FINDING OF NO SIGNIFICANT IMPACT (FONSI)

Restoration of Westslope Cutthroat Trout in the East Fork Specimen Creek Watershed Environmental Assessment

Yellowstone National Park
Idaho/Montana/Wyoming

Prior to environmental changes and nonnative fish introductions in the late 1800s and early 1900s, the abundance and distribution for westslope cutthroat trout (*Oncorhynchus clarki lewisi*, WCT) was the greatest of any cutthroat trout subspecies. The distribution once extended from the eastern slope of the Canadian Rockies south to the Salmon and Clearwater drainages of Idaho and the upper Missouri River of Montana and extreme northwest Wyoming. It included both the east and west slopes of the Continental Divide and several large lakes (Pend Oreille, Coeur D'Alene, and Priest in Idaho, the Flathead in Montana, and Lake Chelan in Washington). However, WCT populations have declined considerably throughout their historic range during the past century from habitat degradation, excessive harvest, and introduced, nonnative species.

The National Park Service (NPS) proposes to begin restoration of WCT in the East Fork Specimen Creek (EFSC) watershed in Yellowstone National Park (Yellowstone or park), located in the park's extreme northwestern corner. The WCT in Yellowstone were substantially reduced due to stocking of nonnative competing and interbreeding species during the early 1900s, resulting in their near extinction by the 1930s. Recent analyses suggest that WCT have been extirpated from 36% of streams and exist in a hybridized form in most of the remaining 64% of streams. In the EFSC watershed, loss of WCT was due to hybridization by nonnative rainbow trout from downstream in the Gallatin River, and Yellowstone cutthroat trout (YCT) stocked in the historically fishless High Lake in 1937. A small genetically pure population (<1,000 WCT) was discovered in 2005 in the park, but it exists in less than two miles of habitat in an isolated, unnamed tributary to Grayling Creek. This core population shows no evidence of being hybridized and can serve a donor of pure WCT for restoration efforts.

Yellowstone prepared an environmental assessment (EA) in the spring of 2006 to provide an opportunity for public comment on alternatives for the project and analyze impacts to park resources and values. Concerns identified during scoping and evaluated in the EA were health and human safety, water quality, fish and wildlife including sensitive species, socioeconomics, wilderness, and visitor use including recreation and angling.

PREFERRED ALTERNATIVE

Under the preferred alternative, the EFSC and High Lake will be chemically treated using piscicides (fish toxins) to remove nonnative and hybridized trout. A permanent in- stream fish barrier will be constructed at the lower reach of the EFSC, and genetically pure WCT will be restored in the EFSC, High Lake and associated tributaries. High Lake and its connected spring seeps, wet meadows, and outlet stream, are isolated from the EFSC to upstream immigration of fish by a natural 15- foot waterfall located approximately 200 yards downstream from the lake outlet. This waterfall and the fish barrier will effectively isolate the system for protection of the established WCT population. The EFSC and the downstream reaches of its tributaries represent more than 12 miles of connected habitat for genetically pure WCT.

MITIGATION MEASURES

The following mitigation measures were analyzed as part of the preferred alternative:

- To inform visitors of WCT restoration activities in the watershed, visible signs will be placed at appropriate trail and campsite locations in the project area. These signs will describe the project, provide water consumption advisories, and specify where potable water is available in the area. Information will be available in park visitor centers and Ranger/Interpretive staff will be informed to answer questions from visitors. A park resource specialist will remain in the watershed during piscicide treatments to respond to visitor questions.
- The park will transport potable water to High Lake and the EFSC during the piscicide treatments for use by project personnel and visitors in the area.
- All project personnel involved with chemicals will wear safety equipment and be trained on the safe handling and use of chemicals. Safety equipment includes eye and skin protection and a respirator. Chemicals will be transported, handled, applied and stored according to the label specifications to reduce human exposure or accidental spill. The EA contains a Safety and Health Plan for chemical spill procedures (Appendix A).
- To reduce excessive sediment inputs to the EFSC, large, flexible pipes will divert water from the stream channel immediately above and around the fish barrier construction site. An NPS fisheries biologist will monitor sediment inputs to the stream channel. If excessive inputs are observed, construction will halt until the cause can be determined and remedied.
- The park will monitor for impacts to water quality throughout the project to ensure that federal and state water quality standards are not exceeded.
- During and after each piscicide treatment in High Lake, project personnel will collect the fish carcasses that rise to the surface of the lake and connected waters, check them for clipped fins, puncture their air bladders, and return them to the deep portion of the lake. This will ensure that nutrients from the trout remain in the lake and reduce the likelihood of wildlife-human interactions/conflicts.
- Fish carcasses will be collected daily from the EFSC and transported to a landfill outside of the park to avoid attracting wildlife to the project area and reduce wildlife- human interactions/conflicts.
- The park will conduct two surveys of breeding amphibians in High Lake and associated waters prior to year 1 of piscicide treatment. Amphibians that are found in waters to be chemically treated will either be removed to waters that will not be chemically treated, or held in containers, as determined appropriate. Hygiene protocols to prevent disease in frogs will be used if amphibians are moved by project personnel.
- The park has completed a wilderness Minimum Requirement Analysis (Appendix B of the EA) for equipment that will be used to implement the project.
- Resource impacts to vegetation and soils will be rehabilitated.
- Commercial outfitters and non- commercial visitors/anglers will be redirected during trail restricted times (during piscicide applications) to nearby trails and campsites by Yellowstone's Backcountry Office to mitigate impacts to outfitters and visitors.

ALTERNATIVES CONSIDERED

Three alternatives were considered in the EA. Alternative 1 was the No Action Alternative in which no action would be taken to restore WCT in the park. Under Alternative 2 (Preferred

Alternative), a fish barrier would be constructed at the lower reach of the EFSC, nonnative and hybridized trout from the EFSC including Yellowstone cutthroat trout (YCT) from High Lake would be removed using approved piscicides, and genetically pure WCT would be reintroduced into the EFSC and introduced into High Lake. Alternative 3 (Environmentally Preferred Alternative) was similar to Alternative 2 except that WCT would not be introduced into High Lake and the lake would remain in its historically fishless condition.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

The environmentally preferred alternative is determined by applying the criteria suggested in the National Environmental Policy Act of 1969 (NEPA, 42 U.S.C.A. § 4321 et seq., Public Law 91- 190 (1970)), which is guided by the CEQ. The CEQ provides direction that "[the] environmentally preferable [alternative] is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101 (40 CFR §1500 et seq.):

(1) Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.

(2) Ensure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings.

(3) Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.

(4) Preserve important historic, cultural, and natural aspects of our heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice.

(5) Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.

(6) Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Alternative 3 is the NPS Environmentally Preferred Alternative because it would best meet the six criteria. Alternative 3 would meet criteria 1, 4, 5, and 6 because it would attempt to reverse the decline of the genetic integrity of a native fish species in the park that is at risk of extinction and continue to provide a viable sport fishery in High Lake for visitors to the park. This alternative would not fully meet criteria 2 and 3 because it would result in a short- term degradation of natural resources, pose a short- term risk to the health and safety of project personnel (but not to visitors), and result in a long- term, minor to moderate adverse impact to wilderness through construction of a permanent in- stream fish barrier. However, it would meet criteria 2 and 3 better than Alternative 2 because it would attain the widest range of beneficial uses by restoring WCT into a portion of the EFSC while removing an introduced fish species from a naturally fishless lake in the park. The YCT introduced into High Lake have likely altered the community structure and inherent ecological integrity of this headwater lake over the past 70 years. NPS Management Policies (December 27, 2000) state that parks "will strive to understand, maintain, restore, and protect the inherent integrity of the natural resources, processes, systems, and values of the park." Alternative 3, while not actively restoring High Lake to its naturally fishless condition, would allow High Lake to restore naturally following removal of an introduced fish species.

NPS Management Policies (December 27, 2000) further state that the NPS will not intervene in natural biological or physical processes except "...When a park plan has identified the intervention as necessary to protect other park resources or facilities." After consideration of public comments throughout the scoping and planning process, careful review of potential resource and visitor impacts, and developing appropriate mitigation to protect resources, the preferred alternative was chosen by the park over the environmentally preferred alternative to achieve successful restoration of WCT in the park. The preferred alternative has a much higher likelihood of achieving the project goals of reversing the decline of a native fish species that is at risk of extinction in the park by providing a secure WCT refugia in High Lake.

WHY THE PREFERRED ALTERNATIVE WILL NOT HAVE A SIGNIFICANT EFFECT ON THE HUMAN ENVIRONMENT

As defined in 40 CFR §1508.27, significance is determined by examining the following criteria:

Impacts that may be both beneficial and adverse.

Impacts to the eight impact topics that were analyzed in the EA are summarized in the table below. The impacts of other alternatives varied and are described in the EA.

Health and Human Safety	Direct, short- term, negligible to minor adverse impacts from piscicides and helicopters. Negligible to minor adverse cumulative impacts.
Water Quality	Direct, short- term, negligible to minor adverse impacts from in- stream fish barrier and piscicides. Negligible to minor adverse cumulative impacts.
Wetlands/ Waters of the U.S.	Direct, short- term, negligible adverse impacts from re- routing of stream for in- stream fish barrier. Direct and indirect, long- term, minor adverse impacts from long- term use of fish barrier. Minor adverse cumulative impacts.
Fish and Wildlife	Direct, short- term, minor to moderate adverse impacts to aquatic invertebrates from piscicides. Direct, short- term, minor adverse impacts to mottled sculpin from piscicides. Direct, short- term negligible to minor adverse impacts to mammals and birds from piscicides and project operations. Minor to moderate adverse cumulative impacts.
Species of Concern	Direct, long- term, moderate beneficial (including cumulative) impacts to WCT from restoration into the EFSC watershed. Direct, long- term minor adverse (including cumulative) impacts to YCT from piscicides and removal from High Lake. Direct, short- term and potentially long- term, minor to moderate adverse (including cumulative) impacts to boreal toad and Columbia spotted frog from piscicides.
Wilderness	Direct, short- term, negligible to minor adverse impacts from in- stream fish barrier, helicopters and project operations. Direct, long- term, minor to moderate adverse (including cumulative) impacts from long- term in- stream fish barrier.
Socioeconomics	Direct, negligible to minor adverse (including cumulative) impacts to outfitters that conduct trips in the EFSC watershed.
Visitor Use Including Recreation and Angling	Direct, short- term, negligible to minor adverse impacts from temporary removal of fish in the EFSC watershed. Indirect, long- term, moderate beneficial impact to visitors and anglers from restoration of WCT. Negligible to minor adverse cumulative impacts.

Degree of effect on public health or safety.

Effects to public health and safety were determined to be negligible to minor adverse with mitigation measures. To inform visitors of WCT restoration activities in the watershed, signs will be placed in clearly visible locations at the Specimen Creek trailhead, in the upper watershed where trails enter from adjacent watersheds, and at all campsites and major trail junctions. These signs will describe the project, provide water consumption advisories, and specify where potable water is available in the area. No established human water supply intakes exist within 10 miles downstream of any proposed piscicide application locations. All project personnel involved with chemicals will wear safety equipment and be trained on their safe handling and application. Safety equipment includes eye and skin protection and a respirator. Chemicals will be transported, handled, applied and stored according to the label specifications to reduce the possibility of human exposure or spill. The Safety and Health Plan (Appendix A in the EA) includes procedures to follow in case of an accidental spill and the required safety equipment to be used by project personnel.

Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.

There are no historic or cultural resources, prime farmlands, wild and scenic rivers, or ecologically critical areas affected. Negligible to minor adverse effects to wetlands/waters of the U.S. will potentially occur from temporary re- routing of the stream for construction and long-term use of the in- stream fish barrier. The proposed action is excluded from NPS Director's Order and accompanying Procedural Manual 77- 2. A Statement of Findings is not required for impacts to floodplains or wetlands because (1) the project will not result in an adverse impact greater than negligible to the natural resources and functions of a floodplain, (2) the project will not increase flood risks, (3) the temporary impacts to wetlands are directly associated with the restoration of an ecological process, and (4) the cumulative impacts are not anticipated to amount to 0.25 acres or more of new long- term adverse impacts. Consultation under Section 106 of the National Historic Preservation Act was not required because there are no effects to historic properties. A copy of the EA was forwarded to the Montana State Historic Preservation Office (MTSHPO) on May 10, 2006, for their review. No comments were received from MTSHPO.

Degree to which the possible effects on the quality of the human environment are highly uncertain or involve unique or unknown risks.

Risks involved in the preferred alternative relate to health and human safety and nontarget species. The mitigating and monitoring measures employed to reduce the impacts to health and human public safety and to nontarget species have been effective in other instances. Therefore, there were no highly uncertain or unique or unknown risks identified.

Degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

Previous fisheries restoration projects using piscicides have occurred in Yellowstone as well as in several other national park units. The action does not establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration.

Whether the action is related to other actions with individually insignificant but cumulatively significant impacts.

The action is not related to other actions with individually insignificant but cumulatively significant impacts. Past, present and future park backcountry activities and visitor use in the Specimen Creek watershed contribute to negligible to minor adverse impacts but are not cumulatively significant.

Degree to which the action may adversely affect districts, sites, highways, structures, or objects listed on National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.

There will not be any impacts to districts, sites, highways, structures, or objects listed on National Register of Historic Places or impacts which may cause loss or destruction of significant scientific, cultural, or historical resources.

Degree to which action may adversely affect an endangered or threatened species or critical habitat.

The U.S. Fish and Wildlife Service (USFWS) concurred with the park's determination of "not likely to adversely affect" for the threatened grizzly bear, gray wolf, Canada lynx, and bald eagle for informal Section 7 consultation under the Endangered Species Act on June 7, 2006.

Whether the action threatens a violation of federal, state, or local environmental protection law.

This action violates no federal, state, or local environmental protection laws.

Impairment

In addition to reviewing the list of significance criteria, the NPS has determined that implementation of the proposal will not constitute an impairment to Yellowstone's resources and values. This conclusion is based on a thorough analysis of the environmental impacts described in the *Restoration of Westslope Cutthroat Trout in the East Fork Specimen Creek Watershed* EA, the public comments received, relevant scientific studies, and the professional judgment of the decision- maker guided by the direction in the NPS Management Policies (December 27, 2000). Adverse impacts identified in the EA are the result of the action taken to preserve and restore the WCT, a native species in the park that is at risk of extinction. Overall, the project results in benefits to park resources and values, opportunities for their enjoyment, and does not result in their impairment.

PUBLIC INVOLVEMENT

The EA was made available for public review and comment during a 30- day period ending June 7, 2006. A total of 26 comment letters were received. All but 3 letters clearly stated a position for or against the project. Comment letters included 1 correspondence from a federal agency (U.S. Environmental Protection Agency), 2 from state agencies (Montana Fish, Wildlife and Parks, Montana Department of Environmental Quality), 5 from non- government organizations (American Wildlands, Beartooth Alliance, Greater Yellowstone Coalition, Montana Trout Unlimited, Save the World Organization), 1 from joint business owners, and 17 letters from individuals. No form letters were received. Substantive comments centered on the use of piscicides, scope and timing of project components, alternatives, sources for fish stocking, impacts to nontarget species, monitoring, and adaptive management. Most of the letters were highly supportive of the project as proposed (17 of 26). An additional 3 letters were supportive

of the project with additional recommendations. Two letters were opposed to the use of piscicides, one was against intervening with nature, one was against fishing in the park, and two were against the park removing YCT from High Lake without first attempting to move them to other waters in the park and/or by providing anglers an opportunity to remove them. Based on the comment letters received, the potential effects on the quality of the human environment from the proposed project are not highly controversial. Responses to substantive comments are attached to this FONSI. These concerns and errors noted by park staff resulted in five changes to the text of the EA that are listed in the Errata Sheet attached to this FONSI. The FONSI and Errata Sheet will be sent to those who provided substantive comments.

CONCLUSION

The preferred alternative does not constitute an action that normally requires preparation of an environmental impact statement (EIS). The preferred alternative will not have a significant effect on the human environment. Adverse environmental impacts that could occur are negligible to moderate in intensity. There are no significant impacts on public health and safety, wetlands/waters of the U.S., fish and wildlife, Species of Concern, wilderness, socioeconomic resources, or visitor use. No highly uncertain or controversial impacts, unique or unknown risks, significant cumulative effects, or elements of precedence were identified. Implementation of the action will not violate any federal, state, or local environmental protection laws.

Based on the foregoing, it has been determined that an EIS is not required for this project and thus will not be prepared.

Recommended: _____ 6/30/06
Suzanne Lewis
Superintendent
Date

Approved: For _____ 7-6-06
Michael D. Snyder
Director, Intermountain Region
Date

Errata Sheet

Restoration of Westslope Cutthroat trout in the East Fork Specimen Creek Watershed Environmental Assessment

Yellowstone National Park

Page 21, paragraph 2, line 5, change "brook trout" to "Yellowstone cutthroat trout."

Page 52, *Visitor Use Including Recreation and Angling* section in table, 3rd column, add "Indirect, long- term, moderate beneficial impact to visitors and anglers."

Page 52, *Visitor Use Including Recreation and Angling* section in table, 4th column, add "Indirect, long- term, minor beneficial impact to visitors and anglers."

Page 61, first paragraph under *Amphibians* section, line 4: Change "boreal chorus frog" to "Columbia spotted frog."

Page 86, add the following text as a fifth bullet to section 5.0 in Appendix A of the EA: "In case of an accidental piscicide spill into the waters of the Specimen Creek drainage, on- site personnel would immediately contact the park communications center. The park would then coordinate with the Montana Department of Fish, Wildlife and Parks (MTFWP) to contain the piscicide within the portion of the Specimen Creek watershed upstream of the Highway 191 bridge. This would be accomplished by rapidly (within 4 hours) deploying potassium permanganate dispensing equipment to the Highway 191 Bridge by Yellowstone staff with possible assistance from MTFWP. Potassium permanganate would be added to Specimen Creek, either as dry crystals or as a concentrated solution, at a rate sufficient to neutralize the amount of spilled piscicide."

SUBSTANTIVE COMMENTS

Scope of project

Comment: While the East Fork Specimen Creek does provide the best habitat and creating an effective barrier in the mainstem of Specimen Creek would be difficult, the North Fork Specimen Creek should also be included as part of the project to significantly increase the restored WCT metapopulation's resistance to stochastic events such as a large fire in a portion of the drainage.

Response: The NPS agrees that restoring North Fork Specimen Creek and physically reconnecting this stream to the EFSC via the mainstem Specimen Creek would increase the resilience of WCT to disturbance in the Specimen Creek watershed. A separate NEPA analysis would be conducted if the park determines in the future that it may be feasible to restore WCT to the North Fork Specimen Creek.

Timing of project components

Comment: Assuming the 2006 treatment in High Lake is successful and the 2007 treatment occurs in early fall, we don't see how the lake can be re- stocked at that point, nor is it desirable. Before restocking the lake, the park will need to survey the lake a final time to ensure the chemical treatment was effective and it would be better, if not more practical, to survey in the spring of 2008 and then restock.

Response: Gillnets will be placed in High Lake during fall of year 1 (planned for 2006) following the second piscicide treatment. The nets will be checked for YCT during fall of year 1 and will remain in High Lake through the entire winter and spring of year 2 (planned for 2007). The nets will be checked for evidence of YCT again during summer of year 2. Following the third piscicide treatment during year 2, gillnets will again be placed in High Lake and checked regularly for YCT. Visual surveys, snorkel surveys, and surveys using kick nets and seines will also be conducted post- treatment to search for evidence of surviving YCT. Only if it is determined through multiple lines of evidence that YCT have been completely removed from High Lake would WCT be introduced.

Alternatives/use of YCT

Comment: I was present at the Park Service presentation and scoping meeting in the Bozeman area and I suggested alternatives to the poisoning of the YCT in High Lake which went unobserved during the formulation of the EA. As the Yellowstone Lake population of YCT is threatened by lake trout and as YCT numbers are declining in many areas, the isolated High Lake population of YCT could serve as a reserve, a stocking source and/or a brood source for these threatened waters. A large percentage of the YCT could be netted or shocked and captured, and then relocated to other natural YCT waters.

Response: Capture by electrofishing and/or angling was addressed in the EA under *Alternatives Considered But Dismissed From Further Analysis.* These methods would result in an incomplete removal of nonnative fish and a failure to meet project goals. Due to the remoteness and wilderness setting of High Lake, it is not cost effective to capture YCT there and then move them for purposes of supporting a sport fishery in another location. The YCT of High Lake represent only <0.008% of all remaining genetically pure YCT in the park. The fish of High Lake were stocked in 1937 from a hatchery source and are not genetically unique. Two well-established brood sources already exist for YCT at the MTFWP's Yellowstone River Trout

Hatchery at Big Timber, Montana, and the Wyoming Game and Fish Department's Ten Sleep Fish Hatchery at Ten Sleep, Wyoming. In addition, promoting YCT angling harvest would result in higher than normal visitor use to the High Lake area and increase resource damage. Due to its proven productive potential, High Lake provides an invaluable opportunity for establishment of a critically- needed WCT refugia in the park.

Comment: Angling should be used to remove fish rather than piscicides.

Response: Use of angling to remove YCT and hybridized WCT was addressed in the EA under *Alternatives Considered But Dismissed From Further Analysis.* Angling would result in incomplete removal of nonnative fish and a failure to meet project goals. Promoting YCT angling harvest would result in higher than normal visitor use to the High Lake area and increase resource damage.

Comment: There does not seem to be a negative effect upon the WCT recovery plan by simply delaying the process by a year or two in order to make a beneficial use of the existing YCT.

Response: The critical status of WCT in the upper Missouri River drainage warrants immediate action by the NPS to aggressively restore and create a secure refugia for this species in the park.

Sources for fish stocking

Comment: It is unclear to us what the source of these fish will be. It will be impossible for the park to tap one of its identified sources, the tributary in the Fan Creek drainage. This, to us, is the most ideal source for the whole project because it is the "nearest neighbor" source. Even if fish from the Fan Creek watershed were collected in 2006 and a brood stock program started at the Sun Ranch—which isn't occurring at this time—the park would not have fish available by 2007 or 2008. It also would be unwise to capture for relocation fish of any age class from the tributary of Fan Creek. The population is simply too small to sustain this scale of removal. ... The park should obtain the source fish from either the Sun Ranch hatchery program or the North Fork of Fan Creek if any of those fish are found to be genetically pure. Fish from the Washoe Park State Trout Hatchery in Anaconda, Montana, should not be used. ... We also recommend the park evaluate and disclose how it might use eyed eggs and remote- site incubators for reintroduction efforts in the stream.

Response: Our intended method of introducing WCT will be through introduction of fertilized (eyed) eggs placed in stream- side incubators. Our preferred source for genetically pure WCT is the recently discovered population in an unnamed tributary to Grayling Creek in the park. More than 700 WCT exist in this tributary, and through collaboration with Lee Nelson with MTFWP, and other regional experts, eggs will be taken from up to 10 females each year. The eggs will either be held at the Sun Ranch facility (where arrangements already been made by the park) for introduction to the EFSC watershed late in the season (such as during fall of year 2 at High Lake) or moved directly to the EFSC watershed without incubation at Sun Ranch for introductions earlier in the season. Our intent is to replicate the existing WCT population in the park and to develop a secure refugia for these fish in High Lake. The intent is not to develop a brood stock in a hatchery facility such as that of Sun Ranch. The Sun Ranch, or other similar facility, would be used only to hold fertilized eggs at cool temperatures for introduction later during the season. The WCT of North Fork Fan Creek (stream specialists) and/or the existing Sun Ranch brood stock (generalists) would also be used for introduction to the EFSC watershed if deemed necessary in the future. The WCT brood stock held at Washoe Park State Trout

Hatchery, Anaconda, Montana (generalist source from west of the Continental Divide) would be the least preferred source of WCT for the EFSC watershed; however, this source may be used if it is determined that all other genetically pure WCT populations/brood sources for some reason are lost in the future (due to disease, introgression, etc.) and the Washoe Park brood stock is the only viable option.

Fish barrier

Comment: It's difficult to evaluate how successful the barrier on the East Fork could be, or the potential difficulty and impacts associated with construction, without the benefits of seeing a hydrological evaluation. The EA contains no information on seasonal flows including peak discharges in the East Fork.

Response: During year 1, engineers and hydrologists from the U.S. Forest Service and the NPS will complete detailed measurements of the barrier site. These measurements will be used to conduct flow modeling at various barrier heights and discharge rates. This hydrological evaluation will provide needed information for proper barrier design and installation during fall of year 1 (planned for 2006).

Comment: Also left unstated is the expected life span of the barrier and what the plan is for long- term monitoring and maintenance.

Response: A similar barrier was constructed in the mid- 1970s on Canyon Creek, a tributary of the Gibbon River in the park, by NPS and the U.S. Fish and Wildlife Service (USFWS) Yellowstone Fisheries Assistance Office. To date, this barrier remains in place, and it is anticipated that the EFSC barrier will have a similar life expectancy (30+ years). Monitoring of the EFSC barrier will occur annually with maintenance/repair conducted as needed to ensure its effectiveness.

Dead fish collection and disposal

Comment: We recommend elaboration on the frequency of dead fish collection and where the dead fish will be disposed.

Response: As stated in the EA, dead fish will be collected daily from piscicide treated waters in the EFSC and connected waters, and transported out of the park using pack stock, and brought to a local landfill for disposal. Air bladders of dead fish from High Lake and connected waters will be punctured and fish will be returned to the deep portion of the lake.

Impacts to nontarget species

Comment: We recommend more fully addressing efforts to restore or compensate for unavoidable impacts to nontarget species.

Response: If post- treatment monitoring indicates a substantial decline and lack of recovery of a nontarget species, advice from the appropriate species expert(s) will be sought and undertaken if deemed necessary and feasible.

Comment: Although grizzly bears (and other large mammals) are not susceptible to piscicides and they have not been observed feeding on fish in Specimen Creek, there is a good chance that staff working on this project will encounter grizzly bears over the nine- year course of this

project. We therefore recommend that all employees working on the field component of this project receive adequate training on how to avoid negative interactions with grizzly bears.

Response: The park agrees with this recommendation and will train all employees working on the field component of this project on how to avoid and minimize negative interactions with grizzly bears in the project area.

Comment: Because detectibility of amphibians in surveys varies, a single search is inadequate to determine presence/absence with high confidence. Searches for larval amphibians should be conducted between mid- June and mid- July. If ephemeral pools are present, they should be surveyed before mid- July.
Response: The park will conduct surveys for amphibians in targeted areas twice during the recommended times prior to treatment with piscicides.

Comment: The EA should disclose that catching amphibians for temporary removal (if necessary) will likely remove only a portion of amphibians actually present.

Response: The park acknowledges that the temporary removal of amphibians (if necessary) will likely result in only a portion of the amphibians being moved because some may avoid capture.

Comment: The timing of chemical treatments should be considered as a mitigating factor for amphibians (and other fauna?).

Response: To achieve a complete fish removal, piscicide application must occur (1) after spring/early summer stream flows have declined to seasonal lows, and (2) prior to an early fall decline in water temperatures. The timing of piscicide applications cannot be changed to later in the season because low water temperatures would reduce piscicide effectiveness and result in an ineffective treatment and a failure to meet project goals.

Comment: I strongly recommend that amphibian monitors be present during chemical treatments to observe if the treatment affects amphibians. This is important for adaptive management, particularly if the park intends similar projects elsewhere.

Response: As with other sensitive, nontarget species, monitoring for amphibian impact/response will occur for several years following piscicide treatments and WCT restocking.

Comment: The EA states that High Lake is a nesting site for Barrow's goldeneyes, and that the birds nest into mid- July. No mention is made of how the project will affect juvenile goldeneyes, which presumably are still present during the time bioassays will occur on the lake in the summer of 2006, and during treatment in 2006 and 2007. We presume the birds will be displaced. How will this apparent conflict be addressed?

Response: The park agrees that that Barrow's goldeneye juveniles would be displaced during the two years of piscicide treatments at High Lake. The ability of these juveniles to move to other water sources will likely be limited and mortality of some or all of them could occur.

Comment: We presume there are no proposals to reintroduce native mountain whitefish to the EFSC. Can mountain whitefish adequately repopulate treated waters without stocking?

Response: Sampling conducted by park staff in 2004 and 2005 did not capture any mountain whitefish in the EFSC drainage. While no barriers to whitefish movement currently exist

between the Gallatin River and the EFSC, mountain whitefish likely rarely utilize the EFSC. For this reason the current proposal does not include the restocking of mountain whitefish to EFSC above the proposed barrier. However, if mountain whitefish are encountered during pretreatment sampling or during the treatment, the park will evaluate whether a plan is needed to restore and monitor this species in the EFSC.

Comment: We recommend that the lowest dosages of rotenone and antimycin that will achieve effective removal of target species be used in order to minimize adverse effects to nontarget species. We believe it would be appropriate to identify the maximum expected concentration of these piscicides that would be used in order to better understand the potential impacts of proposed piscicides upon nontarget species.

Response: The bioassay processes will yield estimates of the lowest effective concentrations of antimycin and rotenone for EFSC and rotenone for High Lake. However, it should be understood that the minimum concentration found to kill fish under the bioassay conditions cannot be assumed to be the minimum effective treatment concentrations. The handling stress that precedes bioassays and confinement, and observation- related stress during bioassays may cause fish to succumb more readily to piscicides than would occur in the lake or stream. Additionally, bioassays conducted on High Lake will be conducted in a confined space with well- mixed treatment water. One of the problems associated with treatment of standing waters with piscicides is achieving a homogenous mixing of toxin throughout the water column. While homogenous distribution of piscicide is our goal for the High Lake treatment, it would be a mistake to assume that it would be precisely accomplished. Increasing concentrations helps ensure that target concentrations are reached throughout the entire water column by setting up a stronger concentration gradient, whereby piscicide travels from areas of high concentration to areas of low concentration. Therefore, treatment concentrations will be based on, but will be higher than, the minimum concentration found to effectively kill fish during the High Lake bioassays.

Flowing water piscicide treatments, such as the ones proposed for the EFSC, require a different strategy for determining the minimum amount of piscicide required. Because antimycin and rotenone break down in the natural environment rapidly, the standard treatment method is to treat the stream to a given concentration and then determine how far downstream the piscicide will effectively kill fish. Minimizing piscicide use is done by accurately calculating the necessary distance between drip stations and avoiding overlap. The accurate calculation of necessary distance between drip stations will be the goal of the EFSC bioassays.
The maximum expected concentrations of piscicides to be used during the proposed project are 50 parts per billion (ppb) active rotenone and 10 ppb active antimycin. These concentrations are the maximum concentrations allowed by the products' respective labels for the conditions we would expect to encounter at High Lake and in the EFSC.

Comment: Will full detoxification be required before High Lake ices over? We would expect additional potential for impacts to nontarget species if long periods of toxicity are allowed, particularly with use of rotenone.

Response: Yellowstone proposes to conduct chemical treatments in the EFSC and High Lake during August when streamflows are lowest and water temperatures are highest. Warm water temperatures promote the rapid degradation of fish toxicants and are therefore desirable because they reduce the amount of time toxins persist in the environment. Estimates made

using a High Lake temperature profile taken during late summer, and the literature concerning rotenone persistence, indicate that detectable levels of rotenone will persist for no more than 18 days in High Lake post treatment. Given the proposed treatment period and the expected persistence times of rotenone in High Lake we expect complete detoxification before High Lake freezes.

Comment: What precautions or mitigation measures are proposed to assure minimal effects on nontarget species from potassium permanganate? How far downstream from detoxification stations on streams will potassium permanganate or piscicide toxicity be evident to aquatic life?

Response: Potassium permanganate levels will be monitored at a point 30 minutes of contact time downstream from the neutralization station using a handheld colorimeter. This method would allow us to measure permanganate levels several times daily and ensure that over- application of permanganate is not occurring. We would expect potassium permanganate concentrations to be approximately 1 parts per million (ppm) at the monitoring point, which is the recommended target level in the USFWS *Rotenone and Antimycin Use in Fish Management* training manual.

Piscicide toxicity is expected to continue up to 30 minutes of flow travel time downstream of the neutralization station. This is due to the fact that 30 minutes of contact time between the piscicide and the potassium permanganate is required to effectively neutralize the toxin. Effectiveness of detoxification of piscicide would be monitored using sentinel caged fish. The distance effects from toxicity of potassium permanganate seen downstream of the neutralization station is not known with complete accuracy, as effects will depend on ambient water conditions at the time of treatment. However, the effect from potassium permanganate should be minimal beyond 30 minutes of travel time downstream of the neutralization station (the point where full neutralization of piscicide is expected) because concentrations are expected to be 1 ppm or less and potassium permanganate is rapidly oxidized in the natural environment.

Availability of aquatic invertebrates for restored WCT

Comment: How will the park determine that there is enough aquatic life in the East Fork Specimen Creek watershed to support the genetically pure WCT?

Response: Recolonization of treated waters by invertebrates will likely occur from streams and lakes in the watershed that are fishless and not treated. Monitoring of invertebrate communities prior, during, and after piscicide treatments using standard protocols will provide information on availability for reintroduced WCT. WCT will not be reintroduced if the park determines that sufficient aquatic life does not exist to support them.

Monitoring/adaptive management

Comment: We recommend providing additional details on monitoring and adaptive management.

Response: Pre- treatment surveys to determine baseline conditions will continue prior to beginning work as described in the EA. Monitoring for potential effects on water quality and/or nontarget species such as invertebrates and amphibians will occur during treatment and will continue post treatment. Monitoring of reintroduced WCT and for potential effects on water quality and/or nontarget species such as invertebrates and amphibians will be conducted using standard protocols. If the fish are not completely removed from High Lake, EFSC, and/or connected waters by the treatments, research to determine the cause of failure would be

undertaken. Additional treatments would be conducted to meet project goals if the reason for initial failure can be identified and rectified. A separate NEPA analysis would be conducted if impacts were determined to be greater than those analyzed in the EA.

Impacts from transport of equipment, materials, and project personnel

Comment: We recommend enhancing discussion of methods of transport of equipment, people, and material to treatment sites and disturbance and impacts associated with such access and transport.

Response: Details on methods of transport of equipment, people, and material to treatment sites are provided in the description of Alternative 2. Analysis of impacts due to these activities is provided in the Environmental Consequences for Wilderness and in the NPS wilderness Minimum Requirement Analysis (Appendix B) of the EA.

Comment: Biological integrity is compromised by introduction of fish to fishless lakes.

Response: The NPS agrees with this comment. Research has demonstrated impacts on native fauna by fish introduced to historically fishless lakes in other areas. At present, the High Lake fauna is already altered by stocking of nonnative YCT in 1937. The community structure and nutrient dynamics that existed prior to the stocking does not likely exist at this time. In addition, this popular sport fishery has been in use for decades. The NPS acknowledges that returning High Lake to its original, fishless condition would be the Environmentally Preferred Alternative. However, because one of the project goals is to create a secure refugia for genetically pure WCT, alternative 2 is the park's preferred alternative for this EA.

Illegal reintroduction of nonnative trout

Comment: A contingency plan is needed in the event that continuing illegal reintroduction of nonnative trout occurs after the proposed treatments.

Response: The NPS does not agree that continued illegal reintroduction of nonnative trout has occurred or is occurring in the park. During the period 1889- 1956, both native and nonnative fishes were intentionally stocked throughout the park. Ecological implications of these stockings were not fully understood at the time. The intent was to provide the greatest number and variety of trout possible to be enjoyed by park visitors. With the (likely) exception of lake trout in Yellowstone Lake, all nonnative fish populations that presently exist are due to intentional, historical stocking activities by park managers, and not by illegal activities of visitors.

Rotenone treatments in Cherry Lake, Montana

Comment: The EA misleads the readers about piscicide treatments conducted by Montana Fish, Wildlife and Parks at Cherry Lake, Montana, in 2005, by implying that significant quantities of rotenone were used in the lake to successfully complete the removal of nonnatives.

Response: The NPS does not agree that the use of significant quantities of rotenone was implied or that readers were mislead regarding the Cherry Lake treatment. The EA makes only a single reference regarding rotenone treatments in Cherry Lake (page 21, paragraph 2, lines 10- 12) where it states: "Rotenone was used in addition to antimycin for the Cherry Lake project in 2005 and all indications are that the treatment was successful."

Piscicide applications and effects

Comment: It would be of interest to include additional discussion regarding piscicide monitoring and piscicide concentration gradients that may occur during treatments.

Response: Piscicide mixing and concentration gradients in High Lake are concerns for this project. Powerful outboard motors would be used to mix the piscicide horizontally and vertically throughout the water column as thoroughly as possible. Regardless, some degree of concentration gradient would presumably be present. It would be our goal to limit the upper extent of that gradient to 50 ppb active rotenone (the maximum concentration allowed by the label) and limit the lower extent to estimated minimum effective concentration. In order to accomplish this we would not apply liquid rotenone in its concentrated form and instead would apply the product as a diluted tank mix. Additionally, diluted product would be applied by backpack sprayers to the vegetated littoral zone.

Comment: We did not see a discussion of whether liquid or powdered rotenone would be the preferred formulation for this project. ... Has the NPS monitored for the presence of ...aromatic solvents in rotenone treated waters following treatments...? Does the NPS propose to monitor the presence and degradation of these compounds with this proposed project? Are sentinel fish cages the only means of monitoring for toxicity?

Response: Yellowstone will use liquid emulsifiable rotenone to complete the main lake treatment and powdered rotenone in sand matrix to treat spring seeps and wetland areas around High Lake. Yellowstone will monitor for the presence and degradation of volatile and semi- volatile organic compounds (VOCs and SVOCs) associated with aromatic solvents used in liquid emulsifiable formulations of rotenone. Yellowstone has selected CFT Legumine as the liquid emulsifiable rotenone product of choice for the project. CFT Legumine is a new product from Prentiss Inc. and was chosen because it is formulated with a detergent and solvents package with a greatly reduced petroleum- based hydrocarbon chemical content. The lower petroleum-based hydrocarbon based chemical package should reduce risk to the environment, piscicide applicators, and the general public by reducing or eliminating associated chemicals. Sentinel fish cages will be the only means of monitoring toxicity during and after piscicide applications.

Public health

Comment: Rotenone has been linked to Parkinson's disease- like conditions in rats according to the article *Scientists Probe Role of Genes, Environment in Parkinson Disease* by The Journal of the American Medical Association (JAMA) (B.M. Kuehn, 2006, Vol. 295, No. 16, pages 1883- 1885).

Response: The article that appeared in JAMA made reference to several studies that have utilized rotenone to induce Parkinson's disease- like symptoms in laboratory animals and cultured animal cells. The first reference to rotenone in the article states: "Animal studies have previously found that MPTP and a pesticide called rotenone cause Parkinson- like symptoms..." This citation likely referrs to an article that appeared in the journal Nature Neuroscience (December 2000) titled *Chronic systemic pesticide exposure reproduces features of Parkinson's disease.* In that study, scientists from Emory University injected rotenone into the jugular veins of rats for between 7 days and more than 5 weeks which caused Parkinson's disease- like symptoms in test animals. However, the study has very little relevance to human- related rotenone risk where the predominant means of exposure is through oral consumption. In a study conducted by the USFWS in 1988, laboratory rats were fed high doses of rotenone over a two- year period and no evidence of physical, histological, or behavioral Parkinson's disease-

like symptoms developed. The second reference to rotenone in the JAMA article refers to the induction of Parkinson's disease- like symptoms in cultured mouse cells. This does not represent a relevant exposure mechanism to investigate risk to humans and other mammals that may encounter the pesticide under conditions in a normal fisheries management application. The American Fisheries Society has thoroughly addressed the link between rotenone and Parkinson's disease on their website, www.fisheries.org/html/rotenone/parkinsonstudy.shtml.

Comment: Any poison deliberately placed in our Montana streams, ponds, and lakes eventually can wind up in our drinking water.

Response: Contamination of drinking water with piscicides is a valid concern. However, several factors minimize the risk of human exposure to piscicides during the project: (1) it degrades naturally in days or weeks; (2) a piscicide used in flowing waters will be neutralized before it flows to a place where humans might drink it; (3) a piscicide binds tightly to sediments when applied in a lake or pond, preventing entry to groundwater and migration to domestic wells; and (4) treatment areas will be well- posted to inform visitors during chemical treatments. No established human water supply intakes exist within 10 miles downstream of any proposed piscicide application locations.

Comment: How can any poison which so quickly kills fish and insects not be potentially deadly to humans?

Response: Because gill- breathing organisms absorb antimycin and rotenone directly into their bloodstream through their gills, the piscicide exhibits rapid toxicity to these organisms. Mammals, including humans and other air breathers, are not as readily susceptible to these pesticides because the exposure risk often comes from oral consumption of the poison and the toxin is broken down by the gut before entering the blood stream. Rotenone in its concentrated form is potentially harmful to humans, particularly as an inhalation risk. Rotenone applicators are required by law to be certified by the state of Montana and wear appropriate personal protective equipment including a fitted respirator.

Comment: Will an applicator licensed by the Montana Department of Agriculture be well-versed in the state regulatory requirements regarding safe and legal use of the piscicides be on-site to supervise or administer the project?

Response: Three to five certified personnel will be licensed by the Montana Department of Agriculture and will be well- trained in the safe and legal use of piscicides. Additionally, two project staff members have been certified through the USFWS *Rotenone and Antimycin Use in Fish Management* training course.

Comment: The EA needs to address an emergency response plan for excessive spills of any chemicals in the East Fork Specimen Creek Watershed. What safeguards will be in place to ensure that the Gallatin River is not impacted?

Response: Appendix A of the EA contains an emergency response plan in the event of an accidental chemical spill. See the Errata Sheet (page 86) for changes to Appendix A regarding measures to safeguard the Gallatin River in case of an accidental spill.

Comment: The EA...does not include any quantified estimates of effects from chronic exposure to water containing treatment chemicals or consumption of fish exposed to such water. We suggest additional evaluation and disclosure of potential human health effects.

Response for rotenone: There are no federal or Montana numeric water quality standards for rotenone; however, methods used by the U.S. Environmental Protection Agency (EPA) for calculating human health criteria (based on noncarcinogenic effects to estimate a safe level for life long exposure to water and the consumption of fish exposed to water containing rotenone) is 40μg/L water plus fish. The calculation is based on several assumptions:

- Long- term (70 years) exposure,
- Average body mass of 70 kg (Body Weight, BW),
- A person consumes 2 L of water per day (Daily Intake, DI),
- A person consumes 0.0065 kg of fish per day (Fish Intake, 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:

- 0.004 mg/kg- day (RfD) * 70 kg (BW)
- 2 L/day (DI) + (0.0065 kg/day (FI) * 770 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 2- 3 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 or float to the surface would be collected and manually submerged in the deep part of High Lake. Fish collected during the EFSC treatment would be collected and disposed of daily outside of the park. 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.

Response for 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 2001 study (Stillmeadow) 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 a few times in the EFSC 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 four 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:
3) A factor of 10 based on the subchronic/chronic uncertainty; and
4) A factor of 3 based on the limited number of studies.

The estimated RfD is: $\frac{0.5 \text{ mg/kg- day}}{10*10*10*3 \text{ (uncertainty factors listed above)}} = 0.0017 \text{ mg/kg- day}$

Some chemicals tend to increase in fish tissue over the concentration in the water or bioconcentrate. 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 subchronic exposure criteria. The calculation of the antimycin criteria is as follows:

- 0.0002 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 μg/L. As with rotenone, the major threat to human health resulting from the use of antimycin is from accidental exposure to abnormally high concentrates during application. To avoid this, applicators are cautioned by the product label and required by the Montana Department of Agriculture to use protective gear.

Response for 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 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.

The following table lists toxicant target concentrations and human health values of rotenone, antimycin, and potassium permanganate.

Toxicant	**Water Column Value (Target Concentrations)**	**Human Health Value**	
		Water plus fish	Water Only
Rotenone	50 •/L	18 •/L	140 •/L
Antimycin	8.0 •/L	- - -	7.0 •/L
Potassium Permanganate	4.5 mg/L	- - -	0.8 mg/L