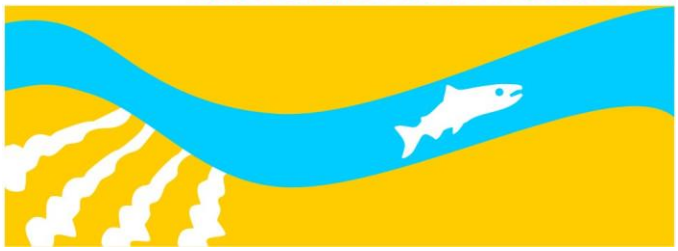
Study 6

Trap and Haul of Adult Fall-Run Chinook

Final
2015 Monitoring and Analysis Plan

SAN JOAQUIN RIVER
RESTORATION PROGRAM



January 2015

1.0 Trap and Haul of Adult Fall-Run Chinook

Theme(s):

- Rearing habitat
- Entrainment protection
- Spawning and incubation
- Adult migration paths
- Fish reintroduction
- Passage and transport

Related Question(s):

- *AM-006: Can trap-and-haul be used to transport adults after water temperatures in Reaches 4B and 5 exceed maximum thresholds? Will transported spring-run fish survive through spawning if trap-and-haul is used?* Proposed adult trap and haul efforts permit adult fall-run Chinook salmon to serve as a surrogate for spring-run to better understand likely post-transport survival and spawning success. Additionally, environmental conditions (i.e., water temperature) will be monitored daily during the proposed study, and may permit a better understanding of how thermal regime influences success of trap and haul operations.

- *AM-007: Is there enough difference in migration-run timing and spatial separation between mature spring-run Chinook salmon and fall-run Chinook salmon in the Restoration Area to limit genetic introgression of the two populations?* Annual adult trap and haul efforts provide data on migration-run timing of adult fall-run Chinook salmon, which can serve as a tool for comparison when adult spring-run Chinook salmon return to the SJR Restoration Area.

- *AM-009: When will spring-run adults begin to migrate into the Restoration Area?* Methodologies developed and practiced in the proposed study may ultimately be used as a tool to monitor temporal patterns of upstream migrating adult spring-run Chinook salmon into the Restoration Area.

- *AM-010: What is the source (origin) and contribution/risk of adult fall-run Chinook salmon that are currently found at the Hills Ferry Barrier?* Fin clips acquired from all captured fall-run Chinook salmon in the proposed study will provide data on origin of fish, and these practiced techniques could ultimately be used on spring-run salmon in future efforts.

Additionally, there are a multitude of questions pertaining to selection and quality of spawning habitat, and, subsequently, success of spawning and survival of embryos – outmigrating juveniles, that currently relies entirely on our ability to trap and haul adult fish permitting them access to Reach 1A where they have spawned historically. Similarly,

juvenile outmigrating fall-run Chinook salmon, necessary to support additional studies (*i.e.*, juvenile trap and haul study), will be progeny from fish captured and transported in the current proposed study.

1.1 Statement of Need

The Hills Ferry Barrier (HFB) is constructed annually by California Department of Fish and Wildlife (DFW) to divert fall-run Chinook salmon (*Oncorhynchus tshawytscha*) into the Merced River and prevent upstream movement into the San Joaquin River (SJR) beyond the confluence with the Merced River. Upstream of this confluence, the SJR does not provide access to suitable spawning habitat for adult salmon because upstream obstacles prevent through access (*e.g.* dry river sections, Sack Dam, Mendota Dam). Furthermore, return flows from Salt and Mud Slough often attract salmon into irrigation canals that provide no spawning habitat nor return access to the river. However, even with the HFB in place, some salmon are able to circumvent the barrier and continue to swim upstream. Until sufficient flows and suitable bypasses are constructed that allow upstream passage, salmon passing the HFB are considered straying losses. Because of this, it provides an opportunity to translocate fall-run Chinook salmon, study their behavior and spawning site preference prior to reintroduction, and provide the means to supply future generations of fish (*i.e.*, juvenile salmon) for further research. Information gathered from this study will help to guide resource management decisions for future reintroduction efforts.

1.2 Background

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging the renewal of long-term water service contracts between the United States and the Central Valley Project Friant Division Long-Term Contractors. After more than 18 years of litigation of this lawsuit, known as NRDC *et al.* vs. Rodgers *et al*., 2006, a settlement was reached. The stipulation of the Settlement establishes two primary goals: (1) Restoration – to restore and maintain fish populations in "good condition" in the mainstem San Joaquin River (SJR) below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish and (2) Water Management – to reduce or avoid adverse water supply impacts on all of the Friant Division long-term contractors that may result from the Interim and Restoration Flows provided for in the Settlement.

Now that the feasibility to capture and translocate adult salmon in the Restoration Area has been established (from previous efforts in 2012 and 2013), these efforts can continue until appropriate conditions support fish populations throughout the Restoration Area. While construction modification projects, intended to provide appropriate habitat and passage conditions to support salmon populations, are pending, biologists can continue to trap and haul salmon from Reach 5 to Reach 1 of the Restoration Area. Because salmon were extirpated from the Restoration Area of the SJR following the construction of Friant Dam in 1942, little information is available regarding life history traits of salmon unique

to this system (*e.g.*, spawning site selectivity, dispersal, offspring production). Data collected from translocated salmon to Reach 1 allows biologists to evaluate adult distribution in this reach, spawning site preference, and success of redds. This information will help in developing future management practices to promote the success of future reintroduction efforts.

1.3 Anticipated Outcomes

Objectives:

1. Capture adult fall-run Chinook salmon upstream of the HFB; evaluate weir effectiveness and loss of fish to false migrational pathways by monitoring for salmon in irrigation canals (Mud and Salt Slough) upstream of these weirs.

2. Translocate adult fall-run Chinook salmon to Reach 1 of the Restoration Area for release into the SJR or to be used for streamside spawning activities.

3. Monitor salmon distribution in Reach 1 and determine locations of spawning site selection (*i.e.*, redd locations).

4. Assess success of streamside spawning and incubation. Streamside spawned fish will be reared to the juvenile life-stage when they will be used to support additional SJRRP studies.

5. Establish a long-term plan for use of trap and haul activities.

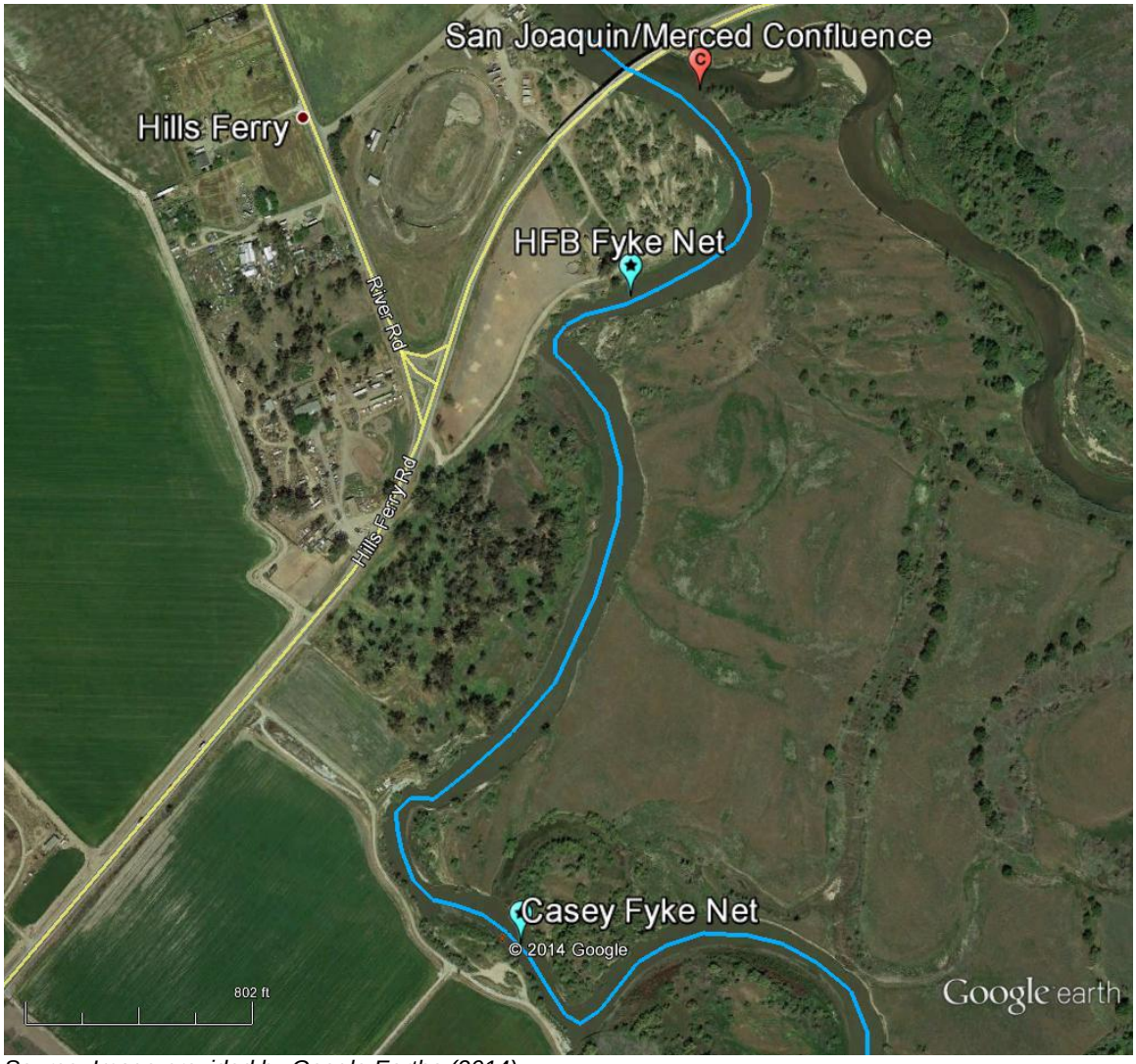
1.4 Methods

Type of Study: Field study

Reach(es): Reach 1 and 5

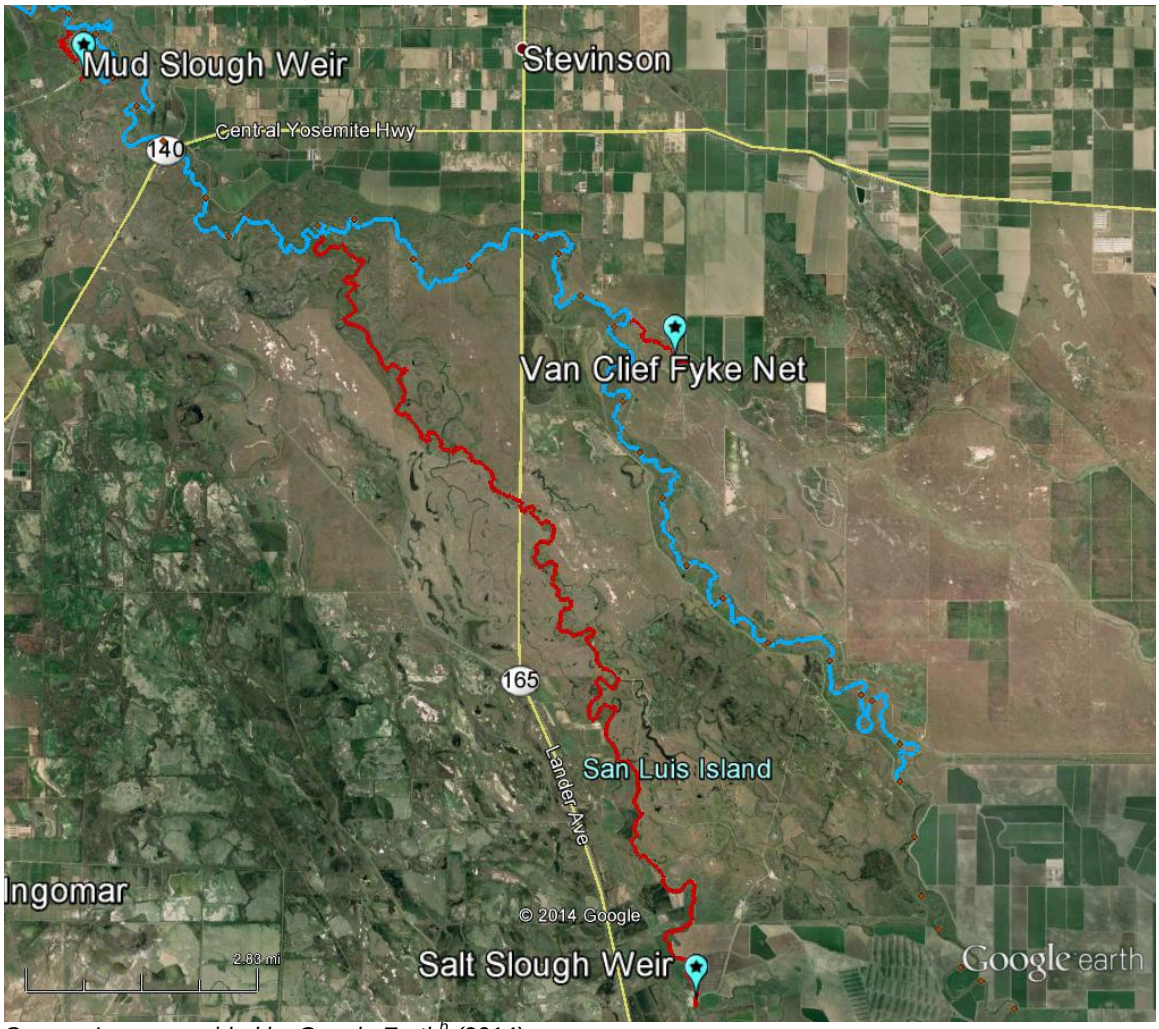
Fish capture gear and locations

The trap and haul phase of this study will take place from October 1 – December 15, 2014. Reclamation personnel will capture adult Chinook salmon using fyke nets and weirs at five locations: immediately above the HFB, approximately 0.6 river miles upstream of the barrier (Casey property), Mud Slough, Salt Slough, and near the confluence of the Eastside Bypass and the SJR (near Van Clief Road; Figure 1 and 2). If deemed necessary, multiple nets may be erected in one or more of the proposed locations. In the unlikely event that interim flows permit significant flows of water over Sack Dam, which could provide attractive flows for upstream migrating salmon, an additional net will be erected and monitored in the area upstream of Highway 165 Bridge.



Source: Image provided by Google Eartha (2014)
Note: Blue line indicates the mainstem San Joaquin River

Figure 1. Approximate Locations for Placement of Hills Ferry Barrier (HFB) and Casey Property Fyke Nets



Source: Image provided by Google Earth[b] (2014)
Note: The mainstem San Joaquin River (SJR) is indicated by the blue line and the adjoining waterways (i.e., sloughs, confluence of SJR with Eastside Bypass) are indicated by the red lines.

Figure 2. Approximate Locations for Placement of Mud and Salt Slough Weirs and Van Clief fyke Net

Fyke nets and weirs are designed to divert upstream migrating fish into a central collection net or box. They are constructed of 2.4-cm square #252 knotless nylon netting formed over 5 consecutive 1.2-m hoops and a 1.2-m square, welded-conduit frame entrance. The traps contain 2 throats with a 25-cm diameter opening. Wings walls, attached to the sides of the net opening, are 1.2 m deep and long enough to span the river (max wing length 30.5 m), with small floats spaced every 61 cm on top, and a lead line on bottom. Nets and wing walls are held in place with anchored T-posts. Net entrances face downstream, with wing walls extending to shore in a v-shaped pattern (Figure 3). The two downstream-most (HFB and Casey property locations, Figure 1) fyke nets are placed in the river with wing walls extending towards each bank, leaving approximately 3 – 5 m open on one side for boat passage. The Van Clief fyke net is placed in a non-navigable area; therefore, the wing walls can encompass the SJR.

Figure 3. Reclamation Personnel Attaching Wing Walls of fyke net to t-posts. Central Net Opening Faced Downstream to Catch Upstream Migrating Fall-run Salmon to Promote Transport of these Fish to Reach 1 of the San Joaquin River Restoration Area

Because of scouring underneath fyke nets in previous study years, as well as significant net failure as a result of beaver damage, both of which likely reduced sample gear success, picket-weirs (similar in design to the HFB, but smaller in scale) will be used at Mud and Salt Slough locations during the proposed study period. Picket-weirs will be constructed of vertically-oriented, evenly-spaced (1.9 cm spaces), metal tubing, assembled into individual panels (2.4 – 3-m long). Metal tubing will be vertically adjustable to accommodate scouring as it occurs (*i.e.*, tubing can be moved downward to close any gaps between the bottom of the panel and the substrate). Similar to the fyke net layout, these panels will be assembled in a v-shaped pattern across the aforementioned sloughs. In the center of the picket weirs will be a collection box. The V-shape design will direct upstream swimming salmon into the collection box. T-posts used to secure fyke nets and wing walls, as well as weir anchor posts, will be marked with highly visible flagging, and at least one flashing light to provide visual warning cues for boaters. Each fyke net and weir will be checked daily for fish, and to ensure potential scouring will not be detrimental to operation. In addition, nets and weirs will be cleaned of debris, as necessary, to minimize flow restrictions. If scouring occurs, nets will be relocated a few meters up- or downstream, as necessary. If scouring occurs with the weirs, metal pickets will be driven further into the substrate to close any gaps that might allow fish to pass.

During 2013 efforts more than half of the adult salmon captured were recovered by DFW biologists in irrigation canals, likely from salmon passing through scour holes underneath fyke nets, jumping over the wing walls, or due to extensive beaver damage to nets. While weir installation is designed to reduce salmon passage past these points, it is necessary to evaluate their effectiveness by continued monitoring of upstream irrigation canals. DFW will monitor and capture salmon found in the terminal end of irrigation

canals, using dip nets, at six locations near Los Banos, CA: Delta Rd., Midway Rd., Hereford Rd., Deepwell Rd., Britto Rd., and Cozzi Ave.

Fish Processing

All captured fish will be removed from nets, weirs or canals, and temporarily maintained in net pens (61×81×135 cm, 0.64 cm mesh) until they can be processed (Figure 4). Bycatch (all non-salmonids) will be measured (nearest mm, fork and total length) and released upstream of the nets and weirs to minimize likelihood of immediate recapture. Chinook salmon will be transferred; one at a time using plastic coated dip nets, from the net pen to a portable plastic trough (66×43×25 cm) filled at least ½ full with SJR water. This method will permit minimal atmospheric exposure during transfer and processing. A fin-clip will be collected from the dorsal or caudal fin, for DNA analysis from each salmon captured. Fish will be sexed (males checked for presence of milt/females determined to be gravid), tagged (see "Tagging methods"), measured, checked for the presence of an adipose fin, overall condition will be recorded, and all captured salmon will be photographed.

Figure 4. Reclamation Personnel Using a Large Dip Net to Transfer Adult Fall-run Chinook Salmon from a Live-cage to a Portable Plastic Trough for Processing

Tagging methods - All salmon will be tagged using 3.18-cm (1.25-inch) Peterson disc tags (Figure 5; Floy Tag & Mfg., Inc., Seattle, WA). A set of tags are affixed below the dorsal fin rays, on either side of the fish, using a nickel pin inserted through the dorsal musculature. Each disc tag has a unique number and is used to identify fish after release. Six solid colors will be used to distinguish gender and month of capture in 2014. A representative sample of the tags used in 2013 are shown in Figure 6.

Figure 5. Fall-run Chinook Salmon Captured in the San Joaquin River Displaying Peterson Disc Tag and Being Placed into Oxygenated Transport Tank

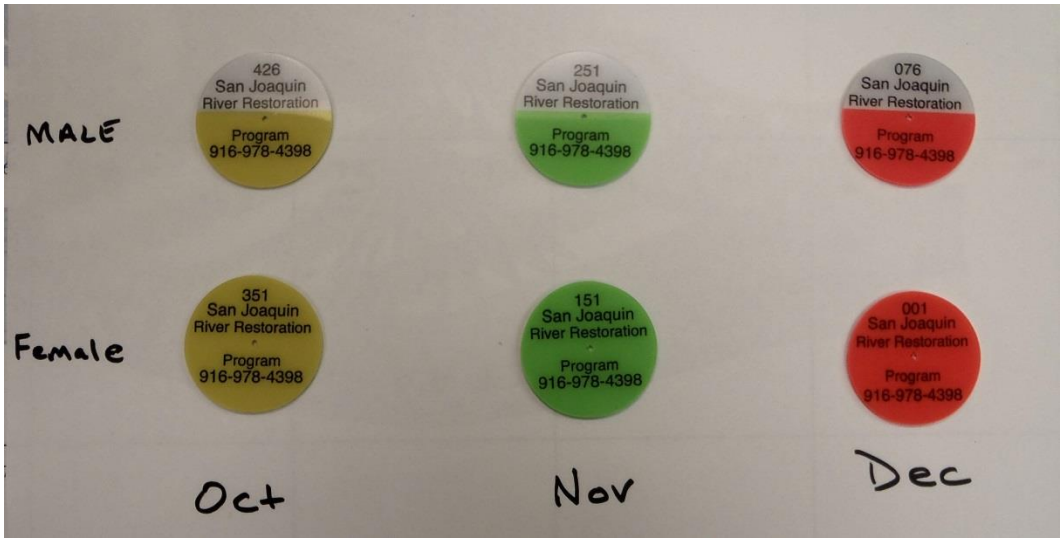


Figure 6. Peterson Disc Tags used for Identification of Fall-run Chinook Salmon in the San Joaquin River by Gender and Month of Capture in 2013

In addition to the disc tags, one-hundred female salmon will be intragastrically implanted with an acoustic transmitter (V13, 69 kHz transmitter; VEMCO, Bedford, Nova Scotia), capable of transmitting a unique signal up to 120 days. A balling gun (often used to dose large pills in livestock), coated in food-grade glycerin is used to place the transmitter in the salmon. These tags will be used to locate salmon and redds in Reach 1 following release (see "Tracking").

Fish transport:

Following capture, fall-run Chinook salmon will be placed in an oxygenated tank (CDFW Tank = 1500 – 1700 L, Reclamation Tank = 2100 - 2300 L), with a maximum of 20 (CDFW transport tank) and 25 (Reclamation transport tank) adult salmon per tank (Figure 7). Transport water will be collected directly from the SJR near the collection sites to ensure minimal differences in water temperature. Salt will be added at approximately 6 – 10 ppt to alleviate osmotic imbalance and stress-related effects. Oxygen will be supplied via a compressed-gas cylinder and oxygen regulator in an effort to maintain dissolved oxygen levels $\geq$ 8 mg/L. Environmental conditions (water temperature (°C), conductivity (mS/cm), salinity (ppt), and dissolved oxygen (mg/L)) will be collected with a handheld multiparameter instrument before loading fish and immediately prior to fish release.

Figure 7. California Department of Fish and Wildlife and Reclamation Personnel Transferring an Adult Fall-run Chinook Salmon into the CDFW Fish Transport Tank

Fish will be truck transported, < 170 km for < 100 min, for release in the SJR near Camp Pashayan (river mile 243.2, near State Highway 99, Reach 1) or retained for streamside spawning activities (see "Streamside spawning" below). Following transport, salmon will be removed from their respective transport tank using dip nets and quickly transferred to on-site net pens identical to those used prior to post-collection processing (see Figure 4). Fish will be given at least 30 minutes to recover from transport, and then will be allowed to leave the net pen under their own volition. Net pens will only be in the water during acclimation and will otherwise be stored in the transport vehicle. Chinook salmon captured in fyke nets and weir traps will be truck transported by Reclamation

personnel, whereas salmon captured in the irrigation canals will be truck transported by DFW personnel.

Fish tracking:

Passive tracking - Single channel acoustic monitoring receivers (receivers; Vemco, Bedford, Nova Scotia), capable of identifying coded transmitters implanted in fall-run Chinook salmon, will be strategically placed, from Friant Dam downstream to State Route 99, to monitor fish movements throughout Reach 1. Up to 20 receivers may be deployed to promote tracking. The receivers will be moored using stainless steel cable anchored to the bank and weighted to the bottom using flat weights, or cement blocks (Figure 8). Nearby structures or trees along the bank will be used to anchor receivers. If these are not available, T-posts will be used to anchor receivers. To keep receivers vertical in the water column, a boat buoy will be attached to the receiver as well. Receivers will be installed in September and will be retrieved in January if conditions allow.

Figure 8. A single Channel Acoustic Monitoring Receiver (Vemco) Being Attached to a Stainless Steel Cable with Weights and Bouy. Stationary Receivers will be used to Track Movements of Adult fall-run Chinook Salmon in Reach 1 of the San Joaquin River

Active tracking - Tagged fish will also be tracked using a portable receiver from a boat and from shore to assist with determining fish locations between fixed receivers. Visual surveys will be conducted by boat to observe adults (live and carcasses) and redd locations. GPS coordinates of these positions will be recorded. Mobile tracking and visual observations will be completed by a crew of three to four individuals floating the river for three days. The survey is planned to cover Friant Dam to Fort Washington, Fort

Washington to Millburn, and Millburn to Donny Bridge. Adult carcasses will be checked for retained eggs/milt and heads will be collected for the DFW Coded Wire Tag Evaluation, as well as to determine when spawning occurred and proportion of adult fall-run Chinook that contributed to spawning. Data from these surveys will provide information regarding habitat utilization, including spawning site preference (i.e., redd locations). California Department of Fish and Wildlife and USFWS will be responsible for passive and active tracking activities.

Redd Superimposition monitoring - Redd grates would be placed over the tailspills of the early spawning fish during fall 2014 and/or fall 2015 to evaluate redd grate effectiveness to minimize late spawning fall-run redd superimposition on early fall-run redds. Redd grates will be constructed of 3-foot pieces of reinforcing bar connected with plastic ties to form a triangle that will be anchored with cobble immediately over the egg pockets. Weekly surveys would be conducted to inspect and if necessary repair redd grates and evaluate whether the grates protect redds from late spawning fall-run. Redd grates would be assumed to be effective, if late spawners do not remove more than 3 inches of gravel from a grate-protected tailspill or bury a grate-protected tailspill with fine sediment.

Streamside spawning:

Based on the condition of the fish, salmon will be sorted for either transport and release or transport and streamside spawning. Only ripe fish, determined by production of milt or eggs as a result of palpation of the abdomen, will be used for streamside spawning. Another factor for determining the disposition of the fish will be whether a ripe male and female are present in the traps on the same day. Streamside spawning will occur at the trapping/collection location or at the incubation location (near Friant Dam) in a darkened or covered area. The preferred method would be to transport fish to the Friant Dam incubation facilities. However, if transportation appears to be causing egg mortality then fish will be spawned immediately following capture. If this method is required, eggs will be stripped from the female and wrapped in wetted cheesecloth, milt from males will be collected into small plastic bags, and both samples will be placed in a chilled cooler. If spawned at the incubation center, eggs will be stripped and milt collected as described below:

Eggs will be stripped from the female and prior to fertilization, the eggs will be enumerated and assessed for abnormalities then good egg will be placed into a mixing bowl or crate (Figure 9). Milt will be extracted form males and may be tested for motility prior to mixing with eggs. Fish will be spawned on a 1:1 male to female ratio. Fertilized eggs will be disinfected with a 10 minute bath treatment containing 100 parts per million of free iodine. After disinfection, eggs will be incubated in stream-side incubators. In the future a holding component (i.e. holding non-ripe adults until they are ripe) to this activity may be implemented to allow for greater genetic diversity. Holding pens will be similar to those described for acclimation during release of transported adults and will be attached to the cod end of the fyke system.

Figure 9. Post-spawned Female (top left image) and Male (bottom left image) Fall-run Chinook Salmon, and Resulting eggs (right image), from 2013 Streamside Spawning Activities

Stream-side incubators - Eggs used in stream-side incubators will be placed in lockable incubators or vertical incubation trays that will either be housed on BOR property near Friant Dam or in a locked trailer. Water for the incubators will be obtained from the SJR through existing plumbing from the BOR facility with water being discharged directly to the river. The eggs themselves do not generate any waste, but may need application of iodine up to three times throughout the incubation phase at a rate of 100 ppm. Treated water will not be drained back to the SJR. After eggs hatch and are in the swim-up stage they will be moved to in-stream holding pens to rear to an appropriate size.

Holding Pens - Once the eggs have reached the swim up stage they will be removed from the streamside incubators and placed into holding pens. The eight holding pens are constructed of aluminum frames (0.9×0.9×1.2 m) with perforated sheet panels (~ 0.3 cm mesh size), and are supported by pontoons (Figure 10). Pens will be fitted with floats or pontoons and will be anchored using a combination of anchors, tethers and t-posts. Pens will be placed in the area below Friant Dam on the Madera County side of the river where boater traffic is prohibited. Fish will be held up to a maximum density of 0.15 lb/ft3/in, following recommendations provided by Banks (1994) and Ewing and Ewing (1995) for rearing spring-run Chinook salmon. Daily, fish will be monitored, fed and pens will be cleaned. The holding pens will be fitted with clock-driven belt-style fish feeders. Fish will be fed daily approximately 4 to 6 % of total body weight using a standard commercial salmon feed. Feed level will be determined using BioGro, an Excel based fish feeding program developed by the University of Washington and used by the Oregon Department of Fish and Wildlife. Fish will be held in cages for at least ten days for imprinting purposes or until they reach a size large enough for tagging. After which, fish will be released in Restoration Area of the SJR. If some of the fish held in these cages are identified as needed for other studies (e.g., predator evaluation, telemetry), they will be held until they are large enough for the intended purpose most likely ending in May.

Figure 10. California Department of Fish and Wildlife Personnel Transferring Fish into Holding Pens Where juvenile Fall-run Chinook Salmon were Maintained Before Release in the San Joaquin River

Other information:

Previous studies:

Trap and Haul efforts were conducted in 2012 and 2013. Proposed efforts contained herein are based, and modified, on practices used in the previous years. The summary report for 2013 adult Chinook salmon trap and haul efforts is available on the SJRRP website and complete report will be available for the annual technical report.

Compliance considerations:

CatEx (NEPA), Nationwide 5 (ACOE), Section 7 (ESA compliance), State of California scientific collection permits, and other relevant permits will be obtained before starting this study.

Invasive species concerns:

Hazard Analysis & Critical Control Points (HACCP) plans will be developed for this activity for aquatic nuisance species.

1.5 Deliverables and Schedule

Milestones (2014-2015):

October 1 Begin adult Chinook salmon trap and haul operations.

December 15 Complete adult Chinook salmon trap and haul operations.

The termination of trap and haul operations could be extended if HFB remains in place or a significant number of fish continue to be captured up to the end date.

Redd and carcass surveys will continue until no new redds are observed, most likely the first or second week of January.

Reclamation will provide a weekly catch update during the October 1- December 15 study period.

Reclamation will complete a summary report of trap and haul efforts, including the location and total fish captured, tagged, and release disposition by August 1, 2015. The final report will be made available on the SJRRP website.

DFW will provide a summary of the fish captured in irrigation canals and the disposition of those fish to Reclamation, to include in the weekly and final reports from Reclamation. DFW will also provide a report documenting streamside spawning efforts by August 1, 2015. The final report will be made available on the SJRRP website.

USFWS will provide a biweekly report regarding redd survey efforts after release into Reach 1 and a final report by August 1, 2015. The final report will be made available on the SJRRP website.

1.6 Budget

The total cost estimate is $ 392,623 for 2015.

Table 1-1. Proposed 2015 Budget

Reclamation Trap and Haul Budget:

	Estimated Costs
October 2014	
2 Biologists	$ 61,380
Travel	$ 11,370
November 2014	
2 Biologists	$ 59,400
Travel	$ 11,100
December 2014	
2 Biologists	$ 29,700
Travel	$ 7,050
6 days set up/removal	$ 10,800
Travel	$ 1,900

Field equipment:

• Four-wheel drive pickup ($330/month + 33¢/mile)	$ 8,000
• Vemco VR2W receivers ($1,533 x 25)	no cost
• Vemco VR 100 manual directional hydrophone receiver	no cost
• Vemco V13 acoustic tags ($330 x 100)	no cost
• Peterson disc tags (1,000 tags)	$ 1,100
• Weir supplies	$ 7,000
• Fisheries supplies	$ 2,000
• Fish haul tanks (300 and 600 gal tanks)	no cost

Data Management, Analyses, Weekly updates, and Report Writing 4 weeks (2 biologist)	$ 30,400
FMTFG and Program Presentations	$ 2,600
Subtotal	$ 243,800

DFW Trap and Haul Budget:

Subtotal	$ *Funding provided by DFW no cost to program.

USFWS Redd Survey/ Fish Monitoring:

	Estimated Costs
Staff (0.35 FTE)	$ 85,432
Travel	$ 26,460
Consumables	$ 1,800
Overhead (30.9%)	$ 35,131
Subtotal	$ 148,823

1.7 Point of Contact / Agency Principal Investigators

Bigelow, Matt J. California Department of Fish and Wildlife, Region 4, 1234 E. Shaw Ave., Fresno, California 93710

Jackson, Zachary. US Fish and Wildlife Service, 850 Guild Ave., Suite 105, Lodi, California 95240, 209-334-2968 x408, 209-403-1457

Portz, Donald E., PhD. Bureau of Reclamation, 303-445-2220, Denver Federal Center, PO Box 25007, Denver, Colorado 80225

1.8 References

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Google Earth[b]. 2014. Latitude 37.245246°, Longitude -120.838327°. Google Earth, Version 7.1.2.2041. Images from 11 April 2013. Accessed on 18 July 2014.