Out-migrant Trapping Monitoring Protocol

Green Diamond Resource Company

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D.3.9 Out-migrant Trapping

D.3.9.1 *Background and Objectives*

The objectives of monitoring out-migrant salmonid smolts are threefold: (1) to estimate overwinter survival of juvenile coho by comparing out-migrant abundance to the summer population estimates; (2) monitor the abundance, size, and timing of out-migrating smolts; and (3) look for long term trends in any or all of these variables. The results of the out-migrant trapping are used in conjunction with the summer juvenile salmonid population monitoring to estimate overwinter survival in the Little River HPA. Eventually this information will be further analyzed to correlate specific habitat conditions with overwinter survival of coho salmon.

Juvenile smolt out-migration is monitored to:

- Determine the diversity of salmonid species.
- Identify physical and age-specific characteristics of each species.
- Determine species specific out-migration timing.
- Establish baseline data to ascertain the viability and abundance of salmonids.
- Monitor long-term trends in smolting populations.

D.3.9.2 *Methods*

Two trapping methods are used to capture juvenile salmonids. The reason two methods are used is because stream habitat conditions are different between sites and each method employed is the best available technique where it is used. In the Little River watershed, a V-notch weir system is used. This methodology uses a combination of a weir, pipe, McBane's ramp, and live-box (Figure D-4). In Ryan Creek, out-migrant trapping is conducted using a 1.5 m rotary screw trap driven by an electric motor. A motor is required to operate this trap because stream flows are insufficient to rotate the trap cone (Figure D-5). Smolting populations of coho salmon (*Oncorhynchus kisutch*), Chinook salmon (*O. tshawytscha*), steelhead trout *(O. mykiss iridens*) and coastal cutthroat trout (*O. clarki clarki*) are the species targeted during out-migrant trapping. The data are used to estimate the relative population sizes of all but one of these species. Chinook are only captured incidentally and estimates are not calculated. The equipment and methods used allow for variation in fish sizes being trapped, maximize the number of out-migrants entering the trap, and minimize the stress and mortality of fish.

D.3.9.2.1 *Establishing the Survey Area*

Selecting an area to sample juvenile salmonids can be a difficult task, and the location must be based on several criteria. There are four very important factors to consider during a field visit to select the trap site. Items considered are: access, stream flow, stream gradient, and substrate composition.

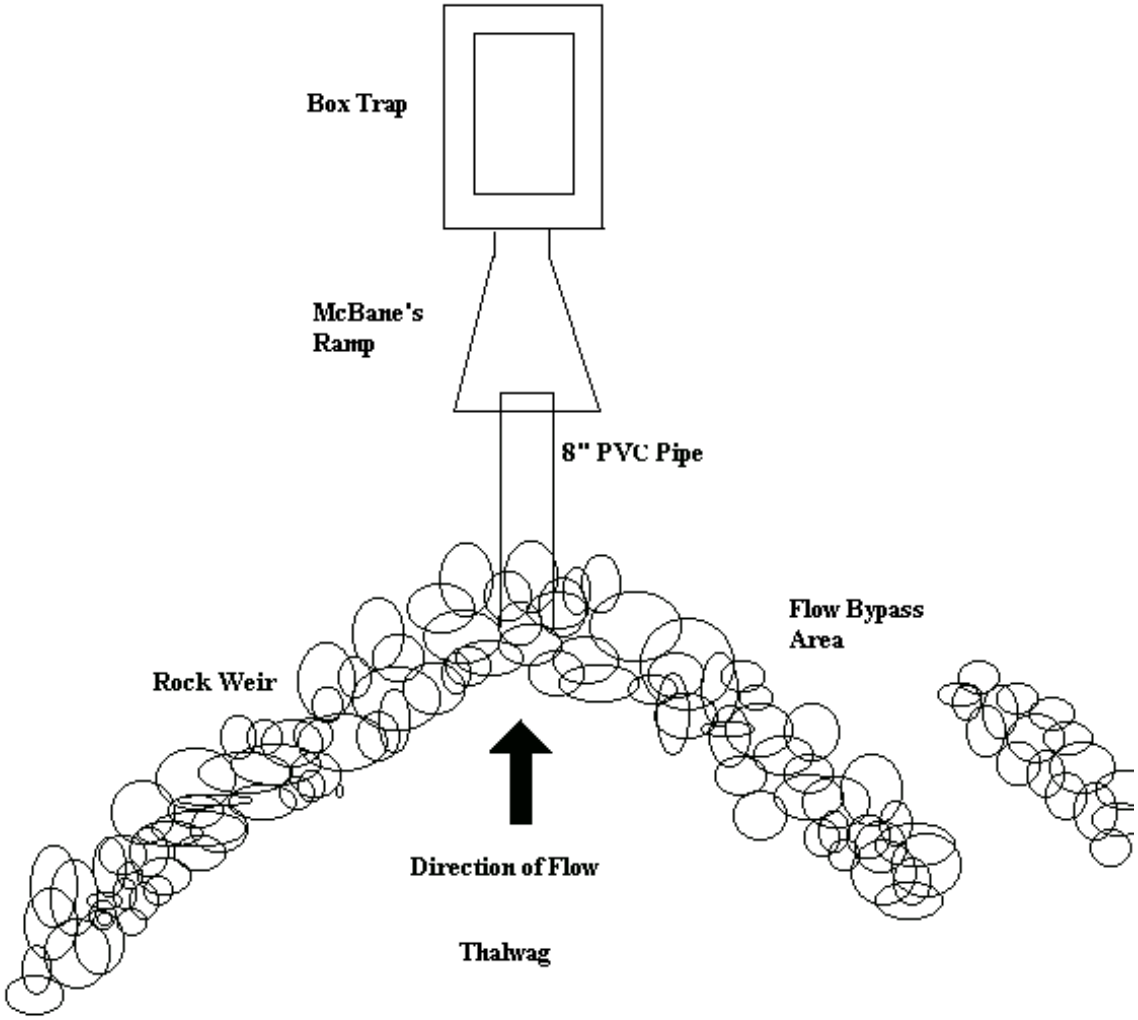

Figure D-4. **Out-migrant Fish Trapping System. The weir can be constructed out of boulder and cobble from the streambed in combination with wooden pallet, fence posts, and wire mesh pannels. Three to six sections of 20-foot, 8 inch diameter PVC connect the weir to the McBane's ramp downstream. The McBane's ramp diffuses the water velocity before entering the box trap. Note: Diagram not shown to scale.**

Figure D-5. **Rotary Screw Trapping System. The weir is constructed of sandbags and panels made of wood and hardware cloth. The opening size on the screw trap is 1.5 meters and the cone is motor driven due to insufficient stream flows.**

Access is extremely important, since juvenile out-migration trapping is a time consuming methodology that requires daily visits, 7 days a week, potentially 150 days of the year (February to July). Having a nearby road or well-established trail is very important, for both delivery of equipment and daily trap maintenance.

Stream discharge is an important factor to consider when selecting the appropriate trapping methodology. Flows ranging from 150 to 200 cubic feet per second (cfs) are the maximum volume of water that has been dammed with a V-notch weir system. Flows of greater volume may require the use of a screw trap or alternative method (if flow regularly exceeds 150 cfs). Weir strength limits water volume being trapped and may be exceeded during early February and March peak flows, resulting in a loss of trap efficiency.

Stream gradient is important, when using a V-notch weir system, to create the vacuum needed to draw fish towards the mouth of the pipe (positioned at the v-notch in the weir). A minimum of one to three percent drop in stream gradient is sufficient and can be best located in a pool to riffle transition area. By placing the weir on the tail-out of a pool or run, the pipe can be placed in the riffle, capturing the drop in stream gradient that will create the suction necessary to attract fish towards the mouth of the pipe.

Substrate composition determines what material will be used in weir construction. Depending on whether there is a sandy bottom with loose gravels or a large cobble/boulder dominant reach, the weir can be fashioned from fence posts and pallets or boulders taking advantage of on-site material. This is important, because if planning to use fence posts as anchoring points, it can be extremely difficult to impossible to drive them through a large cobble/boulder dominated substrate. Where on-site material is unavailable weirs may consist of sandbags and panels construction of wood and hardware cloth.

D.3.9.2.2 Duration of Surveys

Juvenile out-migration trapping can run from early February to late July, and may start earlier and run later depending on the out-migration timing of the species being studied. Out-migration timing can vary widely in parts of northern California, and can be triggered by environmental conditions, competition, or egg deposition time. To ascertain site specific out-migration timing for each species during the first year of trapping, allowance for up to 150 days of continuous trapping (February through July) should be made.

Smolt abundance, size, and timing will be monitored annually. The time required to correlate these results with habitat information and summer population estimates is truly unknown, but will likely require a minimum of ten years due to the high variability observed in both summer population estimates and smolt abundance.

D.3.9.2.3 Equipment List

The following equipment is needed for each V-notch weir trap site established:

- Two wood or plastic live boxes (for retaining fish)
- McBane's ramp (dissipate water velocity)
- 6' Steel fence posts (optional)

- Wooden Pallets (optional)
- 60 to 100 feet of 4’ T Galvanized Hardware Screen (optional)
- Galvanized bailing wire (optional)
- 3-6 20’L x 8”D PVC pipes
- Nylon rope
- Sand bags
- HOBO temperature recorder

The following equipment is needed for each rotary screw trap site established:

- Motor drive (optional) rotary screw trap
- T-posts
- Sand bags (weir construction)
- Weir panels

The list of equipment that will be needed to maintain and check each trap daily is listed below:

- Five or more 5-gallon buckets
- Large meshed fishing net
- Large dip net
- Small dip net
- Measuring board
- Digital scale
- Tray for weighing specimens
- Allegro Field PC (with OMT Data Plus application)
- PIT tag scanner
- PIT tags
- Argentine
- Scalpel
- Scissors

- Scale envelopes
- Sample papers
- Alka-Seltzer® Gold (anesthetic)
- Long handled scrub brush
- Automated release device

D.3.9.3 *V-notch Weir Construction and Trap Installation*

Weir construction is the most time consuming yet important part of trap installation. The appropriate material for weir construction may differ among sites and is selected based on site conditions and substrate composition. When streambed material is predominantly small cobble, gravel, or sand, fence posts will be used in weir construction, in combination with either wooden pallets or wire mesh panels to retain the water. When available, large cobble and boulder substrate from the surrounding stream reach may also be used for constructing the weir.

D.3.9.3.1 *Weir Construction*

First, locate the thalweg of the run or pool. This will be where the mouth of the pipe is placed and the weir converges to form a V-shape. Clear a location for a 20' section of PVC pipe by removing streambed obstructions (i.e., large rocks and boulders). Take a section of PVC (20'L x 8"D) pipe and place it in the thalweg of the downstream riffle running parallel with stream flow. Submerge the PVC pipe in the unobstructed area of the pool thalweg and quickly place large boulders or several fence posts along the pipe to secure it in place. This location will serve as a convergence point to start constructing both sides of the weir. The rock wall or fence post wall should be shaped as a V, with the mouth of the PVC pipe being at the V-notched end of the weir. Before weir construction is complete, create a small, shallow channel at the edge of the weir, which will serve as a bypass area for escaping steelhead adults. Make sure the bypass area is just shallow enough to pass fish moving upstream. Too much flow may draw out-migrants to this section of the weir. Construction materials and procedures for building the weir depends on the weir type required:

- If building a rock weir, form a large base to the wall like a pyramid (4'-5' thick). Around the mouth of the pipe should be the strongest, thickest portion of the weir. This is the location that needs the most protection, because if this section blows out, it will be very difficult to reconstruct under strong flows. Begin construction by building out from the converging points towards the stream bank, keeping the same thickness of wall. Start adding height to the wall until the majority of flow is trapped and funneled towards the mouth of the pipe. This style of weir is very effective in swift flowing, higher gradient (3-4%) streams.

- If building a fence post/pallet weir, use wood pallets as a marker for fence post placement. Construct the weir by moving from the convergence of the weir out towards the stream banks forming a classic or slightly altered V– shape (depending on thalweg location). Using a fence post driver, place one post deep into the substrate of the streambed. Place one end of the wooden pallet over the fence post and sink it until you reach the streambed. Take another fence post and secure the pallet in place making sure the angle and direction form the V-shape necessary to corral the fish. Continue this procedure until the stream banks are reached and the majority of stream flow is dammed behind the weir. Scrape streambed gravel and cobble around the foundation to cover gaps at the foot of the weir. Be sure to cut wooden pallets in half sections and fill in gaps between the wood with redwood slats or other material to effectively block flow. Half pallets can be stacked to form the weir and will make for a very effective system to manage flow during peak events. This style of weir capable of damming large flows in swift flowing streams, and may be the most efficient method for long-term trapping (if substrate allows).

- If building a fence post/screen weir, placement of the fence posts with use of the fence post driver can be done before the screen is attached to the posts. Place the fence posts by moving from the convergence of the weir out towards the stream banks forming a classic V– shape (depending on thalweg location). The fence posts can be 2 – 4 feet apart, spaced closer together if trapping late in the winter during higher flows. Using bailing wire, attach the screen to the fence posts. Scrape streambed gravel and cobble around the foundation of the screen to cover gaps at the foot of the weir. The majority of flow will be filtered through the wire mesh creating very little incentive for fish to move towards the mouth of the pipe. Sometimes, young fish can become impinged on the surface of the screen during higher flows. To avoid this, angle the V of the weir as much as possible, to avoid perpendicular angles to the direction of stream flow. This system works well for low gradient streams that will not experience large flow events, and may be best suited for late season trapping in flows 1 – 50 cfs (if algae blooms are common, strongly consider the use of pallets or boulders).

D.3.9.3.2 *Pipe Installation*

The section of pipe that has already been laid parallel with stream flow and sits at the notch of the weir is connected together with the remaining sections of pipe. This string of pipe is run down the full length of the riffle to take advantage of the change in stream gradient (three to six sections of PVC pipe may be needed to run the full length of the riffle). This will help to create the suction at the mouth of the pipe and draw fish in. An attempt is made to empty the pipe into the next habitat unit, preferably a run or pool with slack water, near the stream bank. Place large boulders or use fence posts to keep the pipe stationary during large flows.

D.3.9.3.3 *Ramp Installation*

If using a rock walled weir, the system is working well when the majority of trapped water is being funneled through the pipe, with the lot of head pressure coming out the far end of the pipe. This will not occur with a fence post/screen weir. In order to reduce the potential for fish mortality, do not place the downstream end of the pipe directly into the box. Alternatively, using a scissors jack, raise the downstream end of the pipe off the ground, and place the mouth of the McBane's ramp under the pipe. The McBane's ramp is a graduated ramp made out of perforated sheet metal, which will dissipate large volumes of water. Adjust the flow over the McBane's ramp by moving it forward or backward. The majority of flow will dissipate through

the McBane's ramp leaving a smooth sheet of water to carry fish into the box trap. Be sure there is just enough water to gently glide the fish into the live box. There should be 10 – 12 inches of clearance between the surface of the water and the mouth of the McBane's ramp, and five to six inches of clearance between the surface water and the portion of the ramp entering the box. The ramp at this point should be at a downward angle when entering the box trap, leaving enough room under the ramp for increased water levels. If there is not enough water flowing over the McBane's ramp to create a constant flow, place plastic on the ramp to cover the holes and achieve more flow. This may be necessary when using a fence post/screen weir.

D.3.9.3.4 *Box Trap Installation*

Attach the box trap to the McBane's ramp. Slide the McBane's ramp into the pre-formed board created to support the ramps' exit point. The box trap can be submerged or remain out of the water depending on the box trap type being used. Preferably, the box trap should be submerged five to eight inches in the water, which will leave room for increased water levels. Placing rocks or other material along the base of the trap should slow flow against the box trap screen. Installation of a second box trap reduces in-trap predation from sculpin, cutthroat and/or steelhead. The second box trap is attached to the second box trap behind the first box with a connector. The second box trap will hold the young-of-the-year fish. Slide two different gauge screens into the series of box traps, one at the rear of the first box trap and the other at the mouth of the second box trap. This will serve as a barrier to separate large salmonids from smaller salmonids, which will naturally segregate themselves into the two boxes. A HOBO temperature recorder is placed next to the live box to monitor the water temperature at each site.

D.3.9.3.5 *Rotary screw Trap Installation*

The rotary screw trap is made up of six general components; a screened cone, two pontoons, cross members, live box, A-frame, and rails. The trap is transported to the sample site on a trailer. Once on-site, the parts are carried into the steam channel where the trap is assembled. The trap is positioned with the opening facing upstream. After installation is complete, weir panels are installed upstream from the trap opening to help guide outmigrating fish into the trap. A HOBO temperature recorder is placed next to the live box to monitor the water temperature at the site.

D.3.9.3.6 *Fine Tuning the Trap Systems*

During the first few weeks of trapping, trap and weir maintenance are required daily, especially if higher flows are present. Use this period to fine tune both the weir and the trap to increase trap efficiency and eliminate potential mortality associated with higher and fluctuating flows.

D.3.9.4 *Daily Monitoring Procedure*

There are three basic steps to the daily monitoring procedure; remove fish from box, identify and measure, and release. All fish entering the box and the number observed are recorded including incidental catches of non-target species such as lamprey, sculpins and amphibians. To initiate the monitoring procedure, the following steps are completed:

D.3.9.4.1 *Organization*

Prior to checking traps, all required sampling equipment are unpacked and set up. This organizational system should help minimize the handling time for captured fish. The first box trap is opened and any steelhead trout down-runners are removed first. These adult fish are measured and any hatchery marks are noted. After removal of adult steelhead, preparations to measure, weigh, mark (if necessary) and release the day's catch are made.

D.3.9.4.2 *Preparation of Holding Containers*

A 3-gallon container is prepared by filling it with two to three inches of water. One Alka Seltzer® Gold tablet is dissolved into the water. This container is used to anesthetize the first batch of fish (CO_2 and MS-222 may be substituted for Alka-Seltzer®). If Alka-Seltzer® is being used, the tablet must be fully dissolved. Two or three 5-gallon buckets are filled 2/3 full with water. These are used as a recovery bucket for processed fish.

D.3.9.4.3 *Capture Fish*

The day's catch is then sampled by sweeping the large dip net through the trap. A group of twenty to twenty-five fish are selected and placed into a bucket for identification, measurement and for potential clip (marking). Until fish-handling proficiency is perfected during the first few weeks of trapping, fewer fish will be selected. Fish are placed into the container to be anesthetized. Smolting steelhead trout, cutthroat trout, and coho salmon are the only species that will be marked to test trap efficiency.

D.3.9.4.4 *Check Fish*

After the selected fish are fully anesthetized they are identified, weighed and measured. All measured parr, pre-smolt and adult fish are placed into the release bucket, and data for: species, weight, length and age class are recorded. If a smolt is being measured, an appropriate mark is made to tag fish and the fish is placed into the holding trap. Recaptured smolts are recorded in the recapture data page. The procedure for marking smolts is found below. Checking fish should take no longer than ten minutes per group, and less time if water temperatures increase or fish are anesthetized quickly. Water in the anesthetizing container and recovery buckets are changed if water temperature rises or buckets become crowded.

D.3.9.4.5 *Marking Smolts*

Two marking techniques are used during outmigrant trapping. Coho salmon smolts, steelhead trout smolts and cutthroat trout smolts are marked with caudal fin clips in the Little River and passive integrated transponder (PIT) tags in Ryan Creek. A total of four different fin clips are used throughout the trapping season. Clips are used for a period of seven-days. The easiest clips to see are caudal fin clips. A horizontal upper caudal, vertical upper caudal, vertical lower caudal and horizontal lower caudal clip are used for each seven-day period, in any sequence seen fit. After the first 28 days, the same sequence of clips is repeated. Having at least a 28-day period before repeating a sequence of clips is absolutely necessary. Passive integrated transponder tags are implanted by way of a ventral incision posterior to the pectoral fin. Only smolts considered healthy (i.e., free of abrasions, undamaged tail, and normal coloration) are marked. When possible, up to 20 smolts/species/day are marked for trap efficiency tests. However, in an effort to increase the overall percentage of marked coho, occasionally up to 30

coho smolts/day will be PIT tagged when high numbers of coho smolts (e.g., ≥100) are captured on a single day.

D.3.9.4.6 *Release Recovered Fish*

After the first bucket of fish are measured and recorded, they are checked to see if the unmarked fish in the recovery bucket are ready to be released. If these fish have recovered from the anesthetic, these fish are released to a portion of slack water downstream of the trap site. Procedures are repeated until the first box trap is empty.

D.3.9.4.7 *Check Young-of-the-Year*

The majority of young-of-the-year Chinook salmon, coho salmon and trout will have already separated themselves into the second box trap. A 5-gallon bucket is filled with water and the young-of-the-year fish are removed from the second box using additional caution on hot days. Twenty measurements from a sample of each species are obtained and recorded daily and twenty weights will be recorded per week per species per site. Once the twenty measurements are recorded, tallies of the remaining young-of-the-year are made until all fish are observed.

D.3.9.4.8 *Release Marked Fish*

Fish marked for trap efficiency estimates are fully recovered from the anesthetic prior to release. Marked fish are allowed to recover in a perforated live-box that is located upstream of the trap site. The live-box has an automatic release device which is programmed to release fish 10 hours following capture. This release time allows fish ample recovery time and provides cover (i.e., darkness) during their release to minimize predation. Trap efficiency is designed to test how well the weir is working; not predation or any other factor. If these fish are recaptured, they are not used again for efficiency testing and are released downstream from the trap.

D.3.9.4.9 *Record Mortality*

Very little trap-related mortality is generated with this method. Under federal and state salmonid trapping permits, mortalities are retained for genetic studies. Appropriate handling and preservation techniques are implemented if permit requires that mortalities be archived.

D.3.9.5 ***Daily Trap Maintenance***

All accumulations of debris is cleaned and removed daily from the McBane's ramp, interior of both boxes, behind the weir and screens that segregate the fish. The majority of mortality is caused by debris accumulations on the ramp or inside the live boxes. The weirs is checked for leaks or debris accumulations that may have piled up. During high winds and alder catkin release the traps are cleaned again at night.

D.3.9.5.1 *Calculating Trap Efficiency*

A "mark-recapture" method is used to estimate trap efficiency. Accurate population estimates depend on this portion of the protocol. A 28-day period is used to test trap efficiency, utilizing coho salmon smolts, cutthroat trout smolts, and steelhead trout smolts, as described above. Trap efficiency is calculated by using only species that are actively leaving the drainage on their seaward migration ("smolts"). These tests are run to determine what percentage of the population is missed by inefficiencies in the traps. Marks (fin clips) are changed every 7-days to

account for variations in environmental attributes. Trap efficiency is calculated using the Darroch Analysis with Rank Reduction (DARR 2.0.1 software) for analysis of stratified mark-recapture data (Bjorkstedt, 2005).

D.3.9.5.2 *Population Estimation*

Population estimates are made for smolt year classes of coho salmon, steelhead and coastal cutthroat trout. Population size is not estimated for Chinook salmon due to their size and abundance during out-migration. Chinook are too small when first entering the traps to mark with a caudal fin clip. Population estimates are not made for young-of-the-year, parr, or pre-smolts of the same species because these life stages are only redistributing themselves within the watershed, and not actively emigrating to the ocean. All outmigrant salmonid smolt population estimates are calculated using the DARR 2.0.1 software for analysis of stratified mark-recapture data (Bjorkstedt, 2005), where possible. In cases where the data do not meet the required DARR criteria, hard counts are used. Criteria violations may result from low species captures or low and no recaptures for a species.

D.3.9.6 *Literature Cited*

Bjorkstedt, Eric P. 2005. DARR 2.0: updated software for estimating abundance from stratified mark-recapture data. NOAA Technical Memorandum NMFS-SWFSC-368. 13 p.