JUNE 2004

SOUTH FORK FLATHEAD WATERSHED WESTSLOPE CUTTHROAT TROUT CONSERVATION PROGRAM

Draft Environmental Impact Statement

DOE/EIS-0353

BONNEVILLE POWER ADMINISTRATION

South Fork Flathead Watershed
Westslope Cutthroat Trout Conservation Program
Draft Environmental Impact Statement

Responsible Agency: U.S. Department of Energy (DOE), Bonneville Power Administration (BPA)

Cooperating Agencies: U.S. Department of Agriculture, Forest Service (FS) and State of Montana Fish, Wildlife, and Parks (MFWP) Department

Title of Proposed Project: South Fork Flathead Watershed Westslope Cutthroat Trout Conservation Program

State Involved: Montana

Abstract:

In cooperation with MFWP, BPA is proposing to implement a conservation program to preserve the genetic purity of the westslope cutthroat trout populations in the South Fork of the Flathead drainage. The South Fork Flathead Watershed Westslope Cutthroat Trout Conservation Program constitutes a portion of the Hungry Horse Mitigation Program. The purpose of the Hungry Horse Mitigation Program is to mitigate for the construction and operation of Hungry Horse Dam through restoring habitat, improving fish passage, protecting and recovering native fish populations, and reestablishing fish harvest opportunities. The target species for the Hungry Horse Mitigation Program are bull trout, westslope cutthroat trout, and mountain whitefish. The program is designed to preserve the genetically pure fluvial and adfluvial westslope cutthroat trout (*Oncorhynchus clarki lewisi*) populations in the South Fork drainage of the Flathead River. In order to accomplish the goals, MFWP is proposing to remove hybrid trout from identified lakes in the South Fork Flathead drainage on the Flathead National Forest and replace them with genetically pure native westslope cutthroat trout over the next 10-12 years. Some of these lakes occur within the Bob Marshall Wilderness and Jewel Basin Hiking Area. Currently, 21 lakes and their outflow streams with hybrid populations have been identified and are included in this proposal. Other lakes may also be included as additional information is discovered. BPA funds would be used to implement this project. These activities would occur on lands administered by FS.

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For additional copies of this document, please call 1-800-622-4520 – leave a message with the name of this project and your name and mailing address. The draft environmental impact statement is also on the internet at: http://www.efw.bpa.gov/cgi-bin/efw/E/Welcome.cgi. Click on the link to South Fork Flathead Watershed/Westslope Cutthroat Trout Conservation Project.

For additional information on DOE National Environmental Policy Act activities, please contact Carol Borgstrom, Director, Office of NEPA Policy and Compliance, EH-42, U.S. Department of Energy, Room 3E-094, 1000 Independence Avenue S.W., Washington, D.C. 20585, phone: 1-800-472-2756.

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Need for Action

The South Fork Flathead River drains 1,681 square miles of land on the Flathead National Forest and is apportioned into several land use areas: the Bob Marshall Wilderness, the Great Bear Wilderness, and the Jewel Basin Hiking Area (all of which are administered by the Forest Service). The South Fork drainage has 355 lakes and approximately 1,898 miles of stream habitat. The South Fork drainage was isolated in 1952 by the construction of Hungry Horse Dam approximately five miles upstream of its mouth.

The South Fork Flathead River, above Hungry Horse Dam, contains one of the largest genetically pure populations of native westslope cutthroat trout in the nation. The South Fork Flathead is a critical stronghold for this species, representing 50 percent of the statewide range for genetically pure large, interconnected populations. The South Fork drainage is protected from invasion by non-native fish because of the barrier created by Hungry Horse Dam. However, historic stocking has introduced non-native trout species (primarily rainbow trout and Yellowstone cutthroat trout) into some headwater lakes that were historically fishless. By the late 1950’s, fish managers became aware of the negative impacts that past stocking could have on native westslope cutthroat trout, and shortly thereafter changed to stocking native trout. Over time many of the fish in these lakes have hybridized (the crossbreeding of two or more dissimilar stocks).

The underlying need for action is to preserve the integrity of the genetically pure populations of native westslope cutthroat that currently exist in the South Fork Flathead River Watershed by removing the threat of future hybridization with non-native trout that currently inhabit lakes in the South Fork River drainage.

Purpose of Action

The purpose statement includes goals to be achieved while meeting the need for the project. These goals are used to evaluate alternatives proposed to meet the need. Bonneville Power Administration (BPA) will use the following purposes to select among the alternatives:

- Helps BPA fulfill its obligation to protect, mitigate, and enhance fish and wildlife affected by the development of Hungry Horse Dam in a manner consistent with the goals and objectives of the Council's Columbia Basin Fish and Wildlife Program.
- Enhances administrative efficiency and cost-effectiveness.
- Avoids or minimizes adverse environmental impacts.
- Provide the potential to achieve the following biological objectives:
    - Preserve genetically pure westslope cutthroat trout populations in the South Fork drainage (including fluvial, adfluvial and resident life history forms).
    - Eliminate from headwater lakes and their outflow streams, to the extent possible and in a timely manner, the non-native trout that threaten genetically pure stocks of westslope cutthroat trout.

Key Resource Issues

The scoping process (agency and public involvement to determine the range of issues to be addressed) identified several potential effects that may result from the proposed project. Comments were received from numerous individuals, organizations, and agencies that had interest in the proposed project. This information was used to focus the draft environmental impact statement (DEIS). These comments were synthesized into several broad issue categories for analysis in this DEIS. The issues of concern include:

- Impacts to quality of fisheries and angling opportunities may be caused by proposed action. What is the extent and duration of such impacts?
- The proposed action may impact non-target species (particularly bull trout populations). Should the westslope cutthroat be preserved at the risk of losing other fish and angling opportunities?
- Will the removal of all hybrids and other non-natives and the use of the M012 genetic stock may create an undesirable monoculture in the South Fork?
- Will the proposed action affect aquatic-dependent organisms such as plankton, insects, and amphibians? Will threatened, endangered, and sensitive species be impacted?
- How will dead fish impact lake habitat and wildlife?
- Will the use of fish toxins impact water quality in the watershed, including drinking water for humans and animals?
- Is the use of fish toxins appropriate in the management of wilderness areas?
- Should the use of aircraft, outboard motors, or any other motorized/mechanized equipment in wilderness be authorized under the administrative exemption clause to expedite the process?
- What economic impacts will be sustained by commercial outfitters? What will be the short- and long-term effects to the local tourism industry?

Decisions to be Made

The decisions to be made include determining the method and extent of fish removal in lakes and streams; seasonal and long-term timing of the action; method of transport for materials, equipment, and personnel; and whether to restock each lake and stream following the removal of fish. Because some lakes occur within wilderness and the Jewel Basin Hiking Area, methodologies and activities selected for implementation must conform to special land use restrictions as much as possible. Based on the environmental analyses presented in this document: BPA will determine whether to fund the program; Montana Fish, Wildlife, and Parks (MFWP) will determine when to implement the selected alternative;; U.S. Forest Service (FS) will decide whether to approve the use of fish toxins within wilderness and whether to approve the short-term use of aircraft, outboard motors, pumps, and mixers in the wilderness area and Jewel Basin Hiking Area.

Proposed Action and Alternatives

Scope of Project

At the time of the preparation of this draft environmental impact statement (DEIS), 21 specific lakes and their designated stream segments are targeted for treatment. Additional information about the sites including location, size, and specifics about the methods of and procedures proposed for treatment can be found in Appendix C. Although there is no specific information indicating other hybrid lakes and streams are present in the South Fork, if any other lakes and streams in the South Fork Flathead are discovered at some time in the future to contain hybrid trout, these would also need to be treated. A list of lakes currently under consideration follows:

- Black
- Blackfoot
- Clayton
- George
- Handkerchief
- Koessler
- Lena
- Lick
- Lower Big Hawk
- Lower Three Eagles (genetic analysis pending)
- Margaret
- Necklace Chain of Lakes ("Smokey Creek Lakes") – total of four
- Pilgrim
- Pyramid
- Sunburst
- Upper Three Eagles
- Wildcat
- Woodward

The determination to treat lakes and streams other than those 21 listed above would be made only if hybridization was determined through genetic analysis.

Alternatives Under Consideration

BPA is considering the following alternatives:

- Alternative A: (No Action) Status Quo Management
- Alternative B: (Proposed Action) Fish Toxins-Combined Delivery and Application Methods
- Alternative C: Fish Toxins-Motorized/Mechanized Delivery and Application Methods
- Alternative D: Suppression Techniques and Genetic Swamping

The No Action alternative would maintain current management practices, including current fish stocking practices, angling regulations, and future fish stocking. BPA would make no effort to affect the westslope cutthroat population in the South Fork which would provide no means to prevent hybrid trout from moving downstream to pioneer new areas. These hybrid trout would continue to compromise the genetic integrity of the genetically pure westslope cutthroat trout by interbreeding and likely creating new hybrid populations in the South Fork Flathead drainage. If Alternative A: No Action is implemented, hybridization would continue to threaten the genetic purity of the westslope cutthroat populations and could also lead to future restrictions on angling, affect angling opportunities, and management for this species. The No Action Alternative could also lead to an Endangered Species Act (ESA) listing of the westslope cutthroat trout and more severe restrictions for all activities affecting the species in the subbasin.

Alternative B would use a combination of motorized/mechanized (i.e., aircraft, motor boats) and non-motorized/non-mechanized (i.e., livestock, hiking) means to access all project sites and apply fish toxins to remove hybrid trout from the lakes and designated portions of the outflow streams, and then restock the lakes and streams with genetically pure westslope cutthroat trout.

Before re-stocking with fish, Montana Fish, Wildlife and Parks Department (MFWP) would install sentinel fish cages in each lake to determine if the water conditions are appropriate, and if so, the lake and stream would be stocked in order to establish genetically pure cutthroat populations in sufficient quantities to dominate any hybrid fish that might remain, and to re-establish the fishery. MFWP would determine future stocking amounts and frequency on a case-by-case basis.

Monitoring of the restocked fish would continue for several years to determine population viability and associated characteristics, determine program success such as presence and degree of natural reproduction, genetic purity, angling quality, and growth rates of fish.

Alternative C is similar to Alternative B in all respects, but differs in the method used to transport materials, equipment and supplies to the project sites and in the application of fish toxins to the lakes. The main difference is in the use of aircraft as the sole means of transport.

Alternative D proposes the combined use of two or more mechanical removal strategies to reduce hybrid trout numbers in an effort to protect downstream genetic purity of the westslope cutthroat. This alternative would rely on the use of mechanical fish collection methods as a means to suppress the hybrid trout populations by removing as many fish as possible. When population levels are adequately reduced, intensive fish stocking would commence on a “frequent or annual” basis (swamping) in an attempt to dominate the remaining hybrid trout in the lakes.

Comparison Summary of Alternatives

Alternative A: No Action or Status Quo Management

Under Alternative A, current management practices would continue to guide activities in the project area. No action would be taken to remove or depopulate hybridized westslope cutthroat populations in the South Fork drainage. This alternative would not address the objectives of the project, and would not satisfy MFWP goals for future conditions. However, this alternative is analyzed in detail as a baseline for comparison with the other alternatives.

Alternative B: (Proposed Action) Fish Toxins – Combined Delivery and Application Methods

Direct and Indirect Effects

The direct and indirect impacts of this alternative vary by resource. The application of piscicides would impact fisheries for 1-3 years. The ESA listed bull trout is not present in any of the lakes proposed for treatment. However, bull trout do occur in the associated drainages downstream of 13 of the lakes proposed for treatment. Any effects would be minimized or negated because of the natural detoxification of the piscicide that occurs as streams drop in elevation and through the use of potassium permanganate to detoxify.

Wildlife impacts would be minimal. Gathering and sinking the dead fish in the treated lake would stimulate plankton growth as a food source for restocked westslope cutthroat the following growing season, and deter opportunistic scavenging by wildlife. Minimal and short-term impacts would occur to some amphibians and invertebrates. Mammals in general exhibit low susceptibility. Organisms killed by antimycin or rotenone would not be a threat to other animals if consumed.

The effects on water quality from the application of piscicides and potassium permanganate would be temporary and would become undetectable after detoxification.

No direct or indirect effects on soil resources are anticipated. Minor soil compaction and abrasion may occur as a result of trail use by pack animals and associated camping near treatment sites. However, this is a traditional means of transportation in a primitive area.

It is not likely that the piscicides would have a negative impact on plant species. Both rotenone and antimycin have been shown to have minimal, if any, effect on vegetation. Based on the fact that rotenone is commonly used in gardening and antimycin is used to control fungus on living rice plants without apparent damage and that the concentrations used to kill fish are very low, it is unlikely that there would be any effects on vegetation in the project area.

Since antimycin requires less volume per area treated, than other piscicides, fewer aircraft trips and pack animals are required, which limits associated impacts. The wilderness experience (e.g., solitude) of users in the area may be affected during the time of delivery and application. This includes the intrusion of additional people, stockpiling of material for those areas delivering material by traditional means (stock), setting up campsites, and the sight and sound of aircraft and other motorized equipment. These impacts would also occur in non-wilderness areas.

To reduce the number of aircraft trips, single-engine aircraft tanker (SEAT) aircraft, instead of helicopters, would be used for non-wilderness applications where possible. Most lakes and associated stream segments would be treated over a three to four day period of time. There would be moderate short-term adverse impacts on proposed wilderness due to noise and disturbance from flights.

Humans in the flight paths or areas near lakes and streams being treated could find noise and visual effects from aircraft, motor boats, humans, and pack animals bothersome. These impacts would be temporary and minimal. Noises and odors from motorboats, pump motors, and aircraft during application would be limited to the duration of treatment (i.e., several days in the fall of a single year).

Cumulative Effects

There is expected to be a cumulative effect on regional guides and outfitters and associated tourism during the periods proposed for treatment. There would be an opportunity cost to guides and outfitters as potential tourists, adjusting for changes in expectation and experience, choose to delay their travel plans, visit other locations, or book expeditions through other guides and outfitters.

Angling opportunities on lakes scheduled for treatment may be temporarily improved as restrictions (i.e., size and catch limits) would be lifted for a season or two prior to treatment. After treatment, angler displacement would likely occur until fishing opportunity is restored at each lake (usually one year but possibly up to three years). Individual lakes and portions of their outlet streams would be unable to serve outfitters and guides for angling until a sport fishery is restored.

Alternative C: Fish Toxins – Motorized/mechanized Delivery and Application Methods

Direct and Indirect Effects

The direct and indirect effects from Alternative C would be very similar to those listed for Alternative B. The only environmental effects that would differ are those associated with the use of livestock in wilderness areas and the increased use of aircraft at wilderness lakes.

Cumulative Effects

Cumulative effects would be similar to those listed under Alternative B.

Alternative D: Suppression Techniques and Genetic Swamping

Direct and Indirect Effects

The most important direct effect of Alternative D would result from fish suppression efforts. Fish removal using mechanical methods (gill nets and trap nets) would result in a long-term (5 to 10 years) reduction in large trout, which are most vulnerable to capture. The intentional reduction in fish numbers would impact fishing opportunities for humans and potentially, fish-eating birds.

One of the primary direct effects of Alternative D is the loss of quality angling opportunities for an extended period of time. Another direct effect of Alternative D is the long-term and high volume stocking of lakes. The intentional overpopulation of westslope cutthroat using this method would increase competition and inbreeding as intended, but also may reduce growth rates, reduce the overall size of fish, and enhance the potential for downstream migration because of population pressure.

The suppression techniques used at each lake may differ based on the site characteristics, but the impacts to soil and vegetation resources would be similar. Suppression techniques, such as gill-netting or trapping, would require long-term camping near lakeshores, use of motor boats to set and check nets or traps, and travel to and from the lake. Each of these activities would likely be continued for several years. Long-term camping and storage of equipment would lead to trampling of vegetation, soil compaction, loss of vegetation cover, and ultimate site degradation. This would also likely impact the recreational desirability of the lake and surrounding areas during that time.

The use of the suppression techniques of gill netting involve long periods of trapping and netting that require the use of an outboard motor and boat. Alternatives B and C would apply similar motorized use for several rather than the entire season as Alternative D does.

Cumulative Effects

The cumulative effects would be very similar to Alternative B, except that fishery quality and angler displacement would be extended several years.

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Chapter 1.0: Purpose of and Need for Action

In this Chapter:

- Purpose of and Need for Action
- Legal and Administrative History
- Decisions to be Made
- Major Issues
- Document Organization

Development of the hydropower system in the Columbia River Basin has had far-reaching effects on many species of fish and wildlife. The Bonneville Power Administration (BPA) is responsible for protecting, mitigating, and enhancing fish and wildlife affected by the development and operation of federal hydroelectric facilities on the Columbia River and its tributaries (see Pacific Northwest Electric Power Planning and Conservation Act (Act), 16 U.S.C. 839 *et seq*., Section 4(h)(10)(A)). BPA meets this responsibility, in part, by funding projects identified through a regional process led by the Northwest Power and Conservation Council.

The South Fork Flathead Watershed/Westslope Cutthroat Trout Conservation Program constitutes a portion of the Hungry Horse Dam Fisheries Mitigation Program. The purpose of the Program is to mitigate for the construction and operation of Hungry Horse Dam through restoring habitat, improving fish passage, protecting and recovering native fish populations, and reestablishing fish harvest opportunities. The target species for the Hungry Horse Mitigation Program are bull trout, westslope cutthroat trout, and mountain whitefish. The Westslope Cutthroat Trout Conservation Program was proposed by Montana Fish, Wildlife and Parks (MFWP) and BPA to put into action a part of the Hungry Horse Mitigation Program. The program is designed to preserve the genetically pure **fluvial**[1] and **adfluvial** westslope cutthroat trout (*Oncorhynchus clarki lewisi*) populations in the South Fork drainage of the Flathead River. The project is a cooperative effort with the U.S. Forest Service (FS). In order to accomplish the goals, MFWP is proposing to remove hybrid trout from identified lakes and streams in the South Fork Flathead drainage on the Flathead National Forest and replace them with genetically pure native westslope cutthroat trout over the next 10 to 12 years. Some of these lakes and streams occur within the Bob Marshall Wilderness and Jewel Basin Hiking Area. Others may also be included as additional information is discovered. BPA funds would be used to implement this project. These activities would occur on lands administered by FS.

Chapter 1 of this **draft environmental impact statement** (DEIS) describes the current situation, why corrective action is needed, and how BPA is working with others to develop alternatives and decide how to proceed.

[1] Words that appear in boldface are defined in the glossary.

1.1 Need for Action

The South Fork Flathead River, above Hungry Horse Dam, contains one of the largest **genetically pure** populations of native westslope cutthroat trout in the nation. The South Fork drainage is protected from invasion by **non-native** fish because of the barrier created by Hungry Horse Dam. However, historic stocking introduced non-native trout species (primarily rainbow trout and Yellowstone cutthroat trout) into some headwater lakes that were historically fishless. By the late 1950's, fish managers became aware of the negative impacts that past stocking could have on native westslope cutthroat trout, and shortly thereafter changed to stocking native trout. However, over time, many of the fish in these lakes hybridized.

Genetic surveys have shown that non-native populations in headwater lakes are escaping and residing in the streams below these lakes (Huston 1988; Huston 1989; Huston 1990; Sage 1993; Leary 2002; Rumsey and Cavigli 2002). This downward progression poses a hybridization threat to the remaining genetically pure populations in the South Fork Flathead. Of the 355 lakes in the South Fork drainage above Hungry Horse Dam, 50 are known to have fish populations. Genetically pure westslope cutthroat exist in 28 of the lakes, and 20 are known to have genetically mixed fish as confirmed through the University of Montana's Wild Trout and Salmon Genetics Lab. Two lake populations (Lower Three Eagles and Crater) are currently under evaluation (see table 3-1). Examination of westslope cutthroat trout in the South Fork Flathead River presently confirms their genetic purity; however, their continued existence is at great risk due to the sources of non-native fish from upstream lakes. Hybridized fish have been collected in tributary streams below lakes with **introgressed** populations. Since 1985, most of these lakes have been stocked with pure westslope cutthroat trout from the state's **M012 brood stock** in an effort to maintain quality sport angling and to reduce the non-native trout genes to undetectable levels. However this technique of "genetic swamping" has not worked because of the lengthy amount of time it takes to accomplish the goals (see Section. 1.2, Background).

In summary, action needs to be taken in order to protect the genetic integrity of the genetically pure populations of native westslope cutthroat trout that currently exist in the South Fork Flathead River Watershed by protecting them from hybridization with non-native trout that currently inhabit lakes and streams in the South Fork River drainage.

1.2 Background

The South Fork Flathead River drains 1,681 square miles of land on the Flathead National Forest and is apportioned into several land use areas: the Bob Marshall Wilderness, the Great Bear Wilderness, and the Jewel Basin Hiking Area, all of which are administered by the FS (see figures 1-5 below for maps of the project area). The South Fork drainage includes 355 lakes and approximately 1,898 miles of stream habitat. The total surface area of lakes with fish is 2,128 acres, with a mean lake size of 42 acres (range 0.5 to 973). The total surface area of fishless lakes in the drainage is 517 acres, with a mean size of 1.7 acres (range 0.1 to 30). The South Fork drainage was isolated in 1952 by the construction of Hungry Horse Dam approximately five miles upstream of its mouth.

MFWP file records indicate that as early as 1959, fish managers had identified sources of rainbow trout and Yellowstone cutthroat trout in the Graves Creek drainage. As early as 1960 they detected unknown sources of rainbow trout in the Big Salmon drainage and were concerned that **hybridization** could impact the westslope cutthroat trout

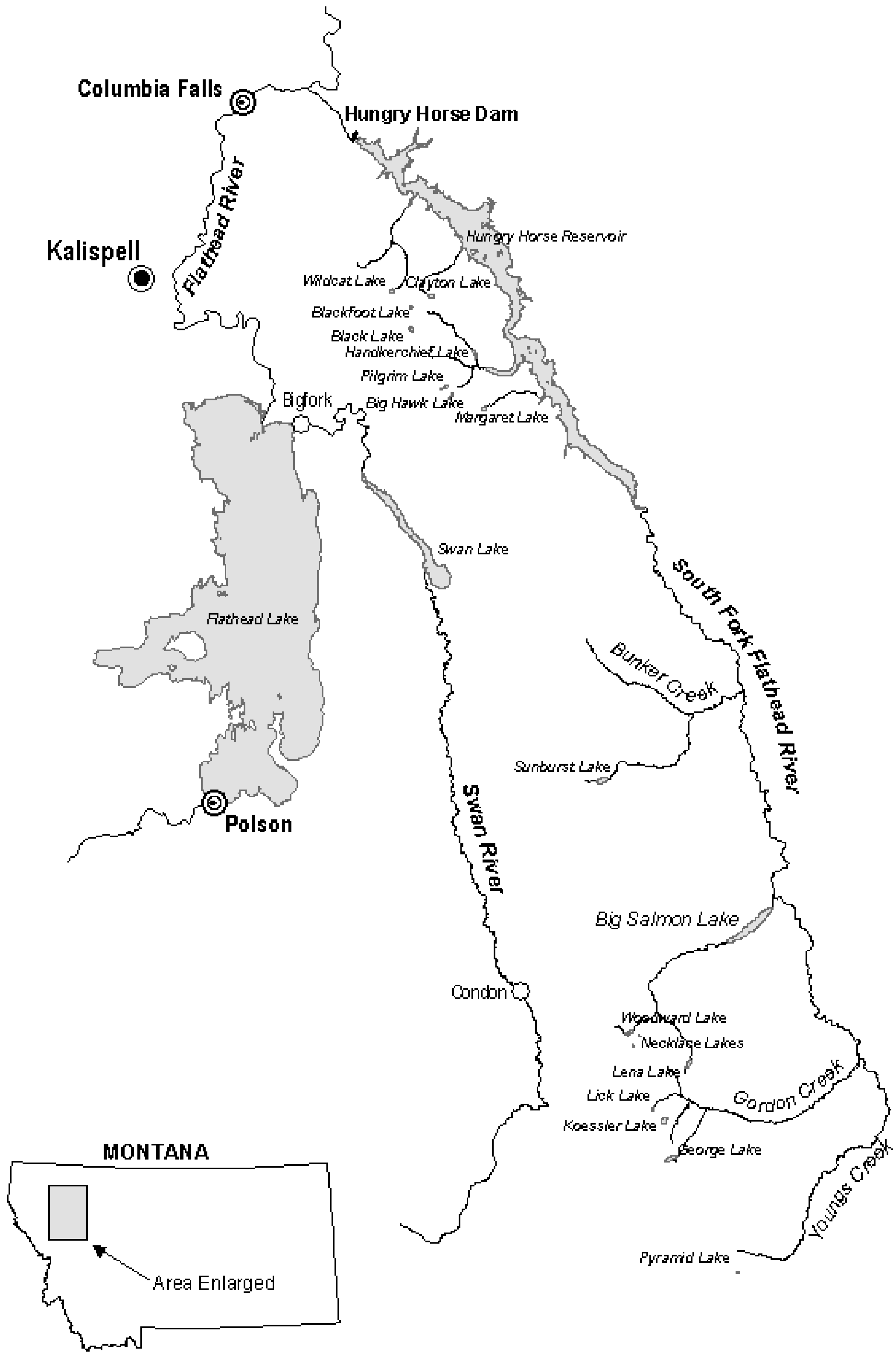

Figure 1-1. Map of the project area.

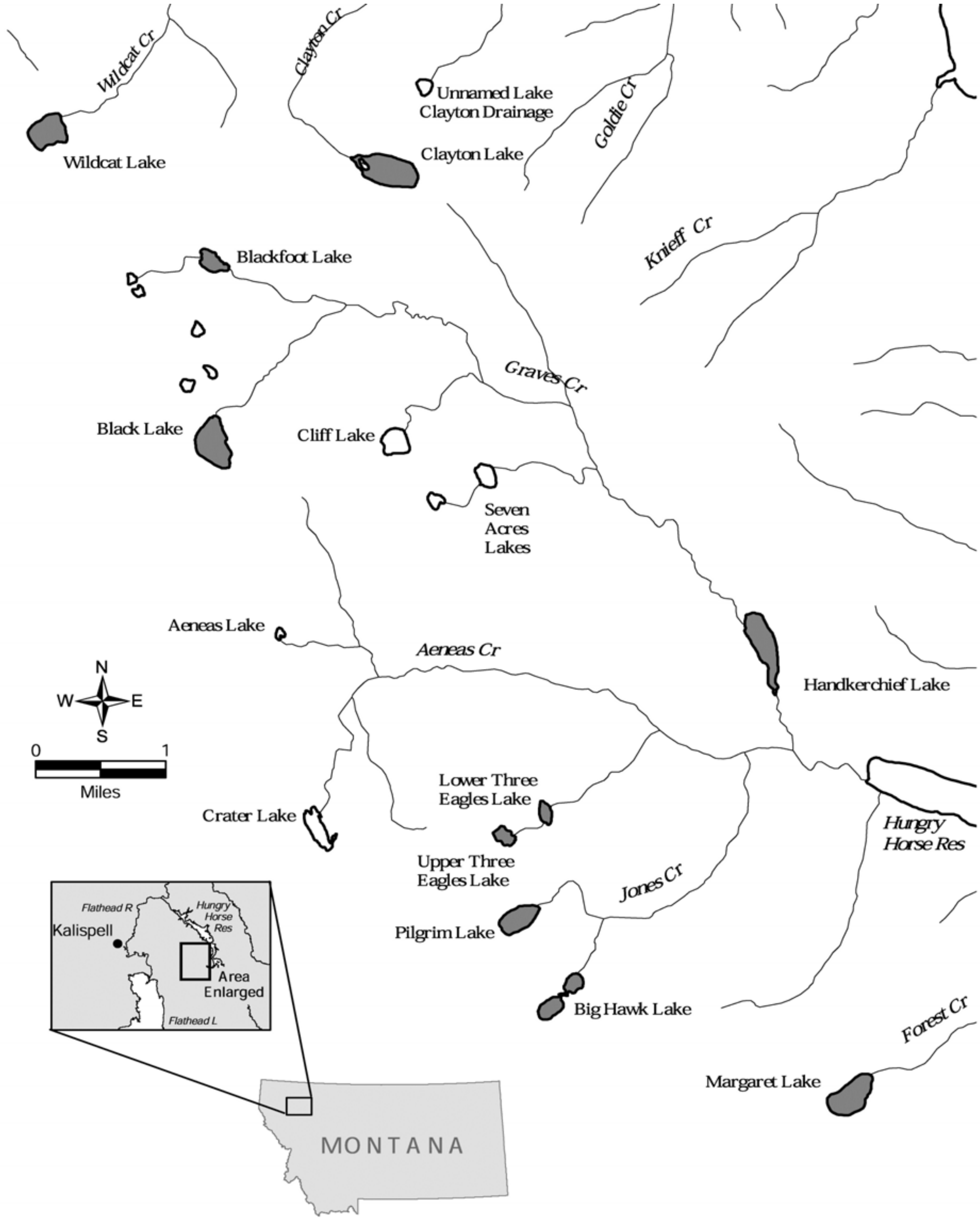

Figure 1-2. Map of non-wilderness lakes in South Fork Flathead River drainage that contain hybrid trout populations. Shaded lakes contain hybrid trout.

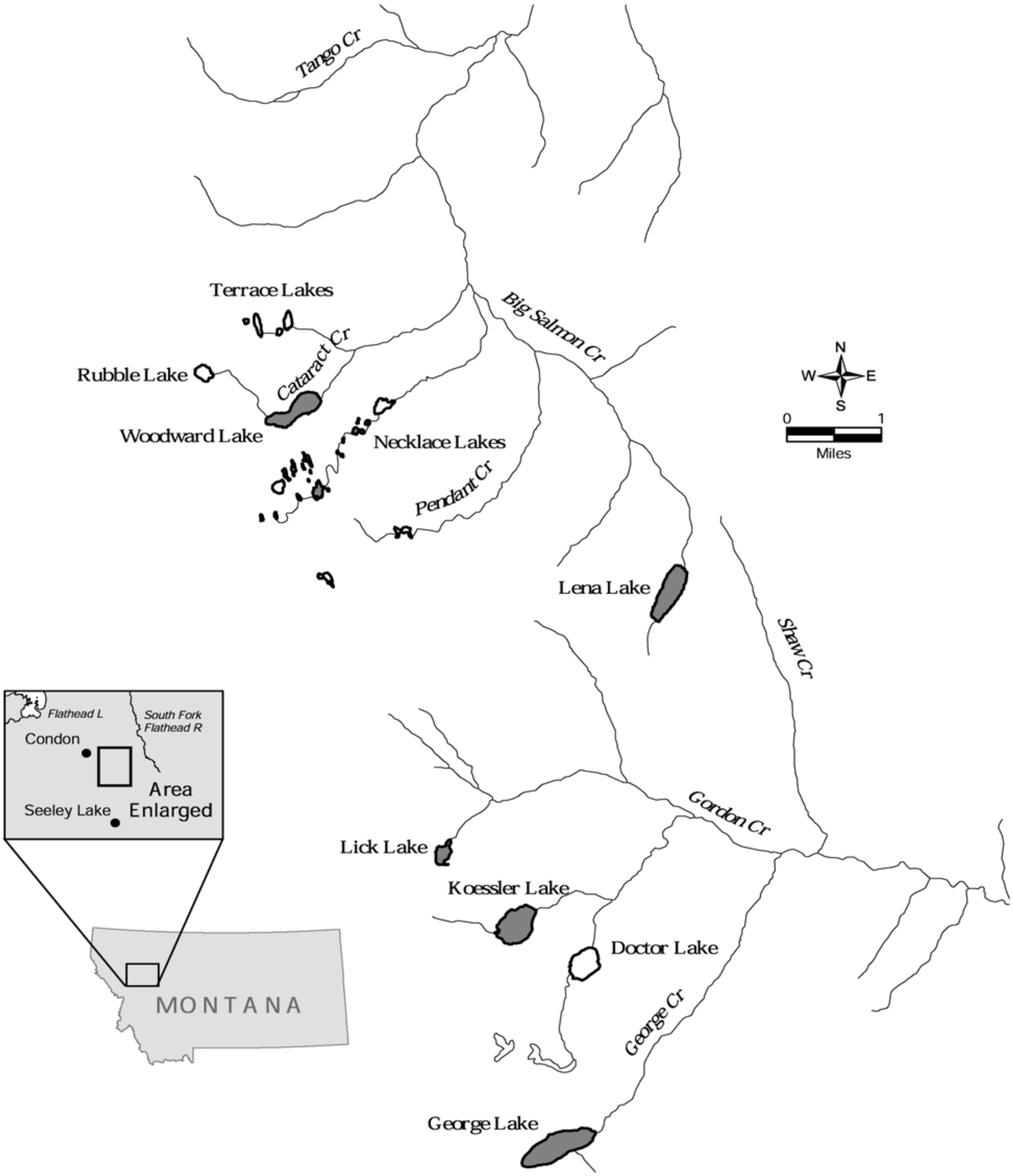

Figure 1-3. Map of wilderness lakes in the South Fork Flathead River drainage that contain hybrid trout populations. Shaded lakes contain hybrid trout.

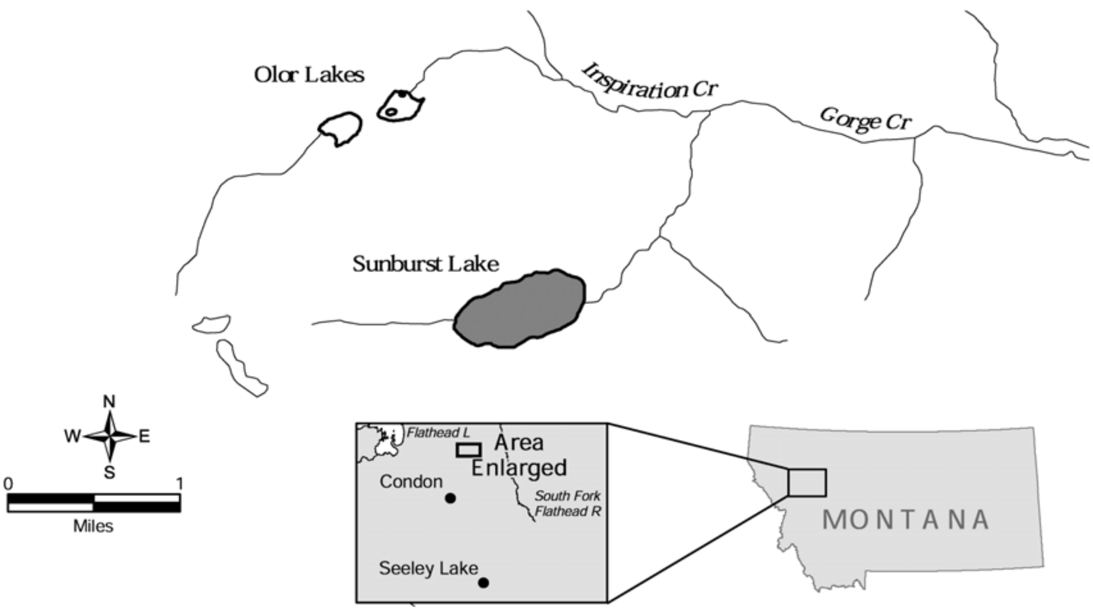

Figure 1-4. Map of Sunburst Lake, which contains a hybrid trout population located on the Bob Marshall Wilderness, South Fork Flathead River drainage.

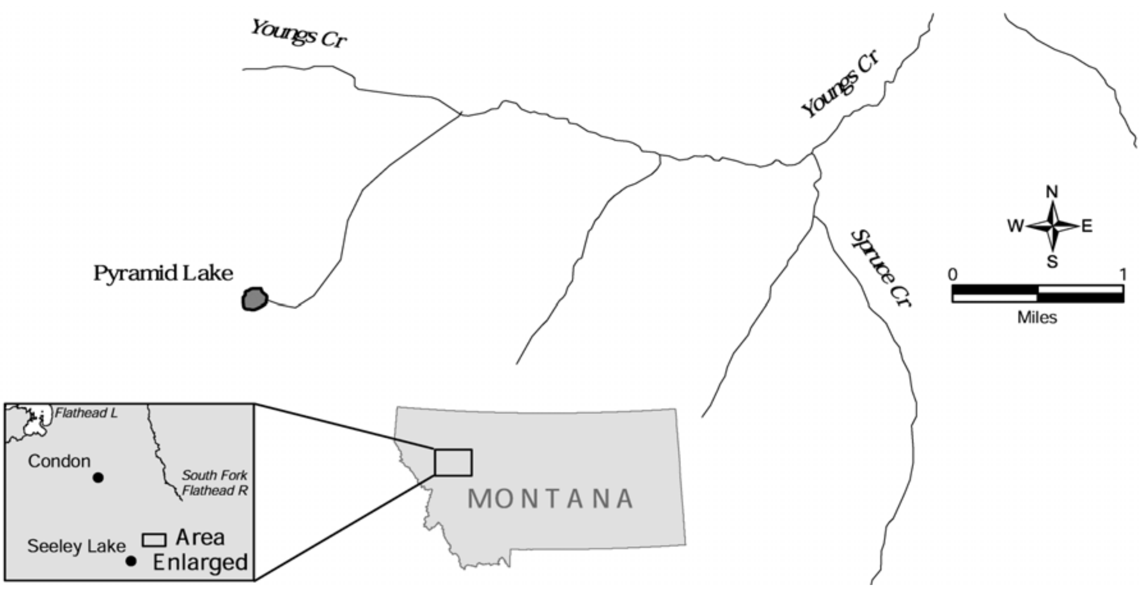

Figure 1-5. Map of Pyramid Lake, which contains a hybrid trout population located on the Bob Marshall Wilderness, South Fork Flathead River drainage.

populations in the South Fork Flathead River drainage. Historical records provide little detail regarding the stocking of rainbow trout in these areas; however, based on the practices of the times, it is believed that these lakes received unrecorded stocks of fish from the 1920's through the 1940's during public fish distribution programs. In Montana, around 1980, conservation efforts to protect the Westslope cutthroat trout increased; and in 1983, MFWP commissioned a status review of westslope cutthroat trout west of the Continental Divide. The South Fork Flathead River drainage was described as the largest and most secure stronghold for the species in Montana (Liknes 1984). The status review determined that hybridization was the primary threat to the South Fork Flathead populations. This threat was especially predictable in drainages that had a lake in the headwaters because many of the water bodies had, historically, been stocked with non-native trout that were escaping downstream.

In Montana, westslope cutthroat trout occur over a range of 19,588 square miles. Genetically pure populations exist in 3,333 square miles of the state. The South Fork Flathead is a critical stronghold of this species, representing 50 percent of the statewide range for genetically pure large, interconnected populations. In the northwestern United States, genetically unaltered westslope cutthroat trout occupy between 8 to 20 percent of historical habitat (Shepard, et al. 2003).

In the early days of trout identification, biologists used morphological features (e.g., spotting patterns, red slashes under the jaw, and color) to visually determine if fish were westslope cutthroat, Yellowstone cutthroat, rainbow, or a mixture of these trout species. By the late 1970s and early 1980s, technological advances allowed for the cost effective use of electrophoresis testing on small amounts of fish tissue. Through this procedure, proteins unique to individual species could be identified. These proteins are also manifested in hybrid fish that, when tested, provide an accurate determination of the level of hybridization at the population level. This technology has been utilized throughout the South Fork Flathead drainage. MFWP file data indicate that since 1983, nearly 130 genetic tests have been conducted by the University of Montana's Wild Trout and Salmon Genetics Lab on fish from lakes and streams in the South Fork Flathead drainage. From these tests, Leary (2002) identified 38 separate populations as pure westslope cutthroat trout residing in both lakes and streams. These tests have determined that 20 of the lakes listed in this proposal, and their outflow streams, contain hybrid populations. Lower Three Eagles Lake is suspected to contain hybrid trout because the lake immediately upstream contains hybrid trout, as does the stream immediately below it. An analysis of this lake population is pending. Most populations have been tested multiple times, measuring the progression of hybridization.

In 1983, MFWP began development of a genetically diverse hatchery brood stock of westslope cutthroat trout that could be used in conservation and restoration programs throughout the state. This was done by gathering wild cutthroat from the South Fork Flathead and lower Clark Fork drainages. In 1984, a second group of wild fish from the South Fork Flathead was added to the broodstock. By 1985, the first offspring were stocked. In 2003, a third group of wild male fish collected from the South Fork Flathead was added to maintain the fitness of this stock. Beginning in 1984-85, a management concept was developed and implemented whereby the newly developed genetically pure westslope cutthroat trout stock were introduced into the South Fork Flathead and area lakes containing hybrid trout on a "frequent or annual" basis in an effort to "replace" the hybrid trout with pure westslope cutthroat (Huston 1988). This concept later became know as the genetic "swamp out" theory. The theoretical time estimate for this management concept to reduce non-native genes to undetectable levels was 20 to 40 years (Huston 1998). Evaluation of the success of this management concept began in 1988 (Huston 1988) and has continued to the present (Leary 2002).

In 1999, eight state and federal agencies (excluding BPA) developed and signed the Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*) in Montana (MFWP 1999a) (hereafter referred to as the Conservation Agreement), which provides a framework for cutthroat conservation strategies in Montana. The overarching goal in the Conservation Agreement states:

> "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 . . ."

In 1999, MFWP stepped up its commitment to westslope cutthroat conservation in the South Fork Flathead. Changing issues surrounding the future of westslope cutthroat trout throughout its historic range have required changing management strategies to favor more conclusive measures of safeguarding, restoring, and conserving the remaining westslope cutthroat trout populations. The present measure of "genetic swamping" is not a decisive measure of eliminating non-native trout due primarily to the extended time frame estimated for this concept to work. Some of the changes in management strategy have included restoring habitat, isolating pure westslope cutthroat populations from non-native fish, and removing non-natives that threaten westslope cutthroats. In the South Fork Flathead, these changing management practices have included the decisive removal of hybrid trout populations that threaten the pure westslope cutthroat trout populations.

From 1999 to 2002, MFWP developed a plan to remove from lakes and streams hybrid trout populations that threaten to expand and hybridize with pure populations throughout the South Fork drainage.

Including the 1999 Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout, there are four mandates or plans that provide the foundation for the proposed action on the behalf of westslope cutthroat trout:

1) Montana Fish Wildlife & Parks is mandated by *state law* (MCA 87-1-201[9ai]) to manage wildlife, fish, game and non-game animals in a manner that prevents the need for listing under by the state (87-5-107) or under the federal Endangered Species Act, and [ii] manage listed species, sensitive species, or a species that is a potential candidate for listing by the state (87-5-107) or under the federal Endangered Species Act in a manner that assists in the maintenance or recovery of those species.

2) Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout in Montana (1999) was developed to expedite implementation and conservation measures for westslope cutthroat trout in Montana as a collaborative and cooperative effort among resource agencies, conservation and industry organizations, resource users, and private landowners. The basic premise of the management goal for westslope cutthroat trout is to protect existing populations, and ensure the long term persistence of the species within its historic range in Montana. Primary among the objectives of this agreement is to protect all genetically pure westslope cutthroat trout populations.

3) Fish, Wildlife and Habitat Management Framework document for the Bob Marshall Wilderness Complex (1995) provides guidelines for the conservation and recovery of Threatened or Endangered species and to protect sensitive species. The principal guideline for this type of activity states to

manage the wilderness to conserve and recover known populations of federally listed Threatened and Endangered species and to protect the habitats on which they depend. Provide habitat for sensitive species to avoid a trend toward federal listing as Threatened or endangered. A myriad of options for executing this type of activity is covered in this framework document including the use of chemical treatments to control exotic fish.

4) Fisheries Management Plan for the South Fork Flathead River Drainage including Hungry Horse Reservoir, and the South Fork Flathead River upstream from Hungry Horse Reservoir (MFWP 1991a), developed by the MFWP, Forest Service and a Citizens Committee lists the drainage wide management goals as (1) maintaining self sustaining fish populations; (2) maintain and improve genetic integrity of westslope cutthroat trout; (3) emphasize a quality fishery over quantity of harvest; and (4) manage the fishery consistent with wilderness management guidelines.

1.3 Purposes

The purpose statement includes goals to be achieved while meeting the need for the project. These goals are used to evaluate alternatives proposed to meet the need. BPA and the FS will consider the following stated purposes in the alternative selection process:

- In a manner consistent with the goals and objectives of the Council's Columbia Basin Fish and Wildlife Program, help BPA fulfill its obligation to protect, mitigate, and enhance fish and wildlife affected by the development of Hungry Horse Dam.
- Enhance administrative efficiency and cost-effectiveness.
- Avoids or minimize, adverse environmental impacts.
- Provide the potential to achieve the following biological objectives:
    - Preserve genetically pure westslope cutthroat trout populations in the South Fork drainage (including fluvial, adfluvial and resident life history forms).
    - Eliminate from headwater lakes and their outflow streams, to the extent possible and in a timely manner, the non-native trout that threaten genetically pure stocks of westslope cutthroat trout.

Though not a decision criterion for selecting an alternative, it is important to note that one of MFWP's purposes is to maintain recreational opportunities in the South Fork cutthroat fishery.

1.4 Public Process and Relevant Issues

1.4.1 Westslope Cutthroat Trout Listing Process

In June of 1997, the U.S. Fish and Wildlife Service (FWS) was petitioned by American Wildlands, Clearwater Biodiversity Project, Inc., Montana Environmental Information Center, The Pacific Rivers Council, Trout Unlimited's Madison-Gallatin Chapter, and Mr. Bud Lilly to list the westslope cutthroat trout as a threatened species under the Endangered Species Act (ESA) (65 FR 20120-20123). On August 8, 2003, the FWS determined that the westslope cutthroat trout should not be listed as a threatened species under the ESA. One of the key reasons cited for this determination was the ongoing conservation efforts, such as the proposed project considered in this document, and their contribution to the viability of these indigenous species in Montana. However, the petitioners may reserve the right to appeal this decision and/or the court response to the agency's decision. For a complete chronology of this action from 1997 to 2003, see Appendix B.

1.4.2 Public Scoping

Scoping refers to a time, early in a project, when the action agency consults the public on what issues should be considered in an EIS. The scoping process helps BPA ensure that the full range of issues and alternatives related to this proposal are addressed in the EIS. The process also identifies significant or potentially significant impacts that may result from the proposed project.

As part of the scoping process, on May 5, 2003, BPA published in the Federal Register a "Notice of Intent (NOI) to prepare an Environmental Impact Statement". The NOI described the proposed action and invited affected landowners, tribes, concerned citizens, special interest groups, local governments, and any other interested parties to comment on the scope of the proposed action. On April 30, 2003, BPA mailed a scoping letter, additional detailed information, answers to frequently asked questions, a project area map, and comment sheet to agencies, tribes, and over 200 potentially interested parties. BPA also held a public scoping meeting on May 22, 2003 in Kalispell, Montana to provide a forum for discussion of the proposed action. At each of these times, BPA requested comments and suggestions defining the issues to be covered in this DEIS. During the scoping process, BPA received 71 comments in the form of letters, e-mails, comment forms, and phone conversations. Comments were received from individuals, organizations, and agencies. This information was used to focus the DEIS. Public scoping comments provided substantial input to the National Environmental Policy Act (NEPA) planning process. BPA received comments that both favored and opposed the proposed action. Commenters recommended some additional alternatives for consideration and discussed many issues of concern. In order to facilitate analysis, these comments were synthesized into several broad issue categories. BPA and the cooperating agencies determined which of these issues were to be addressed in detail in the EIS; these issues are discussed in the sections below.

During the scoping period, MFWP also met with several sporting groups in the area, Professional Wilderness Outfitters Association, two Backcountry Horseman Association groups, Polson Outdoors, and the Flathead Chapter of Trout Unlimited; college groups; and other interested and affected publics. MFWP also coordinated several radio spots, a radio call-in show, and newspaper articles.

1.4.2.1 Summary of Issues Proposed During Scoping

Comments generated during the scoping process suggested several alternatives to the proposed method of using fish toxins to address the need for this project, including installing outlet barriers, screening spawning areas, gill-netting, increasing or removing catch limits, and continuing management concepts like the genetic swamping theory. These alternatives are discussed in more detail in chapter 2.

Fish—As expected, BPA received more comments on fish and the condition of the fishery than on any other resource topic. Commenters discussed their concerns for impacts on non-target species (particularly bull trout populations), and questioned the need to preserve the westslope cutthroat at the risk of losing other fish and angling opportunities. There were also several comments regarding the conclusions drawn from genetics research and testing. Of particular note were commenters that questioned using the M012 brood stock for restocking and swamping purposes. These commenters suggested that the brood stock itself may actually dilute the genetic uniqueness exhibited in the adaptations and phenotypic variations of local pure westslope cutthroat populations. Along this line, several commenters mentioned that with the removal of all hybrids and other non-natives and the use of the M012 genetic stock, the South Fork would become a virtual monoculture, exhibiting little genetic diversity among populations. MFWP is conducting ongoing research to develop so called “nearest neighbor” stocks. Nearest neighbors are the progeny of fish from wild populations that are genetically similar to the population being restored. This strategy is being developed to in order to provide additional diversity to the westslope gene pool. If federal funds are utilized for the development of this stock, additional NEPA environmental review will be completed before this stock is **outplanted.**

There were also a number of comments questioning whether or not the decision to restock lakes after fish removal should be part of the proposed action. Commenters expressed that, “In keeping with the Wilderness Act, the lakes should be restored to their historic fishless condition.” Several commenters suggested keeping a few lakes fishless and restocking the rest for angling.

Wildlife—Commenters expressed considerable interest in the effects of fish removal on local wildlife. Aquatic-dependent organisms such as plankton, insects, and amphibians were mentioned as non-target species. Threatened, endangered, and sensitive terrestrial species were also mentioned. Commenters expressed concern about potential impacts to wildlife habitat from the implementation of treatment options as well as from the transportation of equipment and materials to and from treatment sites. Commenters also expressed that they needed information regarding the impact additional dead fish would have on the environment.

Water—Commenters voiced concern about the impact of fish toxins on water quality in the watershed. Comments included discussions about the safety of drinking water for humans and animals, and the potential for nutrient loading in lakes and streams caused by dead fish. The rate and extent of detoxification of treated waters was also a concern for many. Some commenters urged the careful avoidance of implementation measures within sensitive environments such as wetlands and springs.

Soil and Vegetation—Though not mentioned directly by many commenters, BPA will assess impacts to both soil and vegetation resources. These resources may be impacted by access to remote treatment sites, as well as by the use of **piscicides**.

Land Use and Wilderness—BPA received many comments regarding the implementation of the proposed action within a designated wilderness area. Many commenters voiced opposition to the use of aircraft, outboard motors, or any other motorized/mechanized equipment in designated wilderness areas, while others recommended using motorized equipment exclusively, as authorized under the administrative exemption clause, in order to expedite procedures. Several commenters expressed concern that the use of fish toxins was not appropriate in the management of wilderness areas, and urged the development of a minimum tool analysis.

Recreation—Many commenters expressed concern for the loss of angling opportunities at treated lakes due to the length of time it would take for fish stock to recover, the initial limited size of fish, and the remaining monoculture of fish. Commenters questioned the validity of protecting genetic purity and native species versus providing quality fisheries. Other commenters discussed the visual and auditory impacts treatment activities would have on recreationists. Commenters claimed that these intrusions would result in a lost potential for solitude and a quality wilderness experience.

Socioeconomics—Several commenters expressed concern about the economic impacts that may be sustained by commercial outfitters if lakes were treated, as well as the short- and long-term effects to the local tourism industry.

Methods of Access—As was mentioned above, many commenters were keenly interested in the methods used to convey personnel, materials, and equipment to remote locations, particularly to lakes located within wilderness areas. Some commenters supported the use of aircraft to access wilderness sites in order to expedite the work and to shorten the length of disturbance, and reduce livestock and human impacts to trails, campsites, and lake access areas potentially affected by the project. Others claimed that the use of any motorized or mechanized conveyance in wilderness areas was in direct conflict with the intent of the Wilderness Act. Similar conveyance activity in Jewel Basin was also questioned as it is a designated hiking area, and managed as semi-primitive, non-motorized recreation area. A few commenters pointed out that pack stock should be used in the summer when the trails are dry to avoid excessive impact. Commenters said that pack animals should not be held overnight within wilderness areas.

1.4.2.2 Issues Considered but Eliminated from Further Analysis

BPA looked at many issues and resource concerns when determining the scope of this study. Several of these were eliminated from further analyses.

Air Quality—It was determined that none of the alternatives being considered would impact air quality in any significant way, and would have no short or long-term effects.

Cultural / Tribal—The Confederated Salish and Kootenai Tribes, the Blackfeet Nation, and the Kootenai Tribe of Idaho have been contacted regarding this project and its potential to disturb cultural resources, including religious sites; or hunting, fishing, or gathering sites. None of the tribes have indicated any specific concerns.

Geophysical—Since no ground-disturbing activities are proposed, none of the proposed alternatives would affect geophysical resources or geomorphic (e.g., erosion and sedimentation) processes in the watershed. It is recognized that livestock may have some impact to soils, but this activity is proposed in areas where trail networks are designed to accommodate livestock. The amount of livestock use being considered is not unusually high compared to some other administrative livestock uses in the area.

Restocking—As stated above, comments were received during the scoping period regarding the restocking of lakes after treatment. Commenters felt that lakes in and out of wilderness areas should not be restocked, but left fishless. Other commenters felt that all lakes should be restocked with fish. Since all of the lakes listed in this proposal have been stocked for many years prior to the area’s designation as wilderness, fish stocking is considered a preexisting activity for those lakes that are in the wilderness. As proposed, there would be no change to the fish stocking program.

Further, it is recognized that not restocking the lakes would create impacts to both the environment and the socioeconomics of the area. Angling opportunities would be eliminated, affecting outfitter business. This would also disperse anglers to the remaining fisheries, placing an additional burden on land and fishery resources through concentrated use.

MFWP is proposing to continue historical practices of stocking fish in order to maintain the current recreational and socioeconomic standards, and to increase biological integrity by providing genetically pure westslope cutthroat to seed downstream areas.

1.5 Decisions to be Made

Several decisions are to be made, based on information contained in this DEIS and comments from the public. As the funding agency, BPA is the lead agency for this federal action. MFWP and FS have decision-making authority for this project and are signatories of the Conservation Agreement (MFWP 1999a). The Montana Department of Environmental Quality (MDEQ) and FWS are regulatory agencies that also have considerable input into the final decision.

An analysis was conducted for each lake to determine which of the possible alternatives would best meet the goals of the project. The issues considered included method and extent of fish removal at lakes and streams; seasonal and long-term timing of the action; method of transport for materials, equipment, and personnel; and whether to restock each lake following the removal of fish. Because some lakes occur within wilderness and the Jewel Basin Hiking Area, methodologies and activities selected for implementation would conform to special land use restrictions as much as possible. Each of the agencies involved would contribute their respective expertise, along with public comments, which would be used in the decision making process.

1.5.1 Bonneville Power Administration

BPA is the lead Federal agency for this EIS. MFWP and FS are cooperating agencies. BPA is responsible for protecting, mitigating, and enhancing fish and wildlife affected by the development, and operation of federal hydroelectric facilities on the Columbia River and its tributaries (see Pacific Northwest Electric Power Planning and Conservation Act, 16 U.S.C. 839 *et seq*., Section 4(h)(10)(A)). BPA meets this responsibility, in part, by funding projects identified through a regional process led by the Northwest Power and Conservation Council. The South Fork Flathead Watershed/Westslope Cutthroat Trout Conservation Program, a portion of the Hungry Horse Dam Mitigation Program, was proposed by MFWP through the regional review process. The Council has recommended that BPA fund this project. This draft EIS has been prepared according to NEPA (42 USC 4321 *et seq*.). NEPA is a federal law requiring federal agencies to undergo certain procedures to ensure that the decision maker and the public are informed about environmental consequences of agency actions. Following the environmental review process documented in this EIS, BPA will decide whether to fund the implementation of the proposed action and will issue a **Record of Decision** (ROD).

1.5.2 Montana Fish, Wildlife and Parks

MFWP is a cooperating agency and has jurisdiction and responsibility to manage all fish and wildlife resources that occur on the state, federal, and private lands of Montana. Pursuant to the Montana Environmental Policy Act (MEPA), MFWP has the option of either issuing a separate environmental assessment for this project, or participating in a joint NEPA EIS. The Administrative Rules of Montana govern MFWP actions under Title 12 and provide the basis for conducting joint agency EISs (including MEPA and NEPA) under article 12.2.443. MFWP will issue a ROD on this project as a cooperating agency.

1.5.3 United States Forest Service

The FS is a cooperating agency and has jurisdiction and responsibility for the use and management of National Forest lands, including the Bob Marshall Wilderness and Jewel Basin Hiking Area, all of which occur on the Flathead National Forest. For this project, the Flathead National Forest Supervisor will decide: 1) whether to approve the use of piscicides within wilderness areas for the purpose of eliminating hybrid trout populations from lakes and streams, and 2) whether to approve the short-term use of aircraft, outboard motors, pumps, and mixers within wilderness areas and the Jewel Basin Hiking Area to transport equipment, materials, and personnel needed to accomplish the goals of this proposed project. FS will issue its own ROD on the project, separate from the BPA ROD.

1.5.4 Montana Department of Environmental Quality

Before treating a lake, MFWP must apply for, and secure, a 308 Permit from the Montana Department of Environmental Quality (MDEQ). This permit allows for a short-term exemption from surface water quality standards. MDEQ issues provisions to the permits that ensure the standards of the Water Quality Act will be observed.

1.6 Organization of the DEIS

This DEIS includes information necessary for agency officials to make decisions based on the environmental consequences of proposed actions. Federal regulations specify the kind of information to be provided in order for decision-makers to make informed decisions. This document follows those specifications.

Chapter 1 states the purpose and need for the project. The purposes and need are used to define the range of alternatives and to distinguish between alternatives.

Chapter 2 describes the proposed action and alternatives, including the alternative of taking no action. This chapter summarizes the differences of each alternative, especially each alternative’s potential impact to the environment.

Chapter 3 describes the existing environment that could be affected by the project, and includes both social and natural considerations. This chapter also describes the possible environmental consequences of the proposed action and alternatives on each resource or issue of concern. Impacts can range from no or low impact, to high impact.

Chapter 4 discusses applicable permits and reviews, agency guidance, and legal requirements pertaining to each alternative.

Chapters 5 through 9 list individuals who helped prepare the EIS; individuals, agencies, and groups that were consulted; references used; a glossary of technical terms, and an index.

Supporting technical information is included in the appendices.

Chapter 2.0: Proposed Action and Alternatives

In this Chapter:

- History and Scope
- No Action Alternative
- Proposed Action
- Other Alternatives
- Mitigation Actions
- Alternatives Eliminated from Detailed Consideration
- Comparison of Alternatives and Summary of Impacts

This chapter describes the alternatives being considered to meet the need, summarizes how environmental consequences differ among alternatives, and compares each alternative's potential to satisfy BPA's purposes as outlined in Chapter 1. BPA is considering the following alternatives:

Alternative A: No Action—MFWP continues to manage westslope cutthroat populations as they are currently managed, including current fish stocking practices, angling regulations, and future fish stocking. BPA makes no effort to affect the westslope cutthroat population in the South Fork.

Alternative B: Proposed Action—Use motorized/mechanized and non-motorized/non-mechanized means to access all project sites and to apply fish toxins to remove hybrid trout from designated lakes and designated portions of outflow streams. These designated lakes and streams would then be restocked with genetically pure westslope cutthroat trout.

Alternative C: Use motorized/mechanized means to access all project sites and to apply fish toxins to remove hybrid trout from designated lakes and designated portions of the outflow streams. These designated lakes and streams would then be restocked with genetically pure westslope cutthroat trout.

Alternative D: Use gill netting or other mechanical means of fish removal to suppress hybrid trout populations in designated lakes and, where possible, in designated streams. An intensive "genetic swamping" program would then be implemented.

This chapter also describes other suggested alternatives that have been eliminated from detailed consideration for technical or economic reasons (see section 2.7, Alternatives Considered and Eliminated from Detailed Study). It concludes with a comparative analysis of BPA's alternatives. This analysis provides an overview and introduction to more detailed information presented in Chapter 3.

2.1 History

With the exception of Doctor Lake, most of the lakes in the higher elevations of South Fork drainage were likely fishless before settlers of European origin inhabited the area.

Over time, these lakes were stocked to provide food sources and angling opportunities. Comprehensive genetic testing of South Fork Flathead trout populations began in the mid 80's. A number of non-native trout populations were confirmed by these tests. In 1985, MFWP started a management concept that involved stocking these non-native populations with high densities of genetically pure westslope cutthroat trout on a frequent or annual basis in an effort to reduce non-native genes to a non-detectable level. This management concept later became known as genetic swamping. It was estimated that this management tool would take 40 years to be effective. This method of management *has* increased the percentage of westslope cutthroat genes in some populations; however, some lakes still contain fish with non-native genes. Therefore, a more decisive program to remove the non-native fish and support the genetically pure westslope cutthroat trout populations in the South Fork is being proposed.

2.2 Scope of Project

At the time of the preparation of this DEIS, 21 specific lakes and their designated stream segments are targeted for treatment. A table summarizing information about those lakes and streams is included below. Additional information about the sites including location, size, specifics about the methods of and procedures proposed for treatment can be found in appendix C. Although there is no specific information indicating other hybrid lakes and streams are present in the South Fork, if any other lakes and streams in the South Fork Flathead are discovered, at some time in the future to contain hybrid trout, these would also need to be treated. A list of lakes currently under consideration follows:

- Black
- Blackfoot
- Clayton
- George
- Handkerchief
- Koessler
- Lena
- Lick
- Lower Big Hawk
- Lower Three Eagles (genetic analysis pending)
- Margaret
- Necklace Chain of Lakes ("Smokey Creek Lakes")– total of four
- Pilgrim
- Pyramid
- Sunburst
- Upper Three Eagles
- Wildcat
- Woodward

The determination to treat lakes and streams other than the 21 listed above would be made only if hybridization was determined through genetic analysis. Once hybridization is confirmed, the proposed method of treatment and transportation method would be made based on the following criteria:

- The method of fish removal would include one of those listed in Alternatives B, C, or D; and would be determined by the size and complexity of the project, whether or not any stream segments would require hybrid trout removal, and whether or not sensitive fish species occur in the lake or stream.
- The transport method to the lake would be determined based on land management classification (i.e., wilderness, hiking area, national forest).

BPA would either supplement the existing EIS or prepare a tiered ROD. The public will be notified by utilizing BPA's mailing list for this project. FS would either utilize the supplement prepared to make the appropriate decision or develop a tiered ROD. Under the Administrative Rules of Montana, Title 12 (12.2.445[2]), MFWP would likely prepare a separate ROD. MFWP would utilize the media for announcing the availability of the additional environmental documentation.

2.2.1 Proposed Transportation Method

Conditions under which specific methods of transportation would be selected:

- In all cases, the allowable method of transportation that can be functionally used in a specific area with the least environmental impact would be selected.
- Hiking/Livestock would only be used in areas than can be accessed by system trails.
- Helicopter access would be used in wilderness and non-wilderness areas.
- SEAT aircraft would only be used in non wilderness areas, and would be used when needed to carry and apply large quantities of chemicals.
- The use of helicopters for the transportation of materials, personnel, and equipment would be determined by a lack of appropriate system trail access, and regulations prohibiting the use of livestock.

2.2.2 Proposed Treatment Method

Based on the project proposal, public scoping, analysis of comments, and recommendations contained in this document, fish toxins would be the preferred treatment method, as it is the most reliable and provides the shortest duration of environmental impacts. Although there are no other foreseeable conditions that would prevent implementing fish removal by toxins, it may be necessary to evaluate other possible lake and stream hybridization problems on a case by case basis. Reasons that another treatment method may be considered include:

- Sensitive fish species occur in the lake or stream.
- Any one method may produce too great of an environmental impact.
- The cost of treatment with fish toxins may be prohibitive due to the size of the lake.
- If unanticipated or unforeseen limitations occur with the fish toxin proposed, this may warrant consideration of using the other toxin. For example if **photolosis** of antimycin in large lakes is too rapid, rotenone would be considered to achieve the desired objective.

2.3 Alternative A: No Action or Status Quo Management

Of the 355 lakes in the South Fork drainage above Hungry Horse Dam, 50 are known to have fish. Only 28 of these lakes have genetically pure populations of native westslope cutthroat. The remainder either has hybrid populations (confirmed through the University of Montana's Wild Trout and Salmon Genetics Lab) or are still under investigation to determine their status.

The No Action alternative would maintain current management practices, providing no means to prevent hybrid trout from moving downstream to pioneer new areas. These hybrid trout would continue to compromise the genetic integrity of the genetically pure westslope cutthroat trout by interbreeding, and would likely create new hybrid populations in the South Fork Flathead drainage. If Alternative A: No Action is implemented, hybridization would continue to threaten the genetic purity of the westslope cutthroat populations and could also lead to future restrictions on angling, affect angling opportunities, and management of this species. The No Action alternative could also lead to a Westslope Cutthroat ESA listing and more severe restrictions for all activities affecting the species in the subbasin.

Currently, in general terms, management goals of fisheries in the South Fork focus on the following (MFWP 1991a):

- Maintaining self-sustaining fish populations
- Preventing hybridization of native species
- Maintaining and improving the genetic integrity of westslope cutthroat trout
- Emphasizing high quality fisheries over harvest size
- Managing fisheries consistent with wilderness management guidelines

To accomplish these management goals, MFWP stocks westslope cutthroat trout where needed. Most stocking occurs on a rotational basis, generally in one to five year intervals.

For the foreseeable future, stocking genetically pure fish on a “frequent or annual” basis would likely continue as a management practice, though management goals or administration may change.

2.4 Alternative B: (Proposed Action) Fish Toxins–Combined Delivery and Application Methods

Under the Proposed Action, all fish would be removed from selected lakes and designated portions of their outflow streams in the South Fork of the Flathead that harbor hybrid species that threaten to enter and genetically contaminate streams leading from those lakes, down into the Flathead River and Hungry Horse Reservoir. The piscicides rotenone and antimycin would be used to remove these fish.

The size and volume of these lakes and the quantity of the piscicide needed to treat them has already been measured and calculated. The downstream treatment distances and boundaries have been determined based on past genetic tests, natural barriers such as waterfalls, and the presence of bull trout populations. Calculating the amount of piscicide necessary to treat stream segments would be conducted prior to treatments, and would be based on up-to-date flow measurements and on-site assays. This amount would be small compared to the amount needed for each lake. The piscicides, equipment, and licensed applicators would be transported by livestock, or flown in by helicopter and/or by fixed-wing aircraft. After personnel and material transport is completed, the anticipated time to implement the application on each lake is one day, but may vary depending on unforeseen circumstances. Equipment, materials, and staff would be packed up and removed from the area beginning on the day after the lake treatment. Afterwards, additional personnel would evaluate the lake and collect and measure fish. Stream segments would be treated as necessary to accomplish the downstream goals, and is expected to require one day for setup of **drip stations**, caged fish monitoring stations, and **detoxification stations**; one day for treatment; and several days for detoxification and clean-up. All of these time estimates would vary based on the transport method used, the size and complexity of each project, and site conditions.

Before the re-stocking of fish occurs, MFWP would install sentinel fish cages in each lake to determine if water conditions are appropriate. If so, the lake and stream would be stocked in order to establish genetically pure cutthroat populations in sufficient quantities to ensure domination over any hybrid fish that might remain, and to re-establish the fishery. MFWP would determine future stocking amounts and frequency on a case-by-case basis.

Monitoring of the restocked fish would continue for several years to determine population viability and associated characteristics; to determine program success such as presence; and degree of natural reproduction, genetic purity, angling quality, and growth rates of fish. Lessons learned from these evaluations would be applied to succeeding applications on other lakes. Many of these lessons have already been learned on previous rotenone treatments in the Flathead Basin, contributing to the refinement of safety and technical procedures and the promotion of successful projects. Appendix D provides background detail on the application of rotenone and antimycin, along with their characteristics and historic uses. Table 2-1 below lists the lakes currently being considered for treatment, along with transportation and treatment strategies.

Table 2-1. Lakes proposed for treatment, length of designated outlet stream that would also be treated, and detoxification measures.

Lake	Land Use*	Proposed Treatment Method	Proposed Method of Transport for Personnel, Materials, and Equipment	Outlet Streams or Waters Proposed for Treatment	Detoxification Measures
Wildcat	JBHA	Antimycin	Helicopter	Unnamed pond directly downstream of lake and 1 mile of stream below it.	Use caged fish and potassium permanganate
Clayton	JBHA	Rotenone	SEAT, Helicopter	4.52 miles of stream between the lake barrier and waterfall.	Use caged fish and potassium permanganate
Blackfoot	JBHA	Rotenone	Helicopter	5.76 miles of Graves Creek flowing out of Blackfoot Lake to Handkerchief Lake.	Use caged fish and potassium permanganate

Black	JBHA	Rotenone	SEAT, Helicopter	6.09 miles of stream between Black and Handkerchief Lakes.	Use caged fish and potassium permanganate
Handkerchief	FNF	Antimycin	Truck (lake is accessible by road)	0.5 mile of Graves Creek upstream of lake, and 1.33 miles of stream between the lake and Hungry Horse Reservoir.	Use caged fish and potassium permanganate
Upper Three Eagles (Would be treated concurrent with Lower Three Eagles.)	JBHA	Rotenone	Helicopter	Treated lake water would be allowed to flow downstream, and hybrid trout in the stream would be removed between Upper & Lower Three Eagles Lakes.	Use caged fish and potassium permanganate
Lower Three Eagles	JBHA	Rotenone	Helicopter	2.23 miles of stream to the confluence of Graves Creek.	Use caged fish and potassium permanganate
Pilgrim	JBHA	Rotenone	SEAT & Helicopter	3.27 miles of stream between the lake and the Aeneas-Graves confluence.	Use caged fish and potassium permanganate
Lower Big Hawk	JBHA	Rotenone	Helicopter	2.97 miles of stream between the lake & Graves Creek confluence.	Use caged fish and potassium permanganate
Margaret	FNF	Rotenone	SEAT & helicopter	3.0 miles of stream between the lake & road 895 crossing.	Use caged fish and potassium permanganate

Sunburst	BMW	Antimycin	Livestock	6.1 miles of stream between the lake & the waterfall near Feather Creek.	Use caged fish and potassium permanganate
Woodward	BMW	Antimycin	Livestock	2.96 miles of stream between the lake & Cataract/Big Salmon Creek confluence.	Use caged fish and potassium permanganate
Necklace Chain of Lakes (Smokey Creek Lakes)	BMW	Antimycin	Livestock	Stream segments between the lakes; 2.1 miles of stream between Lower Necklace & Cataract/Big Salmon confluence.	Use caged fish and potassium permanganate
Lena	BMW	Antimycin	Livestock	4.25 miles of Big Salmon Creek between Lena & Cataract Creek confluence.	Use caged fish and potassium permanganate
Lick	BMW	Antimycin	Helicopter	3.7 miles of stream between the lake & rock waterfalls near the Doctor Creek confluence.	Use caged fish and potassium permanganate
Koessler	BMW	Antimycin	Livestock	Treated water will flow from lake to the Doctor Creek confluence.	Use caged fish and potassium permanganate
George	BMW	Antimycin	Helicopter	3.92 miles of stream between the lake and waterfall near its mouth.	Use caged fish and potassium permanganate

Pyramid	BMW	Antimycin	Livestock	Small pond downstream from the lake; 3.3 miles of stream between the lake & Youngs/Devine Creek confluence.	Use caged fish and potassium permanganate

JBHA = Jewel Basin Hiking Area; FNF = Flathead National Forest; BMW=Bob Marshall Wilderness

Based on past experience, piscicide treatments offer the best probability of complete fish removal. However, there have been instances where unforeseen circumstances have required implementing a second treatment to reach project goals. As a measure of treatment success, MFWP would conduct a post treatment survey, which may include netting and observation. Complete success would be defined as no detectible fish. If fish are detected, a second treatment may be implemented to reach project goals. The resultant action stemming from each post treatment evaluation would be considered on a case-by-case basis.

2.4.1 Piscicide Use

2.4.1.1 Background

MFWP has the statutory authority to manage (MCA 87-1-201) and/or restore (MCA 87-1-207) the fishery resources of Montana, specifically to prevent any species from being listed as **endangered** under the federal ESA. Furthermore, it is within the state's purview to stock fish into waters designated as sustainable fisheries, or into those waters where it is necessary to achieve the management goals identified under the above statutes to prevent a species from being listed as endangered.

From 1948 through 2001, MFWP has administered 74 rotenone applications on 63 lakes in the Flathead Basin. Seven of these lakes (11 percent) have required multiple treatments. Reasons for multiple treatments include: survival of unwanted fish in untreated areas (springs, tributaries, etc.); inability to completely remove the source of unwanted fish; or the illegal introduction of a fish species following a treatment. In some of these examples, complete removal has not been an objective of rotenone treatments. Rather the objective has been to reduce unwanted fish to improve angling. Hubbart Reservoir, west of Kalispell, is one such water body that has been treated four times since 1958 to restore quality trout and salmon angling at 12 to 15 year intervals.

The target species from these aforementioned seven lakes have been among the least sensitive to rotenone and include: pumpkinseed sunfish, northern pikeminnow, black bullhead, red-side shiner, yellow perch, largemouth bass, coarse scale sucker, longnose sucker, finescale sucker, and peamouth. Brook trout and rainbow trout are the other species removed from some of these lakes. The average length of time between repeat treatments has been 19 years; and ranges from 8 to 36 years. The number of lakes treated with rotenone in the Flathead Basin represents only 12 percent of the 505 lakes that MFWP considers as managed fisheries in this area.

Piscicides have been used successfully to remove non-native trout from lakes that occur in the project area. In 1986, the East, West, North, and South Jewel lakes were treated with rotenone to remove populations of rainbow trout. In 1994, Devine Lake (located in the Bob Marshall Wilderness) was treated with rotenone to remove the only known population of brook trout from the South Fork drainage. In 2000, Tom Tom Lake was treated with rotenone to remove hybrid trout. All six lakes were restocked with genetically pure westslope cutthroat trout.

2.4.1.2 Rotenone

Rotenone is a compound registered with the U.S. Environmental Protection Agency (EPA) that is used to remove undesirable fish from bodies of water. This compound is extracted from the roots of tropical plants. These roots have been used for centuries by South American natives for a variety of purposes, including capturing fish for food (Gleason, et al. 1969; Teixeira, et al. 1984). The compound was first isolated in 1895, and its chemical structure was established in 1933 (Haley 1978).

Fish managers in North America began using rotenone to manage fish populations in the 1930's. By 1949, 34 states and several Canadian provinces were using rotenone routinely for management of fish populations (Finlayson, et al. 2000). Rotenone is also used as a natural insecticide for gardening and agricultural purposes. Haley (1978) reported that it has been used in humans to control intestinal worms.

Rotenone acts by interfering with cellular respiration in gill-breathing animals. It is particularly effective with fish because it is quickly assimilated into the blood stream through the single cell layer of the gills. Formulations of rotenone products are manufactured (under the brand names Noxfish®, Nusyn-Noxfish®, Prenfish®, and others) and shipped in two different forms: powdered and liquid. For this project, liquid rotenone would be the preferred formulation. Powdered rotenone would have to be mixed at the site with a cement mixer, requiring an auxiliary power source, respirators, protective suits, and additional time to perform the mixing.

Typical dosages of rotenone-based formulations administered to kill fish, range from 0.5 to 6 parts per million (ppm) depending on the species (Gilderhus 1972; Grisak, et al. 2002; Finlayson, et al. 2000). Trout typically require low dosages of 0.5-1 ppm whereas more resilient species like carp and bullhead require dosages of 4-6 ppm. Both fish and aquatic invertebrates (Rach, et al. 1988) are highly susceptible to rotenone. Insects and plankton that are affected by rotenone recover within short periods of time, generally within weeks to months. Bills, et al. (1988) reported that no rainbow trout eggs died from exposure to rotenone.

Rotenone naturally degrades within one to four weeks, depending on water pH, water temperature, alkalinity, ultraviolet light, and dilution by fresh water (Schnick 1974b). Detoxification may be hastened with the addition of a neutralizing agent such as potassium permanganate (Engstrom-Heg 1971, 1972, 1976). For more detailed information on rotenone and its characteristics and uses, see appendix D.

2.4.1.3 Antimycin

Antimycin is an EPA registered chemical under the brand name Fintrol®. It was first discovered in 1945 at the University of Wisconsin as an antifungus treatment for plants (Leben and Keitt 1948). It is a product derived from the fermentation of a species of *Streptomyces* bacteria (Romeo 2002). It has been used in Japan for the control of fungus on rice (Harada, et al. 1959) and is an extremely potent fungicide (Dunshee, et al. 1949).

Antimycin works by inhibiting cellular respiration only in selected organisms. In 1963, Derse and Strong found that it was extremely toxic to fish in much lower concentrations than typically used to control plant diseases. It has been used for over 35 years in commercial aquaculture to kill scaled fish in catfish ponds (Finlayson, et al. 2000). Walker, et al. (1964) reported that trout were extremely sensitive to antimycin, but several plankton and aquatic insects were affected by concentrations much higher than those used to kill fish. Callaham and Huish (1969) reported that zooplankton were severely depleted by antimycin, but began to reappear within 6-9 days, and bottom insects were not affected. Fish are particularly sensitive to antimycin because their gill membranes are only one cell layer thick, which allows for the rapid transfer of it into the blood stream where it ultimately disrupts the electron transfer at the cellular level in vital organs (Schoetteger and Svendsen 1970). This is accentuated in trout because their high oxygen demand requires the movement of a high volume of water across their gills. Different species of fish manifest a different resiliency to the compound.

Antimycin is shipped by the manufacturer in two parts; one is the active ingredient antimycin A with some residual fats, and the second is the surfactant which consists of acetone and detergent. The two parts combined form one "unit," 480 ml weighing 3.75 pounds.

The physical properties of antimycin make it beneficial for site-specific application. When applied to a stream, it loses much of its toxicity with every 200 feet of downstream elevation drop (Tiffan and Bergersen 1996; Romeo 2002). It detoxifies rapidly in a stream because of oxidation created by stream turbulence, interaction with organic substances on the stream bottom, and exposure to sunlight (photolosis). Numerous applicators have described the need to install drip stations at specified intervals to recharge a stream with antimycin in order to successfully carry out the treatment to the designated downstream boundary. This property also makes it an attractive tool in areas where a lake population is targeted and downstream populations are not. Non-target fish populations that occur downstream of a lake treated with antimycin may be safeguarded in this manner if this 200-foot elevation differential is met. In areas where non-target populations are within the 200-foot elevation zone, potassium permanganate has been used to detoxify antimycin (Stefferud, et al. 1992; Gilderhus, et al. 1969). In a stream treatment, more than 1 ppm potassium permanganate would be needed, due to the organic demand of the stream bottom, which reduces much of the compound before it can act with the antimycin.

2.4.1.4 Potassium Permanganate

Potassium permanganate is a strong oxidizer that breaks down into potassium, manganese, and water (Finlayson, et al. 2000). This compound is used in fish aquaculture to remove fungus and parasites, and to increase soluble oxygen in water, thus averting fish kills (Lay 1971). It can be used to detoxify both antimycin (Marking and Bills 1975) and rotenone (Engstrom-Heg 1972, 1976; Lay 1971). Although it is used in fish aquaculture to benefit fish and to neutralize fish toxin, it also can be toxic to fish. Marking and Bills (1975) reported that it is most toxic in low water temperatures, in hard water, and in high pH. Recent bioassays conducted by MFWP indicate that when applied at 1.5 ppm and greater, and with no other substances to oxidize with, it can achieve 100 percent mortality in westslope cutthroat trout after 16 to 24 hours of exposure (Grisak, et al. 2002). Fish exposed to concentrations less than 1.5 ppm survived. Grisak (2003b) found that tailed frog tadpoles and tailed frog adults exposed to 3 and 4 ppm caused 13 percent death at 16 and 24 hours exposure, respectively. No greater mortalities were observed after the 16-hour observation at 3 ppm. A hypothetical application of potassium permanganate might be 4.5 ppm, which includes 1.5 ppm to neutralize the fish toxin, and 3 ppm to account for the organic demand of the stream bottom.

Readily oxidizable substances rapidly decrease the activity of potassium permanganate (Marking and Bills 1975). These substances might include algae on a stream bottom, gravel, mud, leaves from trees, and soil. Applicators must be aware of the amount of time necessary for potassium permanganate and the oxidizing compound (rotenone or antimycin) to contact each other to facilitate detoxification. This time can range from 30 to 60 minutes depending on how fast the stream is flowing. Stream flow can be measured with a flow meter so applicators can calculate the distance a stream would flow over time. Potassium permanganate can detoxify these two compounds more quickly if higher concentrations are used. Typically, potassium permanganate is applied in streams at concentrations ranging from 2 to 6 ppm.

Potassium permanganate would be used to detoxify rotenone and antimycin applied to streams at designated boundaries below each lake. Detoxification drip stations would be monitored throughout the project until a time when caged fish survive below the treatment boundary for a period of 24 hours.

2.4.1.5 Sentinel Fish

Sentinel fish cages would be used in concert with potassium permanganate detoxification stations to evaluate the effectiveness of a treatment and to monitor the effectiveness of detoxification measures. Wild cutthroat trout captured from the target streams would be placed in cages at designated locations throughout the lake and stream drainages that are being treated. A surplus of sentinel fish would be kept at these sites in buckets on the shore in the event that first exposed fish die and more fish are needed for the evaluation. If local fish are not available, genetically pure hatchery westslope cutthroat trout would be used for sentinel evaluations.

2.4.2 Project Assessment and Preparation

Preparations for site-specific implementation would be conducted prior to any treatment. (A minimum of 21 lakes and associated stream segments located on the Flathead National Forest have been proposed for treatment. See appendix C for a detailed description of individual lakes.) Ideally, two to three lakes and the determined amount of each outflow stream would be treated each year over a 10 to 12 year period.

Prior to implementation, the genetic status of lakes would be confirmed through genetic analyses. (Volumetric testing has already been conducted and the amount of piscicide needed has been calculated for the proposed lakes. See figures in appendix C.) On-site assays and current flow measurements would be used to calculate the amount of piscicide and detoxification measures needed for each stream segment. Affected publics would be made aware of treatment times and places.

2.4.2.1 Genetic Testing

Genetic testing has been conducted on most of the lakes in the sub-basin. Confirmation of hybridization, through genetic analyses, has been the impetus for proposing these lakes for treatment. Genetic testing is conducted at the Wild Trout and Salmon Genetics lab at the University of Montana in Missoula.

Over the years, genetic testing methods have evolved with the growing demands and expanding uses for genetic analyses. The early stages of genetic testing in the South Fork Flathead involved the method of allozyme analyses, which was used by fish managers to identify pure populations for use in developing the state's current westslope cutthroat trout hatchery brood stock. This method was later used to measure the progression of hybridization in select populations in the South Fork Flathead, including many of the lakes and streams listed in this proposal. In recent years, however, the methods of genetic testing have changed as have the management objectives for the South Fork Flathead. These changes have allowed different tests, like the PINE-PCR (Paired Interspersed Nuclear DNA Element--Polymerase Chain Reaction) analysis to be used to detect the presence of non-native genes in a population, rather than the percentage of non-native genes in a population. For the purposes of this project, all of the historic genetic tests and the newer PINE-PCR analyses have been used to determine the presence of non-native genes. Due to changing management objectives--primarily from one designed to increase the percentage of westslope cutthroat genes in a population by stocking pure cutthroat on a "frequent or annual basis," to one designed to completely eliminate non-native genes--the PINE-PCR analysis has been an adequate tool for measuring the presence of non-native genes in a population.

In 1986, tests at Upper Three Eagles Lake revealed that it contained Yellowstone cutthroat + westslope cutthroat hybrids (Sage 1993). These tests would be updated to determine whether changes have occurred. Because Upper Three Eagles drains into Lower Three Eagles, it is reasonable to conclude that the fish in the upper lake influence the genome of the fish in the lower lake. However, the lower lake will be sampled one final time to determine its status. Fish angled from Woodward Lake were recently tested and no non-native genes were detected. The lake will be resampled using gillnets in 2004 to confirm this result.

2.4.2.2 Lake and Stream Surveys

A crew would conduct a pre-treatment survey of each lake to map the number and location of surface water inflows and outflows, measure the flow rates, measure water chemistry and temperature, collect plankton samples, and make an estimate or determination of fish habitat features. Some of these surveys have already occurred. Amphibian surveys have been conducted on each lake and are ongoing. Lake **bathymetry** (depth measurement) and locational data have been collected using a handheld sonar device and a global positioning system (GPS) unit. A number of random depth measurements were recorded at GPS locations. These data were entered into a computer program that uses GPS and depth data to create a Triangulated Integrated Network (TIN) representing the lake volume. The program constructs a three-dimensional lake basin as a map and calculates lake volume (see appendix C).

Using this volumetric information, MFWP personnel calculated the proper amount of piscicide needed to remove fish from the lake. The piscicide must be applied at the proper concentration to treat the lake successfully. All calculations and procedures would be double-checked for accuracy by the designated application team prior to formatting the treatment plan for each lake and stream project. The team would then determine the appropriate time for treatment. Most of these projects would be implemented from late September to early November, depending on other, potentially conflicting activities in the area (e.g., spawning seasons, field surveys, and recreation), and weather conditions. Some of the lakes proposed in this project experience low outflow or no outflow during the fall of most years. Conducting treatments at this time would make containment much easier and safer, and would take advantage of lower volume pools. Treatment and detoxification of designated portions of outflow streams would still be required in areas where surface water exists.

Many of the designated streams have been surveyed to gather flow data, water inputs, geologic features, and fish community status. Those that have not yet been thoroughly surveyed would be surveyed in the future, and each stream would be surveyed again prior to any treatment.

Appendix C describes each lake, its associated streams, and the relative presence and distribution of bull trout downstream.

2.4.2.3 Pre-Treatment Plan

Before implementing, a treatment plan will be formulated for each specific lake and stream. The project would be separated into six plan categories each identifying personnel responsible for oversight of the plan and activities contained in each plan. The following are examples of activities that would be outlined in each plan.

(1) <u>Lake treatment</u> application materials management boat/pump maintenance drip stations at lake dead fish collection amphibian collection	(2) <u>Stream treatment</u> sentinel fish collection sentinel fish monitoring drip station spacing drip station monitoring dead fish collection stream flow measure amphibian collection	(3) <u>Detoxification</u> sentinel fish collection sentinel fish monitoring detox station spacing detox station monitoring colorimeter monitoring dead fish collection stream flow measure amphibian collection
(4) <u>Materials management</u> loading/unloading aircraft aircraft fuel	(5) <u>Transport and safety</u> livestock feed & water safety equipment first aid-humans/horses human food & water camp(s) maintenance trail closure/signing spill contingency plan emergency responders	(6) <u>Monitoring</u> water quality samples fish kill evaluation containment of treatment aquatic insects/plankton gill netting pre-treatment flow evaluation

The workers assigned to each area of responsibility would be supervised by an area leader who in turn would report to the project commander. The project commander oversees the entire project. Communication would be maintained by radio, telephone, satellite phone, and messenger.

Before treatment, MFWP fisheries biologists would assign personnel to these respective areas, and provide education and training. The pre-treatment plan would contain vital information on the proposed treatment including breaking the treatment area into zones and assigning personnel to their respective zone and area of responsibility.

In determining the dosage of piscicide needed, the project leaders would consider a variety of physical and biological factors; the most important being lake volume, fresh-water sources to the lake, pH level, elevation difference to downstream non-target fish populations, and proximity of non-target fish species.

Rotenone Dosage

Rotenone dosage is calculated based on a five percent rotenone solution, and is expressed as parts of this liquid formulation per million parts of lake water on a volume basis. One ppm is equivalent to one milligram per liter (1 mg/L). The most common dosages of rotenone formulation used in the lakes treated in Montana range between 1 and 4 ppm, depending on the species and water chemistry. The actual amount of rotenone needed is based on the calculated water volume of the lake (see appendix C). The amount of rotenone needed may be somewhat greater to account for treating freshwater inputs. In theory, rotenone added to freshwater inputs will be discharged into the lake and ultimately add the amount necessary to meet the target concentrations. The rotenone product label recommends using “0.5 to 1 ppm for normal pond use.” Based on assays conducted by MFWP, the target concentration for these lakes and stream segments is 1 ppm (Grisak, et al. 2002).

Antimycin Dosage

The recommended concentrations for lake application of antimycin range from 1 part per billion (ppb) (Derse 1963) to 10 ppb (Gilderhus, et al. 1969), depending on the species of fish. It has been used successfully to remove trout from high altitude lakes in the Mount Massive Wilderness/Rocky Mountain National Park at concentrations of 5 to 8 ppb (Rosenlund and Stevens 1992). The Fish Toxicant Kit Use Direction leaflet that accompanies the product label recommends using 5 to 10 ppb to remove trout. The target concentration for lakes in this proposal is 7.5-8 ppb, and would vary, depending on water chemistry. The amount of antimycin necessary to treat inflow and outflow streams would be determined based on a combination of the label prescriptions and on-site assays.

Potassium Permanganate Dosage

Potassium permanganate dosage is calculated by measuring the amount of organic demand of a stream using a colorimeter instrument, florescent dye, and flow meters to calculate stream discharge. After the amount of stream demand is determined, the appropriate amount necessary to neutralize the piscicide is added.

2.4.2.4 Permitting

Before treating a lake, MFWP must apply for and secure a 308 Permit from MDEQ. This permit would allow for a short-term exemption from surface water quality standards. MDEQ issues provisions to the permits that ensure the standards of the Water Quality Act would be observed.

- The activity must be conducted in accordance with the application.
- Application of antimycin and rotenone must be in compliance with the product label and in accordance with the provisions of the Montana Pesticide Act (Title 80, Chapter 8, MCA) [ARM 17.30.637(8)].
- Excess pesticides and pesticide containers must not be disposed of in a manner or location where they are likely to pollute state waters [ARM 17.30.637(8)].
- The pesticide must be applied by an applicator licensed by the Montana Department of Agriculture to apply restricted-use pesticides (ARM 4.10.313).

- Representatives of the Department of Environmental Quality (DEQ) must have reasonable access to the application site in order to inspect the site for compliance with the terms of this authorization (75-5-603, MCA).
- Signs must be posted at the trailheads, and the Forest Service's authorized outfitters in the area must be notified about the project. Signs must be in place until the project leader determines the pesticide has completely degraded [75-5-308(2), MCA].
- Within 90 days after the pesticide application, the MFWP must report the following information to the DEQ: 1) the amount and type of pesticide used, 2) the location where the pesticide was used, 3) the flow and/or volume of water treated in each lake, stream, stream segment, or tributary, 4) the volume of detoxification chemical used in each stream, stream segment, or tributary, and 5) the results of any chemical or biological monitoring performed [75-5-308(2), MCA].
- Since treatments are planned for lakes and the immediate downstream areas, detoxification will be required at locations designated by MFWP as lower project boundaries. However, to monitor the persistence of un-neutralized antimycin and rotenone, sentinel fish must be posted at designated locations based on stream flow times. If sentinel fish at the lowest site show signs of antimycin or rotenone toxicity, a neutralization station must be located as close as possible to the lowest location and be activated if needed. Sentinel fish at the lowest site will be used to monitor the effectiveness of antimycin and rotenone detoxification [75-5-308(2), MCA].
- Water velocity studies, using accurate instruments, must be performed before the project to determine chemical travel time and chemical application rates [75-5-308(2), MCA].
- The MFWP must notify MDEQ of its intent to apply pesticides at least seven days prior to the activity and within seven days after completion of the pesticide application.

2.4.2.5 Notifying the Public of Treatment Schedules

MFWP would notify the public of treatment schedules via newspaper ads and radio public service announcements. BPA would send a letter annually to its mailing list, including the Confederated Salish and Kootenai Tribes, the Blackfeet Nation, and the Kootenai of Idaho.

Outfitters and guides may be impacted economically when wilderness lakes are unavailable for a period of time due to removal of hybrid fish. Thus, MFWP would notify outfitters groups of the treatment schedule at least two seasons in advance. FS would work with these groups in advance to find alternative lakes that may be used until the lakes they normally use are fishable again. In addition, outfitters and guides planning to use an area during a scheduled treatment time would be notified and given the choice of using a different location or drainage.

2.4.3 Transportation of Staff, Materials, and Equipment to and from the Proposed Treatment Sites

Activities associated with this project are planned to comply with rules in designated wilderness areas and areas in the national forest that are set aside for hiking only. A minimum of six crew members would be used for each lake treatment. Crew size would increase with the size and complexity of each proposed lake. An additional number of personnel would be necessary for stream treatment, detoxification, and monitoring, and would vary depending on the size and complexity of each stream. A party size of 15 would not be exceeded within the wilderness. Pack strings would be broken into strings of 10 to 12 animals.

Treating a lake and stream in a remote location requires the conveyance of licensed applicators, the piscicide, potassium permanganate (the neutralizer applied after the piscicide), the equipment to mix and apply the piscicide, and camp materials. The material would be transported to the lake in one of three ways: livestock, helicopter, or fixed-wing aircraft; and equipment and personnel would be transported by hiking, livestock, or helicopter. Access to downstream areas for application and monitoring purposes would be by livestock or hiking. In wilderness areas, personnel and materials could be transported by livestock to all except two lakes--George and Lick Lakes, which have no maintained access trails, but do facilitate angling by cross-country users. In non-wilderness areas, personnel and materials could be transported by helicopter and, in the case of Handkerchief Lake, by truck. Downstream areas would be accessed at road crossings or by hiking. Single Engine Air Tanker (SEAT) aircraft could be used on non-wilderness lakes to transport and administer a large portion of piscicide to save transportation and application time, and to reduce the number of needed trips. Stock and pack animals are not allowed in the Jewel Basin Hiking Area nor are the trails maintained for such use. Thus, SEAT aircraft are proposed for use in the Jewel Basin.

The method or methods to be used at each lake depends on: (1) the amount and type of needed material, (2) the amount of equipment and required personnel, and (3) applicable land use restrictions.

2.4.3.1 Hiking/Livestock – Wilderness Areas

The use of livestock is a viable alternative in areas that have an improved trail. In 1994, livestock were successfully used to pack 10 gallons of rotenone, equipment, and personnel into the Bob Marshall Wilderness to remove brook trout from Devine Lake. Based on this action, pack stock could transport materials, personnel, and equipment to all lakes that are proposed for treatment that occur in wilderness areas with the exception of George and Lick Lakes, which do not have maintained trails. Lakes that occur on national forest lands outside of the wilderness (e.g., Jewel Basin Hiking Area and other areas) do not have improved trails that would support livestock use. Livestock are not allowed in Jewel Basin. Trails within Jewel Basin Hiking Area are not maintained to support livestock traffic, and livestock are not permitted.

As an example, the following description illustrates how pack animals would be used to navigate equipment, materials, and personnel in and out of the Pyramid Lake area. Similar logistics would be used for other lakes where only personnel would be able to access a candidate lake using pack stock on a maintained trail.

In this example, Pyramid Lake would be treated with antimycin. Access would be made over Pyramid Pass near the Town of Seeley Lake. The antimycin would be transported by livestock in sealed containers secured in reinforced wooden boxes. Manti tarps would be used to cover the boxes for greater protection during travel. The number of pack animals needed for any given treatment would be determined largely by the quantity of piscicide required to treat the lake, the number of personnel needed, and the time required to be at the site. A single pack animal could carry the 38 units (143 pounds) of antimycin. Pyramid Lake would require a total of 17 pack animals:

- One for the antimycin
- Up to six for the conveyance of people, depending on the mix of personnel riding or hiking in.
- Five for personal equipment, camp supplies, and livestock feed
- Five additional for boat motor, raft, drip stations, and miscellaneous equipment

These 17 animals would be separated into multiple pack strings. Travel from Pyramid trailhead to Pyramid Lake would take about 2.5 hours. This represents the least amount of stock needed for transporting materials.

2.4.3.2 Helicopter – Wilderness and Non-wilderness Areas

From 1986 to 2000, helicopters (Bell 47, a Bell 206, and a Hughes 500) were used to transport rotenone, personnel, and equipment to treat eight lakes in remote areas in the Flathead Basin. The helicopters that would be used most in this project would include two Bell OH58s and a Hughes 500. Loads of up to 800 pounds can be sling-loaded under these ships. Depending on air temperature and the amount of fuel onboard, the payload may be increased. An electronic cargo hook on each ship allows loads to be set at the worksite without landing. Each ship can transport three passengers per trip. One of the MFWP OH58 helicopters has floatation struts, making water landings possible. Given this capability, loads can be transported to lakes that do not have landing zones. The helicopter can also land on the water to drop off personnel and to pick up loads near the shoreline.

Figure 2-1. Bell OH58 helicopter at Birch Lake.

Helicopters have been used to dispense rotenone in small high mountain lakes (AFS 2002). A helicopter spray unit was used to apply rotenone to marshy areas of Rogers Lake, Montana in 1993. Although the project was successful, it has not been considered as a viable application technique since that time because rotor wash at this particular site caused excessive aerosolization of the rotenone and made application unsafe for personnel.

For Wilderness lakes with no trail access, administrative helicopter flights would be used to transport materials, equipment, and some personnel. Other personnel would hike or ride if feasible. Project managers would likely stage flights from the Condon airstrip, or other suitable sites near the Owl Creek trailhead. The helicopter flight protocol for treating wilderness lakes would be the same as that described above, but limited to the transport of materials, equipment, and limited personnel.

Because of the lack of trail access or regulations prohibiting the use of livestock, helicopters would be used to transport materials, personnel, and equipment to all lakes outside the Wilderness with the exception of Handkerchief Lake, which is accessible by vehicle. Flights into the lakes in the Jewel Basin area would be staged from the Ferndale Airport near the town of Bigfork. All materials would be brought to the airstrip by truck.

There are no major safety restrictions for wilderness or non-wilderness flights. However, the FWP OH58 is equipped with floatation struts for water landings and would minimize any potential for ground disturbance. Where possible, efforts would be made to avoid flying over camps and trails (see chapter 3, sections 3.8 Recreational Resources and 3.9 Socioeconomic Impacts).

The amount of weight a helicopter can carry per trip determines, in large part, how many trips would be required. Liquid rotenone is packaged in 30-gallon drums that weigh approximately 284 pounds each. The MFWP would likely use their Bell OH58 helicopters, which can carry two 30-gallon drums. The Montana Department of Natural Resources and Conservation (DNRC) have helicopters (Bell UH1) that may carry as many as seven, 30-gallon drums, at 1,988 pounds per trip. The DNRC ships are designated for first-attack fire-suppression, and would be available only if no fires were active. Commercial helicopters would be available, but at a much greater operating expense than that of state-owned ships. Appendix B gives estimates of the amount of piscicide that would be required for each lake.

A typical application using a helicopter for transport would require six people: one boat operator; two drip station installers; one detox station person; one spot sprayer; and one person to load barrels of rotenone, triple-rinse empty barrels, and load/unload cargo nets for the helicopter pilot. Additional personnel would be necessary to treat larger and more complex lakes and streams.

Table 2-2 below is an example of the round-trip flight sequence into Blackfoot Lake located in the Jewel Basin Hiking Area. Assuming rotenone is applied at one part per million (ppm), Blackfoot Lake would need an estimated 68 gallons and would require an estimated nine flights to execute the treatment procedure (see Table 2-2). All downstream applications and monitoring would be accessed by road and trails in the Graves Creek drainage.

Table 2-2: Sample helicopter flight plan: sequence, number, and purpose of flights for typical treatment.

Number of Flights (round-trip)	Purpose
DAY 1	
1	Bring in two crew members.
1	Bring in raft/boat and some equipment.
1	Bring in two, 30-gallon drums of rotenone.
1	Bring in second crew and 8 gallons of rotenone.
1	Remove most equipment and materials.
DAY 2	
2	Remove the remaining equipment.
2	Remove the remaining crew members.

2.4.3.3 Single Engine Aircraft Tanker Airplanes – Non-wilderness Areas

SEAT airplanes could also be used to transport and apply a portion of the piscicide in non-wilderness areas. M18A and M18B Dromader fixed-wing air tankers with a load capacity of 500 gallons are available for use. They have a wing span of 58 feet and are 33 feet long. These aircraft are sufficiently agile that they can apply rotenone from the air on lakes larger than ten surface acres. To test the safety of using SEAT on these applications, four candidate lakes have been pre-flown. Such use would be evaluated on a lake-by-lake basis to determine whether any additional limitations or obstructions would preclude their use, or to determine if this transport and application method could be used on more lakes than just the four that are proposed.

SEAT aircraft can vary the salvo (release) rate of their payload, and can range from full release in as quickly as two seconds to partial release over multiple passes. Distribution rates are calculated in standard distribution guidelines developed for fixed-wing fire suppression and fixed-wing crop dusting. In 2002, MFWP tested SEAT aircraft in Fort Benton, Montana to determine their applicability in this project. Based on the results of those tests, MFWP conducted a final test in May 2003 that involved dropping 500 gallons of dyed water on ice covered Clayton Lake (Grisak 2003d). At full salvo, 500 gallons of dyed water covered an area 403 feet long. Although the ideal application would involve spreading this coverage out, these tests prove that SEAT aircraft are highly precise aerial application tools. Factors that influence application can include air speed, altitude, target site, and terrain limitations. Typical drops are conducted at 40-60 feet altitude and 80 knots (90 mph) airspeed. These variables can be manipulated to achieve the desired outcome for an aerial application.

If SEAT aircraft were used, their role would be to administer a large portion of the rotenone to the surface of the lake, while a boat would be used to mix the compound and administer the remaining portion of rotenone at deeper depths. Due to the potential for aerial applications to generate aerosol, ground applicators would be required to wear protective clothing and respirators to guard against exposure.

In order for a commercial pilot to apply rotenone from the air, the operator must be certified to operate agricultural aircraft, and certified to apply economic poisons (pesticides, fertilizer, herbicides).

The May 2003 test proved that SEAT aircraft can transport and apply large liquid loads to remote high altitude lakes.

Since a paved airstrip is required for SEAT aircraft, they would be staged from the Glacier International Airport. The aircraft would be filled with the desired amount of piscicide and flown to the target lake where the piscicide would be administered over a designated number of passes as determined by the size of the lake. The piscicide administered by boat would be transported to the site by helicopter.

In 2002, four lakes that are candidates for SEAT application--Clayton, Black, Pilgrim, and Margaret--were pre-flown by the SEAT pilot and a project fisheries biologist in a Beechcraft Baron to determine any methodological limitations. No limitations were identified. In order to facilitate a safe and precise application, factors such as target size; approach; exit route, landscape; and probable wind currents, strength, and direction were evaluated at each lake. No factors were identified that could limit the success of the proposed application. Immediately prior to the application of piscicide while the plane is loaded, the lakes would be flown twice to test weather conditions and to establish clear communication with ground personnel. An application where SEAT aircraft are employed would only be conducted if the aircraft is able to administer its load. If weather conditions preclude the application from being conducted that day, it would be postponed until weather conditions improved.

According to the SEAT Program Coordinator for the Bureau of Land Management (BLM), the primary cause of retardant aircraft misplacing loads is misdirection by ground personnel. Ground personnel occasionally misdirect pilots, which results in retardant drops being made in unintended areas. A target that is easy to identify, such as a lake, would ensure no misplacement of piscicide during aerial transport and application. Furthermore, pre-application flyovers would further ensure that SEAT pilots are at the correct location before a load is dropped. Coupled with the flyovers in 2002 and 2003, the SEAT pilot would have flown over each lake at least three times prior to treatment. GPS navigation and communication with ground personnel further ensures proper site delineation.

Based on the information provided by the U.S. Department of Interior (USDOI), Office of Aircraft Services, BLM SEAT Program Coordinators, and independent SEAT aviation contractors regarding the safety record and accuracy of SEAT aircraft, as well as the time-savings for transport and application, SEAT aircraft would be used in combination with a helicopter to transport piscicide to Black, Pilgrim, Margaret, and Clayton Lakes. SEAT aircraft would apply a portion of the piscicide on these lakes in concert with a motorboat.

Because of the larger payload, SEAT aircraft would be used to transport and apply rotenone for the purpose of reducing overall aircraft transport flights, and to expedite applying a large amount of material to some lakes. According to the rotenone label, the directions provide guidance on how to make applications of rotenone to streams and rivers, and ponds, lakes and reservoirs. The label states that the unique nature of every application site could require minor adjustments in the method and rate of application. Should these unique conditions require major deviation from the use directions, a Special Local Need 24(c) registration would be obtained from the Montana Department of Agriculture. Applying pure or lightly diluted formulation with a SEAT aircraft to reduce aircraft transport and application time may constitute a deviation from the use directions. Prior to applying undiluted or slightly diluted rotenone formulation, this label re-write would be obtained; otherwise, label guidelines would be followed under standard application guidelines.

2.4.3.4 Summary of Application Methods

Most applications of piscicide would utilize a combination of transportation methods. This combination would result in the most efficient and least time consuming transportation of personnel and equipment with the least impact on the environment and surrounding designated land areas. Table 2-3 below presents the advantages and disadvantages associated with each mode of project transport.

Table 2-3. Comparison of methods of transportation.

Method	Advantages	Disadvantages
Hiking/Livestock	-Traditional method consistent with wilderness values. -May be more socially acceptable over other methods.	-May contribute to higher environmental impact to trail and surrounding area, depending on trail conditions and maintenance standards. -More time required to transport.

Method	Advantages	Disadvantages
		-Requires securely stored materials on site for longer periods of time. -Longer duration at site. -Potential conflict with other users. -Requires more materials (stock feed, camping gear, etc.).
Helicopter	-Greater time savings. -No disturbance to trails and ground. -Does not require securely stored materials for extended periods of time. -Can access all sites.	-Non-traditional, inconsistent with wilderness values. -May not be as socially acceptable as other methods; e.g., noisy and contrasts with wilderness values. -Short-term impacts from noise. -Less payload than SEAT (requires more flights). -Intrusion within the wilderness and Jewel Basin
SEAT	-Improved time savings. -Minimizes time required for transport and treatment over any other method. -Can transport high volume of material in one trip. -Reduces number of helicopter trips. -High probability of application success. -Does not require storing materials for extended periods of time. -Able to apply large volume of material in short period of time.	-non-traditional, inconsistent with wilderness values -not as socially acceptable as other methods -Public perception that plane may miss target. -Short-term impact from noise. -Intrusion in wilderness area and within Jewel Basin. -Not as agile as helicopter; cannot access every site.

2.4.4 Treatment

Once at the lake, the crew would need to prepare for the next day's application. A sample description of lake treatment is provided below.

Prior to conducting a treatment, the public would be advised of the action well in advance. Notices would target the general public, indicating the lifting of harvest limits from each lake and section of stream, and outfitters would be notified in advance so they could plan client activities accordingly. Immediately before the treatment, trailheads would be signed notifying local users of access restrictions and environmental considerations while recreating in the vicinity of lake and stream treatment areas. Sentinel fish would be collected from the streams. Amphibians also would be collected, if present, for release after the treatment.

2.4.4.1 Day One

After reaching the site, the respective crews would set up a camp, tend to livestock[2], and set up for treatment the next morning. Two crewmembers would travel downstream from the lake, with necessary materials to install sentinel fish cages and install a detox station in preparation to dispense potassium permanganate. As a precautionary measure, this crew would monitor the stream during and after treatment to ensure that the water leaving the lake was sufficiently detoxified. These precautions would be taken to ensure that the piscicide did not affect unintended or non-target fish downstream of the lakes. Trailheads would also be posted to notify recreationists that the lake would be temporarily closed for recreational use during the treatment period. A crew would set up drip stations on inflow streams and prepare for treatment the next day.

2.4.4.2 Day Two

The lake, inflows, and designated downstream sections would be treated with the appropriate piscicide and sentinel cages, drip stations, and detox stations monitored by attendants at each site. The application of piscicide on each lake is intended to be accomplished in a single day, but unforeseen circumstances may necessitate extending this time period briefly. Potassium permanganate would be on hand to administer at intended locations, and to be on hand in other areas in the event of an accidental spill, or in response to unanticipated results.

Application of Rotenone

Rotenone may be applied only by licensed applicators and in adherence to safety precautions identified on the product label. The project supervisor would be knowledgeable and experienced in state regulatory requirements regarding safe and legal use of the rotenone product and applicator safety. All personnel involved with the rotenone application would have received, before treatment, safety training specific to the formulated rotenone product that would be used. All personnel are required to wear protective equipment to avoid unintended exposure to rotenone.

Figure 2-2. Rotenone application by boat.

After the first crew prepared the boat and other necessary equipment, the rotenone would be distributed by motorized boat, using a specialized funnel-and-hose system. The boat would be used to distribute the rotenone around the lake in concentric rings, starting near the shore and then working toward the center. Either a garden hose or pressurized barrel and hose system would be used to distribute

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[2] This step would not apply to those lakes where livestock would not be used for transport.

rotenone to deeper depths. Motorized pumps may also be used to pump rotenone to deeper depths.

Meanwhile, the second crew would prepare drip stations to distribute rotenone and potassium permanganate. At fresh-water inlets to the lake, drip stations would administer a known concentration of rotenone. This action would keep the fish from seeking out fresh water sources and thus avoiding exposure to rotenone. Crew members treating the downstream segments would set up drip stations, sentinel fish monitoring stations, and detoxification stations. All stations would be monitored throughout the treatment and detoxification process.

Information gathered from bioassays on westslope cutthroat trout exposed to 1 ppm rotenone indicates that, once rotenone is fully mixed with lake water, 100 percent mortality can be achieved within two hours of exposure (Grisak, et al. 2002).

On-site assays would determine the location and spacing of all monitoring stations.

As the application takes place, the pilot would continue to bring in rotenone and ferry out empty barrels. At the lake, the “loadmaster” would empty cargo nets, load barrels into the boat, load empty barrels into cargo nets, and hook nets to the helicopter. A second loadmaster (at the airstrip) would load cargo nets with full barrels, unload empty barrels, place them on a trailer, and help fuel the helicopter.

Most of the equipment and materials would be flown out, depending on time, weather, and other conditions; and a small crew would remain at the lake overnight to monitor the treatment.

Application of Antimycin

Prior to the lake treatment, applicators would install drip stations at freshwater inflows; and install drip stations, detoxification stations, and sentinel fish cages in the stream below the lake. The lake application and stream treatment would begin simultaneously.

Application of antimycin begins by administering the compound by boat using an electric bilge pump and a venturi suction mechanism fitted to the outboard motor. In lakes that are greater than 30 feet deep, a pump would be used to administer the compound in deep water using a weighted hose of appropriate length.

Larger lakes would require multiple motorized rafts to ensure the application is completed within one day. Up to date flow data and on-site assays would be used to determine the location and amount of antimycin and potassium permanganate and caged sentinel fish monitoring stations needed. Caged fish would be monitored for 48 hours after the application. Further detoxification monitoring would continue until the caged fish survived a 24 hour time period following the application, after which time, the caged fish would be removed.

2.4.4.3 Day Three and Beyond

If a prolonged detox station is required, then a small camp would remain behind. Two attendants would monitor the station until caged fish were unaffected by the treatment.

Dead fish would be removed from the lakeshore, taken to deeper water, and sunk. This serves to prevent dead fish from becoming an attractant to predators, improve aesthetics at the site, and to stimulate primary production in the lake. To the extent possible, with regard to access, dead fish would be removed from the streams over a several day period following the treatment (Parker 1970; Bradbury 1986).

Detoxification of Rotenone

The rotenone product label (Prenfish 1998) indicates that it will detoxify naturally within 1 to 4 weeks depending on water temperature, alkalinity, etc. Lakes that have no outflow are allowed to detoxify naturally over a period of a few days to several weeks at most (Gilderhaus, et al. 1986; Dawson, et al. 1991; Skaar 2001). A variety of factors influence the natural breakdown of rotenone, including water chemistry, water temperature, and sunlight intensity (photolosis). Sufficient amounts of fresh-water inflow reduce the concentration of rotenone to non-lethal levels to fish. Outflow stream water may also be diluted by freshwater inflows from downstream inputs. Additionally, many lakes in the South Fork Flathead drainage commonly experience low or no outflow in the fall. For this project, if a lake has no outflow it may be prioritized in the treatment schedule because containment of the treatment would be easier. In such cases, the outflow stream would still require treatment in order to remove hybrid trout, but the application would begin at the site where surface water appears in the stream bed and continue to the predetermined downstream boundary.

Additionally, rotenone breaks down rapidly in soil and water as it is exposed to light, heat, oxygen, and alkalinity. It does not easily leach from soil because of its ability to readily bind to sediments, nor is it a groundwater pollutant (see Appendix D). Any rotenone that may drain through fissures in the lakes would bind readily to soils and breakdown rapidly, thus avoiding the potential to contaminate downstream water and soil.

Potassium permanganate would be used to detoxify the rotenone at predetermined locations in the stream. Experiments conducted by Engstrom-Heg (1971, 1972, 1976) provide application rates and concentration levels that take into account the effect that water chemistry, water temperature, and biologic uptake have on the compound, as well as the neutralizing effect of stream and lake substrates. Water chemistry is the major factor that influences this process; it would be evaluated at each site to make the necessary adjustments to achieve the proper concentrations. The appropriate amount of potassium permanganate would be calculated using colorimeter instruments, water tracing dye, and stream flow calculations. MFWP tests indicate that stations can be prevented from freezing by installing them in insulated boxes with small pocket fuel heaters. All detox stations would be maintained until caged fish survive downstream of the detoxification site, which may require several days. The average designated length of the eight streams that would be treated with rotenone is 3.9 miles, with a range from 2.23 to 6.09 miles.

To detoxify a rotenone application, project managers would rely on the following:

- No outflow (detoxification will occur in the lake naturally)
- Dilution by downstream freshwater inputs
- Downstream detoxification with potassium permanganate
- Combinations of all of the above methods

Detoxification of Antimycin

The antimycin product label is accompanied by a Fish Toxicant Kit Use Direction leaflet that indicates that antimycin degrades rapidly and naturally, allowing for fish restocking within about one week (Romeo 2002). Antimycin loses much of its toxicity usually within every 200 feet of downstream vertical elevation drop (Tiffan and Bergersen 1996; Romeo 2002). It detoxifies rapidly in stream environments because of the oxidation action created by stream turbulence, interaction with organic substances on the stream bottom, and exposure to sunlight (photolosis). Numerous applicators have described the need to install drip stations within 200-foot elevation intervals to recharge a stream with antimycin. This characteristic makes antimycin a valuable tool when a lake population is targeted and certain downstream populations are not. Non-target fish populations that occur downstream of a lake treated with antimycin may be safeguarded in this manner if the factors most influencing natural detoxification are present.

The Fish Toxicant Kit Use Direction leaflet indicates, potassium permanganate can be applied at 1ppm to detoxify (more potassium permanganate may be needed if the stream has a high permanganate demand). Antimycin can be detoxified rapidly with potassium permanganate administered in small concentrations (Stefferud, et al. 1992; Gilderhus, et al. 1969). Marking and Bills (1975) reported that antimycin exposed to 1 ppm potassium permanganate had a half life of between 7 and 11 minutes and is rapidly detoxified by 1 ppm potassium permanganate in waters of pH 6.5 to 9.5. Berger (1966) reported that 1 ppm potassium permanganate was used to neutralize 10 ppb antimycin. Using a colorimeter to measure potassium permanganate demand of a stream, field tests would be conducted before the application to determine the appropriate level of potassium permanganate to ensure proper detoxification (Engstrom-Heg 1971, 1976). The likely potassium permanganate concentration would be 3 to 6 ppm, which accounts for the organic demand of the stream and the interaction with antimycin itself. Activated charcoal, tree leaves, and iron rich water will also readily bind with antimycin.

Potassium permanganate drip stations would be used to control the downstream boundary of each antimycin treatment. Below each lake proposed for antimycin treatment, a designated amount of stream would be treated to meet the project objectives. The average designated length of the 10 streams that would be treated with antimycin is 2.8 miles, ranges from 0.1 to 4.25 miles.

2.4.5 Follow-Up

Post treatment plan

Immediately after the lake is treated, evaluations would be made to determine the success of a treatment. As early as possible, during the following spring and summer, a survey would be conducted at each lake. The survey would include setting gill nets; monitoring caged fish to determine water quality and restocking conditions; and, if possible, the evaluation of the status of non-target organisms like plankton, amphibians, and aquatic insects. If live fish remain in the lake, a determination would be made whether to implement a second treatment.

2.4.5.1 Reports

A certified applicator is required to record each treatment and submit a Montana Department of Agriculture—Record of Application report every five years. The report describes, among other things: the type and amount of piscicide applied; the area treated; application rate; equipment used; possibility of a complete kill; water conditions at the time of treatment; and detoxification measures, if any are used. This reporting standard would be maintained throughout the project.

2.4.5.2 Amphibian Monitoring

Substantial evidence collected from past rotenone treatments in the Flathead Basin indicates rotenone would have no long-term adverse impacts on amphibians in the project area. Laboratory tests conducted by MFWP indicate that antimycin would not have a negative effect on amphibians at the levels prescribed to kill fish. Substantial literature supports these evaluations and tests. However, if the application of either compound shows any anomalous effects on local amphibian populations, MFWP would mitigate these impacts by replacing amphibians that may be impacted. This could be accomplished by transplanting egg masses and young and/or adult amphibians from adjacent populations. A follow-up survey for two years after the treatment would be used to confirm whether amphibians were present within treated areas, and whether they would need to be replaced in any given location. Additionally, tailed frogs could be collected from some streams prior to treatment at the location of drip stations and monitoring stations, and replaced following the treatment.

2.4.6 Restocking

Restocking the lakes is not an action funded by BPA, but rather is the sole responsibility of MFWP. Restocking is discussed in this document because it is connected, in part, to the actions proposed for funding by BPA.

In compliance with the piscicide product labels and supplemental label information, caged fish must survive for 48 hours in antimycin treated water before restocking occurs. The antimycin Fish Toxicant Kit Use Direction leaflet states that antimycin naturally degrades to the point where fish can be restocked within about one week. The rotenone label states that caged fish must survive 24 hours in rotenone treated water before restocking, and recommends waiting two to four weeks after the treatment before testing for restocking. Although the antimycin label supplement recommends using fingerling rainbow trout or fingerling bluegills as sentinel fish, these species are non-native to the project area and using them would present a risk of unintentional introduction if an accidental escapement occurred. For this reason, cutthroat trout from the area or genetically pure westslope cutthroat trout would be used as sentinel fish to determine when stocking can take place.

Historic fish stocking in South Fork Flathead lakes developed new fish populations in many cases, or supplemented existing populations for recreational use. Stocking has continued for various management and conservation measures from the 1920s to the present. Although both of the selected piscicides are highly effective at removing undesirable fish species, there have been instances where isolated fish have survived piscicide treatment by inhabiting undetected ground water inflows. To ensure the complete removal of hybrid fish from the system, continued fish stocking with genetically pure westslope cutthroat trout will dominate the lake and stream environments, thus keeping any potential surviving hybrids from re-establishing a population. Post-treatment stocking would begin immediately in the July following treatment, and would occur annually until a population is firmly established. Post treatment stocking is an integral component in all alternatives involving eradication and suppression. A variety of age classes would be stocked in many of the lakes to expedite restoring the fishery.

Once the population is established, it would be monitored to determine if continued stocking is necessary. Factors that influence continued stocking include the level of natural reproduction and angler harvest. Some lakes have adequate habitat for natural reproduction and may not require maintenance stocking, thus dramatically reducing the frequency of stocking from current levels. In this case, certain lakes could be managed as self-sustaining fisheries. Other lakes would require maintenance stocking to sustain angling quality and population viability.

Restocking pure westslope cutthroat trout in the lakes would establish pure cutthroat populations and ensure their domination over any remaining hybrid fish populations. It would also provide genetically pure fish to seed downstream creeks, and would greatly reduce the temptation for illegal introductions of non-native fish. Rather than relying solely on downstream drift from lakes, restocking streams would expedite the restoration of a viable fish population. MFWP would continue to manage the lake fisheries so as to safeguard the westslope cutthroat trout populations in the South Fork and maintain quality angling opportunities.

It is important to recognize that there is no proposal to impact these segments of the environment or socioeconomics through a “no restocking” option. The only change in fish stocking from the present level would be through the reduction in the number of fish stocked and frequency of stocking at some lakes. This action could be perceived as a benefit by reducing the number of flights and pack trips necessary to maintain the westslope cutthroat trout, area wilderness values, established socioeconomic practices, and angling opportunities and qualities.

2.4.6.1 Compliance

MFWP would comply with the ESA and the Wilderness Act for all restocking activities, including monitoring for the presence of any listed species in the area.

Additionally, MFWP would comply with the guidelines established in the Fish, Wildlife, and Habitat Management Framework for the Bob Marshall Wilderness Complex (BMWC); Memorandum of Understanding and Fish and Wildlife Management Addendum (FS and MFWP 1995). Per this management agreement, MFWP would work jointly with the FS in determining time of stocking, and would notify the FS of fish stocking schedules and numbers and species of fish to be stocked, and would adhere to other guidelines established in this document (FS and MFWP 1995).

2.4.6.2 Restocking Decisions

Once the lakes and designated portions of the streams are depopulated of fish there will be an opportunity to either restock the lakes or leave them fishless. The decision whether or not to restock them lies solely with MFWP. Historically, MFWP has stocked these lakes. One of MFWP’s responsibilities is to maintain cutthroat recreational fishing in these areas. If MFWP does not restock all treated lakes, it is likely that unauthorized, illegal stocking would occur as it has in the past. This could result in the introduction of another non-native species. Decisions would be made pursuant to the BMWC Management Framework Document.

2.4.7 Summary of Proposed Action

Table 2-4. Summary of Alternative B.

FS Land Use[1] Designation	**Lake Size[2]**	**Access**	**Delivery and Application Method**	**Type of Fish Toxin**
Wilderness	S, M, L	System trail	Livestock delivery & motor boat application	Antimycin
Wilderness (Lick & George Lakes)	S, L	No system trail	Helicopter delivery & motor boat application	Antimycin
Non-wilderness	S, M, L	System trail	Helicopter and/or SEAT delivery & motor boat application	Rotenone[3]
Non-wilderness	S, M, L	No system trail	Helicopter and/or SEAT delivery & motor boat application	Rotenone
Non-wilderness (Handkerchief Lake)	L	Road	Truck delivery & motor boat application	Antimycin

[1]Non-wilderness includes lakes on other Forest Service lands, including the Jewel Basin Hiking Area.

[2](S)mall = Lakes 1-19 acres in extent; (M)edium = Lakes 20-49 acres in extent; (L)arge = Lakes larger than 50 acres.

[3]Wild Cat Lake would be treated with antimycin to protect a downstream bull trout population.

2.5 Alternative C: Fish Toxins – Motorized/mechanized Delivery and Application Methods

Alternative C is similar to Alternative B in many respects (see Table 2-4), but differs in the method used to transport materials, equipment and supplies to the project sites and in the application of fish toxins to the lakes. The main difference is in the use of aircraft as the sole means of transport.

Implementing this alternative would remove hybrid fish from selected lakes and designated stream sections in the South Fork Flathead that threaten to genetically contaminate the pure westslope cutthroat populations in the drainage. Rotenone and antimycin would be the fish toxins used to remove hybrid species from the lakes and designated downstream sections. The piscicides, equipment, and licensed applicators would be flown in by helicopter or by fixed-wing aircraft. After the application, materials and staff would be packed up and removed from the area as quickly as possible. The day after the treatment, personnel would evaluate the lake and collect and measure fish.

MFWP would install sentinel cages containing westslope cutthroat trout and monitor them for 24 hours prior to re-stocking. The lakes would be restocked with pure strain westslope cutthroat the following spring in order to establish genetically pure cutthroat populations in sufficient quantities to dominate any hybrid fish that might remain, and to re-establish the fishery. Monitoring of the restocked fish would continue for several years to determine population viability and overall program success. Lessons learned from these evaluations would be applied to succeeding applications on other lakes. Appendix D provides background detail on rotenone and antimycin, along with their characteristics and historic uses.

Table 2-5. Summary of Alternative C.

FS Land Use[1]	Lake Size[2]	Maintained Trail Access	Delivery and Application Method	Type of Fish Toxin
Wilderness	S, M, L	9 with system trails 2 with no system trails	Helicopter delivery & motor boat application	Antimycin
Non-wilderness	S, M, L	No maintained trails for pack stock	Helicopter and/or SEAT delivery & motor boat application	Rotenone[3]
Non-wilderness (Handkerchief Lake)	L	Road	Truck delivery & motor boat application	Antimycin

[1]*Non-wilderness includes lakes on other Forest Service lands, including the Jewel Basin Hiking Area.*

[2]*(S)mall = Lakes 1-19 acres in extent; (M)edium = 20-49 acres in extent; (L)arge = Larger than 50 acres.*

[3]*Wild Cat Lake would be treated with antimycin to protect a downstream bull trout population.*

2.6 Alternative D: Suppression Techniques and Genetic Swamping

This alternative proposes the combined use of two or more mechanical removal strategies to reduce hybrid trout numbers in an effort to protect downstream genetic purity of the westslope cutthroat. This alternative would rely on the use of mechanical fish collection methods (i.e., gill netting, trapping) as a means to suppress the hybrid trout populations by removing as many fish as possible. When population levels are adequately reduced, intensive fish stocking would commence on a “frequent or annual” basis (swamping) in an attempt to dominate the remaining hybrid trout in the lakes.

Suppression techniques are unreliable at completely removing fish populations; they are generally used to depress fish populations. Thus, a period of intensive gill netting or combination of suppression techniques that relied on mechanical fish removal methods would be used to deplete the hybrid fish population. This would be followed by stocking genetically pure westslope cutthroat trout in an attempt to breed the remaining non-native genes out of the population. It is believed that removing a high percentage of the non-native trout from the lake would give swamping an improved probability of success. Lakes that may be deemed too expensive or complex to treat with fish toxins may be candidates for this type of action.

The length of time necessary to implement a lake suppression operation depends largely on fish reduction objectives, the size of each lake, and the number of nets and traps used. The number of nets deployed at any given time would depend primarily on the number of boats and personnel available to perform the operation. Larger lakes would likely require the use of both traps and gill nets in order to maximize the effort of the suppression program. Other factors that dictate whether traps would be used include lake depth, the type of shoreline, the size of the lake, and the number of boats and personnel that would be used at each lake.

Gill nets can be used in all types of lakes. It is estimated that a large percentage of the fish population would likely be removed from any one lake in the first four years of effort. During that time, young fish would be produced each year at most lakes. Because of this, and because small fish are not vulnerable to gill netting and only marginally vulnerable to trapping, it is estimated that approximately three additional years would be required to capture fish that were naturally produced at the lake during the suppression program with the understanding that all fish would not be caught. Recognizing the differences among these lakes, it is estimated that any suppression program using mechanical methods would run for a time period of 5 to10 years. In addition, the number of fish captured per net could be used as a benchmark before implementing genetic swamping with pure westslope cutthroat. For example, when the average number of fish captured per net is reduced by 90 percent and is sustained for two years of netting, genetic swamping could then be implemented. Other factors such as age class strength, and fish size could be determining factors in deciding when to discontinue suppression and when to implement stocking genetically pure westslope cutthroat trout.

Angling limits may be lifted a few years prior to any action in order to allow the public to remove as many fish as possible.

A description of each method is provided below.

2.6.1 Gill netting

Gill netting is a passive capture technique used to collect fish by entangling or ensnaring (Hubert 1992). Both gill nets and trammel nets are arrangements of mesh that capture fish when they swim into it. Most often fish bodies become wedged or their teeth entangled in the net. Nets are typically made of cotton, nylon, or monofilament fiber. Mesh sizes can range from ½ inch for small fish to over 5 inches for larger fish species.

The method has been used successfully to remove unwanted fish from very small lakes and reservoirs. Bighorn Lake, a 5.2 acre lake located in Banff National Park in Alberta, Canada, was gill netted from 1997 to 2000 to remove an unwanted population of brook trout (Parker, et al. 2001). Over 10,000 net nights (one net night is defined as one net set overnight for at least 12 hours) were conducted over a four year period in Bighorn Lake to remove the population, which totaled 261 fish. Researchers concluded that the removal of nonnative trout using gill nets might be impractical for lakes larger than five acres. In clear lakes, trout have the ability to become acclimated to the presence of gill nets and avoid them. These researchers reported observing brook trout avoiding gill nets within about two hours of the nets being set.

Knapp and Matthews (1998) reported that Maul Lake, a 3.9 acre lake in the Inyo National Forest in California, was gill netted from 1992 to 1994 to remove a population of brook trout. The population, which totaled 97 fish, was successfully removed with an effort of 108 net days. The researchers reported that following the removal of brook trout from Maul Lake, it was mistakenly restocked with rainbow trout. Efforts to remove those using gill nets were implemented immediately. From 1994 through 1997, 4,562 net days were required to remove the 477 rainbow trout from the lake.

These researchers reported that gill nets could be used as a viable alternative to chemical treatment. They acknowledged that the small size and shallow depth of Maul Lake contributed greatly to the successful fish eradication by the use of gill nets. Their criteria for successful fish removal using gill nets includes: lakes should be less than 3.9 surface acres; less than 19 feet deep, with little or no inflow or outflow to perpetuate reinvasion; and no natural reproduction of targeted fish. Although not tested, the maximum size of a lake that they felt could be depopulated using gill nets was 7.4 surface acres and 32 feet deep.

Selective gill netting has been used in Yellowstone Lake in Yellowstone National Park in an attempt to control the lake trout population since 1995. From 1995 through 1998, approximately 20,000 lake trout were removed from Yellowstone Lake by gillnets. From 1999 to 2001, over 15,031 net nights were necessary to collect approximately 24,500 lake trout (YCR 2001). Yellowstone Lake is approximately 87,000 surface acres and 360 feet deep. This is an ongoing suppression effort not designed to totally remove the lake trout population, and will need to be continued indefinitely. The lake trout population, although reduced by aggressive netting, remains viable and would rebound if netting were discontinued.

Many reports describe the role of gill nets in reducing overpopulated rough fish (Meronek, et al. 1996). Riel (1965) reported that five successive years of intensive gill netting were required to reduce the overpopulation of yellow perch in Bow Lake, New Hampshire. Gill netting for commercial enterprise has been responsible for the collapse of many fisheries throughout the United States and Canada and includes species like lake trout, walleye, cisco, and lake whitefish. Mitchell and Prepas (1990b) reported that many years of intensive commercial gillnetting of Touchwood Lake, Alberta eliminated lake trout from the lake; attempts to re-establish the population between 1967 and 1990 were unsuccessful. Several other species still persist in the lake and the commercial fishery reportedly continues to harvest an average of 44,000 pounds of fish per year. Mitchell and Prepas (1990a) reported that intensive gillnetting of Lesser Slave Lake, Alberta prior to 1940 eliminated the lake trout population. Subsequent high intensity commercial netting for walleye, cisco, and whitefish caused those fisheries to collapse in the 1960's and 1970's. They have since recovered.

When evaluating the effectiveness of this management practice, the Montana Bull Trout Scientific Group concluded that gill netting would not result in a complete removal of fish that compete with bull trout (MFWP 1996). Rather, they recommended that it be used as a suppression technique. They concluded that in very specific circumstances, this method could lead to total removal.

Targeting concentrations of spawning fish can increase the probability of success using gill nets (Riel 1965). However, high altitude lakes in the South Fork drainage have sheets of ice present during normal spawning periods. Large rafts of ice are present as late as mid July. This would make setting and checking gill nets during spawning times difficult, if not impossible. Westslope cutthroat trout typically spawn in June. Spawning is often delayed in high altitude lakes because of cold water temperatures and ice conditions. Because westslope cutthroat do not sexually mature until about three years of age, at any given time there are at least two year classes of fish that would likely not be present at spawning areas. This would require the return of personnel to the spawning sites for at least two more consecutive years to capture the sexually maturing fish that are attempting to spawn.

Implementing an intensive gill netting program on a remote lake would require having an attended camp at each lake during the summer through fall months. A motorized raft would be required to set and pull gill nets on a daily basis in all weather conditions. To set a gill net, it is necessary to use a boat to ensure the net is deployed quickly and properly. A two person crew is required for gill netting--one to operate the boat and the other to set and retrieve the nets. Gill nets are set by first attaching a weight to the bottom line at one end and a float to the top line at the same end. The weights serve to keep the net from being moved by wind, wave action, and fish that are trying to escape the net. The floats serve to mark the location of the net and to make it easier to retrieve in rough water or in low light conditions. The net is deployed by placing one weighted end in the water and then reversing the boat while the netter feeds the gill net into the water, making sure it is deploying properly. At the other end of the net, a second weight is attached to the bottom line and float is attached to the top line. The net is left in place for the appropriate amount of time. To retrieve the net, the netter approaches the float, retrieves it, and draws it and the net with captured fish into a tub. Once the entire net has been removed from the lake, weights and floats are removed from the ends of the nets; thereafter, the fish are removed. The nets are placed back into the tubes and readied for deployment again. Afterwards, the fish are generally weighed and measured and processed accordingly. Although other researches have reported success using gillnets under the ice of very small lakes during winter months, avalanche debris is very common at nearly every lake listed in this proposal, thus, most likely, precluding any prolonged winter gill netting.

Attendees would be mandatory at these lakes during ice-off conditions to prevent vandalism or theft of gill nets. As recent as 2001, a gill net set in Wildcat Lake in the Jewel Basin Hiking Area was stolen by an unknown party. Because gill netting does not remove hybrid trout from the outlet or inlet streams, another suppression method would be required to remove fish from streams in concert with gill netting efforts on targeted lakes.

All of the necessary materials for gill netting could be transported to wilderness lakes by livestock, or by helicopter to lakes located within the national forest non-wilderness areas and the Jewel Basin Hiking Area. Gill nets, floats, weights, rafts, motors, fish working supplies, and camp materials could be transported to all wilderness lakes that have a trail to them. George and Lick lakes do not have system trail access, which would require access by helicopter.

2.6.2 Trap Nets

Trap nets are a passive method of fish capture (Hubert 1992). Trap nets most commonly used are hoop nets and fyke nets. Hoop nets typically consist of five hoops and frames with netting stretched around them and a mesh funnel on one end that directs fish into the net. A typical size would have a series of three, 4-foot diameter hoops that would stretch to about 20 feet in length. Fish that enter the trap are funneled into the cod end, which is a communal holding area. A hoop trap would hold fish alive for an extended period of time until a fishery worker empties it. A motorized boat is mandatory for setting the trap. The trap may be emptied by pulling it to shore, or by lifting it into a boat. Hoop nets are often baited to attract fish. Hoop nets are highly selective for migratory species and species that that are attracted to bait and cover. For these reasons, they can be selective in what species they will catch.

Fyke nets are similar to the hoop net but have a long net called a “lead” or “fence” attached to direct fish into the funnel. This lead can range in length from 50 to 200 feet. The trap lead is staked on the shoreline of a lake and the entire lead and net is stretched perpendicular to the shore. Fish swimming along the shoreline encounter the trap lead and swim into deeper water to get around the obstacle. In doing so, they swim into the funnel and are ultimately captured at the cod end. Fyke nets are selective for what species of fish they will capture, and work best with species that are mobile and orient to cover (e.g., bass, perch, and most trout species).

The vast majority of literature reviewed concerning trap netting for fish removal had objectives to only reduce the number of stunted or overpopulated rough fish, bluegills, perch, bass, and crappie (Meronek, et al. 1996); or were used in combination with other methods (Rose and Moen, 1952). The literature evaluated demonstrated that an incredible amount of effort was required to only reduce the number of fish in these lakes. Grice (1957) reported the results of fyke netting on several Massachusetts waters. Indian Lake (172 acres) was fyke netted from 1954 to 1956 and 19,300 pounds of panfish and rough fish were removed. Jordan Pond (20 acres) was fyke netted from 1953 through 1955 and 5,700 pounds of fish were removed. Netting did not completely remove all the fish from the water bodies.

Targeting spawning areas to capture fish when they are concentrated is one technique that could increase probability of success using traps (MFWP 1996). However, limitations to this method are similar to other netting methods in that sheets of ice are often present in many high altitude lakes during normal spawning periods. This would make setting and checking trap nets difficult, if not impossible.

As above, there is by-catch of non-target species with these traps. In the Flathead River sloughs, they were lethal to otters, and potentially a problem for other mammals. Negative impacts and risks associated with these techniques need to be understood by decision makers. There are also aesthetic concerns; floats and nets would be visible, detracting from the pristine appearance of these lakes.

When evaluating the effectiveness of trap netting, the Montana Bull Trout Scientific Group concluded that trapping would not result in a complete removal of fish that compete with bull trout (MFWP 1996). Rather, they recommended that it be used as a suppression technique. A motorized boat would be required to set and check trap nets, and a camp would be required at each lake to house personnel for an extended time period for this type of operation. To use a trap net, a motorized boat is required to set and check the net. The use of oared rafts is possible, but is very unsafe for those setting and checking the nets. It is also inefficient.

Setting begins by tethering one end of the lead net to the shoreline with a fencepost. The net is placed on the bow of the boat, which is traveling in reverse while the netter feeds the lead out, making sure it is deploying properly. Feeding the frame system from the bow is continued until reaching the cod end of the net. While the boat operator keeps tension on the net, a float and line is attached at his point with a carabineer as well as an anchor line. The float line is cast away, the netter holds onto the anchor line, and the boat continues to reverse until reaching the end of the anchor. A second float and line is attached to the anchor. The boat continues in reverse until reaching the end of this float line. One final tensioning pull is conducted from this point to stretch the whole apparatus and then it is released. Once the anchor reaches the bottom, it bites into the substrate.

When checking a trap net, the boat approaches the float line at the cod end of the net and retrieves the trap up to the boat. At this point, the anchor line is tied to one side of the boat, and the trap is attached to the other side of the boat. The fish are removed from the trap, float and anchor lines are reattached, and the boat backs away from the trap, which sinks back to the bottom and redeploys. Gradual sloping shorelines and banks are required for the most efficient operation of trap nets (Hubert 1992). However, occasional sets have been successful in steep rocky lake bottoms on Tongue River Reservoir, Montana for collection of walleye. Setting in these conditions often yields few fish and nets have a tendency to roll during deployment, which fouls their capture efficiency. To avoid this, three boats can be used to deploy a trap in areas with steep sloping lake bottoms to prevent rolling.

Many, but not all, lakes listed in this proposal have steep rocky shorelines. Because trap nets cannot be used to effectively remove fish from small high gradient streams, another method of fish removal would be required to meet that objective. Although it is not absolutely necessary to check trap nets on a daily basis, their performance is maximized through frequent checks. A daily presence at each lake would be necessary to deter vandalism of these traps.

2.6.3 Merwin Traps

These traps are very similar to fyke nets, but they are much larger. There is some variation in design and size, but a typical trap includes a lead net that directs fish into a holding chamber. Rather than the holding chamber resting on the bottom of the lake like a fyke trap, a Merwin is suspended by floats that allow fishery workers to check the nets from the surface. Deploying a Merwin trap requires at least one motorized boat to set the leads and to set anchors to keep the holding chamber from floating away. Merwin traps usually have leads that are 12 feet deep by 100 feet long. The holding chamber and float assemblies are approximately 20 feet long by 15 feet wide. Due to the size and weight of these traps, many have trailers built onto the trap so that fishery workers can back them directly into the water from a boat ramp for quick assembly and removal. Given the large size and great weight associated with this trap assembly, transporting them to remote lakes could only be accomplished using a helicopter. A boat is necessary to check a Merwin trap. It would be necessary to have an attended camp at each lake where a Merwin trap was used in order to deter vandalism and check the trap on a regular basis. Like the other mechanical fish removal methods, Merwin traps would not effectively remove fish from streams. For this reason, stream environments would require another fish removal method in order to meet objectives. There are also aesthetic concerns; floats and traps would be visible, detracting from the pristine appearance of these lakes.

2.6.4 Genetic Swamping

This concept is considered a passive method that changes the genetic material in a hybrid population by stocking genetically pure fish on a "frequent or annual" basis into lakes that harbor non-native trout to promote competition and hybridization between species, gradually diluting the non-native genetic material to a non-detectable level (Huston 1990, 1991). Between 1985 and 2000, in an effort to dilute non-native genetic material, 14 lakes in the South Fork Flathead drainage were subject to this type of stocking. It is believed that this method could be expedited if coupled with an intensive program of population suppression by removing hybrid trout using nets and traps.

Coupled with an intensive campaign of gill netting and trapping to suppress hybrid populations, it is believed that following up with genetic swamping could help to reduce the percentage of non-native trout genes in a population even further, though it may not be able to completely remove the genetic introgression. No literature has been found outside of Montana that describes the use of this type of management concept; therefore, it is considered an experimental measure of reducing the risk of hybrid trout expansion.

In remote locations, a helicopter has been used to conduct most of these stockings, including those in wilderness areas. If this type of management were continued, annual flights would be necessary to continue this effort. Discontinuing it would likely allow lakes to resume to a three to five year rotational stocking schedule, thus reducing the amount of stocking flights necessary to implement this management strategy. This method entails stocking at very high densities that can lead to poor trout conditions and growth, compromising the value of the recreational fishery and increasing the costs of hatchery production.

2.7 Alternatives Considered for Suppression and Others Eliminated from Detailed Study

There were ten methods of fish removal that were initially considered for inclusion as a potential alternative to achieve this project's stated purposes. Seven of the alternatives have been eliminated from further consideration. The remaining three methods (gill netting, trap netting, genetic swamping) may be used in part, in whole, or in combination with each other in order to offer the best suppression strategy for individual lakes. Angling is one alternative that was eliminated as a sole means of removing hybrid trout. However, angling limits may be lifted a few years prior to any action in order to allow the public to remove as many fish as possible. Alternatives eliminated from further consideration are:

- Angling
- Seining
- Constructing downstream barriers

- Using explosives
- Electrofishing
- De-watering
- Introducing predatory fish (i.e., tiger muskellunge)

Each method was analyzed to determine its suitability to achieve fish removal goals in the lakes and stream networks of the sub-basin.

Public scoping comments received between April 30 and June 23, 2003 also provided additional information used in the formulation of alternatives. The following alternatives were developed and eventually discarded for economic or feasibility reasons, or because they did not meet the goals for the project.

2.7.1 Angling

MFWP has the authority under commission rule to modify angling regulations for the purpose of removing unwanted fish from a lake or stream. Unfortunately, this method is not likely to completely remove all fish. There are a number of reasons why this method may not work, especially in backcountry lakes.

First, liberalizing bag limits does not guarantee every angler would keep all of the fish they caught, primarily because of differences in value systems among anglers. Recreational angling has been shown, in many instances, to reduce the average size of fish and reduce population abundance. As the size of fish decreases, angler satisfaction tends to decrease also. For these reasons, it may be difficult to attract anglers to a site for voluntary angling if angling quality is poor.

Next, very small fish are not vulnerable to angling and require approximately two years to recruit into the fishery. During this time, adult fish have the opportunity to continue reproducing.

Finally, anglers in remote rugged country do not typically target small high gradient, inaccessible streams when larger fish prevail in larger streams and lakes. Lifting bag limits on streams would not likely succeed in removing significant numbers of fish due to access difficulties. The amount of time required for anglers to depress a population in a lake or stream would likely require many years to accomplish, and would work contrary to the management goals established for the South Fork Flathead drainage, which is to provide quality angling opportunities in lakes, rivers, and streams.

For these reasons, this method was considered unreliable at achieving the objective of complete fish removal from the lakes and streams; therefore, it was not developed further. MFWP would pursue lifting bag limits two full seasons prior to any removal effort to reduce the number of fish in most lakes, and to allow anglers to harvest fish for consumption. In addition, increasing angling limits at the wilderness lakes could lead to additional impacts of the adjacent lake shore and camp sites, requiring restoration measures and/or the limiting of wilderness users at these sites.

2.7.2 Seining

Seining is a method of fish sampling considered to be an active capture method that involves the use of a long fence-like net to encircle and draw in fish to the shoreline for collection (Hayes 1992). The top edge of the seine has floats attached to keep the net upright in the water, and the bottom edge of the net is weighted to keep it on or near the bottom.

There are several types of seines for varying applications related to water depth, rocky or mud bottoms, large fish or small fish. These include bag, purse, minnow, beach, and lampara seines. To deploy a seine, one end is attached to or held by a person on the shore of a lake, pond, or river and the other end is stretched out into deeper water while forming a “U” shape with the net. In a lake, a boat is used to stretch the seine into deeper water. The seine is gradually pulled into the shore to reduce the area of the “U” or “bag” and the fish are gradually concentrated where they can be removed by dip netting or by pulling the remainder of the seine onshore.

Factors that interfere with the capture efficiency of a seine include obstructions such as submerged trees, rocks, aquatic plants, flowing water, uneven lake bottoms, and steep banks. Seines have been used successfully to capture fish for commercial harvest. Warnick (1977) reported that commercial seining has been instrumental in providing about 80-85 percent of the 20-30 million pounds of carp commercially marketed annually in the United States. Under-ice winter seining in South Dakota was reported to be far more effective for this type of operation, though seining under the ice is seldom employed for fisheries management purposes.

Ricker and Gottschalk (1940) reported that seining was used to greatly reduce rough fish numbers, which improved game fishing in Bass Lake, Indiana. From 1935 to 1936, 142,000 pounds of carp, buffalo, and quillback were removed from the lake by seine, and subsequent surveys on game fish revealed an improvement on game fish size and abundance. The authors reported that although the Bass Lake experiment was successful, similar attempts made on many other lakes ended in failure, partly because of the scarcity of suitable beaches for seining.

Rose and Moen (1952) reported that 12 years of aggressive seining on Lake Okoboji, Iowa yielded nearly 2.5 million pounds of rough fish. Seining on this lake could not remove all of the rough fish, even when accompanied by gill netting and trapping over an extended period of time.

The use of seines to remove non-native trout from the proposed lakes was examined and found to be impractical for several reasons. The three major papers cited for this sampling methodology employed large seines measuring up to 2,500 feet in length. Although complete removal was not listed as an objective, the intensive effort only reduced the number of target fish, never removing them completely. The amount of time necessary to effect a complete removal would require many years, which is similar to other methods of mechanical removal. A crew of approximately three or four people with a boat would be required to be at each lake for an extended period of time.

Given the remote nature of the lakes in the South Fork Flathead, long-term operations would have a negative impact on the aesthetics of the lakes. The general lack of gradual beaches and snag free shorelines makes depending on seining an impractical method. Although seining is used successfully to capture fish in larger rivers and low gradient streams, it would not be a practical method of fish removal from small high gradient streams because of steep stream bottoms, coarse substrates, and frequently changing habitat features (pools, riffles, waterfalls). In addition, there are ample ways for trout to avoid seining in this type of stream, such as hiding under large rocks. For these reasons, seining was found to be an ineffective method of complete fish removal, being inferior to gill and trap netting; thus, it was not developed further as a viable alternative.

2.7.3 Downstream Barriers

The use of a barrier device to contain non-native trout within the proposed lakes was considered. Barrier devices are commonly used to exclude fish from an area rather than contain them within an area. Barriers are typically used in streams rather than lakes, and are used mostly to prevent upstream fish migration. Rotary drum screens are commonly used on irrigation diversions to prevent fish from entering arterial channels.

Barriers have been used with some success to exclude fish from upstream migration in Muskrat Creek, Montana (Shepard, et al. 2001). Thompson and Rahel (1998) reported that a gabion barrier in Wyoming was unsuccessful at stopping upstream migrants because it passed 18 of 86 marked brook trout.

The Michigan Department of Natural Resources (MDNR 1990) reported that barriers are not completely effective in most cases. It is nearly impossible to keep fish from moving downstream with the flow of water. To be effective, downstream movement barriers must account for the exclusion of all sizes of fish. Smaller screen mesh is often used to exclude the smallest of fish, but it is prone to clogging from algae, leaves, pine needles, and insect exoskeletons. In order to keep screens clean and functional, maintenance requirements must be increased. Several mechanical apparatus have been used successfully to harness the energy of the water to clean rotary screens. One such device is used on Hell Canyon Creek in the Jefferson River drainage of Montana (Spoon 2002). However, the structure is surrounded by a concrete box to keep leaves and sticks from fouling it.

Containing fish in a lake using a screen or barrier would require construction of a fortified structure at each lake outlet. These structures would have to contain fish at high flow and be able to function in low flow to prevent damming. Fish screens are designed for application on waterways where the flow can be controlled, most commonly on irrigation channels. If flow is too low, the screen would not pick up debris and deposit it downstream of the structure. If flow is too high, the screen may pick up small fish and deposit them downstream of the structure. A rotary screen would not pick up coarse debris, which necessitates it being cleaned by an attendant periodically. The cost of installation can range from $2,000/cfs to $7,000/cfs (Lere 2002). This cost would most likely be increased greatly because of the remote location sites. In addition, to be effective, the mechanical structure would require frequent maintenance. While screening mechanisms would be installed only for a given time period before being removed, they would constitute a structure within Jewel Basin and a wilderness area.

Fish screening mechanisms are prone to vandalism, especially in remote areas. Finally, rotary fish screens do not work in the wintertime because snow and ice cause them to freeze up. Additionally, the greatest limitation for the use of fish screens in this project is that they would not remove non-native trout that are already in the lakes and streams. For these reasons, a fish barrier and screen alternative was not developed for further consideration.

2.7.4 Explosives

Pneumatic and percussion explosions were considered as a method to remove fish from a lake. The shock wave created by underwater explosions would kill fish by rupturing air bladders and inner-ear structures, and would most likely cause massive hemorrhaging in the gills and brain. Campbell and O'Neil (1999) found that pneumatic concussion during petroleum exploration under the ice caused severe internal damage to the swim bladders, gonads, and kidneys of northern pike and walleye in Sturgeon Lake, Alberta, Canada.

However, caged fish located 5 meters away from the sounding device suffered no injuries, and no delayed mortality was observed on any of the test fish after 72 hours.

A traditional explosive such as dynamite could be used to cause severe injury and death to fish. Lennon (1970) reported that explosives have been used to control fish populations, with only limited success against sharks and gars. Licensed professional blaster Daniel Lewis of Libby, Montana, was consulted to determine the feasibility of using explosives to remove fish from the project lakes. He recommended that 75 percent or 80 percent semi-gel dynamite should be used for such a project because it is water resistant, it would not **detpress**, and it throws a fast shock wave. In his opinion, “an 85 to 95 percent kill can be expected on all living creatures in the water.”

Non-electric blasting caps would be needed to initiate the powder; primacord trunk line would initiate the non-electric caps; and a cap and fuse would be needed to initiate the primacord. Additionally, charges might have to be delayed to reduce damage to a lake bottom or surrounding structure. Millisecond connectors would be required along the primacord trunk line to create the necessary delays. A geologist would be needed to conduct a comprehensive geological survey of the area to determine whether rock fissures in the lakebed would be opened up (possibly dewatering the lake), or an avalanche would be triggered as a result of the shock wave.

At least two professional blasters would be needed at each lake and would require approximately two-four days to survey and develop a blasting plan, and two to three days to set a grid of charges to cover the surface and depth. A final day would be required for the blasters to retrieve lines, make sure every charge was detonated, and to clean up the refuse from the explosives. A motorized raft would be required to safely and efficiently set up the explosives. The amount of dynamite necessary to accomplish this objective would be between two and five pounds per acre-foot.

All of the necessary blasting materials could be safely packed by livestock, or airlifted by a helicopter. Packing explosives into Woodward Lake, for example, would require 4,500 pounds of dynamite, and an estimated 1,000 pounds of detonating materials e.g., caps, fuses, primacord, connectors, rope, floats, and weights. Assuming each mule could carry 175 pounds, approximately 31 mule loads would be required to transport materials to Woodward Lake only. Additional stock would be required for rafts, motors, camp, SCUBA gear, and personnel.

Based on the estimates of only 85 percent to 95 percent success of a complete fish kill, the apparent difficulty of using explosives in many miles of stream environment, and the lack of information available that indicates this method has been successful at removing all live fish from deep lakes in remote rugged mountainous terrain, this method was determined to be ineffective at achieving the goal of complete fish removal from the lakes and streams, and was not developed for further consideration.

2.7.5 Electrofishing

Electrofishing is considered an active capture technique that involves introducing an electric current into the water (Reynolds 1992). The electricity causes an involuntary muscle contraction in fish, and attracts them to the source of the electricity (electrode) where an attendant nets them. Afterwards, the fish revive within about 30 seconds. Electrical variables like voltage, amperage, pulse frequency, and waveform are manipulated to achieve the desired response by fish. Environmental conditions like water temperature, water clarity, water conductivity, and substrate influence its effectiveness. Species of fish, fish behavior, time of year, and time of day are all variables that play a vital role in the effectiveness of electrofishing. Electrofishing works best in shallow water (Reynolds 1983). It is most commonly used to sample fish in rivers and streams, but is occasionally used to sample the shallow water zones of lakes.

The area of coverage of a typical electrofishing boat has been measured and described by Grisak (1997) to be about two meters. The use of electrofishing for population surveys in the Flathead Basin is conducted almost exclusively on small streams. The primary reason for this is that glacial water is low in conductivity, which does not allow for efficient distribution of electrical current to facilitate fish capture. Small streams have a reduced area for fish to hide and therefore fish can be captured despite low conductivity conditions. In deeper water of rivers and lakes, however, electrofishing is not an efficient means of fish capture, especially in low conductivity clear water. In high altitude lakes in the Flathead, electrofishing would need to be conducted at night to offer the greatest probability of capture. For this method of fish capture to be effective, every fish in the lake would have to swim into the shallow zone of the lake and be exposed to the relatively small electric field during the time the electrofishing operation is being conducted. Because electrofishing in a lake is limited to the shoreline, one disadvantage is that there is ample space for fish to escape the electric field. Reynolds (1992) reported that electrofishing is selective for larger sized fish.

Electrofishing a high altitude lake in the Flathead would require a large motorized boat approximately 14 to 17 feet long, two operators, a 5,000 watt generator, a large water tank, a rectifying unit, nets, and miscellaneous equipment. Inflatable rafts have been retrofitted with electrofishing systems and used to sample rough rivers, but this type would not be feasible in a lake. In low conductivity water, larger electrodes are valuable at creating a larger electrical field, but still do not penetrate much beyond two meters in depth. In many electrofishing operations in Montana, the hull of the boat is constructed of metal and serves as the negative electrode. Boats made of fiberglass or plastic employ an external negative electrode, but these are rarely used in lakes, but more often in areas where water conductivity is much higher than in the Flathead Basin. Because the water is very clear in the Flathead Basin, the operation would need to be conducted at night. The boat would need to be transported to the site with a large helicopter. Because of the extended period of time (summer months for 3-5 years) required for mechanical removal of fish, a boat and operators would need to stay camped at the lake for an extended period of time. An outboard motor and 5,000 watt generator would need to be operated for 5-8 hours each night. The operation would involve conducting multiple electrofishing passes along the shoreline for most of the dark hours each night.

Numerous attempts have been made to remove unwanted fish using electrofishing, but this has occurred mostly in streams. MFWP conducted an electrofishing removal of brook trout from 6 km of stream above a barrier on Muskrat Creek (Shepard, et al. 2001). Over a four year period, researchers electrofished 5,386 brook trout from this section and moved them below a barrier. After four years of the electrofishing effort, they concluded that the operation was not 100 percent effective and recommended that some type of fish toxin be used to permanently eliminate the brook trout from the study section.

While targeting spawning areas and capturing fish when they are concentrated is one strategy that could increase the probability of this method's success, it is still selective for large sized fish. Large debris and log jams occupy outlets of many lakes where spawning occurs. Shelf ice is still present in outlet streams of many high altitude lakes during normal spawning periods. Some lakes have been observed to have large rafts of ice present as late as mid July. Westslope cutthroat trout typically spawn in June. Often times spawning is delayed in high altitude lakes because of cold water temperatures and ice conditions. Because westslope cutthroat do not sexually mature until about three years of age, at any given time, there are at least two year classes of fish that would not be present at spawning areas. This would require returning to the spawning sites for at least two more years to attempt to capture fish as they are becoming sexually mature and attempting to spawn. These factors further complicate the use of electrofishing as a method to remove fish from high altitude lakes. Cold-water temperatures and ice free conditions in many of these lakes reduce the window of effective opportunity using electrofishing to about three months per year.

Little literature was found that described the use of electrofishing to eliminate fish from a lake. Spencer (1967) reported that alternating current (AC) electrofishing in experimental ponds killed excessive numbers of intermediate sized bluegills, but had little effect on largemouth bass. A great number of reports were available on the use of electrofishing to remove or reduce numbers of fish from streams (Shetter and Alexander 1970).

This alternative was deemed infeasible because of: the extended amount of time required for an attempt at fish removal; poor aesthetics associated with operating a boat with a generator and a camp at a lake in a primitive area for an extended period of time; low capture efficiency of electrofishing in clear and deep water; low capture efficiency of electrofishing in low conductivity water; and the lack of past success using this method to fulfill the objectives of this type of project.

Lennon (1970) reported that the greatest use of electricity to control fish has been in the sea lamprey program on the Great Lakes. Because this method involved using an electric field to repel lampreys at weir sites, it is not believed to have a viable application in removing fish from the lakes proposed in this project. For these reasons, electrofishing was found to be ineffective at complete removal of fish from the lakes and streams; therefore, this alternative was not developed for further consideration.

2.7.6 Dewatering

Dewatering involves the complete removal of all water from a lake. Dewatering would require the rerouting of water at lake inlets, and the use of one to several high-volume motorized water pumps for an extended period of time. This alternative would completely kill all species of fish in a given lake and is 100 percent effective.

Pumping would require field generators for operation, extensive amounts of fuel that would need to be replenished periodically, long outflow lines to the lake outlet, and periodic machinery maintenance. Transporting the generators, pumps, fuel storage tanks, and other equipment would require several loads by helicopter or aircraft, including the periodic transporting of diesel to refuel the tanks.

Cleanup of the remaining fish in the lake would need to be performed by hand or by allowing the lake to remain dry for a few days. Lake inlets would be opened again, allowing, over time, lakes to refill to their typical depths.

This action alternative was discarded from further consideration because the process for a number of reasons; dewatering would take extensive setup time and equipment; generate sustained noise for several weeks; greatly increase outflow from lakes, which could cause erosion and associated environmental problems immediately downstream; severely impact lake utility for other wildlife and amphibians; and negatively impact recreational resources. Dewatering operations are also prone to fuel spills.

2.7.7 Introduction of Tiger Muskellunge

The tiger muskellunge is a highly voracious predatory fish that is created by hybridizing the muskellunge with the northern pike. Hybridization in the wild was first observed in 1937 in Wisconsin (Black and Williamson 1947), and Eddy first reported artificial hybridization in 1941 in Minnesota (Crossman and Buss 1965). The hybrid is considered to be sexually sterile (Stein, et al. 1981), but some have reported empirical information suggesting fertility in females is possible, though backcross experiments with northern pike have yielded very few viable offspring (Black and Williamson 1947).

This fish has been used for management purposes to reduce the number of rough fish in lakes in order to provide space for more desirable game species (Storck and Newman 1986). Since 1987, MFWP has stocked 53,500 tiger muskellunge in ten water bodies for species control and diversity of angling opportunity. Most of these fish have been spawned at the Miles City State Fish Hatchery with muskellunge semen imported from Minnesota.

Tiger muskellunge prefer soft rayed fish for prey (Tomcko, et al. 1984). They are territorial fish that tend to stake out areas of a lake. Recapturing them by trap and electrofishing in Iowa has been difficult (Gengerke 1985). Similar territorial behavior has been reported for Little Warm Reservoir in Blaine County, Montana and in H.C. Kuhr Reservoir in Phillips County, Montana (Gilge 2002). This difficulty in recapturing has made evaluating some populations difficult. Although growth is slower in cool water ($<62^{o}$F), survival in cool water at stocking time is better (Lemm and Rotters 1986). Confounding information has been presented in the literature about their value to anglers as a sport fish (Storck and Newman 1986; Wahl and Stein 1993).

If tiger muskellunge were introduced into a lake in the South Fork Flathead, they would be allowed to live in the lake until they died of natural causes. Longevity of tiger muskellunge is not reported, but the parental species can live from 24 years (northern pike) to 30 years (muskellunge) (Scott and Crossman 1973). Hybrid vigor is reported to be manifested well in this species causing accelerated growth. This suggests longevity of the hybrid may be reduced.

The lack of information regarding the efficiency of tiger muskellunge to capture trout as prey may make their use in carrying out project objectives unreliable. If trout are not sufficiently used by tiger muskellunge as a prey source due to low abundance or behavioral differences, shifts to other prey items by this top-level predator could have devastating and long-term effects on lake amphibians, reptiles, and water birds. The parent species of this hybrid are notorious for feeding on frogs, salamanders, and ducks (Scott and Crossman 1973).

The time necessary for tiger muskellunge to remove trout from a lake would be protracted because the trout in many of the lakes would be reproducing and providing a continual source of fish to the lake. The size of prey selection increases with tiger muskellunge length (Wahl and Stein 1993; Gillen, et al. 1981). Given this, proportionately smaller prey would be available to tiger muskellunge in the project lakes as the predators grow larger. This may confound the efficiency of the predator to remove the non-native trout from the lakes.

Schmitz and Hetfeld (1965) reported studies that showed the failure of “the pikes” to secure prey of appropriate sizes resulted in marked reductions in growth. Weithman and Anderson (1977) reported that the introduction of tiger muskellunge for fish management purposes is conducted to crop underused prey fish, convert it to valuable game fish, and to reduce the density of adult prey species. They reported that the species should be used in reservoirs with a surplus of prey.

If the desired outcome of the tiger muskellunge introduction in the South Fork Flathead was to eliminate all non-native trout from a lake, the diminishing food supply would undoubtedly lessen the condition of the predator and ultimately affect its ability to remove all of the fish. Total elimination of non-native trout by tiger muskellunge has not been reported. Introduction of tiger muskellunge into the project lakes would not address the problem of hybrid fish in the outlet streams of some lakes. Finally, using tiger muskellunge to accomplish the goals of this project would require the introduction of a new species in a federally designated wilderness area, and in waters in the lower drainage that support federally endangered bull trout. For these reasons, the use of tiger muskellunge was determined to be an impractical alternative for complete removal of fish from the lakes and streams; therefore, it was not developed for further consideration.

Other hybrid species considered during this evaluation included *saugeye* (walleye x sauger) and *splake* (lake trout x brook trout) but were considered impractical, primarily because these hybrids are sexually fertile (Scott and Crossman 1973) and could become self-sustaining in the South Fork Watershed.

2.8 Comparison of Alternatives and Summary of Impacts

To determine which alternatives were the most reasonable and viable, specific decision factors were used to determine advantages and disadvantages for each proposed alternative. This section compares the above alternatives in context of their ability to satisfy project requirements (purposes) and their potential to affect the human environment (impact).

2.8.1 Comparison of Alternatives and their Ability to Meet Project Purposes

Table 2-6. Predicted performance summary.

Project Purposes	Alt. A: No Action	Alt. B: Proposed Action Fish Toxins – Combined Delivery and Application Methods	Alt. C: Fish Toxins – Motorized/ mechanized Delivery and Application	Alt. D: Suppression Techniques and Genetic Swamping
1. Follows the Northwest Power Planning Council's recommendations for the Hungry Horse Mitigation Program	No	Yes	Yes	Yes
2. Administratively efficient and cost-effective	Yes	Yes	Yes	No
3. Avoids or minimizes adverse environmental impacts:				
a) Toxins	Yes	No	No	Yes
b) Ground Disturbance—Site	Yes	No	No	No
c) Ground Disturbance—Transport	Yes	No	Yes	No
4. High probability of achieving the following biological objectives:				
a) Preserves the genetically pure westslope cutthroat trout populations in the South Fork drainage.	No	Yes	Yes	Yes
b) Eliminates from headwater lakes, to the extent possible and in a timely manner, the non-native trout that threaten genetically pure stocks of westslope cutthroat.	No	Yes	Yes	No

2.8.2 Summary of Impacts from Alternatives

Table 2-7. Comparison of effects on the human environment for each alternative.

Affected Resource	Alt. A: No Action (includes current management practices)	Alt. B: Proposed Action Fish Toxins – Combined Delivery and Application Methods	Alt. C: Fish Toxins – Motorized/mechanized Delivery and Application Methods	Alt. D: Suppression Techniques and Genetic Swamping
Fisheries	• No loss of angling opportunities. • May result in loss of genetically pure populations because of length of time required for development of pure lake populations. Hybrids will continue to outmigrate threatening downstream pure westslope cutthroat populations. • Allows time for hybrid trout to influence remaining pure populations. • Requires continued stocking of pure cutthroat. • May reduce size and quality of fish.	• Antimycin works quickly (within days). • Rapidly detoxifies in streams. • Rotenone detoxifies in 1-4 weeks. • Detox can be hastened with KMnO4. • Alternatives B and C have highest probability of restoring westslope cutthroat populations to lakes and outlets in shortest time period, which eliminates outmigration of hybrids and actively conserves downstream pure westslope cutthroat populations.	• Antimycin Works quickly (within days). • Rapidly detoxifies in streams. Rotenone detoxifies in 1-4 weeks. • Detox can be hastened with KMnO4. • Alternatives B and C have highest probability of restoring westslope cutthroat populations to lakes and outlets in shortest time period, which eliminates outmigration of hybrids and actively conserves downstream pure westslope cutthroat populations.	• Genetic swamping will only work if spawning habitat is present in each lake and stream. Allows time for hybrid trout to influence remaining pure populations. • Severely impairs angling opportunities for 5-10 years during implementation. • Not a proven technique. • Selective for larger sized fish. • High densities of fish may reduce size, weight, and fitness of populations, and may affect ability to reproduce.
Wildlife	• None.	• May affect some plankton & insects (gill breathers) for 0-3 years. • None to minor impacts to amphibians. • No impacts to birds.	• May affect some plankton & insects (gill breathers) for 0-3 years. • None to minor impacts to amphibians. • No impacts to birds.	• No risk to plankton, insects, amphibians. • Birds, mammals and other non-target organisms may get caught in nets or traps. • Fish eating birds may get caught in nets. • Selective for larger sized fish.
Water Quality	• None.	• Water quality standards lowered for 0-3 years.	• Water quality standards lowered for 0-3 years.	• Does not work in streams.
Soil and Vegetation	• None.	• At lake sites and during transport, more trampling of vegetation and ground disturbance than Alternative C.	• The least of the two proposed--trampling of vegetation and ground disturbance at lake sites only.	• Requires an attended camp at each site for 5-10 years, thus the greatest trampling of vegetation and ground disturbance of all the alternatives.
Land Use and Wilderness	• Potential loss of wilderness value in the form of pure westslope cutthroat trout. • Does not meet the goals of Conservation Agreement.	• Requires limited motorized equipment to apply in wilderness and in the Jewel Basin. • Delivery methods are an intrusion within Jewel Basin, but preferred over livestock delivery.	• Requires limited motorized equipment to apply in wilderness and in Jewel Basin. Delivery methods are an intrusion within the wilderness and in Jewel Basin.	• Requires extended motorized equipment use (5-10 years). Could have additional site impacts with longer term staffing onsite.
Recreation	• No loss of angling opportunities. • No user conflicts. • May involve future restrictions to safeguard pure westslope cutthroat. • Poor quality of fish due to high stocking rates.	• Loss of angling quality and quantity for 1-3 years. • Temporary noise and visual impacts at treatment sites. Other recreational values would still be intact.	• Loss of angling quality and quantity for 1-3 years. • Temporary noise and visual impacts at treatment sites. Other recreational values would still be intact.	• Long-term angling loss. Fishery is impaired for 5-10 years.
Socioeconomic	• No disturbance to outfitting.	• Loss of angling quality and quantity would impact outfitters for 1-3 years.	• Loss of angling quality and quantity would impact outfitters for 1-3 years.	• Fishery is impaired for several years. • Long-term (5-10 years) impact to outfitters.

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2.9 Preferred Alternative

Based on the findings of analyses summarized in Chapter 3, it has been determined that Alternative B: Fish Toxins – Combined Delivery and Application Methods, offers the highest probability of success by rapidly removing the non-native trout from both lakes and streams while reducing social conflicts regarding wilderness values over mechanical or biological suppression and transportation means. For this reason, it has been designated the preferred method to achieve the purpose and need of the project.

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Chapter 3.0: Affected Environment and Environmental Consequences

In this Chapter:

- Existing natural and human environment
- Specific impacts from alternatives
- Cumulative impacts
- Comparison of alternatives

This chapter describes the existing environment and the potential impacts of the alternatives on the environment. Most impact definitions are provided in the first part of each resource discussion. Direct and indirect impacts were considered in the short and long-term. Direct impacts are caused by the action and occur at the same time and place. Indirect impacts are caused by the action but would occur at a later time, but still within the reasonably foreseeable future. Impacts can be beneficial or adverse. The impact discussion lists mitigation efforts that could reduce impacts and potential cumulative impacts of the alternatives. Cumulative impacts refer to the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions undertaken by federal or non-federal entities.

3.1 General Description

This chapter describes the prominent features and land use management policies that apply to the South Fork Flathead Subbasin within the Flathead National Forest. Management areas on the Flathead National Forest affected by this action include the Bob Marshall Wilderness and Jewel Basin Hiking Area.

The South Fork Flathead Subbasin drains 1,681 square miles and is bounded on the west by the Swan Mountain range crest and the Continental Divide to the east. The upper half of the drainage (approximately 64 percent) lies within Bob Marshall Wilderness Complex. There is no private land within this subbasin. The communities of Hungry Horse and Martin City lie near the mouth of the South Fork to the north.

Forest elevations range from 3,000 feet in the valley bottoms to mountaintops near 9,000 feet. The average annual temperature at Kalispell is 42.8 degrees Fahrenheit. This average temperature drops with increased altitude in the mountainous areas surrounding Kalispell. The average annual precipitation ranges from approximately 20 inches in the lowest elevations of the Flathead National Forest to nearly 100 inches at the highest peaks. Valleys receive about half of this precipitation as rain and half as snow. About 80 percent of mountain precipitation falls as snow, resulting in a snow pack that exceeds 100 inches on some mountaintops. Snow cover in the alpine areas usually occurs earlier in the season than it does in the foothills.

Streamflow begins to increase in April as the snow pack melts with warming spring temperatures. The stream flows typically peak in late May or June as the snow pack melts. However, not all project area snowmelt or rainfall immediately becomes surface runoff; some water percolates downward as groundwater and resurfaces in springs, seeps, small ponds, and perennial streams at various elevations below the point of infiltration.

The slow release of groundwater provides the stream base flow starting in mid July and continuing on through mid September. Flathead National Forest watersheds provide approximately 7,000,000 acre-feet of water per year to the Columbia River. Flood flows rarely overtop the channel banks of the majority of stream channels in the Flathead River Basin. High flows that erode the upper banks of the channel typically occur every three to five years.

The watersheds of the Flathead National Forest have had a variety of historical and ongoing land management activities since the establishment of the national forest. The major human activities that have occurred over time on the Forest include: wildfire suppression, forest stand thinning, timber harvest, tree planting, road and trail construction/maintenance, grazing, and various motorized and non-motorized recreational activities.

3.1.1 Bob Marshall Wilderness Area

The Bob Marshall Wilderness is part of the Bob Marshall, Great Bear, and Scapegoat Wilderness Complex. This Complex is 1,009,256 acres and follows the Continental Divide about 60 miles from north to south. Several of the lakes that may be treated under this program are located within the Bob Marshall Wilderness Area and adjoining National Forest lands within the South Fork of the Flathead River headwaters.

The affected lakes can generally be described as **cirque basins** that occur near the top of the Swan Mountain Range. Streams that flow from the lakes typically flow for very short distances before they begin to descend in altitude and increase in volume due to tributary inflow. Many lakes have waterfalls near the outlets, or have high gradient outflow streams. These physical attributes prevent downstream fish from re-entering the lakes.


Photo courtesy of MWFP.

Figure 3-1. Lick Lake is located in the Bob Marshall Wilderness area.

The forest environment in this region is primarily a late **seral forest** dominated by spruce and subalpine fir with a component of lodgepole pine. At elevations greater than 5,800 feet there is a component of whitebark pine. All of the sites are considered high elevation sites--meaning they have a short growing season. Understory vegetation is dominated by huckleberry species. In open areas near the lakes there are areas of rushes, grasses, and forbs. **Scree** slopes and rock outcrops are present within the forested environment. Though 88,000 acres burned within the wilderness in the South Fork Drainage, none of the forested areas around the lakes proposed for treatment were affected by the wildfires of 2003.

There are several permitted commercial outfitters that operate within the wilderness and use the areas/lakes for angling, hiking, hunting, and just enjoying the wilderness. There are also permitted institutional outfitters that are approved on an annual basis within the wilderness in the South Fork.

3.1.2 Jewel Basin Hiking Area

The Jewel Basin Hiking Area is located on the Swan Lake and Hungry Horse Ranger Districts of the Flathead National Forest. The hiking area is 15,349 acres, including 27 lakes and 35 miles of trails. It is managed for semi-primitive non-motorized recreational opportunities, and provides a recreational experience between that found in wilderness and roaded areas. Hikers, backpackers, and fisherman use the area extensively. The management direction for the area prohibits the use of pack animals, motorized vehicles, motorized equipment, mechanized trail vehicles, or helicopter landings. However, the Forest Supervisor may authorize use of motorized equipment or livestock as deemed necessary for the administration of the area and its resources.

All of the Jewel Basin, plus an additional 16,000 acres have been recommended for wilderness designation. The wilderness values of this area are to be protected until Congress makes a decision on whether to include the area into the national wilderness preservation system.

During August 2003, the Flathead National Forest had an extreme wildfire season. There was a large fire complex within Jewel Basin. The forest burned around Blackfoot Lake and Clayton Lake. The severity of the fire ranged considerably in the mature forest, leaving areas of mixed high and low mortality.

Since the area is close to Kalispell, over 10,000 summer visitors enjoy the area for hiking, camping, and fishing. The Camp Misery Trailhead located on the west side of the Jewel Basin is the major trailhead for users of the area. Other trailheads area located at Clayton Creek, Pioneer Ridge, Graves Creek, and Wheeler Creek.

No permitted commercial outfitters access these lakes.

3.2 Fisheries Resources

3.2.1 History of Fisheries in the South Fork Flathead Drainage

MFWP has an extensive history of fisheries management in the South Fork Flathead drainage. Fish stocking has been a major component that includes State, Federal, and private actions, some of which have been unauthorized. MFWP records indicate that from 1926 to 1963 a little more than 3 million fish were stocked in 73 lakes and streams in the South Fork drainage. From 1964 to the present, 1.8 million fish have been stocked in 43 lakes and a single stream. Several attempts have been made to capture wild cutthroat from the South Fork drainage for developing hatchery brood stocks; these attempts occurred in 1952, 1954, 1964, 1965, and 1983. In 1952, fish were collected from Big Salmon Lake and flown by airplane from the Big Prairie Ranger station. In 1964 a helicopter was landed on Big Salmon Lake and fish were captured and transported to hatchery trucks in Seeley Lake. The remaining attempts involved collecting fish from Hungry Horse Reservoir tributary streams. The effort that was started in 1983 represents the beginning of the current westslope cutthroat trout brood stock used by the state. Since that time, this stock has been augmented twice (1984 and 2003) with wild genes to maintain genetic variability. Apart from fish stocking and taking wild fish for brood stocks, survey and inventory of the South Fork fisheries represent the bulk of the fisheries management in the drainage. This includes angler surveys, habitat evaluation, population estimates and monitoring, gill netting, electrofishing, and spawning **redd surveys**.

3.2.2 Existing Conditions

The South Fork Flathead River drains 1,681 square miles of public land. The aquatic resources of the South Fork drainage are extensive. There are approximately 1,898 miles of stream habitat and 355 lakes. Of these lakes, 50 are known to have fish (see Table 3-1), 9 others are purported to have been stocked with fish but their present status is unknown, and the remaining 296 lakes are believed to be fishless. South Fork drainage fish populations were isolated in 1952 by the installation of Hungry Horse Dam located approximately five miles upstream of the mouth.

Table 3-1. Hybridization status of westslope cutthroat trout in natural lakes in the South Fork Flathead Subbasin.

Pure westslope cutthroat (based on stocking records or genetic test)	Hybrid-based on University of Montana genetics lab tests	Suspected hybrid	Stocked or rumored stocked, present status unknown
Beta	Big Hawk (lower)	Crater	Christopher
Big Hawk upper	Black	Three Eagles (lower)	Crimson
Big Salmon	Blackfoot		Hart
Blue	Clayton		Olar (upper)
Cliff	George		Olar (lower)
Devine	Handkerchief		Palisade

Pure westslope cutthroat (based on stocking records or genetic test)	**Hybrid-based on University of Montana genetics lab tests**	**Suspected hybrid**	**Stocked or rumored stocked, present status unknown**
Diamond	Koessler		Pendant
Doctor	Lena		Recluse
Doris -upper	Lick		Shelf
Doris (middle)	Margaret		
Doris (lower)	Necklace (upper)		
Jenny	Necklace (middle upper)		
Jewel (north)	Necklace (middle lower)		
Jewel (south)	Necklace (lower)		
Jewel (east)	Pilgrim (lower)		
Jewel (west)	Pyramid		
Marshall (upper)	Sunburst		
Marshall (lower)	Three Eagles (upper)		
North Biglow	Wildcat		
Seven Acres (upper)	Woodward		
Seven Acres (lower)			
Soldier			
Spotted Bear			
Squaw			
Tom Tom			
Trout			
Twin (upper)			
Twin (lower)			

There are at least 20 lakes and designated portions of their outflow streams that have been identified through genetic analyses as having hybrid trout populations. Two additional lakes, Crater and Lower Three Eagles, are under analysis. Lower Three Eagles is suspected to contain hybrid trout because Upper Three Eagles Lake contains westslope cutthroat x Yellowstone cutthroat hybrids, and it drains into the lower lake. The genetic status of Crater Lake is also under investigation.

3.2.3 Species of Concern

3.2.3.1 Westslope Cutthroat Trout

Westslope cutthroat trout is one of several subspecies of cutthroat trout native to the Rocky Mountain region. It often exhibits bright yellow, orange, and red colors and is generally distinguishable from other inland subspecies of cutthroat trout by the particular pattern of black spots that appear on the body. Lewis and Clark's Corps of Discovery caught westslope cutthroat from the Missouri River near present-day Great Falls, Montana in 1805.

Westslope cutthroat trout are native to streams and lakes in western and central Montana (Columbia, Missouri, and Saskatchewan River drainages); northern and central Idaho (Columbia and Snake River drainages); and a few small, scattered river drainages in Washington and Oregon and British Columbia and Alberta, Canada. Today, populations of westslope cutthroat trout occur almost exclusively in small, isolated streams in mountainous areas.

Westslope cutthroat trout feed primarily on **macroinvertebrates**, particularly aquatic insects, terrestrial insects, and, in lakes, zooplankton. These preferences for macroinvertebrates occur at all ages in both streams and lakes. Westslope cutthroat rarely feed on other fishes.

Figure 3-2. Westslope cutthroat trout.

The westslope cutthroat trout usually reaches maturity at 4 or 5 years of age. Spawning occurs primarily in small tributary streams in June and July when water temperatures reach about 50 F. Fertilized westslope cutthroat eggs are deposited in stream gravels where they incubate for several weeks, the actual period of time dependent upon water temperature. Several days after hatching from the egg, when about one inch long, the fry emerge from the gravel and disperse into the stream. The fry may grow to maturity in the spawning stream or they may move downstream and mature in larger rivers or lakes. Thus, three westslope cutthroat trout life-history types are recognized: resident fish that spend their lives entirely in the tributary; fluvial fish that spawn in small tributaries, their resulting young migrating downstream to larger rivers where they grow and mature; and adfluvial fish that spawn in streams but grow and mature in lakes.

Growth of individual westslope cutthroat trout, like that of fish of other species, depends largely upon the interaction of food availability and water temperature. Resident westslope cutthroat usually do not grow longer than 30 cm (12 inches), presumably because they spend their entire lives in small, coldwater tributaries. In contrast, fluvial and adfluvial westslope cutthroat often grow longer than 30 cm (12 inches) and attain weights of 0.9-1.4 kg (2-3 pounds). Such rapid growth results from the warmer, more-productive environments afforded by large rivers, lakes, and reservoirs.

Populations of westslope cutthroat have declined from historic levels due to a variety of factors, including habitat destruction from logging and associated road building; adverse effects on habitat resulting from livestock grazing, mining, urban development, agricultural practices, and the operation of dams; historic and ongoing stocking of nonnative fish species that compete with or prey upon westslope cutthroat or jeopardize the genetic integrity of the subspecies through hybridization; and excessive harvest by anglers. Some publics believe that the decline in the westslope cutthroat trout is continuing unabated.

Most of the habitat for extant westslope cutthroat trout stocks lies on lands administered by federal agencies, particularly the FS. Moreover, many of the strongholds for westslope cutthroat trout stocks occur within roadless or wilderness areas or national parks, all of which afford considerable protection to this trout species.

The 2000 FWS status review for westslope cutthroat trout found that there are numerous federal and state regulatory mechanisms that, if properly administered and implemented, protect the species and its habitats throughout the range of the subspecies. As of 2000, the FS, state game and fish departments, and National Park Service reported more than 700 ongoing projects directed toward the protection and restoration of the westslope cutthroat trout and its habitats. Finally, westslope cutthroat trout accrues some level of protection from the ESA's Section 7 consultation process in geographic areas where westslope cutthroat distribution overlaps with the distributions of one or more ESA-listed fish species, specifically, bull trout (*Salvelinus confluentus*), steelhead (*O. mykiss*), and Pacific salmon (*Oncorhynchus* spp.) and their habitats on federal lands in the Columbia River basin.

The 2000 status review also revealed that WCT presently inhabit about 4,275 tributaries or stream reaches that collectively encompass more than 23,000 linear miles of stream habitat, distributed among 12 major drainages and 62 component watersheds in the Columbia, Missouri, and Saskatchewan River basins. In addition, westslope cutthroat trout presently inhabit 6 lakes in Idaho and Washington, and at least 20 lakes in Glacier National Park, Montana. Although westslope cutthroat stocks that formerly occupied large, mainstem rivers and lakes and their principal tributaries are reduced from their historic levels, the FWS found that viable, self-sustaining westslope cutthroat stocks remain widely distributed throughout the historic range of the subspecies, most notably in headwater areas. On the basis of the available information, the FWS concluded that the westslope cutthroat trout is not likely to become a threatened or endangered species within the foreseeable future. Therefore, listing of the westslope cutthroat trout as a threatened or endangered species under the ESA was not warranted at that time.

The FWS strongly recommended that state game and fish departments, federal land-management agencies, tribal governments, private groups, and other concerned entities continue to work individually and cooperatively to develop and implement programs to protect and restore stocks of westslope cutthroat trout throughout the historic range of the subspecies. The FWS believes additional actions should be taken (e.g., selective placement of barriers to prevent the upstream movement of nonnative fishes) to further protect extant westslope cutthroat trout stocks throughout their historic range from the adverse effects of nonnative fishes. The FWS stated in its review that it is encouraged by ongoing and planned state and local programs, most notably those in Montana, to protect and restore westslope cutthroat trout within its historic range (USFWS 2000).

Subsequent to the 2000 status review, American Wildlands and four other environmental groups filed a lawsuit arguing that the FWS acknowledged hybridization as a threat to the species but included hybrids in the overall westslope cutthroat trout population without providing a justification. The Court ruled in favor of the plaintiffs and ordered FWS to reconsider whether to list the westslope cutthroat as a threatened subspecies. In August 2003, after a thorough review of all available scientific information, the FWS again determined that the westslope cutthroat trout does not warrant listing as a threatened species under the Endangered Species Act (see Appendix B). (68 FR 152)

If programs are not implemented and continued as a means of protecting and restoring stocks of westslope cutthroat trout, the result could lead to future restrictions on angling; affect angling opportunities, and the management of this species. The No Action alternative could also lead to a westslope cutthroat ESA listing and more severe restrictions for all activities affecting the species.

3.2.3.2 Bull Trout

Bull trout, a char in the salmon family, are distinguished from other trout and salmon by the absence of teeth in the roof of the mouth, presence of light colored spots, small scales, and differences in the structure of their skeleton (FWS 1997). The bull trout is a federally listed species (threatened) under the ESA.

Bull trout reach sexual maturity between five and seven years of age. They spawn in gravel and cobble pockets in streams during late summer and early fall generally after water temperatures drop below 9 degrees C. Spawning areas are often associated with springs or areas where stream flow is influenced by cold ground water. Bull trout eggs require a relatively long incubation period when compared to the trout and salmon's. In general, eggs hatch before the end of January with emergence occurring in late spring. Fry and juvenile fish are strongly associated with the stream bottom and are found at or near it. Bull trout commonly live to be about 12 years old (FWS 1997).

In the South Fork subbasin, bull trout exhibit two migratory life history forms or strategies: fluvial and adfluvial. Migratory bull trout spawn in tributary streams where juvenile fish rear from one to four years before migrating to either a lake (adfluvial) or river (fluvial) where they grow to maturity (FWS 1997; Fraley and Shepard 1989).

Bull trout are known to exhibit two life history forms or strategies: resident and migratory. Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn, rear, and reside. Migratory bull trout spawn in tributary streams where juvenile fish rear from one to four years before migrating to either a lake (adfluvial), river (fluvial), or, in certain coastal areas, salt water (anadromous) where they grow to maturity. Growth of resident fish is generally much slower than migratory fish, and resident fish tend to be smaller at maturity and less fecund (FWS 1997). Bull trout of the South Fork Flathead exhibit adfluvial life history characteristics; they spawn and rear in tributary streams and migrate to Hungry Horse Reservoir to grow and mature. Adult bull trout from the South Fork have been known to exceed fifteen pounds.

Where suitable migratory corridors exist, extensive migrations are characteristic of this species. Retention and recovery of migratory life history forms and maintenance or re-establishment of stream migration corridors is considered crucial to the persistence of bull trout subpopulations throughout their geographic range. Migratory bull trout facilitate the interchange of genetic material between local subpopulations and are necessary for recolonizing habitat where subpopulations are, or become, extirpated by natural or human-caused events (FWS 1997).

Bull trout have habitat requirements that are more specific than those of many other salmonid's. These habitat requirements include: spawning and rearing substrate composition that includes **free interstitial spaces**; complex cover including, large woody debris, undercut banks, boulders, shade, pools, or deep water; cold water temperatures; channel and hydraulic stability; and connectedness through migratory corridors (FWS 1997).

Figure 3-3. The bull trout is a threatened species under the ESA.

Bull trout are not found in any of the lakes proposed for treatment. However, bull trout do occur in the associated drainages downstream of some lakes.

In 2004, the South Fork Flathead drainage, including Hungry Horse Reservoir, will be opened to limited bull trout angling. Anglers will be able to harvest two bull trout per year from Hungry Horse Reservoir. Catch and release angling will be allowed on the South Fork Flathead River. None of the lakes or streams proposed for treatment in this project would be affected by the proposed action.

3.2.3.3 Mountain Whitefish

Mountain whitefish is not a federally listed species, but is native to the South Fork subbasin and is the most abundant game fish in the drainage. A survey completed in 1989 estimated that 32 percent of all fish within Hungry Horse Reservoir are whitefish. However, whitefish are greatly under-utilized as a gamefish relative to their abundance.

Whitefish exhibit seasonal movements associated with feeding, overwintering, and spawning behavior. Whitefish can overwinter in deep stream and river pools or in Hungry Horse Reservoir. Both fluvial and adfluvial life forms of mountain whitefish exist within the South Fork drainage. Whitefish mature at three to five years and spawn from October through December, broadcasting their eggs over gravel and small rocks in shallow, fast-flowing, midstream areas. Whitefish are prolific; one female can produce from 3,000 to 8,000 eggs. After hatching in the spring, fry rear in shallow riffles, backwaters, and stream margins, then move to deeper water as they grow. Juveniles that move to the reservoir generally emigrate from their natal tributary during their first year of life. Individual whitefish grow to about 19 inches in length. Whitefish are not found in the in the lakes that are proposed for treatment, but are common in downstream waters and in the reservoir.

Mountain whitefish are typically bottom feeders that primarily consume zooplankton and aquatic insect larvae. When bottom food is less abundant, whitefish will eat suspended zooplankton, insect pupa, and insects in the surface film.

Mountain whitefish occur in the Big Salmon, Gordon Creek, and Youngs Creek drainages located downstream from the wilderness lakes However, in most cases they are far enough downstream that contact with fish toxins is not expected. Any loss of mountain whitefish would not be great enough to affect the overall population of this abundant fish.

3.2.4 Current Management Practices

FS policy recognizes that states have “jurisdiction and responsibilities for the protection and management of wildlife and fish populations in wilderness” (FSM 2323.32). Regarding fish stocking, the FS prioritizes species that should be stocked in the following order (FSM 2323.34c):

- Federally listed threatened or endangered, indigenous species
- Indigenous species

Further, this management direction states that species of fish traditionally stocked before wilderness designation (for the Bob Marshall Wilderness, this would be 1964) may be considered indigenous if the species is likely to survive. This would include many of the hybrids and non-native fish that are currently threatening the genetic purity of the westslope cutthroat trout. This, however, would appear to contradict the intent of the Wilderness Act and the ESA to preserve and protect the integrity of native biological communities. The Management Framework for the BMWC (FS and MFWP 1995) acknowledges this dichotomy:

“It is recognized that stocking fish in the BMWC has altered the natural biological community in many of the approximately 40 lakes in the complex that support fish. The practice was established prior to the passage of the Wilderness Act and, although it is controversial, it is a traditional practice and supports a traditional use by visitors.”

However, the management framework goes on to outline a more “conservative approach” to fish stocking and redefines “indigenous” as it is to apply in the BMWC:

- Only sensitive, genetically tested native species are stocked and management favors sensitive species.
- Non-indigenous species are considered exotic even if they were present before wilderness designation.

MFWP’s drainage-wide fisheries management goals include: 1) maintain self sustaining fish populations; 2) maintain and improve the genetic integrity of westslope cutthroat trout; 3) emphasize a quality fishery over quantity of harvest; and 4) manage the fishery consistent with wilderness management guidelines (MFWP 1991a).

To accomplish these goals, the MFWP maintains high quality lake fisheries by stocking westslope cutthroat trout where needed. Most stocking occurs on a rotational basis, generally at one to five year intervals. At many lakes, a helicopter is used to stock fish, including lakes in wilderness areas. Since the early 1970’s, as a rule, rivers and streams throughout Montana are no longer stocked with fish, in an effort to promote and rely on wild fish in these habitats.

Fishing regulations for the South Fork drainage have been progressively modified with the intent of meeting the above stated management goals. The most significant modification of fishing regulations pertaining to cutthroat trout occurred in the1984 fishing season when the Department implemented more restrictive limits. Wilderness limits were reduced to three fish, none over 12 inches, within streams; and three fish, of any size, from lakes. A catch-and-release area outside the wilderness on the main South Fork from Meadow Creek footbridge to Spotted Bear footbridge was also created to protect fish in higher use areas that are more easily accessed. Later, in 1988, the Department reduced all South Fork drainage tributary and lake limits to coincide with wilderness limits. These limits remain the same today and, based on various population monitoring indices, appear to be providing adequate angling opportunities while protecting the cutthroat fishery.

MFWP regularly monitors the South Fork cutthroat trout fishery by conducting population estimates near the Meadow Creek trailhead and Black Bear guard station. Historically, other cutthroat surveys, monitoring, and population estimates have been conducted on various portions of the river and tributaries and MFWP has continued their efforts to survey and inventory lakes located within the basin. In addition to cutthroat trout, the Department intensively monitors bull trout distribution and abundance throughout the drainage. MFWP has also conducted fisheries investigations within Hungry Horse Reservoir and its tributaries. Annual monitoring includes spawning redd surveys, fall gill netting on Hungry Horse Reservoir, and population abundance estimates for age one fish in tributary streams in an effort to monitor both cutthroat and bull trout populations.

Consistent with article 13 of the Fish Wildlife and Habitat Management Guidelines for the BMWC (FS and MFWP 1995), MFWP implemented a rotenone treatment on Devine Creek Lake in 1996 to remove the only known brook trout population in the South Fork Flathead drainage. The project was completely successful at removing a threatening species and restoring angling opportunity.

3.2.5 Environmental Consequences of Alternative A (No Action)

3.2.5.1 Direct and Indirect Effects on Fisheries Resources

There would be no change in resource conditions under this alternative. Genetic swamp out-type stocking may continue. Continued high-density annual fish stocking would maintain abundant, yet small sized fish.

3.2.5.2 Cumulative Effects on Fisheries Resources

Over time, it is highly likely that the genetic purity of westslope cutthroat trout populations in the subbasin would degrade through continued hybridization. There would be no effect on bull trout or other species of concern.

3.2.6 Environmental Consequences of Alternative B (Proposed Action: Fish Toxins – Combined Delivery and Application Methods)

3.2.6.1 Direct and Indirect Effects on Fisheries Resources

Bull trout are not present in any of the lakes proposed for treatment. However, bull trout do occur in the associated drainages downstream of 13 of the lakes proposed for treatment (table 3-2). The remaining eight lakes either have no downstream bull trout at risk, the bull trout downstream reside in Hungry Horse Reservoir, or the treatment can be contained well before it reaches bull trout waters. It will be necessary to safeguard downstream bull trout populations while removing as many hybrid trout from those streams as possible. It is understood that safeguarding bull trout populations from a piscicide application may prevent some hybrid trout from being removed in some stream segments. The lakes that have bull trout populations downstream include Wildcat, Sunburst, Woodward, Necklace (four lakes), Lena, Lick, Koessler, George, and Pyramid. Although there are no bull trout in Graves Creek downstream of Handkerchief Lake, it will be necessary to protect any bull trout that may be residing at the mouth of Graves Creek in Hungry Horse Reservoir. Eleven of these 13 lakes are located in the Bob Marshall Wilderness. There are three reasons why antimycin, rather than rotenone, would be the preferred fish toxin for these 13 lakes. First, the ability of antimycin to rapidly detoxify in flowing streams makes containment easier. Second, antimycin requires a much lower quantity than rotenone to effect fish kills. This makes the transport of project materials into remote areas easier. Finally, the use of antimycin

Table 3-2. Elevation differential, distance to bull trout populations, and values for natural detoxification using antimycin in lakes with downstream bull trout populations.

Lake	Lake elevation	Elevation at downstream bull trout (ft)	Elevation diff from lake to bull trout habitat	Distance to downstream bull trout habitat (mi)	Detox factor (elev diff ÷200 ft)
George	7,115	5,240	1,875	3.92	9.4
Handkerchief*	3,835	3,560	275	1.33	1.4
Koessler	6,010	5,340	580	0.93	2.9
Lena	6,732	4,420	2,312	9.26	11.6
Lick	5,984	5,280	704	3.23	3.5
Necklace (4)	6,480	4,420	2,060	6.92	10.3
Pyramid	6,927	5,480	1,447	5.21	7.2
Sunburst	5,322	4,160	1,162	7.54	5.8
Wildcat *	5,810	4,040	1,770	3.46	8.9
Woodward	6,433	4,420	2,013	7.73	10.2

**Lake located outside of wilderness.*

would allow the access and transport of supplies to wilderness lakes by the preferred traditional non-motorized means—livestock, which supports wilderness values. George and Lick lakes are two wilderness lakes that have no trail access, requiring the transport of materials by helicopter.

To determine the level of natural detoxification available, the elevation differential from each lake to the downstream bull trout population was calculated, and then a detoxification factor was calculated based on 200 foot elevation intervals (table 3-2 above). Each 200-foot interval represents one complete detoxification based on studies and evaluations conducted by Tiffan and Bergersen (1996). Detoxification factors for these 13 treatments range from 1.4 to 11.6 times more than necessary based on this literature.

Because antimycin detoxifies naturally in this manner, it would be necessary to install recharge stations in streams below certain lakes to maintain lethality down to the treatment boundary; this would aid in removing as many of the hybrid trout as possible while still allowing a safe buffer for bull trout populations downstream.

3.2.6.2 Cumulative Effects on Fisheries Resources

The cumulative effects of this method would include a progressive reduction in angling quality and quantity among the mountain lake fisheries in the South Fork. This impact would be mitigated by staggering the treatments spatially and over a period of 10 years or more.

Genetic inventories have demonstrated that nonnative and hybridized fish populations have expanded from headwater lakes into one of largest remaining strongholds of westslope cutthroat trout in existence. The use of piscicides is a scientifically proven technique for reducing or eliminating non-native fish species. Combined with the post-treatment stocking of genetically pure westslope cutthroat trout, piscicides offer the greatest known potential to successfully protect westslope cutthroat trout in the South Fork Flathead Watershed. Failure to address this problem will result in further expansion of hybridization, impacting the otherwise secure native fish assemblage upstream of Hungry Horse Dam.

Previous monitoring shows that short-term impacts to the fisheries resource caused by chemical treatment (using antimycin or rotenone) are undetectable within the first three years. Post-treatment restoration of the fishery could be accelerated by initially stocking fish from multiple age classes and sizes. In lakes that have been stocked repeatedly with M012 westslope cutthroat from Montana's captive broodstock, post-treatment stocking with the M012 strain would be the most expedient way to restore the fishery.

Once the non-native fish have been eliminated, MFWP would restock with genetically pure westslope cutthroat trout. If MFWP did not restock, it is likely that illegal, unauthorized stocking with fish of unknown origins would be done. This could further spread non-native fish in the westslope cutthroats' range and defeat the purpose of this proposal.

Non-target fish species (e.g., bull trout, mountain whitefish, sculpins, etc.) occurring downstream of the proposed lakes could be protected during the treatment phase as described earlier in this document. Redundant safeguards have been designed to assure that no long-term impacts to the native species assemblage would result from implementation of the proposed project.

A Biological Assessment was submitted to US Fish and Wildlife Service (USFWS) in April 2002. USFWS concurred that the proposed project does not have any potential to cause an adverse effect on bull trout (*Salvelinus confluentues),* impair suitable seasonal habitat or permanent habitat, or to degrade unoccupied habitat that is necessary for the survival of the local population of bull trout. Thus, they concurred with the determination of “may effect, not likely to adversely affect” for bull trout (USFWS 2002).

3.2.7 Environmental Consequences of Alternative C (Fish Toxins – Motorized/mechanized Delivery and Application Methods)

3.2.7.1 Direct and Indirect Effects on Fisheries Resources

The effects would be the same as those for Alternative B (Section 3.2.6.1).

3.2.7.2 Cumulative Effects on Fisheries Resources

The effects would be the same as those for Alternative B (Section 3.2.6.2).

3.2.8 Environmental Consequences of Alternative D (Suppression Techniques and Swamping)

3.2.8.1 Direct and Indirect Effects on Fisheries Resources

The most important direct effect of Alternative D would result from fish suppression efforts. Fish removal using mechanical methods (gill nets and trap nets) would result in a long-term (5 to 10 years) reduction in large trout, which are most vulnerable to capture. The intentional reduction in fish numbers would impact fishing opportunities for humans and, potentially, fish-eating birds.

One of the primary direct effects of Alternative D is the loss of high quality angling opportunities for an extended period of time. Another primary direct effect of Alternative D is the long-term and high volume stocking of lakes. The intentional overpopulation of westslope cutthroat using this method would increase competition and inbreeding as intended, but may also reduce growth rates, the overall size of fish, and enhance the potential for downstream migration because of population pressure. The indirect effect would include promotion of further hybridization downstream as demonstrated by the existing genetic information. Under this alternative, pure downstream cutthroat would continue to be in jeopardy.

3.2.8.2 Cumulative Effects on Fisheries Resources

Coupled with a suppression program expected to last 5 to 10 years on each lake, an aggressive campaign of swamping would increase competition between fish and reduce the overall size and fitness of fish in the lake. It would also prolong the development of a high quality fishery, which may take several years to implement.

3.3 Wildlife Resources

3.3.1 Listed Terrestrial Species of Concern

The project area provides habitat for several threatened and endangered species. Table 3-3 shows the terrestrial species found in the vicinity of the South Fork Flathead Subbasin that are listed as endangered or threatened under the ESA. See Appendix F for additional information.

Table 3-3. ESA-listed terrestrial species in affected environment.

Species	Category	Expected Occurrence
Bald eagle (*Haliaeetus leucocephalus*)	Threatened	Resident/ transient
Canada lynx (*Felis lynx canadensis*)	Threatened	Resident/transient
Gray wolf (*Canis lupus*)	Endangered	Resident/transient
Grizzly bear (*Ursus arctos horribilis*)	Threatened	Resident/transient

Source: U.S. Fish and Wildlife Service, Montana Field Office, November 8, 2001.

3.3.1.1 Bald Eagle

The bald eagle is an opportunistic predator and feeds primarily on fish, but also consumes a variety of birds and mammals (both dead and alive) when fish are scarce or these other species are readily available. Fish may comprise up to 90 percent of its diet (70 to 90 percent) depending on geographic location, season, and relative abundance. Northern pikeminnow, suckers, salmon, and trout are important fish species preyed on by bald eagles. Bird prey species are more important in bald eagle diets during winter when fish are less available due to ice formation on streams, lakes, and reservoirs. Waterfowl are the most common bird species preyed on by eagles. Mammals are taken at a lesser degree than fish and birds. Mammals are taken as live prey or carrion in all seasons, but become more important during winter (FWS 1996a).

Bald eagles occur in the project area seasonally. However, high altitude and mountainous terrain cause snow and ice to be present in these locations through June. Because bald eagles nest in March and incubate eggs in April, there are few available food sources for them in the project area, thus precluding them from nesting in the area. The nearest bald eagle nest that occurs in the project area is located on Clayton Island on Hungry Horse Reservoir. Regional file data from MFWP indicates the nest has been successful four of the past eight years (see table 3-4 below).

The peak time for fledging for this nest most likely occurs in early July (Bergeron 2002).

Known neighboring bald eagle nests are found at the following locations: Swan Lake Refuge, Echo Lake, Swan River at Ferndale, Salmon Lake, Clearwater River two miles north of Clearwater junction, and Blackfoot River four miles east of Clearwater junction (Casey 2002; Firebaugh 2002).

Table 3-4. Clayton Island bald eagle nesting status.

Year	*Successful*	*# fledged*
1994	Yes	1
1995	No	0
1996	No	0
1997	Yes	1
1998	Yes	1
1999	No	0
2000	No	0
2001	Yes	1

Source: Montana Fish, Wildlife &Parks

3.3.1.2 Canada Lynx

Canada lynx are in the cat family (*Felidea*) and are medium-sized cats 30 to 35 inches long and weighing 18 to 23 pounds. Lynx have large feet adapted to walking on snow, long legs, tufts on the ears, and a black-tipped tail. In northern Idaho and northwest Montana, cedar-hemlock habitat types may be considered primary vegetation for lynx. In central Idaho, Douglas fir on moist sites at higher elevations may also be considered primary vegetation. Secondary vegetation, when interspersed with sub-alpine forests, contributing to lynx habitat includes: cool, moist Douglas fir; grand fir; western larch; and quaking aspen (Ruediger, et al. 2000).

Natal den sites are commonly built in large woody debris, either in downed logs or root wads. Den sites may be located within older regeneration stands (>20 years since disturbance) or in mature conifer or mixed conifer-deciduous (typically spruce/fir or spruce/birch) forests. Stand structure appears to be more important to den site selection rather than cover type (Ruediger, et al. 2000). Lynx appear to prefer to move through continuous forest and frequently use ridges, saddles, and riparian areas (Ruediger, et al. 2000).

Snowshoe hares are the primary prey of lynx, comprising 35 to 97 percent of their diet throughout lynx range. Red squirrels are an important alternate prey, especially during snowshoe hare population lows. Mice, voles, flying squirrels, fish, grouse, and ungulate carrion also occur in their diet (Ruediger, et al. 2000).

Canada lynx are found in the South Fork of the Flathead drainage, the Swan Mountain Range, and the Swan River drainage.

3.3.1.3 Gray Wolf

The gray wolf is the largest member of the dog family (*Canidae*). Wolves do not have any particular habitat requirements except for areas that are void of heavy human use (FWS 1996b). The gray wolf is territorial in most areas. Wolf packs occupy rather specific territories. The number of individuals in a pack and the availability of prey determine territory size; packs dependent on migratory prey tend to have the largest territories. Daily pack movements vary, and distances traveled are greater in winter than in summer. Lone wolves cover larger areas than packs, and their territories may overlap two or three pack territories (Fritts 1982).

Wolf dens are used for bearing and protecting pups, and are often abandoned when pups reach the age of two months. The same den may be used year after year, or different dens may be selected. Pups are sometimes moved from one den to another. During spring and summer, a reproductive pack's movements are centered round den and rendezvous sites. Once pups leave the den site, rendezvous sites become important rearing areas. By late summer, pups are mature enough to travel, and pack movements increase (Young 1944; Mech 1970; Fritts 1982).

Wolves prey primarily on large wild mammals such as deer, elk, moose, caribou, bison, and bighorn sheep. However, wolves are opportunistic feeders, eating a wide variety of food including cattle, sheep, horses, dogs, birds, small mammals, fish, plants, and fruits. Prey items often depend on availability and ease of capture. Wolves are also successful scavengers. Wolves hunt as individuals and in packs (Young 1944; Mech 1970; Fritts 1982).

Two wolf packs are known to exist in the project area. The Spotted Bear Pack, as its name implies, is located near the Spotted Bear river drainage. This pack is believed to consist of five wolves and is known to den near Spotted Bear Lake. Members of this pack have been located at low elevations within the Bunker Creek drainage. Most of the pack's activity occurs on the east side of the South Fork drainage. Sunburst Lake is the closest lake proposed for treatment to the Spotted Bear Wolf Pack. Any interaction with wolves in the project area would likely be limited to encounters with individual wolves that are seeking mates from other packs, or seeking to establish new territories (Sime 2002).

The second wolf pack is known as the Red Shale Pack. This pack consists of eight wolves, and it dens in the Gates Park area of the North Fork Sun River. Members of this pack have been located in the Danaher Creek area of the South Fork Flathead. Pyramid Lake is the closest lake proposed for treatment to the range of the Red Shale Pack. Interaction with this pack is expected to be minimal since this pack does not den in the project area and the project is situated, for the most part, at higher altitudes.

3.3.1.4 Grizzly Bear

Grizzly bears are in the bear family (*Ursidea*) and are generally larger than black bears and can be distinguished by having longer front foot claws (by two to four inches); a distinctive shoulder hump; rounded ears that are proportionately smaller than the head; and a dished-in profile between the eyes and at the end of the snout. Adult bears are individualistic in behavior and normally are solitary wanderers. Females with cubs, bears defending food supplies, and unsecured attractants are common causes of confrontation between humans and bears (FWS 1993).

Home ranges of adult bears may overlap. The home ranges of adult male grizzlies are generally two to four times larger than adult females. The home ranges of females are smaller while they have cubs, but increase when the cubs become yearlings. Home ranges vary in relation to food availability, weather conditions, and interactions with other bears. Home ranges are larger in the Yellowstone Ecosystem compared to the more productive habitats in the northern ecosystems (FWS 1993). Mean time for Grizzly bears to excavate dens is November 5 (range October 17 to December 16). Dens are usually dug on steep slopes where wind and topography cause an accumulation of deep snow and where snow is unlikely to melt during warm periods. Dens are found at an average elevation of 6,400 feet at various aspects on steep slopes (60 percent or greater) (Mace and Waller 1997).

Grizzly bears are opportunistic feeders and will prey or scavenge on almost any available food. Plants with high crude protein content and animal matter are most important food items. The search for food has a prime influence on grizzly bear movements. Upon emergence from the den, grizzlies move to lower elevations, drainage bottoms, avalanche chutes, and ungulate winter ranges where their food requirements can be met. Throughout spring and early summer, grizzlies follow plant **phenology** back to higher elevations. In late summer and fall, there is a transition to fruit and nut sources, as well as herbaceous materials. This is a general pattern; however, bears will go where they can meet their food requirements (FWS 1993).

Grizzly bears are found throughout the project area for the proposed program. During autumn, the diet of grizzly bears varies widely. Foraging on persistent fruits such as *Sorbus spp*. and *Arctostaphylos uva-ursi* are common. An important fall food source is gut piles from hunter-harvested game.

3.3.2 Other Potentially Affected Species

3.3.2.1 Amphibians and Reptiles

In 2001, MFWP, in cooperation with the FS Region 1, commissioned a study to survey the presence and distribution of amphibians in the project area with a particular focus on the lakes listed in this proposal (Maxell 2002). Four amphibian species and two reptile species were detected in the project area: the long toed salamander (*Ambystoma macrodactylum*), Rocky Mountain tailed frog (*Ascaphus montanus*), western toad (*Bufo boreas*), Columbia spotted frog (*Rana luteiventris*), Western terrestrial garter snake (*Thamnophis elagans*), and common garter snake (*Thamnophis sirtalis*). Four other species are believed to occur in the project area, but were undetected: pacific tree frog (*Psuedacris regilla*), northern leopard frog (*Rana pipiens*), western painted turtle (*Chrysemyus picta*), and rubber boa (*Charina bottae*). The western toad and northern leopard frog are the only species in western Montana, and possibly the project area that are considered sensitive. A total of 180 sites were surveyed.

Baseline information has been gathered (Grisak 2002; FS 1999) that indicates that these species are widely distributed throughout the project area. The abundance and diversity of habitat identified by Maxell (2002), and the spatial distribution of these species collectively represents a stable ecosystem.

MFWP have frequently encountered amphibians during electrofishing surveys in 14 Hungry Horse Reservoir tributary streams each year since 1987. Most of these observations were of tailed frog tadpoles, but some adults were observed as well as spotted frogs, western toads, and long toed salamanders (Grisak 2003c). Although tadpoles were not quantified, fisheries personnel have characterized them as “abundant” during these surveys. In streams and lakes throughout the South Fork Flathead, native westslope cutthroat trout and native amphibians co-exist much as they do naturally in these streams.

3.3.2.2 Plankton and Aquatic Insects

Plankton surveys have been conducted on 23 lakes in the South Fork, many of which are lakes listed in this project. There are eight species of plankton and a single planktonic insect species that are known to occur in these lakes (Table 3-5).

Table 3-5. Zooplankton and planktonic insect species sampled from 23 lakes in the South Fork Flathead drainage from 2002 to 2003.

Zooplankton species	Number of lakes present	Maximum per liter	Minimum per liter	Mean per liter
Daphnia throata	17	5.13	0.0054	1.142
Daphnia pulex	9	2.57	0.0025	0.83
Bosmina spp.	5	18.4	0.02	3.732
Holopedium gibberum	2	3.6	3.38	3.49
Cyclops spp.	12	5.85	0.0039	0.655
Calanoid spp.	23	3.82	0.02	1.499
Nauplii	11	3.02	0.01	0.707
Epischura spp.	2	0.02	0.8	0.41
Chyboboridae spp. (insect)	2	0.01	0.05	0.03

Source: MFWP file data.

3.3.2.3 Sensitive Wildlife Species on the Flathead National Forest

Sensitive wildlife species are those that show evidence of a current or predicted downward trend in population numbers or habitat suitability that would substantially reduce species distribution. The Regional Forester has identified 11 sensitive wildlife species on the Flathead National Forest (March 12, 1999). None of the alternatives would have direct, indirect, or cumulative effects on riparian and wetland wildlife species, and therefore there would have no effect on the sensitive common loon, harlequin duck, northern bog lemming, northern leopard frog, or western big-eared bat. The peregrine falcon (likely to soon become a Region One sensitive species), fisher, flammulated owl, and northern goshawk would also not be affected by any of the alternatives. These nine wildlife species will not be discussed further in the body of this Environmental Impact Statement.

3.3.3 Environmental Consequences of Alternative A (No Action)

3.3.3.1 Direct and Indirect Effects on Wildlife Resources

There would be no change in present conditions under this alternative.

3.3.3.2 Cumulative Effects on Wildlife Resources

There would be no change in present conditions under this alternative.

3.3.4 Environmental Consequences of Alternative B (Proposed Action: Fish Toxins – Combined Delivery and Application Methods)

3.3.4.1 Direct and Indirect Effects on Wildlife Resources

For most lakes, a one-time application of fish toxin in the early fall (during low water flow period, near the end of the growing season) would effectively eliminate the undesirable fish. Gathering and sinking the dead fish in the treated lake would stimulate plankton growth as a food source for restocked westslope cutthroat trout during the following growing season and deter opportunistic scavenging by wildlife. Some amphibians and invertebrates would incur minimal and short-term impacts. Mammals, in general, exhibit low susceptibility. Organisms killed by antimycin or rotenone would not be a threat to other animals if consumed.

In 2003, the Glacier National Park superintendent issued a Finding of No Significant Impact (FONSI) decision document on the Environmental Assessment to Conduct Additional Administrative Helicopter and Fixed Wing Flights in the park. The FONSI concluded that, due to noise and disturbance, the 102 proposed administrative flights would have minor to moderate short-term adverse effects on wildlife such as the bald eagle, Canada lynx, gray wolf, grizzly bear, and bighorn sheep (Holm 2003). Based on this finding and the fewer number of proposed flights, this alternative would likely generate less or similar impacts in the South Fork Flathead, which displays similar landscapes, wildlife species, and soundscapes.

Bald Eagle—Bald eagles (*Haliaeetus leucocephalus*) nest almost exclusively in live trees, usually within one mile in line of sight of a large river or lake. Bald eagles occur in the project area seasonally. However, only one bald eagle nest has been documented in the project area: it is located on Clayton Island on Hungry Horse Reservoir. Regional file data from MFWP indicate that the nest has been successful in four of the past eight years. The peak time for fledging for the Clayton nest most likely occurs in early July (Bergeron 2002).

The bald eagle is an opportunistic predator and feeds primarily on fish, but also consumes a variety of birds and mammals (both dead and alive) when fish are scarce or these other species are readily available. Fish may comprise up to 90 percent of the diet (70 percent to 90 percent), depending on geographic location, season, and relative abundance (FWS 1996a).

Impacts on the bald eagle would include temporary increases in noise and human disturbance associated with the piscicide treatment process and transportation of materials, equipment, and staff to and from lake sites. No flights would occur in the vicinity of the nest.

In some cases, bald eagles might be attracted to these sites by the presence of dead fish. Efforts would be made to keep dead fish from becoming an attractant as noted under the grizzly bear discussion below. No impacts on the bald eagle would be anticipated as a result of possible consumption of contaminated fish and/or water (see Appendix D).

No loss of bald eagle habitat would result from this program. Since all gill-breathing organisms would be killed from the piscicide treatment, there would be a temporary reduction in the availability of fish as a food source for bald eagle that forage in these areas. This impact is expected to be minor and short-term. The lake would only be fishless during the winter following treatment when eagles are not using the area. Fish would be restocked into the lake following melting of the ice covering in early summer. There are numerous alternate food sources that bald eagle can rely on in these areas, including sources located in adjacent lakes. Lakes treated in the same year would be located large distances from one another in different sub watershed units in order to minimize local impacts on foraging.

Canada Lynx—Canada lynx (*Lynx canadensis*) are found in the South Fork of the Flathead drainage, the Swan Mountain Range, and the Swan River drainage.

Impacts on the Canada lynx would include temporary increases in noise and human disturbance associated with the piscicide treatment process and transportation of materials, equipment, and personnel to and from lake sites. Two lakes (or lake systems) are scheduled to be treated each year over the next 10 to 12 years. All applications would take place during September and October. Increases in noise and human disturbance would last approximately four days: one day for set-up, two days to treat and detoxify a lake, and at least one day for clean up. The number of trips needed to deliver materials, equipment, and personnel would vary depending on lake size and method of transport. Lakes treated in the same year would be located large distances from one another in different sub-watershed units in order to minimize local impacts from increased noise and human disturbance. The presence of humans and traffic would likely displace Canada lynx from the project area during the treatment process. Only minor and short-term increases in motorized vehicle use would result from this program.

No loss of Canada lynx habitat or prey items would result from this program. No impacts on Canada lynx are anticipated to result from possible consumption of contaminated fish and/or water (see Appendix D). In addition, no indirect impacts on Canada lynx would be expected as a result of the temporary absence of fish in the lakes.

Gray Wolf—The Spotted Bear and Red Shale packs are the only known Gray wolf (*Canis lupus*) packs in the affected environment. Sunburst Lake is the closest lake proposed for treatment to the Spotted Bear Wolf Pack. Pyramid Lake is the closet to the range of the Red Shale Pack. Interactions with wolves in the project area would likely be limited to encounters with individuals that are seeking mates from other packs, or seeking to establish new territories. May and June are the critical months for wolves in the sense that they are generally tied to a den site. Disturbance during this period may cause wolves to abandon den sites.

Impacts on gray wolf would include temporary increases in noise and human disturbance associated with the piscicide treatment process and transportation of materials, equipment, and personnel to and from lake sites. All applications would take place during September and October. Increases in noise and human disturbance would last approximately four days. The number of trips needed to deliver materials, equipment, and personnel would vary depending on lake size and method of transport. Lakes treated in the same year would be located large distances from one another in different sub-watershed units in order to minimize local impacts from increased noise and human disturbance. The presence of humans and traffic would likely displace gray wolf from the project area during the treatment process. Only minor and short-term increases in motorized vehicle use would result from this program. Roads would be used to transport materials, equipment, and personnel to only one of the 24 lakes scheduled for treatment.

No loss of gray wolf habitat or prey items would result from this program. No impacts on gray wolf are anticipated to result from possible consumption of contaminated fish and/or water (see technical appendices). In addition, no indirect impacts on gray wolf would be expected as a result of the temporary absence of fish in the lakes.

Grizzly Bear—Impacts on grizzly bear (*Ursus arctos horribilis*) would include temporary increases in noise and human disturbance associated with the piscicide treatment process and transportation of materials, equipment, and personnel to and from lake sites. All applications would take place during September and October. Increases in noise and human disturbance would last approximately four days as discussed in Chapter 2. The number of trips needed to deliver materials, equipment, and personnel would vary depending on lake size and method of transport. Lakes treated in the same year would be located large distances from one another in different sub watershed units in order to minimize local impacts from increased noise and human disturbance. The presence of humans and traffic would likely displace grizzly bear from the project area during the treatment process. Only minor and short-term increases in motorized vehicle use would result from this program.

It is expected that helicopter use and the level of human activity would displace most grizzly bears from the immediate vicinity of a lake during the treatment process. Some bears that may be habituated to humans could remain in the area during the treatment process. Efforts would be made to keep dead fish from becoming an attractant to grizzly bear. Fish that wash up on the shoreline would be taken to deeper water; air bladders would be punctured, and the fish would be sunk. This methodology has been successfully used in previous lake treatments in the proposed project area (Devine Lake in 1994; Tom Tom Lake in 2000).

No impacts on grizzly bear are anticipated to result from possible consumption of contaminated fish and/or water (see Appendix A). To minimize possible interactions between grizzly bear and personnel, requirements outlined in the U.S. Department of Agriculture (USDA) FS Food Storage Special Order LC00-18 would be followed. This includes storing human and livestock food in a bear-resistant manner and packing out any left over food and garbage. It may be possible that grizzly bear would be attracted to these sites by the presence of dead fish and/or human food supplies and garbage. Piscicide containers would also be securely stored.

No loss of grizzly bear habitat would result from this program. Because only one lake or group of lakes in a given sub-watershed unit would be treated in a given year, the grizzly bear could rely on adjacent lakes and other food sources in these areas, thus minimizing local impacts on foraging.

Amphibians— Amphibians have the potential to be directly affected by the application of rotenone, antimycin, and potassium permanganate simply because they use some of the lake and stream environments targeted in this project for portions of their life cycles.

Numerous field evaluations conducted by MFWP indicate that amphibians persist following rotenone applications in the Flathead Basin and, in particular, in the South Fork Flathead. MFWP laboratory studies indicate that spotted frogs, tailed frogs, and long toed salamanders can survive antimycin exposures at levels much higher than those prescribed to kill trout. In addition, there is an exhaustive amount of literature declaring the effects of these compounds on various species of amphibians.

Grisak (2003c) reported that Tom Tom Lake, located in the South Fork Flathead drainage, was treated with rotenone in October, and a survey one year later found numerous spotted frog juveniles, tailed frogs, and long toed salamander larvae. Grisak (2003c) reported the evaluations of 18 lakes treated with rotenone over a 44 year period; he found that amphibians persisted after treatments. Chandler and Marking (1982) found that leopard frog tadpoles were 3 to 10 times more tolerant to rotenone than fish. Brown and Ball (1943) reported that during a May rotenone treatment in Michigan, tadpoles were “greatly affected,” but within three months were “extremely numerous.” Grisak (2003b) reported that tailed frog tadpoles survived exposure to 0.75 ppm formulated rotenone for 24 hours, and 80 percent died at 1 ppm exposure after 24 hours.

Based on this information, MFWP would expect the impacts to native amphibians resulting from this project to be consistent with past applications, laboratory tests, and exhaustive reports from other researchers and biologists. Any impacts to amphibians stemming from the application of rotenone are expected to be minimal and short-term, and likely limited to larval stages. Implementing these projects in the autumn and fall would further reduce any potential for impacts on native amphibians.

A similar amount of research has been conducted on the effects of antimycin on amphibians. Walker, et al. (1964) reported that tiger salamanders survived 80 ppb exposure for 96 hours, but were killed by 600 ppb. Bullfrog tadpoles survived 24 hours exposure to 20 ppb, but those exposed to 40 ppb died. Berger (1966) reported that bullfrog tadpoles required doses five times (40 ppb) greater than fish killing concentrations to effect lethality. Tiger salamanders required doses 75 times (600 ppb) greater to effect death. Likewise, laboratory studies on newts, frogs, tadpoles, bull frogs, leopard frogs, turtles, and snakes have shown that they will survive exposure to antimycin at levels prescribed for trout removal (Schnick 1974a). In 2003, MFWP laboratory tests on larval long toed salamanders showed 10 percent mortality at 96 hours at 30 and 60 ppb exposure; those exposed to 150 ppb showed 100 percent mortality at 84 hours (Grisak et al. 2004). Spotted frog juveniles exposed to 125 ppb showed 20 percent mortality at 96 hours, and 250 ppb showed 70 percent mortality at 96 hours (Grisak, et al. 2004). Tailed frog tadpoles showed 11 percent mortality when exposed to 56 ppm for 24 hours (Grisak 2003b).

Based on these evaluations, MFWP would expect the impacts on amphibians stemming from the application of antimycin to be minimal and short-term. Efforts to mitigate for or offset any negative impacts could include transplanting amphibians from neighboring populations if necessary, and/or capturing specimens from within each project area before each treatment then releasing them after it is complete.

Plankton and Aquatic Insects—Like fish and amphibians, plankton and aquatic insects have the potential to be affected by rotenone and antimycin treated waters because they depend on some of the proposed lake and stream environments as habitat.

Numerous studies indicate that piscicides have temporary or minimal effects on aquatic insects and plankton. Anderson (1970) reported that comparisons between samples of zooplankton taken before and after a rotenone treatment did not change a great deal. Despite the inherent natural fluctuations in zooplankton communities, the application of rotenone had little effect on the zooplankton community. Cook and Moore (1969) reported that the application of rotenone has little lasting effect on the non-target insect community of a stream. Kiser, et al. (1963) reported that 20 of 22 zooplankton species re-established themselves to pre-treatment levels within about four months of a rotenone application. Cushing and Olive (1956) reported that the insects in a lake treated with rotenone exhibited only short-lived effects.

Both Anderson (1970) and Kiser, et al. (1963) reported that most plankton species survive a rotenone treatment via their highly resilient egg structures. In addition, **parthenogenesis** of some female **plankters** occurs, causing sexual dimorphism, which greatly increases reproduction potential, and ultimately, density. Among the aforementioned studies, variation in climate, physical environment, and water chemistry would likely cause subtle differences in results in other areas.

Case studies conducted on Devine Lake in the Bob Marshall Wilderness from 1994-1996 (Rumsey, et al. 1997) indicate that following a rotenone treatment, invertebrates actually increased in number and, very slightly, increased in diversity. This is supported by observations made by Cushing and Olive (1956), who reported that oligochaete (worms) numbers increased after a rotenone treatment then became stable. Neighboring Ross Lake, in the Bob Marshall Wilderness, is fishless and was used to measure natural insect and plankton variation during the Devine Lake treatment and evaluation. Invertebrate numbers in Ross Lake were reported to be relatively stable, but the diversity of insects fluctuated considerably over time.

The effects of antimycin on plankton and aquatic insects has been evaluated by many researchers. Callaham and Huish (1969) reported that zooplankton were severely depleted but began to reappear within six to nine days, and bottom insects were not affected by antimycin. Hughey (1975) concluded that four Missouri ponds treated with antimycin showed little short-term and no long-term effect in regard to population levels of zooplankton. The effects from antimycin on plankton were consistent with the natural variability that is characteristic of plankton populations, and re-colonization was rapid and reached near pre-treatment levels within eight months. Antimycin has been found to be non-toxic to some plankton, bottom insects, and water plants at typical fish killing concentrations (Walker, et al. 1964).

The literature suggests that some impacts to aquatic insects and plankton can be expected from the application of rotenone and antimycin, but they are expected to be minimal and short-term. Based on these findings, we would expect similar impacts to these organisms in the proposed lakes and streams.

3.3.4.2 Cumulative Effects on Wildlife Resources

Because of the short duration of each treatment and the limited number of treatments each year, there would be no cumulative effects under this Alternative. A Biological Assessment was submitted to US USFWS in April 2002. USFWS concurred with BPA that the proposed project may affect but is not likely to adversely affect the threatened grizzly bear (*Ursus arctos horribillis*), bald eagle (*Halieaeetus leucocephalus*), or Canada lynx (*Lynx canadensis*) or the endangered gray wolf *(Canis lupus*). (USFWS 2002).

3.3.5 Environmental Consequences of Alternative C (Fish Toxins – Motorized/mechanized Delivery and Application Methods)

3.3.5.1 Direct and Indirect Effects on Wildlife Resources

The effects would be the same as those for Alternative B (Section 3.3.4.1).

3.3.5.2 Cumulative Effects on Wildlife Resources

There would be no cumulative effects under this Alternative.

3.3.6 Environmental Consequences of Alternative D (Suppression Techniques and Swamping)

3.3.6.1 Direct and Indirect Effects on Wildlife Resources

Human and motorized activities associated with a long-term presence on the lake would likely disrupt normal wildlife behavior. Fish populations would drop over time as suppression techniques were implemented.

Diving ducks, some birds of prey (including bald eagles), and some mammals (e.g., otters) may be attracted to gill nets by dead fish, become entangled, and drown. Dead fish may be an attractant for bears; therefore, they would be collected from the lakes and streams as quickly as possible.

3.3.6.2 Cumulative Effects on Wildlife Resources

There would be no cumulative effects under this Alternative.

3.4 Water Resources

3.4.1 Existing Conditions

The portion of the streams and lakes within the Bob Marshall Wilderness are designated as Outstanding Resource Waters (ORW) [ORW, 75-5-103(20), Montana Code Annotated (MCA)] and have a water-use classification of A-1 [Administrative Rules of Montana (ARM) 17.30.614]. The remainder of the South Fork Flathead Watershed is classified as B-1 (ARM 17.30.610). The portion of South Fork Flathead drainage located in the Bob Marshall wilderness is designated as an ORW because it is within the boundaries of the wilderness, not necessarily because of extraordinary water quality.

The drainages on the Flathead National Forest, including the project area, contribute approximately 7,000,000 acre-feet of water per year to the Columbia River drainage. The chemical water quality of the streams and rivers is generally excellent. The primary water quality contaminant of any consequence is sediment. The MDEQ's 1996 and 2000 303 (d) Reports--Water bodies in need of Total Maximum Daily Load (TMDL) lists several water bodies that are located in the Flathead Basin but none of them are in the South Fork drainage. The South Fork of the Flathead River downstream of Hungry Horse Dam is listed due to hydro-modification caused by the alteration of flow regime as a consequence of the Dam. There are no streams in the South Fork Flathead drainage, located upstream of the dam, that are listed.

The typical stream types found in the project area generally have gradients from 4 to 10 percent, and are characterized by straight (nonsinuous) cascading reaches with frequently spaced pools. Many of the outlet streams associated with the lakes in this project have large waterfalls immediately downstream of the lakes, some reaching 200 feet tall. Also common are streams with gradients from 2 to 4 percent; these streams usually occupy narrow valleys with gently sloping sides.

There are no federal or Montana numeric water quality standards for rotenone or antimycin. However, the Montana Water Quality Act has narrative standards for water quality that prohibit the introduction of substances into waters that are injurious to aquatic life or that affect exiting uses. Under this project, MFWP would apply piscicide for the expressed purpose of killing unwanted fish. There may be some minimal and short-term impacts to other aquatic organisms, but the MDEQ will permit an exemption for this activity under section 75-5-308 of the MCA.

3.4.2 Environmental Consequences of Alternative A (No Action)

3.4.2.1 Direct and Indirect Effects on Water Resources

There would be no change in conditions under this alternative.

3.4.2.2 Cumulative Effects on Water Resources

There would be no change in conditions under this alternative.

3.4.3 Environmental Consequences of Alternative B (Proposed Action: Fish Toxins – Combined Delivery and Application Methods)

3.4.3.1 Direct and Indirect Effects on Water Resources

The alternative does not jeopardize the ORW designation.

Water quantity would not be permanently affected by the proposal. The effects on water quality from the application of piscicides and potassium permanganate would be temporary and would become undetectable after detoxification. See Appendix D for more information on the effect of these chemicals on water quality.

No contamination of groundwater is anticipated to result from this project. Piscicides bind readily to sediments, suggesting that they would not seep into groundwater aquifers (Skaar 2001; Engstrom-Heg 1971, 1976). In California, studies where wells were placed in aquifers adjacent to and downstream of rotenone applications never detected rotenone or any of the other organic compounds in the formulated products (CDFG 1994). Case studies in Montana have concluded that rotenone movement through ground water is minimal. At Tetrault Lake in Montana, rotenone was not detected in a nearby domestic well that was sampled two and four weeks after treatment of the lake with 90 ppb active rotenone. This well was chosen because it was down gradient from the lake and because it drew water from the same aquifer that fed and drained the lake. In 1998, a Kalispell area pond was treated with rotenone. Water from a well located 65 feet from the pond was analyzed; no sign of rotenone was detected. In 2001, another Kalispell area pond was treated with rotenone. Water from a well located 200 feet from that pond was tested four times over a 21-day period and showed no sign of contamination.

Floodplains and wetlands would not be affected by this project because no ground disturbance would occur. Pack animals would be kept at least 200 feet away from the edges of the lakes.

Proper management of the antimycin components would reduce any potential for accidental spills. At the prescribed concentration, Antimycin is virtually non-effective on fish and other aquatic organisms until these components are mixed. These components would be transported separately to avoid unintentional mixing. During transport on livestock, the compounds would be stored in plastic Nalgene®-type bottles with sealed lids. These bottles would be placed in Styrofoam sleeves, wrapped in sealed plastic bags, contained in a wooden or aluminum box, and then wrapped in a manti-tarp. During helicopter or truck transport, these compounds would be sealed in plastic drums or plastic boxes. The potential for water contamination would be minimal.

The only downstream users of water would be outfitter and private hunter camps. Some livestock watering would be expected at some of these downstream locations. A number of factors would aid in the reduction or elimination of project areas users' exposure to compounds: proper containment of piscicide treatments (low concentrations used for fish killing do not have harmful effects on mammals); rapid detoxification of both compounds in flowing streams; temporary closure of the project areas; and proper signing and advance notification that would allow users to find alternate sources for water if necessary.

Because the South Fork Flathead is a headwater system for the Flathead and Columbia River water basins, all water in this area ultimately flows downstream toward municipalities. The closest municipal water intakes are the cities of Hungry Horse, Columbia Falls, and Kalispell. These three communities acquire their municipal water from wells and not from surface water. This form of water intake would further reduce any chemical exposure to humans. By the time source waters reach municipal locations, adequate dilution and natural detoxification would have occurred. Supplemental detoxification with potassium permanganate hastens this chemical process, and would virtually eliminate the possibility of acute or chronic exposure by humans to harmful levels of the chemicals.

There would be a small possibility of fuel spills from pumps and outboard motors. However such spills would be of small quantities (less than 5 gallons) and would vaporize rapidly. No effects to water resources are expected.

3.4.3.2 Cumulative Effects on Water Resources

Alternative B would have no cumulative effects on water resources, either as habitat or for drinking water.

3.4.4 Environmental Consequences of Alternative C (Fish Toxins – Motorized/mechanized Delivery and Application Methods)

3.4.4.1 Direct and Indirect Effects on Water Resources

The effects would be the same as those for Alternative B (Section 3.4.3.1).

3.4.4.2 Cumulative Effects on Water Resources

The effects would be the same as those for Alternative B (Section 3.4.3.2).

3.4.5 Environmental Consequences of Alternative D (Suppression Techniques and Swamping)

3.4.5.1 Direct and Indirect Effects on Water Resources

There would be a small possibility of fuel spills from outboard motors. However such spills would be of small quantities (less than 5 gallons) and would vaporize rapidly. No effects to water resources are expected.

3.4.5.2 Cumulative Effects on Water Resources

Alternative D would have no cumulative effects on water resources, either as habitat or for drinking water.

3.5 Soil and Vegetation Resources

3.5.1 Existing Conditions

The project area is characterized by high rugged peaks with cirque basins and lakes at the high elevations, and long heavily forested drainages. Most soils in the project area have a surface layer of silt loam volcanic ash material originating from volcano eruptions on the west coast of the United States. These eruptions occurred from 6,600 years to as recently as the last few decades. The volcanic ash material is consistent in its characteristics and its location throughout the area. It has silt loam textures; high organic matter content ranging from 2, to more than 5 percent; and a high ability to hold and store nutrients.

Plant communities in this region are naturally diverse. Most of the major vegetative habitat types common to western Montana are located here. The interaction of topographic and climatic variation is evidenced in the wide array of habitats, ranging from the warm dry ponderosa pine (*Pinus ponderosa*)/bunchgrass (*Agropyron spicatum*) type to the cool moist whitebark pine (*Pinus albicaulis*) types. Nearly all tree species native to western Montana grow within the national forest boundaries. Much of the project area is high country with slopes that rise above timberline. In the higher elevation forested areas, subalpine fir and whitebark pine predominate. A mixture of Douglas fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), lodgepole pine (*Pinus contorta*), and Engelmann spruce (*Picea engelmannii*) are found across these higher elevations. Ponderosa pine occurs at lower elevations with native grasses and sagebrush in the valley bottoms in the upper reaches of the drainages. Localized fens with rare plants can be found in the upper reaches of the South Fork. Whitebark pine communities are generally in decline and western white pine communities are in decline in the lower reaches of the South Fork.

3.5.2 Listed Species – Water Howellia

Water howellia, (*Howellia aquatilis*) is an annual aquatic species that grows as a mostly submerged plant rooted in the bottom sediments of ponds and sloughs. Water howellia is typically found in two general types of wetland/riparian habitat: small isolated ponds and river oxbows that may be abandoned or hydrologically linked to adjacent river systems.

Range-wide, no occurrences of water howellia have been found in elevations over 4,500 feet. The FWS has determined that the range of water howellia does not extend above 5,000 feet on the Flathead National Forest. All of the lakes associated with this project are found above 5,000 feet in elevation, except for Handkerchief Lake, which is located at 3,835 feet. No occurrences of water howellia have been noted in the vicinity of Handkerchief Lake (Mantas 2002).

3.5.3 Candidate Species – Slender Moonwort

Slender moonwart (*Botrychium lineare*) is not currently listed; therefore, it has no legal status. However, because this project could potentially span a period of 10 to 12 years, caution should be exercised with regard to the species. There are three known occurrences in Glacier National Park and one historic occurrence (not seen since 1978) at Mission Falls on the Flathead Indian Reservation in Lake County. The occurrences on Glacier National Park are roadside. Habitat for this species varies from forested openings, to grasslands, to disturbed trails and roads, typically at higher elevations (starting at 4,600 feet). There may be potential habitat for this species within the project area, especially alongside trails at higher elevations (Davis 2003).

3.5.4 Sensitive Species

There are a few known occurrences of alpine/subalpine forest sensitive plants that might be minimally affected by this proposed project. Several of these have the potential to occur within the affected environment.

- *Astragalus lackschewitzii* - rock scree, gravel banks.
- *Botrychium spp.* - various habitats.
- *Cetraria subalpina* (lichen) - base of shrubs or whitebark pine near timberline.
- *Diphasiastrum sitchense* - alpine meadows, rocky barrens, conifer woodlands. It occurs along the trails near the Picnic Lakes that lead to Black Lake.
- *Erigeron lackschewitzii* - gravelly talus.
- *Oxytropis podocarpa* - alpine ridges and slopes.
- *Potentilla quinquefolia* - gravel ridges and slopes.
- *Salix barrattiana* - lake shores, boggy meadows.

3.5.5 Environmental Consequences of Alternative A (No Action)

3.5.5.1 Direct and Indirect Effects on Soil and Vegetation Resources

There would be no change in conditions under this alternative.

3.5.5.2 Cumulative Effects on Soil and Vegetation Resources

There would be no change in conditions under this alternative.

3.5.6 Environmental Consequences of Alternative B (Proposed Action: Fish Toxins – Combined Delivery and Application Methods)

3.5.6.1 Direct and Indirect Effects on Soil and Vegetation Resources

No direct or indirect effects on soil resources are anticipated if the proposed action is implemented. Minor soil compaction and abrasion may occur as a result of trail use by pack animals and associated camping near treatment sites. However, this is an accepted means of transportation in this primitive area. This amount of stock would be similar to what is currently used by private and commercial users who install, use and maintain hunting and fishing camps.

It is not likely that the piscicides would have a negative impact on plant species. For example, antimycin, has been used in Japan as an extremely effective fungicide on rice plants (Harada, et al. 1959; Dunshee, et al. 1949). Based on the fact that it is used to control fungus on living rice plants without apparent damage and that the concentrations used to kill fish are very low, it is unlikely that there would be any effects on vegetation in the project area. Schnick (1974b) also listed several researchers who reported rotenone having no affect on either algae or rooted aquatic vegetation. Many of the same researched listed in Schnick (1974b) reported an increase in plankton density immediately following a rotenone application. This phenomenon is corroborated by Bradbury (1986) who reported that 9 of 11 water bodies in Washington treated with rotenone demonstrated an algae bloom. Bradbury attributed this to an increase in phosphorus resulting from the decaying fish through bacterial breakdown and release of bound organic and dissolved inorganic forms.

There are no known occurrences of water howellia in the affected environment. There are no vernal pothole ponds or abandoned river oxbows within any areas affected by this project. As Handkerchief Lake is the only lake at an elevation that could support water howelliia, appropriate surveys for the listed plant would be conducted by a qualified botanist prior to any activity in this area. If water howellia is discovered, appropriate actions would be taken to ensure that these plants are not disturbed during the application process (such as temporary flagging and fencing of these areas). No impacts on water howellia, its habitat, or potential habitat would occur as a result of implementing Alternative B.

If there are any occurrences of slender moonwart in the project area, only ground disturbance in the nature of ripping up the soil would possibly affect plant root systems or associated **mycorrhizal fungi**. Since the seasonal implementation period for the treatments is in August and September, the plants would probably have already **sporulated**, thus partially protecting them from adverse effects on propagation. In addition, non-native weeds brought in along trail corridors by hikers and livestock may also have long-term effects on population viability if there were unknown occurrences within the project area.

Forest sensitive plants may occur in the affected environment. Because equipment and personnel would be flown into Black Lake, there would probably be no effects on *Diphasiastrum sitchense*. Similarly, the potential for adverse effects on *Salix barrattiana* along lake shores within the project area would be minimal. The nearest known occurrences are in Glacier County. Although there would be some potential for these species to occur at higher elevation, it is not likely that they would be impacted. Unknown occurrences of these plants would only be affected if trails bisect the screes and gravelly slopes where most of the habitat is located for these plants (Davis 2003).

In the event of spill of any chemicals or fuels, clean-up will follow the MFWPs spill-contingency plan developed as part of the treatment plan for each lake. This will address specifically how to handle clean-up and or disposal of contaminated soil. These plans will follow suggestions from the product labels, the Material Safety Data Sheets or other plans and manuals.

3.5.6.2 Cumulative Effects on Soil and Vegetation Resources

Alternative B would have no cumulative effects on soil or vegetation resources.

3.5.7 Environmental Consequences of Alternative C (Fish Toxins – Motorized/mechanized Delivery and Application Methods)

3.5.7.1 Direct and Indirect Effects on Soil and Vegetation Resources

The effects of Alternative C would be less than those discussed under Alternative B (Section 3.5.6.1) as there would be no hikers or livestock to disturb soils and vegetation along trails, or to convey non-native weed seeds. In addition, since personnel crews and their accompanying livestock, camp sites and equipment, and chemical stockpiles, would be located at lakes for a shorter period of time, there would be less physical disruption to the environment.

As for Alternative B, in the event of a spill of any chemicals or fuels, clean-up will follow the MFWPs spill-contingency plan.

3.5.7.2 Cumulative Effects on Soil and Vegetation Resources

The effects would be the same as those for Alternative B (Section 3.5.6.2).

3.5.8 Environmental Consequences of Alternative D (Suppression Techniques and Swamping)

3.5.8.1 Direct and Indirect Effects on Soil and Vegetation Resources

Even though suppression techniques used at each lake may differ based on differing environments, the impacts to soil and vegetation resources would be similar. Suppression techniques, such as gill-netting, trapping, or seining would require long-term activity by personnel such as camping near lakeshores, the use of motorboats to set and check nets or traps, and transport to and from the lake. Each of these activities would likely be continued for several years. Long-term camping and storage of equipment would lead to trampling of vegetation, soil compaction, loss of vegetation cover, and ultimate site degradation.

Research has shown that vegetation response to trampling is dependent more on plant morphology than on specific site conditions. In general, erect herbs are readily damaged by trampling, but recover quickly. **Chamaephytes** (low-growing **forbs**) are more resistant, but take longer to recover. Non-erect herbs are the most stable when subjected to trampling (Cole 1995a, 1995b). Site-specific impacts can be predicted based on the structure of local plant communities.

Alternative D would not impact water howelliia or any other listed species (see 3.5.6.1).

3.5.8.2 Cumulative Effects on Soil and Vegetation Resources

Alternative D may have cumulative effects on soil and vegetation resources as a result of long-term camps being established near the lakes to carry the activities proposed in this Alternative.

3.6 Land Use and Wilderness Resources

There are several administrative and legislative land use designations superimposed over the project area in the South Fork Flathead River Drainage on the Flathead National Forest. Designated wilderness, special use areas, and other management areas on the Flathead National Forest are all treated differently in terms of access, use, and management practices.

3.6.1 Hiking Area Designation

The Jewel Basin Hiking Area (Management Area 19) consists of about 15,000 acres. The area provides opportunities for a recreational experience between that found in wilderness and areas accessible by roads, but satisfied by neither. The area is managed for semi-primitive non-motorized recreational opportunities. This area is recommended for wilderness classification; therefore, the FS is to protect all wilderness values that presently exist. The Jewel Basin Hiking Area is located on the Swan Lake and Hungry Horse ranger districts, Flathead National Forest.

Packstock, motorized vehicles, motorized equipment, mechanized vehicles, and helicopter landings are not permitted in the hiking area by the public. The Forest Supervisor may authorize use of motorized equipment or livestock as deemed necessary for the administration of the area and its resources.

3.6.2 Wilderness Designation

A portion of this proposed project would occur in The Bob Marshall Wilderness (Management Area 21), classified in 1964 by the U. S. Congress. The Spotted Bear Ranger District, Flathead National Forest, manages about 70 percent of the designated

Figure 3-4. A high mountain lake in the Bob Marshall Wilderness.

wilderness. These areas are managed to: "preserve wilderness character, to allow natural processes to operate freely, and for the use and enjoyment of the American people."

Motorized vehicles, motorized equipment, mechanized trail vehicles, and helicopter landings are not conforming uses; the public is not permitted these uses in the Wilderness Area. Examples of exceptions that have been granted in the past include search and rescue and firefighting. However, the Forest Supervisor may authorize use of motorized equipment as deemed necessary for the administration of the area and its resources. MFWP is committed, to the extent possible, to minimizing the number of aircraft trips in and out of the Wilderness Area and National Forest. The Regional Forester may authorize chemical treatments to prepare waters for reestablishment of certain species.

The management direction for the BMWC focuses on delivery and preservation of those wilderness-related benefits specified in the Wilderness Act of 1964; the National Forest Management Act of 1976; the Department of Agriculture and FS policy guidelines; the Forest Plan; and the Flathead Land and Resource Management Plan of 1986. The Flathead Land and Resource Management Plan of 1986 includes the amended Recreation Management Direction of 1987 for the BMWC; the International Association of Fish and Wildlife Agencies 1986 agreement; the Fish, Wildlife and Habitat Management Framework for the BMWC (FS and MFWP 1995) and February 1997 Supplement. Selected excerpts from these laws and management guidelines follow.

3.6.3 Wilderness Mandates, Policies, and Directives

3.6.3.1 Federal

Primary direction for managing Wilderness comes from the Wilderness Act of 1964 (PL 88-577). According to the Act, the purpose for establishing Wilderness areas is:

> " . . . to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States . . . leaving no lands designated for preservation and protection in their natural condition. . . . " (Subsection 2a)

> " . . . for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness and so as to provide for the protection of those areas, the preservation of their wilderness character . . . " (Subsection 2a)

Several subsections of the Act further characterize Wilderness and address the administration of these congressionally designated lands:

> "A Wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." (Subsection 2c)

> ". . . an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements of human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of

> land . . . ; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic or historical value . . .” (Subsection 2c)

> “. . . wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation and historical use.” (Subsection 4b)

> “. . . there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act . . . there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.” (Subsection 4c)

Primary direction for managing National Forests comes from the National Forest Management Act of 1976.

> “In developing, maintaining, and revising plans for units of the National Forest System pursuant to this section, the Secretary shall assure that such plans--(1) provide for multiple use and sustained yield of the products and services obtained there from . . . and, in particular, include coordination of outdoor recreation, range, timber, watershed, wildlife and fish, and wilderness.” (Subsection 6e)

Wilderness management is also discussed in the context of forest planning in the following sections of the Code of Federal Regulations:

> 36 CFR Part 219.18 Planning--Wilderness Management

> “Forest planning shall . . . provide for limiting and distributing visitor use of specific areas in accord with periodic estimates of the maximum levels of use that allow natural processes to operate freely and that do not impair the values for which wilderness areas were created . . . ”

> 36 CFR Part 261.16 Prohibitions--Wilderness

> “Prohibits motor vehicles, motorboats, motorized equipment, bicycles, hang gliders, aircraft landings, and dropping or picking up of materials or people by aircraft.”

> 36 CFR Part 293.2 Wilderness

> “ . . . In carrying out such purposes, National Forest Wilderness resources shall be managed to promote, perpetuate, and, where necessary, restore the wilderness character of the land and its specific values of solitude, physical and mental challenges, scientific study, inspiration, and primitive recreation. To that end:

> (a) Natural ecological succession will be allowed to operate freely to the extent feasible.

> (b) Wilderness will be made available for human use to the optimum extent consistent with the maintenance of primitive conditions.

(c) In resolving conflicts in resource use, wilderness values will be dominant to the extent not limited by the Wilderness Act, subsequent establishing legislation, or the regulations in this part."

3.6.3.2 State

The state has no specific mandate to manage fish and wildlife in a wilderness area; however the powers and duties of the agency include statutory directives for fish and wildlife management in the state including:

M.C.A. 87-1-702.

The Montana Fish, Wildlife & Parks (FWP) " . . . is hereby authorized to perform such acts as may be necessary to the establishment and conduct of fish restoration and management projects…"

M.C.A. 87-1-201

(9) (a) . . . the department shall implement programs that:

(i) Manage wildlife, fish, game, and non-game animals in a manner that prevents the need for listing under 87-5-107 or under the federal Endangered Species Act, 16 U.S.C. 1531et seq.;

(ii) Manage listed species, sensitive species, or a species that is a potential candidate for listing under 87-5-107 or under the federal Endangered Species Act, 16 U.S.C. 1531et seq., in a manner that assists in the maintenance or recovery of that species.

3.6.3.3 Forest Service Policy

The FS Manual Direction for Wilderness (FSM 2320, June 1990) indicates that Wilderness is a unique and vital resource. In addition to offering primitive recreational opportunities, it is valuable for its scientific and educational uses, as a benchmark for ecological studies, and for the preservation of historical and natural features.

FSM 2320 takes its authority from the Wilderness Act of 1964 and states several FS objectives (FSM 2320.2):

"Maintain and perpetuate the enduring resource of wilderness as one of the multiple uses of National Forest System land."

"Maintain wilderness in such a manner that ecosystems are unaffected by human manipulation and influences so that plants and animals develop and respond to natural forces." This proposal is designed to help correct ecosystem imbalances caused by past actions (i.e., stocking and illegal species introduction).

"Minimize the impact of those kinds of uses and activities generally prohibited by the Wilderness Act, but specifically excepted by the Act or subsequent legislation."

"Protect and perpetuate wilderness character and public values including, but not limited to, opportunities for scientific study, education, solitude, physical and mental challenge and stimulation, inspiration, and primitive recreation experiences."

The wilderness management model outlined in FSM 2320.6 describes the philosophy that should drive management decisions:

> "Manage wilderness toward attaining the highest level of purity in wilderness within legal constraints."

> "Where a choice must be made between wilderness values and visitor or any other activity, preserving the wilderness resource is the overriding value. Economy, convenience, commercial value, and comfort are not standards of management or use of wilderness."

Management direction for the use of motorized equipment or mechanical transport in wilderness as it pertains to this proposal is found in FSM 2326 which states: "Do not approve the use of motorized equipment or mechanical transport unless justified as described in 2326.1" (FSM 2326.03).

FSM 2326.1 lists several acceptable "conditions under which use may be approved." Condition five states:

"Allow the use of motorized equipment or mechanical transport only . . . to meet minimum needs for protection and administration of the area as wilderness, only as follows:

> a. A delivery or application problem necessary to meet wilderness objectives cannot be resolved within reason through the use of nonmotorized methods.

> b. An essential activity is impossible to accomplish by nonmotorized means because of such factors as time or season limitations, safety, or other material restrictions."

However, FS wilderness management policy dictates that, "Where there are alternatives among management decisions; wilderness values shall dominate over all other considerations except where limited by the Wilderness Act, subsequent legislation, or regulations" (FSM 2320.3). Maintaining naturalness and wildness should dominate what the BPA, FS, and MFWP do in relation to this proposal.

3.6.4 Wilderness Experience

Based on the language in the Wilderness Act (Subsection 2c), wilderness experiences should be characterized by naturalness and solitude. Management influence should not dominate the experience.

3.6.4.1 Naturalness

Wilderness naturalness is generally diminished or enhanced by recreational impacts, nonconforming but allowed uses, and natural processes. Recreational impacts due to overuse of a particular area, such as trampling, devegetation, social trails, and depleted firewood and littering all contribute to the lack of perceived naturalness by wilderness visitors and can negatively impact the experience.

Special provisions that are allowed in wilderness, but are nonconforming have great potential for diminishing the perceived naturalness of wilderness and should be managed to minimize intrusion. Examples of special uses that impact naturalness include: commercial grazing, mining infrastructure, access roads for administrative use or "inholding" landowners. Aircraft use in wilderness would fall into this category and should be used with great discretion. However, aircraft have the benefit of not leaving a lasting footprint on the land and of minimizing impact duration to a few hours.

Natural ecological processes and wildlife are easily observable signs of naturalness that most users identify readily and associate with a high-quality wilderness experience.

Charismatic **megafauna** (e.g., deer, moose, and eagles) normally top this list, while other natural processes such as wildfire and avalanches are perceived in a more negative light. Education of these processes can often clarify perception (Hendee and Dawson 2002).

3.6.4.2 Solitude

Wilderness solitude is a relative term that varies in meaning from one visitor to the next. It is an important component of the wilderness experience; however, social conditions tend to affect experiences more than natural conditions. Solitude is defined and impacted by the presence of other visitors, conflicts with other visitors, and visitor behavior.

Managers often try to manage for solitude by minimizing crowding of the resource. This is usually expressed in terms of the number of encounters per day. These levels of acceptable use are set by managers in response to user surveys and wilderness research that relate visitor satisfaction with the experience to density of users during a given time period. Solitude can also be impacted by encounters with nonrecreational uses, such as grazing, mining, or administrative uses that create noise, air pollution, or other distractions. These conflicts of uses have the potential to negatively impact the wilderness experience. Even different types of recreational users may have their experiences impacted by unwanted encounters with each other. Examples include encounters between an individual and groups or hikers and equestrians. Different or conflicting uses and their impact on the wilderness solitude experience can be tempered by associated visitor behavior such as littering, rule breaking, and yielding trail rights-of-way (Hendee and Dawson 2002).

3.6.5 Minimum Tool Analysis

The FS prepared a Draft Minimum Tool Analysis in 2003 to determine if administrative action was warranted and, if so, to determine the minimum tool required to address the need. The FS determined that the issue could not be resolved outside of wilderness and that if the issue is not resolved, or action not taken, the natural processes of the wilderness would be adversely affected by allowing the loss of genetically pure stocks of westslope cutthroat trout in the South Fork drainage. If the current situation is allowed to continue, the wilderness would continue to be home to non-native fish species and the remaining native cutthroat may be lost. These species are evidence of human manipulation due to their introduction in the past by fish managers and others (for reasons different than those that drive fish stocking practices today) before the area was designated as wilderness. A Final Minimum Tool Analysis is not normally completed prior to having an approved decision.

In the draft minimum tool analysis, the application of piscicides by motorboat, transported by packstring--except to inaccessible lakes such as Lick and George Lakes where a helicopter would be used to transport supplies, equipment, personnel--and utilizing an outboard motor for distributing the antimycin in the water, is preferred over other methods that may prove disruptive to wilderness solitude and entail repeated, long-term applications. (Long-term applications require the continued use of outboard motors. See Alternative D for a description.) Because pack stock is not allowed in the Jewel Basin Hiking Area, , application by aircraft and motorboat at target lakes would fulfill minimum tool requirements and best address the resource values. Antimycin is preferred for the wilderness lakes because it requires fewer trips for transport of supplies than other piscicides, thereby reducing potential impacts to the environment and wilderness visitors. Furthermore, its properties make it easier to contain in drainages that contain non-target species like the bull trout.

Rotenone is preferred for most Jewel Basin Hiking Area and National Forest lakes because it is suitable for application by aircraft in certain situations. Also rotenone's properties make it beneficial to achieve downstream objectives, unlike antimycin that must be reapplied more frequently due to its degradation in rapidly flowing streams. This draft Minimum Tool Analysis would be re-evaluated after the environmental analysis for the project is complete and the EIS is finalized.

3.6.6 Environmental Consequences of Alternative A (No Action)

3.6.6.1 Direct and Indirect Effects on Land Use and Wilderness Resources

There would be no change in conditions under this alternative.

3.6.6.2 Cumulative Effects on Land Use and Wilderness Resources

There would be no change in conditions under this alternative.

3.6.7 Environmental Consequences of Alternative B (Proposed Action: Fish Toxins – Combined Delivery and Application Methods)

3.6.7.1 Direct and Indirect Effects on Land Use and Wilderness Resources

In protecting the South Fork native cutthroat populations, the genetic integrity of the westslope should be enhanced both in and out of the wilderness. Addressing the issue of protecting the species would take a step toward improving the biological integrity of the wilderness by replacing non-native species with a native species.

Since antimycin requires less volume per area treated than other piscicides, fewer aircraft trips and pack animals would be required, limiting associated impacts. The wilderness experience (e.g., solitude) of users in the area may be affected during the time of delivery and application. This includes the intrusion of additional people, stockpiling of material for those areas delivering material by traditional means (stock), setting up campsites, and the sight and sound of aircraft and other motorized equipment. These impacts would also occur in non-wilderness areas.

To reduce the number of trips, SEAT aircraft, instead of helicopters, would be used for non-wilderness applications where possible. Most lakes would be treated over a three to four day period of time. There would be moderate short-term adverse impacts on proposed wilderness due to noise and disturbance from flights.

There would be a temporary reduction (1 to 3 years) in angling opportunity at treated lakes.

The planned stocking of genetically pure westslope cutthroat trout following removal of hybrids would return the overall angling conditions similar to those that are present today.

3.6.7.2 Cumulative Effects on Land Use and Wilderness Resources

There are no cumulative effects.

3.6.8 Environmental Consequences of Alternative C (Fish Toxins – Motorized/mechanized Delivery and Application Methods)

3.6.8.1 Direct and Indirect Effects on Land Use and Wilderness Resources

The effects on Jewel Basin and non-wilderness areas would be the same as those in Alternative B (see section 3.6.7.1). Wilderness sites would experience slightly more impact as there would be additional aircraft flights than proposed in Alternative B.

3.6.8.2 Cumulative Effects on Land Use and Wilderness Resources

There are no cumulative effects.

3.6.9 Environmental Consequences of Alternative D (Suppression Techniques and Swamping)

3.6.9.1 Direct and Indirect Effects on Land Use and Wilderness Resources

The effect of Alternative D on wilderness resources would be of longer duration than that of Alternatives B or C. Examples from the literature indicate that to implement such a program would require a substantial commitment of personnel over many years, and would likely result in an inability to meet the project goal of complete fish removal. The use of the suppression technique of gill netting involves long periods of trapping and netting that require the use of an outboard motor and boat. Alternatives B and C, to be successful, apply such use for one or two days rather than the entire season. Swamping would also affect the wilderness resource since fish populations would be artificially sustained as opposed to a self-sustaining natural fishery. The use of gill netting and other suppression techniques would disrupt natural wilderness processes.

3.6.9.2 Cumulative Effects on Land Use and Wilderness Resources

There would be no cumulative effects.

3.7 Recreational Resources

3.7.1 Recreational Use

The scenic landscape and primitive setting draws a variety of recreational users to the Flathead Valley. A partial list of recreational activities includes:

- Backcountry camping and hiking
- Horseback riding
- Sport fishing (rivers, lake, stream)
- Hunting
- Trapping
- Winter sports (backcountry skiing, cross-country skiing, snowmobiling, snowshoeing)
- Wildlife viewing/bird watching
- Photography

Recreational public uses such as sightseeing, hiking, camping, and snowmobiling would be expected to continue. Public use is anticipated to increase over the next 10 years.

Visitor use studies for the BMWC were completed in 1970 and 1982. There is a sense that recreational use is generally up over the last 20 years, with increased summer use from activities such as backpacking and rafting, and some increase in stock use. Fall use, related primarily to hunting, has decreased some. An additional visitor use study was conducted in 2003. At this time only a preliminary analysis of the data is available, however it is consistent with the 1970 and 1982 studies. There is low foot and stock use in the South Fork Flathead drainage during June. There is still snow remaining in the high country and creeks are high because of spring runoff. Conditions are also rainy. Most passes are open by early July. In July and August, foot, stock and raft use increases dramatically as most snow has melted, rivers have returned to moderate levels, and warmer temperatures dominate. In the South Fork, a large percentage of use is concentrated along the South Fork Flathead River and the lakes containing fish.

In July and August, many of the lakes receive moderate to high foot and stock use. Most of the use requires overnight stays because of the long distances traveled to get in and out of the area. Some summer outfitter base camps offer clients day or overnight use at lakes. Shaw Creek base camp is used both in the summer and fall and is located within two to six miles of several of these lakes. The lakes are readily accessible which allows for day use throughout the summer. Those lakes on the fringes of the wilderness or near summer outfitter base camps typically receive more use than those lakes that are 15 to 20 miles from a trailhead and take two to three days to access.

MFWP uses angler log reports to estimate the amount of fishing pressure a particular water or group of waters in the South Fork Flathead drainage receives. Because this is only a survey and not a census, the data are used to provide a measure of the estimated amount of angling pressure that any water receives. This is a statistically valid sampling method. These statistics may be used for a variety of reasons, including:

1. Estimating the amount of angler use on a particular water or group of waters,

2. Determining the presence of any angler use of a particular water, or
3. Trends in angler use between years.

It is recognized that, in certain years, use may be underestimated on some lakes and overestimated on others. However, multiple year sampling and combining estimates on multiple lakes helps to estimate the amount of angler use for all lakes over an extended period of time.

Table 3-6. Angler use estimates for select lakes in the South Fork Flathead River drainage from 1989 to 2001, and statewide rank based on 1,529 fisheries in the state.

Lake	*1989*	*1991*	*1993*	*1995*	*1997*	*1999*	*2001*	*Mean*	*State ranking*
Big Hawk	---	99	---	44	38	---	---	60	1173
Black	48	89	199	196	135	38	41	107	912
Blackfoot	1282	75	25	311	34	123	478	332	479
Clayton	164	304	289	116	396	83	368	245	579
George	60	76	---	180	---	---	---	105	923
Handkerchief	1096	327	632	703	573	660	924	702	320
Koessler	---	---	---	---	---	---	---	---	---
Lena	---	---	---	165	---	---	---	165	712
Lick	---	---	---	88	---	---	---	88	983
Margaret	288	56	105	250	108	42	36	127	846
Necklace (4)	---	---	189	---	46	---	---	118	869
Pilgrim	---	---	---	---	---	34	---	34	1404
Pyramid	72	37	25	---	---	83	69	57	1175
Sunburst	103	49	115	175	39	45	149	96	965
Three Eagles (2)	---	---	---	---	---	---	---	---	---
Wildcat	181	74	40	148	39	90	214	112	886
Woodward	60	572	---	34	67	45	---	156	732
Total								**2493**	**157**

Source: Montana statewide angler pressure (MWFP 1989, 1991, 1993, 1995, 1997, 1999, 2001), Bozeman.

The big game hunting season in the Bob Marshall and Great Bear wildernesses (hunting districts 150 and 151) begins September 15. Use is fairly heavy from mid-September to late October, and then tapers off as the statewide big game season begins in late October. Most fall use is stock related and 40 to 50 percent of the total fall use is outfitter related. There are several fall base camps that are within day use distance of lakes that are proposed for treatment. While most of the use in the fall is geared towards hunting, there

Figure 3-5. A young angler on the Flathead National Forest.

is the occasional fishing experience, and mixing of services is provided. The outfitters that operate in the base camps near the lakes proposed for treatment would have a changed condition in relation to fishing opportunities (size success) at least for the short-term. In the first three years following treatment there would likely be angling opportunities, but they would be different than those that were available prior to treatment.

3.7.1.1 Limits of Acceptable Change Plan

The Limits of Acceptable Change (LAC) plan for the BMWC was completed in 1987 and amended to the Forest Plan. LAC serves as a tool to help manage visitor use and impact on the forest. LAC data have been collected and assembled for two consecutive five-year periods (1988-1992 and 1993-1997). Most data have been collected for the 1998-2002 period, but have not yet been input into the database. Many lake sites exceeded LAC standards at the time the LAC plan was written. Overall, standards for most areas are improving, but most lakes that contain, or may contain fish, have exceeded LAC standards. This may be attributed to reasons other than fish presence, including location along a mainline trail, outfitted use, and convenience. For example, many alpine lakes are attractive to visitors for their scenic setting and wild, remote conditions that provide solitude. Lakes situated along a mainline trail may also provide a convenient place to rest and obtain water.

Opportunity Classes represent a spectrum of wilderness experience opportunities within the BMWC. These classes describe existing areas where different resource and social conditions are found. The primary determinant of these classes is the setting, which describes the overall environment in which recreation occurs. Setting also influences what specific types of activities can occur and, ultimately, determines what types of experiences users can achieve. The setting is formulated using a number of factors such as remoteness, size, and amount of landscape alteration or development, number of recreational users and their noticeability, and management constraints. Recreation opportunity classes also identify management actions that are acceptable within each class. Inherent in the descriptions are different levels of resource and social conditions acceptable for each class in the spectrum.

Three components are used to describe opportunity classes: resource, social, and managerial settings. Each component has several elements that are used to describe differences between opportunity classes. One end of the spectrum includes Opportunity Class I, which is the most pristine designation; at the other is Opportunity Class IV, which allows for the widest range of use and impacts while still retaining overall Wilderness character.

Opportunity Class I (OCI)

Woodward Lake (65.0 acres) is in OC I. Woodward has exceeded the standards of two of four LAC indicators. This is down from three exceeded standards in the past. The lake receives moderate levels of foot and stock summer and fall use.

Resource Setting—Opportunity Class I is characterized by an unmodified natural environment. Ecological and natural processes are not measurably affected by the actions of users. Environmental impacts are minimal, restricted to temporary loss of vegetation where camping occurs and along some stock travel routes. These areas typically recover on an annual basis, are subtle in nature, and generally not apparent to most visitors.

Social Setting—This area provides an outstanding opportunity for isolation and solitude free from evidence of human activities, and very infrequent encounters with users. The user has outstanding opportunities to travel across country utilizing a maximum degree of outdoor skills. This environment often offers opportunities for a very high degree of challenge, self-reliance, and risk. Interparty contacts will be very few while traveling and rare to non-existent at the campsite.

Managerial Setting—Management strongly emphasizes sustaining and enhancing the natural ecosystem.

Opportunity Class II (OCII)

Lena, Lick, Koessler, and George Lakes are all in OCII. Lena Lake (74.2 acres) is utilized by the outfitted summer Shaw base camp that is located 5.4 miles away, as well as by other foot and stock users. Lena exceeds two of four standards for LAC indicators. Lick Lake (19 acres) went from one to two of the four LAC indicators with exceeded standards. Koessler Lake (81.5 acres) exceeds the standards on all four of the four LAC indicators. Koessler Lake is accessed by the outfitted summer Shaw base camp that it located 4.1 miles away, as well as by other foot and stock users. Use is mostly summer foot and stock access to fish. George Lake (114.2 acres) has increased from one to three of four LAC indicators with exceeded standards. Most use is expected to be summer foot cross-country travel to fish at the lake.

Resource Setting—Opportunity Class II is characterized by an essentially unmodified natural environment. User actions minimally affect the ecological and natural processes and conditions. Environmental impacts are low and restricted to minor losses of vegetation where camping occurs and along most travel routes. Most impacts recover on an annual basis and will be apparent to only a low number of visitors.

Social Setting—A high opportunity exists for exploring and experiencing isolation from the sights and sounds of man with the probability of encountering other users being low.

The user has good opportunity for experiencing independence, closeness to nature, tranquility, and self-reliance through the application of primitive recreation skills. These opportunities occur in an environment that offers a high degree of challenge and risk. Interparty contacts will be low on the trail and fairly low at the campsite, with parties often camped in isolation.

Managerial Setting—Management will emphasize sustaining and enhancing the natural ecosystem.

Opportunity Class III (OCIII)

Both Sunburst Lake and Pyramid Lake are in OCIII. An essentially unmodified natural environment is expected in OCIII. Sunburst had only one of four LAC indicators with exceeded standards. This is a popular summer overnight camping area and fishing destination for people on foot and with stock. Pyramid Lake (8.9 acres) has two of four LAC indicators with exceeded standards. There is fairly heavy foot and stock summer use.

Resource Setting**—**Opportunity Class III is characterized by an essentially unmodified natural environment. In a few areas ecological and natural processes are moderately affected by the action of users. Environmental impacts are moderate, with most areas along travel routes and near human impacted sties showing moderate losses of vegetation. Impacts in some areas often persist from year to year and are apparent to a moderate number of visitors.

Social Setting**—**Moderate opportunities for exploring and experiencing isolation from the sights and sounds of man, with the probability of encountering other users being low to moderate. The user has moderate opportunities for experiencing independence, closeness to nature, tranquility and self-reliance through the application of primitive recreation skills. These opportunities occur in a natural environment that normally offers a moderate degree of challenge and risk. Contact with other visitors both on the trail and while camped will be moderately frequent.

Managerial Setting—Management will emphasize sustaining and enhancing the natural ecosystem.

Opportunity Class IV (OCIV)

The four Necklace Lakes are in OCIV and include Lower (13.8 acres), Middle Lower (3.7 acres), Middle Upper (9.5 acres), and Upper (8.7 acres). For all lakes, most camping and fishing use occurs in summer by foot and stock users. There is some fall hunting use.

- Lower and Middle Lower have one of four LAC indicators exceeded.
- Middle Upper Lake went from zero to two of four LAC indicators exceeded.
- Upper Lake did not exceed standards for any indicator.

Resource Setting**—**Opportunity Class IV is characterized by a predominantly unmodified natural environment. Natural conditions in many locations may be substantially affected by the action of users. Environmental impacts are relatively high in areas along major travel routes, along popular river corridors and lakeshores, and near major entry points. Impacts often persist from year to year and there may be moderate loss of vegetation and soil at some sites. Impacts are readily apparent to most visitors.

Social Setting**—**Opportunities for exploring and experiencing isolation from the sights and sounds of man are moderate to low. The probability of encountering other area users is moderate to high. The user has the opportunity for a high degree of interaction with the natural environment, often with low or moderate challenge and risk. Much of the time contacts with other users will be relatively high, both on the trail and at campsites. It may be common during the main use season for some parties to come within sight and sound of each other.

Managerial Setting—Management will be oriented to sustaining and enhancing the natural ecosystem.

3.7.1.2 Indicators

Indicators of resource and social conditions were identified within the BMWC (see table 3-7). Indicators establish a basis for identifying a need for management action for both areas and specific sites where conditions may be in conflict with those selected as management objectives. Indicators were selected based on their relevancy to the identified issues, the presence of a valid and reliable method of measurement, their sensitivity to change in resource and social conditions, and their ability to monitor conditions.

Table 3-7. LAC indicators for the Bob Marshall Wilderness Complex.

Issue	Indicator
Social	
Solitude while traveling	Number of trail encounters per day
Campsite solitude	Number of other parties camped within sight or continuous sound per day
Environmental	
Human impacted site conditions	Area of barren soil core (sq. ft.) at each human impacted site (excluding authorized horse handling facilities)
	Number of human-impacted sites per 640-acre area
	Number of human impacted sites above a particular condition class index per 640-acre area
Range conditions	Degree of forage utilization (percentage)
	General trend
	Overall condition
	Visual appearance (Maximum impact)
	Forest succession, vegetation changes

Source: Bob Marshall Wilderness Complex Recreation Management Direction – 1987 for the Bob Marshall Wilderness Complex, amended 1987 in the Flathead, Lolo, Lewis and Clark and Helena National Forests, Land Management Forest Plans.

Each opportunity class has specific standards (thresholds or limits of acceptable change to resource or social conditions) that indicators are supposed to measure. In most of the lake areas, the following indicators have been measured and have met the standard for the applicable opportunity class:

- Number of human impacted sites per 640-acre area
- Number of human impacted sites above a particular condition class index per 640-acre area
- Area of barren soil core at each human impacted site

3.7.1.3 Scenery

The Flathead National Forest offers an array of spectacular glaciated peaks and alpine lakes that visitors can use for hiking, camping, fishing, wildlife watching, and other activities. The visual prominence of the mountains defines this area and serves as both a barrier and a backdrop for the forest. The establishment of the forest, BMWC, and nearby Glacier National Park was rooted in the preservation and appreciation of the scenic resources of the area, which are still very important.

The lakes mostly occur in a natural forested environment, punctuated by open meadows and tumbling mountain streams. Many lake sites offer stunning vistas of surrounding mountains and forested hillsides.

3.7.1.4 Soundscape

Soundscapes are acoustic (pertaining to sound) environments. People experience soundscapes by hearing, rather than by seeing. Soundscapes may include both mechanical and natural sounds. They may vary in their character from day to night, and from season to season.

Natural Soundscapes are resources that may include sounds created by wind, flowing water, mammals, birds, insects, and other biological and physical components.

Natural Ambient Sound Levels are the natural soundscape conditions that exist in a park in the absence of any human-produced noise. This is sometimes referred to as **natural quiet**.

Natural sounds predominate through most of the forest. Natural sounds include those made by animals, water, wind, and other natural phenomena. Natural quiet does not mean complete silence; it exists when the only sound produced is by the natural and historic components of the landscape. Most agree that it is thought of as a mixture of mostly low decibel background sounds punctuated by the songs and wingbeats of birds and insects, or by the faint clatter and calls of other wildlife.

In the wild, sound is a matter of life and death. Birds, insects, mammals, and amphibians rely on complex communication networks to live and reproduce. In habitats where wildlife vocalizations signify mating calls, danger from predators, or territorial claims, hearing these sounds is essential to animal persistence and survival. It is also a critical part of the wilderness and recreation experience sought by the millions who visit the Flathead National Forest and BMWC each year.

Intrusive noise levels vary depending on time, wind direction, and location. Sources of noise in the forest include road traffic, motorboats, and human activity (e.g., generators, music, and people). There are also administrative activities that create noise, such as helicopter flights. Noise is generally concentrated and more apparent in developed areas and along roads.

3.7.2 Environmental Consequences of Alternative A (No Action)

3.7.2.1 Direct and Indirect Effects on Recreational Resources

There may be future restrictions on recreational angling resulting from continued degradation of the cutthroat. It is possible that more restrictive angling or elimination of angling for sensitive species would need to be implemented over time. Alternative A could lead to a decline in westslope cutthroat trout populations, potentially leading to a listing that could affect fishing and tourism, and outfitters and guides.

3.7.2.2 Cumulative Effects on Recreational Resources

There would be no change in conditions under this alternative. The potential loss of pure westslope cutthroat trout in one of the largest strongholds in the United States would impact the quality of angling opportunities now and in the future.

3.7.3 Environmental Consequences of Alternative B (Proposed Action: Fish Toxins – Combined Delivery and Application Methods)

3.7.3.1 Direct and Indirect Effects on Recreational Resources

Humans in the flight paths or areas near lakes being treated could find bothersome noise and visual effects from aircraft, motor boats, humans, and pack animals. These impacts would be temporary and minimal. Noises and odors from motorboats, pump motors, and aircraft during application would be limited to the duration of treatment.

The treated lake water would appear somewhat milky immediately after the treatment, but would become clear again within a short time.

The LAC standards are not expected to change with the implementation of alternative B. There could be more natural rehabilitation of existing camp sites as the lakes within wilderness would not be popular destinations with anglers immediately following treatment, though the lakes could still be popular places to camp.

During transport and application within Jewel Basin, users would have a much different experience than what they would likely be expecting; additional aircraft would change visitor experience.

Angling limits could be lifted a few years prior to any action in order to allow the public to remove as many fish as possible.

3.7.3.2 Cumulative Effects on Recreational Resources

Angling opportunities on lakes scheduled for treatment may be temporarily improved as restrictions such as size and catch limits would be lifted for a season or two prior to treatment. After treatment, angler displacement would likely occur until the fishery recovered (usually one year but possibly up to three years later).

3.7.4 Environmental Consequences of Alternative C (Fish Toxins – Motorized/mechanized Delivery and Application Methods)

3.7.4.1 Direct and Indirect Effects on Recreational Resources

The effects would be the same as those for Alternative B (Section 3.7.3.1). In addition, during applications in wilderness, users in the helicopter flight zone could have their wilderness experience impacted, potentially affecting their level of satisfaction. This could be partially mitigated by signing trailheads with the dates, activities, and potential impacts on wilderness so users could make choices. Effects in Jewel Basin would be the same as Alternative B.

Angling limits could be lifted a few years prior to any action in order to allow the public to remove as many fish as possible.

3.7.4.2 Cumulative Effects on Recreational Resources

The effects would be the same as those for Alternative B (Section 3.7.3.2).

3.7.5 Environmental Consequences of Alternative D (Suppression Techniques and Swamping)

3.7.5.1 Direct and Indirect Effects on Recreational Resources

Users in and around areas near lakes being treated could find noise and visual effects from aircraft, motor boats, humans, and pack animals bothersome. Suppression techniques, such as gill-netting, trapping, or seining, would require long-term camping near lakeshores, use of motor boats to set and check nets or traps, and travel to and from the lake. Each of these activities would be continued from five to seven years, and would likely impact the recreational desirability of the lake and surrounding areas during that time.

Angling limits may be lifted a few years prior to any action in order to allow the public to remove as many fish as possible.

3.7.5.2 Cumulative Effects on Recreational Resources

The effects would be similar to those for Alternative B (Section 3.7.3.2), but with angler displacement extending to several years.

3.8 Socioeconomic Issues

3.8.1 Existing Conditions

The Flathead National Forest includes parts of six Montana counties: Flathead, Lincoln, Lake, Missoula, Powell, and Lewis and Clark. About three-fourths of the area of the Forest is in Flathead County. Flathead County encompasses 3,262,720 acres or 5,098 square miles. Approximately 94 percent of the land mass is National or State Forest Land, Wilderness, agricultural, and corporate timber land, thus confining development to the remaining six percent of the area. The project area has no private land holdings.

The region offers an abundance of recreational opportunities, including: Flathead National Forest, Glacier National Park, designated hiking areas, world class fly fishing, two ski resorts, Flathead Lake, and Hungry Horse Reservoir. Flathead County is among the fastest growing and is the fourth most populated county in Montana. The area is an important part of the Northern Continental Divide Ecosystem, which covers most of northwest Montana. This area has significant economic value on a regional, national, and international scale when recreation and tourism, wildlife, and aesthetic values are considered along with a significant timber management program. However, it is beyond the scope of this analysis to evaluate markets for all these resources because they have not been identified as significant economic issues with respect to the proposed action. The emphasis here is on the economic effects that the proposed action and alternatives would have on the local outfitters and guide industry.

Demographic trends in Flathead County are indicative of changes in the region and provide context for potential effects in the project area. There are three incorporated cities in Flathead County. Kalispell, which is the largest, has a population of approximately 14,223. Two additional major municipalities include Whitefish, with a population of 5,032; and Columbia Falls, with a population of 3,645. Countywide, according to the U.S. Census Bureau, population has increased from 59,218 in 1990, to an estimated 74,471 in 2000. This represents a 25.8 percent increase in 10 years. Residents native to Montana are now greatly out numbered by new residents. A large percentage of new residents are retirees and middle-aged professionals (Flathead County 2002).

Development of tourist attractions has greatly increased in recent years. This development has contributed to the influx of tourists and tourism based services, and moved the economic base towards Recreation and Tourism, and creating new jobs in the service industry. Flathead County's population increases by 40 percent during the months of June through August (Flathead County 2002).

This section presents a description of the local economic environment that could be potentially affected by the proposed action amendment along with an estimate of what those effects might be. Emphasis would be placed on those components of the economy that were identified throughout the scoping process, primarily through public comments.

The primary concern related to the economic environment was the ongoing viability of local outfitters and guides that rely on the fisheries resource for employment and income. Both residents and non-residents spend a substantial about of money in the Flathead County area in pursuit of their sport. Visitors to Montana spent $145,000,000 in Flathead County in 1998. In fact, tourism and ranching/farming vie for the state’s largest industry.

3.8.1.1 Commercial Outfitter and Guide Operations

The Fishing Outfitters Association of Montana and the Montana Outfitters and Guides Association list 44 outfitters in this part of the state. At least one-fourth of these companies offer fishing expeditions in the South Fork Subbasin or surrounding drainages. Several specialize in dry fly fishing for westslope cutthroat trout and actively promote guided angling for the native fish component of the area.

In the summer, a large percentage of use is concentrated along the South Fork Flathead River and the lakes containing fish. There are four summer outfitter base camps permitted that allow concentrated use in these and surrounding areas. Approximately 10 to 20 percent of the overall summer use is provided by outfitters. While summer roving use levels drop off by early September, outfitters begin to take in equipment for their fall hunting base camps at this time.

3.8.1.2 Tourism

Flathead National Forest is well known within the tourism industry. Many visitors coming to Glacier National Park extend their visits into northwest Montana, including portions of the forest. It is most likely that visitors to the Flathead would visit Jewel Basin, known widely for its day hikes and some of the wilderness lakes that are within one to two days of the trailheads (e.g., Pyramid and Sunburst Lakes). Visitors wanting a backcountry trip without hiking or stock may choose to visit Handkerchief Lake.

3.8.2 Environmental Consequences of Alternative A (No Action)

3.8.2.1 Direct and Indirect Effects on Socioeconomic Issues

Alternative A could lead to a decline in westslope cutthroat populations potentially leading to a listing that could affect tourism and outfitters and guides.

3.8.2.2 Cumulative Effects on Socioeconomic Issues

There would be no change in conditions under this alternative.

3.8.3 Environmental Consequences of Alternative B (Proposed Action: Fish Toxins – Combined Delivery and Application Methods)

3.8.3.1 Direct and Indirect Effects on Socioeconomic Issues

Individual lakes and portions of their outlet streams would be unable to serve outfitters and guides for angling for an estimated one to three years until a sport fishery is restored. MFWP and FS would work with those operating commercial services on lakes and streams in and out of the wilderness, and notify them well in advance of treatment so that they may schedule alternative sites for their activities.

Some of the lakes (Sunburst, Woodward, Necklace Lakes, Lena, Lick, Koessler, George, and Pyramid) under consideration for treatment are used by guides and outfitters as destinations, or as part of a wilderness fishing or hunting route. The “wilderness experience” of proceeding through an undisturbed and relatively pristine area is an implicit part of the excursion package offered to anglers or hunters. Access to these lakes varies from a managed system trail to cross-country access. Guides and outfitters are required to file an operational plan to indicate place, time, and duration of trips into the wilderness area. Within the wilderness in the South Fork drainage, there are 25 outfitters that are permitted to operate in the summer season and 21 in the fall season. These plans are submitted to the FS for review and approval prior to use. The use is included in the annual operating plan with each specific permit. See table 3-6 in section 3.7.1 for historic use levels by lake.

Most summer-season use within the South Fork drainage is by roving trips—groups traveling on foot or with stock. The lakes proposed for treatment are included on some of the proposed itineraries. Many of the trips include fishing or just observation of different parts of the wilderness. Three base camps operate within the summer period in the South Fork. From approved base camp locations, guides and outfitters generally provide guests with day trips within the wilderness that could include visits to Woodward, Necklace Lakes, and Lena, Lick, Koessler, and George lakes. Another wilderness experience is provided via float trips on the South Fork River.

In the fall period there are approximately 21 approved base camp locations with most use related to the early fall hunting season, which begins on September 15. In addition to the general season, there is a four week period of hunting that opens at the end of October. The season is set by MFWP, and opening dates vary annually. Additional fishing and day trips, not related to hunting, occur in the fall period. Outfitters indicate the type of use that will be occurring on the annual itinerary request. All of the lakes identified within the wilderness would have some use occurring in the fall period by current outfitters. Camps are spread out within the South Fork drainage; there is a base camp near Pyramid Lake, one base camp within the Gorge Creek drainage near Sunburst Lake, and two base camps in the Lena, Lick, Woodward, George and Necklace Lakes areas.

3.8.3.2 Cumulative Effects on Socioeconomic Issues

There is expected to be a cumulative effect on regional guides and outfitters and associated tourism during the periods proposed for treatment. There would be an opportunity cost to guides and outfitters as potential tourists, adjusting for changes in expectation and experience, opt to delay their travel plans, visit other locations, or book expeditions through other guides and outfitters.

3.8.4 Environmental Consequences of Alternative C (Fish Toxins – Motorized/mechanized Delivery and Application Methods)

3.8.4.1 Direct and Indirect Effects on Socioeconomic Resources

The effects would be the same as those for Alternative B (Section 3.8.3.1).

3.8.4.2 Cumulative Effects on Socioeconomic Resources

The effects would be the same as those for Alternative B (Section 3.8.3.2).

3.8.5 Environmental Consequences of Alternative D (Suppression Techniques and Swamping)

3.8.5.1 Direct and Indirect Effects on Socioeconomic Resources

The effects would be the same as those for Alternative B (Section 3.8.3.1). Since angling would not be compatible with gill netting activities, these lakes would not be available to anglers. Additionally, while suppression activities are being implemented, the area may not provide the type of wilderness experience many people would be seeking. Eventually these lakes would be fishable and the long-term effects for fishing would be the same as with Alternatives B and C.

3.8.5.2 Cumulative Effects on Socioeconomic Resources

The effects would be the same as those for Alternative B (Section 3.8.3.2).

3.9 Human Health

Although pesticides are used widely to control unwanted species, legitimate public concerns have been raised regarding the safety and health effects to humans. As with any pesticide, direct exposure to, or consumption of piscicides at full strength, can have harmful or sometimes fatal effects on humans. Rotenone and antimycin are EPA registered pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act, (FIFRA).

3.9.1 Rotenone

There are no federal or Montana numeric water quality standards for rotenone; however, MDEQ (2001) used the EPA method of calculating human health criteria based on non-carcinogenic effects to estimate a safe level for life long exposure to water and the consumption of fish exposed to water containing rotenone: 40µg/L water plus fish. The calculation is based on several assumptions:

- Long-term (70 years) exposure,
- Average body mass of 70 kg (BW),
- A person consumes 2 L of water per day (DI),
- A person consumes 0.0065 kg of fish per day (FI),
- Reference Dose (RfD) for rotenone = 0.004 mg/kg-day (EPA, Integrated Risk Information System, IRIS)
- Some chemicals tend to increase in fish tissue over the concentration in the water or bio-concentrate. The amount the chemical increases in the fish relative to the ambient concentration is the bio-concentration factor (BCF). The BCF does not include possible food chain effects.

The calculation of the Rotenone criteria is as follows:

$$\frac{0.004 \text{ mg/kg-day (RfD)} * 70 \text{ kg (BW)}}{2 \text{ L/day (DI)} + (0.0065 \text{ kg/day (FI)} * 770 \text{ L/kg (BCF)})}$$

The rotenone formulation that would be used contains five percent active ingredient. When the formulation is applied to achieve 1 mg/L in the water body, the active ingredient concentration is 0.05 mg/L or 50 µg/L. The target concentration would be 10 µg/L above the calculated long-term safe level. But the long-term safe level was determined using the standard assumption that fish would be exposed to rotenone and be able to bio-concentrate rotenone. This assumption is extremely protective. Rotenone is a natural chemical but is not naturally found in Montana, and is not a chemical likely to be found in fish that are commercially available for consumption. Fish exposed to rotenone at the target concentration would die within two to three hours; thus bio-concentration is very unlikely. Most of the dead fish in the treated lakes will sink to the bottom of the lake. Fish that wash up during the crew's presence at the lake would be collected for disposal.

The potential long-term risk to humans with water as their only source of rotenone exposure yields 140µg/L as a safe long-term concentration. Since tissue and water concentrations of rotenone decline quickly after a treatment, and people would not likely be exposed to treatments on a continual basis, hazardous life-long exposure to rotenone is extremely unlikely.

Public health issues surrounding the use of rotenone have been studied extensively. In general, the EPA through FIFRA certification process has concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment (Finlayson, et al. 2000) as long as the label instructions are followed.

In their description of how South American Indians prepare and apply *Timbó*, a rotenone parent plant, Teixeira, et al. (1984) reported that the Indians extensively handled the plants during a mastication process, and then swam in lagoons with the plant pulp on their backs for distribution. No harmful effects were reported.

Finlayson, et al. (2000) reported that the EPA "has concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment." In relation to air quality, they further note that "No public health effects from rotenone use as a piscicide have been reported." No waiting period is specified for swimming in rotenone-treated water.

Aside from the rotenone itself, liquid formulations also consist of petroleum emulsifiers. Finlayson (2000) wrote regarding the health risks of these constituent elements:

> " . . . the EPA has concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment. The California Environmental Protection Agency found that adverse impacts from properly conducted, legal uses of liquid rotenone formulations in prescribed fish management projects were nonexistent or within acceptable levels (memorandum from J. Wells, California Department of Pesticide Regulation, to Finlayson, 3 August 1993). Liquid rotenone contains the carcinogen trichloroethylene (TCE). However, the TCE concentration in water immediately following treatment (less than 0.005 mg TCE per liter of water [5 ppb]) is within the level permissible in drinking water (0.005 mg TCE per liter of water, EPA 1980b). None of the other materials including xylenes, naphthalene, piperonyl butoxide, and methylnaphthalenes exceed any water quality criteria guidelines (based on lifetime exposure) set by the EPA (1980a, 1981a, 1993). Many of these materials in the liquid rotenone formulations (trichloroethylene, naphthalene, and xylene) are the same as those found in fuel oil and are present in waters everywhere because of the frequent use of outboard motors . . ."

California Department of Fish and Game (CDFG, 1994) calculated that the maximum expected level of these contaminants following a treatment level of 2 ppm formulation are TCE 1.1 ppb; toluene 84 ppb; xylenes 3.4 ppb; naphthalene 140 ppb.

The product label states:

> " . . . do not use dead fish for food or feed, do not use water treated with rotenone to irrigate crops or release within ½ mile upstream of a potable water or irrigation water intake in a standing body of water such as a lake, pond, or reservoir. . . . do not allow swimming in rotenone treated water until the application has been completed and all pesticide has been thoroughly mixed into the water according to the labeling instructions. This product is flammable and should be kept away from heat and open flame . . ."

The major risks to human health from rotenone come from accidental exposure during application. This is the only time when humans are exposed to concentrations that are greater than that needed to remove fish. To prevent accidental exposure to liquid formulated rotenone, the Montana Department of Agriculture requires applicators to be:

- Trained and certified to apply the pesticide in use
- Equipped with the proper safety gear, which, in this case, includes fitted respirator, eye protection, rubberized gloves, hazardous material suit
- Have product labels with them during use
- Contain materials only in approved containers that are properly labeled
- Adhere to the product label requirements for storage, handling, and application

Any threats to human health during application could be greatly reduced with proper use of safety equipment. Recreationists in the area would likely not be exposed to the treatments because temporary trail closures would preclude many from being in the area. Proper warning through news releases, signing at trailheads, trail closures, and administrative personnel in the project area should be adequate to keep unintended recreationists from being exposed to any treated waters. Dead fish will be collected and sunk in the lakes or removed from the site. Administering application in the fall of the year would further reduce exposure due to the relatively low number of users in this remote area.

Aerial application of rotenone on lakes has been successful and is commonly used today (Spielman 2003; Finlayson, et al. 2000). Due to the potential for rotenone to become aerosolized temporarily during this type of application, there is an inhalation risk to ground applicators. To guard against this, ground applicators would be equipped with protective clothing, eye, and breathing equipment.

3.9.2 Antimycin

There are no Federal criteria or Montana water quality standards for antimycin. The sub-chronic effects to humans from antimycin exposure can be derived from a recent study (Stillmeadow 2001) in which rats were exposed to varying levels of antimycin for 90 days and by a study in 1967 by Herr, Greselin, and Chapplel. In both studies, the authors found no effects (mortality, body weights, food consumption, hematology, histopathology, clinical chemistry) (No-Observed-Adverse-Effect Level, NOAEL) at a dose level of 0.5 mg/kg/day.

It is appropriate to develop a sub-chronic criteria in this case because the chemical will be used only once in each lake and stream and the chemical breaks down in a matter of hours (extremely shorter timeframe than chronic conditions). Using the EPA methodology of calculating human health criteria, an estimate of a safe sub-chronic exposure to water containing antimycin is 59.5 μg/L.

The calculation is based on several assumptions:

- Sub-chronic RfD for antimycin = 0.0017 mg/kg-day,
- Average body mass of 70 kg (BW),
- A person consumes 2 L of water per day (DI),

The EPA has not published an RfD for Antimycin in the Integrated Risk Information System. For this project a sub-chronic RfD was calculated using the NOAEL above and three separate uncertainty factors:

1) A factor of 10 based on the uncertainty in the animal to human translation,

2) A factor of 10 based on average human to sensitive human uncertainty, and

3) A factor of 3 based on the limited number of studies.

The estimated RfD is: <u>0.5 mg/kg-day = 0.0017 mg/kg-day</u>

10*10*3 (uncertainty factors listed above)

Some chemicals tend to increase in fish tissue over the concentration in the water or bio-concentrate. BCF is the amount the chemical increases in the fish relative to the ambient concentration. The BCF does not include possible food chain effects. Antimycin has not been shown to bio-concentrate to levels where harmful effects are anticipated. Ritter and Strong (1966) reported that twenty-one humans associated with their study consumed between one and five 4-oz. servings of fish killed by antimycin and suffered no ill effects. Based on this, they concluded that antimycin-killed fish would be safe as human food. Schnick (1974a) reported that antimycin is not hazardous to humans whether it is consumed in water or food. Therefore, a BCF was not used in the calculation of the sub-chronic exposure criteria.

The calculation of the antimycin criteria is as follows:

0.0017 mg/kg-day (RfD) * 70 kg (BW) /

2 L/day (DI)

Based on the prescribed concentration from the product label of 5-10 ppb, and the anticipated concentration that would likely be used in this project of 7-8 ppb, the maximum allowable concentration that could be used in the water is 10 ug/L.

As with rotenone, the major threat to human health resulting from the use of antimycin is from accidental exposure to abnormally high concentrate during application. To avoid this, applicators are cautioned by the product label, and required by the Montana Department of Agriculture to use protective gear, as listed above.

The product label for antimycin states: " . . . it can be fatal if swallowed or absorbed through the skin, causes substantial but temporary eye injury, is a skin irritant, should not be inhaled, and that protective clothing, eye wear and breathing apparatus should be worn . . ."

The acute toxicity (short-term dose) of antimycin to humans is unknown. Precautions will be taken to limit exposure of high concentrations of Antimycin to mixing and chemical application. Antimycin naturally decomposes very quickly minimizing the potential for accidental intake of a large dose of the chemical.

The major risks to human health from antimycin come from accidental exposure during application. This is the only time when humans are exposed to concentrations that are greater than that needed to remove fish. To prevent accidental exposure to antimycin, the Montana Department of Agriculture requires applicators to be:

- Trained and certified to apply the pesticide in use

- Equipped with the proper safety gear which, in this case, includes eye protection and rubberized gloves
- Have product labels with them during use
- Contain materials only in approved containers that are properly labeled
- Adhere to the product label requirements for storage, handling, and application

Any threats to human health during application could be greatly reduced with proper use of safety equipment. Recreationists in the area would likely not be exposed to the treatments because temporary trail closures would preclude many from being in the area. Proper warning through news releases, signing at trailheads, trail closures, and administrative personnel in the project area should be adequate to keep unintended recreationists from being exposed to any treated waters. Dead fish will be collected and sunk in the lakes or removed from the site. Administering application in the fall of the year would further reduce exposure due to the relatively low number of users in this remote area.

Antimycin piscicide consists of an active ingredient (antimycin) and several inert constituent components (soy lipids, Diethyl phthalate, Nonoxyl-9 detergent [or nonylphenol polyglycol ether], and acetone).

The following table provides estimated criteria for the long term exposure, but this is likely never to occur. The primary reasons for this include;

- Antimycin breaks down within hours of application
- Most dead fish will sink the lake bottom and/or be collected and sunk in the lakes
- Municipal water intakes are located great distances downstream, and they take their water from wells
- The compound will be diluted by freshwater downstream of the application sites
- The project is located in a remote area at a time when use is relatively low
- The project area will be well signed so users can find an alternate source of water
- Trails will be closed during and shortly after the application which will limit people from being in the project area
- Supplemental detoxification using potassium permanganate will neutralize the antimycin

Max treatment rate of 10μg/L Antimycin:

Carrier Chemical	**Concentration**	**Water Quality Standard**	**RfD**	**Estimated Criteria**
Acetone	65 μg/L	N/A	0.9 mg/kg-day	31,500 μg/L
Nonylphenol polyglycol ether	12.5μg/L	N/A	N/A	---
Diethyl phthalate	7 μg/L	23,000 μg/L	N/A	---

Nonoxyl-9 [nonylphenol polyglycol ether] is used in antimycin formulations to make the solution more soluble in water. It is a detergent developed in the early part of the 20th century as a solution for cleaning hospital surfaces. Determined to be an effective spermicidal, it became a leading component in lubes, condom lubricants, and contraceptive films. It is used as an ingredient in skin lotions, scar crèmes, and post medical treatment skin cremes, but is a powerful irritant to internal body surfaces. Skaar (2001) writes:

> " . . . The nonylphenol polyglycol ether does contain some residual amount of ethylene oxide (maximum of 5 mg/L) which is a potential carcinogen. Under a typical treatment level of 10 ug/L antimycin, the maximum level of ethylene oxide introduced into the water would be 62.5 pg/L.
> This compound has a very low vapor pressure and is expected to volatilize immediately upon application. There are no water quality standards for this chemical. The little bit of toxicological information available on rats suggests that this concentration is far below one that would have an effect on any mammal drinking from an antimycin-treated stream or lake. The ATSDR Public Health Statement (1990) states that rats are killed in one day by a 4,000 ug/g dose in the food. A dose of 2,000 ug/g for 21-30 days caused liver damage and stomach irritation. This Statement also says that ethylene oxide in water will either breakdown or be destroyed by bacteria within a few days, suggesting that long-term exposure to this chemical is not possible . . ."

The Fish Toxicant Kit Use Direction Leaflet that accompanies the antimycin label states:

> ". . . fish killed with antimycin A should not be consumed by man or animals. Treated waters should not be used for [swimming] drinking by man or animals, or for crop irrigation, until fingerling rainbow trout or fingerling bluegills survive 48 hours exposure in live cars in the treated waters . . . due to its acetone component, Fintrol Concentrate (antimycin) is flammable: keep away from heat and flame . . ."

3.9.3 Potassium Permanganate

Because potassium permanganate is a strong oxidizing agent, care must be taken when handling the product. Permanganate is considered a "hazardous chemical" because it can react with certain reducing agents and generate heat. The human health hazards on the Material Safety Data Sheet (MSDS) lists it as an irritant to eyes, skin, respiratory system, and gastro intestinal tract. When handled properly, it is safer than other commonly used oxidants. In applying the reference dose for manganese to a risk assessment, it is important that the assessor consider the ubiquitous nature of manganese, specifically that most individuals will be consuming about 2-5 mg Mn/day in their diet. This is particularly important when one is using the reference dose to determine acceptable concentrations of manganese in water and soils. It is recommended that the upper end of the range recommended by the NRC (5 mg/day, described below) be considered to represent a typical human intake from total dietary sources. For determination of acceptable concentrations of manganese in water and soil, then, the risk assessor would subtract this amount from the level specified by the RfD [i.e., 10 mg/day (RfD) - 5 mg/day (typical dietary intake) = 5 mg/day (remaining)]. For applying this number to a non-dietary scenario, it is also recommended that a modifying factor of 3 be applied. The rationale for this modifying factor is three-fold. First, while the data described in section I.A.4 of the IRIS file suggest that there is no significant difference between absorption of manganese as a function of the form in which it is ingested (i.e., food versus water), there was some degree of increased uptake from water in fasted individuals. Second, the study by Kondakis et al. (1989) has raised concerns for possible adverse health effects associated with a lifetime ingestion of drinking water containing about 2 mg/l manganese. While no data are available to quantify total intake of manganese, one would not expect this concentration of manganese in water to be a problem based on dietary information revealing intakes ranging from 2 to 10 mg/day that are not associated with adverse health effects. Third, although toxicity has not been demonstrated, there are remaining concerns for infants fed formula which typically has a much higher concentration of manganese than does human milk (see section I.A.4 of the IRIS file for further discussion). If powdered formula is made with drinking water, the manganese in the water would represent an additional source of intake.

Using the recommended appropriation of 5 mg Mn/day for dietary contributions and a modifying factor of 3 for exposures from soil and drinking water and a body weight of 70 kg, yields a value of 0.0238 mg/kg-day.

Exposure from water + Exposure from soil = (10-5)/(3x70) = 0.0238 mg/kg-day

Assuming no exposure from soil and a 70 kg person drinking 2 L/day, the suggested advisory level is:

0.0238 mg/kg-day x 70 kg x 1 day/2 L = 0.8 mg/L Mn.

Although manganese is a constituent element of this compound, it is likely that once it is broken down, it will be in the form of manganese dioxide (MnO_2) and will precipitate out of the water column. This biogenic precipitation is similar to the reaction between calcium (Ca^{++}) and bicarbonate (HCO_3), which is a naturally occurring reaction.

3.10 Unavoidable Adverse Effects, Irretrievable and Irreversible Commitments of Resources

The implementation of Alternative A would have an unavoidable adverse effect on the genetic purity of the westslope cutthroat trout populations in the subbasin, and the potentially irreversible effect of extirpating the subspecies within the project area. The other three alternatives would have the unavoidable adverse effect of operating motorized equipment in wilderness and the Jewel Basin Hiking Area. None of the three action alternatives would involve irretrievable or irreversible commitments of resources.

3.11 Relationship of Short-term Uses and Long-term Productivity

Alternative A would result in losing the genetic purity of the westslope cutthroat trout while maintaining the short-term quality of the fisheries. Alternatives B and C would each impact the quality of the fisheries in the short-term (1-3 years). Alternative D would impact quality of the fisheries for 5-10 years. Alternatives B, C, and D would each preserve the genetic purity of the westslope cutthroat trout in the South Fork Subbasin over the long-term.

3.12 Unaffected Resources

After a review of resources and issues generated through scoping, analysis, and consultation with local tribes, the following were identified as being unaffected and, therefore, not relevant to this analysis.

3.12.1 Air Quality

None of the alternatives would affect air quality. There is a small possibility that the piscicides would emit a short-term odor during application.

3.12.2 Cultural/Tribal Resources

None of the alternatives include ground-disturbing activities that would compromise or degrade any non-inventoried cultural resource sites. The Confederated Salish and Kootenai Tribes; and the Blackfeet Nation and the Kootenai Tribe of Idaho have been contacted regarding this project and its potential to disturb cultural resources. None of the tribes have indicated any specific concerns. Tribes would be contacted prior to lake treatment so that site-specific issues may be addressed and tribal members may be notified of short-term disturbances.

3.12.3 Geophysical

None of the alternatives include ground-disturbing activities that would degrade soil resources or accelerate geomorphic processes. The piscicides recommended bind readily with sediments. However, this binding also detoxifies them and renders them environmentally benign.

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Chapter 4.0: Consultation, Permit, and Review Requirements

In this Chapter:

- Laws and procedures to be met
- Studies and plans reviewed
- Permits needed

Several federal and state laws and administrative procedures must be met by the alternatives. This chapter lists and briefly describes requirements that would apply to elements of this project, actions taken to assure compliance with these requirements, and the status of consultations or permit applications.

4.1 Applicable Legislation

4.1.1 Endangered Species Act of 1973

The ESA of 1973 (7 U.S.C. 136; 16 U.S.C. 460 et seq.), as amended, requires that Federal agencies ensure that their actions do not jeopardize threatened or endangered species and their critical habitats. The FWS is responsible to ensure that other agencies plan or modify proposed actions so that they will have a minimum impact on listed species and their habitats. Consultation to this end is required by Section 7 of the ESA. MFWP and BPA prepared a biological assessment on the original proposal for this project and submitted it to FWS on April 19, 2002. As a result of this informal consultation, the FWS issued a letter of concurrence based on that assessment (see Appendix D). Pending modifications to the original proposal, BPA and MFWP will provide a project update to the FWS for comment, which will list any impacts to ESA-listed species. FWS will then decide if the proposed action is likely to place in jeopardy a listed species or produce an adverse modification of designated critical habitat.

4.1.2 Federal Insecticide, Fungicide and Rodenticide Act of 1996

The use of rotenone and antimycin are both regulated under FIFRA (7 U.S.C. 136 et seq.). The EPA has given the state authority to authorize short-term exemption of water quality standards, specifically for the purpose of applying an aquatic pesticide. MFWP would apply to MDEQ for a 308 permit which allows such exemption.

4.1.3 Fish and Wildlife Conservation Act of 1980

The Fish and Wildlife Conservation Act of 1980 (16 USC 2901 et seq.) encourages federal agencies to conserve and promote conservation of non-game fish and wildlife species and their habitats.

4.1.4 Montana Environmental Policy Act of 1971

The state of Montana has adopted an Environmental Policy Act (MEPA), which is intended to ensure that environmental values are considered during decision-making by state and local agencies. The objectives and requirements of MEPA are similar to those of NEPA. To this end, MFWP and MDEQ have followed the guidelines for preparing a joint agency MEPA/NEPA EIS as per the Montana Legislative Environmental Policy Office (Mitchell 2002), and the M.C.A. 75-1-201.

4.1.5 Montana Water Quality Act

The Montana Code Annotated (2003) statute pertaining to water quality standards is:

75-5-308. Short-term water authorizations—water quality standards.

(1) Because these activities promote the public interest, the department may, if necessary, authorize short-term exemptions from the water quality standards for the following activities:

> (a) emergency remediation activities that have been approved, authorized, or required by the department; and
>
> (b) application of a pesticide that is registered by the United States environmental protection agency pursuant to 7 U.S.C. 136(a) when it is used to control nuisance aquatic organisms or to eliminate undesirable and nonnative aquatic species.

(2) An authorization must include conditions that minimize, to the extent practicable, the magnitude of any change in the concentration of the parameters affected by the activity and the length of time during which any change may occur. The authorization must also include conditions that prevent significant risk to public health and that ensure that existing and designated uses of state water are protected and maintained upon completion of the activity. Authorizations issued under this section may include conditions that require water quality or quantity monitoring and reporting. In the performance of its responsibilities under this section, the department may negotiate operating agreements with other departments of state government that are intended to minimize duplication in review of activities eligible for authorizations under this section.

(3) An authorization to use a pesticide does not relieve a person from the duty to comply with Title 80, chapters 8 and 15. The department may not authorize an exemption from water quality standards for an activity that requires a discharge permit under rules adopted by the board pursuant to 75-5-401.

MFWP will apply for a 308 permit that authorizes a short-term exemption from water quality standards.

4.1.6 National Environmental Policy Act of 1969

This DEIS is being prepared pursuant to the National Environmental Policy Act (42 U.S.C. 4321 et. seq.) and the Council of Environmental Quality (CEQ) Implementing Regulations (40 C.F.R. 1500-1517) that require Federal agencies to assess the impacts that their proposed actions may have on the environment. This DEIS will provide BPA and the FS with valuable information concerning impacts that the proposed action may, or may not have, and allow for informed decision-making.

4.1.7 Sensitive Wildlife Species

Federal laws and direction applicable to sensitive species include the National Forest Management Act of 1976 and Forest Service Manual 2670. Amendment 21 to the Flathead's LRMP has standards to conduct analyses to review programs and activities, to determine their potential effect on sensitive species, and to prepare a biological evaluation. It also states "adverse impacts to sensitive species or their habitats should be avoided. If impacts cannot be avoided, the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole will be analyzed. Project decisions will not result in loss of species viability or create significant trends towards federal listing." Future conservation strategies for each species will present direction on maintaining habitat diversity and managing for population viability as required by the NFMA and LRMP Amendment 21. The USDA Forest Service is bound by federal statutes (Endangered Species Act, National Forest Management Act), regulation (USDA 9500-4), and agency policy (FSM 2670) to conserve biological diversity on National Forest System lands. A goal in LRMP Amendment 21 is to "ensure that Forest Service actions do not contribute to the loss of viability of native species."

4.1.8 Wilderness Act of 1964

A portion of this project is proposed to occur in The Bob Marshall Wilderness, designated in 1964 by the U. S. Congress (16 U.S.C. 1 1 21 (note), P.L. 88-577). The Spotted Bear Ranger District on the Flathead National Forest manages approximately 70 percent of the designated wilderness. Management objectives are to:

- Maintain an enduring system of high quality wilderness representative of National Forest ecotypes;
- Perpetuate the wilderness resource for future generations;
- Provide opportunities for public use, enjoyment, and understanding of wilderness and the unique experiences dependent upon on a wilderness setting; and
- Maintain plants and animals indigenous to the area by protecting the natural dynamic equilibrium associated with natural, complete ecosystems.

Motorized vehicles, motorized equipment, mechanized trail vehicles, and helicopter landings are not conforming uses and are not permitted in the wilderness area by the public. However, the Forest Supervisor may authorize use of motorized equipment and chemical applications as deemed necessary for the administration of the area and its resources, such as the proposed action (FSM 2320, Direction for Wilderness, June 1990). See Chapter 3 for a detailed discussion.

The FS will determine whether to authorize the use of motorized equipment and chemical application to carry out the objectives of this project.

4.2 Related Plans, Studies, Assessments

- The Biological Assessment for South Fork Flathead Watershed Westslope Cutthroat Trout Conservation Program was prepared by MFWP and BPA, April 19, 2002, in anticipation of a forthcoming Environmental Assessment (EA) to examine the use of rotenone to remove hybrid fish that threaten westslope cutthroat trout populations. The BA was used to provide data on listed species and potential environmental impacts.
- The Bob Marshall/Great Bear Motorized Equipment EA was prepared by MFWP, 2001. Public Review Draft, April 18.
- The EA of Brook Trout Eradication in Devine Creek Lake was prepared by MFWP, 1994. Final Document.
- The Fish, Wildlife and Habitat Management Framework for the BMWC was prepared by the FS and MFWP, April 1995. It establishes overarching goals shared by the two agencies in the management of fish and wildlife on the

BMWC. The document provided guidance regarding fish population management, fish stocking, chemical treatment of exotic species, and the use of motorized equipment in wilderness.

- The Fisheries Management Plan for the South Fork Flathead River Drainage prepared by MFWP, May 1991, outlines fisheries management direction for the South Fork Flathead River drainage from the headwaters to Hungry Horse Dam. It discusses species-specific management for species of concern (e.g., bull trout, westlope cutthroat trout, and mountain whitefish).
- The Flathead National Forest Land and Resource Management Plan was prepared by FS, December 1985 (currently under revision). The forest plan was used to provide general information on the affected environment and resource management goals with its amended Recreation Management Direction (1987) for the Bob Marshall Wilderness Complex.
- The Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout in Montana was prepared by MFWP, May 1999. This agreement established shared conservation goals for the westslope cutthroat trout. Signators of the document include federal and state agencies and conservation and industry organizations. The agreement provided context and direction for alternative development in this DEIS.
- The Restoration of Native Cutthroat Trout in Jewel Basin Lakes was prepared by MFWP, 1986. A preliminary environmental review.
- The Specialist Report for South Fork Flathead Watershed Westslope Cutthroat Trout Conservation Program EIS was prepared by MFWP, January 2003. With content originally prepared for the initial EA, this document was used extensively to provide technical data regarding the proposed action involving the use of piscicides and their application. Specific information regarding potential treatment sites was also gleaned form the document.
- The Wilderness Act and Fish Stocking: An Overview of Legislation, Judicial Interpretation and Agency Implementation was prepared by Aldo Leopold Wilderness Research Institute, Rocky Mountain Research Station, FS. This document examines the role of state wildlife and federal wilderness managers with regard to fish restocking and balancing recreational fishing opportunities with wilderness values.
- The Tom Tom Lake Fish Rehabilitation was prepared by MFWP, 2000. Public Review Draft.
- The Westslope Cutthroat Trout Restoration in Headwater Lakes in the Flathead Basin was prepared by MFWP, 2001.
- Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam, MFWP, Confederated Salish and Kootenai Tribes, March 1991.

4.3 Non-applicable Legislation

4.3.1 Bald Eagle Protection Act of 1940

The Bald Eagle Protection Act (16 U.S.C. 668-668d, June 8, 1940, as amended 1959, 1962, 1972, and 1978) prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions. Because a small number of bald eagles may reside within foraging distance of proposed project sites, there is a remote possibility of some short-term impact on bald eagles. However, because the Act only covers intentional acts, or acts in "wanton disregard" of the safety of golden or bald eagles, this project is not viewed as subject to its compliance.

4.3.2 Clean Water Act of 1972

The Clean Water Act requires that states protect the water quality of their rivers, streams, lakes, and estuaries. To accomplish this, Section 303(d) of the Clean Water Act requires that each state develop a list of water bodies that do not meet the standards. The 303(d) list is a means of identifying water quality problems. Once a stream is placed on the list, the Clean Water Act requires that the state develop a plan to reduce pollution. States must submit this list to the EPA every two years. The South Fork of the Flathead is included in Montana's 2002 303(d) Impaired Waters Database for flow modification due to hydromodification (from Hungry Horse Dam). However, no proposed action discussed in this DEIS would impact that assessment in any way. Because of the short-term nature and transient effects of any piscicides above the reservoir, no additional water bodies would be added to the 303(d) list or require pollution plans.

4.3.3 Cultural Resources

Federal historic and cultural preservation acts include the National Historic Preservation Act of 1966 (16 U.S.C. 470, P.L. 95-515), the Archeological Resource Protection Act of 1979 (16 U.S.C. 470aa et seq., P.L. 96-95), the Archeological and Historic Preservation Act of 1974 (16 U.S.C. 469 et seq., P.L. 93-291), the American Antiquities Act of 1906 (16 U.S.C. 431-433), and the American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996, P.L. 95-341 section 2). No activities proposed in this DEIS would adversely affect resources protected under these acts.

4.3.4 Executive Order (EO) on Environmental Justice

As discussed in EO 12898, alternatives would not adversely affect any minority or economically disadvantaged groups in the project area. For this reason, the alternatives would not defeat the intent of the EO on Environmental Justice.

4.3.5 Floodplain/Wetlands Assessment

In accordance with Department of Energy regulations on compliance with Floodplains/Wetlands environmental review requirements (10 CFR 1022.12), and EOs 11988 and 11990, BPA has determined that floodplains and wetlands would not be affected by this project. Although crews would be working within floodplains and possibly wetlands around the lakes during treatment times, there would be no impacts to the natural and beneficial floodplain and wetland values. There would be no effects to lives and property and no effects on the survival, quality, and function of the wetland. Alternatives to the proposal were considered, including the no action alternative. Within the alternatives, no proposed structures would be built.

4.3.6 Migratory Bird Treaty Act of 1918

The Migratory Bird Treaty Act (16 U.S.C. §§ 703-712, July 3, 1918, as amended 1936, 1960, 1968, 1969, 1974, 1978, 1986 and 1989) implements various treaties and conventions between the United States and other countries, including Canada, Japan, Mexico, and the former Soviet Union, for the protection of migratory birds. Under the act, "taking," killing, or possessing migratory birds or their eggs or nests is unlawful. Most species of birds are classified as migratory under the act, except for upland birds such as pheasant, chukar, and gray partridge. The act contains several exemptions, such as waterfowl hunting. Many types of development result in the taking of migratory birds: collision with windows, for example, is a leading cause of death among songbirds. Taking may be allowed under a scientific permit if research is deemed beneficial to migratory birds.

4.3.7 Noise Control Act of 1972

The proposed project would not violate any local, state, or federal noise regulations (42 U.S.C. 4901 et seq.). Noise impacts in wilderness areas would be short-term and have no cumulative impacts on resources.

4.3.8 Resource Conservation and Recovery Act of 1976

The Resource Conservation and Recovery Act (RCRA) of 1976 (42 U.S.C. 6901 et seq.), as amended, is designed to provide a program for managing and controlling hazardous wastes. No hazardous materials covered by this Act would be used in this project. Any solid wastes would be disposed of according to state law and RCRA at an approved sanitary landfill.

4.3.9 Safe Drinking Water Act of 1974

The Safe Drinking Water Act (SDWA) (42 U.S.C. sec 300f et. seq.) is designed to protect the quality of public drinking water and its sources. SDWA was adopted in 1974. EPA sets standards for drinking water quality and oversees the states, localities, and water suppliers who implement those standards.

The proposed action would not affect a sole-source aquifer. No new injection wells would be required and no pollutants would be expected to reach drinking water supplies as mentioned in the 1974 Act (42 U.S.C. 300f et seq.). The nearest drinking water supply is in the town of Columbia Falls located approximately 10 miles downstream of Hungry Horse Dam. Under the proposed action, natural detoxification of piscicides and potassium permanganate should occur before they enter the reservoir; thus, there should be no risks to municipal drinking water supplies.

4.3.10 Treaty Rights and Trust Responsibility

Portions of the project area have been and continue to be used traditionally by Native American groups. To learn about potential effects on traditional cultural properties (TCPs) as well as other concerns of the tribes, BPA corresponded with potentially affected Indian tribes. None of the tribes contacted expressed any concerns about the project.

4.3.11 Wild and Scenic Rivers Act of 1968

Pursuant to the Wild and Scenic Rivers Act of 1968 (P.L. 90-542, as amended), the South Fork is designated as a Wild River Segment and is classified as Management Area 18 (Wild and Scenic River Corridor) in the Forest Management Plan. However, as there would be no impacts to the main stem of the South Fork, the proposed project would not compromise the protections afforded by the Wild and Scenic Rivers Act.

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Chapter 5.0: List of Preparers

CEQ requirements set forth the need to identify and document all those individuals that contributed to the content and production of this DEIS.

Sarah T. Branum – Environmental Protection Specialist, BPA. Responsible for categorizing scoping comments. Education: B.S. Environmental Studies. Years of professional experience: 4.

Robert Carlin – Forest Staff Officer, Ecosystem Assessment and Planning, Flathead National Forest. Responsible for document review and Forest Service NEPA coordination. Education: B.S. Forestry. Years of professional experience: 23.

Jon Cavigli – Fisheries Technician, MFWP. Responsible for collecting and analyzing field data for lake bathymetry, stream properties, discharge, water chemistry, plankton, fish populations, and organizing sections of the specialist report. Education: A.A. Biology, B.S. Fisheries Resources. Years of professional experience: 24.

Linh Davis – Forest Botanist, Flathead National Forest. Responsible for threatened, endangered, and sensitive plants program management. Education: B.A. Biology, M.S. Biology. Years of professional experience: 10.

Kelson Forsgren – Director of Projects, The Shipley Group. Responsible for coordinating compliance document preparation with BPA. Education: M.A. Technical Communication, B.A. English. Years of professional experience: 13.

Grant Grisak – Fisheries Mitigation Biologist, MFWP. Responsible for collecting field data, fish genetic information, site descriptions, researching information for specialist report, and writing specialist report. Education: A.S. Biology, B.S. Biology, M.S. Fish & Wildlife Management. Years of professional experience: 13.

Thomas Hale – Environmental Planner/Technical Writer, The Shipley Group. Responsible for assembling, writing, and editing environmental impact statement. Education: B.L.A. Landscape Architecture and Environmental Planning, M.S. Park and Natural Resources Management, M.L.A. Landscape Architecture and Resources Management. Years of professional experience: 14.

Jeff Hutten – Fisheries Technician/Geographic Information System (GIS) Programmer, MFWP. Responsible for collecting and analyzing field data for lake bathymetry, stream properties, discharge, water chemistry, and fish populations. Generated volumetric calculations and bathymetric maps using TIN software. Education: 2 years post-secondary. Years of fisheries experience: 13; years of GIS experience: 11.

Kim Lindstrom – GIS Programmer, MFWP. Responsible for generating project area maps using Arc View software. Education: B.A. Geography. Years of professional experience: 6.

Gary Michael – Fisheries Technician, MFWP. Responsible for collecting and analyzing field data for lake bathymetry, stream properties, discharge, water chemistry, fish populations, fish genetic samples, and organizing sections of the specialist report. Education: A.A.S. Fisheries technology. Years of professional experience: 21.

Ronald Morinaka – Fishery Biologist, BPA. BPA's resident fish lead. Responsible for oversight of various projects involving resident fish and fish health in the Columbia basin. Education: B.S. Fisheries Management, FWS's Fish Disease Long Course. Years of professional experience: 28.

Debbie Mucklow – District Ranger, Spotted Bear Ranger District, Flathead National Forest. Responsible for review and resource descriptions. Education: B.S. Forestry. Years of professional experience: 24.

Aaron Rasmussen – Fisheries Technician, MFWP. Responsible for collecting and analyzing field data for lake bathymetry, stream properties, discharge, water chemistry, fish populations and organizing sections of the specialist report. Education: College student, Flathead Valley Community College. Years of professional experience: 2.

Scott Rumsey – Fisheries Management Biologist, MFWP. Responsible for managing the fisheries of the South Fork Flathead drainage, collecting field data, fish genetic information, fish population surveys, and setting fish stocking schedules. Education: B.S. Biology. Years of professional experience: 27.

Kristian Skybak – Fisheries Technician, MFWP. Responsible for collecting and analyzing field data for lake bathymetry, stream properties, discharge, water chemistry, fish populations, and organizing sections of the specialist report. Education: B.S. Environmental Science. Years of professional experience: 1.

Colleen A. Spiering – Environmental Protection Specialist, BPA. Responsible for environmental project coordination and compliance with NEPA. Education: B.S. Public Health, M.P.H. Public Health Education. Years of professional experience: 25.

Shannon C. Stewart – Environmental Protection Specialist, BPA. Responsible for preparation of the biological assessment. Education: B.A. Environmental Science, M.S. Urban and Regional Planning. Years of experience: 5.

Chapter 6.0: List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent

6.1 Federal Agencies

U.S. Environmental Protection Agency
Region 8, Montana Office
Federal Building
10 West 15th Street, Suite 3200
Helena, Montana 59626

U.S. Fish and Wildlife Service
Montana Field Office
100 North Park, Suite 320
Helena, Montana 59601

U.S. Forest Service
Flathead National Forest
Supervisor's Office
1935 3rd Avenue E.
Kalispell, Montana 59901

6.2 State Agencies

Montana Department of Environmental Quality
1520 E. Sixth Avenue
Helena, Montana 59620

Montana Department of Fish, Wildlife and Parks
1420 East Sixth Avenue
Helena, Montana 59620

6.3 Libraries

Flathead County Library
247 1st Avenue E
Kalispell, Montana 59901

Montana State University, Billings
Library
1500 University Drive
Billings, MT 59101-0298

Montana State University, Bozeman
Renne Library
Bozeman, MT 59717-0332

Montana Tech of the University of Montana
Montana Tech Library
1300 West Park Street
Butte, MT 59701-8997

Montana State University, Northern
Vande Bogart Library
300 West 13th Street
Havre, MT 59501-7751

Carroll College
Corette Library
1601 North Benton Avenue
Helena, MT 59625

Montana State Library
1515 East 6th Avenue
Helena, MT 59620-1800

State of Montana
Natural Resource info System Library
1515 E 6th Ave.
Helena, Montana 59601-8206

State Law Library of Montana
215 North Sanders
Helena, MT 59620

University of Montana
Mansfield Library
32 Campus Drive
Missoula, MT 59812-9936

6.4 Tribes Consulted

Blackfeet Nation
PO Box 850
Browning, MT 59417
Mr. James, St. Goddard. Cultural Resources Committee
Ms. Tahnee Armstrong, Natural Resource Secretary
Mr. Gayle Skunkcap, Fish and Wildlife Director

Confederated Salish and Kootenai Tribes
P.O. Box 278
Pablo, MT 59855-0278
Ms. Marcia Pablo, Cultural Resources/Tribal Historic Preservation Officer
Mr. Clayton Matt, Natural Resources Director
Mr. Tom McDonald, Division of Fish and Wildlife Manager
Mr. Les Evarts, Fisheries Program Manager

Kootenai Tribe of Idaho
PO Box 1269
Bonners Ferry, ID 83805
Ms. Josephine Shottanana, Cultural Resources
Ms. Adriane Borgias, Environmental Director
Ms. Sue Ireland, Fish and Wildlife Director

6.5 Special Interest Groups

Aldo Leopold Wilderness Research Institute

Alliance for the Wild Rockies

American Fisheries Society

American Wildlands

Back Country Horseman of Montana

Bob Marshall Wilderness Ranch

Buckhorn Ranch

Cabin Creek Outfitters

Cheff Guest Ranch

Capitol Trail Vehicle Association

Coalition for Canyon Preservation

Continental Divide Trail Society

Diamond R Guest Ranch, Inc.

Double Arrow Outfitters

Duwamish Tribe

FH Sstoltze Land & Lumber Company

Ecology Center Incorporated

Flathead Valley Chapter of Trout Unlimited

Flathead Wildlife

Forest Conservation Council

Friends of the Wild Swan

Glacier Outfitters

Great Bear Outfitters

Hawkins Outfitters

Holland Lake Lodge

K L Ranch Outfitters

Last Chance Back Country Horsemen

Lion Creek Outfitters

Montana Audubon Council

Montana Historical Society

Montana for Multiple Use Association

Montana River Action Network

Montana Wilderness Association

Montana Wildlife Federation

Northwest Montana Gold Prospector

Our Montana Inc.

Professional Wilderness Outfitters Assn

Salmon Fork Outfitters

Skyline Outfit Inc.

Snowy Spring Outfitters

South Fork Outfitters Inc.

Spotted Bear Guest Ranch

Sun Canyon Lodge Outfitters

Swan View Coalition

Thad's Tackle Shop

Trout Unlimited

Whitetail Ranch Outfitters

Wilderness Outfitters Consulting

Wilderness Watch

Williams Outfitters

WTR Outfitters LLC

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Chapter 8.0: Acronyms and Glossary

8.1 Acronyms and Abbreviations

μg/kg	Micrograms per Kilogram
BCF	Bio-concentration Factor
BLM	Bureau of Land Management
BMWC	Bob Marshall Wilderness Complex
BPA	Bonneville Power Administration
C	Centigrade
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	Carbon dioxide
DEIS	Draft Environmental Impact Statement
DNRC	(Montana) Department of Natural Resources and Conservation
DOE	U.S. Department of Energy
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FS	Forest Service
FSM	Forest Service Manual
FWS	Fish and Wildlife Service
GIS	Geographic Information System (or Science)
GPS	Global Positioning System
IRIS	Integrated Risk Information System
km^2	square kilometers
L	Liter
LAC	Limits of Acceptable Change
MCA	Montana Code Annotated
MDEQ	Montana Department of Environmental Quality

MEPA	Montana Environmental Policy Act
MFWP	Montana Fish, Wildlife and Parks
Mg	Milligram
mi^2	Square miles
Ml	Milliliters
mph	Miles per hour
MSDS	Material Safety Data Sheets
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAEL	No-Observed-Adverse-Effect Level
NOI	Notice of Intent
oz.	Ounces
P.L.	Public Law
ppb	parts per billion
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
SCUBA	Self Contained Underwater Breathing Apparatus
SDWA	Safe Drinking Water Act
SEAT	Single Engine Air Tanker
spp.	Species
TCE	Trichloroethylene
TCP	Traditional Cultural Property
TIN	Triangulated Integrated Network
U.S.C.	United States Code
USDA	United States Department of Agriculture
USDOI	United States Department of Interior

8.2 Glossary

Adfluvial: Adfluvial fish spend a portion of their lives in a lake or reservoir then move upstream into flowing waters (e.g., streams and rivers) to spawn.

Anadromous: Refers to fish that live in the ocean and travel up fresh water streams to spawn (e.g., salmon).

Antimycin: A crystalline substance derived from the fermentation of Streptomyces bacteria that is toxic to fungi, and fish in extremely low concentrations.

Bathymetry: The measurement of depth below water level. In this document, a bathymetric map is one that shows the underwater "topography" of a lake.

Bioassay: Determination of the relative strength of a substance by comparing its strength on test organisms with that of a standard preparation.

Bioconcentration: The accumulation of a chemical in tissues of a fish or other organism to levels greater than in the surrounding medium.

Broodstock: Adult fish used to propagate subsequent generations of hatchery fish.

Chamaephytes: Any perennial plant whose winter buds are within 10 inches of the soil surface.

Cirque basin: An abrupt crevasse located at the head of a present or historic mountain glacier, typically having a conclave floor that meets a mountainous headwall and is bounded below by a lip or threshold of rock.

Detoxification station: A drip station used to dispense potassium permanganate (KMnO4) to detoxify lake outflows and mitigate potential harm to non-target species.

Detpress: The compressibility of an explosive material such as dynamite created by the detonation of a nearby explosion of a similar material that may or may not create a chain reaction in detonation of nearby charges.

Drip station: A container that dispenses a known concentration of a substance over time.

Electrophoresis: The movement of suspended particles through a fluid or gel under the action of an electromotive force applied to electrodes in contact with the suspension.

Endangered: Under the ESA, those species officially designated by the NMFS or FWS as in danger of extinction through all or a significant portion of their range. Endangered species are protected by law. See also: Listed and Threatened.

Endangered Species Act: The ESA of 1973, as amended, requires that Federal agencies ensure that their actions do not jeopardize threatened or endangered species.

Fen: A marsh-type area that receives water from the ground.

Fluvial: Fluvial literally means "flowing." Fish that demonstrate a fluvial life history strategy spend their entire lives in flowing water.

Forbs: Herbs other than grasses.

Free interstitial spaces: Spaces between rocks in a stream that have not been filled by smaller particles such as sand or silt.

Genome: The genetic endowment of a species.

Genetically pure: In this document, genetically pure westslope cutthroat trout refers to those populations that are tested to be 100 percent genetically pure through the genetic testing of species-specific proteins.

Hybrid: The offspring of genetically dissimilar parents or stock.

Hybridization: The crossbreeding of two or more dissimilar stock. For this project it refers to the crossbreeding of genetically pure westslope cutthroat trout with other trout species.

Institutional outfitters: An outfitter providing a service to a specific group such as scouting or educational group.

Introgressed: The entry or introduction of a gene from one gene complex into another.

Limits of Acceptable Change: It is a planning framework that establishes limits on the change that may occur within biophysical and social-psychological parameters to main a standard of recreational opportunity.

Listed species: Under the ESA or similar state statute, those species officially designated as threatened or endangered through all or a significant portion of their range. See also: Threatened and Endangered.

M012 brood stock: Broodstock are adult fish used to propagate the subsequent generation of hatchery fish. The M012 are westslope stock maintained at MFWP's Wahsoe Park State Fish Hatchery in Anaconda. The brood stock originated from wild fish taken from 12 tributaries that feed Hungry Horse Reservoir and two tributaries in the Clark Fork drainage.

Natal: Relating to birth, or birth place.

Net nights: A measure of time or effort usually defined as leaving a gill net or trap set overnight.

Non-native: A species that has been introduced into a habitat that is not part of its original territory or range.

Non-target species: Not being the intended object of action by a particular agent.

Megafauna: Refers to large-bodied mammals.

Minimum Tool Analysis: A decision guide designed for wilderness administrators to effectively analyze proposed actions to minimize negative impacts to wilderness character and values. This guide is suggested for wilderness administrators for the four federal land management agencies: the BLM, National Park Service, FWS, and FS.

Mycorrhizal fungi: Fungi that live in the soil surrounding plant roots and contribute to a mutually beneficial relationship between plant roots and fungi. Plants support fungi by providing sugar and a hospitable environment. Fungi support plants by providing increased surface area for water uptake and by selectively absorbing essential minerals.

Natural Quiet: Refers to the natural (non-human produced) ambient (background) sound associated with a particular environment.

Outplanted: Hatchery produced fry (recently hatched fish) that are released into the natural environment.

Pacific Northwest Electric Power Planning and Conservation Act: The Pacific Northwest Electric Power Planning and Conservation Act of 1980 (16 U.S.C. 839 et. Seq.), which authorized the creation of the Northwest Power Planning Council and directed it to develop this program to protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat on the Columbia River and its tributaries.

Parthenogenesis: Reproduction by development of an unfertilized gamete, which allows some female plankton species to reproduce without mating with a male, and typically occurring at times of stress to boost population numbers.

Phenology: The study of relations between climate and periodic biological phenomenon.

Phenotypic: The visible characteristics of an organism.

Photolosis: The breakdown of compounds by ultraviolet light (sunlight).

Piscicide: Piscine literally means "fish." Piscicide is a pesticide that kills fish.

Plankter: An individual of the plankton community.

Plankton: Tiny plants and animals that live in lakes, streams, and rivers.

Potassium permanganate: A dark purple salt (KMnO4) that is used as an oxidizer and disinfectant.

Redd: A spawning nest constructed in the gravel of rivers or streams by most trouts.

Resident fish: Fish that spend their entire life cycle in freshwater. For program purposes, resident fish include landlocked anadromous fish (e.g., white sturgeon, Kokanee, and coho), as well as traditionally defined resident fish species.

Rotenone: A naturally occurring toxin derived from the derris root that is toxic to fish and insects**.**

Scoping: Includes agency and public involvement to determine the range of issues to be addressed. Scoping aids in developing alternatives for a proposed action.

Scree: A collection of ungraded, unconsolidated rocks, small stones, and grit that accumulates at the foot of a cliff or mountain.

Sensitive species: Those plant and animal species, identified by a Regional Forester, for which population viability is a concern as evidenced.

Sentinel fish: Fish contained in a cage that are used to evaluate water conditions.

Seral Forest: Any stage of development of a forest from a disturbed, unvegetated state to a climax plant community. The progression of seral stages describes plant communities that replace one another over time until a climax community is reached.

Soundscape: The totality of sounds that characterize a given environment. Generally refers to natural (non-human produced) sounds.

Sporulation: The act and process of spore formation.

Swamping: The deliberate overstocking of desirable fish with the intent that they will interbreed with undesirable species and take dominance in the lake. Genetic swamping is done for the purpose of increasing the genetic purity of a particular species; effectively "breeding out" other species.

Threatened: Under the ESA, those species officially designated by the FWS as likely to become endangered within the foreseeable future through all or a significant portion of their range. Threatened species are protected by law. See also: Listed Species and Endangered.

Watershed: A region or area bounded by geologic features which directs water inwardly to a central point such as a stream, river, or lake.

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Chapter 9.0: Index

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APPENDICES

A. Scoping and Public Involvement Process
B. Legal Chronology of Westslope Cutthroat Trout Listing Milestones
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F. Endangered and Threatened Species and Forest Sensitive Species

Appendix A: Scoping and Public Involvement Process

MFWP presented information to groups and participated in meetings or other activities relating to the project.

Milestones

- 4/22/03 Flathead Chapter Backcountry Horseman's' Association
- 4/24/03 Taped radio messages (public service announcements) with KALS for broadcast of information regarding the project and public scoping period.
- 4/2903 Region I NW Montana Citizens Advisory Council (represents different interest groups in the valley and provides for open dialogue between the citizen's groups and MFWP)
- 4/30/03 Montana Wilderness Guides and Outfitters Association (Seeley Lake)
- 5/6/03 Flathead Valley Chapter, Trout Unlimited
- 5/7/03 Met with FS
- 5/9/03 Wildlife Class at Flathead Community College
- 5/20/03 Polson Outdoors
- 5/21/03 Talk show with KOFI, "The Wendy Price Show" a radio call-in to answer questions bout the project
- 5/2203 Public scoping open house, BPA, FS, MFWP
- 6/03/03 Mission Valley Backcountry Horseman's Association
- 12/15/03 Montana DEQ and EPA
- 4/9/03 Met with FS

Forest Service Participation

LAC meetings held annually in December that includes FS, and outfitters and guides, and wilderness public interest groups that discuss issues on the Flathead.

Scoping Process

4/30/2003	Letter to public announcing the Public Scoping Meeting Open House; how to comment on the proposed project and the close of the comment period--June 23, 2003.
5/22/03	Public Scoping Meeting Open House, Kalispell, Montana.
6/23/03	Close of Comment Period.

Documents made available to the public during the scoping period

Information Brief – An 11 page document explaining the background, problem, and proposed solution to protecting native westslope cutthroat trout.

Q and A Fact Sheet – Answers to 36 frequently asked questions about the project.

Public Comment Form – Provided information on how to comment on the project and procedure for having your name and address added to the list to receive information.

Maps of the Project Area

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Appendix B: Legal Chronology of Westslope Cutthroat Trout Listing Milestones

In June of 1997, the American Wildlands; Clearwater Biodiversity Project, Inc.; Montana Environmental Information Center; The Pacific Rivers Council; Trout Unlimited, Madison-Gallatin Chapter; and Mr. Bud Lilly petitioned for federal threatened species listing of the westslope cutthroat trout. The following chronology of events details the evolution of this process.

June 6, 1997

FWS receives a petition to list the westslope cutthroat trout as a threatened species throughout its range, pursuant to the Endangered Species Act.

June 6, 1997

Period of 90-day petition review begins. FWS must decide whether or not the petition presents sufficient information to indicate that the requested action (listing) is warranted.

July 2, 1997

FWS sends a letter to petitioners stating that, on the basis of FWS final listing priority guidance published in the December 5, 1996 *Federal Register* (61 FR 64481), the FS has determined that the petition falls into the Tier 3 (low priority) category, and that westslope cutthroat trout do not face "imminent, high-magnitude threats." The Service will proceed with the 90-day finding when completion of ongoing, higher-priority activities allows available funds to be allocated to westslope cutthroat trout.

September 4, 1997

End of 90-day period for petition review.

September 24, 1997

Petitioners send a letter (60-day notice of intent) to Interior Secretary and FWS stating that, unless the FS promptly issues the 90-day finding, the petitioners intend to pursue federal court litigation for alleged violations of the ESA.

January 25, 1998

FWS receives from the petitioners an amended petition that contains a substantial amount of new information on westslope cutthroat trout.

January 25, 1998

Period of 90-day review for amended petition begins. The FWS must decide whether or not the amended petition presents substantial information indicating a listing may be warranted.

March 17, 1998

Petitioners file a complaint in the U.S. District Court for the District of Columbia requesting that the court declare that FWS failure to issue a 90-day finding is a violation of the ESA, its implementing regulations, and the Administrative Procedures Act; and that the court issue a preliminary and permanent injunction requiring the FWS to issue a

90-day finding on the petition and promptly publish such finding in the *Federal Register*. The complaint was filed before the end of the 90-day review for the amended petition.

April 1, 1998

The FWS sends a letter to the petitioners stating that, although the tier system for prioritizing listing actions remains in full force and effect, the FWS is proceeding with preparation of a 90-day finding on the amended petition.

June 10, 1998

The FWS publishes a notice in the *Federal Register* (63 FR 31691) of a 90-day finding that the amended petition provided substantial information indicating that the petitioned action may be warranted; FWS immediately begins a status review of westslope cutthroat trout. In the notice, the FWS requested data, information, technical critiques, comments, or questions relevant to the amended petition.

July, 1998

The FWS receives requests to extend the comment period from MFWP, the Idaho Department of Fish and Game, and US Forest Service Regions 1 and 4. As a result, the FWS announces reopening of the comment period in the August 17, 1998 *Federal Register* (63 FR 43901), and indicates that comments on the 90-day finding should be submitted by October 13, 1998. A September 23, 1998 *Federal Register* notice (63 FR 50850) describes corrections to the preceding notice and the FWS's need for nine months from the date of the 90-day finding (June 10, 1998) to complete the status review.

September 30, 1998

The U.S. District Court dismisses the petitioner's March 17, 1998 complaint pertaining to westslope cutthroat trout.

March 26, 1999

Legal representatives of the petitioners send a Notice of Intent to Interior Secretary Babbitt and the Service stating that, unless the Service promptly issues the 12-month finding, the petitioners intend to pursue federal court litigation for alleged violations of the Act.

August 5, 1999

Legal representatives of the petitioners filed a complaint in the U.S. District Court for the District of Columbia requesting that the court declare that the Service's failure to issue a 12-month finding on the June 6, 1997 petition is a violation of the Act, its implementing regulations, and the Administrative Procedures Act; and that the court issue a preliminary and permanent injunction requiring the Service to issue a 12-month finding on the petition and promptly publish such finding in the *Federal Register*.

September, 1999

The FWS completes the status review for westslope cutthroat trout in the United States.

March 8, 2000

The FWS and its co-defendants reach an agreement with the plaintiffs that, among other things, on or before April 10, 2000, the FWS shall submit for publication in the *Federal Register* a "warranted; not warranted; or warranted, but precluded" determination regarding the westslope cutthroat trout in accordance with Section 4(b)(3)(B) of the ESA.

April 6, 2000

The FWS Director signs a 12-month not-warranted finding for westslope cutthroat trout.

October 23, 2000

Plaintiffs file a lawsuit in federal court claiming the FWS was arbitrary and capricious in its not-warranted decision.

November 2001

Oral arguments by plaintiffs and defendants are heard in federal court in Washington D.C.

March 31, 2002

The court ruled that the FWS must re-evaluate its not-warranted finding. In reconsidering whether to list the westslope cutthroat trout as a threatened species, the FWS must evaluate the threat of hybridization as it bears on the statutory listing factors of the Endangered Species Act. The court gave the Service 12 months to make this evaluation.

August 8, 2003

The FWS determined that the westslope cutthroat trout should not be listed as a threatened species under the ESA. One of the key reasons cited for this determination was the ongoing conservation efforts by FWS, such as the proposed project considered in this document, and their contribution to the viability of these indigenous species in Montana. However, the petitioners may reserve the right to appeal this decision and/or the court response to the agency's decision.

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Appendix C: Detailed Descriptions of Candidate Lakes for Treatment

This section describes the 21 lakes proposed for treatment over a period of approximately 10 to 12 years.

Black Lake

Black Lake is a 49.1-acre lake located in the Jewel Basin Hiking Area at 6,045 feet above sea level in the headwaters of Graves Creek. The lake has a maximum depth of 157 feet and a volume of 4,493 acre-feet (figure C-1). The outflow stream of Black Lake is a headwater tributary of Graves Creek and flows for 0.23 mile where it reaches an unnamed pond. From this pond, the stream flows for 0.93 mile where it reaches the other tributary of Graves Creek (Blackfoot Lake outflow stream). Graves Creek flows for 1.47 miles to the confluence of Cliff Lake Creek, then for 1.43 miles to Seven Acres Creek, then for 2.03 miles before entering Handkerchief Lake. After leaving Handkerchief Lake, Graves Creek flows for 0.54 mile to the confluence of Aeneas Creek, then for 0.79 mile to the barrier waterfall near its mouth. This barrier waterfall blocks all upstream fish passage. Total distance from Black Lake to the Graves Creek fish barrier, including the length of Handkerchief Lake, is 8.05 miles.

A 2.5-mile long trail network beginning at the Camp Misery trailhead accesses Black Lake.

The management objective for this lake is to remove the hybrid trout from it and from the 6.09 miles of stream between Black Lake and Handkerchief Lake. To achieve this objective, rotenone would be applied to the lake at the prescribed concentration of 1 ppm. Water leaving the lake would be allowed to flow downstream in an effort to remove the trout from downstream. MFWP would rely on on-site assays and up to date flow measurements to determine where drip stations, caged fish, and detoxification stations should be placed. Caged live fish would be placed at intervals in Graves Creek upstream and downstream of Handkerchief Lake to measure the toxicity of water. As an added safeguard measure, MFWP would rely on Handkerchief Lake to further dilute treated water. Detoxification stations and caged fish would be monitored and removed only after caged fish survive 24 hours after treatment.

In August 2002, water leaving Black Lake was gauged at the lake outlet and measured to be 1.27 cfs. Twenty days later, Graves Creek was gauged upstream of Handkerchief Lake at 3.3 cfs. Based on these measurements, the rotenone concentration in Graves Creek upstream of Handkerchief Lake would be 0.38 ppm. This represents a 62 percent reduction in concentration. Furthermore, the 811 acre-feet of water in Handkerchief Lake would dilute the stream water to sub-lethal levels. In September 2002, discharge from Jones and Aeneas Creek were measured at 8.9 cfs, and Graves Creek downstream of Handkerchief Lake was measured at 7.2 cfs. Any rotenone treated water leaving Handkerchief Lake would be further diluted by these freshwater inputs.

The removal of fish from Black Lake would require the application of 1,469 gallons (14,396 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed to treat associated stream segments. One thousand gallons (9,800 pounds) of rotenone would be transported to the lake in two trips by SEAT aircraft; the remaining 469 gallons (4,596 pounds) would be transported in six separate loads by helicopter. The transport of a raft and motor, and sprayers and drip stations would require another two flights. Treatment of the lake would require, approximately, a five member team that would be transported to the lake in two separate flights. Prior to treatment, monitoring personnel would set up fish cages, drip stations, and detoxification stations at determined intervals on Graves Creek just above Handkerchief Lake. The monitors below Handkerchief Lake would set up potassium permanganate detoxification stations and caged fish. A helicopter would begin to transport personnel, equipment, and materials first thing in the morning; then prepare for application by boat. Personnel would prepare for treating freshwater inputs and seeps using sprayers and drip stations.

In August 2002, Black Lake was surveyed by air with the SEAT pilot who determined that the layout of Black Lake allows for four drops of 250 gallons of rotenone each. An application plan using SEAT was developed based on terrain features of the site. The dimensions of Black Lake are approximately 2,297 feet long by 1,286 feet wide. Before dispensing, the SEAT would conduct two flyovers to confirm communication with ground personnel at the lake, and to test weather conditions. If communication and application variables were appropriate, the SEAT would then begin administering its load. At this point the stream treatment and detoxification measures would be implemented. Mach flyovers conducted in November 2002 with a Hughes 500 helicopter revealed that the best approach to Black Lake would be from its southwest corner. The plane would make its descent toward the lake, make a slight bank to the east, dispense its load, then continue northeast down Graves Creek drainage. The SEAT would continue down Graves Creek drainage, circle back, then continue dispensing its load. The fact that rotenone appears milky white when it contacts water would allow the SEAT pilot to see precisely where the previous load was dropped; thus allowing the pilot to place subsequent loads directly adjacent to the previous load in order to provide comprehensive application coverage.

After dispensing its load, the SEAT would return to Glacier Airport for refilling. After a complete application of the first load, the personnel at the raft site would begin mixing the rotenone at the surface for application at deeper lake depths, and treatment of freshwater inputs would begin. Upon returning with a second load, the SEAT pilot would conduct flyovers to establish communication with the ground and to test weather conditions. The raft and all personnel would be removed from the lake to wait on the shoreline for the second drop. After the second drop, the treatment with the raft would resume until completed. After treatment, three people would be flown out with most of the equipment while two would remain at the site to monitor the treatment. The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft, and motor) and personnel would be removed from the site. Caged fish and detoxification stations would be monitored, and removed only after caged fish survived for 24 hours following piscicide application. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days, and would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate that Black Lake receives an estimated 107 angler days per year (Table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery to maintain the fishery. Beginning in July following the treatment, 4,900 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. There is little risk of reinvasion of Black Lake by downstream fish due to the high gradient of the stream below the lake and the fact that fish below the lake would be removed during treatment. The stream below the lake would also be stocked to establish a population as quickly as possible.

Blackfoot Lake

Blackfoot Lake is a 16.5 acre lake located in the Jewel Basin Hiking Area at 5,520 feet above sea level and in the headwaters of Graves Creek. The lake has a maximum depth of 22 feet and a volume of 205 acre-feet (figure C-2). The outflow stream of Blackfoot Lake is a headwater tributary that forms Graves Creek. From the lake, it flows 0.83 miles until reaching another tributary that forms Graves Creek (Black Lake outflow stream). Graves Creek flows for 1.47 miles to the confluence of Cliff Lake Creek, 1.43 miles to Seven Acres Creek, then 2.03 miles before entering Handkerchief Lake. After leaving Handkerchief Lake, Graves Creek flows for 0.54 mile to the confluence of Aeneas Creek, then for 0.79 mile to the barrier waterfall near its mouth. This barrier waterfall blocks all upstream fish passage. Total distance from Blackfoot Lake to the Graves Creek fish barrier, including the length of Handkerchief Lake, is 7.72 miles.

A 5.2-mile long trail network starting at the Camp Misery trailhead accesses Blackfoot Lake.

The management objective for this lake is to remove the hybrid trout from it and from the 5.76 miles of stream that flows out of Blackfoot Lake to the inlet of Handkerchief Lake. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. The rotenone treated water leaving the lake would be allowed to flow downstream in an effort to remove as many hybrid trout from downstream as possible. The downstream boundary for this treatment is Handkerchief Lake. Up-to-date flow measurements and on-site bioassays would determine where drip stations, caged fish, and detoxification stations would be placed. Caged live fish would be set in at intervals in Graves Creek upstream of Handkerchief Lake, downstream of Handkerchief Lake, and in Graves Creek Bay of Hungry Horse Reservoir as a means of measuring the toxicity of water. As an added safeguard measure, the waters of Handkerchief Lake would be used to dilute any remaining rotenone in this stream.

In September 2002, water leaving Blackfoot Lake was gauged at the lake outlet and measured to be 0.42 cfs, and Graves Creek was measured upstream of Handkerchief Lake at 3.3 cfs. Based on these measurements, the concentration of rotenone in Graves Creek above Handkerchief Lake would be 0.12 ppm. This represents an 88 percent reduction in concentration. Furthermore, the 811 acre feet of water in Handkerchief Lake would further dilute the 0.12 ppm rotenone to sub-lethal levels.

In September 2002, discharge from Jones and Aeneas Creek were measured at 8.9 cfs, and Graves Creek downstream of Handkerchief Lake was measured at 7.2 cfs. Based on these calculations, any rotenone treated water leaving Handkerchief Lake would be further diluted by these inputs of freshwater.

Removal of fish from Blackfoot Lake would require the application of 68 gallons (667 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed to treat associated stream segments. Rotenone would be transported to the lake by helicopter in 1 load. Two flights would be required to transport a raft, motor, sprayers, and drip stations. Four people would be needed to treat the lake necessitating two transport flights. Prior to treatment, monitors would set up fish cages on Graves Creek above and below Handkerchief Lake to evaluate detoxification. The monitors would have potassium permanganate detoxification stations active. After treatment, two people would be flown out with most of the equipment, while two people would stay at the site to monitor the treatment.

The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) would be removed. Detoxification stations and caged fish would be monitored, and removed only after the caged fish survived 48 hours after treatment. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days, and would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate Blackfoot Lake receives an average 332 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery to maintain the fishery. Beginning in July following the treatment, 1,600 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The stream below the lake would also be stocked to establish a population as quickly as possible. There is little risk of reinvasion by downstream fish due to the high gradient of the stream below the lake, and the fact that downstream fish would be removed during treatment.

Clayton Lake

Clayton Lake is a 62-acre lake located in the Jewel Basin Hiking Area at 6,040 feet above sea level and forms the headwaters of Clayton Creek. The lake has a maximum depth of 193 feet and a volume of 6,948 acre-feet (figure C-3). Small ephemeral streams and spring seeps provide most of the surface water inflow to Clayton Lake, mostly from the south and west shores. Clayton Creek flows out of the lake for 4.52 miles before reaching a barrier falls. The stream continues for 0.03 mile before entering Hungry Horse Reservoir. There are three unnamed tributaries that enter Clayton Creek between the lake and the mouth. The waterfall is believed to be a complete barrier to fish trying to enter Clayton Creek from the reservoir. Bull trout have never been documented in Clayton Creek above the falls. Total distance from this fish barrier to Clayton Lake is 4.52 miles.

Access to Clayton Lake is made by a 2.3 mile trail starting at Forest Road 1633 in the Clayton Creek drainage.

The management objective for this lake is to remove the hybrid trout from the lake and from the 4.52 miles of stream between the lake and the barrier waterfall. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. The rotenone treated water leaving the lake would be allowed to flow downstream in an effort to remove as many hybrid trout from downstream as possible. Up to date flow measurements and on-site assays would be used to determine the number and location of drip stations, caged fish monitoring stations, and detoxification stations. Caged fish would also be placed in Clayton Creek Bay of Hungry Horse Reservoir to monitor the detoxification process. These detoxification stations and sentinel fish cages would be monitored, and removed only after the point at which sentinel fish survive 24 hours after treatment. Implementation and monitoring of the proposed stream treatment procedures, along with the detoxification and cleanup effort, is expected to take about five days, and would be conducted during most of the lake treatment.

In September 2002, the outflow stream of Clayton Lake was gauged and measured to be 0.06 cfs; Clayton Creek was gauged at road 895 crossing and measured to be 3.9 cfs.

Based on these measurements, the rotenone concentration in Clayton Creek would be 0.02 ppm. This represents a 98 percent reduction in concentration.

The removal of fish from Clayton Lake would require the application of 2,316 gallons (22,697 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed to treat associated stream segments. In liquid form, this amounts to 77 30-gallon drums. Because there is not adequate storage space at the lake for this amount of material, and because of the amount of time it would require a helicopter to transport full barrels in and empty barrels out, SEAT aircraft would be used to transport and apply two thousand gallons (19,600 pounds) of rotenone in four trips. The remaining 316 gallons (3,097 pounds) would be transported by helicopter in four loads. Two flights would be required to transport a raft, motor, sprayers, and drip stations. Six people would be needed to treat the lake, requiring two transport flights. Prior to the proposed treatment, monitors would set up drip stations, fish cages, and detoxification stations on Clayton Creek at the above mentioned locations to implement and evaluate the treatment and detoxification procedures. A helicopter would transport equipment and materials to the site the day before the treatment. The following morning, personnel would be transported to the site to prepare for application by boat. Two people would prepare for treatment of freshwater inputs and seeps by sprayers and drip stations.

In August and November 2002, Clayton Lake was surveyed by air with the SEAT pilot who determined that SEAT would be able to perform this application. An application plan using SEAT was developed based on terrain features of the site. Before dispensing, the SEAT would conduct two flyovers to confirm communication with ground personnel at the lake and to test weather conditions. If communication and application variables were appropriate, the plane would begin administering the first load to the lake. The SEAT would approach the lake from the southeast, dispense its load, then exit the lake to the northwest down Clayton Creek drainage. The SEAT would continue down Clayton Creek drainage, circle back, cross over Pioneer Ridge, and then approach from the southeast to continue dispensing. After dispensing the first load, the SEAT would return to Glacier Airport for refilling. Since rotenone appears milky white when it comes in contact with water, the SEAT pilot would be able to accurately judge were to drop subsequent loads in order to provide effective application coverage, applying each load adjacent to the prior load. After the first SEAT load is administered, the raft would begin mixing the rotenone, pumping it to deeper zones of the lake; the treatment of freshwater inputs would also begin. The second SEAT load would return 30 minutes later, conduct the two flyovers to establish communication with the ground, then apply. The raft and all personnel would be removed from the lake each time to wait on the shoreline for the next drop. The third SEAT drop would occur 30 minutes later, and the fourth drop 30 minutes after that. After the fourth drop, the treatment with the raft would resume until finished. When completed, four people would be flown out with most of the equipment. Two people would stay at the site and monitor the treatment. The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) and personnel would be removed from the lake. Detoxification stations would be monitored for the point at which sentinel fish survive for 48 hours after the treatment, and then removed. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days, and would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate Clayton Lake receives an estimated 245 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park

State Fish Hatchery to maintain the fishery. Beginning in July following the treatment, 5,800 fish, of which 1000 would be of catchable size, would be stocked in each of the first two years after the proposed treatment to restore the fishery as quickly as possible. The stream below the lake would also be stocked to establish a population as quickly as possible. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. There is little risk of reinvasion by downstream fish due to the high gradient stream and the fact that fish in the stream below the lake would be removed down to the barrier during the treatment.

George Lake

George Lake is a 119.5-acre lake located in the Bob Marshall Wilderness at 7,115 feet above sea level. The maximum lake depth is 275 feet and lake volume is 13,475 acre-feet (figure C-4). The main surface water inputs to the lake include two perennial streams and four ephemeral streams on the north shore, and many seeps along the south shore. George Creek flows out of the lake for 0.17 mile where it flows over a waterfall. It continues for 3.75 miles to a 90-foot bedrock waterfall, which is located about 0.25 mile above the confluence with Gordon Creek. Six unnamed streams enter from the south over the lower 4 miles of George Creek. Distance from this waterfall to George Lake is 3.92 miles.

Although there is no system trail to George Lake, there is an unimproved foot trail that runs for about 3 miles up the George Creek drainage. Hikers can approach the lake by National Forest access on the west side of the Swan Mountain Range near Sunday Mountain in the East Fork of the Clearwater River.

George Creek flows out of George Lake. The management objective for this lake is to remove the hybrid trout from the lake and from the 3.92 mile of stream between the lake and the waterfall near its mouth. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. The elevation differential between George Lake and the known bull trout population in Gordon Creek is approximately 1,875 feet. Approximately 1,300 feet of altitude drop occurs within the first 1 mile of stream that leaves the lake. Accessing this high gradient section would be difficult. Furthermore, it is unlikely that any fish reside in this section because it is so steep. For this reason, approximately two recharge stations would be installed in the remaining section of stream to remove hybrid fish. The foot trail in George Creek drainage provides access to a point approximately 1 mile below the lake. Recharge stations would begin at this point and treat down to near its mouth, which is the lower boundary of the treatment area. Up to date flow measurements and on-site bioassays would be used to determine the number and location of recharge drip stations and caged fish monitoring stations, as well as the location of detoxification stations and caged fish for detoxification monitoring.

Because there is no trail to George Lake, the 2,695 units (10,106 pounds) of antimycin necessary to treat the lake would be transported via 12 flights by a Bell OH58 helicopter. An additional 4 flights would be required to transport the equipment and personnel. Motorized rafts would be used to administer the antimycin. Five people would be needed to treat the lake, two to monitor recharge stations on the creek, and another to monitor caged fish and administer potassium permanganate if necessary. Livestock would be used to deliver the personnel and materials for the stream work, and would be staged from the Shaw Cabin. The treatment would require approximately one day for transportation, approximately one day for set up, one day for treatment administration, and two days for clean up. Personnel and equipment would then be flown out from the lake site. Detoxification stations and caged fish would be monitored, and removed only after the caged fish survived for 24 hours after treatment. Stream treatment, detoxification, caged fish monitoring, and cleanup are expected to take approximately five days and would be conducted during most of the lake treatment.

George Lake and George Creek would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate George Lake receives an estimated 105 (60-180) angler days per year. Its annual statewide ranking is number 923 out of 1,529 fisheries in the state (table C-1). Restocking genetically pure westslope cutthroat trout would maintain angling opportunity at George Lake, provide a source of pure fish to repopulate downstream areas, genetically dilute any possible remaining hybrids, and reduce the potential for an illegal fish introduction. Maintenance stocking would continue in George Lake to maintain population viability and angling quality. Stocking would occur the July following the treatment, and involve 11,400 fish each year for three years. The fish population would be evaluated on year five-post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish is non-existent due to the steep waterfall immediately downstream of the lake.

Handkerchief Lake

Handkerchief Lake is a 51.3-acre lake located on the Flathead National Forest at 3,835 feet above sea level near the mouth of the Graves Creek drainage. The lake has a maximum depth of 24 feet and a total volume of 811.5 acre-feet (figure C-5). Graves Creek is the only known stream that flows into the lake. Graves Creek flows out of Handkerchief Lake for 0.54 mile before it joins with Aeneas Creek, then flows for another 0.79 mile before reaching the waterfall fish barrier just above Hungry Horse Reservoir. This barrier prevents all fish from moving upstream into Graves Creek from Hungry Horse Reservoir. Distance from this fish barrier to the lake is 1.33 miles.

Access to Handkerchief Lake is made by a road that exits off Forest Road 895.

The management objective for this lake is to remove the hybrid trout from it and from the 1.33 miles of stream between the lake and Hungry Horse Reservoir. It would be necessary to treat a small segment of Graves Creek upstream of the lake to remove any hybrid fish that may have recolonized between the treatments of Black and Blackfoot lakes. To achieve this objective, antimycin would be applied to approximately 1 mile of Graves Creek upstream of Handkerchief Lake. Antimycin would then be applied to the lake at the prescribed rate of 7-8 ppb. The elevation differential between Handkerchief Lake and Hungry Horse Reservoir is approximately 275 feet. The ability of antimycin to detoxify with every 200 feet of stream elevation drop, due to interaction with the stream bottom, oxidation, and exposure to sunlight, makes this the safest method to remove hybrid trout from the lake and stream while safeguarding the bull trout that may be residing in Graves Creek Bay of Hungry Horse Reservoir. All trout populations in the Graves Creek drainage have been identified as a threat to the genetically pure fish in Hungry Horse Reservoir.

There are three detoxification measures that would be used during the proposed treatment of Handkerchief Lake. Caged fish placed in Graves Creek near the mouth would allow the monitoring of the toxicity of water to fish. First, elevation calculations indicate that antimycin would be detoxified before it reaches Hungry Horse Reservoir. However, to measure this, the caged fish would be placed at intervals in Graves Creek downstream of the lake: one at the lake outlet, one at the mouth of the creek, and one at an intermediate location between the two.

Second, dilution by freshwater would also be used to aid in detoxification. In September 2002, Graves Creek above Handkerchief Lake was gauged and measured at 3.3 cfs, and below the lake it was measured at 7.2 cfs. In September 2002, discharge from Jones and Aeneas creeks was measured at 8.9 cfs, and Graves Creek downstream of Handkerchief Lake was measured at 7.2 cfs. Any antimycin treated water leaving Handkerchief Lake would be diluted by these freshwater inputs by nearly 61 percent.

Finally, detoxification stations would be installed and monitored at predetermined locations downstream. This would help safeguard any bull trout in the Graves Creek Bay of Hungry Horse Reservoir. On-site bioassays and current flow measurements would be used to determine the level of natural detoxification available at the time of treatment and the location and amount of detoxification necessary.

The removal of fish from Handkerchief Lake would require the application of 159 units (596 pounds) of antimycin administered at 7-8 ppb; an additional small amount of antimycin would be needed to treat associated stream segments. The antimycin and all related equipment would be transported to the lake by truck. Approximately five people would be needed to treat the lake. Prior to the proposed treatment, monitors would set up fish cages and detoxification stations on Graves Creek upstream and downstream of the lake. After treatment, two people would stay at the lake and monitor the treatment. The following day, the dead fish would be collected from the shoreline, taken to deeper water, and then sunk. Thereafter, the remaining equipment would be removed. Detoxification stations and caged fish would be monitored, and removed only after the caged fish survived for 24 hours after treatment. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days and would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate Handkerchief Lake receives an estimated 702 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery. Stocking would begin in June and July following the treatment, and continue annually as needed to maintain the fishery. Multiple year classes of westslope cutthroat trout, including catchable sizes, would be stocked in the lake to restore the fishery as quickly as possible. MFWP records indicate that 711,000 grayling have been stocked over 14 separate occasions between 1954 and 1998 in Handkerchief Lake. Despite this fact, grayling rarely occur in Hungry Horse Reservoir gill net surveys, and appear to be relatively inert in the fish community. Arctic grayling do not hybridize with or appear to compete for resources with any other game fish in the South Fork Flathead drainage. Semi-annual snorkel surveys on the South Fork Flathead River have failed to observe grayling in the river. Based on this information, MFWP would continue stocking arctic grayling in Handkerchief Lake to maintain the quality fishery. The stream above and below the lake would also be stocked to establish a population as quickly as possible. The risk of reinvasion of Handkerchief Lake by downstream fish would be reduced by the fact that the source fish from adjacent tributaries would be removed during the treatment of the lakes in their headwaters. Also, the large waterfall at the mouth of Graves Creek prevents any upstream movement from Hungry Horse Reservoir fish.

Koessler Lake

Koessler Lake is a 86.5-acre lake located in the Bob Marshall Wilderness at 6,010 feet above sea level. The maximum lake depth is 173 feet and lake volume is 5,731 acre-feet (figure C-6). The main surface water inputs to the lake include two streams on the southwest shore. The lake has a submerged island near the southeast corner that is visible from the air. The outlet stream from Koessler Lake is unnamed and flows for 0.93 mile before reaching the confluence with Doctor Creek. The stream gradient in this short reach is 11.5 percent. From this point, Doctor Creek flows for 1.62 miles to its confluence with Gordon Creek. Gordon Creek then continues for 1.06 mile to the confluence with George Creek. There is a suspected barrier waterfall on Gordon Creek immediately above its confluence with George Creek. This is the furthest known upstream distribution of bull trout in Gordon Creek that migrate from the South Fork Flathead River. MFWP file data document the presence of bull trout in Doctor Lake. It is believed that Doctor Creek below the lake also provides habitat for this disjunct population of bull trout. The section of Doctor Creek between the Koessler Creek confluence and the mouth of Doctor Creek was electrofished in 2000 (Rumsey and Cavigli) and again in 2002 (Grisak 2003a).

In 2000, a single juvenile bull trout was captured during electrofishing for 1.2 hours. In 2002, four sites were electrofished for a total of 1.1 hours and two juvenile bull trout were captured and a third was observed but not captured. The distance from Koessler Lake to the suspected habitat of Doctor Creek bull trout is 0.93 mile.

Access to Koessler Lake is made by traveling 15 miles on trails 35 and 291 beginning at Owl Creek trailhead.

The management objective for this lake is to remove the hybrid trout from the lake. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. The elevation differential between Koessler Lake and Doctor Creek is approximately 580 feet, which allows the antimycin to be detoxified by an elevation drop nearly three times over before it reaches Doctor Creek. Forest Service trail 291 crosses the Koessler Lake outflow stream near its mouth.

Given the proximity of bull trout in the Doctor Creek, caged fish and detoxification stations would be installed at pre-determined intervals to adequately contain the treatment. There would be no supplemental antimycin drip stations placed on this stream. Fresh water input from Doctor Creek would further dilute the antimycin. Up to date flow measurements and on-site bioassays would be used to determine the level of dilution and stream flow time.

In August 2002, discharge of Koessler Creek was measured near its mouth at 5.13 cfs. At the same time, Doctor Creek was measured just above this confluence at 3.76 cfs. Based on these measurements, water leaving Koessler Lake would be diluted by water from Doctor Creek by 64 percent in volume.

Transporting the 1,146 units (4,298 pounds) of antimycin needed to treat the lake would require approximately 25 mule loads. This could be conducted using approximately four, six animal strings in 1 week. An attended camp would be set at Koessler Lake to store the materials. The additional materials, rafts, motors, and camp would require approximately five mule loads.

Outboard motors would be required to administer the antimycin in a timely manner and to mix the compound with lake water. Pumps would be used to distribute the compound at deeper depths. The time required to pack all materials and equipment to the site would be about 10 days. Thereafter, approximately one day would be required for treatment and two for clean up, with departure on the fourth day. Monitoring, detoxification, and cleanup of the stream would require approximately five days and would overlap much of the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived 24 hours after treatment.

Koessler Lake would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. Restocking genetically pure westslope cutthroat trout would maintain angling opportunity at Koessler Lake, provide a source of pure fish to repopulate areas downstream, genetically dilute any possible remaining hybrids, and reduce the potential for an illegal fish introduction. Maintenance stocking would continue in Koessler Lake to maintain population viability and angling quality. Stocking would occur the July following the treatment and consist of 8,500 fish each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish is unlikely due to the steep gradient of the stream below the lake. During a survey of Koessler Lake in 2002, much of the outlet features were obscured by a catastrophic avalanche near the lake outlet.

Lena Lake

Lena Lake is a 74.2-acre lake located in the Bob Marshall Wilderness at 6,732 feet above sea level. The maximum lake depth is measured at 80 feet and lake volume is 2,547 acre-feet (figure C-7). The main surface water inputs to the lake include an ephemeral stream on the southern shore, which presumably receives water from an unnamed basin located 0.4 mile to the south, and a few seeps along the east and west shores. The water flowing out of Lena Lake forms Big Salmon Creek, which flows for 1.79 miles to the confluence with Feline Creek, which enters from the southwest. Big Salmon Creek continues for 1.57 miles to Pendant Creek, which enters from the west, then for 0.92 mile to a barrier waterfall. This waterfall is directly above the Smokey Creek confluence. The Smokey Creek confluence with Big Salmon Creek is 0.17 mile upstream of the Cataract Creek confluence. Big Salmon Creek flows for 1.6 miles where it meets Dart Creek from the west, then continues for 1.9 miles before meeting the confluence with Tango Creek from the northwest. It continues for 0.21 mile before meeting the confluence with Gyp Creek from the south, then for 1.1 mile before meeting the barrier falls. This barrier falls is the uppermost known distribution of bull trout in the Big Salmon drainage. Total distance from Lena Lake to the barrier falls is 9.26 miles.

Access to the Lena Lake is made by a 16.2 mile long trail that begins at the Owl Creek trailhead.

The management objective for this lake is to remove the hybrid trout from the lake and from the 4.25 miles of Big Salmon Creek between Lena Lake and the Cataract Creek confluence. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. The elevation differential between Lena Lake and the mouth of Cataract Creek is approximately 1,292 feet, thus requiring the installation or approximately five caged fish stations and five recharge stations to monitor the proposed treatment and to maintain lethality of the antimycin through this reach of stream. Forest Service trails 212 and 225 parallel much of the upper Big Salmon Creek making installation of drip stations and caged fish easier.

For this project, the mouth of Cataract Creek is the lower boundary of the treatment area. This location is 4.8 miles upstream of the barrier falls on Big Salmon Creek, which is the uppermost known distribution of bull trout in the drainage. The elevation differential from the mouth of Cataract Creek to the Barrier Falls is approximately 950 feet, which is 4.75 times more than is required to detoxify the antimycin. Furthermore, fresh water input from Cataract, Dart, Tango, and Gyp creeks would further dilute the antimycin. As a safeguard measure, caged fish and detoxification stations would be placed in Big Salmon Creek near the Cataract confluence, and near the Dart Creek confluence.

In July 2002, discharge of Big Salmon Creek was measured at three locations; at the outlet of Lena Lake it was 1.36 cfs, at Pendant Cabin it was 5.48 cfs, and near the confluence with Cataract Creek it was 16.56 cfs. Cataract Creek was gauged at 22.1 cfs. Based on theses measurements, antimycin treated water leaving Lena Lake would be diluted at this point by 80 percent in volume. Up to date flow measurements and on-site bioassays would be used to determine dilution and flow time.

Transportation of materials, equipment, and personnel would be accomplished using livestock. Motorized rafts would be used to administer the antimycin. The 507 units (1,900 pounds) of antimycin needed to treat the lake and creek would require 11 mule loads. An additional small amount of antimycin would be required to treat associated stream segments. An attended camp would be set at Lena Lake to store materials. An additional four mules would be required to transport the drip stations, rafts, motors, and sprayers. Approximately five people would be needed to treat the lake, and approximately five to man drip stations, caged fish, and detoxification stations on the stream. Aside from the stock needed to transport antimycin, approximately 18 riding and pack animals would be needed to transport personnel, miscellaneous equipment, feed, and camp materials. The time required to pack materials to the site would be about six days. Thereafter, approximately one day would be needed for treatment and two days for clean up, with likely departure on the fourth day. The stream treatment, monitoring, and detoxification would require approximately five days, and would over-lap most of the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived for 24 hours after treatment.

Lena Lake and upper Big Salmon Creek would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate Lena Lake receives an estimated 165 angler days per year. Its annual statewide ranking is number 712 out of 1,529 fisheries in the state (table C-2). Restocking genetically pure westslope cutthroat trout would maintain angling opportunities at Lena Lake, provide a source of pure fish to repopulate areas downstream, genetically dilute any possible remaining rainbow or rainbow westslope hybrids, and reduce the potential for an illegal fish introduction. Maintenance stocking would continue in Lena Lake to maintain population viability and angling quality. Stocking would occur the July following the treatment with 7,400 fish each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish into Lena Lake is unknown based on present information regarding fish barriers on Big Salmon Creek. Because fish would be removed from the stream between Lena Lake and the Barrier Falls near the Smokey Creek confluence during treatment, the risk of reinvasion is low.

Lick Lake

Lick Lake is a 19-acre lake located in the Bob Marshall Wilderness at 5,984 feet above sea level. The maximum lake depth is 27 feet and lake volume is 141 acre feet (figure C-8). The main surface water inputs to the lake include one high gradient stream near the outlet on the northwest shore, and three ephemeral streams on the southern shore. The water in Lick Lake is high in glacial silt and often appears milky white in color with very little apparent light penetration. Fish have been observed spawning in the outlet.

Lick Creek flows out the lake for 0.71 mile to an unnamed tributary that enters from the north, then for 2.38 miles to the confluence with Gordon Creek. Gordon Creek flows for another 0.87 mile where it reaches the Doctor Creek confluence, then for 1.06 mile to the confluence with George Creek. There is a suspected barrier waterfall on Gordon Creek immediately above its confluence with George Creek. For bull trout that migrate from the South Fork Flathead River, this is the furthest known upstream distribution in Gordon Creek. MFWP file data document the presence of bull trout and mountain whitefish in Doctor Lake. It is believed that Doctor Creek below the lake also provides habitat for this disjunct population of bull trout. In 2000, Gordon Creek was electrofished upstream of the confluence with Doctor Creek for 0.4 hour, and no bull trout were observed (Rumsey and Cavigli 2000). On August 2002, Gordon Creek was electrofished for 1.42 hours upstream of the Doctor Creek confluence, and only two juvenile bull trout were discovered in the first 0.2 miles (Grisak 2003a). Two large rock waterfalls approximately 0.2 mile upstream of the confluence are believed to limit upstream distribution beyond this point. No bull trout were observed upstream of this point. The distance from Lick Lake to the uppermost distribution of bull trout is 3.6 miles.

There is no maintained trail to Lick Lake. Access to the lake is gained by cross country hiking off of trail 35 in section 4 just south of Gordon Pass.

The management objective for this lake is to remove the hybrid trout from the lake and from the 3.7 miles of stream between the lake and rock waterfalls near the Doctor Creek confluence (approximately 0.2 miles upstream of the Doctor Creek confluence). To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. The elevation differential between Lick Lake and the known bull trout population in Gordon Creek is approximately 704 feet, which would require installing approximately two recharge stations to maintain lethality of the antimycin.

For this project, the area directly upstream of the Doctor/Gordon Creek confluence is the lower boundary of the treatment area. The stream should be sufficiently detoxified by this point. Furthermore, fresh water input from one unnamed tributary to Lick Creek and Gordon Creek would be relied upon to further dilute the antimycin. As a safeguard measure, caged fish and detoxification stations would be placed in Gordon Creek upstream of the Doctor Creek confluence. Up to date flow measurements and on-site bioassays would determine the number and locations of detoxification stations and caged fish monitoring sites.

Because there is no trail to Lick Lake, materials, equipment, and personnel would be transported via helicopter. Motorized rafts would be used to administer the antimycin. The 28 units (105 pounds) of antimycin needed to treat the lake and creek would require one helicopter load to the site. An attended camp would be set at Lick Lake where materials would be stored. Three additional helicopter loads would be required to transport motors, sprayers, and equipment. Four people would be needed to treat the lake, and approximately three to monitor the drip stations, caged fish, and detoxification stations. Livestock would be used to deliver the materials needed for creek treatment, detoxification, and monitoring. The treatment would require one day for set up, approximately one day to administer treatment, and two days for cleanup, with departure on the fourth.

Personnel and equipment would be flown out from the site when cleanup is finished. Treatment, monitoring, detoxification, and cleanup of the stream would require approximately five days and would overlap most of the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived for 24 hours after treatment.

Lick Lake and the downstream section would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate Lick Lake receives an estimated 88 angler days per year, but this number seems high given the remote nature of the lake. Empirical information gathered from mountain goat hunters indicates that the lake does get fished. However, based on these figures, its annual statewide ranking is number 983 out of 1,529 fisheries in the state (table C-1). Restocking genetically pure westslope cutthroat trout would maintain angling opportunities at Lick Lake, provide a source of pure fish to repopulate downstream areas, genetically dilute any possible remaining hybrid fish, and reduce the potential for an illegal fish introduction. Maintenance stocking would continue in Lick Lake on an as needed basis. Stocking would occur the July following the treatment with 1,900 fish and continue for two years in order to establish a population. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. It is possible that Lick Lake could be managed as a wild fishery that would require little to no maintenance stocking.

In 2002, MFWP personnel hiked downstream from Lick Lake to the Gordon creek/Doctor Creek confluence. Several large rock waterfalls observed in this reach of stream suggests that risk of reinvasion by downstream fish into lick Lake is very low. Furthermore, the fact that downstream fish would be removed during the proposed treatment makes this risk low.

Lower Big Hawk Lake

Lower Big Hawk Lake is a 27.3-acre lake located in the Jewel Basin Hiking Area at 5,990 feet above sea level and is in a headwater tributary basin to Jones Creek. The lake has a maximum depth of 39 feet and has a volume of 612 acre-feet (figure C-9). The outlet stream flows from the lake for 0.5 mile then joins with the other headwater fork to Jones Creek (Pilgrim Lake effluent). Jones Creek flows for another 2.09 miles before entering Aeneas Creek. Aeneas Creek flows for 0.38 mile where it meets with Graves Creek. Graves Creek flows for an additional 0.79 mile to the barrier waterfall at its mouth. Aeneas, Jones, and Graves Creeks are all isolated from upstream movement by Hungry Horse Reservoir fish by a barrier waterfall at the mouth of Graves Creek. Distance from Lower Big Hawk Lake to the fish barrier at the mouth of Graves Creek is 3.76 miles.

Access to Big Hawk Lake is gained by a 5.6-mile long trail network that starts at Forest Road 895 in the Wheeler Creek Drainage.

The management objective for this lake is to remove the hybrid trout from the lake and from the 2.97 miles of stream between the lake and the Graves Creek confluence.

Rotenone treated water would be allowed to flow downstream to remove any fish that may have escaped the Pilgrim Lake treatment. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. Up-to-date flow measurements and on-site bioassays would be used to determine the number and location of drip stations, detoxification stations, and caged fish monitoring sites.

In September 2002, surface water leaving the lake was gauged and measured to be 0.39 cfs. At the same time Aeneas Creek was gauged at 5.5 cfs, Jones Creek was gauged at 3.4 cfs, and Graves Creek was gauged at 7.2 cfs. Based on these measurements, the rotenone concentration in Graves Creek, downstream of the Aeneas Creek confluence, would be diluted by approximately 98 percent (0.02 ppm).

The removal of fish from Big Hawk Lake would require the introduction of approximately 204 gallons (1,999 pounds) of rotenone administered at 1 ppm. An additional small amount of rotenone would be needed to treat associated stream segments.

The rotenone would be transported to the lake by helicopter in three loads. Two flights would be required to transport a raft, motor, sprayers, and drip stations. Approximately five people would be needed to treat the lake, requiring two transport flights.

Lower Big Hawk Lake is shaped like a large figure “8.” The raft used for treatment would have to be walked through the narrow channel separating the two lobes in order to apply the last half of the rotenone after the first half is applied to the upper lobe.

Prior to the proposed treatment, monitors would set up fish cages, drip stations, and detoxification stations on Aeneas, Jones, and Graves Creeks to implement and monitor stream treatment. After the treatment, three people would be flown out from the lake with most of the equipment. Two people would stay and monitor treatment at the site. The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) would be removed. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived for 24 hours after treatment. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days and would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate Lower Big Hawk Lake receives an estimated 60 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery to maintain the fishery. Beginning in July following the treatment, 2,700 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The stream below the lake would also be stocked to establish a population as quickly as possible. The risk of reinvasion from downstream fish is low to non-existent due to the high gradient of the outflow stream and the fact that downstream fish would be removed during treatment.

Lower Three Eagles Lake

Lower Three Eagles Lake is a 8.7-acre lake located in the Jewel Basin Hiking Area at 5,705 feet above sea level, and is in a headwater tributary basin of Aeneas Creek. The lake has a maximum depth of 84 feet and a volume of 255 acre-feet (figure C-10). The outlet stream flows from the lake for 1.12 mile before entering Aeneas Creek. Aeneas Creek then flows for 0.73 mile before meeting with Jones Creek; it then continues for

0.38 mile where it meets with Graves Creek. Graves Creek flows for an additional 0.79 mile to the barrier waterfall at its mouth. Aeneas, Jones, and Graves creeks are all isolated from upstream movement by Hungry Horse Reservoir fish by a barrier waterfall at the mouth of Graves Creek. Distance from the Three Eagles Lake complex to the fish barrier at the mouth of Graves Creek is 3.02 miles.

There is no known trail access to Lower Three Eagles Lake. The fish population has never been genetically tested. However, MFWP records indicate Lower Three Eagles Lake was stocked once in 1967 with generic cutthroat trout. Follow-up genetic surveys on other lakes stocked with generic cutthroat trout have revealed the stock was largely comprised of Yellowstone cutthroat genes. In addition, the populations upstream and downstream have been tested and found to contain hybrid trout. Based on the fact that Lower Three Eagles Lake is surrounded, both upstream and downstream, by hybrid trout, it is assumed that fish from the upper lake have entered it, or, at least, have had the opportunity to enter it. It would be difficult, if not impossible, to treat the upper lake and the lower stream without treating Lower Three Eagles Lake. For this reason, Lower Three Eagles Lake would be treated to remove any threat of hybrid trout remaining.

The management objective for this lake is to remove the hybrid trout from the lake and from the 2.23 miles of stream down to the confluence with Graves Creek. To achieve this objective, rotenone applied during the treatment of the upper lake would be allowed to enter the lower lake. Water leaving the lower lake would be allowed to flow downstream in an effort to remove as many hybrid trout from downstream as possible. Drip stations, caged fish, and detoxification stations would be placed in the stream at predetermined intervals. Caged fish would be placed in Jones Creek near its mouth and in Graves Creek near the Aeneas-Graves confluence to monitor treatment. Potassium permanganate would be used to detoxify the rotenone. This would safeguard any bull trout in the Graves Creek bay of Hungry Horse Reservoir. Up-to-date flow measurements and on-site bioassays would determine the location and amount of detoxification.

In September 2002, water leaving Lower Three Eagles Lake was gauged at 0.15 cfs, Aeneas Creek was gauged at 5.5 cfs, Jones Creek 3.4 cfs, and Graves Creek was gauged at 7.2 cfs. Based on these measurements, the rotenone concentration in Aeneas Creek would be 0.02 ppm. This represents a 98 percent reduction in concentration. In addition, water from Aeneas Creek would be further diluted by water from Graves Creek by approximately 40 percent.

The removal of fish from Lower Three Eagles Lake would require the introduction of approximately 85 gallons (816 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed for use on associated stream segments.

Rotenone would be transported to the lake by helicopter in one load. Two flights would be required to transport a raft, motor, sprayers, and drip stations. Approximately four people would be needed to treat the lake, requiring two transport flights. This lake would be treated simultaneously with Upper Three Eagles Lake. Before beginning the proposed treatment, monitors would set up drip stations, detoxification stations, and fish cages at designated locations in Jones Creek, and also in Graves Creek just below the confluence of Aeneas Creek to evaluate detoxification. This site is located approximately 385 feet downstream of forest road 9797 crossing and would be accessed by foot. Monitors at these sites would operate potassium permanganate detoxification stations. After treatment, two people would be flown out with most of the equipment, while two stay to monitor the treatment.

The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) would be removed. Detoxification stations, and caged fish stations would be monitored, and removed only after caged fish survived for 48 hours after treatment. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days and would be conducted during most of the lake treatment.

Lower Three Eagles Lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery. Beginning in July following treatment, 900 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The stream below the lake would also be stocked to establish a population as quickly as possible. The risk of reinvasion from downstream fish into this lake is low due to the high gradient of the stream and the fact that downstream fish would be removed during treatment.

Margaret Lake

Margaret Lake is a 46.5-acre lake located on the Flathead National Forest at 5,575 feet above sea level and forms the headwaters of Forest Creek. The lake has a maximum depth of 79 feet and a total volume of 1,962 acre-feet (figure C-11). Small ephemeral streams and spring seeps provide most of the surface water inflow to Margaret Lake. Forest Creek flows out of Margaret Lake and continues for 3.9 miles before it enters Hungry Horse Reservoir. Approximately 0.9 mile up from the mouth of Forest Creek, there is a culvert located on Forest Road 895 that is believed to be a barrier that prevents fish from moving upstream. Total distance from this crossing to Margaret Lake is 3 miles. There are three unnamed tributaries that enter Forest Creek between Margaret Lake and its mouth.

Access to Margaret Lake is made by a 1.3 mile long trail that continues off Forest Road 895E in the Forest Creek drainage.

The management objective for this lake is to remove the hybrid trout from the lake and from the 3 miles of stream between the lake and the forest road 895 crossing. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. Up-to-date flow measurements and on-site assays would determine the number and location of drip stations, detoxification stations, and caged fish monitoring stations necessary for successful stream treatment.

In October 2002, Forest Creek was gauged at the forest road 895 crossing and measured to be 2.9 cfs. At the same time, Margaret Lake was surveyed and outflow was estimated to be <1cfs. From the air, Forest Creek was observed to flow subsurface for approximately 100 yards at a site 1/3 mile below the lake outlet. Based on these observations and measurements, rotenone would be expected to detoxify during subterranean stream flow through natural binding processes. If the stream flowed subsurface, a drip station would be installed at the point where the stream resurfaced in order to continue stream treatment. If surface water was flowing continually, freshwater inputs from the two unnamed tributaries in Forest Creek should dilute the rotenone concentration to approximately 0.34 ppm. This represents a 66 percent reduction in concentration.

Removal of fish from Margaret Lake would require the application of 654 gallons (6,409 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed to treat associated stream segments. Rotenone would be transported to the lake by SEAT in two, 250-gallon loads; a helicopter would transport the remaining 154 gallons in two loads. Two flights would be required to transport rafts, motors, sprayers, and drip stations. Six people would be needed to treat the lake. They would be transported using two flights.

Margaret Lake was surveyed by air in August and November 2002 to plan rotenone application using SEAT. The SEAT pilot indicated that the best approach to Margaret Lake would be from the southwest corner. The plane would approach and make its descent toward the lake, make a slight bank to the east, dispense its load, then continue easterly down Forest Creek. The pilot recommended that two separate loads of 250 gallons each be administered to maximize aircraft performance. After administration of the first load, the plane would return to Glacier International Airport to be loaded with the remaining 250 gallons. It would then return to the lake to apply the final load.

Prior to the proposed treatment, monitors would set up drip stations, detoxification stations, and fish cages at predetermined locations on Forest Creek to implement, monitor, and contain treatment. After treatment, four people would be flown out with most of the equipment. Two people would stay at the site to monitor treatment. The following day, the dead fish would be collected from the shoreline, taken to deeper water, and sunk. Thereafter, the remaining equipment, drip station, sprayers, raft and motor would be removed. Detoxification stations and caged fish stations would be monitored throughout the duration of the treatment and removed only after caged fish survived for 24 hours following treatment. Stream treatment, monitoring, detoxification, and cleanup are expected to take about five days and would be conducted during most of the lake treatment.

Margaret Lake and segments of Forest Creek would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery. Beginning in July following the treatment, 4,700 fish, of which approximately 1,000 would be of catchable size, would be stocked in each of the first two years to restore the fishery and stream populations as quickly as possible. The lake's fish population would be evaluated on year five post treatment to determine population viability and future stocking needs.

The risk of reinvasion by downstream fish into the lake is low to non-existent due to the steep gradient of the stream and the fact that downstream fish would be removed during the treatment.

Necklace Lakes

The Necklace chain of lakes is also known as the Smokey Creek Lakes. This complex consists of approximately 15 water basins; however, the majority of surface water is contained in only eleven of the water basins. The four largest lakes contain the majority of the hybrid fish population (figures C-12 – C-23). Although there are 15 lakes in the complex, the Necklace Lakes have been referred to as having 4 main basins. Prior to 2002, two of the 11 lakes, numbers 3 and 10 (identified from Figure B13), were believed to drain into the Smokey Creek drainage; however, a survey in 2002 revealed that the two lakes actually flow into the Cataract Creek drainage. The other nine lakes, and any connected basins, are targeted for this project.

The Necklace lakes are located in the Bob Marshall Wilderness at approximately 6,480 feet above sea level and form the headwaters of Smokey Creek. Total surface acreage of the nine largest lakes (numbers 1, 2, 4, 5, 6, 7, 8, 9, 11) is 42.8 acres. Total volume of these nine lakes is approximately 324 acre-feet; maximum depth of the deepest lake is 28.5 feet (Figures C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23).

Smokey Creek flows out of the Lower Necklace Lake and continues 1.94 miles down to the confluence of Big Salmon Creek. The Smokey Creek confluence with Big Salmon Creek is 0.17 mile upstream of the Cataract Creek confluence. Big Salmon Creek flows for 1.6 miles where it meets Dart Creek from the west, then continues for 1.9 miles before meeting the confluence with Tango Creek from the northwest. It continues for 0.21 mile before meeting Gyp Creek from the south, then for 1.1 mile before meeting the barrier falls. This barrier falls is the uppermost known distribution of bull trout in the Big Salmon drainage. Total distance from Necklace lakes to the barrier falls is 6.92 miles.

Access to the Necklace lakes is made by an 8.7-mile long trail that begins at the Owl Creek trailhead.

The management objective for this lake complex is to remove the hybrid trout from the lakes, from the stream segments between the lakes, and from the 2.1 miles of stream between lower Necklace Lake and the Cataract/Big Salmon Creek confluence. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material, making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier.

The elevation differential between Necklace lakes and the mouth of Smokey Creek is approximately 1080 feet, which would require the installation of approximately five sentinel fish cages and recharge stations to monitor treatment and maintain the antimycin lethality through this reach of streams. Forest Service trail 110 parallels much of Necklace lakes and Smokey Creek making installation of recharge drip stations easier.

For this project, the confluence of Cataract and Big Salmon creeks is the lower boundary of the treatment area. This location is 4.8 miles upstream of the barrier falls on Big Salmon Creek, which is the uppermost known distribution of bull trout in the drainage. The elevation differential from the mouth of Cataract Creek to the Barrier Falls is approximately 950 feet, which is five times greater than is required to detoxify the antimycin. Fresh water input from Big Salmon, Cataract, Dart, Tango, and Gyp creeks would further dilute the antimycin. As a safeguard measure, caged fish and detoxification stations would be placed in Smokey Creek near the mouth, and in Big Salmon Creek near the Dart Creek confluence.

Based on stream gauging measurements of Big Salmon Creek in July of 2002, empirical calculations of the input of Smokey Creek indicate the stream was flowing slightly greater than 10 cfs. Based on theses estimates, antimycin treated water leaving Smokey Creek is expected to be diluted by Big Salmon Creek ($\pm$6 cfs) and Cataract Creek (22.1 cfs) by approximately 73 percent in volume. Up to date flow measurements and on-site bioassays would be used to determine if the amount of dilution and flow time is sufficient. Potassium permanganate detoxification stations would be installed to ensure containment within the treatment boundaries.

The 64 units (240 pounds) of antimycin required to treat the Necklace lakes complex and Smokey Creek would be transported with two mule loads. An additional small amount of antimycin would be needed to treat associated stream segments. Fourteen people would be required to conduct the treatment--eight for treatment of the lakes; and six to monitor drip stations, detoxification stations, and caged fish. These fourteen people would require one horse each. Transport of the four rafts with motors, sprayers, recharge stations, and camp supplies would require approximately nine mule loads. The treatment would consist of approximately four days--one for set up, one for treatment, and two for clean up and departure. The stream treatment, detoxification, monitoring, and cleanup would require approximately five days and would overlap much of the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived for 24 hours after treatment.

All of the necklace lakes and upper Smokey Creek would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate Necklace receives an average of 118 (46-189) angler days per year (table C-1). Its annual statewide ranking is number 869 out of 1,529 fisheries in the state. Restocking genetically pure westslope cutthroat trout in the lower lakes would maintain angling opportunities at Necklace lakes, provide a source of pure fish to repopulate downstream areas, genetically dilute any possible remaining rainbow or rainbow westslope hybrids, and reduce the potential for an illegal fish introduction.

Maintenance stocking would continue in the Necklace chain of lakes to maintain population viability and angling quality. Beginning in July following the treatment, 1,400 fish would be stocked each year for three years among lakes 1, 5, 6, 8, 11, and the upper portion of Smokey Creek. Fish populations would be evaluated on year five post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish into the Necklace lakes is unlikely due to the high gradient of the stream below the lakes and the removal of downstream fish during the treatment.

Pilgrim Lake

Pilgrim Lake is a 29.9-acre lake located in the Jewel Basin Hiking Area at 6,365 feet above sea level and is in a headwater tributary basin to Jones Creek. The lake has a maximum depth of 154 feet and has a volume of 2,528 acre-feet (figure C-24). The outlet stream flows from the lake for 0.8 mile before joining with the other headwater fork to Jones Creek (Big Hawk Lake effluent). Jones Creek flows for another 2.09 miles before entering Aeneas Creek. Aeneas Creek flows for 0.38 mile where it meets with Graves Creek. Graves Creek flows for an additional 0.79 mile to the barrier waterfall at its mouth. Aeneas, Jones, and Graves Creeks are all isolated from upstream movement by Hungry Horse Reservoir fish by a barrier waterfall at the mouth of Graves Creek. Distance from Pilgrim Lake to the fish barrier at the mouth of Graves Creek is 4.06 miles. Upper Pilgrim Lake was surveyed in 2001 and found to be fishless.

There is no known trail access to Pilgrim Lake.

The management objective for this lake is to remove the hybrid trout from the lake and from the 3.27 miles of stream between the lake and the Aeneas-Graves confluence. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. Rotenone-treated water leaving the lake would be allowed to flow downstream in an effort to remove as many hybrid trout from downstream as possible. Up to date flow measurements and on-site assays would determine the number and location of sentinel fish cages, drip stations, and detoxification stations.

In September 2002, Pilgrim Lake was surveyed and found to have no surface water flowing out of it. The outflow channel from Pilgrim Lake was dry to the point of the confluence with the Big Hawk Lake outflow stream. Under these circumstances, rotenone treated water flowing subterranean would likely be detoxified through natural binding processes. A rotenone drip station would be installed at the point where the stream resurfaced to remove fish from that point down to the Aeneas-Graves confluence.

Removal of fish from Pilgrim Lake would require the application of 842 gallons (8,252 pounds) of rotenone administered at 1 ppm; an additional small amount of rotenone would be needed to treat the associated stream segments. Five hundred gallons (4,900 pounds) would be transported to the lake in one trip by SEAT aircraft; the remaining 342 gallons (3,352 pounds) would be transported by helicopter in four loads. Two helicopter flights would be required to transport a raft, motor, sprayers, and drip stations. Approximately five people would be needed to treat the lake, requiring two transport flights by helicopter.

Prior to treatment, monitors would set up fish cages, drip stations, and detoxification stations at predetermined locations on Aeneas Creek downstream of Jones Creek, and on Graves Creek just below the confluence of Aeneas Creek. All personnel, equipment, and materials would be transported to the site prior to treatment to prepare for application by boat. Two people would prepare for treatment of freshwater inputs and seeps using sprayers and drip stations.

In August and November 2002, Pilgrim Lake was surveyed by air with a SEAT pilot who determined that the layout of Pilgrim Lake allows for four, 125 gallon drops of rotenone. An application plan using SEAT was developed based on terrain features of the site. Before dispensing rotenone, the SEAT would conduct two flyovers to confirm communication with ground personnel at the lake and to test weather conditions. Mach flyovers conducted in November 2002 with a Hughes 500 helicopter revealed that the best approach to Pilgrim Lake would be from the southwest corner. The plane would make its descent toward the lake, make a slight bank to the east, dispense its load, then continue easterly down Jones Creek drainage. The SEAT would circle back to the south of Big Hawk Lake, and approach from the southwest to continue dispensing. After the final drop, the SEAT would return to Glacier Airport.

Since rotenone appears milky white when it comes in contact with water, the SEAT pilot would be able to accurately judge where to drop subsequent loads in order to provide effective application coverage, applying each load adjacent to the prior load. After the first SEAT load is administered, the raft would begin mixing the rotenone, pumping it to deeper zones of the lake; the treatment of freshwater inputs would also begin.

After the SEAT made its initial application, treatment, and detoxification of stream segments would begin. When treatment was completed, three people would be flown out with most of the equipment. Two people would stay at the site and monitor the treatment. The following day, dead fish would be collected from the shoreline, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) and personnel would be removed. Caged fish stations, drip stations and detoxification stations would be monitored continually until treatment is completed, and removed only after caged fish survived 24 hours after treatment. It is expected that stream treatment, monitoring, detoxification, and cleanup would take about five days. These procedures would be conducted during most of the lake treatment.

MFWP angler use statistics from 1989 through 2001 indicate Pilgrim Lake receives an estimated 34 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery to maintain the fishery. Beginning in July following the proposed treatment, 3,000 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The stream below the lake would also be stocked to establish a population as quickly as possible. The risk of reinvasion by fish from downstream is nonexistent due to an approximately 300 feet long steep rock slab fish barrier located, at the outlet of the lake.

Pyramid Lake

Pyramid Lake is an 8.9-acre lake located in the Bob Marshall Wilderness at 6,927 feet above sea level. The maximum lake depth is 37 feet and lake volume is 191 acre-feet (figure C-25). The main surface water input to the lake is located on the southwest shore. Pyramid Creek flows out of the lake for 1.84 miles until it reaches the confluence with Young Creek. This section of stream is at 11 percent gradient and is reported to frequently go dry. Youngs Creek flows for 1.43 miles where it meets with Devine Creek, then 1.08 miles until it reaches Ross Creek, and another 1.69 miles until it reaches Jenny Creek. The area between Spruce and Jenny Creeks is the uppermost distribution of bull trout in the Young Creek drainage. The distance from this point to Pyramid Lake is approximately 5.2 miles.

Pyramid Lake can be accessed by a 2.7-mile long trail beginning at the Pyramid Pass trailhead.

The management objective for this lake is to remove the hybrid trout from the lake, from the small pond downstream of the lake, and from the 3.3 miles of stream between the lake and the Youngs/Devine Creek confluence. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier.

The stream that flows out of Pyramid Lake often runs dry in the fall of the year. If it is flowing, the stream down to Devine Creek would be treated; otherwise, the lower boundary of the project would be where the stream goes dry. The elevation differential between Pyramid Lake and Devine Creek confluence is approximately 1,242 feet, which, if the stream is flowing, would require the installation of approximately five recharge stations to maintain antimycin lethality in this section of stream. Forest Service trail 283 parallels upper Youngs Creek making access to the creek possible. Up to date flow measurements and on-site bioassays would be used to determine the number and location of drip stations, detoxification stations, and caged fish monitoring stations.

Bull trout occur in the Young's Creek drainage and their uppermost known distribution is between the Spruce Creek and Jenny Creek tributaries. The lower treatment boundary for Young's Creek is at the Devine Creek confluence, which is approximately 1.5 miles upstream of the uppermost know bull trout distribution. If Pyramid Creek is flowing and connected to Young's Creek, up-to-date flow measurements and on-site bioassays would be used to determine the number and location of drip stations, detoxification stations, and caged fish monitoring stations. Detoxification and caged fish monitoring stations would be used to safeguard downstream bull trout.

Transporting the estimated 38 units (143 pounds) of antimycin needed to treat the lake would require one mule load. An additional small amount of antimycin may be needed to treat associated stream segments. A camp would be set at Pyramid Lake to conduct the treatment. Approximately five people would be needed to treat the lake; and approximately six to proved stream treatment, detoxification, and caged fish monitoring. Transport of materials, rafts, motors, and camp would require approximately six mule loads. Outboard motors would be required to administer the antimycin in a timely manner and to mix the compound with lake water. Pumps would be used to distribute the compound at deeper depths. All personnel, equipment, and materials would be transported to the site prior to treatment. Thereafter, treatment would require approximately one day and cleanup two, with departure on the fourth. Stream treatment, detoxification, caged fish monitoring, and cleanup would require approximately five days, and would be conducted during the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after cage fish survived 24 hours after treatment.

Pyramid Lake and sections of the stream would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate that Pyramid Lake receives an estimated 57 (25-83) angler days per year. Its annual statewide ranking is number 1,175 out of 1,529 fisheries in the state. Restocking genetically pure westslope cutthroat would maintain angling opportunities at Pyramid Lake, provide a source of pure fish to repopulate downstream, genetically dilute any possible westslope x Yellowstone cutthroat and/or rainbow hybrids, and reduce the potential for an illegal fish introduction.

Maintenance stocking would continue at Pyramid Lake to maintain population viability and angling quality. Stocking would occur the July following the treatment, and would involve 1,000 fish each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish into Pyramid Lake is low due to the high gradient of the stream below the lake and the fact that the stream frequently flows underground.

Sunburst Lake

Sunburst Lake is a 148.5-acre lake located in the Bob Marshall Wilderness at 5,322 feet above sea level. The maximum depth of the lake is 221 feet and the lake volume is 12,687 acre feet (figure C-26). There are at least 10 surface water inputs to the lake including perennial streams, ephemeral streams, and freshwater seeps. These occur around the entire shoreline of the lake, but are more abundant on the south and west shores. Gorge Creek flows out of the lake for 1.53 miles where it meets the confluence with Inspiration Creek. The stream continues for 3.64 miles where it meets Stadium Creek, then it continues for 1.61 miles where it reaches Feather Creek, and, finally, another 0.76 mile where it reaches a barrier waterfall. Gorge Creek continues for 1.36 miles where it reaches the confluence of Bunker Creek. Bull trout use Bunker Creek as a spawning and rearing stream, but at very low levels. Total distance from Sunburst Lake to the barrier falls is 7.54 miles.

Sunburst Lake can be accessed by a 10.7-mile long trail beginning at the Napa Point trailhead. Although this is the closest access, poor trail conditions experienced during an inspection in 2002 indicate that the Inspiration Creek trail precludes use by large numbers of stock. Rather, access to the lake would best be gained by trail 218 starting at the Gorge Creek trailhead and traveling 10.9 miles up Gorge Creek drainage to the lake.

The management objective for this lake is to remove the hybrid trout from the lake and from the 6.1 miles of stream between the lake and the waterfall near Feather Creek. To achieve this objective, antimycin would be used because it is the quickest method for removal; it requires the least amount of material, making transport to a remote location easier; and it naturally detoxifies with every 200 feet of downstream elevation drop, which also makes containment easier. The elevation differential between Sunburst Lake and the waterfall near Feather Creek is approximately 1,875 feet, which would require the installation of approximately seven recharge stations to maintain lethality of the antimycin through this reach of stream. Forest Service trails 693 and 218 parallel Gorge Creek, which makes access easier.

For this project, the barrier waterfall near the mouth of Feather Creek is the lower boundary of the proposed treatment area. Up to date flow measurements and on-site bioassays would be used to determine the level of natural detoxification. As a safeguard measure, caged fish would be placed in Gorge Creek upstream of the waterfall near Feather Creek and, if natural detoxification were not effective, potassium permanganate would be administered at the rate of 1ppm to detoxify the antimycin.

The 2,537 units (9,513 pounds) of antimycin needed to treat Sunburst Lake and Gorge Creek would require 55 mule loads. This could be conducted using six pack strings over a two week period. An attended camp would be set at Sunburst Lake for storage of materials. There would be an additional small amount of antimycin needed to treat associated stream segments. Eight personnel would be required to treat the lake, another eight to treat the stream, and one to monitor the caged fish and set up a detoxification station if needed. All personnel would access the project site by horse. Eight additional mule loads would transport supplies, materials, four rafts, and motors. Boat motors would be used to distribute the compound near the surface, and pumps would be used to distribute the compound at deeper depths. The treatment of Sunburst Lake and Gorge Creek would be conducted in mid to late September to take advantage of warmer water temperature, thus facilitating an effective treatment. The proposed treatment of the lake and stream would be expected to take two days for set up, one day for application, and two days for cleanup and site departure. Stream treatment, detoxification, and cleanup is expected to take approximately five days and would overlap much of the lake project. Detoxification stations and caged fish would be monitored, and removed only after caged fish survived for 24 hours after treatment.

Sunburst Lake and Gorge Creek would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate Sunburst Lake receives an average of 96 (39-175) angler days per year. Its annual statewide ranking is number 965 out of 1,529 fisheries in the state (table C-1). Maintenance stocking would continue on Sunburst Lake to maintain population viability and angling quality. Stocking would occur the July following the treatment and continue for two more years. Approximately 14,800 fish, of which 1,000 would be of catchable size, would be stocked in each of the first two years to restore the fishery as quickly as possible. The stream below the lake would also be stocked to establish a population as quickly as possible. The fish population would be evaluated on year five post treatment to determine population viability and stocking needs. Reinvasion by downstream fish into Sunburst Lake is possible, but to what extent is unknown. Gorge Creek has several likely waterfall barriers that may prevent upstream movement of fish. The risk of reinvasion by downstream fish into Sunburst Lake is unlikely since fish in Gorge Creek would be removed during treatment down to the barrier near its mouth.

Upper Three Eagles Lake

Upper Three Eagles Lake is a 10.8-acre lake located in the Jewel Basin Hiking Area at 6,340 feet above sea level and is in a headwater tributary basin of Aeneas Creek. The lake has a maximum depth of 72 feet and has a volume of 487 acre-feet (figure C-27). The outlet stream flows from the lake for 0.28 mile before entering Lower Three Eagles Lake.

There is no known trail access to Upper Three Eagles Lake.

The management objective for this lake is to remove the hybrid trout population from it and its effluent stream. To achieve this objective, rotenone would be applied to the lake at the prescribed rate of 1 ppm. Water leaving the lake would be allowed to flow downstream in an effort to remove hybrid trout from the intermediate section of stream between the upper and lower lakes. Given the proximity of the two lakes, treating the lower lake would be mandatory during the treatment of the upper lake.

Removal of fish from Upper Three Eagles Lake would require the application of 162 gallons (1,588 pounds) of rotenone administered at 1 ppm. The rotenone would be transported to the lake by helicopter in two loads. Two flights would be required to transport a raft, motor, sprayers, and drip stations. Approximately four people would be needed to treat the lake, requiring two additional transport flights. This lake would be treated simultaneously with Lower Three Eagles Lake.

The lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery. Beginning in July following the treatment, 900 fish would be stocked each year for three years. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The stream below the lake would also be stocked to establish a population as quickly as possible. Due to the steep gradient and removal of fish from this section of the stream, there is little risk of reinvasion by downstream fish into the lake.

Wildcat Lake

Wildcat Lake is a 40-acre lake located in the Jewel Basin Hiking Area at 5,810 feet above sea level that forms the headwaters of Wildcat Creek. The lake has a maximum depth of 112 feet and a total volume of 2,066 acre-feet (figure C-28). The two main surface water inputs to the lake include one perennial stream in the southeast corner and another ephemeral stream in the southwest corner of the lake. The steep gradient of both streams precludes them from harboring a viable population of fish. Fish have been observed spawning at the outlet of the lake on small angular rock.

Wildcat Creek flows out of the lake for approximately 35 feet where it flows over a 25-foot waterfall. The stream flows for another 0.09 mile where it enters a small in-stream pond located on a bench below Wildcat Lake. The stream flows for another 3.37 miles where it encounters another barrier waterfall. Total distance from this waterfall to Wildcat Lake is 3.46 miles. Wildcat Creek continues for 0.02 mile to its confluence with Wounded Buck Creek.

Access to Wildcat Creek is made by a 4.3-mile long trail network that starts at the Camp Misery trailhead.

The management objective for Wildcat Lake is to remove the hybrid trout population from the lake, from the unnamed pond directly downstream, and from about 1 mile of stream below the unnamed lake. To achieve this objective, antimycin would be used because it naturally detoxifies in a stream with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. In addition, since the elevation differential between Wildcat Lake and the waterfall near the mouth of Wildcat Creek is approximately 1,770 feet, the detoxification of the stream would be approximately seven times greater than necessary.

Some fish in the stream below the lakes would be killed during the treatment and natural detoxification process. Drip stations, sentinel fish cages, and detoxification stations would be placed in the stream to treat, monitor, and detoxify the stream at designated locations. Up to date flow measurements and on-site assays would be used to determine the location of these stations.

Detoxification stations and sentinel fish cages would be used to monitor Wounded Buck Creek near the Wildcat Creek confluence as a safeguard measure for any bull trout that may be residing in Wounded Buck Creek.

Removal of fish from Wildcat Lake would require the application of 404 units (1,515 pounds) of antimycin administered at 7-8 ppb; an additional small amount of antimycin would be needed to treat associated stream segments. This would be transported to the lake by helicopter in two loads. Two flights would be required to transport rafts, motors, sprayers, and drip stations. Six people would be needed to treat the lake, and two additional personnel for treatment of the small pond downstream. The transport of personnel would require three flights.

Prior to the proposed treatment, monitors would set up drip stations, sentinel fish cages, and detoxification stations on Wildcat Creek and Wounded Buck Creek downstream from the Wildcat/Wounded Buck confluence in order to evaluate treatment and detoxification measures. After treatment, six people would be flown out with most of the equipment. Two people would remain at the lakes to monitor the treatment. The following day, dead fish would be collected from the shoreline of the lake and the small pond downstream, taken to deeper water, then sunk. Thereafter, the remaining equipment (drip station, sprayers, raft and motor) would be removed from the lake. Detoxification stations and caged fish would be monitored, and removed only after sentinel fish survived for 48 hours after treatment. It can be expected that the proposed stream treatment, monitoring, detoxification, and cleanup would take about five days, and would be conducted during most of the lake treatment.

In August 2002, the outflow stream of Wildcat Lake was gauged and measured to be 2.12 cfs. In September 2002, Wildcat Creek was gauged at its mouth and measured to be 8.2 cfs. At the same time, Wounded Buck Creek was gauged above its confluence with Wildcat Creek and found to be 14.4 cfs. Based on these measurements, antimycin treated water leaving Wildcat Lake would be diluted to a concentration of 0.75 ppb shortly after entering Wounded Buck Creek. This represents a reduction in concentration by approximately 87 percent.

MFWP angler use statistics from 1989 through 2001 indicate Wildcat Lake receives and estimated 112 angler days per year (table C-1). Based on this information, the lake would be restocked with genetically pure westslope cutthroat trout from the Washoe Park State Fish Hatchery to maintain the fishery. Stocking would occur the July following the treatment and continue for two more years. Beginning in July following the treatment, 3,900 fish, of which 700 would be of catchable size, would be stocked in each of the first two years to restore the fishery as quickly as possible. The stream below the lake would also be stocked to establish a population as quickly as possible. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. There is no risk of reinvasion of downstream fish in Wildcat Lake and the pond due to the high gradient stream and numerous waterfalls that prevent fish from moving upstream.

Woodward Lake

Woodward Lake is a 65-acre lake located in the Bob Marshall Wilderness at 6,433 feet above sea level. The lake is located 0.9 mile downstream of Rubble Lake (fishless) and forms the headwaters of Cataract Creek. The maximum lake depth is 119 feet and total volume is 2,255 acre feet (figure C-29). The main surface water inputs to the lake include seeps along the northwest shore from upland snowfields, ephemeral streams on the west and north shores, and several seeps on the south shore. Four of the water basins in the Necklace Lakes chain drain into Woodward Lake. Surveys in July 2002 revealed that these basins are fishless and their outlet streams flowed subsurface shortly after leaving the Necklace plateau. Cataract Creek flows out of the lake, then for 0.7 mile where Terrace Creek joins it from the north. It flows for another 2.26 miles before meeting the confluence with Big Salmon Creek. Big Salmon Creek flows for 1.6 miles where it meets Dart Creek from the west, then continues for 1.9 miles before meeting the confluence with Tango Creek from the northwest. It continues for 0.21 mile before meeting Gyp Creek from the south, then for 1.1 mile before meeting the barrier falls. This barrier falls is the uppermost known distribution of bull trout in the Big Salmon drainage. Total distance from Woodward Lake to the barrier falls is 7.73 miles. Big Salmon Creek continues for 4.84 miles until it reaches Big Salmon Lake.

Access to Woodward Lake is made by a 9.5-mile long trail that begins at the Owl Creek trailhead. Cataract Creek is the outflow stream from Woodward Lake. The management objective for this lake is to remove the hybrid trout from the lake and from the 2.96 miles of stream between Woodward Lake and the Cataract/Big Salmon Creek confluence. To achieve this objective, antimycin would be used because it is the quickest method for fish removal; it requires the least amount of material making transport to a remote location easier; and it naturally detoxifies with contact with the stream bottom (approximately every 200 feet of downstream elevation drop), making containment easier. The elevation differential between Woodward Lake and the mouth of Cataract Creek is approximately 993 feet; in order to maintain antimycin lethality would require the installation of approximately four recharge stations and a number of sentinel fish cages to monitor treatment through this reach of stream.

For this project, the mouth of Cataract Creek is the lower boundary of the treatment area. This is 4.81 miles upstream of the barrier falls on Big Salmon Creek, which is the uppermost known distribution of bull trout in the drainage. The elevation differential from the mouth of Cataract Creek to the Barrier Falls is approximately 950 feet which is 4.75 times greater than is required to detoxify antimycin at the proposed treatment levels. In addition, fresh water input from Big Salmon, Dart, Tango, and Gyp creeks would be relied upon to dilute the antimycin. As a safeguard measure, detoxification stations and caged fish would be placed in Cataract Creek near the mouth and in Big Salmon Creek near the confluence of Dart Creek. If natural detoxification were not effective, potassium permanganate would be administered at the rate of 1ppm to detoxify the antimycin.

Cataract Creek was gauged in July 2002 near its mouth and discharge was measured to be 22.1 cfs. Big Salmon Creek was gauged near this confluence and found to be 16.6 cfs. Based on these measurements, dilution of Cataract Creek by Big Salmon Creek is expected to be at least 43 percent in volume. Up to date flow measurements and on-site bioassays would be used to determine the number and spacing of drip stations, detoxification stations, and caged sentinel fish.

The 451 units of antimycin (1,691 pounds) needed to treat Woodward Lake and Cataract Creek would require approximately 10 mule loads. An additional small amount of antimycin would be needed to treat associated stream segments. This could be conducted using two, five-animal strings prior to the day of treatment. An attended camp would be set at Woodward Lake to store materials. Six personnel would be required to treat the lake, another four to treat the stream, and one to monitor the caged fish and set up a precautionary detoxification station. These eleven people would each need one riding horse and six mules for supplies, materials, rafts, motors, and feed. Two outboard motors would be required to administer the antimycin in a timely manner and to mix the compound with lake water. Pumps would be used to distribute the compound at deeper depths.

The proposed treatment of Woodward Lake and Cataract Creek would be conducted between mid September and early October. The treatment of the lake and stream is expected to take two days for set up, one day for application, and two days for cleanup and site departure.

Treating and cleanup of the stream would require approximately five days for set-up, treatment, and cleanup, and would overlap much of the lake treatment. Detoxification stations and caged fish would be monitored, and removed only after caged sentinel fish survived for 24 hours after treatment.

Woodward Lake and upper Cataract Creek would be restocked with pure westslope cutthroat trout from the Washoe Park State Fish Hatchery in Anaconda. MFWP records indicate Woodward Lake receives an average of 156 (34-572) angler days per year (table C-1). Its annual statewide ranking is number 732 out of 1,529 fisheries in the state. Restocking genetically pure westslope cutthroat would maintain angling opportunities at Woodward Lake, provide a source of pure fish to repopulate downstream, genetically dilute any possible remaining rainbow or rainbow westslope hybrids downstream, and reduce the potential for an illegal fish introduction.

Maintenance stocking would continue on Woodward Lake to maintain population viability and angling quality. Beginning in July following the treatment, 6,500 fish, of which 1,000 would be of catchable size, would be stocked in each of the first three years to restore the fishery as quickly as possible. The fish population would be evaluated on year five post treatment to determine population viability and future stocking needs. The risk of reinvasion by downstream fish into Woodward Lake is low since the high gradient stream below the lake makes upstream passage by fish difficult if not impossible. The risk would also be diminished since downstream fish would be removed during treatment.

Figure C-1. Bathymetric map of Black Lake.

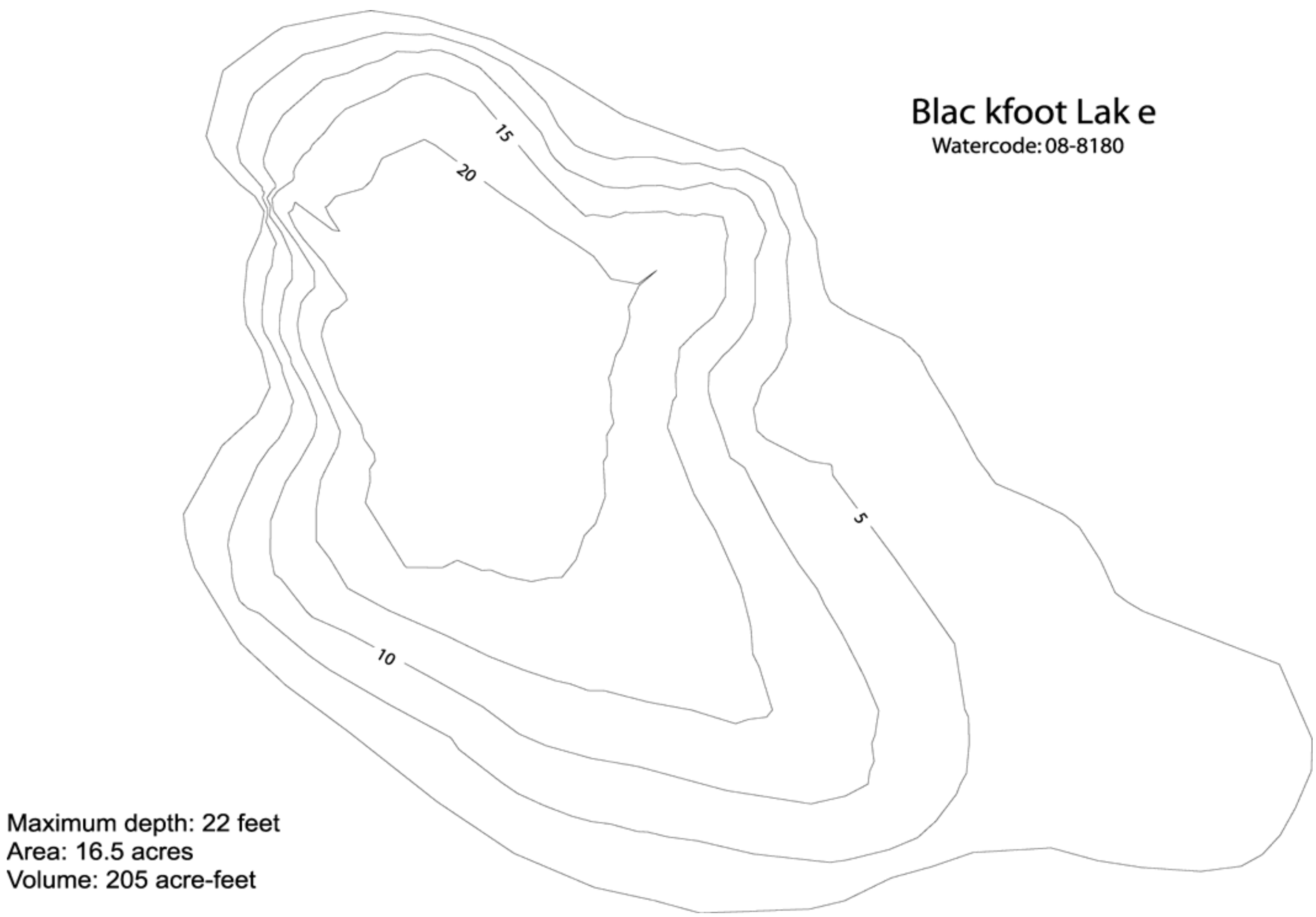

Figure C-2. Bathymetric map of Blackfoot Lake.

Figure C-3. Bathymetric map of Clayton Lake.

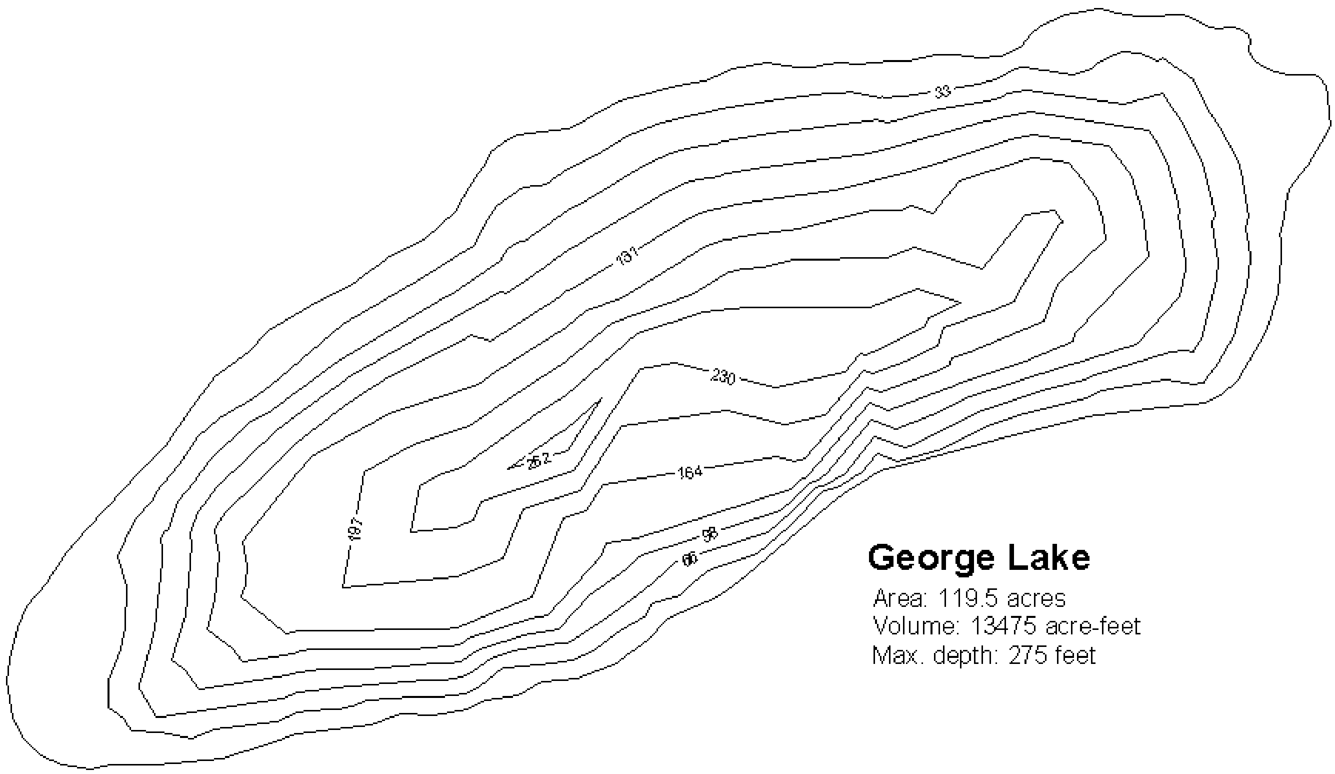

Figure C-4. Bathymetric map of George Lake.

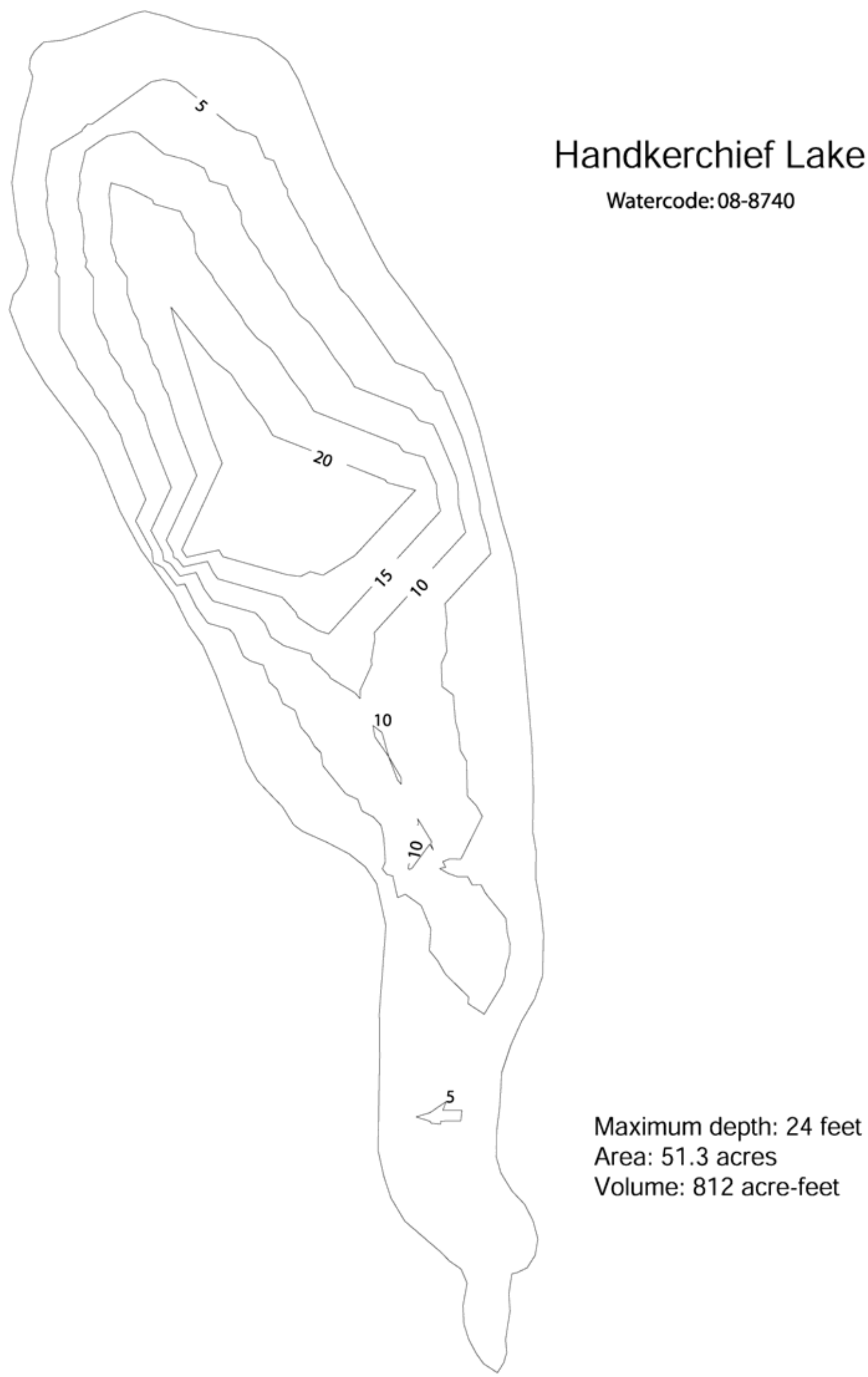

Figure C-5. Bathymetric map of Handkerchief Lake.

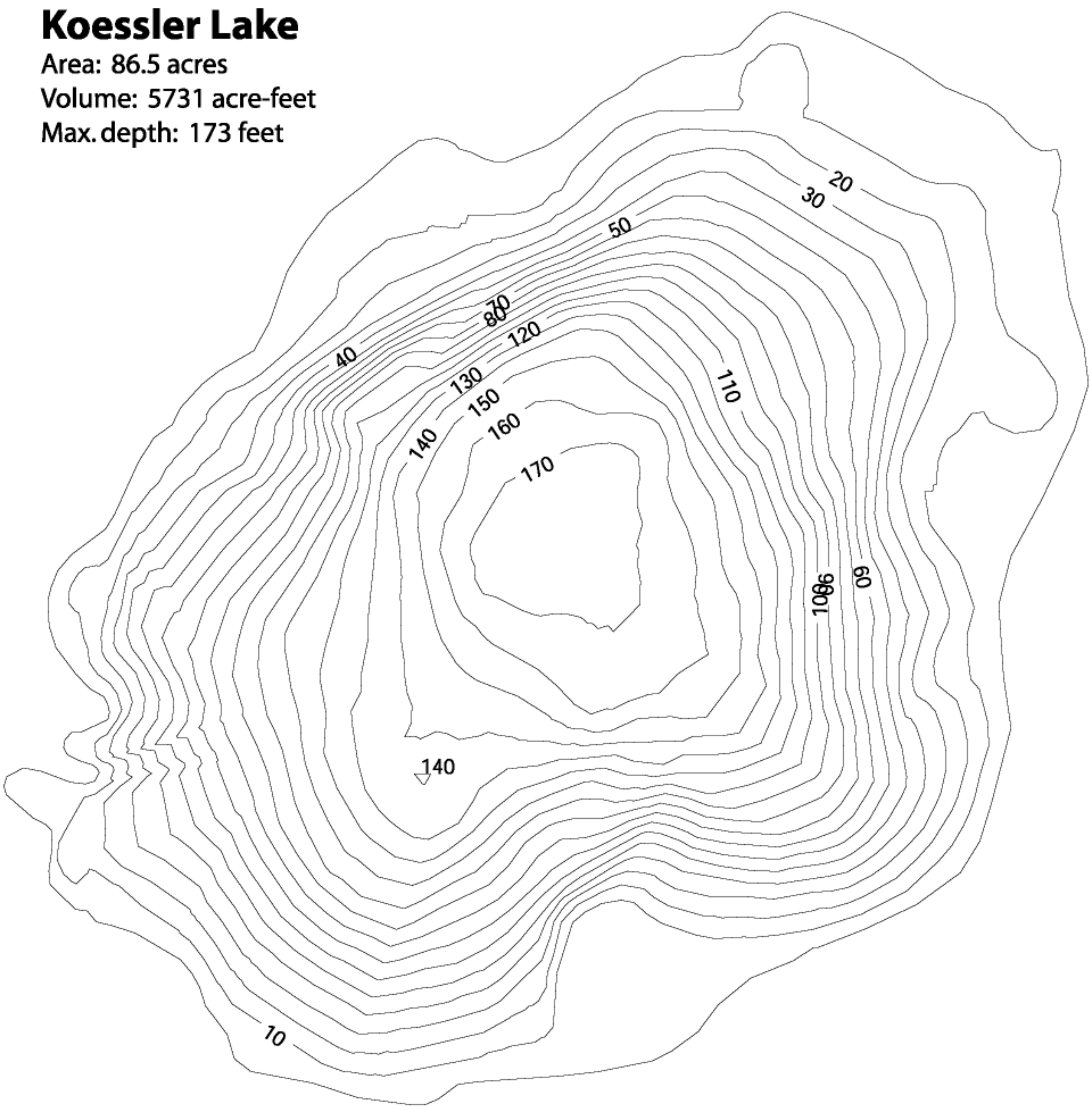

Figure C-6. Bathymetric map of Koessler Lake.

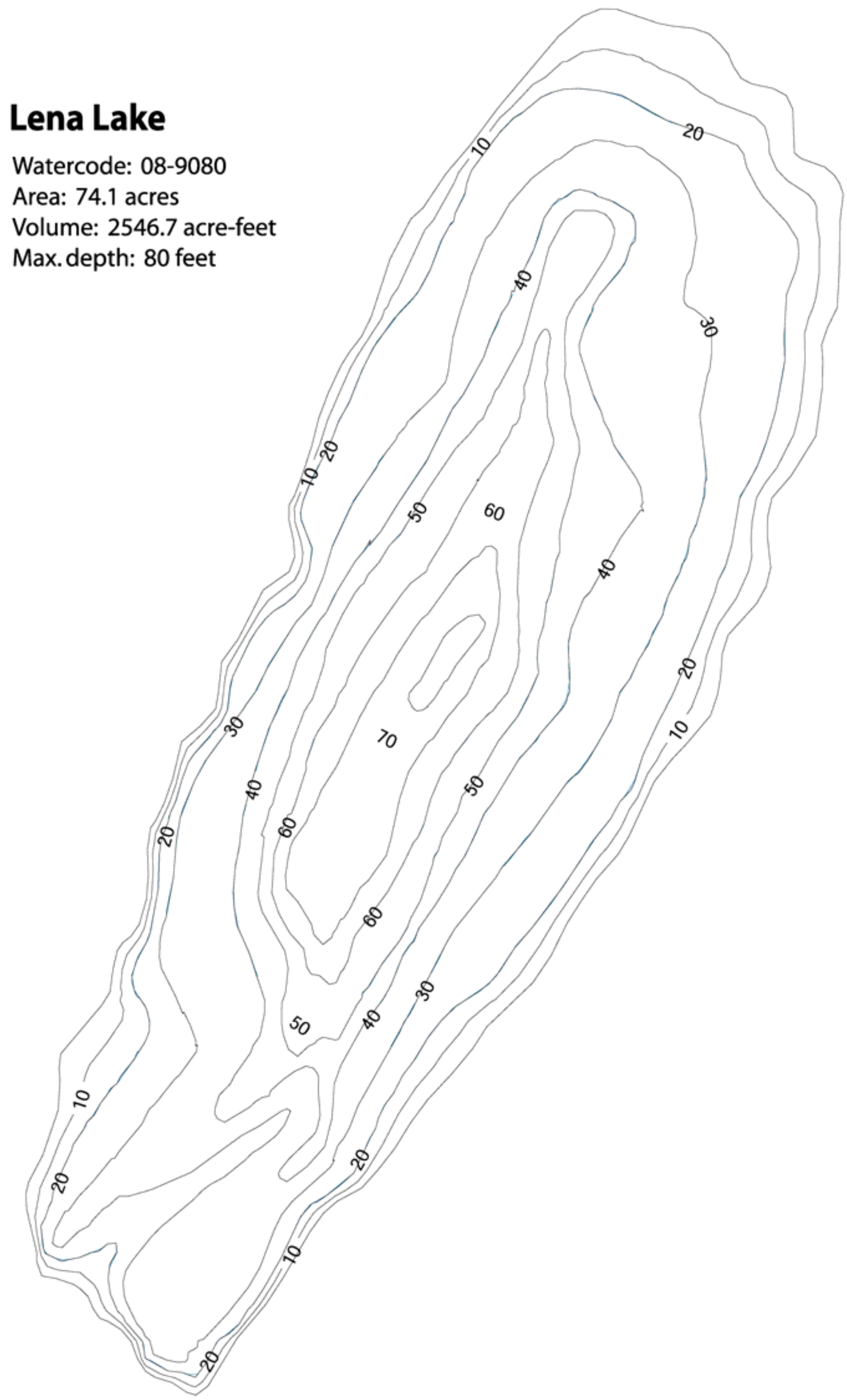

Figure C-7. Bathymetric map of Lena Lake.

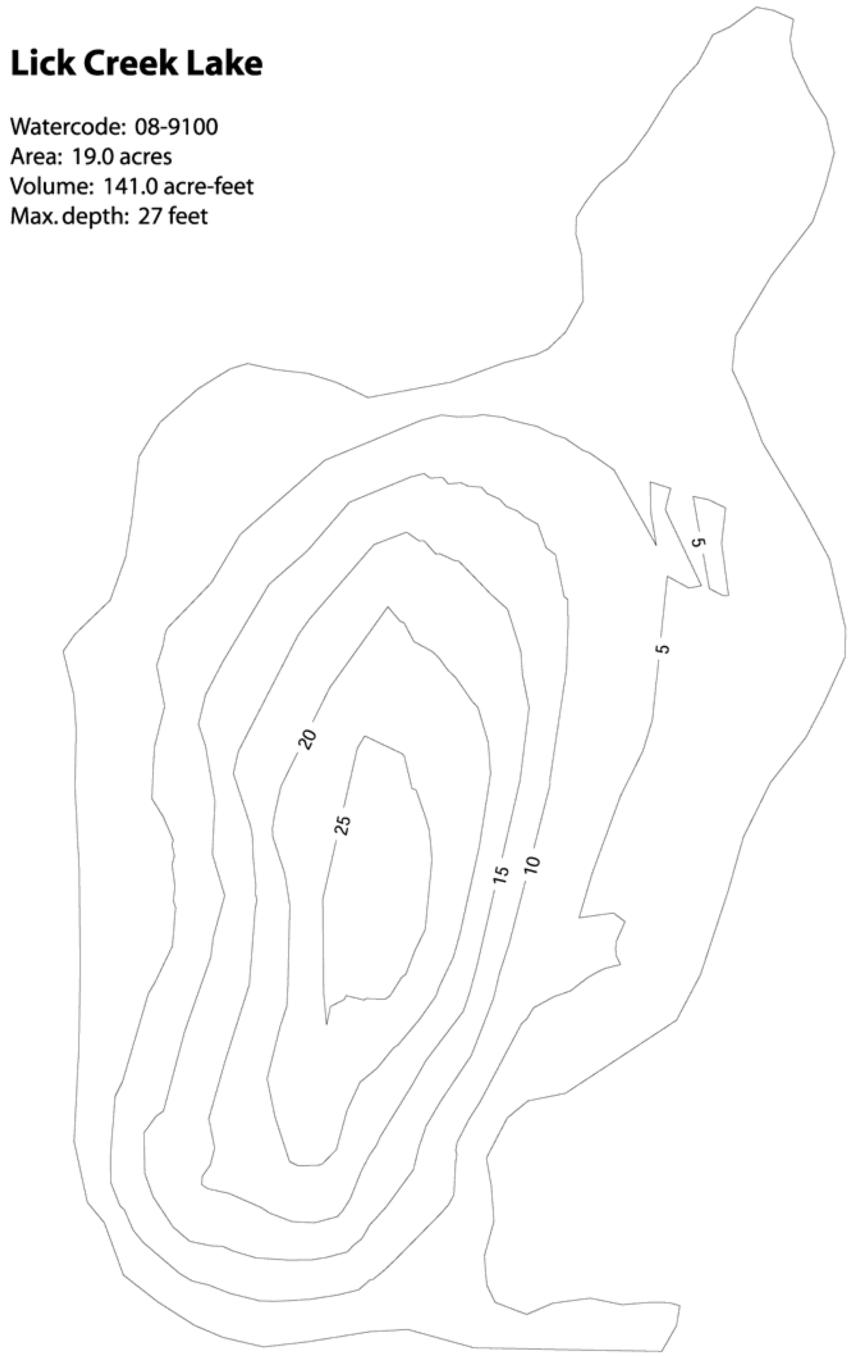

Figure C-8. Bathymetric map of Lick Lake.

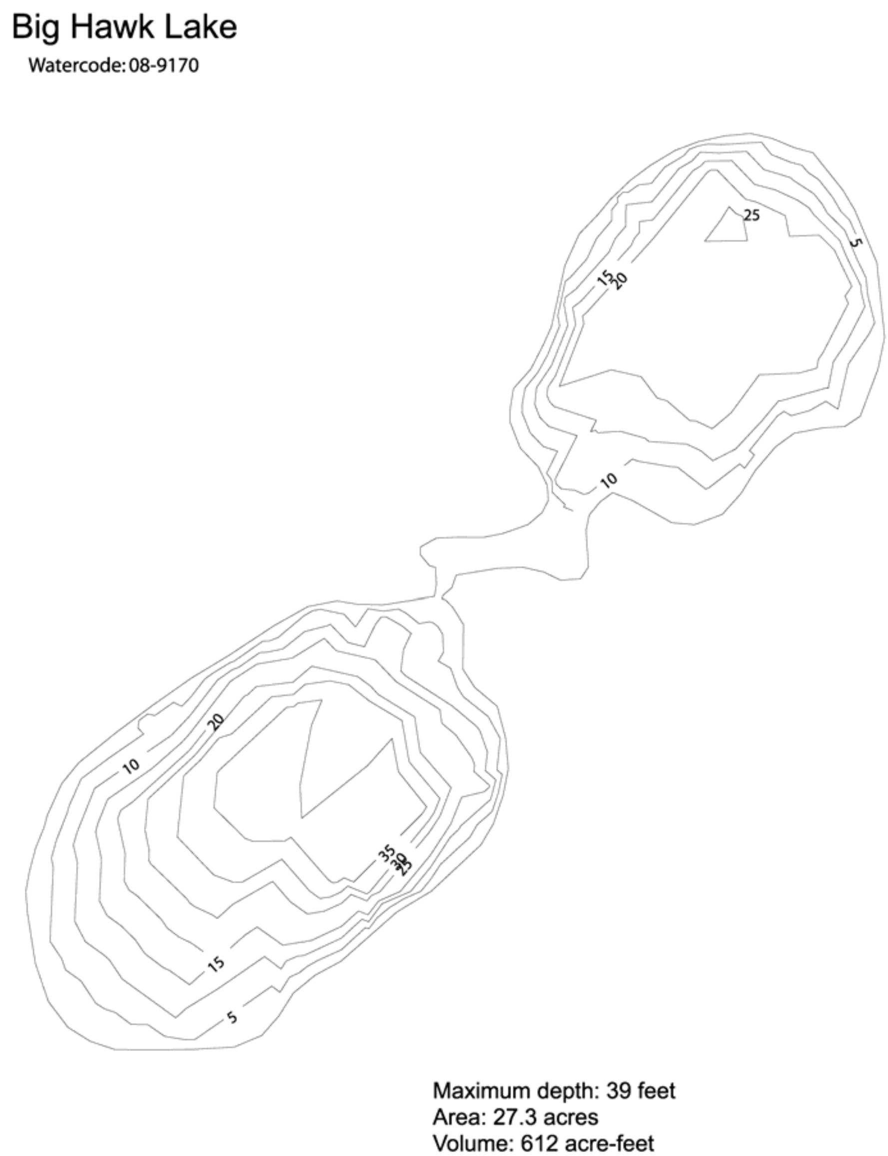

Figure C-9. Bathymetric map of Lower Big Hawk Lake.

Figure C-10. Bathymetric map of Lower Three Eagles Lake.

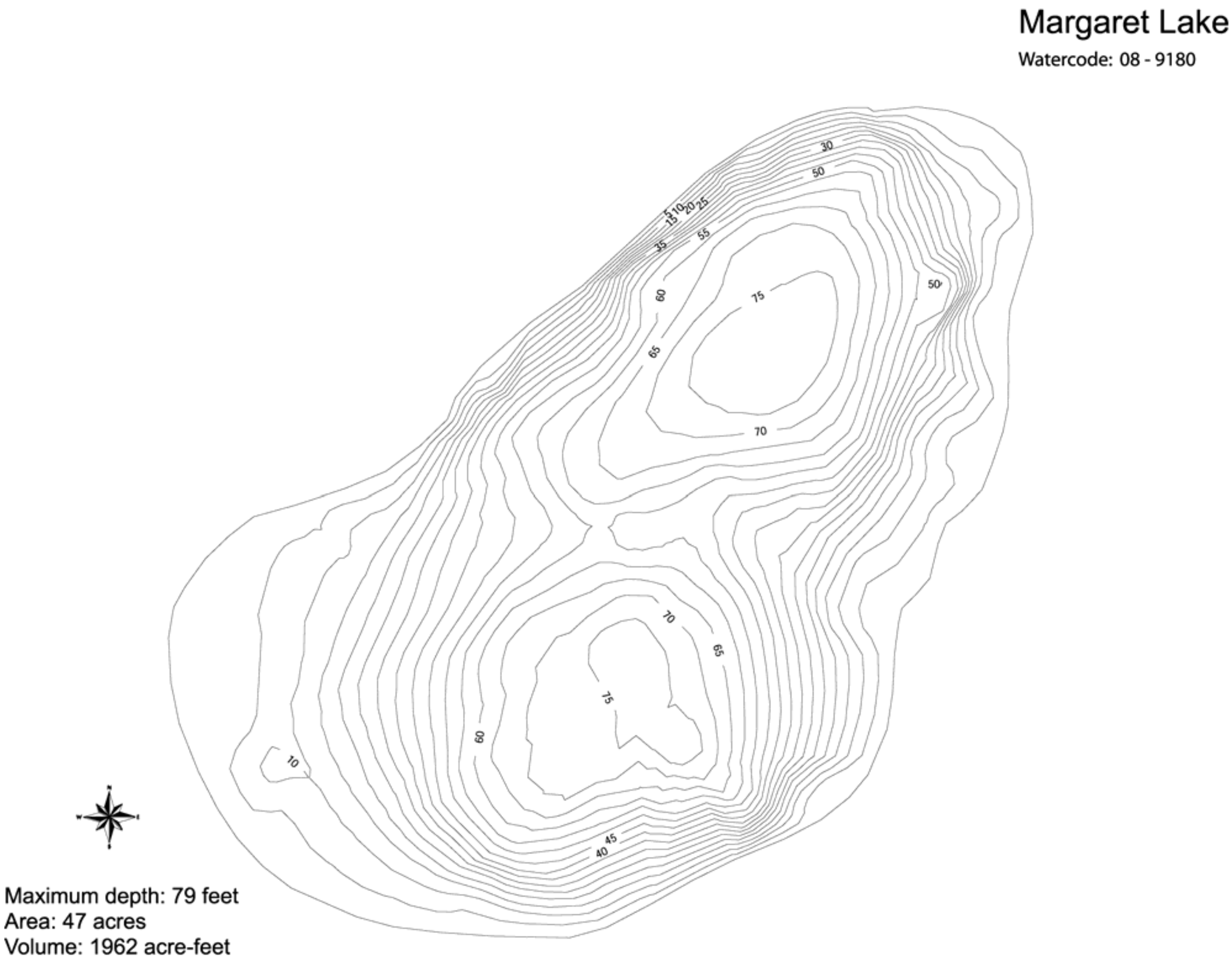

Figure C-11. Bathymetric map of Margaret Lake.

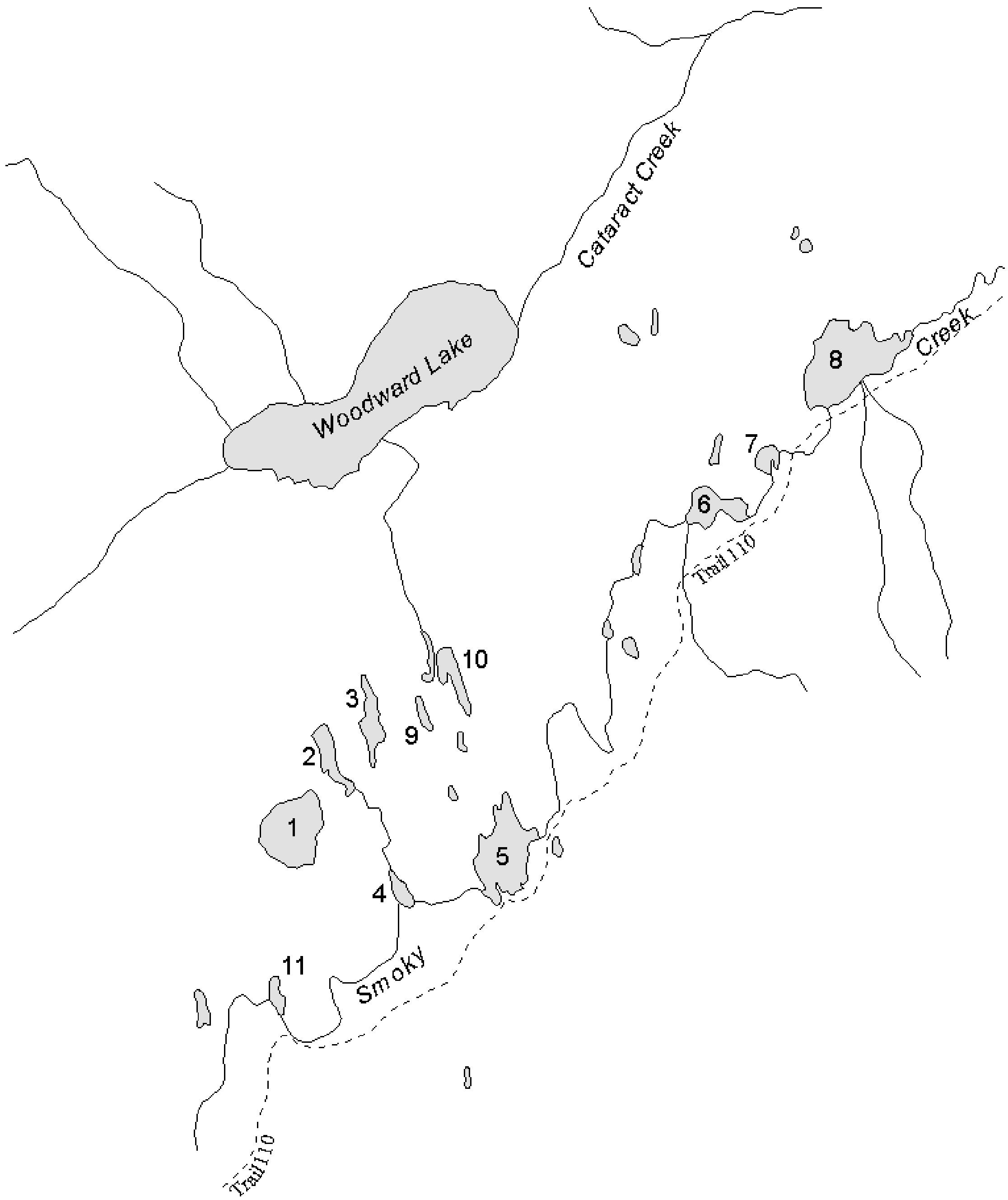

Figure C-12. Location map for the Necklace Lakes.

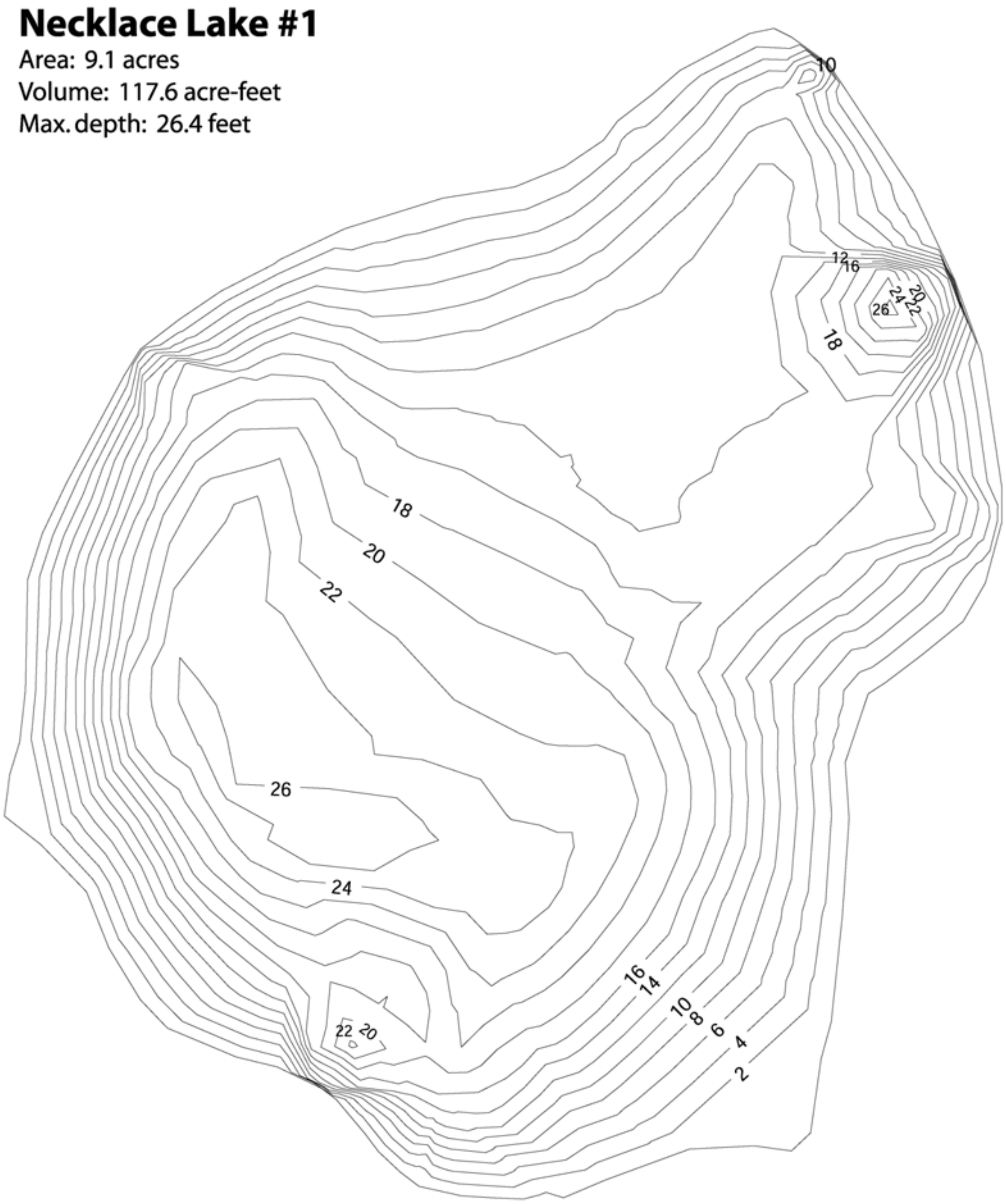

Figure C-13. Bathymetric map of Necklace Lake #1.

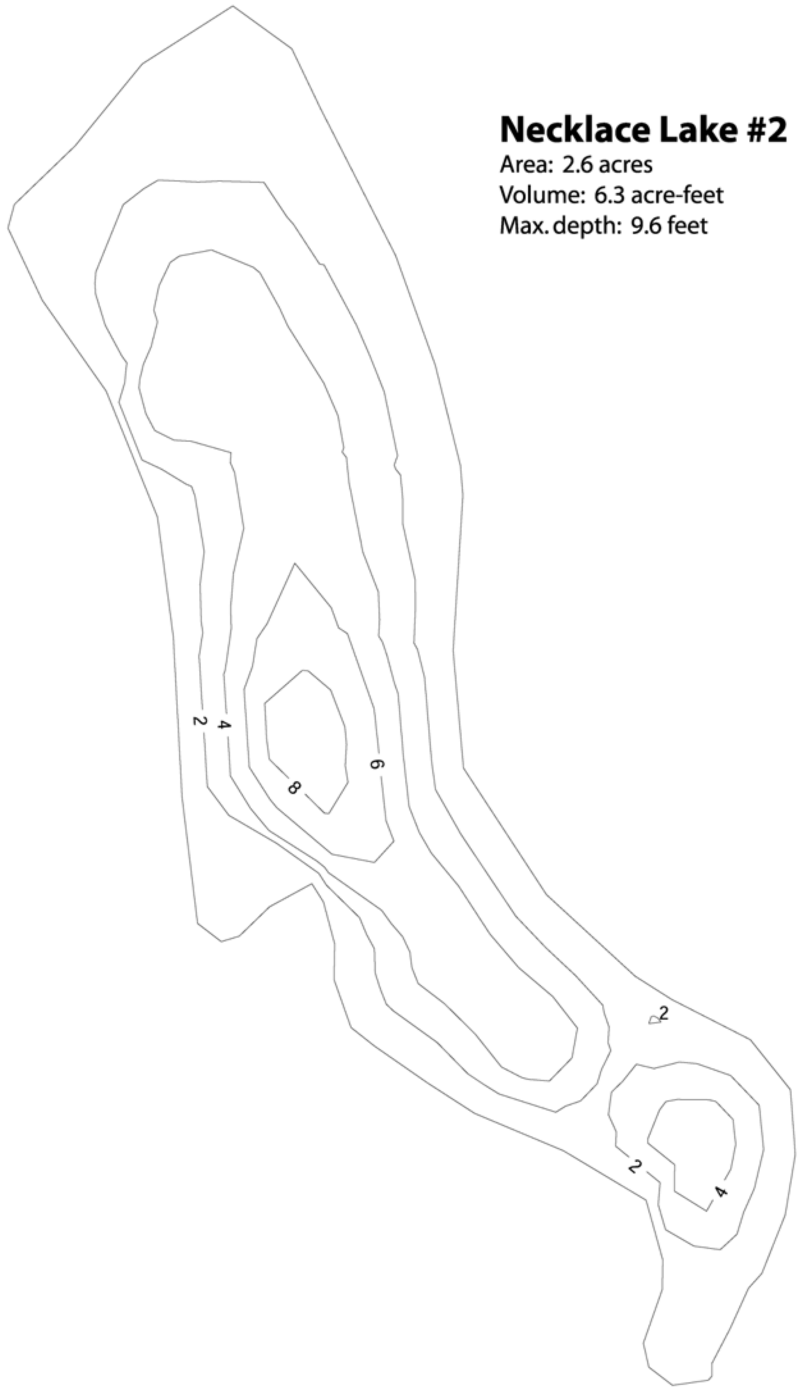

Figure C-14. Bathymetric map of Necklace Lake #2.

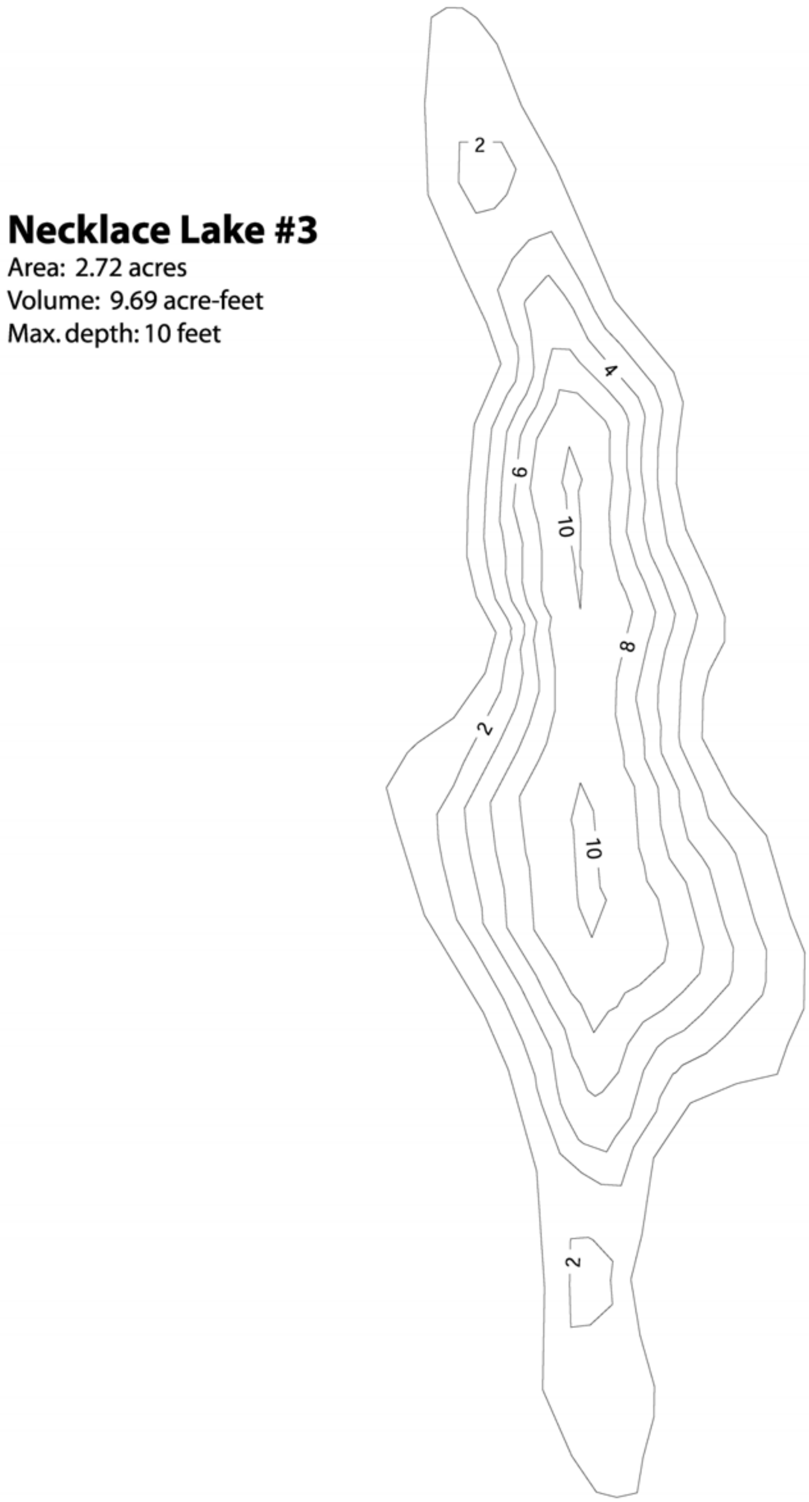

Figure C-15. Bathymetric map of Necklace Lake #3.

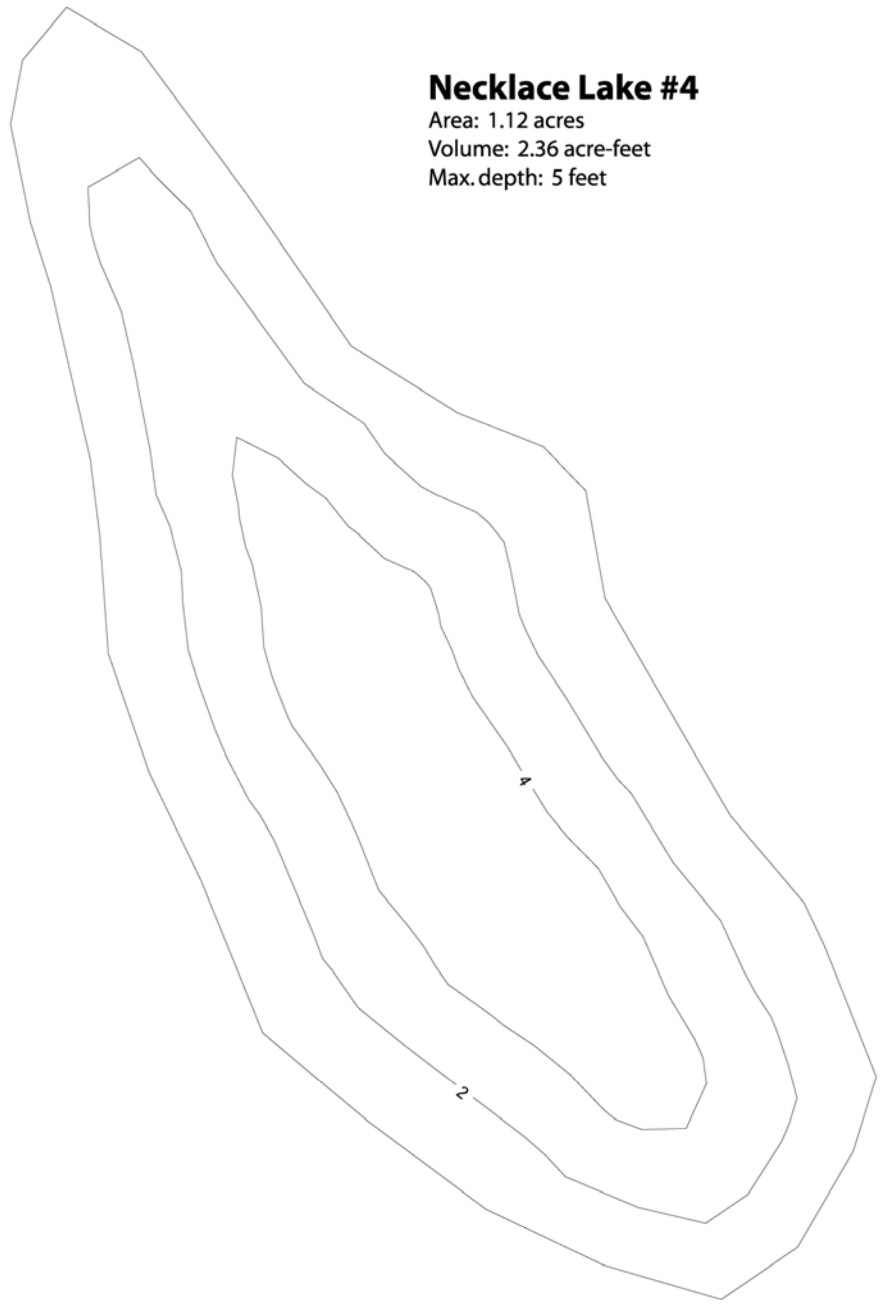

Figure C-16. Bathymetric map of Necklace Lake #4.

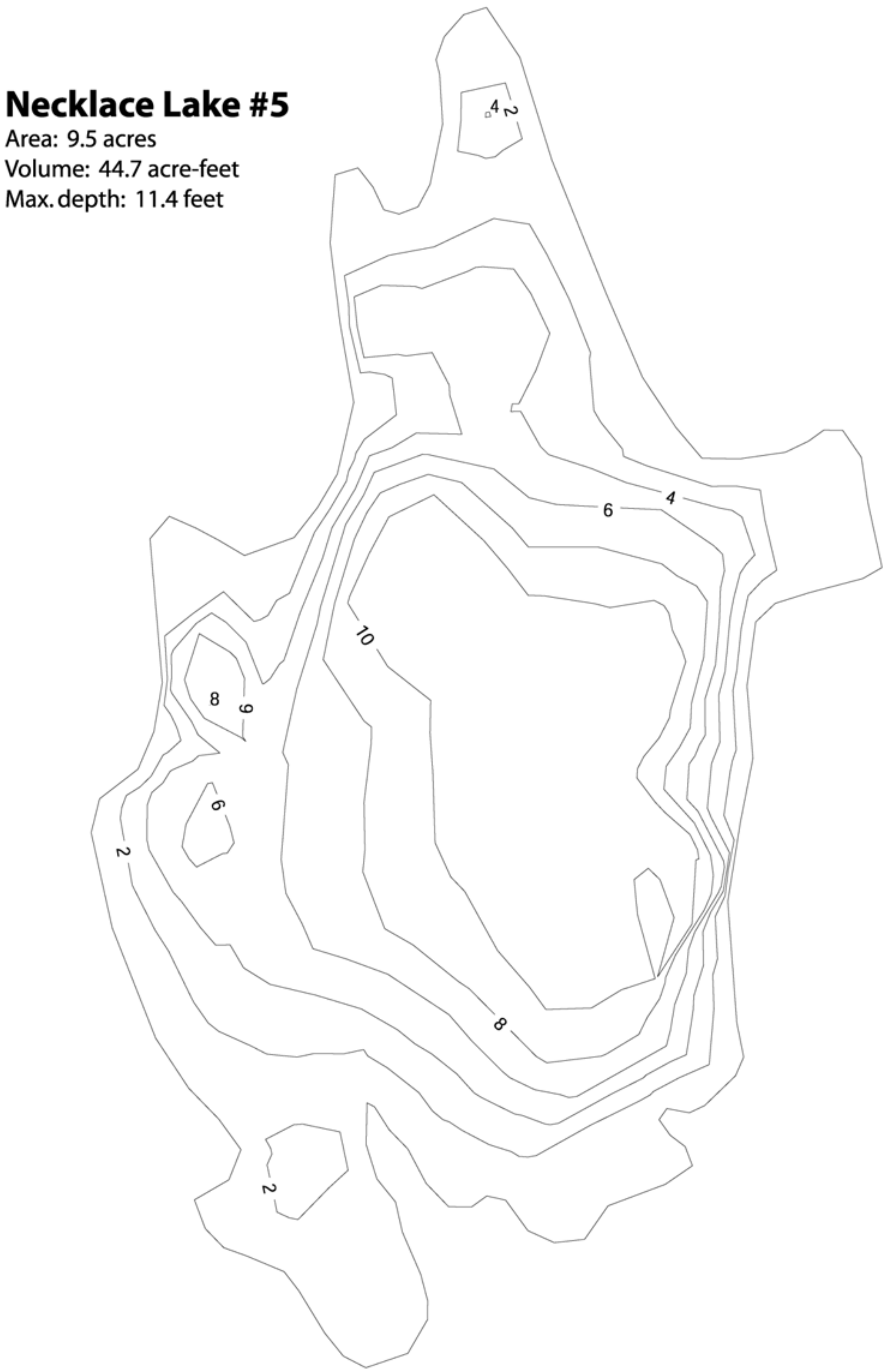

Figure C-17. Bathymetric map of Necklace Lake #5.

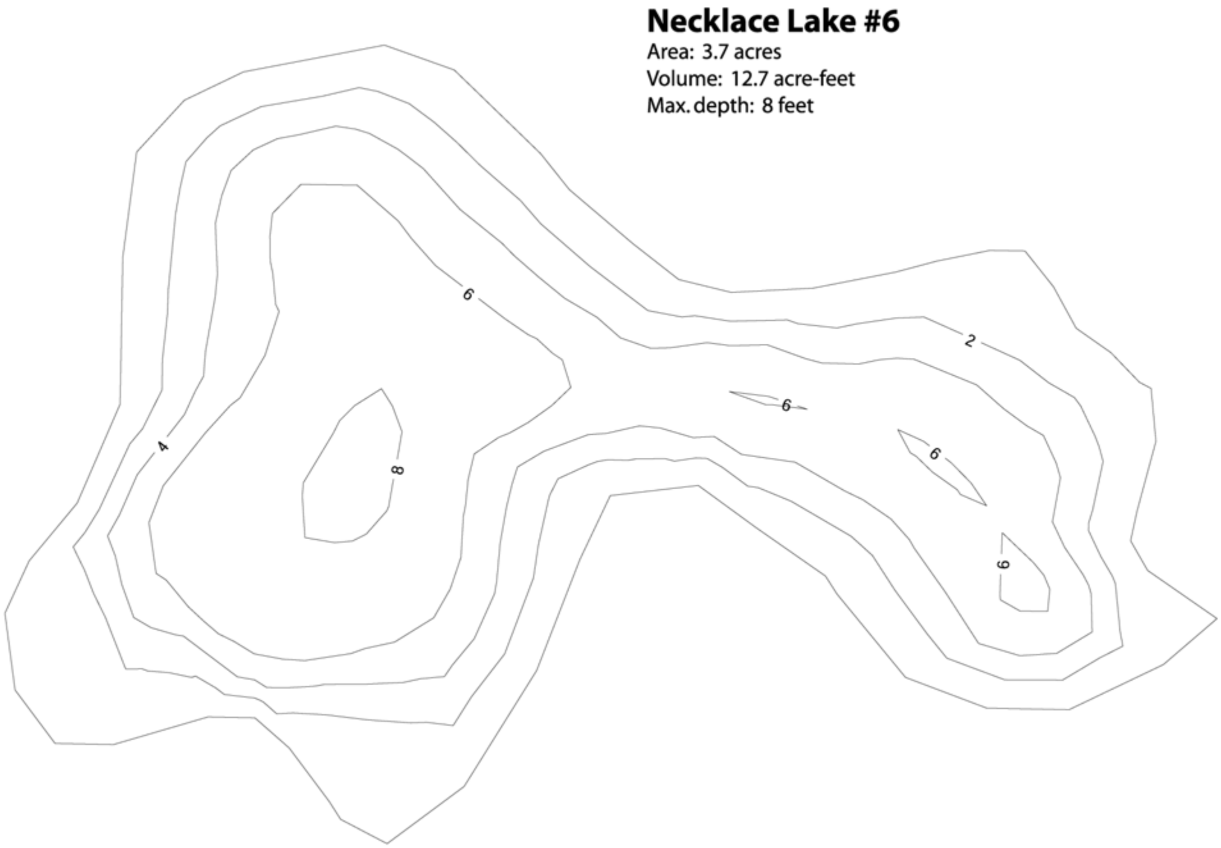

Figure C-18. Bathymetric map of Necklace Lake #6.

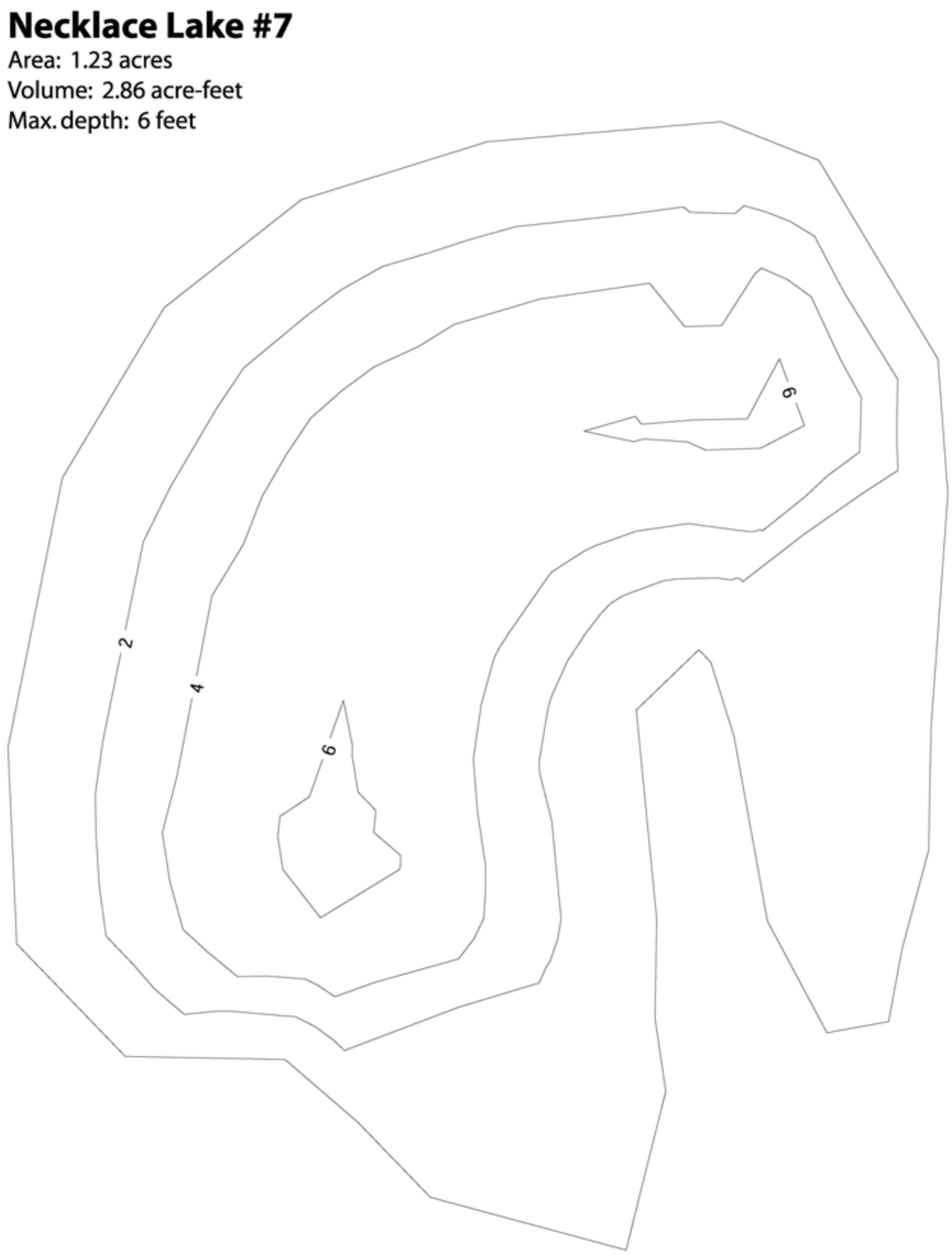

Figure C-19. Bathymetric map of Necklace Lake #7.

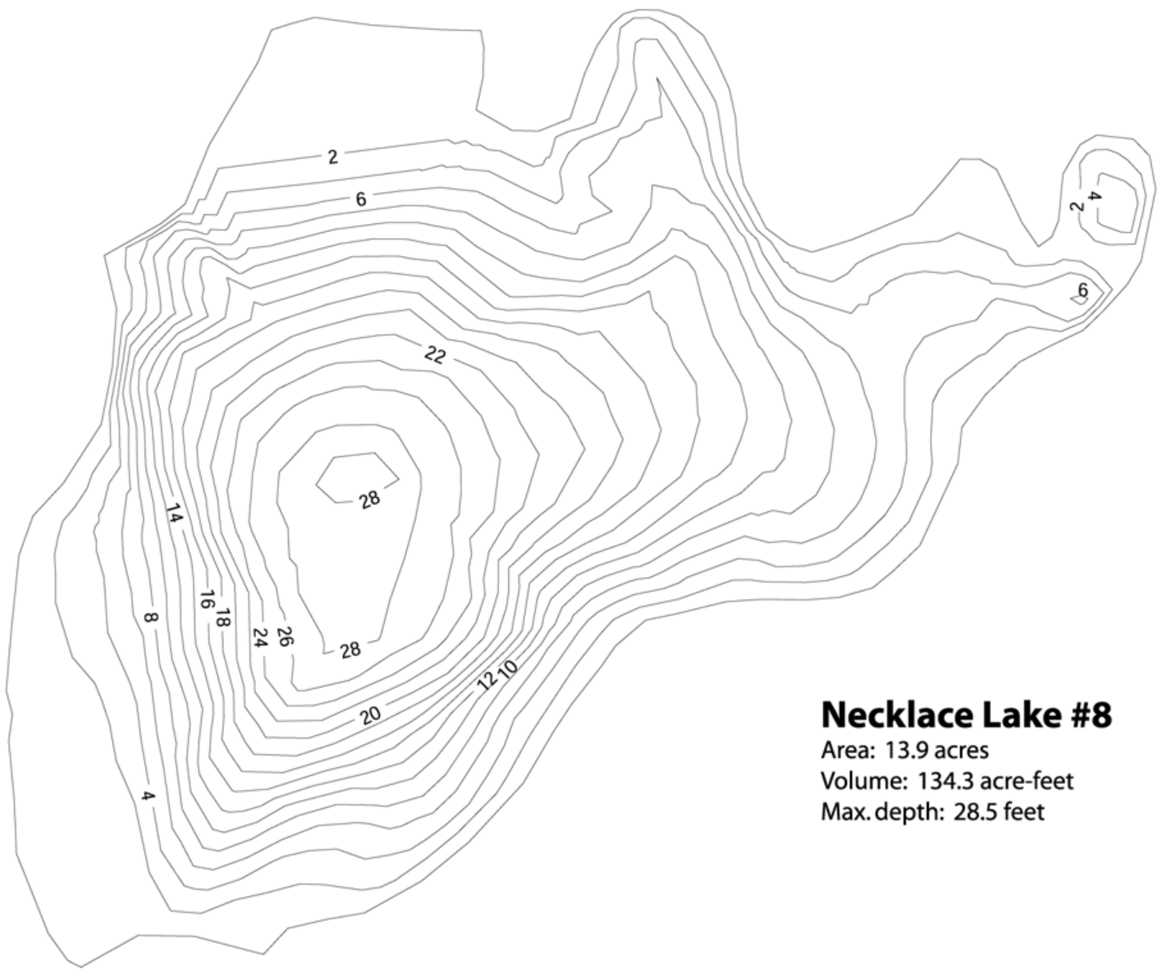

Figure C-20. Bathymetric map of Necklace Lake #8.

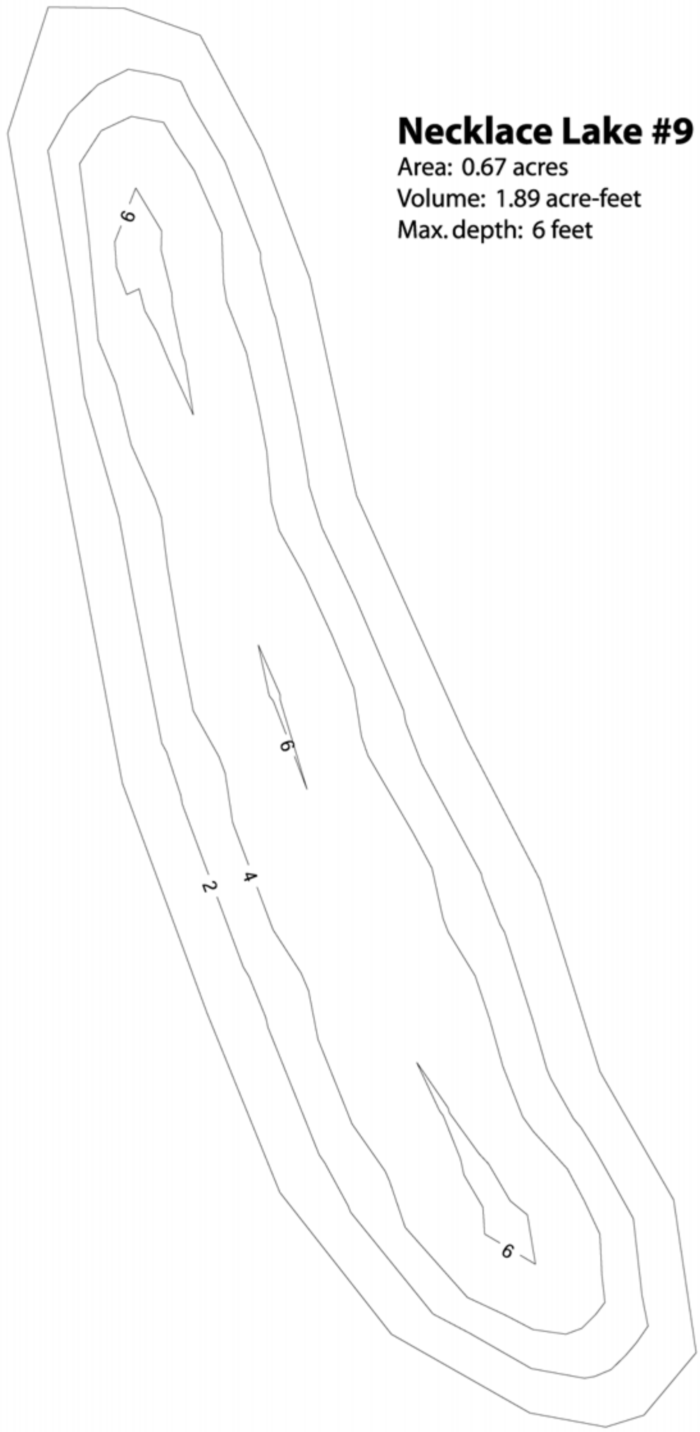

Figure C-21. Bathymetric map of Necklace Lake #9.

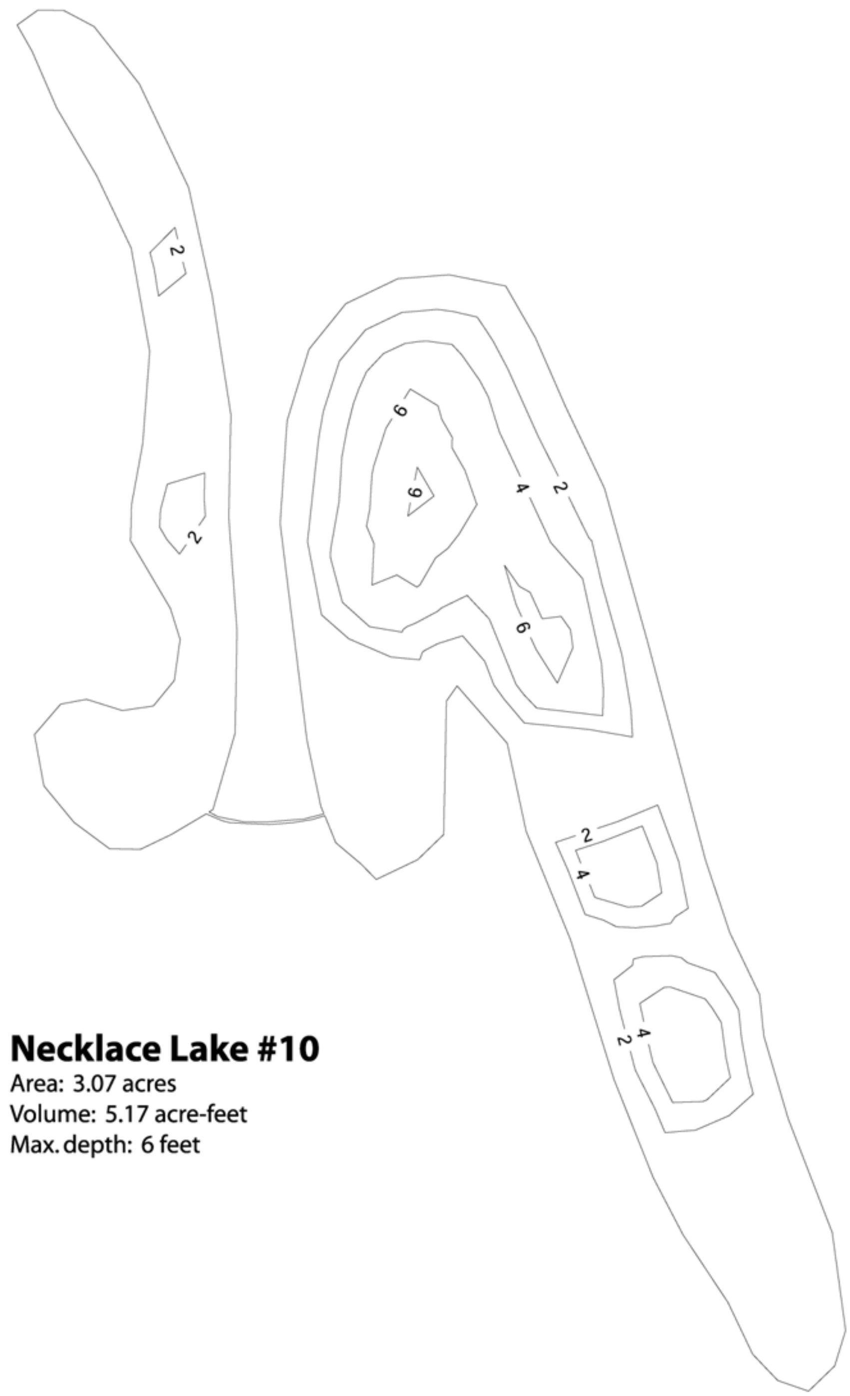

Figure C-22. Bathymetric map of Necklace Lake #10.

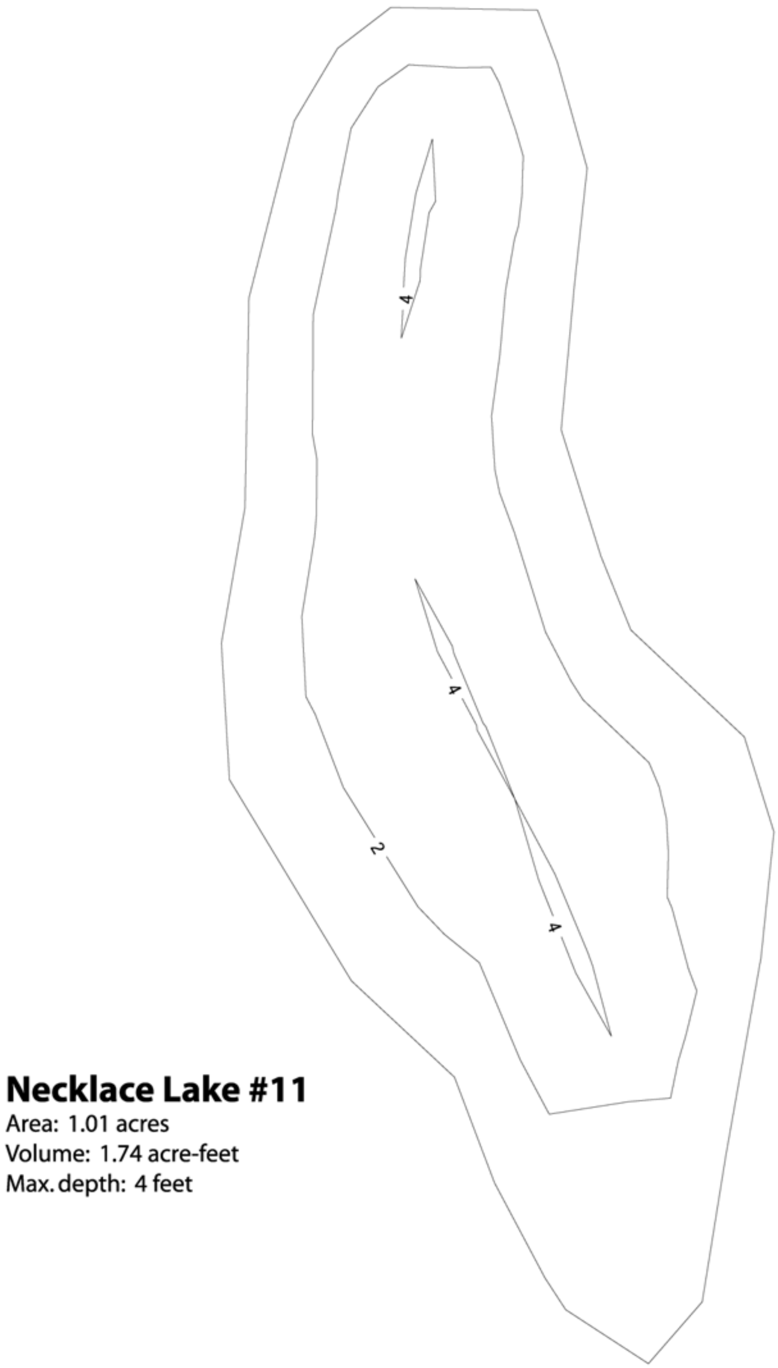

Figure C-23. Bathymetric map of Necklace Lake #11.

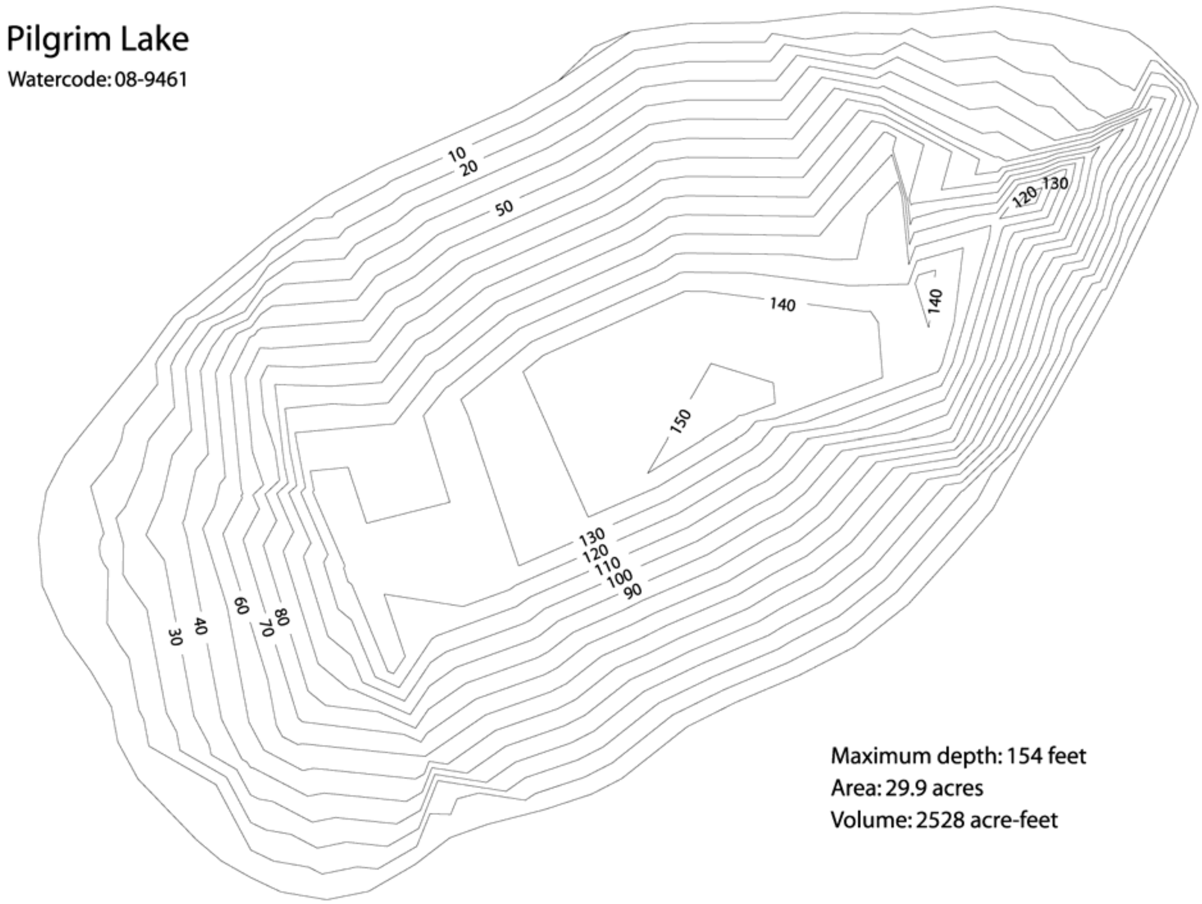

Figure C-24. Bathymetric map of Pilgrim Lake.

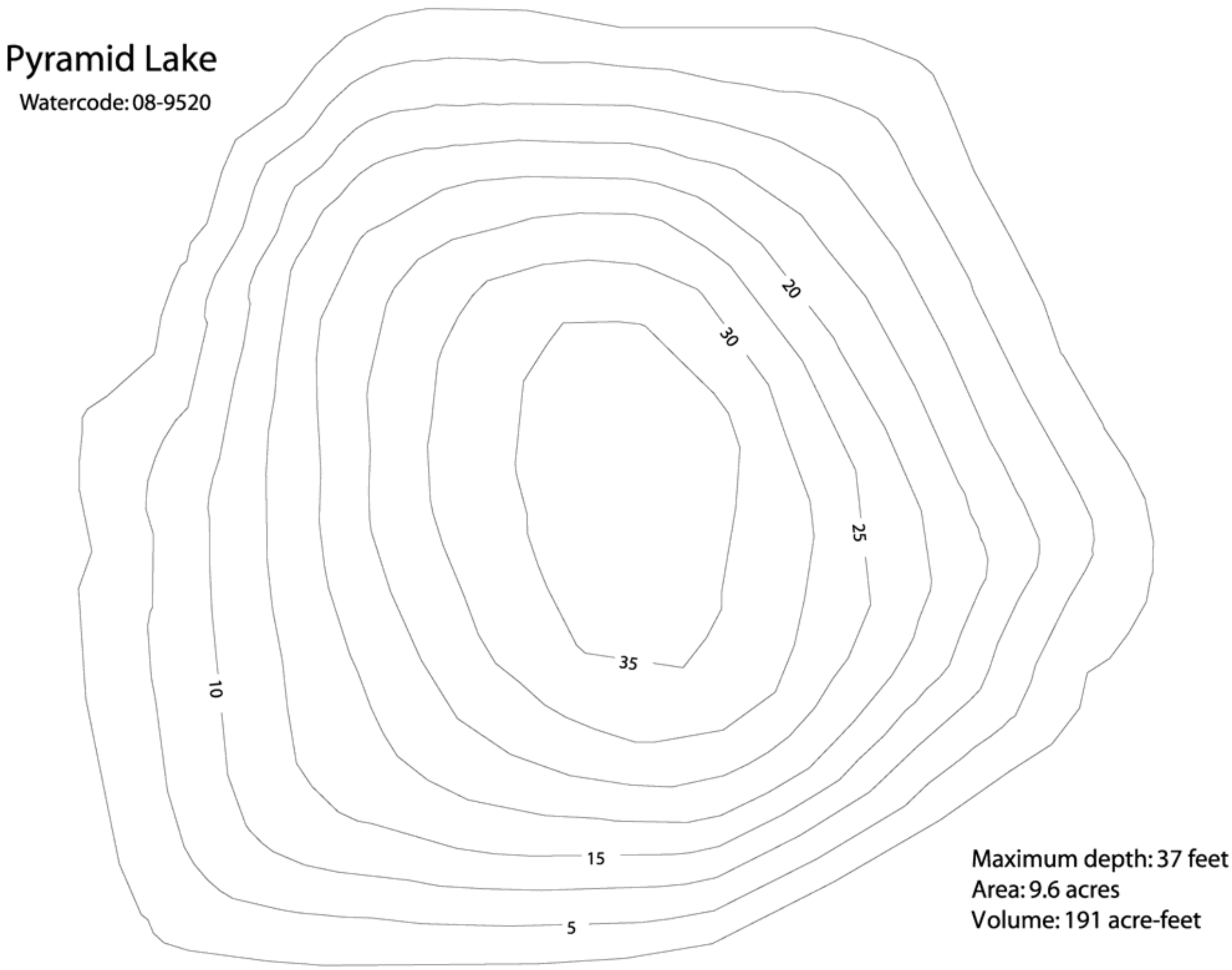

Figure C-25. Bathymetric map of Pyramid Lake.

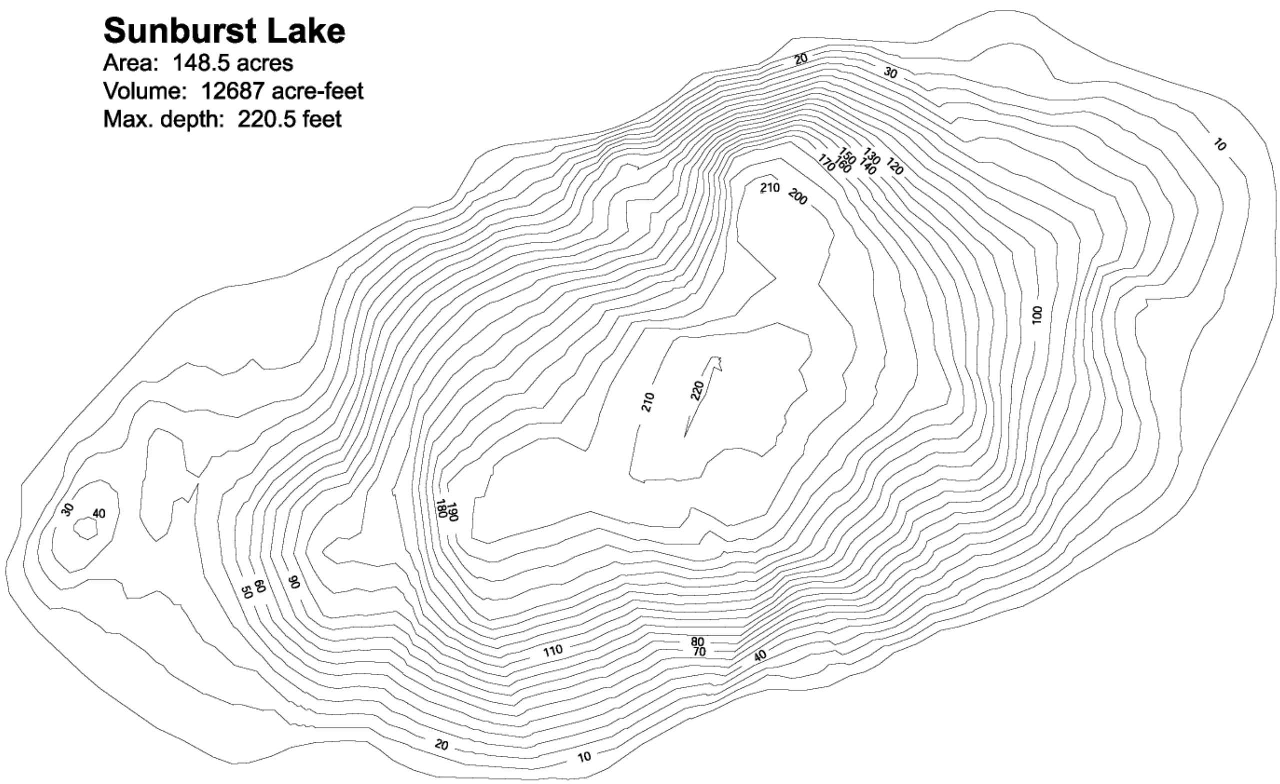

Figure C-26. Bathymetric map of Sunburst Lake.

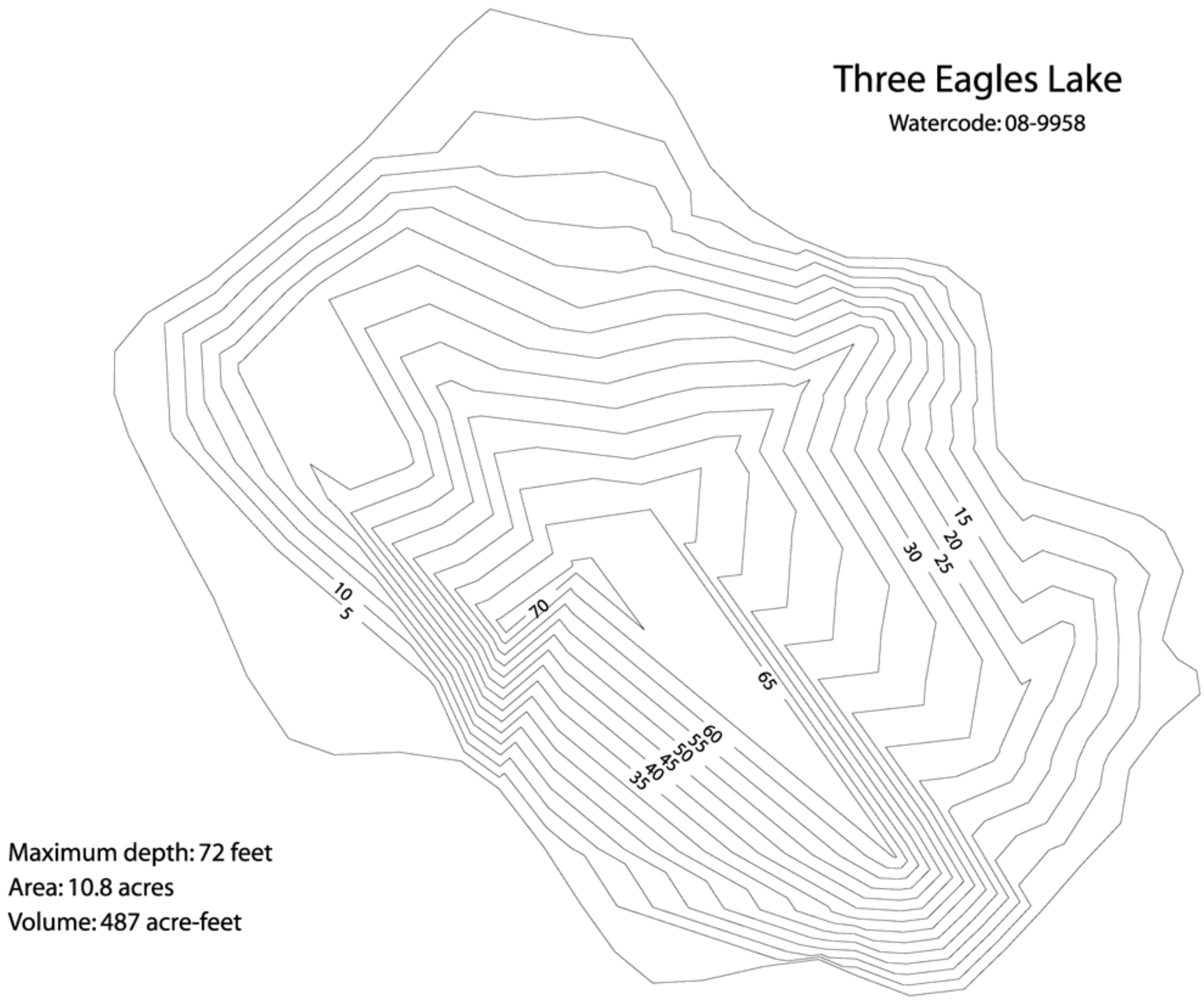

Figure C-27. Bathymetric map for Upper Three Eagles Lake.

Figure C-28. Bathymetric map for Wildcat Lake.

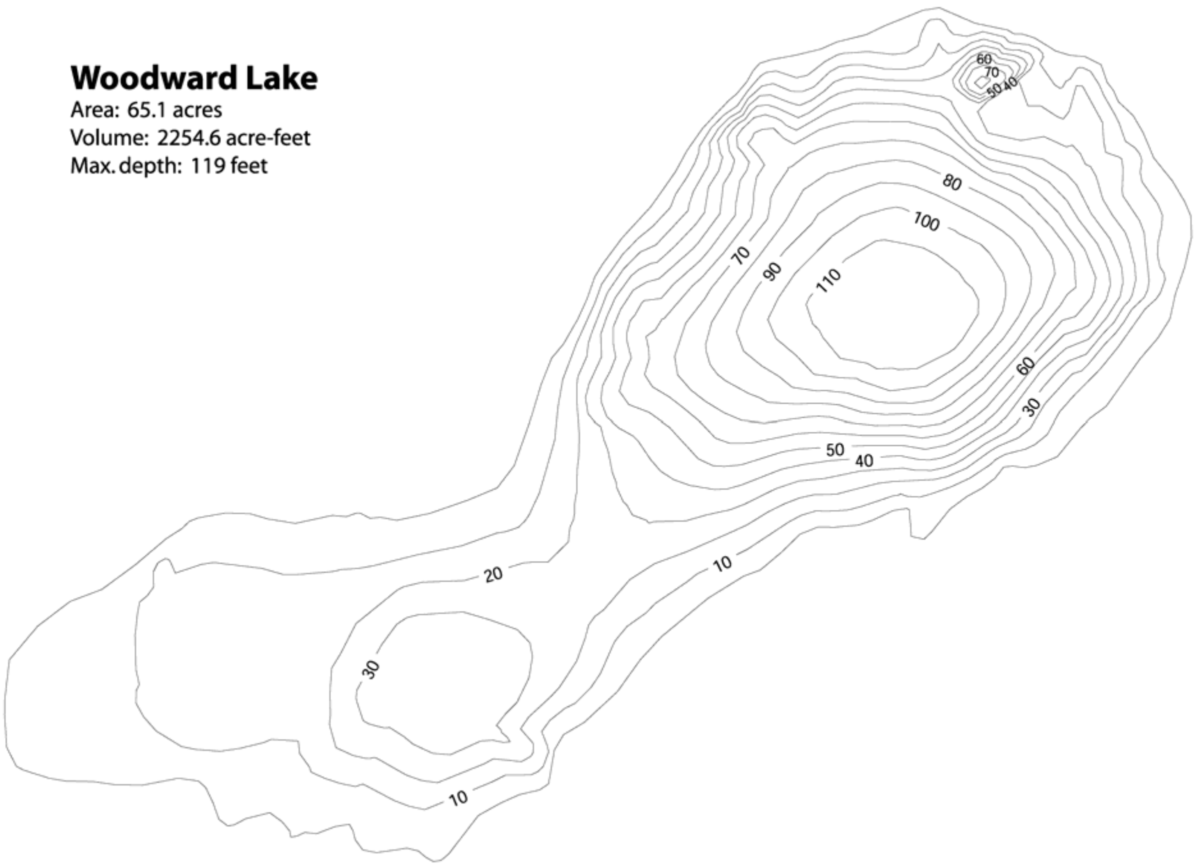

Figure C-29. Bathymetric map for Woodward Lake.

Table C-1. Angler use estimates for select lakes in the South Fork Flathead River drainage from 1989 to 2001, and statewide rank based on 1,529 fisheries in the state.

Lake	*1989*	*1991*	*1993*	*1995*	*1997*	*1999*	*2001*	*Mean*	*State ranking*
Big Hawk	---	99	---	44	38	---	---	60	1173
Black	48	89	199	196	135	38	41	107	912
Blackfoot	1282	75	25	311	34	123	478	332	479
Clayton	164	304	289	116	396	83	368	245	579
George	60	76	---	180	---	---	---	105	923
Handkerchief	1096	327	632	703	573	660	924	702	320
Koessler	---	---	---	---	---	---	---	---	---
Lena	---	---	---	165	---	---	---	165	712
Lick	---	---	---	88	---	---	---	88	983
Margaret	288	56	105	250	108	42	36	127	846
Necklace (4)	---	---	189	---	46	---	---	118	869
Pilgrim	---	---	---	---	---	34	---	34	1404
Pyramid	72	37	25	---	---	83	69	57	1175
Sunburst	103	49	115	175	39	45	149	96	965
Three Eagles (2)	---	---	---	---	---	---	---	---	---
Wildcat	181	74	40	148	39	90	214	112	886
Woodward	60	572	---	34	67	45	---	156	732
Total								**2493**	**157**

Source: Montana statewide angler pressure (MWFP 1989, 1991, 1993, 1995, 1997, 1999, 2001), Bozeman.

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Table C-2. Proposed lake treatments under Alternative B.

Lake	Land Use*	Size (acres)	Antimycin (units)	Antimycin (pounds)	Rotenone (gallons)	Rotenone (pounds)	$KMnO_4$ (pounds)	Transport method	Estimated number of loads for material	Stream miles treated	# of fish to restock	Amphibian status
Black	JBHA	49.1	---	---	1,469	14,396	To be determined after on-site assays	SEAT/heli	2/6	6.09	4,900 x 3	Spotted frog, salamander w/in 0.6 mile
Blackfoot	JBHA	16.5	---	---	68	667	To be determined after on-site assays	helicopter	1	5.76	1,600 x 3	Spotted frog, salamander
Clayton	JBHA	62	---	---	2,316	22,697	To be determined after on-site assays	SEAT/heli	4/4	4.52	5,800 x 3	Spotted frog, salamander
George	BMW	119.5	2,695	10,106	---	---	To be determined after on-site assays	helicopter	12	3.92	11,400 x 3	Spotted frog
Handkerchief	FNF	51.3	159	596	---	---	To be determined after on-site assays	truck	1	1.33	As needed	Spotted frog
Koessler	BMW	86.5	1,146	4,298	---	---	To be determined after on-site assays	livestock	25	0.10	8,500 x 3	Spotted frog, salamander, garter snake
Lena	BMW	74.2	507	1,900	---	---	To be determined after on-site assays	livestock	11	4.25	7,400 x 3	Spotted frog
Lick	BMW	19	28	105	---	---	To be determined after on-site assays	helicopter	1	3.70	1,900 x 3	Spotted frog, garter snake
Lower Big Hawk	JBHA	27.3	---	---	204	1,999	To be determined after on-site assays	helicopter	3	2.97	2,700 x 3	Spotted frog, salamander w/in 1.37 miles
Lower Three Eagles	JBHA	8.7	---	---	85	816	To be determined after on-site assays	helicopter	1	2.23	900 x 3	Spotted frog, salamander w/in 0.83 mile
Margaret	FNF	46.5	---	---	654	6,409	To be determined after on-site assays	SEAT/heli	2/2	3.00	4,700 x 3	N/A

Lake	Land Use*	Size (acres)	Antimycin (units)	Antimycin (pounds)	Rotenone (gallons)	Rotenone (pounds)	$KMnO_4$ (pounds)	Transport method	Estimated number of loads for material	Stream miles treated	# of fish to restock	Amphibian status
Necklace (4)	BMW	42.8	64	240	---	---	To be determined after on-site assays	livestock	2	2.10	1,400 x 3	Spotted frog, salamander
Pilgrim	JBHA	29.9	---	---	842	8,252	To be determined after on-site assays	SEAT/heli	1/4	3.27	3,000 x 3	Salamander w/in 0.69 mile
Pyramid	BMW	8.9	38	143	---	---	To be determined after on-site assays	livestock	1	3.30	1,000 x 3	N/A
Sunburst	BMW	148.5	2,537	9,513	---	---	To be determined after on-site assays	livestock	55	6.10	14,800 x 3	Garter snake
Upper Three Eagles	JBHA	10.8	---	---	162	1,588	To be determined after on-site assays	helicopter	2	0.28	900 x 3	Spotted frog, salamander w/in 0.58 mile
Wildcat	JBHA	40	404	1,515	---	---	To be determined after on-site assays	helicopter	2	0.90	3,900 x 3	N/A
Woodward	BMW	65	451	1,691	---	---	To be determined after on-site assays	livestock	10	2.96	6,500 x 3	Spotted frog

**JBHA= Lakes in the Jewel Basin Hiking Area, which is designated for hiking only (pack animals not permitted); FNF=Flathead National Forest, outside of Wilderness and other special land use areas; BMW=Bob Marshall Wilderness.*

Appendix D: Technical Appendix on Use of Piscicides

This Technical Appendix presents a summary of the origin, uses, and consequences of piscicides (chemical substances used to eliminate undesirable fish species from a selected water body) with a focus on the piscicide rotenone. This appendix also provides a detailed description of past and present uses of these piscicides specific to Montana, and of procedures and protocols for rotenone application within the state. Much of the information in this appendix, unless otherwise stated, is taken from Skaar (2001). Skaar's work, in turn, relies heavily on the following review documents: *A Review of the Literature on the Use of Rotenone in Fisheries* (R.A. Schnick 1974; Fish Control Laboratory, U.S. Fish and Wildlife Service); *Rotenone Use for Fisheries Management, Final Programmatic Environmental Impact Report (Subsequent)* (California Department Fish and Game, 1994); and *Rotenone and Trout Stocking. A literature review with special reference to Washington Department of Game's Lake Rehabilitation Program* (Bradbury 1986). Procedural details specific to Montana are supplied by Grant Grisak, Fisheries Biologist for Montana Fish, Wildlife and Parks (MFWP) (Grisak 2002). Please see the references section of this Technical Appendix.

Historic Use of Piscicides to Manage Fisheries

Piscicides are chemical substances introduced into lakes or streams to kill unwanted fish. Fish managers in North America began using rotenone to manage fish populations in the 1930s [1:1]. It was often used where exotic (non-native) fish had been introduced and had subsequently affected native populations of fish. According to the American Fisheries Society's *Rotenone Use in Fisheries Management: Administrative and Technical Guidelines Manual* (Manual) (Finlayson, et al. 2000; Finlayson, et al. 2000), by 1949, " . . . 34 states and several Canadian provinces were using rotenone routinely for management of fish populations" (Solman 1950; Lennon, et al. 1970). Management may include elimination of fish from a given body of water or sampling of fish populations. Rotenone has also been used as a natural insecticide for agricultural purposes. It has even been used in humans to control intestinal worms (Haley 1978).

Today, according to the American Fisheries Society Manual, rotenone is used in fisheries management for several purposes:

1. To support recreational fisheries by controlling undesirable fish,
2. To eradicate exotic fish,
3. To eradicate competing fish species in rearing facilities or ponds,
4. To quantify populations of aquatic organisms,
5. To treat drainages before initial reservoir impoundment
6. To eradicate fish to control disease, and
7. To restore threatened or endangered species (Finlayson, et al. 2000).

In addition to use of chemicals, a variety of methods may be used to manage fisheries. These include the modification of angling regulations to protect some species or to increase harvest of others; physical removal methods such as trapping or electro-shocking fish; the introduction of predators, explosives, physical methods of manipulating flow or introducing physical barriers in a given stream; and complete dewatering of a body of water (Finlayson, et al. 2000). (For more information on the benefits and drawbacks of each of these fish management methods, see the AFS website listed under *References*.)

However, when complete eradication of a species or of all fish in a body of water is the objective, the only viable management solution is chemical use (by introducing one of two chemicals: either rotenone or antimycin) or dewatering. Dewatering can cost less initially, but it can be more environmentally disruptive to an area (Finlayson, et al. 2000). Rotenone is covered extensively here, as it is the chemical most often used; antimycin is covered briefly at the end of this discussion.

Rotenone

Rotenone is a chemical used for several purposes, including a pesticide for gardening and the removal of undesirable fish in bodies of water. This chemical compound, extracted from the roots of certain species of the bean family, has been used down the centuries to capture fish (Finlayson, et al. 2000). Introduced in powdered or liquid form (with a dispersant, usually a petroleum-based solvent) into water where fish live, rotenone interferes with cellular respiration in gill-breathing animals. Both fish and aquatic insects are highly susceptible to rotenone (Skaar 2001). However, mammals in general are not; mammals neutralize rotenone by enzymatic action in their stomach and intestines (AFS 2000).

Rotenone breaks down naturally and rapidly in water and with exposure to UV light. However, the process may be hastened with the addition of a neutralizer (usually chlorine or potassium permanganate[3]) to the lake water after a short period of time (Finlayson, et al. 2000; Skaar 2001). The toxic effects of rotenone, on some fish, can be reversed, depending on how much is absorbed (Grisak 2002). “Inert” (i.e., non-lethal) ingredients may be added rotenone to enhance its ability to dissolve and disperse throughout a given body of water (Skaar 2001). In a study conducted by the State of California (CDFG, 1994, cited in Skaar 2001), researchers found the following inert ingredients: trichloroethylene (TCE), naphthalene, 2-methylnaphthalene, and xylene (see Regulatory Status, below). Follow-up visit(s) to the lake are required to determine rate and completeness of rotenone degradation via bioassay. If the desired object is to introduce or re-establish a native species of fish in those waters, appropriate broodstock may then later be seeded in the lake or river.

Rotenone Effects

Rotenone is toxic to gill-breathing organisms and is most commonly used on fish. Salmonids are the most sensitive to treatment; salmonid eggs are more resistant than fry or fingerlings (Skaar 2001: 4). Stream-dwelling insects are far more sensitive to rotenone than those in lakes (Skaar 2001:4). Adult frogs and other amphibians would not be seriously affected, but tadpoles and juvenile salamanders would probably be killed as a result of application (Sport Fish Restoration). The effect on amphibians is largely dependent on the time of year rotenone is applied. Fall applications greatly reduce and perhaps eliminate impacts on amphibians of all age classes because these species are in the adult stage.

[3] Use of potassium permanganate ($KMnO_4$) must be carefully planned because “it is itself toxic to fish in relatively low concentrations” (Skaar 2001:2).

Swine may also be sensitive to rotenone (Clemson University Extension). Rotenone is slightly toxic to wildfowl (EXTOXNET 1996). In laboratory tests on rats and dogs that were fed forms of rotenone as part of their diet for periods of six months to two years, researchers observed effects such as diarrhea, decreased food consumption, and weight loss. In other laboratory tests, rotenone was not found to affect reproductive functions (Skaar 2001:4-5). CDFG studies of risk for terrestrial animals found that a 10-kilogram (kg) dog would have to drink 7,915 gallons of lake water within 24 hours, or eat 300,000 kg of rotenone-tainted fish to receive a lethal dose (cited in Skaar 2001:5). Similar results were determined for birds: " . . . environmental levels of rotenone are at least 1,000 to 10,000-fold less than that required for lethality" (Skaar 2001:5).

Because dead fish will result from a rotenone treatment, there would be a temporary overabundance of food for predators following rotenone treatment; this would be followed by a temporary reduction in food supplies until fish are restored (Finlayson, et al. 2004). The rotenone manual (Finlayson, et al. 2000) notes, "There is no indication that this temporary reduction results in any significant impacts to most bird or mammal populations because most animals can utilize other water bodies and sources for food" (Finlayson, et al. 2000:194). If this shortage were to occur during mating season, some birds could be affected unless steps were taken to time rotenone application outside nesting and fledging season (Finlayson, et al. 2000:194).

Several hazard assessments for human health have also been conducted. The lowest level estimated for toxicity would require a 60-kg person to drink, at one time, 180,000 liters of water containing 100ug/L rotenone; or to eat 180 kg of rotenone-killed fish at one sitting. Human ingestion at these levels could be lethal (Gleason et al., 1969, cited in Skaar 2001:5).

One study, in which rats were injected with rotenone for a period of weeks, reported finding lesions characteristic of Parkinson's disease (Bertarbet, et al. 2000). However, the results have been challenged on the basis of methodology: The continuous intravenous injection method used leads to "continuously high levels of the chemical in the blood," and dimethyl sulfoxide (DMSO) was used to enhance tissue penetration. (Normal routes of exposure actually slow introduction of chemicals into the bloodstream.) Similar studies (Skaar 2001 cites Marking 1988) have found no Parkinson-like results. Finally, intramuscular injection into the body is not a normal way (i.e., ingestion) of assimilating the compound.

Skaar (2001) notes that the National Academy of Sciences established (in 1983) a Suggested No-Adverse Response Level of rotenone in drinking water of 14 ug/L, assuming that a 70-kg person drinks 2 liters of water per day for a lifetime. In 1997, the U.S. EPA established a "reference dose"[4] of 0.004mg/ks/d, based on a No Observable Adverse Effect Level in rats of 0.38/mg/k/d. Skaar (2001) notes that freshly treated lakes will have a rotenone level much higher (100 ug/L); however, he notes that since the rotenone will "probably dissipate totally within a month or two, it doesn't seem possible for chronic effects to ever develop from drinking from a rotenone-treated lake" (Skaar 2001:6).

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[4] A "reference dose" is an estimate of "a daily exposure to the human population (including sensitive sub-groups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. (EPA 1997, cited in Skaar 2001). The EPA used an uncertainty factor of 100 to account for extrapolation between species and differences in sensitivity within the human population (Skaar 2001:6).

Extensive research has demonstrated that rotenone does not cause birth defects [(Hazelton 1982)], reproductive dysfunction (Spencer & Sing 1982), gene mutations (Biotech 1981; Goethem, Barnhart, & Fotopoulos 1981; NAS 1983) or cancer (USEPA 1981; Tisdel 1985). The USEPA (USEPA 1981; 1989) ". . . has concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment" (Finlayson, et al. 2004). In relation to air quality, the rotenone manual (Finlayson, et al. 2000) further notes that "No public health effects from rotenone use as a piscicide have been reported."(Finlayson, et al. 2000). No waiting period is specified for swimming in rotenone-treated water.

Skaar (2001) cites Bradbury (1986) in noting that studies show that water temperature, dissolved oxygen, pH, alkalinity, and carbon dioxide are not affected by water treatment with rotenone. Minor temporary changes in taste and odor can be detected. No well-designed studies have ever shown detectable levels of any of the chemicals involved, post-treatment (Skaar 2001:3).

Some temporary recreational and aesthetic impacts may be expected in a body of water where dead fish appear in some quantities. This may be mitigated by removing the fish from the shoreline following the procedure. A treated body of water would have no fish for angling opportunities until after it is restocked. Guides or outfitters using these waters for commercial enterprise would have to find other nearby water resources until a fishery was re-established.

Use of rotenone has raised controversy in some places, particularly where sufficient public involvement or education has not taken place. According to members of the AFS Fish Management Chemicals Subcommittee Task Force on Fishery Chemicals, controversy springs from three main sources: "(1) persons who oppose changes to a perceived natural situation or oppose the use and development of fish monocultures, (2) persons who are alarmed by the perception of widespread application of chemicals that might be dangerous to people and the environment, and (3) persons who oppose the killing fish by any means" (AFS 2000).

Rotenone and National Environmental Policy Act (NEPA) Coverage

California, Washington, and Michigan, among other states, have prepared programmatic environmental studies of rotenone use in fisheries management (WDG 1986; MDNR 1990; WDW 1992; CDFB 1994). Site-specific environmental studies are conducted for each individual rotenone treatment in California (Finlayson, et al. 2000:38-39). Environmental assessments are conducted and public notices issued for each chemical treatment project on public land in Montana (Skaar 2001:8).

Rotenone Application in the Flathead Valley

History and Authority

Between 1948 and 2001, MFWP administered a total of 74 rotenone applications on 63 lakes in the Flathead basin. Between 1948 and 1999, seven of these lakes (11 percent) have required multiple treatments. Reasons for multiple treatments include lack of success in eliminating the non-native species, inability to remove the source of unwanted fish, or illegal introduction of non-natives (by others) following a treatment. The target species from these seven lakes have been pumpkinseed sunfish, northern pikeminnow, black bullhead, red-side shiner, yellow perch, largemouth bass, coarse scale sucker, longnose sucker, finescale sucker, peamouth, eastern brook trout and, rainbow trout. The average length of time between repeat treatments has been 19 years; it ranges from 8 to

36 years. The number of lakes treated with rotenone in the Flathead basin represents only 12 percent of the 505 lakes the department considers as managed fisheries.

MFWP is authorized by law to manage (MCA 87-1-201) and/or restore (MCA 87-1-207) the fisheries resources of Montana, specifically so as to keep any species from being listed as a Federally Endangered Species. Furthermore, it is within the state's purview to stock fish into waters designated as sustainable fisheries, or those necessary to achieve the management goals identified under the above statutes to keep a species from being listed as endangered.

Tom-Tom and Whale, two high mountain lakes located in the Flathead basin, were treated in 2000 to remove hybrid trout. Both lakes were replanted (in July and September 2001, respectively) and the re-established populations have since naturally spawned and are providing sport angling. The goal of the South Fork Flathead Watershed/Westslope Cutthroat Trout Conservation Program is to remove the non-native trout that are moving out of the lakes and hybridizing with genetically pure native westslope cutthroat trout. The proposed treatment using rotenone would eliminate this threat. The lakes would then be restocked with genetically pure westslope cutthroat trout.

Regulatory Status

The State of Montana has Human Health water standards and the EPA has water quality criteria for chronic effects of some of these compounds. The EPA has no drinking water standards for rotenone. According to Skaar (2001), use of rotenone in Montana has been governed for many years by the "Surface Water Quality Standards and Procedures" rules (ARM 17.30.637 (3)(B)), which state:

"If the department [DEQ] approves the location, timing, and methods of game fish population restoration authorized by the Department of Fish, Wildlife and Parks, restoration activities causing violations of surface water quality standards may be exempt from the standards."

This exemption from water quality standards was officially adopted into statute in 1993, with the passage of section 75-5-308 of the Montana Water Quality Act. This statute states:

> "The department [DEQ] may authorize short-term exemptions from the water quality standards or short-term use that exceeds the water quality standards for the purpose of allowing construction, emergency environmental remediation, pesticide application, elimination of undesirable and nonnative aquatic species, and treatment of water for the protection of public health. The authorization must include conditions that minimize to the extent possible the magnitude of any standard violation and the length of time during which any standard violation may occur. The authorization conditions must maximize the protection of state waters by ensuring the maintenance of beneficial uses after the term of the authorization. Authorizations issued under this section may include conditions that require water quality or quantity monitoring and reporting. In the performance of its responsibilities under this section, the department may negotiate operating agreements with other departments of state government that are intended to minimize duplication in review of activities eligible for authorization under this section."

These procedures have been followed in the 1990s. In addition, the State has prepared Environmental Assessments and issued public notices for each project that involves the use of rotenone on public lands.

Rotenone Procedures and Policies

Timing of Rotenone Treatments

Rotenone would be applied in the fall. During this time of year, water levels are generally low, recreational use of the lake is reduced, and most lakes' summer thermal stratification has ended (allowing rotenone to circulate throughout the water column more quickly).

Rotenone Application Procedures

Powdered rotenone is occasionally used in Montana to rid waters of unwanted fish. An electric cement mixer is commonly used on the shoreline to mix the dry form with lake water creating a slurry. The mixture is then applied using standard boat methods described below. All people involved in mixing and applying powdered rotenone must use respirators and eye protection to keep powdered materials from entering the body. For these reasons, liquid rather than powdered rotenone would be used for this proposed project.

Liquid rotenone (the method selected for this proposed project) may be applied to a lake in two ways. Most commonly, the liquid is siphoned out of a barrel with a venturi suction mechanism mounted to the lower unit of an outboard motor directly in front of the propeller. The propeller can then mix the rotenone with water and facilitate distribution. In deeper lakes, a weighted garden hose of appropriate length attached to a pump may be used to distribute the chemical in deeper waters. A CO_2 pressurized barrel and hose may also be used to distribute at deeper depths. Application during the fall of the year takes advantage of the limnetic turn-over in which water density and temperature are consistent throughout the lake; this factor allows for better mixing of rotenone with lake water.

The second method is typically used in small shallow lakes (<15 feet deep): an auxiliary pump is used to mix lake water with rotenone before spraying the mixture over the lake surface while the boat transports the bulk rotenone and applicator.

A typical application requires six people: one boat operator, two drip station installers; one detox person; one spot sprayer; and one person to load barrels of rotenone, triple rinse empty barrels, and to load/unload cargo nets for the helicopter pilot. Two additional people are necessary for each additional boat.

The boat crew first dispenses the rotenone around the shoreline of the lake, continuing the application in concentric rings toward the center until the upper stratum is treated. If necessary, the boat then dispenses rotenone in deeper water, using pumps, and a weighted garden hose.

Simultaneously, other crew members set up drip stations at designated locations, and crews walk the perimeter of the lake to spot spray other water sources. Drip stations for rotenone are used to counter attempts by fish to avoid the rotenone application (they can smell the petroleum emulsifier that is added to make it more soluble in water) by seeking out fresh-water inputs to the lake. For this reason, it is often necessary to install drip stations at those sources around the lake. Drip rates are calculated to ensure that the fresh water sources are discharging (into the lake) lethal doses of rotenone during the treatment period. This step keeps fish from recovering from an initial rotenone exposure.

Drip stations dispense rotenone at a prescribed rate. Crew members often walk the lake perimeters to see whether fish are seeking fresh-water inputs that were not previously identified (i.e., spring inputs versus surface water). A backpack sprayer may be used to spot-spray these water sources. Because the application of rotenone causes lake water to temporarily turn milky-white, it is easy to identify most fresh-water sources, which appear as clear plumes of water.

In streams, known quantities of rotenone are dispersed through drip stations based on the calculated concentration needed to meet the fish removal objectives. Drip stations are typically run for 8 to 12 hours depending on the objectives. Caged fish are used to determine the lethality of stream water, when the desired kill has occurred, and when water is safe for restocking. Drip stations and caged fish stations are monitored continually during a treatment.

Safety Measures

At least one applicator licensed by the Montana Department of Agriculture must be on site to supervise or administer the project. Non-licensed applicators may assist with the project under the direct technical supervision of the licensed applicator. The project supervisor must be well versed in the state regulatory requirements regarding safe and legal use of the rotenone product and applicator safety. All personnel involved with the rotenone application must receive safety training specific to the formulated rotenone product to be used.

At a minimum, specific safety training must include information on the following: (1) properly reading and understanding the product label; (2) the acute and chronic applicator exposure hazards; (3) routes and symptoms of pesticide overexposure; (4) how to obtain emergency medical care; (5) decontamination procedures; (6) how to use the required safety equipment; (7) safety requirements and proper procedures for pesticide handling, transportation, storage and disposal. The Training Records must be maintained in accordance with federal and state regulatory requirements.

When applying liquid rotenone, personnel are required to wear protective clothing, including chest waders, waterproof jacket (rain jacket), and rubber gloves. If mixing powdered rotenone, personnel are required to wear respiration filter masks and eye protection to keep from inhaling or ingesting any powdered material.[5] Pumping any rotenone mixture for a surface application requires that personnel wear respiration filter masks and eye protection to avoid inhaling or ingesting aerosol droplets.

Before application, MFWP must apply for and secure a 308 permit from the Montana Department of Environmental Quality. This permit allows for short-term exemptions for water quality issues.

Rotenone Detoxification

Background

Rotenone breaks down rapidly in soil and water (EXTOXNET 1996) as it is exposed to light, heat, oxygen, and alkalinity (Skaar 2001:2). Other factors that contribute to

[5] The plan is to use liquid rotenone for this project.

degradation include the presence of organic debris, turbidity, lake morphology, dilution by freshwater, and the dosage used (Skaar 2001:2). Degradation is slower under conditions of cold temperature or higher elevation (Skaar 2001:2). Rotenone has a half-life of between three and five days. Because it binds readily to sediments, it does not readily leach from soil, nor is it expected to be a groundwater pollutant. Most lakes completely detoxify within five weeks of treatment.[6] Rotenone breaks down ultimately into carbon dioxide and water (Sousa, et al. 1991).

The "inert" ingredients commonly associated with formulations of rotenone are highly volatile and water soluble (Skaar 2001:3). Skaar notes that "These constituents tend to dissipate to non-detectable levels in less than 14 days in treated impoundments with water temperatures above 50°. None of the constituents has been found in groundwater aquifers following treatment" (Skaar 2001:4). TCE, a known carcinogen, "dissipates quickly by volatilization, less so by oxidation, and very slowly by hydrolysis" (Skaar 2001:3). Results from CDFG (1994) show that it can be found in impoundments three weeks after treatment; the study notes that in Lake Davis, in California, TCE concentrations fell below detection limits only after 37 days post-treatment (cited in Skaar 2001:3). Piperonyl butoxide (the other active ingredient in synergized formulations) remained above the detection limit of 2 ppb in Lake Davis from treatment (October 15) to the following June (cited in Skaar 2001:3).

Montana Procedures

Rotenone will degrade naturally in the treated lake. However, in lakes with stream outlets, outflow must be non-existent or detoxified so as not to affect downstream non-target fish. Dilution of rotenone-treated water by downstream freshwater inputs may reduce the concentration to sub-lethal levels. When this is not possible, an oxidizing agent—usually potassium permanganate—is dripped into the outlet stream to detoxify the rotenone before it can affect non-target organisms downstream. Finlayson et al. (2000) provide detailed guidelines for detoxification with potassium permanganate.

Recent bioassays conducted on westslope cutthroat trout in Montana indicate that potassium permanganate applied in glass aquaria at 1.5 ppm and greater can achieve 100 percent mortality after 16 to 24 hours of exposure (Grisak et al. 2002). Assays including rotenone demonstrated that its toxicity to fish was greatly reduced in the presence of potassium permanganate. Subtle adjustments in concentration of each compound would be made for each lake and stream treatment, and would take into account other factors that influence efficacy of potassium permanganate--like plankton, and interface with stream and lake bottom, water chemistry, etc. (Engstrom-Heg 1971; 1976).

It is common for many lakes in the Flathead watershed to experience low or no outflow in the fall. For this project, lakes with no outflow may be scheduled for treatment first so that no detoxification would be necessary.

The crew detoxifies the lake by one of several methods.

<u>Natural breakdown.</u> The most common method is to allow natural breakdown to occur. A variety of factors influence natural breakdown, including water chemistry, water temperature, and sunlight intensity.

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[6] Skaar notes that in the State of Washington, rotenone-treated lakes remained toxic to fish for a "mean length time of 4.55 – 4.8 weeks." He also notes that most of these lakes "had been poisoned in the fall and had mean surface water temperatures of 57-58° and pH of 7.8 – 8.3 (Bradbury 1986, cited in Skaar 2001).

Basic dilution. This method depends on fresh-water inputs to dilute the concentration of rotenone to levels sublethal to the target species.

Application of binding agent. Other methods rely on the application of a binding agent such as potassium permanganate ($KMnO_4$). This dry crystalline substance is mixed with lake water to produce a concentration of liquid sufficient to detoxify the concentration of rotenone applied. It may be applied to the effluent stream of a lake or reservoir to mix with rotenone-laced water, detoxifying the rotenone. Detoxification is accomplished within about 20-30 minutes of mixing. The potassium permanganate is generally applied using a drip station as described.

> A treatment of potassium permanganate may also be administered by boat to reduce rotenone concentration to a level sublethal to the fish species downstream of the lake. This eliminates the need to staff drip stations at the outlet of the lake for long periods of time.

Simple dilution of effluent stream water may be accomplished by inflow of fresh stream water from downstream inputs.

For each water body treated, the certified applicator submits a Montana Department of Agriculture Record of Application Report that describes, among other things, the type and amount of pesticide applied, the area treated, application rate, equipment used, possibility of a complete kill, water conditions at the time of treatment, and detoxification measures, if any.

Potassium Permanganate

The following information on potassium was taken from the manufacturer's website and contains basic information about the chemical and its uses.

Potassium permanganate is one of the most widely used inorganic chemicals for the treatment of municipal drinking water and wastewater. Hundreds of drinking water treatment plants, large and small, use this versatile oxidant to improve taste and odors; to oxidize iron, manganese, and arsenic; to treat for and control zebra mussels and biofilm in raw water intake lines; to remove color; and to provide an alternative pre-oxidant to chlorine in a trihalomethane (THM) control program. Potassium permanganate is used to treat ground water as well as surface supplies.

In municipal wastewater systems, potassium permanganate is used cost effectively to control odors in collection systems, in the treatment process, and in the mechanical dewatering operations. It is especially effective in oxidizing sulfides and mercaptans, the worst odors generated during the collection and treatment of municipal wastewater.

Municipal Drinking Water Treatment

In the American Waterworks Association's (AWWA) Water Industry Data Base (WIDB), potassium permanganate is listed as the second most widely used chemical for predisinfection and oxidation by treatment plants processing surface water. According to the data base, over 32.9 percent of the surface water plants use potassium permanganate, second only to chlorine, for disinfection and oxidation. In groundwater plants, over 22.6 percent of the plants practicing iron and manganese removal are using potassium permanganate.

The AWWA Research Foundation (AWWARF) conducted a survey of treatment plants and their practices for controlling tastes and odors. Next to activated carbon, potassium permanganate was the most widely used taste and odor control process. Over 48 percent of the plants in the survey listed permanganate usage with an 86 percent satisfaction factor.

Wastewater Treatment

Since its introduction in the early 1980s, the use of potassium permanganate for wastewater treatment has grown to become one of the largest U.S. applications of this versatile oxidant. The major use is for the oxidation of hydrogen sulfide, the "rotten egg" odor caused by the reduction of sulfur compounds normally present in wastewater. In test after test, $KMnO_4$ has been proven to be the fastest working oxidant for this application. Most other sewage odors can also be controlled using potassium permanganate.

The $KMnO_4$ application is especially effective in mechanical biosolids dewatering where toxic sulfides pose a threat to the health of wastewater plant operators as well as to the environment. Control of sulfides also reduces corrosion. Case histories and technical support literature are available.

Municipal Drinking Water Applications

Potassium Permanganate is being used successfully by utilities to remove iron, manganese, and hydrogen sulfide from both groundwater and surface water. In groundwater applications, the permanganate is normally applied directly ahead of greensand filtration. In surface water treatment plants, permanganate is applied as far ahead of the rapid mix as plant design allows, preferably at the raw water intake. Factors that affect oxidation and coagulation include pH, hardness, alkalinity, TOC, and time between permanganate addition and the addition of coagulants.

Potassium permanganate is being used by surface water utilities to successfully remove the cucumber, fishy, septic, and other odors caused by blue-green algae. In combination with activated carbon, utilities report that permanganate is cost effective in controlling musty, earthy odors. The oxidant should be applied before the rapid mix ahead of activated carbon. Potassium permanganate has been approved by U.S. EPA as an alternative oxidant to chlorine in a THM control program. Arsenic (+3) is readily oxidized to Arsenic (+5) by permanganate. The oxidized arsenic is easily adsorbed by alum, iron salts, or manganese treated greensand. Utilities report that potassium permanganate applied at the raw water intake successfully removes zebra mussel infestations and prevents the settling of veligers in pipelines. Other pipeline biofilms are also controlled.

The major application of potassium permanganate in municipal drinking water plants using surface water, is for the control of compounds causing tastes and odors. Surveys have shown that most off-flavors in drinking water are caused by metabolizing blue-green algae. Potassium permanganate treatment, either alone or in combination with other treatment technologies, is effective in controlling these algae generated odors.

According to the work presented at the Water Quality Technology Conference (WQTC), potassium permanganate is more effective at controlling “cucumber” and “grassy” odors than either chlorine or chlorine dioxide.

Potassium permanganate can be combined with powdered activated carbon (PAC) to achieve odor control of musty and earthy odors caused by MIB and Geosmin.

Recycled decant and backwash water can cause taste and odor problems. Permanganate treatment was proven to be more economical and effective than ozone for the control of these tastes and odors.

Trihalomethanes (THMs) and other chlorinated organics are formed when "free" chlorine or other halogens react with organic precursor chemicals in the raw water. By delaying the application of chlorine and applying potassium permanganate to the raw water as a substitute oxidant, and by practicing good coagulation, levels of THMs and other chloro-derivatives can be reduced to meet Safe Drinking Water Act (SDWA) standards. Potassium permanganate is listed by U.S. EPA in the Federal Register as one of the technologies that can be used in a THM control program.

Manganese and iron can be problems in both surface water and groundwater plants. Potassium permanganate effectively oxidizes both of these metals quickly and efficiently. In groundwater plants, permanganate is normally combined with manganese treated greensand filtration.

Arsenic standards may be reduced by changes in the SDWA. Potassium permanganate has been proven an effective oxidant to convert arsenic so that it can be adsorbed in subsequent treatment unit processes.

Zebra mussel control is essential in many surface water treatment plants. Potassium permanganate has case history articles available from utilities who claim effective control using potassium permanganate.

Municipal Wastewater Applications

Potassium permanganate rapidly oxidizes sulfides and other sewage odors in collection systems, in plant treatment processes, and in mechanical biosolids dewatering operations. Corrosion control, improved plant performance, and polymer savings are some of the benefits achieved. The addition of permanganate to Return Activated Sludge has resulted in the reduction of odors from aeration tanks in a conventional activated sludge wastewater treatment plant without any change occurring to the microbiology of the system.

Hydrogen sulfide is one the deadly gases that can be formed in the collection and treatment of municipal wastewater. Other organic sulfur compounds include thiols, mercaptans, and disulfides. These compounds and other nitrogen containing compounds can produce odors described as "skunk, rotten cabbage, rotten eggs, fishy, ammonia, and decaying flesh." The lack of oxygen in the collection system force mains and the active anaerobic bacteria present in a sewage system can chemically reduce sulfates and other chemicals resulting in the production of odorous compounds. These odors become prevalent in lift stations, force main discharges, and at the headworks of treatment plants. Potassium permanganate can be applied to collection systems ahead of the odor source to control most of these odors.

In-plant odors can occur at the headworks, in the primary and secondary clarifiers, in the activated sludge basins, in the fixed film reactors, and during bisolids handling and disposal. Potassium permanganate can be applied economically and effectively to oxidize the odorous compounds.

Additional Information

Potassium permanganate is normally fed early in the drinking water treatment process to allow for as much reaction time as possible before other treatment chemicals are added.

This allows for the permanganate to be reduced to form maganese dioxide, which is then coagulated and flocculated out of the system. Only systems employing filtration should use potassium permanganate because of the need to remove the by-product manganese dioxide from the water.

Industries have developed analytical methods to measure residual permanganate in water to provide analytical control tools. Potassium permanganate can be measured in the presence of residual by-product MnO_2 and chlorine.

In wastewater treatment systems, potassium permanganate should be applied as close to the odor source as possible to provide the best and fastest control. In dewatering operations, the potassium permanganate is applied directly ahead of the sludge pumps or into the sludge conditioning tanks.

Information obtained from Carus website (www.carsuchem.com). Product line is CAIROX®

Cleanup

The day after the proposed treatment is complete, the site is cleaned up. Drip stations are cleaned and removed. Other equipment and materials are removed from the site. A sub-sample of the dead is collected for measuring, weighing, scale sampling, etc. The fish that wash up on the shoreline during the project and immediately afterwards, are taken to deeper water, their air bladders punctured, then sunk. This step provides two benefits: first, nutrients from the dead fish are valuable in stimulating the primary production of the lake, which facilitates plankton blooms that serve to feed fish that are restocked in to the lake following treatment. Second, clearing dead fish from these areas improves aesthetics.

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Appendix E: MSDS Sheets on Treatment Chemicals

Antimycin

MATERIAL SAFETY SHEETS

Section 1. Chemical Identification

CATALOG #: A8674

NAME: ANTIMYCIN A FROM STREPTOMYCES SP.

Section 2. Composition/information on Ingredients

CAS #: 1397-94-0

SYNONYMS

ANTIPIRICULLIN * VIROSIN *

Section 3. Hazards Identification

LABEL PRECAUTIONARY STATEMENTS

HIGHLY TOXIC (USA)

VERY TOXIC (EU)

VERY TOXIC BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.

CALIF. PROP. 65 REPRODUCTIVE HAZARD.

IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE

IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).

WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE

PROTECTION.

Section 4. First-aid Measures

IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.

CALL A PHYSICIAN.

IF INHALED, REMOVE TO FRESH AIR. IF BREATHING BECOMES DIFFICULT,

CALL A PHYSICIAN.

IN CASE OF SKIN CONTACT, FLUSH WITH COPIOUS AMOUNTS OF WATER

FOR AT LEAST 15 MINUTES. REMOVE CONTAMINATED CLOTHING AND

SHOES. CALL A PHYSICIAN.

IN CASE OF CONTACT WITH EYES, FLUSH WITH COPIOUS AMOUNTS OF WATER

FOR AT LEAST 15 MINUTES. ASSURE ADEQUATE FLUSHING BY SEPARATING

THE EYELIDS WITH FINGERS. CALL A PHYSICIAN.

Section 5. Fire Fighting Measures

EXTINGUISHING MEDIA

CARBON DIOXIDE, DRY CHEMICAL POWDER OR APPROPRIATE FOAM.

SPECIAL FIREFIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO

PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS

EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

Section 6. Accidental Release Measures

EVACUATE AREA.

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY

RUBBER GLOVES.

SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.

AVOID RAISING DUST.

VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

Section 7. Handling and Storage

REFER TO SECTION 8.

Section 8. Exposure Controls/personal Protection

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT

GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.

SAFETY SHOWER AND EYE BATH.

USE ONLY IN A CHEMICAL FUME HOOD.

Section 9. Physical and Chemical Properties

DATA NOT AVAILABLE

Section 10. Stability and Reactivity

STABILITY

STABLE.

CONDITIONS TO AVOID

PROTECT FROM MOISTURE.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

CARBON MONOXIDE, CARBON DIOXIDE

NITROGEN OXIDES

HAZARDOUS POLYMERIZATION

WILL NOT OCCUR.

Section 11. Toxicological Information

ACUTE EFFECTS

MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH SKIN. THE TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

RTECS #: CD0350000

ANTIMYCIN A

TOXICITY DATA

ORL-RAT LD50:28 MG/KG	AACHAX -,757,1966
IPR-RAT LD50:810 UG/KG	CNREA8 13,49,1953
SCU-RAT LD50:25 MG/KG	85ERAY 2,1078,1978
ORL-MUS LD50:55 MG/KG	AACHAX -,757,1966
IPR-MUS LD50:820 UG/KG	JAJAAA 11,A26,1958
SCU-MUS LD50:1600 UG/KG	85ERAY 2,1078,1978
IVN-MUS LD50:893 UG/KG	JAJAAA 9,63,1956
ORL-DOG LD50:>5 MG/KG	AACHAX -,757,1966
ORL-RBT LD50:10 MG/KG	AACHAX -,757,1966
ORL-GPG LD50:1800 UG/KG	AACHAX -,757,1966
ORL-PGN LD50:2 MG/KG	AACHAX -,757,1966
ORL-CKN LD50:>160 MG/KG	AACHAX -,757,1966
ORL-QAL LD50:39 MG/KG	AACHAX -,757,1966
ORL-DCK LD50:2900 UG/KG	AACHAX -,757,1966
ORL-DOM LD50:>1 MG/KG	AACHAX -,757,1966
ORL-BWD LD50:5 MG/KG	AACHAX -,757,1966

TARGET ORGAN DATA

LUNGS, THORAX OR RESPIRATION (OTHER CHANGES)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

Section 12. Ecological Information

DATA NOT YET AVAILABLE.

Section 13. Disposal Considerations

DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER. OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

Section 14. Transport Information

CONTACT SIGMA CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

Section 15. Regulatory Information

EUROPEAN INFORMATION

CAUTION: SUBSTANCE NOT YET FULLY TESTED.

VERY TOXIC

R 26/27/28

VERY TOXIC BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.

S 45

IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, SEEK MEDICAL ADVICE

IMMEDIATELY (SHOW THE LABEL WHERE POSSIBLE).

S 36/37/39

WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE

PROTECTION.

U.S. INFORMATION

THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.

THIS PRODUCT IS OR CONTAINS CHEMICAL(S) KNOWN TO THE STATE OF

CALIFORNIA TO CAUSE DEVELOPMENTAL TOXICITY.

CALIFORNIA PROPOSITION 65:

Section 16. Other Information

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA, ALDRICH, FLUKA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

Rotenone

Product: 655-422 Prentox® Prenfish™ Toxicant

Material Safety Data Sheet
U.S. Department of Labor (OSHA 29 CFR 1910.1200)
Manufacturer's Name: Prentiss Incorporated
C. B. 2000
Floral Park, NY 11001
Telephone Number: (516) 326-1919

Section 1: Chemical Identification

Product: 655-422 Prentox® Prenfish™ Toxicant
EPA Signal Word: DANGER
Active Ingredient (percent): Rotenone (5 percent) (CAS # 83-79-4)
Other Cube Resins (10 percent) N/A
Chemical Names: Rotenone – N/A
Chemical Class: Mixture

Section 2: Composition/ Information 0n Ingredients

OSHA ACGIH NTP/IARC/OSHA
Material: PEL TLV Other Carcinogen
Rotenone (TWA) 5 mg/ M_3 (STEL) 10 mg/M_3 No/No/No
(TWA) 5 mg/M_3
Other associated cube resins Not Est. Not Est.
Aromatic Petroleum Solvent (Supplier recommendation 100 ppm)
(CAS # 64742-94-5)
(Not to exceed 80 percent)
Contains the following ingredients, by weight (typical):
Naphthalene (CAS # 91-20-3) 9.9 percent (TWA) 10 ppm
1,2,4-trimethylbenzene (CAS # 95-63-6) 1.7 percent (TWA) 25 ppm
Acetone (CAS # 67-64-1) (not to exceed 7.5 percent) (TWA) 250 ppm
Emulsifier #1 (CAS # N/A) 1.5 percent N/D
Emulsifier #2 (CAS # N/A) 4.5 percent N/D

Section 3: Hazards Identification

Clear liquid with mild odor. Fatal if inhaled. May be fatal if swallowed. Harmful if absorbed through skin. Causes substantial but temporary eye injury. Causes skin irritation. This pesticide is extremely toxic to fish.
Potential Health Effects:
Primary Routes of Entry: Inhalation, ingestion, skin and eye contact.
Product: 655-422 Prentox® Prenfish™ Toxicant
Health Hazards (Acute and Chronic): Causes mucous membrane irritation. Chronic exposure can cause damage to liver and/or kidneys. May be fatal if swallowed. May cause eye injury. Causes skin irritation. Do not get in eyes, on skin or on clothing. Toxicity of other components: This product contains an

aromatic solvent. Inhalation of solvent vapors at high concentrations are irritating to the eyes and respiratory tract, may cause headaches, dizziness, anesthesia, drowsiness, unconsciousness, and other central nervous system effects, including death. Aspiration of solvent during vomiting may cause mild to severe pulmonary injury, possibly progressing to death. Frequent or prolonged skin contact may irritate and cause dermatitis. Skin contact may aggravate an existing dermatitis condition. Emulsifiers may cause severe eye injury.
Signs and Symptoms of Overexposure: Can cause skin irritation. Ingestion or inhalation can cause numbness, nausea, vomiting and tremors.
Medical Conditions Generally Aggravated by Exposure: None known.

Section 4: First Aid Measures

If swallowed, call a physician or Poison Control Center. Do not induce vomiting. This product contains aromatic petroleum solvent. Aspiration may be a hazard. Promptly drink a large quantity of milk, egg white, and gelatin solution, or if these are not available, water. Avoid alcohol.
If inhaled, remove victim to fresh air. If not breathing, administer artificial respiration, preferably by mouth to mouth. Get medical attention.
If on skin, wash with plenty of soap and water. Get medical attention if irritation persists.
If in eyes, flush eyes with plenty of water. Get medical attention if irritation persists.

Section 5: Fire Fighting Measures

Fire and Explosion
Flash Point (Method Used): 60o F. Closed cup.
Flammable Limits: LEL: 1.8 UEL: 11.7 (Solvent--approximate)
NFPA Hazard Ratings: Health: 3 **Flammability:** 4 **Reactivity:** 0
Extinguishing Media: CO_2, foam, dry chemical, or water spray.
Special Fire Fighting Procedures: Do not inhale smoke. Use self-contained breathing apparatus and protective clothing. This product is extremely toxic to fish, and is toxic to birds and other wildlife, prevent spread of contaminated runoff.
Unusual Fire and Explosion Hazards: When heated to decomposition, product emits acrid smoke and fumes.
Flammability Classification/Rating:
NFPA/OSHA Class: I
NFPA Rating (Fire): 4

Section 6: Accidental Release Measures

Wear protective equipment, as required, to prevent contact with product or its vapors. Cover the spilled material with generous amounts of absorbent material, such as clay, diatomaceous earth, sand or sawdust.
Sweep the contaminated absorbent onto a shovel and put the sweepings into a salvage drum. Dispose of wastes as below. Place any leaking container into a similar drum or glass container. Mark the drum or container with name of

product, ingredient statement, precautionary statements and signal word. Contact us for replacement label. This product is extremely toxic to fish. Fish kills are expected at recommended rates. Keep it out of lakes, streams or ponds except under use conditions.
Product: 655-422 Prentox® Prenfish™ Toxicant

Section 7: Handling and Storage

Do not contaminate water, food or feed by storage or disposal. Store in a dry place away from temperature extremes. Avoid inhalation of vapors. Harmful if swallowed, inhaled or absorbed through skin. Avoid contact with skin. Wear clean protective clothing.
Other precautions: Periodically inspect stored materials.

Section 8: Exposure Controls/Personal Protection

Respiratory protection: Mixers and handlers: Do not inhale. Use NIOSH certified respirator for organic vapor protection.
Ventilation:
Local Exhaust: As required to meet TLV.
Special: Not applicable.
Mechanical: As required to meet TLV.
Other: Not applicable.
Protective Gloves: Chemical resistant.
Eye Protection: Safety glasses, face shield or goggles.
Other protective clothing or equipment: Wear long pants, long sleeved shirt or other body covering clothes. Avoid skin or eye contact.
Work/Hygienic practices: Wash thoroughly after handling and before eating or smoking. Remove contaminated clothing and wash thoroughly before reuse.

Section 9: Physical and Chemical Properties

Appearance: Amber Liquid
Odor: Aromatic Solvent Odor
Boiling Point: N/D
Specific Gravity (H_2O = 1): 0.9226
Vapor Pressure (mmHg): N/D
Melting Point: N/D
Vapor Density (Air = 1): N/D
Evaporation Rate (Butyl Acetate = 1): N/D
Solubility in Water: Emulsifies.

Section 10: Stability and Reactivity

Stability: Stable.
Conditions to avoid for stability: None.
Incompatibility: Strong acids and oxidizers.
Hazardous Decomposition or Byproducts: CO, CO_2
Hazardous Polymerization: Will not occur.

Conditions to avoid for Hazardous Polymerization: None.
Product: 655-422 Prentox® Prenfish™ Toxicant

Section 11: Toxicological Information

Acute Toxicity/Irritation Studies:
(The following data were developed with Prenfish)
Ingestion: Oral LD_{50} 55.3 mg/Kg (Rat – female)
264 mg/Kg (Rat – male)
178 mg/Kg (Rat – overall)
Dermal: >2020 mg/Kg (Rabbit) (Slightly toxic)
Inhalation: 4-hour LC_{50} 0.048 mg/l. (Rat) (Highly toxic)
Eye Contact: Moderately irritating (Rabbit)
Skin Contact: Moderately irritating (Rabbit)
Skin Sensitization: Non-sensitizing (Guinea Pig)
(The following data were developed with rotenone technical)
Mutagenic Potential: Rotenone was not mutagenic when tested.
Reproductive Hazard Potential: Rotenone had no reproductive effects when tested
Chronic/Subchronic Toxicity Studies:
Cancer Information: Rotenone was not carcinogenic when tested in rats and mice.
Toxicity of Other Components:
Petroleum solvent: The supplier reports that inhalation of high vapor concentrations (over 1,000 ppm) may cause nervous system effects such as headaches, dizziness, anesthesia, and respiratory tract irritation.
Surfactant: Causes severe eye irritation, which could lead to permanent eye damage. Prolonged or repeated skin contact may cause discomfort and local redness. Mist can irritate the respiratory tract, experienced as nasal discomfort and discharge with chest pain and coughing.
Target Organs: Eyes, skin, respiratory tract.

Section 12: Ecological Information

Summary of Effects: This product is extremely toxic to fish. Fish kills are expected at recommended rates. Consult your State Fish and Game Agency before applying this product to public waters to determine if a permit is needed for such an application. Do not contaminate untreated water when disposing of equipment washwaters.

Section 13: Disposal Considerations

Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by State and local authorities.
Product: 655-422 Prentox® Prenfish™ Toxicant

Section 14: Transport Information

DOT Classification: Pesticide liquid, flammable, toxic, n.o.s. (Acetone, Rotenone)
Hazard Class: 3, PG I
Subsidiary hazard class: 6.1
DOT Shipping Label: Poison and/or Toxic
Note: For transport purposes (49FR Part 173.132), the calculated 1-hour LC50 (Rat) is: 0.192 mg/L

Section 15: Regulatory Information

SARA Title III Classification:
Section 311/312:
Acute health hazard
Fire hazard
Section 313 Chemicals:
Aromatic Petroleum Solvent (Supplier recommendation 100 ppm) (CAS # 64742-94-5)
(Not to exceed 80 percent)
Contains the following ingredients, by weight (typical):
Naphthalene (CAS # 91-20-3) 9.9 percent (TWA) 10 ppm
1,2,4-trimethylbenzene (CAS # 95-63-6) 1.7 percent (TWA) 25 ppm
This product contains a toxic chemical or chemicals subject to the reporting requirements of Section 313 of Title III and of 40 CFR 372. Any copies or redistribution of this MSDS must include this notice.
Proposition 65: This product does not contain any chemical which is known to the State of California to cause cancer or birth defects or other reproductive harm.
CERCLA Reportable Quantity (RQ): None.
RCRA Classification: Ignitable.
TSCA Status: Registered pesticide, exempt from TSCA regulation. All ingredients are on the TSCA inventory.
Other: Rotenone
Illinois toxic substance
Massachusetts Hazardous Substance
New Jersey Special Health Hazardous Substance
Pennsylvania Workplace Hazardous Substance
Acetone
Massachusetts Hazardous Substance
New Jersey Environmental Hazardous Substance
New Jersey Special Health Hazardous Substance
New Jersey Workplace Hazardous Substance
Pennsylvania Workplace Hazardous Substance

Product: 655-422 Prentox® Prenfish™ Toxicant

Section 16: Other Information

NFPA Hazard Ratings: Health: 3 0 Least
Flammability: 4 1 Slight
Reactivity: 0 2 Moderate
3 High
4 Severe
Date Prepared: August 10, 2000
Supersedes: February 2, 1994
Reason: Revised Format

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein.

Appendix F: Threatened and Endangered Species and Forest Sensitive Species

The FWS lists the following endangered or threatened species that might occur within the project area (USFWS 2001).

Table F-1. Threatened and Endangered Species

Common Name	Scientific Name	Status**	Expected Occurrence
Grizzly bear	*Ursus arctos horribilis*	T	Resident/transient
Gray wolf	*Canis lupus*	E	Resident/transient
Bald eagle	*Haliaeetus leucocephalus*	T	Resident/transient
Bull trout	*Salvelinus confluentus*	T	Migratory/resident
Canada lynx	*Lynx canadensis*	T	Resident/ transient
Water howellia*	*Howellia aquatilis*	T	Wetlands; Swan Valley, Lake and Missoula counties
Spalding's campion*	*Silene spaldingii*	T	Upper Flathead River drainage and Tobacco Valley - open grasslands with rough fescue or bluebunch wheatgrass

**These plant species occur only at elevations below 5,000 feet[7]. Nearly all of the lakes are above this elevation.*

***Status: T= threatened, E=endangered*

Additionally, the USFWS lists the following sensitive species that may be present in the project areas (Bosworth 1999).

Peregrine falcon (*Falco perigrinus anatum*)—became sensitive after FWS delisted it.

Northern goshawk (*Accipter gentilis*)

Boreal toad (*Bufo boreas boreas*)

Common loon (*Gavia immer*)

Wolverine (*Gulo gulo*)

Harlequin duck (*Martes pennanti*)

[7] M. Mantas, Botanist, USFWS, personal communication with Colleen Spiering, BPA, Feb.14, 2002.

Flammulated owl (*Otus flammeolus*)

Black-backed woodpecker (*Picoides arcticus*)

Townsend's big-eared bat (*Plecotus townsendi*)

Northern leopard frog (*Rana pipiens*)

Northern bog lemming (*Synaptomys borealis*)

The following Species of Special Concern are also listed:

Coeur d'Alene salamander (*Plethodon idahoensis*) (Not found in the project area.)

References

Bosworth. 1999. Update of Northern Region Sensitive Species List, Wildlife. USDA Forest Service, Northern Region, Missoula, MT. 4 pp.

FWS. 2001. Letter to Colleen Spiering, Nov.8, 2001.