

**Final Environmental Assessment
for
Native Fish Restoration and Enhancement Projects
in Northern Utah**



Prepared by

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and

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Region 6 (Mountain / Prairie Region)
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in Cooperation with

**Bureau of Land Management - Salt Lake Field Office
Salt Lake City, Utah**

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Final Environmental Assessment Native Fish Restoration and Enhancement Projects in Northern Utah

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Abstract

The Utah Division of Wildlife Resources will implement rotenone treatments in eight streams in northern Utah from 2012 to 2018. The proposed action will be implemented in cooperation with the Bureau of Land Management (BLM) -- Salt Lake Field Office (SLFO), and in coordination with both the Sawtooth National Forest (NF) and the Uinta-Wasatch-Cache NF. National Environmental Policy Act (NEPA) compliance is necessary to analyze potential impacts to the environment because partial funding for this project will be granted pursuant to the Sport Fish Restoration Act administered through the U. S. Fish and Wildlife Service (FWS).

Fish migration barriers will be constructed where necessary before treatment to prevent the reinvasion of non-native trout. Native trout from "core" wild populations or fish produced from UDWR native trout brood stocks will be introduced with the goal of establishing self-sustaining populations. Native nongame fish, namely sculpin and mountain sucker, will be re-introduced into currently or previously (known) occupied streams following treatment. Following the rotenone treatment, other native fish, including northern leatherside chub and bluehead sucker, will be introduced into select streams containing suitable habitat within their respective historic ranges.

The Proposed Action will expand the number of native fish populations and the extent of occupied stream miles within native fish historic ranges, thus implementing specific conservation actions listed in conservation agreements and strategies for native trout in Utah. Implementation of this project will offset threats to Bonneville cutthroat trout, a species recognized by state and federal agencies as a species in need of special protection. The proposed project follows recommendations from FWS to reduce threats to native fish and to provide for the long-term conservation of these species. This Environmental Assessment documents an analysis of the effects of the "No Action" Alternative, the Proposed Action, and the Mechanical Removal with Electrofishing Alternative.

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SECTION 1: PURPOSE AND NEED

1.1 PURPOSE AND NEED

Non-native fish pose competition, predation, and hybridization threats to native cutthroat trout, and a predation threat to sensitive nongame fish, throughout the western United States. The co-occurrence of non-native fish and native trout has been a factor contributing to the decline and extirpation of important cutthroat trout conservation populations.

The primary purpose of the Proposed Action is to restore, enhance, and protect populations of native fish in northern Utah while imposing no or only minimal impacts to non-target, native, aquatic, and terrestrial species. Species in need of enhancement include Bonneville cutthroat trout (*Oncorhynchus clarkii utah*), Yellowstone cutthroat trout (*O. c. bouvieri*), northern leatherside chub (*Lepidomeda copei*), bluehead sucker (*Catostomus discobolus*), mountain sucker (*Catostomus platyrhynchus*), and sculpin (*Cottus* species). National Environmental Policy Act (NEPA) compliance is necessary to analyze potential impacts to the environment because partial funding for this project will be granted pursuant to the Sport Fish Restoration Act administered through the U. S. Fish and Wildlife Service (FWS).

1.2 BACKGROUND

Removing non-native trout from currently occupied habitat and reclaiming formerly occupied habitat by removing non-native fish and then reintroducing native cutthroat trout populations are strategies applied to advance the broad goals of population replication and persistence defined in the cutthroat trout conservation agreements, and promotes the conservation of nongame species. Recent efforts to quantify the rangewide distributions have verified these suspicions. May and Albeke (2005) determined that Bonneville cutthroat trout currently occupy approximately 35% of their historic rangewide habitat and 31% of their historic habitat in Utah. Yellowstone cutthroat trout occupy 43% of their historic rangewide habitat and 38% of their historic habitat in Utah (May et al. 2007). Northern leatherside chub and bluehead sucker have also experienced significant range contractions. Consequently, each of these species has been recognized by state, federal, and non-governmental entities as being in need of special management status, and with the exception of bluehead sucker, each has been petitioned for protection under the Endangered Species Act (ESA), and subsequently found not warranted for listing. Detailed timelines of events are included below for the cutthroat subspecies (Table 1.1), northern leatherside chub, and bluehead sucker (Table 1.2).

Table 1.1 Timeline of events (1979-present) for the native cutthroat trout subspecies proposed for restoration (See Appendix A, List of Acronyms and Abbreviations, for acronym definitions).

Year	Cutthroat trout subspecies	
	Bonneville	Yellowstone
1979	AFS/DFC: 'threatened'; petitioned FWS for listing as threatened	
1982	FWS: Candidate Species	
1984	FWS: 'Warranted but precluded'; completed status review	
1989	AFS: 'endangered'	
1992	Petitioned for listing as threatened; FWS: no new information in petition	
1996	FWS removed Candidate status	

Cutthroat trout subspecies		
Year	Bonneville	Yellowstone
1997	State of Utah CAS with FWS, UDWR, USFS, Reclamation, BLM, CTGR, and URMCC	
1998	Petitioned for listing as threatened with critical habitat by Biodiversity Legal Foundation (Feb.); FWS issued positive 90-day finding for petition (Nov.) UDWR: 'conservation species'	Petitioned for listing as threatened
1999	FWS reopened comment period on 90-day finding	
2000	Range-wide CAS signed by FWS, UDWR, IDFG, NDOW, WGFD, BLM, NPS, USFS, CTGR, RCMCC	MOA developed between management agencies to facilitate coordination and cooperation in conservation activities
2001	FWS 12-month finding: listing not warranted due to activities under CAS	FWS 90-day finding: insufficient information to warrant listing; Range-wide status assessment completed
2003	USFS: 'sensitive species'	
2004	Range-wide status assessment completed	Petitioners filed complaint on conclusion of 90-day finding; U.S. District Court ordered FWS to produce 12-month finding
2005	Lawsuit by Center for Biological Diversity against FWS on merits of 12-month finding	USFS: 'sensitive species'
2006		FWS 12-month finding: listing not warranted; Range-wide status assessment completed
2007	Lawsuit (2005) dismissed by U.S. District Court of Colorado; UDWR: 'Conservation Agreement Species'; FWS formal opinion of 'significant portion of range' leads to withdrawal of 2001 12-month finding	UDWR: 'species of concern'
2008	FWS status review to determine need for protection in any 'significant portion of range'; State of Utah CA updated (Feb.); FWS 12-month finding: listing not warranted (Sep.); Removed from AFS list of imperiled species	AFS: 'threatened'
2010	USFS: 'sensitive species'	

Table 1.2 Timeline of events (1998-present) for the native nongame aquatic species proposed for restoration.

	Species	
Year	Northern leatherside chub	Bluehead sucker
1998	UDWR: Leatherside chub designated 'species of special concern'	UDWR: 'species of special concern'
2000	Leatherside chub separated into two distinct <i>clades</i> (phylogenetically distinct groupings), Northern and Southern (Johnson and Jordan 2000)	
2004		Range-wide CAS signed by UDWR, WGFD, CDOW, NMDGF, AZGFD, NDOW, BLM, NPS, JAN
2006		State of Utah CAS for three species signed by UDWR, FWS, BLM, BOR, USFS, NPS, TNC
2007	Petitioned for listing as threatened or endangered; UDWR: 'species of concern'	UDWR: 'Conservation Agreement Species'
2008	AFS: 'endangered'	
2009	Range-wide CAS signed by UDWR, IDFG, WGFD, NDOW, BLM, USFS, TU, NPS, FWS, BOR, TNC; FWS 90-day finding: listing may be warranted; status review initiated	
2010	Lawsuit against FWS for failure to issue a timely petition finding; USFS: 'sensitive species'	
2011	FWS 12-month finding: listing not warranted (Oct.)	

1.3 DECISIONS TO BE MADE

The major decision to be made from this analysis is to determine whether to authorize a FWS-WSFR grant to support implementation of fish removal projects from specific waters, listed in Section 2.2, using rotenone. In some cases, the decision to remove fish, including non-native trout, from project waters will be made in concert with the pertinent land management agency's (FS, BLM) decision to approve the construction of fish-migration barriers to protect upstream areas from reinvasion by non-native fish. The agency and officer responsible for the major decision is listed below:

David McGillivray, Chief
Division of Wildlife and Sport Fish Restoration
Mountain / Prairie Region
U.S. Fish and Wildlife Service
Denver, Colorado

1.4 REQUIRED PERMITS

A Special Use Permit will be required by the Forest Supervisor or District Manager of the appropriate land management agency prior to implementing individual projects. A Pesticide Use Plan or similar document may also be required by resource management agencies. The Utah Department of Environmental Quality, Division of Water Quality, has required a Notice of Intent to apply pesticides under Utah's Pesticide General Permit (PGP) . Stream alteration permits will be obtained from the State Engineer for construction of any fish-migration barriers associated with the projects. A fish migration barrier of this size typically would be covered under Utah's General Permit ("GP") 40. Stream alteration permits are issued in Utah by the State Engineer's Office, under agreement with the U.S. Army Corps of Engineers. Generally, if the proposed structure has 100' or more of shoreline interface, which none of the structures contemplated in this document would, the Corps could elect to review the structure to determine if it requires an Individual Permit. Since the proposed structures are significantly shorter than 100 feet, permitting should be handled fully under the delegated authority.

SECTION 2: PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION, ALTERNATIVES, AND WATERS

2.1.2 No Action Alternative

Under the "No Action" alternative, current management in all of the streams listed in this document would continue. Under this alternative, non-native fish would not be removed from project waters and no additional fish migration barriers would be constructed. As a result, native cutthroat trout enhancement in these waters would not be possible. Cutthroat trout conservation actions cannot occur in streams containing rainbow trout because the two species readily hybridize. Streams containing brook trout and brown trout present significant conservation challenges because these species are well known to displace cutthroat trout (Griffith 1988; McHugh and Budy 2006).

2.1.2 Rotenone Alternative (Proposed Action)

The UDWR proposes to chemically treat eight streams to remove non-native invasive fish during the period 2011-2018 (Figure 2.1; see Appendix C for maps of proposed waters) using liquid emulsifiable (5% Active Ingredient, EPA Registration No. 655-422, or 75338-2), and powder (7.4% Active Ingredient, EPA Registration No. 655-691) rotenone. Rotenone was selected because of demonstrated effectiveness in eradicating fish populations, the modest cost required to purchase needed amounts of the chemical, and the reasonable personnel requirements to implement treatment (Ling 2002). The EPA has approved rotenone for the use intended in this project and it would be applied according to label instructions by personnel certified by the Utah Department of Agriculture and Food as Non-Commercial Pesticide Applicators.

Rotenone is a naturally-occurring fish toxicant that is lethal to fish, aquatic invertebrates, and juvenile amphibians at the concentrations planned for the project. Current research suggests that acute exposure at the concentrations used to remove fish (Turner et al. 2007) is not harmful to humans, other mammals, or birds. Additional analysis of the background and research on exposure may be found in Section 4 and Appendix E. Rotenone has been widely used in the United States since the 1950s, and UDWR has successfully implemented a large number of similar rotenone projects. All fish would be temporarily eliminated from target areas of project waters (for examples, see Figures 2.2 and 2.3).

Waters proposed for treatment would remain open to fishing following treatments. All treatments would be preceded by news releases in local papers to notify the public of treatment sites and dates. In addition, access points at project streams would be posted to notify the public of treatment details.

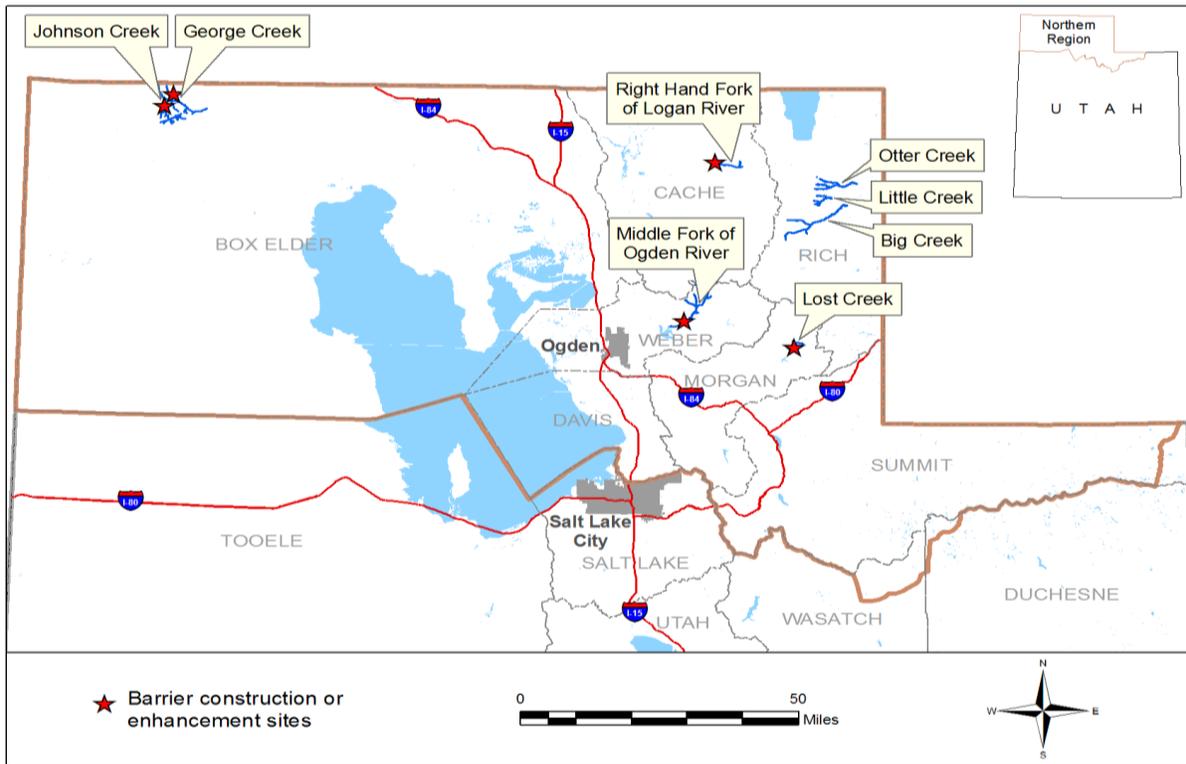


Figure 2.1 Map of proposed native fish restoration projects within UDWR's Northern Region.

Rotenone chemical treatments would occur in a multi-stage effort:

- Pre-treatment monitoring and watershed assessment
- Barrier construction (if necessary)
- Native fish salvage
- Chemical treatment
- Detoxification
- Post-treatment monitoring

Pretreatment monitoring and watershed assessment

A majority of the actions within this stage have been completed. UDWR has identified watersheds that provide an opportunity for native fish restoration while balancing the treatment complexity with available habitat. Past monitoring efforts have revealed strong non-native fish populations in the proposed waters. Pre-project sampling has identified populations of native nongame fish, which would be salvaged prior to the chemical treatment (see *Native Fish Salvage*). Activities that still require action include streamside assessments to determine the presence of major springs as well as potential refugia for salvaged fish.

Barrier Construction

Fish migration barriers, where necessary, would be constructed prior to chemical treatment at the downstream end of project stream reaches where naturally occurring or manmade barriers do not already exist to prevent post-treatment upstream movement of non-native fish into project areas. The project streams that would likely require barrier construction or enhancement are shown in Figure 2.1, and specified in Table 2.1, and include George Creek, Johnson Creek, Lost Creek, Middle Fork of Ogden River, and Right Hand Fork of Logan River. Barriers would generally consist of gabion basket structures or small check-dams constructed of boulders and large rocks, creating a vertical drop of approximately 4-5 ft on the downstream side (for examples, see Figures 2.6 and 2.7). In some instances, barriers may

be created by modifying or enhancing structures such as culverts at stream crossings or diversion structures. Locations for barriers have been selected to utilize naturally occurring drops which can be enhanced, and where the stream channel and floodplain are confined, to reduce the risk of failure, minimize the size of the structure and the footprint of potential disturbance, and to reduce the amount of water impounded behind the barrier.

The George Creek barrier would consist of modifying an existing culvert to make it impassable to fish attempting to migrate upstream (see Appendix C, Figure C2). In Johnson Creek, the barrier likely would be located just upstream of the USFS boundary (see Appendix C, Figure C3). The Lost Creek barrier would be constructed a short distance upstream of Lost Creek Reservoir (see Appendix C, Figure C4).

For the Middle Fork of Ogden River, an existing irrigation diversion would be modified or rebuilt to exclude fish attempting to migrate from lower portions of the drainage (see Appendix C, Figure C5). In the Right Hand Fork of Logan River, a natural bedrock outcropping has been enhanced to restrict fish passage (see Appendix C, Figure C6). NEPA analysis was completed separately for the barrier work on the Right Hand Fork of Logan River (UWCNF 2010).

Fish migration barriers would not be constructed in areas where any threatened, endangered, or candidate species might be impacted. UDWR will research the Utah Natural Heritage Program database to provide additional assurance that threatened, endangered or candidate species are absent from barrier-construction areas, and request a letter of concurrence from FWS. Compliance with regulations relative to cultural resources would be met for each barrier site with the following conditions: (1) an archaeologist permitted by the Utah Public Lands Policy Coordination Office would make a determination of appropriate cultural survey methods; (2) the selected survey techniques would be implemented; (3) compliance with state and federal cultural resource-protection requirements would be documented in communications with the State Historic Preservation Officer (SHPO); and (4) under no circumstances in this proposed action would harm be caused to historical properties considered eligible for listing on the *National Register of Historic Places*.

Any proposed barrier sites on federal lands would be approved beforehand by the appropriate land management agency. Sites where barriers would be constructed would be evaluated prior to construction by a permitted archaeologist, who would consult as necessary with the SHPO to ascertain likelihood of cultural resources being affected, in accordance with the requirements of Utah Code 9-8-404. UDWR would not build a migration barrier as part of this project anywhere that construction actions had a likelihood of adversely affecting properties or features considered eligible for inclusion in the *National Register of Historic Places*.

All barrier construction activities would comply with laws, regulations, and permitting requirements of the State Engineer for stream channel alteration under permitting authority for stream-channel alterations delegated by U.S. EPA under General Permit 40. Barrier materials would be taken from the ground surface, near the stream, or hauled to the site if sufficient material is not available onsite. The collection of these materials would not require excavation, stream alteration, or noticeable disturbance of vegetation. Stream barrier locations would be selected to minimize changes in stream gradient, hydraulic function, and water pooling. In addition, barriers would be constructed adjacent to existing roads where equipment access is acceptable, thus requiring little or no disturbance to surrounding natural areas. Riparian vegetation would be disturbed as little as possible during the construction of migration barriers, while areas where limited surface disturbance would be unavoidable would be restored to pre-project conditions.

Migration barriers are designed to operate under the natural fluctuations of stream flow without routine maintenance. Maintenance, if required, could include the adjustment or replacement of individual rock materials, but such work should be minor.



Figure 2.6. Gabion-type fish migration barrier.



Figure 2.7. Man-made rock barrier.

Native Fish Salvage

Prior to implementing the chemical treatment, representative numbers of native nongame fish would be collected and moved to untreated refugia within the watershed, or into streamside holding pens. Fish salvage would be completed using 1-2 backpack electro-fishing units. Hilderbrand and Kershner (2000) reported that native trout populations require an effective population size of 500 individuals in order to reduce the chance of population extirpation due to demographic and stochastic extinction risks. It should be noted that the effective population size is only a fraction of the total population size. For salmonids, recent evidence suggests that minimum total population sizes should be approximately 2,500 individuals (Allendorf et al. 1997). Every effort will be made to ensure that sufficient numbers of nongame species are salvaged to avoid long term demographic and genetic instability. We will use the target of 500 individuals of each species as a minimum value.

Chemical Treatment

Approximately 116 miles of stream are proposed for treatment (Table 2.1). Liquid rotenone would be applied at a concentration of 0.5-2.0 ppm over a 3-24 hr period using drip stations (Finlayson et. al 2000; see Figure 2.4), which would be located at approximately 0.5-1 mile intervals. Pressurized backpack sprayers would be used to apply a diluted solution of the chemical to fish-bearing springs, backwaters, and areas lacking direct flow-through from the streams (Figure 2.5), because these areas generally would be impossible to treat effectively using only the drip stations. To determine the appropriate rotenone application strength, streamflow will be measured using the methods described by Harrelson et al. (1994).

Backwaters, wetlands, and springs which contain no fish would remain untreated, to provide adequate refuges for amphibians and aquatic macroinvertebrates, thus facilitating recolonization. Application of the chemicals would be conducted by UDWR and other agency personnel certified as Non-commercial Pesticide Applicators by the Utah Department of Agriculture and Food. Standard safety equipment, including rubber gloves, protective coveralls, and respirators would be provided for use in accordance with product label instructions. Where necessary, waters would be treated in successive years to ensure complete removal of targeted species. It is anticipated that two or three waters would be treated per year, allowing completion of the overall project within five to eight years.



Figure 2.2. Johnson Creek, Box Elder County.



Figure 2.3. Big Creek, Rich County.



Figure 2.4. Rotenone drip station.



Figure 2.5. Application via backpack sprayer.

Deactivation

Deactivation is the final step in the proposed chemical treatment, and involves the application of potassium permanganate to facilitate the deactivation process. Rotenone would be neutralized with potassium permanganate (KMnO_4), a strong oxidizing agent, applied at 3.0-5.0 ppm immediately downstream from target waters. Deactivation of rotenone using KMnO_4 requires approximately 30 minutes of contact. Detoxification stations would be comprised of either a 50-gallon barrel of pre-mixed aqueous KMnO_4 or a generator-powered bulk dispensing unit as described in Finlayson et al. (2000). The aqueous solution would be premixed to a known concentration and the distribution strength would be determined on the basis of observed streamflow. Terminal streams would not be neutralized, to ensure that all flowing waters are treated.

Rate of flow is dependent on the time of year, water year, and gradient of the reach where water velocity is measured. These will all come into play and the measurement of water velocity/discharge through the entire drainage (mainstem and tributary streams) will be critical immediately prior to any chemical treatments. Because of the variability of these factors, this estimation is difficult to make prior to the actual treatment date, and will be different for every stream.

Similar sized streams to the larger ones proposed for reclamation flow from 0.3-0.6 m/sec (in August/September) or 18-36 m/min or 540-1080 m for 30 minutes. Big Creek is one of the larger streams proposed for treatment. Depending on where the barrier will be placed, it is possible that 30 km of mainstem stream will be chemically treated. With these estimated flow rates, it could take 14-28 hours for rotenone administered in the headwaters to reach the barrier location. This is an estimate based on a constant flow rate. On many streams (e.g., Rich County streams), water velocity will decrease further downstream in the drainage, consequently, this estimate may be on the low end of what the rotenone travel time will be. Again, the water measurements described above will be critical immediately prior to any chemical treatment in order to accurately complete these calculations.

Rotenone could remain at concentrations lethal to aquatic gill-breathing fauna within the KMnO_4 contact zone for a short period of time. Finlayson et al. (2010) recommends that the mixing zone be about 30 minutes of water travel time. The mixing zone for this project will not be this lengthy because the streams are generally small with low water velocities.

Unintentional fish loss would be prevented by placing sentinel fish in live cages at monitoring locations downstream of the detoxification stations. Sentinel fish are target fish with the same or less sensitivity to rotenone than the target species. Sentinel fish are used to monitor the toxicity of rotenone and potassium permanganate. For the current action, a species of trout would be used (collected from the stream prior to the treatment or a hatchery source). Sentinel fish would be placed in live cages (to where they cannot escape) strategically within the treatment area and just below the 30-minute mixing zone downstream from the detoxification station. On some of the larger streams (with more flow and larger water velocities), the cages may be placed farther downstream. In general, the anticipated mixing zone will be 200-500 m downstream from the detoxification station. Sentinel fish would be monitored continuously to determine the effectiveness of detoxification. Backup detoxification stations would be placed near the live cages to preclude dispersal of rotenone outside of the planned treatment areas. If biologists observe physical signs of stress or mortality in the sentinel fish, then the backup stations would be activated, in accordance with the techniques described in Finlayson et al 2010.

Native Fish Reintroduction

Following fish migration barrier construction and rotenone treatments, native trout and/or other native fish would be introduced into project stream reaches from appropriate donor populations or from fish produced by UDWR native trout brood stocks. Fish can be stocked as early as 2 weeks post second year treatment because the rotenone will have traveled through the stream in hours to days following the treatment. If Bonneville cutthroat trout are available, they may be stocked during the fall immediately following treatment. If Bonneville cutthroat trout are not available, they will be stocked the following year when they are available. If invertebrate densities are a concern, fish will be stocked the year following the second chemical treatment. All transfers or stocking of fish would comply with Utah Department of Agriculture and Food rules and UDWR policies.

Monitoring

Project monitoring would be conducted to measure the effects of the preferred alternative on aquatic resources within the project area. Implementation monitoring assesses whether or not the project was implemented as described in the EA. Effectiveness monitoring determines if the management action had the intended outcome (e.g., non-native species were removed from the treated area and native cutthroat trout were re-established with minimal impacts to non-target species). Project waters would be thoroughly examined during and following treatment to ascertain whether a complete removal of target species has occurred. Visual observations and single-pass electrofishing surveys would be used to determine treatment effectiveness in selected sections. Electrofishing surveys would be used to monitor the expansion and development of native trout populations in project areas and the effectiveness of fish migration barriers constructed or already existing at downstream boundaries of project reaches.

Following the first year of a rotenone treatment in the stream, visual observation of dead fish coupled with some electrofishing (multiple 200-400 m reaches) throughout the drainage would be completed to

help determine if a complete fish eradication has been achieved. Even if no live fish are observed, a second treatment the following year may and likely would occur to make sure the targeted species are removed entirely.

Successful eradication of non-native fish would be documented in a report to be filed in the UDWR Northern Regional Office.

2.1.3 Mechanical Removal with Electrofishing Alternative

Mechanical removal with electrofishing is an alternative to a chemical treatment. Electrofishing is a common technique applied by biologists to collect fish and sample fish populations. The benefit of mechanical removal is that negative impacts to non-target species such as: aquatic macroinvertebrates, existing cutthroat trout, and native nongame fish populations can be greatly reduced because it is a selective treatment measure. The drawback to mechanical removal is that the effort can be labor intensive and requires multiple passes. Eradication may be achieved only after several years of treatment (Shepard 2011) and only if certain conditions which maximize fish catchability exist.

It is understood by fisheries biologists that a single electrofishing event does not remove all of the fish within a population. Several factors contribute to the catchability of fish. These factors include fish size, water conductivity, stream width, and habitat complexity. A number of successive passes have been shown to remove a significant portion of the population (Thompson and Rahel 1996). Eradication of non-native fish has been achieved using mechanical removal in smaller systems with limited habitat complexity (Kulp and Moore 2000, and Shepard 2011) but it has also failed (Thompson and Rahel 1996; Meyer et al. 2006). We are still apprehensive about implementing a broad mechanical removal program, primarily because of the high personnel requirements and perceived risk of failure. However, we think it may provide a reasonable alternative capable of addressing the underlying need, and therefore should be analyzed further within the present document.

A mechanical removal project would be implemented in the following manner: We would investigate the watershed to determine the fish-bearing tributaries and stream segments, similar to the process preceding a typical rotenone treatment. The timing of mechanical removal would be delayed until summer or early fall, but prior to brook trout or brown trout spawning to maximize catchability of target fish. Catchability would be maximized by timing which capitalizes on low flows and by allowing the trout fry to grow to a size where they could be recruited by the electrofishing gear. Three-pass removal has been shown to remove up to 95% of the adult fish from streams. Based on the literature, a minimum of 4 passes should be completed during the first year, and the objective should be to eliminate reproduction of non-native trout during the first year (Shepard 2011).

Mechanical removal would commence by placing temporary, hand-built barriers at the mouths of each tributary. The tributaries would then be electrofished with multiple passes as per Kulp and Moore (2000) and Shepard (2011). We would maintain the barriers on the tributaries until all passes for the year are completed. After the tributaries have been electrofished, the mainstem would be electrofished starting at the most downstream location and moving upstream (Kulp and Moore 2000). All non-native fish would be removed from the stream and stored in coolers for later data collection and disposal. Eradication would be determined if two passes result in the capture of no non-native fish. Long term monitoring would occur to verify that non-native fish had been eradicated.

If eradication is not a realistic scenario, then repeated annual removal passes can reduce the negative impacts of species such as brook trout and possibly brown trout, such that the probability of persistence of a cutthroat trout population can be extended in the presence of non-native trout (Peterson et al. 2008a). This can be particularly useful in a situation where maintaining habitat connectivity is desirable.

2.2 Proposed Waters

The waters specified in Table 2.1 are proposed for native fish restoration. Native trout would be stocked or transferred to all streams to establish populations following the treatments. Other native fish species, including Northern leatherside chub and bluehead sucker, may also be stocked or transferred to treated streams in Rich County. Populations of other native fish species (i.e. sculpin, mountain sucker) occupying any stream would be maintained or enhanced by salvaging prior to treatment, held during treatment, and returned to the stream following treatment. All of these waters have been surveyed prior to proposed treatments. Maps showing specific project areas are included in Appendix C.

Table 2.1 Waters proposed for restoration, with location, size of treatment, target species, whether barrier construction would be necessary, and restoration objective. Small streams in remote locations of the state, far removed from municipal areas, may not require chemical detoxification. Instead, natural mixing and oxidation would detoxify rotenone before human contact with waters that had been treated could possibly take place.

Water Name	Location	Stream length (Miles)	Target species	Barrier Construction	Detoxification	Restoration objective
Big Creek	T9-11N, R5-7E Rich Co.	24	Brook trout, brown trout, rainbow trout	No	Yes	Enhance Bonneville cutthroat trout, sculpin, mountain sucker; establish Northern leatherside chub, bluehead sucker
George Creek	T14-15N, R14-15W Box Elder Co.	11	Rainbow trout.	Yes	No	Enhance Yellowstone cutthroat trout
Johnson Creek	T13-15N, R14-15W Box Elder Co.	24	Brook trout.	Yes	No	Enhance Yellowstone cutthroat trout, sculpin
Little Creek	T10-11N, R5-6E Rich Co.	7	Brook trout.	No	No	Establish Bonneville cutthroat trout, Northern leatherside chub, bluehead sucker
Lost Creek (above Lost Creek Reservoir)	T6N, R5-6E Morgan Co.	5	Non-native cutthroat trout, rainbow trout, Utah chub.	Yes	Yes	Enhance Bonneville cutthroat trout, sculpin, and mountain sucker
Middle Fork of Ogden River	T6-8N, R1-3E Weber Co.	21	Rainbow trout	Yes	Yes	Enhance Bonneville cutthroat trout, sculpin
Otter Creek	T11-12N, R6-7E Rich Co.	18	Brook trout, brown trout.	No	No	Establish Bonneville cutthroat trout, Northern leatherside chub, bluehead sucker, enhance sculpin
Right Hand Fork of Logan River	T12N, R3-4E Cache Co.	6	Brown trout	Yes	Yes	Enhance Bonneville cutthroat trout

2.3 ALTERNATIVES CONSIDERED BUT NOT ANALYZED FURTHER

2.3.1 Chemical treatment with Antimycin-A

Rotenone and Antimycin-A are currently the only chemicals approved by the EPA for general use as piscicides, and both are generally effective for that purpose. The State of Utah has typically used rotenone in its chemical treatment programs. Antimycin-A has been used successfully elsewhere (Hamilton et al. 2009), however the availability of Antimycin-A has been inconsistent (Marking 1992; Finlayson et al. 2000), and its potency and efficacy continue to be variable and unreliable (Meyer and Lopez 2008). In addition the toxicity of Antimycin-A is strongly related to water pH. Antimycin-A is much less effective at high pH (>8) values (Schnick 1974; Marking 1975, 1992). The pH in the Logan River watershed is variable Budy et al (2003) reported that pH consistently ranged between 8.5-9.5 throughout the Logan River watershed. Budy et al. (2010) indicated that the pH in the Right Hand Fork was 7.48 in 2009. Past measurements in the Rich County Streams indicate that pH ranges from 8.5-9 (unpublished UDWR data). Measurements of pH in the West Desert Streams indicate that pH typically occurs at around 7.5 (unpublished UDWR data). Based on the pH measurements Antimycin-A would likely be effective only in the West Desert Streams. Recent information indicates that the Antimycin-A application in Great Basin National Park proved ineffective due to the unreliability of the chemical formulation.

2.4 DIRECTION FROM STATE AND FEDERAL PLANNING DOCUMENTS

The proposed actions are in agreement with direction provided by the Sawtooth National Forest Land and Resource Management Plan (SNFLRMP), the Wasatch-Cache National Forest Land and Resource Management Plan (WCNFLRMP), and the Uinta National Forest Land and Resource Management Plan (UNFLRMP). Goals listed for wildlife and fish in the SNFLRMP include: provide habitat capable of supporting viable populations of native species, with objectives specific to aquatic species, including maintenance or restoration of habitat in perennial streams for cutthroat trout. WCNFLRMP goals for wildlife and fish include: maintain or restore habitat to sustain populations of native species; maintain viability of species-at-risk; manage Forest Service sensitive species (including Bonneville cutthroat trout) to prevent them from being listed as threatened or endangered and where possible provide for delisting as sensitive; maintain or restore aquatic and riparian habitats for cutthroat trout. Goals for wildlife and fish in the UNFLRMP include: provide and maintain habitat to support native fish populations; maintain or restore watersheds to a functional condition. The proposed actions are also in agreement with the direction found in the Bureau of Land Management (BLM) Randolph Management Plan (MFP). Pesticide application would follow BLM procedures and guidelines for pesticide use, including the preparation and approval of a BLM Pesticide Use Proposal, prior to treatment.

The proposed actions are also concordant with direction provided by the Conservation Agreement and Strategy for Bonneville Cutthroat Trout (Lentsch *et al.* 1997; BVCT State of Utah Conservation Team 2008) and the Memorandum of Agreement (MOA) for Conservation and Management of Yellowstone Cutthroat Trout (State of Montana et al. 2000). These documents list the control of non-native species and the expansion of native cutthroat as conservation actions necessary to meet the goals and objectives of the agreements. Signatories to the conservation agreements include the Forest Service, BLM, FWS, and UDWR. Parties involved in the MOA include the Forest Service and UDWR, as well as other state and federal agencies.

Finally, the proposed actions are in agreement with UDWR Drainage Management Plans (DMPs) and draft DMPs for the Bear, Logan, Weber, and Raft river drainages. These DMPs list the negative impacts of non-native species as biological issues to be addressed in the drainages. In addition, the DMPs cite non-native fish eradication, barrier construction, and native trout introduction as solutions or management strategies that could resolve these management issues.

2.5 PUBLIC INVOLVEMENT

Public involvement was initiated in 2009, including notification of state, federal, and local agencies. The proposed projects were explained in letters to the Box Elder, Cache, Morgan, Rich, and Weber County commissioners/councils in April 2009. The Logan City Council was also informed in writing in April 2009 of the project in the Logan River drainage. An application describing the proposed action would be sent to the State Resource Development Coordinating Committee, which includes review by the Bear River Association of Governments and the Wasatch Front Regional Council. These associations include representatives of the counties included in the project area as well as counties in the surrounding areas.

A legal notice describing the project was published in the *Standard-Examiner* (Ogden), the *Herald Journal* (Logan), and the *Box Elder News Journal* on May 13, 2009. These notices requested suggestions for issues to be addressed in the project analysis. Public comments were requested to be submitted by June 19, 2009. In addition, the public was invited to comment on the proposed projects at a meeting of the UDWR Northern Regional Advisory Council (RAC), a citizen-oversight committee to UDWR, on May 20, 2009 (see Appendix F).

SECTION 3: AFFECTED ENVIRONMENT

This section describes the current status of only those resources within the project area which may be affected by the proposed management activities.

3.1 FLOODPLAINS/WETLANDS

The proposed treatments would take place within floodplains and wetlands of the project areas listed in Section 2.1.4, fully complying with any Clean Water Act, "Section 404(b)1" permitting requirements, as detailed in Section 1. The wetlands are generally confined to a small area adjacent to the lakes and streams. There are also a number of springs and seeps associated with the various projects.

3.2 WATER QUALITY

The Utah Department of Environmental Quality (2005) water quality designations (Utah Administrative Rule R317-2, *Standards of Quality for Waters of the State*) for the Project Area waters are listed below (Table 3.1).

Table 3.1 Water quality designations for project waters.

WATER	CATEGORY *	USE CLASS *
Big Creek (Bear River)	Category 1	2B, 3A, 4
George Creek (Raft River)	Category 1	2B, 3A, 4
Johnson Creek (Raft River)	Category 1	2B, 3A, 4
Little Creek (Bear River)	Category 1	2B, 3A, 4
Lost Creek (Weber River)	Category 1	1C, 2B, 3A, 4
Middle Fork of Ogden River (Ogden River)	Category 1	1C, 2B, 3A, 4
Otter Creek (Bear River)	Category 1	2B, 3A, 4
Right Hand Fork of Logan River (Logan River)	Category 1	2B, 3A, 3D, 4

- Water Quality Category and Use Class Designations:

- Category 1** - Waters of high quality, which have been determined by the Board to be of exceptional recreational or ecological significance or have been determined to be a State or National resource requiring protection.
- Class 1C** - Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water.
- Class 2B** - Protected for secondary contact recreation such as boating, wading, or similar uses.
- Class 3A** - Protected for cold water species of game fish and other cold water aquatic life.
- Class 3D** - Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C.
- Class 4** - Protected for agricultural use including irrigation of crops and stock watering.

3.3 RECREATION

Waters in the Project Area receive varying amounts of recreational use. Most of the target waters receive limited fishing pressure. Other activities that occur in the project area include hunting, hiking, ATV riding, snowmobiling, camping, sight-seeing, and wildlife viewing. Table 3.2 gives the relative amount of recreational use at the waters, facilities available at each location, and other information related to recreational use. The recreational use ratings are based upon personal observations of field personnel.

Table 3.2 Recreational use of project waters, including facilities, access, and ownership.

WATER	RECREATION	FACILITIES	COMMENTS
Big Creek (Bear River)	Low	No developed facilities.	Most of mainstem is adjacent to road. Lower portions privately owned, middle reaches BLM and private, with headwaters on USFS and state parcels accessible by foot travel.
George Creek (Raft River)	Low	No developed facilities.	Access along most of the stream is limited, lower portions privately owned, upper portion is USFS parcels accessible by 4wd and foot travel. Fishery limited by small size of stream.
Johnson Creek (Raft River)	Moderate	No developed facilities. Undeveloped camping areas heavily utilized by hunting parties.	Most of mainstem is accessible from adjacent road on USFS land. Fishery limited by small size of stream.
Little Creek (Bear River)	Low	No developed facilities.	Most of mainstem is adjacent to road. Lower portions privately owned, middle reaches BLM and private, with headwaters on USFS and state parcels accessible by foot travel. Fishery limited by small size of stream.
Lost Creek (Weber River)	Moderate	No public facilities.	Upper Lost Creek is privately owned and under controlled access.
Middle Fork of Ogden River (Ogden River)	Moderate	Middle Fork Wildlife Management Area, facilities are limited to parking area, one-hole restroom, horse tie-racks, and undeveloped campsites.	Access along most of the stream is limited to foot/horse travel. Lower perennial portions UDWR with some USFS, upper portions privately owned.

WATER	RECREATION	FACILITIES	COMMENTS
Otter Creek (Bear River)	Low	No developed facilities.	Most of mainstem is adjacent to roads. Lower portions are privately owned, middle reaches BLM and private, with headwaters on USFS and state parcels accessible by foot travel. Fishery limited by small size of stream.
Right Hand Fork of Logan River (Logan River)	Moderate	Public facilities include a USFS campground in the lower reaches, a trailhead, and dispersed camping along the stream. Private camp (Camp Lomia) located in the lower section is operated May through September.	Lower portions of stream are accessible from adjacent road. Upper portions overgrown with willow and accessible only by foot travel. Majority of watershed managed by USFS, portions of lower drainage privately owned.

3.4 FISHERIES

The fishery status of the project waters is listed below (Table 3.3). Estimates of the relative abundance of individual species are given. Most of these waters were stocked at some time in the past with non-native trout. Waters where non-native trout are still present have been maintained primarily by natural reproduction of the species listed, while Lost Creek Reservoir downstream of the project area is stocked regularly to maintain sport fish populations.

Table 3.3 Fishery status of project waters, including species, abundance, and comments on distribution.

WATER	SPECIES PRESENT*	RELATIVE ABUNDANCE	COMMENTS
Big Creek (Bear River)	BCT BKT BNT MTS SC	Abundant Abundant Limited Common Abundant	BCT and BKT sympatric throughout stream, but BCT dominate upper section, BKT dominant in lower. BNT present but sparse.
George Creek (Raft River)	RT RTxCT YCT	Limited Limited Common	RT and RTxCT hybrids occupy the lower portions of the stream, while genetically pure YCT occupy the upper reaches. A large logjam has prevented complete invasion by non-native trout and would mark the upper extent of treatment.

WATER	SPECIES PRESENT*	RELATIVE ABUNDANCE	COMMENTS
Johnson Creek (Raft River)	BKT SC YCT	Common Common Limited	YCT and BKT sympatric, BKT more abundant in lower reaches and YCT more abundant but limited in upper portions.
Little Creek (Bear River)	BKT RT	Limited Unknown	BKT occupy perennial portions of stream. RT stocked seasonally in Little Creek Reservoir, a put-and-take fishery with water drawdown annually for agricultural purposes.
Lost Creek (Weber River)	BCT MTS RT RTxCT SC TG UTC	Common Common Common Limited Abundant Unknown Abundant	Headwaters are occupied exclusively by genetically pure BCT, lower reaches consist primarily of BCT, with some RT and RTxCT hybrids.
Middle Fork of Ogden River (Ogden River)	BCT RT RTxCT SC	Common Limited Limited Limited	Headwaters occupied exclusively by genetically pure BCT, lower reaches consist primarily of RT and RTxCT hybrids.
Otter Creek (Bear River)	BKT BNT SC	Limited Common Abundant	Most abundant salmonid is BNT, BKT present but less abundant.
Right Hand Fork of Logan River (Logan River)	BNT RTxCT	Abundant Limited	Stream occupied primarily by BNT, with limited number of RTxCT hybrids. Headwaters fishless above a series of natural barriers.

* Species acronyms:

BCT	Bonneville cutthroat trout <i>Oncorhynchus clarkii utah</i>
BKT	Brook trout <i>Salvelinus fontinalis</i>
BNT	Brown trout <i>Salmo trutta</i>
MTS	Mountain sucker <i>Catostomus platyrhynchus</i>
RT	Rainbow trout <i>Oncorhynchus mykiss</i>
RTxCT	Rainbow trout X cutthroat trout hybrid
SC	Sculpin <i>Cottus</i> spp.
TG	Tiger trout (Brown trout X Brook trout hybrid)
UTC	Utah chub <i>Gila atraria</i>
YCT	Yellowstone cutthroat trout <i>Oncorhynchus clarkii bouvieri</i>

3.5 WILDLIFE

Numerous species of wildlife utilize the waters in the Project Area and their associated riparian areas. The following is a list of amphibians which may occur in the Project Area: Columbia spotted frog *Rana luteiventris*, northern leopard frog *Rana pipiens*, boreal chorus frog *Pseudacris triseriata*, Great Basin spadefoot *Spea intermontana*, western (boreal) toad *Bufo boreas*, and tiger salamander *Ambystoma tigrinum*. The American dipper *Cinclus mexicanus* and a variety of species of neotropical birds and bats that utilize aquatic invertebrates for food may also be present in the project area. Many of these species

are present only seasonally in northern Utah. Additional species of wildlife are discussed in sections 3.6, 3.7, and 3.8.

3.6 THREATENED, ENDANGERED, AND CANDIDATE SPECIES UNDER THE ENDANGERED SPECIES ACT

The project area contains portions of the historic range of four species classified by the FWS as threatened, endangered, or candidate species. Although suitable habitat is found in the project area, none of the species are known to occur in the area presently. The yellow-billed cuckoo (Candidate) is a neotropical migrant that could possibly be in the area between mid-May and mid-August. The Canada lynx (Threatened) prefers montane coniferous forest, but has not been sighted in Utah since 1972 (Bosworth 2003); however, a hair sample collected in 2001 suggests the lynx may be present in central Utah (Bosworth 2003). Unconfirmed black-footed ferret (Endangered) sightings have been reported in Rich County, but none after 1983 (Bosworth 2003). The ferret prefers open prairie grassland and is almost always found in association with prairie dog colonies, using prairie dogs for food and their burrows for shelter. The Maguire primrose (Threatened) is a federally threatened plant species endemic to Logan Canyon, Cache County. It occurs at lower elevations of Logan Canyon in damp crevices and ledges of north-facing limestone cliffs.

Species classified under the Endangered Species Act that may occur within the counties where the Proposed Action would take place are shown in Table 3.4 and are listed also in Appendix B.

Table 3.4 Threatened (T), endangered (E), or candidate (C) species that may occur in each county.

COMMON NAME	SCIENTIFIC NAME	STATUS
BOX ELDER COUNTY Western Yellow-billed Cuckoo	<i>Coccyzus americanus occidentalis</i>	C
CACHE COUNTY Canada Lynx Maguire Primrose Western Yellow-billed Cuckoo	<i>Lynx canadensis</i> <i>Primula maguirei</i> <i>Coccyzus americanus occidentalis</i>	T T C
MORGAN COUNTY Canada Lynx Western Yellow-billed Cuckoo	<i>Lynx canadensis</i> <i>Coccyzus americanus occidentalis</i>	T C
RICH COUNTY Black-footed Ferret Canada Lynx	<i>Mustela nigripes</i> <i>Lynx canadensis</i>	E T
WEBER COUNTY Canada Lynx Western Yellow-billed Cuckoo	<i>Lynx canadensis</i> <i>Coccyzus americanus occidentalis</i>	T C

3.7 STATE SENSITIVE SPECIES, U.S. FOREST SERVICE SENSITIVE SPECIES

The UDWR has compiled a Utah Sensitive Species List (UDWR 2007) to identify those species in the state that are most vulnerable to population and/or habitat loss. This list is intended to stimulate management actions, e.g., development and implementation of a conservation strategy, for listed species. By developing and implementing timely and sufficient conservation measures for Sensitive Species, the need for federal listing of these species under the Endangered Species Act may be reduced. State Sensitive Species which occur or may occur in the project area are listed in Appendix B, which also

lists species that may occur, or have suitable habitat in the area, that have been designated as Sensitive Species by the USFS Regional Forester in Region IV. Some of these species may use riparian habitats in the project area or forage on invertebrates associated with the project waters.

3.8 MANAGEMENT INDICATOR SPECIES

The National Forest Management Act, 1976, required National Forests to select a group of representative fish and wildlife species whose populations could be monitored relatively easily. Response of these species to management activities is used as an indicator of effects on other species occupying similar habitat. The Wasatch-Cache National Forest established the following Management Indicator Species (MIS) in the LRMP: goshawk *Accipiter gentilis*, snowshoe hare *Lepus americanus*, beaver *Castor canadensis*, Bonneville cutthroat trout, and Colorado River cutthroat trout. The Uinta NF MIS include: goshawk, three-toed woodpecker *Picoides tridactylus*, beaver, Bonneville cutthroat trout, and Colorado River cutthroat trout. The MIS for the Sawtooth NF are pileated woodpecker *Dryocopus pileatus*, Greater sage-grouse *Centrocercus urophasianus*, and bull trout *Salvelinus confluentus*, although the Greater sage-grouse is the only MIS for the Sawtooth NF known to occur within or near the project area. The MIS in the project area are discussed in Section 4 of this document: birds and beaver under Wildlife (Part 4.5) and trout under Fisheries (Part 4.4).

3.9 GRAZING

The project area includes grazing allotments administered by the USFS and BLM. The streams are used as a water source by livestock on the allotments. Riparian vegetation in parts of the project area is also used as forage by livestock.

3.10 CULTURAL RESOURCES

Cultural and historical resources in the restricted areas where migration barriers are tentatively planned have not been determined. The type of sites selected for the barriers (narrow rocky canyons), the small area of disturbance, and the dynamic nature of the streambed itself make the current presence of artifacts in their original locations unlikely. Any cultural resources which might be present would likely be limited to small artifacts of limited cultural information value.

3.11 PUBLIC HEALTH AND SAFETY

Two of the waters within the Project Area are within watersheds used for municipal purposes or domestic water sources, Lost Creek and Middle Fork of Ogden River. As noted in Table 2.1, the rotenone will be completely detoxified long before reaching domestic sources. The cumulative effects area for analysis purposes is considered to be the project area.

SECTION 4: ENVIRONMENTAL CONSEQUENCES

The format of this section will be to describe the direct and indirect effects of each alternative by resource. Cumulative effects will be discussed separately, in Section 4.11. For each resource, the effects of Alternative 1 (No Action) will be discussed first, followed by a discussion of effects of the Proposed Action (rotenone treatment), and the Mechanical Removal with Electrofishing alternative.

4.1 FLOODPLAINS/WETLANDS

4.1.1 No Action – Direct and Indirect Effects

The No Action Alternative would have no direct or indirect effects on wetlands or floodplains.

4.1.2 Proposed Action - Direct and Indirect Effects

There would be no filling or obstruction of floodplains or wetlands during the proposed project. Rotenone does not affect aquatic or riparian vegetation. Small pools would be formed by the migration barriers installed as part of the project in some locations. See sections 1.4 and 4.2.2 for more information on effects of barriers.

4.1.3 Electrofishing – Direct and Indirect Effects

Non-native removal by electrofishing would have similar impacts to floodplains and wetlands as the proposed action.

4.2 WATER QUALITY

4.2.1 No Action - Direct and Indirect Effects

There would be no direct or indirect effects to water quality at the project waters under the No Action Alternative. Rotenone would not be used to treat the project area waters. None of the Beneficial Uses designated for waters in the project area would be affected.

4.2.2 Proposed Action – Direct and Indirect Effects

Effect of Rotenone

There would be short-term direct effects to water quality as a result of the chemical treatment with rotenone. The primary direct effect is caused by the toxicity of rotenone to aquatic organisms (effects on amphibians are addressed in Section 4.5.2), including fish, invertebrates, and possibly freshwater mollusks. Rotenone naturally detoxifies in flowing waters relatively rapidly (often within 24 hours) due to dilution and increased rates of hydrolysis and photolysis (Finlayson et. al 2000). In standing water, toxic effects may occur for up to 4 - 5 weeks depending upon temperature (Bradbury 1986).

One of the primary indirect water quality concerns related to rotenone treatments is the impact to benthic macroinvertebrate communities. Rotenone was historically used as an insecticide, therefore it has a dramatic short-term impact on aquatic macroinvertebrates. The primary concern arises from the population and taxonomic diversity level.

Unfortunately, although many rotenone treatments have been monitored, little is known about the true effects of rotenone treatments on macroinvertebrate communities (Vinson et al. 2010). It is believed that rotenone impacts macroinvertebrates similarly to other natural disturbances such as floods, or drought. Although the mechanisms may be different, all of these events cause catastrophic drift and/or very high mortality for a majority of benthic taxa. For example, when a flood occurs, the catastrophic drift appears to be caused by the initiation of the bedload transport (Gibbins et al., 2007). High proportions of drifting

macroinvertebrates are dead during these events (Dinger and Marks 2007; Gibbins et al. 2007). Numbers of aquatic invertebrates important to the aquatic ecosystem are locally suppressed for variable periods of time after disturbance. Refugia from disturbance, such as areas upstream, offstream habitats (Hynes 1972) and the hyporheic zone (Marmonier et al. 1997) provide a source for recolonization. In addition, many taxa are able to migrate to areas of lower velocity prior to the bedload transport (Horne and Goldman 1994).

We expect a similar benthic macroinvertebrate response with the implementation of a rotenone treatment, with some exceptions. Unlike floods, which directly impact almost all benthic taxa, Mangum and Madrigal (1999) reported rotenone resistance in 9-33% of the taxa that occurred in the Strawberry River. In addition to the resistant taxa maintaining a segment of the macroinvertebrate community, off-stream ponds, bogs, seeps, and springs would be left untreated, thereby possibly serving as refugia for aquatic invertebrates. Although this tactic should be approached with caution because these different habitats likely support a different suite of taxa than the mainstem channel (Horne and Goldman 1994). In addition, benthic macroinvertebrates would not have the opportunity to move to refugia. The current literature indicates that rotenone exhibits little movement through the stream substrate because it adsorbs to fine sediment and organic materials (Turner et al 2007). Therefore we assume that this property of rotenone should protect taxa occupying the hyporheic zone. If this is true, then it should facilitate recolonization within the treated portions of the streams.

A large body of literature exists regarding the recovery of aquatic macroinvertebrate populations after a rotenone treatment (see Vinson et al. 2010). Most of the studies have been short term and likely have not been intensive enough to adequately answer the long-term questions (Vinson et al. 2010). In general, abundance of macroinvertebrates returns to pretreatment densities within a few months to a year. However, recovery times of taxa richness or diversity appear to be much slower. The longest-term monitoring studies reviewed by Vinson et al. (2010) ranged from 2-5 years. Most of the invertebrate species would repopulate the treated area within one or two years (California Department of Fish and Game 1994). In the Strawberry River drainage, where the target concentration of rotenone (3 ppm) was greater than that planned for the project area, and where an attempt was made to treat all water in the drainage, 22-53% of the taxa recovered after one year but 7-14% of the taxa were still missing after 5 years. (Mangum and Madrigal 1999).

Whelan (2002) monitored the effects of the 1995 and 1996 rotenone treatments on Manning Creek, Utah. The Manning Creek treatment had lower target concentrations of rotenone and lower application times than the Strawberry treatment studied by Mangum and Madrigal (1999). Whelan (2002) indicated that leaving fishless stream reaches untreated and using the minimum rotenone concentration and treatment time necessary to achieve the objectives of trout removal were reasonably effective mitigation measures to speed aquatic macroinvertebrate recovery, when compared to the Strawberry treatment. The majority of taxa recovered and were found in the post-treatment samples. Many taxa were only found post-treatment and a few taxa were missing post-treatment. The Whelan study provides an example of the shortcomings of most macroinvertebrate monitoring studies. Vinson et al. (2010) provide the results of a long-term (10-year) macroinvertebrate dataset collected at monthly intervals in the Logan River. They found that, on average, 27.5 genera were found per sample. However the genera accumulation curve indicates that over 80 different genera have been found over the study period and new genera are still being found.

Engstrom-Heg *et al.* (1978) conducted a laboratory study of the rotenone tolerance of aquatic macroinvertebrates. They felt that a treatment of less than 10 ppm-hours would generally result in only mild and temporary reduction of the aquatic macroinvertebrate community. This is a somewhat lower treatment level than the Manning Creek treatment was, but is within the general application rate and time of rotenone treatments conducted in recent years in southern Utah since the Manning Creek treatment. During collections of aquatic macroinvertebrate samples from Pine Creek in southern Utah only 5 days following a rotenone treatment at this lowest application level many live aquatic macroinvertebrates were found.

Very little information is available regarding the toxicity of rotenone to mollusks. A review of the literature only identified one study that characterized the community level response of mollusks to a rotenone treatment (Hart et al. 2001). The Minnesota Department of Natural Resources chemically treated the Knife River in 1989. An extensive survey of bivalves in the Knife River in 2000 revealed all species expected to occur in the watershed and the presence of 10+ year old individuals, indicating that individuals survived the treatment.

Recent literature suggests that acute (as opposed to chronic) exposure to rotenone is not harmful to mammals, including humans, at the concentrations used to control fish (see Appendix E for a fuller discussion of rotenone toxicity). It has been estimated that a 132-lb person would have to consume over 60,000 liters of treated water at one sitting to receive a lethal dose (Sousa et al. 1987). Using a safety factor of 1,000X and the most conservative safe intake level, a person could still drink 14 liters of treated water per day. Extensive testing has not shown rotenone to be carcinogenic (Bradbury 1986). Even though rotenone in the concentrations used for fish control has not been linked to acute toxicity to humans, as a matter of policy, the EPA does not set tolerances for pesticides in potable water. The State of California (California Department Of Fish And Game 1994) and the National Academy of Science (1983) have computed "safe" levels of rotenone in drinking water that are roughly equivalent to the detection level of rotenone in water (0.005 ppm pure rotenone).

The mobility of rotenone in soil is low. In fact, the leaching distance of rotenone is only 2 cm in most types of soils. This is because rotenone is strongly bound to organic matter, making it unlikely that it would enter groundwater. At the same time, rotenone breaks down rapidly into temporary residues that would not persist as pollutants of groundwater (Turner et al. 2007). Ultimately, rotenone breaks down into carbon dioxide and water.

A secondary indirect effect of the treatment would be a temporary increase in the nutrient input to the water as a result of decomposition of fish that are killed and disposed of. This effect would occur for a period of approximately 2 weeks while decomposition occurred. However, natural mortality has always occurred in the target waters and the increase attributable to project treatments would be negligible with respect to the ecosystem. Some of the nutrients would likely be rapidly assimilated by rebounding aquatic macroinvertebrate populations.

We do not believe that changes in water quality during the project would impair other uses. Rotenone would not affect plants and treated water would still be of suitable quality for use by livestock, other mammals, and birds (Turner et al. 2007).

Potassium permanganate would degrade to nontoxic, common compounds or elements shortly after application at the concentrations used. The neutralization is not immediate in space, but requires a short mixing zone where the potassium permanganate is in contact with and oxidizes the rotenone. Downstream of this mixing zone, both fish and aquatic macroinvertebrates would not be affected.

Drinking water supplies would not be affected by the use of potassium permanganate because it rapidly breaks down into potassium, manganese, and water. Because potassium permanganate is commonly used to treat drinking water at levels comparable to those used to neutralize rotenone, there would be no effect to drinking water supplies (Holdaway 2010). In addition, no target streams are used directly as municipal or culinary water sources.

Effect of Barriers

Barriers pose little, if any, threat to the natural stream system or its associated riparian area. Consequently, if a barrier failed, no impacts or only minor impacts would result to the stream environment, potentially including minor sedimentation resulting from bank erosion due to such actions as side-cutting around the structure or release of sediments captured during the life of the barrier. During barrier construction, there would be a temporary increase in turbidity immediately downstream from construction sites. The increase would be limited to a short reach directly below the construction site and would be limited in duration to the construction period, or the time that any heavy equipment (e.g. trackhoe) is

actually in the channel (6-10 hours) and the period immediately following (1-3 hours; compare Figures 4.1 and 4.2).



Figure 4.1 Trackhoe in stream channel above a newly constructed barrier.



Figure 4.2 Difference in water clarity less than 1.5 hours after the photo in Figure 4.1 was taken.

4.2.3 Electrofishing – Direct and indirect effects

Electrofishing is a very commonly used method of collecting fish in lotic systems. Electrofishing does not directly alter the water chemistry, and it occurs in a very short amount of time at a site.

Macroinvertebrates do respond to electrofishing. Bisson (1976) and Taylor et al. (2001) reported that electrofishing induced significant drift. In both studies electrofishing did not cause direct mortality. Drifting invertebrates would be more susceptible to predation by fish.

4.3 RECREATION

4.3.1 No Action - Direct and Indirect Effects

There would be no direct or indirect effects to recreation under the No Action Alternative. Recreational opportunities would remain similar to what is currently available, including angling opportunities for non-native trout. There would be no increase in opportunities to fish for native trout in project waters, and in streams that currently contain native trout there would likely be a decrease in opportunity for native trout angling in the future (i.e. due to continued effects associated with invasion of, competition from, or hybridization with, non-native trout).

4.3.2 Proposed Action - Direct and Indirect Effects

Since one of the recreational activities at most of the project waters is fishing, or fishing-related camping and hiking, there would be a short-term impact to recreation under the Proposed Action Alternative. Fishing opportunities and success at most waters would be reduced during the rotenone treatment periods and, where limited numbers of only native trout are introduced, for several years following the chemical treatments. Following treatments, non-native trout would no longer be available in project waters, but opportunities for sport fishing for non-native rainbow, brook, and brown trout would still be readily available in other waters in the wider area, and would still make up the majority of fishing opportunities in Northern Utah. In the long term, there would be increased opportunities to fish for native trout once those populations became established over the course of the ensuing 3-4 years.

4.3.3 Electrofishing – Direct and indirect effects

Electrofishing is very safe and would not directly affect recreation. People wading or swimming in the water would be asked to exit the stream while they are within the range of the electrofishing equipment. This disturbance would be temporary.

4.4 FISHERIES

4.4.1 No Action - Direct and Indirect Effects

Under the No Action Alternative, species composition of project fisheries would remain similar to what is now present at project waters. Non-native trout would remain the dominant sport fish species in these streams. No increase in habitat available for native trout would be achieved and no progress would be made toward meeting the primary objective of the project.

4.4.2 Proposed Action - Direct and Indirect Effects

Under this alternative, all fish in the treated portions of the project areas would be removed by application of rotenone, and native cutthroat trout would be established in project waters (Table 2.1). In addition, fish migration barriers would be constructed on streams where barriers do not currently exist to prevent the reinvasion of undesirable trout species; existing partial barriers may be enhanced to make them impassable (Table 2.1).

The Proposed Action would result in an increase in the number of populations of, and habitat for, native cutthroat trout. The construction of fish migration barriers and introduction of native trout would result in establishing and expanding pure-strain native cutthroat trout in approximately 116 miles of project waters (Table 2.1). By expanding the range and number of native trout, the risk of the subspecies being lost as the result of a catastrophic event, hybridization, or displacement by other species would be reduced. This would help maintain or increase the genetic diversity in native trout populations, and guard against loss of natural genetic diversity in existing populations.

Any native non-game fishes (e.g. sculpin or mountain suckers) that occupy project waters would be vulnerable to rotenone. We plan to provide temporary facilities for on-site capture, holding, and post-treatment release of individual fish to mitigate the potential for impacts to these native fish populations. As stated above, every effort will be made to maximize the nongame population sizes in order to avoid genetic bottlenecks (Demarais et al. 1993). The native fish which were not captured by electrofishing and held, however, would all succumb to rotenone. The captured and held native, non-game fish, which were successfully released following the treatment, would be expected to repopulate and over time fully replace the individuals lost to rotenone.

4.4.3 Electrofishing – Direct and indirect effects

Non-native trout would be selectively removed from the streams. In some waters, where non-native trout are the predominant sport fish, there will be a reduction in fishing opportunities.

4.5 WILDLIFE

4.5.1 No Action - Direct and Indirect Effects

There would be no direct or indirect impacts to wildlife attributable to the No Action Alternative. Wildlife populations would continue to function as they currently do.

4.5.2 Proposed Action - Direct and Indirect Effects

Effects of Rotenone

Adult amphibians have been shown to be minimally affected by rotenone. In a controlled laboratory setting, Grisak et al. (2007) reported that adult spotted frog survived exposure to rotenone at 4.5 times a field dose of 1 mg/L. Because adult amphibians can leave treated areas through terrestrial pathways, rotenone treatments have not impacted this life stage (Billman 2010; California Department of Fish and Game 1985; McCoid and Bettoli 1996).

Larval amphibians experience a similar response to fish exposed to Rotenone. (Billman 2010; California Department of Fish and Game 1985; Fontenot et al. 1994; Grisak et al. 2007; McCoid and Bettoli 1996). Unless surveys conducted prior to the treatments indicate an absence of amphibians in the target areas, project timing would be planned to occur after metamorphosis to preclude negative impacts to amphibian populations, in the event that amphibian habitat is treated. Recent evidence suggests that the removal of non-native fishes has demonstrated an overall positive effect on amphibian populations, through reductions in predation by non-native predatory fishes (Knapp et al. 2007; Mullin et al. 2004; Pilliod and Peterson 2000; Vredenburg and Wake 2004; Walston and Mullin 2007; Welsh et al. 2006).

Larval amphibians that might be present in the target area could be susceptible to rotenone (Billman 2010; California Department of Fish and Game 1985; Fontenot et al. 1994; Grisak et al. 2007; McCoid and Bettoli 1996). However, seeps, boggy areas, and untreated waters within the same drainages that are not targeted for rotenone treatment would provide refugia and sources for recolonization. This would ensure that amphibian populations would not suffer long-term impacts due to the Proposed Action. In addition to the precaution of leaving suitable refugia, treatments would be timed to avoid the most critical period of vulnerability. Unless surveys conducted prior to the treatments indicated that no amphibians happened to occur in the target areas, treatments would be conducted in the late-summer or fall, when young-of-the-year amphibians would have developed to more terrestrial stages or would be able to leave rotenone treated water and would not be vulnerable to rotenone.

Direct impacts to wildlife associated with the Proposed Action would be limited primarily to aquatic invertebrates (mainly insects within the project areas) and would be similar to that of a flood in the project streams. Aquatic invertebrates vary in their sensitivity to rotenone, but many species would be reduced or temporarily eliminated within parts of the project areas during the treatment period. Refugia in the project areas would facilitate a relatively rapid recovery of invertebrates in treated waters. These refugia would include stream sections upstream from the target areas and ponds, seep areas, and springs outside the immediate target areas but within the same drainages. Following the treatments, some species of aquatic insects, such as those more tolerant to rotenone or quick dispersers from upstream or nearby refugia, would rebound to high population levels in only a few months. The initial reduction in overall numbers may allow formerly obscure taxa to become more prevalent for a short period of time with a series of taxa becoming temporarily dominant. The majority of aquatic insects in target streams would recover within a year, and as numbers of taxa increase, the overall community structure would stabilize. Due to the lack of fish predators immediately following treatment, there may be shifts in dominance within the aquatic invertebrate community until fish are reintroduced. A few aquatic invertebrate taxa with longer life cycles may need a longer time period to recover to pre-treatment levels but by several years after treatment the aquatic invertebrate community would have equivalent numbers of taxa, community richness, and biotic and diversity indices. Also see Section 4.2.2.

Indirect impacts to wildlife may include temporary displacement of some birds that normally feed on fish and/or aquatic invertebrates. It is also possible that the treatment may decrease the forage base for bats that utilize aquatic insects (i.e. terrestrial adult stages) as a portion of their diet. Stream-riparian systems are known to subsidize terrestrial food webs dynamically on a seasonally variable time period and vice versa. For example, Nakano and Murakami (2001) showed that emerging aquatic invertebrates were a significant food source for resident birds during the fall and spring, while terrestrial forest habitats provided ample forage for birds and fish during the warm weather months. The chemical treatment would occur during the late-summer or early-fall months to limit the impacts on resident bird and bat food

sources. By fall, some aquatic macroinvertebrates should have recovered and would be able to provide forage for birds that do not emigrate (Mangum and Madrigal (1999). These effects would be short term and are considered minor due to the abundance of terrestrial insects and other alternate prey, the timing of the projects, the mobility of birds and bats, and the proximity of the target waters to similar aquatic habitats and prey sources.

The overall effect of the proposed treatment on the wildlife that depend on fish or aquatic invertebrates for food, and indirectly, on the processes important to the functioning of the ecosystem, may be best evaluated by looking at the results of past fish eradication projects. Rotenone has been used to treat many waters in Utah as well as other parts of the U.S. since the 1950's. These systems have recovered quickly with no observed long-term impacts on associated ecosystems. In many instances, trout, whose diet often consists primarily of aquatic invertebrates have been successfully stocked in treated waters within a month or two following treatment.

Effect of Barriers

Migration barriers are one of the commonly-used strategies applied by fisheries managers attempting to protect native fish populations from non-native fish that present unacceptable predation, competition or hybridization risks. Peterson et al. (2008b) developed a model to provide guidance to managers weighing the risks and benefits of isolation. The tradeoffs of isolation vs. connectivity continue to be discussed in the literature. Many of the streams proposed for treatment are tributaries to larger streams and rivers, which contain abundant non-native fish populations. It is unfeasible to chemically treat entire watersheds, therefore we have determined that the construction of migration barriers will need to occur at some sites. If barriers are constructed, every effort will be made to ensure that the restored population will meet the persistence criteria following research conducted by Hilderbrand and Kershner (2000) and Dunham and Rieman (1999).

Fish are the target organisms for the construction of migration barriers. However it is widely recognized that other aquatic organisms, such as benthic macroinvertebrates and amphibians move within lotic systems as well. It is important to note that a fish migration barrier will not adversely affect non-target organisms. Aquatic macroinvertebrates have long been known to exhibit downstream drift patterns, which would lead to defaunation of streams without a compensatory mechanism (Malmqvist 2002). This has led to the development of hypotheses to explain how aquatic macroinvertebrates recolonize stream reaches. The life history of most aquatic macroinvertebrates is biphasic, which includes a terrestrial adult phase. Research indicates that, terrestrial movements, such as flying and crawling are the primary means of dispersal (Malmqvist 2002). Although some upstream migration of larval invertebrates occurs, it is generally limited to a range of 10s of meters (Malmqvist 2002). Through simulated modeling, Kopp et al (2001) indicated that macroinvertebrate populations must exhibit an upstream bias in adult dispersal in order to maintain long term population persistence and compensate for downstream drift. A fish migration barrier would mimic a small waterfall on a stream and would minimally affect upstream dispersal.

Amphibian dispersal generally occurs during the terrestrial phase of their life history (Semlitsch 2000). Thompson (2004), identified several Boreal toads (*Bufo boreas*) migrating between hydrologically isolated breeding ponds ranging from 0.9-5km in distance. Northern Leopard Frog (*Rana pipiens*) dispersal success is primarily related to terrestrial habitat management and the resulting conditions (Blomquist and Hunter 2009). The construction of an instream fish migration barrier will have minimum effects on amphibian dispersal and migrations.

There would be no direct or indirect effects to terrestrial MIS. Neither the rotenone treatment activities, nor barrier construction would adversely affect wildlife. Most wildlife species, including birds, mammals, reptiles, adult amphibians, and some invertebrates, are not susceptible to rotenone at the concentrations that would be used in the treatments.

4.5.3 Electrofishing – Direct and indirect effects

Effect of electrofishing

There would be no direct or indirect effect on non-aquatic wildlife associated with electrofishing. Some temporary disturbance in the stream corridor itself may occur from the presence of humans and associated foot traffic when electrofishing is being carried out. This disturbance would be largely undetectable shortly after conclusion of the electrofishing treatments.

Effect of Barriers

Migration barriers would be required under the electrofishing alternative, and the effects would be the same as are described above in Section 4.5.2.

4.6 THREATENED, ENDANGERED, AND CANDIDATE SPECIES

4.6.1 No Action - Direct and Indirect Effects

Under the No Action Alternative, there would be no direct or indirect effects on threatened, endangered, or candidate species listed in Section 3.6.

4.6.2 Proposed Action - Direct and Indirect Effects

Even though the project area is within the historic range of the yellow-billed cuckoo, if cuckoos do occupy the area, the impacts of the Proposed Action would be negligible since rotenone is not toxic to birds at the concentrations that would be applied to project waters. Any potential indirect effects would also be minimal. The migratory behavior of the yellow-billed cuckoo, the timing of the projects, the temporary nature of any impacts on some aquatic insect taxa, and availability of alternate (terrestrial) prey items would minimize any potential indirect impacts on the cuckoo or any other insectivorous birds in the area.

The project area is located within the historic range of the Canada lynx; however, because the area is not currently occupied, the Proposed Action would not directly impact this species. Further, the preferred habitat of Canada lynx is montane coniferous forest, and the only habitat disturbance proposed herein would be associated with the construction of migration barriers, which are not anticipated for areas of lynx preferred habitat. Rotenone is not harmful to lynx or their prey species at the concentrations used for fish removal. If any Canada lynx occupied the project area during proposed treatments, they could be displaced temporarily, but this would be brief in duration. It is therefore concluded that the Proposed Action would have no effect on the Canada lynx or its habitat.

Due to the lack of recent, verified black-footed ferret occupancy in any of the areas under the Proposed Action, it is unlikely that the Proposed Action would result in any effect to the black-footed ferret.

Rotenone would not affect vegetation, so any listed plant species present in or adjacent to project areas would not be directly affected by the chemical treatment, including the Maguire primrose. Specific habitat requirements place the species outside the areas of vehicle or foot travel that would be associated with the proposed rotenone treatment in the Right Hand Fork of Logan River. Although other proposed project areas that may be disturbed outside of the floodplain of streams as a result of barrier construction, none are known to contain any listed plant species. Therefore, there would be no effects to listed plant species from the Proposed Action.

Ecological Services staff in the Utah Field Office of USFWS reviewed the listed species and their critical habitat within the action area and issued an Intra-Service Section 7 concurrence with a determination of no effect for black-footed ferret, Canada lynx, western yellow-billed cuckoo, and Maguire primrose (Appendix D).

4.2.3 Electrofishing – Direct and indirect effects

Electrofishing would not affect threatened or endangered wildlife.

4.7 SENSITIVE SPECIES

4.7.1 No Action - Direct and Indirect Effects

The No Action Alternative would not affect any of the birds, mammals, or amphibians listed in Appendix B. Populations of native cutthroat trout would not be established at the locations listed. The range and population size of these subspecies would not be increased as under the Proposed Action.

4.7.2 Proposed Action - Direct and Indirect Effects

The Proposed Action would not have any direct impacts on any of the birds, mammals, or adult stages of the amphibians listed in Appendix B. These species/stages are not susceptible to rotenone at the concentrations that would be used in the proposed treatment.

Larval amphibians are vulnerable to rotenone, even at very low concentrations (Billman 2010; California Department of Fish and Game 1985; Fontenot et al. 1994; Grisak et al. 2007; McCoid and Bettoli 1996). Three sensitive amphibian species occur or potentially occur in the project area; these amphibians are boreal toad, spotted frog, and northern leopard frog. Boreal toads have been found in nearby drainages to three of the project waters: The Right Hand Fork of Logan River, Big Creek and George Creek. No boreal toad have been verified to date in any of the treatment drainages. Black tadpoles were found in 2008 during pre-treatment surveys in an intermittent tributary of George Creek, however, three subsequent surveys in 2009 did not locate boreal toad or any amphibian species (Thompson and Chase 2009a). Spotted frogs also have not been documented in any of the project area drainages and based on their historic and current distribution in Utah (Bailey et al. 2006), the project area occurs outside of their Utah range. Northern leopard frog have been found in or near three of the project areas: Big Creek, Little Creek, and Otter Creek (Thompson and Chase 2009b) and this species likely occurs in all three drainages. Treatment dates, in general, occur after the metamorphosis of all native amphibian species from aquatic to more terrestrial juvenile stages when they would be less susceptible to rotenone. Boreal toads observed in northern Utah reach terrestrial stages by late-August, while spotted frogs generally reach terrestrial stages by mid-August. According to Hammerson (1999), Northern Leopard Frogs at low elevations in Colorado appear to undergo metamorphosis around late June to early July. At moderate elevations (6,700-7,700') frogs metamorphose around mid-July through September. Essentially it's 3-6 months from egg deposition (Rorabaugh 2005). If present, larval amphibians would likely be found in nearby refugia outside the target areas, thereby providing a source for recolonization. Most successful amphibian breeding actually occurs in off-channel habitat in areas where fish are not present. To avoid impacts to amphibians found in treatment areas, larval amphibians (if found pre-treatment) could be held in freshwater (e.g. buckets or tanks) during the treatment period. There should be no impact on larval amphibians and no impact to boreal toad, spotted frog or northern leopard frog.

Possible indirect effects to some of the insectivorous species listed in Appendix B (some birds, bats) include the temporary loss of a portion of their available forage base of adult flying insects. This impact would be short-term and would be minimized by the presence of alternate prey species and timing of the project.

Habitat suitable for re-establishing pure strain populations of Bonneville cutthroat trout and Yellowstone cutthroat trout would be made available by the Proposed Action. Once populations are established, they would represent an increase in the number of viable populations within the historic ranges of these subspecies of cutthroat trout, as well as an expansion of the current range of the respective subspecies. These actions would reduce the risk that these subspecies would be extirpated as the result of a catastrophic event or other cause. Other species of native fish classified as sensitive, including the bluehead sucker and Northern leatherside chub, would also benefit by removal of non-native trout species from selected habitats in Rich County, into which reintroduction would occur following treatment.

The implementation of some of the proposed work is contingent upon the status of the three subspecies of cutthroat trout with respect to federal listing. Any change from the subspecies' current unlisted status to threatened or endangered would require additional review regarding the use of these fish for fishery enhancement projects.

4.7.3 Electrofishing – Direct and indirect effects

Electrofishing would not have a significant effect on sensitive species. Repeated passes could potentially increase the injury rate for non-target species, but we would plan to use electrofishing settings that reduce the risk for injury to fish. Generally the electrofishing settings used would be a 40-60 Hz pulse frequency, and 2-4 ms pulse duration. Voltage would be set according to the conductivity measured in the water on the days of treatment.

4.8 GRAZING

4.8.1 No Action - Direct and Indirect Effects

Under the No Action Alternative, there would be no direct or indirect effects on livestock or grazing.

4.8.2 Proposed Action - Direct and Indirect Effects

There would be no direct or indirect effects to livestock or grazing under the Proposed Action. Although previously approved uses included uses involving livestock, those uses have been withdrawn by rotenone product manufacturers (Federal Register Document E6-8658). However, rotenone is not harmful to livestock at the concentrations used for fish control. As a result, the UDWR has not asked for any changes in land management practices in project areas with respect to the Proposed Action. When the current allotment management plans are revised for the Project Area, grazing practices would be reviewed to determine if they are meeting Management Area goals. Those effects are beyond the scope of this analysis for the Proposed Action.

4.8.3 Electrofishing – Direct and indirect effects

Electrofishing will not affect livestock grazing.

4.9 CULTURAL RESOURCES

4.9.1 No Action - Direct and Indirect Effects

There are no direct or indirect effects to historical or cultural resources under the No Action Alternative.

4.9.2 Proposed Action - Direct and Indirect Effects

Chemical treatment of the waters in the project area would not have an impact to any historical or cultural resources occurring in the area. Surface disturbance associated with construction of fish migration barriers would be restricted to a narrow zone within a given stream's floodplain, where historical or cultural resources are unlikely to be affected.

4.9.3 Electrofishing – Direct and indirect effects

We do not anticipate any direct effects to cultural resources caused by electrofishing. Electrofishing is implemented by walking in an upstream direction within the stream channel. Occasional foot traffic occurs on the banks, but it is likely not enough to induce incidental damage to cultural resources that may occur.

4.10 PUBLIC HEALTH AND SAFETY

4.10.1 No Action - Direct and Indirect Effects

There are no direct or indirect effects to public health and safety under the No Action Alternative.

4.10.2 Proposed Action - Direct and Indirect Effects

With adequate mitigation to ensure that all public health exposure routes are interrupted effectively, rotenone will not persist in the environment, hence no public health effects are likely (see Appendix E).

4.10.3 Electrofishing – Direct and indirect effects

There are no direct or indirect effects to public health or safety when electrofishing.

4.11 CUMULATIVE EFFECTS

4.11.1 No Action - Cumulative Effects

Under the No Action Alternative there would be no cumulative effects to any of the resources addressed, except recreation and the fishery. If the proposed projects are not implemented and enhancement and protection of native trout populations are not demonstrated, federal listing of the three native subspecies of trout is more likely. Actions mandated under federal listing could include changes in non-native trout stocking programs and fishing regulations.

4.11.2 Proposed Action - Cumulative Effects

Cumulative effects of the Proposed Action could include maintaining fishing opportunities for non-native trout and maintaining a consistent sport fishing management program at other waters in the state. Implementing the proposed projects and meeting the goals of establishing native trout would help to provide additional habitat and enhance the spatial extent of native fish. The ultimate goal is to ensure that these subspecies of native trout would not be federally listed. However, as stated above, if the proposed projects are not implemented and enhancement and protection of native trout populations are not demonstrated, federal listing of the three native subspecies of trout is more likely. Actions mandated under federal listing could include changes in non-native trout stocking programs and fishing regulations. Such actions would alter sport fish management and fishing recreation. There would be no impacts to species listed in Section 3.6 in the cumulative effects analysis area.

There could be cumulative negative effects to water quality if rotenone permanently alters the macroinvertebrate assemblage. For example, Schäfer et al. (2007) found that pesticide use adjacent to European streams altered the benthic macroinvertebrate assemblage, which reduced the leaf-litter decomposition rates. Leaf litter decomposition rates directly affect the nutrient availability to higher trophic levels, including fish (Horne and Goldman 1994). In general, fewer sensitive taxa occurred, and the reduced leaf litter composition rate was a result of an overall reduction in shredder species within the streams. This was somewhat mitigated when undisturbed stream reaches occurred upstream of the impacted reaches. This also represented a more chronic, sublethal, low level exposure of macroinvertebrates to pesticides. Rotenone treatments result in an acute lethal exposure of macroinvertebrates to the chemical. As seen by Vinson et al. (2010) the impacts of acute exposure are generally more difficult to track.

There are no discernible cumulative effects (see Appendix E) to public health and safety under the Proposed Action because of the short-lived toxicity of rotenone and distance of project area from domestic sources of water.

4.11.3 Electrofishing – Direct and Indirect Effects

There would be no cumulative effects of electrofishing aside from the potential success in controlling undesirable non-native fish populations.

SECTION 5: LIST OF PREPARERS

The following individuals assisted in the preparation of this document or provided technical support.

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Kevin Sloan	USFWS Fishery Biologist	Wildlife and Sport Fish Restoration Program (currently Division of Refuges)
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SECTION 6: LIST OF AGENCIES AND PERSONS CONSULTED

Box Elder News Journal (public scoping advertisement)

Bureau of Land Management, Salt Lake Field Office

Bureau of Reclamation, Provo Area Office

Herald Journal (Logan) (public scoping advertisement)

Sawtooth National Forest

Standard-Examiner (Ogden) (public scoping advertisement)

Uinta-Wasatch-Cache National Forest

Utah State Division of Drinking Water

Utah State Division of Water Rights

Utah State Division of Wildlife Resources

Utah State Regional Advisory Council (RAC - Citizen oversight committee to UDWR)

U.S. Fish and Wildlife Service - Utah Ecological Services Field Office

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Appendix A

List of Acronyms and Abbreviations

AFS	American Fisheries Society
ATV	All-terrain vehicle
AZGFD	Arizona Game and Fish Department
BCT	Bonneville Cutthroat Trout
BKT	Brook Trout
BLM	Bureau of Land Management
BNT	Brown Trout
BVCT	Bonneville Cutthroat Trout
C	Candidate
CA	Conservation Agreement
CAS	Conservation Agreement and Strategy
CDFG	California Department of Fish and Game
cm	centimeter
CS	Conservation Strategy
CT	Cutthroat Trout
CTGR	Confederated Tribes of the Goshute Reservation
DFC	Desert Fishes Council
DMP	Drainage Management Plan
E	Endangered
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FS	U.S. Forest Service
FWS	U.S. Fish and Wildlife Service
IDFG	Idaho Department of Fish and Game
JAN	Jicarilla Apache Nation
LRMP	Land and Resource Management Plan
MIS	Management Indicator Species
MOA	Memorandum of Agreement
MTS	Mountain Sucker
NEPA	National Environmental Policy Act
NDOW	Nevada Department of Wildlife
NF	National Forest
NMDGF	New Mexico Department of Game and Fish
NPS	National Park Service
ppm	parts per million (equivalent to mg/L or mg/kg)
PGP	Pesticide General Permit
R (followed by #)	Range
RAC	Regional Advisory Council
Reclamation	Bureau of Reclamation
RT	Rainbow Trout
RTxCT	Rainbow Trout x Cutthroat Trout hybrid
S	Sensitive Species
SC	Sculpin
SNFLRMP	Sawtooth National Forest Land and Resource Management Plan
T	Threatened
T (followed by #)	Township
TG	Tiger Trout
TNC	The Nature Conservancy
TU	Trout Unlimited
UDWR	Utah Division of Wildlife Resources

UIT	Ute Indian Tribe of the Uintah and Ouray Reservation
UNFLRMP	Uinta National Forest Land and Resource Management Plan
URMCC	Utah Reclamation Mitigation and Conservation Commission
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
UTC	Utah Chub
WCNFLRMP	Wasatch-Cache National Forest Land and Resource Management Plan
WGFD	Wyoming Game and Fish Department
WSC	Wildlife Species of Concern
YCT	Yellowstone Cutthroat Trout

Appendix B

Threatened, Endangered, and Sensitive Species Lists by Agency

Appendix B. Species federally listed as threatened or endangered, UDWR Sensitive Species, and species listed as sensitive by the Regional Forester which occur or may occur in the project area.

COMMON NAME / SCIENTIFIC NAME	USFWS ¹	USFS ²	UDWR ³
MAMMAL SPECIES			
Black-footed ferret <i>Mustela nigripes</i>	E		E
Canada lynx <i>Lynx canadensis</i>	T	T	T
Fisher <i>Martes pennanti</i>		S	WSC
Fringed myotis <i>Myotis thysanodes</i>			WSC
Kit fox <i>Vulpes macrotis</i>			WSC
North American wolverine <i>Gulo gulo (luscus)</i>		S	
Pygmy rabbit <i>Brachylagus idahoensis</i>		S	WSC
Spotted bat <i>Euderma maculatum</i>		S	WSC
Townsend's big-eared bat <i>Plecotus townsendii</i>			WSC
Western big-eared bat <i>Corynorhinus townsendii pallescens</i>		S	WSC
Western red bat <i>Lasiurus blossevillii</i>			WSC
White-tailed prairie dog <i>Cynomys leucurus</i>			WSC
BIRD SPECIES			
American white pelican <i>Pelecanus erythrorhynchos</i>			WSC
Bald eagle <i>Haliaeetus leucocephalus</i>		S	WSC
Black swift <i>Cypseloides niger</i>			WSC
Bobolink <i>Dolichonyx oryzivorus</i>			WSC
Boreal owl <i>Aegolius funereus</i>		S	

COMMON NAME / SCIENTIFIC NAME	USFWS ¹	USFS ²	UDWR ³
Burrowing owl <i>Athene cunicularia</i>			WSC
Ferruginous hawk <i>Buteo regalis</i>			WSC
Flammulated owl <i>Otus flammeolus</i>		S	
Grasshopper sparrow <i>Ammodramus savannarum</i>			WSC
Great gray owl <i>Strix nebulosa</i>		S	
Greater sage grouse <i>Centrocercus urophasianus</i>	C	S	WSC
Lewis's woodpecker <i>Melanerpes lewis</i>			WSC
Long-billed curlew <i>Numerius americanus</i>			WSC
Northern goshawk <i>Accipiter gentilis</i>		S	CA
Mountain plover <i>Charadrius montanus</i>		S	WSC
Peregrine falcon <i>Falco peregrinus anatum</i>		S	
Sharp-tailed grouse <i>Tympanuchus phasianellus</i>		S	WSC
Short-eared owl <i>Asio flammeus</i>			WSC
Three-toed woodpecker <i>Picoides tridactylus dorsalis</i>		S	WSC
Western yellow-billed cuckoo <i>Coccyzus americanus occidentalis</i>	C	C	C
FISH SPECIES			
Bonneville cutthroat trout <i>Oncorhynchus clarkii utah</i>		S	CA
Northern leatherside chub <i>Lepidomeda copei</i>		S	
Yellowstone cutthroat trout <i>Oncorhynchus clarkii bouvieri</i>		S	WSC
AMPHIBIAN SPECIES			

COMMON NAME / SCIENTIFIC NAME	USFWS ¹	USFS ²	UDWR ³
Boreal toad <i>Bufo boreas</i>		S	WSC
Columbia spotted frog <i>Rana luteiventris</i>		S	CA
REPTILE SPECIES			
Smooth greensnake <i>Opheodrys vernalis</i>			WSC
MOLLUSK SPECIES			
California floater <i>Anodonta californiensis</i>			WSC
Western pearlshell <i>Margaritifera falcata</i>			WSC
PLANT SPECIES			
Frank Smith's violet <i>Viola franksmithii</i>		S	
Maguire primrose <i>Primula maguirei</i>	T	S	

¹ Federal (ESA) classification: C = candidate; E = endangered; T = threatened.

² Federal (USFS) classification: C = candidate; E = endangered; T = threatened; S = sensitive species as classified by the Regional Forester, Region 4 (USDA 2003, 2005).

³ State (UDWR) classification: C = candidate (ESA); E = endangered (ESA); T = threatened (ESA); WSC = wildlife species of concern due to declining populations or limited distribution; CA = managed under a Conservation Agreement to preclude ESA listing.

Appendix C

Maps of proposed project sites

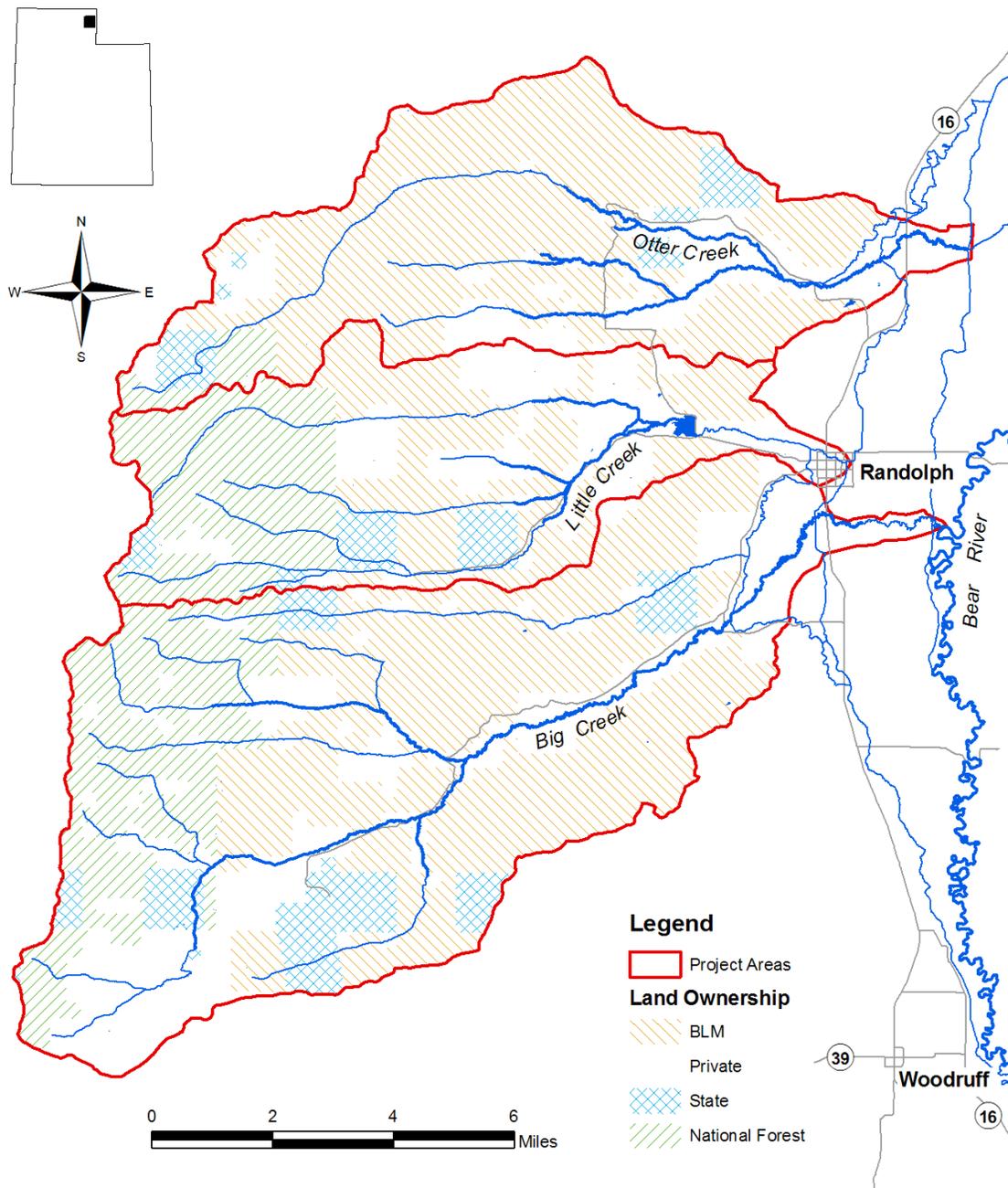


Figure C1. Map of Big Creek, Little Creek, and Otter Creek drainages, Rich County.

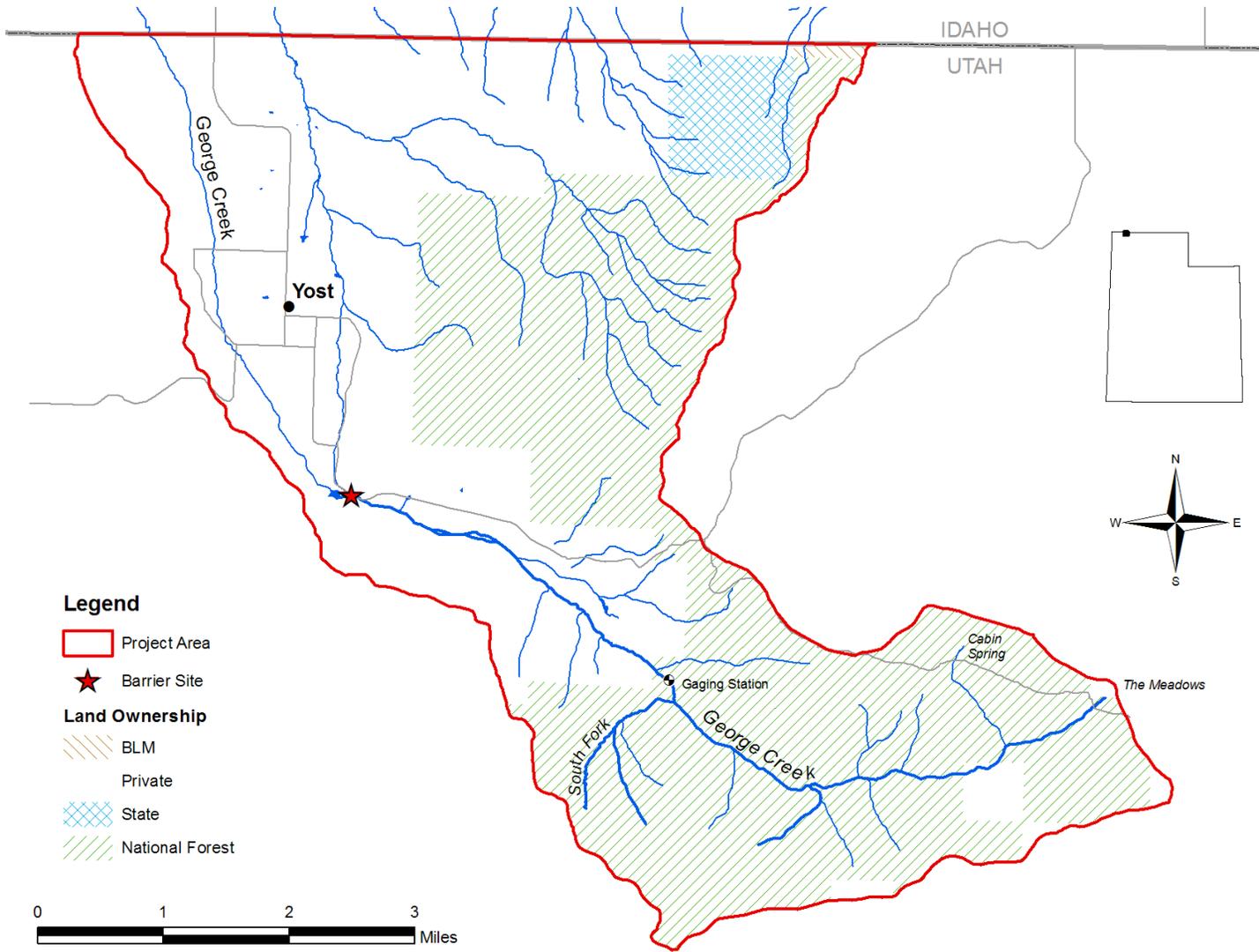


Figure C2. Map of the George Creek drainage, Box Elder County.

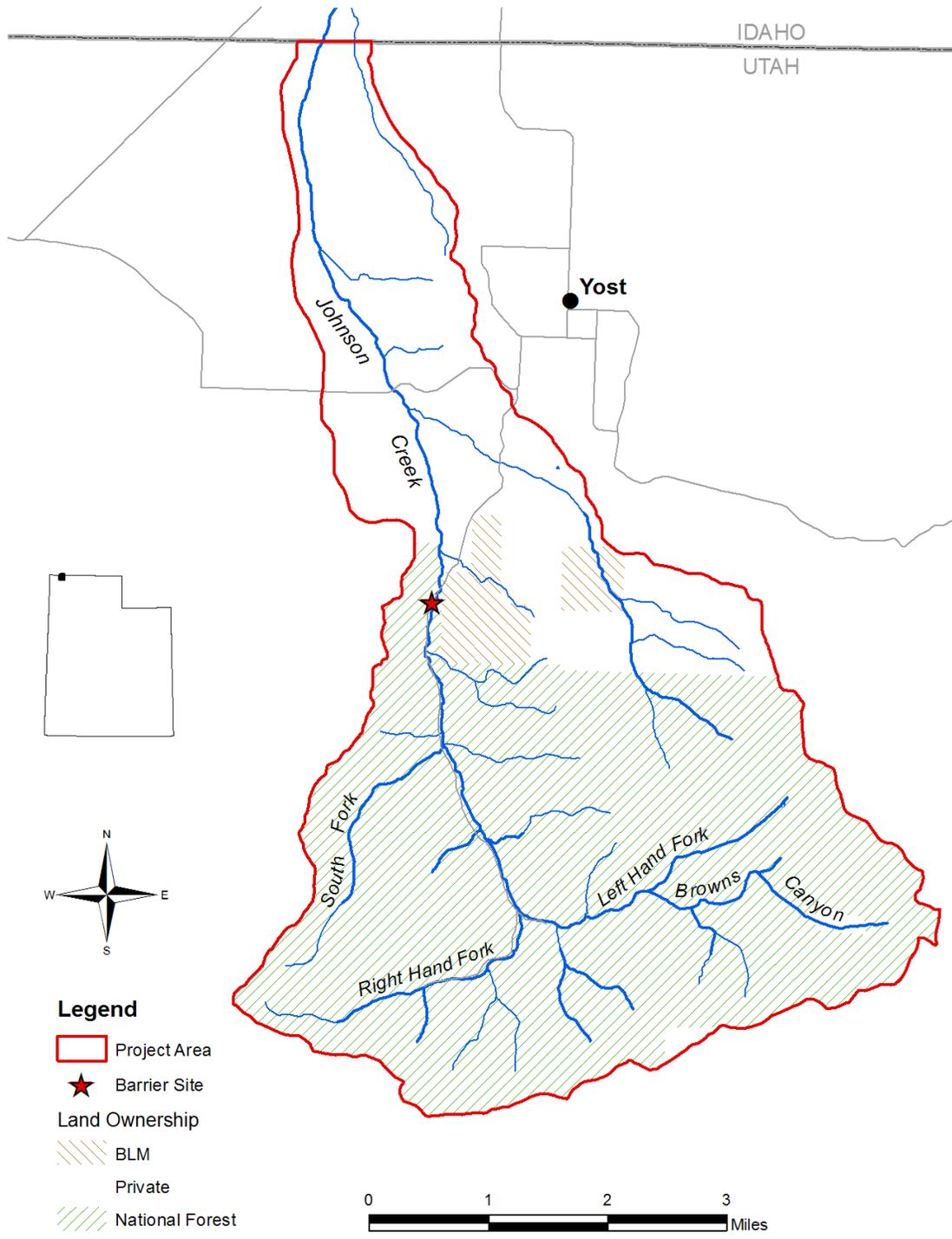


Figure C3. Map of the Johnson Creek drainage, Box Elder County.

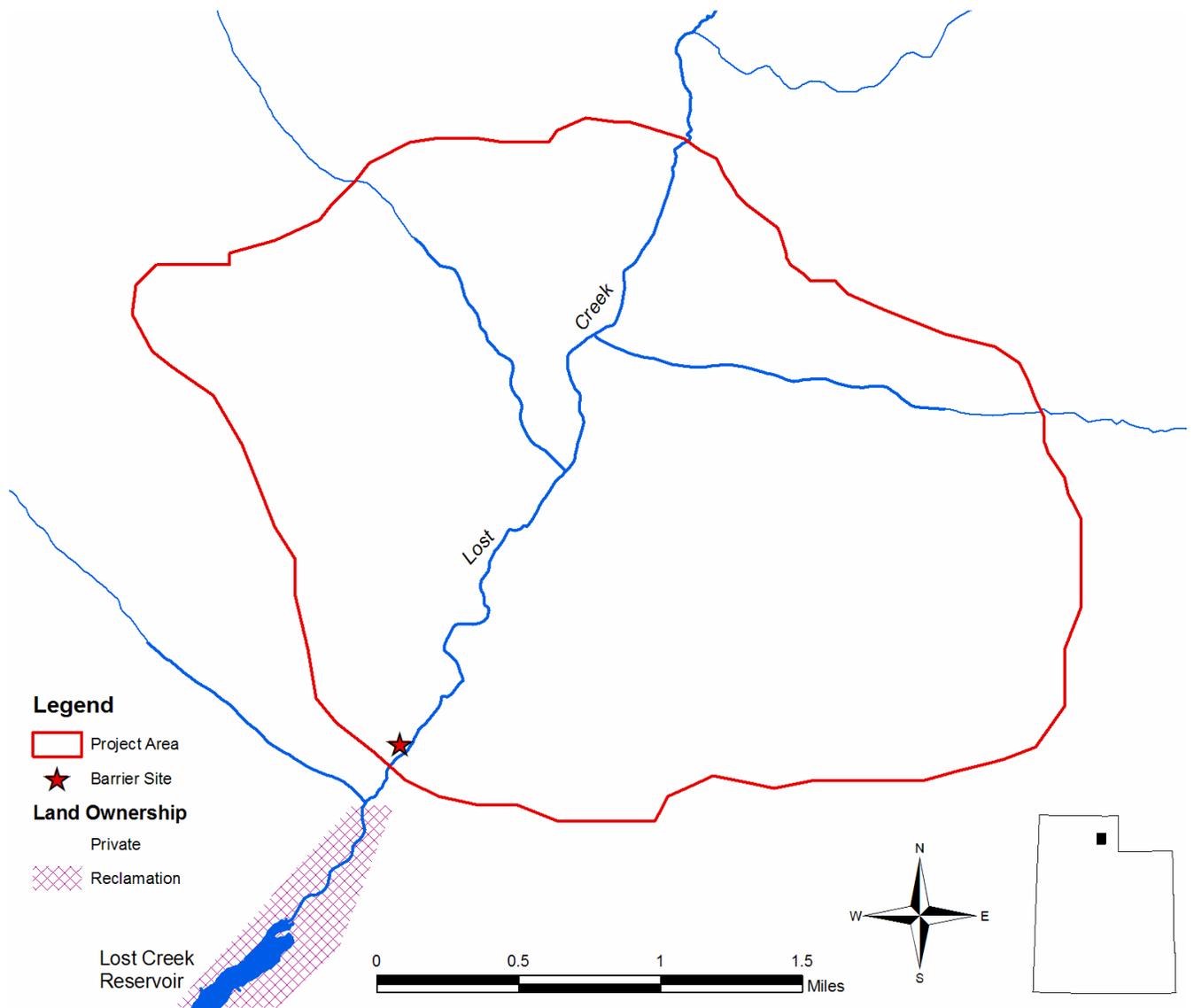


Figure C4. Map of the Lost Creek drainage, Morgan County.

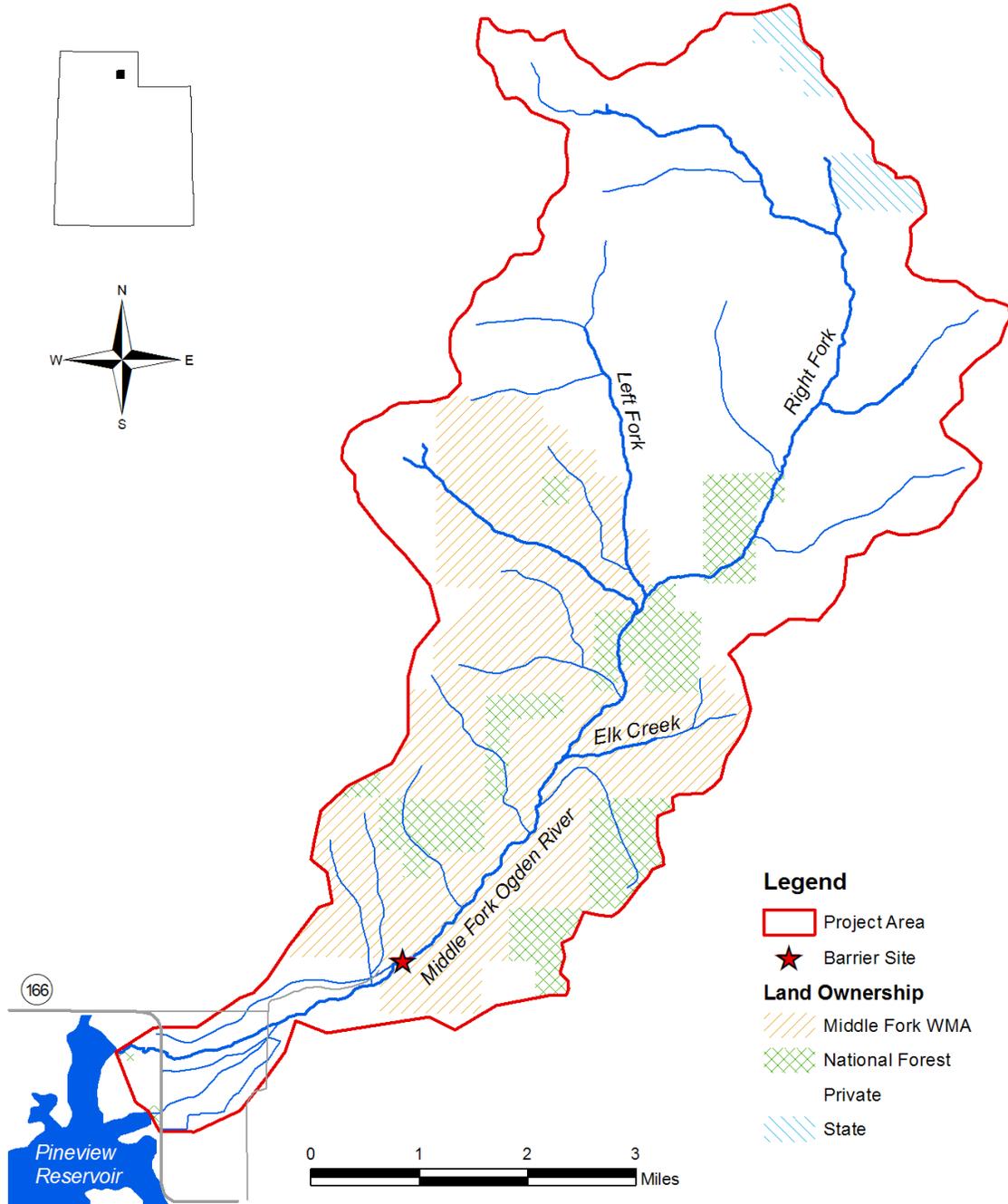


Figure C5. Map of the Middle Fork of Ogden River drainage, Weber County.

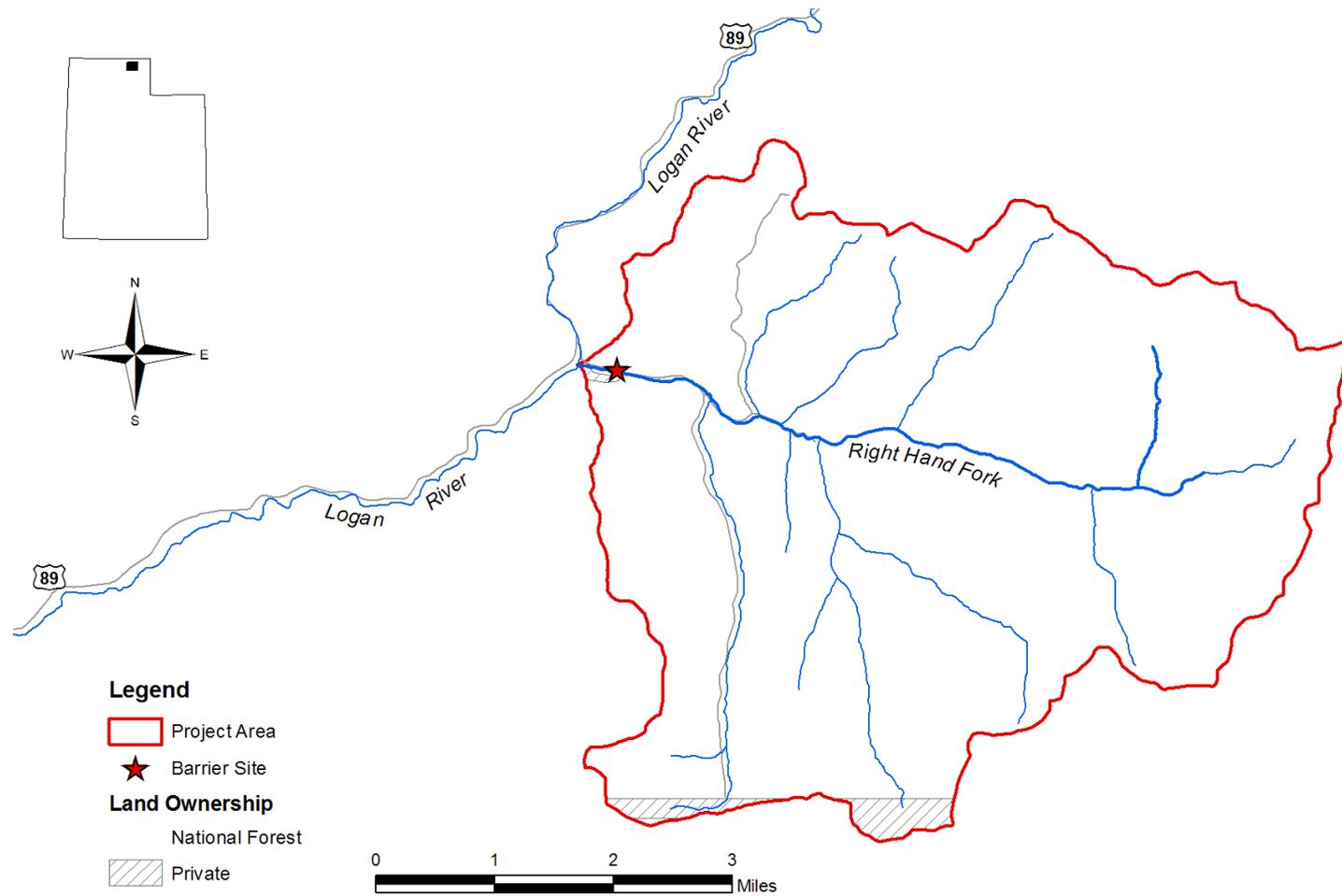


Figure C6. Map of the Right Hand Fork of Logan River drainage, Cache County.

Appendix D

Intra-Service Section 7 Biological Evaluation Form

Intra-Service Section 7 Biological Evaluation Form - Region 6

Originating Person: Connie Young-Dubovsky Date Submitted: March 20, 2012
 (After March 23, 2012, please contact Otto Jose)

Telephone Number: 303-236-8179 (Otto Jose at 303-236-8156 after March 23rd)

I. **Service Program and Geographic Area or Station Name:** Regional Office - Wildlife and Sport Fish Restoration

II. **Flexible Funding Program** (e.g. Joint Venture, etc) if applicable: Sport Fish Restoration (DJ)

III. **Location:** Location of the project including County, State and TSR (township, section & range):

Table 1: Proposed Locations for Rotenone Treatments

Water Name	Location	Stream length (Miles)	Target species	Barrier Construction	Detoxification	Restoration objective
Big Creek	T9-11N, R5-7E Rich Co.	24	Brook trout, brown trout, rainbow trout	No	Yes	Enhance Bonneville cutthroat trout, sculpin, mountain sucker; establish Northern leatherside chub, bluehead sucker
George Creek	T14-15N, R14-15W Box Elder Co.	11	Rainbow trout.	Yes	No	Enhance Yellowstone cutthroat trout
Johnson Creek	T13-15N, R14-15W Box Elder Co.	24	Brook trout.	Yes	No	Enhance Yellowstone cutthroat trout, sculpin
Little Creek	T10-11N, R5-6E Rich Co.	7	Brook trout.	No	No	Establish Bonneville cutthroat trout, Northern leatherside chub, bluehead sucker

Water Name	Location	Stream length (Miles)	Target species	Barrier Construction	Detoxification	Restoration objective
Lost Creek (above Lost Creek Reservoir)	T6N, R5-6E Morgan Co.	5	Non-native cutthroat trout, rainbow trout, Utah chub.	Yes	Yes	Enhance Bonneville cutthroat trout, sculpin, and mountain sucker
Middle Fork of Ogden River	T6-8N, R1-3E Weber Co.	21	Rainbow trout	Yes	Yes	Enhance Bonneville cutthroat trout, sculpin
Otter Creek	T11-12N, R6-7E Rich Co.	18	Brook trout, brown trout.	No	No	Establish Bonneville cutthroat trout, Northern leatherside chub, bluehead sucker, enhance sculpin
Right Hand Fork of Logan River	T12N, R3-4E Cache Co.	6	Brown trout	Yes	Yes	Enhance Bonneville cutthroat trout

IV **Species/Critical Habitat:** List federally endangered, threatened, proposed, and candidate species or designated or proposed critical habitat that may occur within the action area. To obtain species lists: <http://ecos.fws.gov/ipac/>

The project area contains portions of the historic range of four species classified by the FWS as threatened, endangered, or candidate species. Although suitable habitat is found in the project area, none of the species are known to occur in the area presently. The yellow-billed cuckoo (Candidate) is a neotropical migrant that could possibly be in the area between mid-May and mid-August. The Canada lynx (Threatened) prefers montane coniferous forest, but has not been sighted in Utah since 1972 (Bosworth 2003); however, a hair sample collected in 2001 suggests the lynx may be present in central Utah (Bosworth 2003). Unconfirmed black-footed ferret (Endangered) sightings have been reported in Rich County, but none after 1983 (Bosworth 2003). The ferret prefers open prairie grassland and is almost always found in association with prairie dog colonies, using prairie dogs for food and their burrows for shelter. The Maguire primrose (Threatened) is a federally threatened plant species endemic to Logan Canyon, Cache County. It occurs at lower elevations of Logan Canyon in damp crevices and ledges of north-facing limestone cliffs.

Other listed species (See Attachment A) do not occur in the project affected area.

Species classified under the Endangered Species Act that may occur within the counties where the Proposed Action would take place are shown in Table 2 and are listed also in Appendix B of the Draft Environmental Assessment (EA).

Table 2: Threatened (T), endangered (E), or candidate (C) species that may occur in each county.

COMMON NAME	SCIENTIFIC NAME	STATUS
BOX ELDER COUNTY Western Yellow-billed Cuckoo	<i>Coccyzus americanus occidentalis</i>	C
CACHE COUNTY Canada Lynx Maguire Primrose Western Yellow-billed Cuckoo	<i>Lynx canadensis</i> <i>Primula maguirei</i> <i>Coccyzus americanus occidentalis</i>	T T C
MORGAN COUNTY Canada Lynx Western Yellow-billed Cuckoo	<i>Lynx canadensis</i> <i>Coccyzus americanus occidentalis</i>	T C
RICH COUNTY Black-footed Ferret Canada Lynx	<i>Mustela nigripes</i> <i>Lynx canadensis</i>	E T
WEBER COUNTY Canada Lynx Western Yellow-billed Cuckoo	<i>Lynx canadensis</i> <i>Coccyzus americanus occidentalis</i>	T C

Project Description: Describe proposed project or action or, if referencing other documents, prepare an executive summary (attach additional pages as needed):

The Utah Division of Wildlife Resources is proposing to implement rotenone treatments in eight streams in northern Utah from 2012 to 2018, The proposed action will be implemented in cooperation with the Bureau of Land Management (BLM) -- Salt Lake Field Office (SLFO), and in coordination with both the Sawtooth National Forest (NF) and the Uinta-Wasatch-Cache NF. Consultation pursuant to Section of the Endangered Species Act is necessary because partial funding will be provided pursuant to the Sport Fish Restoration Act administered through the Service.

The purpose of the action is to remove non-native fish and then re-establish populations of native fish, including Bonneville cutthroat trout and Yellowstone cutthroat trout. Fish migration barriers would be constructed where necessary before treatment to prevent the reinvasion of non-native trout. Native trout from “core” wild populations or fish produced from UDWR native trout brood stocks would be introduced with the goal of establishing self-sustaining populations. Native nongame fish, namely sculpin and mountain sucker, would be re-introduced into currently or previously (known) occupied streams following treatment. Following the rotenone treatment, other native fish, including northern leatherside chub and bluehead sucker, would be introduced into select streams containing suitable habitat within their respective historic ranges.

The Proposed Action would expand the number of native fish populations and the extent of occupied stream miles within native fish historic ranges, thus implementing specific conservation actions listed in conservation agreements and strategies for native trout in Utah. Implementation of this project would offset threats to Bonneville cutthroat trout, a species recognized by state and federal agencies as a species in need of special protection. The proposed project follows recommendations from FWS to reduce threats to native fish and to provide for the long-term conservation of these species.

See attached Draft EA for more details.

VI. **Determination of Effects:**

(A) Description of Effects: Describe the action(s) that may affect the species and critical habitats listed in item IV. Your rationale for the Section 7 determinations made below (B) should be fully described here.

Even though the project area is within the historic range of the yellow-billed cuckoo, if cuckoos do occupy the area, the impacts of the Proposed Action would be negligible since rotenone is not toxic to birds at the concentrations that would be applied to project waters. Any potential indirect effects would also be minimal. The migratory behavior of the yellow-billed cuckoo, the timing of the projects, the temporary nature of any impacts on some aquatic insect taxa, and availability of alternate (terrestrial) prey items would minimize any potential indirect impacts on the cuckoo or any other insectivorous birds in the area.

The project area is located within the historic range of the Canada lynx; however, because the area is not currently occupied, the Proposed Action would not directly impact this species. Further, the preferred habitat of Canada lynx is montane coniferous forest, and the only habitat disturbance proposed herein would be associated with the construction of migration barriers, which are not anticipated for areas of lynx preferred habitat. Rotenone is not harmful to lynx or their prey species at the concentrations used for fish removal. If any Canada lynx occupied the project area during proposed treatments, they could be displaced temporarily, but this would be brief in duration. It is therefore concluded that the Proposed Action would have no effect on the Canada lynx or its habitat.

Due to the lack of recent, verified black-footed ferret occupancy in any of the areas under the Proposed Action, it is unlikely that the Proposed Action would result in any effect to the black-footed ferret.

Rotenone would not affect vegetation, so any listed plant species present in or adjacent to project areas would not be directly affected by the chemical treatment, including the Maguire primrose. Specific habitat requirements place the species outside the areas of vehicle or foot travel that would be associated with the proposed rotenone treatment in the Right Hand Fork of Logan River. Although other proposed project areas that may be disturbed outside of the floodplain of streams as a result of barrier construction, none are known to contain any listed plant species. Therefore, there would be no effects to listed plant species from the Proposed Action.

ATTACHMENT A

T & E List for Northern Utah Rotenone Project and EA

BOX ELDER COUNTY

Goose Creek milkvetch	<i>Astragalus anserinus</i>	C
Greater sage-grouse	<i>Centrocercus urophasianus</i>	C
June sucker ¹	<i>Chasmistes liorus</i>	E
Lahontan cutthroat trout	<i>Oncorhynchus clarkii henshawi</i>	T
Least chub ²	<i>Iotichthys phlegethontis</i>	C
Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	C

¹ Introduced, refugia population

² The species occupies habitat in one or more hydrologic unit (8-digit HUC) within this county. Any water depletion from an occupied hydrologic unit may adversely affect the species.

CACHE COUNTY

Canada lynx	<i>Lynx canadensis</i>	T
Greater sage-grouse	<i>Centrocercus urophasianus</i>	C
Least chub ¹	<i>Iotichthys phlegethontis</i>	C
Maguire primrose	<i>Primula maguirei</i>	T
Ute ladies'-tresses	<i>Spiranthes diluvialis</i>	T
Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	C

¹ The species occupies habitat in one or more hydrologic unit (8-digit HUC) within this county. Any water depletion from an occupied hydrologic unit may adversely affect the species.

MORGAN COUNTY

Canada lynx	<i>Lynx canadensis</i>	T
Greater sage-grouse	<i>Centrocercus urophasianus</i>	C
Least chub ¹	<i>Iotichthys phlegethontis</i>	C
Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	C

¹ The species occupies habitat in one or more hydrologic unit (8-digit HUC) within this county. Any water depletion from an occupied hydrologic unit may adversely affect the species.

RICH COUNTY

Black-footed ferret ¹	<i>Mustella nigripes</i>	E
Canada lynx	<i>Lynx canadensis</i>	T
Greater sage-grouse	<i>Centrocercus urophasianus</i>	C
Least chub ²	<i>Iotichthys phlegethontis</i>	C

¹ Historical range

² The species occupies habitat in one or more hydrologic unit (8-digit HUC) within this county. Any water depletion from an occupied hydrologic unit may adversely affect the species.

WEBER COUNTY

Canada lynx	<i>Lynx canadensis</i>	T
Greater sage-grouse	<i>Centrocercus urophasianus</i>	C
June sucker ¹	<i>Chasmistes liorus</i>	E
Least chub ²	<i>Notichthys phlegethontis</i>	C
Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	C

¹ Introduced, refugia population

² The species occupies habitat in one or more hydrologic unit (8-digit HUC) within this county. Any water depletion from an occupied hydrologic unit may adversely affect the species.

Appendix E

Public Health Considerations Associated with Rotenone Use

Background

Rotenone use has attracted increasing public attention over approximately the last ten years, because of mounting concern over specific human health hazards associated with rotenone exposure. These concerns, which will be described more fully in subsequent sections, are fundamentally rational: they draw on the findings of a series of research studies published in peer-reviewed, scientific journal articles¹.

Because of the rigorous editorial review process to which scientific research is subjected prior to publication in these sorts of scientific journals, the simple fact that a study was published in such a journal earns a substantial credibility. Especially when patterns of similar or corroborative findings emerge from distinct scientific studies, conducted by different research teams, operating in discrete academic environments -- at times even on separate continents -- the emergent pattern demands attention and deserves closer scrutiny as it begins to consolidate into a new understanding of facts.

The rotenone-effects studies mentioned above describe and experimentally demonstrate a physiological pathway through which rotenone, under well-defined circumstances, causes cell death (*apoptosis*, a cellular biology / medical term indicating a form of programmed "cell suicide") among the type of human brain cells in which apoptosis is linked to Parkinson's-like symptoms. Durkin (2008) concludes that rotenone is neurotoxic, and that concern is warranted.

This dramatic association causes the question to be asked whether there may be a link between Parkinson's Disease and rotenone exposure. Could rotenone use have played a role in the observed prevalence of Parkinson's Disease (PD) in North America? PD is one of the more common movement disorders and clearly constitutes a serious disease affecting many people. What risk exists that rotenone exposure might cause PD among some people?

The seriousness of PD leads quickly to a policy question for natural resource agencies, as to whether rotenone should be applied at all, under any foreseeable circumstances, to free-flowing aquatic systems. It is presumed here and in the rest of the environmental assessment that no preventable cases of PD are considered acceptable.

¹ The studies are too numerous and varied to cite in one place without discussion of their individual relevance; accordingly, the studies are cited subsequently in this appendix as they arise. The literature cited, plus several bibliographic references which may prove useful, are detailed in the concluding section of the appendix.

The agencies, therefore, to comply with the National Environmental Policy Act and to proceed responsibly, must review the potential for public health risks associated with using rotenone in streams and rivers.

Risk assessment in public health

Public health experts generally use a structured process to analyze risk². The two main factors in the equation of risk calculation are: how serious is the potential harm, and what is the probability of the serious occurrence? Describing only the two major terms in the risk equation oversimplifies the complex challenge of assessing public health risk, which generally demands dealing with incomplete and inadequate information, but it provides a foundation of understanding.

To build upon that understanding, the process for estimating public health risk generally makes use of three (or more) distinct analytic phases, or stages. Once all three of the basic stages are completed, the analytical results are combined, and public health experts, epidemiologists, toxicologists and other technical specialists then synthesize the results into an overall risk assessment leading to some type of public health finding.

The first phase is “hazard identification.” In this stage, the qualitative nature of the hazard is described. In simple terms, this phase involves mapping out the elements of the destructive process, demonstrating what could occur, without providing any quantitative assessment of dosing, disease responses, or exposure rates. Instead, hazard I.D. focuses on the mechanisms of how a particular environmental toxicant -- for instance, a pesticide such as rotenone -- would cause harm. Once that mechanism is characterized (qualitatively described), public health specialists have a reason to further analyze the risk posed.

The second phase is “dose / response analysis.” This is essentially the process of determining the relationship between dose, and probability (or incidence) of effect. One way of going about this task is to determine a concentration which is unlikely to produce observable effects. A common conservative approach to dealing with uncertainty is to include a safety factor, typically on the order of 10x for each unknown step in the dose / response analysis. This approach helps to deal with the uncertainty inherent in the complexities and extrapolations required in the absence of full and complete data, which generally are unavailable, especially in complex natural systems.

The third phase is known as “exposure quantification,” and involves attempts to determine the dose individuals are likely to receive. Because of differences in exposures and susceptibilities, the individuals in a population do not respond to exposures all in the same way.

²

http://en.wikipedia.org/wiki/Risk_assessment#Risk_Assessment_in_public_health [Accessed 22 FEB 2011]

Rotenone neurotoxicity³

In 2007 the U.S. Environmental Protection Agency (EPA) completed a re-registration eligibility decision for the use of rotenone and performed a risk-assessment for public health as part of that decision (USEPA 2006, USEPA 2007). Similarly, in 2008 the U.S. Department of Agriculture -- Forest Service commissioned an independent risk assessment for the use of rotenone, including an analysis of public health effects (Durkin 2008). In addition, the potential human health risks associated with use of rotenone as a piscicide have been reviewed and assessed by several other authors in the past decade (Finlayson et al. 2000, Ling 2003, Entrix 2007, Fisher 2007, Turner et al. 2007, Ott 2008, Entrix 2010, Finlayson et al. 2010). Durkin (2008) was a primary reference for evaluating the human health risks of applying rotenone.

In addition to toxicity studies that are relatively standard for pesticides, there is a large body of literature available on the neurotoxicity of rotenone with particular emphasis on the use of rotenone as an animal model for Parkinson's Disease (Jenner 2001, Orr et al. 2002, Greenamyre et al. 2003, Hirsch et al. 2003, Perier et al. 2003, Trojanowski 2003, Uversky 2004, Höglinger et al. 2006, Gomez et al. 2007, Drechsel and Patel 2008). Additional literature supporting the contention that rotenone can have neurological effects has emerged since the Forest Service commissioned its own risk assessment (Durkin 2008); therefore, these studies were also reviewed and incorporated into the consideration of potential impacts to human health (e.g. Dhillon et al. 2008, Hancock et al. 2008, Cicchetti et al. 2009, Allen et al. 2010, Tanner et al. 2011).

The known components of the potential liquid rotenone formulations to be used under the Proposed Action are described in Durkin (2008). Durkin (2008) examined the potential negative effects of these compounds on humans. He concluded that metabolites, a breakdown product of rotenone, did not increase the risk of human health effects associated with the use of rotenone. Similarly, he concluded that available data indicate that the inerts are not present in amounts that would increase the risks associated with the proposed formulations. Durkin (2008) did find that adjuvants and impurities could increase that risk; however, because none of the proposed formulations use an adjuvant (e.g. piperonyl butoxide), there should be no impacts to human health associated with adjuvants under the Proposed Action. The impact of impurities, such as degeulin and the "other associated resins," are considered in Durkin (2008).

Mechanism

Durkin (2008) characterizes the mechanism by which rotenone acts as being well described. Essentially, rotenone interferes with oxidative phosphorylation, a

³ Substantial sections of the following text, and the ensuing discussion of rotenone neurotoxicity, drew heavily from an unpublished specialist's report written in 2010 by Mike Golden, Forest Fisheries Biologist, Dixie National Forest

fundamental process in living cells in which nutrients are oxidized and the energy of oxidation is stored by the conversion of adenosine diphosphate (ADP) to adenosine triphosphate (ATP). While rotenone exposure will result in a decrease in ATP (i.e., an increase in ADP/ATP ratios), there is no indication that the toxicity of rotenone is based on bioenergetic deficits (Sherer et al. 2003; Uversky 2004). Rotenone inhibits a catalyst of the ADP to ATP conversion (NADH dehydrogenase), which resembles oxygen deprivation. This is not because of a direct blockage of oxygen uptake but because the blockage of NADH dehydrogenase prevents the use of oxygen in later stages of oxidative phosphorylation (Fontenot et al. 1994, Finlayson et al. 2000, Entrix 2007). The net result of rotenone toxicity at the cellular level is similar to oxygen deprivation and leads to anaerobic metabolism with the formation of lactic acid leading to acidosis. The central role of oxidative stress to the toxicity of rotenone is also supported by studies indicating that antioxidants can reduce or prevent expressions of rotenone toxicity (Inden et al. 2007; Nehru et al. 2008).

Acute toxicity

Data on acute oral toxicity of rotenone was reviewed in the both the EPA and Forest Service assessments of rotenone (EPA 2006, EPA 2007, Durkin 2008). For characterizing the acute risks associated with oral exposures to mammalian wildlife, the U.S. EPA -- Office of Prevention, Pesticides, and Toxic Substances (EPA 2006) uses acute oral LD₅₀ values of 102 mg/kg body weight in male rats and 39.5 mg/kg body weight in female rats. The lower LD₅₀ value in female rats is associated with a lower excretion rate of rotenone. Other toxicity studies of rotenone formulations that yield somewhat lower LD₅₀ values in terms of rotenone exposure —e.g., 6.5 rotenone mg/kg body weight in female rats — and in terms of combined rotenone and other extracts — e.g., 13 mg/kg body weight in female rats. In all studies, female rats appear to be somewhat more sensitive than male rats.

De Wilde et al. (1986) provide a relatively well-documented case report of a fatal accidental poisoning of a 3-year-old girl in which the dose was estimated at 10 mL of an older liquid formulation, Galicide. Galicide's intended use was as an insecticide on animals. Galicide contains 6% rotenone. Assuming a bulk density of 1 g/mL as an approximation, 10 mL of a 6% rotenone solution corresponds to 600 mg of rotenone. The body weight of the child is reported by De Wilde et al. (1986) as 15 kg. Thus, they calculated a lethal dose of 40 mg rotenone/kg body weight (kg bw). This dose is virtually identical to the oral LD₅₀ of 39.5 mg/kg bw of rotenone in female rats (U.S. EPA/OPP 2006c). The correspondence between the rotenone oral LD₅₀ for female rats and the lethal dose in a young girl may be coincidental, but the overall patterns in the acute lethal potency of rotenone do not suggest substantial species differences. Additionally, Wood et al. (2005) report on the fatality of a 47 year old female with extenuating health issues that died after consuming approximately 200 ml of a Bio

Liquid Derris Plus (0.8% rotenone solution). If the rotenone poisoning was the sole cause of death the estimated dose was 25 mg rotenone/kg bw.

Systemic and chronic toxicity

Durkin (2008) reviewed data on systemic and chronic toxicity and determined that the most significant study in terms of assessing human health affects was the chronic toxicity/oncogenicity study on which the EPA bases the chronic Reference Dose (RfD). In this study, rats were exposed to rotenone at dietary concentrations of 0, 7.5, 37.5, and 75 ppm for 2 years. The daily doses were estimated by the EPA at 0, 0.375, 1.88, and 3.75 mg/kg bw/day. The lowest dose, 0.375 mg/kg bw/day is classified as a “no observed adverse effect level” (NOAEL). Based on decreased body weight accompanied by decreased food consumption, EPA classifies the dose of 1.88 mg/kg bw/day as the “lowest observed adverse effect level” (LOAEL). Relative to a different route of exposure, Durkin (2008) indicated that rotenone is more likely to be toxic by inhalation than by oral exposure because inhalation exposures bypass initial metabolism and detoxification by the liver. Durkin (2008) cites studies submitted to the EPA in support of the registration of rotenone that report 4-hour LC₅₀ values of 0.0235 mg/L in male rats and 0.0193 mg/L in female rats. As with the acute oral studies, female rats appear to be somewhat more sensitive than male rats to inhalation exposure to rotenone.

Durkin (2008) also reviews the potential for rotenone to affect the immune, endocrine, and reproductive systems, as well as its potential to be a mutagen and carcinogen. No studies were found suggesting that rotenone may have an effect on pathogen resistance with *in vivo* exposures. Weight loss is reported in several studies but appeared to be more related to toxicity than endocrine disruption; however, one study reported that intraperitoneal doses of 2 mg/kg bw/day to rats over a period of 30-60 days caused a decrease in plasma testosterone (Alam and Schmidt 2004). Although they attributed the effect to diminished bioenergetics, as well as general oxidative damage to adrenal and testicular tissue, not changes in thyroid or pituitary hormones, an alteration in testosterone levels would constitute disruption of the endocrine system.

Durkin (2008) cites several studies showing potential for developmental impacts in rats and mice including: decreased body weight gain, increased unossified sternabrae, increased resorptions, and decreased fetal survival. The NOAEL for rats was identified by EPA as 3 mg/kg bw/day, while the NOAEL for mice was identified at 15 mg/kg bw/day. Similarly, Durkin (2008) cites studies indicating the potential for reduced litter sizes and pup weights for rats, which produced an NOAEL of 2.4-3 mg/kg bw/day for litter size and 0.5-0.6 mg/kg bw/day for offspring weight.

Parkinson's disease and neurologic effects

Durkin (2008) acknowledges that there is a substantial body of literature concerning the use of rotenone to develop animal models for Parkinson's disease citing numerous published reviews (Jenner 2001, Orr et al. 2002, Perier et al. 2003, Trojanowski 2003, Greenamyre et al. 2003, Hirsch et al. 2003, Uversky 2004, Höglinger et al. 2006, Gomez et al. 2007, Drechsel and Patel 2008). Durkin (2008) points out that all of the early studies and many subsequent studies using rotenone to develop an animal model of Parkinson's disease involve routes of exposure that are not directly relevant to a human health risk (e.g. subcutaneous infusion, intravenous administration, or direct instillation into the brain).

Durkin (2008) focuses on a study by Inden et al. (2007) in which Parkinson's like effects were observed in mice after oral administration of rotenone by gavage (force-feeding through a tube passed into stomach). They treated mice with gavage doses of 0, 0.25, 1.0, 2.5, 5.0, 10 or 30 mg/kg rotenone for 28 days. At doses of 10 and 30 mg/kg bw/day, effects included degeneration of dopaminergic neurons as well as decreased endurance in a "roto-rod" test (a standard assay for motor function, employing a rotating rod mechanism which rodents must travel through; allows a scientifically repeatable quantification of motor impairment). Effects on dopamine neurons were sporadic at 10 mg/kg body weight but were seen in nearly all mice at 30 mg/kg body weight. Furthermore, Inden et al. (2007) discovered an accumulation of protein (synuclein) within viable neurons which may be consistent with Lewy body formation, which is another characteristic sign of PD. Durkin (2008) recognized that the Inden et al. (2007) study showed adverse neurological effects, whether or not they are directly related to Parkinson's disease, may occur at oral doses of rotenone as low as 10 mg/kg bw/day (LOAEL) with an apparent NOAEL of 5 mg/kg bw/day.

While oral administration was able to reproduce some of the neurological effects seen with subcutaneous and intravenous administration in test animals, the same was not true for a study examining potential inhalation effects (Rojo et al. 2007). Rojo et al. (2007) inoculated mice intranasally with a 2.5 mg/kg dose of rotenone for 30 days. They found that rotenone did not produce any obvious motor alteration or damage to the nigrostriatal system.

Despite the publication of the Inden et al. (2007) study showing an oral dose of NOAEL below 10 mg/kg, Durkin (2008) used the most conservative acute and chronic reference doses of 0.015 mg/kg bw/day and 0.0004 mg/kg bw/day derived in the recent EPA re-registration eligibility document for the use of rotenone (USEPA 2007). One of the major reasons that these reference doses were adopted was EPA's use of an uncertainty factor of 1000 in their derivation. The uncertainty factor of 1000 was generated by multiplying together separate factors of 10 for each of three factors considered as contributing to uncertainty: inter-species variability, intra-species

variability, and uncertainties in the available data on rotenone. The factor for uncertainties in the available data reflects concern for the potential of rotenone to cause essentially permanent neurotoxic damage in pre-natal or early post-natal exposures, which might not induce observable adverse effects until late in life.

In addition Durkin (2008) discusses the scientific debate on the use of rotenone as an animal model for Parkinson's disease because of the broader spectrum of neurological effects induced by rotenone relative to the neurological effects seen in Parkinson's disease (Lapointe et al. 2004; Ravenstijn et al. 2008; Richter et al. 2007). The debate continues on if and how the rotenone animal model can be used to emulate the potential effects of Parkinson's Disease in humans (Cicchetti et al. 2009, Cicchetti et al. 2010, Greenamyre et al. 2010).

More recent medical research

Since Durkin (2008), additional studies and reviews have been released supporting and building on much of the earlier work showing that rotenone is a neurotoxin. Many (Allen et al. 2009, Drolet et al. 2009, Klintworth et al. 2009, Meurers et al. 2009) involve routes of exposure not relevant to assessing the human health risk under the proposed action. The most germane studies would be those in which the exposure route mimics those likely under the proposed action's application as well as epidemiological studies of environmental risk factors elevating the risk of Parkinson's Disease.

Pan Montojo et al. (2010) offer information on relevant exposure routes not previously analyzed by EPA and Durkin (USEPA 2006, Durkin 2008). Pan Montojo et al. (2010) administered a rotenone solution to mice intragastrically with a stomach tube at a concentration of 5mg/kg bw 5 days a week for 1.5 to 3 months. They found that mice treated with rotenone produced alpha-synuclein accumulation in a number of nervous system structures. They also observed inflammation and alpha-synuclein phosphorylation in the enteric nervous system and the dorsal motor nucleus of the vagus. Finally, the mice treated with rotenone showed motor system impairment in a roto-rod test.

Epidemiological studies have been published postulating a link between rotenone exposure and Parkinson's-like symptoms in humans (Hancock et al. 2008, Dhillon et al. 2008). Hancock et al (2008) conducted a case-control study of approximately 300 case and 300 control individuals that indicated an increased risk of PD with increasing pesticide exposure; however, they did not find a significantly increased risk specific to botanical pesticides, such as rotenone. Similarly, Dhillon et al.'s (2008) case-control study with 100 cases and 84 controls indicated an increased risk for PD for individuals that had used rotenone versus those that had not.

Prior to these studies, a consensus statement from a group of researchers regarding Parkinson's disease and the environment had determined that there was "limited

suggestive evidence” that people exposed to pesticides had an increased risk of Parkinson’s disease and that there was “inadequate or insufficient evidence” to determine” whether people exposed to specific pesticides have an increased risk of Parkinson’s disease (Bronstein et al. 2007). Essentially these researchers agreed that evidence suggested an association between pesticide exposure and increased risk of Parkinson’s disease but that the body of evidence had bias and/or was confounding. They felt that the quantity, quality, and/or consistency of studies on specific pesticides were insufficient up to that time. Many of these issues apply to the more recent epidemiological studies (Dhillon et al. 2008 and Hancock et al. 2008).

Conclusions differed between studies, for example, Dhillon et al. (2008) claimed a highly significant relationship between rotenone exposure and an elevated risk of Parkinson’s disease, while Hancock et al. (2008) were unable to establish a significant relationship between the use of botanical pesticide exposure and an elevated risk of Parkinson’s disease. Design was an issue, for example, Hancock et al. (2008) disclosing their study design lacked statistical power because of the family-based case-control study design they employed. Dhillon et al. (2008) and Hancock et al. (2008) both had small sample sizes of individuals exposed to either botanical (approximately 14 people) or organic pesticides including rotenone (23 people).

Although they tried to control for it, Dhillon et al. (2008) identified several forms of bias involving self-reported data by subjects and case vs. control knowledge of subjects by interviewers. Finally, Dhillon et al. (2008) raise questions of their own that could affect their conclusions. The authors argue that elevated risk for Parkinson’s disease may be attributable to rotenone based mostly on the responses to the question of “any rotenone use”; however, they also state that the question on “use of ‘organic pesticides’ such as rotenone in the past year” may reflect other pesticides that subjects considered as organic pesticides. Given the questions surrounding bias and study design, raised by authors themselves, these epidemiological studies do not provide a definitive causal link between rotenone exposure and an increased risk of Parkinson’s disease. Additionally, relationship of the study to the Proposed Action is also of question, because the Dhillon et al. (2008) study had only 2 (maybe 3, although this is unclear in the study) of the 100 case studies and none of the 84 control studies using rotenone in a fisheries context, and no information is provided on application methods or rates.

Finlayson et al. (2010) recently published a manual detailing Standard Operating Procedures for the use of rotenone. As with the many risk assessments that have been conducted for the use of rotenone as a piscicide, they concluded that while rotenone can indeed cause neurological problems, adverse effects are unlikely given the quick degradation time of rotenone, the small concentrations used during piscicide treatments, and the limited exposure routes.

Since Finlayson et al. (2010), two significant additions to the medical research literature on the effects of rotenone have emerged. Tanner et al. (2011), using a more robust experimental design, studied 110 people with Parkinson's disease and 358 matched controls from the Farming and Movement Evaluation (FAME) Study (<http://www.niehs.nih.gov/research/atniehs/labs/epi/studies/fame/index.cfm>) to investigate the relationship between Parkinson's disease and exposure to pesticides or other agents that are toxic to nervous tissue. People who used rotenone or paraquat pesticides developed Parkinson's disease approximately 2.5 times more often than non-users. The particular significance of this finding is that it, for the first time, demonstrates a clear correlation between rotenone exposure and Parkinson's disease. This conclusion intensifies the interpretation of "neurological problems" acknowledged in the Finlayson et al. (2010) report, but otherwise does not impact their conclusion that adverse effects are unlikely, which they attribute to rapid natural degradation, low concentrations which are carefully controlled, and limited exposure routes which have potential to impact the public. Chemical neutralization of rotenone provides a further measure for decreasing the likelihood of any public exposure.

Effects on public health from potassium permanganate

Durkin (2008) considered the potential risks associated with using potassium permanganate to neutralize rotenone. Literature reviewed in the assessment indicated that potassium permanganate is a strong oxidizing agent, is irritating to the skin and respiratory tract, and can cause severe eye damage on direct contact. Literature also indicated excessive oral exposures to potassium permanganate can cause irritation to the gastrointestinal tract. Latent symptoms similar to Parkinson's disease were reported in a single case study; however, that case study used a concentration of potassium permanganate 230 to 455 times the concentration of potassium permanganate that would be added to detoxify rotenone. Additionally, potassium permanganate will not persist in the water, because the oxidation reaction it has with rotenone will reduce it to potassium and manganese.

Effects on public health from post-oxidation elements

Durkin (2008) considered the potential human health effects of increased potassium and manganese concentrations in water following the oxidation reaction with rotenone. Both manganese and potassium are essential elements; however, excessive exposure to manganese can also cause neurological issues termed manganism or manganese-induced Parkinsonism. Durkin (2008) found that this neurotoxicity was well documented for inhalation exposure but less so for ingestion exposure. The studies that were available suggested that in the absence of very high levels of background manganese levels, the small increase (generally 140-280 µg/l) in manganese associated using

potassium permanganate as a neutralization agent should not elevate human health risks.

Potential for public exposure from the Proposed action

Public exposure routes to rotenone, the associated chemicals in rotenone formulations, and the potassium permanganate neutralizer as part of the proposed action consist of the following:

- 1) Dermal, inhalation, and possible ingestion exposure to non-pesticide applicators within the project area.
- 2) Dermal, inhalation, and possible ingestion exposure to non-pesticide applicators outside of the project area.
- 3) Ingestion exposure to non-pesticide applicators from consumption of fish, wildlife, livestock, and/or crops exposed to rotenone within or downstream from the project area.

Dermal, inhalation, and possible ingestion exposure to non-pesticide applicators within the project area

Durkin (2008) found that non-accidental acute exposure scenarios for the general public within a given project area where 200 µg/l active ingredient rotenone was being applied would modestly exceed the level of concern (hazard quotient central estimate = 1.3 upper bound = 1.9). The scenario that exceeded the level of concern involved a child drinking water from a treated water body. At the maximum active ingredient concentration to be used under the proposed action a 40 pound child would have to drink approximately 2.5 liters (0.7 gal) of water from the treated area during the treatment period to reach the most conservative acute Reference Dose (0.015 mg/kg bw/day) offered by the EPA and accepted in the Forest Service Risk Assessment (USEPA 2007, Durkin 2008). The chronic reference dose is not germane since rotenone has not been shown to persist in flowing water and potassium permanganate will be used to neutralize the rotenone (Finlayson et al. 2001, Finlayson et al. 2010).

To reach the lowest observable effects level for neurological effects (5 mg/kg) seen in the Pan Montojo et al. (2010) study, a 40-pound child would have to drink 913 liters (241 gal) of water from the treated area during the time of treatment. Finally, to reach the lowest level (25 mg/kg) observed to cause mortality in a human (in association with other chemicals and health issues), a 40-pound child would have to drink 4,563 liters (1,205 gal) of water from the treatment area during the treatment. Therefore, it seems unlikely that the general public would suffer ill effects unless a large amount of water were consumed directly from the treated area.

Such water consumption by the public should be highly unlikely under the proposed action. Public news releases and community postings prior to the treatment will inform

the general public to avoid the treatment area during the treatment. Similarly, design criteria include EPA's recommended mitigation measure of placarding to instruct the public not to enter the treatment area (EPA 2007). Rotenone exposure to the general public within the treatment area should be limited and consumption levels (sufficient to cause ill effects) unlikely; thus, the public health risk would be low.

Potassium permanganate ingestion can cause gastrointestinal irritation and possibly neurological damage but at considerably higher doses than those specified under the proposed action. Informing the public and restricting their access to the treatment area, per design criteria, should ameliorate the risk of the general public consuming water with potassium permanganate in it. Levels of elemental manganese and potassium will be temporarily increased in the treatment area but not to a level expected to increase human health risks.

Dermal, inhalation, and possible ingestion exposure to non-pesticide applicators outside of the project area.

Because potassium permanganate will be used to neutralize the rotenone formulation at all areas where water can exit the treatment area, exposure to the general public outside of the treatment area and the 0.25 to 0.5 miles downstream of the neutralization stations would range from limited to nonexistent. Contingency potassium permanganate stations will be used in the event that the main stations malfunction. Additionally, to ensure that neutralization is proceeding properly, the sentinel fish monitoring procedures highlighted in Finlayson et al. (2010) will be used. Informing the public and restricting their access to the treatment area, per design criteria, should ameliorate the risk of the general public consuming water containing potassium permanganate.

Stream courses over 0.5 miles downstream from neutralization sources will not contain concentrations of rotenone or potassium permanganate high enough to be a public health concern (Finlayson 2001, Durkin 2008, Finlayson et al. 2010). Levels of elemental manganese and potassium may be temporarily elevated downstream from the project area but not to a level that would increase human health risks (Durkin 2008).

Ingestion exposure to non-pesticide applicators from consumption of fish, wildlife, livestock, and/or crops exposed to rotenone within or downstream from the project area.

As highlighted above the use of the neutralization station will ameliorate any concerns with public consumption of crops watered downstream from the project area. Areas that might use irrigation water to irrigate personal or commercial crops for human consumption are sufficiently far downstream from the closest neutralization station, that no active chemicals should still be present.

Durkin (2008) examined the potential bioconcentration of rotenone in fish exposed within a treatment area and found that the level of risk through human consumption of these fish was low. Any risk would be further ameliorated by informing the public and restricting public access during and shortly after the treatment. The public would be warned against consuming the fish, not just because of the rotenone but also because of hazards from bacterial growth in the dead fish.

It is possible that game animals that may be harvested for human consumption could consume water that has been treated with rotenone. In his review of rotenone toxicity, Ling (2003) found that rotenone is “not easily absorbed in higher animals and does not accumulate in the body.” Absorption is relatively slow and, if absorbed, is broken down by the liver to less toxic, excretable metabolites. Livestock that may be used for human consumption may also ingest water from the treated area; however, consumption by livestock would be very low, because the overlap in period of use by livestock and presence of rotenone or potassium permanganate in the water would occur only briefly. Also, other water would be available for livestock in the area. Durkin (2008) reviewed literature regarding the absorption and excretion of ingested rotenone and it would suggest that bioaccumulation is not likely in exposed animals. With potential exposure of animals limited, potential for bioaccumulation in animals low, and human consumption of exposed animals low, human exposure to bioaccumulated chemicals in animals is even less likely. In addition, at the concentrations to be used under the proposed action, an enormous volume of water from the treated area would have to be ingested during the 6-8 hour treatment time frame in order for a significant concentration of chemical to undergo uptake in any exposed animal.

Implications of these findings

Potential impacts to human health from exposure to rotenone have been recently reviewed by both the EPA during the re-registration process for rotenone use and by the Forest Service in relationship to the use of rotenone as a piscicide (USEPA 2006, USEPA 2007, Durkin 2008). Rotenone has been shown to have acute and chronic impacts to laboratory animals, and there are two documented cases of fatal rotenone poisoning in humans. Rotenone has been shown to be a neurotoxin in test animals when administered at certain amounts for certain time periods, in some cases producing symptoms similar to certain forms of Parkinsonism, although the routes of exposure and concentrations differ from those of the Proposed Action.

While rotenone and potassium permanganate have been shown to have potential impacts to human health, the concentrations to be used, duration of application, and potential exposure routes in the proposed action limit the potential for human health impacts. Each past treatment in the cumulative effects analysis occurred for one day in four of the last 11 years, resulting in potential acute exposure but not chronic exposure.

Because there would be no chronic exposure from the proposed action, there would be no added effects and, thus, no cumulative effects to public health are expected.

Additionally, neutralizing rotenone with potassium permanganate, informing the public of treatment timing and location, and restricting public access to the treatment area would further ameliorate potential human health risks through reducing chemical exposure. With no direct effects, including no chronic effects, there would be no cumulative effects from any of the alternatives. Although there is the potential for acute exposure to rotenone under the proposed action, under the application schedule, there would not be chronic exposure that could affect public health; therefore, there would be no cumulative effects under the proposed action.

Conclusions and recommendations regarding the current proposed action

Considering the nature of the proposed action, the planned application and neutralization mechanisms, and the brevity of the treatment schedules, the public health hazards are essentially controllable. The mitigation mechanisms recommended by U.S. EPA under current rotenone product labeling should be incorporated into the NEPA documentation as requisite elements of the proposed action. Systematic use of sentinel fish, and carefully monitored application of potassium permanganate as a neutralization agent, should permit project staff to avoid exposing the public to any active rotenone or potassium permanganate compounds. Ultimately, neutralization is the key to avoiding public health risks related to rotenone use, as none of the demonstrated toxicity of rotenone persists once it is fully oxidized with potassium permanganate, or otherwise naturally oxidized. To further ensure that no unintended exposure pathways remain open, project personnel should coordinate before treatment with all municipal water authorities in areas located within 5 miles downstream of neutralization stations. With these steps applied, there should be no discernible public health risk associated with rotenone use, as described in the proposed action.

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Appendix F

Transcription of public comment on the proposed projects at a meeting of the UDWR Northern Regional Advisory Council (RAC), a citizen oversight committee to UDWR, on May 20, 2009

(transcribed by Matthew McKell, UDWR, circa February 2010, from digital recording)

Craig Schaugaard, Native Cutthroat Trout Restoration Presentation (runs from 01:28:20-01:42:01)

Brad Slater: Questions from the public on this presentation? Questions from the Council? Jim.

Jim Gaskill: First of all, how many species of cutthroat trout are there?

Craig: In Utah?

Jim: Anywhere.

Craig: In Utah there's three.

Jim: Three species?

(Paul Cowley: Subspecies)

Craig: Three native species.

Paul: Subspecies.

Jim: Three native species.

Paul: Subspecies.

Jim: Want to define species?

Craig: Huh?

Jim: Would you define species for me?

Craig: They're subspecies.

Jim: Okay, and then there's how many, so there's how many species? One? One species.

Craig: There's one cutthroat species, then there's several, we have three subspecies: Yellowstone, Colorado, and Bonneville. The Fish and Wildlife Service considers those as three separate species, and they petition them for listing, they've petitioned all three of them for listing.

Jim: All three subspecies.

Craig: Yes.

Jim: And then we have what you're calling strains?

Craig: I'm probably mixing those two terms. Well, no, we have--there's evidence that Bear Lake and Bear River cutthroat might not actually be Bonneville, they might be a Bear River cutthroat, but for right now they're being called Bonneville, and so that's why I called those two different strains.

Jim: And so, is the bottom line that we don't really have good definitions of strains vs. subspecies vs. species?

Craig: No, we have a pretty definite on the subspecies. We know that--

Jim: What is the definition of a subspecies?

Craig: I wouldn't know the scientific definition.

Roger Wilson: Can I add something?

Jim: Please.

Roger: Greenbacks are also here in the state.

Craig: That's true, I forgot that.

Paul: Four subspecies.

Roger: So we have four and I think Craig's alluded to this, strains is really below the subspecies level. The Bear Lake cutthroat is a strain of the Bonneville. So does that make it clear, or not?

Jim: It answers my question. My question, though, is one of, I guess--maybe we'll drop that line of questioning and go to another line of questioning, which is, what is the basic reason for this whole cutthroat program?

Craig: To prevent listing.

Jim: To what?

Craig: Prevent listing.

Jim: To prevent listing, so it's not so much biological, that it's mandated by the feds. Is that what you're saying?

Craig: We don't want it to be mandated by the feds. Right now it isn't, and if we don't do things to conserve the species, it will become that way.

Roger: Well, and Jim, I'd like to add, too, that there are intrinsic values with this fish. They are native fish, there are a lot of people interested in these fish, a lot of anglers travel from all over the West to catch native Bonneville cutthroat trout. I ran into some guys from Seattle who were in the West Desert in Baker, Nevada, looking for Bonneville cutthroats. So, you know, there are other values. Certainly, we do want to prevent listing, but we feel like we have a responsibility to maintain these native fish as well.

Craig: And we actually have five species of cutthroat in the state, but only four of them may be native.

Jim: Subspecies.

Craig: Well--

Brad: Would that be Lahontan?

Roger: Oh, that's right.

Craig: We have Lahontans in a couple of drainages.

Jim: They're all still *Salmo clarkii*, right?

Craig: Yes.

Roger: That's correct.

Jim: Yeah, okay.

Unknown: *Oncorhynchus*.

Roger: Yeah, right. *Oncorhynchus* is the genus now.

Jim: Species.

Craig: *clarkii* is the species name, *Oncorhynchus* is the genus.

Jim: Yeah, okay, but those names change and they're based on taxonomists ideas of what a species is and what a subspecies is and it's not as straightforward as saying what is and what it

isn't and all of us who have done a little study of taxonomy understand that, that next year there might be another strain or next year some biologist might decide that there's two species of cutthroat, for that matter, might happen.

Craig: Genetics is pushing that a lot.

Roger: As Craig alluded to, there's really two lineage groups in the Bonneville Basin. The Bear River cutthroat were diverted into the Bonneville Basin when the Bear River diverted into Lake Bonneville, and that was a separate invasion from the original Bonneville invasion. And so we have two, well, you could call them lineages, you could call them strains, whatever you will, but that's why Craig mentioned we go with the nearest neighbor. The nearest neighbor is the safest approach. Like in Rich County, if we want to recover that fish, we come up with a fish that's close at hand. There's strains, there's subpopulations, there's discrete population segments, there's all sorts of things, but you're really safe by going nearest neighbor on recovery.

Jim: And there's individual variation as well.

Roger: We want individual variation, you don't want to get your population based on too few of individuals because you have inbreeding suppression that way.

Jim: We'll let somebody else ask a question, then I'll--

Brad: I'm glad we had a lesson on taxonomy, I'm still struggling from 30 years ago with p-orbitals and s-orbitals and you're trying to get me through that.

Jim: We won't go into that. And so, what's wrong with brook trout and brown trout?

Craig: In the right places there's nothing wrong with them. They have a competitive or maybe even a predation advantage over cutthroat trout and most often displace cutthroat trout and eliminate them from--

Jim: That's because they're--

Craig: They're better competitors.

Jim: They're better adapted to whatever environment they outcompete in, correct?

Craig: They're competitors, yes, in most cases. Sometimes they aren't. In certain situations they can't outcompete cutthroat, but often they do.

Roger: Well, in the East the brook trout aren't doing very well in their native habitat in many cases, so same issues--you've got non-native fish introduced. The brook trout do very well in Utah systems, especially High Uinta-type situations. But as Craig mentioned, these fish are not for everywhere, we want brook trout to be available to anglers, but we also need native cutthroat in waters and we need to expand our efforts.

Brad: Any more questions?

Jim: About a hundred of them, but I think I'll let it go for now.

Brad: I think we should go for a road trip to the North Slope and see these and have you ask your questions.

Jim: Can I ask one more question? Is it true that Colorado spent \$400,000 and discovered they had the wrong strain of cutthroat?

Craig: I know they've had some issues over there concerning the Greenbacks and the Colorados, I'm not up-to-date on that, and that's kind of part of, you know, when we discovered them in the La Sals that we were kind of surprised by that because the literature said that they shouldn't have been in those areas. But then as they have re-looked at how they distributed that it is possible that they are native to that. This is all science and we don't know everything and we're continuing to obtain knowledge and we just need to do the best science we can with the knowledge that we have at present time.

Brad: Okay, thank you, Drew. (01:50:25) We'll come to Public Input now, we have Paul Roberts who would like to address native trout restoration.

Paul Roberts: A lot of my questions have been answered about the various strains that would be put in there. How Yellowstone got into the Raft River drainage is a question, were they planted or are they--?

Craig: The Raft River often connects with the Snake River and we believe that they probably still migrate out of the Snake in good flow years up the Raft River and into this drainage.

Paul: Are they the lower stem, middle stem, Jackson Hole strain, Snake River, *Oncorhynchus clarkii behnkei* version, or are they one of those many unidentifieds?

Craig: I don't know that, Matt do you know?

Matt McKell: I think they've identified them as the large-spotted Yellowstone.

Paul: The Yellowstone Lake version?

Craig: Yes.

Paul: They must have been hauled there.

Matt: Well, they're mixed throughout the drainage. There's two, basically two strains, as far as they understand at this time, in the Snake River drainage. They have of large-spotted Yellowstone cutthroat and then a race, I guess, or a strain that they refer to as the Snake River cutthroat, and those are a little bit separate from the fine-spotted, so I guess technically there's probably three.

Paul: Okay, I guess the Colorado got into the Uintah Basin natively, or did they--

Craig: Through the Colorado and Green rivers.

Paul: So they really belong there?

Craig: Yes.

Paul: Okay, obviously if you eliminate the fish from a stream, you ought to bring in the nearest neighbor, which you seem to be planned on, but catching 300 fish or a hundred fish, hauling them over 10 miles, is this going to be enough contribution of fish to re-populate it and maintain a--

Craig: Genetic diversity?

Paul: ... a genetic thing and a population enough... I consider that you take the fish, run them through a multiplication in the hatchery for one or two generations, then put them back to challenge them with the specifics of that drainage. Then, after a generation, then you multiply them again to reinforce functional selection for that particular drainage. You're also selecting for suitability for hatchery propagation of that strain. If there's fishing pressure, the native reproduction might not be there and some strains of trout just don't transfer from one kind of waters to the other and then still set up a reproducing population. It's amazing, Atlantic salmon do great in hatcheries anywhere in the world, but they can't move them between river basins 50 miles apart. And I'm sure that cutthroat may, because of its varieties of cutthroat that are available, there's probably more difference between a cutthroat and another cutthroat from different places or environments than there is between cutthroat and a generic rainbow, there's such a broad spectrum of varieties of cutthroat. And so we need to really reinforce that we use the proper fish in the specific waters and then do things that will enhance the population, even if it means doing it through a hatchery system. Salmonids, if you have the lake at the head of the water, and they s-...

Brad: Mr. Roberts?

Paul: Time?

Brad: Way over time.

Paul: Okay...upper end or if they spawn below the lake are not going to work, ones that spawn above the lake. Thank you.

Brad: Alright, any more input from the public? Okay, input from the Council? Yes, Professor.

Jim Gaskill: Well, if it isn't already obvious, I'm philosophically and biologically opposed to killing a fish that is better adapted to the environment simply because it was brought here by a man rather than swam upstream.

Brad: Paul.

Paul Cowley: Having worked in the Uintas and here along the Front for the last 16 years, I'll just give you my perspective. Over on the North Slope of the Uintas in the Blacks Fork when we surveyed that two years ago and it had been previously surveyed about eight years ago, we saw that areas eight years ago that only had cutthroat, two years ago had shifted to almost 60% brook trout in those areas. We have also seen the loss of mountain sucker that were there disappear from that survey reach with brook trout moving into those areas. As you look up the Logan River, when I first got here we were busy doing a tagging study up in the upper end of the Logan to see which tributaries those native cutthroat were using so we could see the significance of each of those tributaries. At that time we were only picking up one or two brown trout in those tribs. More recent studies, and we typically try and go on a 10-year cycle because we have over 650 miles of stream on National Forest lands just on the Wasatch-Cache portion, and we try to hit an entire basin at a time, but we've seen a marked increase in brown trout in both the distance up that drainage that they've traveled. If you look specifically at Spawn Creek, we typically had a few brook trout at the top of that drainage, a large section of nothing but cutthroat, and then a few brown trout down near the bottom. When we worked on that trib just a few years ago, there is no 100% cutthroat section anymore; brown trout have moved all the way up that drainage to where they basically intersect the brook trout up there. My concern is right now we have a cooperative agreement between the states and also the land management agencies, the tribes, Fish and Wildlife Service -- Craig's correct in that a lot of these cutthroat species have been petitioned for listing. Because of the active management that those cooperators have done, it's left that management in the forum here, at the RACs, and has allowed us to continue to manage for those species. If they become listed, then that management opportunity is withdrawn from this group and from the public and is moved to the federal agency and the federal agency does recognize the individual subspecies as separate groups and have entertained petitions on those individual subspecies. With the Forest Service, we support the actions that the state is taking and recognize that in some cases we have our own processes that we have to go through to accept public comment, but we just view that that's fairly critical to try and protect these native species here within the state. In some cases we've altered the habitat significantly; if you look on the North Slope, we ran railroad ties down those drainages for the railroads between 1880 clear up until 1930, and banked miles of stream to make a canal ditch out of them to make those railroad ties which shifted some of that habitat emphasis to these non-native species. So, I'm not trying to sway, but I think it's important that we as the State of Utah try to maintain the responsibility we have to care for these native fish and other native wildlife, if not for the fishing opportunities they provide but the watchable wildlife opportunities and I think the steps that the Northern Region here is proposing help us basically preserve this species for our grandchildren. If you think about some of the activities that may have occurred in the past, if you look at some of the survey work done in the 1870s when we had three-foot long cutthroat in Utah Lake, and what a treasure that would be if those were still there today. There were different values and the early researcher said unless we implement regulatory changes and get support from the public, we'll probably lose this group of fish; and he was right on, back in the 1870s. So, I'd encourage us to really look at opportunities to preserve that native wildlife of the State of Utah and let the management occur where public can have an input and meet those needs. Thank you.

Brad: Any further input? Shawn, and then Jim.

Shawn Groll (02:01:55): As a representative of the public at-large, I've had a few comments, specifically with the Rich County one. I think we probably need to do some of these things to keep them from being listed. But most people over there don't care if it's a rainbow or a cutthroat, so my only concern and I think there's some things we can do about it, is if we've got the three streams over there to be treated, still provide some fishing. If we're treating one, obviously there's going to be no fishing in that stream, and if we're taking some of the fish from another one, that one's going to be cut drastically. So, at least, and I know you mentioned some of it, stock some sterile rainbow or something for a few years until these native fish get established, still provide that because those three streams over there are about the only ones that the kids over there fish and they spend a lot of time up these streams fishing for. And near stream work is good and it's great, but in the meantime if someone's got a kid and it takes five, six, seven, eight years, like Paul said, for different ones to get established, during that time a lot of those kids are grown up and gone in that eight year when they really need to be out there fishing. So that would just be a concern I would have, to think about and maybe implement some things in the meantime with some other stocking options.

Brad: Jim.

Jim: Yeah, well, I realize I'm a lone voice in the wilderness, and I don't expect that I am ever going to change the federal government's mind on sensitive species, but I commented last week about extinction and letting biological processes. If you tell me that there didn't used to be any brown trout in the river and there are brown trout now, that tells me that something has changed to make it so that brown trout are doing better and if we're talking about a bad fish, if we're talking about a fish that's going to harm the environment, like an invasive purple loosestrife, we're not talking about that, we're talking about a good fish, a brown trout is--I think the majority of anglers like brown trout better than they like cutthroat trout, and they probably like brook trout better than they like cutthroat trout. So that's my opinion, and I may be wrong, but I don't think anybody considers any trout to be something that hurts the environment, other than maybe outcompeting another trout and that's nature, that's not politics, that's nature and so if the brown trout crowd out the brook trout then that tells me brown trout are outcompeting and there's some reason for that. We're not to blame for that. So I think we just have to be very, very careful in saying well, this is a sensitive species and so we've got to save it. Maybe we've got to save it, maybe it's time has passed, just like 10 million million species that were extinct before us and we didn't do that and we probably aren't making the cutthroats become extinct either, the brown trout and the cutthroat trout, or the brook trout, are doing it naturally. We're the ultimate non-native species here, of course.

Brad: Alright, we've had some good mental jousting here and that's good. I would just point out that it's 10 after 8 and we've been after a few informational items, we still have some action items to go. So we'll have plenty of opportunity for some more dialogue and more information to surface in those things, but at this point I'm going to call a recess... (02:05:50)

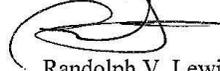
Public Comment Letters:

Dear Dr. McGillivray,

I would like to make a positive comment on the recommended alternative of using rotenone to remove undesirable fish in several northern Utah streams to enable reestablishment of native cutthroat trout. Being a Professor of Biology at USU as well as an avid flyfisherman for many years I feel I have substantial expertise in evaluating this proposal. Having studied the proposal and the expected outcomes I believe this is by far the best choice. I realize that there are some who fear the use of rotenone but frankly it is effective and safe as used by those with the training and knowledge to use it properly. I have had the opportunity to talk and discuss the Right Hand Fork proposed work with the UDWR personnel involved and have no doubts about their ability to carry out the proposed work safely and effectively. There are also those who would like to see the predominantly brown trout fishery in the Logan River and its tributaries maintained as is. Frankly from both a biological and fishing perspective there is plenty of river miles of brown trout fishing and the impact of removing these 6 miles from Right Hand Fork will have no real impact at all.

Thank you for your consideration of this letter. Also I need to note that this is written as a member of the public and in no way represents the views of Utah State University or any of its departments.

Sincerely yours,



Randolph V. Lewis
USTAR Professor of Biology
Synthetic Biomanufacturing Center
Utah State University
3832S 250E, Nibley, UT 84321

Received in WSFR

APR 18 2012



Cache Anglers
POB 3303
Logan, UT 84323

11 April 2012

Chief, Wildlife and Sport Fish Restoration Program
U.S. Fish and Wildlife Service
P.O. Box 25486
Denver, CO 80225

To whom it may concern:

After reviewing the Draft Environmental Assessment for Native Fish Restoration and Enhancement Projects in Northern Utah, the Northern Utah chapter of Trout Unlimited has prepared the following comment.

We are in favor of rotenone treatment of the Right Hand Fork of the Logan River for the purpose of nonnative fish removal and Bonneville cutthroat trout restoration.

Cache Anglers has been working with the Paul Thompson and other UDWR personnel to establish a population of Bonneville cutthroat trout in Right Hand Fork. The goal is to create a Bonneville cutthroat trout stronghold that will feed the Logan River with cutthroats, which will in turn strengthen the Logan River cutthroat population in its battle with nonnative brown trout encroachment. This project now requires removal of nonnative brown trout upstream of the newly established fish barrier in Right Hand Fork. Cache Anglers understands there are risks and impacts of using rotenone for fish removal, and these are well explained in Environmental Assessment. Mr. Thompson and others have also explained the process and associated risks to our organization.

We are convinced the rotenone treatment of Right Hand Fork will be carefully and properly conducted, that there will be no lasting negative impacts to Right Hand Fork, and that the risks of negatively impacting the Logan River are negligible.

For these reasons, we are hopeful that this Environmental Assessment will be finalized and the rotenone treatment permitted, so that we may take the next steps in our conservation efforts in this area.

Sincerely,

A handwritten signature in black ink, appearing to read "Chadd VanZanten". The signature is written in a cursive, flowing style.

Chadd VanZanten
President, Cache Anglers

Response to Public Comments:

Randolph V. Lewis

We agree with Dr. Lewis, a biology professor at Utah State University, that rotenone is safe and effective when used by personnel who are properly trained in the current rotenone application and monitoring practices, as all involved UDWR personnel would be. We, as well, consider rotenone the best choice to remove brown trout from the Right Hand Fork of the Logan River. As Dr. Lewis pointed out, only six river miles are being treated in the Right Hand Fork, so that many miles of angling opportunities will remain for brown trout living elsewhere within the Logan River system (as well as other streams in Cache Valley, e.g., Blacksmith Fork), following rotenone treatment of the Right Hand Fork.

Chadd VanZanten, President, Cache Anglers

We have been meeting with Cache Anglers during the past 3-4 years and they have been involved in the planning phases, and therefore are supportive, of the rotenone treatment of the Right Hand Fork of the Logan River. We also agree with Chadd and the Cache Anglers that there will be no lasting impacts to the Right Hand Fork or Logan River following the treatment. Particularly, we appreciate informed, involved, active support of this local chapter of Trout Unlimited.