid their spread. HHM also installed information kiosks at primary fishing access sites. The proposed interpretive pathway at Sekokini Springs would inform the public and school groups on the importance of native plants and animals and impacts caused by species introductions.

Exhibits would highlight progress by HHM on westslope cutthroat trout conservation and other current conservation issues.

Two fish viewing galleries would present an underwater view of Montana's state fish. Fish viewing locations would be separated from the primary culture program to reduce stress on donor fish reared for restoration actions. The site would accommodate visiting scientists and volunteers.

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Acronyms

ADA	Americans with Disabilities Act
AFS	American Fisheries Society
ARM	Administrative Rules of Montana
BKD	Bacterial kidney disease
BKT	Brook trout
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
cfs	cubic feet per second
CNFH	Creston National Fish Hatchery
CSKT	Confederated Salish and Kootenai Tribes
DEIS	Draft Environmental Impact Statement
DNA	Deoxyribose Nucleic Acid
DTU	Daily Temperature Units
DO	Dissolved Oxygen
ESA	Endangered Species Act
F1	First filial generation
FAT	fluorescent antibody test
FHS	Fish Health Section
ft	Feet or Foot
GIS	Geographic Information Services
GPS	Global Positioning System
HHD	Hungry Horse Dam
HHMP	Hungry Horse Mitigation Program
HHR	Hungry Horse Reservoir
HUC	Hydrologic Unit Code
ICBEMP	Interior Columbia River Basin Ecosystem Management Project
IFIM	Instream Flow Incremental Methodology
IHOT	Integrated Hatchery Operations Team
IHNV	Infectious Hematopoietic Necrosis Virus
IPNV	Infectious Pancreatic Necrosis Virus
km	kilometers
LA	Landscape Approach
m	meter
M&E	Monitoring and Evaluation
MFISH	Montana Fisheries Information System
MFWP	Montana Fish, Wildlife & Parks
MOU	Memorandum of Understanding
NPS	National Park Service
NWPPC	Northwest Power Planning Council

NPCC	Northwest Power and Conservation Council
OMV	*Oncorhynchus masou* Virus (OMV)
ORV	Outstandingly Remarkable Values
PIT	Passive Integrated Transponder
PINE	Paired Interspersed Nuclear DNA Element
PNFHPC	Pacific Northwest Fish Health Protection Committee
QHA	Quality Habitat Assessment model
RBT	Rainbow Trout
Rkm	River Kilometers
RM	River Mile
RSI	Remote Site Incubators
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
VHSV	Viral Hemorrhagic Septicemia Virus
WCT	Westslope Cutthroat Trout
YCT	Yellowstone Cutthroat Trout

Technical Terms

Acclimation. Allowing fish to adjust to environmental variables. Older hatchery practices resulted in high mortalities because the young fish were released directly from the hatchery, without a chance for them to adjust to the natural stream environment. Acclimation is a process which is used to allow the fish to gradually adjust to a more natural environment.

Acclimation site. Sites at which young fish are held in artificial ponds to allow them to imprint to that they return to that place to spawn.

Anadromous. A species reared in fresh water, lives in the ocean for part of the life cycle then returns to fresh water to spawn.

Anthropogenic. Relating to human impact on nature.

Broodstock. Fish that will be spawned to create hatchery stock.

Carrying capacity. The maximum number or biomass of fish that could potentially be supported by a given habitat, as determined by prevailing physical, chemical, and biological conditions.

Cumulative impact. Cumulative impacts are created by the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions.

Domestication selection. Natural selection for traits which affect survival and reproduction in a human-controlled environment.

Empirical. Based on observation or experience.

Escapement. Fish that are allowed to spawn naturally.

Evolutionarily significant unit. A population or group of populations that is considered distinct (and hence a "species") for purposes of conservation under the ESA. To qualify as an ESU, a population must: (1) be reproductively isolated from other conspecific populations; and (2) represent an important component in the evolutionary legacy of the biological species.

Extirpated. To destroy completely.

Eyed-eggs. Life stage of a fertilized egg between the time the eyes become visible and hatching occurs.

Facility. Fish culture facility used for incubation and rearing of salmon and steelhead.

Fluvial. Migrating between smaller streams and larger rivers.

Fry. Juvenile salmonid life stage following absorption of yolk sac.

Genetic drift selection. The result of a small representative sample size of a population contributing to the next generation; genetic drift can cause reduced fitness.

Heterozygosity. In an individual that has two different chromosomes for a gene.

Homing. navigational behavior that guides species during migrations.

Imprinting. Term refers to the process where a fish records long-term memory of the chemical nature of its natal tributary, so that it can relocate the stream as a spawning adult. The exact timing of imprinting is believed to coincide with chemical changes and axon development in the fish's brain (for example, a sudden increase in thyroxine hormone concentration).

Inbreeding depression. Reduced fitness caused by inbreeding.

Indigenous. Occurs naturally in an area or environment.

Introgression. Loss of, or changes in, population identity including loss of diversity among populations, characteristics of adaptation with populations, or of other evolved features of genetic organization (may occur through crossbreeding or inadvertent effects of artificial selection).

Lotic. Of, or relating to moving water.

Metapopulations. A set of partially isolated populations belonging to the same species

Naturally reproducing. Adult fish spawning in a stream or river regardless of how parents were spawned, specifically if spawned at a hatchery.

100-year floodplain. That portion of a river valley adjacent to the stream channel which is covered with water when the stream overflows its banks during a 100-year flood event. A 100-year flood event is one that has a 1 in 100 chance of happening in any given year.

Outplant. Outplanting is the process by which artificially propagated fish are released into a natural system.

Pathogen. A disease-causing agent.

Piscivorous. Fish eating.

Population. A group of individuals of a species living in a certain area.

Population viability. The overall condition and long-term probability of survival of the fish population.

Predation. The harm, destruction, or consumption of a prey organisms by an animal predator.

Production. Number of individuals produced from a natural environment or fish culture facilities.

Race. A group of individuals within a species, forming a permanent variety; a particular breed.

Raceway. Holding area or rearing facility for juvenile or adult salmonids in a hatchery.

Redd. A fish spawning depression and egg mound or "nest" created in stream sediments by spawning salmonids as they dig a pit to remove fine sediments, then bury their fertilized eggs with clean gravel. The depression and hump forces oxygenated water to flow through the incubating eggs.

Reproduction. The process of forming new individuals of a species by sexual or asexual methods.

Resident. Present year round (not migratory).

Resident Fish. Term used to describe fish that do not migrate to the ocean, used to differentiate interior fish species from anadromous (sea run) fish.

Riparian habitat. The zone of water-adapted vegetation which extends from the water's edge landward to the edge of the vegetative canopy. Associated with watercourses such as streams, rivers, springs, ponds, lakes, or tidewater.

Salmonid. Belonging to the family salmonidae, i.e., salmon, trout, steelhead, whitefish.

Sensitive species. Those plants and animals identified by the Regional Forester for which population viability is a concern as evidenced by significant current or predicted downward trend in populations or density and significant or predicted downward trend in habitat capability.

Smolt. Juvenile salmon undergoing metamorphosis into a saltwater fish, usually during the downstream migration period.

Smoltification. The physical and chemical process in which salmonid parr undergo as they prepare to migrate downstream and enter salt water.

Species. A group of interbreeding individuals not interbreeding with another such group; similar, and related species are grouped into a genus.

Species of special concern. Native species that are either low in number, limited in distribution, or have suffered significant population reductions due to habitat losses.

Steelhead. The sea going rainbow trout, reclassified as a Pacific salmon in 1989.

Stock. A distinct management of genetic unit of fish.

Subbasin. Subdivision of a larger drainage basin. The drainage or catchment area of a stream which along with other subbasins make up the drainage basin of a larger stream.

Substrate. The material comprising the bed of a stream.

Supplementation. The use of artificial propagation in the attempt to maintain or increase natural production while maintaining the long-term fitness of the target population, and while keeping the ecological and genetic impacts on non-target populations within specified biological limits.

Varial Zone. An area of wider water fluctuation caused by alterations of the hydrograph

Wild fish. A fish that has not spent any part of its life history in an artificial environment and are the progeny of naturally-reproducing salmon regardless of parentage.

Appendix A

Recorded Easement to Access the Sekokini Springs Site

19981520935O

⑦

ROAD EASEMENT

THIS GRANT OF EASEMENT, made the 22nd day of April, 1998, by and between Belton Mercantile, Inc., a Montana corporation, of 200 Going to the Sun Road, West Glacier, Montana 59936, hereafter called the Grantor, and the Montana Department of Fish, Wildlife and Parks, 1420 East Sixth Avenue, P O Box 200701, Helena, Montana 59620-0701, hereafter called the Grantee.

WITNESSETH

That the Grantor for and in consideration of the sum of One and no/100 Dollars ($1.00) and other good and valuable consideration, the receipt of which is hereby acknowledged, does hereby grant and convey unto the Grantee,and Grantee's guests, lessees, licensees, and visitors, a perpetual, non-exclusive easement upon, over and along an existing road, together with the right to enter upon the described road easement to maintain and repair the road and to travel upon and use the same for all lawful purposes, including but not limited to residential and commercial uses, over and across the land described as follows:

> *The road easement shall consist of a thirty (30) foot right-of-way across the Grantor's land in the SE1/4 of Section 8, T31N, R19W, PMM, Flathead County, Montana, running south from Blankenship Road to the boundary with Grantee's leasehold interest in Section 17, T31N, R19W, PMM, Flathead County, Montana.*

The easement is shown and depicted on Exhibit "A" attached hereto and incorporated herein by this reference.

This easement shall be and is appurtenant to the Grantee's 11.4 acre leasehold interest located in the NE1/4 of Section 17, T. 31 N., R. 19 W., Flathead County, Montana. This leasehold interest is in land owned by the United States Forest Service and may be modified, renewed, transferred, or reissued from time to time. Any such modification, renewal, transfer, or reissue of the leasehold interest shall not affect this road easement. This grant of easement shall run with the land and shall be binding upon and inure to the benefit of the parties to this easement, their respective successors and assigns, provided that Grantee does not have the right, power or authority to assign this easement. Furthermore, if Grantee ever abandons or ceases to retain the leasehold interest, this easement will automatically terminate.

The Grantee agrees to hold harmless, indemnify and defend the Grantor and its employees, agents and contractors from and against all liabilities, penalties, costs, losses, damages, expenses, causes of action, claims, demands or judgments, including without limitation, reasonable attorneys' fees, arising from or in any way connected with injury to or the death of any person or physical damage to any property, resulting from any action, omission, condition or other matter related to or occurring on or about the easement area, as a result of the Department's exercise of its rights granted under this easement, unless due to the negligence or willful misconduct of the Grantor or its agents, employees or contractors.

199815209350

The Grantee by this grant will not acquire any interest in or to the land described above belonging to the Grantor save and except the right to maintain and use a road for access purposes.

To have and to hold the easement unto the Grantee and its successors forever.

IN WITNESS WHEREOF, the Grantor executes and conveys this road easement on the day and year first above written.

Belton Mercantile, Inc.

By: ____________________
President

ATTEST: ____________________
Secretary-Treasurer

STATE OF MONTANA)
:ss.
County of Flathead)

This instrument was acknowledged before me on April 22, 1998 by

Dan H. Lundgren

Everett M. Lundgren

as president, and secretary-treasurer, respectively, of Belton Mercantile, Inc.

(SEAL)

____
Notary Public for the State of Montana
Residing at Coram, MT
My Commission Expires 4-30-98

OLMSTED NOTARY PUBLIC OF MONTANA

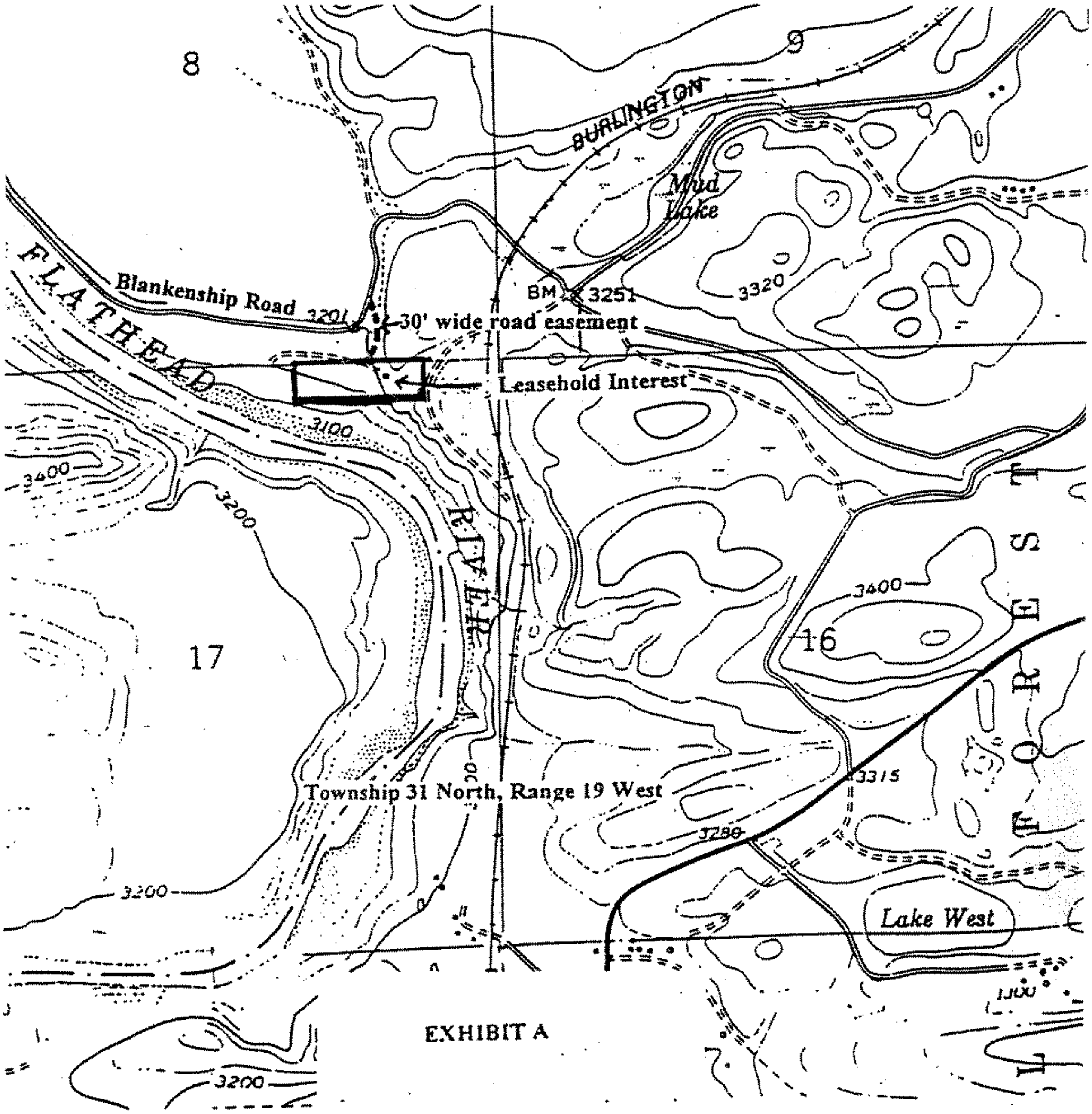

EXHIBIT A

STATE OF MONTANA, } ss
County of Flathead

Recorded at the request of FWP
this 1 day of June, 19 98 at 9:35 o'clock A M and recorded in the records of Flathead County, State of Montana.

Fee $ 18- Pd.

(Flathead County Clerk and Recorder)

RECEPTION NO. 199815209350

RETURN TO FWP, Attn: Debbi King
Box 200701 Helena MT 59620-0701

(Deputy)

Clerk&R-Rec5

Appendix B

Results of Water Quality Testing of the Sekokini Springs Water Source

Department of Public Health and Human Services

ENVIRONMENTAL LABORATORY

Cogswell Building, Rm B219, 1400 Broadway, PO BOX 4369, Helena MT 59604 Phone 444-2642

RESULTS OF <INORGANIC> CHEMICAL ANALYSIS

DON SKAAR
FISH WILDLIFE AND PARKS
1420 E 6TH AVE
HELENA. MT 59620

Acct #: B0000075
PWSID #: B0000075
Report Date: 07-Dec-01

Collected: 11/1/01
Time: 15:00
By: DON SKAAR

Lab#: C0111-4050

Sample ID: FISH WILDLIFE AND PARKS/ SEKOKANI SPRING

ANALYTE		RESULTS	UNITS	METHOD	DATE	ANALYST
INORGANIC PARAMETERS						
Total Ammonia as N	<	0.01	mg/L	EPA 350.1	11/8/01	ljh
Chloride in Water		1.90	mg/L	EPA 300.0	11/2/01	ljh
Nitrate plus Nitrite as N		0.20	mg/L	EPA 300.0	11/2/01	ljh
Sulfate		3.15	mg/L	EPA 300.0	11/2/01	ljh
SCAN FOR METALS BY ICP				EPA 200.7	11/15/01	gal
Aluminum	<	0.02	mg/L	EPA 200.7	11/15/01	gal
Arsenic	<	0.05	mg/L	EPA 200.7	11/15/01	gal
Boron	<	0.10	mg/L	EPA 200.7	11/15/01	gal
Barium		0.275	mg/L	EPA 200.7	11/15/01	gal
Beryllium	<	0.002	mg/L	EPA 200.7	11/15/01	gal
Calcium		47.6	mg/L	EPA 200.7	11/15/01	gal
Cadmium	<	0.002	mg/L	EPA 200.7	11/15/01	gal
Cobalt	<	0.01	mg/L	EPA 200.7	11/15/01	gal
Chromium	<	0.002	mg/L	EPA 200.7	11/15/01	gal
Copper	<	0.002	mg/L	EPA 200.7	11/15/01	gal
Iron	<	0.01	mg/L	EPA 200.7	11/15/01	gal
Potassium	<	1.00	mg/L	EPA 200.7	11/15/01	gal
Magnesium		14.5	mg/L	EPA 200.7	11/15/01	gal
Manganese	<	0.005	mg/L	EPA 200.7	11/15/01	gal
Molybdenum	<	0.01	mg/L	EPA 200.7	11/15/01	gal
Sodium		2.70	mg/L	EPA 200.7	11/15/01	gal
Nickel	<	0.01	mg/L	EPA 200.7	11/15/01	gal
Lead	<	0.02	mg/L	EPA 200.7	11/15/01	gal
Antimony	<	0.10	mg/L	EPA 200.7	11/15/01	gal
Selenium	<	0.05	mg/L	EPA 200.7	11/15/01	gal
Strontium		0.06	mg/L	EPA 200.7	11/15/01	gal
Titanium	<	0.005	mg/L	EPA 200.7	11/15/01	gal
Vanadium	<	0.005	mg/L	EPA 200.7	11/15/01	gal
Zinc	<	0.005	mg/L	EPA 200.7	11/15/01	gal
Total Hardness as CaCO3		179	mg/L	EPA 200.7	11/15/01	gal
Hardness, Grains / Gallon		10.4	gr/gal	EPA 200.7	11/15/01	gal
Alkalinity in Water		240	mg/L	EPA 310.2	11/16/01	jhf

Approved by: ____________________

FLAGS: < = less-than
> = greater-than

Department of Public Health and Human Services

ENVIRONMENTAL LABORATORY

Cogswell Building, Rm B219, 1400 Broadway, PO BOX 4369, Helena MT 59604 Phone 444-2642

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Time: 15:00
By: DON SKAAR

Lab#: C0111-4050

Sample ID: FISH WILDLIFE AND PARKS/ SEKOKANI SPRING

ANALYTE	RESULTS	UNITS	METHOD	DATE	ANALYST
INORGANIC PARAMETERS					
pH	7.96	units	EPA 150.1	11/16/01	jhf

Approved by: ____________

FLAGS: < = less-than
> = greater-than

Department of Public Health and Human Services

ENVIRONMENTAL LABORATORY

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ANALYTE		RESULTS	UNITS	METHOD	DATE	ANALYST
ORGANIC PARAMETERS						
CHLORINATED PESTICIDES				EPA 508	11/13/01	WS
Toxaphene	<	1.00	ug/L	EPA 508	11/13/01	WS
Chlordane	<	.200	ug/L	EPA 508	11/13/01	WS
Dieldrin	<	0.020	ug/L	EPA 508	11/13/01	WS
Polychlorinated biphenyl screen	<	0.500	ug/L	EPA 508	11/13/01	WS
SYNTHETIC ORGANIC COMPOUNDS				EPA 525.2	11/13/01	WS
di(2-ethylhexyl) phthalate	<	0.600	ug/L	EPA 525.2	11/13/01	WS
di(2-ethylhexyl) adipate	<	0.600	ug/L	EPA 525.2	11/13/01	WS
Benzo(A)pyrene	<	0.020	ug/L	EPA 525.2	11/13/01	WS
Propachlor	<	0.100	ug/L	EPA 525.2	11/13/01	WS
Metribuzin	<	0.100	ug/L	EPA 525.2	11/13/01	WS
Butachlor	<	0.100	ug/L	EPA 525.2	11/13/01	WS
Metolachlor	<	0.100	ug/L	EPA 525.2	11/13/01	WS
Hexachlorobenzene	<	0.100	ug/L	EPA 525.2	11/13/01	WS
Hexachlorocyclopentadiene	<	0.100	ug/L	EPA 525.2	11/13/01	WS
Atrazine	<	0.100	ug/L	EPA 525.2	11/13/01	WS
Alachlor	<	0.200	ug/L	EPA 525.2	11/13/01	WS
Endrin	<	0.010	ug/L	EPA 525.2	11/13/01	WS
Heptachlor	<	0.040	ug/L	EPA 525.2	11/13/01	WS
Heptachlor Epoxide	<	0.020	ug/L	EPA 525.2	11/13/01	WS
Lindane (g-BHC)	<	0.020	ug/L	EPA 525.2	11/13/01	WS
Methoxychlor	<	0.100	ug/L	EPA 525.2	11/13/01	WS
Simazine	<	0.070	ug/L	EPA 525.2	11/13/01	WS
Aldrin	<	0.100	ug/L	EPA 525.2	11/13/01	WS
VOC - STATE MONITORED				EPA 524.2	11/5/01	ws
1,1-Dichloropropene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
cis 1,3-Dichloropropene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
trans 1,3-Dichloropropene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,3-Dichlorobenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
2-Chlorotoluene	<	0.50	ug/L	EPA 524.2	11/5/01	ws

Approved by: ____________________

FLAGS: < = less-than
> = greater-than

Department of Public Health and Human Services

ENVIRONMENTAL LABORATORY

Cogswell Building, Rm B219, 1400 Broadway, PO BOX 4369, Helena MT 59604 Phone 444-2642

RESULTS OF < ORGANIC > CHEMICAL ANALYSIS

DON SKAAR
FISH WILDLIFE AND PARKS
1420 E 6TH AVE
HELENA. MT 59620

Acct #: B0000075
PWSID #: B0000075
Report Date: 07-Dec-01

Collected: 11/1/01
Time: 15:00
By: DON SKAAR

Lab#: C0111-4050

Sample ID: FISH WILDLIFE AND PARKS/ SEKOKANI SPRING

ANALYTE		RESULTS	UNITS	METHOD	DATE	ANALYST
ORGANIC PARAMETERS						
4-Chlorotoluene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Bromobenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,1,1,2-Tetrachloroethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,1,2,2-Tetrachloroethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,1-Dichloroethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Chloroethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Bromomethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Chloromethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Dibromomethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,2,3-Trichloropropane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,3-Dichloropropane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
2,2-Dichloropropane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Methyl Tert Butyl Ether	<	1.50	ug/L	EPA 524.2	11/5/01	ws
TRIHALOMETHANES				EPA 524.2	11/5/01	ws
Chloroform	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Bromodichloromethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Dibromochloromethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Bromoform	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Total Trihalomethanes	<	2.00	ug/L	EPA 524.2	11/5/01	ws
VOC - REGULATED				EPA 524.2	11/5/01	ws
Benzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Ethylbenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Toluene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
ortho Xylene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
meta plus para Xylene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Total Xylenes	<	2.00	ug/L	EPA 524.2	11/5/01	ws
Total BTEX	<	2.00	ug/L	EPA 524.2	11/5/01	ws
1,2,4-Trichlorobenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,2-Dichlorobenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,4-Dichlorbenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws

Approved by: ____________

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FISH WILDLIFE AND PARKS
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Acct #: B0000075
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Report Date: 07-Dec-01

Collected: 11/1/01
Time: 15:00
By: DON SKAAR

Lab#: C0111-4050

Sample ID: FISH WILDLIFE AND PARKS/ SEKOKANI SPRING

ANALYTE		RESULTS	UNITS	METHOD	DATE	ANALYST
ORGANIC PARAMETERS						
Chlorobenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Carbon Tetrachloride	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,1,1-Trichloroethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,1,2-Trichlorethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,2-Dichloroethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,1-Dichloroethene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
cis 1,2-Dichloroethene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
trans 1,2-Dichloroethene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Methylene Chloride	<	2.00	ug/L	EPA 524.2	11/5/01	ws
1,2-Dichloropropane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Tetrachloroethene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Trichloroethene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Vinyl Chloride	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,2-Dibromo-3-Chloropropane	<	1.00	ug/L	EPA 524.2	11/5/01	ws
Styrene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
VOC - UNREGULATED				EPA 524.2	11/5/01	ws
1,2,3-Trichlorobenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,2,4-Trimethylbenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,3,5-Trimethylbenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
N-Butylbenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
N-Propylbenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
tert-Butylbenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Dichlorodifluoromethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
1,2-Dibromoethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Hexachlorobutadiene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Isopropylbenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
4-Isopropyltoluene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Bromochloromethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
Naphthalene	<	0.50	ug/L	EPA 524.2	11/5/01	ws
sec-Butylbenzene	<	0.50	ug/L	EPA 524.2	11/5/01	ws

Approved by: ______________

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Collected: 11/1/01
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By: DON SKAAR

Lab#: C0111-4050

Sample ID: FISH WILDLIFE AND PARKS/ SEKOKANI SPRING

ANALYTE		RESULTS	UNITS	METHOD	DATE	ANALYST
ORGANIC PARAMETERS						
Trichlorofluoromethane	<	0.50	ug/L	EPA 524.2	11/5/01	ws
CHLOROPHENOXY HERBICIDES				EPA 515.3	11/19/01	JC
Dalapon	<	1.00	ug/L	EPA 515.3	11/19/01	JC
Pentachlorophenol	<	0.040	ug/L	EPA 515.3	11/19/01	JC
2,4-D	<	0.100	ug/L	EPA 515.3	11/19/01	JC
Dinoseb	<	0.200	ug/L	EPA 515.3	11/19/01	JC
Picloram (Tordon)	<	0.100	ug/L	EPA 515.3	11/19/01	JC
2,4,5-TP (Silvex)	<	0.200	ug/L	EPA 515.3	11/19/01	JC
Dicamba	<	1.00	ug/L	EPA 515.3	11/19/01	JC
Acifluorfen	<	0.100	ug/L	EPA 515.3	11/19/01	JC

Approved by: [signature]

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> = greater-than

Appendix C

Water Temperature Monitoring of Hatchery Spring Source

Water Temperature and Temperature Units, Sekokini Springs Natural Fish-Rearing Project (Progress Report: July 23, 1997 - March 31, 1998)

Introduction

Water flowing into the fish-rearing ponds at Sekokini Springs, MT, comes from three main springs and one spring complex. Little is known, however, about the springs' sources, connectedness, and temperatures. In July 1997, the USFWS began a 1-year project to describe water temperature patterns in the three main springs and the spring complex. This report summarizes data collected between July 23, 1997, and March 31, 1998 (days 1-252).

Study Area and Methods

In each of the three main springs and the spring complex (Figure 1), water temperatures were measured to the nearest 0.1°C with an Onset Optic StowAway submersible thermometer programmed to record temperatures every 2 hours. Data were downloaded and converted to °F with Onset Logbook 2.04+ software (OCC 1997) and summarized statistically and graphically with NCSS 6.0.1 (Hintze 1995) and Grapher 1.25 (Golden Software 1994) software.

Results and Discussion

Upper Pond

Water flows into the Upper Pond from the Upper Spring and the Spring Complex (Figure 1). In the Upper Spring (Tables 1 and 2, Figure 2, and Appendix Table 1), mean daily temperatures were in the high 50s°F from late July through mid-September, gradually decreased to the low 40s°F by early February, and remained in the low 40s°F through March. For the period July 23-March 31 (252 days), mean daily temperature averaged 51°F (range, 43-59°F), and temperature units averaged 18.6 per day (total, 4,679).

In the Spring Complex (Tables 1 and 2, Figure 3, Appendix Table 2), the Optic StowAway thermometer functioned properly only from July 28 through March 12 (228 days). Mean daily temperatures in the Spring Complex were in the low-to-mid 60s°F from late July through late September, dropped to the low 40s°F by early February, and stayed in the low 40s°F through mid-March. For the 228-day period, mean daily temperature averaged 53°F (range, 43-65°F), and temperature units averaged 20.7 per day (total, 4,725).

Egg Trough Spring

In Egg Trough Spring (Tables 1 and 2, Figure 4, Appendix Table 3), mean daily temperatures were in the low 50s°F from late July through early October and then slowly and steadily decreased to the mid-40s°F by the end of March. For the period July 23-March 31 (252 days), mean daily temperature averaged 48°F (range, 44-53°F), and temperature units averaged 16.3 per day (total, 4,115).

Cold Spring

In Cold Spring (Tables 1 and 2, Figure 5, Appendix Table 4), mean daily temperatures were consistently in the low-to-mid 40s°F from July 23 through March 31. During the 252-day period, mean daily temperature averaged 44°F (range, 42-45°F), and temperature units averaged 11.5 per day (total, 2,902).

References

Golden Software. 1994. Grapher 1.25 for Windows. Golden Software, Inc., Golden, Colorado.

Hintze, J. 1995. NCSS 6.0.1 for Windows. Number Cruncher Statistical Systems, Kaysville, Utah.

OCC (Onset Computer Corporation). 1997. Logbook 2.04+ for Windows. Onset Computer Corporation, Pocasset, Massachusetts.

Daniel Carty
USFWS
Creston Fish and Wildlife Center
780 Creston Hatchery Road
Kalispell, MT 59901

sekokrpt2.wpd, wp7, 4/08/98, dc

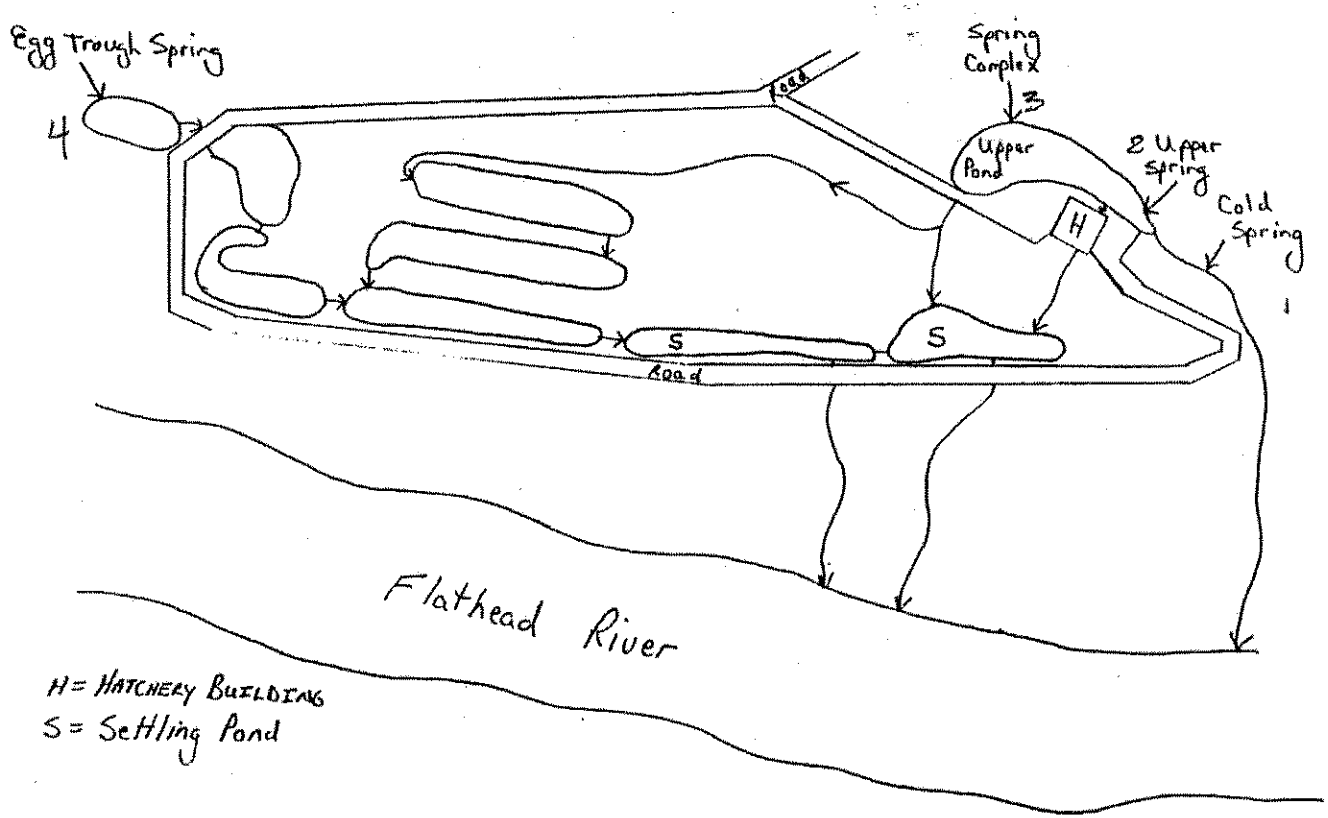

Figure 1.—Sekokini Springs Fish Hatchery, showing ponds, the three main springs, and the one spring complex.

Table 1.—Summary of water temperatures (°F) measured in the three main springs and the one spring complex, Sekokini Springs, MT, July 23, 1997-March 31, 1998.[a]

Spring	Dates	Days	Mean	SD	Min	Max	Range
Upper Pond-Upper Spring	Jul 23, 1997 - Mar 31, 1998	252	50.6	6.0	42.7	59.1	16.4
Upper Pond-Spring Complex[b]	Jul 28, 1997 - Mar 12, 1998	228	52.7	7.8	42.6	64.8	22.2
Egg Trough Spring	Jul 23, 1997 - Mar 31, 1998	252	48.3	2.2	44.3	52.5	8.2
Cold Spring	Jul 23, 1997 - Mar 31, 1998	252	43.5	0.56	41.5	44.6	3.1

[a] For each site, statistics were derived from the analysis of mean daily temperatures.

[b] The thermometer in the Upper Pond-Spring Complex malfunctioned on March 13; consequently, no temperatures were recorded at that site between March 13 and March 31, 1998.

Table 2.—Summary of temperature units for the three main springs and the one spring complex, Sekokini Springs, MT, July 23, 1997-March 31, 1998.[a]

Spring	Dates	Days	Mean	SD	Min	Max	Range
Upper Pond-Upper Spring	Jul 23, 1997 - Mar 31, 1998	252	18.6	6.0	10.7	27.1	16.4
Upper Pond-Spring Complex[b]	Jul 28, 1997 - Mar 12, 1998	228	20.7	7.8	10.6	32.8	22.2
Egg Trough Spring	Jul 23, 1997 - Mar 31, 1998	252	16.3	2.2	12.3	20.5	8.2
Cold Spring	Jul 23, 1997 - Mar 31, 1998	252	11.5	0.6	9.5	12.6	3.1

[a] For each site, statistics are based on daily temperature units, which were calculated as: Daily TUs = (Mean daily temperature-32).

[b] The thermometer in the Upper Pond-Spring Complex malfunctioned on March 13; consequently, no temperatures were recorded at that site between March 13 and March 31, 1998.

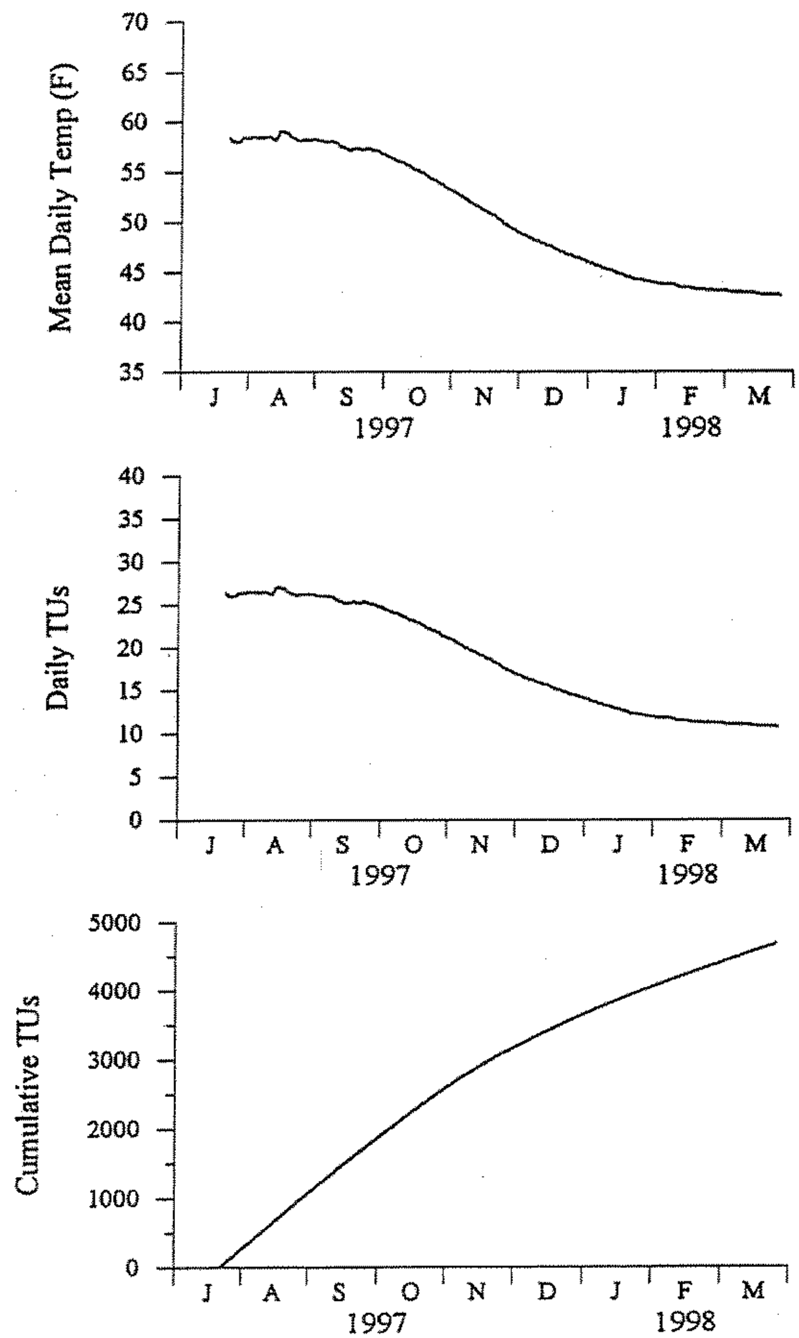

Figure 2.—Mean daily water temperature, daily temperature units, and cumulative temperature units for Upper Pond- Upper Spring, Sekokini Springs, MT, July 23, 1997 to March 31, 1998 (252 days).

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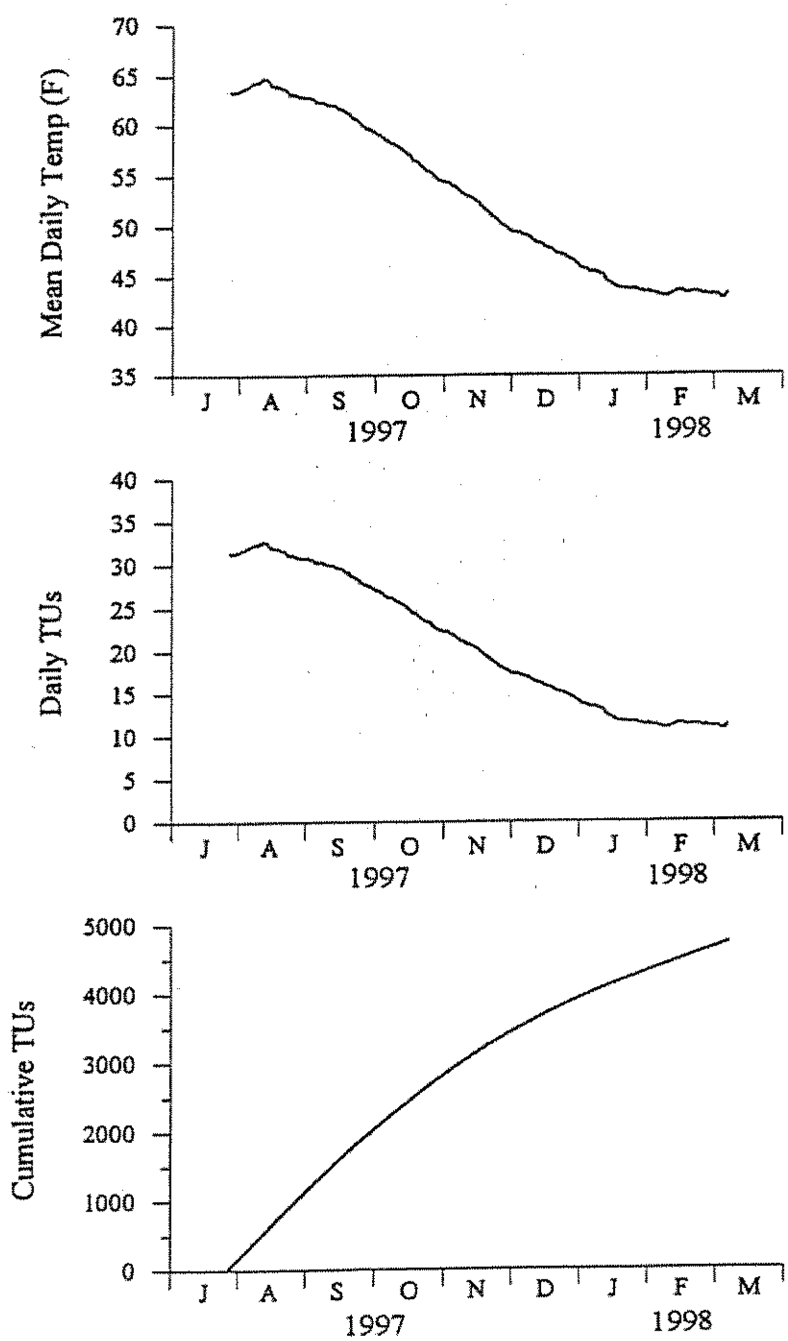

Figure 3.—Mean daily water temperature, daily temperature units, and cumulative temperature units for Upper Pond-Spring Complex, Sekokini Springs, MT, July 28, 1997 to March 12, 1998 (228 days).

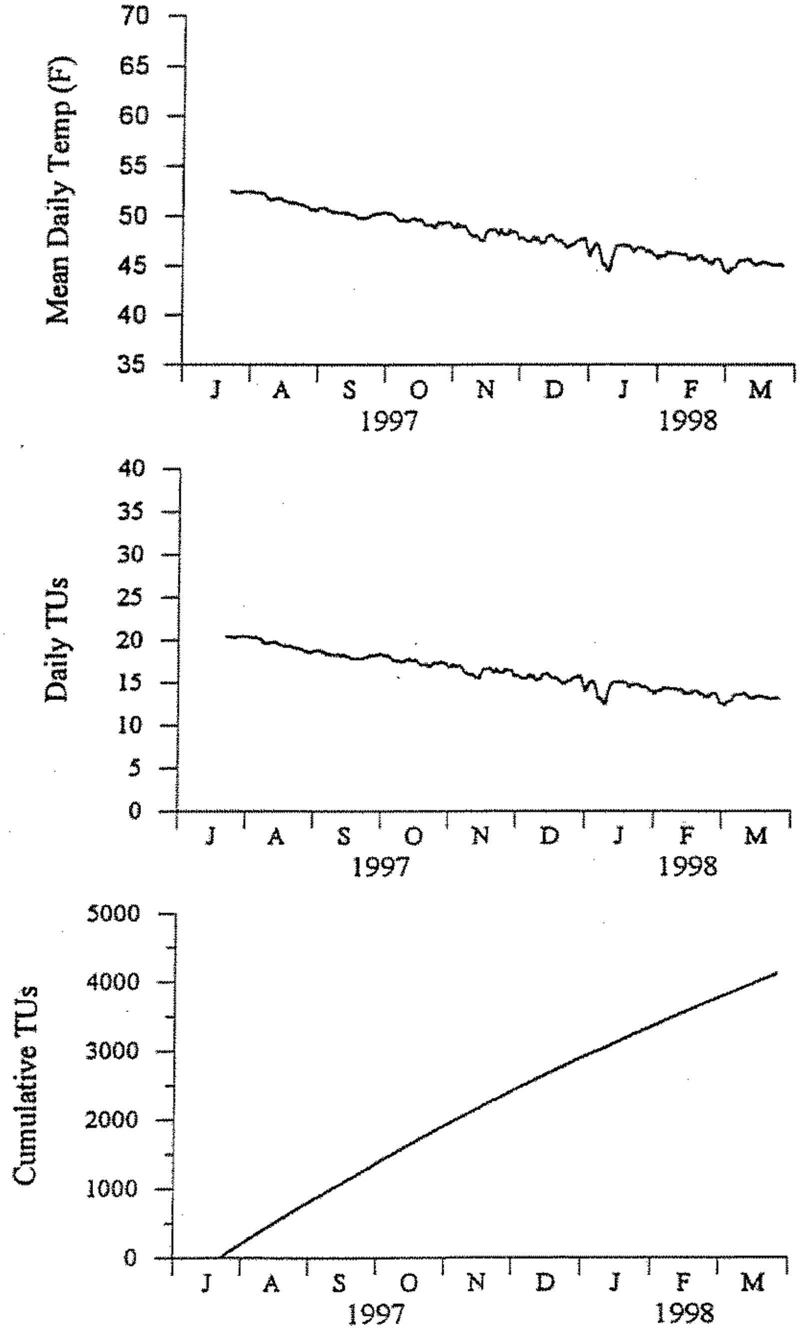

Figure 4.—Mean daily water temperature, daily temperature units, and cumulative temperature units for Egg Trough Spring, Sekokini Springs, MT, July 23, 1997 to March 31, 1998 (252 days).

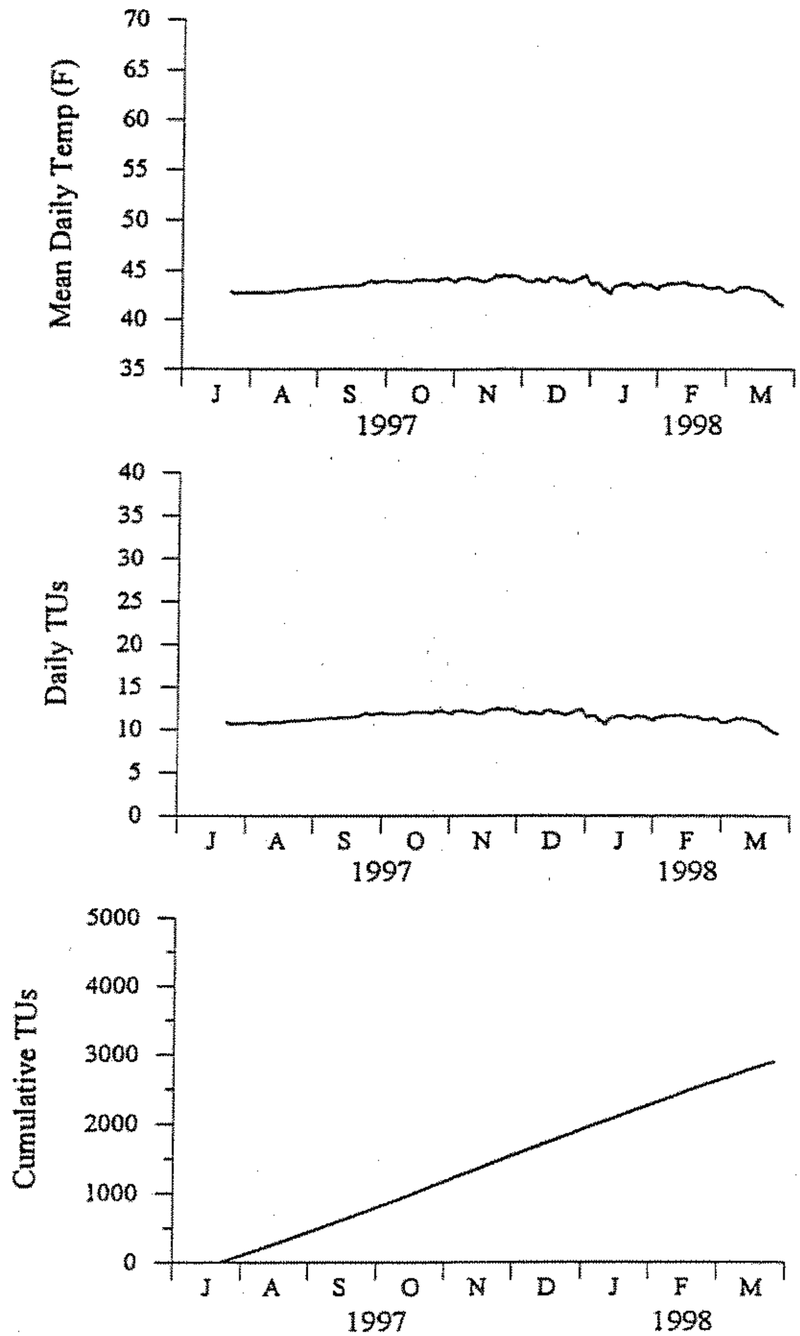

Figure 5.—Mean daily water temperature, daily temperature units, and cumulative temperature units for Cold Spring, Sekokini Springs, MT, July 23, 1997 to March 31, 1998 (252 days).

Appendix Table 1.—Water temperatures (F) and temperature units for Upper Pond-Upper Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
970723	204	4	58.4	0.49	0.24	58.0	59.1	1.1	26.4	0026
970724	205	12	58.1	0.33	0.09	58.0	59.1	1.1	26.1	0053
970725	206	12	58.0	0.25	0.07	58.0	58.8	0.9	26.0	0079
970726	207	12	58.1	0.22	0.06	57.7	58.5	0.8	26.1	0105
970727	208	12	58.0	0.25	0.07	58.0	58.8	0.9	26.0	0131
970728	209	12	58.2	0.60	0.17	57.7	59.4	1.7	26.2	0157
970729	210	12	58.5	0.11	0.03	58.2	58.5	0.3	26.5	0183
970730	211	12	58.5	0.24	0.07	58.2	59.1	0.9	26.5	0210
970731	212	12	58.4	0.25	0.07	58.2	59.1	0.9	26.4	0236
970801	213	12	58.4	0.18	0.05	58.2	58.8	0.6	26.4	0263
970802	214	12	58.6	0.33	0.10	58.5	59.7	1.1	26.6	0289
970803	215	12	58.5	0.42	0.12	58.2	59.7	1.4	26.5	0316
970804	216	12	58.5	0.32	0.09	58.2	59.4	1.1	26.5	0342
970805	217	12	58.4	0.25	0.07	58.2	59.1	0.9	26.4	0369
970806	218	12	58.6	0.41	0.12	58.5	60.0	1.4	26.6	0395
970807	219	12	58.4	0.15	0.04	58.2	58.5	0.3	26.4	0422
970808	220	12	58.5	0.13	0.04	58.2	58.5	0.3	26.5	0448
970809	221	12	58.5	0.15	0.04	58.2	58.8	0.6	26.5	0475
970810	222	12	58.6	0.37	0.11	58.2	59.7	1.4	26.6	0501
970811	223	12	58.5	0.40	0.12	58.2	59.7	1.4	26.5	0528
970812	224	12	58.3	0.25	0.07	58.2	59.1	0.9	26.3	0554
970813	225	12	58.2	0.00	0.00	58.2	58.2	0.0	26.2	0580
970814	226	11	58.6	0.65	0.20	58.0	59.4	1.4	26.6	0607
970815	227	12	59.1	0.08	0.02	59.1	59.4	0.3	27.1	0634
970816	228	12	59.1	0.00	0.00	59.1	59.1	0.0	27.1	0661
970817	229	12	59.1	0.30	0.09	58.8	60.0	1.1	27.1	0688
970818	230	12	58.9	0.14	0.04	58.8	59.1	0.3	26.9	0715
970819	231	12	59.0	0.25	0.07	58.8	59.7	0.9	27.0	0742
970820	232	12	58.6	0.19	0.06	58.5	59.1	0.6	26.6	0769
970821	233	12	58.5	0.00	0.00	58.5	58.5	0.0	26.5	0795
970822	234	12	58.4	0.19	0.06	58.2	58.8	0.6	26.4	0822
970823	235	12	58.2	0.00	0.00	58.2	58.2	0.0	26.2	0848
970824	236	12	58.2	0.16	0.05	58.0	58.5	0.6	26.2	0874
970825	237	12	58.1	0.18	0.05	58.0	58.5	0.6	26.1	0900
970826	238	12	58.3	0.20	0.06	58.0	58.8	0.9	26.3	0926
970827	239	12	58.3	0.08	0.02	58.2	58.5	0.3	26.3	0953
970828	240	12	58.2	0.14	0.04	58.0	58.5	0.6	26.2	0979
970829	241	12	58.2	0.00	0.00	58.2	58.2	0.0	26.2	1005
970830	242	12	58.3	0.08	0.02	58.2	58.5	0.3	26.3	1031
970831	243	12	58.3	0.08	0.02	58.2	58.5	0.3	26.3	1058
970901	244	12	58.3	0.08	0.02	58.2	58.5	0.3	26.3	1084
970902	245	12	58.2	0.08	0.02	58.0	58.2	0.3	26.2	1110
970903	246	12	58.1	0.15	0.04	58.0	58.2	0.3	26.1	1136

Appendix Table 1.—Water temperatures (F) and temperature units for Upper Pond-Upper Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
970904	247	12	58.1	0.19	0.05	58.0	58.5	0.6	26.1	1162
970905	248	12	58.0	0.13	0.04	58.0	58.2	0.3	26.0	1188
970906	249	12	58.0	0.13	0.04	58.0	58.2	0.3	26.0	1214
970907	250	12	58.1	0.14	0.04	58.0	58.2	0.3	26.1	1240
970908	251	12	58.1	0.14	0.04	58.0	58.2	0.3	26.1	1266
970909	252	12	58.0	0.11	0.03	58.0	58.2	0.3	26.0	1292
970910	253	12	58.0	0.00	0.00	58.0	58.0	0.0	26.0	1318
970911	254	12	57.8	0.24	0.07	57.4	58.0	0.6	25.8	1344
970912	255	12	57.5	0.15	0.04	57.4	57.7	0.3	25.5	1370
970913	256	12	57.6	0.14	0.04	57.4	57.7	0.3	25.6	1395
970914	257	12	57.4	0.11	0.03	57.1	57.4	0.3	25.4	1421
970915	258	12	57.3	0.19	0.05	56.8	57.4	0.6	25.3	1446
970916	259	12	57.1	0.08	0.02	57.1	57.4	0.3	25.1	1471
970917	260	12	57.3	0.14	0.04	57.1	57.4	0.3	25.3	1496
970918	261	12	57.3	0.15	0.04	57.1	57.4	0.3	25.3	1522
970919	262	12	57.4	0.00	0.00	57.4	57.4	0.0	25.4	1547
970920	263	12	57.4	0.00	0.00	57.4	57.4	0.0	25.4	1572
970921	264	12	57.3	0.15	0.04	57.1	57.4	0.3	25.3	1598
970922	265	12	57.2	0.11	0.03	57.1	57.4	0.3	25.2	1623
970923	266	12	57.3	0.21	0.06	57.1	57.7	0.6	25.3	1648
970924	267	12	57.4	0.08	0.02	57.4	57.7	0.3	25.4	1674
970925	268	12	57.4	0.08	0.02	57.1	57.4	0.3	25.4	1699
970926	269	12	57.2	0.13	0.04	57.1	57.4	0.3	25.2	1724
970927	270	12	57.1	0.00	0.00	57.1	57.1	0.0	25.1	1749
970928	271	12	57.1	0.00	0.00	57.1	57.1	0.0	25.1	1774
970929	272	12	57.1	0.11	0.03	56.8	57.1	0.3	25.1	1799
970930	273	12	56.9	0.11	0.03	56.8	57.1	0.3	24.9	1824
971001	274	12	56.8	0.00	0.00	56.8	56.8	0.0	24.8	1849
971002	275	12	56.8	0.13	0.04	56.6	56.8	0.3	24.8	1874
971003	276	12	56.6	0.00	0.00	56.6	56.6	0.0	24.6	1899
971004	277	12	56.5	0.13	0.04	56.3	56.6	0.3	24.5	1923
971005	278	12	56.4	0.14	0.04	56.3	56.6	0.3	24.4	1947
971006	279	12	56.3	0.00	0.00	56.3	56.3	0.0	24.3	1972
971007	280	12	56.2	0.14	0.04	56.0	56.3	0.3	24.2	1996
971008	281	12	56.0	0.00	0.00	56.0	56.0	0.0	24.0	2020
971009	282	12	56.0	0.00	0.00	56.0	56.0	0.0	24.0	2044
971010	283	12	56.0	0.08	0.02	55.7	56.0	0.3	24.0	2068
971011	284	12	55.8	0.08	0.02	55.7	56.0	0.3	23.8	2092
971012	285	12	55.7	0.00	0.00	55.7	55.7	0.0	23.7	2115
971013	286	12	55.6	0.14	0.04	55.5	55.7	0.3	23.6	2139
971014	287	12	55.5	0.00	0.00	55.5	55.5	0.0	23.5	2162
971015	288	12	55.3	0.18	0.05	55.2	55.7	0.6	23.3	2186
971016	289	12	55.2	0.16	0.05	55.2	55.7	0.6	23.2	2209

Appendix Table 1.—Water temperatures (F) and temperature units for Upper Pond-Upper Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
971017	290	12	55.2	0.12	0.03	54.9	55.5	0.6	23.2	2232
971018	291	12	55.0	0.19	0.05	54.9	55.5	0.6	23.0	2255
971019	292	12	54.9	0.08	0.02	54.9	55.2	0.3	22.9	2278
971020	293	12	54.9	0.16	0.05	54.6	55.2	0.6	22.9	2301
971021	294	12	54.6	0.00	0.00	54.6	54.6	0.0	22.6	2324
971022	295	12	54.6	0.13	0.04	54.3	54.6	0.3	22.6	2346
971023	296	12	54.4	0.11	0.03	54.3	54.6	0.3	22.4	2368
971024	297	12	54.3	0.11	0.03	54.1	54.3	0.3	22.3	2391
971025	298	12	54.2	0.14	0.04	54.1	54.3	0.3	22.2	2413
971026	299	12	54.1	0.00	0.00	54.1	54.1	0.0	22.1	2435
971027	300	12	54.0	0.13	0.04	53.8	54.1	0.3	22.0	2457
971028	301	12	53.8	0.11	0.03	53.8	54.1	0.3	21.8	2479
971029	302	12	53.8	0.08	0.02	53.5	53.8	0.3	21.8	2501
971030	303	12	53.5	0.08	0.02	53.5	53.8	0.3	21.5	2522
971031	304	12	53.4	0.13	0.04	53.2	53.5	0.3	21.4	2543
971101	305	12	53.3	0.11	0.03	53.2	53.5	0.3	21.3	2565
971102	306	12	53.2	0.00	0.00	53.2	53.2	0.0	21.2	2586
971103	307	12	53.1	0.15	0.04	52.9	53.2	0.3	21.1	2607
971104	308	12	53.0	0.11	0.03	52.9	53.2	0.3	21.0	2628
971105	309	12	52.8	0.15	0.04	52.7	52.9	0.3	20.8	2649
971106	310	12	52.7	0.11	0.03	52.7	52.9	0.3	20.7	2670
971107	311	12	52.6	0.12	0.04	52.4	52.7	0.3	20.6	2690
971108	312	12	52.4	0.00	0.00	52.4	52.4	0.0	20.4	2711
971109	313	12	52.3	0.14	0.04	52.1	52.4	0.3	20.3	2731
971110	314	12	52.1	0.00	0.00	52.1	52.1	0.0	20.1	2751
971111	315	12	52.0	0.13	0.04	51.8	52.1	0.3	20.0	2771
971112	316	12	51.8	0.00	0.00	51.8	51.8	0.0	19.8	2791
971113	317	12	51.7	0.14	0.04	51.6	51.8	0.3	19.7	2810
971114	318	13	51.6	0.20	0.05	51.0	51.8	0.8	19.6	2830
971115	319	12	51.5	0.08	0.02	51.3	51.6	0.3	19.5	2849
971116	320	12	51.3	0.11	0.03	51.3	51.6	0.3	19.3	2868
971117	321	12	51.2	0.11	0.03	51.0	51.3	0.3	19.2	2888
971118	322	12	51.0	0.00	0.00	51.0	51.0	0.0	19.0	2907
971119	323	12	51.0	0.00	0.00	51.0	51.0	0.0	19.0	2926
971120	324	12	50.8	0.14	0.04	50.7	51.0	0.3	18.8	2944
971121	325	12	50.7	0.00	0.00	50.7	50.7	0.0	18.7	2963
971122	326	12	50.7	0.13	0.04	50.4	50.7	0.3	18.7	2982
971123	327	12	50.4	0.00	0.00	50.4	50.4	0.0	18.4	3000
971124	328	12	50.3	0.14	0.04	50.2	50.4	0.3	18.3	3019
971125	329	12	50.2	0.00	0.00	50.2	50.2	0.0	18.2	3037
971126	330	12	49.9	0.11	0.03	49.9	50.2	0.3	17.9	3055
971127	331	12	49.8	0.13	0.04	49.6	49.9	0.3	17.8	3072
971128	332	12	49.6	0.11	0.03	49.6	49.9	0.3	17.6	3090

Appendix Table 1.—Water temperatures (F) and temperature units for Upper Pond-Upper Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
971129	333	12	49.5	0.13	0.04	49.3	49.6	0.3	17.5	3108
971130	334	12	49.3	0.08	0.02	49.3	49.6	0.3	17.3	3125
971201	335	12	49.3	0.11	0.03	49.0	49.3	0.3	17.3	3142
971202	336	12	49.0	0.00	0.00	49.0	49.0	0.0	17.0	3159
971203	337	12	49.0	0.11	0.03	48.8	49.0	0.3	17.0	3176
971204	338	12	48.8	0.00	0.00	48.8	48.8	0.0	16.8	3193
971205	339	12	48.8	0.00	0.00	48.8	48.8	0.0	16.8	3210
971206	340	12	48.6	0.14	0.04	48.5	48.8	0.3	16.6	3226
971207	341	12	48.5	0.00	0.00	48.5	48.5	0.0	16.5	3243
971208	342	12	48.5	0.00	0.00	48.5	48.5	0.0	16.5	3259
971209	343	12	48.2	0.08	0.02	48.2	48.5	0.3	16.2	3276
971210	344	12	48.2	0.00	0.00	48.2	48.2	0.0	16.2	3292
971211	345	12	48.2	0.00	0.00	48.2	48.2	0.0	16.2	3308
971212	346	12	48.0	0.14	0.04	47.9	48.2	0.3	16.0	3324
971213	347	12	47.9	0.00	0.00	47.9	47.9	0.0	15.9	3340
971214	348	12	47.9	0.00	0.00	47.9	47.9	0.0	15.9	3356
971215	349	12	47.7	0.11	0.03	47.7	47.9	0.3	15.7	3371
971216	350	12	47.7	0.00	0.00	47.7	47.7	0.0	15.7	3387
971217	351	12	47.7	0.00	0.00	47.7	47.7	0.0	15.7	3403
971218	352	12	47.5	0.14	0.04	47.4	47.7	0.3	15.5	3418
971219	353	12	47.4	0.00	0.00	47.4	47.4	0.0	15.4	3434
971220	354	12	47.3	0.11	0.03	47.1	47.4	0.3	15.3	3449
971221	355	12	47.1	0.08	0.02	47.1	47.4	0.3	15.1	3464
971222	356	12	47.1	0.00	0.00	47.1	47.1	0.0	15.1	3479
971223	357	12	47.1	0.08	0.02	46.8	47.1	0.3	15.1	3494
971224	358	12	46.8	0.08	0.02	46.8	47.1	0.3	14.8	3509
971225	359	12	46.8	0.00	0.00	46.8	46.8	0.0	14.8	3524
971226	360	12	46.8	0.13	0.04	46.5	46.8	0.3	14.8	3539
971227	361	12	46.6	0.11	0.03	46.5	46.8	0.3	14.6	3553
971228	362	12	46.5	0.00	0.00	46.5	46.5	0.0	14.5	3568
971229	363	12	46.5	0.00	0.00	46.5	46.5	0.0	14.5	3582
971230	364	12	46.5	0.13	0.04	46.3	46.5	0.3	14.5	3597
971231	365	12	46.3	0.00	0.00	46.3	46.3	0.0	14.3	3611
980101	1	12	46.3	0.00	0.00	46.3	46.3	0.0	14.3	3625
980102	2	12	46.2	0.14	0.04	46.0	46.3	0.3	14.2	3639
980103	3	12	46.0	0.00	0.00	46.0	46.0	0.0	14.0	3653
980104	4	12	46.0	0.00	0.00	46.0	46.0	0.0	14.0	3667
980105	5	12	46.0	0.00	0.00	46.0	46.0	0.0	14.0	3681
980106	6	12	45.7	0.08	0.00	45.7	46.0	0.3	13.7	3695
980107	7	12	45.7	0.00	0.00	45.7	45.7	0.0	13.7	3709
980108	8	12	45.7	0.11	0.03	45.4	45.7	0.3	13.7	3723
980109	9	12	45.5	0.11	0.03	45.4	45.7	0.3	13.5	3736
980110	10	12	45.4	0.00	0.00	45.4	45.4	0.0	13.4	3749

Appendix Table 1.—Water temperatures (F) and temperature units for Upper Pond-Upper Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
980111	11	12	45.4	0.13	0.04	45.2	45.4	0.3	13.4	3763
980112	12	12	45.2	0.08	0.02	45.2	45.4	0.3	13.2	3776
980113	13	12	45.2	0.00	0.00	45.2	45.2	0.0	13.2	3789
980114	14	12	45.2	0.00	0.00	45.2	45.2	0.0	13.2	3802
980115	15	12	45.1	0.12	0.04	44.9	45.2	0.3	13.1	3815
980116	16	12	44.9	0.08	0.02	44.9	45.2	0.3	12.9	3828
980117	17	12	44.9	0.00	0.00	44.9	44.9	0.0	12.9	3841
980118	18	12	44.9	0.00	0.00	44.9	44.9	0.0	12.9	3854
980119	19	12	44.8	0.13	0.04	44.6	44.9	0.3	12.8	3867
980120	20	12	44.6	0.11	0.03	44.6	44.9	0.3	12.6	3879
980121	21	12	44.6	0.00	0.00	44.6	44.6	0.0	12.6	3892
980122	22	12	44.6	0.00	0.00	44.6	44.6	0.0	12.6	3905
980123	23	12	44.4	0.14	0.04	44.3	44.6	0.3	12.4	3917
980124	24	12	44.3	0.08	0.02	44.3	44.6	0.3	12.3	3929
980125	25	12	44.3	0.00	0.00	44.3	44.3	0.0	12.3	3942
980126	26	12	44.3	0.00	0.00	44.3	44.3	0.0	12.3	3954
980127	27	12	44.3	0.00	0.00	44.3	44.3	0.0	12.3	3966
980128	28	12	44.3	0.00	0.00	44.3	44.3	0.0	12.3	3979
980129	29	12	44.2	0.14	0.04	44.0	44.3	0.3	12.2	3991
980130	30	12	44.1	0.13	0.04	44.0	44.3	0.3	12.1	4003
980131	31	12	44.1	0.11	0.03	44.0	44.3	0.3	12.1	4015
980201	32	12	44.0	0.00	0.00	44.0	44.0	0.0	12.0	4027
980202	33	12	44.0	0.00	0.00	44.0	44.0	0.0	12.0	4039
980203	34	12	44.0	0.08	0.02	43.8	44.0	0.3	12.0	4051
980204	35	12	43.9	0.14	0.04	43.8	44.0	0.3	11.9	4063
980205	36	12	43.8	0.13	0.04	43.8	44.0	0.3	11.8	4075
980206	37	12	43.8	0.13	0.04	43.8	44.0	0.3	11.8	4087
980207	38	12	43.8	0.00	0.00	43.8	43.8	0.0	11.8	4098
980208	39	12	43.8	0.00	0.00	43.8	43.8	0.0	11.8	4110
980209	40	12	43.8	0.00	0.00	43.8	43.8	0.0	11.8	4122
980210	41	12	43.8	0.00	0.00	43.8	43.8	0.0	11.8	4134
980211	42	12	43.8	0.00	0.00	43.8	43.8	0.0	11.8	4146
980212	43	12	43.7	0.13	0.04	43.5	43.8	0.3	11.7	4157
980213	44	12	43.6	0.14	0.04	43.5	43.8	0.3	11.6	4169
980214	45	12	43.5	0.11	0.03	43.5	43.8	0.3	11.5	4180
980215	46	12	43.5	0.08	0.02	43.5	43.8	0.3	11.5	4192
980216	47	12	43.5	0.08	0.02	43.5	43.8	0.3	11.5	4203
980217	48	12	43.5	0.08	0.02	43.5	43.8	0.3	11.5	4215
980218	49	12	43.5	0.00	0.00	43.5	43.5	0.0	11.5	4226
980219	50	12	43.5	0.12	0.03	43.2	43.8	0.6	11.5	4238
980220	51	12	43.3	0.14	0.04	43.2	43.5	0.3	11.3	4249
980221	52	12	43.3	0.14	0.04	43.2	43.5	0.3	11.3	4260
980222	53	12	43.3	0.13	0.04	43.2	43.5	0.3	11.3	4272

Appendix Table 1.—Water temperatures (F) and temperature units for Upper Pond-Upper Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
980223	54	12	43.3	0.25	0.07	43.2	44.0	0.8	11.3	4283
980224	55	12	43.3	0.13	0.04	43.2	43.5	0.3	11.3	4294
980225	56	12	43.3	0.13	0.04	43.2	43.5	0.3	11.3	4306
980226	57	12	43.2	0.11	0.03	43.2	43.5	0.3	11.2	4317
980227	58	12	43.3	0.25	0.07	43.2	44.0	0.8	11.3	4328
980228	59	12	43.3	0.25	0.07	43.2	44.0	0.8	11.3	4339
980301	60	12	43.2	0.11	0.03	43.2	43.5	0.3	11.2	4351
980302	61	12	43.2	0.00	0.00	43.2	43.2	0.0	11.2	4362
980303	62	12	43.2	0.00	0.00	43.2	43.2	0.0	11.2	4373
980304	63	12	43.2	0.11	0.03	43.2	43.5	0.3	11.2	4384
980305	64	12	43.2	0.00	0.00	43.2	43.2	0.0	11.2	4395
980306	65	12	43.3	0.24	0.07	43.2	44.0	0.8	11.3	4407
980307	66	12	43.1	0.19	0.05	42.9	43.5	0.6	11.1	4418
980308	67	12	43.0	0.14	0.04	42.9	43.2	0.3	11.0	4429
980309	68	12	43.0	0.14	0.04	42.9	43.2	0.3	11.0	4440
980310	69	12	43.1	0.33	0.09	42.9	44.0	1.1	11.1	4451
980311	70	12	43.0	0.14	0.04	42.9	43.2	0.3	11.0	4462
980312	71	12	43.1	0.25	0.07	42.9	43.8	0.8	11.1	4473
980313	72	12	43.0	0.13	0.04	42.9	43.2	0.3	11.0	4484
980314	73	12	43.0	0.18	0.05	42.9	43.5	0.6	11.0	4495
980315	74	12	43.0	0.11	0.03	42.9	43.2	0.3	11.0	4506
980316	75	12	43.0	0.32	0.09	42.9	44.0	1.1	11.0	4517
980317	76	12	43.0	0.17	0.05	42.9	43.5	0.6	11.0	4528
980318	77	12	43.0	0.11	0.03	42.9	43.2	0.3	11.0	4539
980319	78	12	43.0	0.24	0.07	42.9	43.8	0.8	11.0	4550
980320	79	12	42.9	0.11	0.03	42.6	42.9	0.3	10.9	4561
980321	80	12	42.9	0.11	0.03	42.6	42.9	0.3	10.9	4572
980322	81	12	42.8	0.14	0.04	42.6	42.9	0.3	10.8	4582
980323	82	12	42.8	0.14	0.04	42.6	42.9	0.3	10.8	4593
980324	83	12	42.8	0.15	0.04	42.6	42.9	0.3	10.8	4604
980325	84	12	42.8	0.14	0.04	42.6	42.9	0.3	10.8	4615
980326	85	12	42.8	0.14	0.04	42.6	42.9	0.3	10.8	4626
980327	86	12	42.8	0.15	0.04	42.6	42.9	0.3	10.8	4636
980328	87	12	42.8	0.25	0.07	42.6	43.5	0.8	10.8	4647
980329	88	12	42.8	0.25	0.07	42.6	43.5	0.8	10.8	4658
980330	89	12	42.8	0.25	0.07	42.6	43.5	0.8	10.8	4669
980331	90	6	42.7	0.14	0.06	42.6	42.9	0.3	10.7	4679

Appendix Table 2.—Water temperatures (F) and temperature units for Upper Pond-Spring Complex @ Sekokini Springs, MT (July 28, 1997 to March 31, 1998)[a].

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
No data collected at this site from July 23-27										
970728	209	5	63.4	0.00	0.00	63.4	63.4	0.0	31.4	0031
970729	210	12	63.3	0.11	0.03	63.1	63.4	0.3	31.3	0063
970730	211	12	63.4	0.08	0.02	63.4	63.6	0.3	31.4	0094
970731	212	12	63.5	0.14	0.04	63.4	63.6	0.3	31.5	0125
970801	213	12	63.6	0.13	0.04	63.4	63.6	0.3	31.6	0157
970802	214	12	63.7	0.08	0.02	63.6	63.9	0.3	31.7	0189
970803	215	12	63.8	0.15	0.04	63.6	63.9	0.3	31.8	0221
970804	216	12	63.9	0.00	0.00	63.9	63.9	0.0	31.9	0252
970805	217	12	64.0	0.13	0.04	63.9	64.2	0.3	32.0	0284
970806	218	12	64.2	0.12	0.04	63.9	64.5	0.6	32.2	0317
970807	219	12	64.3	0.11	0.03	64.2	64.5	0.3	32.3	0349
970808	220	12	64.4	0.14	0.04	64.2	64.5	0.3	32.4	0381
970809	221	12	64.5	0.00	0.00	64.5	64.5	0.0	32.5	0414
970810	222	12	64.4	0.18	0.05	64.2	64.8	0.6	32.4	0446
970811	223	12	64.7	0.18	0.05	64.5	65.1	0.6	32.7	0479
970812	224	12	64.8	0.17	0.05	64.5	65.1	0.6	32.8	0512
970813	225	12	64.7	0.18	0.05	64.5	65.1	0.6	32.7	0544
970814	226	11	64.7	0.59	0.18	64.2	66.0	1.8	32.7	0577
970815	227	12	64.3	0.45	0.13	63.9	65.7	1.7	32.3	0609
970816	228	12	64.0	0.17	0.05	63.9	64.5	0.6	32.0	0641
970817	229	12	64.1	0.53	0.15	63.6	65.4	1.7	32.1	0673
970818	230	12	63.9	0.21	0.06	63.6	64.5	0.9	31.9	0705
970819	231	12	64.0	0.47	0.14	63.6	65.4	1.7	32.0	0737
970820	232	12	63.8	0.42	0.12	63.6	65.1	1.5	31.8	0769
970821	233	12	63.7	0.39	0.11	63.4	64.8	1.4	31.7	0801
970822	234	12	63.7	0.61	0.18	63.4	65.1	1.7	31.7	0833
970823	235	12	63.4	0.45	0.13	63.1	64.5	1.4	31.4	0864
970824	236	12	63.1	0.00	0.00	63.1	63.1	0.0	31.1	0895
970825	237	12	63.2	0.47	0.13	62.8	64.2	1.4	31.2	0926
970826	238	12	63.2	0.54	0.16	62.8	64.5	1.7	31.2	0958
970827	239	12	63.1	0.59	0.17	62.8	64.5	1.7	31.1	0989
970828	240	12	62.9	0.14	0.04	62.8	63.1	0.3	30.9	1020
970829	241	12	62.9	0.42	0.12	62.8	64.2	1.4	30.9	1050
970830	242	12	62.9	0.36	0.10	62.8	63.9	1.2	30.9	1081
970831	243	12	62.8	0.18	0.05	62.8	63.4	0.6	30.8	1112
970901	244	12	62.9	0.40	0.11	62.8	63.9	1.2	30.9	1143
970902	245	12	62.9	0.40	0.11	62.8	63.9	1.2	30.9	1174
970903	246	12	62.7	0.19	0.05	62.5	63.1	0.6	30.7	1205

Appendix Table 2.—Water temperatures (F) and temperature units for Upper Pond-Spring Complex @ Sekokini Springs, MT (July 28, 1997 to March 31, 1998)[a].

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
970904	247	12	62.6	0.33	0.09	62.2	63.4	1.2	30.6	1235
970905	248	12	62.3	0.33	0.10	62.2	63.4	1.2	30.3	1266
970906	249	12	62.4	0.40	0.11	62.2	63.4	1.2	30.4	1296
970907	250	12	62.3	0.43	0.12	61.9	63.4	1.4	30.3	1326
970908	251	12	62.4	0.46	0.13	62.2	63.6	1.4	30.4	1357
970909	252	12	62.2	0.52	0.15	61.9	63.6	1.7	30.2	1387
970910	253	12	62.0	0.13	0.04	61.9	62.2	0.3	30.0	1417
970911	254	12	62.0	0.15	0.04	61.9	62.2	0.3	30.0	1447
970912	255	12	62.0	0.13	0.04	61.9	62.2	0.3	30.0	1477
970913	256	12	62.0	0.43	0.12	61.6	63.4	1.7	30.0	1507
970914	257	12	61.9	0.08	0.02	61.6	61.9	0.3	29.9	1537
970915	258	12	61.7	0.11	0.03	61.6	61.9	0.3	29.7	1567
970916	259	12	61.7	0.08	0.02	61.6	61.9	0.3	29.7	1596
970917	260	12	61.6	0.17	0.05	61.4	61.9	0.6	29.6	1626
970918	261	12	61.4	0.00	0.00	61.4	61.4	0.0	29.4	1655
970919	262	12	61.2	0.26	0.07	61.1	61.9	0.9	29.2	1685
970920	263	12	61.2	0.33	0.10	61.1	62.2	1.1	29.2	1714
970921	264	12	60.9	0.25	0.07	60.8	61.6	0.9	28.9	1743
970922	265	12	60.7	0.16	0.05	60.5	61.1	0.6	28.7	1771
970923	266	12	60.6	0.17	0.05	60.5	61.1	0.6	28.6	1800
970924	267	12	60.5	0.17	0.05	60.2	60.8	0.6	28.5	1828
970925	268	12	60.2	0.17	0.05	59.9	60.5	0.6	28.2	1857
970926	269	12	59.9	0.00	0.00	59.9	59.9	0.0	27.9	1884
970927	270	12	59.9	0.13	0.04	59.6	59.9	0.3	27.9	1912
970928	271	12	59.6	0.00	0.00	59.6	59.6	0.0	27.6	1940
970929	272	12	59.7	0.23	0.07	59.4	60.2	0.9	27.7	1968
970930	273	12	59.4	0.18	0.05	59.4	59.9	0.6	27.4	1995
971001	274	12	59.4	0.08	0.02	59.4	59.6	0.3	27.4	2022
971002	275	12	59.2	0.19	0.05	59.1	59.6	0.6	27.2	2050
971003	276	12	59.1	0.00	0.00	59.1	59.1	0.0	27.1	2077
971004	277	12	59.0	0.14	0.04	58.8	59.1	0.3	27.0	2104
971005	278	12	58.8	0.08	0.02	58.5	58.8	0.3	26.8	2130
971006	279	12	58.6	0.14	0.04	58.5	58.8	0.3	26.6	2157
971007	280	12	58.5	0.08	0.02	58.5	58.8	0.3	26.5	2184
971008	281	12	58.3	0.19	0.05	58.2	58.8	0.6	26.3	2210
971009	282	12	58.2	0.00	0.00	58.2	58.2	0.0	26.2	2236
971010	283	12	58.2	0.13	0.04	57.9	58.2	0.3	26.2	2262
971011	284	12	58.0	0.08	0.02	57.9	58.2	0.3	26.0	2288
971012	285	12	57.9	0.17	0.05	57.7	58.2	0.6	25.9	2314
971013	286	12	57.7	0.00	0.00	57.7	57.7	0.0	25.7	2340
971014	287	12	57.6	0.13	0.04	57.4	57.7	0.3	25.6	2365
971015	288	12	57.4	0.11	0.03	57.4	57.7	0.3	25.4	2391
971016	289	12	57.2	0.14	0.04	57.1	57.4	0.3	25.2	2416

Appendix Table 2.—Water temperatures (F) and temperature units for Upper Pond-Spring Complex @ Sekokini Springs, MT (July 28, 1997 to March 31, 1998)[a].

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
971017	290	12	57.1	0.11	0.03	57.1	57.4	0.3	25.1	2441
971018	291	12	56.9	0.14	0.04	56.8	57.1	0.3	24.9	2466
971019	292	12	56.5	0.14	0.04	56.3	56.8	0.6	24.5	2491
971020	293	12	56.5	0.17	0.05	56.3	56.8	0.6	24.5	2515
971021	294	12	56.3	0.11	0.03	56.3	56.6	0.3	24.3	2539
971022	295	12	56.0	0.08	0.02	56.0	56.3	0.3	24.0	2563
971023	296	12	55.9	0.13	0.04	55.7	56.0	0.3	23.9	2587
971024	297	12	55.7	0.08	0.02	55.7	56.0	0.3	23.7	2611
971025	298	12	55.5	0.14	0.04	55.4	55.7	0.3	23.5	2635
971026	299	12	55.4	0.00	0.00	55.4	55.4	0.0	23.4	2658
971027	300	12	55.4	0.13	0.04	55.2	55.4	0.3	23.4	2681
971028	301	12	55.1	0.08	0.02	54.9	55.2	0.3	23.1	2705
971029	302	12	54.9	0.00	0.00	54.9	54.9	0.0	22.9	2727
971030	303	12	54.7	0.14	0.04	54.6	54.9	0.3	22.7	2750
971031	304	12	54.5	0.17	0.05	54.3	54.9	0.6	22.5	2773
971101	305	12	54.5	0.15	0.04	54.3	54.6	0.3	22.5	2795
971102	306	12	54.3	0.00	0.00	54.3	54.3	0.0	22.3	2818
971103	307	12	54.3	0.00	0.00	54.3	54.3	0.0	22.3	2840
971104	308	12	54.3	0.13	0.04	54.0	54.3	0.3	22.3	2862
971105	309	12	54.1	0.11	0.03	54.0	54.3	0.3	22.1	2884
971106	310	12	54.0	0.00	0.00	54.0	54.0	0.0	22.0	2906
971107	311	12	53.9	0.14	0.04	53.8	54.0	0.3	21.9	2928
971108	312	12	53.7	0.13	0.04	53.5	53.8	0.3	21.7	2950
971109	313	12	53.5	0.11	0.03	53.5	53.8	0.3	21.5	2971
971110	314	12	53.2	0.08	0.02	53.2	53.5	0.3	21.2	2993
971111	315	12	53.2	0.12	0.03	52.9	53.5	0.6	21.2	3014
971112	316	12	53.0	0.14	0.04	52.9	53.2	0.3	21.0	3035
971113	317	12	52.9	0.14	0.04	52.6	53.2	0.6	20.9	3056
971114	318	12	52.8	0.28	0.08	52.6	53.5	0.8	20.8	3076
971115	319	12	52.7	0.25	0.07	52.6	53.5	0.8	20.7	3097
971116	320	12	52.6	0.22	0.06	52.4	53.2	0.8	20.6	3118
971117	321	12	52.4	0.00	0.00	52.4	52.4	0.0	20.4	3138
971118	322	12	52.3	0.12	0.04	52.1	52.4	0.3	20.3	3158
971119	323	12	52.0	0.14	0.04	51.8	52.1	0.3	20.0	3178
971120	324	12	51.8	0.00	0.00	51.8	51.8	0.0	19.8	3198
971121	325	12	51.6	0.13	0.04	51.5	51.8	0.3	19.6	3218
971122	326	12	51.4	0.19	0.05	51.3	51.8	0.6	19.4	3237
971123	327	12	51.2	0.13	0.04	51.0	51.3	0.3	19.2	3256
971124	328	12	51.0	0.00	0.00	51.0	51.0	0.0	19.0	3275
971125	329	12	50.8	0.13	0.04	50.7	51.0	0.3	18.8	3294
971126	330	12	50.7	0.17	0.05	50.4	51.0	0.6	18.7	3313
971127	331	12	50.4	0.12	0.03	50.1	50.7	0.6	18.4	3331
971128	332	12	50.2	0.08	0.02	50.1	50.4	0.3	18.2	3349
971129	333	12	50.1	0.13	0.04	49.8	50.1	0.3	18.1	3367

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Appendix Table 2.—Water temperatures (F) and temperature units for Upper Pond-Spring Complex @ Sekokini Springs, MT (July 28, 1997 to March 31, 1998)[a].

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
971130	334	12	49.9	0.08	0.02	49.8	50.1	0.3	17.9	3385
971201	335	12	49.8	0.24	0.07	49.6	50.4	0.9	17.8	3403
971202	336	12	49.6	0.08	0.02	49.6	49.8	0.3	17.6	3421
971203	337	12	49.4	0.14	0.04	49.3	49.6	0.3	17.4	3438
971204	338	12	49.3	0.00	0.00	49.3	49.3	0.0	17.3	3455
971205	339	12	49.3	0.08	0.02	49.3	49.6	0.3	17.3	3473
971206	340	12	49.3	0.00	0.00	49.3	49.3	0.0	17.3	3490
971207	341	12	49.3	0.08	0.02	49.0	49.3	0.3	17.3	3507
971208	342	12	49.0	0.08	0.02	49.0	49.3	0.3	17.0	3524
971209	343	12	49.0	0.00	0.00	49.0	49.0	0.0	17.0	3541
971210	344	12	49.0	0.08	0.02	49.0	49.3	0.3	17.0	3558
971211	345	12	48.9	0.14	0.04	48.7	49.0	0.3	16.9	3575
971212	346	12	48.7	0.14	0.04	48.5	49.0	0.6	16.7	3592
971213	347	12	48.5	0.11	0.03	48.5	48.7	0.3	16.5	3608
971214	348	12	48.4	0.13	0.04	48.2	48.5	0.3	16.4	3625
971215	349	12	48.2	0.11	0.03	48.2	48.5	0.3	16.2	3641
971216	350	12	48.2	0.00	0.00	48.2	48.2	0.0	16.2	3657
971217	351	12	48.2	0.12	0.03	47.9	48.5	0.6	16.2	3673
971218	352	12	47.9	0.00	0.00	47.9	47.9	0.0	15.9	3689
971219	353	12	47.8	0.17	0.05	47.6	48.2	0.6	15.8	3705
971220	354	12	47.8	0.14	0.04	47.6	47.9	0.3	15.8	3721
971221	355	12	47.6	0.08	0.02	47.6	47.9	0.3	15.6	3736
971222	356	12	47.6	0.21	0.06	47.4	47.9	0.6	15.6	3752
971223	357	12	47.4	0.00	0.00	47.4	47.4	0.0	15.4	3767
971224	358	12	47.2	0.14	0.04	47.1	47.4	0.3	15.2	3783
971225	359	12	47.2	0.14	0.04	47.1	47.4	0.3	15.2	3798
971226	360	12	47.1	0.00	0.00	47.1	47.1	0.0	15.1	3813
971227	361	12	47.1	0.00	0.00	47.1	47.1	0.0	15.1	3828
971228	362	12	46.9	0.14	0.04	46.8	47.1	0.3	14.9	3843
971229	363	12	46.8	0.00	0.00	46.8	46.8	0.0	14.8	3858
971230	364	12	46.7	0.14	0.04	46.5	46.8	0.3	14.7	3872
971231	365	12	46.5	0.00	0.00	46.5	46.5	0.0	14.5	3887
980101	1	12	46.5	0.00	0.00	46.5	46.5	0.0	14.5	3901
980102	2	12	46.2	0.16	0.05	46.0	46.5	0.6	14.2	3915
980103	3	12	46.0	0.00	0.00	46.0	46.0	0.0	14.0	3929
980104	4	12	45.8	0.15	0.04	45.7	46.0	0.3	13.8	3943
980105	5	12	45.7	0.08	0.02	45.7	46.0	0.3	13.7	3957
980106	6	12	45.7	0.00	0.00	45.7	45.7	0.0	13.7	3971
980107	7	12	45.6	0.14	0.04	45.4	45.7	0.3	13.6	3984
980108	8	12	45.3	0.13	0.04	45.1	45.4	0.3	13.3	3997
980109	9	12	45.4	0.11	0.03	45.4	45.7	0.3	13.4	4011
980110	10	12	45.4	0.00	0.00	45.4	45.4	0.0	13.4	4024
980111	11	12	45.4	0.25	0.07	45.1	46.0	0.8	13.4	4038
980112	12	12	45.2	0.11	0.03	45.1	45.4	0.3	13.2	4051

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Appendix Table 2.—Water temperatures (F) and temperature units for Upper Pond-Spring Complex @ Sekokini Springs, MT (July 28, 1997 to March 31, 1998)[a].

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
980113	13	12	45.1	0.08	0.02	45.1	45.4	0.3	13.1	4064
980114	14	12	45.1	0.11	0.03	44.8	45.1	0.3	13.1	4077
980115	15	12	44.7	0.14	0.04	44.6	44.8	0.3	12.7	4090
980116	16	12	44.4	0.19	0.05	44.3	44.8	0.6	12.4	4102
980117	17	12	44.3	0.11	0.03	44.3	44.6	0.3	12.3	4115
980118	18	12	44.2	0.24	0.07	44.0	44.8	0.8	12.2	4127
980119	19	12	44.0	0.12	0.03	43.7	44.3	0.6	12.0	4139
980120	20	12	43.8	0.14	0.04	43.7	44.0	0.3	11.8	4151
980121	21	12	43.7	0.08	0.02	43.7	44.0	0.3	11.7	4162
980122	22	12	43.7	0.00	0.00	43.7	43.7	0.0	11.7	4174
980123	23	12	43.7	0.08	0.02	43.4	43.7	0.3	11.7	4186
980124	24	12	43.7	0.00	0.00	43.7	43.7	0.0	11.7	4197
980125	25	12	43.6	0.14	0.04	43.4	43.7	0.3	11.6	4209
980126	26	12	43.6	0.15	0.04	43.4	43.7	0.3	11.6	4221
980127	27	12	43.6	0.14	0.04	43.4	43.7	0.3	11.6	4232
980128	28	12	43.7	0.24	0.07	43.4	44.3	0.8	11.7	4244
980129	29	12	43.7	0.16	0.05	43.4	44.0	0.6	11.7	4256
980130	30	12	43.5	0.13	0.04	43.4	43.7	0.3	11.5	4267
980131	31	12	43.5	0.25	0.07	43.4	44.3	0.8	11.5	4279
980201	32	12	43.4	0.11	0.03	43.2	43.4	0.3	11.4	4290
980202	33	12	43.3	0.14	0.04	43.2	43.4	0.3	11.3	4301
980203	34	12	43.3	0.14	0.04	43.2	43.4	0.3	11.3	4313
980204	35	12	43.4	0.31	0.09	43.2	44.0	0.8	11.4	4324
980205	36	12	43.3	0.22	0.06	43.2	43.7	0.6	11.3	4335
980206	37	12	43.2	0.08	0.02	43.2	43.4	0.3	11.2	4347
980207	38	12	43.2	0.11	0.03	43.2	43.4	0.3	11.2	4358
980208	39	12	43.2	0.00	0.00	43.2	43.2	0.0	11.2	4369
980209	40	12	43.0	0.15	0.04	42.9	43.2	0.3	11.0	4380
980210	41	12	43.0	0.23	0.07	42.9	43.4	0.6	11.0	4391
980211	42	12	42.9	0.11	0.03	42.9	43.2	0.3	10.9	4402
980212	43	12	42.9	0.11	0.03	42.9	43.2	0.3	10.9	4413
980213	44	12	42.9	0.08	0.02	42.9	43.2	0.3	10.9	4424
980214	45	12	43.1	0.39	0.11	42.9	44.0	1.1	11.1	4435
980215	46	12	43.1	0.28	0.08	42.9	43.7	0.9	11.1	4446
980216	47	12	43.3	0.19	0.05	43.2	43.7	0.6	11.3	4457
980217	48	12	43.4	0.36	0.10	43.2	44.3	1.1	11.4	4469
980218	49	12	43.4	0.32	0.09	43.2	44.3	1.1	11.4	4480
980219	50	12	43.5	0.45	0.13	43.2	44.6	1.4	11.5	4492
980220	51	12	43.4	0.35	0.10	43.2	44.3	1.1	11.4	4503
980221	52	12	43.2	0.13	0.04	43.2	43.4	0.3	11.2	4514
980222	53	12	43.2	0.11	0.03	43.2	43.4	0.3	11.2	4526
980223	54	12	43.3	0.25	0.07	43.2	44.0	0.8	11.3	4537
980224	55	12	43.3	0.14	0.04	43.2	43.4	0.3	11.3	4548
980225	56	12	43.3	0.19	0.05	43.2	43.7	0.6	11.3	4559

Appendix Table 2.—Water temperatures (F) and temperature units for Upper Pond-Spring Complex @ Sekokini Springs, MT (July 28, 1997 to March 31, 1998)[a].

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
980226	57	12	43.3	0.22	0.06	43.2	43.7	0.6	11.3	4571
980227	58	12	43.3	0.18	0.05	43.2	43.7	0.6	11.3	4582
980228	59	12	43.2	0.40	0.12	42.9	44.3	1.4	11.2	4593
980301	60	12	43.0	0.19	0.06	42.9	43.4	0.6	11.0	4604
980302	61	12	43.2	0.43	0.12	42.9	44.3	1.4	11.2	4615
980303	62	12	43.0	0.15	0.04	42.9	43.2	0.3	11.0	4626
980304	63	12	43.0	0.19	0.06	42.9	43.4	0.6	11.0	4637
980305	64	12	43.0	0.23	0.07	42.9	43.4	0.6	11.0	4648
980306	65	12	43.1	0.49	0.14	42.9	44.3	1.4	11.1	4659
980307	66	12	43.0	0.14	0.04	42.9	43.2	0.3	11.0	4670
980308	67	12	43.0	0.33	0.10	42.9	44.0	1.1	11.0	4681
980309	68	12	42.8	0.36	0.10	42.6	43.7	1.1	10.8	4692
980310	69	12	42.6	0.47	0.14	42.3	43.7	1.4	10.6	4703
980311	70	12	42.8	0.47	0.14	42.3	43.7	1.4	10.8	4714
980312	71	12	43.1	0.47	0.14	42.6	44.0	1.4	11.1	4725
980313	72	0								
980314	73	0								
980315	74	0								
980316	75	0								
980317	76	0								
980318	77	0								
980319	78	0								
980320	79	0								
980321	80	0								
980322	81	0								
980323	82	0								
980324	83	0								
980325	84	0								
980326	85	0								
980327	86	0								
980328	87	0								
980329	88	0								
980330	89	0								
980331	90	0								

a The Optic StowAway thermometer did not function properly from March 13-31, 1998, so no temperatures were recorded during that time.

Appendix Table 3.—Water temperatures (F) and temperature units for Egg Trough Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
970723	204	5	52.5	0.23	0.10	52.2	52.7	0.6	20.5	0020
970724	205	12	52.4	0.28	0.08	51.9	52.7	0.8	20.4	0041
970725	206	12	52.4	0.32	0.09	51.9	53.0	1.1	20.4	0061
970726	207	12	52.3	0.30	0.09	51.9	52.7	0.8	20.3	0082
970727	208	12	52.3	0.34	0.10	51.9	52.7	0.8	20.3	0102
970728	209	12	52.5	0.34	0.10	52.2	53.0	0.8	20.5	0122
970729	210	12	52.5	0.25	0.07	52.2	53.0	0.8	20.5	0143
970730	211	12	52.5	0.16	0.05	52.2	52.7	0.6	20.5	0163
970731	212	12	52.4	0.30	0.09	52.2	53.0	0.8	20.4	0184
970801	213	12	52.5	0.25	0.07	52.2	52.7	0.6	20.5	0204
970802	214	12	52.4	0.25	0.07	52.2	52.7	0.6	20.4	0225
970803	215	12	52.3	0.32	0.09	51.9	52.7	0.8	20.3	0245
970804	216	12	52.3	0.34	0.10	51.9	52.7	0.8	20.3	0265
970805	217	12	52.4	0.21	0.06	52.2	52.7	0.6	20.4	0286
970806	218	12	52.3	0.30	0.09	51.9	52.7	0.8	20.3	0306
970807	219	12	52.2	0.23	0.07	51.9	52.4	0.6	20.2	0326
970808	220	12	52.0	0.21	0.06	51.6	52.4	0.8	20.0	0346
970809	221	12	51.7	0.23	0.07	51.3	51.9	0.6	19.7	0366
970810	222	12	51.6	0.45	0.13	51.1	52.2	1.1	19.6	0385
970811	223	12	51.7	0.46	0.13	51.1	52.2	1.1	19.7	0405
970812	224	12	51.8	0.34	0.10	51.3	52.2	0.8	19.8	0425
970813	225	12	51.8	0.24	0.07	51.6	52.2	0.6	19.8	0445
970814	226	11	51.9	0.32	0.10	51.6	52.4	0.8	19.9	0465
970815	227	12	51.7	0.27	0.08	51.3	52.2	0.8	19.7	0484
970816	228	12	51.5	0.14	0.04	51.3	51.6	0.3	19.5	0504
970817	229	12	51.5	0.30	0.09	51.1	51.9	0.8	19.5	0523
970818	230	12	51.3	0.39	0.11	50.8	51.9	1.1	19.3	0543
970819	231	12	51.4	0.24	0.07	51.1	51.9	0.8	19.4	0562
970820	232	12	51.3	0.43	0.12	50.8	51.9	1.1	19.3	0581
970821	233	12	51.4	0.34	0.10	51.1	51.9	0.8	19.4	0601
970822	234	12	51.3	0.46	0.13	50.5	51.9	1.4	19.3	0620
970823	235	12	51.1	0.40	0.11	50.5	51.6	1.1	19.1	0639
970824	236	12	51.1	0.11	0.03	51.1	51.3	0.3	19.1	0658
970825	237	12	51.1	0.29	0.08	50.8	51.6	0.8	19.1	0677
970826	238	12	51.0	0.36	0.10	50.5	51.3	0.8	19.0	0696
970827	239	12	50.9	0.33	0.09	50.5	51.3	0.8	18.9	0715
970828	240	12	50.6	0.33	0.09	50.2	51.1	0.8	18.6	0734
970829	241	12	50.7	0.27	0.08	50.5	51.1	0.6	18.7	0753
970830	242	12	50.5	0.45	0.13	49.9	51.1	1.1	18.5	0771
970831	243	12	50.7	0.39	0.11	49.9	51.1	1.1	18.7	0790
970901	244	12	50.8	0.32	0.09	50.5	51.3	0.8	18.8	0809
970902	245	12	50.8	0.40	0.12	50.2	51.3	1.1	18.8	0827
970903	246	12	50.9	0.22	0.06	50.8	51.3	0.6	18.9	0846

Appendix Table 3.—Water temperatures (F) and temperature units for Egg Trough Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
970904	247	12	50.8	0.27	0.08	50.5	51.3	0.8	18.8	0865
970905	248	12	50.5	0.42	0.12	49.9	51.1	1.1	18.5	0884
970906	249	12	50.6	0.25	0.07	50.2	51.1	0.8	18.6	0902
970907	250	12	50.3	0.46	0.13	49.7	50.8	1.1	18.3	0920
970908	251	12	50.5	0.35	0.10	49.9	51.1	1.1	18.5	0939
970909	252	12	50.3	0.48	0.14	49.7	50.8	1.1	18.3	0957
970910	253	12	50.3	0.39	0.11	49.7	50.8	1.1	18.3	0975
970911	254	12	50.3	0.29	0.08	49.9	50.5	0.6	18.3	0994
970912	255	12	50.4	0.18	0.05	49.9	50.5	0.6	18.4	1012
970913	256	12	50.1	0.56	0.16	49.4	50.8	1.4	18.1	1030
970914	257	12	50.4	0.15	0.04	50.2	50.5	0.3	18.4	1049
970915	258	12	50.2	0.12	0.03	49.9	50.5	0.6	18.2	1067
970916	259	12	50.1	0.18	0.05	49.9	50.5	0.6	18.1	1085
970917	260	12	50.1	0.19	0.05	49.9	50.5	0.6	18.1	1103
970918	261	12	49.9	0.08	0.02	49.7	49.9	0.3	17.9	1121
970919	262	12	49.8	0.28	0.08	49.4	50.2	0.8	17.8	1139
970920	263	12	49.8	0.37	0.11	49.4	50.2	0.8	17.8	1157
970921	264	12	49.9	0.42	0.12	49.4	50.5	1.1	17.9	1174
970922	265	12	49.8	0.44	0.13	49.4	50.5	1.1	17.8	1192
970923	266	12	49.9	0.52	0.15	49.4	50.5	1.1	17.9	1210
970924	267	12	50.0	0.48	0.14	49.4	50.8	1.4	18.0	1228
970925	268	12	50.1	0.53	0.15	49.4	50.8	1.4	18.1	1246
970926	269	12	50.3	0.21	0.06	49.9	50.5	0.6	18.3	1265
970927	270	12	50.2	0.11	0.03	49.9	50.2	0.3	18.2	1283
970928	271	12	50.3	0.14	0.04	50.2	50.5	0.3	18.3	1301
970929	272	12	50.3	0.41	0.12	49.7	50.8	1.1	18.3	1319
970930	273	12	50.3	0.51	0.15	49.7	50.8	1.1	18.3	1338
971001	274	12	50.5	0.24	0.07	50.2	50.8	0.6	18.5	1356
971002	275	12	50.4	0.14	0.04	50.2	50.5	0.3	18.4	1374
971003	276	12	50.2	0.11	0.03	49.9	50.2	0.3	18.2	1393
971004	277	12	50.3	0.23	0.07	49.9	50.8	0.8	18.3	1411
971005	278	12	50.2	0.16	0.05	49.9	50.5	0.6	18.2	1429
971006	279	12	50.0	0.30	0.09	49.7	50.5	0.8	18.0	1447
971007	280	12	49.8	0.32	0.09	49.4	50.5	1.1	17.8	1465
971008	281	12	49.6	0.36	0.11	49.1	50.2	1.1	17.6	1482
971009	282	12	49.5	0.22	0.06	49.4	49.9	0.6	17.5	1500
971010	283	12	49.7	0.29	0.08	49.4	50.2	0.8	17.7	1518
971011	284	12	49.5	0.22	0.06	49.4	49.9	0.6	17.5	1535
971012	285	12	49.5	0.19	0.05	49.4	49.9	0.6	17.5	1553
971013	286	12	49.7	0.26	0.08	49.4	49.9	0.6	17.7	1570
971014	287	12	49.8	0.22	0.06	49.4	50.2	0.8	17.8	1588
971015	288	12	49.9	0.28	0.08	49.7	50.5	0.8	17.9	1606
971016	289	12	49.6	0.48	0.14	49.1	50.5	1.4	17.6	1624

Appendix Table 3.—Water temperatures (F) and temperature units for Egg Trough Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
971017	290	12	49.6	0.61	0.18	48.8	50.5	1.7	17.6	1641
971018	291	12	49.8	0.39	0.11	49.1	50.5	1.4	17.8	1659
971019	292	12	49.4	0.40	0.11	48.8	49.9	1.1	17.4	1676
971020	293	12	49.1	0.55	0.16	48.5	49.9	1.4	17.1	1694
971021	294	12	49.1	0.57	0.16	48.5	49.9	1.4	17.1	1711
971022	295	12	49.2	0.44	0.13	48.5	49.7	1.1	17.2	1728
971023	296	12	49.2	0.40	0.12	48.8	49.9	1.1	17.2	1745
971024	297	12	48.8	0.41	0.12	48.3	49.4	1.1	16.8	1762
971025	298	12	49.0	0.40	0.12	48.3	49.4	1.1	17.0	1779
971026	299	12	49.5	0.30	0.09	49.1	49.9	0.8	17.5	1796
971027	300	12	49.4	0.35	0.10	48.8	49.9	1.1	17.4	1814
971028	301	12	49.2	0.34	0.10	48.8	49.7	0.8	17.2	1831
971029	302	12	49.5	0.14	0.04	49.4	49.7	0.3	17.5	1848
971030	303	12	49.4	0.13	0.04	49.4	49.7	0.3	17.4	1866
971031	304	12	49.4	0.08	0.02	49.4	49.7	0.3	17.4	1883
971101	305	12	49.3	0.33	0.09	48.8	49.9	1.1	17.3	1901
971102	306	12	48.8	0.37	0.11	48.5	49.4	0.8	16.8	1917
971103	307	12	48.9	0.52	0.15	48.3	49.4	1.1	16.9	1934
971104	308	12	49.3	0.30	0.09	48.8	49.9	1.1	17.3	1952
971105	309	12	48.9	0.41	0.12	48.5	49.7	1.1	16.9	1968
971106	310	12	49.0	0.44	0.13	48.5	49.7	1.1	17.0	1985
971107	311	12	49.1	0.21	0.06	48.8	49.4	0.6	17.1	2002
971108	312	12	48.8	0.25	0.07	48.3	49.1	0.8	16.8	2019
971109	313	12	48.3	0.41	0.12	47.7	49.1	1.4	16.3	2036
971110	314	12	48.2	0.33	0.09	48.0	48.8	0.8	16.2	2052
971111	315	12	47.9	0.44	0.13	47.4	48.5	1.1	15.9	2068
971112	316	12	48.1	0.43	0.12	47.7	48.8	1.1	16.1	2084
971113	317	12	48.0	0.48	0.14	47.4	48.8	1.4	16.0	2100
971114	318	11	47.7	0.54	0.16	47.1	48.5	1.4	15.7	2115
971115	319	12	47.5	0.50	0.15	46.9	48.3	1.4	15.5	2131
971116	320	12	47.5	0.55	0.16	46.9	48.3	1.4	15.5	2146
971117	321	12	48.3	0.18	0.05	48.0	48.5	0.6	16.3	2163
971118	322	12	48.6	0.14	0.04	48.5	48.8	0.3	16.6	2179
971119	323	12	48.7	0.15	0.04	48.5	48.8	0.3	16.7	2196
971120	324	12	48.6	0.24	0.07	48.0	48.8	0.8	16.6	2213
971121	325	12	48.8	0.14	0.04	48.5	49.1	0.6	16.8	2229
971122	326	12	48.3	0.38	0.11	47.7	48.8	1.1	16.3	2246
971123	327	12	48.1	0.36	0.10	47.7	48.5	0.8	16.1	2262
971124	328	12	48.7	0.22	0.06	48.3	49.1	0.8	16.7	2279
971125	329	12	48.3	0.21	0.06	48.0	48.5	0.6	16.3	2295
971126	330	12	48.1	0.25	0.07	47.7	48.5	0.8	16.1	2311
971127	331	12	48.2	0.38	0.11	47.4	48.5	1.1	16.2	2327
971128	332	12	48.7	0.22	0.06	48.5	49.1	0.6	16.7	2344

Appendix Table 3.—Water temperatures (F) and temperature units for Egg Trough Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
971129	333	12	48.4	0.28	0.08	48.0	48.8	0.8	16.4	2360
971130	334	12	48.5	0.26	0.08	48.0	48.8	0.8	16.5	2377
971201	335	12	48.4	0.33	0.09	47.7	48.8	1.1	16.4	2393
971202	336	12	47.7	0.31	0.09	47.4	48.3	0.8	15.7	2409
971203	337	12	47.9	0.18	0.05	47.7	48.3	0.6	15.9	2425
971204	338	12	47.9	0.21	0.06	47.4	48.3	0.8	15.9	2441
971205	339	12	47.6	0.22	0.06	47.1	48.0	0.8	15.6	2457
971206	340	12	47.5	0.20	0.06	47.1	47.7	0.6	15.5	2472
971207	341	12	47.4	0.23	0.07	47.1	47.7	0.6	15.4	2487
971208	342	12	47.6	0.25	0.07	47.1	48.0	0.8	15.6	2503
971209	343	12	48.0	0.18	0.05	47.7	48.3	0.6	16.0	2519
971210	344	12	47.6	0.41	0.12	46.9	48.0	1.1	15.6	2535
971211	345	12	47.9	0.25	0.07	47.7	48.3	0.6	15.9	2550
971212	346	12	47.2	0.30	0.09	46.9	47.7	0.8	15.2	2566
971213	347	12	47.4	0.19	0.05	47.1	47.7	0.6	15.4	2581
971214	348	12	47.4	0.25	0.07	47.1	47.7	0.6	15.4	2597
971215	349	12	48.0	0.18	0.05	47.7	48.3	0.6	16.0	2613
971216	350	12	48.1	0.15	0.04	48.0	48.3	0.3	16.1	2629
971217	351	12	48.2	0.08	0.02	48.0	48.3	0.3	16.2	2645
971218	352	12	47.9	0.13	0.04	47.7	48.0	0.3	15.9	2661
971219	353	12	47.6	0.22	0.06	47.1	47.7	0.6	15.6	2676
971220	354	12	47.5	0.20	0.06	47.1	47.7	0.6	15.5	2692
971221	355	12	47.7	0.17	0.05	47.4	48.0	0.6	15.7	2708
971222	356	12	47.2	0.18	0.05	46.9	47.4	0.6	15.2	2723
971223	357	12	47.2	0.22	0.06	46.9	47.4	0.6	15.2	2738
971224	358	12	46.8	0.31	0.09	46.3	47.1	0.8	14.8	2753
971225	359	12	47.0	0.19	0.05	46.9	47.4	0.6	15.0	2768
971226	360	12	47.2	0.13	0.04	47.1	47.4	0.3	15.2	2783
971227	361	12	47.2	0.28	0.08	46.9	47.7	0.8	15.2	2798
971228	362	12	47.5	0.13	0.04	47.4	47.7	0.3	15.5	2814
971229	363	12	47.6	0.31	0.09	47.1	48.0	0.8	15.6	2829
971230	364	12	47.8	0.13	0.04	47.7	48.0	0.3	15.8	2845
971231	365	12	47.6	0.14	0.04	47.4	47.7	0.3	15.6	2861
980101	1	12	47.9	0.17	0.05	47.7	48.3	0.6	15.9	2877
980102	2	12	47.0	0.81	0.24	46.0	48.0	1.9	15.0	2892
980103	3	12	46.0	0.29	0.08	45.5	46.3	0.8	14.0	2906
980104	4	12	46.5	0.21	0.06	46.3	46.9	0.6	14.5	2920
980105	5	12	47.0	0.22	0.06	46.6	47.4	0.8	15.0	2935
980106	6	12	47.3	0.15	0.04	47.1	47.4	0.3	15.3	2950
980107	7	12	47.1	0.14	0.04	46.9	47.4	0.6	15.1	2965
980108	8	12	46.2	0.51	0.15	45.2	47.1	1.9	14.2	2980
980109	9	12	45.1	0.51	0.15	44.4	45.8	1.4	13.1	2993
980110	10	12	45.2	0.12	0.03	44.9	45.5	0.6	13.2	3006

Appendix Table 3.—Water temperatures (F) and temperature units for Egg Trough Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
980111	11	12	44.6	0.39	0.11	44.1	45.2	1.1	12.6	3019
980112	12	12	44.5	0.69	0.20	43.8	45.5	1.7	12.5	3031
980113	13	12	45.6	0.32	0.09	45.2	46.0	0.8	13.6	3045
980114	14	12	46.5	0.24	0.07	46.3	46.9	0.6	14.5	3059
980115	15	12	47.1	0.08	0.02	46.9	47.1	0.3	15.1	3074
980116	16	12	47.1	0.12	0.03	46.9	47.4	0.6	15.1	3089
980117	17	12	47.1	0.20	0.06	46.9	47.4	0.6	15.1	3104
980118	18	12	47.2	0.14	0.04	46.9	47.4	0.6	15.2	3120
980119	19	12	47.0	0.19	0.05	46.9	47.4	0.6	15.0	3135
980120	20	12	47.2	0.08	0.02	47.1	47.4	0.3	15.2	3150
980121	21	12	47.0	0.14	0.04	46.9	47.1	0.3	15.0	3165
980122	22	12	46.8	0.17	0.05	46.6	47.1	0.6	14.8	3180
980123	23	12	46.4	0.23	0.07	46.0	46.6	0.6	14.4	3194
980124	24	12	46.8	0.20	0.06	46.6	47.1	0.6	14.8	3209
980125	25	12	46.9	0.20	0.06	46.6	47.1	0.6	14.9	3224
980126	26	12	46.8	0.21	0.06	46.6	47.1	0.6	14.8	3238
980127	27	12	46.9	0.00	0.00	46.9	46.9	0.0	14.9	3253
980128	28	12	46.6	0.20	0.06	46.3	46.9	0.6	14.6	3268
980129	29	12	46.4	0.14	0.04	46.3	46.6	0.3	14.4	3282
980130	30	12	46.6	0.26	0.07	46.3	47.1	0.8	14.6	3297
980131	31	12	46.4	0.29	0.08	46.0	46.9	0.8	14.4	3311
980201	32	12	46.1	0.19	0.05	46.0	46.6	0.6	14.1	3325
980202	33	12	46.1	0.14	0.04	46.0	46.3	0.3	14.1	3340
980203	34	12	45.7	0.51	0.15	44.9	46.3	1.4	13.7	3353
980204	35	12	46.1	0.28	0.08	45.8	46.6	0.8	14.1	3367
980205	36	12	46.1	0.45	0.13	45.5	46.9	1.4	14.1	3381
980206	37	12	46.0	0.44	0.13	45.5	46.6	1.1	14.0	3395
980207	38	12	46.5	0.24	0.07	46.3	46.9	0.6	14.5	3410
980208	39	12	46.3	0.25	0.07	46.0	46.6	0.6	14.3	3424
980209	40	12	46.4	0.14	0.04	46.3	46.6	0.3	14.4	3439
980210	41	12	46.3	0.19	0.05	46.0	46.6	0.6	14.3	3453
980211	42	12	46.3	0.23	0.07	46.0	46.6	0.6	14.3	3467
980212	43	12	46.3	0.32	0.09	46.0	46.9	0.8	14.3	3482
980213	44	12	46.3	0.22	0.06	46.0	46.6	0.6	14.3	3496
980214	45	12	46.1	0.30	0.09	45.5	46.6	1.1	14.1	3510
980215	46	12	46.3	0.28	0.08	46.0	46.9	0.8	14.3	3524
980216	47	12	46.3	0.23	0.07	46.0	46.6	0.6	14.3	3538
980217	48	12	45.6	0.49	0.14	44.9	46.3	1.4	13.6	3552
980218	49	12	45.9	0.36	0.11	45.5	46.6	1.1	13.9	3566
980219	50	12	45.7	0.46	0.13	44.9	46.3	1.4	13.7	3580
980220	51	12	45.8	0.49	0.14	45.2	46.6	1.4	13.8	3593
980221	52	12	46.1	0.24	0.07	45.8	46.3	0.6	14.1	3608
980222	53	12	46.1	0.14	0.04	46.0	46.3	0.3	14.1	3622

Appendix Table 3.—Water temperatures (F) and temperature units for Egg Trough Spring @ Sekokini Springs, MT (July 23, 1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
980223	54	12	46.1	0.19	0.05	46.0	46.6	0.6	14.1	3636
980224	55	12	45.6	0.34	0.10	45.2	46.0	0.8	13.6	3649
980225	56	12	45.8	0.23	0.07	45.5	46.3	0.8	13.8	3663
980226	57	12	45.3	0.42	0.12	44.6	46.0	1.4	13.3	3677
980227	58	12	45.5	0.31	0.09	45.2	46.0	0.8	13.5	3690
980228	59	12	45.2	0.33	0.10	44.9	45.8	0.8	13.2	3703
980301	60	12	45.8	0.36	0.10	45.5	46.3	0.8	13.8	3717
980302	61	12	45.8	0.38	0.11	45.2	46.3	1.1	13.8	3731
980303	62	12	45.8	0.20	0.06	45.5	46.0	0.6	13.8	3745
980304	63	12	45.3	0.25	0.07	44.9	45.8	0.8	13.3	3758
980305	64	12	44.6	0.40	0.11	44.1	45.2	1.1	12.6	3771
980306	65	12	44.6	0.35	0.10	44.1	45.2	1.1	12.6	3783
980307	66	12	44.3	0.61	0.18	43.5	45.2	1.7	12.3	3796
980308	67	12	44.8	0.25	0.07	44.4	45.2	0.8	12.8	3808
980309	68	12	44.9	0.26	0.08	44.6	45.2	0.6	12.9	3821
980310	69	12	44.9	0.40	0.11	44.1	45.5	1.4	12.9	3834
980311	70	12	45.4	0.26	0.07	45.2	45.8	0.6	13.4	3848
980312	71	12	45.7	0.31	0.09	45.5	46.3	0.8	13.7	3861
980313	72	12	45.6	0.57	0.17	44.9	46.3	1.4	13.6	3875
980314	73	12	45.6	0.48	0.14	44.9	46.3	1.4	13.6	3888
980315	74	12	45.8	0.50	0.14	45.2	46.6	1.4	13.8	3902
980316	75	12	45.8	0.17	0.05	45.5	46.0	0.6	13.8	3916
980317	76	12	45.5	0.16	0.05	45.2	45.8	0.6	13.5	3930
980318	77	12	45.3	0.32	0.09	44.9	45.8	0.8	13.3	3943
980319	78	12	45.1	0.45	0.13	44.4	45.8	1.4	13.1	3956
980320	79	12	45.3	0.51	0.15	44.6	46.0	1.4	13.3	3969
980321	80	12	45.3	0.25	0.07	44.9	45.8	0.8	13.3	3983
980322	81	12	45.5	0.00	0.00	45.5	45.5	0.0	13.5	3996
980323	82	12	45.5	0.16	0.05	45.2	45.8	0.6	13.5	4010
980324	83	12	45.4	0.17	0.05	45.2	45.8	0.6	13.4	4023
980325	84	12	45.2	0.26	0.08	44.9	45.5	0.6	13.2	4036
980326	85	12	45.2	0.12	0.03	44.9	45.5	0.6	13.2	4049
980327	86	12	45.1	0.14	0.04	44.9	45.2	0.3	13.1	4062
980328	87	12	45.1	0.22	0.06	44.9	45.5	0.6	13.1	4076
980329	88	12	45.2	0.30	0.09	44.9	45.8	0.8	13.2	4089
980330	89	12	45.2	0.30	0.09	44.9	45.8	0.8	13.2	4102
980331	90	6	45.1	0.34	0.14	44.9	45.8	0.8	13.1	4115

Appendix Table 4.—Water temperatures (F) and temperature units for Cold Spring @ Sekokini Springs, MT (July 23,1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
970723	204	4	42.9	0.40	0.20	42.6	43.5	0.8	10.9	0011
970724	205	12	42.7	0.17	0.05	42.6	43.2	0.6	10.7	0022
970725	206	12	42.6	0.08	0.02	42.6	42.9	0.3	10.6	0032
970726	207	12	42.7	0.13	0.04	42.6	42.9	0.3	10.7	0043
970727	208	12	42.7	0.18	0.05	42.6	43.2	0.6	10.7	0054
970728	209	12	42.7	0.18	0.05	42.6	43.2	0.6	10.7	0064
970729	210	12	42.7	0.11	0.03	42.6	42.9	0.3	10.7	0075
970730	211	12	42.7	0.11	0.03	42.6	42.9	0.3	10.7	0086
970731	212	12	42.7	0.22	0.06	42.6	43.2	0.6	10.7	0096
970801	213	12	42.8	0.22	0.06	42.6	43.2	0.6	10.8	0107
970802	214	12	42.8	0.19	0.05	42.6	43.2	0.6	10.8	0118
970803	215	12	42.8	0.22	0.06	42.6	43.2	0.6	10.8	0129
970804	216	12	42.8	0.25	0.07	42.6	43.2	0.6	10.8	0139
970805	217	12	42.8	0.22	0.06	42.6	43.2	0.6	10.8	0150
970806	218	12	42.8	0.24	0.07	42.6	43.2	0.6	10.8	0161
970807	219	12	42.7	0.14	0.04	42.6	42.9	0.3	10.7	0172
970808	220	12	42.7	0.13	0.04	42.6	42.9	0.3	10.7	0182
970809	221	12	42.7	0.14	0.04	42.6	42.9	0.3	10.7	0193
970810	222	12	42.8	0.25	0.07	42.6	43.2	0.6	10.8	0204
970811	223	12	42.9	0.33	0.09	42.6	43.5	0.8	10.9	0215
970812	224	12	42.9	0.33	0.09	42.6	43.5	0.8	10.9	0226
970813	225	12	42.8	0.14	0.04	42.6	42.9	0.3	10.8	0236
970814	226	12	42.9	0.14	0.04	42.6	43.2	0.6	10.9	0247
970815	227	12	42.9	0.14	0.04	42.6	43.2	0.6	10.9	0258
970816	228	12	42.8	0.13	0.04	42.6	42.9	0.3	10.8	0269
970817	229	12	42.8	0.23	0.07	42.6	43.2	0.6	10.8	0280
970818	230	12	42.9	0.21	0.06	42.6	43.2	0.6	10.9	0291
970819	231	12	43.0	0.13	0.04	42.9	43.2	0.3	11.0	0302
970820	232	12	43.0	0.14	0.04	42.9	43.2	0.3	11.0	0313
970821	233	12	43.0	0.14	0.04	42.9	43.2	0.3	11.0	0324
970822	234	12	43.1	0.22	0.06	42.9	43.5	0.6	11.1	0335
970823	235	12	43.1	0.22	0.06	42.9	43.5	0.6	11.1	0346
970824	236	12	43.0	0.14	0.04	42.9	43.2	0.3	11.0	0357
970825	237	12	43.0	0.14	0.04	42.9	43.2	0.3	11.0	0368
970826	238	12	43.1	0.24	0.07	42.9	43.5	0.6	11.1	0379
970827	239	12	43.1	0.20	0.06	42.9	43.5	0.6	11.1	0390
970828	240	12	43.1	0.14	0.04	42.9	43.2	0.3	11.1	0401
970829	241	12	43.1	0.14	0.04	42.9	43.2	0.3	11.1	0412
970830	242	12	43.1	0.23	0.07	42.9	43.5	0.6	11.1	0423
970831	243	12	43.2	0.21	0.06	42.9	43.5	0.6	11.2	0434
970901	244	12	43.2	0.13	0.04	43.2	43.5	0.3	11.2	0446
970902	245	12	43.3	0.22	0.06	43.2	43.7	0.6	11.3	0457
970903	246	12	43.3	0.14	0.04	43.2	43.5	0.3	11.3	0468

Appendix Table 4.—Water temperatures (F) and temperature units for Cold Spring @ Sekokini Springs, MT (July 23,1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
970904	247	12	43.3	0.22	0.06	43.2	43.7	0.6	11.3	0480
970905	248	12	43.3	0.19	0.05	43.2	43.7	0.6	11.3	0491
970906	249	12	43.3	0.25	0.07	43.2	43.7	0.6	11.3	0502
970907	250	12	43.3	0.22	0.06	43.2	43.7	0.6	11.3	0513
970908	251	12	43.4	0.25	0.07	43.2	43.7	0.6	11.4	0525
970909	252	12	43.4	0.25	0.07	43.2	43.7	0.6	11.4	0536
970910	253	12	43.3	0.14	0.04	43.2	43.5	0.3	11.3	0548
970911	254	12	43.3	0.14	0.04	43.2	43.5	0.3	11.3	0559
970912	255	12	43.4	0.13	0.04	43.2	43.5	0.3	11.4	0570
970913	256	12	43.5	0.40	0.12	43.2	44.6	1.4	11.5	0582
970914	257	12	43.4	0.19	0.05	43.2	43.7	0.6	11.4	0593
970915	258	12	43.4	0.08	0.02	43.2	43.5	0.3	11.4	0605
970916	259	12	43.4	0.18	0.05	43.2	43.7	0.6	11.4	0616
970917	260	12	43.5	0.00	0.00	43.5	43.5	0.0	11.5	0627
970918	261	12	43.5	0.00	0.00	43.5	43.5	0.0	11.5	0639
970919	262	12	43.5	0.08	0.02	43.5	43.7	0.3	11.5	0650
970920	263	12	43.5	0.22	0.06	43.2	44.0	0.8	11.5	0662
970921	264	12	43.6	0.28	0.08	43.5	44.3	0.8	11.6	0673
970922	265	12	43.7	0.24	0.07	43.5	44.0	0.6	11.7	0685
970923	266	12	43.8	0.43	0.12	43.5	44.8	1.4	11.8	0697
970924	267	12	43.9	0.49	0.14	43.5	44.8	1.4	11.9	0709
970925	268	12	44.0	0.45	0.13	43.7	45.1	1.4	12.0	0721
970926	269	12	43.8	0.11	0.03	43.7	44.0	0.3	11.8	0733
970927	270	12	43.7	0.00	0.00	43.7	43.7	0.0	11.7	0744
970928	271	12	43.8	0.14	0.04	43.7	44.0	0.3	11.8	0756
970929	272	12	43.9	0.25	0.07	43.7	44.3	0.6	11.9	0768
970930	273	12	43.9	0.22	0.06	43.7	44.3	0.6	11.9	0780
971001	274	12	44.0	0.17	0.05	43.7	44.3	0.6	12.0	0792
971002	275	12	44.0	0.00	0.00	44.0	44.0	0.0	12.0	0804
971003	276	12	43.8	0.14	0.04	43.7	44.0	0.3	11.8	0816
971004	277	12	43.9	0.19	0.05	43.7	44.3	0.6	11.9	0828
971005	278	12	43.9	0.15	0.04	43.7	44.0	0.3	11.9	0840
971006	279	12	43.8	0.14	0.04	43.7	44.0	0.3	11.8	0851
971007	280	12	43.8	0.14	0.04	43.7	44.0	0.3	11.8	0863
971008	281	12	43.8	0.13	0.04	43.7	44.0	0.3	11.8	0875
971009	282	12	43.8	0.08	0.02	43.7	44.0	0.3	11.8	0887
971010	283	12	43.8	0.14	0.04	43.7	44.0	0.3	11.8	0899
971011	284	12	43.8	0.13	0.04	43.7	44.0	0.3	11.8	0910
971012	285	12	43.8	0.11	0.03	43.7	44.0	0.3	11.8	0922
971013	286	12	43.9	0.14	0.04	43.7	44.0	0.3	11.9	0934
971014	287	12	44.0	0.11	0.03	43.7	44.0	0.3	12.0	0946
971015	288	12	44.1	0.18	0.05	44.0	44.6	0.6	12.1	0958
971016	289	12	44.0	0.28	0.08	43.7	44.6	0.8	12.0	0970

Appendix Table 4.—Water temperatures (F) and temperature units for Cold Spring @ Sekokini Springs, MT (July 23,1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
971017	290	12	44.0	0.28	0.08	43.7	44.6	0.8	12.0	0982
971018	291	12	44.1	0.19	0.05	44.0	44.6	0.6	12.1	0994
971019	292	12	44.0	0.25	0.07	43.7	44.6	0.8	12.0	1006
971020	293	12	44.0	0.29	0.08	43.7	44.6	0.8	12.0	1018
971021	294	12	44.0	0.23	0.07	43.7	44.3	0.6	12.0	1030
971022	295	12	44.0	0.22	0.06	43.7	44.3	0.6	12.0	1042
971023	296	12	44.1	0.13	0.04	44.0	44.3	0.3	12.1	1054
971024	297	12	43.9	0.21	0.06	43.7	44.3	0.6	11.9	1066
971025	298	12	43.9	0.21	0.06	43.7	44.3	0.6	11.9	1078
971026	299	12	44.2	0.14	0.04	44.0	44.3	0.3	12.2	1090
971027	300	12	44.2	0.14	0.04	44.0	44.3	0.3	12.2	1103
971028	301	12	44.1	0.17	0.05	43.7	44.3	0.6	12.1	1115
971029	302	12	44.3	0.08	0.02	44.0	44.3	0.3	12.3	1127
971030	303	12	44.2	0.11	0.03	44.0	44.3	0.3	12.2	1139
971031	304	12	44.0	0.00	0.00	44.0	44.0	0.0	12.0	1151
971101	305	12	44.0	0.14	0.04	43.7	44.3	0.6	12.0	1163
971102	306	12	43.8	0.14	0.04	43.7	44.0	0.3	11.8	1175
971103	307	12	43.9	0.22	0.06	43.7	44.3	0.6	11.9	1187
971104	308	12	44.2	0.19	0.05	44.0	44.6	0.6	12.2	1199
971105	309	12	44.2	0.19	0.05	44.0	44.6	0.6	12.2	1211
971106	310	12	44.2	0.22	0.06	44.0	44.6	0.6	12.2	1223
971107	311	12	44.3	0.00	0.00	44.3	44.3	0.0	12.3	1236
971108	312	12	44.3	0.14	0.04	44.0	44.6	0.6	12.3	1248
971109	313	12	44.1	0.19	0.05	44.0	44.6	0.6	12.1	1260
971110	314	12	44.1	0.19	0.05	44.0	44.6	0.6	12.1	1272
971111	315	12	44.0	0.25	0.07	43.7	44.6	0.8	12.0	1284
971112	316	12	44.1	0.17	0.05	43.7	44.3	0.6	12.1	1296
971113	317	12	44.0	0.27	0.08	43.7	44.6	0.8	12.0	1308
971114	318	12	43.9	0.22	0.06	43.7	44.3	0.6	11.9	1320
971115	319	12	43.8	0.30	0.09	43.5	44.3	0.8	11.8	1332
971116	320	12	43.8	0.33	0.09	43.5	44.3	0.8	11.8	1344
971117	321	12	44.0	0.16	0.05	43.7	44.3	0.6	12.0	1356
971118	322	12	44.1	0.14	0.04	44.0	44.3	0.3	12.1	1368
971119	323	12	44.2	0.13	0.04	44.0	44.3	0.3	12.2	1380
971120	324	12	44.3	0.14	0.04	44.0	44.6	0.6	12.3	1392
971121	325	12	44.5	0.14	0.04	44.3	44.6	0.3	12.5	1405
971122	326	12	44.4	0.19	0.05	44.3	44.8	0.6	12.4	1417
971123	327	12	44.3	0.17	0.05	44.0	44.6	0.6	12.3	1430
971124	328	12	44.6	0.11	0.03	44.6	44.8	0.3	12.6	1442
971125	329	12	44.5	0.14	0.04	44.3	44.6	0.3	12.5	1455
971126	330	12	44.4	0.14	0.04	44.3	44.6	0.3	12.4	1467
971127	331	12	44.3	0.14	0.04	44.0	44.6	0.6	12.3	1479
971128	332	12	44.5	0.18	0.05	44.3	44.8	0.6	12.5	1492

Appendix Table 4.—Water temperatures (F) and temperature units for Cold Spring @ Sekokini Springs, MT (July 23,1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
971129	333	12	44.4	0.14	0.04	44.3	44.6	0.3	12.4	1504
971130	334	12	44.4	0.13	0.04	44.3	44.6	0.3	12.4	1517
971201	335	12	44.4	0.13	0.04	44.3	44.6	0.3	12.4	1529
971202	336	12	44.1	0.19	0.05	44.0	44.6	0.6	12.1	1541
971203	337	12	44.1	0.13	0.04	44.0	44.3	0.3	12.1	1553
971204	338	12	44.0	0.12	0.03	43.7	44.3	0.6	12.0	1565
971205	339	12	43.8	0.13	0.04	43.7	44.0	0.3	11.8	1577
971206	340	12	43.8	0.13	0.04	43.7	44.0	0.3	11.8	1589
971207	341	12	43.8	0.11	0.03	43.7	44.0	0.3	11.8	1600
971208	342	12	43.9	0.15	0.04	43.7	44.0	0.3	11.9	1612
971209	343	12	44.1	0.13	0.04	44.0	44.3	0.3	12.1	1624
971210	344	12	44.0	0.16	0.05	43.7	44.3	0.6	12.0	1636
971211	345	12	44.1	0.14	0.04	44.0	44.3	0.3	12.1	1648
971212	346	12	43.8	0.25	0.07	43.5	44.3	0.8	11.8	1660
971213	347	12	43.8	0.08	0.02	43.7	44.0	0.3	11.8	1672
971214	348	12	43.8	0.21	0.06	43.5	44.0	0.6	11.8	1684
971215	349	12	44.2	0.16	0.05	44.0	44.6	0.6	12.2	1696
971216	350	12	44.3	0.08	0.02	44.0	44.3	0.3	12.3	1708
971217	351	12	44.3	0.08	0.02	44.3	44.6	0.3	12.3	1721
971218	352	12	44.3	0.11	0.03	44.3	44.6	0.3	12.3	1733
971219	353	12	44.0	0.17	0.05	43.7	44.3	0.6	12.0	1745
971220	354	12	43.9	0.15	0.04	43.7	44.0	0.3	11.9	1757
971221	355	12	44.1	0.18	0.05	44.0	44.6	0.6	12.1	1769
971222	356	12	43.9	0.14	0.04	43.7	44.0	0.3	11.9	1781
971223	357	12	43.9	0.14	0.04	43.7	44.0	0.3	11.9	1793
971224	358	12	43.7	0.14	0.04	43.5	44.0	0.6	11.7	1804
971225	359	12	43.8	0.14	0.04	43.7	44.0	0.3	11.8	1816
971226	360	12	43.9	0.15	0.04	43.7	44.0	0.3	11.9	1828
971227	361	12	44.0	0.17	0.05	43.7	44.3	0.6	12.0	1840
971228	362	12	44.1	0.14	0.04	44.0	44.3	0.3	12.1	1852
971229	363	12	44.2	0.14	0.04	44.0	44.3	0.3	12.2	1864
971230	364	12	44.4	0.13	0.04	44.3	44.6	0.3	12.4	1877
971231	365	12	44.3	0.00	0.00	44.3	44.3	0.0	12.3	1889
980101	1	12	44.5	0.13	0.04	44.3	44.6	0.3	12.5	1902
980102	2	12	44.0	0.33	0.10	43.5	44.6	1.1	12.0	1914
980103	3	12	43.5	0.00	0.00	43.5	43.5	0.0	11.5	1925
980104	4	12	43.5	0.11	0.03	43.5	43.7	0.3	11.5	1936
980105	5	12	43.7	0.00	0.00	43.7	43.7	0.0	11.7	1948
980106	6	12	43.7	0.08	0.02	43.5	43.7	0.3	11.7	1960
980107	7	12	43.7	0.00	0.00	43.7	43.7	0.0	11.7	1972
980108	8	12	43.4	0.22	0.06	42.9	43.7	0.8	11.4	1983
980109	9	12	43.0	0.30	0.09	42.6	43.5	0.8	11.0	1994
980110	10	12	43.1	0.14	0.04	42.9	43.2	0.3	11.1	2005

Appendix Table 4.—Water temperatures (F) and temperature units for Cold Spring @ Sekokini Springs, MT (July 23,1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
980111	11	12	42.8	0.19	0.05	42.6	43.2	0.6	10.8	2016
980112	12	12	42.6	0.28	0.08	42.3	42.9	0.6	10.6	2026
980113	13	12	43.1	0.14	0.04	42.9	43.2	0.3	11.1	2037
980114	14	12	43.4	0.11	0.03	43.2	43.5	0.3	11.4	2049
980115	15	12	43.5	0.11	0.03	43.5	43.7	0.3	11.5	2060
980116	16	12	43.5	0.14	0.04	43.5	43.7	0.3	11.5	2072
980117	17	12	43.6	0.14	0.04	43.5	43.7	0.3	11.6	2083
980118	18	12	43.7	0.16	0.05	43.5	44.0	0.6	11.7	2095
980119	19	12	43.6	0.19	0.05	43.5	44.0	0.6	11.6	2107
980120	20	12	43.7	0.19	0.05	43.5	44.0	0.6	11.7	2118
980121	21	12	43.5	0.14	0.04	43.5	43.7	0.3	11.5	2130
980122	22	12	43.5	0.13	0.04	43.5	43.7	0.3	11.5	2142
980123	23	12	43.2	0.21	0.06	42.9	43.5	0.6	11.2	2153
980124	24	12	43.5	0.14	0.04	43.5	43.7	0.3	11.5	2164
980125	25	12	43.5	0.14	0.04	43.5	43.7	0.3	11.5	2176
980126	26	12	43.6	0.19	0.05	43.5	44.0	0.6	11.6	2187
980127	27	12	43.7	0.13	0.04	43.5	43.7	0.3	11.7	2199
980128	28	12	43.6	0.19	0.05	43.5	44.0	0.6	11.6	2211
980129	29	12	43.5	0.17	0.05	43.5	44.0	0.6	11.5	2222
980130	30	12	43.6	0.28	0.08	43.5	44.3	0.8	11.6	2234
980131	31	12	43.5	0.33	0.10	43.2	44.3	1.1	11.5	2245
980201	32	12	43.3	0.18	0.05	43.2	43.7	0.6	11.3	2257
980202	33	12	43.2	0.13	0.04	43.2	43.5	0.3	11.2	2268
980203	34	12	43.0	0.30	0.09	42.6	43.5	0.8	11.0	2279
980204	35	12	43.4	0.35	0.10	43.2	44.3	1.1	11.4	2290
980205	36	12	43.5	0.40	0.12	42.9	44.3	1.4	11.5	2302
980206	37	12	43.4	0.28	0.08	42.9	43.7	0.8	11.4	2313
980207	38	12	43.7	0.23	0.07	43.5	44.0	0.6	11.7	2325
980208	39	12	43.6	0.14	0.04	43.5	43.7	0.3	11.6	2336
980209	40	12	43.7	0.08	0.02	43.5	43.7	0.3	11.7	2348
980210	41	12	43.6	0.28	0.08	43.5	44.3	0.8	11.6	2360
980211	42	12	43.6	0.22	0.06	43.5	44.0	0.6	11.6	2371
980212	43	12	43.7	0.30	0.09	43.5	44.3	0.8	11.7	2383
980213	44	12	43.7	0.16	0.05	43.5	44.0	0.6	11.7	2395
980214	45	12	43.7	0.27	0.08	43.5	44.3	0.8	11.7	2406
980215	46	12	43.8	0.14	0.04	43.5	44.0	0.6	11.8	2418
980216	47	12	43.8	0.14	0.04	43.5	44.0	0.6	11.8	2430
980217	48	12	43.5	0.26	0.08	43.2	44.0	0.8	11.5	2441
980218	49	12	43.6	0.22	0.06	43.5	44.0	0.6	11.6	2453
980219	50	12	43.4	0.28	0.08	43.2	44.0	0.8	11.4	2464
980220	51	12	43.5	0.30	0.09	43.2	44.0	0.8	11.5	2476
980221	52	12	43.5	0.13	0.04	43.5	43.7	0.3	11.5	2487
980222	53	12	43.5	0.13	0.04	43.5	43.7	0.3	11.5	2499

Appendix Table 4.—Water temperatures (F) and temperature units for Cold Spring @ Sekokini Springs, MT (July 23,1997 to March 31, 1998).

Date	Julian day	N	Mean	SD	SE	Min	Max	Range	TUs	Cum TUs
980223	54	12	43.6	0.28	0.08	43.5	44.3	0.8	11.6	2510
980224	55	12	43.3	0.19	0.05	43.2	43.7	0.6	11.3	2522
980225	56	12	43.3	0.28	0.08	43.2	44.0	0.8	11.3	2533
980226	57	12	43.1	0.23	0.07	42.9	43.7	0.8	11.1	2544
980227	58	12	43.2	0.24	0.07	42.9	43.7	0.8	11.2	2555
980228	59	12	43.1	0.29	0.08	42.9	43.7	0.8	11.1	2567
980301	60	12	43.3	0.19	0.05	43.2	43.7	0.6	11.3	2578
980302	61	12	43.4	0.39	0.11	42.9	44.0	1.1	11.4	2589
980303	62	12	43.2	0.08	0.02	43.2	43.5	0.3	11.2	2600
980304	63	12	43.2	0.19	0.05	42.9	43.5	0.6	11.2	2612
980305	64	12	42.9	0.25	0.07	42.6	43.2	0.6	10.9	2623
980306	65	12	42.8	0.21	0.06	42.6	43.2	0.6	10.8	2633
980307	66	12	42.8	0.30	0.09	42.3	43.2	0.8	10.8	2644
980308	67	12	42.9	0.17	0.05	42.6	43.2	0.6	10.9	2655
980309	68	12	43.0	0.15	0.04	42.9	43.2	0.3	11.0	2666
980310	69	12	43.0	0.22	0.06	42.6	43.5	0.8	11.0	2677
980311	70	12	43.2	0.21	0.06	42.9	43.5	0.6	11.2	2688
980312	71	12	43.4	0.39	0.11	43.2	44.3	1.1	11.4	2700
980313	72	12	43.3	0.44	0.13	42.9	44.0	1.1	11.3	2711
980314	73	12	43.3	0.39	0.11	42.9	44.0	1.1	11.3	2722
980315	74	12	43.4	0.31	0.09	43.2	44.0	0.8	11.4	2734
980316	75	12	43.3	0.19	0.05	43.2	43.7	0.6	11.3	2745
980317	76	12	43.2	0.16	0.05	42.9	43.5	0.6	11.2	2756
980318	77	12	43.0	0.22	0.06	42.9	43.5	0.6	11.0	2767
980319	78	12	43.0	0.22	0.06	42.9	43.5	0.6	11.0	2778
980320	79	12	43.0	0.19	0.05	42.9	43.5	0.6	11.0	2789
980321	80	12	43.0	0.14	0.04	42.9	43.2	0.3	11.0	2800
980322	81	12	42.9	0.11	0.03	42.9	43.2	0.3	10.9	2811
980323	82	12	42.9	0.00	0.00	42.9	42.9	0.0	10.9	2822
980324	83	12	42.6	0.14	0.04	42.3	42.9	0.6	10.6	2833
980325	84	12	42.4	0.14	0.04	42.3	42.6	0.3	10.4	2843
980326	85	12	42.3	0.14	0.04	42.1	42.6	0.6	10.3	2853
980327	86	12	42.1	0.00	0.00	42.1	42.1	0.0	10.1	2863
980328	87	12	41.9	0.19	0.05	41.8	42.3	0.6	09.9	2873
980329	88	12	41.7	0.20	0.06	41.5	42.1	0.6	09.7	2883
980330	89	12	41.6	0.22	0.06	41.5	42.1	0.6	09.6	2893
980331	90	6	41.5	0.11	0.05	41.5	41.8	0.3	09.5	2902

Appendix D

Geology Report for Sekokini Springs

Geologic Report for
Sekokini Springs Experimental Hatchery and Educational Center
Northwestern Montana

Regional Resource & Technical Services
Geology, Exploration & Instrumentation Group

U.S. Department of Interior
Bureau of Reclamation
Pacific Northwest Regional Office
Boise, Idaho

June 1999

Department of the Interior
Bureau of Reclamation
Pacific Northwest Region

Geologic Report for Sekokini Springs Experimental Hatchery and Educational Center Northwestern Montana

Regional Resource & Technical Services Office
Geology, Exploration & Instrumentation Group
Boise, Idaho

June 1999

Report prepared by
Allen C. Lockhart, Geologist
under general supervision of
Brent H. Carter
Regional Geologist

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SUMMARY AND CONCLUSIONS

Sekokini Springs has existed as a private fish hatchery/rearing site for over 40 years under a special uses permit on land managed by the Flathead National Forest. The site is approximately 12 acres in size and is adjacent to the Flathead River. The Sekokini Springs site is located in Flathead County about 10 miles northeast of Columbia Falls, Montana.

The Montana Fish, Wildlife and Parks (MFWP) hopes to develop the site, which contains four existing springs, into an experimental fish hatchery and educational center for bull and cutthroat trout. They have requested assistance from the Bureau of Reclamation (Reclamation) under the States Assistance Program for the construction of the center.

The major structures required at the site are a moderate-sized residence for the site manager and a medium-size fish hatchery building (existing structure may be upgraded). Also needed are spring capture boxes, head gates, weirs, pipelines, habitat viewing windows, walking paths, and a fish separating platform at the river. A parking lot with restrooms will be constructed near the access road to the site. Some of the existing ponds will be enhanced and used and others will be filled and sloped to make stream channels for fish habitat.

The surficial geologic units exposed at the site consist of a thin veneer of forest soil covering a shallow thickness of alluvium overlying a great thickness of glacial debris. The soil is composed of silty fines, fine sand, and organic matter. The alluvium is composed of an unconsolidated, heterogeneous mixture of hard subrounded to rounded sand, gravel, and cobbles deposited by the Flathead River. The alluvium was derived in part from reworked glacial debris. Thickness of the alluvium is highly variable in the area with a maximum thickness of 50 feet reported by regional researchers. The glacial debris is composed of a heterogeneous mixture of crudely layered clay to silty, bouldery glacial till and thinly bedded, fine-grained lacustrine deposits. The glacial debris could be several hundred feet thick at the site.

The various slopes around the site in the alluvium and glacial debris are highly variable in slope angles and heights. The slope angles vary from 2H:1V (25 degrees) to 3/4H:1V (50 degrees). The height of the slopes vary with the maximum height being about 30 feet along the upper ponds and along the river. The condition of the slopes is generally stable. Vegetation in the form of grass, shrubs, and trees covers most of the slopes. Minor slope failures have occurred at the site in areas where water has overtopped the ponds and washed a ravine into the glacial slope.

The four springs at the site should supply the water needed to operate the hatchery and maintain the streams. This is based on the fact that a private hatchery operated for over 30 years at the site. By capturing the springs and running them through a control structure, the water can be directed to various stream channels, ponds, and hatchery sites or over a waste-way to the river.

To assist with the site preparation for the hatchery, geologic mapping and site explorations should be conducted at the site. The explorations can be conducted with a backhoe to determine the engineering properties of the glacial till and lacustrine sediments to support the slopes and structure that will be constructed at the site.

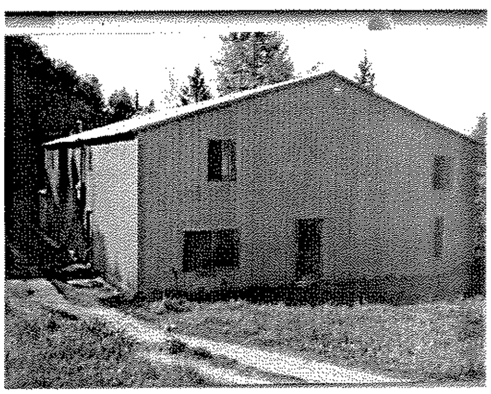
Topography and/or aerial photography of the site should be prepared to assist with the site layout for stream channels, ponds and other structures.

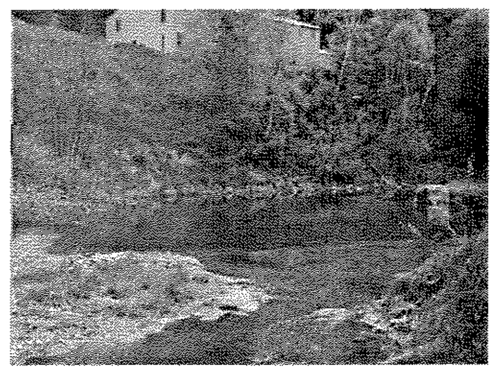
Removal and replacement of existing structures at the site will require moderately deep (up to 25 feet) excavations into the glacial till and associated materials. These temporary cut-slopes should be laid back to 1 1/2H:1V for safety.

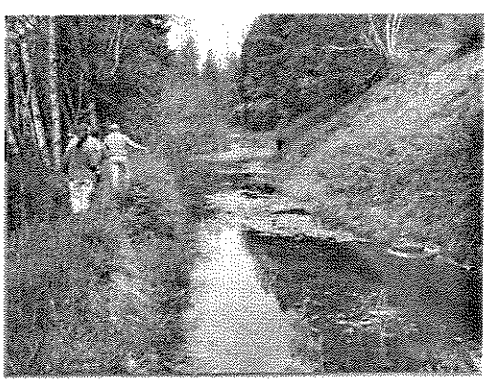
INTRODUCTION

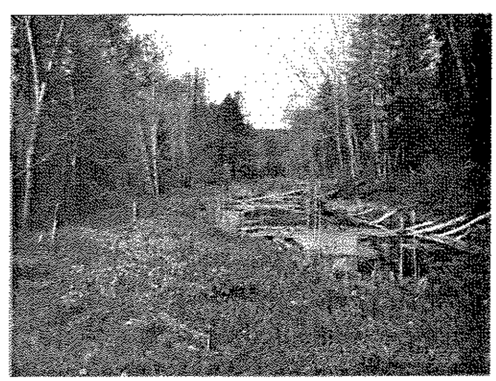
Background and Purpose

Sekokini Springs has existed as a private fish rearing site for over 40 years under a special uses permit on land managed by the Flathead National Forest. The site is approximately 12 acres in size and is adjacent to the Flathead River. The existing site consists of a metal hatchery shed, approximately 60 feet by 30 feet in size, seven shallow ponds, and shallow channels connecting the ponds (photographs 99-1 and -2). The ponds were developed around three springs that flow directly into the ponds. Access around the site is by narrow dirt roads that are overgrown with shrubs and small trees (photographs 99-3 and -4).



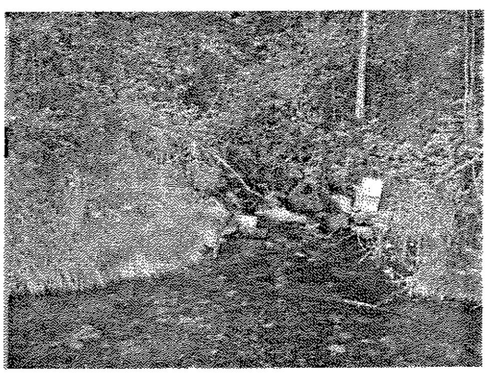






Montana FWP hopes to develop the site into an experimental fish hatchery and educational center for westslope cutthroat and bull trout. They envision the development of a natural stream-type habitat for the fish with underwater viewing windows, walkways, and informational signs to educate the visiting public. The hatchery building will be replaced or upgraded from its present deteriorated condition, a residence for the site manager will be constructed, and a parking lot with restrooms will be added to the site. MFWP has requested assistance from Reclamation under the Western Montana Water Conservation Program for the construction of the center.

A one-day site visit was conducted on May 28, 1999 with MFWP officials and representatives from the Bureau of Reclamation, Pacific Northwest Regional Office. The work is planned to start during the summer and fall of 1999 and the project should be completed by 2002. The first phase of the project will be to capture the four onsite springs into flow control structures; and replace or upgrade the hatchery building (photographs 99-5 and -6). During the summer and fall of 2000 through 2002, ponds and channels, viewing and fish handling areas, a manager's residence, and parking area will be constructed.



Location

The Sekokini Springs site is located in T.31 N., R.19 W., section 17, on the Hungry Horse, Montana 7.5-minute Quadrangle. The site is located in Flathead County about 10 miles Northeast of Columbia Falls, Montana. The site is accessible from the west by the North Fork and Blankenship Roads and from the east by State Highway 2 and Blankenship Road (figure 1).

Proposed Features

The major structure at the site will consist of a moderate-size residence for the site manager and a medium-size fish rearing building. Minor structures will consist of concrete spring capture boxes, head gates, weirs, pipelines, habitat viewing windows, walking paths, and a fish separating platform at the river. A parking lot with restrooms will be constructed near the access road to the site.

Some of the existing ponds will be enhanced and used and others will be filled in to make stream channels for habitat (figure 2). Water will be moved to the river down an existing road that will be converted to a stream channel.

LOCAL GEOLOGY

The site is located in the eastern portion of the Northern Rocky Mountains physiographic province (USGS 1959). The main structural features near the site are the southern end of the northwest-trending North Fork Valley to the west and the northwest-trending Apgar Mountains to the east. The North Fork Valley is a long trough that extends well into British Columbia and lies along the western margin of Glacier National Park (Bureau of Mines and Geology 1963). The Apgar Mountains are considered a part of the mountain ranges forming Glacier National Park (USGS 1959). The rocks forming the rugged mountain ranges in and around Glacier National Park are units of the Precambrian Belt Series (USGS 1959). The Belt Series rocks dip to the east leaving steep rock faces to the west (USGS 1959). The rocks are shallow sea bed deposits of fine sand, silt, and clays that have undergone metamorphism to form shales, argillites, quartzite, and limestone. Mud cracks, ripple marks, banding, and early fossils are common features in the rock units.

The local area around the site was covered with glacial ice leaving only the highest mountain peaks exposed above the ice sheet (Bureau of Mines and Geology 1963). Much of the spectacular scenery in the area, such as sharp peaks and U-shaped valleys, was formed by the glacial activity. During late-Pleistocene, glacial deposits and associated lacustrine deposits refilled the lower valleys excavated by the earlier glaciation to depths of hundreds of feet (Bureau of Mines and Geology 1963). Streams, first fed by meltwater from the glaciers, reworked the glacial debris and produced meanders, flood plains, and terraces along their channels (Bureau of Mines and Geology 1963). Recent alluvial gravels up to 50 feet thick cover many of the older glacial deposits near the major streams (Bureau of Mines and Geology 1963).

SITE GEOLOGY

Topography, Geomorphology, and Drainage

A detailed geologic study of the site has not been conducted and the geologic summary presented below was developed from one-day of field observations and a library search of regional mapping. The topography of the Sekokini Springs site consists of a elongated, mostly flat, river terrace eroded into older glacial debris located about one mile east of the confluence of the North Fork and Middle Fork of the Flathead River (figure 1). The proposed site is at the southern end of the river terrace, which is about 80 to 100 feet above the present river level. The large river terrace is about three-quarters of a mile long and one-half mile wide (figure1). Glacial features such as morainal ridges, kettle lakes, and pothole topography are located northeast and upslope from the site (figures 1 and 3). The nearest exposed, *in situ* rock to the site is located about one mile northeast at the northern end of Lake Five. The rock units are meta-sediments of the Belt Series (figure 3).

The general trend of both ground and surface water is to the southwest from the kettle lakes located northeast of the site at elevation 3265 to 3256 feet, to the Flathead River located along the southwest side of the site at elevation 3100 feet. The four springs that daylight along the northeast side of the site at about elevation 3200 feet are most likely related to the ground-water movement from the kettle lakes (figure 3). Another indicator that the springs are associated with the kettle lakes is documented by MFWP. In the past, MFWP had poisoned the lakes to remove trash fish. The poison was carried underground, about one mile over several days, to the existing hatchery ponds where the fish were killed. Three of the springs at the site are directed by ditches into the existing site ponds. The fourth spring located along the east side of the site flows down slope through a small, naturally armored, channel to the river.

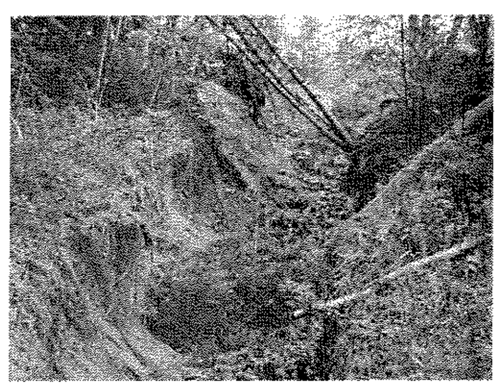
Geologic Units

The surficial geologic units exposed at the site consist of a thin veneer of forest soil covering a shallow thickness of alluvium overlying a great thickness of glacial debris. The soil is composed of silty fines, fine sand, and organic matter. The alluvium is composed of an unconsolidated, heterogeneous mixture of hard subrounded to rounded sand, gravel, and cobbles deposited by the Flathead River. The alluvium was derived in part from reworked glacial debris. Thickness of the alluvium is highly variable in the area with a maximum thickness of 50 feet reported by regional geologists. The glacial debris is composed of a heterogeneous mixture to crudely layered clayey to silty, bouldery glacial till and thinly bedded, fine-grained lacustrine deposits. The thickness of the glacial debris could be several hundred feet thick at the site.

Visual classification of hand-collected samples of the glacial debris from the site consists of Silty Sand with Gravel and Cobbles (SM)gc to Silty Gravel with Sand and Cobbles (GM)sc. The percent of fines in the samples ranged from 15 to 30 percent. The reworked glacial debris and outwash deposits in the glacial debris could have less fines. Scattered boulders to over three feet in diameter were noted around the site.

Observations made at several localized washouts at the site that have eroded small channels into the terrace reveal a weathered, red to brown, lacustrine clay layers in the glacial till (photograph 99-7). The thickness and lateral extent of the clay layers are unknown.

Slopes



The various slopes around the site in the alluvium and glacial debris are highly variable in slope angles and heights (photographs 99-2 and 99-3). The slope angles vary from 2H:1V (25 degrees) to 3/4H:1V (50 degrees). The height of the slopes is varied with maximum height of 30 feet along the upper ponds and along the river. The condition of the slopes is generally stable. Vegetation in the form of grass, shrubs, and trees is covering the slopes. The only slope failures observed at the site are in areas where water has overtopped the ponds and washed a rugged ravine into the slope (photograph 99-6).

FINDINGS

Sekokini Springs Hatchery site is located on a large, mostly flat, river terrace about 80 to 100 feet above the Flathead River. The large river terrace was eroded through the glacial debris that mantles most of the local area. The hatchery site is located toward the southern end of the large terrace where several narrow, lower river cut terraces were formed as the river erodes down through the glacial debris.

The site was selected because four springs daylight at the site, which was previously a private hatchery. Montana FWP officials would like to enhance the site by making natural stream channels and ponds for rearing bull trout and cutthroat trout. Several buildings, viewing windows, walking paths, and a parking lot with restrooms will be added to the site. Concrete headworks and a control structure will be installed at each pond and along channels between ponds.

The terraces where the hatchery site is located were formed by the river eroding into the glacial material composed of silty to clayey, bouldery till, and lacustrine sediments. These materials should form a stable foundation for the structures at the site. The existing slopes at the site have had some localized instabilities in the past. These failures are in areas where water has overtopped the existing dikes and embankments causing extensive erosion into the till. The majority of the slopes are remaining stable at slope angles ranging from 20 to 50 degrees with heights up to 30 feet.

The four springs should supply the water needed to operate the hatchery and the stream system at the site. This judgment is corroborated by the operation of a private hatchery at the site for over 30 years. By capturing the springs and running them through a control structure, the water can be directed to various stream channels, ponds, and hatchery sites or over a waste-way to the river.

RECOMMENDATIONS

To assist with the site preparation for the hatchery, geologic mapping and site explorations should be conducted at the site. The explorations can be conducted with a backhoe to determine the engineering properties of the glacial till and lacustrine sediments to support the slopes and structure that will be constructed at the site. In areas where low density lacustrine sediments are encountered under a structure, the footing area should be over excavated and backfilled with a suitable material.

Topography and/or aerial photographs of the site should be prepared to assist with the site layout for stream channels, ponds, and other structures.

Removal or replacement of some existing structures at the site will be required. These excavations will be moderately deep excavations (up to 25 feet) into the glacial till and associated materials. These temporary cut-slopes should be laid back to 1 1/2H:1V for safety.

REFERENCES

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U.S. Department of the Interior. U.S. Geological Survey. 1959. *Geology of Glacier National Park and the Flathead Region, Northwestern Montana.* Geological Survey Professional Paper 296. U.S. Government Printing Office Washington.

Appendix E

Geotechnical Investigation of Sekokini Springs Site

Prepared by NTL Engineering and Geoscience

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February 12, 2003

Fishpro, Inc.
3780 SE Mile Hill Drive
Port Orchard, WA 98366

Attention: Mr. Mike McGowan

Subject: Preliminary Geotechnical Investigation Reconnaissance
Sekokini Springs Natural Fish Hatchery
East Bank of Flathead River Near Blankenship Bridge
Flathead County, Montana

Dear Mr. McGowan:

At your request, we are providing a preliminary geotechnical investigation reconnaissance report for the proposed Sekokini Springs Natural Fish Hatchery and Juvenile Rearing Facility along the east bank of the Flathead River, about 1 mile east of the Blankenship Bridge in Flathead County, Montana. These services were performed in accordance with our proposal dated December 18, 2002, and your written authorization to proceed. The report provides general geotechnical engineering recommendations to assist in the feasibility evaluation of this project. The report also provides recommendations for future explorations and analyses to evaluate the global stability of the site and the subsurface conditions in the vicinity of the planned structures.

PROJECT OVERVIEW

Based on discussions with you and Mr. Andy Belski with Water Consulting, Inc., we understand the Sekokini Springs Fish Hatchery has not been operational for a few years and is the proposed site of a natural fish hatchery and juvenile rearing facility. Many ponds and stream channels fed by springs along the hillside are present on the site. The proposed construction will consist of regrading the existing ponds and berms, construction of an above/below ground fish viewing window, construction of various fish passage and sorting structures, and construction of a retaining wall near the current building at the northeast corner of the property. Construction of an educational facility and residence located above the slope at the north edge of the site may also be constructed as future improvements. A preliminary site plan with the proposed improvements and existing topography is attached.

RECONNAISSANCE

NTL visited the site with Andy Belski of Water Consulting, Inc. on December 4, 2002. At the time of this visit, the site was covered with about 2 inches of snow. The site is located on a relatively steep hillside along the north bank of the Flathead River. Ponds and stream channels are present on a relatively flat bench between relatively steep slopes. The ground north of the relatively flat bench extends upward with slopes as steep as 1H:1V. The ground south of the bench extends downward to the Flathead River with slopes generally ranging from about 1½H:1V to 2H:1V. Elevations range from about 3,210 feet at the north edge of the site to 3,155 feet on the bench near the center of the site to about 3,105 feet at the south edge of the site along the Flathead River.

Based on observations during the December 4th site visit, it appears that significant erosion has occurred in the vicinity of all stream channels with relatively steep gradients. It also appears that significant erosion of the downhill berm along the south side of Pond 7 has occurred in 3 locations, possibly during a storm or runoff event when Pond 7 was full and water flowed over the top of the lower berm. At the time of this site visit, minimal water was present in the ponds and streams.

Observations along eroded stream banks or areas of pond overtopping indicate soils generally consist of silty sand and gravel. Previous lab testing results, provided by Fishpro Inc., indicate soils in the vicinity of the existing ponds and berms consist of gravel with sand and sandy silt/silty sand.

CONCLUSIONS AND RECOMMENDATIONS

The majority of the proposed improvements consist of regrading existing stream channels and ponds. We anticipate earthen water retention structures, such as berms constructed of compacted soil, will be constructed around ponds and possibly stream channels to control the flow of water and reduce the risk of overtopping during the design weather events. Proposed structures also consist of a two-story fish viewing window near the center of the site, various fish and water control structures throughout the stream channels, and a retaining wall between 6 and 8 feet in height near the building in the northeast corner of the property. Future buildings consisting of a new educational facility and new residence may also be constructed at the north edge of the site in the near future. In conjunction with the normal geotechnical study for evaluating the suitability of the site for the proposed structures, we recommend a subsurface investigation to evaluate the global stability of the site be conducted.

During our December 4th site visit, numerous springs and evidence of wet areas were observed along the north slope of the site, bordering the relatively flat bench. Water from the springs and wet areas is collected by stream channels and ponds on the bench. The ground slopes downward from the north edge of the site at a relatively steep slope. The steep slopes continue south of the bench, down to the north bank of the Flathead River. Undulating and hummocky terrain is present on the relatively flat bench and in localized areas on the lower hillside. The bench also reduces in width to the east and west of the site, and grades back into a relatively continuous slope from the Flathead River to the top of the slope above the proposed fish hatchery improvements. Based on topography, the presence of seeps and springs, and the presence of a large fast flowing river at the toe of the lower slope, it appears the majority of the fish hatchery site may be constructed on a landmass that has experienced downhill movement in the past. We understand the existing fish hatchery was constructed in the mid 1950's, and we are unaware of noticeable slide activity during the life of the fish hatchery.

Prior to final design, we recommend a more detailed global stability study be conducted to evaluate the potential for landmass movement in the vicinity of the proposed improvements. The study should include detailed field reconnaissance and mapping, review of aerial photographs of the area, a global stability analysis, and possibly geotechnical borings and installations of slope inclinometer tubes and piezometers. The slope inclinometers can serve as an indicator of landmass movement when properly installed and periodically evaluated. Piezometers provide a means to measure the static groundwater level for use in stability analysis and foundation design. The scope of such investigation is somewhat dependent on the acceptable level of risk determined by the owner; first order risk assessment can be made following geological mapping and field reconnaissance and a review of aerial photographs. If it appears previous movement has occurred, we recommend a minimum of 3 to 4 borings be drilled to depths of about 60 to 70 feet in the vicinity of the movement to evaluate subsurface materials and groundwater conditions as well as facilitate the possible installation of slope inclinometers. Instrumentation should be installed well in advance of final design to allow extended-term assessment of groundwater fluctuations and slope movements/response.

We also recommend a final geotechnical engineering report be conducted for the proposed structures and earthwork. The investigation should consist of shallow borings or test pits in the vicinity of proposed earthwork, the fish viewing window, retaining wall, and future building improvements. The investigation should address foundations for all structures in addition to increased lateral earth pressures on embedded walls due to the lack of a drainage zone behind the walls. We recommend the final geotechnical investigation report also provide recommendations to reduce erosion on the stream banks. Repair of existing erosional features due to the apparent overtopping of berms during flood events should also be addressed. Future ponds should be designed with overflow spillways that will guide the water into riprap armored stream channels during large flow and flood events. A certain level of risk is inherent when constructing ponds and impounding water in the vicinity of steep hillsides and areas of marginal stability. Constructing relatively impermeable liners in the bottom and on the banks of all ponds and stream channels will help minimize the risk of saturating the hillside and triggering an unstable condition. Riprap over a thickness of bedding gravel can usually be placed over the top of liners.

We anticipate a final geotechnical investigation will consist of detailed geological field reconnaissance and mapping of the site, review of aerial photographs, 3 to 4 geotechnical borings advanced to a depth of 60 to 70 feet with installation of slope inclinometers and piezometers, a global stability analysis, shallow borings or test pits in the vicinity of proposed earthwork and structures, and preparation of a report. We estimate the total cost for a final geotechnical investigation for this site will be about $30,000.00. An additional $5,000.00 should be budgeted for periodic evaluation of the slope inclinometers and piezometers over several seasonal cycles. If minimal evidence of large landmass movement is observed during review of aerial photographs and the geological field reconnaissance, the borings with installation of slope inclinometers and piezometers will likely not be necessary and the cost of a final geotechnical investigation will be on the order of $15,000.00. In our opinion, the more detailed study will provide much more information for making a final decision on developing the site.

LIMITATIONS

NTL Engineering & Geoscience has strived to prepare this report in accordance with generally accepted geotechnical engineering practices in this area solely for use by the client for feasibility study purposes and is not intended as a construction or bid document representing subsurface conditions. The conclusions and recommendations presented are based upon the limited data obtained during our December 4th, 2002 site visit and topographic information provided by Water Consulting Engineers of Whitefish, Montana.

Please contact us with any questions regarding our preliminary reconnaissance findings or if we can be of further service in project development.

Sincerely,

Joshua C. Smith, P.E.
Project Engineer

Gary A. Quinn, P.E.
Senior Geotechnical Engineer

JCS/GAQ/ll
Enclosures
In four copies

Appendix F

North Fork Flathead River Tributaries - Genetic Analysis

Appendix G. Genetic analysis data for North Fork Flathead tributaries and lakes. A 100 under the WCT column indicates a 100 percent genetically pure population of WCT in that waterbody.

North Fork Flathead

	GENETICS*						DISEASE*
NAME	Sample.	Date	Sample Size	RB	WCT	YCT	Pathogen Results
Akokala Creek	10094	8/8/2000	25		100		
Anaconda Creek	1911	9/21/1998	20	27.4	72.6		
Big Creek	116	8/22/1984	19	0.9	99.1		
Big Creek	10107	8/3/2001	25		100		
Big Creek	10108	8/2/2000	12	1.4	98.6		
Bowman Creek	10095	8/6/2001	25		100		
Camas Creek	1912	9/21/1998	6	23.9	76.1		
Coal Creek	125	8/29/1984	26		100		
Coal Creek	10101	8/11/2000	15	3.6	96.4		
-North Coal							
-South Coal							
Colts Creek	70	7/12/1984	26		100		
Cyclone Creek	106	8/15/1984	23		100		
Cyclone Creek	1915	8/10/1998	25	7.5	92.5		
Cyclone Creek	10104	8/6/2001	24		100		
Cyclone Lake	1616	9/14/1988	50		100		
Cyclone Lake	1652	7/8/1988	17		100		
Dead Horse Creek	10103	8/4/2001	23		100		
Depuy Creek	102	8/14/1984	27		100		
Depuy Creek	10112	8/3/2001	25		100		
Dutch Creek	1916	8/11/1998	23	32.4	67.6		
Hay Creek	99	8/14/1984	25		100		
Hay Creek	104	8/15/1984	27		100		

Hay Creek	207	6/15/1987	39		100		
Hay Creek	1921	8/26/1998	2		100		
Hay Creek	1922	8/26/1998	8		100		
Hay Creek	1923	8/26/1998	8		100		
Hay Creek	10096	7/19/2000	24		100		
Hay Creek	10097	7/21/2000	24	1.1	98.9		
Hay Creek		8/13/2001					Negative
Hay Lake	1666	6/15/1987	39		100		
Hay Lake	1667	8/14/1984	25		100		
Huntsberger Lake	1708	7/18/1996	27		100		
Kletomus Creek	122	8/28/1984	25		99.1	0.9	
Kletomus Creek	10111	8/4/2001	25		100		
Langford Creek	101	8/14/1984	15	2	98		
Langford Creek	1924	8/1/1998	20	30.2	69.8		
Langford Creek		8/14/2001					Negative
Logging Creek	10105	9/17/2000	16		100		
Logging Creek	10106	9/16/2000	16	2.1	97.9		
McGinnis Creek	107	8/15/1984	25		100		
McGinnis Creek	10113	7/18/2000	12	9.8	90.2		
Moose Creek	69	7/12/1984	27		100		
Moose Creek	208	6/16/1987	20	1.5	98.5		
Moose Creek	10084	9/11/2001	19		100		
Moose Creek	10090	9/11/2001	25		100		
Moran Creek	105	8/15/1984	29		100		
Moran Creek	10098	7/18/2000	21		100		
Nasukoin Lake	1631	9/2/1998	25		100		
Nicola Creek	123	8/28/1984	25		100		
Nicola Creek	10109	9/14/2000	15	4	96		
Quartz Creek	10099	9/18/2000	24		100		
Quartz Creek	10100	8/9/2000	20		100		

Red Meadow Creek	103	8/15/1984	22		99.2	0.8	
Red Meadow Creek	10091	9/10/2001	25	1.4	98.6		
Red Meadow Creek	10092	9/10/2001	25				
Red Meadow Lake	1695	8/15/1984	23		100		
Skookoleel Creek	117	8/22/1984	11		100		
Skookoleel Creek	10110	8/4/2001	20	1.7	98.3		
South Fork Coal Creek	100	8/14/1984	25		100		
South Fork Coal Creek	10102	8/5/2001	10	6.1	93.9		
South Fork Red Meadow Creek	72	7/13/1984	24		100		
South Fork Red Meadow Creek	10093	7/19/2000	20	0.9	99.1		
Tepee Creek	71	7/13/1984	25		100		
Tuchuck Creek		8/15/2001					Negative
Whale Creek	76	8/1/1984	25		85.4	14.6	
Whale Lake	1709	7/18/1996	18		10.4	89.6	
Yakinikak Creek	128	9/11/1984	26		100		

* Blanks indicate no data

Appendix G

Middle Fork Flathead River Tributaries - Genetic Analysis

Appendix H. Genetic analysis data for Middle Fork Flathead tributaries and lakes. A 100 under the WCT column indicates a 100 percent genetically pure population of WCT in that waterbody.

Middle Fork Flathead

GENETICS*

NAME	Sample.	Date	Sample Size	RB	WCT	YCT
Almeda Lake	2335	9/22/2001	25		100	
Bear Creek	10118	7/29/1998	13		100	
Bergsicker Lake	1710	9/12/1995	16		100	
Challenge Creek	337	8/24/1989	25		100	
Coal Creek	1913	8/16/1998	1		100	
Coal Creek	1914	8/18/1998	5	5.3	94.7	
Cox Creek	359	9/29/1989	25		100	
Cup Lake	1649	8/26/1994	15		100	
Cup Lake	1650	8/26/1994	17		100	
Dickey Lake	2331	7/13/2001	24		100	
East Tranquil Basin Lake	1621	7/11/1995	34		89	11
Elk Lake	1647	8/11/1994	24		100	
Essex Creek	1917	7/27/1998	10		100	
Essex Creek	1918	7/27/1998	10	2.7	94.2	3.1
Flotilla Lake	1622	8/1/1995	10	6	93	
Harrison Lake	10119	8/30/2000	15	1.7	98.3	
Lincoln Creek	1925	9/23/1998	22	18.5	81.5	
Marion Lake	1619	8/5/1994	24	76	18	5
Middle Fork Flathead River	358	9/27/1989	18		100	
Middle Fork Flathead River	871	10/1/1993	8		100	
Middle Fork Flathead River	978	8/2/1994	26		100	
Middle Fork Flathead River	1282	8/11/1998	25		100	
Moose Lake	1646	8/11/1994	5	6	94	
Ole Creek	1928	8/17/1998	10		100	
Park Creek	10117	8/20/1998	22		100	
Pinchot Creek	1929	8/18/1998	10		100	
Rubideau Creek	10114	8/7/2001	12	11.1	88.9	
Scott Lake	1651	8/1/1995	10		100	
Stanton Creek	10115	8/11/2001	15	2.3	97.7	
Stanton Lake	1648	9/16/1994	11		100	
Tunnel Creek	1180	9/11/1996	26		100	
Tunnel Creek	10116	8/11/2001	25		100	
West Tranquil Basin Lake	1620	7/14/1994	9		57	43

* Blanks indicate no data

Appendix H

South Fork Flathead River Tributaries Genetic Analysis

Appendix I. Genetic analysis data for the South Fork Flathead tributaries and lakes. A 100 under the WCT column indicates a 100 percent genetically pure population of WCT in that waterbody.

South Fork Flathead

GENETICS*

NAME	Sample.	Date	Sample Size	RB	WCT	YCT	WCTxRB	WCTxYCT
Aeneas Creek	53	8/31/1983	15	7.4	92.6			
Aeneas Creek	318	8/11/1989	24	4.6	95.4			
Aeneas Creek	10069	6/1/1998	25		98.6	1.4		
Baptiste Creek	85	8/2/1984	14		100			
Bent Creek	142	8/16/1985	2		100			
Beta Lake	1691	1/8/1985	-99		100			
Beta Lake	2318	9/4/2002	25		100			
Big Hawk Lake	1700	9/27/1995	25		72			28
Big Salmon Creek	2129	8/10/2000	25		100			
Big Salmon Creek	2130	8/11/2000	12		100			
Big Salmon Creek	2134	8/13/2000	25	4	96			
Big Salmon Lake	1615	7/22/1988	19		100			
Black Lake	1701	9/27/1994	50		86		14	
Black Lake	2333	9/5/2001	21				95	5
Black Lake	10070	8/5/1999	25		99	1		
Blackfoot Lake	1702	9/27/1994	30	10	37		53	
Blackfoot Lake	2328	9/6/2001	15	34	66			
Blackfoot Lake	10071	7/28/1999	16	6	50		44	
Bunker Creek	88	8/7/1984	10		96.4	3.6		
Canyon Creek	84	8/2/1984	26		100			
Cataract Creek	2132	8/13/2000	25	91	9			
Clark Creek	78	8/1/1984	26		100			
Clayton Creek	49	8/31/1983	26	5	90	5		
Clayton Creek	10072	9/10/1998	19		97.1	2.9		

Clayton Lake	1653	8/15/1989	26		100			
Clayton Lake	1704	9/28/1994	30		47	6		47
Clayton Lake	2332	9/6/2001	20		92	8		
Clayton Lake	10073	8/25/1999	37		94.5	5.5		
Cliff Lake	1668	7/1/1991	30	98		2		
Crater Lake	10074	8/10/1999	39	0.3	99.7			
Danaher Creek	295	6/27/1989	26		100			
Doctor Creek	2138	8/6/2000	22		99	1		
Doris Creek	96	8/13/1984	25		100			
Dudley Creek	64	5/2/1984	25		100			
Emery Creek	34		27		100			
Felix Creek	35		25		100			
Forest Creek	48	8/30/1983	30	0.6	99.4			
Forest Creek	55	9/15/1983	33		51.9	48.1		
Forest Creek	10075	9/17/1998	14		100			
George Creek	2135	8/7/2000	8		94	6		
George Creek	2136	8/7/2000	3		90	10		
George Lake	2316	8/30/2002	26		96.8	3.2		
Goldie Creek	90	8/8/1984	22		100			
Gordon Creek	308	8/2/1989	26		100			
Gordon Creek	2126	8/5/2000	25		100			
Gordon Creek	2127	8/5/2000	25		100			
Gorge Creek	263	9/29/1988	25		99	1		
Graves Creek	50	8/31/1983	27	17.6	80.1	2.3		
Graves Creek	315	8/10/1989	26	15.4	83.1	1.5		
Graves Creek	1084	9/13/1995	29	8.3	91.7			
Graves Creek	10076	9/7/1999	25		97.6	2.4		
Handkerchief Lake	1705	7/6/1995	14		36		64	
Handkerchief Lake	10077	6/26/2000	17	2.4	96.6	1		
Harris Creek	81	8/1/1984	25		100			

Harrison Creek	92	8/10/1984	11	2.2	97.8			
Hoke Creek	68	6/12/1984	35		100			
Hungry Horse Creek	36		48		100			
Hungry Horse Reservoir	1661	5/1/1985	36		100			
Hungry Horse Reservoir	2169	11/7/2001	28		93			7
Jenny Lake	2266	6/29/2002	29		100			
Jones Creek	54	8/31/1983	12		91.8	8.2		
Jones Creek	319	8/11/1989	26		94.7	5.3		
Knieff Creek	91	8/8/1984	27		100			
Lena Lake	1692	7/9/1987	26	50	50			
Lena Lake	1711	7/10/1996	25	32	60		8	
Lena Lake	2288	7/24/2002	34	16.3	83.7			
Lick Creek	2137	8/6/2000	25		98	2		
Lick Lake	1693	7/23/1987	35		50	50		
Lick Lake	1712	7/10/1996	22		#6	#6		#7
Lick Lake	2314	8/27/2002	28		91.5	8.5		
Logan Creek	80	8/1/1984	26		100			
Lost Johnny Creek	126	8/30/1984	22		100			
Lost Mare Creek		10/8/2002	36		97		3	
Lower Marshall Creek Lake	1683	9/23/1988	27		100			
Lower Necklace Lake	1714	9/11/1996	5		40		60	
Lower Seven Acres Lake	2325	9/9/2002	28		100			
Lower Seven Acres Lake	2327	9/6/2001	13	1	99			
Lower Twin Creek	73	7/20/1984	39		100			
Margaret Creek		10/8/2002	34		100			
Marshall Creek	224	8/26/1987	26		100			
McInernie Creek	65	5/2/1984	28		100			
Mid Creek	242	7/3/1988	26		100			
Murray Creek	97	8/13/1984	28		100			
North Biglow Lake	1634	9/5/1984	25	2	98			

North Biglow Lake	2323	9/9/2002	29		100			
North Biglow Lake	2334	9/5/2001	17		100			
North Jewel Lake	10078	7/24/2001	21		100			
Paint Creek	83	8/2/1984	17		100			
Pilgrim Lake #1	2337	9/5/2001	11	1	99			
Pyramid Lake	1690	8/5/1987	12				-10	
Pyramid Lake	1706	7/10/1994	23		96		4	
Pyramid Lake	2027	7/30/2001	27	1	99			
Quintonkon Creek	40	8/5/1983	22		100			
Riverside Creek	93	8/10/1984	12	1	99			
Riverside Creek	94	8/10/1984	12		100			
Smoky Creek	2133	8/13/2000	25	38	61	1		
Soldier Creek	77	8/1/1984	26		100			
South Fork Flathead River	95	8/10/1984	12		100			
South Fork Flathead River	241	7/3/1988	35		100			
South Fork Flathead River	1281	7/22/1998	25		100			
South Fork Flathead River	2128	8/1/2000	25		100			
South Fork Flathead River	2131	8/1/2000	22		100			
South Fork Logan Creek	79	8/1/1984	20		100			
Spotted Bear River	86	8/3/1984	28		100			
Sullivan Creek	33		25		100			
Sunburst Lake	1637	8/2/1991	14	50		50		
Sunburst Lake	1696	7/9/1987	25	50		50		
Sunburst Lake	2326	9/26/2002	75	0.5	82	17.5		
Tent Creek	98	8/13/1984	27	0.6	99.4			
Tiger Creek		10/8/2002	35		100			
Tin Creek	47	8/30/1983	30		100			
Tom Tom Lake	1608	8/12/1999	36		42	3		55
Tom Tom Lake	1707	9/14/1994	62		50	19		31
Twin Creek	89	8/7/1984	21		100			

Upper Big Hawk Lake	2338	9/7/2001	7		100			
Upper Marshall Creek Lake	1682	9/23/1988	7		100			
Upper Necklace Lake	1689	7/9/1987	8	100				
Upper Necklace Lake	1713	9/11/1996	9		22		78	
Upper Seven Acres Lake	2324	9/9/2002	25		100			
Upper Seven Acres Lake	2336	9/6/2001	4		100			
Wheeler Creek	51	8/31/1983	20		98.7	1.3		
Wheeler Creek	52	8/31/1983	3		8.3	91.7		
Wheeler Creek	87	8/7/1984	21		98.7	1.3		
Wheeler Creek	1017	9/14/1994	18		42.3	57.7		
Wheeler Creek	1018	9/14/1994	30		98.3	1.7		
Wheeler Creek	10079	9/10/1999	25		63.2	36.8		
White River	802	8/10/1993	25		100			
Wildcat Creek	115	8/17/1984	15		90.2	9.8		
Wildcat Creek	268	10/5/1988	38		97.2	2.8		
Wildcat Creek	1187	7/15/1996	25		100			
Wildcat Lake	1614	8/24/1988	39		98	2		
Wildcat Lake	2330	9/5/2001	9		89			11
Wildcat Lake	10080	6/1/1999	25		94.7	5.3		
Woodward Lake	1633	7/9/1987	12				-10	
Wounded Buck Creek	124	8/28/1984	15		98	2		
Wounded Buck Creek	127	8/30/1984	26		97.5	2.5		

* Blanks indicate no data

Appendix I

All Flathead River Tributaries
Genetic Analysis

Appendix J. Genetic analysis data for the entire Flathead River system, including all tributaries and lakes. A 100 under the WCT column indicates a 100 percent genetically pure population of WCT in that waterbody. A # under column indicates the number of individuals representing each category, not the percentage.

HUC	NAME	Sample.	Date	Sample Size	RB	WCT	YCT	WCTxRB	WCTxYCT
17010206	Akokala Creek	10094	8/8/2000	25		100			
17010206	Anaconda Creek	1911	9/21/1998	20	27.4	72.6			
17010206	Big Creek	116	8/22/1984	19	0.9	99.1			
17010206	Big Creek	10107	8/3/2001	25		100			
17010206	Big Creek	10108	8/2/2000	12	1.4	98.6			
17010206	Bowman Creek	10095	8/6/2001	25		100			
17010206	Camas Creek	1912	9/21/1998	6	23.9	76.1			
17010206	Coal Creek	125	8/29/1984	26		100			
17010206	Coal Creek	10101	8/11/2000	15	3.6	96.4			
17010206	Colts Creek	70	7/12/1984	26		100			
17010206	Cyclone Creek	106	8/15/1984	23		100			
17010206	Cyclone Creek	1915	8/10/1998	25	7.5	92.5			
17010206	Cyclone Creek	10104	8/6/2001	24		100			
17010206	Cyclone Lake	1616	9/14/1988	50		100			
17010206	Cyclone Lake	1652	7/8/1988	17		100			
17010206	Dead Horse Creek	10103	8/4/2001	23		100			
17010206	Depuy Creek	102	8/14/1984	27		100			
17010206	Depuy Creek	10112	8/3/2001	25		100			
17010206	Dutch Creek	1916	8/11/1998	23	32.4	67.6			
17010206	Hay Creek	99	8/14/1984	25		100			
17010206	Hay Creek	104	8/15/1984	27		100			
17010206	Hay Creek	207	6/15/1987	39		100			
17010206	Hay Creek	1921	8/26/1998	2		100			
17010206	Hay Creek	1922	8/26/1998	8		100			
17010206	Hay Creek	1923	8/26/1998	8		100			
17010206	Hay Creek	10096	7/19/2000	24		100			
17010206	Hay Creek	10097	7/21/2000	24	1.1	98.9			
17010206	Hay Lake	1666	6/15/1987	39		100			
17010206	Hay Lake	1667	8/14/1984	25		100			

17010206 Huntsberger Lake	1708	7/18/1996	27		100	
17010206 Kletomus Creek	122	8/28/1984	25		99.1	0.9
17010206 Kletomus Creek	10111	8/4/2001	25		100	
17010206 Langford Creek	101	8/14/1984	15	2	98	
17010206 Langford Creek	1924	8/1/1998	20	30.2	69.8	
17010206 Logging Creek	10105	9/17/2000	16		100	
17010206 Logging Creek	10106	9/16/2000	16	2.1	97.9	
17010206 McGinnis Creek	107	8/15/1984	25		100	
17010206 McGinnis Creek	10113	7/18/2000	12	9.8	90.2	
17010206 Moose Creek	69	7/12/1984	27		100	
17010206 Moose Creek	208	6/16/1987	20	1.5	98.5	
17010206 Moose Creek	10084	9/11/2001	19		100	
17010206 Moose Creek	10090	9/11/2001	25		100	
17010206 Moran Creek	105	8/15/1984	29		100	
17010206 Moran Creek	10098	7/18/2000	21		100	
17010206 Nasukoin Lake	1631	9/2/1998	25		100	
17010206 Nicola Creek	123	8/28/1984	25		100	
17010206 Nicola Creek	10109	9/14/2000	15	4	96	
17010206 Quartz Creek	10099	9/18/2000	24		100	
17010206 Quartz Creek	10100	8/9/2000	20		100	
17010206 Red Meadow Creek	103	8/15/1984	22		99.2	0.8
17010206 Red Meadow Creek	10091	9/10/2001	25	1.4	98.6	
17010206 Red Meadow Creek	10092	9/10/2001	25			
17010206 Red Meadow Lake	1695	8/15/1984	23		100	
17010206 Skookoleel Creek	117	8/22/1984	11		100	
17010206 Skookoleel Creek	10110	8/4/2001	20	1.7	98.3	
17010206 South Fork Coal Creek	100	8/14/1984	25		100	
17010206 South Fork Coal Creek	10102	8/5/2001	10	6.1	93.9	
17010206 South Fork Red Meadow Creek	72	7/13/1984	24		100	
17010206 South Fork Red Meadow Creek	10093	7/19/2000	20	0.9	99.1	
17010206 Tepee Creek	71	7/13/1984	25		100	
17010206 Whale Creek	76	8/1/1984	25		85.4	14.6
17010206 Whale Lake	1709	7/18/1996	18		10.4	89.6

17010206	Yakinikak Creek	128	9/11/1984	26		100	
17010207	Almeda Lake	2335	9/22/2001	25		100	
17010207	Bear Creek	10118	7/29/1998	13		100	
17010207	Bergsicker Lake	1710	9/12/1995	16		100	
17010207	Challenge Creek	337	8/24/1989	25		100	
17010207	Coal Creek	1913	8/16/1998	1		100	
17010207	Coal Creek	1914	8/18/1998	5	5.3	94.7	
17010207	Cox Creek	359	9/29/1989	25		100	
17010207	Cup Lake	1649	8/26/1994	15		100	
17010207	Cup Lake	1650	8/26/1994	17		100	
17010207	Dickey Lake	2331	7/13/2001	24		100	
17010207	East Tranquil Basin Lake	1621	7/11/1995	34		89	11
17010207	Elk Lake	1647	8/11/1994	24		100	
17010207	Essex Creek	1917	7/27/1998	10		100	
17010207	Essex Creek	1918	7/27/1998	10	2.7	94.2	3.1
17010207	Flotilla Lake	1622	8/1/1995	10	6	93	
17010207	Harrison Lake	10119	8/30/2000	15	1.7	98.3	
17010207	Lincoln Creek	1925	9/23/1998	22	18.5	81.5	
17010207	Marion Lake	1619	8/5/1994	24	76	18	5
17010207	Middle Fork Flathead River	358	9/27/1989	18		100	
17010207	Middle Fork Flathead River	871	10/1/1993	8		100	
17010207	Middle Fork Flathead River	978	8/2/1994	26		100	
17010207	Middle Fork Flathead River	1282	8/11/1998	25		100	
17010207	Moose Lake	1646	8/11/1994	5	6	94	
17010207	Ole Creek	1928	8/17/1998	10		100	
17010207	Park Creek	10117	8/20/1998	22		100	
17010207	Pinchot Creek	1929	8/18/1998	10		100	
17010207	Rubideau Creek	10114	8/7/2001	12	11.1	88.9	
17010207	Scott Lake	1651	8/1/1995	10		100	
17010207	Stanton Creek	10115	8/11/2001	15	2.3	97.7	
17010207	Stanton Lake	1648	9/16/1994	11		100	
17010207	Tunnel Creek	1180	9/11/1996	26		100	
17010207	Tunnel Creek	10116	8/11/2001	25		100	

17010207	West Tranquil Basin Lake	1620	7/14/1994	9		57	43		
17010209	Aeneas Creek	53	8/31/1983	15	7.4	92.6			
17010209	Aeneas Creek	318	8/11/1989	24	4.6	95.4			
17010209	Aeneas Creek	10069	6/1/1998	25		98.6	1.4		
17010209	Baptiste Creek	85	8/2/1984	14		100			
17010209	Bent Creek	142	8/16/1985	2		100			
17010209	Beta Lake	1691	1/8/1985	-99		100			
17010209	Beta Lake	2318	9/4/2002	25		100			
17010209	Big Hawk Lake	1700	9/27/1995	25		#18			#7
17010209	Big Salmon Creek	2129	8/10/2000	25		100			
17010209	Big Salmon Creek	2130	8/11/2000	12		100			
17010209	Big Salmon Creek	2134	8/13/2000	25	4	96			
17010209	Big Salmon Lake	1615	7/22/1988	19		100			
17010209	Black Lake	1701	9/27/1994	50		#43		#7	
17010209	Black Lake	2333	9/5/2001	21				#20	#1
17010209	Black Lake	10070	8/5/1999	25		99	1		
17010209	Blackfoot Lake	1702	9/27/1994	30	#3	#11		#16	
17010209	Blackfoot Lake	2328	9/6/2001	15	34	66			
17010209	Blackfoot Lake	10071	7/28/1999	16	#1	#8		#7	
17010209	Bunker Creek	88	8/7/1984	10		96.4	3.6		
17010209	Canyon Creek	84	8/2/1984	26		100			
17010209	Cataract Creek	2132	8/13/2000	25	91	9			
17010209	Clark Creek	78	8/1/1984	26		100			
17010209	Clayton Creek	49	8/31/1983	26	5	90	5		
17010209	Clayton Creek	10072	9/10/1998	19		97.1	2.9		
17010209	Clayton Lake	1653	8/15/1989	26		100			
17010209	Clayton Lake	1704	9/28/1994	30		#14	#2		#14
17010209	Clayton Lake	2332	9/6/2001	20		92	8		
17010209	Clayton Lake	10073	8/25/1999	37		94.5	5.5		
17010209	Cliff Lake	1668	7/1/1991	30	98		2		
17010209	Crater Lake	10074	8/10/1999	39	0.3	99.7			
17010209	Danaher Creek	295	6/27/1989	26		100			
17010209	Doctor Creek	2138	8/6/2000	22		99	1		

17010209 Doris Creek	96	8/13/1984	25		100			
17010209 Dudley Creek	64	5/2/1984	25		100			
17010209 Emery Creek	34	10/10/1982	27		100			
17010209 Felix Creek	35	10/10/1982	25		100			
17010209 Forest Creek	48	8/30/1983	30	0.6	99.4			
17010209 Forest Creek	55	9/15/1983	33		51.9	48.1		
17010209 Forest Creek	10075	9/17/1998	14		100			
17010209 George Creek	2135	8/7/2000	8		94	6		
17010209 George Creek	2136	8/7/2000	3		90	10		
17010209 George Lake	2316	8/30/2002	26		96.8	3.2		
17010209 Goldie Creek	90	8/8/1984	22		100			
17010209 Gordon Creek	308	8/2/1989	26		100			
17010209 Gordon Creek	2126	8/5/2000	25		100			
17010209 Gordon Creek	2127	8/5/2000	25		100			
17010209 Gorge Creek	263	9/29/1988	25		99	1		
17010209 Graves Creek	50	8/31/1983	27	17.6	80.1	2.3		
17010209 Graves Creek	315	8/10/1989	26	15.4	83.1	1.5		
17010209 Graves Creek	1084	9/13/1995	29	8.3	91.7			
17010209 Graves Creek	10076	9/7/1999	25		97.6	2.4		
17010209 Handkerchief Lake	1705	7/6/1995	14		#5		#9	
17010209 Handkerchief Lake	10077	6/26/2000	17	2.4	96.6	1		
17010209 Harris Creek	81	8/1/1984	25		100			
17010209 Harrison Creek	92	8/10/1984	11	2.2	97.8			
17010209 Hoke Creek	68	6/12/1984	35		100			
17010209 Hungry Horse Creek	36	10/10/1982	48		100			
17010209 Hungry Horse Reservoir	1661	5/1/1985	36		100			
17010209 Hungry Horse Reservoir	2169	11/7/2001	28		#26			#2
17010209 Jenny Lake	2266	6/29/2002	29		100			
17010209 Jones Creek	54	8/31/1983	12		91.8	8.2		
17010209 Jones Creek	319	8/11/1989	26		94.7	5.3		
17010209 Knieff Creek	91	8/8/1984	27		100			
17010209 Lena Lake	1692	7/9/1987	26	50	50			
17010209 Lena Lake	1711	7/10/1996	25	#8	#15		#2	

17010209 Lena Lake	2288	7/24/2002	34	16.3	83.7			
17010209 Lick Creek	2137	8/6/2000	25		98	2		
17010209 Lick Lake	1693	7/23/1987	35		50	50		
17010209 Lick Lake	1712	7/10/1996	22		#6	#6		#7
17010209 Lick Lake	2314	8/27/2002	28		91.5	8.5		
17010209 Logan Creek	80	8/1/1984	26		100			
17010209 Lost Johnny Creek	126	8/30/1984	22		100			
17010209 Lower Marshall Creek Lake	1683	9/23/1988	27		100			
17010209 Lower Necklace Lake	1714	9/11/1996	5		#2		#3	
17010209 Lower Seven Acres Lake	2325	9/9/2002	28		100			
17010209 Lower Seven Acres Lake	2327	9/6/2001	13	1	99			
17010209 Lower Twin Creek	73	7/20/1984	39		100			
17010209 Marshall Creek	224	8/26/1987	26		100			
17010209 McInernie Creek	65	5/2/1984	28		100			
17010209 Mid Creek	242	7/3/1988	26		100			
17010209 Murray Creek	97	8/13/1984	28		100			
17010209 North Biglow Lake	1634	9/5/1984	25	2	98			
17010209 North Biglow Lake	2323	9/9/2002	29		100			
17010209 North Biglow Lake	2334	9/5/2001	17		100			
17010209 North Jewel Lake	10078	7/24/2001	21		100			
17010209 Paint Creek	83	8/2/1984	17		100			
17010209 Pilgrim Lake #1	2337	9/5/2001	11	1	99			
17010209 Pyramid Lake	1690	8/5/1987	12				-10	
17010209 Pyramid Lake	1706	7/10/1994	23		#22		#1	
17010209 Pyramid Lake	2027	7/30/2001	27	1	99			
17010209 Quintonkon Creek	40	8/5/1983	22		100			
17010209 Riverside Creek	93	8/10/1984	12	1	99			
17010209 Riverside Creek	94	8/10/1984	12		100			
17010209 Smoky Creek	2133	8/13/2000	25	38	61	1		
17010209 Soldier Creek	77	8/1/1984	26		100			
17010209 South Fork Flathead River	95	8/10/1984	12		100			
17010209 South Fork Flathead River	241	7/3/1988	35		100			
17010209 South Fork Flathead River	1281	7/22/1998	25		100			

17010209 South Fork Flathead River	2128	8/1/2000	25		100			
17010209 South Fork Flathead River	2131	8/1/2000	22		100			
17010209 South Fork Logan Creek	79	8/1/1984	20		100			
17010209 Spotted Bear River	86	8/3/1984	28		100			
17010209 Sullivan Creek	33	10/10/1982	25		100			
17010209 Sunburst Lake	1637	8/2/1991	14	50		50		
17010209 Sunburst Lake	1696	7/9/1987	25	50		50		
17010209 Sunburst Lake	2326	9/26/2002	75	0.5	82	17.5		
17010209 Tent Creek	98	8/13/1984	27	0.6	99.4			
17010209 Tin Creek	47	8/30/1983	30		100			
17010209 Tom Tom Lake	1608	8/12/1999	36		#15	#1		#20
17010209 Tom Tom Lake	1707	9/14/1994	62		#31	#12		#19
17010209 Twin Creek	89	8/7/1984	21		100			
17010209 Upper Big Hawk Lake	2338	9/7/2001	7		100			
17010209 Upper Marshall Creek Lake	1682	9/23/1988	7		100			
17010209 Upper Necklace Lake	1689	7/9/1987	8	100				
17010209 Upper Necklace Lake	1713	9/11/1996	9		#2		#7	
17010209 Upper Seven Acres Lake	2324	9/9/2002	25		100			
17010209 Upper Seven Acres Lake	2336	9/6/2001	4		100			
17010209 Wheeler Creek	51	8/31/1983	20		98.7	1.3		
17010209 Wheeler Creek	52	8/31/1983	3		8.3	91.7		
17010209 Wheeler Creek	87	8/7/1984	21		98.7	1.3		
17010209 Wheeler Creek	1017	9/14/1994	18		42.3	57.7		
17010209 Wheeler Creek	1018	9/14/1994	30		98.3	1.7		
17010209 Wheeler Creek	10079	9/10/1999	25		63.2	36.8		
17010209 White River	802	8/10/1993	25		100			
17010209 Wildcat Creek	115	8/17/1984	15		90.2	9.8		
17010209 Wildcat Creek	268	10/5/1988	38		97.2	2.8		
17010209 Wildcat Creek	1187	7/15/1996	25		100			
17010209 Wildcat Lake	1614	8/24/1988	39		98	2		
17010209 Wildcat Lake	2330	9/5/2001	9		#8			#1
17010209 Wildcat Lake	10080	6/1/1999	25		94.7	5.3		
17010209 Woodward Lake	1633	7/9/1987	12				-10	

17010209	Wounded Buck Creek	124	8/28/1984	15		98	2
17010209	Wounded Buck Creek	127	8/30/1984	26		97.5	2.5
17010210	Alder Creek	1988	10/1/1999	25		100	
17010210	Chepat Creek	578	9/22/1991	25		100	
17010210	Fitzsimmons Creek	445	9/13/1990	24		100	
17010210	Good Creek	243	7/26/1988	25		100	
17010210	Good Creek	2146	8/1/2001	26	4	96	
17010210	Gooderich Bayou	1919	6/2/1998	22	2.4	97.6	
17010210	Gregg Creek	1920	7/13/1998	25		100	
17010210	Haskill Creek	2166	11/1/2001	25	1.8	98.2	
17010210	Johnson Creek	714	9/10/1992	52		98.9	1.1
17010210	Johnson Creek	1280	7/9/1998	3		100	
17010210	Lupine Lake	1656	9/4/1990	6		49	51
17010210	Martin Creek	2145	5/1/2001	25	2	69	29
17010210	West Fork Swift Creek	129	9/11/1984	26	2.6	97.4	
17010210	Whitefish River	10121	6/15/2001	15	98.2	1.8	
17010211	Cat Creek	1989	7/7/2000	21	2	98	
17010211	Cat Creek	1990	7/7/2000	22	5	95	
17010211	Groom Creek	38	6/1/1983	25		100	
17010211	Hall Creek	435	9/1/1990	19	37.7	62.3	
17010211	Hall Lake	1657	8/8/1990	13	100		
17010211	Pony Creek	1991	7/7/2000	30	1	99	
17010211	Sixmile Creek	39	6/1/1983	25		100	
17010211	Soup Creek	59	6/6/1983	25		100	
17010211	Wolf Creek	1279	7/7/1998	11	2	98	
17010211	Wyman Creek	260	9/14/1988	19		100	
17010211	Wyman Creek	261	9/14/1988	7		100	

Appendix J

Hatchery Genetic Management Plan/Template

HATCHERY AND GENETIC MANAGEMENT PLAN
RESIDENT FISH EDITION
(HGMP-RF)

Hatchery Program:
Montana Fish, Wildlife & Parks

Sekokini Springs Natural Fish Rearing Facility

Species:
Wild Genetically Pure Westslope Cutthroat

Agency / Operator:
Montana Fish, Wildlife & Parks

Watershed and Region:
Flathead Subbasin, Mountain-Columbia Ecological Province

Date Submitted:
September 2004

Date Last Updated:
September 2004

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Sekokini Springs Natural Rearing Facility – Westslope Cutthroat Trout Restoration

1.2) Species and population (or strain) under propagation, ESA\ population status.

Westslope Cutthroat Trout, *Oncorhynchus clarki lewisi*

1.3) Responsible organization and individuals

Name (and title): Brian Marotz, Fisheries Program Manager
Gary Bertellotti, Hatchery Bureau Chief

Agency or Tribe: Montana Fish, Wildlife, & Parks
Address: 490 North Meridian Road Kalispell, MT 59901
Telephone: (406) 751-4546
Fax: (406) 257-0349
Email: bmarotz@state.mt.us; gbertellotti@state.mt.us
Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

Confederated Salish and Kootenai Tribes, US Bureau of Reclamation, US Forest Service, US Fish and Wildlife Service.

1.4) Funding source, staffing level, and annual hatchery program operational costs.

This project is part of the Hungry Horse Fisheries Mitigation Program funded by Bonneville Power Administration (BPA). BPA contributions to date include $ 72,000 to purchase the improvements (a private trout farm) on land owned by the US Forest Service, $57,000 for a gravity water routing system and spring caps to protect the small hatching facility against disease contamination and $26,000 to replace the building's exterior and insulate the interior. This HGMP will be appended to the Master Plan for the facility being finalized by FishPro, a subsidiary of HDR Consulting, for Montana Fish, Wildlife & Parks (MFWP), BPA and US Bureau of Reclamation (BoR)

Prior to assuming the special use permit, BPA funded the USFWS Creston National Fish Hatchery to experimentally hatch and rear westslope cutthroat trout at the site to assess the water source. MFWP contributed services to conduct a fish disease inventory at the site and determined the water source to be free of all reportable fish pathogens. The BoR Technical Assistance

Program provided additional funding (at approximately $50,000/yr) during the design / planning phase. The BoR funded a high-resolution topographical map of the site and details of proposed improvements and contributed a $70,000 grant for a water conservation exhibit on the proposed interpretive trail at the site.

Fish have been removed from the facility pending completion of the spring caps and water routing system. The single Fish Culturist position was funded at 0.5 FTE until repairs were completed. The staff position is currently vacant pending completion of the 3-step APR process. Ultimately, MFWP recommends a two person staff. Annual operation is estimated at $200,000.

1.5) Location(s) of hatchery and associated facilities.

The Sekokini Springs site is located in Flathead County, Montana, about 10 miles northeast of Columbia Falls, Montana (T.31 N., R. 19 W., Sec. 17, Hungry Horse, Montana 7.5 minute Quadrangle; the location has been recorded in the state GIS data base). The physical address is 5625 Blankenship Road, Columbia Falls, Montana. 59912 (Mail should be directed to 490 North Meridian, Kalispell, MT 59901). The site is located approximately 1 km downstream of the confluence of the North and Middle Forks, near Blankenship Bridge. The Forest Service lease involves 11.4 acres on terraced land overlooking the Flathead River.

1.6) Type of program(s).

Sekokini Springs is part of an Integrated Recovery Program for westslope cutthroat trout within the Flathead River Watershed, Montana. This artificial production facility is integrated with habitat restoration, fish passage improvements, nonnative fish species suppression, modified dam operations, water temperature control via selective withdrawal at Hungry Horse Dam and offsite mitigation in closed basin lakes within the watershed. This project will also coordinate with Montana's Rose Creek Facility, scheduled for completion in September 2004. The new Rose Creek facility will provide additional capacity for hatching and rearing of progeny from wild westslope cutthroat trout conserved at Sekokini Springs.

1.7) Purpose (Goal) of program(s).

The goal of this program is the restoration of westslope cutthroat trout in the Flathead Watershed by conserving genetically diverse indigenous stocks.

The goal of the **Hungry Horse Mitigation Program** is to mitigate fisheries losses attributable to the construction and operation of Hungry Horse Dam. Council approved fisheries losses include 65,000 juvenile westslope cutthroat trout annually, to be restored using a combination of habitat restoration, dam operation changes, harvest management and experimental hatchery techniques. **The Sekokini Springs site will be used in the restoration of westslope cutthroat in the Flathead Drainage by preserving and replicating pure genetic stocks from donor populations within the Flathead Watershed.** Wild progeny from endemic donor populations will be raised in restored natural habitat at the site to preserve behavioral traits and provide gametes for reestablishing F1 progeny in selected areas where the species has been impacted or extirpated. The site will also conserve remnant populations that are threatened by nonnative species or environmental damage. Rescued fish will be protected at the site and raised to create a donor population for reintroduction to their aboriginal habitat after the threats have been eliminated.

1.8) Justification for the program.

Native populations of westslope cutthroat trout in the Flathead system have declined due to loss of spawning and rearing habitat, genetic introgression / hybridization and through negative interaction with nonnative fish species. Seventy-eight miles of high quality, low gradient spawning and rearing habitat were lost due to inundation when Hungry Horse Reservoir filled (FWP and CSKT 1991). Habitat degradation and fish passage barriers have eliminated nearly 60 percent of the habitat once available to native westslope cutthroat and bull trout (Fraley et al. 1989). The Hungry Horse Mitigation program is striving to offset these habitat losses by protecting remaining habitat and by restoring and reconnecting damaged habitats. In certain areas, there is a need to reestablish pure populations of westslope cutthroat trout in the restored habitat.

Nonnative species or environmental damage in some locations threatens remnant populations of genetically pure cutthroat and there is a need to conserve the genetic diversity of the species.
Genetic inventories of existing stocks of westslope cutthroat trout have revealed that hybridized/introgressed populations in headwater lakes are escaping downstream and threatening pure populations of westslope cutthroat trout. Lake rehabilitation has been initiated to remove this threat to pure native stocks. BPA recently drafted an Environmental Impact Statement (DEIS) for removing nonnative fish species and genetically introgressed cutthroat trout from lakes in the South Fork Flathead River headwaters upstream of Hungry Horse Dam. A source of genetically compatible fish is needed to replace these populations. Currently, the state's M012 brood stock is being strengthened using wild stocks to continue the excellent record of maintaining a genetically diverse and disease-free source of westslope cutthroat trout. Sekokini Springs has been used to facilitate this stock maintenance and can be used develop additional local strains for species recovery in Flathead River tributaries. The hatchery portion of the Hungry Horse Mitigation program was redirected to experimental culture of native species as directed by the Hungry Horse Mitigation Plan (MFWP and CSKT 1991) and Implementation Plan (1993). The Northwest Power Planning Council (NPPC) approved the plans and amended their Columbia Basin Fish and Wildlife Program (Measure 10.3A, NPPC 1994).

The for this project, the restoration of WCT is historic ranges of the Flathead River Subbasin using genetically pure indigenous stocks, is consistent with the Westslope Cutthroat Trout Conservation Agreement [1999, Memorandum of Understanding (MOU)], which states the following:

> *The management goal for westslope cutthroat trout in Montana is to ensure the long-term, self-sustaining persistence of the subspecies within each of the five major river*

drainages they historically inhabited in Montana (Clark Fork, Kootenai, Flathead, upper Missouri, and Saskatchewan), and to maintain the genetic diversity and life history strategies represented by the remaining local populations.

The goal of the MOU is to ensure that population aggregates persist, with at least one of the local populations remaining viable for a period of more than 10 years (2-3 generations of fish). Once a population becomes viable, monitoring at a frequency of at least once every 10 years must be done to document its persistence. According to the Conservation Agreement, each tributary that supports WCT, regardless of length, is considered a population.

The Sekokini Springs site has potential to become a primary focus of our native westslope cutthroat trout recovery program in the Flathead Watershed. To assess the potential for the Sekokini Springs facility to successfully rear WCT, experimental trials were conducted with the MO12 stock of WCT in 1997-1999 and 2001. The results of the experimental rearing of WCT successfully demonstrated, over several seasons, that an experimental conservation-rearing program at Sekokini Springs could occur. The site offers a unique combination of natural habitat for onsite restoration work and a small trout rearing facility. Four natural springs of varying water temperatures and the isolated setting provide an opportunity for small scale, experimental rearing of native species under natural habitat conditions. Sekokini Springs can provide an isolation facility (separate effluent management) to hold wild fish until they can be tested for fish pathogens and genetic purity. Individual genetic strains of pure westslope cutthroat trout can be protected and replicated for reintroduction to aboriginal habitats. Experimentation on fish imprinting will be used to initiate wild runs. Where successful, adults returning to their natal waters will be recaptured to assess the effectiveness of various imprinting strategies (e.g. eyed eggs as compared to fingerling imprinting). In the future, it may become possible to obtain gametes from newly created alternative sources (as opposed to remnant donor populations) for hatchery assisted recovery actions elsewhere in the Flathead watershed.

The Sekokini Springs facility will be used to establish varying sources of genetic material to restore populations with different genetic complements than the state's captive MO12 broodstock held at Washoe Park Hatchery in Anaconda, MT. Westslope cutthroat trout at Sekokini Springs will be reared in naturalized habitat to avoid domestication. A variety of rearing techniques will be used including: native substrate, floating cover, submerged structures, and natural feed supplementation in rearing ponds utilized to rear F1 juveniles that are as similar to their wild counterparts as possible. The Sekokini Springs facility would be innovative by incorporating natural rearing environments, to the extent possible, and enhancing WCT populations through rearing of multiple unique genetic populations over time.

1.9) List of program "Performance Standards".

(1) By 2007, conserve the genetic and life history diversity of at least one westslope cutthroat trout population in the Flathead Subbasin by replicating the donor stock held in natural habitat at Sekokini Springs;

(2) Restore and initiate viable, naturally spawning populations using reintroduction strategies by

2013;

(3) Reintroduce pure populations where hybridized/introgressed populations have been removed;

(4) Provide harvest in closed-basin lakes to offset lost angling opportunity due to harvest restrictions or fishing bans designed to minimize adverse effects to wild populations;

(5) By 2007, create an interpretive area for public education on the benefits of native species and their recovery.

1.10) List of program "Performance Indicators", designated by "benefits" and "risks."

1.10.1) "Performance Indicators" addressing benefits.

(1) By 2007, conserve the genetic and life history diversity of at least one westslope cutthroat trout population in the Flathead Subbasin by replicating the donor stock held in natural habitat at Sekokini Springs.

Pre- and post-treatment inventories of the genetic makeup of the targeted fish populations will be used to measure trends in genetic purity. A genetically pure population is one in which 100 percent of tested individuals, through genetic analysis, show no evidence of hybridization or introgression with other species or subspecies. Depending on the goals for each site, genetic sampling may involve protein electrophoresis, paired interspersed nuclear DNA element – PCR (or PINE marker) method or various mitochondrial DNA marker techniques, to differentiate westslope cutthroat trout from rainbow, Yellowstone cutthroat or introgressed forms. The Montana Wild Trout and Salmon Laboratory at the University of Montana, Missoula or suitable laboratory will analyze samples.

The diversity of life history strategies is related to total available habitat. For instance, assuring access to historic habitat by fluvial or adfluvial spawners, or by protecting resident forms by isolating headwater populations above barriers. The Hungry Horse mitigation program is assessing recruitment from and genetic integrity of fluvial and adfluvial trout in selected index streams (primary spawning streams and habitat enhancement sites. Experiments use PIT tags and remote detectors, migrant trapping, radio telemetry and microelemental signatures in fish scales to assess spawning success and determine the natal stream of origin of individual fish.

(2) Restore and initiate viable, naturally spawning populations using reintroduction strategies by 2013.

Successful restoration of wild spawning runs of genetically pure westslope cutthroat trout in tributaries to the Flathead River can be assessed by migrant trapping, redd surveys, population estimation and genetic inventory, before and after habitat restoration or reconnection. In earlier mitigation projects, runs of native fish had been extirpated prior to habitat restoration or fish passage improvements. Assessment of experimental imprint plants of marked eyed eggs or fry has shown that fish survive and rear in test streams through emigration (smolt stage). After such treatments, redd surveys revealed that a spawning run had been reestablished. Our goal is to assess whether imprint plants of eggs and/or fry return to spawn as adults. Unfortunately, the origin of the spawning adults could not be determined using marking technology available at the time (e.g. tags or tetracycline marking did not always persist through adult returns or was only detectable through lethal methods and thus counter-productive). We are now assessing tools to determine spawner origin and to assess the effectiveness of various techniques for establishing runs. Non-lethal sampling techniques such as microprobe spectrometry of the protein matrix in scales have yielded promising results (Wells et al. 2003; Muhlfeld et al. – In review). Experiments using batch marking to cold-mark otoliths in trout fry are ongoing, but require lethal sampling (otolith removal) to assess the presence of a mark.

(3) Reintroduce pure populations where hybridized/introgressed populations have been removed.

The westslope cutthroat population in the Flathead subbasin will benefit by increasing the number of wild, genetically pure spawning populations and by reducing the threat to pure populations from nonnative species and hybridized/introgressed populations. The success of chemical rehabilitation is assessed through pre- and post-treatment inventory using gill nets, electrofishing and/or U/W visual inspection. Late fall treatment of closed-basin lakes has produced total eradication of the target fish species in several case studies. Pure populations are reintroduced and monitored as described in 4 below.

(4) Provide harvest in closed-basin lakes to offset lost angling opportunity due to harvest restrictions or fishing bans designed to minimize adverse effects to wild populations.

Providing alternative opportunities for angler harvest benefits remaining wild populations of westslope cutthroat trout. Natural westslope cutthroat trout populations in most Montana rivers are protected by mandatory catch and release regulations.
Offsite lakes receiving yearlings and spawners from the facility will provide opportunities for harvest, partially offsetting restrictive regulations elsewhere in the Flathead River system. The offsite lakes program is monitored through periodic gill net surveys, angler interviews and the annual statewide angler creel census. Stocking rates are established to a large degree by trial and error, and then refined to optimize post-stocking survival and growth. Gill netting provides data on species relative abundance, growth rates and fish condition factor. Angler surveys are qualitative indicators of catch rates, angler satisfaction and rough estimates of harvest. Although rigorous quantitative analyses of CPUE, survival and total harvest are possible, the number of lakes involved makes this level of monitoring economically impractical, unless certain lakes are used as indices.

(5) By 2008, create an interpretive area for public education on the benefits of native species and their recovery.

This aspect could be measured in terms of visitor days, school groups instructed or patron satisfaction indices. Our goal is to inform the public about the need to protect aboriginal stocks or reestablish native trout where they have been extirpated. The site will also present the relation between habitat restoration and artificial culture techniques.

1.10.2) "Performance Indicators" addressing risks.

Onsite and offsite mitigation projects will use the Sekokini Springs facility as a source of genetically compatible westslope cutthroat trout to expand the existing range of the species where native populations have been extirpated or to conserve threatened populations. Our goal is to protect aboriginal stocks or, where natives were extirpated, replicate nearest neighbor stocks, or to replace nonnative, hybridized or introgressed populations. Since genetic inventories have documented problem areas, our strategy is to reduce or eliminate existing risks to the integrity of pure native stocks.

Removing gametes or fish from a donor population presents a risk to that population. Given this, we propose to capture wild juveniles or partially spawn adults to collect gametes for rearing at Sekokini Springs. Removal of juveniles is less likely to disrupt natural reproduction in the donor population. Capture of juveniles can be accomplished before or after spawning adults are present in the stream, thus eliminating risk to the spawning population. Incremental removal of a subset of the rearing population over time during each of three to five years will provide a random selection from the available genetic material, while protecting the remaining wild juveniles. Numbers to be removed will be limited to take no more than 25 percent of the estimated juvenile population in a given year.

Donor streams will be monitored to determine whether removing 25 percent of juveniles impacts the population. Initially, donor streams will be sampled annually to assess trends in juvenile densities and annual variation. Mark-recapture population estimates will be performed using standard electrofishing techniques prior to or during juvenile collections. Ad fluvial populations will be sampled before or after the spring spawning run to avoid migratory fish. Fish density (fish / 150 m stream length) will be used to estimate the length of stream required to provide the appropriate number of juveniles for collection. The sampling reach will be recorded using GPS coordinates. Some proposed donor streams are designated index streams that are monitored annually as part of a juvenile population assessment conducted by MFWP. Past data from the index streams provide a measure of natural annual variation. One year following juvenile collection, the population in the sampling reach will be surveyed for comparison. The timing of samples will be consistent seasonally. When fish populations decline beyond the known annual variation in reference streams, juvenile collections will be terminated until survey results indicate that the population has rebounded to previous levels. Annual sampling of donor populations will be used to assess rates of population recovery after juvenile collections cease. Sampling in a given stream will end after the population rebounds to previous levels.

Our fish health specialist will allow transport of juveniles (as opposed to gametes or eyed eggs) to an isolation facility at Sekokini Springs from sources having a long history of reportable pathogen negative status. Subsequent fish health testing will be accomplished in the isolation facility before juvenile fish are released into the rearing habitat. Individuals to be reared at the facility will be individually marked and non-lethally inventoried for genetic purity. Only genetically pure populations will be used to produce family crosses of F1 progeny. This strategy was designed to reduce the risk to the donor population, disease transmission to the rearing habitat and protection/conservation of genetically pure stocks for restoration actions.

Alternatively, wild gametes may be collected from adult spawners throughout the spawning run. Allowing for escapement of a percentage of the wild population and techniques that partially spawn adults before releasing them to continue to spawn naturally can reduce risk to the spawning population. If only a few adults can be safely removed from the donor population, collections can be made over a series of years to assure that the resulting progeny represent the genetic diversity in the original population. In captivity, wild juveniles can be reared to maturity and spawned to produce F1 progeny. Differing age at maturity will allow cross-fertilization between year classes. Donor populations will be monitored to assure that gamete or juvenile collections do not impact the wild populations.

1.11) Expected size of program.

1.11.1) Proposed annual broodstock need (maximum number of fish).

Sekokini Springs will not be a traditional broodstock facility. Instead, gametes from wild spawners or juveniles will be held until maturity to provide a source of F1 gametes or fry for use in imprint planting experiments. Once a spawning run is established in the restored or reopened habitat, the captive population will be released into a closed-basin lake to provide a recreational fishery and to make space available for another experimental stock. The number of fish to be reared at Sekokini Springs will vary depending on annual needs for specific genetic stocks and the genetic makeup of each stock. The facility master plan proposes out-door rearing of up to four isolated genetic stocks. Rearing in nearly natural habitat is intended to maintain wild behavioral traits.

We anticipate that up to 1,000 individual juveniles will be removed from a given donor population each year (based on a percentage of the population estimated through electrofishing estimates, not to exceed 25 percent of the donor population). Sixty individuals from each lot will be sacrificed from each lot for disease testing before the fish are moved from the isolation facility (a separate water source) to the natural outdoor rearing habitat. Fish will be reared to maturity to produce approximately 300 spawning adults within each of the four rearing ponds. Progeny from crosses will be held separately through the fry stage and released to targeted recovery streams at a density not to exceed the density of wild trout in a comparable stream-by-stream order, gradient and flow range.

1.11.2) Proposed annual production and fish release levels (maximum number) by life stage and location.

Production Stage Criteria	Parameter	Number
Number of juveniles to collect per population	up to 1,000	
Juvenile survival to spawn	67%	
Fish health sampling	60	
Number of juveniles surviving to spawn	630	
Ratio of males to females	1:1	
Number of females	315	
% spawn at age 3	37%	115
% spawn at age 4	59%	185
% spawn at age 5	63%	200
Fecundity per female		
age 3	500	57,500
age 4	1,000	185,000
age 5	1,200	240,000
Number of green eggs produced	482,500	
Green to eyed egg survival	65%	
Total eyed egg production per population	313,625	
Eyed egg distribution by Stocking Program		
RSI's	25%	78,406
Artificial Redds	20%	62,725
Smolt Release	55%	172,494
Number of eyed eggs surviving to fry		
RSI's	60%	47,044
Artificial Redds	10%	6,273
Smolt or Imprint fingerling release program	75%	129,371
Number of fry surviving to 4 inch smolt for release	85%	109,965
Assumptions: Production for each population will occur over 3 years assuming fish will mature between age 3 and 5. Fecundity based on MO12 for age 3 and 4 (Sweeney 2003 pers. comm.), age 5 estimated. Ratio males to females based on MO12 (Sweeney 2003 pers. comm..). Age at maturity estimated based on combination of MO12 observations and wild population information (Gresswell 1988). Survival to spawn based on MO12 (Sweeney 2003 pers. comm.). Egg, fry and smolt survival based on MO12 (Sweeney 2003 pers. comm.).		

1.12) Current program performance, including estimated survival rates, adult production levels, and escapement levels. Indicate the source of these data.

Experimental hatching and rearing began in 1997 and was completed by 2001. Approximately

90,000 eyed-eggs (M012 westslope cutthroat stock) were transferred from Washoe Park State Fish Hatchery in Anaconda, Montana, hatched and reared at Sekokini Springs. Fish were reared with automatic feeders and minimal attention, remotely from Creston Hatchery. The growth and condition of juveniles at the Sekokini facility was encouraging (the fish were robust and had all their fins). Fish outplanted to Rogers Lake appeared similar to wild trout, with rapid growth and vibrant color. Survival was high enough that stocking rates were cut by 25 percent the following year. No data are available from other closed-basin lakes.

1.13) Date program started (years in operation), or is expected to start.

Experimental culture began in 1997. Fish were removed from the site in 1999 and the facility was not operated again until 2001. In 2000, three water sources were isolated for disease prevention by capping the spring sources and removing the original "head pond" at the site. Water was collected for on-demand, gravity feed to a valve box in the small hatchery building. Water temperatures in the various springs can be mixed to achieve a target temperature in the facility. In 2001, MFWP installed 14 rearing troughs and plumbing in the hatchery building. The facility was tested in January 2002 when MFWP began rearing approximately 90,000 eyed M012 westslope cutthroat eggs in the facility. The fish were reared using automatic feeders checked weekly. After this initial test, roughly 21,000 4-inch smolts were stocked in a local lake and the facility is remains vacant pending the 3-step APR review. In the future, we plan to begin experiments with wild fish from nearest neighbor donor populations.

1.14) Expected duration of program.

The program combines experimental artificial propagation for restoring westslope cutthroat and an interpretive center. Artificial propagation will address the needs of specific recovery actions and experiments directed toward cutthroat restoration. When a particular restored stock is secure and self-sustaining in the wild, the stock will be removed from the facility to make room for other needs. It is uncertain how many years it will take to restore wild, self sustaining populations in a given recovery area, however, we anticipate about 10 years per stock. Surplus fish will be released in closed-basin lakes to provide angling opportunity. Captive stocks (of approximately 200 fish per restored stream reach) will be retained for public education and viewing as part of the proposed interpretive trail exhibits.

1.15) Watersheds targeted by program.

Flathead River Drainage (HUC 17010208) including the main stem Flathead River downstream of the North and Middle Forks, Recovery actions will be carried out in the portion of the Flathead Watershed upstream of Flathead Lake, headwater lakes and closed-basin lakes within the watershed.

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

Two alternative sites were considered for meeting the program needs:

- Use of the Washoe Park Trout Hatchery - State's MO12 captive broodstock
- Develop the Sekokini Springs site (Proposed Alternative)

Use of the Washoe Park Trout Hatchery - State's MO12 Captive Broodstock

With recent improvements, including a new hatchery building and a new public education center consisting of an aquarium with a "living stream," the Washoe Hatchery is one of the leading aquaculture educational facilities in the state. Additionally, the hatchery has variable water temps in its spring water supply and is the only facility in the state that has 2 wells with different water temperatures. One spring is 56° F (13.3°C) and the other is 45° F (7.2° C), with the capability of mixing the two water sources to get a wide range of temperatures. With the exception of a natural-rearing environment, the Washoe Park Trout Hatchery meets the screening criteria for the proposed program. Although natural rearing techniques are not currently utilized at the existing facility, it is likely that facilities could be modified, if necessary, to meet screening objectives.

The genetic composition of captive WCT broodstock (MO12) reared at the Washoe Park Trout Hatchery was established with the first spawn of captive WCT in 1983/84 (MFWP 2003). The parental stock included 4,600 genetically pure WCT collected from 12 streams in the South Fork Flathead and 2 tributary streams to the Clark Fork River. On-going genetic testing of the MO12 stock confirms that it is genetically variable and has no introgression. While genetic diversity is ideal, the MO12 stock was not been infused with wild gametes until 2003 and the existing strain is primarily a captive broodstock derivative.

Leary et al (1998) suggest that MO12 broodstock could be used to supplement populations throughout the state if wild gametes are introduced into the broodstock. Because live fish cannot be transported into Montana state hatcheries, gametes or milt are the preferred options for infusion of new genetic material (M. Sweeney, MFWP, personal communication, March 4, 2003). In 2003, MFWP collected milt from wild males in Quintonkon and Deep Creeks (South Fork Flathead River) for infusion into the Montana captive broodstock (MO12) held at Washoe Park Trout Hatchery. Wild males were temporarily held in isolation (separate water source) at Sekokini Springs. Although these source populations have a history of pathogen-free status through disease testing, all male fish were sacrificed for additional disease testing after milt has been collected. This milt collection strategy will occur in various years throughout the life of the Sekokini Springs project, when co-managers determine there is a need for additional infusion of wild genes into the state's existing broodstock.

Although it is true that geneticists have designated the MO12 broodstock as suitable for use in WCT restoration throughout Montana, especially in waters previously planted with MO12s, geneticists also recognize the value of replicating genetically distinct WCT populations to preserve diversity across the historic range. As identified in the Conservation Agreement (MFWP 1999a) each tributary that supports WCT regardless of length constitutes a population, and all genetically pure populations are to be protected. Exclusive use of the MO12 stock will not achieve this objective.

Use Sekokini Springs site

Facilities at Sekokini Springs can be modified for use as an experimental isolation WCT rearing facility to establish varying sources of genetic material to restore populations with different genetic complements than the MO12 stock. Modification of the existing facilities would make it possible to meet the goals of this project, including assisting with the conservation of WCT. The production goal for the Sekokini Springs Natural Rearing Facility is to provide genetically pure WCT following the nearest neighbor concept for re-establishing genetically pure WCT populations in newly opened habitat. These stocks would be reared to avoid domestication using a variety of rearing techniques including: native substrate, floating cover, submerged structures, and natural feed supplementation in rearing ponds utilized to rear donor fish and F1 juveniles that are as similar to their wild counterparts as possible. The Sekokini Springs facility would be innovative by incorporating natural rearing environments, to the extent possible, and enhancing WCT populations through rearing of multiple unique genetic populations over time.

Alternatives for collecting fish or gametes from donor populations included:

- collecting milt from wild males for infusion into the state's M012 brood stock;
- collection of eggs and milt from wild spawners and
- collection of juveniles from wild populations.

Each alternative has pros and cons. The first two alternatives are beneficial because gametes can be treated for disease before being brought to Sekokini Springs. The isolation facility will allow additional testing before fish are released to outdoor habitat at the site. The first alternative is the least time intensive strategy of the two, however the M012 stock contains donor populations from outside the Flathead subbasin (Clark Fork River drainage) and therefore does not constitute a Flathead stock, so has been ruled out. The second alternative is time intensive and because males and females ripen at different times, fish or gametes must be held to assure that family crosses are representative of the donor population. Multiple-year crosses will be required to assure that progeny represent the genetic diversity of the donor population. Also, these alternatives require capturing and handling spawners during the run over several years (3 to 5 years), causing additional stress on the donor population. At this time, we are favoring the last alternative, although greater care must be taken in the isolation facility to guard against disease transmission to the rearing habitat. We believe that the risk of disease contamination can be reduced to acceptable levels by holding progeny in the isolation facility (separate water source) until additional disease screening (60 fish sacrificed from each lot) reveals that fish can be safely released to the rearing facility.

SECTION 2. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

2.1) Describe alignment of the hatchery program with other hatchery plans and policies (e.g. the NPCC *Annual Production Review* Report and Recommendations - NPCC document 99-15). Explain any proposed deviations from the plan or policies.

Our strategy is consistent with the NPCC plan, although because we intend to use captive wild fish to produce F1 progeny under wild rearing conditions, we plan to preserve up to four isolated nearest-neighbor stocks to preserve wild behavioral traits as well as genetic integrity.

Currently, the MFWP, in association with various tribal, state and federal agencies, maintains WCT broodstock and rearing facilities throughout the state. The present broodstock was founded in 1983 from fish collected from the South Fork Flathead River tributaries above Hungry Horse Dam. These stocks were found to be genetically pure and are raised in several hatcheries throughout the state. These facilities include the Flathead Lake Salmon Hatchery, Murray Springs Trout Hatchery, Jocko River Trout Hatchery and the Washoe Park Trout Hatchery. Stocking efforts aim to reintroduce WCT stocks to degraded river systems that have been rehabilitated or that were previously blocked to fish passage by man made barriers.

The isolation facility at Sekokini Springs was used by MFWP in 2003 and 2004 to collect milt from wild male WCT to infuse wild genes into the M012 brood stock. The site provided a stable water supply of the correct water temperature to hold wild fish for milt extraction. All donors were sacrificed for disease sampling, and were determined to be free of all reportable fish pathogens.

2.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates. *Indicate whether this HGMP is consistent with these plans and commitments, and explain any discrepancies.*

Experimental culture of native westslope cutthroat is the next step in the decision path outlined in the Hungry Horse Mitigation Implementation plan approved by NWPPC in 1993. The Sekokini Springs Master Plan and Flathead Subbasin Plan provide additional details for our proposed actions at Sekokini Springs. The Flathead Subbasin Plan received high scores from the ISRP and NPCC for adoption into the Fish and Wildlife Program. Actions for the restoration of westslope cutthroat trout under the Hungry Horse Mitigation Program are consistent with the Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat trout in Montana (May 1999) recently signed by MFWP, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI Forest Service, and the Flathead Lake Co-management Plan developed by MFWP and CSKT.

2.3) Relationship to harvest objectives.

The state of Montana has implemented a mandatory catch and release regulation for westslope cutthroat in the contiguous Flathead River system. Wild runs established in Flathead River tributaries will be protected by the mandatory "catch and release" regulation. Surplus cutthroat from the facility will be planted in closed-basin lakes to provide angler harvest as part of Montana's Family Fishing program.

Approximately 50,000 RBT and 60,000 cutthroat trout are reared at CNFH annually to provide subsistence and recreational fisheries for tribal and non-tribal anglers in closed-basin lakes on the Flathead Indian Reservation. Approximately 20,000 WCT were propagated at CNFH in 1999 and 35,000 in 2000 for release in closed-basin lakes in State-managed waters. Nearly all of the offsite lakes planted under this program do not support natural reproduction. Where natural reproduction is possible, the primary objective is to create genetic reserves for isolated populations of native stocks. In these cases, habitat restoration is performed to enhance fish passage and natural reproduction in the closed system. CNFH hatchery production does not currently supply fish to waters scheduled for native species restoration. The closed-basin lakes that are planted through this program provide alternative fisheries to meet public demands for harvest and partially offset fishing bans or reduced limits enacted for native species recovery. This program may indirectly benefit native species recovery by redirecting harvest away from sensitive recovery areas in the contiguous Flathead watershed.

2.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

This program has experimentally reared M012 westslope cutthroat trout from Montana's captive brood stock for only three years during the last twelve years. Fish were released into a closed-basin lake, Rogers Lake to provide angling opportunities. Based on observation and intermittent surveys of angler satisfaction, closed-basin lakes have provided high rates of hatchery to creel survival. Although harvest estimates are not available, Rogers Lake has become one of the most popular small lakes in Region 1 of MFWP. Offsite lakes receiving yearlings and spawners from the Sekokini Springs facility will provide opportunities for harvest, partially offsetting restrictive regulations elsewhere in the Flathead River system.

The westslope cutthroat population in the Flathead subbasin will benefit by increasing the number of wild, genetically pure spawning populations and by reducing the threat to pure populations from nonnative species and hybridized/introgressed populations. High mountain lakes proposed for chemical rehabilitation will become genetic reserves for the species.

Public awareness of the importance of native fish species conservation and hydropower mitigation will benefit recovery actions through increased public support for the program.

2.4) Relationship to habitat protection and purposes of artificial production.

Habitat reconstruction at the Sekokini Springs site will benefit natural rearing of captive wild stocks. The upper stream reaches at the site and rearing ponds will be isolated from the remaining habitat by a "fishless" zone maintained by passage barriers. In the future, habitat below the barrier could be reconnected to the Flathead River to provide for natural reproduction by wild spawners without risking upstream disease transmission. At this time, if wild spawners from the Flathead River were allowed to access the site, there is a risk that hybridized adults could colonize and spawn in the restored habitat. We will therefore isolate the facility by installing fish barrier to stop migrations to and from the site.

The Hungry Horse Mitigation and Implementation Plans list individual streams to be targeted for habitat enhancement and fish passage improvements. Identified donor populations are listed in the Master Plan. Although our primary objective of the habitat component of the Mitigation program is to encourage natural recolonization and recruitment, suitable stocks are not always available to reoccupy restored habitats. Where appropriate, we will use Sekokini Springs to provide pure westslope cutthroat for restoration activities elsewhere in the watershed. Experimental imprint planting of eyed eggs or fry will be used to initiate spawning runs in restored or reconnected habitats. Experimentation will be used to assess the effectiveness and cost of various techniques for restoring wild spawning runs (e.g. RSIs, imprint fry plants and release timing). Documentation of the results of these experiments will expand our knowledge of cutthroat restoration techniques.

2.5) Ecological interactions.

Describe all species that could (1) negatively impact program; (2) be negatively impacted by program; (3) positively impact program; and (4) be positively impacted by program.

1) Species like mink, otters, kingfishers, herons, grizzly bears and other picivorous birds and mammals will likely prey on captive wild stocks at the site. It is unknown at this time whether predation will negatively impact the program. The rearing ponds will contain overhead cover and habitat diversity designed to provide fish security from avian predators. Additional measures such as ground-mounted electric fences may be required to prevent predation by river otters. Hybridization with rainbow trout could occur if rainbow trout or hybridized adults are allowed to invade the site. A weir trap will be installed in the outlet to the Flathead River to allow capture and analysis of attempting to enter the site.

2) The program could negatively impact donor populations and care must be taken to avoid this possibility. We favor removing up to 25 percent of juveniles from donor populations

and subsequent population monitoring to avoid detaining and handling adult spawners. Progeny will not be planted in streams containing donor populations.

3) Restoration of habitat at the site should positively impact aquatic wildlife and plants. Wetlands at the site will be enhanced and protected by elevated walkways as part of the interpretive trail system.

4) Terrestrial wildlife could be positively impacted by habitat restoration and weed control at the site.

SECTION 3. WATER SOURCE

3.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

The water source is comprised of four springs of varying water temperatures (Figure 3.1). Three springs originate up hill from the hatching building and the forth enters the stream/pond system on a bench above the Flathead River. Geologic studies conducted in support of the proposed project indicate that the general trend of both surface and groundwater flows appears to be from the kettle lakes located northeast of the site at elevations 3,265 to 3,256 feet (ft), towards the Flathead River located along the southwest side of the subject property at 3,100 ft in elevation. The on-site springs surface at an approximate elevation of 3,200 ft.

The springs fluctuate in flow and temperature similar to a wild stream. The total output of the upper three springs is approximately 4 cfs during spring runoff and declines toward a minimum flow of .8 cfs during winter. The lower spring flows roughly .6 cfs and has not been fully captured. A spring cap would undoubtedly increase water available from the source. No pumping will be necessary to operate the gravity-fed system.

Water quality in the four springs is ideal for fish rearing. Prior to capping the springs, nitrogen saturation was seasonally as high as 104% and the temperature in the warmest spring reaches 66 degrees Fahrenheit during mid summer. No elevated nitrogen has been detected since the springs were capped. If elevated nitrogen saturation is detected, packed columns or degassing towers may be necessary to decrease nitrogen saturation to an ideal level.

We recently capped a cold water spring (originally used for a domestic water supply at the site) for gravity feed to the hatching building. Three springs were capped and plumbed to the small hatchery building to allow mixing of water at varying temperatures to achieve temperature control. Return flows from the isolation room will flow separately from other waters at the site and percolate into the ground. Return flows from the indoor rearing area will be routed through a vegetated stream channel before rejoining the stream in the natural rearing habitat. Existing ponds and stream segments will be reconstructed to provide rearing habitat and fish viewing opportunities (viewing windows) along the interpretive trail.

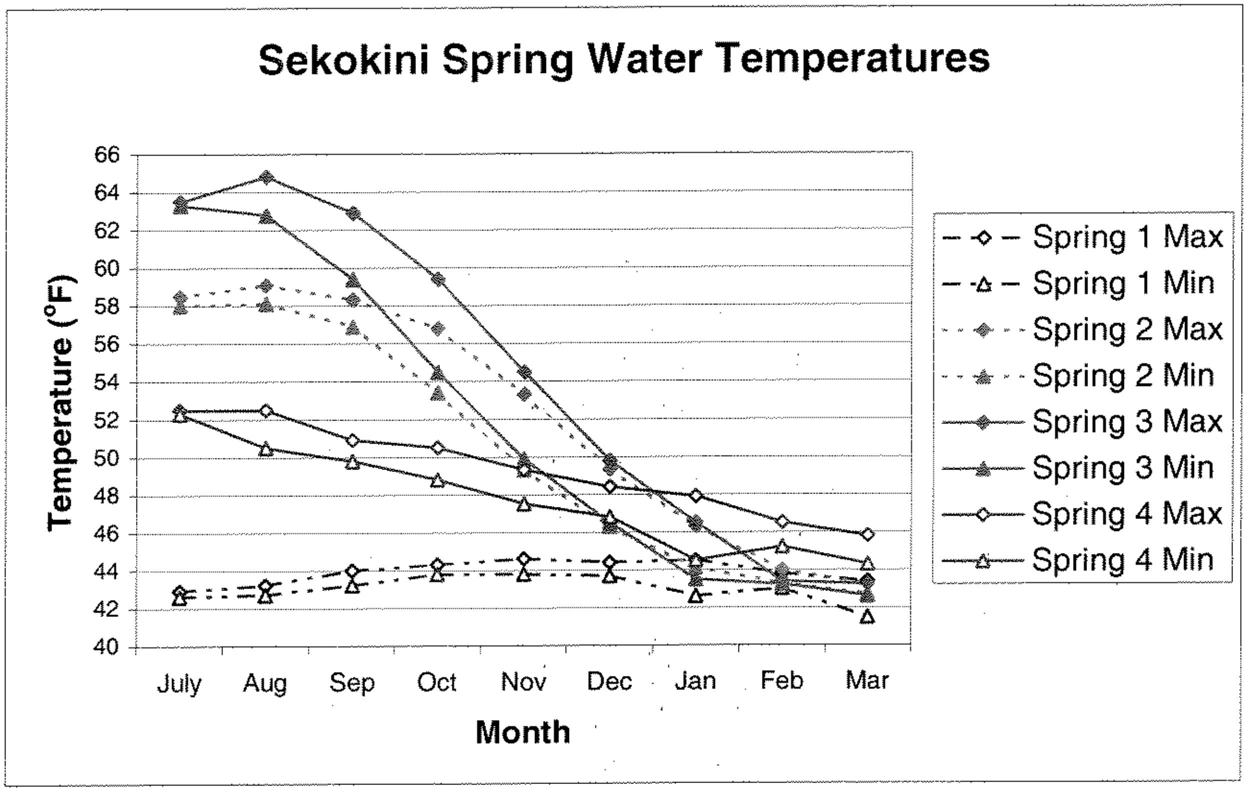

Figure 3.1. Sekokini Springs Maximum and Minimum Mean Daily Water Temperature Data by Month – July 23, 1997 and March 31, 1998.

3.2) Indicate any appropriate risk aversion measures that will be applied to minimize the likelihood for the take of listed species as a result of hatchery water withdrawal, screening, or effluent discharge.

There are no listed fish species in the water source. Effluent from the building will pass through naturalized streams and wetlands (see Master Plan) for biological water quality treatment before entering the Flathead River. A two-way fish barrier near the mouth on the Flathead River will prevent fish from entering or exiting the site.

SECTION 4. FACILITIES

For each item, provide descriptions of the hatchery facilities that are to be included in this plan, including dimensions of trapping, holding incubation, and rearing facilities. Indicate the fish life stage held or reared in each. Also describe any instance where operation of the hatchery facilities, or new construction, results in adverse effects to habitat for listed species.

4.1) Broodstock collection, holding, and spawning facilities .

The Sekokini Springs site will not be operated as a traditional brood stock facility. Wild gametes or juveniles will be collected from wild donor populations through migrant trapping, electrofishing or seining. Fish will be held to maturity to obtain F1 progeny.

Fish products brought to the site will first be held in an isolation room attached to the small hatchery building until the stock has been certified by the State Fish Health Specialist and the genetic complement can be ascertained by the Genetics Lab. This room has a separate water source and return flows will enter a subsurface drain, separated from the surface flow at the site. All hatchery equipment in the isolation room will be kept separate from equipment used in the main building.

Fertilized eggs collected from wild donor populations will be hatched in incubation trays and reared in fiberglass troughs in the hatchery building until they can be released to stream and pond habitat outdoors. Juveniles will be reared to maturity in the natural rearing habitat at the site. Up to four genetic strains will be isolated in four earthen ponds. The ponds will be plumbed to allow independent manipulation of the water surface elevation so that water levels can be withdrawn from shoreline cover. Pond morphometry will be designed to allow crowding of adults into a collection gallery in the pond bottom for ease of capture via seine net.

Adults will be spawned in family groups portable shelter adjacent to the ponds. The spawning platform will be equipped with a live car, table and separate containers for each lot.

4.2) Fish transportation equipment (description of pen, tank truck, or container used).

Fish will be transported in an insulated fiberglass transportation tank, either in a one-ton truck or MFWP helicopter.

4.3) Incubation facilities.

Standard incubation trays that allow for egg lot segregation will be utilized. Eggs from up to four females may be held in one tray. These trays would be fed by a combination of water from Springs 1 – 3, depending upon the temperature desired for incubation. Spring 1, the coldest spring with an average temperature around 43° F (6.1°C), will be chilled with ice for otolith marking to aid in the identification of individuals for program Monitoring and Evaluation (M&E) activities. Water from spring 1 will be blended with warmer water from springs 2 and 3 to achieve desired water temperatures. Discharge of incubation water would be piped out of the incubation room, through chlorination/dechlorination facilities, and discharged into living stream.

4.4) Rearing facilities.

Presently, early rearing can occur in 14 rectangular fiberglass tanks in the hatchery building. Fingerlings will be transferred to reconstructed earthen ponds and associated stream habitat.

4.5) Acclimation/release facilities.

The reconstructed habitat at the site is intended to acclimate fish to wild conditions. Progeny will be released using experimental techniques (e.g. eyed-eggs will be reared in RSIs or artificial redds and fingerling will be "imprint" planted). Progeny will be released in small numbers into habitat suitable for the specific lifecycle phase. MFWP no longer tempers fish by circulating surface waters through release enclosures to prevent the possible transmission of pathogens from the wild. Instead, release timing is varied to assure water temperature in the release facility is within a few degrees of the recipient waters.

4.6) Describe operational difficulties or disasters that led to significant fish mortality.

Significant fish mortality did not occur during experimental rearing tests. The water source is a gravity fed system, so it is not likely that the water flow will be interrupted. Summer water temperatures may be rise above optimal as the third cold spring source dries up. We anticipate that under normal operation, fish will be transported to the outdoor rearing areas before the spring sources warm above optimal rearing temperatures. Water temperatures in the pond/stream habitat on the lower bench can be controlled using cold water from the fourth cold-water spring. We anticipate a low probability of water temperature related mortality.

The possible introduction of fish diseases would be a disaster. The natural habitat at the site would be nearly impossible to purify if it were to be contaminated. That is why the isolation facility in the hatchery building will have a separate water source and fish brought to the site will first be disease-tested in the wild, then checked again in the isolation facility before any fish can be moved to the outdoor rearing habitat.

4.7) Indicate available back-up systems, and risk aversion that minimize the likelihood for the take of listed species that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

(e.g. "The hatchery will be staffed full-time, and equipped with a low-water alarm system to help prevent catastrophic fish loss resulting from water system failure.").

Once fully operational, the site will be managed full time by a fish culture manager and a site curator.

The site has artesian springs that flow via gravity throughout the watercourse. No pumping will be necessary. A low water alarm will be installed to alert personnel to water flow problems in the hatchery building. All spring water that is not directed to the building will flow by gravity through the living streams and pond system to the Flathead River.

Fish reared at the site will originate only from donor populations within in the same subbasin and will be isolated for disease testing before being released into the outdoor rearing habitat at the site. Three spring sources have been capped to prevent the potential for disease transmission from the water source. The site was previously tested for fish diseases by the State Fish Health Specialist and found to be reportable pathogen negative.

4.8) Indicate needed back-up systems and risk aversion measures that minimize the likelihood for the take of listed species that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

No listed aquatic species inhabit the springs or the grounds. Needed systems include but are not limited to: low and high water alarm systems, on site housing for full-time staffing and security, water control for the isolation facility, and wetland reconstruction for treatment of effluent (low fish densities may make this superfluous given the nature of the stream/pond complex).

SECTION 5. BROODSTOCK ORIGIN AND IDENTITY

5.1) Source.

Sekokini Springs is not a traditional broodstock facility. All fish brought to the site will be form wild donor populations that are designated genetically pure and free of all reportable fish pathogens. However, initial experimental rearing used Montana's M012 brood stock, which originates from the Washoe Park State Trout Hatchery in Anaconda, MT. The M012 brood stock was originally founded from pure westslope cutthroat trout primarily from the South Fork Flathead River, although some parental stocks were collected in the Clark Fork drainage. Future plans are to use only wild stocks from the Flathead Watershed.

5.2) Supporting information.

5.2.1) History.

The history of the existing broodstock held at Washoe Park State Trout Hatchery is explained in a manuscript entitled *Collection of Wild Fish for Hatchery Brood Pure Strain Cutthroat Trout* – January 1985 - written by Joe Huston of Montana Fish, Wildlife and Parks (retired). An excerpt from that manuscript follows (verbatim).

> "In the spring of 1983, fish were collected from Sullivan Creek (which includes Battery, Ball, Branch, Connor, and Quintonkon Creeks) and Felix Creek. Samples were found to be pure westslope cutthroat. In addition, fish from Emery and Hungry Horse were collected for disease testing; testing was negative.
>
> Fish collected in the summer of 1983 were from Emery Creek, Hungry Horse Creek drainage (Hungry Horse, Margaret, Tiger and Lost Mare Creeks), Felix Creek, and Sullivan Creek drainage (Battery, Quintonkon, Ball, Branch, Connor and Sullivan Creeks). The targeted goal of 3,000 fish was decided primarily by Mr. Huston based upon conversations with Emmett

Colley, G. Holton, Darryl Hodges, and Mr. Huston's knowledge of the creeks' fish populations, collection methods and manpower availability. The same number goal was also set for 1984 collections.

Additional electrophoretic testing was done in the summer of 1983 and early 1984 to broaden the streams for collection of cutthroat trout scheduled for the summer of 1984. We wanted to include streams that contained resident populations as well as migratory populations. Streams determined to contain pure strain populations included Tin Creek in the South Fork Flathead River drainage (migratory fish mostly), and Marten Creek and Vermilion River above Vermilion River Falls in the lower Clark Fork River drainage (resident fish only).

Disease testing was done on cutthroat trout from Tin and Marten Creeks and cutthroat and brook trout from Vermilion River. All disease tests were negative.

Methods used to collect cutthroat were the same each year. Fish were collected using a backpack shocker (Coffelt Model BP-2) from all the creeks. Some fish in Hungry Horse and Emery Creek were caught in a downstream trap. Fish caught in downstream traps were classified as all adfluvial smolts. Fish caught by electrofishing in those streams known to be used as rearing areas for adfluvial smolts and also populated by resident cutthroat could not be classified as ad-fluvial or resident with any degree of accuracy. I have divided catch into ad fluvial and resident fish based upon my experience.

In general, fish less than 3 inches total length were not collected and adults from Hungry Horse Reservoir (12 inches or longer) were not kept. All sizes of resident fish were captured and with one exception, all these fish were less than 10 inches total length. The one exception was fish taken from Marten Creek where a few of the adults exceeded 10 inches total length; maximum length in Marten Creek was about 13 inches.

At no time were individual fish examined for deformities. Handling of fish was kept to the minimum needed to get them from the creek into the fish truck. Fish taken from the fish traps were netted and immediately placed in a holding box in Hungry Horse Creek or into a bucket, fish truck, and then the holding tank in Hungry Horse Creek. Fish caught by electrofishing were dip netted, placed into buckets, and when the bucket held 20-40 fish, the fish were transported to the fish truck. Fish were counted from the bucket into the tank truck and a running total kept. Dead fish were removed whenever or wherever they occurred, in the bucket, fish truck, or holding tank.

Captured fish were held in live boxes in various streams until a truckload was captured; then they were moved to Murray Springs Hatchery. Fish captured by trap or electrofishing in Emery and Hungry Horse Creek were held in live boxes in Hungry Horse Creek immediately above the downstream trap site. Some fish were held up to a week. Felix Creek fish were trucked directly to Murray Springs the same day of capture. Fish from the Sullivan Creek drainage and Tin Creek were held 4-5 days in Quintonkon Creek about 100 feet above its junction with Sullivan Creek before being trucked to Murray Springs. One small load of Marten Creek fish (150 fish) were trucked to Murray Springs the day of capture, June 28, while the remainder were mixed in with Vermillion River Fish, held overnight in Vermillion River, and then transported to Murray Springs."

For further descriptions of the streams and collection methods please refer to the Sekokini Springs Master Plan. A summary of location, timing and life history of wild westslope cutthroat collected for broodstock can be found in Table 1. A map showing the location of collection in the South Fork Flathead River drainage can be found in Appendix A. A map showing the location of collection in the Lower Clark Fork River can be found in Appendix B.

Table 1. Location, timing and life history of wild westslope cutthroat trout collected for broodstock in 1983 and 1984.

Year = 1983

Location	Date	Adfluvial	Resident	# to Eureka	# to Anaconda
Emery Cr.	June 29,30 July 5-10,13,14	700	100	800	574
Hungry Horse Cr.	June 22,29,30 July 5-11,13,14	1,030	120	1,150	826
Felix Cr.	August 29	0	200	200	144
Battery Cr.	August 4	0	35	35	25
Sullivan Cr.	August 1-4	510	160	670	481
Quintonkon Cr.	August 5	20	130	150	108
Total for 1983		2,260	745	3,005	2,158

Year = 1984

Location	Date	Adfluvial	Resident	# to Eureka	# to Anaconda
Emery Cr.	July 16,17,21-24	300	100	400	245
Hungry Horse Cr.	July 16,17,21-24	600	50	650	398
Felix Cr.	July 20	0	100	100	61
Tin Cr.	July 19, August 7	220	20	240	147
Battery Cr.	August 7	0	25	25	15
Sullivan Cr.	August 7,9	540	60	600	367
Quintonkon Cr.	August 8	40	325	365	223
Marten Cr.	June 28, July 25-26	0	600	600	367
Vermillion River	July 26,27	0	450	450	275
Total for 1984		1,700	1,730	3,430	2,098
Grand Total		3,960	2,475	6,435	4,256

After five years of spawning and genetic analysis of the broodstock, a meeting was held during which the future direction of the broodstock was discussed. The manuscript that resulted from this meeting is entitled: *Westslope Cutthroat Trout Restoration Program: Past and Present Distribution, Broodstock Program and Conservation Genetics Committee Report* - Robb Leary (Committee Chairman). While there is no date on the manuscript, we believe it was written around 1991. What follows is an excerpt that relates to the broodstock and, specifically, this years project.

> " The present brood stock was founded in 1983 and 1984 from fish collected from South Fork Flathead River tributaries above Hungry Horse Dam and Clark Fork River tributaries in the Noxon area. Prior to collection, electrophoretic analysis indicated that all these streams contained pure westslope cutthroat trout populations. Disease analysis also indicated a lack of detectable pathogens. The objective of founding this brood stock was to establish a genetically diverse hatchery population of westslope cutthroat trout that would be capable of surviving and reproducing in a variety of natural situations.
>
> In order to incorporate genetic diversity into the brood stock, fish were collected from a number of streams. Electrophoretic data indicate that westslope cutthroat trout populations are characterized by having little genetic variation within them but substantial differentiation among them even over short geographic distances (Allendorf and Leary 1988; Leary et al 1988). This genetic divergence is largely due to the presence of many alleles that exist at appreciable frequency in only a small proportion of the populations. It was felt that by collecting fish from many populations a number of variant alleles would be introduced into the brood stock thereby increasing genetic diversity. Analysis of the 1986 through 1989 year classes indicated that this goal was achieved (Leary, unpublished data).
>
> Efforts will be made to maintain genetic variation in the brood stock. Individuals will be spawned at random with each fish having an equal chance of mating with any other fish. The only fish that purposefully will not be spawned are those with obvious morphological deformities. To avoid selecting for early maturity, future brood stock will be retained from crosses between four-year-old males and five year old females. At these ages, 90% of the individuals of each sex have attained maturity. This practice will also result in genetic exchange among year classes preventing the establishment of a number of reproductively isolated brood stocks in the hatchery. Selection for time of spawning during the season will be avoided by randomly choosing one percent of the eyed eggs from each spawning period for future brood stock. The efficacy at which this procedure maintains genetic variation will be monitored by obtaining electrophoretic data from 70 loci and the counts of five bilateral meristic characters from 50 randomly sampled individuals from each year class of future brood stock when they are about one year old.
>
> *Every ten years wild fish from aboriginal populations will have a five to 10% genetic contribution to the brood stock for three successive years. This will be accomplished by the introduction of gametes or fish from immediately confirmed Al or A populations that are certified disease free. It is hoped that this will prevent developing a highly domestic brood stock, which could adversely affect survival of the fish in the wild. Hatchery personnel will monitor the brood stock for obvious signs of domestication. If this appears to be happening,*

wild fish will be collected more frequently or given a greater genetic contribution. [Italics added]

To avoid altering the genetic characteristics of native westslope cutthroat trout; populations by the introduction of hatchery fish, it would be necessary to maintain numerous brood stocks. Space and financial constraints, however, dictate that only one brood stock can be maintained. Thus, it is important to adopt stocking guidelines to minimize the potential effects of hatchery fish on wild fish.

No fish from the brood stock will be introduced into waters containing class Al populations. Maintaining adequate environmental conditions and possibly restrictive regulations should ensure the continued viability of these populations. If augmentation of natural reproduction is considered essential, the gametes or fish for the introductions will be collected from the population itself. These fish or the resulting progeny will temporarily be raised in isolation at one of the hatcheries.

Fish from the brood stock will be used in genetic restoration programs west of the Divide designed to protect class A populations with the following exceptions; those that exist in unusual environments (e.g., warm or saline water) or have unusual behavioral characteristics (e.g., spawning time) unless they are in imminent danger of becoming hybridized in which case genetic restoration of the hybridized population may require the introduction of hatchery fish. This eventually may alter the genetic characteristics of the class A populations, but it is considered more desirable that westslope mate with westslope cutthroat trout than with hybrid or non-native fishes resulting in the further loss of class A populations."

5.2.2) Annual size.

Sekokini Springs will not be a production facility. We plan to rear up to 1,000 fish from each donor population to maturity. The number of progeny to be reared for restoration efforts will depend on site-specific need and is unknown at this time. The intent is to experimentally rear small numbers of fish in nearly natural habitat for use in restoration activities. Based on past experience, we estimate that individual lots will not exceed 150,000 individual eyed-eggs or fingerlings.

5.2.3) Past and proposed level of natural fish in broodstock.

100% of the fish reared at Sekokini Springs will be wild, genetically pure westslope cutthroat trout and F1 progeny.

5.2.4) Genetic or ecological differences.

Genetic research has shown that individual tributary streams exhibit greater genetic differences than can be detected between the primary subbasins within the Flathead Watershed. Our intent is to use genetically pure "nearest neighbor" donor populations in restoration activities where pure westslope cutthroat have been extirpated. Existing literature indicates that there are three life history strategies represented in the wild population: resident, fluvial and adfluvial. However, recent radio telemetry results show that individual fish, at various times during their development, may use more than one of these perceived life history strategies. Research has so far been unable to correlate genetic differences with these life history strategies. Nor can we differentiate non-migratory juvenile resident forms from migratory juvenile fluvial and adfluvial forms. The safest way to assure that migratory forms are utilized for replication at Sekokini Springs is to trap emigrating juveniles during the migration period in June and July, or to collect gametes from migratory adults. Research continues to examine the effectiveness of these collection strategies.

5.2.5) Describe traits or characteristics for which broodstock was chosen.

Although Sekokini Springs will not be utilized as a traditional brood stock facility, progeny from genetically pure wild westslope cutthroat trout from populations with documented disease free status will be reared to maturity at the site.

5.2.6) ESA-Listing status

Proposed, not warranted.

5.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects that may occur as a result of using the broodstock source.

Using indigenous stocks of Westslope Cutthroat will reduce the likelihood for adverse genetic or ecological effects. Donor populations will be incrementally collected over several years to assure that the replicated population represents the genetic heterogeneity of original donor population.

SECTION 6. BROODSTOCK COLLECTION

6.1) Life-history stage to be collected (eggs, juveniles, adults).

Juvenile wild fish or gametes from wild adults will be obtained from donor populations designated genetically pure and free of all reportable fish pathogens.

6.2) Collection or sampling design.

Juveniles will be randomly selected from tributary donor populations through electrofishing or downstream trapping. Removal of juveniles is less likely to disrupt natural reproduction in the donor population. Capture of juveniles can be accomplished before or after spawning adults are present in the stream, thus eliminating risk to the spawning population. Incremental removal of a subset of the rearing population will provide a random selection from the available genetic material, while protecting the remaining wild juveniles. Numbers to be removed will be based on a percentage of the juvenile population. Up to 25 percent of the juveniles will be removed from the donor population.

Donor streams will be monitored to determine whether removing 25 percent of juveniles impacts the population. Mark-recapture population estimates will be performed using standard electrofishing techniques prior to or during juvenile collections. Ad fluvial populations will be sampled before or after the spring spawning run to avoid migratory fish. Fish density (fish / 150 m stream length) will be used to estimate the length of stream required to provide the appropriate number of juveniles for collection. The sampling reach will be recorded using GPS coordinates. One year following juvenile collection, the population in the sampling reach will be surveyed for comparison. The timing of samples will be consistent seasonally. Initially, donor streams will be sampled annually to assess trends in juvenile densities and annual variation. Some proposed donor streams are designated index streams that are monitored annually as part of a juvenile population assessment conducted by MFWP. Past data from the index streams provide a measure of natural annual variation. When fish populations decline beyond the known annual variation in reference streams, juvenile collections will be terminated until survey results indicate that the population has rebounded to previous levels. Annual sampling of donor populations will be used to assess rates of population recovery after juvenile collections cease. Sampling in a given stream will end after the population rebounds to previous levels.

The State Fish Health Specialist will allow transport of juveniles (as opposed to gametes or eyed eggs) to an isolation facility at Sekokini Springs from sources having a long history of disease free status. Subsequent disease testing will be accomplished before juvenile fish are released into the rearing habitat. Individuals to be reared at the facility will be individually marked and non-lethally inventoried for genetic purity. Individuals will be marked and non-lethally sampled for genetic inventory and migrant class information. Only genetically pure populations will be used to produce family crosses of F1 progeny. This strategy was designed to reduce the risk to the donor population, disease transmission to the rearing habitat and protection/conservation of genetically pure stocks for restoration actions.

Alternatively, wild gametes may be collected from adult spawners throughout the spawning run. Allowing for escapement of a percentage of the wild population and techniques that partially spawn adults before releasing them to continue to spawn naturally can reduce risk to the spawning population. If only a few adults can be safely removed from the donor population, collections can be made over a series of years to assure that the resulting progeny represent the genetic diversity in the original population. In captivity, juveniles can be reared to maturity and allow cross-fertilization between year classes. The donor population can be monitored to assure that gamete collection does not impact the wild stock.

6.3) Identity.

Lethal sampling will be kept to a minimum necessary to assure captive wild progeny are free of reportable pathogens and to identify fish captured after release. Non-lethal sampling will be utilized wherever possible.

Lethal sampling/marking techniques:

Fry from RSIs will be otolith-marked using cold water treatments. This is a batch mark that can be coded to individual RSIs (or stream reach) by varying the timing of cold treatments during otolith growth. Otoliths must be removed from recaptured fish to determine their origin.

Imprint plants may be marked with elements or isotopes, tetracycline or coded wire implants. Tetracycline marks can be detected for approximately three years by viewing bones under UV light. Marks may be lost when fingerlings reside in sunlit stream margins or as the fish mature. Coded wire tags may be expelled from the fish over time and lost. The wire must be removed to identify individual codes.

Non-lethal techniques:

Batch marking may use fluorescent pigments, fin clips or coded wire tags. Fluorescent tags may not be detectable in returning adults. Wire tags can be detected non-lethally as batch marks, but this technique is not suitable for individual tags unless they are extracted. Adipose fin clips may be used in combination with other marks.

MFWP has begun experimenting with microprobe ablation spectrometry techniques in combination with stream-specific water chemistry to identify the source of smolts and adults. Such marks can be detected in fish scales that can be obtained without sacrificing individual fish.

6.4) Proposed number to be collected:

6.4.1) Program goal (assuming 1:1 sex ratio for adults):

This will be determined based on the experimental design in each application. All study tributaries will be trapped to determine the source of returning adults.

Up to 1000 juveniles from each donor population will be reared to maturity at Sekokini Springs to produce F1 progeny.

6.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

No brood stock have been collected. Sekokini Springs will not be brood stock facility.

6.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

Describe procedures for remaining within programmed broodstock collection or allowable upstream hatchery fish escapement levels, including culling.

Surplus fish will be released into closed-basin lakes to provide a fishery.

6.6) Fish transportation and holding methods.

Juveniles collected will be transported to the isolation facility at Sekokini Springs in an insulated hatchery tank with oxygen. Since the donor population will be free of reportable pathogens, no anesthetics, salves, and antibiotics will be used.

Individually marked fish will be sampled a second time for disease and genetic status. Approximately sixty individuals, or a number determined by the MFWP fish health specialist to be sufficient, from each lot will be sacrificed for disease testing before the fish are moved from the isolation facility (circular holding tanks in the hatchery building). If disease test is negative, fish will be reared in restored habitat at the site in the outdoor ponds. If however the disease testing results are positive for a reportable fish pathogen, fish will be removed from the isolation facility and all equipment will be sanitized. The source population will be removed from the list of possible donor populations.

6.7) Describe fish health maintenance and sanitation procedures applied.

1. Transfer of live fish from the wild to Sekokini Springs

Prior to transferring any live fish to Sekokini Springs from a wild fish population, fish from the wild population must be health tested. The inspection may consist of testing cutthroat trout from the specific population planned for transfer, or other salmonid fish from the same water. The inspection must be conducted as close to the date of transfer as possible, but no more than 24 months prior to the transfer. Samples shall consist of lethal and non-lethal samples depending upon availability of suitable fish for testing. A fish health-testing plan will be developed and approved by the FWP Fish Health Coordinator, and reviewed and approved by the FWP Fish Health Committee, when appropriate.

2. Transfer of eggs from wild populations to Sekokini Springs

Eggs may be transported to Sekokini Springs only after the parent stock has been health tested and determined to be free of salmonid pathogens. Health testing may consist of a combination of lethal sampling of adults, other salmonids in the water from which eggs are taken and non-lethal sampling, including ovarian and seminal fluid testing for virus. All eggs collected for transfer to Sekokini Springs should be collected using procedures outlined in the FWP wild egg collection policy. Eggs must be disinfected in iodophor prior to being placed in incubators at Sekokini Springs.

3. Stocking fish from Sekokini Springs

Sixty fish from each individual lot of fish at Sekokini Springs must be health tested for salmonid pathogens prior to being stocked from the facility. The FWP Fish Health Coordinator shall be responsible for determining sampling protocol and time of inspection. In addition, a fish health inspection of all fish at the facility must be conducted annually prior to stocking any fish from

Sekokini Springs. This inspection shall include fish from hatchery troughs and outside ponds. Fish selected for sampling shall be agreed upon by the FWP Fish Health Coordinator and the Sekokini Springs facility manager.

4. Care of fish at Sekokini Springs

All individual lots of cutthroat trout fish or eggs must be kept isolated from other fish lots at Sekokini Springs. Each lot must have its own set of hatchery equipment, including nets, brushes and other routine handling equipment. Every effort must be taken to prevent accidental contamination or mixing of fish from one lot to another.

Equipment used at the hatchery must be disinfected with chlorine, iodophor or other approved disinfectant between uses.

Fish health must be monitored by a fish culturist on site. All fish health problems or unusual symptoms or mortality must be reported to the FWP Fish Health Coordinator immediately.

Every effort shall be made to ensure that no pathogens are introduced to Sekokini Springs with fish or eggs from wild fish populations, and every effort shall be made to keep fish healthy at Sekokini Springs. Fish health management shall follow Montana laws, ARM rules and FWP policy.

6.8) Disposition of carcasses.

Fish that are suitable for human consumption will be donated to local food banks. Unusable carcasses will be removed from the site and disposed of by MFWP to prevent attraction of grizzly bears, skunks or otters that may utilize the site. Some fish may be utilized by the raptor rehabilitation center.

6.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed species resulting from the broodstock collection program.

We have chosen to collect juveniles to avoid impacting the spawning population. Up to 25 percent of the juveniles in the donor tributary population will be collected to create the captive stock. This will be repeated for three years to provide for family crosses among the year classes sampled. Rearing juveniles will allow for individual analysis of genetic material, and crosses will be made accordingly to assure that the donor population is replicated, maintaining the maximum heterogeneity.

SECTION 7. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

7.1) Selection method.

Juvenile Donor Stock Collection - Creation of F1 Generation from Local Stock Conservation Strategy

Juveniles will be randomly selected from previously described donor populations through electrofishing or downstream trapping. The timing of collection would be based on access, and likely would occur in July and August when the weather would allow access to collection streams.

Capture of juveniles can be accomplished when spawning adults are absent from the stream, thus eliminating risk to the spawning population. Juveniles would be transported to Sekokini Springs in an insulated hatchery tank with oxygenation. Incremental removal of a subset of the natural population will provide a random selection from the available genetic material, while protecting the remaining wild population. Juveniles will be raised to maturity in outdoor natural rearing habitat.

Onsite selection procedure

Upon maturation, likely at ages 3-5, donor WCT will be ready for spawning. Migratory behavior will be stimulated by the use of a false attraction weir at the kettle for each pond. A false weir will provide a migration path for the mature component of the population. These fish, following their instinct to migrate toward the false attraction flow, ascend the weir and be collected in the trap area. Kettles may also provide another method of collection. The water level in the ponds can be drawn down and fish collected in the kettle for sorting. Mature fish will be moved from the kettle to temporary holding tanks located adjacent to the ponds where they will be held until spawning. A concrete pad will be constructed adjacent to the donor fish ponds for use as a spawning area. A temporary shelter may be placed on the pad during spawning operations.

Milt Collection - Infusion of New Material into MO12 Stock Conservation Strategy

Wild mature male spawning WCT were collected initially from Quintonkon and Deep creeks through electrofishing methods. Individuals collected from Quintonkon were transferred via helicopter, while individuals collected from Deep Creek were transferred via haul truck to be held and spawned at Sekokini Springs. Those individuals were held in isolation (a separate water source at Sekokini Springs during the spawning procedure. Post-spawn, all adults were sacrificed to assure the fish were free of all reportable fish pathogens and genetically pure. The lab results determined that the fish were genetically pure and free of pathogens. Additional donor populations have been identified by MFWP.

For the collection of milt to infuse into the MO12 stock, the program goal is to collect up to 60 mature males from each donor stream. This will be accomplished over several years to avoid removing more than 50 percent of spawning males each year. In the future, if gametes from males and females are collected, the program goal is to obtain gametes from at least 25 females and 25 males, collected over the spawning period. No more than 25 percent of the females would be removed from the donor population in any given year. If gametes are used from wild spawners, adults will be captured randomly during the migration period. Adults will be partially spawned and released to spawn naturally.

7.2) Fertilization.

Mature adults will be held over winter in natural temperature water in outdoor ponds During the he second week in April the mature females of all age classes will experience an increase in water temperature to about 51 degrees. It is anticipated that the first egg take of the year will be April 29th and 30th. On April 29th we will use false attraction flows to attract ripe adults in the morning and collect the eggs in the afternoon. During spawning the fish will be anesthetized with MS222 in a knock out tub with 2% saline solution. Ripe females will be counted and placed in a holding pen where they will remain here until they are stripped of eggs in the afternoon.

Spawning Procedures

Spawning will occur in the afternoon. Sperm from 10 males will be collected and pooled into a vial. A portion of this pooled sperm will be added to the dry collection pan. Small ripe females will be stripped of eggs into a sterile pan with about 15 to 18 females usually contributing to each pan of eggs. The eggs from larger females will be collected and fertilized in much the same manor, except the sperm collected from 10 males is used to fertilize the eggs from 10 females. Each female will be rinsed of MS222 and checked for broken eggs. Fish with broken eggs will not be used. After the last female's eggs are transferred to the pans the remaining pooled sperm will be added. Water is added at this point to activate the sperm. Each pan of fertilized eggs will be set-aside for 1 minute. After one minute, the excess sperm will be rinsed off. These eggs are now placed into a net and lowered into an iodophor solution of 100ppm and allowed to water harden for 30 minutes. After the initial 30 minutes the eggs will be removed from the iodophor solution and placed into fresh water to continue water hardening for another 30 minutes. Eggs will then be placed into a up-welling incubation jar.

7.3) Cryopreserved gametes.

If used, describe number of donors, year of collection, number of times donors were used in the past, and expected and observed viability.

No cryopreservation has been used in the past. Cryopreservation may be necessary if male and female wild adults do not become ripe simultaneously. We will first attempt to initiate spawning through hormonal injections of females. Acclimating wild fish to a hatchery environment often causes sufficient stress to impede reproductive cycles in male and female trout. Gonadotrophin hormones like Leuteinizing Hormone/Releasing Hormone (LH/RHa) analogue and carp pituitary have been used successfully to synchronize spawning in captive trout. These tools would be valuable in developing distinct stocks of westslope cutthroat trout. Injecting wild cutthroat trout with LHRHa in Montana proved to be highly successful at accelerating egg maturation in females by 4-7 days (Grisak and Marotz 2002). Male fish likewise, demonstrated a favorable response when 60% of those treated began spermiating within 4 days of treatment.

7.4) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

Sekokini Springs will not hold a captive broodstock and will only replicate wild donor populations for use as nearest neighbor reintroductions, thus reducing risk to wild populations.

Breeding plans will use a factorial mating design to reduce the loss of genetic material. At Washoe Park State Trout Hatchery, MFWP uses a 10 female x 10 male cross protocol. Sekokini will use this breeding plan as a standard and will consider alternative breeding plans to maximize genetic heterogeneity. Juvenile collections will yield fish of unknown ages and wild trout exhibit highly variable growth at age, making age determinations difficult without direct inspection of scale annuli. If ages can be determined prior to spawning, it may be possible to spawn across year classes to reduce the possibility of sibling matings.

SECTION 8. INCUBATION AND REARING -

8.1) Incubation:

8.1.1) Number of eggs taken/received and survival rate at stages of egg development.

Provide data for the most recent twelve years (1988-99), or for years dependable data are available.

Experimental culture occurred only two years at the site. There are presently no fish at Sekokini Springs pending completion of the NPCC 3-step APRE process.

Year	# Eyed Eggs from Washoe Park SFH	% to hatch
1997	80,200	81.8
1998	81,153	58.2

8.1.2) Loading densities applied during incubation.

Year	Egg size #/oz	Flow rate gpm	# Eggs/tray
1997	372	4.0	13,370
1998	381	4.0	13,525

8.1.3) Incubation conditions.

In 1997, eggs were incubated in a Heath Tray stack placed in an outdoor location at the site to make use of a constant 52° F temperature spring for water source. Oxygen was near saturation level. A chain link fence and a Quonset-style tent covering protected the trays.

In 1998, eggs were incubated in similar trays located in main facility and were supplied with constant 56° F temperature spring water piped into building. Oxygen levels were more than sufficient, but higher incubation temperature proved to be detrimental to egg survival.

In the future, all eggs will be incubated at 56° F and will eye up in about 13 days. During incubation, eggs will be treated every third day with argentine at 50 ppm for 15 minutes. They will also be treated at this dose just prior to moving. Every third day they will also be treated with formalin at 1667 ppm for 15 minutes.

8.1.4) Ponding.

Westslope cutthroat fry are removed from incubator trays 5 days before swim up and placed in fiberglass troughs (10'x1'x.5') receiving 8 gpm from same water source. After fish are on feed for 2 weeks, they are moved to hatchery rearing tanks (10'x2.5'x2') in late July.

8.1.5) Fish health maintenance and monitoring.

Dead eggs and/or fry, and egg membranes are removed daily from incubator trays with suction bulbs, before, during, and after hatching takes place. No chemicals were used to date.

8.1.6) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to fish during incubation.

There would be no adverse genetic or ecological effects to environment caused by loss of incubating Westslope cutthroat trout eggs. Fish will be reared initially in the hatchery building, then released to outdoor habitat in spring water. The spring source has a natural annual flow and thermal regime, similar to a wild mountain stream.

8.2) <u>Rearing:</u>

8.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available..

Westslope cutthroat trout survival

Year	**% fry to fingerling**	**% fingerling to release**
1997-1998	60.7	80.9
1998-1999	74.1	68.6

8.2.2) Density and loading criteria (goals and actual levels).

The rearing facility has not been completed. Densities are expected to mimic natural waters.

8.2.3) Fish rearing conditions

Fish will be reared to maturity in natural outdoor habitat. Rearing ponds will contain overhead cover in the littoral zone and overhanging shoreline vegetation to mimic wild conditions. The existing ponds are inhabited by aquatic insects and the surface traps terrestrial insects, providing natural feed. An adjacent "fishless" pond will have a section with a bottom suitable for seining that will provide a source of natural prey items (insects and amphipods) for use in supplemental feeding. Water temperature and dissolved gasses will be monitored with meters at points throughout the watercourse. Existing conditions mimic a natural hydrography and thermal regime. Three springs above the hatching building were capped and plumbed to allow water temperatures to be optimized by mixing flows of varying temperatures. The fourth cold-water spring, entering the system on the bench below the building, may be used to regulate water temperatures in the pond and stream habitat in the future. The final design of the water system can be amended if water temperatures become atmospherically heated as the proposed stream flows toward the Flathead River. The BoR Technical Assistance Program has provided initial designs for the flowage described in the Master Plan. We expect that vegetative shading can maintain cool temperatures in the habitat during summer.

8.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

Sample counts (#/lb) were made when fish were moved to other rearing units, or hauled off the facility for stocking. Condition factors were not measured directly in most cases. Lengths are estimated from standard species condition factor charts. Monthly temperature units (T.U.) growth data from 2 year classes of Westslope cutthroat indicate an average of 67 T.U.'s per inch growth. (1 T.U. = 1 degree F above freezing for 30 days)

8.2.5) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Our goal is to maintain habitat for natural invertebrate production. The existing stream / pond complex produced mayflies, caddis and Diptera. Improving the currently degraded habitat will improve productivity. A working example of a "living stream" design (MK Nature Center, Boise, Idaho) revealed that supplementary feeding was required only once per week to maintain fish in the exhibits. We also plan to experiment with natural prey items to be reared in the restored wetland (also natural water treatment) to be located immediately adjacent to the rearing ponds.

8.2.6) Fish health monitoring, disease treatment, and sanitation procedures.

The Fish, Wildlife and Parks fish health management project has tested fish reared at the Sekokini Springs site for pathogens annually since 1995. Annual inspections for the period 1995-1998 were conducted on fish held by the previous owner of the facility. The most recent inspection of M012 WCT reared at this facility was conducted in 2002. In this inspection 60 cutthroat trout and 60 Arctic grayling (*Thymallus arcticus)* being reared at Sekokini Springs were tested for bacterial and viral pathogens, in addition to *Myxobolus cerebralis*, the parasite responsible for whirling disease (MFWP lab number 020027). No pathogens were detected during this inspection. No pathogens of concern were detected during subsequent inspections of wild fish held in isolation at the site. All lab results are available from the MFWP fish health laboratory in Great Falls (Contact Jim Peterson, MFWP Fish Health Coordinator).

Stocking Inspection Requirements

Annual fish health inspections will be conducted at the Sekokini Springs facility, as they are at all Montana state fish culture facilities. However, instead of lot-by-lot testing conducted during a single inspection, periodic testing will be done at various times of the year depending on what fish are present at the facility. For example, young-of-the-year wild fish collected from wild populations will be tested at 4 inches in length. They will be tested again at sexual maturity. Fingerlings in the hatchery building will be tested prior to stocking.

Fish health inspections will include testing for all salmonid pathogens of concern as specified in the Administrative Rules of Montana (ARM 12.7.502). These pathogens include the following eight disease organisms:

*Infectious Hematopoietic Necrosis Virus (IHNV)
*Infectious Pancreatic Necrosis Virus (IPNV)
*Viral Hemorrhagic Septicemia Virus (VHSV)
**Oncorhynchus masou* Virus (OMV)
**Renibacterium salmoninarum*
**Aeromonas salmonicida*
**Yersinia ruckeri*
**Myxobolus cerebralis*

No fish may leave the Sekokini Springs facility until testing is completed, a fish pathogen-free status is determined and a fish health inspection report is issued. Inspections will be conducted by the MFWP fish health project. Testing will be conducted using procedures established by the American Fisheries Society (AFS), Fish Health Section (FHS) in the AFS/FHS Bluebook, Suggested Procedures for the Detection and Identification of Certain Finfish and Shellfish Pathogens, 2003 Edition.

If a pathogen of concern is detected during any fish health inspection at the Sekokini Springs facility, the facility will immediately be placed under quarantine as specified in the MFWP Fish Health Policy. A meeting of the MFWP Fish Health Committee will be convened in order to develop an appropriate course of action. Actions may include removal of infected fish or disinfection of the entire facility, depending upon the pathogen detected and the risk to the facility and Montana's fishery resources. MFWP's Fish Health Policy will be followed regarding initiation and removal of a quarantine.

"Importation" Requirements – fish/eggs into Sekokini Springs Facility

All fish and eggs transported from any stream, lake, fish culture facility or any source to the Sekokini Springs facility must be from a source, which has a history of pathogen testing and found free of the salmonid pathogens of concern (See additional discussion under Pathogens of Particular Interest below). MFWP is collecting fish health data from waters proposed donor populations. Prior to this effort that began in 2002, very little was known about the health status of stocks selected for donor sources. Fish health testing will be conducted on fish from each donor source prior to collection of fish, regardless of the known health history of the water. Testing will be limited in many waters due to the availability of suitable fish for testing. MFWP will attempt to sample a suitable number of fish from each donor population to obtain a reasonable confidence of detecting fish pathogens, if they are present. Generally, MFWP will attempt to sample a minimum of 60 fish, 4 inches or larger. A sample size of 60 fish will result in a 95% confidence of being able to detect a fish pathogen, assuming as few as 5% of the fish in the population are infected with the pathogen (AFS/FHS Bluebook, attribute sampling table.) If 60 fish are not available due to limited population size, less fish may be tested. A donor stream will not be selected unless a minimum of 15 four inch or larger fish can be health tested and determined pathogen-free prior to collection of fish for transfer to Sekokini Springs. Fifteen fish is not enough to establish reasonable confidence of pathogen detection. However, this number is felt to provide an idea of the pathogen risk associated with donor waters. If no pathogens are detected, fish may be moved from the donor water to the isolation facility at Sekokini Springs where they will be tested again prior to being moved to the outdoor habitat at the facility.

MFWP prefers collecting fish from donor streams for which an established health history over several years is available. However, few of these waters exist. The risk inherent to moving live fish increases with fish from waters with little or no health history.

In the case of eggs taken to the facility, the parent stock from which the eggs are collected must have been pathogen tested prior to the eggs being taken to Sekokini Springs. These eggs must be held in isolation in the Sekokini incubators until results of the parental health inspection are received indicating no pathogens of concern were detected. Effluent from the incubators will be piped out of the building and run into a percolation gallery in a drainage adjacent to and hydrologically separate from the "living stream". No effluent from egg incubation will be allowed to enter any of the Sekokini ponds. The eggs will remain in the incubators until the health testing from the adults is completed. If a pathogen is detected in the health samples collected from the adult fish from which eggs were collected, the eggs will be destroyed before they hatch. Note: The level of testing of adults will be determined at the time of spawning based on the number of fish in the donor stream. Generally, a minimum of 60 fish, or 100% of the contributing adults from which eggs are collected, will be tested at the time of egg collection.

There will be many times when juvenile fish may have to be collected for transport to Sekokini Springs from a source which can not be adequately health tested. However, regardless of the health history of the donor fish, all wild fish collected and taken to the Sekokini Springs facility will be held in tanks, which are isolated from all other fish at the facility until they are a minimum of four inches TL. At four inches a representative 60-fish sample will be health tested. If no pathogens of concern are detected in these samples, the fish may be moved to the lower rearing ponds. In addition, there may be times when eggs will be collected for transport to Sekokini Springs from sources where adequate testing of the parent stock is not possible. In these cases, the fish or eggs must be held in isolation at the facility, until such time that adequate health testing can be conducted on the fish (four inch minimum size.) A minimum sample of 60 fish, representative of the collection lot, must be tested and determined to be pathogen of concern negative prior to transfer to the rearing ponds.

While no pathogens of concern have ever been detected at the Sekokini Springs facility, it must be emphasized that the potential to import pathogens exists every time fish or eggs are collected from a wild source and transported to the facility. For this reason inspection of representative fish at all donor sources, and annual inspections of the Sekokini Springs facility is essential.

Pathogens of Particular Interest:

Viral pathogens (IHNV, IPNV, VHSV, OMV). Fish or eggs will not be collected from any donor population where any of these viruses are known to occur. If any virus is detected in fish after being taken to the Sekokini Springs facility, the facility will be placed under quarantine and the fish will be destroyed.

Myxobolus cerebralis. The whirling disease parasite has been present in Montana waters since 1994 and is present in the Flathead River drainage, having been detected in the Swan River and several tributaries to the Swan River, and in Mission Creek and Crow Creek, below Flathead Lake. The parasite has not been detected in the upper Flathead River or any of the three main forks of the Flathead River above Flathead Lake. However, as of printing of this plan, the parasite has been detected in over 120 different waters in Montana, and it is expected to continue to spread (J. Peterson, MFWP, personal communication, 2004).

Renibacterium salmoninarum is the bacteria which causes bacterial kidney disease (BKD). This bacteria is known to occur in many waters across Montana. It has resulted in fish losses at fish hatcheries, but clinical disease has not been observed in the wild. It is important to discuss in the Master Plan because this bacteria may be present at low levels in donor fish, from which eggs will be collected for transport to Sekokini Springs. It is also of interest because this bacterial fish pathogen is known to be transmitted with eggs. MFWP requires *R. salmoninarum* testing of all stocks from which eggs are collected. Testing required by MFWP is the fluorescent antibody test (FAT). While other testing methods may be more sensitive than the FAT test, MFWP relies on the FAT procedure to detect medium and high range infections. Fish which test positive for *R. salmoninarum* using the FAT test will not be considered as egg sources for Sekokini Springs.

Aeromonas salmonicida and *Yersinia ruckeri* (type 1). *Aeromonas salmonicida* is known to occur in various waters in the Flathead drainage. Donor stocks are tested for these bacterial pathogens. Live fish infected with either of these pathogens will not be allowed to enter Sekokini Springs. Since these bacterial pathogens are not known to be egg-transmitted, properly disinfected eggs from parents infected with either of these organisms may be transported to Sekokini Springs with approval of the MFWP Fish Health Coordinator. Note: all eggs which are taken into the Sekokini Springs facility must be thoroughly disinfected with iodophor disinfectant prior to entering the facility. Eggs will be water hardened in an iodophor solution at the time of fertilization. A 100 mg/L solution of povidone iodine will be used for this process. Eggs will be water hardened in this solution for 30 minutes. This will be done at the time and place of fertilization. External disinfection of eggs will be conducted prior to eggs entering the Sekokini Springs hatchery building. It is anticipated this will be done in the parking lot behind the building. External egg disinfection will be conducted at a concentration of 100 mg/L for 10 minutes. At times, green eggs may need to be collected for fertilization at Sekokini Springs. These eggs will also be water hardened in iodophor as described above. If this process takes place inside the hatchery building, special care must be taken to avoid contamination of the hatchery facility.

Gamete Collection for Westslope Broodstock Development - Infusion of New Material into MO12 Stock Conservation Strategy

One of the primary objectives of the Sekokini Springs project is collection of gametes for incorporation into the MO12 WCT broodstock. In order to accomplish this, wild fish may be taken to Sekokini Springs for egg or sperm collection. Prior to collecting these fish from the wild, health testing will be conducted as described above for wild fish collection. Once at the facility, these wild fish will be treated the same as wild fish brought to the facility for rearing. They will be taken to the isolated wild fish tanks, where gametes will be collected. After collection of gametes, these fish will be sacrificed for health testing.

Onsite Fish Health management

The MFWP Fish Health Coordinator shall be responsible for determining sampling protocol and time of inspection. The MFWP Fish Health Coordinator will schedule all inspections at the facility with the Sekokini Springs facility manager. Fish health inspections conducted prior to collection of fish or eggs from wild sources will be coordinated with the MFWP Fish Health Coordinator, regional staff responsible for management of waters from which fish will be collected, and the Sekokini Springs facility manager. Collection and transfer of fish in specific situations, which do not meet the requirements of this section, must be approved by the MFWP Fish Health Committee prior to transfer.

The following on-site inspections will be conducted:

- Wild fish brought to Sekokini Springs will be health tested at 4 inches (60 fish)
- Mature spawning fish at Sekokini Springs will be health tested at the time of spawning (Minimum of 60 fish or 100% of spawning adults)

- Fingerlings will be health tested prior to being stocked back into the wild (60 fish)
- Other testing at Sekokini Springs may be conducted as necessary.

An on-site fish culturist will monitor fish health at the facility. All fish health problems or unusual symptoms or mortality will be immediately reported to the MFWP Fish Health Coordinator. Fish health management will be consistent with MFWP fish health policy, Pacific Northwest Fish Health Protection Committee (PNFHPC) Model Program, Integrated Hatchery Operations Team (IHOT) policies, and Montana laws (87-3-209), ARM 12.7.502-12.7.504. Equipment used at the hatchery will be disinfected with chlorine, iodophor or other approved disinfectant between uses.

8.2.7) Indicate the use of "natural" rearing methods as applied in the program.

Up to 1000 juveniles from each donor population will be raised to maturity in low densities (approximately .5 to1 fish per m^2) in four "natural" rearing ponds and stream habitat at the site. Spring caps were designed so that all water that is not used within the building overflows into a restored creek channel in the "living stream" exhibit. Additional spring seeps join the channel enroute downstream. Return flows from the building will return to the stream via a buried pipe at a lower elevation and appear as a natural spring along the stream bank. Based on stream gradient, the stream type transitions from Rosgen type E to C to B to A and again B before entering a wetland immediately above the four earthen rearing ponds. Discharge from the ponds will flow through a proposed E channel that traverses the lower bench before entering a proposed A channel to the Flathead River. The four ponds will be designed to restrict fish movement, so that fish within each pond can be maintained as separate lots. Each pond will contain a short stream reach in the inflow, woody debris for overhead cover and a pool. The design will allow independent control of the surface elevation in each pond. Water stage can be lowered to crowd fish into an area that contains a smooth bottom and collection gallery, so that fish can be easily captured. Fish will be reared in the stream reaches to provide viewing opportunities.

8.2.8) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to fish under propagation.

Wild fish will be reared to maturity in natural habitat to provide a source of F1 progeny. Progeny will be outplanted as eyed eggs or imprint fry to restored or reconnected habitats within the Flathead subbasin. The goal is to initiate wild rearing and spawning runs. Collection of juveniles and gametes from the donor population will occur throughout the emigration or spawning period, over several years, to provide family crosses between yearclasses. Progeny will be genetically compared with the donor population to guard against inadvertent grading. Wild fish will only be used to replicate F1 offspring from "nearest neighbor" populations for use in recovery actions elsewhere within the Flathead Watershed. No captive hatchery broodstock will be maintained.

SECTION 9. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

Our goal is to experimentally determine the most cost-effective way to initiate self sustaining spawning runs of westslope cutthroat trout in restored or reconnected tributary habitat. We will compare eyed egg RSIs, and imprint plants (fry & fingerlings) from juvenile rearing through adult returns. Surplus fish will be planted in restored headwater lakes and closed-basin lakes to provide angling opportunity.

9.1) Proposed fish release levels. *(Use standardized life stage definitions by species presented in **Attachment 2**.*

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs	Numbers to be estimated based on area of receiving habitat	2-3 mm	May	Restored or reconnected tributary habitat
Unfed Fry	none			
Fry	Numbers to be estimated based on area of receiving habitat	10-20mm	Late May Early June	Restored or reconnected tributary habitat or onsite lakes
Fingerling	Numbers to be estimated based on area of receiving habitat	25-40mm	June	Restored or reconnected tributary habitat or onsite lakes
Yearling	50,000 (as available)	75-130mm	June-July	Restored offsite and onsite lakes

9.2) Specific location(s) of proposed release(s).
Stream, river, or watercourse:

See figures and tables in the Sekokini Springs Master Plan.

Selected restoration sites in Flathead River tributaries include Abbott Creek, Taylors Outflow, Elliot Spring Pond/Creek, an unnamed tributary (across the Flathead River from Sekokini Springs) and Haskill Creek. Progeny are also scheduled for release in lake included in the South

Fork Flathear River westslope cutthroat trout conservation project (BPA DEIs 2004) and sites to be determined.

Release point:
Fertilized eggs will be released into RSIs distributed upstream of fry rearing habitats in each stream. The exact location in each stream will be determined separately for each application.

Major watershed:
Flathead River Watershed

Basin or Region:
Mountain Columbia Ecological Province

9.3) Actual numbers and sizes of fish released by age class through the program.

Experimentally reared fish were released as yearlings to closed basin lakes in 1998, 1999 and 2002. No further releases have occurred since. Records stored in fish lot history files kept at Creston National Fish Hatchery (1998-1999) and MFWP Fish Hatchery Division (2002).

Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1998					47696	3.69"		
1999					19487	4.41"		
2002					21,000	4.45"		
Average					29,394	4.18"		

Data source: Creston National Fish Hatchery (1998-1999); MFWP Fish Hatchery Division (2002)

9.4) Actual dates of release and description of release protocols.

During the 3-year experimental cutthroat trout rearing program, fingerling fish were stocked when receiving waters reached a suitable temperature, (50-55 °F) generally mid-May to mid-June. Fish were transported to the lakes via tank truck. Future methods will be determined for each specific action.

9.5) Fish transportation procedures, if applicable.

Transportation in an insulated fiberglass tank in a one ton truck or helicopter . Oxygen will be added to the tank through air stones and densities will be set at a low Densities during transport are size dependant, at 1 lb/gallon.

9.6) Acclimation procedures (*methods applied and length of time*).

Montana no longer acclimates fish by circulating water pumped from surface waters into the hatchery tank before outplanting to avoid the risk that equipment may become contaminated. Instead, fish are released when the recipient stream temperature is similar (within 5 degrees F) to the temperature of the holding tank. MFWP is experimenting with methods to adjust the temperature of water in the transport vehicle.

9.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

All fish from the hatchery stock will be marked using fin clips, otolith cold marking, fluorescent pigments or mass-marking using microelements (e.g. strontium isotopes and/or barium).

9.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Surplus fish will be released in closed-basin lakes as part of MFWP's Family Fishing Initiative.

9.9) Fish health certification procedures applied pre-release.

Certification by State Fish Health Specialist, Jim Peterson: 95 % confidence with a 60 fish sample (see MFWP fish health policy summarized in the Master Plan)

9.10) Emergency release procedures in response to flooding or water system failure.

Natural flow variation of this type has not been observed or recorded in this gravity-flow artesian spring source. If flows do become low, we anticipate that fish will move to pools.

9.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed species resulting from fish releases.

The facility will provide only F1 progeny of wild fish from donor populations within the Flathead Watershed that have been designated genetically pure and free of reportable pathogens. Normally, fish will not be planted back into donor populations to protect the donor populations for future use. However, in "rescue operations" such as Haskill Creek where efforts are being taken to replicate pure WCT that are threatened by nonnative brook trout and habitat degradation, the progeny of fish from the same site will be planted to restore the population after the limiting factors have been mitigated (habitat restored and brook trout removed). Sekokini Springs will be used to restore genetically pure populations within the historic range of westslope cutthroat trout in areas where the native species has been extirpated. Fish planted into closed-basin lakes will not encounter wild populations. Where artificially propagated fish may encounter wild stocks, we will attempt to imprint juveniles on the receiving waters to reduce the potential for straying. If pioneering occurs into waters occupied by wild populations, the potential for negative genetic interactions will be low, because fish released from the Sekokini facility will be genetically pure and free of fish pathogens. Increasing the number of local populations within the Flathead Watershed is expected to be beneficial to maintaining the overall genetic diversity of wild populations.

SECTION 10. PROGRAM EFFECTS ON ALL ESA-LISTED, PROPOSED, AND CANDIDATE SPECIES (FISH AND WILDLIFE)

10.1) List all ESA permits or authorizations in hand for the hatchery program.

No listed species are involved in this project.

10.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

10.2.1) Description of ESA-listed, proposed, and candidate species affected by the program.

This project is not expected to affect bull trout populations which are listed as threatened in the Flathead Watershed.

- Identify the ESA-listed population(s) that will be directly affected by the program.
None.

- Identify the ESA-listed population(s) that may be incidentally affected by the program.

There is a very low probability that bull trout could be incidentally affected by this project. There are no bull trout at the Sekokini Springs site. Bull trout could only be affected by WCT collections and monitoring activities (see below).

10.2.2) Status of ESA-listed species affected by the program.

This project is not expected to affect bull trout populations in the Flathead Watershed.

- Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds *(see definitions in "Attachment 1").*

Bull trout are listed as "threatened" (USFWS 1998). A draft Recovery Plan built on the foundation of state restoration plans (USFWS 2002a, Internet-accessible at http://pacific.fws.gov/bulltrout/recovery/Default.htm) and proposed critical habitat (USFWS

2002b, http://pacific.fws.gov/bulltrout/criticalhab.htm), were released in November 2002. The draft Recovery Plan and proposed critical habitat are organized hierarchically by "local populations" within "core areas" within "recovery subunits" within 24 "recovery units" within three (of five) designated "distinct population segments" (DPSs). The draft Recovery Plan covers the Klamath basin, Columbia River and St. Mary-Belly River DPSs. Critical habitat designation is currently proposed only for the Klamath and Columbia River DPSs. Proposed critical habitat is limited to bankfull stream channel width within designated stream segments and excludes habitat within existing approved HCPs with bull trout "incidental take" permits. In Montana, 5,341 stream km (3,319 mi) and 88,051 lake/reservoir ha (217,577 ac) are proposed as critical habitat, of which 60% is in federal ownership, 1% tribal, 5% state/local and 34% private. Ten local populations within four core areas have been identified within the Kootenai River Recovery Unit in Montana. About 119 local populations distributed among 36 core areas within three Recovery Subunits (Flathead, Upper and Lower Clark Fork) are identified within Montana in the Clark Fork Recovery Unit. Nine local populations within six core areas are identified within Montana in the St. Mary-Belly River Recovery Unit. Bull trout in Montana are still widely distributed throughout their historic range, although numbers and distribution have declined during the past century (MBTSG 1995a and 1995b].

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

This is a new project. Data not currently available.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

Bull trout redd counts in the Flathead Watershed are available for the period 1997 through 2003 (Deleray et al. 1999 and MFWP files).

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

All spawners are wild. Montana does not stock bull trout.

10.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed species in the target area, and provide estimated annual levels of take

Collection of juvenile fish or gametes has a "low" potential to take listed bull trout. Many streams containing WCT donor populations do not contain bull trout. Where WCT and bull trout are sympatric, however, there is some potential for inadvertent take. Bull trout mortality can be mitigated by sampling and collecting techniques. Bull trout may be impacted through migrational delay, inadvertent capture or handling in WCT migrant traps, although fall-spawning bull trout are seldom present during the spring when the WCT spawning run occurs. Bull trout may be stunned by electrofishing during juvenile WCT collections or population monitoring. MFWP uses electroshocking equipment configured to a pulse form designed to reduce injury to fish and no bull trout mortalities have been reported in the Flathead Watershed during electrofishing operations during the last five years. A "worst case" estimate of bull trout take associated with this project is predicted to be less than five juveniles or adults per year.

Our proposed contingency plan for addressing situations where take levels within a given year have exceeded, or are projected to exceed 5 bull trout per year, is to utilize WCT donor populations where bull trout are not present. Monitoring in waters inhabited by bull trout could be restricted to visual (snorkel survey) observation.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.

1). By 2007, conserve the genetic and life history diversity of at least one westslope cutthroat trout population in the Flathead Subbasin by replicating the donor stock held in natural habitat at Sekokini Springs.

Initially, MFWP is attempting to replicate genetically pure westslope cutthroat in Haskill Creek to restore the population after limiting factors (habitat degradation and nonnative brook trout) are mitigated. Pre- and post-treatment inventories of the genetic makeup of the targeted fish populations will be used to measure trends in genetic purity. Genetic sampling may involve protein electrophoresis, paired interspersed nuclear DNA element – PCR (or PINE marker) method or various mitochondrial DNA marker techniques, to differentiate westslope cutthroat trout populations. Samples are analyzed by the Montana Wild Trout and Salmon Laboratory at the University of Montana, Missoula or suitable laboratory.

The Hungry Horse mitigation program is assessing recruitment from and genetic integrity of fluvial and adfluvial trout in selected index streams (primary spawning streams and habitat enhancement sites by electrofishing and migrant trapping. Experiments use PIT tags and remote detectors, radio telemetry and microelemental signatures in fish scales to assess spawning success and determine the natal stream of origin of individual fish.

2). Restore and initiate viable, naturally spawning populations using reintroduction strategies by 2013.

Successful restoration of wild spawning runs of genetically pure westslope cutthroat trout in tributaries to the Flathead River can be assessed by migrant trapping, redd surveys, population estimation and genetic inventory, before and after habitat restoration or reconnection. We are now assessing tools to determine spawner origin and to assess the effectiveness of various techniques for establishing runs. Non-lethal sampling techniques such as microprobe spectrometry of the protein matrix in scales has yielded promising results (Wells et al. 2003; Muhlfeld et al. – In review). Experiments using batch marking to cold-mark otoliths in trout fry are ongoing, but require lethal sampling (otolith removal) to assess the presence of a mark.

3). Reintroduce pure populations where hybridized/introgressed populations have been removed.

The success of chemical rehabilitation is assessed through pre- and post-treatment inventory using gill nets, electrofishing and/or U/W visual inspection.

4). Provide harvest in closed-basin lakes to offset lost angling opportunity due to harvest restrictions or fishing bans designed to minimize adverse effects to wild populations.

Gill netting provides data on species relative abundance, growth rates and fish condition factor. Angler surveys are qualitative indicators of catch rates, angler satisfaction and rough estimates of harvest.

5). By 2008, create an interpretive area for public education on the benefits of native species and their recovery.

This aspect could be measured in terms of visitor days, school groups instructed or patron satisfaction indices.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to appropriate "Performance Indicator" identified for the program.

Successful restoration of wild spawning runs in tributaries to the Flathead River can be assessed by migrant trapping, redd surveys and population estimation before and after habitat restoration or reconnection. Upstream spawning migrations into restored and reconnected streams will be sampled using trap weirs. Spawners will be examined for marks (described earlier) to determine their natal stream or origin. Unmarked fish will be sampled non-lethally (fin clip) for genetic purity. All non-native species (e.g. rainbow trout) or apparently hybridized or introgressed individuals will be held for transport to a closed-basin "put and take" children's fishing pond. Spawning will be assessed through standard redd counts. Progeny will be assessed using 150 m electrofishing reaches and standard population estimates.

Experimental imprint plants of marked eyed eggs or fry will be assessed using various marks determined by the longevity of the marks and the intent of the assessment. Short-term marks (e.g. tetracycline, temporary fin clips or fluorescent pigments) will be used to assess rearing survival in the natal tributary and emigration rates. Migrant class can be determined using growth checks on scales, or through known intervals between the time of marking and subsequent emigration. Long-term marks (PIT tags, microelemental signatures in fish scales and/or otolith marks) will be used to assess the origin of returning adults. Condition factor and incremental growth from scales and/or otoliths will be used to describe the health of individual fish relative to other treatments or control groups.

We will experiment with microprobe ablation and mass spectrometry techniques combined with stream-specific water chemistry to "finger print" fish and their origin. An understanding of the origin of wild fish and F1 progeny from Sekokini Springs can help us assess the effectiveness of various techniques for reestablishing self-sustaining runs.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

The Hungry Horse Mitigation Program currently funds monitoring activities. The ongoing program currently conducts all the actions except the microprobe laser ablation technology described above. We recently tested a non-lethal technique to "finger print" the origin of fish using laser ablation analysis of material from fish scales. Results showed that this technique is nearly 90 percent accurate in correlating juvenile cutthroat trout to the water source in their natal tributary. Non-lethal genetic sampling provides a second layer of evidence to further refine accuracy. Research continues to examine the persistence of these microelemental signatures in fish scales to determine the natal stream of origin of adult cutthroat trout. Results will be used to focus protection measures in streams containing genetically pure populations and focus mitigation efforts to reduce sources of genetic introgression.

Monitoring planned at the site is not currently funded and is proposed as part of the annual operation and maintenance costs.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed species resulting from monitoring and evaluation activities.

Trap weirs have been designed to provide low velocity holding areas to avoid injuring fish. Unless absolutely necessary, downstream traps will be used to avoid delaying or obstructing upstream migrations. We will continue to explore non-lethal sampling techniques. Of course, disease sampling, otolith extraction and protein electrophoresis techniques will require sacrificing a subsample of fish in each lot to verify non-lethal samples. Where lethal sampling must be used, we will monitor wild or donor stocks for damage using standard electrofishing population estimates.

SECTION 12. RESEARCH

12.1) Objective or purpose.

Self-supporting migratory fish populations need to be established in areas where habitat or fish passage has been improved. This can be accomplished through imprint planting of genetically appropriate eyed eggs or subyearlings. The facility will play necessary role in experimentation to determine the most cost-effective way to restore wild spawning runs where native cutthroat have been extirpated.

Lake rehabilitations and other offsite work is ongoing on the Hungry Horse Mitigation Program to create genetic reserves for native fish, expand the range of native fisheries, and eliminate source populations for further illegal introductions. A source of pure westslope cutthroat trout is needed to replace non-native species or introgressed populations.

There is a need for increased public outreach and education on the need to protect native species and their required habitat. The working experimental culture facility, habitat restoration project and interpretive trail will serve as an education tool.

12.2) Cooperating and funding agencies.

Funding for this project provided by the BPA through the Hungry Horse Fisheries Mitigation Program.

USFWS has and will continue to cooperate on the experimental culture program by providing technical assistance and services.

The BoR Technical Assistance Program has contributed to the design phase and has provided funding for the interpretive trail exhibits.

The US Forest Service owns the land at the site and cooperated on high resolution topographic mapping of the site and the sensitive plant inventory. The Service is also contributing to NEPA documents and amendments to the Special Use Permit that is provided with no annual fee.

The Boy Scouts of America has offered to assist with trails and bridges.

Trout Unlimited plans to provide monetary assistance and volunteer labor as the Master Plan is implemented.

12.3) Principle investigator or project supervisor and staff.

Brian Marotz, Fisheries Program Manager
John Wachsmuth, Project Technician
Montana Fish, Wildlife & Parks
Kalispell, MT 59901

12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.

No stocks are currently maintained at the facility pending improvements to the facility.

12.5) Techniques: include capture methods, drugs, samples collected, tags applied.

See above.

12.6) Dates or time period in which research activity occurs.

We plan to have the site functioning within five years. Phase I: Cap springs, improve plumbing and repair office 2000; Phase II: Finalize Master Plan and restore the stream reach where the original head pond was. Construct stream pond complex and first viewing area 2002-2003; Phase III: construct fish ladder (A2 channel to reconnect source to the Flathead River) and fish trap weir 2006; Phase IV: construct interpretive trail system and exhibits 2007; Phase V: complete visitor facilities 2008. This schedule is tentative pending amendments to the Special Use Permit and cost-share funding.

12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.

Potential donor populations were sampled for genetic compliment and reportable fish pathogens. Once the donor population is certified free of fish pathogens and genetically pure. Juveniles and/or fertilized eggs will be transported to Sekokini Springs in an insulated hatchery tank with oxygenation where they will be held in isolation pending a second screening for pathogens and genetic purity.

12.8) Expected type and effects of take and potential for injury or mortality.

No ESA-listed fish will be transferred to the site.

12.9) Level of take of listed species: number or range of individuals handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table" (Table 1).

NA

12.10) Alternative methods to achieve project objectives.

The Sekokini Springs site was selected because of the natural habitat available for outdoor rearing. Traditional hatcheries do not provide this condition. Unlike other hatcheries in the state system, the experimental designation of the site allows researchers to bring wild juvenile fish onto the site for holding in isolation (separate water source) until the fish can be certified free of fish pathogens and genetically pure. Only gametes can be transported to other Montana hatcheries.

In the past, projects of this type utilized the states M012 brood stock. This source was founded using wild fish from the Flathead and Clark Fork drainages, so is not identical to the wild populations throughout the Flathead Watershed. We have developed this plan to create sources of "nearest neighbor" stocks that are genetically compatible with local wild populations. There is no other source of pure westslope cutthroat trout reared under natural conditions.

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

There are no listed fish species at the site.

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed species as a result of the proposed research activities.
(e.g. "Listed coastal cutthroat trout sampled for the predation study will be collected in compliance with NMFS Electrofishing Guidelines to minimize the risk of injury or immediate mortality.").

NA

SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by Brian Marotz, Fisheries Program Manager Date: September 30, 2004

Appendix K

Juvenile WCT Estimates for the Flathead River System

Appendix L. The reach, stream order, gradient and juvenile WCT estimates (>75mm) for tributaries to the North, Middle and South Forks of the Flathead River

Drainage	Stream	Reach	Stream Order	Gradient (%)	WCT Juveniles per 100m
North Fork	Kintla	1	2	1.7	29.3
	Starvation	2	2	1.8	7.3
	Dutch	2	2	2.0	80.5
	Moose	3	2	2.8	291.4
	Mathias	1	2	2.8	6.8
	Akokala	2	2	2.9	66.6
	Langford	2	2	3.0	119.0
	Langford	1	2	3.0	101.0
	Moose	2	2	3.5	158.9
	Cummings	1	2	6.6	30.7
	Coal	4	2	7.5	8.8
	Hay	4	2	7.6	14.8
	Red Meadow	3	2	7.9	16.1
	Dutch	3	2	10.1	14.5
	Anaconda	2	2	11.7	16.7
	Long Bow	1	2	12.3	34.2
	Coal	2	3	0.7	35.0
	Camas	2	3	1.0	10.9
	Yakinikak	4	3	1.3	48.8
	Hay	2	3	1.5	69.2
	Hay	1	3	1.5	28.9
	Tuchuck	1	3	1.6	76.0
	Logging	1	3	1.6	28.6
	Ketchikan	1	3	1.6	90.7
	Bowman	1	3	1.7	145.6
	Red meadow	2	3	1.7	87.6
	Dutch	1	3	1.8	79.2
	Anaconda	1	3	2.0	75.6
	Red meadow	1	3	2.2	84.0
	Spruce	1	3	2.3	20.9
	Spruce	2	3	2.6	50.0
	Moose	1	3	2.6	51.8
	Coal	3	3	2.7	18.0
	Cyclone	1	3	2.9	15.5
	Ford	2	3	2.9	14.1
	South Fork Coal	1	3	3.0	2.4
	Starvation	1	3	3.1	14.0
	Ketchikan	3	3	3.1	37.6
	Ford	1	3	3.4	39.2
	Hay	3	3	3.4	31.0

	Coal	3	3	3.8	28.0
	Moran	1	3	3.9	89.9
	Parke	2	3	4.9	28.0
	Parke	1	3	4.9	41.6
	Ketchikan	2	3	4.9	51.3
	Moran	3	3	5.5	3.7
	Kletomas	1	3	7.3	0.9
	Moran	2	3	7.6	20.1
	Werner	1	3	8.0	13.2
	McGinnis	1	3	8.9	6.0
	Kimmerly	1	3	9.8	38.9
	Yakinikak	5.	3	10.7	2.7
	Ford	3	3	17.0	11.1
	Whale	2	4	0.7	7.8
	Coal	1	4	1.2	13.5
	Akokala	1	4	1.4	18.7
	Big	1	4	1.5	1.4
	Granite	1	4	1.7	4.3
	Hallowat	1	4	1.7	1.4
	quartz	1	4	2.0	62.1
	Coal	1	4	2.4	12.1
	Canyon	1	4	3.7	7.5
Middle Fork	Gateway	4	2	1.2	89.8
	Whistler	1	2	1.6	4.2
	Bergsicker	1	2	1.7	2.4
	Long	2	2	1.8	3.1
	Essex	1	2	2.2	108.4
	Charlie	1	2	2.2	28.0
	Basin	3	2	2.2	44.6
	Walton	2	2	2.5	55.5
	Argosy	2	2	2.7	43.3
	Charlie	2	2	2.7	1.2
	long	3	2	3.2	4.9
	Miner	2	2	3.3	10.1
	South Fork Trail	1	2	3.8	15.4
	Bowl	5	2	3.8	0.6
	Park	4	2	4.5	31.0
	Gateway	3	2	4.8	30.5
	Schafer	4	2	5.5	15.6
	Argosy	1	2	5.8	6.5
	Clack	3	2	7.0	3.1
	Cox	1	3	0.6	2.5
	Lake	2	3	0.7	4.3
	Park	2	3	0.9	39.5
	Schafer	3	3	1.0	24.2
	Strawberry	4	3	1.0	2.6
	Dolly varden	1	3	1.0	2.0

Lodgepole	1	3	1.1	3.1
Basin	2	3	1.1	32.2
Basin	1	3	1.1	67.9
Ole	2	3	1.1	45.1
Miner	1	3	1.3	4.3
Schafer	2	3	1.6	12.1
Cox	2	3	1.5	55.7
Trail	1	3	1.6	2.1
Ole	1	3	1.6	16.3
Morrison	3	3	1.7	20.5
Harrison	1	3	1.9	6.8
Strawberry	3	3	1.9	0.5
Ole	3	3	2.0	43.7
Park	3	3	2.2	50.5
Calbic	1	3	2.3	27.7
Morrison	2	3	2.3	7.0
Pinchot	2	3	2.6	41.8
Trail	2	3	2.7	3.4
Lodgepole	2	3	2.8	18.1
Lake	1	3	2.9	16.3
Lincoln	2	3	3.0	24.6
Challenge	1	3	3.3	54.0
Bowl	4	3	3.4	4.1
Stanton	1	3	3.5	8.2
Muir	2	3	3.8	31.3
West fork Schafer	1	3	3.8	31.9
Gateway	1	3	3.8	3.6
Gateway	2	3	4.0	6.1
Muir	3	3	4.4	90.2
Pinchot	1	3	4.5	15.6
Walton	1	3	4.8	22.4
Twentyfive mile	3	3	4.9	34.3
muir	1	3	5.0	62.6
E. Fork Strawberry	1	3	5.2	33.9
Strawberry	1	4	0.7	1.3
Schafer	1	4	0.7	0.8
Shorty	1	4	0.9	9.9
Tunnel	2	4	0.9	1.1
Bowl	1	4	1.0	2.0
Granite	2	4	1.0	9.6
Bowl	3	4	1.0	35.3
Strawberry	2	4	1.1	54.1
Morrison	1	4	1.1	2.1
Park	1	4	1.7	12.9
Lincoln	1	4	2.0	8.3
Bowl	2	4	2.2	2.2
Nyack	2	4	2.5	1.8

	Giefer	1	4	2.5	19.7
	Sear	3	4	2.6	4.5
	Skyland	1	4	3.1	6.1
	Tunnel	1	4	4.2	0.8
	McDonald	1	5	0.2	20.9
	Bear	2	5	0.9	18.9
	Trail	1	5	1.2	9.0
	Bear	1	5	1.8	3.1
South Fork	Emery	1	2	2.0	84.1
	Clark	1	2	3.9	49.9
	mcInernie	1	2	4.0	53.2
	Bent	2	2	4.8	34.4
	South Fork Logan	1	2	6.3	21.3
	Murray	1	2	6.8	37.3
	Dead horse	2	2	7.9	3.6
	Ryle	1	2	8.4	19.1
	Deep	1	2	9.6	51.1
	Devil's corkscrew	1	2	11.3	24.4
	Gordon	3	3	0.5	80.0
	Gordon	4	3	1.7	106.7
	Wounded buck	1	3	2.0	53.7
	Quintonkon	2	3	2.3	27.2
	Tent	1	3	3.6	41.9
	Dead horse	1	3	3.8	3.2
	Lost Johnny	1	3	4.1	81.8
	Wounded buck	3	3	4.5	16.7
	Riverside	1	3	5.3	48.9
	forest	1	3	5.5	76.0
	Gordon	1	4	0.4	4.9
	Little Salmon River	1	4	0.6	5.5
	Youngs	1	4	0.8	9.6
	White river	1	4	1.1	12.9
	Sullivan	2	4	1.6	52.9
	White river	2	4	3.3	45.6
	Danaher	1	5	0.7	19.6

Source: Zubik and Fraley 1986