Trout Habitat Restoration Plan

Implementation Plan

Upper West Branch LeClerc Creek Native Fish Restoration Phase 2: Proposed Piscicide Treatment

Prepared for:

Box Canyon Hydroelectric Project
Technical Committee

Submitted by

Brian M. Walker, Nick J. Bean, Shane Harvey, William P. Baker, and Jason A. Olson

July 19, 2024

Table of Contents

List of Figures

List of Tables

1.0 INTRODUCTION

The Box Canyon Hydroelectric Project (FERC license no. 2042-013) is operated by the Public Utility District No. 1 of Pend Oreille County (PUD). Box Canyon Dam is located on the Pend Oreille River in Northeast Washington State, approximately 90 miles north of the City of Spokane. On July 11, 2005, the Federal Energy Regulatory Commission (FERC or Commission) issued a new license for operation of Box Canyon Dam (Order; US-FERC 2005). Some of the provisions in the Order were subsequently modified in a Settlement Agreement (SA) and included in an order amending the Project license on February 19, 2010 (130 FERC 61,148; US-FERC 2008). Amongst other amendments was a requirement for the Trout Habitat Restoration Plan (THRP) in the Box Canyon Watershed (Appendix A of the License Amendment Order, Revised 4(e) Condition 6).

Per the THRP, the PUD is required to restore 164 miles of tributary habitat. Conditions for habitat restoration are provided in Section 1.1 as follows:

> *The Licensee shall restore 164 miles of tributary habitat pursuant to the terms identified in this section. These restoration efforts shall be completed within 25 years of this agreement and shall be prioritized in the Calispell, Cee Cee Ah, Cedar, LeClerc, Indian, Mill, Ruby, and Tacoma creek watersheds. If 164 miles of appropriate tributary habitat cannot be restored in these watersheds, restoration efforts may occur in other watersheds in the Project area with priority given to suitable streams within Pend Oreille County. The Secretary retains authority to continue requiring additional Restoration Projects by the Licensee, if at the end of the 25-year implementation period 164 miles of restoration has not been achieved, until the Licensee achieves 164 miles of restoration.*

In Section 1.3.1, the THRP goes on to say:

> *"Restoration" of each stream segment will include a combination (some or all) of the following measures as determined necessary by the Technical Committee:*
>
> - *Channel improvements (limited to geomorphologic improvements and barrier removal)*
> - *Floodplain restoration*
> - *Riparian corridor restoration*
> - *Fencing*
> - *Conservation easements and/or purchases*
> - *Non-native fish removal (see section 1.3.2)*
> - *Reintroduction of target fish species (see section 1.3.3)*

In meetings of the Box Canyon Technical Committee (TC) and Fish Subcommittee (FSC) during 2019, an agreement was reached that restoration work in the LeClerc Creek Watershed (Figure 1) would be the top near-term priority. The TC and FSC approved Phase 1 of the Upper West Branch LeClerc Creek Native Fish Restoration project in 2020, with field work beginning during summer 2020 and completed by summer 2022 (WDFW & KNRD 2020, Walker et al. 2022).

Phase 1 of the Upper West Branch LeClerc Creek Native Fish Restoration project consisted of data collection to inform proposed piscicide (rotenone) treatments (Phase 2) of the Upper West Branch LeClerc Creek (UWBL) Watershed. The treatments would remove non-native fish (e.g., Brook Trout *Salvelinus fontinalis*) in preparation for native fish restoration (e.g., Westslope Cutthroat Trout *Oncorhynchus clarkii lewisi;* WCT). Data collected in Phase 1 are described in Walker et al. (2022) and have been incorporated into a piscicide treatment implementation plan (this document) in support of the non-native Brook Trout eradication proposal.

The UWBL Project Area is located within the LeClerc Creek Watershed, in Township 36N, Range 44E, Sections 3 and 4, and Township 37N, Range 44E, Sections 14-17, 20-23, 25-29, and 32-35. It encompasses approximately 13.4 km (8.32 miles) of UWBL and tributaries (Table 1).

2.0 TEMPORARY FISH MANAGEMENT STRUCTURE

Given the size and complexity of the UWBL Watershed, a single piscicide treatment above the confluence with East Branch LeClerc Creek would not be feasible. Rather, the watershed must be divided via the use of temporary Fish Management Structures (tFMS), allowing non-native fish eradication to proceed in stages (e.g., Flume Creek tFMS; Baker and Walker 2019).

A site immediately upstream of United States Forest Service (USFS) Road #1935 was selected (Figure 1), based on a combination of slope, valley confinement, and access (Bruce Heiner, Environmental Engineer, pers. comm). Additional tFMS site surveys to inform design and construction were conducted in spring/summer 2022 by the PUD, and 100% design was completed in November 2022 (Scott Jungblom, Natural Resource Manager, PUD; email to FSC November 22, 2022). The project went to bid in April 2023 and was completed in September 2023 (Figure 2). As described in this document, annual piscicide treatments will be proposed to proceed above the tFMS until eradication of non-native fish is achieved. Following that, WCT would be reintroduced to the treated area. Concurrent with upstream WCT reintroduction, non-native fish eradication would be proposed to commence below the tFMS.

3.0 LAND OWNERSHIP

Most property within the UWBL Project Area is owned by the USFS (>98%; Colville National Forest; CNF; Figure 3). Private inholdings within the project area (<2%) are owned by Stimson Washington, Inc. (timber company) and are limited to a single small parcel in the Diamond Fork Tributary 2 (DF T2) drainage.

4.0 PROJECT AREA ACCESS

Portions of the UWBL Project Area can be accessed by vehicle on USFS Road #1935, but few locations are road-accessible. Most of the project area is only accessible by foot. Walk-in access from USFS Road #1935 is generally across steep, forested ground with downed trees and thick understory shrubs. Certain locations are accessible via hiking closed (gated) and decommissioned roads or existing trails. Following approval of a treatment option (see Section

11), KNRD would identify and establish trails to create primary access routes as needed. Trails would be flagged, but no brushing of roads or trails would occur for this project.

5.0 WATER RIGHTS

There are no potable water rights in the UWBL Project Area (Knudsen 2020; Figure 1). Domestic water rights are present in the Lower WBL drainage but would not be affected by proposed treatments above the tFMS.

6.0 PERMITTING AND OTHER CONSIDERATIONS

The following permits and licenses would be required to implement the proposed piscicide treatment of the UWBL Project Area:

6.1 Beaver Dam Notching/Diversion Permits

Several inactive beaver complexes are located within the UWBL Project Area, primarily in DF and UWBL T2. Ponds created by beaver dams provide potential refugia for Brook Trout and would increase duration of rotenone deactivation due to slow discharge of treated water from the ponds. Reduction of standing water via diversion or beaver dam notching would likely be necessary to facilitate effective treatment. Temporary water diversion does not require a USACE permit if there is no excavation or fill (D. Jordan, USACE, pers. comm.), making it the preferred method to be used whenever possible. However, if excavation, fill, or beaver dam notching is necessary, four permits would be required:

1. **NEPA (**USFS**)**
2. **Hydraulic Project Approval** (HPA; WDFW).
3. **Pend Oreille County Critical Areas Ordinance** (CAO; Pend Oreille County).
4. **USACE Nationwide permit**.

6.2 Piscicide Treatment

1. National Pollutant Discharge Elimination System (NPDES) Permit

An NPDES permit (administered by Washington Department of Ecology; DOE; DOE 2023) is required to conduct rotenone treatments in fresh waters of the State of Washington, and WDFW is the sole entity permitted to apply rotenone. The Aquatic and Invasive Species Control General Permit is available at: https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Aquatic-pesticide-permits/aquatic-invasive-species-control-general-permit

2. NEPA

Lake and stream rehabilitation (rotenone treatment) projects proposed by WDFW are subject to State Environmental Policy Act (SEPA) review. However, the USFS elected to have the UWBL project, including beaver dam notching, rotenone treatment, etc., reviewed under the National Environmental Policy Act (NEPA), which supersedes SEPA. The NEPA process was completed with approval in July 2023 (Vadala 2023).

3. USDA Forest Service Special Use Permit (SUP)

The UWBL Project Area is located on property owned by the Colville National Forest (USFS). The USFS may require SUPs to authorize several proposed project actions (e.g., drip can

placement, overnight camping, etc.). WDFW and KNRD submitted separate SUP applications to the USFS on August 11, 2022, reflective of division of duties and responsibilities. In May 2023, the USFS requested an implementation plan (this document) to reference in order to issue the SUP's (W. Baker, WDFW District 1 Fish Biologist, pers. comm.). In January 2024, the USFS indicated that SUP's may not be necessary, but a final determination had not been made (Steve Eahart, USFS, pers. comm). If necessary, once obtained, copies of each SUP will be available from WDFW and KNRD project management staff.

4. Washington Department of Agriculture Pesticide Applicator License

A Washington State Department of Agriculture (WSDA) Pesticide License with an Aquatic Endorsement (or direct supervision by a Licensed Applicator) is required to apply rotenone in the State of Washington. Core KNRD and WDFW staff hold these credentials and would supervise the proposed UWBL piscicide treatment. Pesticide License numbers and expiration dates are available via request to WDFW and KNRD Project management staff. Additional information on WSDA Pesticide Applicator Licensing can be found at: http://agr.wa.gov/PestFert/LicensingEd/Licensing.aspx.

7.0 USFS GRAZING ALLOTMENT

The UWBL Project Area is contained within the Mineral Creek and Upper Bunchgrass Pasture, one of four pastures comprising the LeClerc Creek grazing allotment. Grazing on the pasture is authorized from July 16th through September 30th (USFS 2014; 2017). The USFS has informed the permit holder of the proposed treatment (B. Weinmann, USFS Range/Invasive Plants Program Manager, pers. comm.), and WDFW would work with the USFS and permit holder to prevent conflict between cattle and treatment activities.

8.0 PRE-TREATMENT DATA COLLECTION

General habitat features and conditions in the UWBL Project Area have been previously surveyed and described (Maroney and Andersen 2000; Andonaegui 2003; Walker et al. 2022). Fish-bearing habitat in mainstem UWBL predominately consists of high gradient (3–10%), riffle-dominated reaches with generally fine substrate (Maroney and Andersen 2000; Walker et al. 2022). During survey work conducted in 2020, relic beaver activity was identified in DF, DF T2, and UWBL T2, but no beavers or recent activity were observed within the project area at that time (Walker et al. 2022). However, more recently, beavers re-occupied the lower DF and DF T2 watersheds in 2023 (KNRD unpublished data). Beavers within the project area will be targeted for harvest under current state hunting/trapping regulations or State-issued permit prior to treatment. Cattle are grazed throughout the UWBL watershed, and negatively impact stream habitat wherever they spend sufficient time (e.g., through loss of riparian vegetation, sedimentation, etc.).

8.1 Fish Species Distribution

Fish distribution in the UWBL Project Area was defined through presence/absence electrofishing and environmental DNA (eDNA) sampling (Carim et al. 2015; Figure 3; Table 2). Flowing

tributaries were spot-sampled via backpack electrofishing, as surveyors moved upstream from the mouth until Brook Trout were no longer observed. Continuous electrofishing was then initiated and continued until surveyors sampled upstream a minimum of 100 m from the last location where Brook Trout were observed without sighting or capturing additional Brook Trout. An eDNA sample was collected at that location, and a GPS waypoint was recorded. If Brook Trout DNA was detected, follow-up eDNA samples were collected further upstream until a negative result was obtained. Brook Trout distribution for the project area is shown in Figure 3.

8.2 Fish-Bearing Waters

8.2.1 Upper West Branch LeClerc Creek

Mainstem UWBL is the largest stream in the UWBL Project Area (wetted width 2-8 m). Brook Trout and WCT are sympatric from the proposed tFMS site upstream approximately 2 km to a series of cascades (-117.22479W, 48.67232N), with only WCT present above that point.

8.2.2 Upper West Branch LeClerc Creek Tributary 2

Upper West Branch LeClerc Creek Tributary 2 (UWBL T2) originates on Molybdenite Mountain and flows into the UWBL mainstem from the northwest. The sub-watershed consists of four perennial, fish-bearing forks (UWBL T2 and Forks A, B, C). Brook Trout are present in all 4 streams, with WCT occupying the headwaters of each, mainly above Brook-Trout distribution. A total of 5.0 km of the UWBL T2 drainage will require treatment, comprised of 2.5 km in the mainstem, 1.0 km in Fork A, 0.2 km in Fork B, and 1.3 km in Fork C. Relic beaver complexes exist in the lower portions of UWBL T2, but, due to age and deterioration, no longer pond much water, so will not likely require breaching prior to treatment.

8.2.3 Upper West Branch LeClerc Creek Tributary 3

Upper West Branch LeClerc Creek Tributary 3 (UWBL T3) joins the UWBL mainstem from the north approximately 100 m downstream of the mouth of Saucon Creek. Incorrectly shown on the USGS topographic maps as a tributary to Saucon Creek, this tributary will require treatment from its mouth upstream to a cascade located 0.5 km upstream. Comprehensive fish presence/absence surveys were conducted in 2017 via backpack electrofishing and eDNA collections. Sampling confirmed that Brook Trout were not present above the cascade (KNRD unpublished data; Carim et al. 2017). Several WCT were noted above end-of-Brook-Trout (KNRD unpublished data) in UWBL T3 in 2013, but only a single WCT was observed during a fish distribution survey in 2017. Concurrent eDNA sampling in 2017 also detected WCT DNA at only a single location (1 of 6 sample sites; Carim et al. 2017). In 2022 extremely low flows were observed throughout UWBL T3, with many reaches completely dewatered and little surface flow reaching the confluence with the WBL mainstem (KNRD unpublished data).

8.2.4 Saucon Creek

Saucon Creek flows south-east and joins the UWBL mainstem from the north. Although not a complete fish passage barrier, a cascade reach largely isolates most of the drainage from downstream fish populations. Intensive suppression from 2014-2022 eliminated Brook Trout

above the cascades, leaving a robust, allopatric WCT population in more than 3 km of habitat (Harvey and Bean 2020; Harvey and Bean 2021; N. Bean, pers. comm.). Piscicide application will be necessary for the lowermost 237 m of Saucon Creek, below the cascades.

8.2.5 Diamond Fork

Diamond Fork (DF) flows south-west off Monumental Mountain and joins the UWBL mainstem from the south. Most of the historic beaver activity observed during field surveys in 2020 was in the DF drainage, particularly in the lower reaches of DF and DF T2. The riparian zone surrounding the lower half of DF is comprised of dense alder and dogwood thickets that will be difficult for spray crews to navigate and treat. Predominately inhabited by Brook Trout, very few WCT persist in mainstem DF. Five small, short headwater tributaries hold populations of Brook Trout and will require drip stations for effective treatment (Diamond Fork Tributary 5, DF T5; Diamond Fork Tributary 6, DF T6; Diamond Fork Tributary 6 Tributary, DF T6T; Diamond Fork Tributary 7, DF T7; and Diamond Fork Tributary 8, DF T8).

8.2.6 Diamond Fork Tributary 2

Diamond Fork Tributary 2 (DF T2) joins DF from the east after flowing through a series of 5 inactive beaver impoundments. All 5 beaver dams impounded substantial amounts of water in 2020, but most had failed by 2022, leaving only a single dam intact. Brook Trout predominate in the lower reaches of DF T2, primarily in and below the beaver complexes. Moving upstream from the relic beaver activity, Brook Trout are gradually replaced by WCT, with an allopatric WCT population in the headwaters. Piscicide application and deactivation may require water diversion or notching of relic beaver dams in this drainage if ponding reoccurs.

8.3 Discharge

Water discharge was measured at 8 sites in the UWBL drainage in summer 2022 and ranged between 1.00-1.99 ft^3/s in the UWBL mainstem, 0.57 ft^3/s in DF, and 0.05-0.97 ft^3/s in the remaining tributaries (Table 3). Discharge measurements were used to estimate the amounts of rotenone and potassium permanganate ($KMnO_4$) necessary for proposed treatment and deactivation of the UWBL Project Area.

8.4 Travel Time

Steam flow travel time was measured via marker dye tracing in the UWBL Project Area in August 2022 (Table 4). Travel times were used to estimate the number of rotenone drip stations necessary for effective treatment of the UWBL Project Area.

8.5 Water Temperature Monitoring

Water temperature loggers (Hobo Tidbit v2 Water Temperature Data Logger; Onset, Bourne, MA) were deployed in 6 locations throughout the UWBL Project Area in June 2021 (Figure 3; Table 5). Piscicide treatments are most effective in the late summer and fall, due to comparatively low flows (reducing habitat available to fish) and warmer water temperatures. Rotenone efficacy declines with declining water temperature, particularly below 6^o C (WDFW

unpublished data). The optimum treatment window is the period during lowest annual flows when the daily minimum temperature remains >8° C. Based on data collected in 2021 and 2022 (Figures 4-7), the optimum treatment window for the UWBL Project Area is August 1 – August 31. Temperature data will be retrieved on an annual basis and immediately prior to proposed treatments to refine treatment timing and inform rotenone concentration.

8.6 Bioassay

Pre-treatment ex-situ bioassays using hatchery Rainbow Trout *O. mykiss* were conducted in October 2022 using water from mainstem UWBL collected immediately below the site of the proposed tFMS. Four 5-gallon (19 L) buckets were filled with ambient stream water (14°C) and known concentrations of liquid rotenone and mixed thoroughly. Rotenone concentrations (5% active ingredient; ai) were 0.5 ppm (25 ppb ai), 1 ppm (50 ppb ai), 1.5 ppm (75 ppb ai), and 2 ppm (100 ppb ai). Five fish were placed in each bucket and observed to determine the minimum rotenone concentration that would result in a complete kill during a 4-hour treatment period. All bioassay fish were killed within the proposed treatment duration, with fish in the 0.5 ppm concentration surviving longest, but no fish surviving longer than 1 hour (Table 6).

Follow-up bioassays will be conducted 1-2 days prior to treatment to inform the final treatment concentration. It is likely that treatment concentration for the proposed UWBL Project Area would be ≥ 1 ppm to account for cool water temperatures, habitat complexity, and potential groundwater inputs within the treatment area.

9.0 PISCICIDE TREATMENT METHODS

The initial UWBL rotenone treatment is proposed to occur in 2025 over a distance of approximately 8.32 miles. However, timing of implementation is contingent on a variety of factors, including WCT salvage, agreement for use of the newly completed Seattle City Light (SCL) Native Salmonid Conservation Facility (NSCF) to fulfill native fish stocking needs for the Box Canyon Dam FERC license, and staff availability. Rotenone would be applied over a 4-hour period, scheduled to overlap with the daily thermal maximum within the month of August. Deactivation of rotenone through application of $KMnO_4$ would be required for an estimated 7 days post-treatment. Specific methods and treatment/deactivation options are discussed in Section 10.

9.1 Rotenone Treatment Staff Safety Training

All staff participating in the proposed UWBL rotenone treatment will be required to complete training prior to project implementation. Training will consist of a project overview, safety briefing and associated documentation, respirator certification, and specialized instruction in assigned task (e.g., drip station operator, back-pack spray team, etc.). Following training, participants will be escorted to their duty station within the treatment area to allow familiarization with assigned location prior to treatment.

9.2 Public Notification and Signage

9.2.1 Notification of Landowners

Washington Department of Fish and Wildlife will notify all business and landowners within a ¼ mile radius along the shoreline or bank of the proposed treatment area 14-45 days prior to rotenone treatment (DOE 2023). Notices must be in writing and include the name and location of the waterbody to be treated, name of the piscicide (and $KMnO_4$, if used), purpose of the treatment, any public or water restrictions, the date of the treatment, duration of any water use restrictions, and contact names and phone numbers for the WDFW project lead and a representative from DOE.

9.2.2 Notification of Legal Surface Water Right Holders

Notice, in writing, of the proposed treatment must be supplied by WDFW to holders of legal surface water rights within the proposed treatment area (DOE 2023). If a water right holder draws/diverts water intended for potable use from a source that would be treated or could be affected by rotenone prior to deactivation, an alternative source of drinking water must be provided by WDFW from the date of treatment until the rotenone concentration drops below 40 ppb. However, there are no potable water rights within the UWBL Project Area, and other water rights (e.g., for fire protection) are above Brook Trout distribution, thus will not be affected by treatment or deactivation (Figure 1).

9.2.3 Treatment Area Signage

All accessible entry points to the UWBL treatment area will be posted according to rotenone product labels and DOE (2015). Signage (Figure 8) will indicate public use and entry restrictions, products used, treatment purpose, application dates, and contacts from WDFW and DOE.

9.3 Fish Salvage

Native Westslope Cutthroat Trout are present within the project area, so salvage will be necessary. Fish will be collected via single-pass backpack electrofishing using a Smith Root LR-24 (or equivalent) backpack electrofishing unit fished with pulsed-DC at the lowest voltage, amperage, and frequency settings adequate to collect fish without injury. Captured fish will be held overnight within the donor stream in covered totes with perforated sides to allow stream flow to move freely through the container. Salvaged WCT will be transported via truck to the SCL NSCF or to a temporary holding stream to reside until Brook Trout are extirpated from the UWBL Project Area (likely 3 years). Upon removal of the Brook Trout population, salvaged fish and their progeny will be repatriated from the holding location to the UWBL Project Area.

9.4 Fish Toxicant (piscicide)

- Prentox Fish Toxicant Powder (powder formulation), EPA Reg. #89459-32
- CFT Legumine Fish Toxicant (liquid formulation), EPA Reg. #655-899
- Prenfish Fish Toxicant (liquid formulation), EPA Reg. #89459-85

Liquid rotenone (CFT Legumine and/or Prenfish) will be applied via drip stations and backpack sprayers, and powdered rotenone (Prentox) will be mixed with sand and gelatin to create a slow-release mixture for application to seeps, springs, and off-channel habitats (Finlayson et al. 2018). Liquid rotenone is produced by the manufacturer at 5% ai, while powdered rotenone typically ranges from 5-8% ai.

9.5 Rotenone Drip Stations

A series of drip stations will be utilized to treat the UWBL Project Area with liquid rotenone (Finlayson et al. 2018). Equipment for each drip station will include one 5.4-gallon (20.4 L) drip can, drip can stand, 5-gallon bucket, graduated cylinder, stopwatch, PPE (gloves, eye protection, respirator, chemical resistant boots or waders, Tyvek suit), hand-held radio, notepad and pencil, and a service container with a pre-measured amount of liquid rotenone. All drip cans will be calibrated to deliver a constant drip rate of 2.87 ounces/minute (85 ml/minute) to dispense 5.4 gallons of diluted liquid rotenone in 4 hours.

Staff members assigned to drip stations will be instructed to arrive at their designated station 30 minutes prior to the initiation of treatment. Upon arrival, drip cans will be charged with a prescribed amount of liquid rotenone from the service container, diluted with water to achieve the appropriate in-stream treatment concentration, and operated continuously for 4 hours. Individual staff may be required to operate up to 3 drip stations, depending on the treatment option selected (Section 10).

9.6 Backpack Sprayers and Rotenone/Sand/Gelatin Mix

Spray teams will rove throughout their assigned treatment area, equipped with backpack pesticide sprayers filled with a 2% liquid rotenone solution and a small amount of marker dye. These teams will apply rotenone to backwaters, off-channel standing water, and other habitats not adequately treated by drip station (Finlayson et al. 2018). Each team will consist of a certified applicator operating the backpack sprayer and a support member responsible for placing rotenone/sand/gelatin mixture in seeps and springs to eliminate any refugia available to fish during the treatment period. Equipment for each team will include one 4-gallon backpack sprayer (pre-tested), PPE (gloves, eye protection, respirator, chemical resistant boots or waders, Tyvek suit), hand-held radio, bucket with premixed rotenone/sand/gelatin mixture, and a service container of liquid rotenone to recharge the backpack sprayer. Detailed maps and GPS units pre-loaded with the perimeter shape files for each zone will be provided to teams to ensure accurate coverage.

9.7 Bioassay Monitoring During Treatment

To monitor treatment efficacy, bioassay cages holding 5 live sentinel fish (hatchery triploid Rainbow Trout) will be installed at predetermined locations along the mainstem and in each fish-bearing tributary to allow for observation of rotenone delivery and toxicity timing (Finlayson et al. 2018). Additional bioassay cages may be placed in side-channels or beaver ponds to ensure even distribution of piscicide during application. Monitoring of bioassay fish will begin just prior to the initiation of the treatment. Personnel responsible for monitoring will record observations of fish behavior (e.g., time to first detection of rotenone presence, time to loss of equilibrium, and time to death) throughout the course of the treatment.

9.8 Rotenone Deactivation

- Potassium Permanganate (free-flowing powder formulation), CAS# 7722-64-7.

Deactivation of rotenone (Finlayson et al. 2018) will occur at the tFMS site. A 1% solution of $KMnO_4$ would be mixed in 400-gal tanks and applied to the stream via 0.83 hp chemical-resistant pump (March Pump, Glenview, IL) powered by a Honda EU2000 generator at a constant rate to achieve a 3 ppm concentration of $KMnO_4$ instream. Deactivation will begin at least 2 hours prior to initiation of treatment to satiate organic demand prior to the arrival of rotenone. Secondary equipment (i.e., extra tanks or Mariotte bottles) will be available on-site for use in the event of primary equipment malfunction.

In-stream measurements of $KMnO_4$ concentration will be conducted throughout the treatment at 30 minutes (flow) travel time and 60 minutes travel time downstream of the deactivation station. Hourly samples will be analyzed using a Hach model DR900 colorimeter. Continual monitoring of $KMnO_4$ concentration will allow for adjustment of the application rate of 1% $KMnO_4$ solution to the stream, so that a residual concentration of 0.5–2.0 ppm $KMnO_4$ would be maintained in the stream at all times. Deactivation will continue until bioassay fish placed above the upstream deactivation station survive 24 consecutive hours. Deactivation teams will consist of a minimum of 2 personnel at all times, and shift changes will occur every 12 hours to prevent fatigue.

9.9 Post-Treatment Fish Collection and Disposal

Following the conclusion of treatment, drip station operators will walk downstream and collect all dead fish observed. Inaccessible fish (e.g., due to depth, complex habitat, etc.) will be tallied, and totals would be reported. Fish collected will be transported back to the tFMS where assigned staff will collect biological data (e.g., species, length, weight, otoliths). All collected carcasses will be disposed of by burying carcasses under the duff layer on the unvegetated forest floor within the riparian area. Burial sites will be located at least 200 m from dispersed recreation sites. No digging below the duff layer will occur in order to prevent disturbance to cultural resources.

10.0 TREATMENT PLAN

10.1 Option 1

All Brook Trout-bearing portions of the UWBL watershed upstream of the tFMS would be treated in a single day. Rotenone deactivation would occur at the tFMS and 30 minutes flow-time downstream of the tFMS. Forty-seven (47) drip stations (5 on mainstem UWBL, 24 in the DF watershed, 1 on Saucon Creek, 2 on UWBL T3, and 15 in the UWBL T2 watershed) would be used to apply rotenone throughout the watershed (Figure 9; Table 7).

In addition to drip stations, 12 spray teams would be utilized to adequately cover the project area (Figure 10; Table 8). Two (2) teams would treat mainstem UWBL and minor tributaries (including Saucon Creek and UWBL T3), 6 teams would cover the DF watershed, and 4 teams would be required for the UWBL T2 drainage. Each team would include at least 1 certified pesticide applicator.

Three (3) staff would conduct deactivation at the tFMS during and following treatment, while 2 staff would oversee project operations. Thirty-six (36) drip station operators, 24 spray team members, 3 deactivation staff, and 2 project overseers totals 65 staff required for the project (Tables 7 and 8).

10.2 Option 2

All Brook Trout-bearing portions of the UWBL watershed above the tFMS would be treated over a three-day period. Rotenone deactivation would occur at the tFMS and 30 minutes flow time downstream of the tFMS and would be operated continuously throughout the three-day treatment and afterward until all applied rotenone was deactivated. Drip station and spray zone locations would be the same as described in Option 1 (Figure 9 and 10; Tables 7 and 8), but treatment would be partitioned into three sub-watersheds to reduce staffing needs.

The DF sub-watershed would be treated on Day 1. Twenty-four (24) drip stations would be operated by 16 personnel, with 6 spray zones treated by 12 staff (Figure 11). Three staff would conduct deactivation, and 2 others would oversee project operations. Thirty-three (33) staff would be required to treat the DF sub-watershed (Table 9). Following treatment of the lower-most spray zone, the crew assigned to that zone would install a block net across the mouth of DF at its confluence with mainstem UWBL as a safe-guard to prevent reinvasion by Brook Trout.

The UWBL T2 sub-watershed would be treated on Day 2. Fifteen drip stations would be operated by twelve personnel, and 4 spray zones would be treated by 8 staff (Figure 12). Three staff would conduct deactivation, with 2 overseeing project operations. Twenty-five (25) staff would be required to treat the UWBL T2 sub-watershed (Table 10). Following treatment of the lower-most spray zone, the crew assigned to that zone would install a block net across the mouth of UWBL T2 at its confluence with mainstem UWBL as a safe-guard to prevent reinvasion by Brook Trout.

All remaining Brook Trout-bearing waters within the UWBL Project Area would be treated on Day 3, including mainstem UWBL, Saucon Creek, and UWBL T3. Ten (10) drip stations would be operated by 10 staff (including drip stations at the mouths of DF and UWBL T2), with 2 spray zones treated by 4 staff (Figure 13). Three staff would conduct deactivation with 2 overseeing project operations. Nineteen staff would be required to treat this portion of the project area (Table 11).

Deactivation would begin 2-4 hours prior to rotenone application on Day 1 and operate continuously throughout the period of rotenone toxicity in the project area. Block nets installed at the mouths of DF and UWBL T2 would remain in place until completion of deactivation.

10.3 Estimated Quantities of Rotenone and Potassium Permanganate

The quantities and concentrations of rotenone and potassium permanganate ($KMnO_4$) required for treatment will be influenced by several factors, including, but not limited to, water temperature, discharge, and biochemical organic demand (BOD; Finlayson et al. 2018), which will be collected immediately prior to each treatment to inform the necessary volume and concentration of rotenone needed. Bioassay fish will be monitored closely during treatment, and post-treatment carcass collections will be conducted to determine treatment efficacy and to estimate biomass of standing stock. Observations during and following treatment will be used to identify problem areas (e.g., areas of in-stream ground water inputs or other refugia), allowing for adjustment to rotenone concentration, drip station spacing, or placement of rotenone/sand/gelatin mix to maximize success in subsequent treatments. Quantities of rotenone and $KMnO_4$ required for treatment of the UWBL Project Area based on discharge observed in August 2022 (Table 3) are estimated in Tables 12-15.

Stream treatments primarily consist of liquid rotenone application. However, powdered rotenone is also utilized for treating seeps and springs via rotenone/sand/gelatin mixture. Previous treatments (Baker and Walker 2017) have required approximately 20 pounds of powdered rotenone per 8 km (5 miles) of stream, adding approximately 0.3 ppm product (12.5 ppb ai) to the treatment concentration. Previous stream treatment rotenone concentrations in northeastern Washington have ranged between 1.0-2.5 ppm product (50 ppb-125 ppb ai; Walker and Baker 2015, Baker and Walker 2016, 2017a, 2017b, 2018, 2019, 2020, 2021). Discharged rotenone must be completely deactivated by $KMnO_4$ before leaving the project area, with deactivation continuing until 5 bioassay fish survive for 24 hours upstream of the deactivation location (DOE 2015). Duration of deactivation is dependent on stream treatment length, discharge, and travel time, which can vary widely between streams. Previous stream treatments have required 42-144 hours of deactivation (Walker and Baker 2015, Baker and Walker 2016, 2017a, 2017b, 2018, 2019, 2020, 2021). The amount of $KMnO_4$ required differs between the two treatment options detailed in this plan (Tables 12-15).

11.0 REFERENCES

Andonaegui, C. 2003. Bull trout habitat limiting factors for Water Resource Inventory Area (WRIA) 62 (Pend Oreille County, Northeast Washington State). Washington State Conservation Commission, Olympia, Washington.

Baker, W. P. and B. M. Walker. 2016. 2016 Post treatment and discharge monitoring report for Smalle Creek, Pend Oreille County, Washington. Washington Department of Fish and Wildlife, Spokane.

Baker, W. P. and B. M. Walker. 2017a. 2017 Post treatment and discharge monitoring report for Smalle Creek, Pend Oreille County, Washington. Washington Department of Fish and Wildlife, Spokane.

Baker, W. P. and B. M. Walker. 2017b. 2017 Post treatment and discharge monitoring report for Highline Creek, Pend Oreille County, Washington. Washington Department of Fish and Wildlife, Spokane.

Baker, W. P. and B. M. Walker. 2018. 2018 Post treatment and discharge monitoring report for Highline Creek, Pend Oreille County, Washington. Washington Department of Fish and Wildlife, Spokane.

Baker, W. P. and B. M. Walker. 2019. 2019 Post treatment and discharge monitoring report for Flume Creek, Pend Oreille County, Washington. Washington Department of Fish and Wildlife, Spokane.

Baker, W. P. and B. M. Walker. 2020. 2020 Post treatment and discharge monitoring report for Flume Creek, Pend Oreille County, Washington. Washington Department of Fish and Wildlife, Spokane.

Baker, W. P. and B. M. Walker. 2021. 2021 Post treatment and discharge monitoring report for Flume Creek, Pend Oreille County, Washington. Washington Department of Fish and Wildlife, Spokane.

Carim, K. J., T. Padgett-Stewart, T. M. Wilcox, M.K. Young, K.S. McKelvey, and M.K. Schwartz. 2015. Protocol for collecting eDNA samples from streams. U.S.D.A. Forest Service, National Genomics Center for Wildlife and Fish Conservation. V2.3.

Carim, K. J., S. E. Greaves, T. W. Franklin, and M.K. Schwartz. 2017. Environmental DNA Sampling for Detection of Westslope Cutthroat Trout, Brook Trout and Northern Pike in the Eastern Washington by the Kalispel Tribe of Indians. Report submitted to the Kalispel Tribe of Indians. U.S.D.A. Forest Service, Rocky Mountain Research Station, National Genomics Center for Wildlife and Fish Conservation.

Engstrom-Heg, R. 1971. Direct measurement of potassium permanganate demand and residual potassium permanganate. New York Fish and Game Journal 18(2):117-122.

Finlayson, B., D. Skaar, J. Anderson, J. Carter, D. Duffield, M. Flammang, C. Jackson, J. Overlock, J. Steinkjer, and R. Wilson. 2018. Planning and standard operating procedures for the use of rotenone in fish management – rotenone SOP manual, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Harvey, S. and N. J. Bean. *2021 Draft*. Kalispel non-native fish suppression project: Annual report (May 20120-April 2021). Project no. 2007-149-00. Report to Bonneville Power Administration by Kalispel Tribe of Indians, Usk, Washington

Harvey, S. and N. J. Bean. 2020. Kalispel non-native fish suppression project: Annual report (May 2019-April 2020). Project no. 2007-149-00. Report to Bonneville Power Administration by Kalispel Tribe of Indians, Usk, Washington.

Hisata, J. S. 2002. Final supplemental environmental impact statement. Lake and stream rehabilitation: Rotenone use and health risks. Washington Department of Fish and Wildlife, Olympia.

Hueckel, G. 1992. Final supplemental environmental impact statement: Lake and Stream Rehabilitations, 1992-1993. Report # 92-14. Washington Department of Wildlife, Olympia.

Knudsen, C. 2020. Water rights summary – West Branch LeClerc fish removal. Memorandum from C. Knudsen, Water Right Specialist, to B. Walker, Fish and Wildlife Biologist 2, and B. Baker, District 1 Fish Biologist. Washington Department of Fish and Wildlife, Olympia.

Maroney, J. R., and T. A. Andersen. 2000. Habitat inventory and salmonid abundance for West Branch LeClerc Creek. Prepared for Pend Oreille County Public Utility District #1. Kalispel Tribe of Indians Natural Resource Department, Usk, Washington.

Walker, B. M., and W. P. Baker. 2015. 2015 Post treatment and discharge monitoring report for Smalle Creek, Pend Oreille County, Washington. Washington Department of Fish and Wildlife, Spokane.

Walker, B. M., N. J. Bean, S. Harvey, W. P. Baker, and J. A. Olson. 2022. Upper West Branch LeClerc Creek native fish restoration phase 1: Pre-treatment data collection – Progress Report. Prepared for the Box Canyon Hydroelectric Project Technical Committee. Washington Department of Fish and Wildlife, Spokane, and Kalispel Tribe of Indians Natural Resource Department, Usk, Washington.

Washington Department of Ecology (DOE). 2023. Aquatic and invasive species control general permit: National Pollutant Discharge Elimination System and State Waste Discharge General Permit. Washington Department of Ecology, Olympia.

Washington Department of Fish and Wildlife (WDFW) and Kalispel Tribe of Indians Natural Resource Departments (KNRD). 2020. Upper West Branch LeClerc Creek native fish restoration – Phase 1: Pre-treatment data collection. Project Proposal to Box Canyon

Hydroelectric Project Technical Committee. WDFW, Spokane, and KNRD, Usk, Washington.

United States Department of Agriculture – Forest Service (USFS). 2014. Colville National Forest, LeClerc Creek Cattle Grazing Allotment. Federal Register 79:75(April 18, 2014): 21892-21893.

United States Department of Agriculture – Forest Service (USFS). 2017. Grazing allotment permit for Steven and Trudi Fountain; Tiger Hill and LeClerc Creek allotments. June 1, 2017; File Code 2230. United States Department of Agriculture – Forest Service, Newport, Washington.

United States Federal Energy Regulatory Commission (US-FERC). 2005. Order issuing new license: Public Utility District No. 1 of Pend Oreille County. Project # 2042-013. United States of America, Washington D. C.

United States Federal Energy Regulatory Commission (US-FERC). 2008. Settlement agreement for Order issuing new license: Public Utility District No. 1 of Pend Oreille County. Project # 2042-013. United States of America, Washington D. C.

Vadala, C. 2023. Upper West Branch LeClerc Creek fish management structure, fish salvage, and piscicide treatments. Decision memo. United States Forest Service, Colville National Forest, Newport-Sullivan Ranger District. Newport, Washington.

FIGURES

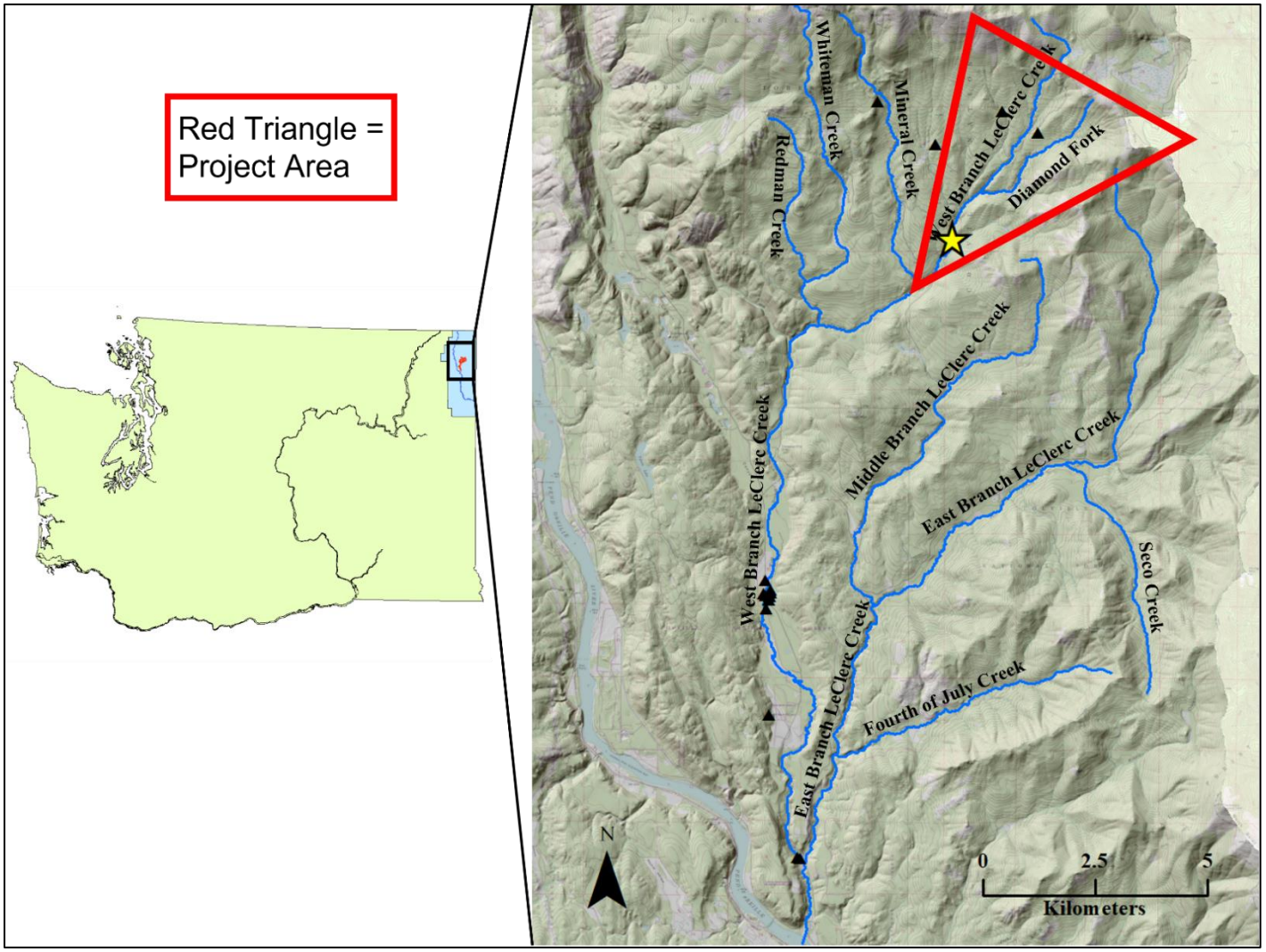

Figure 1. Map showing the location of West Branch LeClerc Creek in Washington State, its location in the LeClerc Creek Watershed, and the project area for proposed non-native fish eradication. The yellow star indicates the location of the proposed tFMS. Black triangles denote the location of water rights in the West Branch LeClerc Creek drainage. Water rights shown inside the red triangle are held by Washington Department of Natural Resources for fire protection, recreation, wildlife, and stock watering. None are potable, and all are above Brook Trout distribution and will not be affected by treatment activities.

Figure 2. West Branch LeClerc Creek temporary fish management structure.

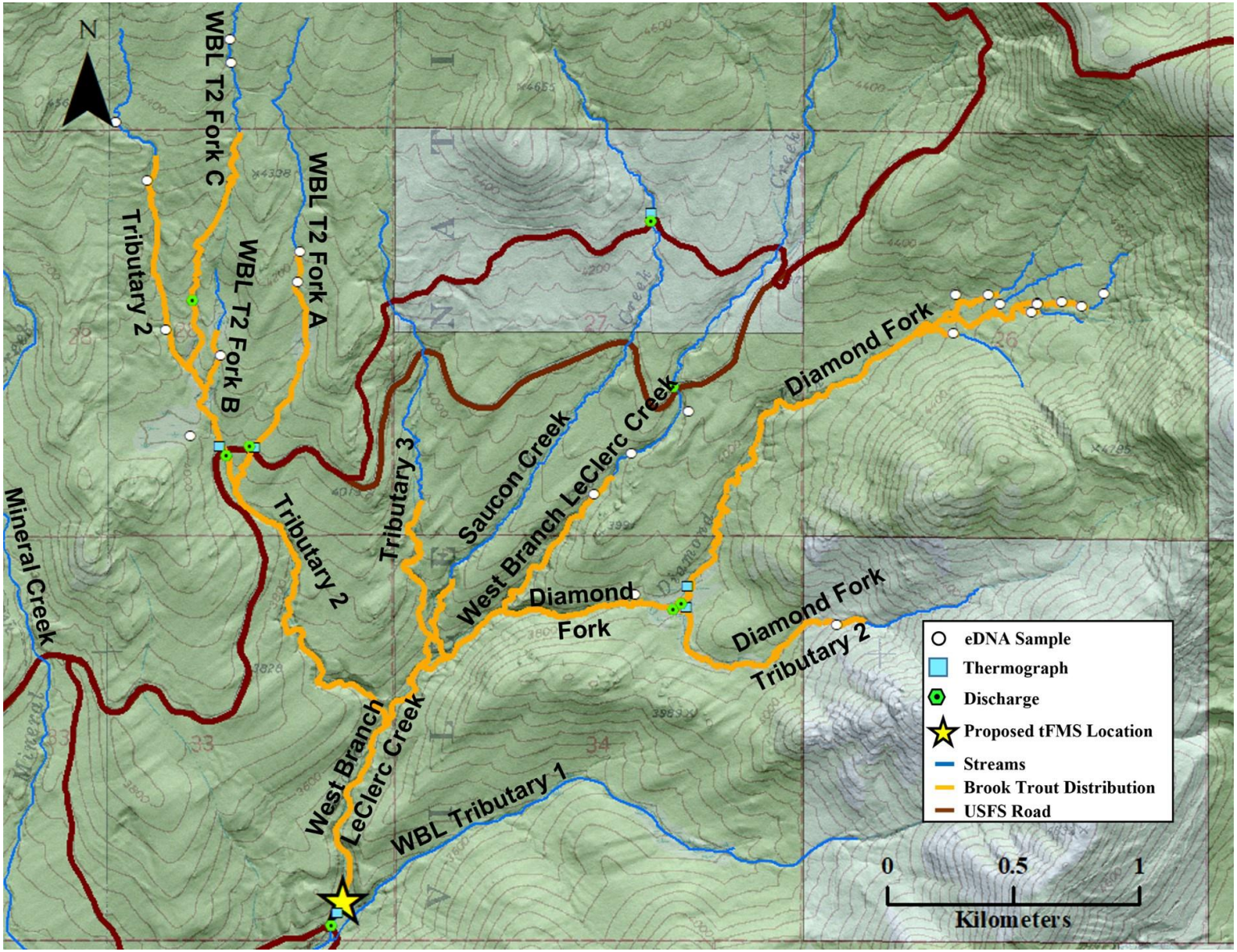

Figure 3. Map of the upper West Branch LeClerc Creek project area. Land ownership is depicted with USFS propoerty shown in green and parcels owned by Stimson Lumber Company in blue.

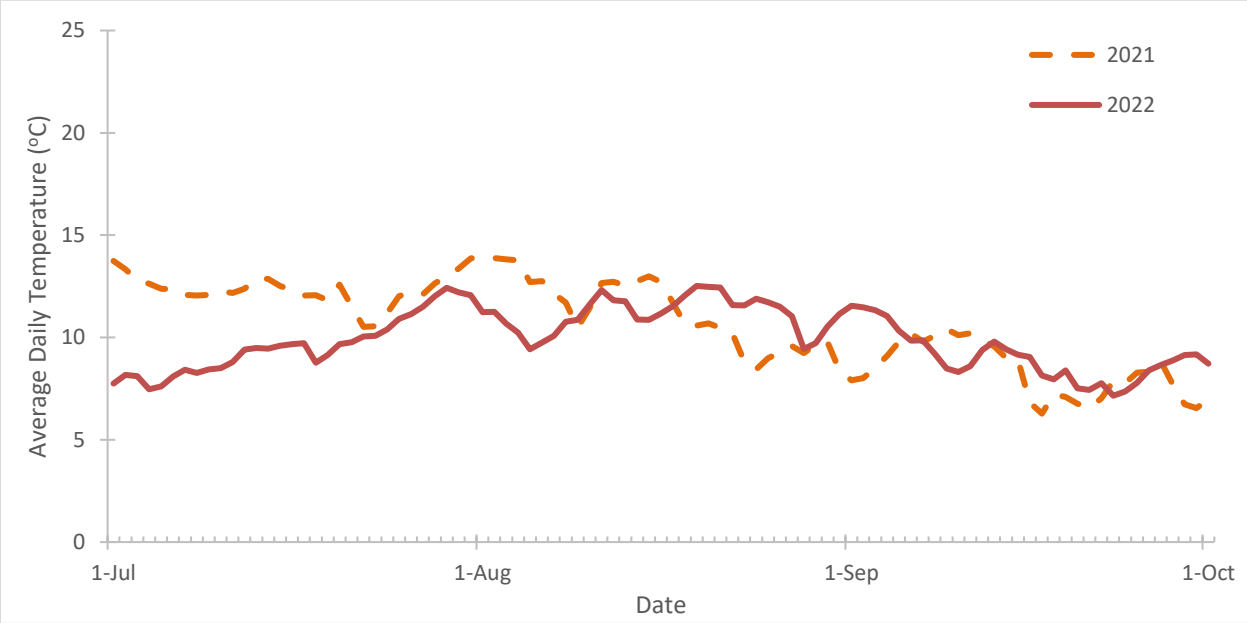

Figure 4. Daily mean temperature profile for Diamond Fork.

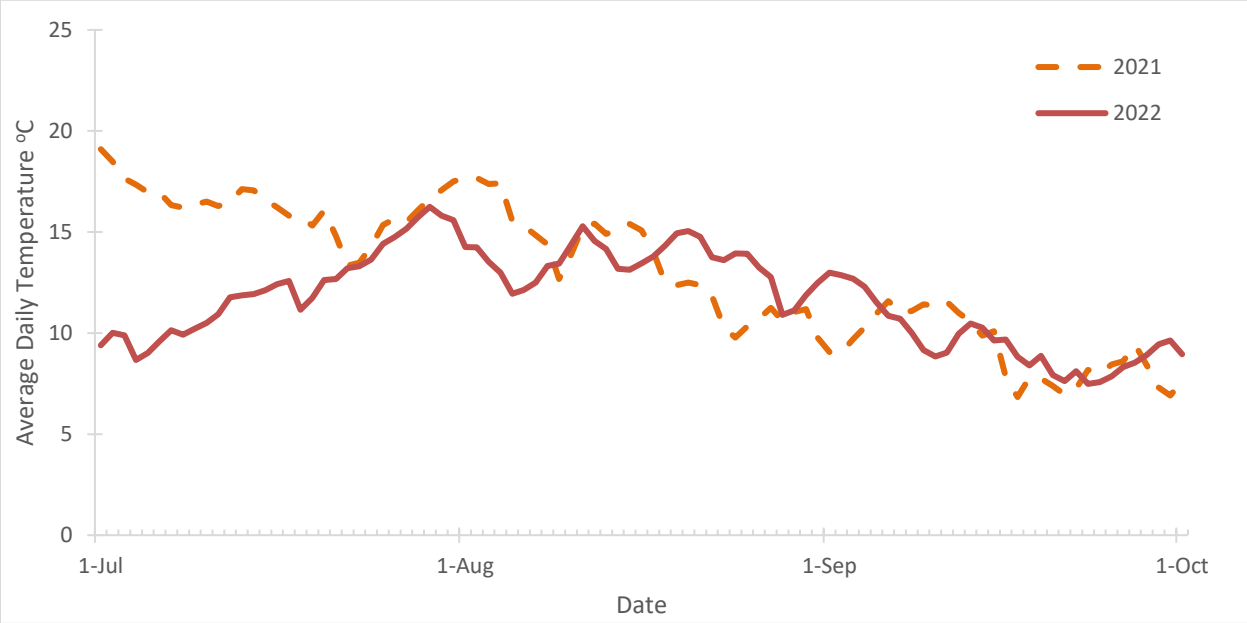

Figure 5. Daily mean temperature profile for Diamond Fork Tributary 2.

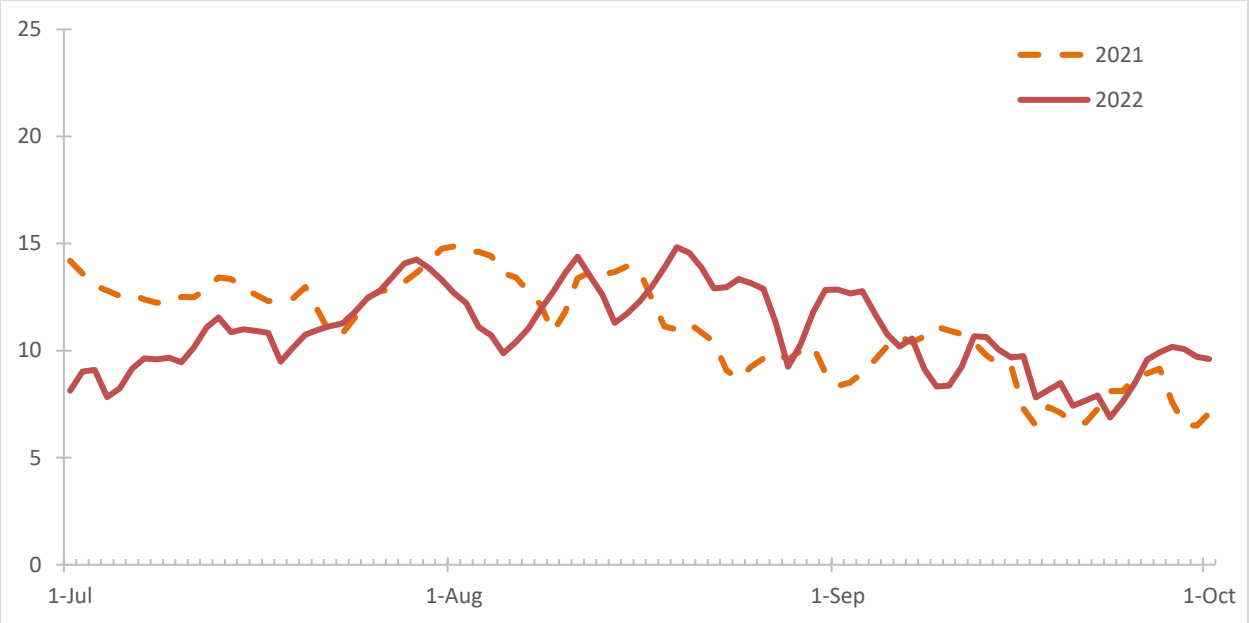

Figure 6. Daily mean temperature profile for UWBL Tributary 2.

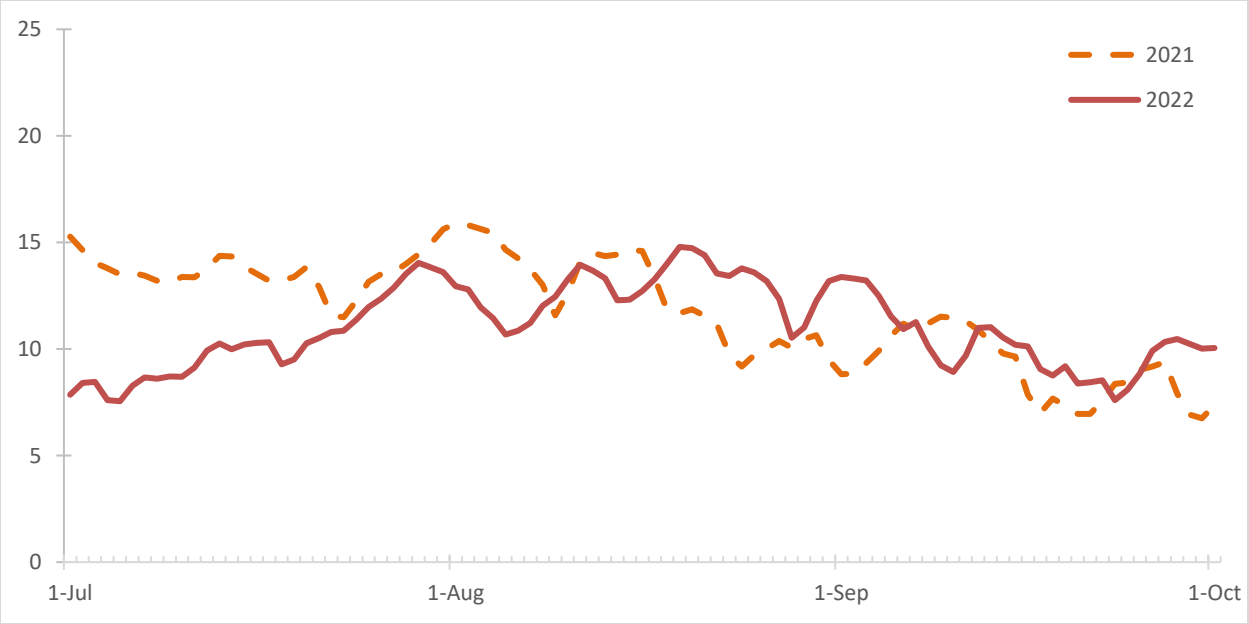

Figure 7. Daily mean temperature profile for UWBL Tributary 2, Fork A.

Figure 8. Signage (draft) to be posted at entry points during the proposed Upper West Branch LeClerc Creek piscicide application.

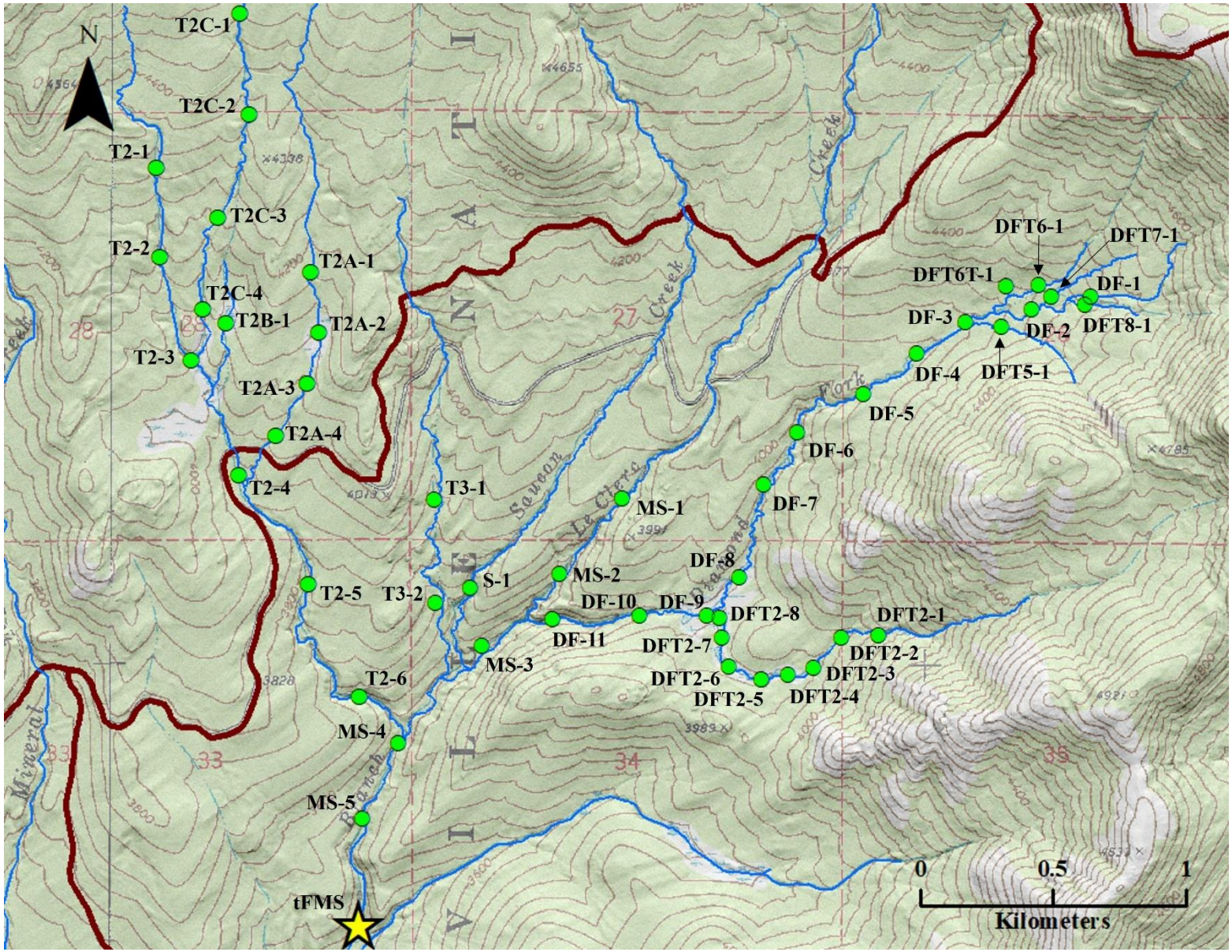

Figure 9. Proposed drip station locations (green circles) for the UWBL project area.

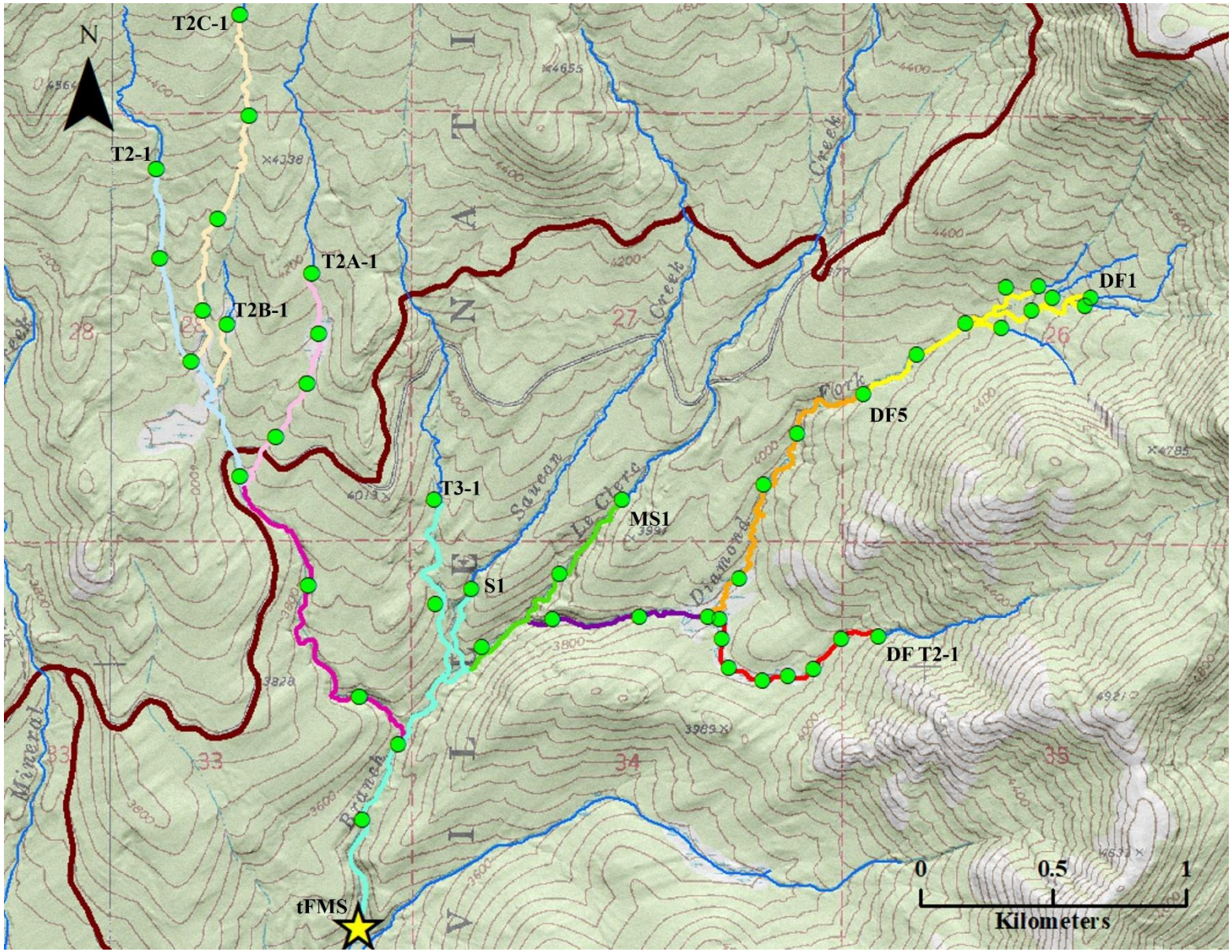

Figure 10. Proposed spray zones for the UWBL project area (colored stream reaches) with proposed drip stations (green circles) shown for reference.

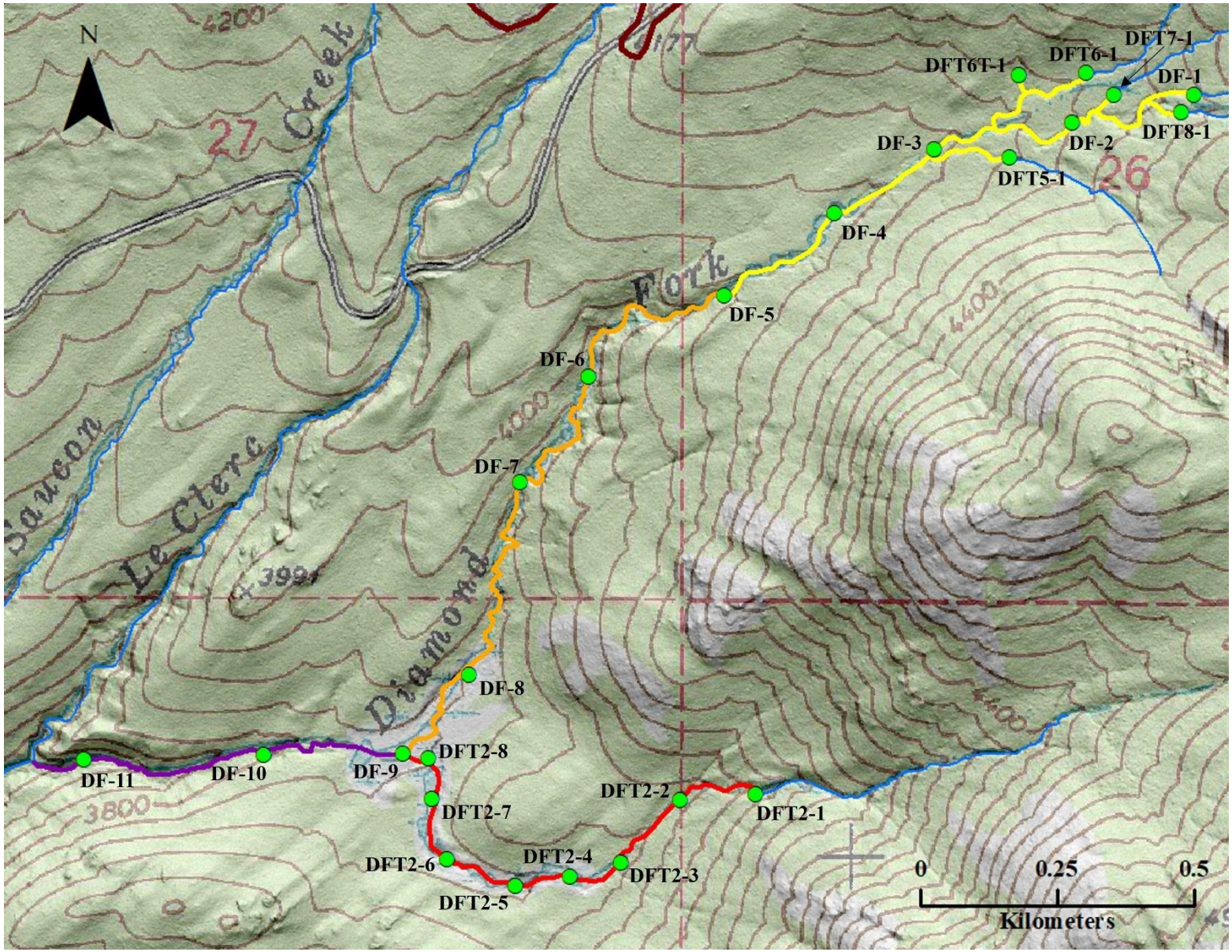

Figure 11. Day 1 (Option 2) treatment area proposed drip stations and spray zones.

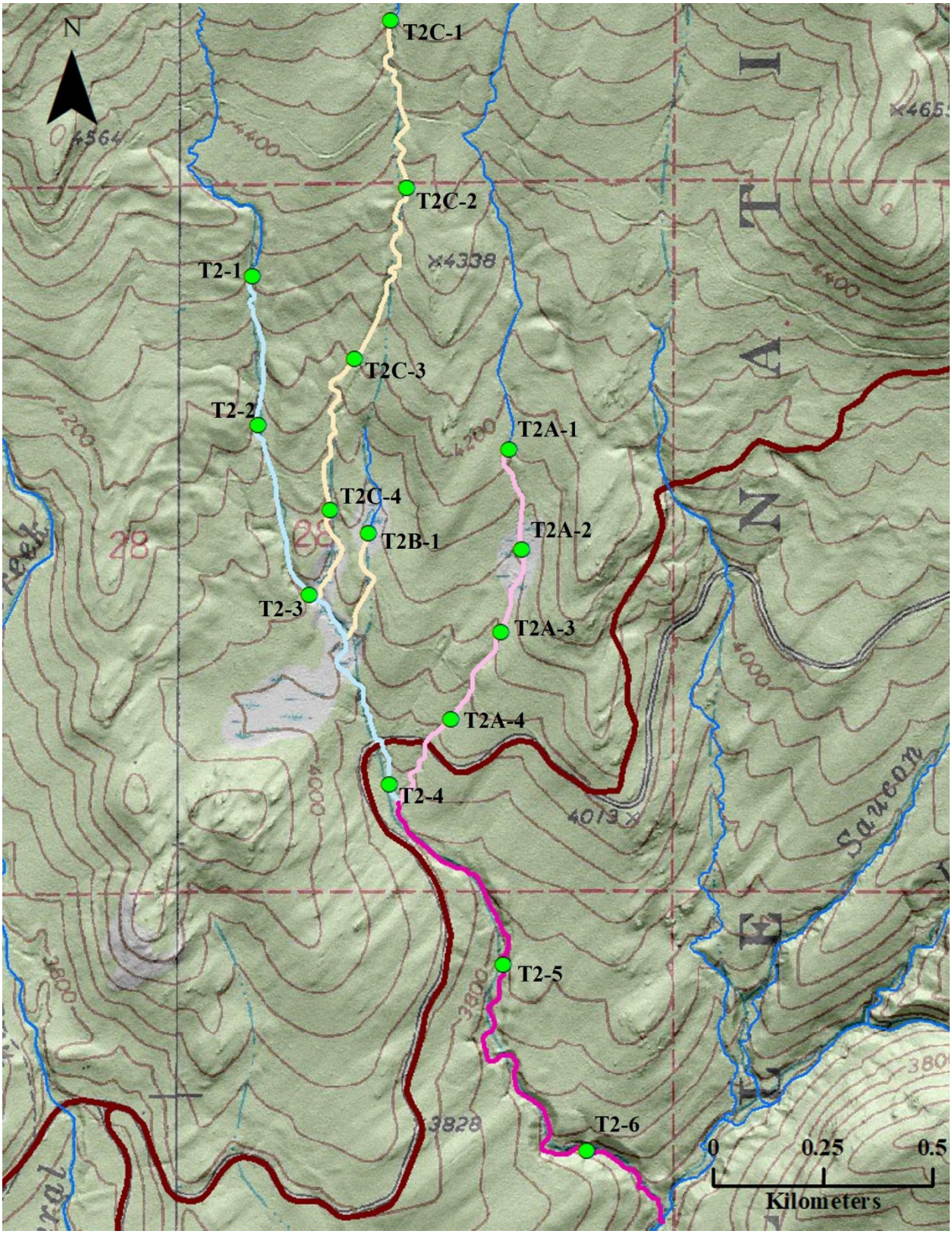

Figure 12. Day 2 (Option 2) treatment area proposed drip stations and spray zones.

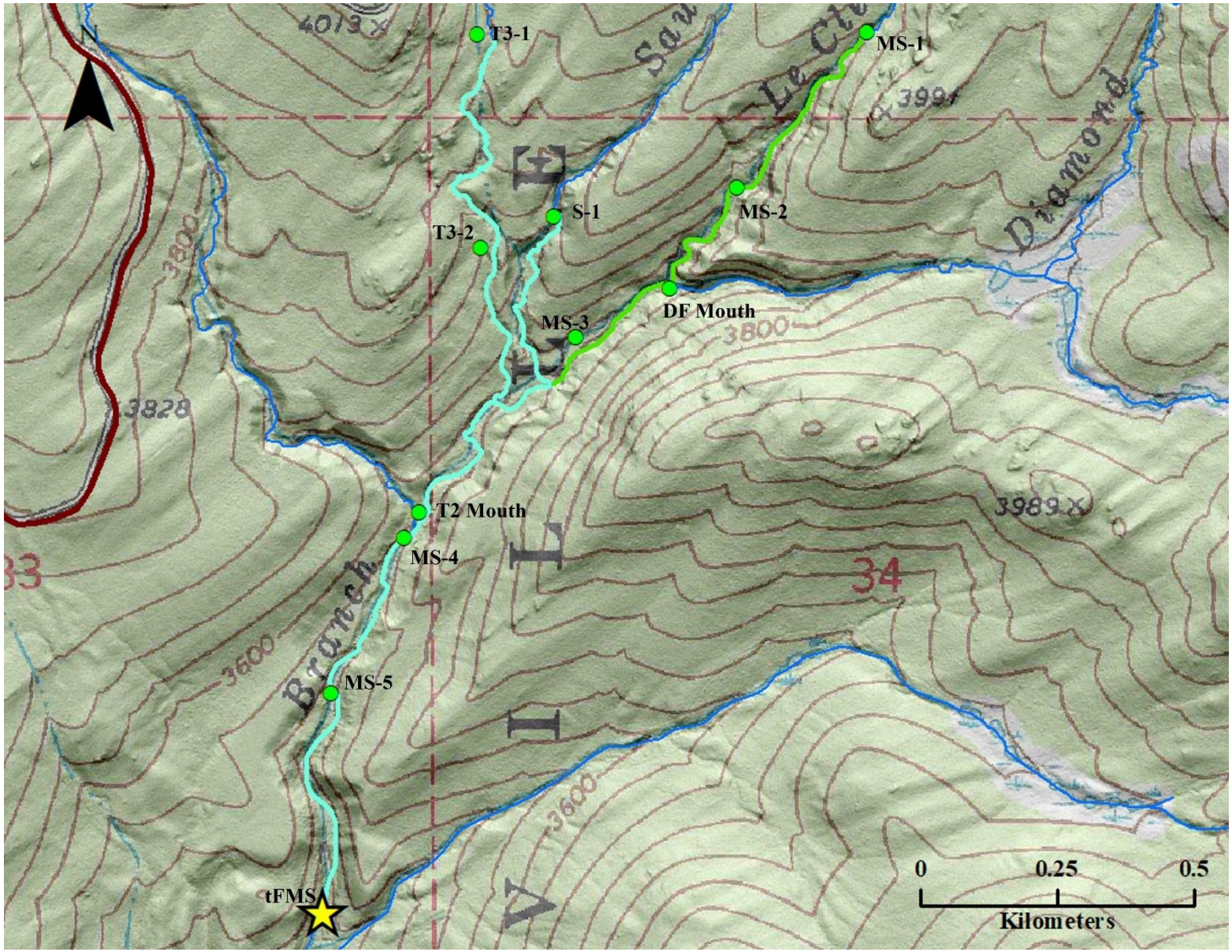

Figure 13. Day 3 (Option 2) treatment area proposed drip stations and spray zones.

TABLES

Table 1. Distance (m) to be treated by stream in the UWBL Project Area.

Stream	Distance (m)
West Branch LeClerc Creek	2,257
UWBL T2 Mainstem	2,827
UWBL T2 Fork A	943
UWBL T2 Fork B	278
UWBL T2 Fork C	1,027
UWBL T3	870
Saucon Creek	410
Diamond Fork	3,254
DF T2	959
DF T5	165
DF T6	237
DF T6A	35
DF T7	47
DF T8	75
Total Distance (m)	**13,384**
Miles	**8.32**

Table 2. Environmental DNA samples (Brook Trout) collected in the UWBL Project Area.

Sub-watershed	Site ID	Latitude	Longitude	Date	Positive?
Diamond Fork	DFTrib1	48.667670	-117.211780	7/13/2020	No
Diamond Fork	DF Trib 8 eDNA1	48.678852	-117.201276	7/14/2020	No
Diamond Fork	DFeDNA1	48.679210	-117.200950	7/14/2020	Yes (1/3 wells)
Diamond Fork	DFTrib3	48.678120	-117.205530	7/14/2020	No
Diamond Fork	DFTrib4 fork A	48.679500	-117.203650	7/14/2020	No
Diamond Fork	DFTrib4 fork B	48.679470	-117.205360	7/14/2020	No
Diamond Fork	DFTrib5	48.679150	-117.202970	7/14/2020	No
Diamond Fork	DFTRIB1	48.66875	-117.22263	6/10/2021	No
Diamond Fork	DF 2021 eDNA 1	48.67916	-117.20096	9/23/2021	No
Diamond Fork	DF 2021 eDNA 2	48.67926	-117.19963	9/23/2021	No
Diamond Fork	DF 2021 eDNA 3	48.67908	-117.19857	9/23/2021	No
Diamond Fork	DF 2021 eDNA 4	48.67956	-117.1974	9/23/2021	No
Saucon Creek	29	48.68327	-117.22223	6/22/2017	No
Saucon Creek	30	48.68703	-117.22634	6/22/2017	No
UWBL T2	UWBL Trib 2 upland BP eDNA1	48.674349	-117.246676	7/16/2020	No
UWBL T2	UWBL Trib 2 eDNA1	48.685571	-117.250708	8/5/2020	No
UWBL T2	Trib 2C eDNA1	48.687709	-117.244509	9/22/2020	Yes (3/3 wells)
UWBL T2	Trib 2B eDNA1	48.677246	-117.245044	9/23/2020	No
UWBL T2	Trib 2 eDNA2	48.683480	-117.249000	9/30/2020	No
UWBL T2	Trib 2D eDNA1	48.678150	-117.248010	10/8/2020	No
UWBL T2	WBLeClerc Trib 2C 2021 eDNA1	48.68853	-117.24458	9/22/2021	No
UWBL T2	WBLeClerc Trib 2C 2021 eDNA2	48.69012	-117.24414	9/22/2021	No
UWBL T2	WBLeClerc Trib 2A 2022 eDNA1	48.67987	-117.24091	8/25/2022	No
UWBL T2	WBLeClerc Trib 2A 2022 eDNA2	48.68095	-117.24079	8/25/2022	No
UWBL T3	31	48.67129	-117.23463	9/26/2017	No
UWBL T3	32	48.67321	-117.23441	9/26/2017	No
UWBL T3	33	48.67497	-117.23522	9/26/2017	No
UWBL T3	34	48.67689	-117.23396	9/26/2017	No
UWBL T3	35	48.67844	-117.23467	9/26/2017	No
UWBL T3	36	48.67942	-117.23607	9/26/2017	No
UWBL	WBL eDNA 1	48.672340	-117.224882	7/15/2020	No
UWBL	WBL eDNA 2	48.673805	-117.222848	7/15/2020	No
UWBL	WBL eDNA 3	48.675300	-117.219760	7/15/2020	No

Table 3. Water discharge by location in the UWBL Project Area in August 2022.

Stream	Latitude	Longitude	Flow (ft^3/s)
Upper West Branch LeClerc Creek	48.67616	-117.22058	1.00
Upper West Branch LeClerc Creek	48.65685	-117.23894	1.99
Diamond Fork	48.66821	-117.22055	0.57
Diamond Fork Tributary 2	48.66843	-117.22010	0.05
Saucon Creek	48.68208	-117.22184	0.15
Upper West Branch LeClerc Creek Tributary 2	48.67365	-117.24469	0.97
Upper West Branch LeClerc Creek Tributary 2A	48.67400	-117.24343	0.13
Upper West Branch LeClerc Creek Tributary 2C	48.67919	-117.24653	0.32

Table 4. Stream flow travel times measured in the UWBL Project Area in August 2022.

Site	Travel Time (HR:MIN)	Latitude	Longitude
Upper West Branch LeClerc Creek Start	0:00 (Start)	48.67226	-117.22491
Upper West Branch LeClerc Creek Hour 1	1:00	48.66971	-117.22813
Upper West Branch LeClerc Creek Hour 2	2:00	48.66724	-117.23210
Upper West Branch LeClerc Creek Hour 3	3:00	48.66393	-117.23635
Upper West Branch LeClerc Creek Hour 4	4:00	48.65927	-117.23812
Upper West Branch LeClerc Creek End	4:20 (End)	48.65872	-117.23829
Diamond Fork Start	0:00 (Start)	48.67914	-117.20097
Diamond Fork Hour 1	1:00	48.67870	-117.20383
Diamond Fork Hour 2	2:00	48.67824	-117.20741
Diamond Fork Hour 3	3:00	48.67715	-117.20986
Diamond Fork Hour 4	4:00	48.67576	-117.21243
Diamond Fork Hour 5	5:00	48.67449	-117.21580
Diamond Fork Hour 6	6:00	48.67275	-117.21756
Diamond Fork Hour 7	7:00	48.66965	-117.21896
Diamond Fork Hour 8	8:00	48.66822	-117.22057
Diamond Fork Hour 9	9:00	48.66826	-117.22400
Diamond Fork Hour 10	10:00	48.66817	-117.22847
Diamond Fork End	10:15 (End)	48.66802	-117.22983
Diamond Fork Tributary 2 Start	0:00 (Start)	48.66764	-117.21181
Diamond Fork Tributary 2 Hour 1	1:00	48.66754	-117.21367
Diamond Fork Tributary 2 Hour 2	2:00	48.66651	-117.21514
Diamond Fork Tributary 2 Hour 3	3:00	48.66628	-117.21639
Diamond Fork Tributary 2 Hour 4	4:00	48.66629	-117.21774
Diamond Fork Tributary 2 Hour 5	5:00	48.66656	-117.21944
Diamond Fork Tributary 2 Hour 6	6:00	48.66754	-117.21982
Diamond Fork Tributary 2 Hour 7	7:00	48.66828	-117.21989
Diamond Fork Tributary 2 End	7:10 (End)	48.66843	-117.22010
Upper West Branch LeClerc Creek Tributary 2 Start	0:00 (Start)	48.68339	-117.24884
Upper West Branch LeClerc Creek Tributary 2 Hour 1	1:00	48.68036	-117.24864
Upper West Branch LeClerc Creek Tributary 2 Hour 2	2:00	48.67688	-117.24704
Upper West Branch LeClerc Creek Tributary 2 Hour 3	3:00	48.67300	-117.24455
Upper West Branch LeClerc Creek Tributary 2 Hour 4	4:00	48.66930	-117.24101
Upper West Branch LeClerc Creek Tributary 2 Hour 5	5:00	48.66552	-117.23839
Upper West Branch LeClerc Creek Tributary 2 End	5:15 (End)	48.66405	-117.23611

Site	Travel Time (HR:MIN)	Latitude	Longitude
Upper West Branch LeClerc Creek Tributary 2A Start	0:00 (Start)	48.67987	-117.24090
Upper West Branch LeClerc Creek Tributary 2A Hour 1	1:00	48.67783	-117.24049
Upper West Branch LeClerc Creek Tributary 2A Hour 2	2:00	48.67613	-117.24109
Upper West Branch LeClerc Creek Tributary 2A Hour 3	3:00	48.67435	-117.24265
Upper West Branch LeClerc Creek Tributary 2A End	4:00 (End)	48.67274	-117.24419
Upper West Branch LeClerc Creek Tributary 2C Start	0:00 (Start)	48.68864	-117.24458
Upper West Branch LeClerc Creek Tributary 2C Hour 1	1:00	48.68522	-117.24408
Upper West Branch LeClerc Creek Tributary 2C Hour 2	2:00	48.68171	-117.24568
Upper West Branch LeClerc Creek Tributary 2C Hour 3	3:00	48.67861	-117.24642
Upper West Branch LeClerc Creek Tributary 2C End	3:20 (End)	48.67669	-117.24658

Table 5. Location of thermographs deployed in the UWBL Project Area.

Stream	Latitude	Longitude
DF T2	48.66828	-117.21989
Diamond Fork	48.66902	-117.21983
Saucon Creek	48.68221	-117.22202
UWBL T2	48.67399	-117.24506
UWBL T2, Fork A	48.67395	-117.24318
UWBL	48.65731	-117.23866

Table 6. Results of an *ex-situ* bioassay conducted using water from Upper West Branch LeClerc Creek (taken from the USFS Road 1935 crossing) on 10/28/2022 showing location and time in minutes required to kill 5 Rainbow Trout exposed to known concentrations of rotenone. Water temperature was 14ºC.

Concentration (ppm)	Time to All Fish Dead (Mins)
0.5	60
1	44.5
1.5	32.5
2	30

Table 7. Drip station locations for the proposed UWBL treatment area (Personnel assigned to highlighted drip stations will simultaneously operate all drip stations of that color).

Personnel	Site	Station ID	Latitude	Longitude
	Upper West Branch LeClerc Creek			
1	Mainstem 1	MS-1	48.67226	-117.22491
1	Mainstem 2	MS-2	48.66971	-117.22813
1	Mainstem 3	MS-3	48.66724	-117.23210
1	Mainstem 4	MS-4	48.66393	-117.23635
1	Mainstem 5	MS-5	48.66135	-117.23821
	Diamond Fork			
1	Diamond Fork 1	DF1	48.67914	-117.20097
1	Diamond Fork 2	DF2	48.67916	-117.20406
1	Diamond Fork 3	DF3	48.67824	-117.20741
1	Diamond Fork 4	DF4	48.67715	-117.20986
1	Diamond Fork 5	DF5	48.67591	-117.21260
1	Diamond Fork 6	DF6	48.67449	-117.21596
1	Diamond Fork 7	DF7	48.67275	-117.21767
1	Diamond Fork 8	DF8	48.66959	-117.21892
1	Diamond Fork 9	DF9	48.66828	-117.22055
1	Diamond Fork 10	DF10	48.66826	-117.22400
1	Diamond Fork 11	DF11	48.66817	-117.22847
1	Diamond Fork Tributary 2 1	DFT2-1	48.66764	-117.21181
1	Diamond Fork Tributary 2 2	DFT2-2	48.66754	-117.21367
1	Diamond Fork Tributary 2 3	DFT2-3	48.66651	-117.21514
-	Diamond Fork Tributary 2 4	DFT2-4	48.66628	-117.21639
-	Diamond Fork Tributary 2 5	DFT2-5	48.66613	-117.21775
1	Diamond Fork Tributary 2 6	DFT2-6	48.66656	-117.21944
-	Diamond Fork Tributary 2 7	DFT2-7	48.66754	-117.21982
-	Diamond Fork Tributary 2 8	DFT2-8	48.66821	-117.21992
-	Diamond Fork Tributary 5 1	DFT5-1	48.67811	-117.20553
1	Diamond Fork Tributary 6 1	DFT6-1	48.67950	-117.20365
-	Diamond Fork Tributary 6 Tributary 1	DFT6T-1	48.67948	-117.20536
	Diamond Fork Tributary 7	DFT7-1	48.67914	-117.20297
	Diamond Fork Tributary 8	DFT8-1	48.67885	-117.20128
	Saucon Creek			
1	Saucon Creek 1	S-1	48.66921	-117.23265
	UWBL Tributary 3			
1	West Branch LeClerc Creek Tributary 3 1	T3-1	48.67221	-117.23456
1	West Branch LeClerc Creek Tributary 3 2	T3-2	48.66870	-117.23446
	UWBL Tributary 2			
1	West Branch LeClerc Creek Tributary 2 1	T2-1	48.68339	-117.24884
1	West Branch LeClerc Creek Tributary 2 2	T2-2	48.68036	-117.24864
1	West Branch LeClerc Creek Tributary 2 3	T2-3	48.67688	-117.24704
1	West Branch LeClerc Creek Tributary 2 4	T2-4	48.67300	-117.24455
1	West Branch LeClerc Creek Tributary 2 5	T2-5	48.66930	-117.24101
1	West Branch LeClerc Creek Tributary 2 6	T2-6	48.66552	-117.23839
1	West Branch LeClerc Creek Tributary 2A 1	T2A-1	48.67987	-117.24090
1	West Branch LeClerc Creek Tributary 2A 2	T2A-2	48.67783	-117.24049
-	West Branch LeClerc Creek Tributary 2A 3	T2A-3	48.67613	-117.24109
-	West Branch LeClerc Creek Tributary 2A 4	T2A-4	48.67435	-117.24265
-	West Branch LeClerc Creek Tributary 2B 1	T2B-1	48.67814	-117.24522
1	West Branch LeClerc Creek Tributary 2C 1	T2C-1	48.68864	-117.24458
1	West Branch LeClerc Creek Tributary 2C 2	T2C-2	48.68522	-117.24408
1	West Branch LeClerc Creek Tributary 2C 3	T2C-3	48.68171	-117.24568
1	West Branch LeClerc Creek Tributary 2C 4	T2C-4	48.67861	-117.24642
36	***Total Personnel Required***			

Table 8. Staffing requirements for backpack spray zones, drip stations, deactivation, and project oversight for treatment of the entire Upper West Branch LeClerc Creek project area on a single day.

Location/Activity	Start (upstream)	End (downstream)	Distance	Personnel
Upper Mainstem	MS 1	Saucon Confluence	1.0 km	**2**
Lower Mainstem	S1	tFMS	2.2 km	**2**
Upper Diamond Fork	DF1	DF5	1.0 km	**4**
Middle Diamond Fork	DF5	DFT2 Confluence	1.2 km	**4**
Lower Diamond Fork	DFT2 Confluence	WBL Confluence	0.8 km	**2**
Diamond Fork Tributary 2	DFT2-1	DF Confluence	1.0 km	**2**
Upper Tributary 2	WBLT2-1	T2A Confluence	1.4 km	**2**
Lower Tributary 2	T2A Confluence	WBL Confluence	1.3 km	**2**
Tributary 2 Fork B and C	T2B-1 and T2C-1	T2 Confluence	1.6 km	**2**
Tributary 2 Fork A	T2A-1	T2 Confluence	1.0 km	**2**
Drip Stations	-	-		**36**
Deactivation Stations	tFMS	60 mins		**3**
Project Oversight	Roving			**2**
Total Personnel Required				**65**

Table 9. Staffing requirements for backpack spray zones, drip stations, deactivation, and project oversight for treatment of the DF sub-watershed on Day 1 (Option 2).

Location/Activity	Start (upstream)	End (downstream)	Distance	Personnel
Upper Diamond Fork	DF1	DF5	1.0 km	**4**
Middle Diamond Fork	DF5	DFT2 Confluence	1.2 km	**4**
Lower Diamond Fork	DFT2 Confluence	WBL Confluence	0.8 km	**2**
Diamond Fork Tributary 2	DFT2-1	DF Confluence	1.0 km	**2**
Drip Stations	-	-		**16**
Deactivation Stations	tFMS	60 mins		**3**
Project Oversight	Roving			**2**
Total Personnel Required				**33**

Table 10. Staffing requirements for backpack spray zones, drip stations, deactivation, and project oversight for treatment of the UWBL T2 sub-watershed on Day 2 (Option 2).

Location/Activity	Start (upstream)	End (downstream)	Distance	Personnel
Upper Tributary 2	T2-1	T2A Confluence	1.4 km	**2**
Lower Tributary 2	T2A Confluence	WBL Confluence	1.3 km	**2**
Tributary 2 Fork B and C	T2B-1 and T2C-1	T2 Confluence	1.6 km	**2**
Tributary 2 Fork A	T2A-1	T2 Confluence	1.0 km	**2**
Drip Stations	-	-		**12**
Deactivation Stations	tFMS	60 mins		**3**
Project Oversight	Roving			**2**
Total Personnel Required				**25**

Table 11. Staff requirements for backpack spray zones, drip stations, deactivation, and project oversight for treatment of the remainder of the project area on Day 3 (Option 2).

Location/Activity	Start (upstream)	End (downstream)	Distance	Personnel
Upper Mainstem	MS 1	Saucon Confluence	1.0 km	**2**
Lower Mainstem	S1	tFMS	2.2 km	**2**
Drip Stations	-	-		**10**
Deactivation Stations	tFMS	60 mins		**3**
Project Oversight	Roving			**2**
Total Personnel Required				**19**

Table 12. Estimated liquid (gal) and powdered rotenone (lbs), and $KMnO_4$ (lbs) required for a 1 ppm (50 ppb ai) treatment and deactivation of the UWBL Project Area under Option 1. Assumes 100 hr deactivation time.

Option 1 (1.0 ppm)	Liquid Rotenone (gal)	Powdered Rotenone (lbs)	$KMnO_4$ (lbs)
UWBL Project Area	2.1	30	140

Table 13. Estimated liquid (gal) and powdered rotenone (lbs), and $KMnO_4$ (lbs) required for 2.5 ppm (125 ppb ai) treatment and deactivation of the UWBL Project Area under Option 1. Assumes 100 hr deactivation time.

Option 1 (2.5 ppm)	Liquid Rotenone (gal)	Powdered Rotenone (lbs)	$KMnO_4$ (lbs)
UWBL Project Area	5.2	30	205

Table 14. Estimated liquid (gal) and powdered rotenone (lbs), and $KMnO_4$ (lbs) required for 1 ppm (50 ppb ai) treatment and deactivation of the UWBL Project Area under Option 2. Assumes 150 hr deactivation time.

Option 2 (1.0 ppm)	Liquid Rotenone (gal)	Powdered Rotenone (lbs)	$KMnO_4$ (lbs)
Diamond Fork	0.5	11.0	-
Tributary 2	0.7	11.3	-
Mainstem	0.9	7.7	-
Total	2.1	30	205

Table 15. Estimated liquid (gal) and powdered rotenone (lbs), and $KMnO_4$ (lbs) required for 2.5 ppm (125 ppb ai) treatment and deactivation of the UWBL Project Area under Option 2. Assumes 150 hr deactivation time.

Option 2 (2.5 ppm)	Liquid Rotenone (gal)	Powdered Rotenone (lbs)	$KMnO_4$ (lbs)
Diamond Fork	1.2	11.0	-
Tributary 2	1.8	11.3	-
Mainstem	2.2	7.7	-
Total	5.2	30	306