National Park Service
U. S. Department of the Interior

GLACIER NATIONAL PARK
Montana
Waterton-Glacier International Peace Park

Westslope Cutthroat Trout and Bull Trout Preservation in the Upper Camas Drainage

Environmental Assessment

March 2019

Top left: Juvenile bull trout and westslope cutthroat trout. **Top right:** Juvenile bull trout *(photos courtesy of Johnny Armstrong)***. Center:** Westslope cutthroat trout *(NPS photo).*

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Chapter 1 – Proposed Action and Need for Action

The Proposed Action

The National Park Service (NPS) is proposing to use rotenone, a fish toxicant, to remove non-native Yellowstone cutthroat trout from Camas Lake, Lake Evangeline, and Camas Creek above Arrow Lake in the upper Camas drainage of Glacier National Park (Glacier). Following the removal of the Yellowstone cutthroat trout, genetically pure (less than one percent non-native genes) native westslope cutthroat trout as well as bull trout and native sculpin would be translocated (i.e. stocked) into Camas Lake and Lake Evangeline. This would be done to establish a native fish assemblage that is secure against the threats of non-native fish and climate-related habitat degradation.

Need for Action

Camas Lake and Lake Evangeline were historically fishless, but stocked with non-native Yellowstone cutthroat trout in the 1920s and 30s. The presence of non-native Yellowstone cutthroat trout in the lakes presents an ongoing risk of hybridization to downstream native westslope cutthroat trout populations. Genetically pure populations of westslope cutthroat trout in the park are already at risk, with some populations at risk of extirpation and/or a loss of historic genetic lineages due to competition and hybridization with non-native rainbow trout, brook trout, and Yellowstone cutthroat trout. In the North Fork of the Flathead River system, of which the Camas drainage is a tributary, important genetic characteristics of native westslope cutthroat trout that evolved in the North Fork are threatened by expanding non-native rainbow trout populations.

Action is necessary to reduce the overall risk of hybridization in the Camas drainage and increase the protection of native westslope cutthroat trout populations downstream and throughout the North Fork system. Establishing a new, genetically secure population of westslope cutthroat trout would expand the distribution of pure westslope cutthroat trout, and protect the genetic characteristics of North Fork of the Flathead westslope cutthroat trout. It would also create a means to gradually reverse hybridization throughout the North Fork, as pure westslope cutthroat trout move downstream and gradually reproduce with fish from Trout, Arrow, and Rogers Lakes and into the North Fork and broader Flathead River system.

The proposed action would also advance the long-term preservation of native bull trout. As with other bull trout populations in the park, bull trout in Rogers Lake in the Camas drainage are threatened by non-native invasive lake trout. Several bull trout populations in the park are at near risk of functional extinction due to non-native lake trout. Establishing a secure bull trout population at Lake Evangeline and Camas Lake would compensate for the risks to the Rogers Lake bull trout population, help mitigate some of the losses in bull trout abundance in other areas of the park, and expand the overall distribution of bull trout on the west side of the park.

The stressors to westslope cutthroat trout and bull trout from non-native fish are compounded by habitat changes that are occurring as a result of climate change, such as altered precipitation patterns, higher water temperatures, and damage to spawning beds from flood events. Changes in stream flow and increasing frequency and intensity of disturbances, such as wildfire and rain-on-snow events, also have the potential to impact native fish (Williams et al. 2009). Research suggests a trend of increasing stream temperatures in the Crown of the Continent Ecosystem (Jones et al. 2017).

Glacier has a critical role in the conservation of westslope cutthroat trout, listed by Montana as a species of concern, and bull trout, also a state listed species of concern and federally listed as threatened under the Endangered Species Act (ESA). The park contains a high proportion of natural lake (i.e. undammed) core areas for westslope cutthroat trout and bull trout, and is considered a stronghold for both species (Liknes and Graham 1988; Behnke 1992; Shepard et al. 2005; Muhlfeld et al. 2016). In the US, Glacier supports approximately one-third of the remaining bull trout populations inhabiting natural lakes (Fredenberg et al.

2007). Westslope cutthroat trout and bull trout are essential to maintaining biodiversity throughout the Crown of the Continent Ecosystem, are part of a historic fishery that is fundamental to Glacier's designation as a biosphere reserve and World Heritage Site, and have long been integral to the culture of the park and surrounding communities. Westslope cutthroat trout and bull trout are increasingly at risk, however, from the severe, negative effects of non-native fish, which were introduced to Glacier via fish stocking that began soon after the park was established in 1910 and continued until the 1970s. Non-native fish have also migrated into park waters from lakes and streams outside the park.

The upper Camas drainage is well-suited for the establishment of secure native fish habitat, or habitat refugia, where westslope cutthroat trout and bull trout would be protected from both non-native fish and climate-related habitat degradation. Several waterfalls between Camas Lake and downstream Arrow Lake provide natural barriers to upstream fish migration, preventing the invasion or reinvasion of non-native fish. Given its high elevation (over 5000 feet), the upper Camas watershed also has a high likelihood of sustaining the cold-water habitats necessary for westslope cutthroat trout and bull trout to persist in a changing climate. This project would not only advance native fish conservation in Glacier, but would also bolster ongoing efforts by Montana Fish, Wildlife and Parks (MFWP), the US Fish and Wildlife Service (USFWS), and the Flathead National Forest to conserve these important native species in the larger Flathead River ecosystem.

Finally, the hybridization of westslope cutthroat trout is degrading recreational opportunities for anglers to fish for native trout. The ability to fish for and catch westslope cutthroat trout is of long-standing value to park visitors and surrounding communities. Protecting and even enhancing such opportunities where possible is integral to the conservation of Glacier's angling heritage for future generations.

Objectives

- Conserve genetically pure westslope cutthroat trout populations.
- Expand the overall, long-term distribution of native westslope cutthroat trout and native bull trout.
- Complement efforts by MFWP, USFWS, and the Flathead National Forest to protect and conserve westslope cutthroat trout and bull trout in the Flathead River ecosystem.
- Protect and enhance recreational opportunities for anglers to fish for native trout.

Project Area

The Camas Creek drainage is on the west side of Glacier National Park in the southern portion of the North Fork District, and is the next major drainage north of Lake McDonald. The drainage has six instream lakes, including Rogers, Trout, Arrow, Camas, and Ruger Lakes, and Lake Evangeline (Figure 1). The Camas drainage and entire treatment area are within the park's 1974 recommended wilderness boundary. The Camas Creek Trail runs along Camas Creek from the Inside North Fork Road to the foot of Camas Lake. There is no maintained trail from Camas Lake to Lake Evangeline and Ruger Lake. There are two backcountry campgrounds in the Camas drainage, at the foot of Arrow Lake and Camas Lake.

The treatment area for this environmental assessment (EA) extends between the inlet to Lake Evangeline and the head of Arrow Lake (Figure 1). The overall project area, however, also includes Arrow and Trout Lakes downstream of the treatment area, an unnamed tributary to Camas Creek, Avalanche Lake (in the Lake McDonald District), and Ford Creek and Starvation Creek in the North Fork District, since individual native fish would be translocated from some or all of these waters to Camas Lake and/or Lake Evangeline.

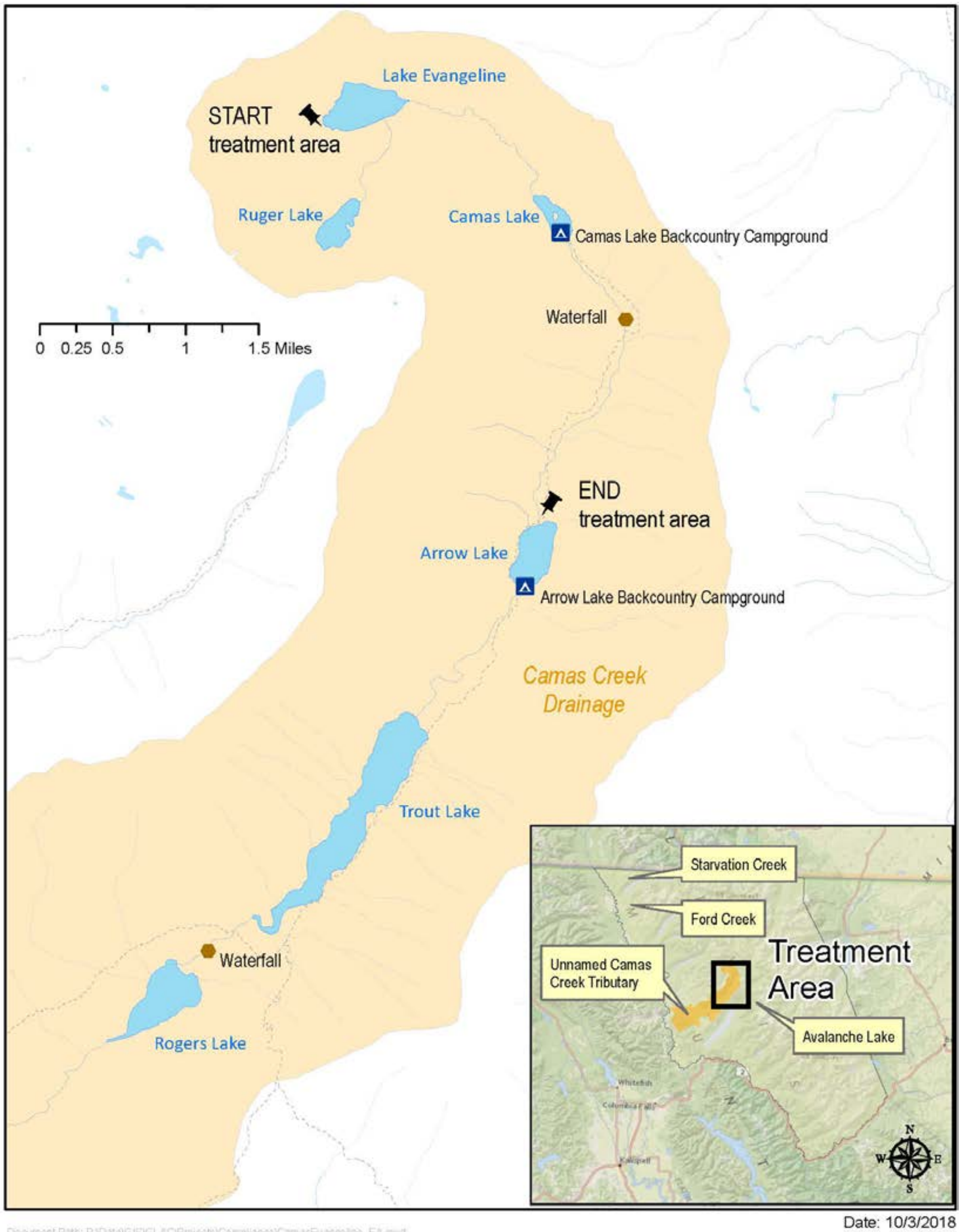

Figure 1: Map of the project area.

Chapter 2 – Alternatives

Two alternatives, an action alternative (Alternative A) and a no-action alternative (Alternative B), have been carried forward for detailed analysis and are described below. Three alternatives and one alternative element were considered but eliminated from further analysis and are briefly described in Appendix C.

Alternative A – Proposed Action and Preferred Alternative

Alternative A has two components: 1) the removal of Yellowstone cutthroat trout from Camas Lake, Lake Evangeline, and Camas Creek upstream of Arrow Lake, followed by 2) the translocation of westslope cutthroat trout, bull trout, and native sculpin to Camas Lake and Lake Evangeline.

Remove Yellowstone Cutthroat Trout

Alternative A would remove non-native Yellowstone cutthroat trout from Camas Lake, Lake Evangeline, and Camas Creek upstream of Arrow Lake by means of rotenone (CFT Legumine). Rotenone is a fish toxicant applied with the intent of killing fish. It is proposed for this project because, compared with mechanical methods of removing fish (e.g. netting, trapping, electrofishing, and angling), it would remove non-native fish in a period of days as opposed to years, and would achieve a complete removal. Removing fish via electrofishing and possibly other mechanical methods would also be used as needed. While other fish toxicants are available, rotenone is the only one that is registered and approved for use by the EPA. Rotenone is extracted from the roots of several plant species in the bean (legume) family. The chemical deprives aquatic gilled organisms of oxygen by interfering with cellular respiration, and is highly toxic to fish. Rotenone is naturally degraded by sunlight and water movement; detoxification would be hastened with the addition of a neutralizing agent, potassium permanganate ($KMnO4$) (USFWS 2015).

The amount of rotenone used would be in accordance with product labeling and would be calculated based on lake volume derived from bathymetric mapping, stream flow measurements, and calculations of travel time (the amount of time it would take rotenone to flow a given distance). A 5-percent formulated product would be applied to achieve a concentration of 1 ppm (parts per million). As 1 ppm is equivalent to 1 milligram per liter, applying a 5-percent formulated product at 1 ppm would result in an active ingredient (rotenone) concentration of 0.05 milligram per liter in the water. Volume estimations for Lake Evangeline and Camas Lake are 4258.5 and 136.3 acre feet, respectively. It is currently estimated that a total of approximately 1450 to 1500 gallons of rotenone would be required to achieve a 1 ppm concentration; this amount is approximate and could change as final calculations are made closer to the time of application.

Rotenone would be applied to the lakes from motorized watercraft, such as a zodiac with an outboard motor or small motorboat, and to the stream from drip stations and backpack sprayers. Two motorized boats would be used, one on each lake, and could be in operation simultaneously. The boats would run intermittently for an estimated 8 to 12-hour period each day of the rotenone application period, estimated at up to approximately two to three days, and would likely produce noise ranging from 60 to 90 dBA (see Chapter 2, Natural Soundscapes, Table 2 for comparison of common sounds). At least five drip stations are currently anticipated, with stations at the inlet and outlet of Evangeline, two stations between Evangeline and Camas, and a station at the outlet of Camas (Figure 2). Additional drip stations may be necessary at small inlets; the total number of drip stations is not expected to exceed eight at the most. Drip stations are generally a simple, non-motorized apparatus, such as a 5-gallon bucket or drip bag with tubing extending into the stream. Backpack sprayers would be used to apply rotenone to the braided meadow area on the north end of Camas Lake. Water pumps would be used to help distribute the rotenone as needed; the pump(s) would likely produce noise at approximately 105 dBA.

Rotenone is often applied during low water periods, in late summer or early fall to reduce the volume of water that needs to be treated and minimize the likelihood of non-target organisms, such as larval amphibians, being present in the treatment area. If approved, the project is currently anticipated to begin in late August or early September of 2019. Only one application of rotenone is usually needed for successful treatment. If a complete kill is not achieved, however, a second application may be necessary and could occur during the same or a following year. The application of rotenone would discontinue once treatment is effective, or if it is determined to be ineffective.

Following application of the rotenone, a potassium permanganate solution would be used to detoxify the stream and neutralize the rotenone before it reaches native fish populations, including westslope cutthroat trout and bull trout, in Arrow Lake. Potassium permanganate is an odorless oxidizing agent, often used to remove foul tastes and odors from drinking water and reduce odors at wastewater treatment plants. The potassium permanganate would only be applied to Camas Creek. Camas Lake and Lake Evangeline would not be treated with potassium permanganate, but would be left to detoxify naturally. The potassium permanganate solution would be applied to the stream from a detox station upstream of Arrow Lake (Figure 2) by means of an auger dispenser powered by a generator (anticipated to be 1000-3000 watts in size, producing noise ranging from 53 to 68 dBA). The generator would operate continuously (24 hours a day, 7 days a week) until the rotenone detoxifies. Per general guidance provided by the USFWS (2015), the anticipated concentration would be a ratio of 3:1 potassium permanganate to rotenone. An estimate of approximately 1112.6 pounds of potassium permanganate would be dispensed (2-4 milligrams per liter).

The amount of time required for detoxification varies, depending on factors such as amount of sunlight exposure, water volume and turbulence. Live fish (i.e. sentinel fish) would be caged at the downstream end of the detox area and monitored to determine if the rotenone treatment is effective and when the stream has detoxified to the point where it is safe for native fish. The application of potassium permanganate to the stream would continue until the sentinel fish survive for four hours without any sign of stress, in accordance with aquatic life standards set forth in the American Fisheries Society Rotenone SOP Manual (Finlayson et al. 2010). Detoxification with potassium permanganate is currently estimated to take place for approximately two to three weeks. Afterwards, while safe for fish, the stream could contain some residual levels of rotenone, which would be left to neutralize naturally. Rotenone has a half-life (the time it takes for a substance to break-down by 50 percent) in water of a few days to a few weeks, depending on the type of habitat (stream or lake), amount of sunlight, water temperature and turbulence (EPA 2007). Finlayson et al. (2001) reported rotenone half-lives of two to eight days for a number of California Lakes. In Lake Davis, where water temperatures are cold, ranging from 5-12 degrees Celsius (similar to Lake Evangeline), the half-life of rotenone was eight days. Gilderhaus et al. (1988) reported a half-life of 10 days for a cold (0 to 5 degrees Celsius), shallow pond (similar to Camas Lake). Since treatments would be at the minimum product concentration necessary to ensure a complete fish kill (1 ppm), levels would be expected to drop below those that are toxic to aquatic life within two to three weeks (i.e. the first half-life would reduce concentrations to 0.5 ppm, well below the lethal level for fish).

Rotenone breaks down into rotelonone, which is far less toxic to aquatic life but has a longer half-life (Finlayson et al. 2001). In studies of Lake Davis, California, Vasquez et al. (2012) showed rotelonone levels in the water dropping below detection levels within 60 days post-treatment. Similarly, other inert ingredients associated with the product formulation dropped below detection levels in water samples within 90 days post-treatment (Vasquez et al. 2012). The authors further reported finding no chemical evidence of the rotenone treatment in water, sediment, or invertebrate or fish tissues 212 days post-treatment. Therefore, water chemistry at Camas Lake, Lake Evangeline, and Camas Creek would be expected to be fully restored to pre-treatment levels over the winter, before the following spring.

During rotenone applications, many of the dead fish typically remain submerged. Any dead fish that come to the surface would be collected and either sunk in the lakes or removed from the site to avoid attracting bears and other wildlife. While Camas Lake and Lake Evangeline are 100 percent Yellowstone cutthroat trout, westslope cutthroat trout and other native fish are present in Camas Creek upstream of Arrow Lake, within the rotenone treatment area. The exception is bull trout, which have not been found in the treatment area. The stream above Arrow Lake would be electrofished prior to the application of rotenone and any bull trout found would be released downstream of the treatment area where they would not be affected. There is a dry reach of Camas Creek occurring in late summer downstream of the treatment area but upstream of Arrow Lake that would prevent bull trout from re-entering the treatment area. Other fish species captured in this reach would be used as sentinel fish.

Certified Piscicide Applicators and trained staff would oversee the application of the rotenone and other chemicals, as required by the Montana Department of Agriculture, MFWP, and NPS policy (2006 Management Policies, Section 4.4.5.3). Approximately 15 project personnel would be on site. Personnel would likely camp at the backcountry campgrounds at Camas and/or Arrow Lakes for the duration of the rotenone application and detoxification period, anticipated to last approximately three to four weeks (an estimated two to three days for rotenone application and two to three weeks for detoxification).

Pre-treatment biological surveys and monitoring for macroinvertebrates, plankton, and amphibians have already taken place in order to help assess baseline community conditions and allow post-project monitoring to evaluate organism response and recover rates. Established monitoring protocols in Montana's Piscicide Policy would be followed, which draw from the American Fisheries Society piscicide Standard Operating Procedures manual and the Department of Environmental Quality and Environmental Protection Agency's water quality and aquatic invertebrate monitoring protocols. If treatment is not successful, a second application could occur in the same year or during a following year. Reapplication methods and protocols (e.g. chemical concentrations and application methods, treatment areas, timeframes, etc.) would generally be as just described. If reapplication procedures change, resources management staff at the park would review them prior to implementation; if review determines that impacts from reapplication would exceed those identified in this EA, reapplication would not occur without separate environmental analysis and compliance as appropriate. If reapplication of the rotenone is necessary, some equipment may be temporarily cached onsite (e.g. boat motors would likely be hauled out but the boats without motors and other equipment may be cached).

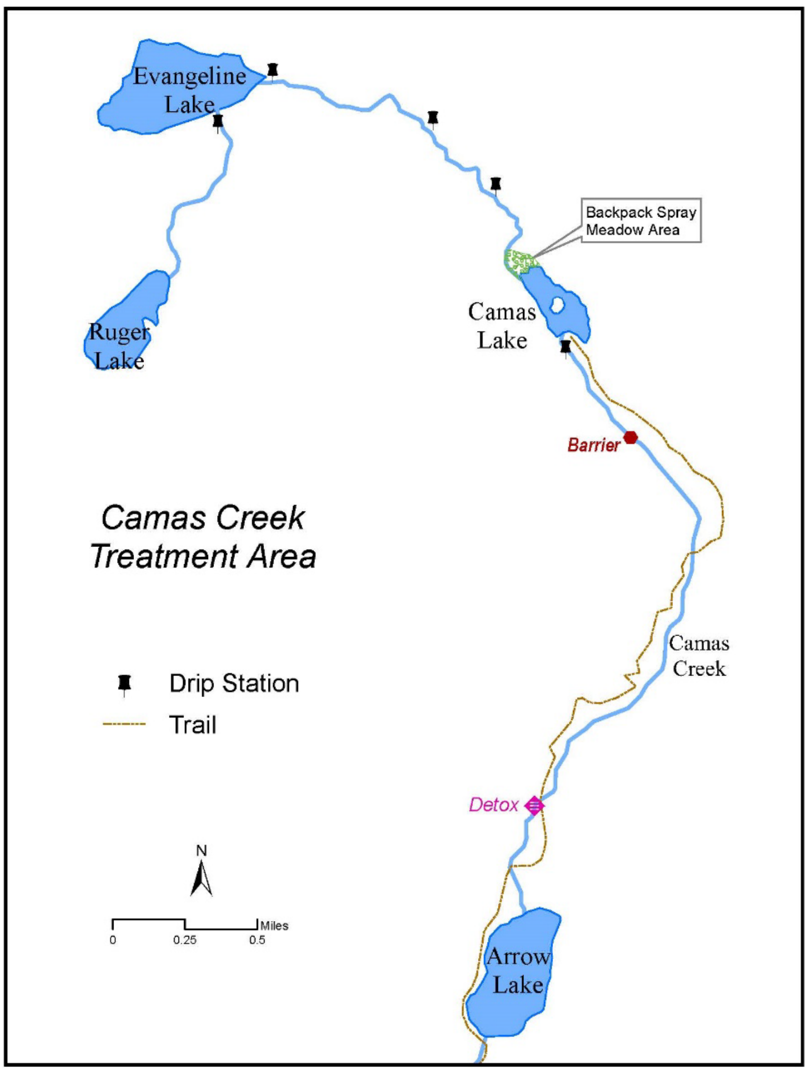

Figure 2: Map of treatment area illustrating approximate locations of rotenone drip stations, backpack spray area, and detox station (*courtesy MFWP*).

The treatment area would be temporarily closed to the public during rotenone application and detoxification. The closure would extend from the head of Arrow Lake to Ruger Lake, and include the Camas Creek Trail and Camas Lake backcountry campground. The closure would be in place from late summer/early fall when the project begins, until the following spring (by which time the rotenone and potassium permanganate would be completely neutralized). The Arrow Lake backcountry campground at the foot of Arrow Lake would also be temporarily closed because it would be occupied by project personnel; the closure of the Arrow Lake backcountry campground would only be in effect during implementation of the project, estimated to last approximately three to four weeks (an estimated two to three days for rotenone application and two to three weeks for detoxification). Arrow Lake and the Camas Creek Trail to the head of Arrow Lake would remain open during this time. The public would be informed of the project prior to implementation by means of media releases and postings on the park's website, backcountry permit office, and visitor centers. Signs informing visitors of the project and temporary area closures would be posted at the Camas Creek and West Lakes trailheads before and during the project.

Translocate Native Westslope Cutthroat Trout, Bull Trout, and Sculpin

Following the complete removal of Yellowstone cutthroat trout from Camas Lake and Lake Evangeline, bull trout and genetically pure (less than one percent non-native genes) westslope cutthroat trout would be translocated into the lakes. If water temperatures at Camas Lake are not optimal for bull trout (i.e. cold enough for maximum translocation success), bull trout may only be stocked into Lake Evangeline and left to migrate freely into Camas Lake. Native sculpin would also be translocated into the lakes to establish a holistic native fish assemblage and preserve species interactions (bull trout prey on sculpin, for example). Translocated fish would come from donor populations within the Camas drainage or other drainages that are similar or near enough on the landscape to have under undergone similar evolutionary pressures. Westslope cutthroat trout donor populations under consideration in addition to the Camas drainage include those from Avalanche Lake (Lake McDonald District), and Ford Creek and Starvation Creek (North Fork District) (Figure 1). Bull trout donor populations would be from Trout and Arrow Lakes. Native sculpin would be translocated from Trout Lake. Other waters in the park may be considered as donor sources as well, provided they are demographically strong enough (such as Kintla, Bowman, Quartz, and Logging Lakes, for example); separate review and environmental compliance would be done as appropriate. Translocated fish would be sourced from these populations because monitoring shows they are demographically strong enough to support the removal (i.e. the populations are large enough to withstand the removal of some fish) (C. Downs, personal communication). It is anticipated that less than 10 percent of a given source population would be removed.

Individual westslope cutthroat trout and bull trout would be collected from donor populations using methods such as angling, dip netting, trapping, electrofishing, and/or seining. Collected westslope cutthroat trout would be taken to a hatchery outside the park where they would be spawned, and where the fertilized eggs would be hatched and raised. Collected bull trout would be spawned and released onsite (generally within 24 hours of capture), and the spawned/fertilized bull trout eggs would be taken to a hatchery outside the park where they would also be hatched and raised. The hatchery-raised westslope cutthroat trout and bull trout would remain in the hatchery until they are approximately two years of age, after which they would be transported by helicopter or pack stock to Camas Lake and/or Lake Evangeline. The juvenile fish would be directly released into the lakes from helicopter tanks immediately above the water surface, or released from coolers or other containers from the shoreline. Prior to being loaded with fish, the helicopter tanks and all fish transport containers would be cleaned of all potential pathogens and contaminants, in accordance with state of Montana rules and regulations for live fish transport. Westslope cutthroat trout and bull trout may also be moved directly from source waters to the lakes without hatchery propagation. Or, gametes (eggs and sperm) may be collected from spawning adults, fertilized, and reared naturally in stream-side incubators in the new habitat, whereby the fish could swim into the lakes from the stream. Native sculpin would be collected using methods such as electrofishing or fish traps, transported in containers to the release sites, and directly released into upstream areas.

Collection of the donor fish would likely begin in 2019. Project personnel (an estimated five to ten member crew would be anticipated) would be onsite collecting the donor fish over an approximately one to two-week period. Native fish collection could occur any time during spring, summer, or fall. Personnel would likely camp at either the Arrow Lake or Camas Lake backcountry campground. No area closures would be required during native fish collection, but depending on the size of the crew, some or all campsites at the campground may not be available to the public when personnel are stationed there (since the campgrounds each have a capacity for only eight people). Depending on the success of hatchery propagation and the number of fish that can be translocated to Camas Lake and Lake Evangeline at a given time, collection procedures may need to be repeated each year for an estimated three years.

The translocation, or physical transfer or planting, of the hatchery-reared fish would not begin until the spring of 2020 at the earliest, but may begin later depending on the amount of time needed for the hatchery to raise a sufficient number of mature fish. Native westslope cutthroat trout would be translocated first, followed by bull trout, possibly beginning in the spring of 2021 at the earliest. No area closures would be required during fish planting operations. Personnel (an estimated two to five-member crew would be anticipated) may need to stay at one of the campgrounds if planting operations cannot be completed in one day. Translocation would likely take place over multiple years (estimated six to seven) to establish multiple age classes of both species. Translocated fish would be monitored, which could require marking them with tags, fin clips, or other means and tracking them using fixed-location remote stations.

Fish health testing is generally conducted prior to moving fish to a hatchery or other waters, and has already been done as a preliminary measure to evaluate the feasibility of the project. Fish health samples were collected from Avalanche Creek, Ford Creek, and Starvation Creek, and no pathogens were reported.

<u>Project Transportation Needs</u>

Project personnel would hike to the project area for all phases of the project (i.e. removal of Yellowstone cutthroat trout, translocation of native fish, monitoring, etc.). Helicopters would be necessary to transport boats, rotenone, the generator, water pumps, and possibly other equipment. Helicopters would also be used to transport fish and fish eggs during native fish translocation (including flying collected fish and eggs out of the project area and, as explained above, planting fish into the lakes), since the time required for ground transport and the jostling from using livestock or backpacks would put the fish and/or eggs at risk. Helicopters would deliver and pick up equipment (and fish) by means of long-line sling loads. The number of flights would range from an estimated six to ten inbound flights and three to six outbound flights for rotenone application, followed by an estimated four flights per year for six or seven years for translocation. The number of flights would depend on the size of helicopter available at the time (i.e. smaller helicopters could carry less weight, resulting in more flights). Glacier National Park limits administrative flights to 50 flights each year. The park conducts additional environmental review and analysis for projects that exceed the 50-flight limit (e.g. rebuilding the Sperry Chalet required a separate EA in part due to the need for additional helicopter flights). To keep the number of administrative flights as low as possible, park staff meet annually to evaluate flight needs and combine flights. The park would make every effort to include helicopter flights for this project within the 50-flight limit on administrative flights. For the purposes of impacts analysis, this EA evaluates flights for this project as if they were in addition to the 50-flight limit. Every effort would also be made to combine flights for this project with other administrative flights. This would also be the case if reapplication of the rotenone is necessary (i.e. flights would be part of the 50-flight limit if possible but may exceed the limit, and flights would be combined with others if possible).

Because Alternative A would affect wilderness character and include uses prohibited under Section 4(c) of the Wilderness Act (motorized equipment and helicopter landings) within recommended wilderness, a minimum requirements analysis (MRA) is required by NPS policy (NPS Management Policies, 6.3.5). An MRA will be prepared and appended to the decision document for this EA.

Alternative B – No Action

Under Alternative B, the National Park Service would not remove Yellowstone cutthroat trout from the upper Camas drainage and would not stock Camas Lake or Lake Evangeline with westslope cutthroat trout, bull trout, or other native fish.

Mitigation Measures for Alternative A

Aquatic Resources including Fisheries; Threatened, Endangered and Special Status Aquatic Species; Water Quality; and Hydrology

- Prior to applying rotenone, the lower reaches of Camas Creek accessible to bull trout from Arrow Lake would be electrofished to determine if bull trout are present. If any bull trout are found, they would be relocated downstream to Arrow Lake (bull trout are not present in Camas Lake or Lake Evangeline but could be present in Camas Creek upstream of Arrow Lake; see Chapter 3, Table 1).
- To minimize impacts to bull trout from the removal of eggs during translocation, females would be only partially spawned, with only about 50 percent of the eggs taken from each female handled. This would allow for some natural reproduction, producing enough eggs to fully seed the available juvenile rearing habitat.
- Oxygen levels and cold water temperatures would be maintained during native fish collection and transport to prevent fish mortality (e.g. fish could be temporarily held upon collection in tubs submerged in stream water until they are transported in coolers to the hatchery, and/or containers transporting fish would contain sufficient water to maintain oxygen and temperature levels).
- If post treatment sampling indicates populations of aquatic insects have been lost from the treatment area, efforts would be made to re-establish the populations using a nearest neighbor approach, i.e. translocate individual insects from nearby, similar habitat.
- To protect water (and air) quality, the cleanest burning outboard motors available (reduced emission 4-stroke technology) would be used.
- A spill plan would be developed and followed in case of a fuel or hazardous material leak. The plan would be reviewed by the park's Safety Office for comment and approval. Personnel would inspect boat engines, fuel lines, and fittings as well as other equipment for leaks prior to beginning project activities each day. Appropriate absorbent supplies would be on site to address a spill on shore and on the water. Petroleum products would be properly stored, to include the use of spill-proof and bear-proof containers.
- Protocols to prevent aquatic invasive species (AIS) (such as zebra and quagga mussels, and Eurasian watermilfoil) from entering the Camas drainage would be followed at all times, in accordance with the park's Aquatic Invasive Species Action Plan (NPS 2018a).
- Prior to being loaded with fish and water from the hatchery, helicopter tanks and all fish transport containers would be cleaned of all potential pathogens and contaminants to prevent contamination of the lakes, in accordance with state of Montana rules and regulations for live fish transport. Only hatcheries that are regularly inspected for AIS, certified to be free of pathogens, and/or treat the holding water to remove or kill any pathogens (such as with filters or UV light, for example) would be used.

Wildlife, including federally listed threatened species and state listed species of concern

- Camas Lake and Lake Evangeline would be surveyed for common loons and other water birds before applying rotenone. In the off chance that common loons have nested on the lakes and flightless juveniles are present (this would be highly unlikely, as described in the Affected Environment for common loons, but could occur), or if flightless juveniles of other exclusively fish-dependent water bird species are present, the application of rotenone would be scheduled for as late as possible. This would be to minimize impacts from the removal of fish to fish-dependent juvenile birds that are unable to fly and forage on nearby lakes. Rotenone would be applied as late in the season as practicable but no later than September 1, by which time juvenile birds should be able to fly.

- The treatment area would be surveyed for black swift nests prior to the rotenone treatment. If nests are found, rotenone would be applied as late in the season as practicable but no later than September 1 to minimize potential impacts to invertebrate forage for juvenile black swifts.
- Project personnel would be trained on appropriate behavior in the presence of bears and other wildlife and would adhere to park regulations concerning proper storage of food, garbage, and other attractants.
- If encountered in project areas, specimens of the state listed smoky taildropper (*Prophysaon humile*, a slug), reticulate taildropper (*Prophysaon andersoni*, a slug), and shiny tight coil (*Pristiloma wascoense*, a terrestrial snail) that are at risk of trampling would be moved to a safe location.
- The following conservation measures as agreed to with the USFWS in the park's programmatic biological assessment for administrative flights (NPS 2018b) are required for all park administrative flights and would be followed for any flights associated with this plan:
    - Flights would follow suggested flight paths away from sensitive areas. Where possible, flight paths would follow road corridors and occur over developed areas.
    - Flights would occur one hour after sunrise and one hour before sunset from 1 May to 1 October to minimize impacts to grizzly bears. Grizzly bear denning activity peaks during den emergence from 15 March to 15 May and during den construction from 15 October to 15 November. No flights would occur over known dens or potential den habitat during den emergence and den construction. In order to conserve prey species, flights would avoid ungulate winter range from 15 January to 1 May when wintering ungulates are most vulnerable.
    - Restricting flights to the 1 May to 1 October period, or minimizing them outside that period, would eliminate or minimize impacts to sensitive wildlife.
    - The helicopter would fly at a minimum of 2000 feet above ground level (AGL) over the park whenever possible, depending on mountainous topography, weather, and except when it is landing or taking off or when it is delivering supplies via long line or during fish planting operations.
    - To minimize impacts on denning Canada lynx, no flights would be permitted over known den sites from 1 May to 1 September.
    - Flight paths would be designated so as to avoid open alpine meadows, talus slopes, or other areas where grizzly bears congregate but do not have access to cover. If a low level flight or landing is needed in an alpine area and a bear is seen, the flight would be postponed. If the flight cannot be postponed, the flight would keep a maximum distance from the bear(s).
    - The flight manager would be responsible for coordinating with the park biologist to identify sensitive sites prior to the flight.

Recommended Wilderness and Natural Soundscapes

- To minimize administrative flights over recommended wilderness, the park would make every effort to include helicopter flights for this project within the 50-flight limit on administrative flights. Flights would be considered with other proposed administrative flights, coordinated with other projects, and combined with other hauling needs whenever possible.
- A heavy lift helicopter would be used, pending availability, to carry as much heavy material as possible and reduce the number of flights. More efficient, lower noise models would be preferred.

- To minimize the duration of generator noise associated with rotenone detoxification, the detox site would be located as far downstream as possible to maximize the potential for rotenone to break down naturally through exposure to water movement and sunlight. This would reduce the detoxification time and, therefore, the duration of generator noise.
- Boat motors and other motorized equipment would be selected for the lowest possible noise production while still using equipment that would meet project objectives.

Wetlands

- The project area would be surveyed for wetland resources before the project begins to identify the presence and extent of wetlands; sensitive wetland resources would be marked and avoided.
- Motorized equipment would not be used for overland transport; personnel would enter the project area on foot.
- Best Management Practices listed in NPS Procedural Manual #77-1, Appendix 2, would be followed as applicable (NPS 2016a).

Vegetation and Soils

- The project area would be surveyed for rare plants before work begins; locations of rare plants would be marked and avoided.
- Project personnel would stay on trails, rocky surfaces, or bare ground whenever possible and avoid the creation of social trails.
- If necessary, areas of disturbance would be rehabilitated and restored through consultation with the park's Vegetation Management Specialist. Only seeds and plants originating from the park or from approved sources would be used in restoration activities.
- All equipment and materials would be cleaned and inspected prior to entering the park to prevent the spread of non-native invasive plants and AIS.

Visitor Use and Experience

- Interpretive programs and materials would be considered to educate visitors about project activities and native aquatic ecosystem conservation.
- The park's backcountry permit office would be notified in advance of the projected rotenone application and detoxification dates, and when the Arrow Lake or Camas Lake backcountry campgrounds may be occupied by fisheries personnel, to minimize inconvenience to visitors planning a backcountry camping trip in the Camas drainage.

Health and Safety

- All appropriate personal protective equipment (PPE) would be worn by applicators when handling chemicals.

Chapter 3 – Affected Environment and Environmental Consequences

This chapter considers resources or impact topics that would be affected by the proposed action and for which a detailed analysis of impacts to those resources is necessary. The general current status of each resource is described in the affected environment section, followed by an analysis of impacts. Issues are retained for detailed analysis if they are pivotal or central to the proposed action, necessary to make a reasoned choice between alternatives, a major point of contention among the public or other agencies, and/or associated with resources that could be significantly affected if the proposed action is implemented. Impact topics that have been dismissed from detailed analysis are described in Appendices D and E.

Native Fish and Aquatic Species

Westslope cutthroat trout, bull trout, sculpin, amphibians, aquatic macroinvertebrates, and zooplankton

Affected Environment

The native fish assemblage in the Camas drainage includes westslope cutthroat trout, bull trout, mountain whitefish, longnose sucker, redside shiner, northern pikeminnow, and sculpin (Rocky Mountain sculpin and or slimy sculpin) (Table 1). Ruger and Camas Lakes and Lake Evangeline were all historically fishless. Ruger Lake remains fishless, but Camas Lake and Lake Evangeline were stocked with Yellowstone cutthroat trout and an unspecified strain of cutthroat trout in the 1920s and 30s. NPS records show that Camas Lake was stocked with 100,000 "cutthroat" eggs in 1926 and 19,440 "cutthroat" fingerlings in 1935, and Lake Evangeline was stocked with 50,000 "cutthroat" eggs in 1926 and 38,800 "cutthroat" fingerlings in 1935 (NPS file data). Camas Lake and Lake Evangeline are currently 100 percent Yellowstone cutthroat trout, based on samples collected in 2011 (NPS file data). Other species of fish have not colonized the lakes due to the presence of several waterfalls downstream of Camas Lake that prevent upstream fish migration. Rogers, Trout, and Arrow Lakes were all historically fish-bearing. None of the species found in Rogers Lake are present in upstream lakes due to a waterfall between Rogers Lake and Trout Lake that prevents upstream fish migration. Native, non-native, and hybrid fish currently present in the six lakes in the Camas drainage are listed below in Table 1.

Table 1: Native, non-native, and hybrid fish currently documented in the Camas drainage (ha=hectare).

Lake	Elevation	Lake Size	Native Fish	Non-native Fish	Hybrids
Rogers Lake	3793 feet (1156 meters)	84.36 acres (34.14 ha)	Westslope cutthroat trout Bull trout Mountain whitefish Longnose sucker Redside shiner Northern pikeminnow Sculpin	Lake trout	Admixture of westslope cutthroat trout (92%), Yellowstone cutthroat trout, and rainbow trout
Trout Lake	3904 feet (1190 meters)	213.05 acres (86.22 ha)	Westslope cutthroat trout Bull trout Sculpin	None	Admixture of westslope cutthroat trout (99%) and rainbow trout
Arrow Lake	4072 feet (1241 meters)	57.45 acres (23.25 ha)	Westslope cutthroat trout Bull trout	None	Admixture of westslope cutthroat trout (96%), Yellowstone cutthroat trout, and rainbow trout
Camas Lake	5075 feet (1547 meters)	17.52 acres (7.09 ha)	None	Yellowstone cutthroat trout (100%)	None
Lake Evangeline	5246 feet (1599 meters)	72.23 acres (29.23 ha)	None	Yellowstone cutthroat trout (100%)	None
Ruger Lake	5804 feet (1769 meters)	33.33 acres (13.49 ha)	None	None	None

Among native fish, only westslope cutthroat trout, bull trout, and sculpin have been carried forward for detailed analysis in this chapter. Other native fish species found in the Camas drainage and listed in Table 1 have been dismissed from detailed analysis (see Appendix D, "Issues and Impact Topics Dismissed from Detailed Analysis"). Impacts to amphibians, aquatic macroinvertebrates, and zooplankton are also carried forward for detailed analysis and are discussed below.

Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) – State listed species of concern
Historically the most abundant and widely distributed subspecies of cutthroat trout throughout the west, the westslope cutthroat trout currently occupies less than 30 percent of its historic range in Montana (Muhlfeld et al. 2016). Population declines are due to a variety of factors, including habitat loss or degradation, excessive harvest by anglers, and effects from non-native fish (Liknes and Graham 1988). Hybridization with non-native rainbow trout is one of the primary threats to westslope cutthroat trout (Muhlfeld et al. 2016). Non-native rainbow trout and brook trout are also believed to compete with westslope cutthroat trout for food and space (Shepard 2004; Hitt et al. 2003; Muhlfeld et al. 2016). Lake trout pose a major predation and competition risk to westslope cutthroat trout in Glacier. These influences threaten the long-term persistence of westslope cutthroat trout in the majority of their occupied habitat in the park.

Non-hybridized populations of westslope cutthroat trout occupy less than ten percent of their historic range in the US (Shepard et al. 2005), and less than three percent in Montana (Liknes and Graham 1998). In recent years, rainbow trout and westslope cutthroat trout hybrids have been expanding their distribution in the Flathead River drainages adjacent to the park (Boyer et al. 2008; Muhlfeld et al. 2009) (Appendix B, Figures B-1 and B-2). In the Camas drainage, westslope cutthroat trout populations in Trout and Arrow Lakes have low levels (approximately one and four percent, respectively) of hybridization with non-native rainbow and Yellowstone cutthroat trout (Table 1). Trout, Arrow, and Rogers Lakes in the Camas drainage are among several identified westslope cutthroat trout conservation populations in the park (Muhlfeld et al. 2016). A significant component of hybridization in Arrow Lake (and risk of hybridization in Trout Lake) is the result of downstream movement of Yellowstone cutthroat trout from Camas Lake and Lake Evangeline.

Additionally, climate change is causing alterations to fisheries habitat, including increased water temperature, temporal changes in stream flow and precipitation patterns, increased sediment levels, and scouring of spawning beds due to a higher frequency and intensity of forest fires and rain-on-snow events. Evidence of glacial recession and shrinking is already well documented in the park (USGS 2018). The loss of glaciers will cause changes in drainages where late-season streamflow depends on melting glaciers and snowfields, thus impacting native fish habitat in those areas. Jones et al. (2017) investigated potential changes in stream temperature in the Crown of the Continent Ecosystem under current and future climate scenarios. Their results suggest a trend of increasing stream temperatures in spring, summer, and fall, with earlier onset and longer duration of warmer temperatures (Jones et al. 2017). Such habitat alterations present a risk to native fish (including westslope cutthroat trout) through the degradation of cold-water habitats, and compound the existing stressors of non-native fish.

Climate change-induced habitat alterations are also impacting westslope cutthroat trout through increased rates of hybridization (Muhlfeld et al. 2014). Warmer stream temperatures may give non-native invasive fish an advantage, as with rainbow trout, which tolerate higher water temperatures than native cutthroat trout (Kovach et al. 2017). In the northern Rocky Mountains, warmer water temperatures may hasten or facilitate the ability of rainbow trout to spread and hybridize with native westslope cutthroat trout, likely due to multiple physiological, biological, and life-history factors, such as spawning and incubation times, combined with decreases in spring precipitation and runoff (Kovach et al. 2017). In areas near historical rainbow trout stocking areas, hybridization with native westslope cutthroat trout was more likely in waters with warmer water temperatures, lower spring precipitation and runoff, and higher rainbow trout numbers, but cold-water sites were also susceptible to invasion (Kovach et al. 2017).

Bull Trout (*Salvelinus confluentus*) – ESA listed as threatened; state listed species of concern

Bull trout are a large char (growing up to 35 inches long), are native to the northwestern US and western Canada, and are a top aquatic predator in waters they inhabit. Once abundant in the Columbia River basin, bull trout have declined in distribution and abundance in recent decades (USFWS 1999). The imperiled status of bull trout led the USFWS to list the species as threatened under the ESA in 1998. Glacier's western waters are an important stronghold for bull trout, since the park contains approximately one-third of the remaining natural (i.e. undammed) lake core habitat areas supporting bull trout in the US (USFWS 2015).

Of seventeen lakes on the west side of the park that support bull trout, nine have been invaded by non-native lake trout, including Rogers Lake in the Camas drainage (Appendix B, Figure B-3). Lake trout consistently displace bull trout in systems where they have been introduced (Donald and Alger 1993; Fredenberg 2002; Martinez et al. 2009). Lake trout live longer and spawn in lakes where they likely benefit from relatively stable and expansive juvenile rearing habitat. This gives them a reproductive advantage over bull trout, which spawn in streams and tributaries where spawning and rearing habitat is generally more limited and vulnerable to disturbance from floods, fire, and drought. In less than 30 years, lake trout have largely replaced bull trout as the dominant top-level aquatic predator in systems they have invaded (Fredenberg 2002). Where monitoring data exist, lake trout are driving bull trout towards functional extinction (NPS 2011; NPS 2013), and some bull trout populations in the park are at high risk of extirpation. The exception is Quartz Lake, where lake trout suppression activities were initiated in 2009 and are proving successful in reducing lake trout numbers and conserving the size and functional integrity of the lake's bull trout population (NPS 2018c). There is no long-term data on how non-native lake trout are specifically affecting bull trout in Rogers Lake. The lake is very shallow, at approximately 14 feet, so does not provide optimal habitat for lake trout, which prefer deeper water. But given what is known about the effects of lake trout on bull trout in other lakes, there is a strong likelihood that the Rogers Lake bull trout population is at risk due to non-native lake trout.

As with westslope cutthroat trout, the threats to bull trout are being compounded by climate-related habitat alterations. Bull trout require among the lowest water temperatures for optimal growth of any North American trout or salmon species (Selong et al. 2001). Bull trout also require stable stream channels with gravel and cobble bottoms for spawning and rearing young; these conditions are at risk from climate-induced increases in sedimentation in the wake of more frequent forest fires and channel instability during rain-on-snow events. In the Camas drainage, the bull trout population in Rogers Lake may be at a particularly high risk from climate-related impacts. This is because the lake is shallow (approximately 14 feet) and, as a result, especially susceptible to increases in water temperatures.

Sculpin (*Cottus bondi* and/or *Cottus cognatus*)

Several species of sculpin are present in the park. The Camas drainage is inhabited by the Rocky Mountain sculpin (*C. bondi*) and/or the Columbia slimy sculpin (*C. cognatus*). Identification between the two species is not possible in the field, since it requires examination of the teeth through a microscope. The Columbia slimy sculpin is considered widespread and abundant throughout its range, which includes most of Canada, Alaska, and northwest Montana (MNHP 2018). The Rocky Mountain sculpin is considered widespread in Montana on both sides of the Continental Divide, and also ranges into Canada (MNHP 2018). Sculpin generally forage on bottom-dwelling aquatic insects, and both species tend to prefer clear, cold streams with a gravelly or cobble substrate (MNHP 2018). Sculpin are a prey species for other fish, including trout. In Canada, *Cottus* species west of the Rocky Mountains (known as Westslope populations, which also include populations found in the North and Middle Forks of the Flathead River in Montana) were listed in 2017 as a species of Special Concern under the Canadian Species at Risk Act (Fisheries and Oceans Canada 2018). The population appears to be stable, with expanding distribution, but the species was listed due to threats from pollution during resource extraction, the use of all-terrain vehicles, and sedimentation caused by road construction and maintenance (Fisheries and Oceans Canada 2018).

Amphibians

The presence of non-native fish in historically fishless lakes can affect amphibian populations through predation and displacement from optimal habitat (Ellis et al. 1992; Herwig et al. 2013; Kenison et al. 2014; Reissig et al. 2006; Pilliod et al. 2010; and NPS 2018d). Amphibians inhabiting the previously fishless Camas Lake and Lake Evangeline have likely been similarly impacted by the stocking of non-native Yellowstone cutthroat trout. There is no evidence, however, that the persistence of amphibian populations in either lake is at risk, and amphibian populations in the Camas drainage are generally considered healthy and functional. Amphibian species documented in the rotenone treatment area include Columbia spotted frogs along the Camas Lake shoreline and wetlands upstream of Camas Lake, and western toads, also at Camas Lake (as a state listed species of concern, the western toad is discussed separately, below). Other amphibian species could be present based on the presence of likely habitats. These include the tailed frog, long-toed salamander, and Pacific chorus frog.

Western Toad (*Anaxyrus boreas*) – State listed species of concern. The western toad (also known as the boreal toad) is the most widely distributed amphibian in the park (Blake Hossack, USGS, personal communication). While the species is disappearing from parts of its Rocky Mountain range and is listed as a species of concern in Montana (MNHP 2018), there is no evidence that it is declining in Glacier. Western toads utilize a wide variety of habitats, including springs and streams, meadows and woodlands, mountain wetlands, beaver ponds, and marshes. Western toad tadpoles are not a preferred prey item for fish because both adult toads and tadpoles secrete a toxic substance that deters predators (Ontario Nature 2017).

Aquatic Macroinvertebrates

Glacier supports a diversity of aquatic macroinvertebrates, and recent stream surveys have provided information on the distribution and abundance of a number of species at the parkwide scale (NPS data; Giersch et al. 2017). MFWP sampled benthic macroinvertebrates (species inhabiting the bottom of water environments) at Camas Lake and Lake Evangeline in 2016 (MFWP, unpublished data). Samples were evaluated to the genus level; species were not identified because there were not sufficient diagnostic morphological features for definitive identification of larval and nymph stages. Sampling results included a diversity of mayflies, stoneflies, caddisflies, midges, craneflies, dragonflies, riffle beetles, mollusks, and worms, among others.

Two state listed aquatic macroinvertebrate species that could be present in the project area are discussed separately below; other state-listed aquatic macroinvertebrate species that are highly unlikely to be present in the project area have been dismissed from detailed analysis in Appendix E (including the state listed and ESA proposed meltwater lednian stonefly (*Lednia tumana*) and western glacier stonefly (*Zapada glacier*).

Cordilleran Forestfly (*Zapada cordillera*) – State listed species of concern. Rangewide, Zapada cordillera is known from scattered localities in California, Oregon, Washington, Idaho, and Montana (Baumann et al. 1977), and possibly represents disjunct glacial refugium populations. The species inhabits very small streams and seeps and has been documented in the park, but not within the Camas drainage (J. Giersch, personal communication). The Cordilleran forestfly could nevertheless be present in seeps or small streams above or adjacent to Camas creek, though likely not within the main channel (J. Giersch, personal communication). *Zapada cordillera* has been described as rare due to habitat specificity (Baumann et al. 1977) and is never abundant when collected.

A primitive minnow mayfly (*Parameletus columbiae)* – State listed species of concern. This species is a relatively large, swimming mayfly that inhabits wetlands and other slow moving waters. Larvae are found in temporary ponds and fringe wetlands on the edges of lakes in association with heavy growth of broad-leaved sedges. The species has been recently discovered in a few wetland locations within the Flathead River basin, including Glacier and marshes at McGee Meadow (Newell and Hossack 2009). The species has not been documented in surveys of Camas Lake and Lake Evangeline, but could be present in the rotenone treatment area due to the presence of wetlands (J. Giersch, personal communication).

Zooplankton

Zooplankton sampling at Camas Lake and Lake Evangeline has resulted in species from eight different taxa. They include *Daphnia*, *Holopedidea*, *Cyclopidae*, *Diaptomidae*, and *Nauplii* at both lakes; *Bosminidae* species and instars at Camas Lake; and *Polyphemida* species at Lake Evangeline (MFWP 2017). The presence of non-native fish in historically fishless lakes elsewhere in the park has altered species composition and abundance of native zooplankton communities due to predation (Ellis et al. 1992). Fish tend to graze on larger plankton species, impacting the relative abundance of zooplankton in a body of water and causing a shift in species that favors smaller species. It is likely that the presence of Yellowstone cutthroat trout has resulted in similar effects to zooplankton in Camas Lake and Lake Evangeline.

Environmental Consequences

Impacts from Alternative A (Proposed Action and Preferred Alternative)

Westslope Cutthroat Trout

Alternative A would benefit westslope cutthroat trout for the long term by conserving and establishing non-hybridized populations. The Yellowstone cutthroat trout component of hybridization in Arrow Lake is the result of downstream movement of Yellowstone cutthroat trout from Camas Lake and Lake Evangeline over the years. This alternative would remove this source of hybridization, and protect populations of westslope cutthroat trout in Trout and Arrow Lakes that have a high degree of genetic purity (99% and 96%, respectively). Removing Yellowstone cutthroat trout would also remove a source of competition and displacement, decreasing the risk of westslope cutthroat trout being displaced from optimal habitat.

Once the Yellowstone cutthroat trout are removed, establishing genetically pure westslope cutthroat trout populations at Camas Lake and Lake Evangeline (by means of translocation) would provide a mechanism to gradually reverse existing levels of hybridization. This would occur as pure westslope cutthroat trout move downstream from the newly established populations and gradually reproduce with fish from Trout and Arrow Lakes, in a process known as genetic swamping. The benefit would extend to westslope cutthroat trout populations downstream, as non-hybridized individuals migrate downstream through Rogers Lake and into the Flathead River system. In other words, a future source of genetically healthy westslope cutthroat trout in Camas Lake and Lake Evangeline would to some degree serve as a source of native westslope cutthroat trout to the broader Flathead system.

Alternative A would have beneficial impacts at a regional, ecosystem-wide level, since the establishment of westslope cutthroat trout populations in the upper Camas drainage would expand the species' overall distribution. Removing the risk of hybridization with Yellowstone cutthroat trout would protect the westslope cutthroat conservation areas at Trout, Arrow, and Rogers Lakes, and establishing genetically pure populations that are secure from invasion by non-native fish and habitat degradation from climate change would expand the conservation area to include the upper Camas drainage. By including westslope cutthroat trout sources from the North Fork system (from Ford and Starvation Creeks) for translocation, Alternative A would protect the irreplaceable genetic lineage of North Fork westslope cutthroat trout, and offset threats to the North Fork system from expanding rainbow trout. A number of region-wide efforts to conserve westslope cutthroat trout are underway by MFWP and the Flathead National Forest, and Alternative A would bolster these programs.

Alternative A would also result in some temporary adverse impacts to westslope cutthroat trout from the mortality of individual fish during rotenone and potassium permanganate applications. It is likely that at the time of application some westslope cutthroat trout would be present in Camas Creek upstream of Arrow Lake. Potassium permanganate would also be toxic to native fish at the anticipated neutralization concentration (2-4 milligrams per liter). The toxicity of the potassium permanganate would decline rapidly as it reacts with the natural stream environment and the rotenone. Any toxic effects would not be expected to persist for more than 15 to 30 minutes of flow time, as the residual concentration should drop below fish toxicity levels in that time and distance (approximately 0.25 miles in a typical small mountain stream) (Engstrom-Heg 1971 and 1972). The degree of mortality would not likely exceed a few individuals, and would be too limited to affect westslope cutthroat trout at the community or population level. Given the small amount of anticipated mortality, the same would be the case if reapplication of rotenone is necessary.

Translocation of westslope cutthroat trout would have some adverse impact on donor populations, since it would result in the removal of eggs and/or individuals from the population. But the donor populations under consideration for this project are large enough (exist at either high density or occupy large habitat areas) to support the removal of a small fraction (i.e. less than 10 percent) of the population. For example, the westslope cutthroat trout donor population in the unnamed tributary to Camas Creek has more than ten fish per every 100 square-meter of stream, and the donor population in Starvation Creek occupies over five miles of stream habitat). Adverse impacts from translocation would, therefore, be too low to change the long-term abundance or distribution of the donor population in any meaningful way and would not threaten its existence.

Bull Trout

Alternative A would benefit bull trout through the establishment of a population that is secure from invasion of non-native fish and habitat degradation occurring due to climate change. Establishing a secure population of bull trout in the upper Camas drainage (via translocation) would compensate for risks to the Rogers Lake bull trout population presented by non-native lake trout, as well as bull trout population losses in other areas of the North Fork of the Flathead drainage. As with westslope cutthroat trout, establishing bull trout in Camas Lake and Lake Evangeline would increase the overall distribution of the species, and expand the size of the core bull trout population at Trout and Arrow Lakes to include the upper Camas drainage. The benefits of this would be regional, given the link between core populations in the park and the conservation of bull trout throughout the Crown of the Continent Ecosystem. A secure bull trout population in the upper Camas drainage would also support regional efforts by numerous state, tribal, Federal and Provincial entities to conserve bull trout.

The potential for adverse impacts to bull trout from the use of rotenone and potassium permanganate would be very low, because the chemicals would be completely detoxified before reaching bull trout populations, and because surveys have not indicated the presence of bull trout within the treatment area. There is a chance that one or more individual bull trout (e.g. juveniles) could migrate into the treatment area and be present during rotenone application, resulting in a slight potential for bull trout mortality. Electrofishing the treatment area where bull trout could be present prior to applying rotenone and relocating any bull trout that are found to Arrow or Trout Lake, downstream of the rotenone treatment area, would mitigate this risk to the point where bull trout mortality would be highly unlikely. Should mortality occur, it would be at the individual level, and too low to measurably impact bull trout populations. The same conclusion would hold if rotenone needed to be reapplied, also because the chance of mortality would be very low and limited to the individual level.

There would be some adverse impact to bull trout from translocation due to the need to capture and handle adult bull trout as well as the removal of eggs from the donor system. These impacts would be short-term, as population level impacts would not be expected from the removal of the eggs. This is because the removal of the eggs would be mitigated by partially spawning each female (only about 50 percent of the eggs would be taken from each female handled) to allow for some natural reproduction, producing enough eggs to fully seed the available juvenile rearing habitat. Impacts would also be mitigated by removing a relatively small number of eggs from the population each year.

Since adverse impacts to bull trout would be of low intensity and short-term, with no expected mortality given the mitigation measures just described, the determination of effects to bull trout under section 7 of the ESA is "may affect, not likely to adversely affect." An aquatics biological assessment has been prepared and submitted to the USFWS; consultation is ongoing.

Sculpin

Alternative A would have adverse impacts to sculpin from the mortality of individual fish that are present in the treatment area when rotenone and potassium permanganate are applied. Sculpin have not been detected in the treatment area, but there is a chance that one or more individuals could migrate into affected waters. Mortality would likely be limited to a few individuals and would be too low to affect sculpin populations. There would be some adverse impacts to sculpin during translocation, since eggs and/or individual fish would be removed from the donor population. But the impacts would be temporary and of low intensity, since only a small proportion (less than 10 percent) of the total population would be translocated. This would ensure that the donor population would be demographically strong enough to support the removal. The existence of the donor sculpin population would not, therefore, be threatened.

Amphibians

Since rotenone and potassium permanganate affect gill-breathing organisms and amphibians breathe with gills during their stream-life stage, some larvae, if present, would be killed during the rotenone treatment. Species affected could include Columbia spotted frogs, tailed frog, long-toed salamander, and Pacific chorus frog (see Affected Environment, Amphibians, above). The amount of amphibian larvae mortality during rotenone treatments depends in part on the time of year, with less mortality occurring if rotenone is applied later in the year when the larvae have metamorphosed into terrestrial adults. This would be the case for all amphibians present except tailed frogs, which spend multiple years as tadpole larvae. Laboratory studies have documented the sensitivity of tailed frog larvae to rotenone and documented an 80 percent mortality rate of tailed frog tadpoles 24 hours after exposure to rotenone at a concentration of 1 ppm (the same concentration that would be used under Alternative A) (Grisak 2003a). However, numerous field evaluations by MFWP indicate the persistence of amphibian populations following rotenone applications in the Flathead Basin and, in particular, in the South Fork Flathead (Fried et al. 2018). One year after Tom Tom Lake in the South Fork of the Flathead was treated with rotenone, a survey documented numerous spotted frog juveniles, tailed frogs, and long-toed salamander larvae (Grisak 2003b). The evaluation of 18 lakes treated with rotenone over a 44-year period found that amphibian populations persisted after the treatments (Grisak 2003b). Brown and Ball (1943) reported that during a May rotenone treatment in Michigan, tadpoles were "greatly affected," but within three months were "extremely numerous." Based on this information, impacts to amphibians would likely be limited to larval stages for the short term with local population abundance likely recovering within a year or two. Adverse impacts would be reduced by implementing the project in late summer/fall when many amphibian species have developed into terrestrial adults.

The change in fish species composition following translocation of westslope cutthroat trout, bull trout, and sculpin to Camas Lake and Lake Evangeline would not result in new predatory influences that are noticeably different from that of the Yellowstone cutthroat trout currently present. Therefore, the abundance, composition, and distribution of amphibians would likely be very similar to what currently exists, and there would be few, if any, impacts as a result of translocation.

<u>Western Toad</u>. Western toad adults would not be affected by rotenone or potassium permanganate because they are terrestrial and would not be present in the water. The tadpoles would have matured into terrestrial juveniles by the time rotenone and potassium permanganate would be applied in late summer/early fall. While some tadpoles could still be in the water and killed, the number would be too small to be of any measurable or lasting consequence to the population, especially since they would be rapidly replaced by the following year's hatch.

Aquatic Macroinvertebrates

Aquatic insects in the treatment area would be affected by rotenone because they rely on gills for respiration. Susceptibility varies by species, with caddisflies and mayflies generally more susceptible than stoneflies (Oplinger and Wagner 2014). Aquatic mollusks are more resistant, with concentrations required to kill snails considerably higher than what is needed to remove trout (Oplinger and Wagner 2014). Numerous studies indicate that piscicides have temporary or minimal effects on aquatic insects. Cook and Moore (1969) reported that the application of rotenone has little lasting effect on the insect community of a stream. Cushing and Olive (1956) reported that insects in a lake treated with rotenone exhibited only short-lived effects. Case studies conducted on Devine Lake in the Bob Marshall Wilderness from 1994-1996 indicate that following a rotenone treatment, invertebrates actually increased in number and, very slightly, increased in diversity (Rumsey et al. 1997). Cushing and Olive (1956) reported that oligochaete (aquatic worm) numbers increased after a rotenone treatment then became stable. Therefore, some mortality of aquatic insects would be expected immediately following the application of rotenone, but it is likely that some would survive rotenone exposure within the treated waterbodies. Downstream drift and overland migration from untreated waters within the catchment also aid recolonization and help mitigate against short term effects. Extensive pre- and post-treatment monitoring from 21 alpine lakes and associated stream networks in the adjacent South Fork Flathead watershed have documented aquatic macroinvertebrate recovery in abundance and community composition within two to four years following piscicide application for even the most rare and sensitive taxa (Bourret et al. 2018; Schnee et al., In Prep).

Aquatic invertebrate populations would likely be recovered before westslope cutthroat trout are introduced, since it would likely take at least two years to produce the juvenile fish for introduction. As with amphibians, the presence of westslope cutthroat trout and bull trout would not result in predatory influences that are noticeably different from that of Yellowstone cutthroat trout. Westslope cutthroat trout and juvenile bull trout have feeding preferences that are similar to those of Yellowstone cutthroat trout, and prey on aquatic and terrestrial insects. Sub-adult and adult bull trout are less dependent on aquatic insects and prey primarily on other fish. Sculpin would be an additional predator, foraging primarily on benthic aquatic insects and invertebrates. But the abundance, composition, and distribution of aquatic macroinvertebrates would likely not change substantially as evidenced by diverse and abundant aquatic macroinvertebrate populations in lakes and streams across the park where various species of sculpin are present. Therefore, translocation would cause few, if any, impacts to aquatic macroinvertebrates.

<u>Cordilleran Forestfly (*Zapada cordillera*) and primitive mayfly minnow (*Parameletus columbiae*).</u> Impacts to these state listed aquatic macroinvertebrates would be as described above for aquatic macroinvertebrates in general. Impacts to the Cordilleran forestfly are unlikely, since the species inhabits small streams and seeps and would not be present in the main channel where rotenone would be used. If the Cordilleran forestfly or *P. columbiae* are present, their larvae could be killed by the rotenone or potassium permanganate, causing adverse impacts at the individual level. The loss of individuals from the treatment area would not have long-term impacts to either species at the population level, because studies have shown rapid recolonization following rotenone treatments. Recolonization would occur from the migration of individuals from untreated upstream and downstream areas, as well as from individuals within the treatment area that survive the rotenone.

Zooplankton

Studies have shown that piscicides have temporary effects on 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. Kiser et al. (1963) reported that 20 of 22 zooplankton species re-established themselves to pretreatment levels within about four months of a rotenone application. Both Anderson (1970) and Kiser et al. (1963) reported that most plankton species survive a rotenone treatment via their highly resilient egg structures. Sexual dimorphism as a result of parthenogenesis of some female plankters also greatly increases reproduction potential among zooplankton and, ultimately, density. MFWP sampling before and after rotenone treatment of 15 alpine lakes in the South Fork Flathead River drainage demonstrated a minor decline in zooplankton densities post-treatment, but no change in species diversity and a return to pre-treatment densities the following year (Schnee et al., in prep). Based on these studies, adverse impacts to zooplankton would be expected, but they would be temporary until the following spring and of no meaningful consequence to zooplankton communities.

Translocating westslope cutthroat trout, bull trout, and sculpin to Camas Lake and Lake Evangeline would not noticeably change predation influences on zooplankton. This is because westslope cutthroat trout have similar feeding preferences as Yellowstone cutthroat trout, and because bull trout and sculpin do not typically forage on zooplankton. Therefore, impacts to zooplankton from translocation of westslope cutthroat trout, bull trout, and sculpin would be very slight, if they occur at all.

Impacts from Alternative B (No Action)

Westslope Cutthroat Trout

Under Alternative B, Yellowstone cutthroat trout would continue to hybridize and compete with westslope cutthroat trout in the Camas drainage. While Yellowstone cutthroat trout are not currently present downstream of Arrow Lake, left unchecked they could migrate downstream into Trout and Rogers Lakes, and possibly into the greater North Fork of the Flathead River system. At the very least, their hybrids would likely colonize areas downstream, including the North Fork, and hybridize with westslope cutthroat trout. Hybridization disrupts local adaptations that confer fitness advantages in native environments. Weakened fitness can result in lower reproductive rates and individuals that are less resilient to disease and environmental stressors. Competition results in displacement from optimal habitat. Therefore, allowing hybridization and competition from Yellowstone cutthroat trout to continue and potentially expand downstream would likely cause observable demographic changes among westslope cutthroat trout populations, including decreased abundance and distribution.

Hybridization levels in westslope cutthroat trout populations in Trout and Arrow Lakes are currently low, which is one reason why these populations are considered conservation populations. But since a significant portion of the existing hybridization risk comes from Yellowstone cutthroat trout migrating downstream from Camas Lake and Evangeline Lake, taking no action to remove Yellowstone cutthroat trout would significantly jeopardize the currently healthy genetic status of westslope cutthroat populations in Trout and Arrow Lakes. As hybridization with Yellowstone cutthroat trout continues, the result would be eventual loss of westslope cutthroat conservation populations at Trout, Arrow, and Rogers Lakes.

Adverse impacts from hybridization would not be limited to the Camas drainage. Westslope cutthroat trout in the North Fork system are already at risk from hybridization with expanding non-native rainbow trout, and the continued added stressor of hybridization with Yellowstone cutthroat would put genetic lineages that evolved in the North Fork at risk of permanent loss. Since the park's westslope cutthroat trout conservation populations are important to the preservation of westslope cutthroat trout throughout the Crown of the Continent Ecosystem, losing even one conservation population and putting other genetically pure populations in the North Fork at risk would have adverse impacts at the regional level. Allowing hybridization with Yellowstone cutthroat trout to continue in the Camas drainage and spread downstream into the North Fork system would also undermine ongoing efforts by MFWP and Glacier to reduce overall hybridization levels through the removal of rainbow trout from high-risk tributaries of the North Fork.

Alternative B would also forego the opportunity to establish secure populations of genetically pure westslope cutthroat trout in an area well-suited to provide habitat refugia, i.e. cold-water habitat that is inaccessible to non-native fish and can remain stable for the long term despite the effects of climate change. Research demonstrating that non-native fish are able to tolerate warmer water temperatures than native fish (Muhlfeld et al. 2017) underscores the critical importance of secure westslope cutthroat trout populations in sustainable cold-water habitats. Alternative B would not provide the advantage that westslope cutthroat trout need to persist in the face of the combined threat of hybridization, competition, and climate change.

Bull Trout

Alternative B would have indirect adverse impacts to bull trout because it would forego an opportunity to establish a secure population of bull trout in an area of habitat refugia. This is notable given the risks to bull trout from non-native lake trout in Rogers Lake and other lakes on the west side of the park. Based on what is known about the effects on non-native lake trout on bull trout populations, non-native lake trout could drive down or completely replace bull trout in Rogers Lake. Climate change could also causes temperatures in the lake to rise to the point where bull trout are not able to persist there for the long term. Under no action, there would be no compensation for these effects to the Rogers Lake bull trout population, since new, secure bull trout populations would not be established at Camas Lake or Lake Evangeline. This could have indirect adverse impacts to the overall conservation of bull trout on the west side of the park, especially if bull trout are extirpated or their numbers are diminished in other areas outside the Camas drainage due to non-native invasive lake trout. In other words, because bull trout populations in the park are in such a precarious position, any missed opportunity to protect the species increases the overall risk to its long-term conservation.

Sculpin

Under Alternative B, Yellowstone cutthroat trout could expand downstream into Rogers and Trout Lakes and prey on sculpin. The potential impacts of this are unknown, but the overall adverse impacts of Yellowstone cutthroat trout on sculpin would likely be minimal. This is because Yellowstone cutthroat trout do not hybridize with sculpin, and would not compete with or displace them due to niche differences (i.e. Yellowstone cutthroat trout have different forage and habitat preferences). Therefore, Alternative B would not likely impact sculpin in any observable or meaningful way.

Amphibians

If Yellowstone cutthroat trout are preying on amphibians in Camas Lake and Lake Evangeline, their continued presence would result in continued adverse impacts to amphibian populations. Species affected could include Columbia spotted frogs, tailed frog, long-toed salamander, and Pacific chorus frog (see Affected Environment, Amphibians, above). Any predation impacts have been ongoing since the lakes were stocked with Yellowstone cutthroat trout in the 1920s and 30s, however. Since such impacts would have been occurring for some time, there would not be any noticeable changes to the existing status of amphibians in either lake. Predation by Yellowstone cutthroat trout that migrate downstream of Camas Lake and Lake Evangeline would also not notably affect amphibian populations, since amphibians in downstream waters are already exposed to predation by fish.

Western Toad. Same as for amphibians.

Aquatic Macroinvertebrates

As with amphibians, aquatic macroinvertebrates in Camas Lake and Lake Evangeline have likely been impacted by predation from Yellowstone cutthroat trout since the 1920s and 30s, and these impacts would continue under Alternative B. Since these effects have been underway for some time, there would be no measurable change to the current status of aquatic macroinvertebrate populations in either lake. If Yellowstone cutthroat trout migrate downstream, predation effects to aquatic macroinvertebrates in downstream waters would not be expected to differ much from what currently exists due to predation by other species of fish. This would also apply to the state listed cordilleran forestfly and primitive mayfly minnow (*P. columbiae*) if present.

Zooplankton

Under Alternative B, predation of zooplankton by non-native Yellowstone cutthroat trout would continue at Lake Evangeline and Camas Lake. It is likely that, in general, smaller zooplankton species are in higher abundance than larger species, since fish tend to graze on larger organisms. But it is unknown to what degree zooplankton communities at the lakes have changed since the lakes were stocked with Yellowstone cutthroat trout in the 1920s and 30s. Regardless, since the effects have been occurring for some time, no observable changes to the existing status of zooplankton communities in either lake would be expected. Any predation effects to zooplankton downstream from migrating Yellowstone cutthroat trout would not likely differ noticeably from the existing effects of predation from other fish.

Cumulative Impacts

Past, present, and reasonably foreseeable actions with impacts to native fish and aquatic species include fish passage barriers on Quartz and Akokala Creeks, lake trout suppression on Quartz and Logging Lakes, bull trout translocation to Grace Lake, NPS and other agency fisheries research and monitoring (including USGS, MFWP, and USFWS), and previous rainbow trout suppression on the North Fork. In summary, these actions have had beneficial impacts by protecting certain populations of native fish from the effects of non-native fish. Adverse impacts include impeded upstream migration of native fish from the fish passage barriers, and some bycatch mortality of native fish and likely amphibians, which has remained low enough to avoid measurable impacts to populations. When the impacts of Alternative A (preferred) are combined with the impacts of past, present, and reasonably foreseeable actions, the removal of a source of hybridization from the Camas drainage and the establishment of secure populations of westslope cutthroat trout and bull trout would complement beneficial impacts from other actions and contribute a noticeable degree of benefit that would increase the overall conservation potential for both species. The potential for mortality to native fish under Alternative A would contribute slightly to adverse impacts from past, present, and reasonably foreseeable actions, but would not substantially change the level at which adverse impacts are already occurring, nor increase them to the point where populations are impacted. When the impacts of Alternative B (no action) are combined with the impacts of past, present, and reasonably foreseeable actions, unchecked hybridization with Yellowstone cutthroat trout and lost opportunities to establish secure populations of westslope cutthroat trout and bull trout would increase the overall level of risk to the long-term conservation of both species.

Conclusion

Alternative A would benefit native westslope cutthroat trout for the long term by conserving and establishing non-hybridized populations, removing a source of hybridization (with non-native Yellowstone cutthroat trout), and gradually reversing existing levels of hybridization through genetic swamping. Benefits would be on a regional scale, as genetically healthy populations in the upper Camas drainage would be a source of native westslope cutthroat trout to the broader Flathead system, and because conservation populations at Trout, Arrow, and Rogers Lakes would be protected. This alternative would also protect the genetic lineage of North Fork westslope cutthroat trout and offset threats from expanding rainbow trout. Alternative A would also benefit bull trout by establishing a population that is secure from non-native fish and climate-related habitat degradation. This would compensate for risks to other bull trout populations from non-native invasive lake trout. Alternative A would have some adverse impacts from the mortality of individual westslope cutthroat trout and sculpin during rotenone treatments, and from the handling of fish and removal of eggs and/or individuals from existing populations during translocation. But mortality would be too limited to affect native fish at the community or population level, and, since donor populations exist at high density or occupy large areas, they are healthy enough to support the removal of some eggs/individuals. Bull trout would not be affected by rotenone because it would be detoxified before reaching bull trout populations. Amphibian larvae and some macroinvertebrates (aquatic insects) and zooplankton would be killed during rotenone treatments. Local population abundance would likely recover in a year or two for amphibians and two to four years for macroinvertebrates and zooplankton.

Cumulatively, Alternative A would complement beneficial impacts from other actions and increase the overall conservation potential for both westslope cutthroat trout and bull trout.

Under Alternative B, non-native Yellowstone cutthroat trout would continue to hybridize and compete with westslope cutthroat trout in the Camas drainage, jeopardizing the currently healthy genetic status of populations in Trout and Arrow Lakes, putting conservation populations in the Camas drainage at risk, and risking the permanent loss of genetic lineages of westslope cutthroat trout that evolved in the North Fork. Alternative B would also adversely impact the overall conservation of bull trout on the west side of the park by foregoing an opportunity to establish secure populations that would compensate for effects to other populations from lake trout. Cumulatively, Alternative B would increase the overall level of risk to the long-term conservation of both westslope cutthroat trout and bull trout.

Recommended Wilderness and Natural Soundscapes

Affected Environment

Recommended Wilderness

In 1973, Glacier completed a wilderness study and environmental impact statement (EIS) to comply with the 1964 Wilderness Act. The Wilderness Study/EIS identified 927,550 acres in Glacier (over 90 percent of the park) for Wilderness designation (NPS 1974) and resulted in a recommendation of same by the President of the United States to both houses of Congress. Congress has not enacted legislation to formally designate Glacier's wilderness recommendation as Wilderness. But pursuant to NPS Management Policies (2006), Glacier manages recommended wilderness to ensure that wilderness character is preserved, and will take no action that would diminish the wilderness eligibility of any area possessing wilderness characteristics until the legislative process of wilderness designation has been completed. Landscapes within the park's recommended wilderness have retained their intrinsically wild character and persist in their essentially natural condition. Park visitors are encouraged to practice principles of "Leave No Trace" outdoor ethics in order to minimize impacts to park resources and visitor experiences. The Camas drainage and entire treatment area for this project are within recommended wilderness.

The defining qualities of wilderness from the Wilderness Act [Section 2(c)] include *untrammeled*, i.e. "affected primarily by the forces of nature"; *undeveloped*, i.e. "without permanent improvements or human habitation"; *natural*, whereby the land is "protected and managed so as to preserve its natural condition"; "*outstanding opportunities for solitude or a primitive and unconfined type of recreation*"; and *other features of value*, including scientific, educational, scenic, or historical. Wilderness is managed according to these five different qualities of wilderness character. The following discussion describes the current status of each in Glacier.

Untrammeled quality. Keeping It Wild 2 describes the untrammeled quality as wilderness that is "essentially unhindered and free from the intentional actions of modern human control or manipulation," referencing the Wilderness Act's definition of wilderness as an area that "generally appears to have been affected primarily by the forces of nature" (Landres et al. 2015). Thus, preserving the untrammeled quality hinges on restraint from the intentional manipulation of the biophysical environment. Recommended wilderness in Glacier, including the Camas drainage, is a largely untrammeled, unmanipulated landscape. But some management of the biophysical environment occurs to protect other park resources and preserve the natural condition of wilderness character. Such management actions that have occurred or could occur in the Camas drainage include but are not limited to controlling the spread of non-native invasive plants, fire suppression, and bear management.

Undeveloped quality. The majority of Glacier's recommended wilderness is undeveloped, despite the presence of historic, administrative, and scientific structures and installations. Developments in the Camas drainage include the Camas Creek Patrol Cabin and the historic Matejka homestead cabin at the bottom of the drainage near the Inside North Fork Road. Scientific instruments may occasionally be present, including remote cameras, tree markers, data loggers, etc. Motorized equipment and mechanical transport devices also degrade the undeveloped quality of wilderness character, and the park uses non-motorized, traditional hand tools and non-mechanical transport for administrative activities in recommended wilderness whenever possible. But motorized equipment (such as chainsaws, portable generators, etc.) must sometimes be used during trail and campsite maintenance and maintenance of historic structures. Motorboats are currently used at four lakes in the park's recommended wilderness, including Quartz and Logging Lakes for lake trout suppression (NPS 2014), and Bowman and Kintla Lakes where NPS Park Rangers maintain boats for administrative purposes (such as shuttles for trail crews and researchers) and emergencies. Public motorboat use was previously allowed on Bowman Lake, but only electric motors are currently allowed there due to the risk of aquatic invasive species (AIS). Motorboats have not previously been used in the Camas drainage. Helicopters may also be used in the park to fly materials and equipment to remote project areas. NPS administrative flights increased considerably in 2018 (150-200 flights) during reconstruction of the Sperry Chalet and are scheduled to be at a high number again in 2019 (200-300 flights) as work on the chalet continues. Helicopter activity in the Camas drainage is relatively infrequent, but helicopters may fly over the area when travelling to other destinations.

<u>Natural condition</u>. The natural condition of recommended wilderness in Glacier is characterized by native plants and animals, healthy terrestrial and aquatic ecosystems, biodiversity, air and water quality, geologic processes, and other natural processes. Glacier is at the core of the Crown of the Continent ecosystem, one of the most ecologically intact areas remaining in the temperate regions of the world, and is noted for its remarkable number and diversity of plant and animal species. The natural condition of the park's wilderness character is degraded by a number of influences, including non-native species, which can put the long-term persistence of native species and ecological integrity at significant risk. As described in Chapter 1 of this EA, native westslope cutthroat trout and bull trout populations in the park are at risk due to the severely detrimental effects of non-native fish. This includes the Camas drainage, where non-native Yellowstone cutthroat trout are a direct threat to genetically pure westslope cutthroat trout populations.

<u>Solitude or primitive and unconfined recreation</u>. Glacier's recommended wilderness provides numerous outstanding opportunities for solitude and primitive or unconfined recreation, among which hiking and backcountry camping are some of the most popular. The park's recommended wilderness also gives visitors the opportunity to experience solitude and self-reliance. This quality of wilderness character depends on remoteness from the sights and sounds of human activity and the ability to recreate freely without constraints, whereby visitors rely upon their own skills. Opportunities for solitude and unconfined recreation can be degraded by activities such as helicopter flights, NPS maintenance projects, scientific research, and increasing visitation. Managerial restrictions, such as requiring permits for overnight stays and temporary trail or area closures (during fire and bear management activities, for example) interfere with unconfined recreation. Recreational facilities such as trails, bridges, and backcountry campgrounds are necessary to provide for visitor use and experience and protect park resources, but can also interfere with unconfined recreation and diminish a sense of primitiveness. The Camas drainage offers excellent opportunities for solitude and primitive recreation, even though the area is popular among hikers and anglers. Recreational facilities include the Camas Creek Trail, and backcountry camping is regulated through permits at two designated campgrounds at the foot of Arrow and Camas Lakes.

<u>Other features of value</u>. The fifth quality of wilderness character focuses on the ecological, geological, or other features of scientific, educational, scenic, or historical value within recommended wilderness. Glacier possesses unique scenic and geological value due to its dramatic scenery and 1.6 billion-year geologic history associated with mountain building and glaciation. Glacier's recommended wilderness also possesses unique historical value, as the park's resources and landscapes have drawn people to the region for over 10,000 years. The park also has unique scientific and educational value and, as a result, a notable legacy of research and scientific accomplishment. Scientific research in the park includes investigations on the effects

of non-native fish on native fish and aquatic ecosystems, including methods on how to control non-native fish and protect native species. In the Camas drainage, each of these values are present due to scenic beauty, pronounced geologic features and glaciated terrain, historic structures and archeological sites, and opportunities for scientific inquiry.

Natural Soundscapes

An important part of the NPS mission is to preserve the natural soundscapes of national parks. Natural soundscapes are the sounds of nature, a diminishing resource in an ever modernizing world. Natural sounds have intrinsic value as part of Glacier's unique environment, and they predominate throughout most of the park. Glacier's natural soundscapes are characterized by quiet and stillness as well as low decibel background sound, such as birdsong and the sound of wind, rain, and water. Natural soundscapes vary across the park, depending on elevation, proximity to water, vegetative cover, topography, time of year, weather, and other influences. Noise intrusions from human activity can mask biologically important sounds, degrade habitat, cause behavioral and physiological changes among wildlife, and interfere with visitors' experience. The effects of noise typically diminish as the distance from the source of the noise increases. The upper Camas drainage is in the park's alpine/subalpine acoustic zone, where natural ambient sound levels range between 30 and 35 dBA (US DOT 2009). Soundscapes in the area are characterized almost exclusively by natural sounds, but are interrupted at times by hiking parties or park administrative activities, such as trail and backcountry campground maintenance, and by noise from NPS administrative flights, search and rescue flights, and commercial air tours.

Environmental Consequences

Impacts from Alternative A (Proposed Action and Preferred Alternative)

Recommended Wilderness

Untrammeled quality. Alternative A would adversely impact the untrammeled quality of recommended wilderness because it would intentionally manipulate the biophysical environment in the upper Camas drainage. Adverse impacts would occur from removing non-native Yellowstone cutthroat trout and translocating native westslope cutthroat trout, bull trout, and sculpin. The intensity of impact would initially be dramatic, because rotenone would lethally remove all fish and many other gill-breathing organisms from Camas Lake and Lake Evangeline in a matter of days. But these effects would be highly localized, limited to two lakes that comprise approximately 89.7 acres (Camas Lake = approximately 17.5 acres; Lake Evangeline = approximately 72.2 acres), and an estimated three miles of stream. This would be only approximately 0.07 percent of the total acreage (13,623.5 acres) of lakes in the park's recommended wilderness, and approximately 0.2 percent of the 1550 miles of perennial stream in the park. Impacts to the untrammeled quality would also be temporary, lasting until the biophysical environment in the upper Camas drainage is no longer being actively controlled. Following treatment and translocation, the intensity of adverse impacts would dissipate over time as the area becomes once again "affected primarily by the forces of nature."

Undeveloped quality. Alternative A would cause temporary adverse impacts to the undeveloped quality of recommended wilderness from the use of motorized watercraft, generators, water pumps, and helicopters, which would be in conflict with the absence of mechanization that is part of the core definition of wilderness. Long-line sling load operations and planting fish with helicopters would also be considered aircraft landings, which are Section 4(c) prohibited uses under the Wilderness Act. Auger dispensers, remote incubators, and fish monitoring devices, such as tags and fixed-location remote sensors, would also adversely impact this quality because they would be installations on an otherwise undeveloped landscape. Impacts would be temporary, ceasing once the rotenone has been detoxified and equipment can be removed from the project area (estimated three to four weeks). After this, adverse impacts would be infrequent and punctuated, occurring only during long-line sling load and helicopter fish planting operations for translocation (estimated at four flights per year for six or seven years). Monitoring devices for translocated fish would cause longer-term impacts, as they could be in place for several years. But such devices would be too small and concealed to noticeably change the undeveloped quality of wilderness character.

Natural condition. Alternative A would benefit the natural condition by preserving and protecting indigenous species and ecological processes that are integral to wilderness character and essential to the value, integrity, and quality of Glacier's recommended wilderness. Benefits would extend regionally, since removing non-native Yellowstone cutthroat trout would reduce the overall risk of hybridization in the broader Flathead system and because translocation would expand the distribution of native species. These benefits would be permanent, since non-native fish would be completely removed from the treatment area and because the treatment area is secure against reinvasion. Alternative A would also have adverse impacts to the natural condition from the mortality of aquatic invertebrates, amphibians, and individual native fish. As described in the analyses for these species, impacts would either be temporary and/or would not affect species at population levels. Additional adverse impacts would occur to the natural condition from noise impacts to natural soundscapes, discussed below.

Opportunities for solitude and primitive and unconfined recreation. Alternative A would have temporary adverse impacts to opportunities for unconfined recreation since the treatment area would be temporarily closed to public access during rotenone application. The closure would be in place from late summer/early fall, when the project begins, until spring, by which time the rotenone would be completely neutralized. Impacts to unconfined recreation would, therefore, be temporary, ending once the closure is lifted in the spring. Alternative A would also have the potential to adversely impact solitude due to noise from motorized watercraft, water pumps, generators, and helicopters (impacts from noise are discussed in detail below, under "Natural Soundscapes"). But since the treatment area would be closed to the public, most of the project noise would likely be too distant from wilderness recreationists to noticeably impact a sense of solitude (as discussed in impacts to "Visitor Use and Experience," below). Potential impacts to solitude from project noise would be temporary, since most of the noise would end following the rotenone portion of the project (three to four weeks), and would cease completely after helicopter long-line sling load and fish planting operations for translocation are completed (estimated at four flights per year for six or seven years). The presence of project personnel could have the potential to interfere with opportunities for solitude, but these impacts would not differ noticeably from the existing effects of campers, hikers, and anglers (see analysis of impacts to "Visitor Use and Experience"). While adverse impacts would be meaningful for people seeking solitude and unconfined recreation in or near upper Camas Creek, this quality would be affected in only a fraction of the park's recommended wilderness (limited to the upper Camas drainage), with the vast majority of park's 927,550 acres of recommended wilderness unaffected.

Other features of value. Alternative A would benefit the unique scientific and educational values of Glacier's recommended wilderness because it would provide a valuable research opportunity, investigating methods of preserving and protecting native fish and aquatic ecosystems that are at risk from non-native species and climate change. This alternative would also protect opportunities for continued research on genetically intact populations of westslope cutthroat trout. Alternative A would, therefore, make an important contribution to a vital, growing body of knowledge regarding fisheries management, the control of non-native species, and the protection of native species. These benefits would be long-term, since results of the project would be a useful source of information in the future management and preservation of native aquatic fish and ecosystems. The presence of motorboats on the lakes would adversely impact scenic values in the Camas drainage, but effects would be temporary, ending once the boats are removed, and would not be observable since the project area would be closed to public access. Helicopter flights would adversely impact scenic values along the flight path, but the effects would be short-lived and intermittent. There would be no impacts to features of geological or historical value.

If a second application of rotenone is necessary during the same year or in a following year, the type and degree of impacts to the five qualities of wilderness character would be as just described, with no meaningful increase in the type or degree of impact. This is because reapplication would follow the same general protocol as the initial application, and adverse impacts would remain temporary.

Natural Soundscapes

Alternative A would have temporary adverse impacts to natural soundscapes due to noise from motorized watercraft, water pumps, helicopters, and generators. Noise impacts would occur intermittently over an 8 to 12-hour period each day for approximately two to three days when motorized watercraft and water pumps are in use; for a few minutes at a time during helicopter long-line sling-load operations or fish planting with a helicopter (for an estimated six to 10 inbound flights and three to six outbound flights for rotenone application, depending on the size of the aircraft, and another four flights per year for six or seven years for translocation and native fish planting); and for 24-hours a day, seven days a week for an estimated two to three weeks when the generator is running during detoxification (to power the auger dispensing the potassium permanganate). As described in Chapter 2, "Alternatives," the motorboats would likely produce noise ranging from 60 to 90 dBA, and the generator would likely produce noise ranging from 53 to 68 dBA. The water pumps would be expected to produce noise at approximately 105 dBA. Noise levels from helicopters are highly variable depending on the type of aircraft used, so cannot be known at this time. To provide context for these sound levels, the table below gives examples of common sound sources with the same average sound levels, measured in dBA.

Table 2: Sound level (dBA) of common sound sources.

Common Sound Sources	Sound Level (dBA)
Whispering; leaves rustling	20
Residential area at night; crickets at five meters	40
Busy restaurant; conversation at five meters	60
Curbside of busy street; cruiser motorcycle at 15 meters	80
Jackhammer at two meters; thunder	100
Train horn at one meter; military jet at 100 meters above ground level	120

Noise from Alternative A would generally be sporadic, occurring intermittently with periods of relative quiet when noise-producing equipment is not in use. Continuous noise would occur during detoxification of the rotenone, however, since the generator would run 24 hours a day, seven days a week (for an estimated two to three weeks). Noise would be loudest at the source and attenuate, or reduce in amplitude, over distance until it reaches background natural ambient sound levels (30-35 dBA). The noise would still be audible, however, since noise typically remains audible until it attenuates to eight dB below the ambient level (64 Fed. Reg. 134 1999).

The distance that noise under Alternative A would need to travel before attenuating to a natural ambient level of approximately 30 dBA are presented below in Table 3 and graphically illustrated in Appendix F. The attenuation distances were derived from an attenuation calculator/sound modeling tool developed by the NPS Natural Sounds and Night Skies Division (NSNSD). Actual noise attenuation distances may be shorter than derived by the model, since the NSNSD attenuation calculator cannot account for changes in wind direction, temperature, and humidity, which also influence sound. The noise levels and attenuation distances presented are meant to provide the best possible approximations.

Table 3: Estimated approximate distances over which noise would need to travel before attenuating to a natural ambient level of 30 dBA as derived from the NSNSD attenuation calculator.

Equipment	Estimated Attenuation Distance (to 30 dBA)
Motorboat	1.1 – 1.2 miles (1.8 – 1.9 kilometers)
Water pump	Unknown*
Generator	0.21 miles (341 meters)
Helicopter	1.6 to 3.4 miles (2.5 – 5.5 kilometers)

*data not available to model attenuation distances for a water pump.

The attenuation distance for motorboats is likely inflated, since the modeling does not factor in changing weather conditions or the exact location of the motorboat. Also, the 4-stroke engine makes/models used to model noise levels and attenuation would not necessarily be the make or model used during Alternative A; these models were selected because they represent the same general type and dBA of motors that could be used. The NSNSD calculator also models the boats at full throttle, but motorboats would be operating at their lowest speeds most of the time, producing sound levels toward the lower end of the possible range. To estimate attenuation of generator noise, the NSNSD calculator modeled a generator with an average sound level of 66 dBA, measured 50 meters away from the source. Modeling data was not available to estimate attenuation distances for a water pump. The calculator estimates noise from three different models of helicopter (Appendix F). Helicopter noise would be most audible and disruptive as the helicopter hovers at low elevation during sling-load and fish planting operations. Figure 3 illustrates how sound levels from different types of helicopters increase when the aircraft hovers at lower distances above ground level. The graph is adopted from the environmental assessment prepared to rebuild the Sperry Chalet; while the type of helicopters that could be used for Alternative A are not known at this time, they could be similar to those shown in Figure 3. Generally, helicopter noise goes up with the weight and size of the machine.

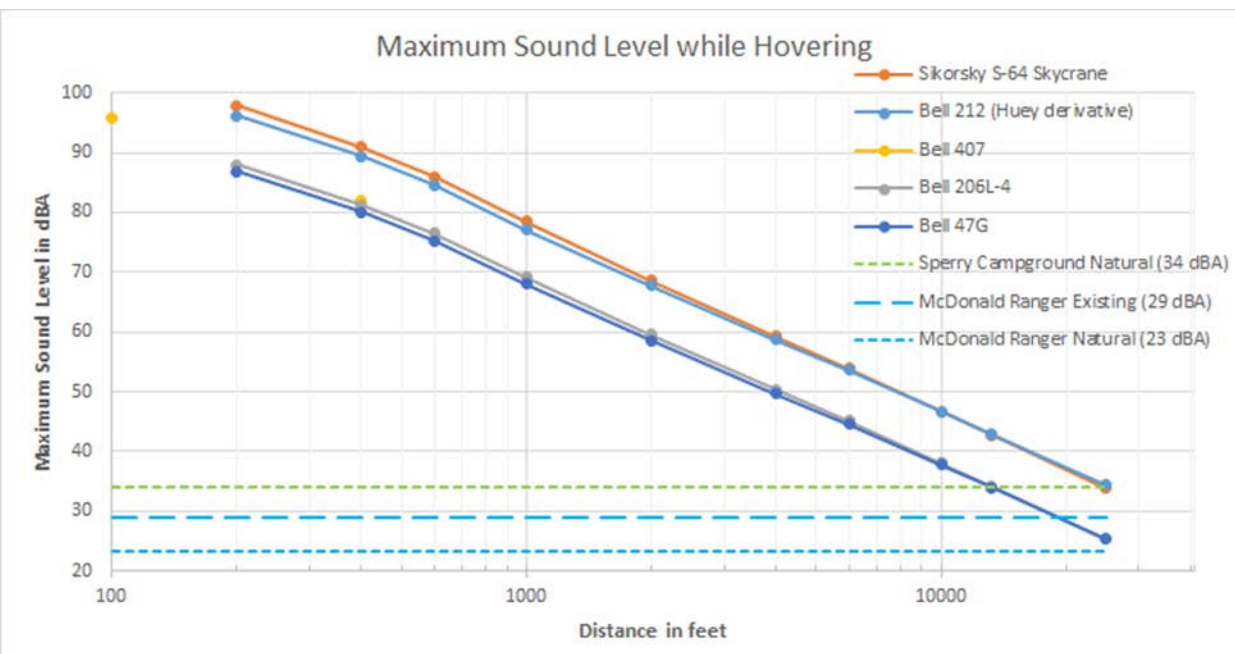

Figure 3: Helicopter noise levels while hovering (from the EA for the Sperry Chalet rebuild (NPS 2018e).

Environmental factors would influence the amplitude of noise produced by Alternative A and the distance required for it to attenuate to the natural ambient sound level. Since sound travels over water and because Camas Lake and Lake Evangeline are within a cirque-type basin where the topography would likely cause sound to bounce, noise from the motorboats, water pumps, and helicopters would likely be fairly audible. However, the steep terrain surrounding the lakes would block the noise (known as terrain shielding), reducing its audibility outside the basin. Weather conditions, such as wind, would also have a masking effect. Vegetation may minimize noise levels somewhat, although vegetation is far less influential than terrain in shielding low frequency noise (dense foliage that completely blocks the line of sight along the sound propagation path can account for only a few decibels of attenuation). Noise from the generator, which would be situated near the stream, would be masked by the sound of moving water.

Adverse impacts to natural soundscapes could disrupt a sense of solitude and the experience of natural backcountry sounds for visitors recreating near the treatment area. Visitors would not be in close proximity, however, since the treatment area would be closed during rotenone application and detoxification (see analysis of impacts to "Visitor Use and Experience," below). Noise would also have the potential to displace animals, cause brief behavioral and physiological changes, and mask biologically important sounds (sounds that would alert animals to threats or foraging opportunities, for example). But as explained above, the noise would be too sporadic or, in the case of the generator, too localized and sufficiently masked to measurably interfere with biological processes or meaningfully change the overall character of soundscapes in the upper Camas drainage. Noise impacts would also be temporary, with most of the noise ending at the end of the rotenone application/detoxification process in three to four weeks. After that, there would be some follow up noise from helicopter long-line sling-load operations and fish planting with a helicopter during native fish translocation, but this would be very infrequent (estimated at four flights per year over the course of six to seven years). Because project noise would attenuate to ambient levels within approximately 3.5 miles (at most) of the treatment area (Table 3), soundscapes in the vast majority of the park would remain unaffected. Alternative A would also not represent a change in the overall level and type of noise that already occurs in the park's recommended wilderness. Water pumps and generators are used during backcountry operations such as trails maintenance, helicopters are used to support administrative work in recommended wilderness, and motorboats currently operate on Bowman and Kintla Lakes for NPS administrative support and on Quartz and Logging Lakes for lake trout suppression. While Alternative A could cause the number of administrative helicopter flights to exceed the park's annual limit of 50, any increase would not be permanent, occurring for one season if a single application of rotenone is sufficient, or two seasons at most if reapplication is necessary, and then infrequently for native fish translocation.

If a second application of rotenone is necessary, impacts to natural soundscapes would be as just described, with no meaningful increase in the type or degree of impact. This is because reapplication would follow the same general protocol as the initial application. Also, while reapplication would extend the duration of noise for another three to four weeks, the noise produced would still be temporary, ending once reapplication has concluded, and would not meaningfully change existing soundscapes or produce a type or level of noise that represents a change from what already occurs in the park's recommended wilderness.

Impacts from Alternative B (No Action)

Recommended Wilderness

Since no action would be taken, there would be no manipulation of the biophysical environment, no use of motorized equipment or helicopters, no installations, and no area closures. Therefore, there would be no new adverse impacts to the untrammeled and undeveloped qualities of recommended wilderness, nor to opportunities for solitude and unconfined recreation. These qualities of wilderness character would be preserved in their current condition. Alternative B would, however, adversely impact the natural condition by allowing non-native Yellowstone cutthroat trout to continue to hybridize and compete with native westslope cutthroat trout. This would jeopardize westslope cutthroat populations in Trout and Arrow Lakes, resulting in the eventual loss of westslope cutthroat conservation populations in the Camas drainage, and put genetic lineages of the species in the North Fork at risk of permanent loss. In addition, the missed opportunity to provide habitat refugia for bull trout would increases the overall risk to their long-term conservation. Alternative B would also have adverse impacts to the unique scientific and educational value of recommended wilderness through the loss of a valuable opportunity to continue research on genetically intact populations of westslope cutthroat trout, the control of non-native species, and the conservation of native species.

Natural Soundscapes
Since no action would be taken, no noise would be produced and there would be no impacts to natural soundscapes under Alternative B.

Cumulative Impacts

There are a number of past, present, and reasonably foreseeable actions with both adverse and beneficial impacts to recommended wilderness and natural soundscapes. Fish passage barriers on Quartz and Akokala Creeks, lake trout suppression at Quartz and Logging Lakes, bull trout translocation at Grace Lake, five-needle pine restoration, invasive plant control, fire management, bear management, and certain resource monitoring and research activities (such as those that involve specimen collection) adversely impact the untrammeled quality of wilderness character because they intentionally control or manipulate the biophysical environment. These actions also benefit the natural condition, however, because they directly protect natural resources and/or inform management decisions regarding the protection of those resources. Installations for these actions (e.g. fish barriers, bear traps, tree markers, remote cameras, radio collars, weather stations, etc.) and for other NPS administrative operations (e.g. radio repeaters) adversely impact the undeveloped quality. Temporary area closures for fire and bear management cause temporary adverse impacts to unconfined recreation. The use of motorboats for lake trout suppression and NPS administrative activities on Bowman and Kintla Lakes, the use of chainsaws, generators, water pumps, and other motorized equipment during maintenance of backcountry trails, campgrounds, and historic structures, and NPS administrative flights, search and rescue flights, fire management flights, and commercial air tours adversely impact natural soundscapes, opportunities for solitude, and the undeveloped quality. NPS administrative flights increased considerably in 2018 (150-200 flights) during reconstruction of the Sperry Chalet and are scheduled to be at a high number again in 2019 (200-300 flights). While the chalet itself is outside of recommended wilderness, the flights and construction activity will have temporary adverse impacts to opportunities for solitude in adjacent areas during construction, but will permanently benefit other features of value (unique historical values).

When the impacts described for Alternative A are combined with the impacts of past, present, and reasonably foreseeable actions, Alternative A would slightly increase but would not notably change the number and degree of adverse impacts already occurring. This is because the use of motorized equipment would be sporadic and temporary and would not represent a change in the type and level of noise or motorized use that already occurs in the park's recommended wilderness, and because there would be no permanent increase to the park's annual limit of 50 administrative flights. Alternative A would contribute a greater degree of beneficial impact because of the long-term protection of the natural condition and unique scientific and educational values from the preservation of native westslope cutthroat trout and bull trout. Under Alternative B, no action, there would be no cumulative adverse impacts to the untrammeled and undeveloped qualities of recommended wilderness, solitude and recreation, or natural soundscapes since there would be no manipulation of the biophysical environment, no installations, and no motorized use. Alternative B would, however, contribute a notable degree of adverse impact to the natural condition, since the continued hybridization between non-native Yellowstone cutthroat trout and native westslope trout would result in the eventual loss of westslope cutthroat conservation populations, put genetic lineages of the species at risk of permanent loss, and undermine other efforts to conserve native fish.

Conclusion

Alternative A would have adverse impacts to recommended wilderness and natural soundscapes from the manipulation of the biophysical environment; installations of detoxification equipment and fish monitoring devices; and the use of motorized watercraft, water pumps, a generator, and helicopters. Impacts would be limited to approximately 0.07 percent of the total acreage of lakes in the park's recommended wilderness and approximately 0.2 percent of the perennial stream miles. Impacts would be temporary, ending when the project is over. Project noise would be too sporadic or localized to measurably change the overall character of natural soundscapes, and would not represent a change in the overall level and type of noise that already occurs in the park's recommended wilderness. Alternative A would benefit the natural condition by preserving and protecting indigenous species and ecological processes, and would benefit unique scientific and educational values by providing a valuable research opportunity on the conservation of native fish. Alternative B would adversely impact the natural condition and unique scientific and educational values of recommended wilderness because it would put westslope cutthroat trout conservation populations at risk, put genetic lineages of westslope cutthroat trout in the North Fork at risk; increases overall risks to the long-term conservation of bull trout; and lose a valuable opportunity to research the control of non-native species and the conservation of native species. Cumulatively, Alternative A would not notably change the number and degree of adverse impacts already occurring because the use of motorized equipment would be sporadic and temporary, would not represent a change in the type and level of noise or motorized use that already occurs, and because there would be no permanent increase to the park's annual limit of 50 administrative flights. Alternative B would notably increase adverse impacts to the natural condition of recommended wilderness due to continued hybridization between non-native Yellowstone cutthroat trout and native westslope cutthroat trout.

Common Loons and Other Water Birds

Affected Environment

Common Loons (*Gavia immer*) – State listed species of concern

Common loons occur on lakes throughout the park from spring through fall, but rarely during winter. Glacier is inhabited by a high proportion of Montana's nesting pairs, making the park especially important to the viability of the state's loon population. Common loons are very particular about nesting habitat, which requires accompanying nursery areas for the chicks. Loons nest along shorelines or the water margin, typically within one meter of the water's edge, generally on lakes larger than 13 acres in size. Loons in Glacier typically begin laying their eggs in the beginning of June. Common loons feed on fish, small amphibians, or invertebrates. Common loons tend to reuse nest sites (J. Belt, personal communication) and are most vulnerable to disturbance-related nest failure during the critical nesting period in April-July. The brood-rearing period can continue into late August/early September.

Common loons are well documented in the Camas Creek drainage at Trout, Rogers, and Arrow Lakes, with loons observed at each of these lakes for a number of years. Successful nesting was documented at Trout Lake in 2006, 2007, and 2009, then not again until 2018. Chicks have been recorded at Rogers Lake in 2011 and 2018, although chicks at both lakes may have gone undocumented in 2015-2017 due to incomplete surveys (J. Belt, personal communication). There are no records of nesting loons at Arrow Lake, but loons nesting at Trout and Rogers Lake frequently forage at Arrow Lake. Common loons have not been documented at Camas Lake or Lake Evangeline, and there is no evidence of nesting at either lake. The lakes are not currently included in the park's routine loon survey program because the elevations (5075 feet at Camas Lake and 5246 feet at Lake Evangeline) are higher than what is typically considered optimal nesting habitat for loons (at or below 4500 feet) (J. Belt, personal communication). Both lakes likely provide supplemental forage for loons nesting at Trout and Rogers Lakes, however, and may also be used by migratory loons in the fall.

Water Birds (ducks, swans, geese, loons, grebes, cormorants, and coots)

Most of the lakes and streams in Glacier provide primary breeding and foraging habitat for water birds (ducks, swans, geese, loons, grebes, cormorants, and coots). Many of these species are migratory, arriving in April and May, whereas others such as Canada geese, common mergansers, goldeneyes, buffleheads, and mallards are year-round residents if waters remain ice-free. Breeding among these species typically begins in May, with nesting beginning in May or June and finishing by late July. The brood-rearing period, when chicks are out of the nest but still dependent on the adults, typically extends into August/September depending on the species. Species known to breed in the park include:

Canada good	Trumpeter swan
Wood duck	Mallard
Ring-necked duck	Harlequin duck
Bufflehead	Common goldeneye
Barrow's goldeneye	Hooded merganser
Common merganser	Red-breasted merganser
Eared grebe	Red-necked grebe

In the Camas drainage, common goldeneyes, mallards, hooded mergansers, and Canada geese have been documented (NPS files), but other species could use the area. While some water bird species feed almost exclusively on fish, some feed primarily on insects, and others are omnivorous, feeding also on aquatic vegetation. Although Glacier is important for breeding and foraging waterfowl, it is not known as a stopover location for migrating waterfowl. This is likely due to colder conditions that keep lakes in the park frozen when lakes outside the park have thawed. As a result, ducks and geese reported on lakes in Glacier in the spring and fall only number in the tens or hundreds at the most (NPS files). This is in contrast to the lakes and flooded agricultural fields in the Flathead Valley west of the park (C. Hammond, MFWP, personal communication) and Freezeout Lake area east of the park (Milewski and Schwitters 2018), where tens of thousands of waterfowl are reported annually during migration. Waterfowl are sensitive to human disturbance, especially those associated with loud noise and visible features, and are most vulnerable during the nesting, brood-rearing, molting, migration, and wintering periods of their annual cycle (Korschgen and Dahlgren 1992).

Environmental Consequences

Impacts from Alternative A (Proposed Action and Preferred Alternative)

Common Loons

Since elevations at Camas Lake and Lake Evangeline are higher than what is typically considered optimal nesting habitat for loons, and since there is no evidence of loons nesting at either lake, it is unlikely that loons would be nesting at Camas Lake or Lake Evangeline during the project. As previously described in "Affected Environment," loons nesting elsewhere (e.g. Trout and Arrow Lakes) could forage at Camas Lake and Lake Evangeline, and loons could also feed at the lakes during the migration period. There would be no direct effects to foraging loons from rotenone, since treatment concentrations would be far below levels that are toxic to birds. Rotenone would, however, remove a source of food for any loons using the lakes, since it would kill all fish inhabiting the lakes, as well as some amphibian and aquatic macroinvertebrate larvae. Impacts would be temporary, lasting until amphibians and macroinvertebrates recover (amphibians are estimated to recover by the following year or two; macroinvertebrates are estimated to recover abundance and community composition and in two to four years) and until translocated native fish become established. This could take several years, depending on how long it takes native fish to establish self-sustaining populations. Impacts would not measurably affect loon distribution in the Camas drainage, however, since loons would still be able to forage in Arrow, Trout, and Rogers Lakes as well as Lake McDonald, approximately eight miles (12 kilometers) away on the other side of Howe Ridge, as those lakes would remain unaffected. Prior to applying rotenone, the park would survey Camas Lake and Lake Evangeline for common loons. In the off chance that loons have nested on either lake and are raising chicks, the application of rotenone would be scheduled as late as possible, allowing more time for the juvenile birds to acquire the ability to fly to nearby lakes for forage. Rotenone could not be applied later than September 1 due to fall weather considerations, by which time any juvenile loons would likely be able to fly.

There would be some potential to disturb loons during helicopter long-line sling-load operations, planting fish with a helicopter, and the use of motorboats. Effects of disturbance could range from physiological stress responses, such as increased heart rate, without any observable behavioral changes, to interruptions of behavior, to physical displacement. The potential for disturbance from motorboats would be sporadic, occurring intermittently over an estimated 8 to 12-hour period each day for approximately two to three days, ending once application of the rotenone is complete. The potential for disturbance during helicopter long-line sling-load and fish planting operations would be highly intermittent, for a few minutes at a time for each flight (estimated at six to ten inbound flights and three to six outbound flights for rotenone application, followed by an estimated four flights per year for six or seven years for translocation).

Since there would be undisturbed habitat at Arrow, Trout, and Rogers Lakes downstream of the treatment area and at Lake McDonald, disturbance or displacement would not meaningfully alter the availability of resting or foraging habitat for loons. Since loons would not likely be nesting on the treatment lakes, as previously explained, there would be very little potential to disturb nesting loons. Depending on the flight path, helicopter flights could disturb loons nesting at other lakes. But the potential impacts would be slight since most of the flights would take place for the rotenone portion of the project, which would not occur until late summer (late August/early September), after the critical nesting period, and flights for translocation would be relatively infrequent. Fisheries personnel visiting the lakes earlier in the season for pre-treatment activities (such as surveys or stream flow-monitoring, for example) may encounter breeding or nesting loons. But this type of human activity would not be much different from existing activity already occurring from hikers and anglers. The potential to disturb breeding or nesting loons would not, therefore, be expected to change in any noticeable way. Fisheries personnel are also experienced in identifying and avoiding loons, which would minimize the potential for disturbance.

If reapplication of rotenone is necessary, the type and degree of impacts to common loons would remain as just described, since reapplication would not occur during the critical nesting/brood-rearing season, the potential for disturbance would be temporary, and undisturbed habitat would be available at other nearby lakes. For the reasons described, Alternative A would have no lasting or biologically meaningful impacts to common loons and would not observably change the abundance or distribution of the species.

Water Birds

Impacts to other water birds would generally be as described above for common loons. There would be no direct impacts from rotenone, since treatments concentrations would be below levels that are toxic to birds. A source of prey would be removed for species that prey on fish, such as loons, grebes, cormorants, mergansers, some species of duck. But as with common loons, impacts would be temporary, lasting until translocated native fish become established, and impacts would be limited to Camas Lake and Lake Evangeline, leaving fish-based prey unaffected in nearby Arrow, Trout, and Rogers Lake, as well as Lake McDonald. A source of food would also be reduced for water birds that feed on amphibian and macroinvertebrate larvae. Some aquatic macroinvertebrates would likely survive the rotenone treatment, and the reduction would be temporary until amphibian and invertebrate populations recover (likely in a year or two for amphibians, two to four years for macroinvertebrates). This type of prey would also be readily available at other, nearby lakes. As with common loons, if juveniles of exclusively fish-dependent water birds are present on either of the treatment lakes, the application of rotenone would be scheduled as late as possible, allowing more time for juvenile birds to acquire the ability to fly to nearby lakes. Juveniles would be expected to be able to fly by September 1, the latest date that the rotenone application could begin.

Birds that are resting or foraging in the treatment area during helicopter long-line sling load operations, fish planting with a helicopter, and motorboat use could be disturbed or displaced. Effects would be very minimal, with no measurable changes to species abundance or distribution, since many birds typically migrate out of the park by late summer/early fall. For those that are still present, abundant habitat would remain available at Arrow, Trout, and Rogers Lake downstream, and at Lake McDonald. Disturbances would be short-lived, occurring intermittently over an estimated for 8 to 12-hour period each day for approximately two to three days when motorboats are in operation and for a few minutes during helicopter long-line sling load and fish planting operations. There would be little if any potential to disturb nesting water birds or broods, since the project would not occur until after the critical nesting and brood-rearing periods are generally over. Personnel visiting the project area for pre-treatment activities such as surveys and monitoring could have some potential to disturb nesting water birds, but it would not exceed that which already exists from hikers and anglers. If reapplication of rotenone is necessary, the type and degree of impacts would be as just described, since reapplication would not occur during the critical nesting/brood-rearing season, the potential for disturbance would be temporary, and undisturbed habitat would be available at other nearby lakes. For the reasons described, Alternative A would have no lasting or biologically meaningful impacts to water birds and would not observably change water bird abundance, distribution, or species composition.

Impacts from Alternative B (No Action)

Since no action would be taken, there would be no potential to disturb common loons or other water birds and there would be no impacts under Alternative B.

Cumulative Impacts

Past, present, and reasonably foreseeable actions with the potential to impact common loons and other water birds include lake trout suppression on Quartz and Logging Lakes and bull trout translocation to Grace Lake. There is no evidence that these actions have affected common loons or other water birds in any observable way. But motorboat operations at Quartz and Logging Lakes have the potential to disturb and displace common loons and other water birds, and the presence of project personnel at Grace Lake could also result in some disturbance of much lesser intensity. When these potential impacts are combined with the impacts described for Alternative A, the total cumulative impact to common loons and other water birds would be adverse overall. The greatest degree of impact would be attributable to motorboat operations on Quartz and Logging Lakes, since motorboats operate at the lakes intermittently for several weeks each spring and fall. Alternative A would contribute only a slight degree of adverse impact, since motorboat operations at Camas Lake and Lake Evangeline would only be underway for approximately two to three days. This would contribute slightly, but would not substantially change the existing potential for adverse impacts from lake trout suppression on Quartz and Logging Lakes. Alternative A would contribute adverse impacts to forage for common loons and other water birds because it would remove a source of food (fish, amphibians, aquatic insects) from Camas Lake and Lake Evangeline. But sufficient prey would be available at other nearby lakes, and impacts would be temporary until amphibian and invertebrate populations recover, and until translocated native fish become established in the following years. Under Alternative B, there would be no cumulative impacts to common loons and other water birds, since no action would be taken, with no potential for impacts.

Conclusion

Alternative A could disturb or displace common loons and other water birds and would remove forage for birds using the lakes. But impacts would be temporary until native fish populations become established and amphibians and aquatic macroinvertebrates recover, and would not observably change the composition, abundance or distribution of water birds or common loons in the park or the Camas drainage. Treatment concentrations of rotenone would be far below levels that are toxic to birds; rotenone treatments would not begin until late summer, after the critical nesting and brood-rearing period; habitat at Trout, Arrow, and Rogers Lakes and Lake McDonald would remain unaffected; and, if juvenile birds are present on either treatment lake, the application of rotenone would be scheduled for as late as possible prior to September 1, when juveniles would likely be able to fly and seek forage in other waters. Under Alternative B, there would be no impacts to common loons and other water birds, because no action would be taken. Cumulatively, Alternative A would contribute only a slight degree of adverse impact to impacts of past, present, and reasonably foreseeable actions, since motorboat operations would be of shorter duration than what currently occurs on Quartz and Logging Lakes. There would be no cumulative impacts from taking no action under Alternative B.

Grizzly Bears

(*Ursos arctos*) Federally listed under the ESA as threatened; state listed species of concern

Affected Environment

Glacier is part of the Greater Glacier Area (GGA) in the northern third of the Northern Continental Divide Ecosystem (NCDE) Grizzly Bear Recovery Zone. The GGA is defined from north to south by the Canadian border and the park's southern boundary, and from east to west by the Blackfeet Indian Reservation and the Whitefish Mountains (Kendal et al. 2008). Genetic analysis of hair samples collected during 1998-2000 resulted in a population estimate of 241 grizzly bears in the GGA (Kendall et al. 2008). No population estimate has been developed exclusively for Glacier. Data from the NCDE grizzly bear population trend monitoring project indicates that the ecosystem's grizzly bear population trend is increasing at three percent per year (data from 2004-2011; Mace and Roberts 2012; Mace et al. 2012).

Grizzly bear seasonal movements and habitat use are tied to the availability of different food sources. In spring, grizzly bears feed on dead ungulates and early greening herbaceous vegetation at lower elevations (Martinka 1972). During the summer, some bears move to higher elevations in search of glacier lilies and other roots, berries, and army cutworm moths. Avalanche chutes provide an important source of herbaceous forage for grizzly bears in the early summer and fall (Mace and Waller 1997). During the winter, grizzly bears hibernate in dens, typically at higher elevations on steep slopes where wind and topography cause an accumulation of deep snow. The denning season in the western portion of the NCDE usually begins in early October, and females might linger near dens until late May (Mace and Waller 1997).

Population studies including DNA analysis of grizzly bear hair samples collected in 2000 and 2004 show that the Camas drainage is used extensively by grizzly bears (K. Kendall, personal communication). The number of grizzlies detected in the Camas drainage in 2004 at baited bear hair traps and numerous naturally occurring rub trees were among the highest of all drainages in the park (K. Kendall, personal communication). The remote, expansive backcountry in the Camas drainage provides travel corridors, valuable habitat, and seclusion from human activity for resident and non-resident bears. Grizzly bear habitat modeling by the Cumulative Effects Model (CEM) Working Group indicates high-value grizzly bear habitat in the Camas drainage, especially in the spring (CEM 2004, based on findings from Mace et al., 1999). In summer and fall, habitat values are high in the upper drainage in the vicinity of Camas Lake and Lake Evangeline, with decreased values in the lower and middle portions of the drainage.

Environmental Consequences

Impacts from Alternative A (Proposed Action and Preferred Alternative)

Alternative A could have temporary adverse impacts to grizzly bears due to disturbance or displacement caused by noise and increased human activity. Grizzly bears could be displaced from travel routes and foraging areas. Some bears would likely avoid the project area and peripheral habitat. The potential for disturbance would be highest during helicopter long-line sling-load operations, fish planting with a helicopter, the use of motorized watercraft, and other motorized equipment such as generators and water pumps. Adverse impacts would be temporary, ending once the project has concluded. Impacts would occur at the individual level; there would be no population effects and no effects to the overall distribution of bears because adjacent and widespread areas of undisturbed, secure habitat would be available beyond the project area. No grizzly bear habitat would be lost and there would be no potential for grizzly bear mortality.

Alternative A would increase the chance of grizzly bears in the Camas drainage becoming habituated to people, and could increase the risk of potentially dangerous bear-human encounters as project personnel work off trail in densely vegetated riparian areas and/or near rushing water where surprise encounters could occur. But this risk would not be meaningfully different from the existing risk presented by hikers and anglers. Bear safety training would be required for all project personnel, which would reduce the risk of dangerous encounters. The chance of a grizzly bear obtaining human sources of food would be extremely low, given the park's strict enforcement of attractant storage requirements.

Grizzly bears are known to prey on non-native fish at Hidden and Otokomi Lakes, but there are no records of grizzly bears foraging on Yellowstone cutthroat trout at Camas Lake or Lake Evangeline and, in general, there is little to suggest that fish provide much of a food source for grizzly bears at Glacier (J. Waller, personal communication). Therefore, the removal of Yellowstone cutthroat trout and the establishment of native fish in the upper Camas drainage would not change forage for grizzly bears. During the removal of Yellowstone cutthroat trout, sinking dead fish that do not remain submerged would eliminate much of the potential for grizzly bears to scavenge the carcasses, but some scavenging could still occur. Grizzly bears would not be affected by any consumption of fish killed by rotenone, since treatment concentrations would be far below levels that are toxic to mammals (as described in Appendix D, Issues and Impact Topics Dismissed from Detailed Analysis, Wildlife).

If a second application of rotenone is necessary, the impacts would be as just described, since reapplication would only affect grizzly bears at the individual level, with no impacts to the population; adjacent and widespread undisturbed habitat would be available; no grizzly bear habitat would be lost; and there would be no potential for mortality. In summary, for the reasons just explained, Alternative A would have no lasting or biologically meaningful adverse impacts to grizzly bears, and would not observably change the abundance or distribution of grizzly bears in the park or the Camas drainage.

The effects determination for grizzly bears under section 7 of the ESA is "may affect, not likely to adversely affect," based on the temporary nature of the activity, the availability of displacement areas, no increased risk of mortality, no creation of attractants, and no alteration of grizzly bear habitat. A biological assessment has been prepared and submitted to the USFWS; consultation is ongoing.

Impacts from Alternative B (No Action)

Since no action would be taken, there would be no potential to disturb grizzly bears and no impacts under Alternative B.

Cumulative Impacts

Past, present, and reasonably foreseeable actions with impacts to grizzly bears include lake trout suppression on Quartz and Logging Lakes, bull trout translocation to Grace Lake, backcountry scientific research and monitoring, radio repeater installations, NPS administrative helicopter flights (including search and rescue flights), fire management flights, and commercial air tours. Motorboat operations at Quartz and Logging Lakes have the potential to disturb and displace bears, and the presence of project personnel at Grace Lake and during backcountry research project could also result in some disturbance, although to a much lesser degree. Radio repeater installations and NPS and commercial helicopter flights present an ongoing potential to disturb or displace grizzly bears. NPS administrative flights increased considerably in calendar year 2018 (150-200 flights) and are scheduled to be at a high number again in 2019 (200-300 flights) during reconstruction of the Sperry Chalet. The flights and construction activity at the chalet will disturb and temporarily displace grizzly bears. When these impacts are combined with the impacts described for Alternative A, the total cumulative impact to grizzly bears would be adverse overall, with the greatest degree of impact attributable to past, present, and reasonably foreseeable actions, most notably from helicopter flights for the Sperry Chalet reconstruction. Alternative A would contribute only a slight degree of adverse impact, since intermittent motorboat operations would only be underway for approximately two to three days and the number of helicopter flights (an estimated six to ten inbound and three to six outbound flights for rotenone application, and an estimated four flights per year for six or seven years for translocation) would be relatively few compared to the number of commercial and administrative flights in the park annually, especially in 2018 and 2019 when multiple flights occurred/will occur during reconstruction of the Sperry Chalet. Alternative A, therefore, would contribute slightly but would not notably change the number and degree of adverse impacts already occurring. Under Alternative B, there would be no cumulative impacts to grizzly bears, since no action would be taken.

Conclusion

Alternative A could temporarily displace grizzly bears from the treatment area, but impacts would only occur at the individual level, with no population effects and no effects to the overall distribution of bears. This is because adjacent and widespread areas of undisturbed habitat would be available beyond the treatment area, no grizzly bear habitat would be lost, and the project would not cause grizzly bear mortality. Bears scavenging on dead fish would not be affected since rotenone treatment concentrations would be far below levels that are toxic to mammals, and the majority of the dead fish would be sunk and unavailable to bears. Alternative B would not impact grizzly bears because no action would be taken. Cumulatively, Alternative A would contribute slightly but would not notably change the number and degree of adverse impacts already occurring, since motorboat operations would be of shorter duration than what is currently occurring on Quartz and Logging Lakes, and because helicopter flights would be few compared to the number of flights in the park. There would be no cumulative impacts from Alternative B, since no action would be taken.

Visitor Use and Experience

Affected Environment

Since Glacier was established in 1910, visitors have established a strong heritage of recreation in the park. Visitation has increased dramatically in the last five years, from about 2,190,000 visitors in 2013 to over 3,305,000 million in 2017 (NPS files). Visitors from around the world come to Glacier to enjoy world-class backcountry recreational opportunities, such as hiking, backcountry camping, and mountain climbing, as well as a primitive wilderness experience. Remote, pristine, and spectacularly scenic, Glacier's backcountry lakes are especially popular destinations, including those within the Camas drainage. Fishing on lakes and streams is a popular activity for some visitors, and many come to the park for the opportunity to fish for native trout. Most fishing in the park is catch and release for native species of fish, but some non-native fish may be kept. Approximately five percent of visitation in the park includes fishing (NPS 2015 survey).

In general, most backcountry use in the park (approximately 70 percent) occurs during July and August, and includes both day use and overnight camping. Approximately 30 percent of backcountry use occurs in June and September. Backcountry overnight use accounts for less than one percent of total visitation (including front country visitors). There are two backcountry campgrounds in the Camas drainage, one at Arrow Lake and one at the foot of Camas Lake, both of which have a capacity for eight people (two campsites each, limited to four people per campsite). Over a five-year period from 2014 to 2018, an average of 52 and 9 campers stayed at the Camas Lake backcountry campground during August and September, respectively, and an average of 94 and 17 campers stayed at the Arrow Lake backcountry campground during August and September, respectively (Table 4) (NPS files). This represents approximately 1.2 percent of backcountry campground stays parkwide during August, and 0.5 percent of backcountry campground stays parkwide during September over the same five-year period. In addition, day hiking is a common activity on the Camas Creek Trail, and a number of summits surrounding the drainage are popular with mountain climbers, including Longfellow Peak, Heaven's Peak, Mt. Stanton, Mt. Vaught, and McPartland Mountain. Lakes in the drainage are used by recreational anglers, with most use likely occurring at Rogers, Arrow, Trout, and Camas Lakes.

Table 4: Average number of backcountry campers at the Arrow Lake and Camas Lake backcountry campgrounds during August and September over a five-year period (2014 to 2018).

Month	No. of Campers at Camas Lake BC Campground	No. of Campers at Arrow Lake BC Campground	Percent of Backcountry Campground Stays Parkwide
August	52	94	1.2 %
September	9	17	0.5 %

Environmental Consequences

Impacts from Alternative A (Proposed Action and Preferred Alternative)

Closure of the treatment area from the beginning of the project in late summer/early fall until spring would adversely impact visitors who wish to camp at the Camas Lake backcountry campground in late summer, as well as hikers and winter recreationists on the Camas Creek Trail above Arrow Lake. Impacts would be temporary, ending once the closure of the treatment area is lifted in the spring. Closure of the Arrow Lake backcountry campground during project implementation would also impact visitors, but this closure would only be in place for an estimated four to six weeks (during rotenone application and detoxification), possibly longer if a second rotenone application is required during the same year. Given the average number of backcountry campers at the Camas Lake and Arrow Lake campgrounds over the last five years (52 and 9 in August and September, respectively, at Camas Lake; 94 and 17 at Arrow Lake; with a total average of 172 campers at both campgrounds during both months), closure of the campgrounds would not be expected to affect more than approximately 170 campers, at most. This is likely a considerable overestimate, since the average represents two months of camping, including early August. The campground closures would not begin until mid or late August, when the number of backcountry campers begins to decrease to notably fewer campers in mid to late fall. The number of campsites available for visitors would also be limited on occasion, i.e. during native fish collection when most or all of the campsites at either the Arrow or Camas Lake backcountry campground may be occupied by fisheries personnel, depending on the crew size. The number of campers affected would depend on the time of year the campground is occupied. With 65 backcountry campgrounds in the park (223 campsites combined) and approximately 750 miles of trail that provide access to the park's backcountry, the majority of the park's backcountry campgrounds and trails would remain open and available, and the overall majority of backcountry campers and hikers would not be affected. Since the backcountry permit office would be notified in advance about projected closure and campground occupancy dates, early-booking visitors would have ample time to book a stay at another campground. The closures would likely be a one-time event, possibly occurring for a second season if reapplication of the rotenone is necessary.

Since the treatment area would be closed during rotenone application and detoxification, most visitors would not be near enough to detect most of the project noise, i.e. the generator, water pumps, and motorboats. The nearest hiking trails are the Camas Creek Trail downstream of the treatment area and Dutch Lake Trail, both approximately two miles (about 3.5 kilometers) away, and the trail over Flattop Mountain, approximately three miles (about five kilometers) away. Popular mountain climbing summits nearest the treatment area include Longfellows Peak, just over a mile (about 1.8 kilometers) from Lake Evangeline, and Heaven's Peak, approximately 2.5 miles (about 4 kilometers) from Camas Lake. Visitors on these trails and summits would not likely detect noise from the motorboats or generator, since the noise from the motorboats would be expected to attenuate to ambient levels within approximately 1.2 miles, with noise from the generator attenuating to ambient levels within approximately 0.21 mile (Table 3). Therefore, since the anticipated attenuation distance for noise from the motorboats and generators is less than the distance to the trails and closest summits, project noise would likely not be audible on surrounding trails and summits. Water pumps may be audible, given the relatively higher noise level they produce (approx. 105 dBA). But the pumps would be used intermittently, resulting in only sporadic audibility that would be reduced by terrain shielding, distance, and possibly weather conditions. Helicopters could be audible, since a longer distance would be required for helicopter noise to attenuate to ambient levels, up to approximately 3.4 miles, depending on the type of helicopter (Table 3). Helicopters may also be required to fly over hiking trails and climbing routes, depending on the flight path. But the noise from the helicopter in flight would be highly transient, dissipating in a matter of minutes (or less, depending on masking effects from weather conditions, such as wind). Noise from helicopter long-line sling load operations and fish planting with a helicopter in the treatment area would likely be too distant and sufficiently dampened by terrain shielding to be more than barely audible, and would occur for only a few minutes at a time. Off-trail recreationists within one to three miles of the treatment area could potentially detect project noise, but the likelihood of visitors recreating off-trail near the treatment area is low given the difficult terrain in the upper Camas drainage.

The presence of project personnel would be barely noticeable to visitors during the rotenone portion of the project, since the treatment area would be closed to the public (although day-use visitors to Arrow Lake may encounter personnel staying at the Arrow Lake backcountry campground). The effects of personnel in the project area during the native fish translocation portion of the project would not be noticeably different from the existing effects of campers, hikers, and anglers. This is because the number of personnel (anticipated at five to ten during native fish collection and two to five during fish planting operations) would approximate the capacity of the Arrow and Camas Lake backcountry campgrounds, the area is popular with day-use hikers and anglers, and the activities of the crews (e.g. collecting fish via angling, dip netting, trapping, electrofishing, and/or seining; hiking between work sites, etc.) would be similar in intensity to hiking and angling. While the translocation portion of the project could require the presence of personnel every year for several years (an estimated three years for native fish collection, and approximately six to seven years for fish planting), crews would likely only be in the area for relatively short periods of time (an estimated one to two weeks during native fish collection and a few days during fish planting). The presence of personnel during post rotenone treatment and translocation monitoring would also be of low intensity and similar in nature to visitor activities, as well as ongoing resource management activities throughout the park (i.e. monitoring would not result in an observable change from current conditions).

The loss of opportunities to fish for Yellowstone cutthroat trout at Camas Lake and Lake Evangeline would adversely impact some anglers. Adverse impacts would be slight, however, because the majority of angling opportunities throughout the park would remain unaffected. The translocation of westslope cutthroat trout would also benefit anglers by providing future opportunities to fish for native trout. These benefits would extend downstream, as non-hybridized westslope cutthroat trout migrate downstream into the Flathead River system, protecting opportunities to fish for non-hybridized westslope cutthroat for the long-term.

If rotenone reapplication is necessary, impacts to visitor use and experience from the area closure, noise, and changes to angling opportunities would be as described above. This is because the majority of backcountry campgrounds, trails, and angling opportunities would be unaffected, the majority of project noise would not be detectable and/or would be temporary, and the translocation of native westslope cutthroat trout would replace any lost angling opportunities and benefit downstream opportunities to fish for non-hybridized westslope cutthroat trout.

Impacts from Alternative B (No Action)

Alternative B would not impact visitor use and experience, because no action would be taken and there would be no change to existing conditions for visitors.

Cumulative Impacts

Past, present, and reasonably foreseeable actions with impacts to visitor use and experience include lake trout suppression at Quartz and Logging Lakes, NPS administrative flights, fire management flights, commercial air tours, and trail and campground maintenance, which can adversely impact visitors due to noise from motorboats, helicopters, chainsaws, and other equipment. NPS administrative actions and resource monitoring and research can adversely impact visitors due to visible equipment, such as radio repeaters, weather stations, radio collars, and remote cameras, on an otherwise mostly undeveloped landscape. Some research projects can also adversely impact visitors who object to the handling of animals. Fire and bear management can adversely impact visitors due to area closures at trails and campgrounds; the potential use of herbicides during future invasive plant control could also require closures. Reconstruction of the Sperry Chalet in 2018 and 2019, while primarily beneficial to visitors, also requires temporary closure of two backcountry campgrounds at Lincoln and Snyder Lakes. Reconstruction of the chalet has resulted in a considerable but temporary increase in NPS administrative flights in 2018 (150-200 flights) and 2019 (200-300 flights), which, along with construction, will have temporary adverse impacts from noise to campers and hikers in adjacent areas. When the impacts of Alternative A are combined with those of past, present, and reasonably foreseeable actions, impacts to visitor use and experience would be adverse, with other actions contributing the majority of impacts. This is because impacts from noise, limited campsite availability, and the area closure under Alternative A as described would be temporary, and flights (estimated six to ten inbound and three to six outbound flights for rotenone application, and four flights per year for six or seven years for translocation) would be relatively few compared to the total number of commercial and administrative flights in the park (especially in 2018 and 2019 when multiple flights occurred/will occur during reconstruction of the Sperry Chalet). There would be no cumulative impacts from Alternative B, because no action would be taken that would change existing conditions for visitors.

Conclusion

Alternative A would adversely impact visitor use and experience due to temporary closure of the Camas Lake and Arrow Lake backcountry campgrounds and a portion of the Camas Creek Trail, limited campsites during personnel occupancy, the potential for temporarily audible noise from motorboats, helicopters, and other motorized equipment, and lost opportunities to fish for Yellowstone cutthroat trout in the upper Camas drainage. Adverse impacts from closures would be temporary, ending once the closures are lifted, and the majority of trails, backcountry campgrounds, and angling opportunities throughout the park would remain unaffected. The presence of personnel over the course of the project would not be noticeably different from that of campers, hikers, and anglers. Since the treatment area would be closed during rotenone application and detoxification, most visitors would not be near enough to detect the majority of project noise. The translocation of westslope cutthroat trout would benefit anglers by providing new opportunities to fish for native trout and protecting opportunities to fish for non-hybridized westslope cutthroat trout in downstream waters for the long term. There would be no impacts to visitor use and experience from Alternative B, because no action would be taken that would change existing conditions for visitors. Cumulatively, Alternative A would contribute but would not notably change the number and degree of adverse impacts already occurring, because impacts would be temporary and flights would be relatively few compared to the total number of commercial and administrative flights in the park. There would be no cumulative impacts from Alternative B because there would be no impacts from taking no action.

List of Agencies and Persons Consulted

US Fish and Wildlife Service
Montana Fish, Wildlife and Parks
Montana State Historic Preservation Office
Blackfeet Nation
Confederated Salish and Kootenai Tribes

EA Preparers and Contributors

Name/Title	Contribution
Lisa Bate, Wildlife Biologist, Glacier National Park	Provided technical support on common loons and other water birds.
Jami Belt, Biologist, Crown of the Continent Research Learning Center, Glacier National Park	Provided technical support on common loons.
Mark Biel, Natural Resources Program Manager, Glacier National Park	Provided technical support on wildlife.
Chris Downs, Fisheries Biologist/Program Manager, Glacier National Park	Developed proposed action; prepared sections on native fish and aquatic species, fisheries BA for section 7 consultation with USFWS.
Dawn LaFleur, Restoration Biologist, Glacier National Park	Provided technical support on vegetation, soils, and wetlands.
Joe Giersch, Aquatic Entomologist, US Geological Survey, Northern Rocky Mountain Science Center	Provided technical support on aquatic invertebrates.
Kathryn Neussly, Ecologist, Natural Sounds Night Skies Division, National Park Service	Provided technical support on natural soundscapes.
Mary Riddle, Chief of Planning and Compliance, Glacier National Park	Provided oversight, reviewed and edited EA.
Amy Secrest, Environmental Protection Specialist/Natural Resources Specialist, Glacier National Park	Prepared EA and BA in cooperation with subject matter experts; coordinated EA schedule, agency consultation, and internal review.
Roger Semler, Chief of Wilderness Stewardship Division, National Park Service	Reviewed and edited EA, provided technical support and guidance on wilderness status and analysis.
Joel Wagner, Wetlands Program Lead, National Park Service	Provided guidance and technical support on wetlands.
John Waller, Wildlife Biologist, Glacier National Park	Provided technical support on grizzly bears and Canada lynx.

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U. S. administration. March 2019. **Printed on *recycled paper***.

Appendices

Appendix A – References

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Appendix B – Progressive Hybridization of Rainbow Trout and Westslope Cutthroat Trout, and Lakes Invaded by Lake Trout in Glacier National Park

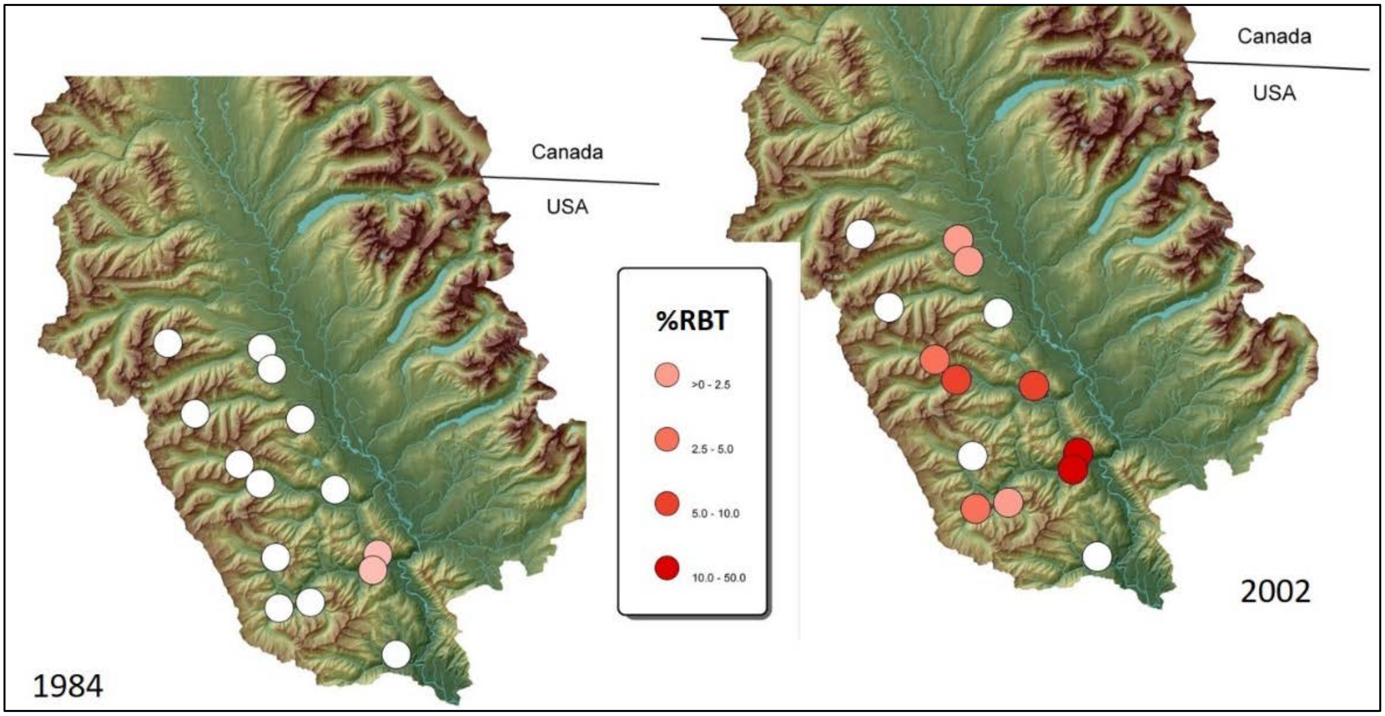

Figure B-1: Progressive hybridization between westslope cutthroat trout and non-native rainbow trout in the North Fork of the Flathead River drainage, where westslope cutthroat/rainbow trout hybridization has been progressing over time (RBT=rainbow trout).

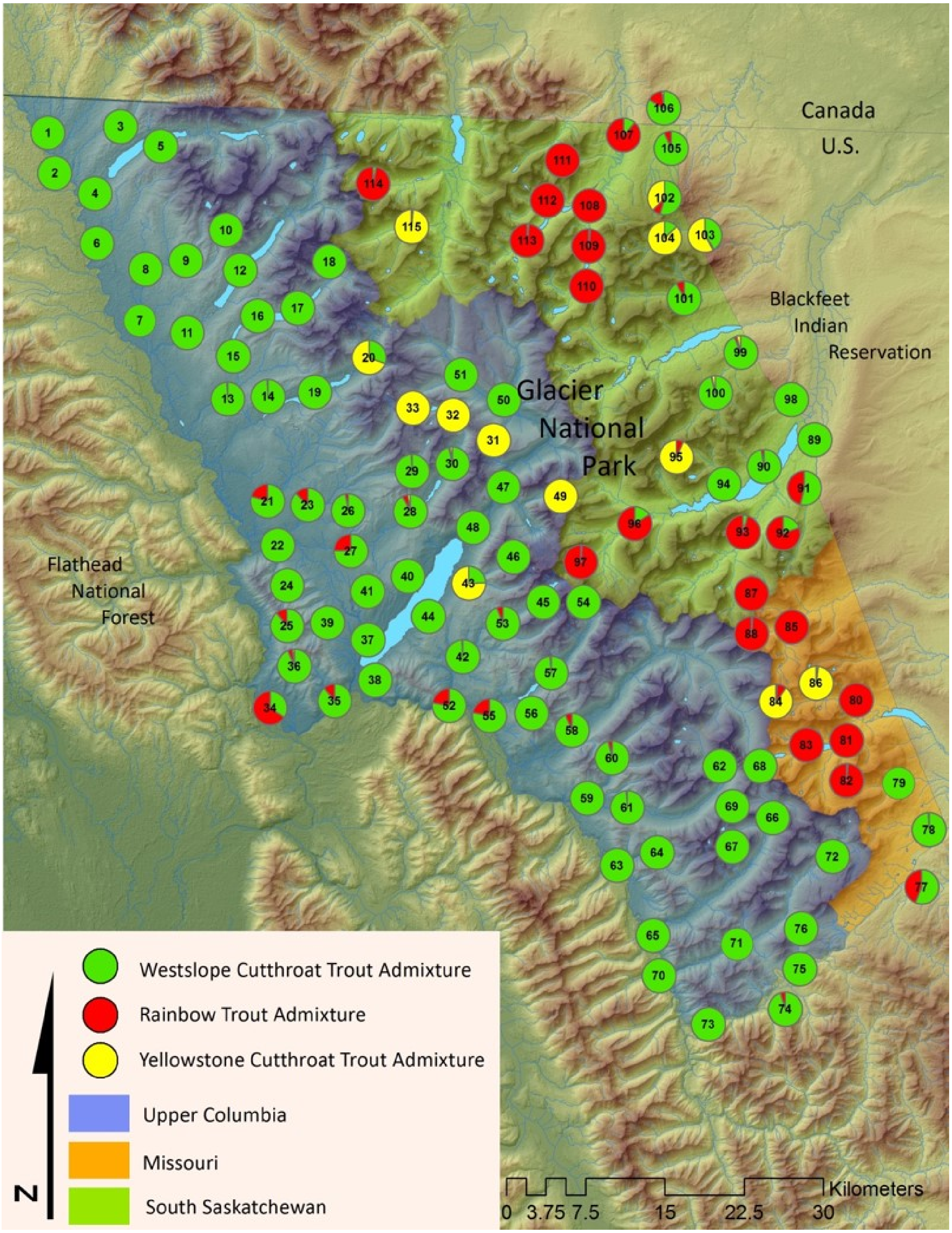

Figure B-2: Hybridization between westslope cutthroat trout and non-native rainbow trout in Glacier National Park. Green=westslope cutthroat trout genes; red=rainbow trout genes.

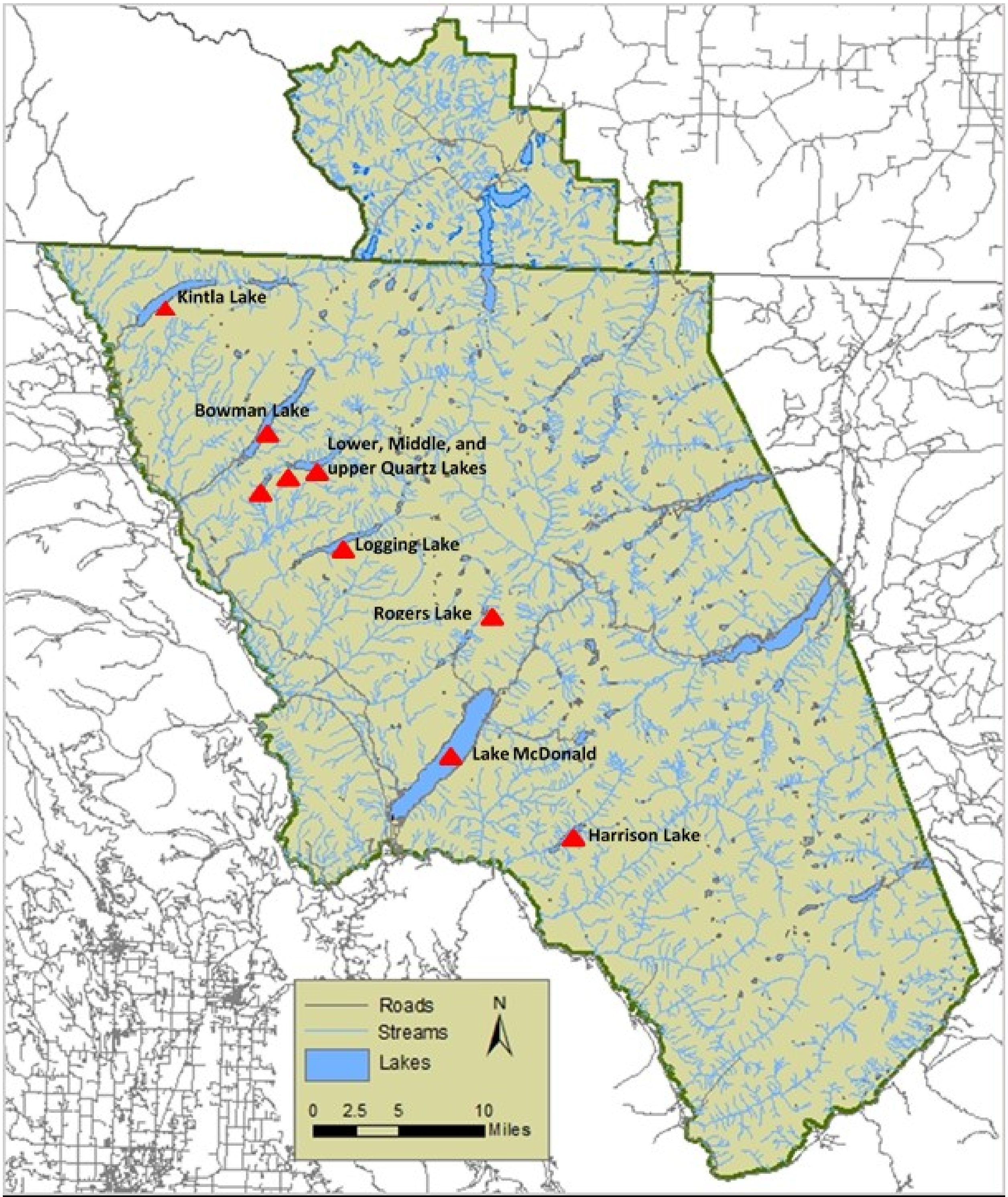

Figure B-3: Lakes (n=9) west of the Continental Divide that have been invaded by non-native lake trout.

Appendix C – Alternatives and Elements of Alternatives Considered but Dismissed from Detailed Analysis

Three alternatives and one alternative element were considered but eliminated from further analysis. The following is a brief description of the dismissed alternatives and element, including reasons for dismissal.

Remove Yellowstone cutthroat trout with electrofishing, angling, gill nets, and/or trap nets instead of rotenone. At 17.5 and 72.2 acres (7.1 and 29.2 hectares) respectively, Camas Lake and Lake Evangeline are too large for electrofishing and/or angling to remove Yellowstone cutthroat trout to any measurable degree. Gill and/or trap netting would be also necessary for any observable reduction. Such methods have been successful in removing non-native fish from small lakes and short reaches of stream elsewhere (Knapp et al. 2007; Pacas and Taylor 2015; and Vredenburg 2004). For example, in Banff National Park, non-native brook trout were successfully removed from a 57.1-acre lake (23.1-hectares), a 23.9-acres lake (9.7-hectares), and a 2.8-mile (4.5-kilometer) downstream stretch of river using electrofishing and gill nets deployed from a rowboat (Pacas and Taylor 2015). Similarly, Shepard et al. (2002) removed brook trout using backpack electrofishing from a relatively short, small, and simplified (through riparian vegetation removal) stream in Montana to benefit westslope cutthroat trout. But these efforts required year-round net sets and/or electrofishing for five to eight years (Pacas and Taylor 2015; Shepard et al. 2002). Using motorized watercraft to deploy and work the gill nets would increase efficiency, but would still likely require five years or more to successfully reduce the population. Gill netting also rarely achieves complete removal of the target population, and is generally more useful for suppressing non-native fish numbers (i.e. reducing them such that they pose a decreased threat to native species but are not necessarily eliminated). This is especially the case for lakes that are also inhabited by native fish, since non-native fish can be targeted while native fish are avoided. Rotenone, on the other hand, would enable the complete removal of the Yellowstone cutthroat trout populations in Camas Lake and Lake Evangeline, and is an appropriate choice since the lakes are 100% inhabited by the target species. Complete removal of the Yellowstone cutthroat trout population from the lakes and the stream above Arrow Lake is necessary to reduce the overall risk of hybridization downstream and to provide secure habitat for translocated westslope cutthroat trout and bull trout. The mortality of individual native fish downstream would be a tradeoff that would not affect native fish at the population level (see impacts analysis for westslope cutthroat trout and bull trout in Chapter 3, and Other Native Fish in Appendix D) and would be mitigated by collecting and moving as many native fish as possible to untreated waters.

Protecting and preserving westslope cutthroat trout and bull trout populations is a race against time. The time required for this alternative would put the project at risk of falling short of making meaningful conservation gains. Therefore, the exclusive use of electrofishing, angling, gill or trap netting to remove Yellowstone cutthroat trout from the project area has been dismissed from further analysis because it would not meet project objectives or resolve the purpose and need for taking action.

Use recreational angling only to remove non-native Yellowstone cutthroat trout from Camas Lake and Lake Evangeline. The purpose of the project is to completely remove Yellowstone cutthroat trout from the upper Camas drainage in order to reduce the overall risk of hybridization downstream and provide secure habitat for translocated westslope cutthroat trout and bull trout. As evidenced by previous creel surveys and angler use information (NPS file data and Montana MFISH database), there is not sufficient fishing activity in the Camas drainage for recreational anglers to achieve the complete removal of Yellowstone cutthroat trout from the project area. An attempt to use angling to reduce brook trout from Quirk Creek in Alberta was unsuccessful, despite skilled anglers putting in hundreds of rod-hours each year over several years (Paul et al. 2003). Further, angling alone has not been sufficient to reduce non-native fish populations on other, more heavily fished waters outside the park, such as Swan Lake, Flathead Lake, or Lake Pend Oreille, which have excellent access for anglers with boats. For example, despite a $15/lake trout bounty on Lake Pend Oreille in Idaho for almost a decade, anglers alone have not been able to suppress (let alone completely remove) lake trout from the lake. Similarly, despite mandatory kill regulations for lake trout on Yellowstone Lake, anglers have not been able to eliminate or even substantially reduce lake trout. Commercial-scale gill netting has been employed in both of these circumstances to supplement angler removal. Lake trout fishing regulations on Flathead Lake have been relaxed and annual fishing contests (Mack Days) with substantial cash prizes have been held since 2002, yet the lake trout population has not declined (CSKT 2014). The use of anglers alone to remove Yellowstone cutthroat trout has, therefore, been dismissed from further analysis because of an inability to meet project objectives and resolve the purpose and need for taking action.

Introduce other non-native species to prey upon Yellowstone cutthroat trout. Introducing other non-native fish species (such as various species of whitefish, or Corogonids) to control non-native fish has been suggested for previous fisheries management projects in the park. This approach would be in conflict with long-standing management objectives to prevent non-native species from establishing populations in park waters. The ecological results of introducing another non-native species would be uncertain and difficult to reverse in the event of unexpected outcomes. The history of non-native fish stocking across the western US is fraught with examples of well-intended introductions of non-native fish species that have resulted in major negative impacts to local native species. For example, the widespread stocking of non-native rainbow and brook trout outside of their native range has led to the demise of native cutthroat trout in many waters, and the initial stocking of lake trout in the early 1900s in Flathead Lake is the root cause of the largest threat facing bull trout in Glacier (Liknes and Graham 1988; Marnell 1988; Fredenberg 2002; NPS 2016). Introducing a non-native species to prey upon Yellowstone cutthroat trout was dismissed from further analysis due to the potential to cause unintended environmental impacts and because it would be inconsistent with project objectives and the purpose and need.

Use electric trolling motors for the boats instead of gas-powered outboard motors. This element to Alternative A was considered as a means of reducing impacts to natural soundscapes and wilderness character. It was dismissed, however, because the battery life of electric trolling motors would not be sufficient for the estimated two to three days necessary to apply the rotenone, and there would not be a way to rapidly recharge the batteries due to the remote location. Electric trolling motors have, therefore, been dismissed because they would not be feasible.

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Appendix D – Issues and Impact Topics Dismissed from Detailed Analysis

The following impact topics have not been analyzed in detail because the issues associated with these resources are not pivotal or central to the proposal, a detailed analysis of impacts to these resources is not necessary to make a reasoned choice between alternatives, these topics are not contentious among the public or other agencies, and/or there would be no potentially significant impacts to these resources.

Other Native Fish (i.e. excluding westslope cutthroat trout, bull trout, and sculpin)
Westslope cutthroat trout, bull trout, and sculpin have been carried forward for detailed analysis in Chapter 3. Other species of native fish in the Camas drainage include mountain whitefish, longnose sucker, redside shiner, and northern pikeminnow (see also "Summary of the Fish Assemblage in the Camas Drainage" in Chapter 3, under "Affected Environment"). These species would not be affected by the proposed action because they are not present in the rotenone treatment area. Their range in the Camas drainage does not extend upstream of the waterfall above Rogers Lake, which is over 3.5 miles downstream of the rotenone treatment area. Rotenone would not, therefore, be used where these species are present, and treated water would be fully neutralized before it reaches them. Also, none of these species would be translocated, so would not be affected by translocation. These species would also not be much affected by taking no action. Yellowstone cutthroat trout are not currently present downstream of Arrow Lake. If no action is taken, Yellowstone cutthroat trout could expand downstream to Rogers Lake and prey on some of these species. The potential impacts of this are unknown, but the overall adverse impacts to these species from Yellowstone cutthroat trout expansion would likely be minimal. This is because Yellowstone cutthroat trout do not hybridize with mountain whitefish, longnose sucker, redside shiner, or northern pikeminnow, and would not compete with or displace them due to niche differences (i.e. Yellowstone cutthroat trout have different feeding and habitat preferences). Because neither alternative would impact these species of native fish, they have dismissed from detailed analysis.

Wetlands
Wetland habitat is present in the project area, primarily associated with the lakeshores and stream channel. Surveys and GIS vegetation mapping indicates little to no presence of wetlands outside the stream channel or lake areas. Wetland soils and vegetation in the project area would be at some risk of trampling. Impacts from trampling would be slight, however, and would not measurably exceed the existing human influence from hikers and anglers since, during rotenone application, project personnel (with a crew size estimated at approximately 15 people) would only use the shoreline around the lakes and stream intermittently for an estimated period not likely to exceed two to three days. The potential for impacts from trampling would be very fleeting during activities such as surveys, monitoring and preliminary site preparations. There would be a higher potential for trampling during the detoxification period, since project personnel would be at the detox site for a longer period of time, estimated at up to two to three weeks. The intensity of impacts would remain low, however, because the work would occur in late summer (late August/early September), when wetland vegetation begins entering dormancy for the season and is less susceptible to permanent damage. This would also be the case if a second application is necessary in the same year or a following year, resulting in project personnel being on site for longer periods of time. Personnel would be working for an estimated one to two weeks along streambanks and lakeshores during the collection of native fish, which could occur any time during spring, summer, or fall. But the activity would be dispersed, rather than concentrated in any one area. Any trampling that occurs would be short enough in duration for wetland soils and vegetation to recover independently, without restoration measures. Surveys for rare wetland vegetation would occur prior to implementing the project, and any identified locations would be marked and avoided. This combined

with mitigation measures requiring personnel to stay on trails and unvegetated surfaces whenever possible and avoid the creation of social trails would reduce the potential for trampling to the point that any effects that do occur would be barely noticeable and would not affect wetland vegetation permanently or at a community or population level. In the unlikely event that wetland plants or soils are trampled or compacted to the degree that they cannot recover on their own, the site would be restored.

The use of rotenone would not affect wetland vegetation, since rotenone is not known to be toxic to plants at the concentration that would be used (Finlayson et al. 2010). Rotenone would also not affect wetland soils and hydrology. As a non-persistent chemical, rotenone breaks down quickly and does not accumulate in the water, soil, plants, or surviving animals (ODFW 2019). Rotenone has low to slight mobility in soil, with an expected leaching distance of about two centimeters, and binds to organic matter (ODFW 2019). The likelihood of the chemical leaching into groundwater, therefore, is extremely low (see also dismissal of impacts to Water Quality, below). None of the project activities would cause physical alterations to water flow patterns within wetlands.

Rotenone would cause mortality among aquatic insects, other invertebrates, and zooplankton, but numerous studies indicate temporary effects on these organisms from the use of piscicides; aquatic invertebrates would be expected to recover abundance and community composition in two to four years (see Chapter 3, “Affected Environment and Environmental Consequences”). Overall, the project would benefit wetlands because it would protect native fish habitat for the long term. Impacts to wetlands have, therefore, been dismissed from detailed analysis because impacts from trampling would occur late in the season and be temporary and too slight to noticeably change wetland communities; wetland vegetation would recover without the need for restoration; sites would be restored if they cannot regenerate on their own; rotenone is not toxic to plants; impacts to invertebrates would be temporary; and the protection of native fish habitat would benefit wetlands for the long term.

NPS Procedural Manual #77-1, Wetland Protection, requires preparation of a Wetlands Statement of Findings (WSOF) for proposed actions that would have adverse impacts to wetlands (NPS 2016). However, Section 4.2 waives certain actions from the WSOF requirement, including those designed to restore degraded ecological conditions (Excepted Action #9), provided Best Management Practices (BMPs) cited in Procedural Manual #77-1 are followed (NPS 2016). The proposed action would work towards the restoration of the security, genetic integrity, and long-term viability of genetically pure native westslope cutthroat trout in waters of the North Fork of the Flathead River drainage. These conditions have been degraded by the introduction of non-native Yellowstone cutthroat trout and other non-native fishes. The use of rotenone would temporarily impact larval amphibians and aquatic macroinvertebrates, because a number of these organisms would be killed during treatment. Section 4.2 Excepted Action #9 in Procedural Manual #77-1 waives impacts to aquatic fauna (Condition 2 of the BMPs) if impacts are necessary to achieve restoration objectives (NPS 2016). Temporary adverse impacts to larval amphibians and aquatic macroinvertebrates would be necessary to achieve restoration objectives because the project could not be implemented without the use of rotenone. Condition 2 of the BMPs in NPS Procedural Manual #77-1 would, therefore, be waived. All other conditions of the BMPs would either be met or would not be applicable. The proposed action would be, therefore, be waived from the WSOF requirement in accordance with Section 4.2 Excepted Action #9 of NPS Procedural Manual #77-1 because: 1) it would work toward restoration of ecological degradation that has occurred in the North Fork of the Flathead River drainage as a result of introduced non-native fishes, and 2) the BMPs listed in NPS Procedural Manual #77-1 for wetlands would either be met, do not apply, or, in the case of condition 2, would be waived.

Soils and Vegetation

Potential impacts to soils and vegetation from trampling and measures to mitigate any impacts would be as described above for "Wetlands." Otherwise, there would be no ground disturbance or other activities that would cause noticeable or measurable impacts to soils and vegetation, and the topic has, therefore, been dismissed from detailed analysis. Special status plant species of concern dismissed from detailed analysis are addressed in Appendix E.

Floodplains

The use of rotenone would not affect floodplain function or value, nor present a risk to life/safety or capital investment. Floodplains have, therefore, been dismissed from detailed analysis, and an SOF for floodplains is not required.

Water Quality

The inert ingredients associated with rotenone formulations are highly volatile and naturally degrade within one to five weeks depending on pH, temperature, alkalinity, UV light, and dilution by fresh water (Schnick 1974; Skaar 2001). Cold water can result in longer degradation time (Skaar 2001). Rotenone is not water soluble so it must be formulated with solvents. The rotenone-based product CFT Legumine uses N-methylpyrrolidone (NMP) and di(ethylene glycol) ethyl ether (DGEE) as solvents for the dispersal of rotenone. When diluted to the low concentrations for piscicidal applications (a concentration of 1 ppm [parts per million], would be used for this project), solvent components are substantially below the safe concentrations set for drinking water contaminants by the EPA (Ott 2006).

Rotenone binds to sediments, does not readily leach from soil, and its constituents have not been found in groundwater following treatment (Skaar 2001; EXTOXNET 1996). In California, studies where wells were placed in aquifers adjacent to and downstream of rotenone applications have 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 groundwater does not occur. At Tetrault Lake in Montana, rotenone was not detected in a nearby domestic well sampled two and four weeks after applying 90 ppb (parts per billion) rotenone to the lake (this well was chosen because it was down gradient from the lake and also drew water from the same aquifer that fed and drained the lake) (G. Grisak, MFWP, personal communication). In 1998, a Kalispell area pond was treated with rotenone. Water from a well 65 feet from the pond was analyzed and no sign of rotenone was detected. In 2001, another Kalispell area pond was treated with rotenone and water from a well 200 feet away was tested four times over a 21-day period with no sign of contamination (G. Grisak, MFWP, personal communication).

Potassium permanganate ($KMnO_4$) (which would be used to hasten detoxification of rotenone in Camas Creek) is one of the most widely used inorganic chemicals for the treatment of municipal drinking water and wastewater. At the anticipated concentration (3:1 ratio of potassium permanganate to rotenone), potassium permanganate can be toxic to fish (USFWS 2015). But its toxicity would decline rapidly as it reacts with the natural stream environment and the rotenone, and would not be expected to persist for more than 10-15 minutes of flow time (Engstrom-Heg 1971 and 1972). Potassium permanganate would produce a temporary dark purple color to the creek, which usually dissipates in a few hundred yards.

Decomposing dead fish in the lakes could potentially decrease dissolved oxygen in the immediate vicinity of the carcasses. This would be of little consequence, however, since gill-breathing organisms in the lakes would be killed by the rotenone (i.e. few oxygen-dependent aquatic organisms would be left in the lakes to be affected by an oxygen sag). Amphibian larvae and aquatic macroinvertebrates that survive the rotenone would be susceptible to changes in dissolved oxygen. But since the fish carcasses would likely be spread out and not concentrated in any one area, areas of low dissolved oxygen would be small, and there would still be areas in the lake where oxygen levels are unchanged. Oxygen sags that are large enough to cause meaningful impacts would also be unlikely in Lake Evangeline due to the volume of water (4258.5 acre-feet) that would compensate for changes, and at Camas Lake due to a relatively high inflow/outflow and high groundwater input. Any oxygen sags would also be temporary, recovering to normal levels likely by the following spring.

A small amount of hydrocarbons would be deposited into Camas Lake and Lake Evangeline during operation of motorized watercraft. This impact would be unavoidable because outboard motors emit exhaust under water through the propeller. Using the cleanest burning outboard motors available (reduced emission 4-stroke technology) as a mitigation measure would minimize the release of hydrocarbons as much as possible. Water volumes in the lakes (4258.5 acre-feet at Lake Evangeline; 136.3 acre-feet at Camas Lake) and water exchange through the inlets and outlets would be sufficient to dilute any hydrocarbon emissions to levels that would not be measurable or affect water quality in any meaningful way. The risk of contamination from gasoline or motor oil in the event of mechanical failure or spill would be low due to mitigation measures that require inspection of the engine, fuel lines, and fittings prior to operating the boat each day. Absorbent supplies would also be required onsite to address any spills. Bulk fuel would be stored in spill/bear proof containers. Impacts to water quality have been dismissed from detailed analysis because rotenone and potassium permanganate would dissipate to the point where there would be no detectable long-term changes to water quality; decreases in dissolved oxygen would be of little consequence due to water volume and movement and because rotenone would kill gill-breathing organisms that would otherwise be affected; and because hydrocarbons released from motorboats would be minimized through use of 4-stroke motors and diluted to a non-measurable level by water volume and inlet/outlet flow. There would be no impacts to water quality from translocating native fish into Lake Evangeline or Camas Lake, because the helicopter tank and/or containers used to transport the fish prior to translocation would be cleaned of any contaminants prior to use. Only hatcheries that are regularly inspected for AIS, certified to be free of pathogens, and/or treat the holding water to remove or kill any pathogens (such as with filters or UV light, for example) would be used.

Wild and Scenic Rivers

Camas Creek is a tributary of the designated Wild and Scenic North Fork of the Flathead River on Glacier's northwest boundary. Outstandingly Remarkable Values (ORVs) for the North Fork include fisheries, based on the presence of native fish and native fish habitat. The proposed action would benefit this ORV by conserving native fish, expanding native fish habitat in the North Fork drainage, and conserving the genetic characteristics of native westslope cutthroat trout that evolved in the North Fork drainage. The project would not alter the river's physical and scenic characteristics, disturb any historic or ethnographic sites, measurably increase the potential for disturbance to wildlife, or cause sediment releases. Therefore, because there would be no adverse impacts to the North Fork of the Flathead River or to the ORVs that led to its designation as a Wild and Scenic River, this topic is dismissed from detailed analysis.

Wildlife (excluding common loons, other water birds, and grizzly bears carried forward for detailed analysis)

The use of rotenone would not affect wildlife because, while highly toxic to fish and aquatic gilled organisms, rotenone has been shown to have much lower toxicity to mammals and birds. Studies of rats showed a No Observed Effect Level of 7.5 parts per million. Mallards and pheasants had an LD50 (lethal dose needed to kill 50% of the test subjects) of 2000 parts per million and 1,680 parts per million, respectively (Negerhbon 1959). These are unrealistically high doses that would not be achieved by either birds or mammals under proper label application. California Department of Fish and Game (1994) studies of risk for terrestrial animals estimated that a 22-pound dog would have to drink 7,915 gallons of lake water within 24 hours or eat thousands of pounds of rotenone-killed fish to receive a lethal dose. The State of Washington reported that a half-pound mammal would need to consume 12.5 milligrams of pure rotenone to receive a lethal dose (Bradbury 1986). There would be insufficient quantities of rotenone to represent a risk of acute effects in terrestrial animals that may scavenge and consume fish killed by rotenone or rotenone treated water (EPA 2007). The potential for wildlife to scavenge on rotenone-killed fish would also be low, since dead fish that do not remain submerged would be sunk in the lake.

Human activity and noise from helicopters, motorboats, and a generator(s) could disturb or displace individual wildlife within or near the project area (see impacts to Natural Soundscapes, Chapter 3, for a detailed analysis of anticipated noise impacts). Effects could range from physiological responses (e.g. increased heart rate) with no observable physical displacement, to disruptions of behaviors such as foraging, to the observable physical displacement of one or more individuals. The extent and duration of displacement would vary depending on the species. Smaller animals may find undisturbed habitat only a short distance away (e.g. a few feet or meters), while larger animals may need to travel further to achieve a comfortable distance from the source of disturbance. The potential for displacement would be temporary, lasting until the project concludes. Project activities are estimated to be underway for up to approximately three to four weeks, but could be longer in duration if a second application is immediately necessary (i.e. during the same year). Impacts would not meaningfully affect wildlife use of the area given the widespread availability of adjacent undisturbed habitat. This would also be the case if reapplication is necessary. Any temporarily displaced wildlife would resume use of the area after the project, and a number of individual animals would probably continue to use the area while work is underway. There would be no impacts to nesting or denning, since the project would occur in the late summer/early fall (August/September), when critical nesting/denning periods are over.

Removing Yellowstone cutthroat trout from Camas Lake and Lake Evangeline would remove a source of food for wildlife that prey on fish. The effects would be temporary, since the lakes would be restocked with native fish, which would be available to fish-eating wildlife in an estimated three to four years. The temporary absence of fish-based prey in the lakes would not cause an observable change to food availability since other kinds of prey/forage would remain available for generalist predators, and since fish would be available in other nearby lakes (e.g. Arrow and Rogers Lakes) for species that rely more heavily on fish.

Therefore, wildlife have been dismissed from detailed analysis because there would be no adverse impacts from rotenone; any disturbance or displacement effects would be temporary; widespread adjacent, undisturbed habitat would remain available; and impacts to the availability of fish as a source of food would be temporary and of little consequence given the availability of other prey and/or fish in nearby lakes. Impacts would occur only at the individual level, with no effects at the population level or to the distribution, composition, and abundance of wildlife within or surrounding the project area. Wildlife state-listed species of concern and federally listed species that have been dismissed from detailed analysis are discussed in Appendix E.

Air Quality

While the use of gas-powered equipment (e.g. motorboats, helicopters, generators) would produce emissions, the amount would be barely detectable, especially compared to those produced in developed areas and along park roads, and would make a non-measurable contribution to the park's overall emissions profile and air quality metrics. Emissions associated with the project would not undermine or cancel the benefits of ongoing efforts to reduce emissions parkwide, or interfere with mandates to protect the park's Class I airshed. For these reasons, impacts to air quality are dismissed from further analysis.

Night Skies
There would be no impacts to night skies since the project would not require the use of nighttime lighting (except as necessary for overnight camping, e.g. headlamps, etc.). Night skies have, therefore, been dismissed from further analysis.

Cultural Resources, including historic structures, cultural landscapes, archeological resources, and ethnographic resources
Two historic structures within the Camas drainage, the Inside North Fork Road and the Matejka Cabin, are listed with the National Register of Historic Places. There are also a number of archeological sites, as well as the historic but unrecorded Camas Creek Trail and Lake Evangeline Campground. None of the project activities under the action alternative (Alternative A) would have any potential to affect any of these resources. The Inside North Fork Road and Matejka Cabin are in the lower portion of the drainage, well away from the treatment area. There would be no ground disturbance and, therefore, no potential to impact archeological resources. The Camas Creek Trail has not been evaluated under cultural landscape criteria, but effects to the trail are not anticipated beyond possible visibility of equipment. Visual effects would not be permanent since all equipment would be removed at the end of the project, and may not be detectable since the treatment area would be closed during rotenone application and detoxification. It is unknown if ethnographic resources exist in the project area. Neither the Blackfeet Tribe nor the Confederated Salish and Kootenai Tribes shared concerns about the Camas drainage during initial consultation meetings. From a traditional cultural perspective, it is anticipated that positive impacts would result from the preservation of native westslope cutthroat trout and bull trout. Glacier recognizes that the tribes hold a body of knowledge that may result in the future identification of ethnographic resources in or near the project area; consultation with the tribes would, therefore, continue during implementation of the project to identify any necessary mitigation measures. For these reasons, cultural resources have been dismissed from detailed analysis.

Visual Resources
Project equipment, including watercraft and helicopters during long-line sling load and fish planting operations, would be visible in the project area. Most effects to visual resources would not be observable, however, because the treatment area above Arrow Lake would be closed to the public during rotenone application and detoxification. The visibility of helicopters would have adverse impacts to visual resources along the flight path, with an estimated six to ten inbound flights and three to six outbound flights for rotenone application, and an estimated four flights per year for six or seven years for translocation. The effects from the flights would be episodic and short-lived, occurring only when the helicopter is in the area, becoming infrequent after rotenone application. Otherwise, observable impacts to visual resources would generally be limited to the activities of personnel and small-scale equipment, such as electrofishing gear, trap nets, remote monitoring stations, etc. These impacts would be limited to the project area, with no effects to the park's landscape and scenery. With the possible exception of equipment needed to monitor translocated fish (e.g. remote monitoring stations), equipment would be removed at the end of the project, and most observable impacts would, therefore, be temporary. Given the low intensity and duration of impacts, visual resources have been dismissed from detailed analysis.

Socioeconomics
The project would not alter visitation, spending, income, or employment in the local or regional economy. Socioeconomics would not, therefore, be affected and this topic has been dismissed.

Human Health and Safety
Rotenone is registered with the Environmental Protection Agency (EPA) and approved for use as a fish toxicant (Finlayson et al. 2010). The concentration of rotenone that would be used (5-percent

formulated product at 1 ppm [parts per million]), resulting in an active ingredient concentration of 0.05 milligrams per liter) is at least one order of magnitude lower than "No Observed Adverse Effect Levels" (NOEL) in mammals and birds, and well below the 200 ppb (parts per billion) maximum limit for rotenone treatments set by the American Fisheries Society (Finlayson et al. 2010). Acute oral toxicity for humans would require a 150-pound person to eat between 5 and 71 ounces of pure formulation in order to die (Bradbury 1986). Gleason et al. (1969) estimated the lowest dose for human lethality would require a 60-kilogram (130 pounds) person to consume 180,000 liters (47,550 gallons) of water containing 0.1 milligram per liter rotenone, or eat 180 kilograms (397 pounds) of rotenone-killed fish at one sitting. The EPA standard for safe drinking water threshold is 0.8 ppm (40 ppb) rotenone, which is only 20 percent below the 1 ppm target application concentration (M. Boyer, MFWP, personal communication). Given a half-life of rotenone of 1-7 days, this concentration would be achieved in less than a week. 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." While the label requirements for rotenone state that public entry into the treatment area could occur immediately after application, the treatment area would be temporarily closed to visitors, warning signs would be posted, and news releases would be issued ahead of time to minimize the chance of public exposure. Only trained personnel would apply rotenone. Any risk to human safety during application would be avoided through training, personal protective equipment, and adherence to the Montana Department of Agriculture application requirements. Application requirements would also be followed when handling potassium permanganate, which can be an irritant to eyes, skin, respiratory system, and the gastro intestinal tract when handled improperly. Prior to use of any chemicals, emergencies procedures would be developed, provided to personnel, and kept on site during implementation.

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Appendix E – Federally and State Listed Species Dismissed from Detailed Analysis

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Native Lake Trout (*Salvelinus namaycush*) state listed species of concern	Lake trout are native to the South Saskatchewan River drainage of the park. In where both lake and bull trout are native, lake trout are the dominant species in lake habitats almost to the exclusion of bull trout (NPS 2018). Lake trout are non-native and introduced to the Missouri River drainage and the west side of the park. Lake trout inhabit very deep, cold lakes, living in water up to 200 feet deep.	Lake trout are present in the Camas drainage, but are not native. Lake trout are only native to waters east of the Continental Divide. Non-native lake trout cause severe negative impacts to native fish from predation and competition. Therefore, because they are not native to the project area and are a source of negative impacts to native fish, impacts to lake trout have been dismissed from detailed analysis.
Pygmy whitefish (*Prosopium coulterii*) State listed species of concern	Pygmy whitefish are a native salmonid in northwestern Montana. In Glacier, they are native to some of the waters in the Middle Fork of the Flathead River drainage (Lake McDonald and Harrison Lake) and the South Saskatchewan River drainage (Upper Waterton Lake).	Pygmy whitefish do not inhabit the North Fork of the Flathead River drainage nor the Camas drainage, and are not present in the project area.
Deepwater sculpin (*Myoxocephalus tompsonii*) State listed species of concern	Deepwater sculpin have only been documented in Upper Waterton Lake in the South Saskatchewan River (Hudson Bay) drainage of Glacier and Waterton Lakes National Park, Alberta (Sheldon et al. 2008). As a glacial relict species, the isolated distribution of this fish in Montana is a result of glaciers and ancient fragmentation of aquatic habitats. The next nearest population of deepwater sculpin is more than 500 kilometers to the north (Sheldon et al. 2008).	Deepwater sculpin are only known to inhabit the park in Upper Waterton Lake. The species are not, therefore, present in the project area.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Spoonhead sculpin (*Cottus ricei*) State listed species of concern	Spoonhead sculpin are found only in the St. Mary and Waterton river drainages of Glacier and the adjacent Blackfeet Indian Reservation. Like the deepwater sculpin, spoonhead sculpin have a much wider distribution in Canada, extending eastward beyond the Great Lakes.	Because spoonhead sculpin only inhabit waters east of the Continental Divide, the species is not present in the project area.
Trout-perch (*Percopsis omiscomaycus*) State listed species of concern	Trout-perch is a species of limited distribution and is native to St. Mary and Waterton Lakes in the South Saskatchewan River (Hudson Bay) drainage of Glacier, as well as the adjacent Blackfeet Indian Reservation.	Because the distribution of trout perch is limited to areas east of the Continental Divide, the species is not present in the project area.
Western Glacier Stonefly *(Zapada glacier*) State listed species of concern and proposed for federal listing as threatened under the ESA	The western glacier stonefly is associated within the outlet streams of glacially fed lakes and glacier-associated streams. The species has an extremely limited distribution and is only known from a handful of sites in Glacier and the Teton Mountain Range in Wyoming (Giersch et al. 2017). The western glacier stonefly has a restricted distribution in the park. Despite parkwide surveys, the species has never been documented west of the Continental Divide, nor has it been detected in the rotenone treatment area for this project during recent surveys.	While remotely possible, it is highly unlikely that the western glacier stonefly is present in the treatment area given the species' limited distribution and the distance between the treatment area and permanent snow and ice sources. Perennial snowfields exist nearby, the closest of which is approximately one kilometer from Lake Evangeline. But the distance would cause the small streams to warm as they flow hundreds of meters over exposed rock from their snow and ice melt-water sources down to the treatment area. The stream water would warm to the point where the water temperature would be inhospitable for the western glacier stonefly (J. Giersch, personal communication). In the off chance that the species is present, its larvae could be killed by the rotenone or potassium permanganate, causing adverse impacts at the individual level. The loss of individuals from the treatment area would not have long-term impacts to the western glacier stonefly at the population level, because studies have shown rapid recolonization following rotenone treatments. Recolonization would occur from the migration of individuals from untreated upstream and downstream areas, as well as from individuals within the treatment area that survive the rotenone. For these reasons, and due to the very low likelihood that the species is present in the project area, the western glacier stonefly has been dismissed from further analysis. For the reasons described here, the effects determination for the western glacier stonefly under section 7 of the ESA is "not likely to jeopardize." A biological assessment has been prepared and submitted to the USFWS.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Meltwater Lednian Stonefly (*Lednia tumana*) State listed species of concern and proposed for federal listing as threatened under the ESA	The meltwater lednian stonefly is found in extremely cold glacier/snowmelt-fed springs and streams at high elevations, within a few hundred meters of snowfields. It is believed to be endemic to the Banff National Park and Glacier areas, with collections occurring in Glacier or on nearby US Forest Service and Confederated Salish and Kootenai Tribal lands (Giersch et al. 2017). The species has not been documented within the rotenone treatment area during recent surveys, but there is one record from an upper elevation drainage nearby, above and outside the upper Camas drainage.	As with the western glacier stonefly, there is a remote chance that the meltwater lednian stonefly could be present. But this is not expected because stream water running down cliff faces would become too warm to support the species (J. Giersch, personal communication). (See also discussion dismissing the western glacier stonefly, above). In the off chance that the meltwater lednian stonefly is present, its larvae could be killed by the rotenone or potassium permanganate, causing adverse impacts at the individual level. The loss of individuals from the treatment area would not have long-term impacts to the species at the population level, because studies have shown rapid recolonization following rotenone treatments. Recolonization would occur from the migration of individuals from untreated upstream and downstream areas, as well as from individuals within the treatment area that survive the rotenone. The species is dismissed from detailed analysis for these reasons, and because it is not likely present. For the reasons described here, the effects determination for the meltwater lednian stonefly under section 7 of the ESA is "not likely to jeopardize." A biological assessment has been prepared and submitted to the USFWS.
Northern Rocky Mountain Refugium Stonefly (*Soyedina potteri*) State listed species of concern	This stonefly is found in small streams and springs and has been documented in both Montana and Idaho (Baumann et al. 1977). Based on collection locations, it is likely a cold-water obligate species with a narrow temperature tolerance (less than 10 degrees Celsius, 50 degrees Fahrenheit) (MNHP 2018a). In Montana, the species has generally been collected in small forested streams that are either fishless or contain westslope cutthroat trout (MNHP 2018a). A scattered distribution of this stonefly has been documented in the park; the species has not been documented in the Camas drainage.	There is some chance the northern Rocky Mountain refugium stonefly could be present in the project area, but this is highly unlikely due to stream water running down cliff faces becoming too warm to support the species (J. Giersch, personal communication). (See also discussion dismissing western glacier and meltwater lednian stoneflies, above). In the off chance that the stonefly is present, its larvae could be killed by the rotenone or potassium permanganate, causing adverse impacts at the individual level. The loss of individuals from the treatment area would not have long-term impacts to the northern Rocky Mountain refugium stonefly at the population level, because studies have shown rapid recolonization following rotenone treatments. Recolonization would occur from the migration of individuals from untreated upstream and downstream areas, as well as from individuals within the treatment area that survive the rotenone. For this reason, and given the very low likelihood that it is present in the project area, the species is dismissed from detailed analysis.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Alberta Snowfly (*Isocapnia integra*) State listed species of concern	Very little information exists about the ecology of the Alberta snowfly. Early records report specimens in Banff National Park and the North Fork of the Flathead River, which are both cold water systems. The Alberta snowfly is a groundwater species, tending to inhabit floodplains. The species has only been collected twice in the interior of the park, at Preston Park (J. Giersch, personal communication), though multiple records exist from the mainstem Middle Fork and North Fork of the Flathead River bordering Glacier National Park (Zenger and Baumann 2004).	The Alberta snowfly could be present in the treatment area, but this is not likely given the absence of suitable floodplain habitat (J. Giersch, personal communication). In the off chance that the species is present, its larvae could be killed by the rotenone or potassium permanganate, causing adverse impacts at the individual level. The loss of individuals from the treatment area would not have long-term impacts to the Alberta snowfly at the population level, because studies have shown rapid recolonization following rotenone treatments. Recolonization would occur from the migration of individuals from untreated upstream and downstream areas, as well as from individuals within the treatment area that survive the rotenone. For these reasons and because it is not likely present, the Alberta snowfly has been dismissed from detailed analysis.
Hooked Snowfly (*Isocapnia crinita*) State listed species of concern	The hooked snowfly is a stonefly with very limited and/or potentially declining population numbers, range and/or poorly sampled habitat. As with the Alberta snowfly, the hooked snowfly is a groundwater species, inhabiting floodplain habitat in larger streams and rivers (Zenger and Baumann 2004; J. Giersch, personal communication).	The species has been found in the park, but is not likely in the treatment area given the absence of suitable habitat (J. Giersch, personal communication). In the off chance that the species is present, its larvae could be killed by the rotenone or potassium permanganate, causing adverse impacts at the individual level. The loss of individuals from the treatment area would not have long-term impacts to the hooked snowfly at the population level, because studies have shown rapid recolonization following rotenone treatments. Recolonization would occur from the migration of individuals from untreated upstream and downstream areas, as well as from individuals within the treatment area that survive the rotenone. The hooked snowfly has been dismissed from detailed analysis for these reasons, and because the species is not likely present.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Springs Stripetail (*Isoperla petersoni*) State listed species of concern	The springs stripetail is a rare cold-water stonefly occurring in small springs and spring-fed creeks with nymphs occupying large woody debris accumulations and mossy cobbles. The species has limited distribution in Montana but is found elsewhere in the Northern and Southern Rocky Mountains, including Alberta, British Columbia, Wyoming, Idaho, and Utah. The species has been collected in the park, but is not likely in the treatment area because most records are from lower elevations (J. Giersch, personal communication).	The springs stripetail has been collected in the park, but is not likely in the treatment area because most records are from lower elevations (J. Giersch, personal communication). In the off chance that the species is present, its larvae could be killed by the rotenone or potassium permanganate, causing adverse impacts at the individual level. The loss of individuals from the treatment area would not have long-term impacts to the springs stripetail at the population level, because studies have shown rapid recolonization following rotenone treatments. Recolonization would occur from the migration of individuals from untreated upstream and downstream areas, as well as from individuals within the treatment area that survive the rotenone. For these reasons and because the species is not likely present, the springs stripetail has been dismissed from detailed analysis.
Four species of caseless caddisflies (*Rhyacophila ebria; R. glaciera; R. potteri; R. rickeri*) State listed species of concern	*Rhyacophila ebria, R. glacier, R. potteri*, and *R. rickeri* are all high-elevation and cold-water dependent species (J. Giersch, personal communication). Specimens from the genus *Rhyacophil*a were collected from both Camas Lake and Lake Evangeline during MFWP sampling in 2016, but enough information was not available for definitive species identification of larval stages (M. Schnee, MFWP, personal communication).	As with cold-water stoneflies described above (western glacier stonefly, meltwater lednian stonefly, Northern Rocky Mountain refugium stonefly), there is a remote chance that these species could be present in the treatment area, but this is not likely due to stream water running down cliff faces becoming too warm to support them (J. Giersch, personal communication). In the off chance that any of these caddisfly species are present, their larvae could be killed by the rotenone or potassium permanganate, causing adverse impacts at the individual level. The loss of individuals from the treatment area would not have long-term impacts to any of these four species at the population level, because studies have shown rapid recolonization following rotenone treatments. Recolonization would occur from the migration of individuals from untreated upstream and downstream areas, as well as from individuals within the treatment area that survive the rotenone. Therefore, and because the species is not likely present, these four caddisfly species have been dismissed from detailed analysis.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Canada lynx (*Lynx Canadensis*) State listed species of concern and listed as threatened under the ESA	Preliminary lynx habitat modeling for the park defined moist conifer forest above 4,000 feet in elevation as most likely to support lynx. Habitat throughout the park meets these criteria and the park has documented lynx presence in the North Fork, McDonald, Saint Mary, Many Glacier, and Two Medicine Valleys. No lynx den sites have been documented, but family groups have been observed via remote camera stations, and winter tracking has indicated the presence of resident lynx populations in the North Fork, Middle Fork, Many Glacier, and Two Medicine Valleys and elsewhere on the east side of the Continental Divide. There are no records of lynx in the Camas drainage, but there is suitable habitat in the area and the species could be present.	If individual lynx are in the project area during project activities, they could be disturbed or displaced by noise and activity. Widespread areas of undisturbed habitat beyond the source of disturbance would be readily available, however, and displacement effects would be temporary, with no measurable change in lynx behavior or essential activities. The proposed action would not affect lynx prey, and except for helicopter flights during translocation (estimated at four flights per year for six or seven years), would not occur during the sensitive denning period in the spring. For these reasons, any adverse impacts would be negligible or less, potentially affecting Canada lynx only at the individual level, with no effects to distribution, population, or abundance. For the reasons described here, the effects determination for Canada lynx under section 7 of the ESA is "may affect, not likely to adversely affect." A biological assessment has been prepared and submitted to the USFWS.
Wolverine (*Gulo gulo*) State listed species of concern and proposed for federal listing as threatened under the ESA	The wolverine is a wide-ranging mustelid that uses a range of habitats, including alpine areas, mature forests, ecotonal areas, and riparian areas. Wolverine typically inhabit high-elevation areas that maintain deep snow late into the warmer months of the year. Glacier's alpine areas provide very high quality wolverine habitat, and the species is well documented within the park. There are no records of wolverines at Camas Lake and Lake Evangeline. There are records (1970s and 1980s) of wolverine in the lower Camas drainage and the vicinity of Trout and Arrow Lakes (MNHP 2018b), and the species could use the Camas drainage sporadically.	If individual wolverines are in the project area during project activities, they could be disturbed or displaced by noise and activity. Widespread areas of undisturbed habitat beyond the source of disturbance would be readily available, however, and displacement effects would be temporary, with no measurable change in behavior or essential activities. The proposed action would not affect wolverine prey and except for helicopter flights during translocation (an estimated four flights per year for six or seven years), would not occur when wolverine are denning in the spring. For these reasons, any adverse impacts would be negligible or less, potentially affecting wolverines only at the individual level, with no effects to distribution, population, or abundance. For the reasons described here, the effects determination for wolverines under section 7 of the ESA is "not likely to jeopardize." A biological assessment has been prepared and submitted to the USFWS.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Fisher (*Pekania pennanti*) State listed species of concern	The fisher is a large mustelid that prefers densely forested habitat. Based on surveys, it is highly unlikely that fishers are residents of the park. Previous credible reports may have been individuals dispersing from areas outside the park (Waller 2018).	Because there is no recent evidence of fishers in the park, the species would not likely be present in the project area. Any fisher presence would likely be dispersing individuals and would, therefore, be sporadic. In the unlikely event that individuals are disturbed or displaced by noise or human activity, widespread areas of undisturbed habitat would be readily available. Any effects would, therefore, be temporary, with no measurable change in fisher behavior or essential activities.
Little Brown Bat (*Myotis lucifugus*) State listed species of concern	Little brown bats use a variety of habitats, and frequently forage over water. The species uses buildings, bridges, caves, abandoned mines, snags, and loose bark for hibernacula, maternity roosts, and/or day roosts. Little brown bats are common in the park, with numerous recorded observations. There is one record from the Camas drainage in the Christensen Meadows area (MNHP 2018b).	Little brown bats could be present in the project area, and potentially be at risk of disturbance or displacement due to project noise and activity. But bats are highly mobile, and undisturbed adjacent habitat would be available. Any displaced bats would likely resume use of the area once human activity has stopped, and/or continue to use habitat in the project area while work is underway. Rotenone treatments could cause reduced emergences of flying aquatic insects. But this would not measurably affect foraging for bats, since bats also feed on non-aquatic insects, of which a multitude would remain. Aquatic insect species composition and abundance would also likely return to pre-treatment conditions in two to four years. Rotenone treatments would occur in late summer/early fall, after pups have left maternity roosts. For these reasons, any adverse impacts would be negligible, with potential to only affect the little brown bat at the individual level and no biologically meaningful effects to essential activities such as roosting or foraging, no measurable effects to overall distribution, and no effects to population and abundance.
Bald Eagle (*Haliaeetus leucocephalus*) State listed species of concern	Bald eagles are well documented in Glacier and nest at several of the park's larger lakes. The park is also within a major bald eagle migration corridor (McClelland et al. 1994, Yates et al. 2001). Bald eagles have been documented at Trout, Rogers, and Arrow Lakes (MNHP 2018b and NPS files), but nesting has not been observed at the lakes. There are no records of bald eagles at Camas Lake and Lake Evangeline. Lakes in the Camas drainage are likely too small to support nesting pairs of bald eagles.	Migrating bald eagles as well as eagles nesting elsewhere in the park may occasionally use lakes in the Camas drainage, including Camas Lake and Lake Evangeline, for forage. But given numerous large lakes on the west side of the park and several tributaries that provide optimal forage for bald eagles, the Camas drainage is not likely an essential foraging area. Bald eagles may be disturbed by helicopters flights. Through consultation with the park's wildlife staff, locations of active nests and eagle migration routes would be avoided whenever possible during flights. This would reduce the risk of impacts such that any adverse impacts would be negligible, with potential to only affect bald eagles the individual level, with no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to bald eagle population and abundance.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Northern Hawk Owl (*Surnia ulula*) State listed species of concern	Northern hawk owls are found in moderately dense coniferous or mixed coniferous-deciduous forests with suitable perch sites, often adjacent to wet meadows and marshes or openings. The species is present in Glacier, with strong association with burned forests. There are several records of the species from the lower Camas drainage, and one record south of Arrow Lake (MNHP 2018b).	If present, individual hawk owls could be disturbed or displaced by project noise and activity. The project would occur after the breeding and nesting period, however, and would not alter the availability of forage. Undisturbed, adjacent habitat would also be available and any displaced individuals would likely resume use of the area once human activity has stopped, and/or continue to use the area while work is underway. For these reasons, any adverse impacts would be negligible, potentially affecting the species only at the individual level, with no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to populations and abundance.
Northern Goshawk (*Accipiter gentilis*) State listed species of concern	Northern goshawks prefer mature conifer forest with a dense canopy cover. Nesting occurs in a variety of forest types with nest sites constructed high up in larger diameter trees. The species is known to nest within the park, and has been observed in the vicinity of Rogers Lake and below Christensen Meadows (MNHP 2018b).	Goshawks could be present in the project area, and potentially be at risk of disturbance or displacement due to project noise and activity. But the project would not occur until after the breeding and nesting period, and undisturbed, adjacent habitat would be available for any displaced individuals. Goshawks would likely resume use of the area once human activity has stopped. The project would not alter the availability of goshawk prey. For these reasons, any adverse impacts would be negligible, with potential to only affect goshawks at the individual level, and no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to population and abundance.
Great Gray Owl (*Strix nebulosi*) State listed species of concern	Known to use lodgepole pine/douglas-fir habitats; nesting occurs in the tops of large broken-off tree trunks, old nests of other large birds, or in dwarf mistletoe platforms. The species is known to nest within Glacier and has been observed in the lower Camas drainage, below Christensen Meadows (MNHP 2018b).	Great gray owls could be present in the project area, and potentially be at risk of disturbance or displacement due to project noise and activity. But the project would not occur until after the breeding and nesting period, and undisturbed, adjacent habitat would be available for any displaced individuals. Individual owls may continue to use habitat in the project area while work is underway, or would likely resume use of the area once human activity has stopped. The project would not alter the availability of prey. For these reasons, any adverse impacts would be negligible, with potential to affect the species only at the individual level. There would be no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to population and abundance.

Species and Special Listing Status	Habitat type, distribution, and documentation in Glacier National Park	Impacts and reason for dismissal from detailed analysis
Great Blue Heron (*Ardea herodias*) State listed species of concern	Great blue herons nest in colonies in cottonwoods along rivers and lakes. The birds may use ponderosa pines or nest on the ground on treeless islands, and feed on fish, amphibians, invertebrates, reptiles, and small birds and mammals. The species is present in the park and has been recorded in the Camas drainage, including near Rogers and Trout Lakes (MNHP 2018b).	Great blue herons could be present in the project area, and potentially be at risk of disturbance or displacement due to project noise and activity. But project activities would not occur until after the breeding and nesting period, and undisturbed, adjacent habitat would be available for any displaced individuals. Great blue herons would likely resume use of the area once human activity has stopped. The project would not alter the availability of prey for great blue herons. For these reasons, any adverse impacts would be negligible, with potential to only affect the species at the individual level, and no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to populations and abundance.
Horned grebe (*Podiceps auritus*) State listed species of concern	Horned grebes are found in freshwater ponds and marshes and use large bodies of water (rivers and lakes) in spring and fall. Grebes prey on aquatic insects and crustaceans. Horned grebes have been recorded on numerous lakes in the park, including Lake McDonald (MNHP 2018b); there are no records of the species from lakes in the Camas drainage, but they could be present since they have been recorded at other lakes in nearby drainages.	If present, horned grebes could be disturbed by project noise and activity. But the project would not occur until after the breeding and nesting period, and undisturbed habitat at Arrow, Trout, and Rogers Lake would remain available, as well as at Lake McDonald. Rotenone could alter the availability of aquatic insect prey. But this would be temporary, as aquatic insect species composition and abundance would be expected to return to pre-treatment conditions in two to four years. For these reasons, there would be no biologically meaningful or noticeable impacts to the species.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Black Swift (*Cypseloides niger*) State listed species of concern	Black swifts typically nest behind or near waterfalls on steep cliff faces where the nests are inaccessible to predators and there are unobstructed flyways. Black swifts forage over open water feeding primarily on flying insects and arthropods. The species is known to nest in the park. There is one record of the species from the lower Camas drainage; habitat in the vicinity of the project area is considered optimal (MNHP 2018b). This is likely due to the presence of a waterfall between Camas and Arrow Lakes.	If black swifts are present in the rotenone treatment area, the application of rotenone could cause a localized reduction in their prey, since rotenone would result in a reduced emergences of caddisflies, stoneflies, and other flying aquatic insects within the treatment area. These impacts would not occur until late in the summer (late August/early September), when juvenile birds have an increased ability to fly and forage outside the treatment area. The treatment area would be surveyed for black swift nests prior to rotenone application. Since juvenile swifts could still be somewhat dependent on the nesting site for forage, if nests are present, rotenone would be applied as late in the summer as practicable (e.g. without missing optimal temperature and weather windows, for example), to further minimize potential impacts. Any reduction in prey would be temporary, as aquatic insect species composition and abundance would be expected to return to pre-treatment conditions in two to four years. This combined with the availability of foraging habitat beyond the treatment area and the presence of insects that would not be affected by rotenone, adverse impacts would be negligible, with potential to only affect black swifts at the individual level. There would be no biologically meaningful or lasting effects to essential activities such as nesting or foraging, no measurable effects to overall distribution throughout the park, and no effects to populations and abundance.
Varied Thrush *(Ixoreus naevius*) State listed species of concern	The varied thrush typically breeds in mature and old-growth mixed-coniferous forests and nests on the branches of conifers, the ground, or shrubs and vines. Varied thrushes forage on ground-swelling arthropods, as well as fruits and berries. The species is known to nest within Glacier, and is generally common to the park. Varied thrushes have been observed in the Camas drainage below Arrow Lake (MNHP 2018b).	If present, individual varied thrushes could be disturbed or displaced by project noise and activity. The project would occur after the breeding and nesting period, however, and would not alter the availability of forage, which is not aquatic dependent. Undisturbed, adjacent habitat would also be available and any displaced individuals would likely resume use of the area once human activity has stopped, and/or continue to use the area while work is underway. For these reasons, any adverse impacts would be negligible, with potential to only affect the species at the individual level, with no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to population and abundance.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Boreal Chickadee *(Poecile hudsonicus*) State listed species of concern	Boreal chickadees prefer boreal coniferous and mixed forest habitat. Nests are typically constructed in natural cavities or abandoned woodpecker holes within one meter of the ground. Boreal chickadees forage on conifer and birch seeds and insects. The species is known to nest within Glacier. There are numerous observations from the Camas drainage in the vicinity of Rogers and Trout Lakes (MNHP 2018b).	If present, individual boreal chickadees could be at risk of disturbance or displacement from noise and human activity associated with the project. The project would occur after the breeding and nesting period, however, and would not alter the availability of forage, which is not aquatic dependent. Undisturbed, adjacent habitat would also be available and any displaced individuals would likely resume use of the area once human activity has stopped, and/or continue to use the area while work is underway. For these reasons, any adverse impacts would be negligible, possibly affecting boreal chickadees at the individual level, with no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to population and abundance.
Cassin's Finch (*Haemorhous cassinii*) State listed species of concern	Cassin's finches use a wide variety of forest habitats but prefer ponderosa pine and post-fire forests. Nests are typically constructed near the end of a tree branch. Cassin's finches feed primarily on seeds with a portion of their diet consisting of invertebrates. The species is known to nest within the park, and has been recorded in the Camas drainage on the north slope above Rogers and Trout Lakes (MNHP 2018b).	Cassin's Finches could be present in the project area, and potentially be at risk of disturbance or displacement due to noise and activity. But project activities would not occur until after the breeding and nesting period, and undisturbed, adjacent habitat would be available for any displaced individuals. Cassin's finches would likely continue to use habitat in the area while work is underway, or would resume use of the area once human activity has stopped. The project would not alter the availability of seeds or other forage. For these reasons, any adverse impacts would be negligible or less, potentially affecting the Cassin's finch at only the individual level, with no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to population and abundance.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
LeConte's Sparrow (*Ammodramus leconteii*) State listed species of concern	Documented to use wet meadows within peatland habitats. Nests are typically constructed on or just above the ground in thick clumps of grass. LeConte's sparrows feed primarily on insects and seeds. LeConte's sparrows are known to nest within the park, and have been recorded in the lower Camas drainage (MNHP 2018b).	LeConte's sparrows are not likely to be present in the project area; if present they could be disturbed or displaced by project noise and activity. But project activities would not occur until after the breeding and nesting period, and undisturbed, adjacent habitat would be available for any displaced individuals. Individuals would likely continue to use habitat in the area while work is underway, or would resume use of the area once human activity has stopped. Insect abundance could be reduced after treatment with rotenone, but this would not meaningfully affect the availability of forage for the LeConte's sparrow, since the species also relies on seeds. Aquatic insect populations would also recover within two to four years. For these reasons, any adverse impacts would be negligible, with potential to only affect the LeConte's sparrow at the individual level, and no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to population and abundance.
Evening Grosbeak (*Coccothraustes vespertinus*) State listed species of concern	Prefer habitats in mixed coniferous and spruce-fir forests. Nests are typically constructed in the upper portions of coniferous trees. Evening grosbeaks forage on invertebrates, seeds, and fruits. The species known to nest within the park, including at least one record from the Camas drainage in the vicinity of Rogers and Trout Lakes (MNHP 2018b).	Evening grosbeaks could be present in the project area, and potentially be at risk of disturbance or displacement due to noise and activity. But the project would not occur until after the breeding and nesting period, and undisturbed, adjacent habitat would be available for any displaced individuals. Individual evening grosbeaks would likely continue to use habitat in the area while work is underway, or would resume use of the area once human activity has stopped. The project would not alter the availability of forage. For these reasons, any adverse impacts would be negligible, potentially only affecting evening grosbeaks at the individual level, with no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to population and abundance.

Species and Special Listing Status	Habitat type, distribution, and documentation in Glacier National Park	Impacts and reason for dismissal from detailed analysis
Pileated Woodpecker (*Dryocopus pileatus*) State listed species of concern	Inhabit late successional coniferous or deciduous forests. Roost and nest trees are typically larger diameter snags often with broken tops. Pileated woodpeckers primarily forage on wood-dwelling carpenter ants extracted from down woody material and standing live or dead trees. The species is known to nest within the park, and has been recorded in the Camas drainage in the vicinity of Rogers and Trout Lakes (MNHP 2018b).	This species could be present in the project area, and potentially be at risk of disturbance or displacement due to noise and activity. But project activities would not occur until after the breeding and nesting period, and undisturbed, adjacent habitat would be available for any displaced individuals. Pileated woodpeckers would likely continue to use habitat in the area while work is underway, or would resume use of the area once human activity has stopped. The project would not alter the availability of prey. For these reasons, any adverse impacts would be negligible, with potential to only affect the species at the individual level, and no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to population and abundance.
Black-backed Woodpecker (*Picoides arcticus*) State listed species of concern	Inhabit early successional mixed conifer burned forests; nests are typically constructed in western larch/douglas-fir forests with an old-growth component. Black-backed woodpeckers feed on wood-boring beetle larvae and other insects. The species is known to nest within the park, and has been recorded in the lower Camas drainage (MNHP 2018b).	Black-backed woodpeckers could be present in the project area, and potentially be at risk of disturbance or displacement from noise and activity. But project activities would not occur until after the breeding and nesting period, and undisturbed, adjacent habitat would be available for any displaced individuals. Individual woodpeckers would likely continue to use habitat in a given area while work is underway, or would resume use once human activity has stopped. The project would not alter the availability of forage for black-backed woodpeckers. For these reasons, any adverse impacts would be negligible, potentially affecting the species only at the individual level, with no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to population and abundance.
Lewis' Woodpecker *(Melanerpes lewis*) State listed species of concern	Typically prefer open forest habitats, including old-growth cottonwood forests and burned forests, with standing snags for nest cavities, dead or downed woody debris, perch sites, and abundant insects. During summer, the species forages opportunistically on adult emergent insects. Lewis' woodpeckers are known to nest within Glacier; the species has been recorded in the Camas drainage in the vicinity of Christensen Meadows (MNHP 2018b).	The Lewis' woodpecker could be present in the project area, and potentially be at risk of disturbance or displacement due to noise and activity. But project activities would not occur until after the breeding and nesting period, and undisturbed, adjacent habitat would be available for any displaced individuals. Individual woodpeckers would likely continue to use habitat in the area while work is underway, or would resume use once human activity has stopped. The project would not alter the availability of prey. For these reasons, any adverse impacts would be negligible, with potential to only affect Lewis' woodpeckers at the individual level, and no biologically meaningful effects to essential activities such as nesting or foraging, no measurable effects to overall distribution, and no effects to populations and abundance.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Water Howellia (*Howellia aquatilis*) Federally listed as threated under the ESA and a state listed species of concern	Water howellia is a wetland species that has been documented in northwest Montana. However, there are no known locations of the species within the park, despite multiple survey efforts over the years.	If water howellia is documented during onsite wetland inventories prior to project implementation, the location of the plant(s) would be marked and avoided. Water howellia has been dismissed from detailed analysis because it has not been documented in the park, suggesting a low likelihood of presence, and there would be no effect to the species since, if detected during surveys, any locations would be marked and avoided. For the reasons described here, the effects determination for water howellia under section 7 of the ESA is “no effect.” A biological assessment, therefore, is not required.
Spalding’s Campion (*Silene spaldingii*) Federally listed as threated under the ESA and a state listed species of concern	Spalding’s campion is an open grassland species that has been documented in northwest Montana. However, there are no known locations of the species within the park, despite multiple survey efforts over the years.	If Spalding’s campion is documented during onsite wetland inventories prior to project implementation, the location of the plant(s) would be marked and avoided. Spalding’s campion has been dismissed from detailed analysis because it has not been documented in the park, suggesting a low likelihood of presence, and there would be no effect to the species since, if detected during surveys, any locations would be marked and avoided. For the reasons described here, the effects determination for Spalding’s Campion under section 7 of the ESA is “no effect.” A biological assessment, therefore, is not required.
Whitebark Pine +(*Pinus albicaulis*) State listed species of concern and candidate for federal listing under the ESA.	Whitebark pine are present in forested environments at elevations between 5000 and 7000 feet. The species is well documented in Glacier. There are three records of whitebark pine in the Camas drainage, on the high-elevation ridge south of Trout and Rogers Lakes and northeast of Arrow Lake (MNHP 2018b).	At 5075 and 5246 feet respectively, Camas Lake and Lake Evangeline are at the lower elevation zone for whitebark pine. If whitebark pine is present at or near the lakes, it would not be affected since the proposed action does not involve any ground or vegetation disturbing activities.
Moonworts (*Botrychium* spp.) State listed species of concern	Moonworts are found in wet areas. Seven species have been found in the park. There is one observation of the northern moonwort (*Botrychium pinnatum*) from along the Camas Creek Trail, south of Arrow Lake.	Moonworts could occur in the project area and be at risk of trampling. Surveys for rare plants, including moonworts, would occur prior to implementing the project. Any identified locations would be marked and avoided. The species would not, therefore, be affected.

Species and Special Listing Status	**Habitat type, distribution, and documentation in Glacier National Park**	**Impacts and reason for dismissal from detailed analysis**
Arctic Sweet Coltsfoot (*Petasites frigidus var. frigidus*) State listed species of concern	Found in swamps, fen margins, and riparian seeps within open forest and meadows in valley and foothill zones. The species is rare in Montana, where it is at the southern edge of its range, and is known from a few widely scattered sites in the northwest corner of the state. Four populations have been documented in the park, but there are no records of the species in the Camas drainage.	The species could occur in the project area and be at risk of trampling. Project areas where arctic sweet coltsfoot could be affected would be surveyed, and any identified locations would be marked and avoided. The species would not, therefore, be affected.
Tufted club-rush (*Tricophorum cespitosum)* State listed species of concern	Found in wet meadows and sphagnum-dominated fens in montane to alpine zones. The species is rare in Montana, where it is currently documented from over a dozen fens and wet meadows in the mountainous portion of western Montana.). Four populations have been documented in the park. There are no records of the species in the Camas drainage.	The species could occur in the project area and be at risk of trampling. Project areas where the species could be affected would be surveyed, and any identified locations would be marked and avoided. The species would not, therefore, be affected.

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Appendix F – Results of NPS Natural Sounds and Night Skies Division sound mapping tool and attenuation calculator

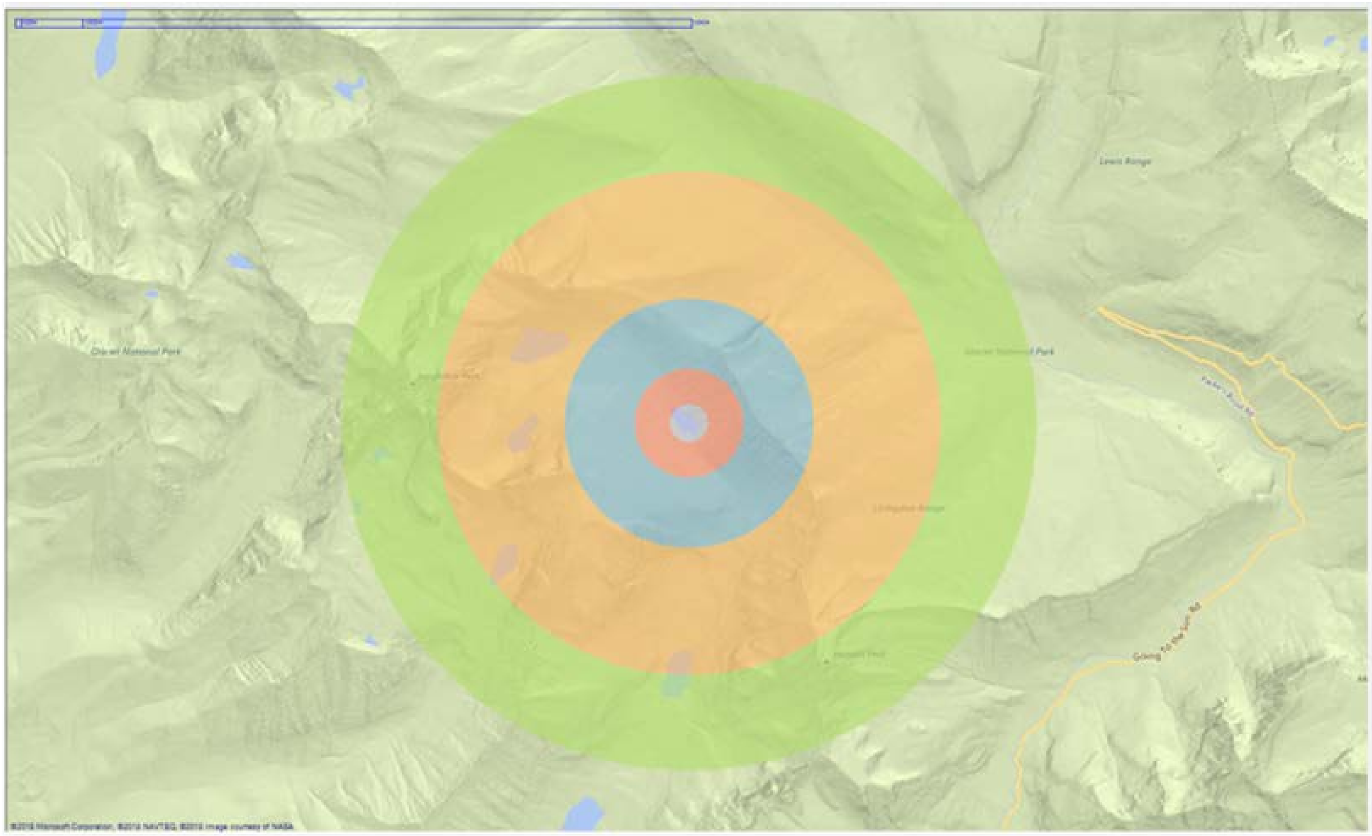
The following graphics illustrate coarse approximations of the distances over which noise produced under Alternative A would need to travel before it attenuates to a natural ambient level of 30 dBA. Actual attenuation distances may be different than shown in the graphics, because the exact make and model of helicopters, motorboats, and generator are not known at this time and so cannot be factored into the sound modeling. The model also only calculates noise produced at Camas Lake. Therefore, these graphics provide approximations and a comparison between the different attenuation distances for equipment that would be used. The makes and models of the equipment for each graphic are only examples, selected because they represent the same general type and sound level of equipment that would be used under Alternative A, and because noise data was obtainable for these models.

The NPS Natural Sounds and Night Skies Division incorporates a standard method of calculating the attenuation of noise with distance using a sound mapping tool and attenuation calculator. The attenuation calculator accounts for the effects of divergence or spreading loss, which accounts for a 20 dB decrease in level for every 10-fold increase in distance (spherical spreading is assumed). The frequency-dependent effects of atmospheric attenuation are also computed, with attenuation coefficients calculated according to standard formulae (ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation). Finally, the software utilizes a simplified method to approximate ground absorption along the transmission path. Sound propagation conditions are affected by the height of the source (AGL) and receiver (e.g. a person or animal receiving the sound), receiver height) values, the ambient temperature, relative humidity, and atmospheric pressure values, and the porous ground values. The ISO 9613-2 standard assumes that sounds are propagating downwind, or equivalently, under a moderate temperature inversion favorable to long-range propagation. Under weather conditions that produce inversions, the attenuation calculator will underestimate the noise produced by the noise source.

Helicopter A350

Noise would attenuate to ambient level (30 dBA) at approximately 5.1 kilometers (3.2 miles).

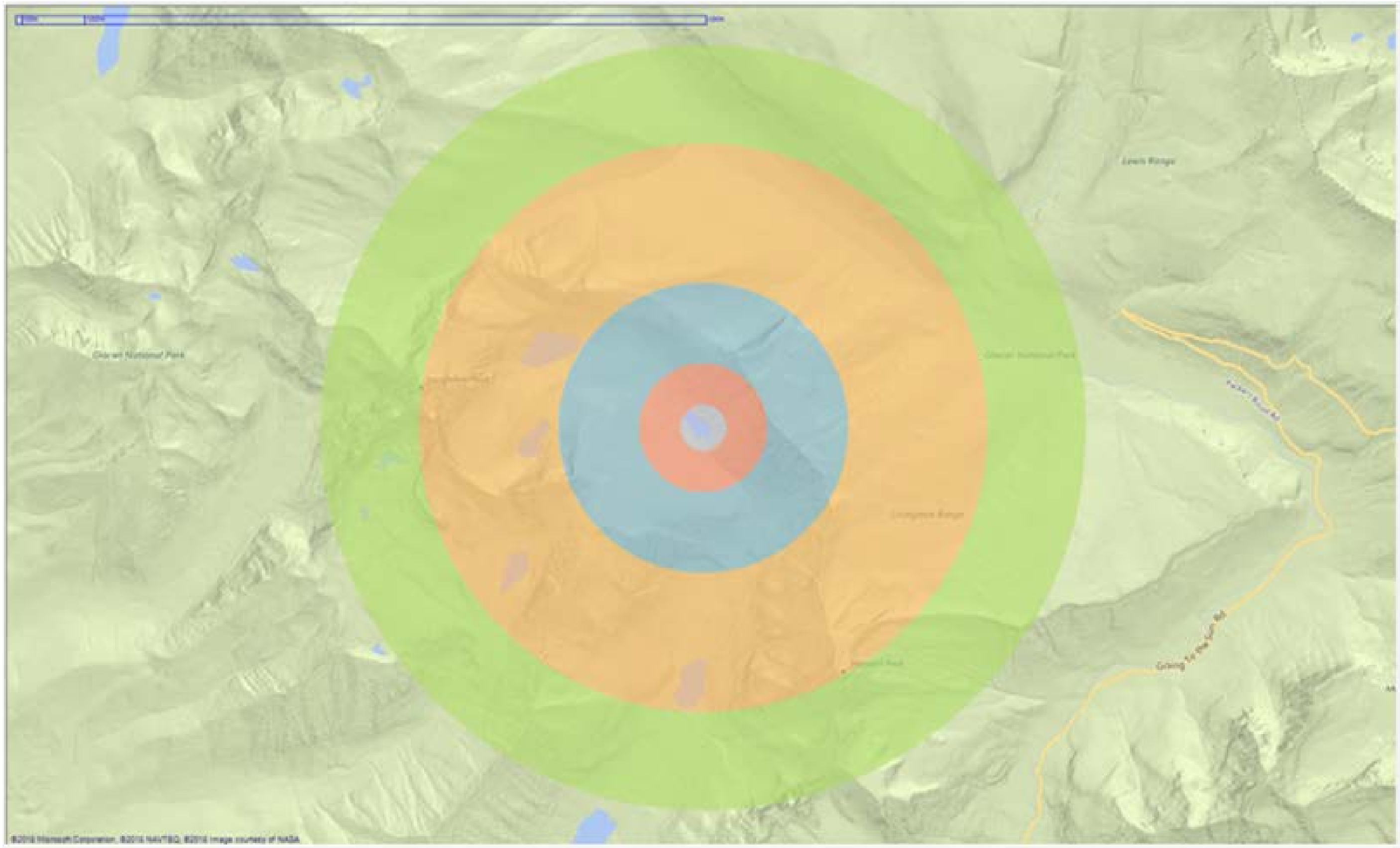
	85 dBA	75 dBA	65 dBA	55 dBA	45 dBA	35 dBA	Ambient
Distance	--	--	279 m	802 m	1.8 km	3.7 km	5.1 km



Helicopter B260B

Noise would attenuate to ambient level (30 dBA) at approximately 5.5 kilometers (3.4 miles).

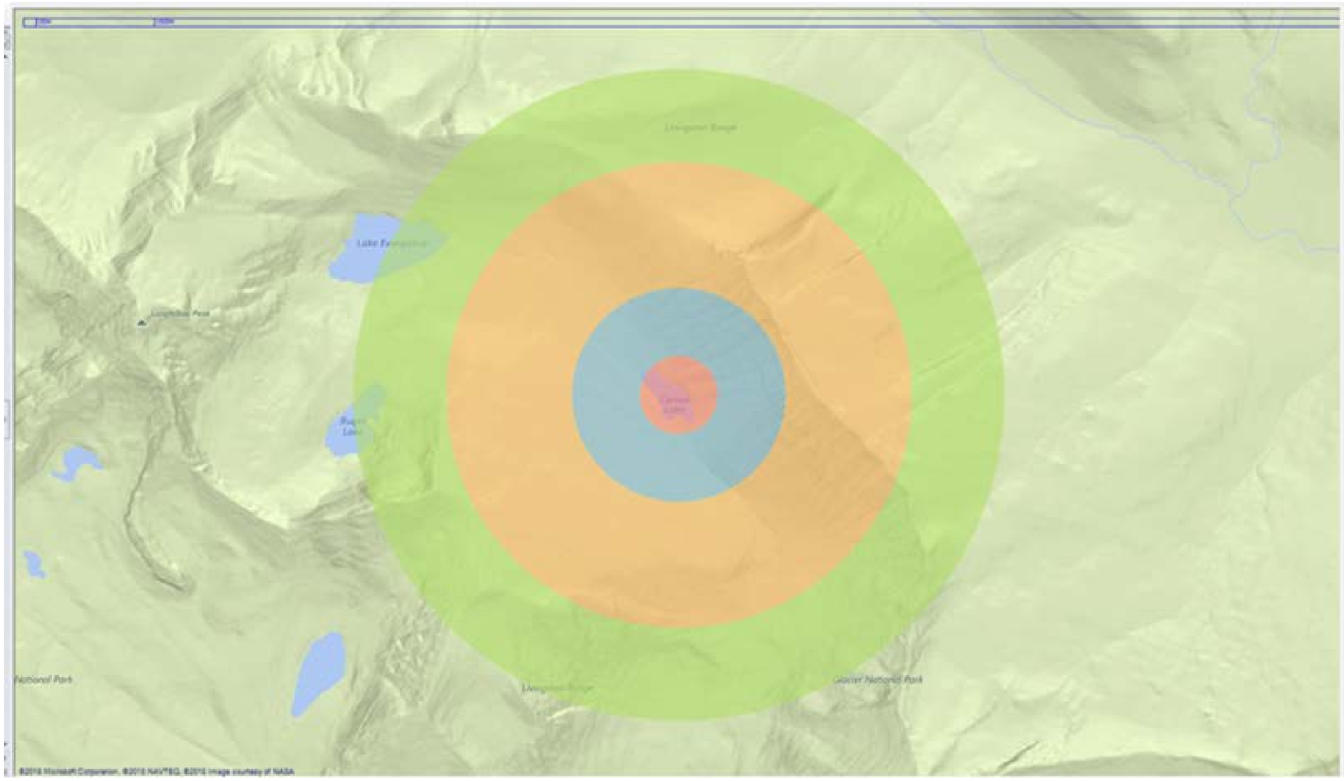
	85 dBA	75 dBA	65 dBA	55 dBA	45 dBA	35 dBA	Ambient
Distance	—	—	333 m	928 m	2.1 km	4.1 km	5.5 km



Helicopter B260L

Noise would attenuate to ambient level (30 dBA) at approximately 2.5 kilometers (1.6 miles).

	85 dBA	75 dBA	65 dBA	55 dBA	45 dBA	35 dBA	Ambient
Distance	--	--	--	296 m	810 m	1.8 km	2.5 km



Motorboat (Kawasaki 1100 STX DI QT (66.5 dB), 4 stroke, direct injection, full throttle)

Noise would attenuate to ambient level (30 dBA) at approximately 1.8 kilometers (1.1 miles).

	85 dBA	75 dBA	65 dBA	55 dBA	45 dBA	35 dBA	Ambient
Distance	4 m	13 m	43 m	166 m	487 m	1.2 km	1.8 km

2001 Sea-Doo GTX DI QT (66.6 dB), 4 stroke, direct injection, full throttle

Noise would attenuate to ambient level (30 dBA) at approximately 1.9 kilometers (1.2 miles).

	85 dBA	75 dBA	65 dBA	55 dBA	45 dBA	35 dBA	Ambient
Distance	4 m	13 m	43 m	166 m	493 m	1.2 km	1.9 km

Generator, 66dBA measured at 50 meters

Noise would attenuate to ambient level (30 dBA) at approximately 341 meters (0.21 mile).*

	85 dBA	75 dBA	65 dBA	55 dBA	45 dBA	35 dBA	Ambient
Distance	---	2 m	8 m	25 m	77 m	213 m	341 m

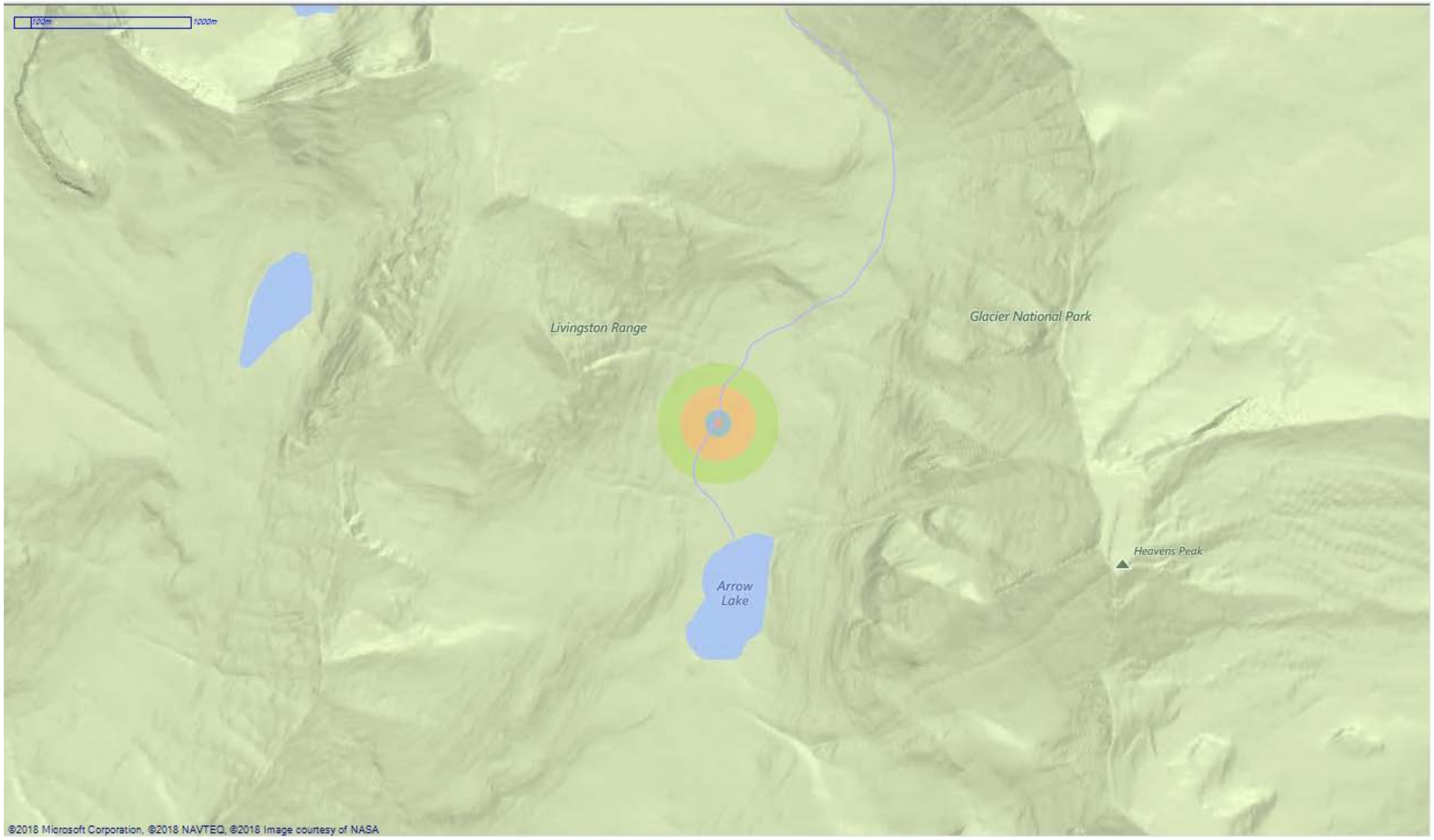


*illustration of stream is approximate.