CONTROL NUMBER:

Standard Operating Procedures for Fish Handling Related to the Collection, Sampling, Transport, and Release of Salvaged Fish at the Central Valley Project's Tracy Fish Collection Facility

(DO NOT DISTRIBUTE)

PREPARED BY: Reyes, Rene C, TO-411
rreyes@usbr.gov

Frontispiece—Tracy Fish Collection Facility, a component of the Central Valley Project, is located in the southern region of the Sacramento-San Joaquin River Delta, about 50 miles from San Francisco, California. The facility was constructed in 1955-1956 and was designed to divert and remove fish entrained in water exported from the Delta by the C.W. “Bill” Jones Pumping Plant.

CONTROL NUMBER:

Standard Operating Procedures for Fish Handling Related to the Collection, Sampling, Transport, and Release of Salvaged Fish at the Central Valley Project's Tracy Fish Collection Facility

Central Valley Project

California-Great Basin, Region 10

South-Central California Area Office

Tracy Office

October, 2020

TRANSMITTAL LETTER

SUMMARY OF REVISIONS

The following Standard Operating Procedure for fish handling at the Tracy Fish Collection Facility is the first publication dated October 2020.

ACRONYMS

BDO. Bay Delta Office.
CALFED. California Federal Bay-Delta.
CDFW. California Department of Fish and Wildlife.
CHNT. Chinook Salmon Tagged.
CVO. Central Valley Operations.
CVP. Central Valley Project.
CVTA. Central Valley Tissue Archive, operated by CDFW.
CWT. Coded Wired Tag.
DMC. Delta-Mendota Canal.
DWR. Department of Water Resources.
ESA. Endangered Species Act.
HDPE. High Density Poly Ethylene.
HT. Holding Tank.
JPP. C.W. “Bill” Jones Pumping Plant, formerly the Tracy Pumping Plant.
LTO. Long-Term Operation
NFPA. National Fire Protection Association.
NMFS. National Marine Fisheries Service.
O&M. Operations and Maintenance.
PIT. Passive Integrated Transponder.
SCCAO. South Central California Area Office.
SDFPF. Skinner Delta Fish Protective Facility.
SDS. Safety Data Sheet, formerly Material Safety Data Sheet.
SJRRP. San Joaquin River Restoration Program.
SLDMWA. San Luis & Delta-Mendota Water Authority.
SOP. Standard Operating Procedure.
SWP. State Water Project.
SWRCB. State Water Resources Control Board.
TFCF. Tracy Fish Collection Facility.
TO. Tracy Office.
USFWS. United States Fish and Wildlife Service
USGS. United States Geological Survey.
VC. Velocity control.

TABLE OF CONTENTS

APPENDICES

FIGURES

Fish Handling related to Collection, Sampling, Transport, and Release of Salvaged Fish at the Tracy Fish Collection Facility

A. Purpose of the SOP

The purpose of the Standard Operating Procedure (SOP) is to provide guidance on fish handling related to the collection, sampling, transport and release of salvaged fish from the Tracy Fish Collection Facility (TFCF).

A.1. Description of Salvage Operation

The TFCF, a component of the Central Valley Project (CVP), is located in the southern region of the Sacramento-San Joaquin River Delta (Delta). The facility was designed to divert and remove fish entrained in water exported from the Delta by the C.W. “Bill” Jones Pumping Plant (JPP). The TFCF uses a behavioral louver array and vertical rotating traveling screens to guide fish into the primary and secondary bypasses, respectively, and into collection (holding) tanks. Entrained fish that reach the holding tank are salvaged fish. Salvaged fish are estimated daily and are transported by truck to fixed release sites near the confluence of the Sacramento and San Joaquin Rivers. Refer to Appendix A for location of the TFCF and related structures in the Delta. Refer to Appendix B for location of structural components of the TFCF.

A.2. Description of Fish Handling

Fish handling is the mechanical or manual action performed on fish during collection, sampling, transport, and release. Proper fish handling procedures shall be followed to minimize the effects of stress and reduce immediate and delayed mortality.

B. Assignment of Responsibility

The Bureau of Reclamation has a prime interest in the TFCF and a continuing responsibility for ascertaining that unauthorized encroachments do not occur, that existing or potential conditions do not lead to public criticism or injury to the public, and that nothing is done which conflicts with the authorized purpose of the TFCF.

The TFCF is operated by the Tracy Office as part of the South Central California Area Office (SCCAO) under the jurisdiction of the California Great Basin Regional Office. The Communications Directory, located at the end of the SOP in Appendix V, includes telephone numbers for the responsible offices, cooperating agencies and entities, and emergency services.

B.1. Office Responsibilities

B.1.a. Interior Region 10, California-Great Basin Regional Office

The Interior Region 10, California-Great Basin Office located in Sacramento, California, provides technical, and administrative support services, as well as periodic inspections of the TFCF to the South Central California Area Office. When necessary, the Regional Office coordinates the services through the Technical Service Center in Denver, Colorado. The region (Figure 1) fulfills water obligations for agriculture, power generation, water conservation, water recycling and reuse while protecting natural resources including state and federally protected fish and wildlife resources.

B.1.b. South Central California Area Office (SCCAO)

The SCCAO is headquartered in Fresno, California, and is responsible for overseeing and addressing Reclamation's interests and issues within the geographic scope of SCCAO. That geographic scope lies entirely within California and is generally bound by the San Francisco Bay/Delta Region to the north, the Sierra foothills to the east, the Pacific Ocean to the west, and Santa Barbara and Ventura counties to the south.

B.1.c. Tracy Office (TO)

As part of SCCAO, the Tracy Office (TO), located in Byron, California, is responsible for the direction and oversight of operation and maintenance (O&M) at the TFCF. The TO operates under the guidance of the SCCAO and in cooperation with the California-Great Basin Regional Office.

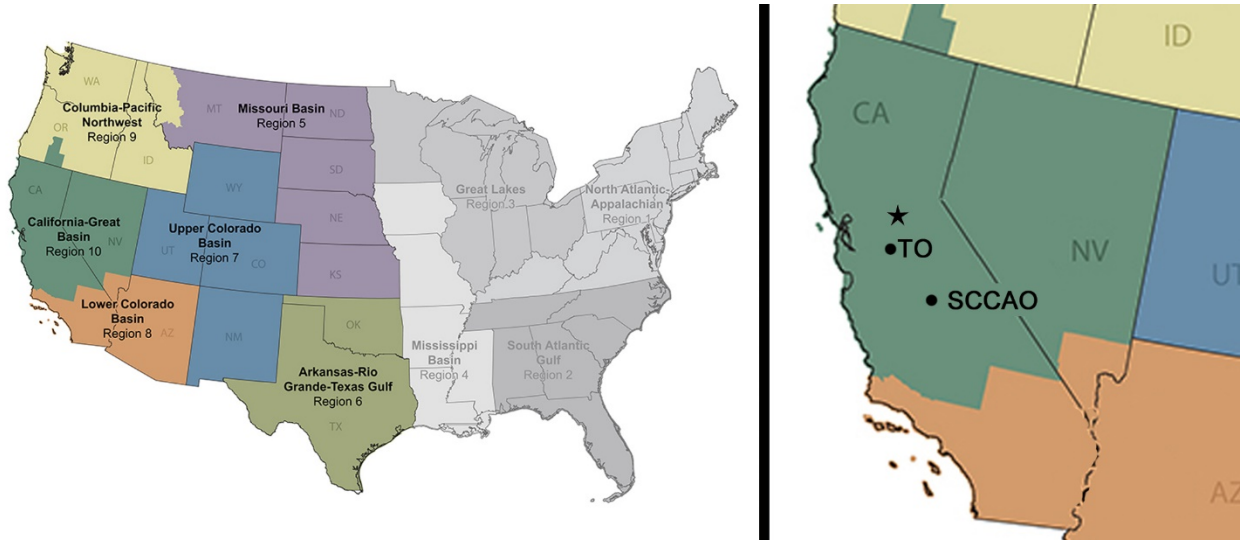


Figure 1.— California-Great Basin Region 10: locations of the Regional Office in Sacramento, CA (star), Tracy Office (TO) located in Byron, CA and South Central California Area Office (SCCAO) located in Fresno, CA.

B.2. Staff Positions

The TO is organized under the umbrella of the SCCAO (Figure 2).

B.2.a. Chief, Engineering, Operations & Maintenance Division

The Chief of Engineering, Operations & Maintenance Division (O&M Division Chief) leads the TO and is responsible for the overall oversight of the TFCF.

B.2.b. Chief, Fish Facility Branch

The Fish Facility Branch Chief is responsible for the oversight of the maintenance, operational, and biological needs of the TFCF.

B.2.c. Supervisory Fish Biologist

The Supervisory Fish Biologist is responsible for the biological requirements of the fish salvage operation and environmental regulatory compliance of the TFCF, including the supervision of the Biological Resources Section staff.

B.2.d. Biological Resources Section

The Biological Resources Section includes fish biologists and biological science technicians who are responsible for environmental regulatory compliance of the TFCF.

B.2.e. Equipment Operator Supervisor

The Equipment Operator Supervisor is responsible for the daily operations of the TFCF, including the supervision of Equipment Operators.

B.2.f. Equipment Operator

Equipment Operators are responsible for the salvage operation at the TFCF.

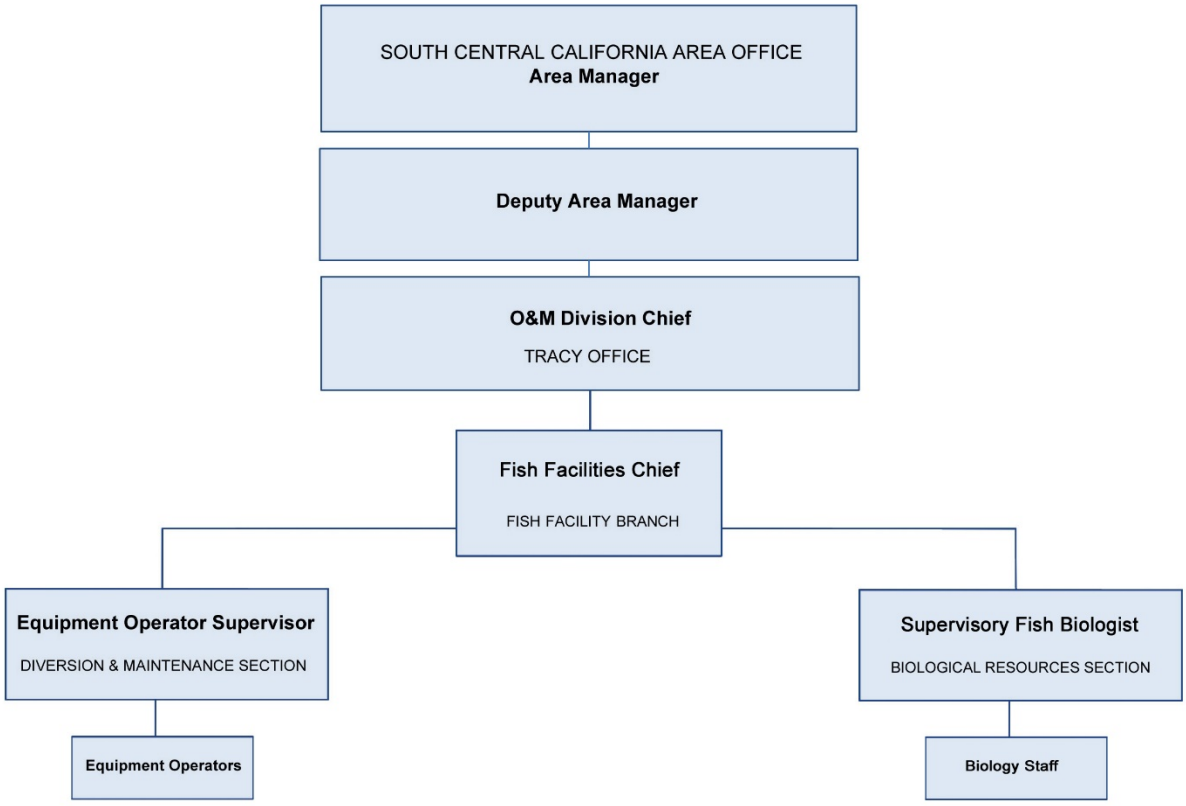


Figure 2.—South Central California Area Office and Tracy Office Organizational Hierarchy

C. Data Reporting

C.1. Salvage Operations Data Reporting Forms (data sheets)

Monitoring of salvage operations involve the collection of data from several points within the facility: from the point of entrainment, to fish guidance and collection, and to transport and release. These metadata work together for the proper operation and biological compliance of the fish facility. Facility operational criteria and data gathering are driven by State Water Resources Control Board Decision 1485 (Appendix C), Direct Loss Mitigation Agreement (Appendix D), and the Biological Opinions and Long-Term Operation Action (Appendix E). The criteria guideline for the operation of the TFCF is listed in Appendix F.

The Equipment Operator collects and records operational and fish salvage data. Salvage data is collected through fish counts, a subsample of fish salvage collected for 30 minutes every two hour period. This subsample is called a “30-minute fish count” or “fish count” (see E. Fish Sampling for details). The Equipment Operator is required to collect data on listed fish and fish of special concern during fish counts. The data gathered from each processed fish are used by different agencies and managers to determine proper actions needed to protect the species and minimize impact to water users. It is the responsibility of the Equipment

Operator Supervisor or designated team lead to review all data forms (data sheets) at the beginning of the day shift and ensure they are complete.

The Biological Resources Section staff will review the data sheets for accuracy each morning (see F.4 Data QAQC for details) before being electronically sent to distribution lists. All data sheets are printed on waterproof paper. The Equipment Operator will fill out the data sheets in pencil and will record data and information directly onto the data sheets. All recorded times are in military time format.

Blank hard copies of all data sheets are stored inside the O&M computer room and are maintained by the Equipment Operator Supervisor; electronic master forms are stored on the Biology Resources drive. A copy of all the salvage operations blank sheets are included in Appendix G. Only the Operations and Counts Summary Data Sheet (see C.1.a.), Operations and Counts Data Sheets (see C.1.b.), and the Length Data Sheets (see C.1.c.) are distributed publicly.

C.1.a. Operations and Counts Summary Data Sheet (Appendix G-1)

The Operations and Counts Summary Data Sheet is also known as the “CVO Data Sheet” because it was developed as a summary sheet of operations and fish counts at the TFCF for the Central Valley Operations (CVO) managers. The form tracks and summarizes the daily number of fish salvaged that are listed under the Endangered Species Act (listed species) or are “Species of Management Concern”. This list includes winter-run Chinook Salmon, spring-run Chinook Salmon, Steelhead, Delta Smelt, Longfin Smelt, and Green Sturgeon. White Sturgeon and Sacramento Splittail, although not listed species, are included in this sheet because they are California Species of Special Concern. Summary of the counts are listed on the top half of the form; fish lengths recorded in millimeters (mm) are listed in the bottom half of the form. The form is initially faxed after the final fish count of the day to CDFW by the Equipment Operator on duty, soon after midnight. The “head tag/coded wire tag” column is completed the following day by the Biological Resources Section staff (see F.5 for details). During larval smelt season, a “Y” for “Yes present” or an “N” for “Not present” is written after the corresponding larval fish counts (0400, 1000, 1600, and 2200) for Longfin Smelt and Delta Smelt. After the form is verified for accuracy by staff of the Biological Resources Section, it is distributed through email by 10 AM to the following offices and agencies: Reclamation (BDO, CVO, SJRRP), SLDMWA, CDFW, DWR, USFWS, and NMFS. **Note:** The winter-run Chinook Salmon tally is reset to zero every October 1, the start of the water year.

C.1.b. Operations and Counts Data Sheet (Appendix G-2)

The Operations and Counts Data Sheet is used to record the duration in minutes of salvage, counts, and exports at JPP for each two hour period. Additionally, water temperature, water depth, and estimated hydraulic flows in the primary channel, secondary channel, and holding tank are recorded. The bottom section of the form

lists the total number of each fish species collected during each fish count. If no fish are collected from a count, “0” must be entered in the Total Count Code 98 box at the bottom of the sheet. Special study fish take is also reported and summarized using this form and complement the form described in C.1.c. Special study take of fish occurs when fish are collected for, or incidentally captured during, experiments or research studies performed outside of normal facility operations. If a special study fish is salvaged during a count, “8888” must be entered in the appropriate box for Special Study Code. After the form is verified for accuracy by staff of the Biological Resources Section, it is distributed through email by 10 AM to the following offices and agencies: Reclamation (TO, BDO), NMFS, DWR, and CDFW.

C.1.c. Length Data Sheet (Appendix G-3)

The Length Data Sheet is used to record fish lengths from the 0200, 0600, 1400, and 1800 fish counts. Salmon and Steelhead lengths collected outside these times are also recorded using this form. Fish species are written by common name with the corresponding species-specific two to three digit code. For each fish species collected, only the first 24 fish lengths greater than 20 mm fork length (FL) are recorded; after the first 24 fish are counted and measured, the number of additional fish is recorded in the box to the right of the fish species code titled “Additional Fish Not Measured”. The Length Data Sheets complement the Operations and Counts Data Sheet (see C.1.b.) and are distributed together by 10 AM. During special studies, the fish species and lengths are reported using this form.

C.1.d. Operations Data Sheet (Appendix G-4)

The Operations Data Sheet is used to record hydraulic information for every two hour period. Data for the form is associated with a fish count and will be collected before a fish count is started. This form is used to record all metered, non-estimated flows (cfs), channel velocities (ft/sec), calculated bypass ratios, depths (ft), water level differentials (ft), temperature (F), velocity control (VC) pumps status, holding tank (HT) pump status, butterfly valve status, and clean water loop system status. Relevant formulas are listed in Appendix H and Appendix M-2. Hydraulic data that are not within operational criteria as dictated in Appendix F are noted in this form. A remedy to the non-compliant hydraulic measurement must be attempted before the fish count is started. This usually involves adjusting the number of velocity control (VC) pumps operating.

Measurements that are estimated due to meter failure are noted with an “F” after the measurement. The “F” means “failed” and signifies that the measurement recorded came from a meter that is not emitting correct values and must be estimated. These estimated readings affect other related calculated measurements; therefore, calculated measurements affected by meter failure will also have an “F” after the value. See section E.6.g. Extraordinary Situations Affecting Fish Sampling Data for details. Data collected on the Operations Data

Sheet are kept in-house and are physically and electronically archived by the Biological Resources Section staff.

C.1.e. Fish Transport Log Data Sheet (Appendix G-5)

The Fish Transport Log Data Sheet is used to record fish accumulation in holding tanks and estimate the cumulative percent of a truck load being utilized based on the Bates Fish Transport Tables, *i.e.*, Bates Tables (see Appendix J-2). Accumulation of fish is calculated after every fish count by expanding the number of collected fish by an expansion factor (see E.3. Expansion Factor for details).

In the Fish Transport Log Data Sheet, fish are categorized into seven groups: Salmon/Steelhead, Catfish, Threadfin Shad, American Shad, Spiny Rayed, Smelt, and Others. The appropriate Bates Table to be used will depend on the size class of the fish group. After a fish count, fish will be categorized by group and recorded in the corresponding "Count" section. This count will then be multiplied by an expansion factor and the value recorded in the "Total" section. The "% Load" is obtained from the corresponding Bates Table. The "% Load" of each fish category is then summed to obtain the "% Load, All Species" located at the bottom of the data sheet. The previous fish count's "Accumulative % Load" is added to the "% Load, All Species" in order to obtain the most recent fish count's "Accumulative % Load". This cumulative percent of a truck load is used, in part, to determine when fish transport is necessary. Once a truck load of fish is released, the Accumulative % Load is reset to zero.

Other data recorded in the Fish Transport Log Data Sheet include the specific holding tank used to accumulate fish, the release site location (sites 1-5) where the fish were released, release time, and oxygen/salinity levels of the water in the fish truck at the time of fish release. Other water quality measurements such as temperature is not included in this form but are recorded in the Transport Truck Water Quality Data Sheet (see C.1.g). Data collected for the Fish Transport Log Data Sheet are kept in-house and are physically and electronically archived by the Biological Resources Section staff.

C.1.f. Fish Release Data Sheet (Appendix G-6)

The Fish Release Data Sheet is used to summarize the fish transport data including fish collection start and end times, truck details, percent load and number of fish released (transferred from Fish Transport Log Data Sheet), time of release, condition of the fish truck, miles driven, and driver details. Release site locations are numbered from 1-6: 1=Curtis Landing, 2=Horse Shoe Bend, 3=Emmaton, 4= Antioch, 5=Brannan Island, 6=Other. Sites 1 and 2 are owned by State Water Project (SWP); 3-5 are owned by CVP. Site 6 is a site to be developed in the future. Data collected for the Fish Release Data Sheet are kept in-house and are physically archived by the Biological Resources Section staff.

C.1.g. Transport Truck Water Quality Sheet (Appendix G-7)

The Transport Truck Water Quality Sheet is used to record all relevant water quality parameters for the transport of fish from the facility to the release site. Water quality values are collected using a YSI Pro2030 multiparameter meter, calibrated on a monthly basis by the Biological Resource Section staff or a certified Equipment Operator. Refer to Appendix I for maintenance of the YSI Pro2030 meter. Parameters include DO (ppm), DO (%L), Specific Conductivity (µS/cm), Salinity (ppt), and Temperature (°C). Values are listed on the form in chronological order based on the YSI Pro2030 program. Data collected for the Transport Truck Water Quality Sheet are kept in-house and physically archived by the Biological Resources Section staff.

C.1.h. Debris Data Collected During Fish Counts Sheet (Appendix G-8)

The Debris Data Collected During Fish Counts Sheet is used to record the weight of debris (kg) collected from a fish count and the weight of debris (kg) removed by the secondary channel traveling screen. Composition of debris (Categories: Egeria, Woody or Reed, Hyacinth, and Shells or Sand) is visually estimated and quantified by volume percentage. Equipment Operators are trained to visually identify the type of debris present in the count sample and that each type is represented on the datasheet with a reasonable estimation that must add up 100 percent. Data collected for the form are kept in-house and are physically and electronically archived by the Biological Resources Section staff.

C.1.i. Debris Data Collected from Truck (Trash Rack) (Appendix G-9)

The Debris Data Collected from Truck (Trash Rack) form is used to record truckloads of debris removed from the trash rack. Composition of debris (Categories: Weed, Wood, Hyacinth, Peat Moss, and Trash) is visually estimated and quantified by volume percentage. Equipment Operators are trained to visually identify the type of debris present in the truckload and that each type is represented on the datasheet with a reasonable estimation that must add up 100 percent. Data collected for the form are kept in-house and are physically and electronically archived by the Biological Resources Section staff.

C.1.j. Debris Data Collected from Truck (Boom/Conveyer Belt) (Appendix G-10)

The Debris Data Collected from Truck (Boom/Conveyer Belt) form is used to record truckloads of debris removed from the trash deflector boom and the conveyer belt. Composition of debris (Categories: Weed, Wood, Hyacinth, Peat Moss, and Trash) is visually estimated and quantified by volume percentage. Equipment Operators are trained to visually identify the type of debris present in the truckload and that each type is represented on the datasheet with a reasonable estimation that must add up 100 percent. Data collected for this form are kept in-

house and are physically and electronically archived by the Biological Resources Section staff.

C.1.k. CVP Salmon DNA–Tissue Collection Form (Appendix G-11)

The CVP Salmon DNA–Tissue Collection Form is used to record the tissue (fin clip) collection data from Chinook Salmon. Data collected include collection date, time, collector initials, fish fork length (mm FL), the vial sample ID number, and whether the fish is adipose fin clipped or not. The completed form is picked up by CDFW's Central Valley Tissue Archive (CVTA) along with the vials of fin clip tissue. Chain of custody forms (see Appendix S-1) are signed by CVTA and a biologist from the Biological Resources Section before vials and collection forms are removed from the TFCF. Copies of the collection form are retained at the Biological Resources Building. **Note:** Although this form is for recording tissue collection events for Chinook Salmon, it is currently used for recording all Chinook Salmon, regardless of adipose fin status, from fish counts. This enables the Biological Resources Section staff to track all Chinook Salmon collected from fish counts.

C.1.l. CVP Steelhead DNA–Tissue Collection Form (Appendix G-12)

The CVP Steelhead DNA–Tissue Collection Form is used to record the tissue (fin clip) collection data from all Steelhead regardless of adipose fin status. The form is outlined red to differentiate it from the CVP Salmon DNA–Tissue Collection Form. Data collected include collection date, time, collector initial, fish fork length (mm FL), the vial sample ID number, and whether the fish is adipose clipped or not. The Steelhead DNA tissue collection form is picked up by CDFW's CVTA along with the vials of fin clip tissues. Chain of custody forms (see Appendix S-1) are signed by CVTA and a biologist from the Biological Resources Section before vials and collection forms are removed from the TFCF. Copies of the collection form are retained at the Biological Resources Building.

C.1.m. Larval Fish Data Sheet (Appendix G-13)

The Larval Fish Data Sheet is used during the smelt larval sampling to be completed as part of the 2019 CVP Long-term Operation (LTO) Action. Equipment Operators perform the larval sampling procedures with guidance from the Biological Resources Section and record data for the first row of the data sheet. The rest of the data sheet is completed by the Biological Resources Section staff and includes a second larval picking and sample verification. Larval picking is the action of sorting and removing collected fish larvae from a sample. Data collected for this form are added to the data sheet described in F.1.a under the columns Delta Smelt and Longfin Smelt with a "Y" (Yes present) or an "N" (Not present) after the corresponding larval fish counts (0400, 1000, 1600, 2200). Larval data are physically and electronically archived by the Biological Resources Section staff.

C.1.n. Coded Wire Tag Sheet (Appendix G-14)

Coded Wire Tag Sheets are used to archive coded wire tags (CWT) that are extracted and read from salvaged Chinook Salmon. Data for the form include head number, fork length (mm), date, and time. These have to match the label used during the collection and recording of the fish. Reader 1 and Reader 2 refer to the individuals extracting and reading the CWT: Reader 1 is initialed by the first reader, Reader 2 is initialed by the second reader, verifying Reader 1's code reading. Extracted CWT and data related to the CWT are physically archived by the Biological Resources Section staff. A chain of custody form (see Appendix S-2) must be signed by a Biological Resources staff biologist and the borrower before the CWT is removed from the TFCF.

C.1.o. Loss Density Salmonid Calculation Form (Appendix G-15)

The Loss Density Salmonid Calculation Form is used to calculate the estimated combined salmon loss and the preliminary estimated salmon loss density at the SWP and CVP. The form utilizes the Length-at-Date Salmon Run Table and salmon salvage information from both salvage facilities. Both loss estimates are calculated by the Biological Resources Section staff and are reported each morning, if needed, as part of the Rapid Genetic Analysis of Salvaged Chinook Salmon program (see Appendix G-15 for procedures). This form is entirely electronic and does not contain physical copies.

C.2. Supporting Operations Tables

All supporting operations tables are listed in Appendix J, Salvage operations tables.

C.2.a. Secondary Velocity–Velocity Control Pump Combination Table (Appendix J-1)

Secondary Velocity–Velocity Control (VC) Pump Combination Table aids with the selection of the proper VC pump combination to attain secondary channel velocity criteria according to primary depth. D-1485 dictates secondary channel velocity criteria. This table is posted inside the control panel for the VC pumps, inside the control panel for the bypasses, and in the O&M computer room.

C.2.b. Bates Fish Transport Tables (Appendix J-2)

Bates Fish Transport Tables (Bates Tables) are used in conjunction with the Fish Transport Log Data Sheet to determine when a fish haul is required. The Bates Tables estimate the cumulative percent of a truck load of fish present in a holding tank based on the number of fish salvaged, the species of fish salvaged, fish size classes and water temperature. These tables are posted inside the O&M computer room.

C.2.c. Length-at-Date (LAD) Salmon Run Table (Appendix J-3)

LAD Salmon Run Table is used to differentiate the four Chinook Salmon runs by coinciding the length of fish with a specific date in the Delta. The table is used to distinguish listed spring-run and winter-run Chinook Salmon from fall-run and late fall-run Chinook Salmon. Rapid genetic determination of Chinook Salmon that fall within the winter-run Chinook Salmon length-at-date size range verifies the true genetic identity of the run. This table is stored at the fish count station dry table and inside the O&M computer room.

C.2.d. Clean Water Loop Table (Appendix J-4)

The Clean Water Loop System (formerly Screened Water System) uses a traveling water screen to remove minute debris from water downstream of the secondary channel vertical traveling screen and pumps screened water into a loop that discharges just upstream of the secondary bypass opening. The system was designed to remove debris from water and allow debris-free water to be diverted to holding tanks. The water velocity near the discharge of the system is adjusted to be 60 percent of the secondary channel velocity. The Clean Water Loop Table provides flow guidelines using secondary channel velocity and secondary channel depth to achieve the 60 percent flow criteria. Flow is adjusted using a butterfly valve. This table is posted by the “Screened Water” flow meter inside the holding tank building.

C.2.e. Flow Tables (Appendix J-5)

Flow Tables are used to obtain the estimated flows for the primary channel [Primary Flow (cfs)], secondary channel [Secondary Flow (cfs)], and the holding tank [Holding Tank Flow (cfs)] for the Operations and Counts Data Sheet (see C.1.b.). The use of the tables depends on the operational criteria (*i.e.*, Salmon or Striped Bass criteria, see Appendix F) and the number of pumps operating at JPP.

D. Fish Collection (Continuous Salvage)

When JPP is exporting water, the TFCF salvages fish simultaneously and continuously unless there is an operational outage in the salvage process. During normal salvage operation, water and fish flow from the primary channel into one of four bypass tubes. The bypass tubes empties into the secondary channel where fish encounter the rotating traveling screen that removes debris and guide fish into a holding tank. Fish that reach the holding tank are considered “salvaged”.

Water flow in the holding tank system is controlled by pneumatic valves and pumps. Water and fish leave the secondary channel through the secondary channel bypass via a 20-inch cast-iron influent “COLLECT” line and finally enter the holding tank. The 20-inch pneumatic valve in the influent valve pit is used as a shut-off valve. When this valve is

open, water and fish flow into the holding tank. When this flow is to be stopped, the valve is closed. This valve is never to be used to throttle or restrict the flow of fish and water entering the holding tank. The cylindrical holding tank screen retains fish in the holding tank while water flows through the screen and effluent sump to the 18-inch “FILL” line (large drain), and is then pumped by holding tank (HT) pumps back to the main canal. The water level in the holding tank varies with the pumping rate of the HT pumps, the water surface in the primary channel which rises and falls with the tide, and the number of pumps operating at the JPP. The rate of flow through the holding tank system depends upon the number of HT pumps in operation and the water level in the main canal.

The 18-inch pneumatic valve for the “FILL” line in the effluent valve pit is used to drain water from the holding tank during fish sampling and continuous salvage. Generally, the amount of water allowed to flow into the holding tank is roughly equal to the flow of water being drained out of the tank. The 18-inch pneumatic valve for the holding tank “FILL” line (large drain) will either be fully opened or fully closed. The valve is not to be used to throttle or regulate the flow through the holding tank. The 12-inch pneumatic valve, also in the effluent valve pit, is the holding tank drain valve that controls the “DRAIN” line (small drain). When the drain valve is opened, water in the holding tank discharges to the dewatering sump where it is automatically pumped back into the main canal by the dewatering pumps. The “FILL” line is used during collection of the fish-count subsample as well as for continuous salvage. The “DRAIN” (small drain) is only used when draining down the fish-count subsample. The “JACK” lever is used to lift and lower the holding tank screen.

All the pneumatic control levers for operating the 20-inch influent valve, 18-inch effluent valve, 12-inch drain valve, and the holding tank screen jack lift are located at a control panel along the side of the holding tank at the edge of the holding tank walkway structure (Figure 3). This allows the operator to observe the position of the valve or lever as a holding tank is operated. The pneumatic control panels of holding tanks 1 and 2 are located together in a common control panel between the two tanks. The control panels for holding tanks 3 and 4 are similarly located between these tanks.

Lever name:	JACK	COLLECT	DRAIN	FILL
Controls:	HT Screen Jack Lift	20”-influent valve	12”-effluent valve	18”-effluent valve

Figure 3.—Pneumatic control levers for a holding tank at the Tracy Fish Collection Facility.

Position of the pneumatic control levers indicate the status of the valves controlled (Figure 4). If the control lever is pushed forward (away from the operator) the valve is in the closed position. If the control lever is pulled backward (towards the operator) the valve is in the open position. Positioning the control lever in neutral (center of travel) after completely opening or closing the valves relieves the valves of air pressure. The control levers should be maintained in the open or closed position and should only be positioned in neutral when the pneumatic valves have a leak.

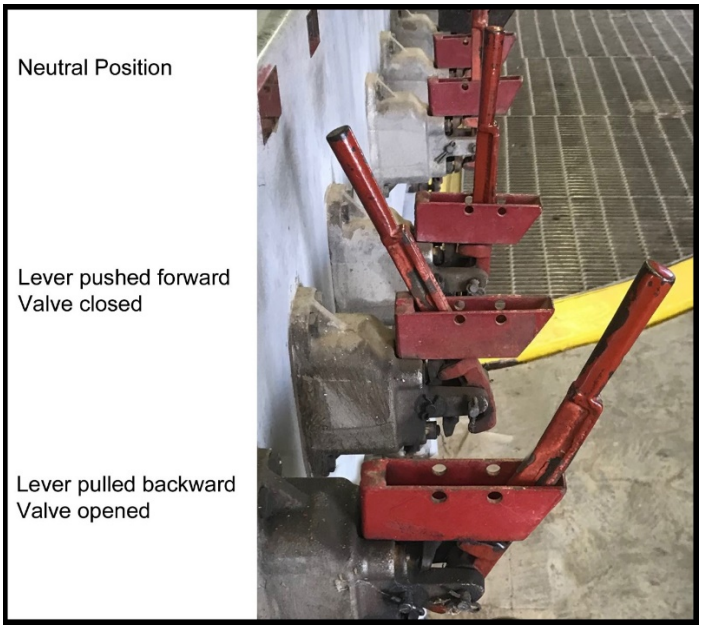


Figure 4.—Position of the pneumatic control lever indicate the status of the valves being controlled.

D.1. Purpose

The purpose of continuous salvage is to collect entrained fish, both ESA-listed and non-listed, into holding tanks for later return to the Delta.

D.2. Schedule

The TFCF continuously and simultaneously collects (salvages) fish in holding tanks as water is exported by the JPP unless there is an operational outage in the salvage process. The successful guidance of entrained fish into the holding tanks relies on the facility being operated within criteria (see Appendix F. Criteria Guideline for the Operation of the Tracy Fish Collection Facility).

D.3. Procedures

Entrained fish are diverted into a holding tank where they are continuously collected. Any holding tank can be used for continuous salvage, although holding tanks 3 or 4 are preferred. The continuous salvage is temporarily interrupted when subsampling occurs (see E. Fish Sampling).

D.4. Operational Steps for Continuous Salvage

For the Operational Steps for continuous salvage, refer to Appendix K for location of pumps, valves, lines, and other related hydrological components.

Step 1. Fill the secondary channel. Open the 4 bypasses allowing water from the primary channel to fill the secondary channel. Control panel for the bypass slide gates are located upstream of the secondary channel.

Step 2. Fill a holding tank. Open the holding tank's 20-inch influent (COLLECT) and 18-inch effluent (FILL) valves. Make sure holding tank screen is lowered and the 12-inch effluent (DRAIN) valve is closed.

Step 3. Verify facility criteria. Use the criteria guideline table (Appendix F) to verify appropriate facility criteria to follow. Adjust flows and velocities of the secondary channel using the Secondary Velocity–VC Pump Combination Table (see C.2.a, Appendix J-1). Adjust flow and velocity of the secondary channel using the controls for the VC pumps and HT pumps. The control panel is located south of the VC pumps. To fine tune secondary channel velocity, open or close the 30-inch butterfly valve adjacent to the VC pumps. Refer to Appendices M-1 and M-2 for location of controls and readouts.

Step 4. Adjust clean water loop flows. Using the Clean Water Loop Table (see C.2.d, Appendix J-4), adjust the clean water loop pump flow by opening or closing the 24-inch butterfly valve of the clean water loop supply line.

Step 5. Monitor salvage. Periodic fish sampling (Section E) is done to monitor salvage numbers and schedule fish transport (Section H).

D.5. Fish Health Maintenance in Holding Tanks

During continuous salvage, holding tanks will be monitored by the Equipment Operator for fish and debris accumulation that can potentially affect fish health. Fish and debris accumulation is monitored by fish sampling (Section E), the Bates Tables (see C.2.b and Section H), and Fish Transport Log Data Sheet (see C.1.e). Failure to follow the Bates Tables will potentially result in over accumulation of fish in a holding tank and increased fish mortality. The holding tank used for continuous collection will require aeration to keep the dissolved oxygen (DO) at >7 mg/L. This is necessary to prevent DO from dropping to stressful (5-6 mg/L) or lethal levels (<5 mg/L).

D.6. Accumulation

Fish sampling numbers are “expanded” (see E.3) in order to estimate the total number of fish salvaged. The estimated numbers are then tracked using the Fish Transport Log Data Sheet (see C.1.e). Fish accumulation in a holding tank is not to exceed 100% accumulative load. Exceeding 100% accumulative load will result in increased risk of fish mortality due to hypoxia (low DO levels in the water), as well as increased ammonia and carbon dioxide concentrations.

E. Fish Sampling (Fish Count)

Fish salvage is monitored and estimated by collecting a 30-minute subsample of salvage every 2-hour period. This subsample is called a “30-minute fish count” or “fish count” and is designed to sample 25 percent of the time JPP is in operation. When high debris or high numbers of fish are present, fish counts may be reduced to less than 30 minutes per 2-hour period. A fish count is performed by a trained and qualified Equipment Operator or a Fish Biologist because ESA-listed (listed) fish species may be processed. Refer to Appendix L for fish count station component nomenclature.

E.1. Purpose

The purpose of fish sampling is to record the species and numbers of fish collected during 12 daily 2-hour periods. This information is then used to estimate total daily fish salvage, entrainment, and loss at the TFCF. In addition, this information is used along with the Bates Fish Transport Tables and Fish Transport Log to estimate the cumulative percent of a truck load present in a holding tank and determine when transport of fish is necessary.

E.2. Schedule

The 30-minute fish count takes place every 2-hour period, 12 times a day, every day of the year. The 30-minute fish count sample shall be collected towards the end of the 2-hour period and reported on the even hour. For example, for the 1200 fish count, the 30-minute sample is collected from 1130-1200. When high debris or high numbers of fish are present, fish counts may be reduced to less than 30 minutes per 2-hour period.

E.2.a. Non-length Counts

Non-length counts are collected daily, at 0400, 0800, 1000, 1200, 1600, 2000, 2200, and 2400. All fish are identified to species and counted. These fish are recorded in the Operations and Counts Data Sheet (see C.1.b). Fish numbers that are recorded in this data sheet are not expanded.

E.2.b. Length Counts

Fish Lengths counts happen four times daily, at 0200, 0600, 1400, and 1800. All species of fish are identified and measured for length. These fish are recorded in the Operations and Counts Data Sheet (see C.1.b) and Length Data Sheet (see C.1.c). Fish numbers that are recorded in these data sheets are not expanded. Fish lengths are measured from snout to fork of the tail fin (fork length [FL]); fish that do not have a forked tail are measured from snout to the tip of the tail fin (total length [TL]). All fish lengths are recorded in millimeters. Only the first 24 individuals of each species are measured; count the extra fish (plus count) after 24th individual is measured. The plus count for each species is recorded on the Length Data Sheet and the total number of fish of each species is recorded in the Operations and Counts Data Sheet for each count.

E.2.c. Fish Identification and Verification

Identification and processing of fish during fish counts is the responsibility of trained Equipment Operators. Equipment Operators are trained by the Biological Resources Section staff and must complete annual fish identification and processing procedure training, as well as pass testing on an annual basis. Fish identification and fish processing manuals are available at the fish count station for reference.

Fish that cannot be absolutely identified to species by the Equipment Operator must be initially identified, recorded, and noted on the appropriate data sheets. The questionable specimen(s) must be kept alive at the count station aquarium for verification by the Biological Resources Section staff. The responsible Equipment Operator must notify the Biological Resources Section staff by phone, text, or email soon after a fish count when a questionable specimen is saved for species verification. If necessary, it will be the responsibility of the Biological Resources Section to make all appropriate changes to data sheets after identifying questionable specimens to species.

E.3. Expansion Factor

Fish sample numbers are multiplied by an expansion factor to estimate the number of each fish species that were collected during that sample period. An expansion factor of 4 (120 minutes ÷ 30 minute counts = 4) is assumed for all fish counts. For example, if 8 Chinook Salmon and 3 White Catfish were collected from a 30-minute fish sample, the expanded salvage total for the two hour period will be 32 Chinook Salmon and 12 White Catfish. If an expansion factor is not 4, which occurs during outages or deviation from a 30 minute count length, the expansion factor must be noted in the Operations and Counts Summary Data Sheet.

The method for estimating the total number of fish entering the holding tanks during each period is based on the assumption that the number of fish entering the system is constant over time. For example, if 50 fish are collected in a 30-minute period, it is assumed that 200 fish will be collected in 2 hours.

E.4. Procedures

Fish samples are collected by stopping the continuous collection tank and diverting water and fish into a sampling holding tank for 30 minutes. Any holding tank can be used, although holding tank 1 or 2 are preferred for the 30-minute fish count sampling. The 90-gallon fish sampling bucket is used to transfer the fish sample from the sampling holding tank to the fish count station.

E.5. Operational Steps for Fish Sampling

Step 1: Backfill the sampling holding tank. Open the “FILL” valve of the sampling holding tank to allow water to backfill the sampling holding tank from the 18-inch effluent line. Make sure the holding tank screen is lowered and the small drain is closed. Backfilling ensures water-to-water transfer of fish from the influent pipe to the sampling holding tank.

Step 2: Verify facility criteria. Adjust flows and velocities of the secondary channel and holding tanks (see D.4. for steps on making adjustments), if needed, to meet current criteria.

Step 3: Record hydraulics data. Begin recording hydraulics data using the Operations Data Sheet (see C.1.d). Refer to Appendix M-1 for location of meters, gauges, and other sensor readouts. Data sheet terms and locations of where and how to find the data are summarized in Appendix M-2.

Step 4: Open “COLLECT” valve of sampling holding tank.
Open the sampling holding tank’s 20-inch influent valve. Note the time “COLLECT” valve was opened since this is the start time for the sample. “FILL” valve from Step 1 remains open.

Step 5: Close "COLLECT" and "FILL" valves of the continuous salvage holding tank. Close the continuous salvage holding tank's "COLLECT" valve. Close the "FILL" valve of the continuous salvage holding tank. This step isolates the continuous salvage holding tank. Adjust holding tank aeration if needed to keep fish alive.

Step 6: Collect fish in sampling holding tank. While collecting the sample, verify that all necessary hydraulics data has been obtained for Step 3.

Step 7: After sample time, switch collection back to the continuous salvage holding tank. Open the "COLLECT" and "FILL" valves of the continuous salvage holding tank.

Step 8: Stop collecting the 30-minute sample. Close the "COLLECT" and "FILL" valves of the sampling holding tank and open the "DRAIN" valve. Draining of the sampling holding tank using "DRAIN" line will take about 7 minutes. Do not use "FILL" line to drain a sampling holding tank.

Step 9. Check sampling bucket ball check valve. As water drains from the sampling holding tank, check the ball check valve of the sampling bucket by using the monorail hoist and hoist control to lower the sampling bucket into the holding tank to fill with water. After the sampling bucket is filled with water, use the monorail hoist and hoist control to raise the sampling bucket in order to see if water is retained in the sampling bucket. Leave water in sampling bucket and make sure the release pulley cable is inside the sampling bucket (Figure 5).

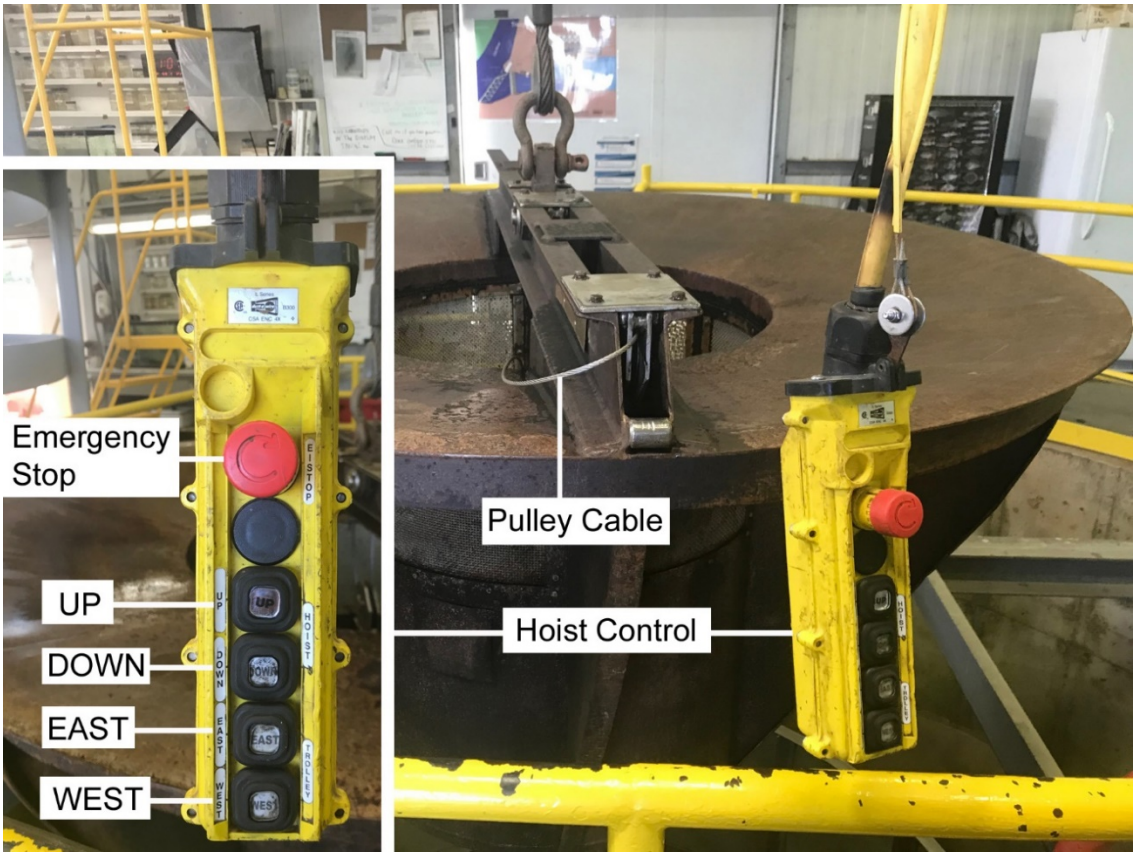


Figure 5.—Monorail hoist control and release pulley cable inside the sampling bucket. *Inset*: Hoist control button details.

Step 10. Lower sampling bucket. Allow water in the sampling holding tank to drain until the water surface is drawn down to the top of the holding tank screen's solid sleeve. Using the monorail hoist and hoist control, lower the sampling bucket into the holding tank drain pit at the center of the sampling holding tank. Position the sampling bucket in the holding tank drain pit (Figure 6). Verify the sampling bucket is seated, *i.e.*, the lip of the sampling bucket is flush to the bottom of the holding tank floor.

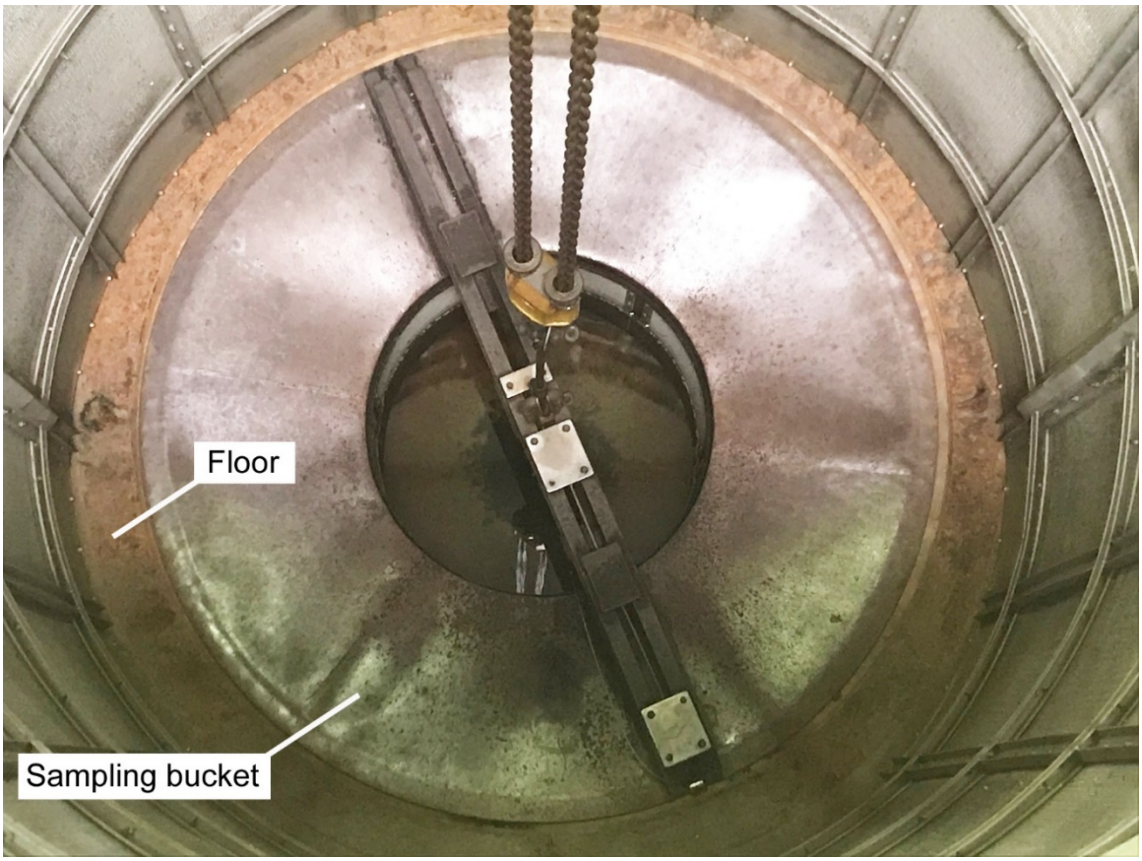


Figure 6.—Sampling bucket seated in the holding tank drain pit. The lip of the sampling bucket is flush to the floor of the holding tank.

Step 11. Lift screen of sampling holding tank. Lift the sampling holding tank screen. This step lifts the sampling holding tank screen approximately 6-inches, allowing water and fish to enter the sampling bucket. Using a high pressure hose, spray off debris attached to the outside of the holding tank screen and other parts of the holding tank. Do not spray the monorail hoist block or chain. Allow the water to drain through the sampling bucket.

Step 12. Rinse floor of the sampling holding tank. Open the "COLLECT" valve for approximately 5 seconds to wash fish and debris that may have been stranded on the holding tank floor into the sampling bucket. A second flush may be needed. Allow all water to drain through the sampling bucket.

Step 13. Lift the sampling bucket. The sampling bucket will have water up to the bottom of the sampling bucket screen and is lifted up to the level of the holding tank guardrail using the monorail hoist and hoist control. At the guardrail level, spray off debris that is attached to the sampling bucket screen. Move the release pulley handle and cable to the outside of the sampling bucket (Figure 7).

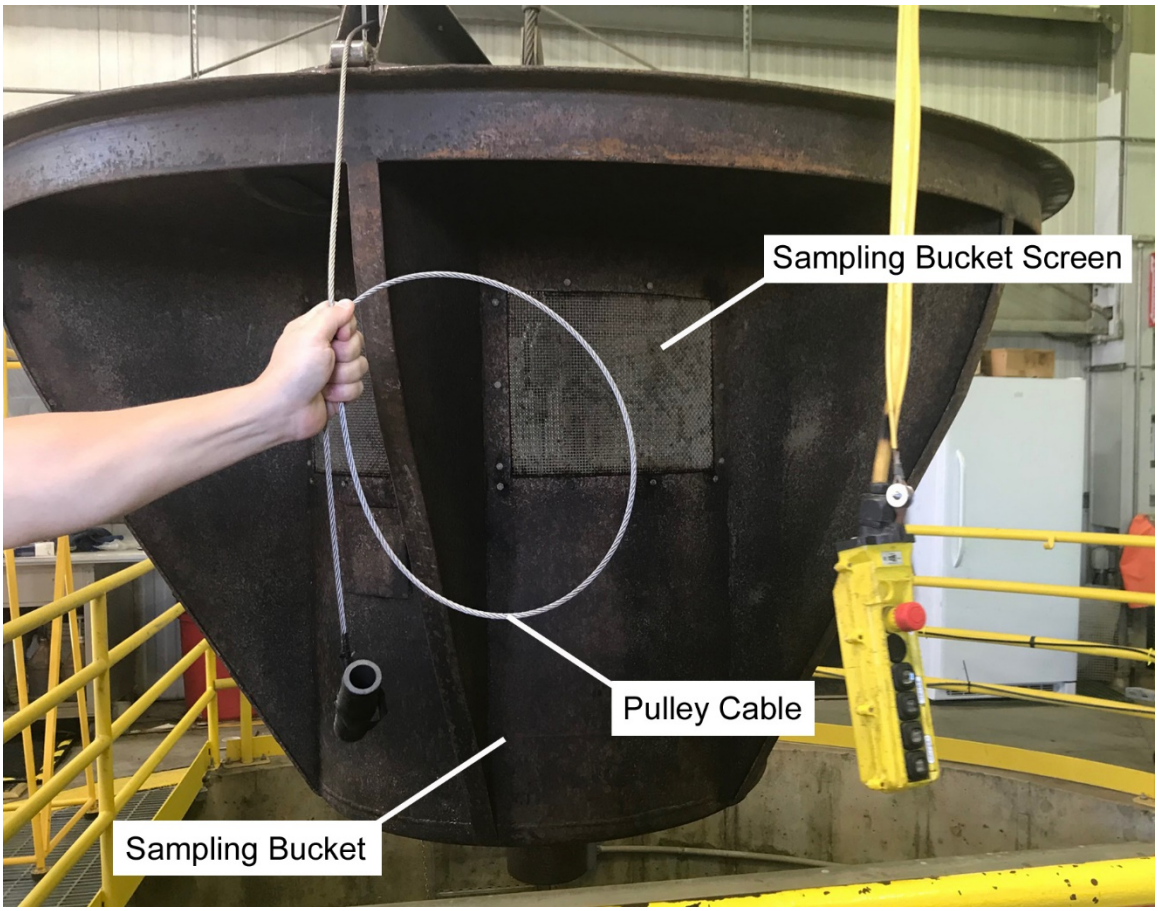


Figure 7.—Move pulley cable to the outside of sampling bucket. Sampling bucket will have water up to the bottom of the sampling bucket screen.

Step 14. Close "DRAIN" valve of the sampling holding tank. Close the 12-inch effluent drain line.

Step 15. Lower the sampling holding tank screen. Push the "JACK" lever to the neutral position to lower the sampling holding tank screen.

Step 16. Move the sampling bucket to the fish count station screen at the fish count station. Use the monorail hoist and hoist control to move the bucket to the fish count station. Make sure the drain plug of the fish count station is seated on the drain opening and that a tire is placed on top of the fish count screen. Make sure the slide gate for the release trough is in place and that water to the release trough is on.

Step 17. Position sampling bucket on the tire. Slowly lower the sampling bucket on the tire so that there is no space between the sampling bucket and tire where fish can escape (Figure 8). Do not rest the full weight of the sampling bucket on the fish count screen.

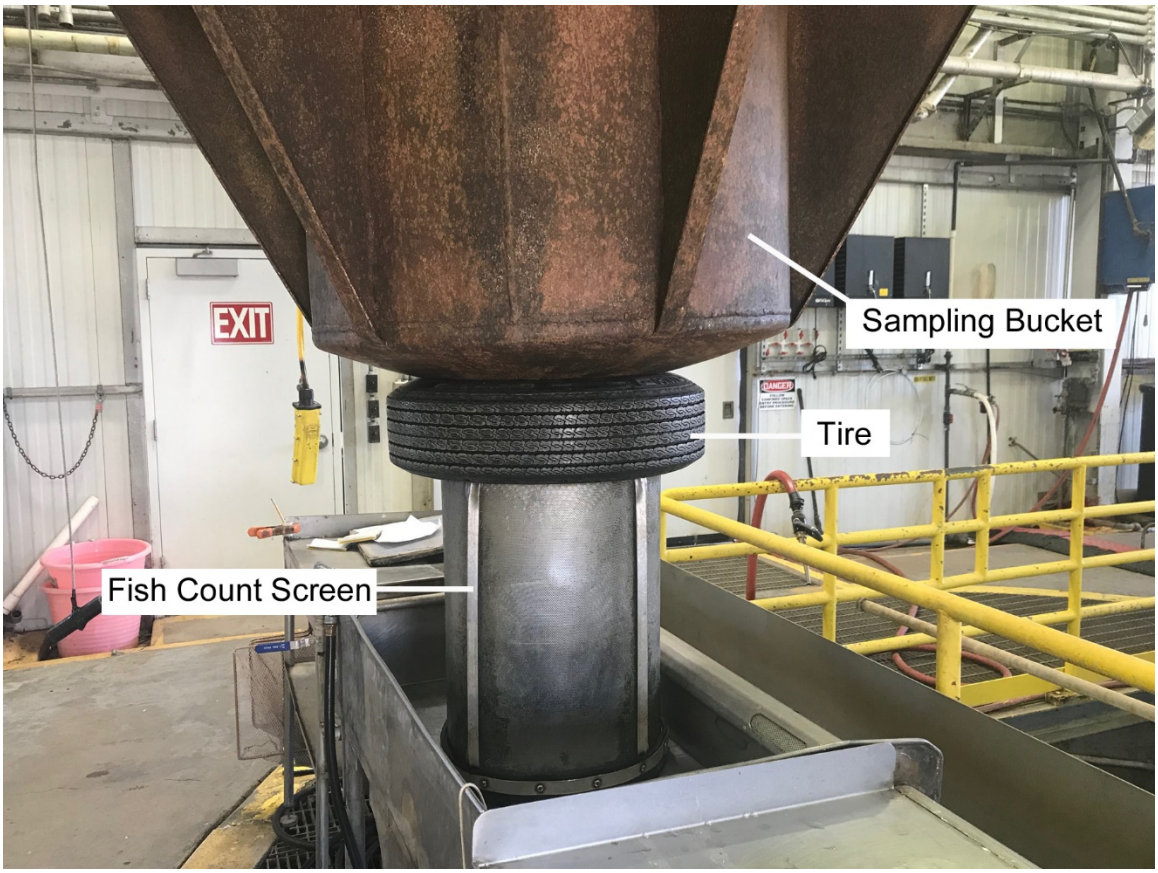


Figure 8.—Sampling bucket properly seated on the tire. There is no space between sampling bucket and the tire.

Step 18. Release fish from sampling bucket to the fish count station. Use the handle of the pulley cable to lift the sampling bucket's ball check valve and allow water and fish to spill into the count station screen. Pull the cable slowly initially to fill the count station basin with water before fully pulling the cable. Water will overflow from the count basin and into the fish release trough.

Step 19. Return the sampling bucket to center position over the sampling holding tank. Use the monorail hoist and hoist control to move the sampling bucket back to center position over the sampling holding tank. Make sure the pulley cable and handle are inside the sampling bucket.

Step 20. Remove tire and count screen from the count station basin. Using a low pressure hose, rinse off debris and fish that may be attached to the inside of the count screen. Lift count screen out of count station to allow debris and fish to disperse within the count station basin.

Step 21. Determine the type of fish count. If the fish count is a non-length count, record only the fish species and the total number of each fish species (see E.2.a). If the fish count is a length count, record the fish species, the total number of each fish species, and the lengths in mm of the first 24

individuals of each fish species (see E.2.b). Listed species are an exception. Refer to E.6.e for the proper handling and processing of listed fish.

Step 22. Identify and count each fish. Fish that are 20 mm FL and greater are to be identified and counted. Fish less than 20 mm FL are to be released into the fish release trough without being counted or documented. Use a dip net to catch fish from the count station basin. Use the stainless steel tables (wet tables) for measuring, counting, and separating fish from debris. Slide fish to the fish release trough after recording fish. Turn on the count station basin's spray bar if the count station basin is full of fish. Separate and accumulate debris into a waste basket. Refer to E.6 for the proper handling and processing of fish.

Step 23. Separate listed fish species. When listed fish species are encountered during the counting process, they are to be placed in a separate bucket containing aerated freshwater and shall be processed after identifying and counting the non-listed fish. Refer to E.6.e. for the proper handling and processing of listed fish.

Step 24. Drain the count station basin. When most of the fish and debris have been removed from the count station basin, position a small-meshed net at the drain located below the count station basin and pull the count station basin's plug to allow the remaining fish and debris to be rinsed into the small-meshed net. Count and record remaining fish from the small-meshed net and release into fish release trough; add remaining debris to the waste basket.

Step 25. Weigh and identify the debris. Place empty waste basket on the floor scale and tare (zero) the weight of the empty waste basket. Remove empty waste basket from floor scale. Place waste basket containing separated debris from steps 22 and 24 on the floor scale and obtain weight of debris. Visually estimate the debris composition percentage by volume for *Egeria*, wood/reed, Hyacinth, and shells/sand. Percentage volume must add up to 100 percent. Record the weight of debris in kg and debris composition percentages on the Debris Data Collected during Fish Counts Data Sheet (see C.1.h.). Properly dispose of debris in designated area.

Step 26. Release recorded fish to the continuous collection holding tank. All counted and recorded fish from steps 22 and 23 must be allowed to recover from handling stress in the fish release trough. When all fish are swimming normally, lift the gate to allow the water-to-water transfer of recovered fish from the fish release trough and into the continuous salvage holding tank. Check that no fish are left stranded in the fish release trough.

Step 27. Reset the count station. When all fish and debris are accounted for, return the count station to its original setting for the next fish count.

Reposition the count station screen at the center of the count station basin and place tire on top. Replace the plug in the count station basin drain making sure it is seated. Replace the fish release trough slide gate. Turn off the spray bars for the fish release trough and the count station basin. Spray wash the stainless steel wet tables. If listed species were processed, clean up the dry table of the fish count station.

Step 28. Finalize data sheets at the operator computer room. After a fish count, update the following data sheets:

- Operations and Counts Summary Data Sheet (see C.1.a.)
- Operations and Counts Data Sheet (see C.1.b.)
- Length Data Sheet (see C.1.c.)
- Operations Data Sheet (see C.1.d.)
- Fish Transport Log Data Sheet (see C.1.e.)
- Debris Data Collected During Fish Counts Sheet (see C.1.h.)

Note: For the operational steps, refer to Appendix K for location of pumps, valves, lines, and other related hydrological components.

E.6. Fish Handling and Processing

Fish will experience stress because fish sampling involves mechanical and manual handling. Limiting stress experienced by fish during the fish count will decrease mortality and increase survival. Techniques listed and described below are to limit stress-induced fish injury and mortality during and after fish sampling. “Processing” is defined as the act of collecting data from a fish during a fish count. This includes identifying fish, measuring fish, searching fish for internal metal tags (“wanding”), and collecting tissue samples.

E.6.a. Preparation of Anesthesia

The TFCF uses Tricaine methanesulfonate (MS-222) to temporarily anesthetize fish as needed. Refer to the Safety Data Sheet (SDS), available at the dry table of the fish count station, for hazards and chemical exposure control. The SDS also includes recommended Personal Protective Equipment (PPE) related to the use of MS-222. A high concentration of 5,000 ppm MS-222 solution, prepared by staff of the Biological Resources Section, is contained in a 1-gallon High Density Poly Ethylene (HDPE) jug with handle and pump dispenser, and stored under the dry table of the fish count station.

If anesthesia is needed for a fish count, add two full pumps of high concentration MS-222 solution to 2 gallons (7.6 L) of water to create a solution of 50-100 ppm anesthetic solution (bath). Use freshwater from the low pressure line for the bath; do not use water from the high pressure line. Prepare a fresh bath for each fish count, when needed. This will ensure that the water in the bath is at appropriate

water temperature, has sufficient oxygen, low bacterial count, less debris, and low amounts of ammonia. Do not reuse bath from the previous fish count. MS-222 anesthetic solutions should be diluted and disposed of in soil, away from storm drains, creeks, lakes or other bodies of water.

If fish will be euthanized, use a separate bath with a 500 ppm MS-222 concentration. To make the bath for euthanasia, add 5 pumps of high concentration MS-222 solution from the 1-gallon HDPE jug to a 1-L container of freshwater. The 1-L container must be labeled "Euthanasia" and have a National Fire Protection Association (NFPA) hazardous chemical label. When not in use, place a lid on the 1-L container.

E.6.b. Use of Anesthesia

An anesthetic bath is used to prevent injury to fish and personnel processing the fish. Use an anesthetic bath for fish that require special processing such as Chinook Salmon, Steelhead, Delta Smelt, Longfin Smelt, and Green Sturgeon. Follow the steps below for the proper use of anesthesia:

Step 1. Place fish in bath. If fish loses equilibrium immediately (within 30 seconds), the bath solution is too strong. To avoid accidental euthanasia, remove the fish and add a gallon of freshwater to dilute the bath or make a new bath. If the proper bath concentration is attained, fish will decrease their breathing and will succumb to the anesthesia in approximately 2-5 minutes. At this point, the fish can be handled. Add only the number of fish that can be reasonably processed in 2-5 minutes. For Steelhead, place a net over the bath to prevent escapement prior to the anesthesia taking effect.

Step 2. Handling fish for processing. Remove the immobilized fish from the anesthetic bath by cradling the fish's body in a gloved hand; do not handle fish by the head or by the fins.

Step 3. Process fish. Follow processing procedures according to the species specific processing requirements. Wet the measuring board before placing fish on it. Limit each fish's exposure to air to less than 20 seconds during processing.

Step 4. Euthanasia. If a fish is to be euthanized as per that species Decision Tree (see Appendices N and O), it can be left in the bath and processed last. Long term exposure to the bath humanely euthanizes a fish. Alternatively, the fish can be placed in the 500 ppm euthanasia bath.

E.6.c. Handling and Processing during Non-length Counts

Non-length counts involve identifying and counting fish. Turn on the count station basin's spray bar if the count station basin is full of fish. Wet the stainless steel

table before placing fish on it. Use a dip net to remove fish and debris from the count station basin and spread contents onto the stainless steel wet table. Separate fish from debris on the wet table. Identify, count, and record fish 20 mm in length and greater; fish less than 20 mm in length can be released without being documented or counted. Slide fish to the release trough after identifying and recording fish. Place debris into a waste basket.

If a listed fish species is collected during a non-length count sample, place the fish in a separate bucket containing aerated freshwater and complete the non-length count sample. Determine the type of listed fish species and follow the corresponding species procedure. All listed fish species from a non-length count sample are measured and recorded.

E.6.d. Handling and Processing during Length Counts

Length counts involve identifying, measuring, and counting fish. Turn on the count station basin's spray bar if the count station basin is full of fish. Wet the stainless steel table before placing fish on it. Use a dip net to remove fish and debris from the count station basin and spread contents onto the stainless steel table. Separate fish from debris on the table. Identify, measure, count, and record fish 20 mm in length or greater; fish less than 20 mm in length can be released without being documented or counted. Measure the first 24 individuals of each species, the rest shall be counted. Slide fish to the release trough after identifying and recording fish. Place debris into a waste basket.

If a listed fish species is collected during a length count sample, place the fish in a separate bucket containing aerated freshwater and complete the length count sample. Determine the type of listed fish species and follow the corresponding species procedure. All listed fish species from a length count sample are measured and recorded.

E.6.e. Handling and Processing of Listed Species

The TFCF encounters 5 federally listed fish species that have specific processing procedures. Procedures described below shall be followed to remain within regulatory compliance. Handling and processing of listed species will involve the use of chemicals. Refer to the SDS for hazards and chemical exposure control related to the use of MS-222, ethanol, iodine, formalin, and rose bengal. Only certified Equipment Operators and Biological Resources Section staff may process Chinook Salmon, Steelhead, Delta Smelt, Longfin Smelt, and Green Sturgeon. Splittail, although not a listed species, is included in this section because it is a California Species of Special Concern. Certification will be provided by the Biological Resources Section and will include proper handling of listed species, use of hazardous chemicals, and current fish processing procedures.

E.6.e.1. Chinook Salmon Procedures

Refer to Appendix N, decision tree for Chinook Salmon. Ready a metal detector wand, a PIT tag wand, MS-222 anesthetic bath, ethanol vials, pair of scissors, forceps, iodine, zip seal plastic bag, sample labels, and Chinook Salmon datasheets including “Length Data Sheet” (see C.1.c) and “CVP Salmon DNA-Tissue Collection Form” (see C.1.k). Process Chinook Salmon at the dry table of the fish count station.

E.6.e.1.1. Use of Wands for Chinook Salmon

There are two wands to use for detecting internal tags in Chinook Salmon, the coded wire tag (CWT) wand and the Passive Integrated Transponder (PIT) tag wand. Both wands will be used on all Chinook Salmon.

CWT Wand.—For the use of CWT wand (Figure 9), follow the steps below. CWT are embedded on the front lobe of the head. Turn on the CWT wand by flipping the power button to the right.

Step 1. Anaesthetize salmon. Wand only when fish is immobilized from anesthesia to limit damage to fish. Refer to E.6.a. for the proper use of anesthesia and handling of anesthetized fish.
Step 2. Position salmon for wanding. Cradle the salmon’s body in hand exposing the head (Figure 9, left).
Step 3. Move wand side to side. The sensors for the wand are on the sides (Figure 9, right), thus, while holding the fish with one hand, slowly move the wand with the sensor side close to the fish’s head. The wand does not need to touch the fish.
Step 4. Determine if fish has CWT. The wand will emit a beeping sound and a red light if metal (the CWT) is detected. If the wand detects metal, check for sutures as some fish may have transmitters and other tracking devices. Avoid using wand near jewelry, watches, and other nearby metal which may set-off the wand.

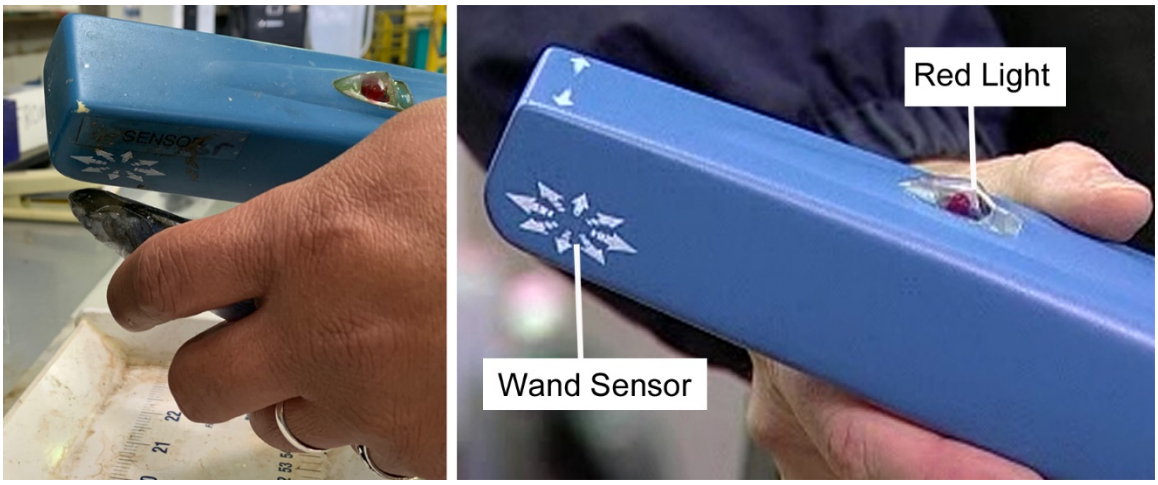


Figure 9.—CWT Wand and location of sensor on the side. The wand will emit a beeping sound and emit a red light if metal is detected.

PIT Tag Wand.—For the use of PIT tag wand (Figure 10), follow the steps below. PIT tags are embedded inside the fish's body cavity. Turn on the PIT tag wand by holding down the power button. PIT tag wand is ready to use when the screen says "READY".

Step 1. Anaesthetize salmon. Wand only when fish is immobilized from anesthesia to limit damage to fish. Refer to E.6.a. for the proper use of anesthesia and handling of anesthetized fish.
Step 2. Position salmon for wanding. Hold the salmon's body exposing either side of the body.
Step 3. Wand the salmon. While holding the "READ" button, pass the PIT tag wand over the side of the fish. The sensors for the PIT tag wand are in the detection ring of the wand (Figure 10, left).
Step 4. Determine if fish has PIT tag. The PIT tag wand will beep and vibrate and will display a code on the screen if a PIT tag is present in the fish. If the PIT tag wand does not beep or display a code after several passes, there is no tag.

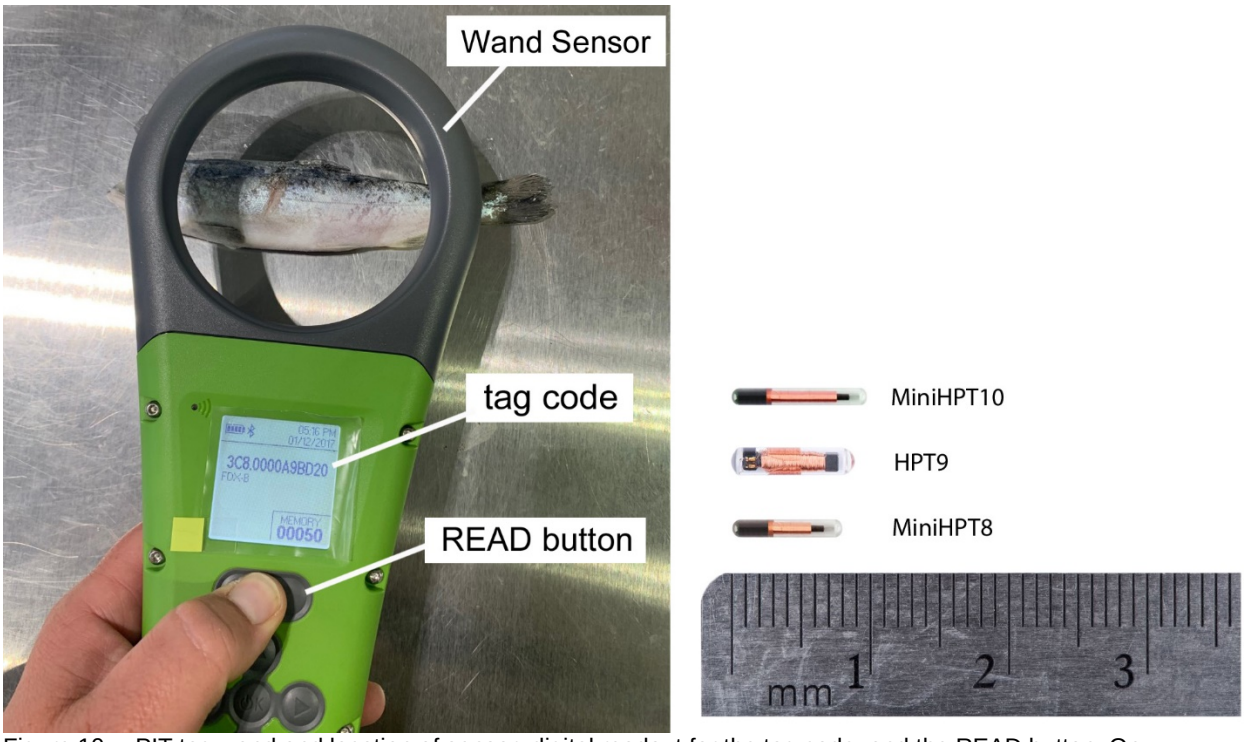


Figure 10.—PIT tag wand and location of sensor, digital readout for the tag code, and the READ button. On the right shows the size of the various models of PIT tags inserted inside the body cavity of salmon.

E.6.e.1.2. Coded Wire Tags in Chinook Salmon

Coded wire tags (CWT) are embedded in the frontal lobe of the salmon's head and contain codes that the Biological Resources Section staff extracts and reports. Handling of salmon with CWT will follow E.6.b. Follow the operational steps below for proper processing of CWT:

Step 1. Verify salmon has CWT. Wand the fish and check for external markings including adipose fin status. Refer to the Use of Wands and the Use of Anesthesia.

Step 2. Euthanize fish. Since salmon with CWT will be euthanized, they can be left in the anesthetic bath to be processed last; "wild" salmon can be processed in the meantime. The only approved method for euthanizing fish is by anesthetic bath. Any other method may dislodge the CWT.

Step 3. Record the salmon. Record the length in mm FL, adipose fin status ("C" after the length if adipose fin clipped), and "*beeped bagged*" on the Length Data Sheet.

Step 4. Bag the salmon. Place the euthanized salmon in a zip sealed bag and include a uniquely numbered "head tag" label. Enclose only one fish and one label per bag. Assure that the head tag label does not touch the fish in the zip sealed bag.

Step 5. Store the salmon. Store the salmon in the appropriate labelled bin in the freezer.

E.6.e.1.3. PIT Tags in Chinook Salmon

Passive Integrated Transponder (PIT) tags are inserted inside the body cavity of the salmon. **Note: Salmon with PIT tags are not to be euthanized.** Handling of salmon with PIT tag will follow E.6.b. Follow the operational steps below for proper processing of salmon with PIT tag:

Step 1. Verify salmon has PIT tag. Wand the fish using the PIT tag wand. Refer to the Use of Wands and the Use of Anesthesia.
Step 2. Record the PIT tag code. Record the alpha-numerical code displayed on the LED screen of the wand. If wand's screen displays a code, then the fish has a PIT tag.
Step 3. Release fish. Place fish with PIT tag into the count station release trough for recovery and release. Fish with PIT tags will not be euthanized.

E.6.e.1.4. DNA Collection from Chinook Salmon

DNA samples are collected from all "wild" Chinook Salmon. "Wild" Chinook Salmon do not have a CWT or other external marking such as painted fins, clipped fins, clipped adipose fin, visible tags, and sutures. Handling of salmon for DNA collection includes anesthesia procedures listed in E.6.b. Follow the operational steps below for proper fin clip collection from Chinook Salmon:

Step 1. Verify salmon is "wild". Wand the fish and check for external markings including adipose fin status. Refer to the Use of Wand and the Use of Anesthesia. It is considered "wild" if salmon has neither CWT nor external markings.
Step 2. Measure salmon in mm FL. Use the measuring board to measure the salmon. Make sure measuring board is wet before placing fish on it.
Step 3. Sterilize scissor blades and forceps. Dip the scissor blades and forceps in iodine and dip in freshwater afterwards to rinse off the iodine.
Step 4. Position salmon for fin clipping. Cradle the salmon's body in hand exposing caudal fin.
Step 5. Clip a sample. Using other hand, clip a 2-4 mm tissue sample from the upper caudal fin (Figure 11). Do not cut an entire fin lobe. Only one fin clip per salmon is collected to ensure proper genetic assignment.

Figure 11.—A 2-4 mm tissue sample clipped from the upper caudal fin of a Chinook Salmon.

Step 6. Let salmon recover. Check that the fin clip sample is attached to the scissor blades before releasing the salmon for recovery. Let salmon recover in the release trough or temporary holding aquarium with aeration.

Step 7. Preserve the sample. Insert fin clip sample into a vial by dipping the scissor blades into the ethanol solution in the vial. Forceps can be used to help place the fin clip in the vial. Vials are uniquely numbered and used in chronological order. Cap the vial and make sure the fin clip is in the ethanol solution. Only one fin clip tissue per salmon should be in the vial. If more than one fin clip tissue was collected from a salmon, note the reason in the CVP Salmon DNA-Tissue Collection Form (see C.1.k).

Step 8. Record the sample. Record sample data into the CVP Salmon DNA-Tissue Collection Form including collection date, time, collector initials, fish fork length (mm FL), the vial sample ID number, adipose fin status, and fate of the salmon ("DNA, released"). Record the Chinook Salmon on the Length Data Sheet (see C.1.c) including fork length (mm FL) and "DNA, released".

Step 9. Store the sample. Store the sample in a vial tray inside a cabinet in the holding tank building. Samples are not to be frozen or refrigerated.

Step 10. Release the salmon. When salmon recovers after step 6, release the salmon back into the continuous collection tank.

E.6.e.1.5. DNA Collection and High Volume of Salmon ("First 10" rule)

Chinook Salmon school when migrating and occasionally, large schools are encountered during fish sampling. When more than 10 "wild" Chinook Salmon are collected in a fish count sample, collect fin clip samples from the first 10 "wild" Chinook Salmon, then collect fin clip samples from 1 of every 5 "wild" Chinook Salmon. This rule only applies when the sampler is alone and the number of salmon in the sample is larger than 25. The "first 10" rule ensures that the processing period will not overlap into the next fish

sampling period. All Chinook Salmon, including the ones not fin clipped for DNA, must be measured and recorded.

E.6.e.1.6. Acoustic Tags in Chinook Salmon

Chinook Salmon with acoustic tags have visible sutures on their belly and must be recorded and released unless specifically instructed otherwise. Do not collect DNA from Chinook Salmon with acoustic tag. Anesthetize the fish before processing (see E.6.b. Operational Steps on the Use of Anesthesia). On the Operations and Counts Summary Data Sheet (see Appendix G-1), record the time that the fish was collected and length of the fish. Write “sutured” in the “Head Tag/Coded Wire Tag” column. On the Length Data Sheet (see Appendix G-3), record the species name, species code, and length of the fish. Write “sutured” in the “Additional Fish Not Measured” column.

E.6.e.1.7. Radio Tags in Chinook Salmon

Chinook Salmon with radio tags have a visible antenna wire emanating from their body. Anesthetize the fish before processing (see E.6.b. Operational Steps on the Use of Anesthesia). Fish with radio tags must be euthanized, recorded, and labeled/stored in the freezer unless specifically instructed otherwise. Do not collect DNA from Chinook Salmon with radio tags. On the Operations and Counts Summary Data Sheet (see Appendix G-1), record the time that the fish was collected and length of the fish. Write “radio tag” in the “Head Tag/Coded Wire Tag” column. On the Length Data Sheet (see Appendix G-3), record the species name, species code, and length of the fish. Write “radio tag” in the “Additional Fish Not Measured” column.

E.6.e.1.8. External Colored Marks in Chinook Salmon

Chinook Salmon with external colored marks must be recorded and released. Anesthetize the fish before processing (see E.6.b. Operational Steps on the Use of Anesthesia). Do not collect DNA from Chinook Salmon with external colored marks. On the Operations and Counts Summary Data Sheet (see Appendix G-1), record the time that the fish was collected, length of the fish, and external colored mark details. Write the color and location of the external colored mark in the “Head Tag/Coded Wire Tag” column. On the Length Data Sheet (see Appendix G-3), record the species name, species code, length of the fish, and external colored mark details. Write the color and location of the external colored mark in the “Additional Fish Not Measured” column.

E.6.e.1.9. Post-Operational Steps for Chinook Salmon

After processing Chinook Salmon from a fish count, follow the steps below:

Step 1. Turn off wand. This will preserve battery and eliminate false positives.
Step 2. Check CWT salmon data. The number of frozen CWT salmon from a fish count must match the number of salmon recorded as “beep, bagged” on the Length Data Sheet.
Step 3. Check DNA fin clip data. The number and lengths of salmon that were fin clipped for a DNA tissue sample from a fish count recorded on the CVP Salmon DNA-Tissue Collection Form (C.1.k.) must match the number of salmon recorded as “DNA, released” on the Length Data Sheet (C.1.c.).
Step 4. Release “DNA, release” salmon. Allow salmon to recover in release trough or in aerated aquarium before releasing to the continuous salvage holding tank. Do not leave salmon in the recovery trough or in the aerated aquarium for more than 30 minutes.

E.6.e.2. Steelhead Procedures

Refer to Appendix O, decision tree for Steelhead. Ready MS-222 anesthetic bath, ethanol vials, pair of scissors, forceps, iodine, and Steelhead datasheets including “Length Data Sheet” (see C.1.c) and “CVP Steelhead DNA-Tissue Collection Form” (see C.1.l). Process Steelhead at the dry table of the fish count station.

E.6.e.2.1. PIT Tags in Steelhead

Passive Integrated Transponder (PIT) tags are inserted inside the body cavity of the Steelhead. **Note: Steelhead with PIT tags are not to be euthanized.** Wand Steelhead for PIT tag only. Do not wand Steelhead for coded wire tag (CWT) since Steelhead do not have CWT. Handling of Steelhead with PIT tag will follow E.6.b. Follow the operational steps below for proper processing of Steelhead with PIT tag:

Step 1. Verify Steelhead has PIT tag. Wand the fish using the PIT tag wand. Refer to the Use of Wands and the Use of Anesthesia.
Step 2. Record the PIT tag code. Record the alpha-numerical code displayed on the LED screen of the wand. If wand’s screen displays a code, then the fish has a PIT tag.
Step 3. Release fish. Place fish with PIT tag into the count station release trough for recovery and release. Fish with PIT tags will not be euthanized. Release fish to the holding tank once fish has recovered.

E.6.e.2.2. DNA Collection from Steelhead

Collect DNA sample (fin clip tissue) from all Steelhead regardless of adipose fin status. Handling of Steelhead for DNA collection will follow E.6.b. Follow the operational steps below for proper fin clip collection from Steelhead:

Step 1. Anesthetize Steelhead. Refer to E.6.a. for the proper use of anesthesia and handling of anesthetized fish. Cover the anesthesia bath with a net since Steelhead are active jumpers. Proceed to step 2 only when Steelhead is sedated.
Step 2. Measure Steelhead in mm FL. Make sure measuring board is wet before placing fish on it. Note and record adipose fin status and external markings.
Step 3. Sterilize scissor blades. Dip the scissor blades and forceps in iodine and dip in freshwater afterwards to rinse off the iodine.
Step 4. Position Steelhead for fin clipping. Cradle the Steelhead's body in hand exposing caudal fin.
Step 5. Clip a sample. Using other hand, clip a 2-4 mm tissue sample from the upper caudal fin.
Step 6. Let Steelhead recover. Check that the fin clip sample is attached to the scissor blades before releasing the Steelhead for recovery. Let Steelhead recover in the release trough. Do not use temporary holding aquarium for Steelhead recovery since Steelhead may jump and escape.
Step 7. Preserve the sample. Vials are uniquely numbered and used in chronological order. Insert fin clip sample into a vial by dipping the scissor blades into the ethanol solution in the vial. Forceps can be used to help place the fin clip in the ethanol. Cap the vial and make sure the fin clip is in the ethanol solution. Only one fin clip tissue per Steelhead should be in the vial to ensure proper genetic assignment. If more than one fin clip tissue is in the vial, note the reason in the CVP Steelhead DNA-Tissue Collection Form (see C.1.l).
Step 8. Record the sample. Record sample data into the CVP Steelhead DNA-Tissue Collection Form including collection date, time, collector initials, fish fork length (mm FL), the vial sample ID number, adipose fin status, and fate of the Steelhead ("DNA, released"). Record the Steelhead in the Length Data Sheet (see C.1.c) including fork length (mm FL), adipose fin status ("C" after the length if adipose fin clipped), and "DNA, released".
Step 9. Store the sample. Store the sample in a vial tray inside a cabinet in the holding tank building. Samples are not to be frozen or refrigerated.
Step 10. Release the Steelhead. When Steelhead recovers after step 6, release the Steelhead back into the continuous collection tank.

E.6.e.2.3. Post-Operational Steps for Steelhead

After processing Steelhead from a fish count, follow the steps below:

Step 1. Check DNA fin clip data. The number and lengths of Steelhead that were fin clipped for a DNA tissue sample and recorded in the CVP Steelhead DNA-Tissue Collection Form must match the number of Steelhead recorded as "DNA, released" in the Length Data Sheet.
Step 2. Release "DNA, release" Steelhead. Allow Steelhead to recover in release trough before releasing to the continuous salvage holding tank. Do not leave Steelhead in the recovery trough for more than 30 minutes.

E.6.e.3. Delta Smelt Procedures

All adult Delta Smelt collected during 30-minute sampling period are euthanized. Prepare MS-222 anesthetic bath, tall vials prefilled with 70% ethanol solution, pair of scissors, and iodine. Follow the operational steps below for proper handling and processing of Delta Smelt:

Step 1. Euthanize smelt. Place fish in the anesthetic bath or in a high concentration of MS-222 to euthanize smelt.
Step 2. Identify smelt. Refer to the identification guide titled "Fish Identification for the South Delta" for identifying Delta Smelt.
Step 3. Measure Delta Smelt in mm FL. Make sure measuring board is wet before placing fish on it. Record the length in the Operations and Counts Summary Data Sheet (see C.1.a.).
Step 4. Preserve Delta Smelt. Insert the euthanized Delta Smelt into a tall vial with pre-filled 70% ethanol solution. Insert fish head first.
Step 5. Label vial. Insert a waterproof label into the vial to identify the collected Delta Smelt. On the label, write the name of the smelt species, date collected, fish count time collected, length in mm FL, and the species code for Delta Smelt (code 26).
Step 6. Store the Delta Smelt. Vial with euthanized Delta Smelt will be stored at the dry table of the count station. Electronically notify Biological Resources Section staff through email that a Delta Smelt was collected. The Biological Resources Section staff will collect the vial for species verification and additional processing.

E.6.e.4. Longfin Smelt Procedures

All adult Longfin Smelt collected during 30-minute sampling period are euthanized. Prepare MS-222 anesthetic bath, and tall vials prefilled with

70% ethanol solution. Follow the operational steps below for proper handling and processing of Longfin Smelt:

Step 1. Euthanize smelt. Place fish in the anesthetic bath or in a high concentration of MS-222 to euthanize smelt.
Step 2. Identify smelt. Refer to the identification guide titled “Fish Identification for the South Delta” for identifying Longfin Smelt.
Step 3. Measure Longfin Smelt in mm FL. Make sure measuring board is wet before placing fish on it. Record the length in the Operations and Counts Summary Data Sheet (see C.1.a.).
Step 4. Preserve Longfin Smelt. Insert the euthanized Longfin Smelt into a tall vial with pre-filled 70% ethanol solution. Insert fish head first.
Step 5. Label vial. Insert a waterproof label into the vial to identify the collected Longfin Smelt. On the label, write the name of the smelt species, date collected, fish count time collected, length in mm FL, and the species code for Longfin Smelt (code 25).
Step 6. Store the Longfin Smelt. Vial with euthanized Longfin Smelt will be stored at the dry table of the count station. Electronically notify Biological Resources Section staff through email that a Longfin Smelt was collected. The Biological Resources Section staff will collect the vial for species verification and additional processing.

E.6.e.5. Splittail Procedures

All Splittail collected during a 30-minute fish count sampling are recorded in the “Splittail (SPT)” column located in the top half of the Operations and Count Summary Data Sheet. Splittail is tallied daily using this column. Do not include Splittail data in the lower half of the data sheet.

Splittail with abnormal curvatures of the body or spine (Figure 12) have been observed in the past. If collected during a fish count, these fish must be saved alive at the fish count station for confirmation by the Biological Resources Section staff.

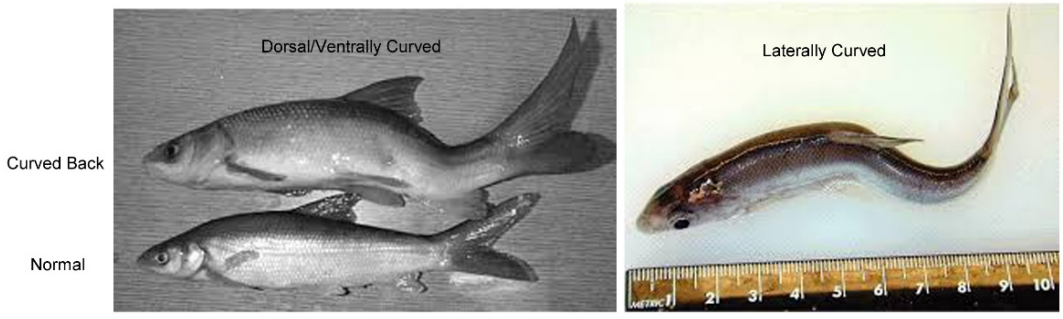


Figure 12.—Splittail with abnormal curvatures of the body or spine.

E.6.e.6. Sturgeon Procedures

All sturgeon species (Green Sturgeon and White Sturgeon) collected during a 30-minute sampling are measured for fork length and total length. Prepare an MS-222 anesthetic bath. Follow the operational steps below for proper handling and processing of sturgeon:

Step 1. Anesthetize sturgeon. Refer to E.6.a. for the proper use of anesthesia and handling of anesthetized fish. Handle sturgeon only when sedated. Be aware of the sharp scutes.
Step 2. Identify sturgeon. Refer to the identification guide titled "Fish Identification for the South Delta" for identifying Green Sturgeon and White Sturgeon.
Step 3. Measure sturgeon in mm FL and mm TL. Measuring board must be wet before placing fish on it. The fork length in mm (mm FL) and total length in mm (mm TL) are recorded. Record lengths in the Operations and Counts Summary Data Sheet (see C.1.a.).
Step 4. Save sturgeon for verification. Place sturgeon in the aerated aquarium. The Biological Resources Section staff will verify the species before releasing the sturgeon to the continuous salvage tank. Fin clip tissue sample from a pectoral fin will be collected from Green Sturgeon by the Biological Resources Section staff.

E.6.f. Larval Sampling Procedures

Larval sampling occurs annually to detect the presence and the absence of Delta Smelt and Longfin Smelt less than 20 mm FL from 30-minute fish counts. Larval sampling is incorporated into the 30-minute fish counts collected at 0400, 1000, 1600, and 2200. Rose Bengal and formalin will be used in the operational steps. Only certified Equipment Operators and Biological Resources Section staff can carry out larval sampling.

E.6.f.1. Description

Larval sampling will start when one of three triggers are met: (1) the average daily water temperature at Rio Vista, Antioch, or Mossdale reach 12 °C, (2) "spent" adult female Delta Smelt are found in the CDFW Spring Kodiak Trawl survey or at the CVP and SWP fish salvage facilities, (3) larval smelt are found in the CDFW 20 mm survey. Triggers are monitored by the Biological Resources Section staff and then electronically communicated with the Equipment Operator Supervisor when larval sampling will be initiated. Smelt gonadal development and presence of "spent" adult female Delta Smelt at the TFCF are monitored by the Biological Resources Section staff in coordination with the Equipment Operator staff. Before larval sampling is initiated, all Equipment Operators are retrained in the larval sampling procedures and in the handling of hazardous chemicals used for the larval sampling program. Larval sampling will end when the 3-day mean water

temperature at Clifton Court Forebay reaches 25 °C or June 30, whichever occurs earlier. These end triggers are also monitored by the Biological Resources Section staff and electronically communicated to the Equipment Operator Supervisor.

E.6.f.2. Operational Steps for Larval Sampling

Step 1. Verify larval sampling need. Larval sampling will be completed during the 0400, 1000, 1600, and 2000 30-minute fish counts.
Step 2. Verify correct count screen. Replace regular count screen (2.4 mm opening) with the larval count screen (0.5 mm opening). Refer to Appendix L for screen details.
Step 3. Perform fish sampling. Follow the Operational Steps for Fish Sampling up to Step 19 (see E.5.).
Step 4. Remove tire from the larval count screen and rinse larval count screen. Use a low pressure water hose with a spray nozzle to rinse the inside of the larval count screen. Verify no larval fish are stuck to the inside of the larval count screen.
Step 5. Remove larval count screen from count basin.
Step 6. Process all non-larval fish first. Use hands and/or a dip net to remove fish from the count basin and record fish greater than or equal to 20 mm FL as normal salvage. Leave fish < 20 mm FL in the count basin.
Step 7. Remove debris and rinse off larvae from debris. Remove debris such as sticks, trash, and *Egeria densa* strands from the count basin and place into a 6 mm net (rinse net) inside an empty 20 liter bucket. Pour water (~ 10 liters) over the rinse net to wash larvae off of the debris and into the bucket. Set aside rinsed debris to be weighed later. Repeat step 7 until all debris in the count basin is removed. The bucket will contain rinsed larvae.
Step 8. Net remaining larvae in the count basin. Use a fine mesh dip net to collect the remaining larvae in the count basin by sweeping the entire length of the count basin with the fine mesh dip net.
Step 9. Drain the count basin. Position the same fine mesh dip net from step 8 at the drain of the count basin. Pull the count basin drain plug to allow count basin's content to drain into the fine mesh dip net.
Step 10. Combine the larvae into a single sample. Pour the bucket with the rinsed larvae from step 7 into the fine mesh dip net. The fine mesh dip net will now contain the entire fish count larval sample.
Step 11. Stain the fish count larval sample. Dip the fine mesh net with the fish count larval sample into a 100 ppm Rose Bengal bath (~1 liter) for 3-5 minutes.
Step 12. Rinse the fish count larval sample. Use low pressure hose to rinse the fish count larval sample. Place the lid back on the Rose Bengal bath.
Step 13. Transport the fish count larval sample to the picking station. Secure the fish count larval sample when transporting especially on windy days.

Step 14. Prepare the fish count larval sample. Empty the fish count larval sample into a 27.5 x 42.5 cm glass Pyrex dish. Pour ½ liter of water to rinse the net and the larval sample into the Pyrex dish. Place the pyrex dish on a light table.

Step 15. Prepare a vial. If there are larval fish present in the sample, fill out an internal label and insert into a 20 ml vial prefilled with 10 ml of water. Fill out an external label attached to the lid of the vial. Both labels must contain the facility name, date, time, and sampler's initials.

Step 16. Prepare a datasheet. Fill out the Larval Fish Data Sheet (see C.1.m) with date, time, initials, and picking start time.

Step 17. Pick the fish count larval sample. Rose Bengal will stain larvae pink or red making it easier to locate. Use forceps to pick up larvae and place picked larvae into the prefilled 20 ml vial. Slender and long larvae will take priority since smelt larvae are targeted. Use a handheld clicker to keep count of the number of larval fish removed from the sample.

Step 18. Conclude picking. Actively pick for no more than 30 minutes. If there are still fish present in the sample after 30 minutes, make a note on the bottom of the Larval Fish Data Sheet stating that the 30 minute maximum time limit was reached and there still may be fish left in the sample. Fill out the Larval Fish Data Sheet with picking end time, total time of picking in minutes, and number of larvae picked. If there are remaining larvae after 30 minutes of picking, they can be left in the Pyrex dish.

Step 19. Preserve the fish count larval sample. Under a fume hood, add formalin to the vial up to the neck of the vial. Cap the vial. Leave vial with picked larvae under the fume hood. This vial will be processed by the Biological Resources Section staff.

Step 20. Store the sample. Cover the Pyrex dish with a lid. Place the Larval Fish Data Sheet on top of the Pyrex dish and store together in the refrigerator. The sample will be picked through a second time by the Biological Resources Section staff in order to calculate the sampler's larval picking efficiency.

E.6.g. Extraordinary Situations Affecting Fish Sampling

E.6.g.1. Outages and Missed Fish Counts

A fish facility outage is defined as the inability to (1) properly screen the entire flow (e.g., due to mechanical breakdown, low water conditions, or excessive debris conditions) or (2) conduct fish salvage operations according to mandated operational criteria. When a fish facility outage occurs, exports at JPP may continue and fish counts may be missed. If salvage ceases and it is certain that fish counts will be missed or if salvage inefficiency occurs due to operational issues, the Equipment Operator Supervisor or others designated by the O&M Division Chief must follow the outage notification decision tree (Appendix P-1) or the notification protocol explained in the CDFW memorandum (Appendix P-2). Distribution or contact list for outage notifications is in Appendix P-3.

If an outage is planned, all attempts should be made to conduct a fish count within the two-hour period during which the outage is planned. For example, if an outage is planned for 0830, the 1000 fish count sample must be collected between 0800-0830.

If a fish count is missed due to an outage and pumping continued at JPP, minutes of pumping at JPP must be accounted by transferring the minutes pumping at JPP to the next fish count. For each missed fish count, transfer 120 pumping minutes to the next fish count. For example, if a single fish count is missed, 120 pumping minutes is transferred to the next fish count; therefore, the next fish count will have 240 pumping minutes. If two fish counts are missed, 240 pumping minutes is transferred to the next fish count and this fish count will have 360 pumping minutes.

If a fish count is missed due to an outage and pumping continued at JPP, salvage minutes must also be accounted by transferring the salvage minutes to the next fish count. For example, if an outage occurred from 0830 to 1000 and the 1000 fish count was missed, 30 minutes must be transferred to the 1200 fish count salvage minutes; therefore, the 1200 fish count will have 150 salvage minutes.

Sampling rates at the TFCF for fish salvage counts shall be no less than 25 percent of operational time (*i.e.*, pumping minutes). If pumping minutes for a fish count are increased, the duration of the fish count (Count Minutes) must also be increased so that it is at least 25 percent of the pumping minutes. For example, if pumping minutes are increased to 240 minutes, a 60 minute fish count will need to be performed for that period to sample at least 25 percent of the pumping minutes.

If a facility outage requires pumping reduction at JPP, the request to the Central Valley Operations (CVO) for reduction will come from the Equipment Operator Supervisor or the O&M Chief by telephone. CVO will reduce pumping based on the severity of the outage.

E.6.g.2. Meter failures

Meters located throughout the facility collect water temperature, flow, velocity, and depth measurements (see Appendix M). When an electronic meter fails, it can negatively affect the ability of the facility to stay within criteria, including velocities at the secondary channel and bypass ratios (velocity at the bypass opening: velocity in the channel). Fish salvage may be compromised because the effectiveness of the facility at diverting fish into holding tanks relies on its ability to stay within criteria.

When a flow meter is not working properly, a flashing “-9999” will show in the LCD display. Values must be estimated and are noted with an “F” after the value to mean “failed” in the Operations Data Sheet (see C.1.d.). Failed readings affect

other related calculated values; therefore, calculated values using estimates for failed readings will also have an “F” after the value.

When an electronic depth gauge is not working properly, a staff gauge should be used to obtain water depth. Staff gauges help verify the accuracy of the electronic depth gauges. For the primary channel, add 14 ft to the staff gauge reading to compensate for elevation (Figure 13, left). For the secondary channel, no elevation compensation is needed. Only holding tank 1 has a staff gauge and it is not elevation compensated. Each mark on the staff gauge represents a tenth of a foot (Figure 13, right).

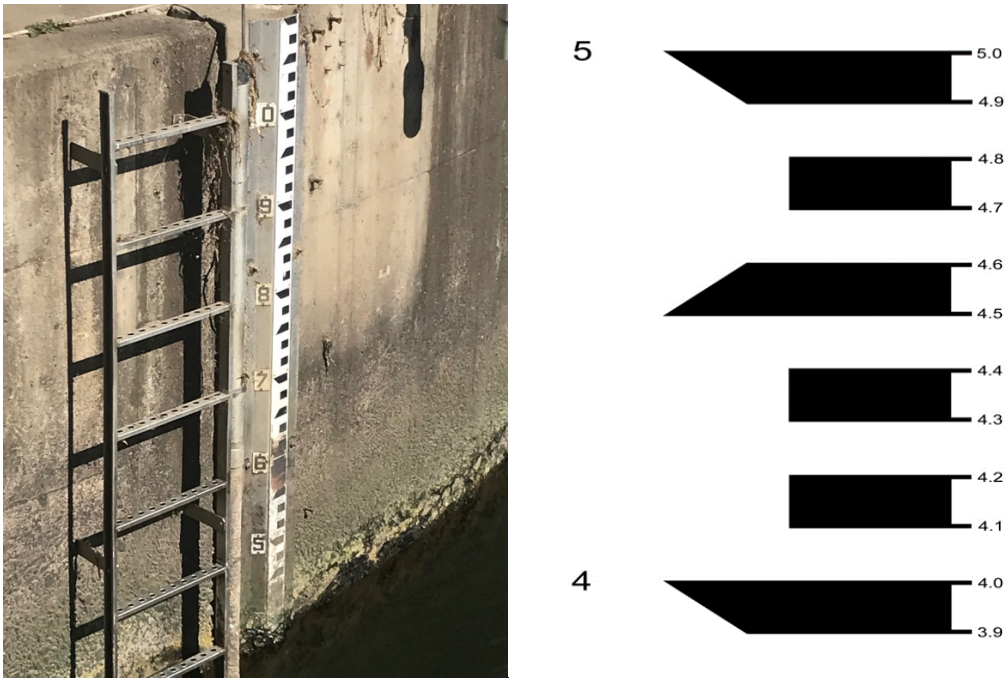


Figure 13.—Left: Staff gauge at the primary channel. Fourteen feet must be added to the depth reading. Right: A representative portion of the staff gauge. This portion of the depth gauge is for the 4 and 5 foot level as seen on the left side of the gauge. The tenths of a foot on the right are provided only for this figure.

E.6.g.3. High Volume of Debris

High volume of debris going into the holding tanks can injure and suffocate fish during fish sampling. To avoid missing fish samples, employ the options below during heavy debris periods to limit injury to fish:

E.6.g.3.1. Jack Flush Technique

If the previous count had complications due to debris (e.g., count station screen was full of debris or debris clogged the bucket), the jack flush technique can be employed. When done properly, mortality should be less than 10% compared to >50% if debris was not removed at all. Follow the steps below to properly perform the technique:

Step 1. Lower the bucket into the holding tank with the intent of collecting debris and not fish. Verify that the sampling bucket has been filled and tested for leaks. Verify that the sampling bucket is seated in the center drain. Refer to E.5. Operational Steps for Fish Sampling for details.
Step 2. Partially lift the holding tank screen for approximately 1 second by pulling the jack lever backwards (towards the operator) for approximately one second and then immediately pushing the jack lever forwards (away from the operator). This step allows debris to go under the holding tank screen and into the sampling bucket. The screen is not to be lifted all the way up. Repeat the process as necessary.
Step 3. Lift the sampling bucket. Verify the holding tank screen is lowered back down and the water level has receded into the bucket before lifting the sampling bucket.
Step 4. Release debris into count station. Sort through the debris to verify no fish are in the debris. Record fish depending on type of fish count (see E.2.a and E.2.b.). Separate debris into a basket to be weighed (see E.5. Step 25) after Step 6.
Step 5. Decide if another jack flush technique is needed. If the holding tank is clean, then proceed with collecting the fish in the sampling bucket; otherwise, perform another jack flush.
Step 6. Collect the fish sample. Lower the bucket back into the holding tank and proceed to collect the fish count sample.
Step 7. Record that the jack flush technique was employed on facility data sheets. This will alert the next operator that they may need to perform this debris removal step before processing the fish.

E.6.g.3.2. Decreased Sampling Duration

Deviating from a 30-minute fish sampling duration may be employed only as a last option during extreme debris situations. The Equipment Operator Supervisor would provide the authorization, in consultation with the Supervisory Fish Biologist, if a decrease in sampling duration is requested. If a decreased fish sampling duration is determined to be necessary, the Equipment Operator Supervisor or Fish Biologist Supervisor must contact the Fish Facility Branch Chief, O&M Division chief and the responsible regulatory agencies, specifically CDFW, USFWS, and NMFS. If the extreme debris situation and the decision to decrease fish sampling duration occur in the evening, the Equipment Operator Supervisor or the Supervisory Fish Biologist, must notify the responsible regulatory agencies by email.

E.6.g.4. High Volume of Fish

When high volumes of fish are encountered at the facility, it is often dominated by one fish species. For example, large schools entrained in fall are often Threadfin

Shad and, in wet years, large schools entrained in late-spring are Splittail. These schools of fish can inundate a fish sample. When this occurs, sampling methods can be modified to limit injury to fish (See E.6.g.3.2). An acceptable, modified method of sampling is the weight estimation method.

E.6.g.4.1. Weight Estimation Method

The weight estimation method is only to be employed when a fish count sample contains ~500 or more fish of a single species. Permission to use this method must be obtained from the Equipment Operator Supervisor. The Equipment Operator Supervisor will provide authorization, in consultation with the Fish Supervisory Biologist, before the method is employed. If this process is performed, the Equipment Operator Supervisor shall inform both the Fish Facility Branch Chief and the O&M Division Chief. Because fish salvage is higher at night, the weight estimation method is more likely to be employed during the night shift of 10 PM to 6 AM. Follow the steps below for the method:

Step 1. Decide to use the method. If the previous fish count contained a large volume of fish that filled the count screen, the method can be employed. Obtain permission before going to step 2.
Step 2. Prepare the count station for the method. Tare the weight of the large 2.5 mm mesh bag net and 30-gallon plastic tub with 5 gallons of water. Place the bag net on the count station basin so that it overhangs the basin. Place the count station screen on the bag net. Place tire on top of the count station screen. Refer to Figure 14 for the count station set-up for the weight estimation method.

Figure 14.—Count station set-up for the weight estimation method.

Step 3. Perform a 30-minute fish count. See E.5. Operational Steps for Fish Sampling.

Step 4. Release the sample into the fish count basin.

Step 5. Remove the tire and the count screen to allow fish and debris to pour into the bag net.

Step 6. Remove listed fish, large fish, and large debris by hand first. Chinook Salmon and Steelhead will swim to the top of the pile of fish; remove them first and place them in an aerated bucket. Remove large fish and place them in another aerated bucket. These fish will be processed after the method is completed. Debris will be removed and can be discarded since weight of debris will not be collected when weight estimation method is employed. The remaining sample is assumed to be all fish.

Step 7. Collect a subsample. Spread the remaining fish and debris uniformly in the count basin and collect a sub-sample of fish using a net. The subsample must have 100-300 fish. Set the subsample aside.

Step 8. Weigh the fish (kg) in the bag net. Gathering the edges of the bag net, lift the bag net of fish into the 30-gallon plastic tub. The weight displayed is the total weight of the fish since the weight of the bag net and 30-gallon tub with water was tared in step 2. Record the total weight and release the fish immediately back to the continuous salvage tank. Step 8 must be completed within 30 seconds.

Step 9. Weigh the fish (kg) in the subsample. Weigh the subsample. Make sure to zero the balance.
Step 10. Obtain total weight (kg) of fish count sample. Add the weight of the fish from the net bag (step 8) to the weight of fish and debris in the subsample (step 9).
Step 11. Obtain a multiplier. Divide the total fish count sample weight by the subsample weight to obtain a multiplier.
Step 12. Process the subsample. Count the total number of each species in the subsample. Record lengths at the appropriate hours (0200, 0600, 1400, 1800 hr) using fish from the subsample. Release fish from the subsample into the holding tank.
Step 13. Obtain the estimated fish numbers. Multiply the number of each fish species collected in the subsample by the multiplier. Round the numbers to the nearest whole number.
Step 14. Process listed species and large fish from step 6.
Step 15. Record the data. Record the estimated fish numbers as well as the listed and large fish on the appropriate facility data sheets. Note the sampling times when the weight estimation method was employed on the Operations and Counts Data Sheet (C.1.b.) and Length Data Sheet (see C.1.c.) by writing "weight estimation method used" at the bottom of the appropriate data sheets.

E.6.g.5. Daylight Savings Time

During spring, the time changes on the second Sunday in March at 0200. Time is advanced by one hour. Perform the 0200 fish count as normal. The 0400 fish count will only include 60 pumping minutes and 60 salvage minutes due to the time change. The expansion factor for the 0400 fish count will be 2. See Appendix Q-1 for correct data entry for daylight savings in spring.

During fall, the time changes on the first Sunday in November at 0200. Time is moved back one hour. For the 0200 fish count, the pumping minutes and the salvage minutes will include an additional 60 minutes due to the time change. Therefore, the pumping minutes and the salvage minutes will be 180 minutes. In order to achieve the required 25% sampling period of the 180 minutes, perform a 45 minute 0200 fish sub-sample or fish count. See Appendix Q-2 for correct data entry for daylight savings in fall.

E.6.g.6. Lost sample

Lost sample occurs when a collected 30-minute fish count sample cannot be transferred from the holding tank to the fish count station and the sample cannot be recovered. Examples of scenarios when samples are lost include: 1) holding tank screen jack remaining in the lifted position during the sampling period and, 2) sampling bucket ball check valve left in the open position during sample lifting. When a sample is lost, a new 30-minute fish count sample must be collected

immediately if still within the two hour period being estimated. In the Operations and Counts Summary Data Sheet and the Operations and Counts Data Sheets, write 90 in the "Salvage Minutes" column since 30 minutes of fish was lost in the period.

E.6.g.7. Equipment malfunction

If a 30-minute fish count sample has been collected but cannot be immediately recovered due to a mechanical malfunction (e.g. broken hoist), the sample can be left in the holding tank until the mechanical issue is resolved. Aeration must be provided to the holding tank if the sample will remain in the holding tank for more than an hour. Up to three 2-hour periods of samples (*i.e.*, three 30-minute fish count samples) can be collected in three holding tanks. The Equipment Operator Supervisor must notify the O&M Chief to resolve the issue. If after 6 hours the mechanical issue persists, fish counts will be missed and the situation must be treated as an outage. The O&M Chief or the Equipment Operator Supervisor must follow the outage notification protocol decision tree (see Appendix P-1) for reporting outages.

F. Post-Sampling

F.1. Purpose

Data gathered from the fish counts undergo a quality assurance and quality control (QAQC) process before it is distributed. The purpose of this section is to detail the steps taken to assure salvage data integrity.

F.2. Schedule

Salvage and operational data, as well as other appurtenant data, are collected by the Equipment Operators daily. The Equipment Operator Supervisor or the team lead reviews the data sheets at the end of each shift to ensure they are complete. The Biological Resources Section staff reviews the datasheets for accuracy each morning and electronically sends them to various distribution lists. **Note:** All steps listed in sections F.3 to F.7 are completed by the Biological Resources Section staff.

F.3. Operational Steps for Post-Sampling

Step 1. Gather data sheets and appurtenances. Salvage and operational data sheets from the previous day will be located in the O&M computer room. Frozen Chinook Salmon for CWT extraction will be in a freezer by the fish count station, preserved smelt samples will be in vials at the fish count station, and larval samples will be in the picking lab station by the O&M Building. The Biological Resources Section staff will gather these samples along with the following data sheets each morning:

- Operations and Counts Summary Data Sheet (Appendix G-1)
- Operations and Counts Data Sheet (Appendix G-2)
- Length Data Sheet (Appendix G-3)
- Operations Data Sheet (Appendix G-4)
- Fish Transport Log Data Sheet (Appendix G-5)
- Debris Data Collected during Fish Counts Sheet (Appendix G-8)
- Larval Fish Data Sheet (Appendix G-13)

Step 2. Verify Chinook Salmon and Steelhead data. DNA–Tissue Collection Forms are stored on the dry table of the fish count station. Verify that the number and lengths of Chinook Salmon and Steelhead recorded for the DNA–Tissue Collection Forms match the number and lengths recorded in the Length Data Sheets. The DNA–Tissue Collection Forms are to be left in the holding tank building after verification. These forms will be gathered for the CDFW Tissue Archive.

Step 3. Obtain coded wire tag information. If Chinook Salmon requires CWT extraction, proceed to F.5. CWT extraction and reading is performed by the Biological Resources staff.

Step 4. Obtain larval smelt information. During larval smelt season (see E.6.f.), verify larval smelt identification and their presence/absence. Larval smelt identification is completed by the Biological Resources staff.

Step 5. Photocopy data sheets. A subset of the data sheets will be photocopied including:

- Operations and Counts Summary Data Sheet (Appendix G-1)
- Operations and Counts Data Sheet (Appendix G-2)
- Length Data Sheet (Appendix G-3)

Step 6. Review the data. Review that the hydraulic and biological data are correct. If errors or discrepancies are detected, mark them on the photocopies with a red pen. If data is missing, determine if the data are recorded elsewhere. If so, using a red pen, record the missing data and circle the mistake. Do not put a guess if data is missing. The “red-pen corrected” photocopy is stored on site at the Biological Resources Building. Changes are made to the original data sheets in pencil and these are released to the public. For details on data accuracy and control, see F.4. Data QAQC.

Step 7. Incorporate appurtenant data. Add the CWT head tag numbers and codes, as well as larval smelt presence/absence data, to the Operations and Counts Summary Data Sheet (see C.1.a).

F.4. Data QAQC

Data gathered from the operation of the TFCF is verified for accuracy before being distributed, input into a database, and archived. Below is a list of all facility data sheets including step-by-step instructions on how to verify the accuracy of data in each sheet:

F.4.a. Operations and Counts Summary Data Sheet

Step 1. At the top of the sheet, verify:

- date (mm/dd/yyyy) is correct and in proper format.
- Daily Acre Feet of Water Pumped at JPP is correct. This value is the total water exported for the day and must match Jones Pumping Plant Acre Feet from the San Luis and Delta-Mendota Water Authority (SLDMWA) Daily Pumping Report. Daily Acre Feet of Water Pumped at JPP may need to be recorded during QAQC if report was not transmitted prior to collection.
- length ranges for the winter-run and spring-run Chinook Salmon. Use the Length-at-Date (LAD) Salmon Run Table (see Appendix J-3) for the appropriate length ranges. There may be two length ranges per run, both are required.
- additional pages are accounted in "Page__of__" on top right.

Step 2. Verify:

- Count Minutes, Pumping Minutes and Salvage Minutes for each fish count are correct. Any deviation in typical minutes (*i.e.*, Count Minutes = 30, Pumping Minutes = 120 and Salvage Minutes = 120) must have an asterisk. An explanation for the asterisk must be detailed at the bottom of the sheet. If a fish-count is missed and pumping at the JPP continued, transfer the Count Minutes, Pumping Minutes and Salvage Minutes to the next fish count. See section E.6.g.1 for details.
- the appropriate number of winter-run salmon, spring run salmon, other run salmon, Steelhead, Longfin Smelt, Delta Smelt, Splittail and sturgeon (GST and WST) were recorded for each fish count.
- winter-run tally values are included for each fish count and are correct. Winter-run tally is reset on October 1 of every year.
- daily totals are included and are correct.
- collect time and fork lengths for all Chinook Salmon, Steelhead, Delta Smelt and Longfin Smelt were recorded.
- collect time, fork and total length for all sturgeon (White Sturgeon and Green Sturgeon) were recorded.
- all Chinook Salmon and Steelhead lengths listed on the Operations and Counts Summary Data Sheet are accurate by comparing with data on Length Data Sheets.

- all listed Chinook Salmon are designated W for winter-run length or S for spring-run length. If Chinook Salmon is neither W nor S, put a long dash (*i.e.*, —) or leave blank.
- all fish listed on the Operations and Counts Summary Data Sheet are accounted for. This includes the frozen samples (check species, date, fish length, fin clip, tag, etc.) and DNA samples.
- the lengths listed on the CVP Salmon DNA-Tissue Collection Form and the CVP Steelhead DNA-Tissue Collection Form accurately reflect what is listed on the Operations and Counts Summary Data Sheet. Verify the number sequence of DNA vials in the storage box to make sure that they are in the proper order and reflect what is listed on the DNA-Tissue Collections Forms and Operations and Counts Summary Data Sheet. Verify that all salmon in the freezer are adipose clipped and, if not, verify why they were saved.

Step 3. Include Head Tag/Coded Wire Tag information if Chinook Salmon has coded wire tag. See section F.5 for details.

Step 4. At the bottom of the sheet, check that:

- asterisk with explanation is recorded if there were deviations from typical Count Minutes, Pumping Minutes, and/or Salvage Minutes. Include additional comments such as start and end time for outage and reason for outage.
- the initial of the data reviewer is included. Initials signify that the data sheet has been reviewed.

F.4.b. Operations and Counts Data Sheet

Step 1. For the hydraulic data section (top half of the data sheet), verify:

- date (mm/dd/yyyy) is correct and in proper format. Check dates on all pages.
- Daily Acre Feet Pumped is correct. Check daily acre feet pumped on all pages. This value is the total water exported for the day and must match Jones Pumping Plant Acre Feet from the San Luis and Delta-Mendota Water Authority (SLDMWA) Daily Pumping Report. Daily Acre Feet of Water Pumped at JPP may need to be recorded during QAQC if report was not transmitted prior to collection.
- Sample Time for each fish count. Samples are collected every two hour period and reported on the even hours.
- Special Study Code. Use a long dash mark (*i.e.*, —) or leave blank for salvage, 8888 for special studies, and 9999 for predator removals.
- Pumping Minutes. This refers to the number of minutes the Jones Pumping Plant (JPP) was pumping water since the last fish count. This is typically 120 minutes because the counts are performed every two hours. If one fish count is skipped, for example during a facility outage, the Pumping Minutes at the next count should be recorded as 240 minutes, since that is the amount of time that lapsed since

the previous count. Whenever Pumping Minutes deviate from 120 minutes, an asterisk must be placed next to the Pumping Minute value. An explanation for the asterisk must be detailed at the bottom of the sheet. Pumping Minutes on this sheet must match Pumping Minutes on the Operations and Counts Summary Data Sheet.

- Salvage Minutes. This refers to the number of minutes that water has passed into the Holding Tanks since the last fish count. This is typically 120 minutes because the fish counts are performed every two hour period. If one fish count is skipped, for example during a facility outage, the Salvage Minutes at the next fish count must be recorded as 240 minutes, since that is the amount of time that lapsed since the previous fish count. When Salvage Minutes deviate from 120 minutes, an asterisk must be placed next to the Salvage Minute value. Explanation for the asterisk must be detailed in the bottom of the sheet that explains the reason for the deviation. Salvage Minutes on this sheet must match Salvage Minutes on the Operations and Counts Summary Data Sheet.
- Count Minutes. Fish counts are typically collected for 30 minutes. Sometimes during special studies longer counts are performed. Shorter counts may also be conducted under high debris loads or instances of high fish abundance. If one fish count is skipped, a 60 minute fish count needs to be performed during the next fish count to sample 25% of the Pumping Minutes as required by regulatory agencies; therefore, the Count Minutes for the next fish count must be recorded as 60 minutes. When Count Minutes deviate from 30 minutes, an asterisk must be placed next to the minutes. Explanation for the asterisk must be detailed in the bottom of the sheet. Count Minutes on this sheet must match Count Minutes on the Operations and Counts Summary Data Sheet.
- Temperature was recorded for each fish count and that it is rounded to one significant figure (*e.g.,* 64.0^{o} F).
- Bypasses Open is recorded as 1-2-3-4. Bypasses Open is the number of bypass tubes open during the 2 h period. If less than 4 bypasses are open, include an asterisk and a reason at the bottom of the data sheet.
- Primary and Secondary Depths (ft) are recorded for each fish count and rounded to one significant figure (*e.g.*, 18.2 ft).
- Primary Flow (cfs) is correct. This flow is estimated based on the primary depth (ft), the number of pumps operating at the JPP, and the operational criteria (SB or CS) using the appropriate Flow Tables (see Appendix J-5 Flow Tables).
- Secondary Channel Flow: Secondary Flow (cfs) is estimated based on the primary depth (ft), the number of pumps operating at the JPP, and the operational criteria (Striped Bass or Chinook Salmon) using the appropriate Flow Tables (see Appendix J-5 Flow Tables).

- Holding Tank Flow: The Holding Tank flow (cfs) is estimated based on the primary depth (ft), the number of pumps operating at the JPP, and the operational criteria (Striped Bass or Chinook Salmon) using the appropriate Flow Tables (see Appendix J-5 Flow Tables).

Step 2. For the biological data section (bottom half of the data sheet), verify:

- fish species common names and species codes are correct. Refer to Appendix R.
- total number of each species reported matches that from the Length Data Sheet and the Operations and Counts Summary Data Sheet. If no fish are collected during a fish count, Total Count Code 98 entry must be "0". If fish are collected during a fish count, Total Count Code 98 must be left blank.
- Sampler's Initials are included for each fish count.
- species and length data reported are appropriate for the time of year. If not, contact the Equipment Operator(s) responsible for reporting the data to confirm data.

Step 3. Verify that deviations from pumping minutes, salvage minutes, count minutes and bypasses open are identified with an asterisk and a justification is recorded at the bottom of the data sheet.

Step 4. Initial the bottom of the Operations and Counts Data Sheets to signify that the data sheets have been reviewed.

F.4.c. Length Data Sheets

Step 1. Verify:

- fish count times of 0200, 0600, 1400 and 1800 were recorded.
- date (mm/dd/yyyy), sampling time, and sampler's initials are recorded.
- fish species common names and species codes are correct. Species codes must be 2-3 digits.
- number of fish present on the Length Data Sheet (including Additional Fish Not Measured) matches the species totals on the Operations and Counts Data Sheet and the Operation and Counts Summary Data Sheet.
- lengths recorded must be 20 mm or greater.

Step 2. Verify that Chinook Salmon and Steelhead salvaged at any of the fish counts have Length Data Sheets.

Step 3. Verify that the lengths recorded are species appropriate. If not, then contact the Equipment Operator responsible for reporting the data to confirm ID.

Step 4. Initial all Length Data Sheets to signify that the data sheets have been reviewed.

F.4.d. Operations Data Sheet

Step 1. Verify:

- date (mm/dd/yyyy) is correct. Check this on all pages.
- Daily Acre Feet is entered. This value must match Jones Pumping Plant acre feet from the SLDMWA Daily Report. Check this on all pages. Daily Acre Feet of Water Pumped at JPP may need to be recorded during QAQC if report was not transmitted prior to collection.
- meter failures are recorded properly. Measurements that are estimated due to meter failure are noted with an "F" after the measurement and all measurements related to this must also have an "F" after the measurement.
- data entry is complete and that all necessary values have been recorded or calculated.
- depths reported for each count are the same as those on the Operations and Counts Data Sheets. If they are not the same, the Operations Data Sheet has precedence.
- all bypass ratios and secondary velocity are within operating criteria. Meeting criteria is sometimes negatively affected by tidal actions. Note in the data sheet if out of criteria. Contact the Equipment Operator Supervisor if not meeting criteria is due to reasons other than tidal actions.
- pump changes and times are recorded in the Comments.

Step 2. Initial the bottom of the Operations Data Sheets to signify that the data sheets have been reviewed.

F.4.e. Fish Transport Log Data Sheet

Step 1. Verify:

- date (mm/dd/yyyy) is correct.
- appropriate Bates Tables is used in Chart Used column.
- Accumulative Total, Accumulative % Load, and Holding Tank # from the previous day are carried over.
- multiplier used for each fish count.
- number of fish counted under each species group, expanded total number of fish under each species group, and percentage of a truck load from the Bates Tables.
- % Load, All Species is 1 or greater.
- Accumulative % Load of a truck for each count.

Step 2. Verify that release location and release time are documented and that truck was not overloaded at time of release (*i.e.*, Accumulative % Load is less than 100).

Step 3. Verify that oxygen and salinity are recorded and that values are adequate for fish transport. If values are not adequate for fish transport, check the status of the YSI meter and notify the Equipment Operator Supervisor.

F.4.f. Debris Data Collected During Fish Counts Sheet

Step 1. Verify date (mm/dd/yyyy).
Step 2. Verify that columns are filled out legibly.
Step 3. Verify percent volumes of debris for each fish count add up to 100%.

F.4.g. Larval Fish Sampling Data Sheet

Step 1. This sheet is processed by two people. First, Biological Resources Section staff completes QC of the sample picked by the Equipment Operators.
Step 2. Second, a Biological Resources Section staff member checks the ID of each fish in the sample and completes all remaining verification and processing (listed below). The ID QC is performed by a qualified taxonomist.
Step 3. Verify:

- date (mm/dd/yy) and time. Larval samples are collected at 0400, 1000, 1600, and 2200.
- Sample Duration (min) is 30. Sample duration refers to the length of the fish count. When Count Minutes deviate from 30 minutes, an asterisk must be placed next to the minutes. Explanation for the asterisk must be detailed in the bottom of the sheet.
- Equipment Operator and Picking QC checker initialed the data sheet.
- total time for processing the sample is recorded and percent of fish found is accurate based on the number of fish recovered.

Step 4. Account for Delta Smelt and Longfin Smelt recovered in the samples that are ≥ 20 mm FL. These fish must be added to the Operation and Counts Data Sheet and Operation and Counts Summary Data Sheet. Other fish species recovered in the samples that are ≥ 20 mm must also be added to the Operations and Counts Data Sheet. If the other fish species recovered in the samples that are ≥20 mm are identified as salmonid, sturgeon, or Splittail, they must be added to the Operation and Counts Summary Data Sheet. If daily salvage data sheets have already been distributed, distribute all data again by email after all necessary fish have been added.
Step 5. Account for the presence or absence of Delta Smelt and Longfin Smelt that are <20 mm. Their presence or absence must be indicated on the Operation and Counts Summary Data Sheet with a “Y” (Yes presence) or “N” (No presence). The “Y” or “N” should be placed on this sheet next to the number of Delta Smelt and Longfin Smelt ≥ 20 mm that were collected during the fish count. If salvage data sheets have already been distributed, distribute all data again by email after adequately noting presence or absence of Delta Smelt and Longfin Smelt for each larval fish sample.

F.5. CWT Extraction, Reading, and QAQC

F.5.a. CWT Extraction

Extraction is the process of recovering the CWT from the snout of the frozen fish.

This section is completed by the Biological Resources Section staff. Prepare a scalpel with sharp blade, V-detector, strip magnet, telescoping magnetic pick-up tool, plastic forceps, a piece of paper towel, small post-it tape, small sealable bag, and CWT archive binder. All metallic objects such as rings, watches, lights, and magnets are to be kept a considerable distance away from the V-detector to avoid false detections. Vibrations (e.g., bumping the table) will give false readings. If several fish in a row do not register as having tags, the battery in the tag V-detector may need replacing.

Step 1. Begin with a clean work space (Figure 15). After removing everything from the station, sweep the entire station with a bar magnet to remove previous lost tags. Wipe the station clean. Only paper towel, scalpel, plastic forceps and the V-detector should be in the station.
Step 2. Verify V-detector works by wanding a metallic object.
Step 3. Verify fish has CWT. Wand the fish to make sure CWT is present. Remove any rings, watches, and other metals that may set off the detector. If there is no beep, check adipose fin. If adipose fin is clipped, write “no beep” in the Coded Wire Tag Data Sheet (see Appendix G-14). Double check salvage sheets to make sure this fish was recorded correctly (*i.e.*, verify the unclipped fish was not recorded as adipose clipped).

Figure 15.—Work station with a 3-side acrylic workspace, a magnifying lamp, and a tag detector called a V-detector.

Step 4. Cut frozen fish. Using a scalpel, cut the frozen fish by shaving a thin slice off the snout while looking for the appearance of the CWT.

Step 5. Wave fish and cut piece for CWT. Separately wave both the fish and then the thin slice removed from the snout of the fish in front of the V-detector. Wave the fish or piece of tissue up and down about 2 cm away from the center of the V-detector.

Step 6. Repeat if needed. If the CWT is still in the fish, continue making thin slices, using the detector between every slice to locate the tag. Once the piece which contains the tag is found, keep cutting this into smaller sections until the tag can be seen and removed. Use the telescopic magnetic pick-up tool to recover CWT.

Step 7. Rules if tags are lost, missing, or damaged. If a tag is misplaced after extraction, methodically sweep the work station with the bar magnet. Check the scalpel, clothes, and proximity. If the tag is found within the workstation, write LFT ("Lost and Found Tag"), initials, and the date in the CWT archive binder and process the tag as normal. If a tag is lost and cannot be located, write LT ("Lost Tag"), initials, and the date in the tag code space. Before working on the next fish, clean the work space and start with a clean paper towel. Other abbreviations include NT ("No Tag") for when a CWT is not present from a head and DT ("Damaged Tag") for when a CWT cannot be read due to tag damage.

F.5.b. CWT Reading

CWTs are read and reported within 24 hours after extraction. Follow the steps below to properly read CWTs:

Step 1. Attach CWT to end of brass pencil. Use the end of the brass pencil (magnetized tag holder) to position the CWT straight out from the brass pencil (Figure 16). Sometimes dry fish tissue is stuck to the tag making it difficult to read. In this situation, put a drop of vinegar on fingertip or in the palm of the hand and roll the tag back and forth in the vinegar. The vinegar will dissolve the fish tissue while the rolling action will remove the tissue from the tag.

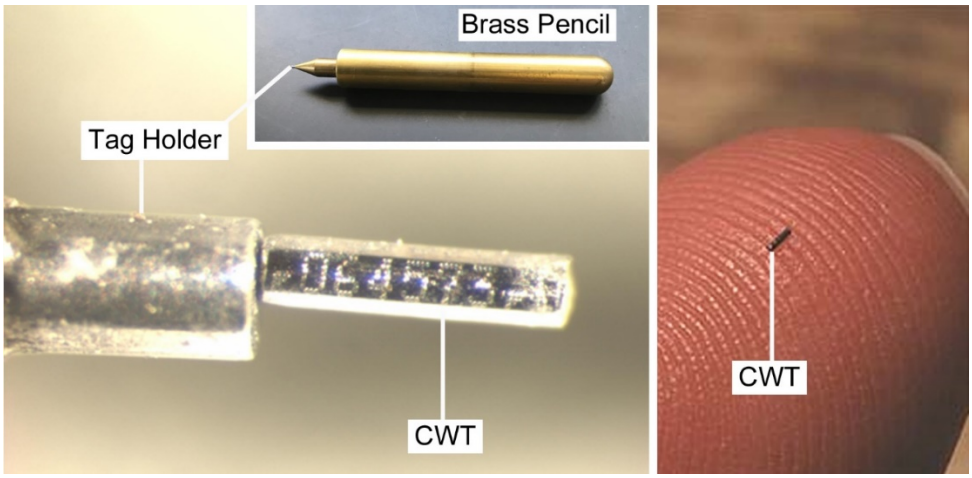


Figure 16.—CWT positioned at the end of the brass pencil's magnetized tag holder. Image on right shows relative size of CWT.

Step 2. Read the CWT. Insert the brass pencil with the CWT carefully inside the portable microscope (Figure 17). Turn on the light source by twisting the knob clockwise. Use the eyepiece and fine focus to read the CWT. If a tag cannot be read, record tag as DT ("Damaged Tag"). If a tag is lost before it is read, sweep the location where the tag was lost using a bar magnet. Refer to Step 7 of Section F.5.a CWT Extraction for details. Turn off light source after reading by twisting the knob counterclockwise.

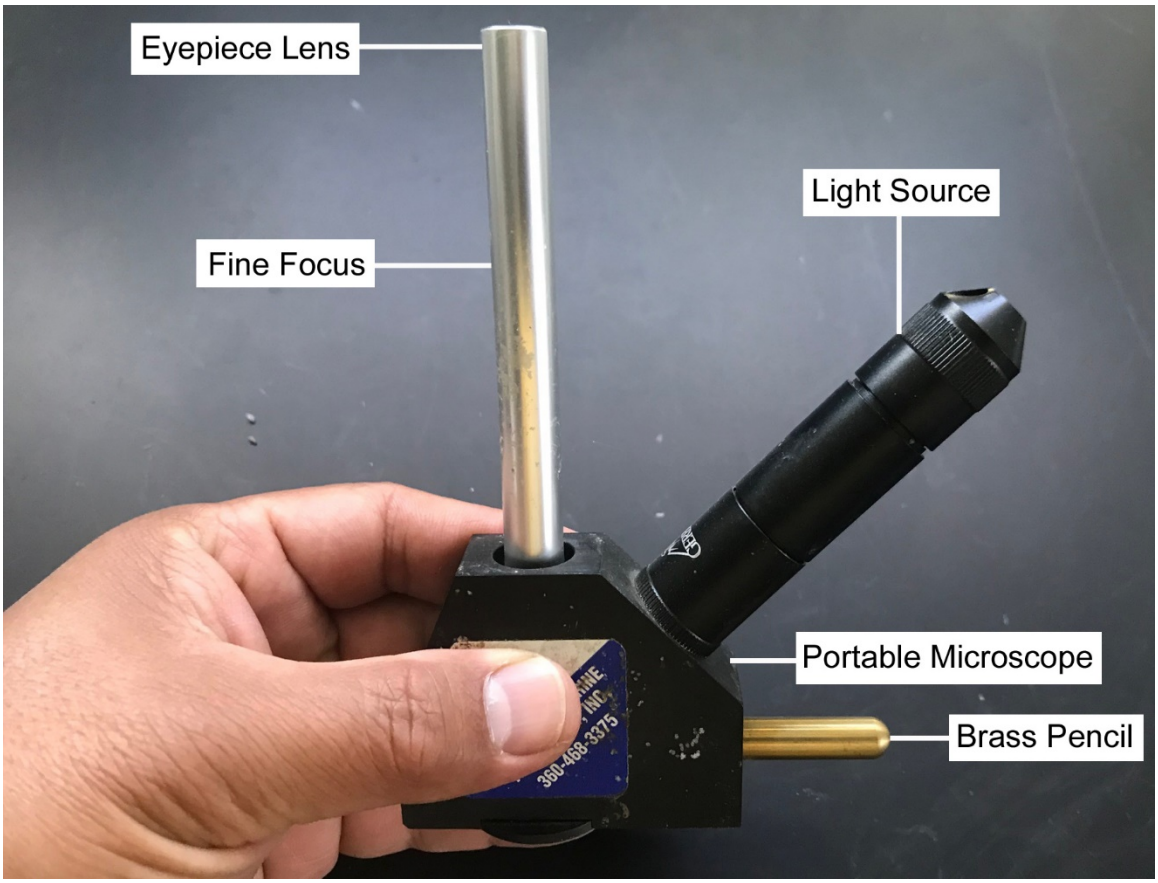


Figure 17.—Brass pencil inside the portable microscope.

Step 2a. Full Decimal Coded Wire Tags. The full decimal CWT is used by most agencies and will have three 2-digit codes (Agency, Data 1 or D1, Data 2 or D2) written on a single side of the tag (Figure 18, left). The full decimal tag uses a flag character to mark the beginning of the tag code. This flag character will be placed to the left of the first digit of the agency number. The agency number will always be either "06" for State or "05" for Federal. The code is replicated on four sides of the wire with the starting point offset by two character positions. This redundancy makes a tag readable no matter where it is cut. If a CWT is cut lengthwise and unrolled, CWT will look similar to Figure 18, right. In this example, the CWT code is written as 16 58 09.

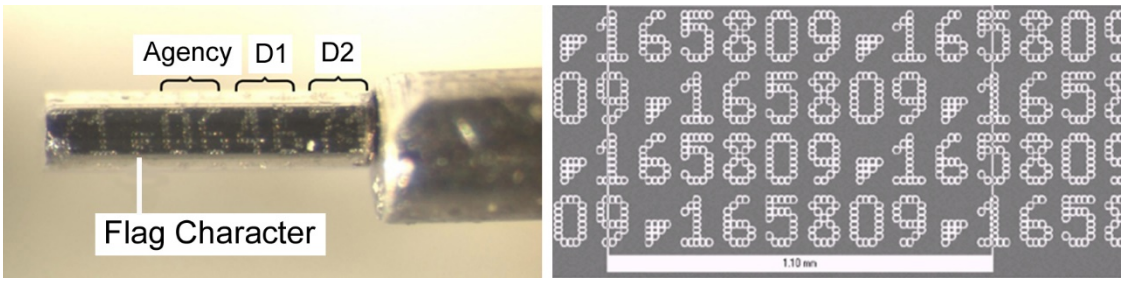


Figure 18.—Left: Coded wire tag with a flag character followed by a 6 digit code. In this example, the agency code is “06”, D1 is “46”, and D2 is “71”. The code would then be written as 06 46 71. Right: Code is replicated on four sides of the wire with the starting point offset by two character positions.

Step 2b. Half Decimal Coded Wire Tags. The half decimal CWT will have five 2-digit codes (Agency [A1 and A2], D1, D2, D3, D4). The tag will have a flag character (similar to full decimal tags) to mark the beginning of the tag code. The row with the flag character contains the two digits of the agency code (A1 and A2) and D1. Aligned below it are D2, D3, and D4. To fit the data on the tag, the digits are written on two longitudinal rows. The digits are repeated once and offset to gain reliability. Figure 19, left, is a diagram showing the location of the 6 digits. Dashed lines show the space taken by a character; the gray bar at the bottom of the diagram shows the length of the tag. The black triangle indicates the flag character.

The example on Figure 19, right, shows A1=1, A2=6, D1=5, D2=8, D3=0, and D4=9. The white lines in the figure show the size of the half decimal tag. Since the half decimal CWT must be written as five two-digit codes, the code is 16 05 08 00 09.

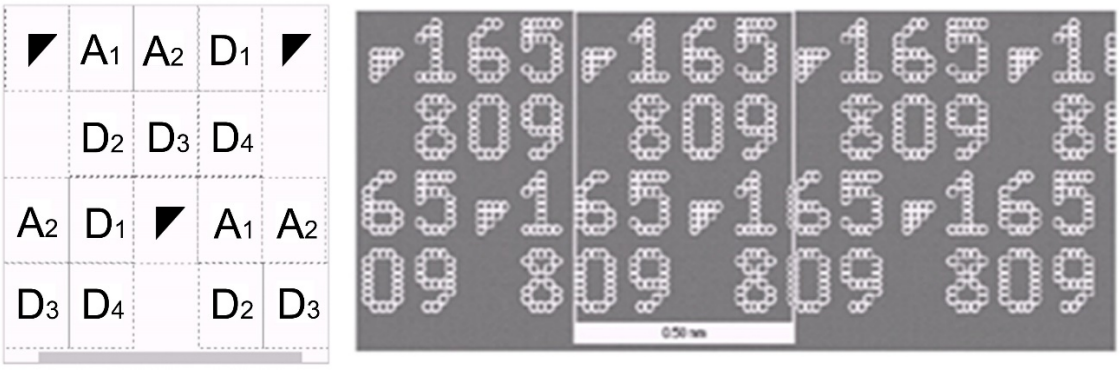


Figure 19.— Left: Diagram of the half decimal tag showing locations of the six digits A1, A2, D1, D2, D3, and D4. Right: An example of a half decimal tag. In this example, the agency code is “16”, D1 is “5”, D2 is “8”, D3 is “0”, and D4 is “9”. The code would then be written as 16 05 08 00 09.

Step 3. Record CWT code. After reading a decimal tag, write the tag code on the bottom line of the tag box and initial Reader 1.

Step 4. Archive recovered CWT. Place CWT on a post-it tape and into a small sealable bag (4 cm x 5 cm). Verify tag is lying on its side in the bag so it won’t poke through the bag and be lost.

Step 5. Attach sealable bag to appropriate tag box. Tape the sealable bag in the correct square (*i.e.,* tag box) on the Coded Wire Tag Data Sheet (Figure 20).

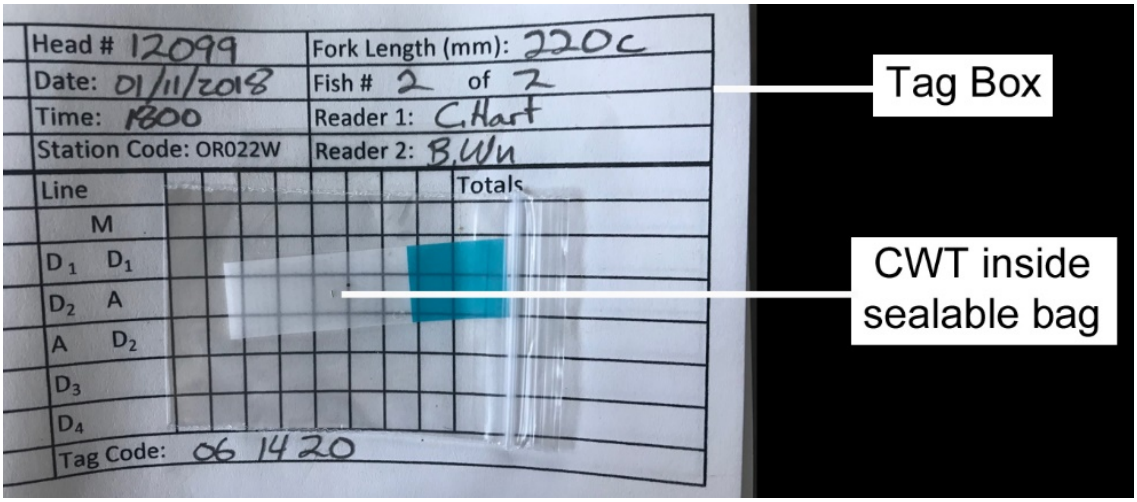


Figure 20.—Archived recovered CWT. The sealable bag is then taped to the corresponding head number information written in the tag box of the Coded Wire Tag Data Sheet.

F.5.c. CWT Quality Assurance/Quality Control

Reading the coded wire tags a second time by a second reader is part of the QAQC process. If the second read of a tag code is the same as the first read, then put the tag back in its bag and enter initials in the “Reader 2” space. If a different code is read, make changes to the tag box with a red pen and leave a flag in the book next to that tag marked “3rd read”. A third person will need to read the tag to determine which tag code was correct. Do not erase original marks. Cross out errors with one line and write the correction in red pen. Before moving to the next tag, initial “Reader 2” space.

Agencies, organizations, and individuals not part of Reclamation’s Tracy Biological Resource Section, have to follow chain of custody procedures before borrowing and transporting CWTs outside of the TFCF premises. The chain of custody form is included in Appendix S-2.

F.6. Distribution of Salvage Data

After the QAQC process, salvage data are emailed by the TFCF Biological Resources Section staff to two distribution lists:

1) CVO Summary Distribution List: The Operations and Counts Summary Data Sheet is emailed to this list that includes Reclamation CVO, NMFS, USFWS, CDFW, DWR, USGS, SLDMWA, and Westlands Water District;

2) Salvage Data Distribution List: The Operations and Counts Summary Data Sheet, Operations and Counts Data Sheet and Length Data Sheets are emailed

to this shorter list that includes CDFW Fish Facilities Monitoring Project, DWR, and Reclamation. The distribution lists are managed and updated regularly by the Biological Resources Section. CDFW Fish Facilities Monitoring Project prepares and posts the salvage data for a wider audience online.

Fish salvage and loss information at the SDFPF and TFCF is used extensively in water project monitoring and planning. The CDFW Fish Facilities Monitoring Project manages the data collected on fish entrained and salvaged at the SDFPF and TFCF. Directed by cooperative agreements and funded by USBR and DWR, project staff are responsible for key entry, quality assurance, data processing, data reporting, and other database management activities for these facilities. The project maintains one of the largest historical databases on Delta species available and has been used in assessing the effects of new facilities and programs, water project operations proposals, and evaluation of proposed CALFED alternatives. Data can be obtained via FTP from the CDFW Bay-Delta server. Data files on the server are compressed in zip format: ftp://ftp.dfg.ca.gov/salvage/

Salvage data along with data from Delta-wide monitoring programs, is also available through: https://baydeltalive.com/

F.7. Salvage Data Archive

All federal salvage records (original data records) are archived at the CDFW Bay-Delta Office in Stockton, CA. The Biological Resources Section staff physically archives all fish salvage (marked photocopies) and operational (original data records) data since 1993. All data records are electronically archived by the Biological Resources Section.

F.8 Disposition of Sampled Specimens

Collected fish tissue must be disposed of or archived accordingly:

- Chinook Salmon and Steelhead fin tissue: collected fin clips are stored in vials with ethanol inside the holding tank building for no more than one week before they are retrieved and archived by CDFW's CVTA.
- CWT Chinook Salmon: after CWT is recovered, Chinook Salmon body and head are returned to their zip sealed plastic bag with label and stored in a freezer inside the Biologist Building for 6 months to one year. After one year, the specimen can be added to the facility's debris disposal or recycled as fish feed.
- Green Sturgeon fin tissue: collected fin clips are stored in vials with ethanol and archived inside the Biologist Building.
- Delta Smelt, Longfin Smelt, Wakasagi: collected smelt from a fish count is preserved in 70% ethanol solution. After smelt ID verification and gonad maturation determination, smelt body and head are preserved in a vial of

70% ethanol solution, and stored in the Biologist Building before they are retrieved and archived by CDFW. Insert only one specimen per vial.
Note: Injured or dead Delta Smelt observed in salvage outside of fish counts must also be preserved in 70% ethanol solution containing a label with date and time when the smelt was found, fork length, the location where it was found, and the name of the person who collected the specimen. Dead smelt will be verified and reported to USFWS within 24 hours by the Biological Resources Section staff.

- Larval samples: larval samples are stored for 5 years in vials of formalin before they are disposed as hazardous waste.

G. Predator Removal

G.1. Purpose

Removal of predatory fish ("predator removal") within the fish salvage facility limits fish loss and improves fish salvage efficiency. In addition, predator removals allow Reclamation to meet regulatory requirements for the protection of listed fish species.

G.2. Schedule

Carbon dioxide (CO_2) treatment is used for the predator removal to flush all fish residing in the bypass pipes, secondary channel, and holding tank conduit on a monthly basis.

G.3. Procedures

The Supervisory Fish Biologist and the Equipment Operator Supervisor will coordinate the timing and labor required for predator removals to limit negative impacts on facility operations. The predator removal will be initiated at an even hour, soon after a fish count. The Supervisory Fish Biologist will coordinate with SLDMWA to access the JPP Headworks (located downstream of the JPP) where predators will be transported and released. A biologist will coordinate the acquisition and delivery of the dry ice.

G.4. Operational Steps for Predator Removal

The steps listed below are for the removal of predators from the bypass pipes, secondary channel, and holding tank conduit using the CO_2 treatment methodology. Safety equipment such as hard hats, harnesses, insulated gloves, proper footwear, and personal floatation devices are required. Carbon dioxide used during predator removals is in the form of dry ice (~10 lb blocks) and is delivered the day before the removal. A minimum of three individuals are needed to safely accomplish the predator removal. Labor for the predator removal is

divided in two: one individual will control the hydraulic parameters and 2-4 individuals will prepare and release the dry ice.

Step 1. Prepare dry ice. Prepare dry ice by removing all packaging and place in a cooler. Each bypass pipe will be treated with 150 lbs of dry ice. Prepare 4 coolers, each having 15 dry ice blocks. Insulated gloves are required for this step.
Step 2. Adjust hydraulics. Adjust water flows in the bypasses and secondary channel and divert water to a new holding tank. Leave 1 small VC pump on to obtain minimum water flow and velocity through the secondary channel. Verify that only 1 holding tank pump is in operation and ensure that all bypasses are open.
Step 3. Insert dry ice at the bypass opening. Insert fifteen 10-lb dry ice blocks into the mouth of each bypass, beginning with bypass 4 and ending at bypass 1. A minimum of two people are needed for this step. Fall protection equipment, personal floatation devices, and insulated gloves are required for this step.
Step 4. Dose the bypasses. Allow dry ice to release CO_2 for 15 minutes to dose fish.
Step 5. Flush dosed fish into holding tank. Turn on all VC pumps (4 large VC pumps and 2 small VC pumps) and both holding tank pumps for 15 minutes to obtain maximum water flow and velocity in the secondary channel to flush lethargic fish into a holding tank.
Step 6. Stop collection. After 15 minutes of increased flows, stop collection into the predator holding tank. Start collecting into a new holding tank and change the secondary velocity to the appropriate criteria.
Step 7. Remove dosed predators. Using the fish haul bucket, lift the fish from the holding tank and slowly release the sample into the large green trough.
Step 8. Separate Predators. Striped Bass will be counted, measured, and placed into a tank for transport to the JPP Headworks. Count and release all other predators and non-predatory fish into the continuous collection holding tank to be released during the next fish transport. All fish removed from predator removal events are not part of the fish counts and are reported separately.
Step 9. Transport and Release Striped Bass. Transport Striped Bass via truck to the JPP headworks and release via net to the Delta Mendota Canal.
Step 10. Report removed fish. Report fish collected to CDFW as predator removal take (9999) and distribute the data to the Salvage Distribution List within 24 hours of the predator removal event.

H. Fish Transporting (Transport)

When a truck load of fish, as determined by the periodic fish sampling and the Bates Tables, has been collected in the holding tank, the accumulated fish in that holding tank must be transported to a release site at the confluence of the Sacramento and San Joaquin River. Refer to D.5 and D.6 for accumulation of fish in a holding tank and fish health maintenance. Fish transport begins from the moment fish are moved from the holding tank to the transport truck and ends when the transport truck reaches a fish release site.

H.1. Purpose

Fish accumulated in a holding tank during salvage operations must be removed and transported to prevent mortality due to injuries from the continuous swirling of water in the holding tank and from suffocation caused by exceeding the allowable biomass carrying capacity of the holding tank. The amount of fish that can be collected in a holding tank is dependent on the carrying capacity of the fish haul truck; the carrying capacity of the fish haul truck is applied to the carrying capacity of the holding tank using the Bates Tables.

H.2. Schedule

Fish are transported to a release site daily. When the facility is operated at Striped Bass criteria, fish transport schedule will depend on the Bates Tables. During salmon and smelt season (roughly November to June) transport schedule is based on H.2.b. Salmonid and Smelt Transport Rule, as well as the Bates Tables. The Equipment Operator Supervisor is responsible for tracking the Fish Transport Log Data Sheet used to record fish accumulation in holding tanks and scheduling fish transport activity.

H.2.a. Bates Tables

The Fish Transport Log Data Sheet was developed to track fish accumulation in the continuous holding tank collection using the Bates Tables. The Bates Tables were updated to reflect larger hauling truck tanks currently in use and are listed in Appendix J-2.

Fish Transport Log Data Sheet enables the tracking of listed fish species that are transported and the frequency of transport in general. Refer to C.1.e. for the description of the Fish Transport Log Data Sheet. This data sheet in conjunction with the Bates Tables serve 3 purposes: 1) provides an indication on when holding tank is getting close to maximum holding capacity to prevent fish mortality due to overcrowding in the holding tank, informing operators to start a new collection tank, 2) allows the Equipment Operator Supervisor to predict the number of truckloads of fish, haul-out times, and scheduling of Equipment Operators, and 3) keeps facility operations within regulatory criteria.

The Fish Transport Log Data Sheet is completed by following the steps below:

Step 1. Enter the number of fish collected during the fish count (Count) for each category of fish and the location (Holding Tank #) where the salvaged fish are held. Leave cells blank if no fish within a category are collected during a fish count.
Step 2. Expand the count for each category by a multiplier to estimate the number of fish that entered the holding tank (Total). The multiplier is obtained by dividing the salvage minutes by the count minutes and NOT the pumping minutes by the

count minutes.

Step 3. For each category of fish, determine its average size and find the corresponding Bates Tables to estimate the percentage of the truck load that a category represents (% Load). When few fish are being salvaged and the percent of a truck load is very close to zero, record that it is 1% of a load.

Step 4. Total the column for each fish count to give the total number of fish collected (Total, All Species) and total percent of a truck load (% Load, All Species) that one fish count represents.

Step 5. Add the new data to the running total at the bottom of the datasheet so that the accumulation of fish is known.

Step 6. When a truck load of fish is hauled to the release site, insert an asterisk in the bottom row and record the release location. This lets everyone know to zero out the accumulative count. Record oxygen and salinity on the Fish Transport Log Data Sheet upon arrival from the release site. These two water quality parameters are collected at the release site (see I. Fish Release\I.2. Check Water Quality).

Step 7. At midnight each day, start a new datasheet. The number of fish (Accumulative Total) and percentage of a fish haul (Accumulative % Load) that are remaining in the holding tank should be entered onto the next day's datasheet in the "Carryover" section located on the first column at the bottom of the sheet.

H.2.b. Salmonid and Smelt Transport Rule

Transport schedule will be affected when a Chinook Salmon, Steelhead, or Delta Smelt is detected during a fish count. If a Chinook Salmon or Steelhead is detected in a fish count, all fish accumulated in the holding tank must be transported within 12 hours. If a Delta Smelt is detected in a fish count, all fish accumulated in the holding tank must be transported within 8 hours.

H.3. Procedure

H.3.a. Fish Loading

Fish loading refers to the transfer of accumulated salvaged fish from a holding tank into a fish transport truck.

H.3.a.1. Truck Preparation

Step 1. Pre-trip check. Perform a pre-trip check on the truck before loading. Pre-trip check includes checking tires, all vehicle lights, oxygen and compressed air pressure, and diesel fuel level. Do not load the truck if it fails the pre-trip inspection. Equipment Operator must also ensure the water quality meter (YSI model Pro2030) is in working condition and the Transport Truck Water Quality Sheet (see C.1.g.) is in the truck's cabin. If the water quality meter is malfunctioning, the Biological Resources Section staff must be

notified electronically with as much information regarding the malfunction as possible.

Step 2. Mix salt. Add 150 lbs of salt into the salt mixer no earlier than 1 hour before the haul-out time. Turn on high pressure water to the salt mixer. The salt mixer will help the water in the fish transport tank attain a consistent 8 ppt concentration, the recommended salinity level to ease fish stress and help with osmoregulation during fish transport.

Step 3. Add water to truck. Fill transport truck tank to ¾ full with salt-mixed water. Do not fill past ¾ full.

Step 4. Turn on truck. Start the truck before loading the fish into the truck tank.

H.3.a.2. Holding Tank to Bucket Transfer

Load fish into truck using loading bucket and monorail hoist no earlier than 15 minutes prior to the haul-out time. Begin collecting in another holding tank and drain the holding tank to be loaded. Refer to figures 3 and 4 for the use of pneumatic control levers.

Step 1. Attach haul-out bucket. Position hoist above the haul-out bucket. Use the hoist to lift the bucket from the stand, making sure the sling assembly is in proper alignment and that no kinks exist during the lift. If a kink develops, set the bucket back down onto the stand and reposition the sling to remove the kink.

Step 2. Travel to the holding tank to be loaded. Ensure proper clearances exist during traveling**. Warning: Ensure personnel are not in the path of travel. Do not lift bucket over personnel.**

Step 3. Lower the bucket into the holding tank. Do not allow excess slack to develop while submerging the bucket. Do not submerge the hook/block assembly into the water. Lower the bucket as the water recedes until the bucket is fully seated in the holding tank. Do not allow excess slack to develop when the bucket is seated fully.

Step 4. Lift bucket of fish. Use caution when lifting bucket. Use slow speed until sling is taught. Lift bucket, making sure bucket is clear of screen and other objects prior to traveling. Ensure clear path of travel to the fish transport truck.

H.3.a.3. Bucket to Truck Transfer

Step 1. Position haul-out bucket in truck tank hatch. The haul-out bucket must be centered on the tanker's hatch opening. Lower the bucket into the hatch's opening as low as possible, without putting the full weight of the bucket on the truck, to limit the distance

of impact for the fish as they are released into the truck tank (Figure 21, left). This position prevents fish jumping out of the hatch (Figure 21, right).

Step 2. Release fish to truck tank. Pull the release pulley cable of the haul-out bucket. Hold the pulley in place until all of the haul-out bucket's contents are released into the truck tank. Ensure the haul-out bucket is empty by visually checking from the top of the truck. Move the haul-out bucket back into the haul-out bucket storage stand.

Step 3. Top off the truck tank. After loading fish into truck, fill tank to the top with water to prevent surges during transport. Top off the truck tank but do not overfill the tank. Overfilling will allow fish to escape the tank. If fish escape due to overfilling, collect and return them to the truck tank. If fish escape due to reasons other than overfilling, report the incident to the Equipment Operator Supervisor promptly. Document all fish escape in the equipment operator log book located in the O&M computer room. Ensure operation of the oxygen and air system before closing the hatch.

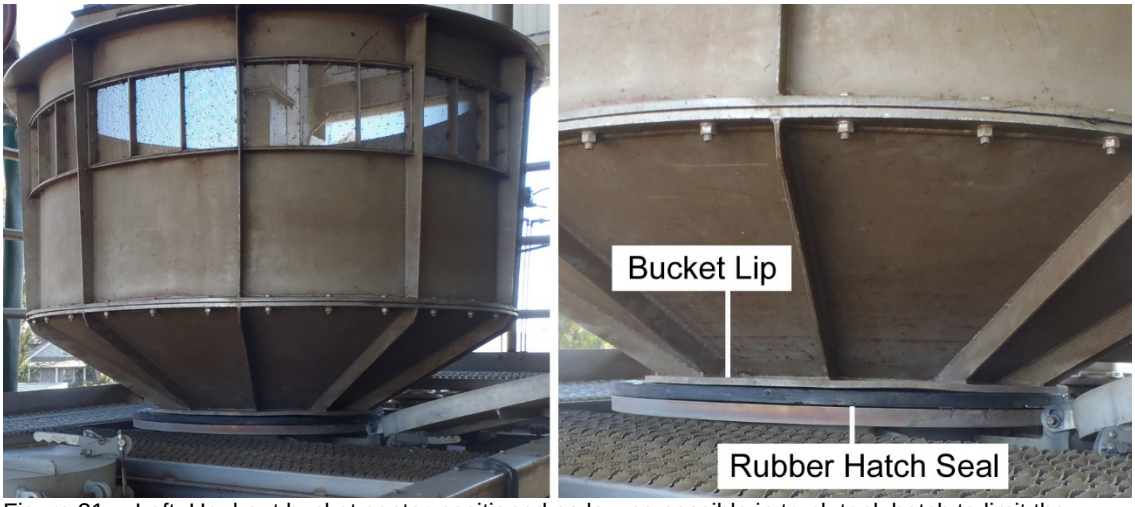


Figure 21.—Left: Haul-out bucket center-positioned as low as possible in truck tank hatch to limit the distance of impact for fish and limit fish loss through the hatch. Right: Decreased space between the haul-out bucket lip and the rubber hatch seal limits fish loss.

H.3.b. Fish Transport

The fish transport duration is about 1 hour, but can be variable due to traffic conditions. The oxygen levels are monitored by checking alarm monitoring lights in the truck's console during transport. The regular route shall be followed and the driver shall not deviate unless required by detours.

If the Equipment Operator arrives to a fish release site and senses threat or harm to personal safety or safety of government property from public, environmental or equipment conditions, the Equipment Operator must attempt to use an alternate

release site. If vandalism is observed at the site, the operator needs to notify the proper authorities within 24 hours, the Equipment Operator on duty and the Equipment Operator Supervisor. All incidents shall be documented in the equipment operator log book located in the O&M computer room and reported to the Equipment Operator Supervisor.

I. Fish Release

Fish are released at fixed release sites owned by the CVP in the San Joaquin River located in Antioch (known as site 4) and in the Sacramento River located in Emmaton (known as site 3). A third CVP-owned site located in Three Mile Slough near Brannan Island (known as site 5) is currently non-operational. Fish can also be released at release sites owned by the SWP including a site in the San Joaquin River at Curtis Landing (known as site 1) and three sites in the Sacramento River located at Horseshoe Bend (known as site 2), Little Baja, and Manzo Ranch. The SWP Horseshoe Bend site is not readily compatible with the CVP trucks, thus trucks must carry a 90 degree elbow to connect to the pipe. Permission to use SWP-owned release sites must first be granted by DWR. The Equipment Operator Supervisor must contact the supervisor of the Skinner Delta Fish Protective Facility to obtain this permission. Refer to Appendix T for locations of the release sites.

I.1. Operational Steps for Fish Release

At the fish release site, follow the steps below:

Step 1. Align truck to the release pipe. Open the gates to the release site and slowly back the transport truck up to the parking block or a wheel stop of the release site.

Step 2. Check Water Quality. Turn off the compressor and/or the oxygen system before collecting water quality. Collect water quality from the sampling port located at the back of the fish transport truck (Figure 22, left). If the sampling port is clogged, obtain water quality from the opened hatch of the tanker (Figure 22, right). Use the YSI Pro2030 meter to obtain the water quality parameters. Record the values in the Transport Truck Water Quality Sheet (see C.1.g.). Store the YSI Pro2030 meter and the Transport Truck Water Quality Sheet in the cab after use.

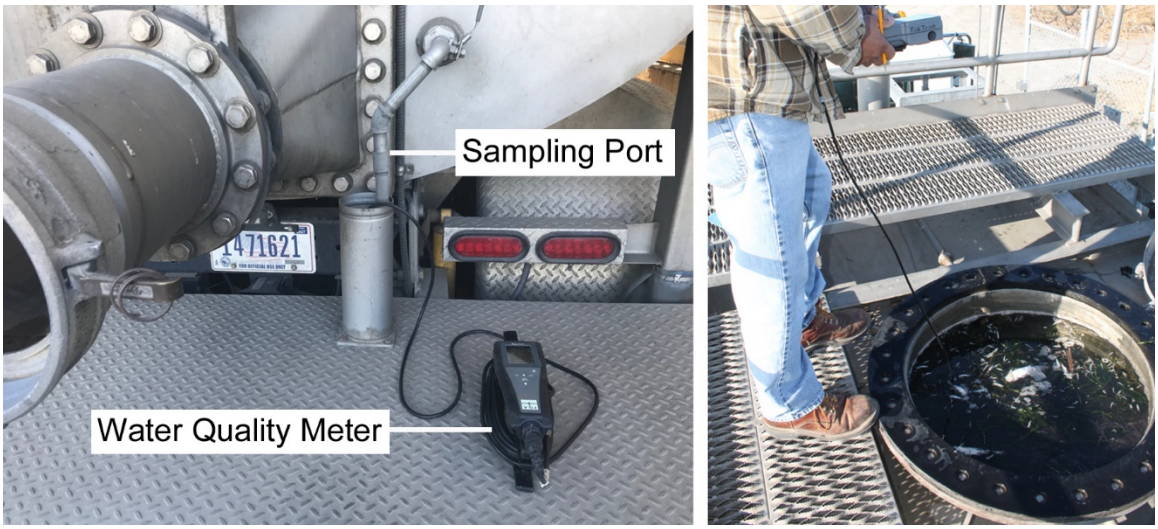


Figure 22.—Left: Collect water quality using sampling port at the rear of the transport truck. Right: Alternatively, water quality can be measured from the opened hatch of the transport truck.

Step 3. Connect the release pipe to the fish truck. Connect the flexible tube of the release site pipe to the drain outlet of the fish transport truck.

Step 4. Turn on water pump. Start water pump at release site. This pump will supply water to either the wash out hose or to the release pipe during flushing. Water should be directed to the release pipe first. Pull the lever near the mouth of the release pipe to allow water to be diverted to the wash out hose.

Step 5. Open the truck's hatch. Use the truck's ladder to access the hatch of the truck. Open the hatch to check for the health of transported fish and eliminate the vacuum that can occur when the truck's drain valve is opened. Water quality can be recorded during this step.

Step 6. Release fish. Raise truck's slide gate valve to release fish into the pipe.

Step 7. Rinse remaining fish from tanker. Fish may remain stranded inside the truck tanker. Use wash out hose to rinse the remaining fish in to the release pipe. The valve to open the wash out hose is accessible from the top of the truck. Close the valve after washing out remaining fish from tanker.

Step 8. Disconnect truck. When all fish and debris have been rinsed out, disconnect the flexible tube from the truck and return the tube back into the release pipe. Lock flexible tube to prevent vandalism and/or theft. Lower truck's slide gate valve to close the drain outlet of the fish transport truck.

Step 9. Flush the release pipe. Push the lever from step 4 to divert water to the release pipe for flushing. Flush the release pipe until clear, approximately 10-15 minutes. At the Emmaton Release Site (site 3), the pump can be left on since the pump is on a timer. At the Antioch Fish Release Site (site 4), the pump must be turned off since it does not have a timer.

Step 10. Secure the release site. After ensuring that the gate is closed and secured, return to fish facility using the established route.

Step 11. Post-release. At the fish facility, change out oxygen cylinders (if necessary), perform fuel report, and verify correct data were entered in the Fish Transport Log Data Sheet (see C.1.e.).

J. References

California Department of Fish and Wildlife and Department of Water Resources. 1986. *Delta Fish Agreement (formerly known as Four Pumps Agreement)*.

Littleworth, A.L., and E.L. Garner. 2019. *California Water.*

National Marine Fisheries Service. 2019. Biological Opinion. *Endangered Species Act section 7 consultation Biological Opinion and Conference Opinion on the long-term operations of the Central Valley Project and State Water Project*.

Reyes, R.C. 2012. *Fish Identification for the South Delta.* Tracy Fish Collection Facility.

State Water Resources Control Board. 1978. Water Right Decision 1485. August 1978.

U.S. Bureau of Reclamation. 1955. *Schedule, General Provisions, Specifications and Drawings. Fish Collecting Facilities Delta-Mendota Canal Intake.* Delta Division, Central Valley Project, California.

U.S. Bureau of Reclamation. 1956. *Designers' Operating Criteria.* Central Valley Project.

U.S. Bureau of Reclamation & California Department of Fish & Wildlife. 1992. *Direct Loss Mitigation Agreement*. July 1992.

U.S. Bureau of Reclamation. 2001. *Standing Operating Procedures Guide for Dams, Reservoirs, and Power Facilities.*

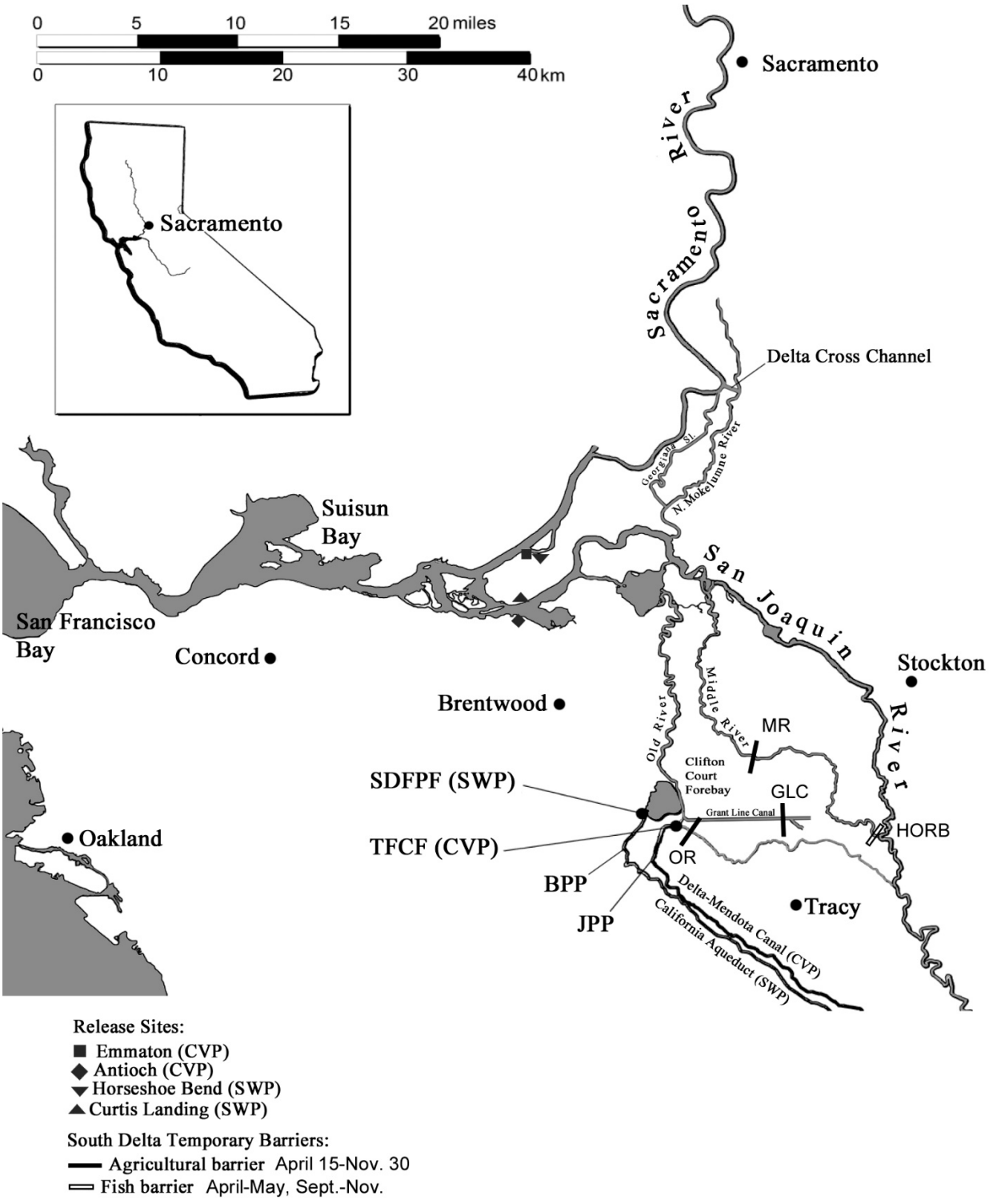
U.S. Bureau of Reclamation. 2013. *Water Rights Law.*

U.S. Bureau of Reclamation. 2019. *Procedures for Rapid Analysis of Salvaged Chinook Salmon*. Cramer Fish Sciences.

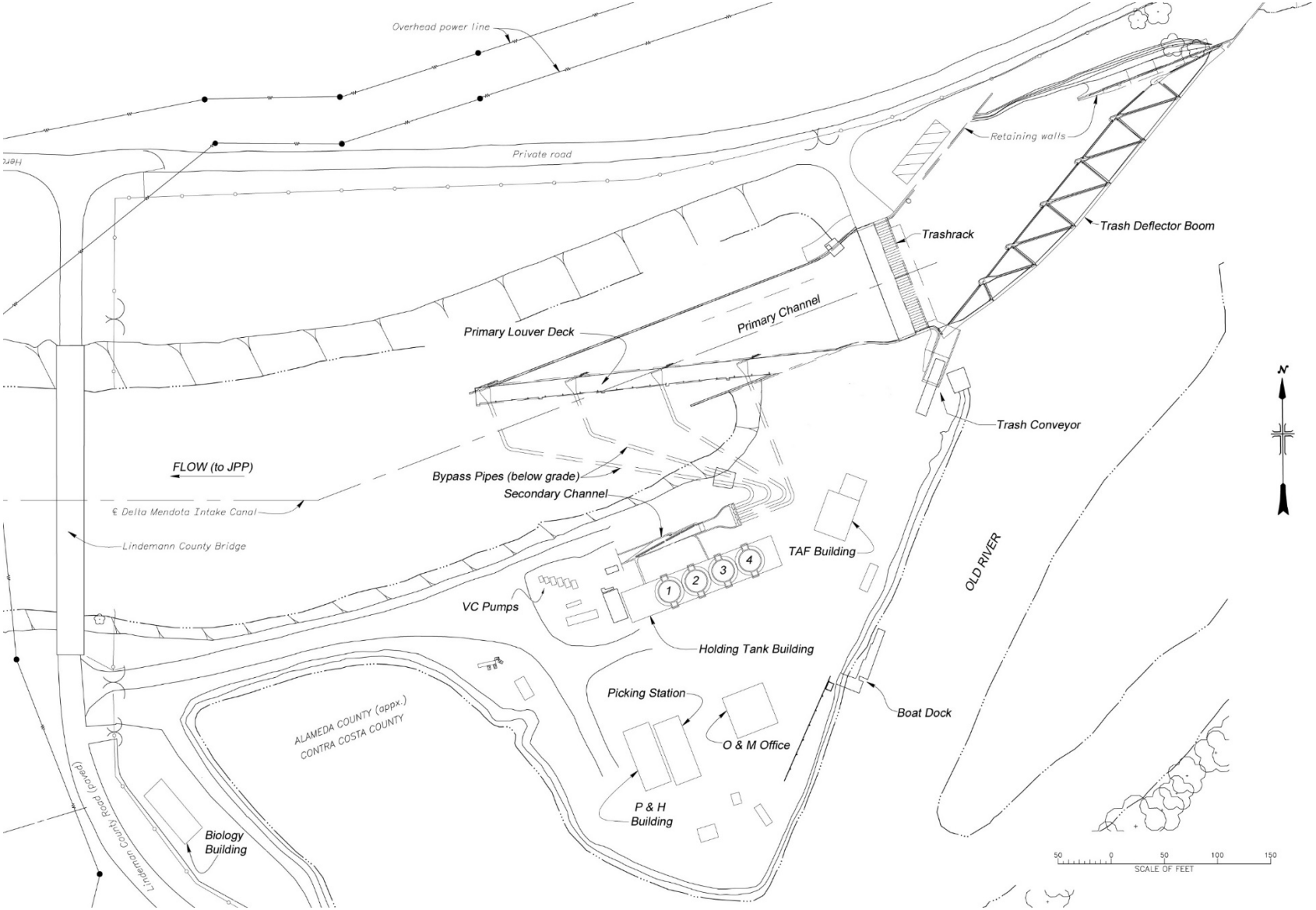
United States Fish and Wildlife Service. 2019. *Biological Opinion. Formal Endangered Species Act consultation on the proposed coordinated operations of the Central Valley Project (CVP) and the State Water Project (SWP). Memorandum from USFWS Regional Director to Reclamation's Operation Manager at the Central Valley Operations Office.*

APPENDIX

APPENDIX A. Location of the Tracy Fish Collection Facility and Related Structures in the Sacramento-San Joaquin Delta.



APPENDIX B. Structural Components of the Tracy Fish Collection Facility.



APPENDIX C. State Water Resources Control Board Decision 1485 (D 1485) Operational Guidelines (D 1485) for the Operation of the Tracy Fish Collection Facility.

The 1978 decision amends the water rights permits for the CVP and SWP facilities, exercised its jurisdiction to set terms for protections of fish and wildlife, and coordinated the terms for both facilities. The decision requires standards to be maintained for the protection of fish and wildlife as a condition of CVP and SWP permits. Standard for operation of the TFCF are listed in Table II Appendix A of the D 1485 including:

1. Maintain appropriate records of the numbers, size, kind of fish salvaged, and of the water export rates and facility operations.

2. The secondary system is to be operated to meet the following standard, to the extent that they are compatible with water export rates:

A. The secondary velocity should be maintained at 3.0 to 3.5 fps, whenever possible, from February through May while salmon are present.

B. To the extent possible, the secondary velocity should not exceed 2.5 fps and preferably not exceed 1.5 fps between June 1 and August 31 to increase the efficiency for Striped Bass, catfish, shad, and other fish. Secondary velocities should be reduced even at the expense of bypass ratios in the primary, but the ratio should not be reduced below 1:1.

C. The screened water discharge (from the Clean Water Loop System) should be kept at the lowest possible level consistent with its purpose of minimizing debris in the holding tanks.

D. The bypass ratio in the secondary should be operated to prevent excessive velocities in the holding tanks, but in no case should the bypass velocity be less than the secondary approach velocity.

APPENDIX D. Direct Loss Mitigation Agreement.

On July 17, 1992, CDFW and Reclamation executed a cooperative agreement to reduce and offset Striped Bass and Chinook Salmon losses associated with the operation of the JPP and the TFCF. Under the agreement, Reclamation's responsibilities included:

1. Operate the TFCF whenever the JPP is in operation, except during required maintenance, and shall notify CDFW prior to any scheduled outages.

2. Operate the TFCF in accordance with operational criteria provided in Table II of D 1485.

3. Maintain and adjust holding tank velocities so that the flow in any one tank shall not exceed 10 cfs.

4. Replacement of existing fish hauling trucks with two new trucks (each having a capacity of 2,000 gallons). Fish hauling shall be scheduled in accordance with the most recent set of fish hauling tables and fish shall not be held in the holding tanks for more than 24 hours without prior approval from CDFW.

5. Existing fish release sites shall be maintained in good condition and other sites shall be obtained for use in case both existing sites are not available.

6. During operation of the TFCF, conduct fish counts every two hours, conduct length counts four times a day, and provide monthly and annual reports of the number, size, and kinds of fish, and of facility operations and exports.

7. Improve salvage efficiencies at the TFCF when primary approach velocities are excessive or when the TFCF is removed from operation for other than normal maintenance purposes.

8. Reclamation will provide funding for CDFW's oversight of the fish salvage and enumeration aspects of TFCF operations.

9. Reclamation, with input from CDFW, shall develop and implement a predator control program at the TFCF to regularly remove and/or control predators in the vicinity of the primary louvers, the primary bypasses, and the secondary bypasses and channels.

APPENDIX E. Biological Opinions and Long-Term Operation (LTO) Action.

Listed below are relevant standards that have become part of the operation of the Tracy Fish Collection Facility. These standards are based on Reclamation's 2019 LTO Action and the most recent Biological Opinions.

The U.S. Fish and Wildlife Service (USFWS) issued their Biological Opinion in 1995, 2004, 2008, and 2019 for the operation of the TFCF to minimize take of Delta Smelt. The relevant requirements are listed below:

1. Between December 1 and March 30, trucks must go to the "new" release site when catch is 0.5 Delta Smelt per count minute.
2. Delta Smelt are to be held in holding tanks for no more than eight hours.
3. Reclamation are to monitor for the presence of spent female Delta Smelt and ≤ 20 mm larval Delta Smelt and Longfin Smelt.

National Marine Fisheries Service (NMFS) issued their Biological Opinion for the Operation of the CVP and the SWP in 1993, 2002, 2004, 2009 and 2019 to minimize the take of winter-run Chinook Salmon, Steelhead, and Green Sturgeon. The most relevant requirements to the TFCF were:

1. The secondary channel velocity be approximately 1 fps between May 15–Oct. 31 for Striped Bass criteria and approximately 3 fps between Nov. 1–May 14 for Chinook Salmon criteria.
2. Fish counts are conducted no less than 30 minutes every two hours year-round. Exceptions may occur with NMFS concurrence under unusual situations.
3. Salt to be added to water in hauling trucks to attain 8 parts per thousand (ppt) salinity.
4. Fish transportation runs for salmonids — at least every 12 hours, more frequently if required by the "Bates Tables."
5. Reclamation to remove predators in the secondary channel at least once per week.
6. Reclamation to install equipment to monitor for the presence of predators in the secondary channel.
7. Reclamation to operate the TFCF to target whole facility salvage efficiency of 75 percent.
8. Reclamation to maintain head differential at the trash rack of less than 1.5 ft at all times.
9. Reclamation to install/maintain flow meters in primary and secondary channels to continuously monitor/record flow rates.
10. Websites shall be created/improved to make salvage count data publicly available within two days. Information on the website shall include:

A. Duration of count minutes.
B. Species of fish salvaged.
C. Number of fish salvaged including raw counts and expanded counts.
D. Volume of water in acre-feet and average daily flow in cfs.
E. Daily average channel velocity and bypass ratio in primary and secondary channel.
F. Average daily water temperature and electrical conductivity data.
G. Periods of non-operation because of cleaning, power outages, or repairs.

11. All personnel conducting fish counts must be trained in juvenile fish identification.
12. DNA tissue samples/coded wire tag samples from Chinook Salmon and Steelhead shall be collected for genetic analysis or tag removal/reading.

Long-Term Operations Actions relevant to the TFCF include:

1. Reclamation to continue screening of fish from Jones Pumping Plant with the TFCF.
2. Reclamation to install a carbon dioxide injection device to allow remote controlled anesthetization of predators in the secondary channel of the TFCF.
3. Reclamation to continue transporting salvaged fish to release sites with injected oxygen and 8 parts per thousand salt solution to reduce stress.
4. TFCF personnel to monitor for the presence of spent female Delta Smelt in anticipation of expanding the salvage operations to include sub-20 mm larval Delta Smelt detection.
5. Larval smelt sampling at the TFCF commences once a trigger is met (detection of a spent female at CVP and SWP being one of three triggers).
6. As a conservation measure, Reclamation proposes to increase the number of release sites to reduce predation.
7. Reclamation would conduct studies and physical improvements aimed to improve fish survival and improve TFCF efficiency, reducing mortality through the facility, fish hauling and release operations through the Tracy Fish Facility Improvement Program. Activities include louver improvement and replacement, predation studies and piscivorous predator control, improvement of hydrologic monitoring and telemetry systems, holding area improvements including fish count automation and tank aeration and screening, improvement of data management as well as aquaculture facility maintenance, operation and improvements.
8. Reclamation to continue to improve the TFCF to reduce loss.
9. Reclamation to continue work with DWR to incorporate flexibility in salvage release sites, using DWR's sites, or sites on a barge.

APPENDIX F. Criteria Guideline for the Operation of the Tracy Fish Collection Facility.

Criteria Name	Effective Dates	Criteria
Salmon	November 1–May 31	Secondary velocity of 3.0-3.5 ft/s. Individual primary bypass ratios equal to or greater than 1.0 (bypass #4 shall have a bypass ratio equal to or greater than 1.0). Secondary bypass ratio equal to or greater than 1.0.
Striped Bass	June 1–October 31	Secondary velocity of 1.0-2.5 ft/s. Individual primary bypass ratios equal to or greater than 1.0 (bypass #4 shall have a bypass ratio equal to or greater than 1.0). Secondary bypass ratio equal to or greater than 1.0.
Larval Sampling	Starts on triggers (Approximately March 15)	(1) Average water temperature at Rio Vista, Antioch, or Mossdale reach 12 ℃ *or* (2) "spent" adult female in Spring Kodiak Trawl survey or CVP and SWP salvage facilities or (3) larval smelt found in CDFW's 20 mm survey.
	Ends on triggers or June 30, whichever occurs earlier.	3-day mean water temperature at Clifton Court Forebay reaches 25 ℃.

APPENDIX G. Salvage Operations and Data Reporting Forms.

Appendix G-1: Operations and Count Summary Data Sheet (*i.e.*, CVO Data Sheet).

Facility: #2 **Operations and Count Summary Data Sheet - FEDERAL FACILITY** Page:_____ of _____

Operations 209-836-6233, Biologists 209-836-6221

This table is for tracking numbers of endangered, threatened, and species of concern for CVO.

Fax to Central Valley Operations (USBR) FAX: **916-979-3080**; phone number: **916-979-2448**

DATE: _____ Daily Acre Feet of Water Pumped at Bill Jones Pumping Plant: _____

Chinook Salmon Run Fork Length Ranges Based On Date

Winter-Run Range (mm): **Spring-Run Range (mm):**

				Numbers of Chinook Salmon (CS)				**Number of Threatened and Species of Concern. Y or N after the numbers indicate whether fish <20 mm FL are present in the sample.**				
Time	Count Minutes	Pumping Minutes	Salvage Minutes	CS Winter Run	Running Tally Winter Run	CS Spring Run	Other CS Runs	Steelhead (STH)	Longfin Smelt (LFS)	Delta Smelt (DS)	Splittail (SPT)	Sturgeon (GST or WST)
0200												
0400												
0600												
0800												
1000												
1200												
1400												
1600												
1800												
2000												
2200												
2400												
Total												

Fork lengths are measured to the nearest mm for all species. *In addition Total Length is measured for sturgeon. The letter "C" or "S" following the length measurement denotes that the salmon adipose fin is clipped or if the smelt is spent respectively. Abbreviate species names below (e.g. CS = Chinook Salmon).

Species	Collect Time	FL (mm)/ *TL(mm)	CS Run Winter=W Spring=S	Head Tag/ Coded Wire Tag #	Species	Collect Time	FL (mm)/ *TL(mm)	CS Run Winter=W Spring=S	Head Tag/ Coded Wire Tag #

Appendix G-2: Operations and Counts Data Sheet, 0200-1200.

Operations and Counts Data Sheet - FEDERAL FACILITY

Facility #2 **Date: __/__/_____** **Daily Acre Feet Pumped:_____**

MM / DD /YYYY

Sample Time		0200	0400	0600	0800	1000	1200
Special Study Code							
Pumping Minutes							
Salvage Minutes							
Count Minutes							
Temperature (F)							
Bypasses Open							
Primary Depth (ft)							
Primary Flow (cfs)							
Secondary Depth Before (ft)							
Secondary Flow (cfs)							
Holding Tank Flow (cfs)							
Species Name	Code	Count	Count	Count	Count	Count	Count
Chinook Salmon	01						
Steelhead Trout	02						
Striped Bass	03						
White Catfish	04						
Channel Catfish	06						
American Shad	07						
Threadfin Shad	08						
Splittail	09						
Golden Shiner	13						
Black Crappie	18						
Bluegill	21						
Largemouth Bass	22						
Redear Sunfish	49						
Prickly Sculpin	29						
Yellowfin Goby	30						
Inland Silverside	31						
Delta Smelt	26						
Total Count	98						
Samplers Initials							

Data Reviewed By:

Appendix G-2: Operations and Counts Data Sheet, 1400-2400.

Operations and Counts Data Sheet - FEDERAL FACILITY

Facility #2 **Date: __/__/_____** **Daily Acre Feet Pumped:_____**

MM / DD /YYYY

Sample Time		1400	1600	1800	2000	2200	2400
Special Study Code							
Pumping Minutes							
Salvage Minutes							
Count Minutes							
Temperature (F)							
Bypasses Open							
Primary Depth (ft)							
Primary Flow (cfs)							
Secondary Depth Before (ft)							
Secondary Flow (cfs)							
Holding Tank Flow (cfs)							
Species Name	Code	Count	Count	Count	Count	Count	Count
Chinook Salmon	01						
Steelhead Trout	02						
Striped Bass	03						
White Catfish	04						
Channel Catfish	06						
American Shad	07						
Threadfin Shad	08						
Splittail	09						
Golden Shiner	13						
Black Crappie	18						
Bluegill	21						
Largemouth Bass	22						
Redear Sunfish	49						
Prickly Sculpin	29						
Yellowfin Goby	30						
Inland Silverside	31						
Delta Smelt	26						
Total Count	98						
Samplers Initials							

Data Reviewed By:

Appendix G-3: Length Data Sheet.

Facility: #2

Length Data Sheet - FEDERAL FACILITY

Date:____/____/_____ Time:_____ Operators Initials:_____ Data Reviewed By:_____

MM DD YYYY

Special Study Type:_____

Species Name	Species Code	Additional Fish Not Measured	Fork Lengths (mm) - Indicate Adipose Clipped Salmon with a "C" after the Length Measurement. 1	2	3	4	5	6	7	8	9	10	11	12

FOR OFFICIAL USE ONLY

Appendix G-4: Operations Data Sheet, 0200-1200.

Operations Data Sheet - FEDERAL FACILITY

Date:____/____/_____ (MM/DD/YYYY) Daily Acre Feet: _____

Sample Time	0200	0400	0600	0800	1000	1200
Trash Rack Differential (ft)						
Primary Louver Differential (ft)						
Primary Bypass Ratio						
Secondary Bypass Ratio						
Secondary Velocity (ft/sec)						
Primary Depth Before (ft)						
Primary Depth Between (ft)						
Primary Depth After (ft)						
Primary Flow (CFS)						
Primary Velocity (ft/sec)						
Water Temperature (Deg F)						
Bypasses that are open	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Secondary Depth Before (ft)						
Secondary Depth After (ft)						
Bypass #1 Flow (CFS)						
Bypass #2 Flow (CFS)						
Bypass #3 Flow (CFS)						
Bypass #4 Flow (CFS)						
Secondary Flow Total (CFS)						
Holding Tank Flow (CFS)						
# of Pumps On @the BJPP (1-6)						
Circle Operating Large VC Pumps	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Circle Operating Small VC Pumps	1 2	1 2	1 2	1 2	1 2	1 2
Circle Operating Holding Tank Pumps	1 2	1 2	1 2	1 2	1 2	1 2
HT Butterfly Valve Angle (0-90)						
VC Butterfly Valve Angle (0-90)						
Screened Water System (On/Off)						
Screened Water System (0-90 deg)						
Screened Water System Flow (CFS)						
Operator's Initials						

Comments:

Appendix G-4: Operations Data Sheet, 1400-2400.

Operations Data Sheet - FEDERAL FACILITY

Date:____/____/_____ (MM/DD/YYYY) Daily Acre Feet: _____

Sample Time	1400	1600	1800	2000	2200	2400
Trash Rack Differential (ft)						
Primary Louver Differential (ft)						
Primary Bypass Ratio						
Secondary Bypass Ratio						
Secondary Velocity (ft/sec)						
Primary Depth Before (ft)						
Primary Depth Between (ft)						
Primary Depth After (ft)						
Primary Flow (CFS)						
Primary Velocity (ft/sec)						
Water Temperature (Deg F)						
Bypasses that are open	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Secondary Depth Before (ft)						
Secondary Depth After (ft)						
Bypass #1 Flow (CFS)						
Bypass #2 Flow (CFS)						
Bypass #3 Flow (CFS)						
Bypass #4 Flow (CFS)						
Secondary Flow Total (CFS)						
Holding Tank Flow (CFS)						
# of Pumps On @the BJPP (1-6)						
Circle Operating Large VC Pumps	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Circle Operating Small VC Pumps	1 2	1 2	1 2	1 2	1 2	1 2
Circle Operating Holding Tank Pumps	1 2	1 2	1 2	1 2	1 2	1 2
HT Butterfly Valve Angle (0-90)						
VC Butterfly Valve Angle (0-90)						
Screened Water System (On/Off)						
Screened Water System (0-90 deg)						
Screened Water System Flow (CFS)						
Operator's Initials						

Comments:

Appendix G-5: Fish Transport Log Data Sheet.

Facility: #2

Date (MM/DD/YYYY):_____ **Fish Transport Log Data Sheet - FEDERAL FACILITY**

Species	Chart Used		0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	2400
Salmon and Steelhead		Count												
		Total												
		% Load												
Catfish		Count												
		Total												
		% Load												
Threadfin Shad		Count												
		Total												
		% Load												
American Shad		Count												
		Total												
		% Load												
Spiny Ray		Count												
		Total												
		% Load												
Smelt		Count												
		Total												
		% Load												
Other		Count												
		Total												
		% Load												
	Total, All Species													
Carryover	% Load, All Species													
	Accumulative Total													
	Accumulative % Load													
	Holding Tank #													
	Release Location (1-6)													
	Release Time													
	Oxygen (ppm)													
	Salinity (ppt)													

Note: Remember to write the remainder of fish held from this day on the carryover section of tomorrows datasheet. Updated:3/11/2014

Appendix G-6: Fish Release Data Sheet.

Facility: #2

Fish Release Data Sheet - FEDERAL FACILITY

Collection Period				Truck Number	Release Site Number	Release Date	Release Time	Number of Fish	% Load	Miles Start	Miles End	Fuel Added (gal)	Oxgyen Bottles Added	Tickets	Driver
Start MM/DD/YYYY	Time	Stop MM/DD/YYYY	Time			MM/DD/YYYY									

Remarks: _____

State Release Sites
1 Curtis Landing
2 Horseshoe Bend
3 Emmaton

Federal Release Sites
4 Antioch/CDFW Delta Base
5 Brannan Island

Fish Haul Truck : 2600 gallons

Updated: 8/14/2020

Appendix G-7: Transport Truck Water Quality.

Transport Truck Water Quality (Tracy Fish Collection Facility)

Date mm-dd-yy	Time (0200-2400)	Site 1,2,3, 4, or 5	DO ppm	DO %L	Spc Cond µS/cm	Salinity ppt	Temp (°C) °C	Initials

1: Curtis Landing **2**:Horseshoe Bend **3**: Emmaton **4**: Antioch **5**: Brannan Island

Appendix G-8: Debris Data Collected During Fish Count.

Facility #2 Debris Data Collected During Fish Count - FEDERAL FACILITY
Date:

		Debris From Holding Tank					Debris From Hydrolox Screen					
			Eyeball percent based on volume					Eyeball percent based on volume				
Time	Hyacinth Condition in Delta (green or brown)*	Wet Weight of Debris (kg), xx.x kg	% Egeria	% Woody or Reed	% Hyacinth	% Shells or Sand	Wet Weight of Debris (kg), xx.x kg	% Egeria	% Woody or Reed	% Hyacinth	% Shells or Sand	Hydrolox Hopper Fullness When Emptied (inches)
200												
400												
600												
800												
1000												
1200												
1400												
1600												
1800												
2000												
2200												
2400												

* Hyacinth is green before the frost season. After first big winter frost the plant will turn brown.

Comments: _____

_____

_____

Appendix G-9: Debris Data Collected from Truck (Trash Rack).

Year: _____

Debris data collected from Truck (Trash Rack)

Date	# of Load	Weed	Wood	Hyacinth	Peat moss	Trash	Other

Appendix G-10: Debris Data Collected from Truck (Boom/Conveyer Belt).

Year: _____

Debris data collected from Truck (Boom/Conveyer Belt)

Date	# of Load	Weed	Wood	Hyacinth	Peat moss	Trash	Other

Appendix G-11: CVP Salmon DNA–Tissue Collection Form.

STATE OF CALIFORNIA – NATURAL RESOURCES AGENCY
DEPARTMENT OF FISH AND WILDLIFE
CALIFORNIA SALMONID TISSUE ARCHIVE
980 RIVERSIDE PARKWAY, SUITE 110
WEST SACRAMENTO, CA 95605
Telephone (916) 375-6092

Gavin Newsom, Governor

Central Valley Project (CVP)
SALMON DNA - TISSUE COLLECTION FORM - 2019
2018-2019 DNA Sample Goal **- sample all un-clipped Chinook Salmon**

Initials	Collection Date	Time	FL (mm)	Sample ID	Ad Clip? Y	Ad Clip? N	Sampler Comments and initials	CVTA pick-up Comments and initials
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ /2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				
	/ / 2019	:		C19 CVP				

Missed taking an un-clipped Chinook Salmon DNA sample? Please record here - use sheet back if needed

	/ / 2019	:		not sampled		X	reason:
	/ / 2019	:		not sampled		X	reason:
	/ / 2019	:		not sampled		X	reason:

DATE TRANSPORTED _____

Next empty vial # _____

Archive -- Data Edit: _____

FOR OFFICIAL USE ONLY

Appendix G-12: CVP Steelhead DNA–Tissue Collection Form.

STATE OF CALIFORNIA - NATURAL RESOURCES AGENCY

Gavin Newsom, Governor

DEPARTMENT OF FISH AND WILDLIFE
CALIFORNIA SALMONID TISSUE ARCHIVE
980 RIVERSIDE PARKWAY, SUITE 110
WEST SACRAMENTO, CA 95605
Telephone (916) 375-6092

Central Valley Project (CVP)
STEELHEAD DNA - TISSUE COLLECTION FORM - 2019
2018-2019 DNA Sample Goal **- sample all steelhead**

Initials	Collection Date	Time	FL (mm)	Sample ID	Ad Clip? Y	Ad Clip? N	Sampler Comments and initials	CVTA pick-up Comments and initials
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ /2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				
	/ / 2019	:		M19 CVP				

Missed taking a steelhead DNA sample? Please record here - use sheet back if needed

	/ / 2019	:		not sampled			reason:
	/ / 2019	:		not sampled			reason:
	/ / 2019	:		not sampled			reason:

DATE TRANSPORTED _____

Next empty vial # _____

Archive -- Data Edit: _____

Appendix G-13: Larval Fish Data Sheet.

Larval Fish Data Sheet - FEDERAL FACILITY

Facilitiy: #2

Date (mm/dd/yy): _____ **Time:** _____ **Sample Duration (min):**_____

Collection Data

Operator	Picking QC Checker	Picking Start Time	Picking End Time	Total Time (min)	Number of Fish Found	Percent of Fish Found	Comments

Smelt ID data

	Number of Delta Smelt	Min Length (mm)	Max Length (mm)		Number of Longfin Smelt	Number of Wakasagi Smelt	Comments
Prolarvae							
Postlarvae							
Prejuvenile							
Juvenile							

Non-Smelt ID Data

Species	Numbers	Lengths (mm), TL or FL. Indicate which length is being used.	Comments

Fish ID completed by: _____ ID QC completed by: _____

Prolarvae: ≤6 mm TL, has yolk and oil globule
Postlarvae: 6-10 mm TL, yolk and oil absorbed, fin fold developed
Prejuvenile: 11-24 mm TL, not all fin rays developed, air bladder developed during this time
Juvenile: ≥25 mm TL, fin rays developed in all fins, looking more like miniature adults

Updated: 5 02/2018

Appendix G-14. Coded Wire Tag Data Sheet.

BOR-TFCF July 6, 2011

Coded Wire Tag Data Sheet

Species Code _CHNT/RBTT_ Page #________

Head #	Fork Length (mm):	Head #	Fork Length (mm):
Date:	Fish # of	Date:	Fish # of
Time:	Reader 1:	Time:	Reader 1:
Station Code: OR022W	Reader 2:	Station Code: OR022W	Reader 2:

Line									Totals	Line									Totals
M										M									
D_1 D_1										D_1 D_1									
D_2 A										D_2 A									
A D_2										A D_2									
D_3										D_3									
D_4										D_4									
Tag Code:										Tag Code:									

Head #	Fork Length (mm):	Head #	Fork Length (mm):
Date:	Fish # of	Date:	Fish # of
Time:	Reader 1:	Time:	Reader 1:
Station Code: OR022W	Reader 2:	Station Code: OR022W	Reader 2:

Line									Totals	Line									Totals
M										M									
D_1 D_1										D_1 D_1									
D_2 A										D_2 A									
A D_2										A D_2									
D_3										D_3									
D_4										D_4									
Tag Code:										Tag Code:									

Head #	Fork Length (mm):	Head #	Fork Length (mm):
Date:	Fish # of	Date:	Fish # of
Time:	Reader 1:	Time:	Reader 1:
Station Code: OR022W	Reader 2:	Station Code: OR022W	Reader 2:

Line									Totals	Line									Totals
M										M									
D_1 D_1										D_1 D_1									
D_2 A										D_2 A									
A D_2										A D_2									
D_3										D_3									
D_4										D_4									
Tag Code:										Tag Code:									

Entered By:____ Date Entered: ____________________

PROCEDURES FOR RAPID ANALYSIS OF SALVAGED CHINOOK SALMON

TABLE OF CONTENTS

CRAMER FISH SCIENCES
An Employee Owned Consulting Company

GENIDAQS℠
aquatic species sampling, simplified

1. OVERVIEW

This process of rapid genetic analysis of salvaged older juvenile Chinook Salmon is for November 2018 through June 2019. These "older juveniles" are at or above the minimum winter-run size based on the length-at-date model at the fish collection facilities and below the maximum size considered by the length-at-date model, on a given date. This period is inclusive of the duration of actions IV.2.1, IV.2.3, and IV.3 in the NMFS Biological Opinion on the Coordinated Long term Operations of the Central Valley Project and State Water Project.

All references to a specific day includes weekend days and holidays, unless noted otherwise.

2. PROCEDURES

A. Salvage Data on Fax Sheet at Fish Facilities

1. Operations and Count Summary Data Sheet Previous 24 hours

a. Salvage data includes operational and count summary for 12:00am to 11:59 of the previous day.
b. Salvage data sheets checked (for the previous day) and emailed by 9:00 am each day by fish collection facility staff.

B. Preliminary Reporting of Loss through Laboratory Arrival (Day 1)

1 Preliminary LOSS

a. This happens by 9:00 am
b. If fish are counted that meet size-at-date criterion for older juveniles and no loss density trigger or annual take limit is reached then DNA-based run assignment of fish will be determined later (accompanying the next set of rapidly analyzed samples). Under non-rapid analysis conditions the BOR contract manager may still request that the DNA-based run assignment be run anytime. This may be important if triggers are not being exceeded, a large number of samples are collected, and there is a desire for accurate genetic identification.
c. Preferably by 8:00a and by no later than 9:00a, CDFW's Central Valley Tissue Archive staff (CVTA) and Cramer Fish Sciences (CFS) staff will be notified by USBR staff as to whether or not rapid processing is needed for that day.
d. If preliminary loss calculations indicate a trigger is reached then:
    a. the preliminary loss calculation will be confirmed or corrected via a Quality Assurance/ Quality Control (QA/QC) process
        i. If trigger is on weekday then CDFW does QA/QC.
        ii. If trigger is on weekend then USBR does QA/QC.
e. CVP/SWP operational contacts are notified of trigger exceedance.
    a. Operational contacts notify NMFS and CDFW contacts.

b. Operators automatically begin implementing RPA action response.

2. Receipt and Sample Transport

a. This is an approximately four hour process.
b. If rapid analysis needs to occur (see step B.1.c), CVTA staff will proceed to the facilities (CVP/SWP as needed) to retrieve samples (CVTA staff should retrieve all samples present).
c. CVTA will notify CVP/SWP facility staff that persons are on route to retrieve samples.
d. Chain of Custody (COC) will start at facilities
e. The CVTA staff checks all sample vials with the data sheets, making sure they match, the data are complete, and that the data makes sense (date/time in chronological order, data legible, etc.).
f. If the CVTA staff have notes about the sample (i.e., yellow EtOH, multiple samples in vial) they will write it down on the data sheet and initial it.
g. The CVTA staff will leave copies of the data sheets at the facility.
h. Tissues will be brought to the CVTA and CVTA will retain a portion of sample; and the other portion of sample will be prepared for transfer to CFS laboratory. CVTA staff will notify CFS staff when samples will be available for transfer.
i. At the direction of the USBR contract manager, CVTA will prepare additional pre-extracted staged samples for analysis to minimize empty wells on the genotyping plate.

C. Sample Receiving and Analysis

1. Sample "log in"/receipt.

a. This is a less than one hour process
b. Notify CFS staff when CVTA staff return from the pumps (including the number of samples picked up) so CFS staff can start heading over to pick up the split samples. If something unexpected occurs and sample delivery is delayed or will not occur, CFS, DWR and Reclamation will be notified as soon as possible.
c. CFS and CVTA will account for samples received. CFS will verify the COC ID's, sample tube ID's and contents.
d. CFS will generate a QA/QC report and communicate to the USBR contract manager.
e. A copy of COC and QA/QC will be emailed to USBR contract manager.

2. DNA extraction

a. This is a 3 hour process for up to 96 samples
b. Sample ID's will be entered into CFS database
c. DNA extraction will be done by automated laboratory robot.

3. Genotyping

a. This is a 5 hour process for up to 96 samples.
b. This step includes pre-amplification of samples, chip loading, and sample cycling. Poor sample quality may prevent the production of genotype information. If a

verified sample pre-screening process is developed that is predictive of genotype failure, this procedural step will be included. Pre-screening will not guarantee results, which may be delayed or unavailable due to poor material quality.

c. This step will use positive and no template controls on the standard west coast salmonid 96-SNP panel.
d. This step will generate raw genotype and verification of positive control and no template controls.

4. Genetic Identification (Day 2)

a. Laboratory will review raw genotypes and undertake data processing (R code for processing).
b. Data will be used in Mixed Stock Analysis using ONCOR and NOAA reference database.
c. CFS will generate report including at least the following information:
    i. Sample number,
    ii. size-at-date identity of each sample,
    iii. genetic identity of each sample, and
    iv. assignment scores (i.e. maximum likelihood) to each baseline population
d. CFS will distribute to USBR Contracting Officer Representative and DWR Task Manager.

D. Genetically-identified LOSS

1. Results of genetically-identified LOSS estimate will be calculated by DWR (weekdays) or USBR (weekends) and sent to NMFS and DFW contacts.
2. Results will also be communicated to appropriate operations teams (DOSS, WOMT, other management team (TBD)).

E. Operational Decision

1. Operational decision will be reviewed:
    (a) If genetic-based run determination(s) matches size-at-date-based run determination(s), then no change in action is needed.
    (b) If genetic-based run determination(s) does *not* match size-at-date-based run determination(s), genetically-identified loss used for implementing appropriate action (i.e. rescind action, shift to lower exceedance action).

F. Documentation

1. Data records will be updated, as appropriate (CDFW salvage database).
2. Genetic assignment results and associated operational decisions will be reviewed at DOSS during the following week and captured in the DOSS notes.

APPENDIX H. Formulas.

1. Primary Flow

   = Primary Depth x 84 x Primary Velocity

2. Secondary Flow

   = sum of bypass flows

   = bypass 1 flow + bypass 2 flow + bypass flow 3 + bypass flow 4

3. Primary Bypass Ratio

   = Secondary Flow x Primary Width ÷ Primary Flow ÷ Primary Bypass Width

   = Secondary Flow x 84 ÷ Primary Flow ÷ 2

   Note: 84' is Primary Channel width, 2' is total width of all 4 opened primary bypass

   Example: primary bypass ratio = 140 x 84 ÷ 2940 ÷ 2 *or*

   = 11,760 ÷ 5880 = 2

4. Secondary Bypass Ratio

   = Holding Tank Flow x Secondary Width ÷ Secondary Flow ÷ Secondary Bypass Width

   = Holding Tank Flow x 8 ÷ Secondary Flow ÷ 0.5

   Note: 8' is Secondary Channel Width, 0.5' is width of secondary bypass

   Example: secondary bypass ratio = 11.2 x 8 ÷ 140 ÷ 0.5 *or*

   = 89.6 ÷ 70 = 1.28

5. Primary Velocity

   = Primary Flow ÷ Primary Width ÷ Primary Depth

   = Primary Flow ÷ 84 ÷ Primary Depth

   Example: 2940 ÷ 84 ÷ 18.3 = 1.9 ft/sec

6. Secondary Velocity

   = Secondary Flow ÷ Secondary Depth ÷ Secondary Width

   = Secondary Flow ÷ Secondary Depth ÷ 8

   Example: 140 ÷ 4.6 ÷ 8 = 3.8 ft/sec

APPENDIX I. Maintenance of the YSI Pro2030 Meter.

Steps for maintaining the fish truck YSI meter. The meter has to be maintained at the beginning of every month.

1. Remove the rubber protective cap and unthread the metal guard
2. Unthread the yellow cap membrane

a. If the membrane is clear, reuse

b. If the membrane is opaque, replace

3. Rinse the sensor anode with distilled water; if there is white deposit, gently rub off using fine sand paper disc and then rinse with distilled water
4. Fill the yellow cap membrane with NaCl electrolyte solution
5. Holding the yellow cap membrane with the electrolyte solution, insert and thread the sensor anode moderately tight. Some liquid will overflow.
6. Install the metal guard and the rubber protective cap
7. If the 2 holes of the probe is dirty or blocked with algae, insert the black bottle brush into the holes and rinse.

APPENDIX J. Supporting Operations Tables.

Appendix J-1: Secondary Velocity–VC Pump Combination Table. To obtain the correct VC pump combination, find the primary depth along the top row, scroll down to the secondary velocity criteria to be targeted, and scroll left to find the VC pump combination to turn on.

	Primary Depth (ft)													
VC Pump Combinations	15.5	16	16.5	17	17.5	18	18.5	19	19.5	20	20.5	21	21.5	22
1S	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3
1L	1.0	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.6	0.5	0.5
2S	1.0	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.6	0.5	0.5
1L+1S	1.7	1.6	1.5	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.9	0.8	0.7	0.6
2L	2.0	1.9	1.9	1.8	1.7	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9
1L+2S	2.0	2.0	2.0	1.9	1.8	1.8	1.6	1.5	1.4	1.3	1.2	1.1	1.0	1.0
2L+1S	2.5	2.4	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.5	1.3	1.2	1.0
3L	2.9	2.8	2.8	2.7	2.6	2.5	2.4	2.2	2.1	1.9	1.8	1.6	1.4	1.2
2L+2S	3.0	2.9	2.9	2.8	2.7	2.6	2.5	2.3	2.2	2.0	1.9	1.7	1.5	1.3
3L+1S	3.3	3.2	3.1	3.0	2.8	2.7	2.6	2.5	2.3	2.2	2.1	1.9	1.8	1.7
4L	3.3	3.3	3.2	3.1	3.0	2.9	2.8	2.7	2.5	2.4	2.2	2.1	1.9	1.7
3L+2S	3.3	3.3	3.2	3.2	3.1	3.0	2.9	2.8	2.6	2.5	2.3	2.2	2.0	1.8
4L+1S	3.4	3.4	3.3	3.2	3.2	3.1	3.0	2.9	2.7	2.6	2.5	2.3	2.2	2.0
4L+2S	3.9	3.7	3.6	3.5	3.4	3.3	3.2	3.0	2.9	2.8	2.7	2.6	2.5	2.4

Color Codes:

Pink = 1 and 2 Pumps On at JPP During Striped Bass Criteria
Blue = 3 Pumps On at JPP During Striped Bass Criteria
Red = 4 Pumps On at JPP During Striped Bass Criteria
Green = 5 Pumps On at JPP During Striped Bass Criteria

Yellow = Salmon Criteria (3-3.5 ft/sec) in secondary channel (Nov 1 - May 31).
Orange = Striped Bass Criteria (1.0-2.5 ft/sec in secondary channel from June 1-Oct 31)
*This table does not show the bypass ratio (BR) in the primary or secondary channel but BR should be >1 if this table is followed.

Appendix J-2: Bates Tables, Table for Size Class A (or fish under 1.5 inches in length).

2400 Gallon Truck

Percentage of truck load of fish in a holding tank at a given temperature

Size class A: Fish under 3.8 cm (1.5 inches) in length.

Water Temp.	Number of Fish				Thousands of fish																											
	100	250	500	750	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
80	0	0	0	1	1	2	3	4	5	6	7	8	9	10	16	21	26	31	36	42	47	52	57	62	68	73	78	83	88	94	99	104
79	0	0	0	1	1	2	3	4	5	5	6	7	8	9	14	18	23	28	32	37	41	46	51	55	60	64	69	74	78	83	87	92
78	0	0	0	1	1	2	3	3	4	5	6	7	8	8	13	17	21	25	29	33	38	42	46	50	54	58	63	67	71	75	79	83
77	0	0	0	0	1	1	2	3	4	4	5	6	7	7	11	15	19	23	26	30	34	38	41	45	49	53	56	60	64	68	72	75
76	0	0	0	1	1	1	2	3	3	4	5	6	6	7	10	14	17	21	24	28	31	35	38	42	45	49	52	56	59	62	66	69
75	0	0	0	0	1	1	2	3	3	4	4	5	6	6	10	13	16	19	22	26	29	32	35	38	42	45	48	51	55	58	61	64
74	0	0	0	0	1	1	2	2	3	4	4	5	5	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
73	0	0	0	1	1	1	2	2	3	4	4	5	5	6	9	11	14	17	20	23	26	28	31	34	37	40	42	45	48	51	54	57
72	0	0	0	1	1	1	2	2	3	3	4	4	5	5	8	11	13	16	19	21	24	27	29	32	35	38	40	43	46	48	51	54
71	0	0	1	1	1	1	2	2	3	3	4	4	5	5	8	10	13	15	18	21	23	26	28	31	33	36	38	41	43	46	48	51
70	0	0	0	0	1	1	2	2	3	3	3	4	4	5	7	10	12	15	17	20	22	24	27	29	32	34	37	39	42	44	46	49
69	0	0	0	0	0	1	1	2	2	3	3	4	4	5	7	9	12	14	16	19	21	23	26	28	30	33	35	37	40	42	44	47
68	0	0	0	0	1	1	1	2	2	3	3	4	4	5	7	9	11	13	16	18	20	22	25	27	29	31	33	36	38	40	42	45
67	0	0	0	0	1	1	1	2	2	3	3	4	4	4	6	9	11	13	15	17	19	21	24	26	28	30	32	34	36	38	41	43
66	0	0	0	0	1	1	1	2	2	3	3	3	4	4	6	8	10	12	14	17	19	21	23	25	27	29	31	33	35	37	39	41
65	0	0	0	0	0	1	1	2	2	2	3	3	4	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
64	0	0	0	0	0	1	1	2	2	2	3	3	4	4	6	8	10	12	14	15	17	19	21	23	25	27	29	31	33	35	37	38
63	0	0	0	0	0	1	1	2	2	2	3	3	3	4	6	8	9	11	13	15	17	19	21	23	24	26	28	30	32	34	36	38
62	0	0	0	0	0	1	1	1	2	2	2	3	3	3	5	7	9	11	13	14	16	18	20	22	24	26	27	29	31	33	35	37
61	0	0	0	0	0	0	1	1	2	2	2	3	3	3	5	7	9	11	12	14	16	18	19	21	23	25	27	28	30	32	34	36
60	0	0	0	0	0	0	1	1	2	2	2	3	3	3	5	7	8	10	12	14	15	17	19	21	22	24	26	28	29	31	33	35

Appendix J-2: Bates Tables, Table for Size Class B (or fish between 1.5–2.5 inches in length).

2400 Gallon Tank: Percentage of truck load of fish in a holding tank at a given temperature
Size class B: Fish between 3.8-6.4 cm (1.5-2.5 inches) in length.

Water	Number of Fish				Thousands of fish																									
Temp. F	100	250	500	750	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	25	30	35	40	45	50
80	0	0	1	1	1	2	4	5	6	7	8	10	11	12	13	14	16	17	18	19	20	21	23	24	30	36	42	48	54	59
79	0	1	1	1	1	2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	21	22	27	32	38	43	48	54
78	1	1	1	1	2	3	4	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	25	30	34	39	44	49
77	0	1	1	1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	15	16	17	18	19	24	29	33	38	43	48
76	1	1	1	1	1	2	3	4	5	6	7	7	8	9	10	11	12	13	14	14	15	16	17	18	22	27	31	35	40	44
75	0	0	1	1	1	2	3	3	4	5	6	7	8	8	9	10	11	12	13	14	14	15	16	17	21	25	30	34	38	42
74	0	0	0	1	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12	13	14	14	15	16	20	24	28	32	36	40
73	0	0	0	0	1	1	2	3	4	4	5	6	7	7	8	9	10	10	11	12	13	13	14	15	19	23	26	30	34	38
72	0	0	0	0	1	1	2	3	3	4	5	6	6	7	8	8	9	10	11	11	12	13	13	14	18	21	25	28	32	36
71	0	0	0	1	1	1	2	3	3	4	5	5	6	7	7	8	9	9	10	11	11	12	13	13	17	20	23	27	30	33
70	0	0	0	0	1	1	2	2	3	4	4	5	6	6	7	8	8	9	9	10	11	11	12	13	16	19	22	25	29	32
69	0	0	0	0	0	1	2	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	11	12	15	18	21	24	27	30
68	0	0	0	0	1	1	2	2	3	4	4	5	5	6	6	7	8	8	9	9	10	11	11	12	15	18	20	23	26	29
67	0	0	0	0	0	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	10	10	11	11	14	17	20	23	25	28
66	0	0	0	0	0	1	2	2	3	3	4	4	5	5	6	6	7	8	8	9	9	10	10	11	14	16	19	22	24	27
65	0	0	0	0	0	1	1	2	2	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	13	16	18	21	23	26
64	0	0	0	0	0	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10	10	13	15	18	20	23	26
63	0	0	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	13	15	18	20	23	25
62	0	0	0	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	12	14	17	19	22	24
61	0	0	0	0	0	1	1	2	2	3	3	4	4	5	5	6	6	6	7	7	8	8	9	9	12	14	16	19	21	24
60	0	0	0	0	0	1	1	2	2	3	3	4	4	5	5	5	6	6	7	7	8	8	9	9	11	14	16	18	21	23

Appendix J-2: Bates Tables, Table for Size Class C (or fish between 2.5–4.5 inches in length).

2400 Gallon Tank: Percentage of truck load of fish in a holding tank at a given temperature
Size class C: Fish between 6.4-11.4 cm (2.5-4.5 inches) in length.

Water	Number of Fish				Thousands of fish																				
Temp.	100	250	500	750	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	25	30
80	1	3	5	8	10	21	31	42	52	63	73	83	94	104	115	125	135	146	156	167	177	188	198	208	260	313
79	1	2	5	7	9	19	28	38	47	56	66	75	85	94	104	113	122	132	141	151	160	169	179	188	235	282
78	1	2	4	6	9	17	26	35	43	52	61	69	78	87	95	104	113	121	130	139	147	156	165	173	217	260
77	1	2	4	6	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	143	151	159	199	239
76	1	2	4	5	7	15	22	30	37	44	52	59	67	74	82	89	97	104	111	119	126	134	141	149	186	223
75	1	2	3	5	7	14	21	28	35	42	49	55	62	69	76	83	90	97	104	111	118	125	132	139	174	208
74	1	2	3	5	6	13	19	26	32	39	45	52	58	65	71	78	84	91	97	104	110	117	123	130	162	195
73	0	1	3	4	6	12	18	24	30	37	43	49	55	61	67	73	79	85	92	98	104	110	116	122	153	183
72	0	1	3	4	6	11	17	23	29	35	40	46	52	58	64	69	75	81	87	93	98	104	110	116	145	174
71	0	1	3	4	5	11	16	22	27	33	38	44	49	54	60	65	71	76	82	87	93	98	104	109	136	163
70	0	1	3	4	5	10	16	21	26	31	36	42	47	52	57	62	68	73	78	83	88	94	99	104	130	156
69	0	1	2	3	5	10	15	20	25	30	35	40	44	49	54	59	64	69	74	79	84	89	94	99	124	149
68	0	1	2	3	5	9	14	19	23	28	33	38	42	47	52	56	61	66	71	75	80	85	89	94	118	141
67	0	1	2	3	4	9	13	18	22	27	31	36	41	45	50	54	59	63	68	72	77	81	86	90	113	135
66	0	1	2	3	4	9	13	17	22	26	30	34	39	43	47	52	56	60	65	69	73	78	82	86	108	130
65	0	1	2	3	4	8	13	17	21	25	29	33	38	42	46	50	54	58	63	67	71	75	79	83	104	125
64	0	1	2	3	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	100	120
63	0	1	2	3	4	8	11	15	19	23	27	31	35	38	42	46	50	54	58	61	65	69	73	77	96	115
62	0	1	2	3	3	7	11	15	18	22	26	30	33	37	41	45	48	52	56	59	63	67	71	74	93	112
61	0	1	2	3	3	7	11	14	18	21	25	28	32	36	39	43	46	50	54	57	61	64	68	71	89	107
60	0	1	2	2	3	7	10	14	17	21	24	28	31	35	38	42	45	48	52	55	59	62	66	69	87	104

Appendix J-2: Bates Tables, Table for Size Class D (or fish >4.5 inches in length).

2400 Gallon Truck
Percentage of truck load of fish in a holding tank at a given temperature
Size class D: Fish over 11 cm (4.5 inches) in length.

Water Temp.	Number of Fish				Thousands of fish																		
	100	250	500	750	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
80	2	5	10	16	21	31	42	52	63	73	83	94	104	115	125	135	146	156	167	177	188	198	208
79	2	4	9	13	18	27	36	45	54	63	72	81	90	99	108	117	126	135	144	153	162	171	180
78	2	4	8	13	17	25	33	42	50	58	67	75	83	92	100	108	117	125	133	142	150	158	167
77	1	4	7	11	15	22	30	37	44	52	59	67	74	82	89	97	104	111	119	126	134	141	149
76	1	3	7	10	13	20	27	33	40	47	53	60	67	73	80	87	93	100	107	113	120	127	133
75	1	3	6	9	13	19	25	31	38	44	50	56	63	69	75	81	88	94	100	106	113	119	125
74	1	3	6	9	12	18	24	30	36	41	47	53	59	65	71	77	83	89	95	101	107	113	119
73	1	3	5	8	11	16	22	27	33	38	44	49	54	60	65	71	76	82	87	93	98	104	109
72	1	3	5	8	10	16	21	26	31	36	42	47	52	57	62	68	73	78	83	88	94	99	104
71	1	2	5	7	10	14	19	24	29	34	39	43	48	53	58	63	68	73	77	82	87	92	97
70	1	2	5	7	9	14	18	23	28	32	37	41	46	51	55	60	64	69	74	78	83	87	92
69	1	2	4	6	9	13	17	21	26	30	34	39	43	47	52	56	60	65	69	73	78	82	86
68	1	2	4	6	8	13	17	21	25	29	33	38	42	46	50	54	58	63	67	71	75	79	83
67	1	2	4	6	8	12	16	19	23	27	31	35	39	43	47	51	55	59	63	67	70	74	78
66	1	2	4	6	7	11	15	19	23	26	30	34	38	41	45	49	53	57	60	64	68	72	75
65	1	2	4	5	7	11	14	18	21	25	29	32	36	39	43	46	50	54	57	61	64	68	71
64	1	2	3	5	7	10	14	17	21	24	28	31	35	38	42	45	48	52	55	59	62	66	69
63	0	1	3	5	6	10	13	16	20	23	26	30	33	36	40	43	46	49	53	56	59	63	66
62	0	1	3	5	6	9	13	16	19	22	25	29	32	35	38	41	45	48	51	54	57	61	64
61	1	1	3	4	6	9	12	15	18	21	24	27	30	34	37	40	43	46	49	52	55	58	61
60	0	1	3	4	6	9	12	15	18	21	24	27	30	33	36	38	41	44	47	50	53	56	59

Appendix J-3: Chinook Salmon Length at Date (LAD) Tables

SALMON LENGTH-DATE CRITERIA WINTER RUN=BLUE / SPRING RUN = GREEN

Date	Winter		Winter		LateFall		Fall		Fall		Spring		Spring	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
07/01	0	35	255	300	36	59	60	132			133	254		
07/02	0	35	257	300	36	60	61	133			134	256		
07/03	0	35	259	300	36	60	61	134			135	258		
07/04	0	35	261	300	36	60	61	135			136	260		
07/05	0	36	263	300	37	61	62	136			137	262		
07/06	0	36	266	300	37	61	62	137			138	265		
07/07	0	36	268	300	37	62	63	138			139	267		
07/08	0	37	270	300	38	62	63	139			140	269		
07/09	0	37	272	300	38	63	64	140			141	271		
07/10	0	37	274	300	38	63	64	141			142	273		
07/11	0	37	277	300	38	63	64	142			143	276		
07/12	0	38	279	300	39	64	65	142			143	278		
07/13	0	38	281	300	39	64	65	143			144	280		
07/14	0	38	284	300	39	65	66	144			145	283		
07/15	0	39	286	300	40	65	66	145			146	285		
07/16	0	39	288	300	40	66	67	146			147	287		
07/17	0	39	291	300	40	66	67	147			148	290		
07/18	0	40	293	300	41	66	67	148			149	292		
07/19	0	40	295	300	41	67	68	149			150	294		
07/20	0	40	298	300	41	67	68	150			151	297		
07/21	0	41			42	68	69	151			152	300		
07/22	0	41			42	68	69	152			153	300		
07/23	0	41			42	69	70	153			154	300		
07/24	0	42			43	69	70	154			155	300		
07/25	0	42			43	70	71	155			156	300		
07/26	0	42			43	70	71	156			157	300		
07/27	0	43			44	71	72	157			158	300		
07/28	0	43			44	71	72	158			159	300		
07/29	0	43			44	71	72	159			160	300		
07/30	0	44			45	72	73	160			161	300		
07/31	0	44			45	72	73	162			163	300		
08/01	0	44			45	73	74	163			164	300		
08/02	0	45			46	73	74	164			165	300		
08/03	0	45			46	74	75	165			166	300		

SALMON LENGTH-DATE CRITERIA WINTER RUN=BLUE / SPRING RUN=GREEN

Date	Winter		Winter		LateFall		Fall		Fall		Spring		Spring	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
08/04	0	46			47	74	75	166			167	300		
08/05	0	46			47	75	76	167			168	300		
08/06	0	46			47	75	76	168			169	300		
08/07	0	47			48	76	77	169			170	300		
08/08	0	47			48	76	77	170			171	300		
08/09	0	47			48	77	78	171			172	300		
08/10	0	48			49	77	78	173			174	300		
08/11	0	48			49	78	79	174			175	300		
08/12	0	49			50	78	79	175			176	300		
08/13	0	49			50	79	80	176			177	300		
08/14	0	49			50	79	80	177			178	300		
08/15	0	50			51	80	81	178			179	300		
08/16	0	50			51	81	82	180			181	300		
08/17	0	51			52	81	82	181			182	300		
08/18	0	51			52	82	83	182			183	300		
08/19	0	51			52	82	83	183			184	300		
08/20	0	52			53	83	84	184			185	300		
08/21	0	52			53	83	84	186			187	300		
08/22	0	53			54	84	85	187			188	300		
08/23	0	53			54	84	85	188			189	300		
08/24	0	54			55	85	86	189			190	300		
08/25	0	54			55	86	87	191			192	300		
08/26	0	54			55	86	87	192			193	300		
08/27	0	55			56	87	88	193			194	300		
08/28	0	55			56	87	88	194			195	300		
08/29	0	56			57	88	89	196			197	300		
08/30	0	56			57	88	89	197			198	300		
08/31	0	57			58	89	90	198			199	300		
09/01	0	57			58	90	91	200			201	300		
09/02	0	58			59	90	91	201			202	300		
09/03	0	58			59	91	92	202			203	300		
09/04	0	59			60	91	92	204			205	300		
09/05	0	59			60	92	93	205			206	300		
09/06	0	60			61	93	94	206			207	300		

SALMON LENGTH-DATE CRITERIA WINTER RUN=BLUE / SPRING RUN=GREEN

Date	Winter		Winter		LateFall		Fall		Fall		Spring		Spring	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
09/07	0	60			61	93	94	208			209	300		
09/08	0	61			62	94	95	209			210	300		
09/09	0	61			62	94	95	210			211	300		
09/10	0	62			63	95	96	212			213	300		
09/11	0	62			63	96	97	213			214	300		
09/12	0	63			64	96	97	215			216	300		
09/13	0	63			64	97	98	216			217	300		
09/14	0	64			65	98	99	217			218	300		
09/15	0	64			65	98	99	219			220	300		
09/16	0	65			66	99	100	220			221	300		
09/17	0	65			66	100	101	222			223	300		
09/18	0	66			67	100	101	223			224	300		
09/19	0	66			67	101	102	225			226	300		
09/20	0	67			68	102	103	226			227	300		
09/21	0	67			68	102	103	228			229	300		
09/22	0	68			69	103	104	229			230	300		
09/23	0	68			69	104	105	231			232	300		
09/24	0	69			70	104	105	232			233	300		
09/25	0	70			71	105	106	234			235	300		
09/26	0	70			71	106	107	235			236	300		
09/27	0	71			72	106	107	237			238	300		
09/28	0	71			72	107	108	238			239	300		
09/29	0	72			73	108	109	240			241	300		
09/30	0	72			73	109	110	242			243	300		
10/01	0	73			74	109	110	243			244	300		
10/02	0	74			75	110	111	245			246	300		
10/03	0	74			75	111	112	246			247	300		
10/04	0	75			76	111	112	248			249	300		
10/05	0	75			76	112	113	250			251	300		
10/06	0	76			77	113	114	251			252	300		
10/07	0	77			78	114	115	253			254	300		
10/08	0	77			78	114	115	255			256	300		
10/09	0	78			79	115	116	256			257	300		
10/10	0	79			80	116	117	258			259	300		
10/11	0	79			80	117	118	260			261	300		

SALMON LENGTH-DATE CRITERIA WINTER RUN=BLUE / SPRING RUN=GREEN

Date	Winter		Winter		LateFall		Fall		Fall		Spring		Spring	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
10/12	30	80			81	118	119	261			262	300	0	29
10/13	30	81			82	118	119	263			264	300	0	29
10/14	31	81			82	119	120	265			266	300	0	30
10/15	31	82			83	120	121	267			268	300	0	30
10/16	31	83			84	121	122	268			269	300	0	30
10/17	31	83			84	122	123	269			270	300	0	30
10/18	32	84			85	122	123	270					0	31
10/19	32	85			86	123	124	270					0	31
10/20	32	85			86	124	125	270					0	31
10/21	32	86			87	125	126	270					0	31
10/22	33	87			88	126	127	270					0	32
10/23	33	87			88	126	127	270					0	32
10/24	33	88			89	127	128	270					0	32
10/25	33	89			90	128	129	270					0	32
10/26	34	90			91	129	130	270					0	33
10/27	34	90			91	130	131	270					0	33
10/28	34	91			92	131	132	270					0	33
10/29	35	92			93	132	133	270					0	34
10/30	35	93			94	132	133	270					0	34
10/31	35	93			94	133	134	270					0	34
11/01	35	94			95	134	135	270					0	34
11/02	36	95			96	135	136	270					0	35
11/03	36	96			97	136	137	270					0	35
11/04	36	96			97	137	138	270					0	35
11/05	37	97			98	138	139	270					0	36
11/06	37	98			99	139	140	270					0	36
11/07	37	99			100	140	141	270					0	36
11/08	38	100			101	141	142	270					0	37
11/09	38	100			101	142	143	270					0	37
11/10	38	101			102	142	143	270					0	37
11/11	38	102			103	143	144	270					0	37
11/12	39	103			104	144	145	270					0	38
11/13	39	104			105	145	146	270					0	38

SALMON LENGTH-DATE CRITERIA WINTER RUN=BLUE / SPRING RUN=GREEN

Date	Winter		Winter		LateFall		Fall		Fall		Spring		Spring	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
11/14	39	105			106	146	147	270					0	38
11/15	40	105			106	147	148	270					0	39
11/16	40	106			107	148	149	270					0	39
11/17	40	107			108	149	150	270					0	39
11/18	41	108			109	150	151	270					0	40
11/19	41	109			110	151	152	270					0	40
11/20	41	110			111	152	153	270					0	40
11/21	42	111			112	153	154	270					0	41
11/22	42	112			113	154	155	270					0	41
11/23	42	113			114	155	156	270					0	41
11/24	43	113			114	156	157	270					0	42
11/25	43	114			115	157	158	270					0	42
11/26	43	115			116	158	159	270					0	42
11/27	44	116			117	159	160	270					0	43
11/28	44	117			118	160	161	270					0	43
11/29	45	118			119	162	163	270					0	44
11/30	45	119			120	163	164	270					0	44
12/01	45	120			121	164	165	270	0	32			33	44
12/02	46	121			122	165	166	270	0	32			33	45
12/03	46	122			123	166	167	270	0	33			34	45
12/04	46	123			124	167	168	270	0	33			34	45
12/05	47	124			125	168	169	270	0	33			34	46
12/06	47	125			126	169	170	270	0	33			34	46
12/07	48	126			127	170	171	270	0	33			34	47
12/08	48	127			128	171	172	270	0	34			35	47
12/09	48	128			129	173	174	270	0	34			35	47
12/10	49	129			130	174	175	270	0	34			35	48
12/11	49	130			131	175	176	270	0	34			35	48
12/12	50	131			132	176	177	270	0	35			36	49
12/13	50	132			133	177	178	270	0	35			36	49
12/14	50	134			135	178	179	270	0	35			36	49
12/15	51	135			136	180	181	270	0	35			36	50
12/16	51	136			137	181	182	270	0	36			37	50
12/17	52	137			138	182	183	270	0	36			37	51

SALMON LENGTH-DATE CRITERIA WINTER RUN=BLUE / SPRING RUN=GREEN

Date	Winter		Winter		LateFall		Fall		Fall		Spring		Spring	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
12/18	52	138			139	183	184	270	0	36			37	51
12/19	52	139			140	184	185	270	0	36			37	51
12/20	53	140			141	186	187	270	0	37			38	52
12/21	53	141			142	187	188	270	0	37			38	52
12/22	54	143			144	188	189	270	0	37			38	53
12/23	54	144			145	189	190	270	0	37			38	53
12/24	55	145			146	191	192	270	0	38			39	54
12/25	55	146			147	192	193	270	0	38			39	54
12/26	56	147			148	193	194	270	0	38			39	55
12/27	56	148			149	194	195	270	0	38			39	55
12/28	56	150			151	196	197	270	0	39			40	55
12/29	57	151			152	197	198	270	0	39			40	56
12/30	57	152			153	198	199	270	0	39			40	56
12/31	58	153			154	200	201	270	0	39			40	57
01/01	58	155			156	201	202	270	0	40			41	57
01/02	59	156			157	202	203	270	0	40			41	58
01/03	59	157			158	204	205	270	0	40			41	58
01/04	60	158			159	205	206	270	0	40			41	59
01/05	60	160			161	206	207	270	0	41			42	59
01/06	61	161			162	208	209	270	0	41			42	60
01/07	61	162			163	209	210	270	0	41			42	60
01/08	62	164			165	210	211	270	0	42			43	61
01/09	62	165			166	212	213	270	0	42			43	61
01/10	63	166			167	213	214	270	0	42			43	62
01/11	63	168			169	215	216	270	0	42			43	62
01/12	64	169			170	216	217	270	0	43			44	63
01/13	64	171			172	217	218	270	0	43			44	63
01/14	65	172			173	219	220	270	0	43			44	64
01/15	65	173			174	220	221	270	0	44			45	64
01/16	66	175			176	222	223	270	0	44			45	65
01/17	66	176			177	223	224	270	0	44			45	65
01/18	67	178			179	225	226	270	0	44			45	66
01/19	68	179			180	226	227	270	0	45			46	67
01/20	68	181			182	228	229	270	0	45			46	67

SALMON LENGTH-DATE CRITERIA WINTER RUN=BLUE / SPRING RUN=GREEN

Date	Winter		Winter		LateFall		Fall		Fall		Spring		Spring	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
01/21	69	182			183	229	230	270	0	45			46	68
01/22	69	184			185	231	232	270	0	46			47	68
01/23	70	185			186	232	233	270	0	46			47	69
01/24	70	187			188	234	235	270	0	46			47	69
01/25	71	188			189	235	236	270	0	47			48	70
01/26	71	190			191	237	238	270	0	47			48	70
01/27	72	191			192	238	239	270	0	47			48	71
01/28	73	193			194	240	241	270	0	48			49	72
01/29	73	194			195	242	243	270	0	48			49	72
01/30	74	196			197	243	244	270	0	48			49	73
01/31	74	198			199	245	246	270	0	49			50	73
02/01	75	199			200	246	247	270	0	49			50	74
02/02	76	201			202	248	249	270	0	49			50	75
02/03	76	202			203	250	251	270	0	49			50	75
02/04	77	204			205	251	252	270	0	50			51	76
02/05	78	206			207	253	254	270	0	50			51	77
02/06	78	207			208	255	256	270	0	50			51	77
02/07	79	209			210	256	257	270	0	51			52	78
02/08	79	211			212	258	259	270	0	51			52	78
02/09	80	213			214	260	261	270	0	52			53	79
02/10	81	214			215	261	262	270	0	52			53	80
02/11	81	216			217	263	264	270	0	52			53	80
02/12	82	218			219	265	266	270	0	53			54	81
02/13	83	220			221	267	268	270	0	53			54	82
02/14	83	221			222	268	269	270	0	53			54	82
02/15	84	223			224	269	270	270	0	54			55	83
02/16	85	225			226	270			0	54			55	84
02/17	86	227			228	270			0	54			55	85
02/18	86	229			230	270			0	55			56	85
02/19	87	231			232	270			0	55			56	86
02/20	88	233			234	270			0	55			56	87
02/21	88	234			235	270			0	56			57	87
02/22	89	236			237	270			0	56			57	88
02/23	90	238			239	270			0	57			58	89

SALMON LENGTH-DATE CRITERIA WINTER RUN=BLUE / SPRING RUN=GREEN

Date	Winter		Winter		LateFall		Fall		Fall		Spring		Spring	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
02/24	91	240			241	270			0	57			58	90
02/25	91	242			243	270			0	57			58	90
02/26	92	244			245	270			0	58			59	91
02/27	93	246			247	270			0	58			59	92
02/28	94	248			249	270			0	58			59	93
02/29	94	248			249	270			0	58			59	93
03/01	94	250			251	270			0	59			60	93
03/02	95	252			253	270			0	59			60	94
03/03	96	254			255	270			0	60			61	95
03/04	97	256			257	270			0	60			61	96
03/05	97	259			260	270			0	60			61	96
03/06	98	261			262	270			0	61			62	97
03/07	99	263			264	270			0	61			62	98
03/08	100	265			266	270			0	62			63	99
03/09	101	267			268	270			0	62			63	100
03/10	101	269			270	270			0	63			64	100
03/11	102	272							0	63			64	101
03/12	103	274							0	63			64	102
03/13	104	276							0	64			65	103
03/14	105	278							0	64			65	104
03/15	106	281							0	65			66	105
03/16	107	283							0	65			66	106
03/17	107	285							0	66			67	106
03/18	108	287							0	66			67	107
03/19	109	290							0	66			67	108
03/20	110	292							0	67			68	109
03/21	111	295							0	67			68	110
03/22	112	297							0	68			69	111
03/23	113	299							0	68			69	112
03/24	114	300							0	69			70	113
03/25	115	300							0	69			70	114
03/26	116	300							0	70			71	115
03/27	117	300							0	70			71	116
03/28	118	300							0	71			72	117

SALMON LENGTH-DATE CRITERIA WINTER RUN=BLUE / SPRING RUN=GREEN

Date	Winter		Winter		LateFall		Fall		Fall		Spring		Spring	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
03/29	118	300							0	71			72	117
03/30	119	300							0	71			72	118
03/31	120	300							0	72			73	119
04/01	121	300			0	32			33	72			73	120
04/02	122	300			0	32			33	73			74	121
04/03	123	300			0	33			34	73			74	122
04/04	124	300			0	33			34	74			75	123
04/05	125	300			0	33			34	74			75	124
04/06	126	300			0	33			34	75			76	125
04/07	128	300			0	33			34	75			76	127
04/08	129	300			0	34			35	76			77	128
04/09	130	300			0	34			35	76			77	129
04/10	131	300			0	34			35	77			78	130
04/11	132	300			0	34			35	77			78	131
04/12	133	300			0	35			36	78			79	132
04/13	134	300			0	35			36	78			79	133
04/14	135	300			0	35			36	79			80	134
04/15	136	300			0	35			36	79			80	135
04/16	137	300			0	36			37	80			81	136
04/17	138	300			0	36			37	81			82	137
04/18	139	300			0	36			37	81			82	138
04/19	141	300			0	36			37	82			83	140
04/20	142	300			0	37			38	82			83	141
04/21	143	300			0	37			38	83			84	142
04/22	144	300			0	37			38	83			84	143
04/23	145	300			0	37			38	84			85	144
04/24	146	300			0	38			39	84			85	145
04/25	148	300			0	38			39	85			86	147
04/26	149	300			0	38			39	86			87	148
04/27	150	300			0	38			39	86			87	149
04/28	151	300			0	39			40	87			88	150
04/29	153	300			0	39			40	87			88	152
04/30	154	300			0	39			40	88			89	153
05/01	155	300			0	39			40	88			89	154

SALMON LENGTH-DATE CRITERIA WINTER RUN=BLUE / SPRING RUN=GREEN

Date	Winter		Winter		LateFall		Fall		Fall		Spring		Spring	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
05/02	156	300			0	40			41	89			90	155
05/03	158	300			0	40			41	90			91	157
05/04	159	300			0	40			41	90			91	158
05/05	160	300			0	40			41	91			92	159
05/06	162	300			0	41			42	91			92	161
05/07	163	300			0	41			42	92			93	162
05/08	164	300			0	41			42	93			94	163
05/09	166	300			0	42			43	93			94	165
05/10	167	300			0	42			43	94			95	166
05/11	168	300			0	42			43	94			95	167
05/12	170	300			0	42			43	95			96	169
05/13	171	300			0	43			44	96			97	170
05/14	172	300			0	43			44	96			97	171
05/15	174	300			0	43			44	97			98	173
05/16	175	300			0	44			45	98			99	174
05/17	177	300			0	44			45	98			99	176
05/18	178	300			0	44			45	99			100	177
05/19	180	300			0	44			45	100			101	179
05/20	181	300			0	45			46	100			101	180
05/21	183	300			0	45			46	101			102	182
05/22	184	300			0	45			46	102			103	183
05/23	186	300			0	46			47	102			103	185
05/24	187	300			0	46			47	103			104	186
05/25	189	300			0	46			47	104			105	188
05/26	190	300			0	47			48	104			105	189
05/27	192	300			0	47			48	105			106	191
05/28	193	300			0	47			48	106			107	192
05/29	195	300			0	48			49	106			107	194
05/30	196	300			0	48			49	107			108	195
05/31	198	300			0	48			49	108			109	197
06/01	200	300			0	49			50	109			110	199
06/02	201	300			0	49			50	109			110	200
06/03	203	300			0	49			50	110			111	202
06/04	205	300			0	49			50	111			112	204

SALMON LENGTH-DATE CRITERIA WINTER RUN=BLUE / SPRING RUN=GREEN

Date	Winter		Winter		LateFall		Fall		Fall		Spring		Spring	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
06/05	206	300			0	50			51	111			112	205
06/06	208	300			0	50			51	112			113	207
06/07	210	300			0	50			51	113			114	209
06/08	211	300			0	51			52	114			115	210
06/09	213	300			0	51			52	114			115	212
06/10	215	300			0	52			53	115			116	214
06/11	217	300			0	52			53	116			117	216
06/12	218	300			0	52			53	117			118	217
06/13	220	300			0	53			54	118			119	219
06/14	222	300			0	53			54	118			119	221
06/15	224	300			0	53			54	119			120	223
06/16	226	300			0	54			55	120			121	225
06/17	228	300			0	54			55	121			122	227
06/18	229	300			0	54			55	122			123	228
06/19	231	300			0	55			56	122			123	230
06/20	233	300			0	55			56	123			124	232
06/21	235	300			0	55			56	124			125	234
06/22	237	300			0	56			57	125			126	236
06/23	239	300			0	56			57	126			127	238
06/24	241	300			0	57			58	126			127	240
06/25	243	300			0	57			58	127			128	242
06/26	245	300			0	57			58	128			129	244
06/27	247	300			0	58			59	129			130	246
06/28	249	300			0	58			59	130			131	248
06/29	251	300			0	58			59	131			132	250
06/30	253	300			0	59			60	132			133	252

Appendix J-4: Clean Water Loop Table.

The Clean Water Loop Table below provides target flows (cfs) at 60% of the secondary channel speed near the Clean Water Loop exit. Only green cells is likely achievable.

Secondary	**Secondary Velocity** (ft/sec) at 8 ft wide cross section												
Depth (ft)	**1**	**1.2**	**1.4**	**1.6**	**1.8**	**2**	**2.2**	**2.4**	**2.6**	**2.8**	**3**	**3.2**	**3.4**
8	4.7	5.9	7.1	8.4	9.6	10.8	12.0	13.2	14.4	15.6	16.8	18.0	19.2
7.8	4.6	5.8	6.9	8.1	9.3	10.5	11.6	12.8	14.0	15.2	16.3	17.5	18.7
7.6	4.4	5.6	6.7	7.9	9.0	10.2	11.3	12.4	13.6	14.7	15.9	17.0	18.2
7.4	4.3	5.4	6.5	7.6	8.7	9.9	11.0	12.1	13.2	14.3	15.4	16.5	17.7
7.2	4.1	5.2	6.3	7.4	8.5	9.6	10.6	11.7	12.8	13.9	15.0	16.1	17.1
7	4.0	5.0	6.1	7.1	8.2	9.3	10.3	11.4	12.4	13.5	14.5	15.6	16.6
6.8	3.8	4.9	5.9	6.9	7.9	9.0	10.0	11.0	12.0	13.0	14.1	15.1	16.1
6.6	3.7	4.7	5.7	6.7	7.7	8.7	9.6	10.6	11.6	12.6	13.6	14.6	15.6
6.4	3.5	4.5	5.5	6.4	7.4	8.4	9.3	10.3	11.2	12.2	13.2	14.1	15.1
6.2	3.4	4.3	5.3	6.2	7.1	8.1	9.0	9.9	10.9	11.8	12.7	13.7	14.6
6	3.2	4.1	5.0	5.9	6.8	7.7	8.7	9.6	10.5	11.4	12.3	13.2	14.1
5.8	3.1	4.0	4.8	5.7	6.6	7.4	8.3	9.2	10.1	10.9	11.8	12.7	13.6
5.6	2.9	3.8	4.6	5.5	6.3	7.1	8.0	8.8	9.7	10.5	11.4	12.2	13.0
5.4	2.8	3.6	4.4	5.2	6.0	6.8	7.7	8.5	9.3	10.1	10.9	11.7	12.5
5.2	2.6	3.4	4.2	5.0	5.8	6.5	7.3	8.1	8.9	9.7	10.5	11.2	12.0
5	2.5	3.2	4.0	4.7	5.5	6.2	7.0	7.7	8.5	9.3	10.0	10.8	11.5
4.8	2.3	3.1	3.8	4.5	5.2	5.9	6.7	7.4	8.1	8.8	9.6	10.3	11.0
4.6	2.2	2.9	3.6	4.3	5.0	5.6	6.3	7.0	7.7	8.4	9.1	9.8	10.5
4.4	2.0	2.7	3.4	4.0	4.7	5.3	6.0	6.7	7.3	8.0	8.7	9.3	10.0
4.2	1.9	2.5	3.1	3.8	4.4	5.0	5.7	6.3	6.9	7.6	8.2	8.8	9.5
4	1.7	2.3	2.9	3.5	4.1	4.7	5.3	5.9	6.5	7.1	7.7	8.4	9.0
3.8	1.6	2.2	2.7	3.3	3.9	4.4	5.0	5.6	6.2	6.7	7.3	7.9	8.4

Appendix J-5. Flow Tables: Estimated flows for Striped Bass Criteria with 1 JPP unit.

# of JPP Pumps	**1**									
Bypass Ratio	**1.2**									
Primary Depth (ft)	13	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9
Primary Flow (cfs)	546	550	554	559	563	567	571	575	580	584
Secondary Flow (cfs)	16	16	16	16	16	16	16	16	17	17
Holding Tank Flow (cfs)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3
Primary Depth (ft)	14	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9
Primary Flow (cfs)	588	592	596	601	605	609	613	617	622	626
Secondary Flow (cfs)	17	17	17	17	17	17	18	18	18	18
Holding Tank Flow (cfs)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Primary Depth (ft)	15	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9
Primary Flow (cfs)	630	634	638	643	647	651	655	659	664	668
Secondary Flow (cfs)	18	18	18	18	18	19	19	19	19	19
Holding Tank Flow (cfs)	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Primary Depth (ft)	16	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9
Primary Flow (cfs)	672	676	680	685	689	693	697	701	706	710
Secondary Flow (cfs)	19	19	19	20	20	20	20	20	20	20
Holding Tank Flow (cfs)	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Primary Depth (ft)	17	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9
Primary Flow (cfs)	714	718	722	727	731	735	739	743	748	752
Secondary Flow (cfs)	20	21	21	21	21	21	21	21	21	21
Holding Tank Flow (cfs)	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Primary Depth (ft)	18	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9
Primary Flow (cfs)	756	760	764	769	773	777	781	785	790	794
Secondary Flow (cfs)	22	22	22	22	22	22	22	22	23	23
Holding Tank Flow (cfs)	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7
Primary Depth (ft)	19	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9
Primary Flow (cfs)	798	802	806	811	815	819	823	827	832	836
Secondary Flow (cfs)	23	23	23	23	23	23	24	24	24	24
Holding Tank Flow (cfs)	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8
Primary Depth (ft)	20	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9
Primary Flow (cfs)	840	844	848	853	857	861	865	869	874	878
Secondary Flow (cfs)	24	24	24	24	24	25	25	25	25	25
Holding Tank Flow (cfs)	1.8	1.8	1.8	1.8	1.8	1.8	1.9	1.9	1.9	1.9
Primary Depth (ft)	21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9
Primary Flow (cfs)	882	886	890	895	899	903	907	911	916	920
Secondary Flow (cfs)	25	25	25	26	26	26	26	26	26	26
Holding Tank Flow (cfs)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	2.0	2.0	2.0
Primary Depth (ft)	22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9
Primary Flow (cfs)	924	928	932	937	941	945	949	953	958	962
Secondary Flow (cfs)	26	27	27	27	27	27	27	27	27	27
Holding Tank Flow (cfs)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1

Appendix J-5. Flow Tables: Estimated flows for Striped Bass Criteria with 2 JPP unit.

# of JPP Pumps	**2**									
Bypass Ratio	**1.2**									
Primary Depth (ft)	13	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9
Primary Flow (cfs)	1092	1100	1109	1117	1126	1134	1142	1151	1159	1168
Secondary Flow (cfs)	31	31	32	32	32	32	33	33	33	33
Holding Tank Flow (cfs)	2.3	2.4	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5
Primary Depth (ft)	14	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9
Primary Flow (cfs)	1176	1184	1193	1201	1210	1218	1226	1235	1243	1252
Secondary Flow (cfs)	34	34	34	34	35	35	35	35	36	36
Holding Tank Flow (cfs)	2.5	2.5	2.6	2.6	2.6	2.6	2.6	2.6	2.7	2.7
Primary Depth (ft)	15	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9
Primary Flow (cfs)	1260	1268	1277	1285	1294	1302	1310	1319	1327	1336
Secondary Flow (cfs)	36	36	36	37	37	37	37	38	38	38
Holding Tank Flow (cfs)	2.7	2.7	2.7	2.8	0.8	2.8	2.8	2.8	2.8	2.8
Primary Depth (ft)	16	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9
Primary Flow (cfs)	1344	1352	1361	1369	1378	1386	1394	1403	1411	1420
Secondary Flow (cfs)	38	39	39	39	39	39	40	40	40	41
Holding Tank Flow (cfs)	2.9	2.9	2.9	2.9	2.9	3.0	3.0	3.0	3.0	3.0
Primary Depth (ft)	17	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9
Primary Flow (cfs)	1428	1436	1445	1453	1462	1470	1478	1487	1495	1504
Secondary Flow (cfs)	41	41	41	42	42	42	42	42	43	43
Holding Tank Flow (cfs)	3.1	3.1	3.1	3.1	3.1	3.2	3.2	3.2	3.2	3.2
Primary Depth (ft)	18	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9
Primary Flow (cfs)	1512	1520	1529	1537	1546	1554	1562	1571	1579	1588
Secondary Flow (cfs)	43	43	44	44	44	44	45	45	45	45
Holding Tank Flow (cfs)	3.2	3.3	3.3	3.3	3.3	3.3	3.3	3.4	3.4	3.4
Primary Depth (ft)	19	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9
Primary Flow (cfs)	1596	1604	1613	1621	1630	1638	1646	1655	1663	1672
Secondary Flow (cfs)	46	46	46	46	47	47	47	47	48	48
Holding Tank Flow (cfs)	3.4	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.6	3.6
Primary Depth (ft)	20	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9
Primary Flow (cfs)	1680	1688	1697	1705	1714	1722	1730	1739	1747	1756
Secondary Flow (cfs)	48	48	48	49	49	49	49	50	50	50
Holding Tank Flow (cfs)	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.8
Primary Depth (ft)	21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9
Primary Flow (cfs)	1764	1772	1781	1789	1798	1806	1814	1823	1831	1840
Secondary Flow (cfs)	50	51	51	51	51	52	52	52	52	53
Holding Tank Flow (cfs)	3.8	3.8	3.8	3.8	3.9	3.9	3.9	3.9	3.9	3.9
Primary Depth (ft)	22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9
Primary Flow (cfs)	1848	1856	1865	1873	1882	1890	1898	1907	1915	1924
Secondary Flow (cfs)	53	53	53	54	54	54	54	54	55	55
Holding Tank Flow (cfs)	4.0	4.0	4.0	4.0	4.0	4.1	4.1	4.1	4.1	4.1

Appendix J-5. Flow Tables: Estimated flows for Striped Bass Criteria with 3 JPP unit.

# of JPP Pumps	**3**									
Bypass Ratio	**1.2**									
Primary Depth (ft)	13	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9
Primary Flow (cfs)	1638	1651	1663	1676	1688	1701	1714	1726	1739	1751
Secondary Flow (cfs)	47	47	48	48	48	49	49	49	50	50
Holding Tank Flow (cfs)	3.5	3.5	3.6	3.6	3.6	3.6	3.7	3.7	3.7	3.8
Primary Depth (ft)	14	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9
Primary Flow (cfs)	1764	1777	1789	1802	1814	1827	1840	1852	1865	1877
Secondary Flow (cfs)	50	51	51	51	52	52	53	53	53	54
Holding Tank Flow (cfs)	3.8	3.8	3.8	3.9	3.9	3.9	3.9	4.0	4.0	4.0
Primary Depth (ft)	15	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9
Primary Flow (cfs)	1890	1903	1915	1928	1940	1953	1966	1978	1991	2003
Secondary Flow (cfs)	54	54	55	55	55	56	56	57	57	57
Holding Tank Flow (cfs)	4.1	4.1	4.1	4.1	4.2	4.2	4.2	4.2	4.3	4.3
Primary Depth (ft)	16	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9
Primary Flow (cfs)	2016	2029	2041	2054	2066	2079	2092	2104	2117	2129
Secondary Flow (cfs)	58	58	58	59	59	59	60	60	60	61
Holding Tank Flow (cfs)	4.3	4.3	4.4	4.4	4.4	4.5	4.5	4.5	4.5	4.6
Primary Depth (ft)	17	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9
Primary Flow (cfs)	2142	2155	2167	2180	2192	2205	2218	2230	2243	2255
Secondary Flow (cfs)	61	62	62	62	63	63	63	64	64	64
Holding Tank Flow (cfs)	4.6	4.6	4.6	4.7	4.7	4.7	4.8	4.8	4.8	4.8
Primary Depth (ft)	18	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9
Primary Flow (cfs)	2268	2281	2293	2306	2318	2331	2344	2356	2369	2381
Secondary Flow (cfs)	65	65	66	66	66	67	67	67	68	68
Holding Tank Flow (cfs)	4.9	4.9	4.9	4.9	5.0	5.0	5.0	5.0	5.1	5.1
Primary Depth (ft)	19	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9
Primary Flow (cfs)	2394	2407	2419	2432	2444	2457	2470	2482	2495	2507
Secondary Flow (cfs)	68	69	69	69	70	70	71	71	71	72
Holding Tank Flow (cfs)	5.1	5.2	5.2	5.2	5.2	5.3	5.3	5.3	5.3	5.4
Primary Depth (ft)	20	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9
Primary Flow (cfs)	2520	2533	2545	2558	2570	2583	2596	2608	2621	2633
Secondary Flow (cfs)	72	72	73	73	73	74	74	75	75	75
Holding Tank Flow (cfs)	5.4	5.4	5.5	5.5	5.5	5.5	5.6	5.6	5.6	5.6
Primary Depth (ft)	21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9
Primary Flow (cfs)	2646	2659	2671	2684	2696	2709	2722	2734	2747	2759
Secondary Flow (cfs)	76	76	76	77	77	77	78	78	78	79
Holding Tank Flow (cfs)	5.7	5.7	5.7	5.8	5.8	5.8	5.8	5.9	5.9	5.9
Primary Depth (ft)	22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9
Primary Flow (cfs)	2772	2785	2797	2810	2822	2835	2848	2860	2873	2885
Secondary Flow (cfs)	79	80	80	80	81	81	81	82	82	82
Holding Tank Flow (cfs)	5.9	6.0	6.0	6.0	6.0	6.1	6.1	6.1	6.2	6.2

Appendix J-5. Flow Tables: Estimated flows for Striped Bass Criteria with 4 JPP unit.

# of JPP Pumps	**4**									
Bypass Ratio	**1.2**									
Primary Depth (ft)	13	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9
Primary Flow (cfs)	2184	2201	2218	2234	2251	2268	2285	2302	2318	2335
Secondary Flow (cfs)	62	63	63	64	64	65	65	66	66	67
Holding Tank Flow (cfs)	4.7	4.7	4.8	4.8	4.8	4.9	4.9	4.9	5.0	5.0
Primary Depth (ft)	14	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9
Primary Flow (cfs)	2352	2369	2386	2402	2419	2436	2453	2470	2486	2503
Secondary Flow (cfs)	67	68	68	69	69	70	70	71	71	72
Holding Tank Flow (cfs)	5	5.1	5.1	5.1	5.2	5.2	5.3	5.3	5.3	5.4
Primary Depth (ft)	15	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9
Primary Flow (cfs)	2520	2537	2554	2570	2587	2604	2621	2638	2654	2671
Secondary Flow (cfs)	72	72	73	73	74	74	75	75	76	76
Holding Tank Flow (cfs)	5.4	5.4	5.5	5.5	5.5	5.6	5.6	5.7	5.7	5.7
Primary Depth (ft)	16	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9
Primary Flow (cfs)	2688	2705	2722	2738	2755	2772	2789	2806	2822	2839
Secondary Flow (cfs)	82	82	83	83	84	84	84	85	85	86
Holding Tank Flow (cfs)	5.8	5.8	5.8	5.9	5.9	5.9	6.0	6.0	6.0	6.1
Primary Depth (ft)	17	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9
Primary Flow (cfs)	2856	2873	2890	2906	2923	2940	2957	2974	2990	3007
Secondary Flow (cfs)	82	82	83	83	84	84	84	85	85	86
Holding Tank Flow (cfs)	6.1	6.2	6.2	6.2	6.3	6.3	6.3	6.4	6.4	6.4
Primary Depth (ft)	18	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9
Primary Flow (cfs)	3024	3041	3058	3074	3091	3108	3125	3142	3158	3175
Secondary Flow (cfs)	86	87	87	88	88	89	89	90	90	91
Holding Tank Flow (cfs)	6.5	6.5	6.6	6.6	6.6	6.7	6.7	6.7	6.8	6.8
Primary Depth (ft)	19	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9
Primary Flow (cfs)	3192	3209	3226	3242	3259	3276	3293	3310	3326	3343
Secondary Flow (cfs)	91	92	92	93	93	94	94	95	95	96
Holding Tank Flow (cfs)	6.8	6.9	6.9	6.9	7.0	7.0	7.1	7.1	7.1	7.2
Primary Depth (ft)	20	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9
Primary Flow (cfs)	3360	3377	3394	3410	3427	3444	3461	3478	3494	3511
Secondary Flow (cfs)	96	96	97	97	98	98	99	99	100	100
Holding Tank Flow (cfs)	7.2	7.2	7.3	7.3	7.3	7.4	7.4	7.5	7.5	7.5
Primary Depth (ft)	21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9
Primary Flow (cfs)	3528	3545	3562	3578	3595	3612	3629	3646	3662	3679
Secondary Flow (cfs)	101	101	102	102	103	103	104	104	105	105
Holding Tank Flow (cfs)	7.6	7.6	7.6	7.7	7.7	7.7	7.8	7.8	7.8	7.9
Primary Depth (ft)	22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9
Primary Flow (cfs)	3696	3713	3730	3746	3763	3780	3797	3814	3830	3847
Secondary Flow (cfs)	106	106	107	107	108	108	108	109	109	110
Holding Tank Flow (cfs)	7.9	8.0	8.0	8.0	8.1	8.1	8.1	8.2	8.2	8.2

Appendix J-5. Flow Tables: Estimated flows for Striped Bass Criteria with 5 JPP unit.

# of JPP Pumps	**5**									
Bypass Ratio	**1.2**									
Primary Depth (ft)	13	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9
Primary Flow (cfs)	2730	2751	2772	2793	2814	2835	2856	2877	2898	2919
Secondary Flow (cfs)	78	79	79	80	80	81	82	82	83	83
Holding Tank Flow (cfs)	5.9	5.9	5.9	6.0	6.0	6.1	6.1	6.2	6.2	6.3
Primary Depth (ft)	14	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9
Primary Flow (cfs)	2940	2961	2982	3003	3024	3045	3066	3087	3108	3129
Secondary Flow (cfs)	84	85	85	86	86	87	88	88	89	89
Holding Tank Flow (cfs)	6.3	6.3	6.4	6.4	6.5	6.5	6.6	6.6	6.7	6.7
Primary Depth (ft)	15	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9
Primary Flow (cfs)	3150	3171	3192	3213	3234	3255	3276	3297	3318	3339
Secondary Flow (cfs)	90	91	91	92	92	93	94	94	95	95
Holding Tank Flow (cfs)	6.8	6.8	6.8	6.9	6.9	7.0	7.0	7.1	7.1	7.2
Primary Depth (ft)	16	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9
Primary Flow (cfs)	3360	3381	3402	3423	3444	3465	3486	3507	3528	3549
Secondary Flow (cfs)	96	97	97	98	98	99	100	100	101	101
Holding Tank Flow (cfs)	7.2	7.2	7.3	7.3	7.4	7.4	7.5	7.5	7.6	7.6
Primary Depth (ft)	17	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9
Primary Flow (cfs)	3570	3591	3612	3633	3654	3675	3696	3717	3738	3759
Secondary Flow (cfs)	102	103	103	104	104	105	106	106	107	107
Holding Tank Flow (cfs)	7.7	7.7	7.7	7.8	7.8	7.9	7.9	8.0	8.0	8.1
Primary Depth (ft)	18	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9
Primary Flow (cfs)	3780	3801	3822	3843	3864	3885	3906	3927	3948	3969
Secondary Flow (cfs)	108	109	109	110	110	111	112	112	113	113
Holding Tank Flow (cfs)	8.1	8.1	8.2	8.2	8.3	8.3	8.4	8.4	8.5	8.5
Primary Depth (ft)	19	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9
Primary Flow (cfs)	3990	4011	4032	4053	4074	4095	4116	4137	4158	4179
Secondary Flow (cfs)	114	115	115	116	116	117	118	118	119	119
Holding Tank Flow (cfs)	8.6	8.6	8.6	8.7	8.7	8.8	8.8	8.9	8.9	9.0
Primary Depth (ft)	20	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9
Primary Flow (cfs)	4200	4221	4242	4263	4284	4305	4326	4347	4368	4389
Secondary Flow (cfs)	120	121	121	122	122	123	124	124	125	125
Holding Tank Flow (cfs)	9.0	9.0	9.1	9.1	9.2	9.2	9.3	9.3	9.4	9.4
Primary Depth (ft)	21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9
Primary Flow (cfs)	4410	4431	4452	4473	4494	4515	4536	4557	4578	4599
Secondary Flow (cfs)	126	127	127	128	128	129	130	130	131	131
Holding Tank Flow (cfs)	9.5	9.5	9.5	9.6	9.6	9.7	9.7	9.8	9.8	9.9
Primary Depth (ft)	22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9
Primary Flow (cfs)	4620	4641	4662	4683	4704	4725	4746	4767	4788	4809
Secondary Flow (cfs)	132	133	133	134	134	135	136	136	137	137
Holding Tank Flow (cfs)	9.9	9.9	10.0	10.0	10.1	10.1	10.2	10.2	10.3	10.3

Appendix J-5. Flow Tables: Estimated flows for Chinook Salmon Criteria with 1 JPP unit.

# of JPP Pumps	**1**									
Bypass Ratio	**1.6**									
Primary Depth (ft)	13	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9
Primary Flow (cfs)	546	550	554	559	563	567	571	575	580	584
Secondary Flow (cfs)	21	21	21	21	21	22	22	22	22	22
Holding Tank Flow (cfs)	2.1	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.2	2.2
Primary Depth (ft)	14	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9
Primary Flow (cfs)	588	592	596	601	605	609	613	617	622	626
Secondary Flow (cfs)	22	23	23	23	23	23	23	24	24	24
Holding Tank Flow (cfs)	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4
Primary Depth (ft)	15	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9
Primary Flow (cfs)	630	634	638	643	647	651	655	659	664	668
Secondary Flow (cfs)	24	24	24	24	25	25	25	25	25	25
Holding Tank Flow (cfs)	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5
Primary Depth (ft)	16	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9
Primary Flow (cfs)	672	676	680	685	689	693	697	701	706	710
Secondary Flow (cfs)	26	26	26	26	26	26	27	27	27	27
Holding Tank Flow (cfs)	2.6	2.6	2.6	2.6	2.6	2.6	2.7	2.7	2.7	2.7
Primary Depth (ft)	17	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9
Primary Flow (cfs)	714	718	722	727	731	735	739	743	748	752
Secondary Flow (cfs)	27	27	28	28	28	28	28	28	28	29
Holding Tank Flow (cfs)	2.7	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.9
Primary Depth (ft)	18	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9
Primary Flow (cfs)	756	760	764	769	773	777	781	785	790	794
Secondary Flow (cfs)	29	29	29	29	29	30	30	30	30	30
Holding Tank Flow (cfs)	2.9	2.9	2.9	2.9	2.9	3.0	3.0	3.0	3.0	3.0
Primary Depth (ft)	19	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9
Primary Flow (cfs)	798	802	806	811	815	819	823	827	832	836
Secondary Flow (cfs)	30	31	31	31	31	31	31	32	32	32
Holding Tank Flow (cfs)	3.0	3.1	3.1	3.1	3.1	3.1	3.1	3.2	3.2	3.2
Primary Depth (ft)	20	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9
Primary Flow (cfs)	840	844	848	853	857	861	865	869	874	878
Secondary Flow (cfs)	32	32	32	32	33	33	33	33	33	33
Holding Tank Flow (cfs)	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.3
Primary Depth (ft)	21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9
Primary Flow (cfs)	882	886	890	895	899	903	907	911	916	920
Secondary Flow (cfs)	34	34	34	34	34	34	35	35	35	35
Holding Tank Flow (cfs)	3.4	3.4	3.4	3.4	3.4	3.4	3.5	3.5	3.5	3.5
Primary Depth (ft)	22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9
Primary Flow (cfs)	924	928	932	937	941	945	949	953	958	962
Secondary Flow (cfs)	35	35	36	36	36	36	36	36	36	37
Holding Tank Flow (cfs)	3.5	3.5	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.7

Appendix J-5. Flow Tables: Estimated flows for Chinook Salmon Criteria with 2 JPP unit.

# of JPP Pumps	**2**									
Bypass Ratio	**1.6**									
Primary Depth (ft)	13	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9
Primary Flow (cfs)	1092	1100	1109	1117	1126	1134	1142	1151	1159	1168
Secondary Flow (cfs)	42	42	42	43	43	43	44	44	44	44
Holding Tank Flow (cfs)	4.2	4.2	4.2	4.3	4.3	4.3	4.4	4.4	4.4	4.4
Primary Depth (ft)	14	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9
Primary Flow (cfs)	1176	1184	1193	1201	1210	1218	1226	1235	1243	1252
Secondary Flow (cfs)	45	45	45	46	46	46	47	47	47	48
Holding Tank Flow (cfs)	4.5	4.5	4.5	4.6	4.6	4.6	4.7	4.7	4.7	4.8
Primary Depth (ft)	15	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9
Primary Flow (cfs)	1260	1268	1277	1285	1294	1302	1310	1319	1327	1336
Secondary Flow (cfs)	48	48	49	49	49	50	50	50	51	51
Holding Tank Flow (cfs)	4.8	4.8	4.9	4.9	4.9	5.0	5.0	5.0	5.1	5.1
Primary Depth (ft)	16	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9
Primary Flow (cfs)	1344	1352	1361	1369	1378	1386	1394	1403	1411	1420
Secondary Flow (cfs)	51	52	52	52	52	53	53	53	54	54
Holding Tank Flow (cfs)	5.1	5.2	5.2	5.2	5.2	5.3	5.3	5.3	5.4	5.4
Primary Depth (ft)	17	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9
Primary Flow (cfs)	1428	1436	1445	1453	1462	1470	1478	1487	1495	1504
Secondary Flow (cfs)	54	55	55	55	56	56	56	57	57	57
Holding Tank Flow (cfs)	5.4	5.5	5.5	5.5	5.6	5.6	5.6	5.7	5.7	5.7
Primary Depth (ft)	18	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9
Primary Flow (cfs)	1512	1520	1529	1537	1546	1554	1562	1571	1579	1588
Secondary Flow (cfs)	58	58	58	59	59	59	60	60	60	60
Holding Tank Flow (cfs)	5.8	5.8	5.8	5.9	5.9	5.9	6.0	6.0	6.0	6.0
Primary Depth (ft)	19	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9
Primary Flow (cfs)	1596	1604	1613	1621	1630	1638	1646	1655	1663	1672
Secondary Flow (cfs)	61	61	61	62	62	62	63	63	63	64
Holding Tank Flow (cfs)	6.1	6.1	6.1	6.2	6.2	6.2	6.3	6.3	6.3	6.4
Primary Depth (ft)	20	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9
Primary Flow (cfs)	1680	1688	1697	1705	1714	1722	1730	1739	1747	1756
Secondary Flow (cfs)	64	64	65	65	65	66	66	66	67	67
Holding Tank Flow (cfs)	6.4	6.4	6.5	6.5	6.5	6.6	6.6	6.6	6.7	6.7
Primary Depth (ft)	21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9
Primary Flow (cfs)	1764	1772	1781	1789	1798	1806	1814	1823	1831	1840
Secondary Flow (cfs)	67	68	68	68	68	69	69	69	70	70
Holding Tank Flow (cfs)	6.7	6.8	6.8	6.8	6.8	6.9	6.9	6.9	7.0	7.0
Primary Depth (ft)	22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9
Primary Flow (cfs)	1848	1856	1865	1873	1882	1890	1898	1907	1915	1924
Secondary Flow (cfs)	70	71	71	71	72	72	72	73	73	73
Holding Tank Flow (cfs)	7.0	7.1	7.1	7.1	7.2	7.2	7.2	7.3	7.3	7.3

Appendix J-5. Flow Tables: Estimated flows for Chinook Salmon Criteria with 3 JPP unit.

# of JPP Pumps	**3**									
Bypass Ratio	**1.6**									
Primary Depth (ft)	13	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9
Primary Flow (cfs)	1638	1651	1663	1676	1688	1701	1714	1726	1739	1751
Secondary Flow (cfs)	62	63	63	64	64	65	65	66	66	67
Holding Tank Flow (cfs)	6.2	6.3	6.3	6.4	6.4	6.5	6.5	6.6	6.6	6.7
Primary Depth (ft)	14	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9
Primary Flow (cfs)	1764	1777	1789	1802	1814	1827	1840	1852	1865	1877
Secondary Flow (cfs)	67	68	68	69	69	70	70	71	71	72
Holding Tank Flow (cfs)	6.7	6.8	6.8	6.9	6.9	7.0	7.0	7.1	7.1	7.2
Primary Depth (ft)	15	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9
Primary Flow (cfs)	1890	1903	1915	1928	1940	1953	1966	1978	1991	2003
Secondary Flow (cfs)	72	72	73	73	74	74	75	75	76	76
Holding Tank Flow (cfs)	7.2	7.2	7.3	7.3	7.4	7.4	7.5	7.5	7.6	7.6
Primary Depth (ft)	16	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9
Primary Flow (cfs)	2016	2029	2041	2054	2066	2079	2092	2104	2117	2129
Secondary Flow (cfs)	77	77	78	78	79	79	80	80	81	81
Holding Tank Flow (cfs)	7.7	7.7	7.8	7.8	7.9	7.9	8.0	8.0	8.1	8.1
Primary Depth (ft)	17	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9
Primary Flow (cfs)	2142	2155	2167	2180	2192	2205	2218	2230	2243	2255
Secondary Flow (cfs)	82	82	83	83	84	84	84	85	85	86
Holding Tank Flow (cfs)	8.2	8.2	8.3	8.3	8.4	8.4	8.4	8.5	8.5	8.6
Primary Depth (ft)	18	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9
Primary Flow (cfs)	2268	2281	2293	2306	2318	2331	2344	2356	2369	2381
Secondary Flow (cfs)	86	87	87	88	88	89	89	90	90	91
Holding Tank Flow (cfs)	8.6	8.7	8.7	8.8	8.8	8.9	8.9	9.0	9.0	9.1
Primary Depth (ft)	19	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9
Primary Flow (cfs)	2394	2407	2419	2432	2444	2457	2470	2482	2495	2507
Secondary Flow (cfs)	91	92	92	93	93	94	94	95	95	96
Holding Tank Flow (cfs)	9.1	9.2	9.2	9.3	9.3	9.4	9.4	9.5	9.5	9.6
Primary Depth (ft)	20	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9
Primary Flow (cfs)	2520	2533	2545	2558	2570	2583	2596	2608	2621	2633
Secondary Flow (cfs)	96	96	97	97	98	98	99	99	100	100
Holding Tank Flow (cfs)	9.6	9.6	9.7	9.7	9.8	9.8	9.9	9.9	10.0	10.0
Primary Depth (ft)	21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9
Primary Flow (cfs)	2646	2659	2671	2684	2696	2709	2722	2734	2747	2759
Secondary Flow (cfs)	101	101	102	102	103	103	104	104	105	105
Holding Tank Flow (cfs)	10.1	10.1	10.2	10.2	10.3	10.3	10.4	10.4	10.5	10.5
Primary Depth (ft)	22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9
Primary Flow (cfs)	2772	2785	2797	2810	2822	2835	2848	2860	2873	2885
Secondary Flow (cfs)	106	106	107	107	108	108	108	109	109	110
Holding Tank Flow (cfs)	10.6	10.6	10.7	10.7	10.8	10.8	10.8	10.9	10.9	11.0

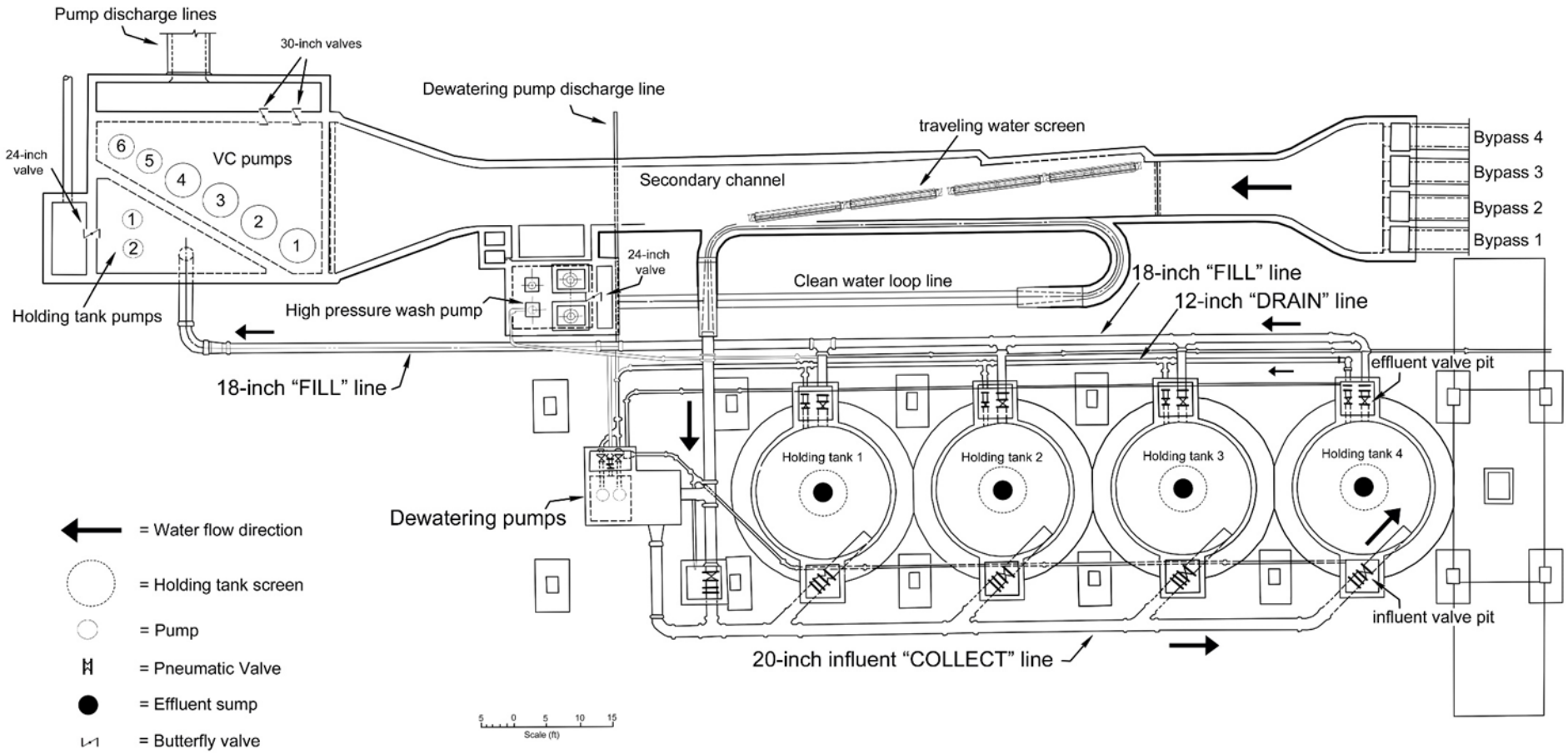
Appendix J-5. Flow Tables: Estimated flows for Chinook Salmon Criteria with 4 JPP unit.

# of JPP Pumps	**4**									
Bypass Ratio	**1.6**									
Primary Depth (ft)	13	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9
Primary Flow (cfs)	2184	2201	2218	2234	2251	2268	2285	2302	2318	2335
Secondary Flow (cfs)	83	84	84	85	86	86	87	88	88	89
Holding Tank Flow (cfs)	8.3	8.4	8.4	8.5	8.6	8.6	8.7	8.8	8.8	8.9
Primary Depth (ft)	14	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9
Primary Flow (cfs)	2352	2369	2386	2402	2419	2436	2453	2470	2486	2503
Secondary Flow (cfs)	90	90	91	92	92	93	93	94	95	95
Holding Tank Flow (cfs)	9.0	9.0	9.1	9.2	9.2	9.3	9.3	9.4	9.5	9.5
Primary Depth (ft)	15	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9
Primary Flow (cfs)	2520	2537	2554	2570	2587	2604	2621	2638	2654	2671
Secondary Flow (cfs)	96	97	97	98	99	99	100	100	101	102
Holding Tank Flow (cfs)	9.6	9.7	9.7	9.8	9.9	9.9	10.0	10.0	10.1	10.2
Primary Depth (ft)	16	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9
Primary Flow (cfs)	2688	2705	2722	2738	2755	2772	2789	2806	2822	2839
Secondary Flow (cfs)	102	103	104	104	105	106	106	107	108	108
Holding Tank Flow (cfs)	10.2	10.3	10.4	10.4	10.5	10.6	10.6	10.7	10.8	10.8
Primary Depth (ft)	17	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9
Primary Flow (cfs)	2856	2873	2890	2906	2923	2940	2957	2974	2990	3007
Secondary Flow (cfs)	109	109	110	111	111	112	113	113	114	115
Holding Tank Flow (cfs)	10.9	10.9	11.0	11.1	11.1	11.2	11.3	11.3	11.4	11.5
Primary Depth (ft)	18	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9
Primary Flow (cfs)	3024	3041	3058	3074	3091	3108	3125	3142	3158	3175
Secondary Flow (cfs)	115	116	116	117	118	118	119	120	120	121
Holding Tank Flow (cfs)	11.5	11.6	11.6	11.7	11.8	11.8	11.9	12.0	12.0	12.1
Primary Depth (ft)	19	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9
Primary Flow (cfs)	3192	3209	3226	3242	3259	3276	3293	3310	3326	3343
Secondary Flow (cfs)	122	122	123	124	124	125	125	126	127	127
Holding Tank Flow (cfs)	12.2	12.2	12.3	12.4	12.4	12.5	12.5	12.6	12.7	12.7
Primary Depth (ft)	20	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9
Primary Flow (cfs)	3360	3377	3394	3410	3427	3444	3461	3478	3494	3511
Secondary Flow (cfs)	128	129	129	130	131	131	132	132	133	134
Holding Tank Flow (cfs)	12.8	12.9	12.9	13.0	13.1	13.1	13.2	13.2	13.3	13.4
Primary Depth (ft)	21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9
Primary Flow (cfs)	3528	3545	3562	3578	3595	3612	3629	3646	3662	3679
Secondary Flow (cfs)	134	135	136	136	137	138	138	139	140	140
Holding Tank Flow (cfs)	13.4	13.5	13.6	13.6	13.7	13.8	13.8	13.9	14.0	14.0
Primary Depth (ft)	22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9
Primary Flow (cfs)	3696	3713	3730	3746	3763	3780	3797	3814	3830	3847
Secondary Flow (cfs)	141	141	142	143	143	144	145	145	146	147
Holding Tank Flow (cfs)	14.1	14.1	14.2	14.3	14.3	14.4	14.5	14.5	14.6	14.7

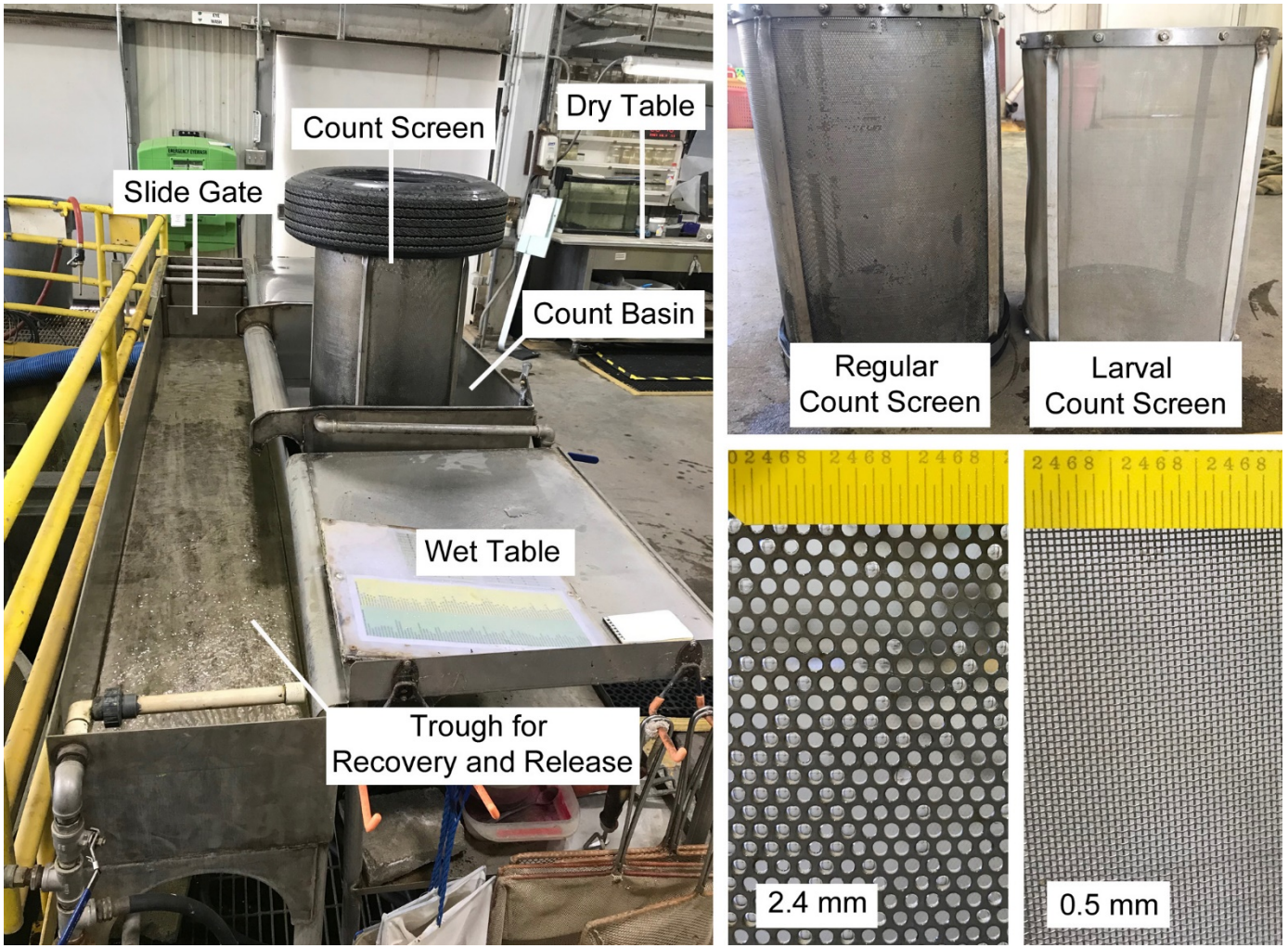
Appendix J-5. Flow Tables: Estimated flows for Chinook Salmon Criteria with 5 JPP unit.

# of JPP Pumps	**5**									
Bypass Ratio	**1.6**									
Primary Depth (ft)	13	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9
Primary Flow (cfs)	2730	2751	2772	2793	2814	2835	2856	2877	2898	2919
Secondary Flow (cfs)	104	105	106	106	107	108	109	110	110	111
Holding Tank Flow (cfs)	10.4	10.5	10.6	10.6	10.7	10.8	10.9	11.0	11.0	11.1
Primary Depth (ft)	14	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9
Primary Flow (cfs)	2940	2961	2982	3003	3024	3045	3066	3087	3108	3129
Secondary Flow (cfs)	112	113	114	114	115	116	117	118	118	119
Holding Tank Flow (cfs)	11.2	11.3	11.4	11.4	11.5	11.6	11.7	11.8	11.8	11.9
Primary Depth (ft)	15	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9
Primary Flow (cfs)	3150	3171	3192	3213	3234	3255	3276	3297	3318	3339
Secondary Flow (cfs)	120	121	122	122	123	124	125	126	126	127
Holding Tank Flow (cfs)	12.0	12.1	12.2	12.2	12.3	12.4	12.5	12.6	12.6	12.7
Primary Depth (ft)	16	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9
Primary Flow (cfs)	3360	3381	3402	3423	3444	3465	3486	3507	3528	3549
Secondary Flow (cfs)	128	129	130	130	131	132	133	134	134	135
Holding Tank Flow (cfs)	12.8	12.9	13.0	13.0	13.1	13.2	13.3	13.4	13.4	13.5
Primary Depth (ft)	17	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9
Primary Flow (cfs)	3570	3591	3612	3633	3654	3675	3696	3717	3738	3759
Secondary Flow (cfs)	136	137	138	138	139	140	141	142	142	143
Holding Tank Flow (cfs)	13.6	13.7	13.8	13.8	13.9	14.0	14.1	14.2	14.2	14.3
Primary Depth (ft)	18	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9
Primary Flow (cfs)	3780	3801	3822	3843	3864	3885	3906	3927	3948	3969
Secondary Flow (cfs)	144	145	146	146	147	148	149	150	150	151
Holding Tank Flow (cfs)	14.4	14.5	14.6	14.6	14.7	14.8	14.9	15.0	15.0	15.1
Primary Depth (ft)	19	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9
Primary Flow (cfs)	3990	4011	4032	4053	4074	4095	4116	4137	4158	4179
Secondary Flow (cfs)	152	153	154	154	155	156	157	158	158	159
Holding Tank Flow (cfs)	15.2	15.3	15.4	15.4	15.5	15.6	15.7	15.8	15.8	15.9
Primary Depth (ft)	20	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9
Primary Flow (cfs)	4200	4221	4242	4263	4284	4305	4326	4347	4368	4389
Secondary Flow (cfs)	160	161	162	162	163	164	165	166	166	167
Holding Tank Flow (cfs)	16.0	16.1	16.2	16.2	16.3	16.4	16.5	16.6	16.6	16.7
Primary Depth (ft)	21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9
Primary Flow (cfs)	4410	4431	4452	4476	4494	4515	4536	4557	4578	4599
Secondary Flow (cfs)	168	169	170	170	171	172	173	174	174	175
Holding Tank Flow (cfs)	16.8	16.9	17.0	17.0	17.1	17.2	17.3	17.4	17.4	17.5
Primary Depth (ft)	22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9
Primary Flow (cfs)	4620	4641	4662	4683	4707	4725	4746	4767	4788	4809
Secondary Flow (cfs)	176	177	178	178	179	180	181	182	182	183
Holding Tank Flow (cfs)	17.6	17.7	17.8	17.8	17.9	18.0	18.1	18.2	18.2	18.3

APPENDIX K. Location of Pumps, Valves, Lines, and Other Related Hydrological Components for the Tracy Fish Collection Facility.

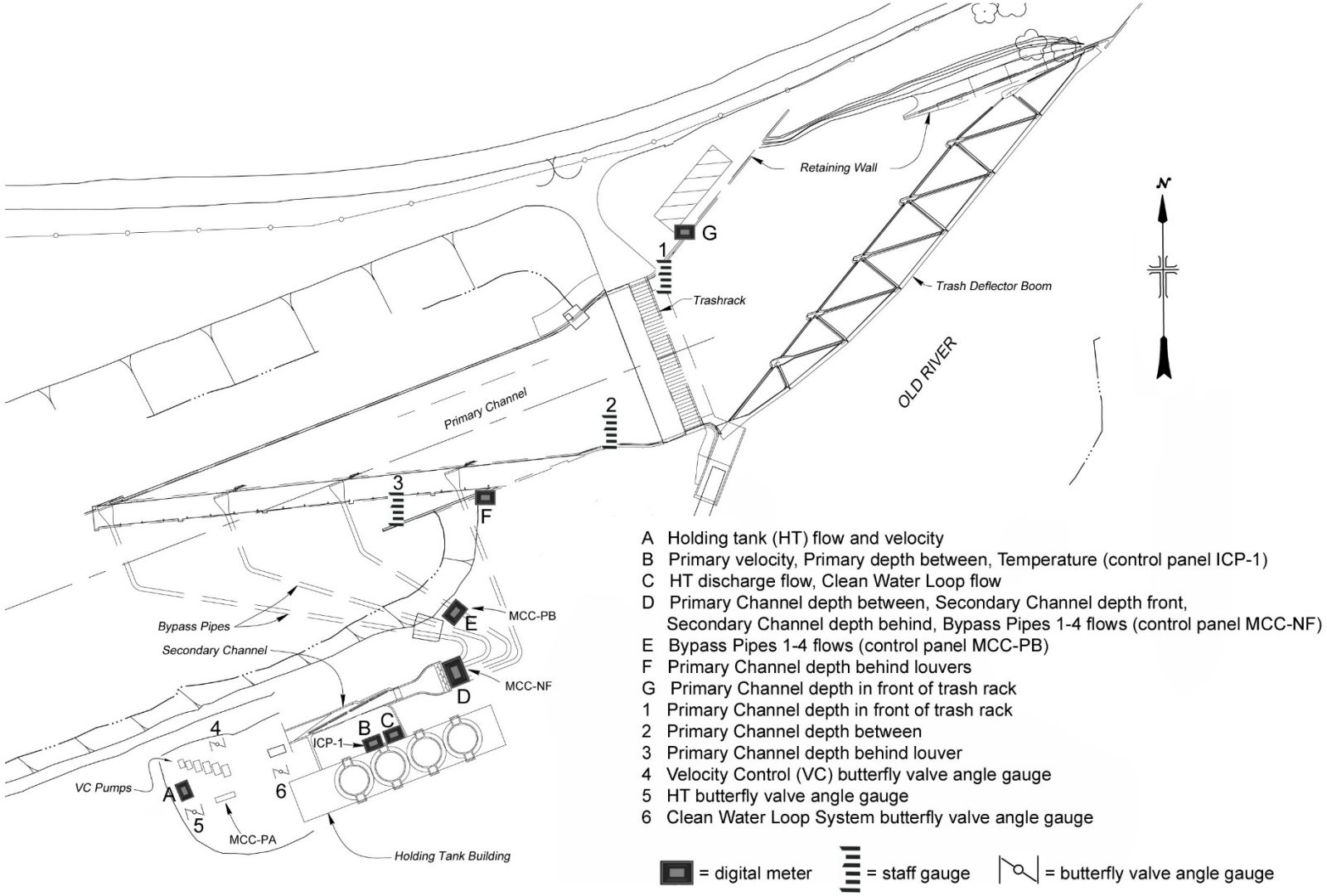


APPENDIX L. Fish Count Station Nomenclature. Left: named components of the fish count station. Right: regular count screen with 2.4 mm diameter opening and the larval count screen with 0.5 mm square opening.



A**PPENDIX M.** Location of Meters and Gauges at the Tracy Fish Collection Facility.

Appendix M-1: Locations of digital meters, staff gauges, valve angle gauges, and control panels.



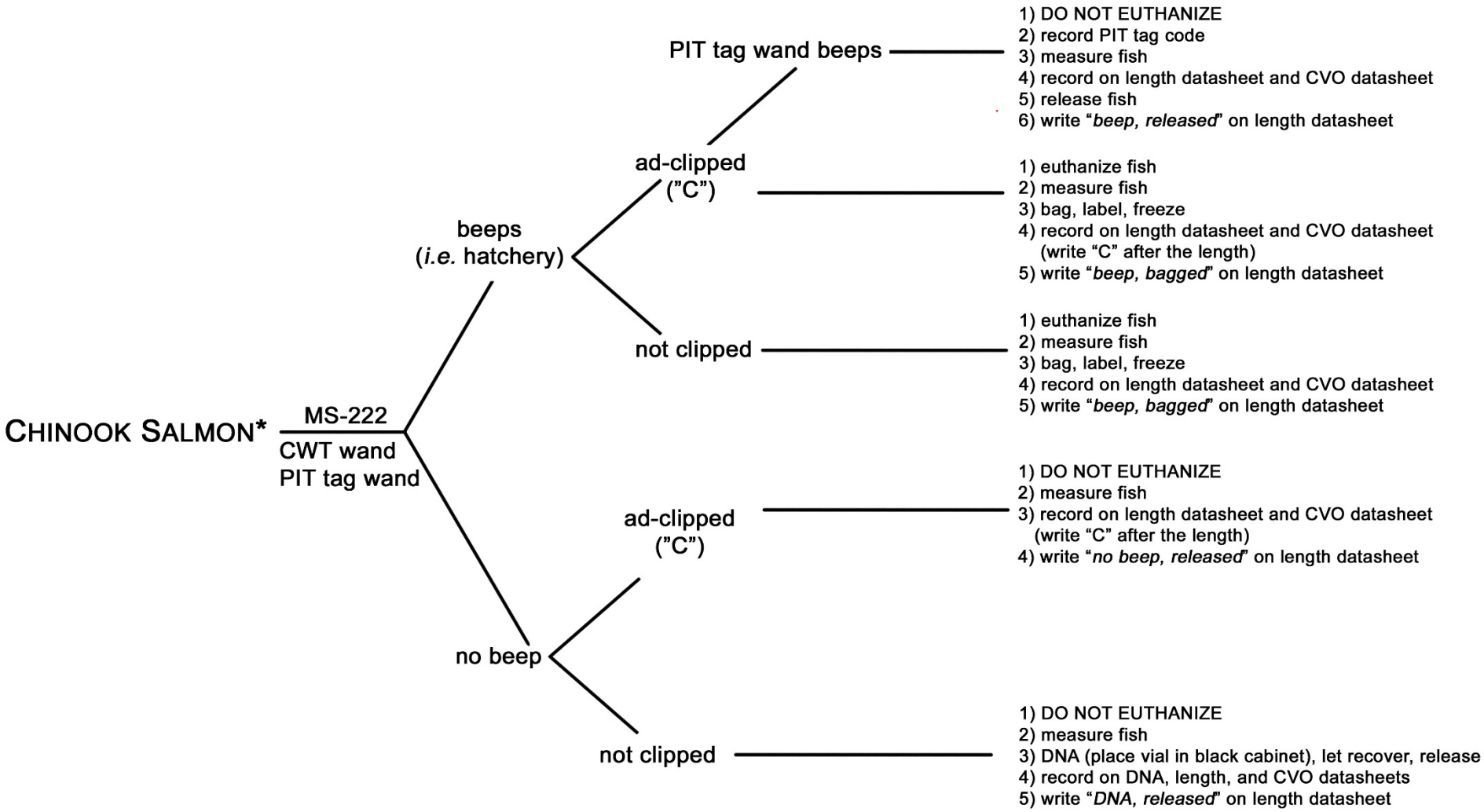
APPENDIX M. Location of Meters and Gauges at the Tracy Fish Collection Facility.

Appendix M-2: Operations Data Sheet term and Method of Obtaining Hydraulic Data.

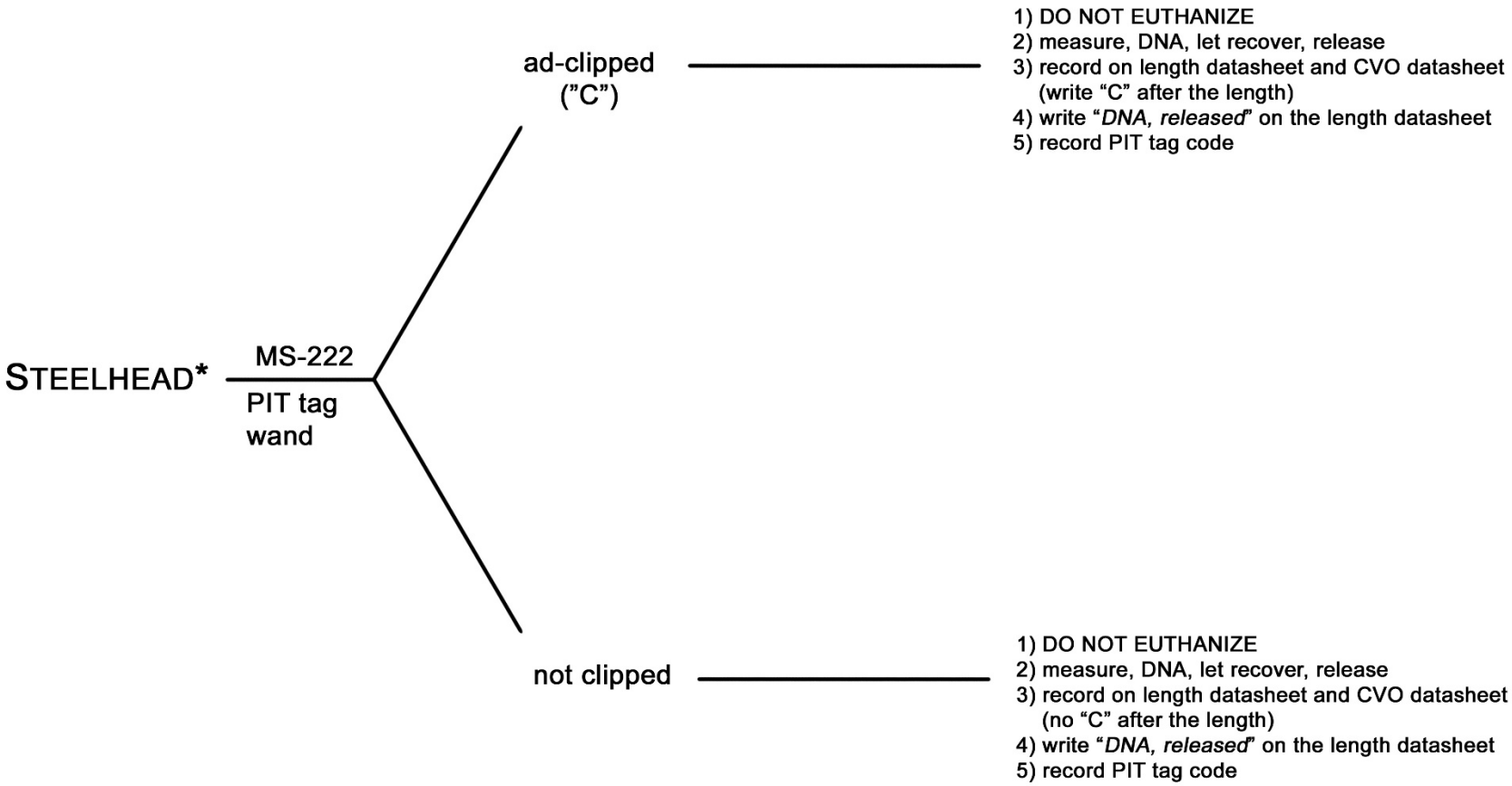
Data Sheet Term	Method of Obtaining Hydraulic Data
Daily Acre Feet	Transmitted value: Record information from daily pumping report emailed by SLDMWA.
Trash Rack Differential (ft)	Calculated value: Primary Depth Before (ft) – Primary Depth Between (ft)
Primary Louver Differential (ft)	Calculated value: Primary Depth Between (ft) – Primary Depth After (ft)
Primary Bypass Ratio	Calculated Value: Primary Depth x 84 x Primary Velocity
Secondary Bypass Ratio	Calculated Value: Holding Tank Flow x 8 ÷ Secondary Flow ÷ 0.5
Secondary Velocity (ft/sec)	Calculated Value: Secondary Flow ÷ Secondary Depth ÷ 8
Primary Depth Before (ft)	Digital Meter: Record from Siemens HydroRanger 200 located upstream of the trash track on the north bank. Staff Gauge: Add 14 ft to staff gauge reading.
Primary Depth Between (ft)	Digital Meters: Record from Control Panel ICP-1 inside the holding tank building or Control Panel MCC-NF upstream of the secondary channel. Staff Gauge: Add 14 ft to staff gauge reading.
Primary Depth After (ft)	Digital Meter: Record from Siemens HydroRanger 200 located on east end of the primary louver deck. Staff Gauge: Add 14 ft to staff gauge reading.
Primary Flow (CFS)	Calculated Value: Primary Depth x 84 x Primary Velocity
Primary Velocity (ft/sec)	Digital Meter: Record from Control Panel ICP-1 inside the holding tank building (round up to 1 decimal place). Calculated Value: Primary Flow ÷ 84 ÷ Primary Depth
Water Temperature (°F)	Digital Meter: Record from Control Panel ICP-1 inside the holding tank building (round up to 1 decimal place).
Secondary Depth Before (ft):	Digital Meter: Record from Siemens HydroRanger 200 in Control Panel MCC-NF.
Secondary Depth After (ft):	Digital Meter: Record from Siemens HydroRanger 200 in Control Panel MCC-NF.
Bypass #1 Flow (CFS)	Digital Meters: Record from Line Meter #1 in panel MCC-NF or MCC-PB.

Bypass #2 Flow (CFS):	Digital Meters: Record from Line Meter #2 in panel MCC-NF or MCC-PB.
Bypass #3 Flow (CFS):	Digital Meters: Record from Line Meter #3 in panel MCC-NF or MCC-PB.
Bypass #4 Flow (CFS):	Digital Meters: Record from Line Meter #4 in panel MCC-NF or MCC-PB.
Secondary Flow Total (CFS)	Calculated Value: Bypass #1 Flow + Bypass #2 Flow + Bypass #3 Flow + Bypass #4 Flow
Holding Tank Flow (CFS):	Digital Meters: Record from Holding Tank Discharge meter SM500F inside holding tank building. If meter is not working, record from Panametrics DF868 (VOLUM reading, not VEL reading) by the holding tank drain pit.
# Pumps on at JPP (1-6)	Transmitted Value: Record information from Change Order–JPP Schedule transmitted by Central Valley Operations.
# of Large VC Pumps On (1-4):	Record information from VC Control Panel MCC-PA.
# of Small VC Pumps On (1-2):	Record information from VC control panel MCC-PA.
# Holding Tank Pumps On (1-2):	Record information from VC control panel MCC-PA.
HT Butterfly Valve Angle (0- 90°)	Record data from butterfly valve.
VC Butterfly Valve Angle (0- 90°)	Record data from VC butterfly valve.
Clean Water Loop System (On/Off)	Record operating status of Clean Water Loop System.
Clean Water Loop System (0-90°)	Record angle from Clean Water Loop System Butterfly Valve Angle.
Clean Water Loop System Flow (CFS)	Digital Meter: Record from Clean Water Loop Flow meter inside the holding tank building.

APPENDIX N. Chinook Salmon Decision Tree.

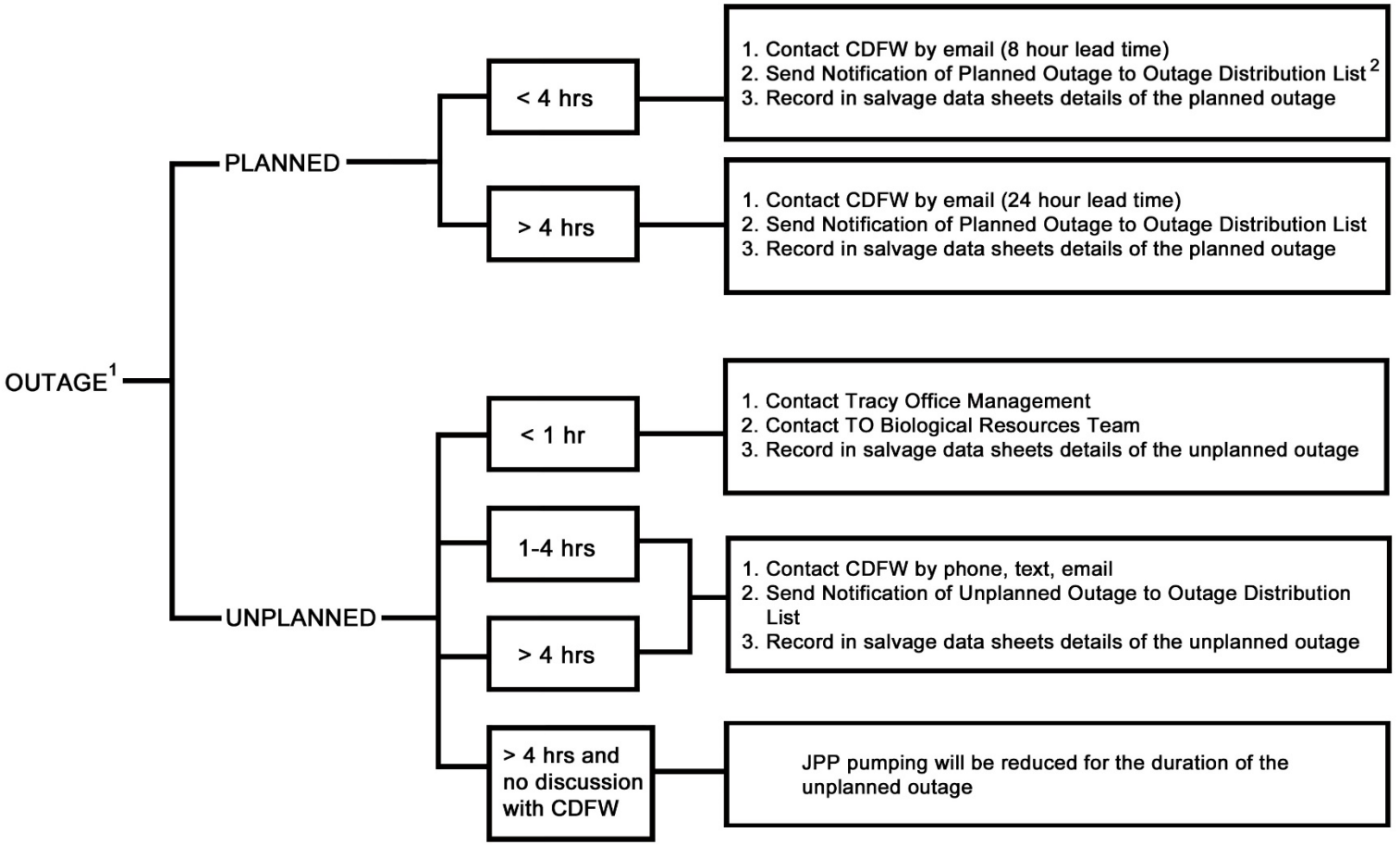


APPENDIX O. Steelhead Decision Tree.



APPENDIX P. Outage Criteria and Notification Protocol.

APPENDIX P-1: Outage Notification Decision Tree.



[1] An outage is defined as the inability to (1) properly screen the entire flow (e.g., due to mechanical breakdown, low water conditions, or excessive debris conditions) and (2) conduct fish salvage operations according to mandated operational criteria.

[2] Outage Distribution List includes contacts for Reclamation (TO, TO Bio Res, BDO, CVO), CDFW, NMFS, and USFWS.

APPENDIX P-2: CDFW Memorandum on Planned and Unplanned Outages.

State of California
Department of Fish and Wildlife

Flex your POWER

Memorandum

Date: January 23, 2019

To: Mr. Dave Duval, Department of Water Resources
Mr. Carl Torgersen, Department of Water Resources
Mr. John Leahigh, Department of Water Resources
Ms. Tracy Hinojosa, Department of Water Resources
Mr. Allen Lindauer, U. S. Bureau of Reclamation

From: Mr. Gregg Erickson, Regional Manager
California Department of Fish and Wildlife-Bay Delta Region, 2825 Cordelia Road, Suite 100, Fairfield, CA 94534

Subject: State Water Project and Central Valley Project Delta Fish Facility Notification Procedures for Planned and Unplanned Outages

This memorandum outlines the interagency contact procedures for planned and unplanned outages at the State Water Project (SWP) and Central Valley Project (CVP) fish salvage facilities. This replaces the previous memorandum distributed on November 7, 2013.

A fish facility outage is defined as inability to (1) properly screen the entire export flow (e.g., due to mechanical breakdown, low water conditions, or excessive debris conditions) and (2) conduct fish salvage operations according to protocol.

If you have questions or require further information, please contact Mr. Geir Aasen, California Department of Fish and Wildlife (CDFW) Salvage Environmental Scientist, at (209) 234-3672 (office), (209) 639-2750 (cellular), or by email at Geir.Aasen@wildlife.ca.gov.

Planned Outages

For all *planned outages* conducted for *normal maintenance and repair work* (e.g., predator clean-outs, normal maintenance procedures, repairs to valves and controls), contact the CDFW Salvage Environmental Scientist by email at least 8 hours in advance of outages lasting less than 4 hours and at least 24 hours in advance of outages more than 4 hours in duration.

To minimize impact of outages on salvage and the take of listed species, it is best to consult with the CDFW Salvage Environmental Scientist before scheduling outages.

Unplanned/Emergency Outages

The procedure and contact list for *unplanned outages or emergencies* will be as follows:

For unplanned outages greater than 1 hour and less than 2 hours, please notify the CDFW Salvage Environmental Scientist by phone, text, or email immediately. Notification by phone or text is needed on weekends (Friday after 4:30 p.m. through 8:00 a.m. Monday) since email is generally not checked on weekends. If discussion by phone, text, or email is not possible, leave a message detailing the source, was pumping continued, and estimated duration of the outage. The CDFW Salvage Environmental Scientist will contact the fish facility as soon as the message is picked up.

For unplanned outages greater than 2 hours and less than 4 hours, please contact (in order) an individual on the following list:

Geir Aasen	(209) 639-2750 work cell phone (209) 234-3672 office phone and voice mail (209) 712-8550 home phone (cell phone)
Walter Griffiths	(209) 403-0518 work cell phone and voice mail (209) 234-3671 office phone and voice mail (650) 219-0149 home phone (cell phone)
Jim Starr	(209) 470-3674 work cell phone and voice mail (209) 234-3440 office phone and voice mail (209) 823-2603 home phone (cell phone)

If the outage exceeds 4 hours and there has been no discussion with the above CDFW staff, pumping should be reduced as soon as feasible for the duration of the outage.

Please post this information for all parties to read or incorporate this information into your agency's posted emergency notification procedures and contact list.

Thank you for your cooperation.

cc: California Department of Water Resources
Ms. Barbara McDonnell
Mr. Paul Massera
Ms. Cynthia Schut
Ms. Sheryl Moore

U. S. Bureau of Reclamation
Mr. Carl Dealy
Mr. Joel Imai
Mr. Rene Reyes
Mr. Yow-min Tsao

California Department of Fish and Wildlife
Mr. Jim Starr
Mr. Walter Griffiths
Mr. Geir Aasen

APPENDIX P-3: Contact List for Outage Notifications.

PLANNED OUTAGES:		
Instructions: 1) Email CDFW, 2) email Outage Distribution List, 3) record in salvage data sheets details		
of planned outage.		
California Department of Fish and Wildlife (CDFW):		
1. CDFW Salvage Biologist:	Geir.Aasen@wildlife.ca.gov	email
2. CDFW Biologist:	Walter.Griffiths@wildlife.ca.gov	email
3. CDFW Permitting:	Jim.Starr@wildlife.ca.gov	email
Outage Distribution List:		
Name	**e-mail address**	**Affiliation**
Barbara Byrne	Barbara.Byrne@noaa.gov	NMFS
Brandon Wu	BWu@usbr.gov	Reclamation/TO Bio Resources
Christopher Hart	Chart@usbr.gov	Reclamation/TO Bio Resources
David Mooney	Dmmooney@usbr.gov	Reclamation/BDO
Elizabeth Kiteck	EKiteck@usbr.gov	Reclamation/CVO
Garwin Yip	Garwin.Yip@noaa.gov	NMFS
Geir Aasen	Geir.Aasen@wildlife.ca.gov	CDFW
Jana Affonso	Jana_Affonso@fws.gov	USFWS
Jeff Stuart	J.Stuart@noaa.gov	NMFS
Jim Starr	Jim.Starr@wildlife.ca.gov,	CDFW
John Dealy	Jcdealy@usbr.gov	Reclamation/TO
Josh Israel	JAIsrael@usbr.gov	Reclamation/BDO
Katherine Sun	Katherine_sun@fws.gov	USFWS
Kristin White	Knwhite@usbr.gov,	Reclamation/CVO
Kyle Griffiths	Walter.Griffiths@wildlife.ca.gov	CDFW
Lauren Damon	Lauren.Damon@wildlife.ca.gov	CDFW
Mario Manzo	MManzo@usbr.gov	Reclamation/BDO
Nader Noori	NNoori@usbr.gov	Reclamation/TO Management
Randi Field	RField@usbr.gov	Reclamation/CVO
Rene Reyes	RReyes@usbr.gov	Reclamation/TO Bio Resources
William Dutton	WDutton@usbr.gov	Reclamation/TO
Yow-min Tsao	YTsao@usbr.gov	Reclamation/TO Management

UNPLANNED/EMERGENCY OUTAGES (<1 hour):		
Instructions: 1) Contact both groups below, 2) record in salvage sheets details of unplanned outage.		
Tracy Office (TO) Management:		
1. Division Chief		email
	(209) 836-6252	office phone and voice mail
	(916) 588-0827	work cell phone and voice mail
2. Fish Facility Branch Chief	YTsao@usbr.gov	email
	(209) 836-6276	office phone and voice mail
	(916) 434-6717	work cell phone and voice mail
	(832) 433-5361	cell phone and voice mail
TO Biological Resources Section:		
1. Supervisory Fish Biologist	RReyes@usbr.gov	email
	(209) 836-6221	office phone and voice mail
	(209) 601-5821	work cell phone and voice mail
2. Fish Biologist	BWu@usbr.gov	email
	(209) 836-6223	office phone and voice mail
3. Fish Biologist	Chart@usbr.gov	email
	(209) 836-6222	office phone and voice mail

UNPLANNED/EMERGENCY OUTAGES (1-4 hours, >4hours):		
Instructions: 1) Contact CDFW, 2) email Outage Distribution List, 3) record in salvage data sheets details		
of the unplanned outage.		
California Department of Fish and Wildlife (CDFW):		
1. CDFW Salvage Biologist:	Geir.Aasen@wildlife.ca.gov	email
	(209) 639-2750	work cell phone
	(209) 234-3672	office phone and voice mail
	(209) 712-8550	home cell phone
2. CDFW Biologist:	Walter.Griffiths@wildlife.ca.gov	email
	(209) 403-0518	work cell phone and voice mail
	(209) 234-3671	office phone and voice mail
	(209) 219-0149	home cell phone
3. CDFW Permitting:	Jim.Starr@wildlife.ca.gov	email
	(209) 470-3674	work cell phone and voice mail
	(209) 234-3440	office phone and voice mail
	(209) 823-2603	home cell phone
Outage Distribution List:		
Name	**e-mail address**	**Affiliation**
Barbara Byrne	Barbara.Byrne@noaa.gov	NMFS
Brandon Wu	BWu@usbr.gov	Reclamation/TO Bio Resources
Christopher Hart	Chart@usbr.gov	Reclamation/TO Bio Resources
David Mooney	Dmmooney@usbr.gov	Reclamation/BDO
Elizabeth Kiteck	EKiteck@usbr.gov	Reclamation/CVO
Garwin Yip	Garwin.Yip@noaa.gov	NMFS
Geir Aasen	Geir.Aasen@wildlife.ca.gov	CDFW
Jana Affonso	Jana_Affonso@fws.gov	USFWS
Jeff Stuart	J.Stuart@noaa.gov	NMFS
Jim Starr	Jim.Starr@wildlife.ca.gov,	CDFW
John Dealy	Jcdealy@usbr.gov	Reclamation/TO
Josh Israel	JAIsrael@usbr.gov	Reclamation/BDO
Katherine Sun	Katherine_sun@fws.gov	USFWS
Kristin White	Knwhite@usbr.gov,	Reclamation/CVO
Kyle Griffiths	Walter.Griffiths@wildlife.ca.gov	CDFW
Lauren Damon	Lauren.Damon@wildlife.ca.gov	CDFW
Mario Manzo	MManzo@usbr.gov	Reclamation/BDO
Nader Noori	NNoori@usbr.gov	Reclamation/TO Management
Randi Field	RField@usbr.gov	Reclamation/CVO
Rene Reyes	RReyes@usbr.gov	Reclamation/TO Bio Resources
William Dutton	WDutton@usbr.gov	Reclamation/TO
Yow-min Tsao	YTsao@usbr.gov	Reclamation/TO Management

APPENDIX Q. Daylight Savings Times.

Appendix Q-1: Spring. Proper accounting for daylight savings in spring.

Facility: #2 **Operations and Count Summary Data Sheet - FEDERAL FACILITY** Page:_____ of _____

Operations 209-836-6233, Biologists 209-836-6221

This table is for tracking numbers of endangered, threatened, and species of concern for CVO.

Fax to Central Valley Operations (USBR) FAX: **916-979-3080**; phone number: **916-979-2448**

DATE: _____ Daily Acre Feet of Water Pumped at Bill Jones Pumping Plant: _____

Chinook Salmon Run Fork Length Ranges Based On Date

Winter-Run Range (mm): **Spring-Run Range (mm):**

				Numbers of Chinook Salmon (CS)				**Number of Threatened and Species of Concern. Y or N after the numbers indicate whether fish <20 mm FL are present in the sample.**				
Time	Count Minutes	Pumping Minutes	Salvage Minutes	CS Winter Run (CSWR)	Running Tally CSWR	CS Spring Run	Other CS Runs	Steelhead (STH)	Longfin Smelt (LFS)	Delta Smelt (DS)	Splittail (SPT)	Green Sturgeon (GST)
200	30	120	120									
*0400	30	60	60									
0600												
0800												
1000												
1200												
1400												
1600												
1800												
2000												
2200												
2400												
Total												

*** Expansion factor = 2 due to daylight savings.**

Fork lengths are measured to the nearest mm for all species. *In addition Total Length is measured for sturgeon. The letter "C" or "S" following the length measurement denotes that the salmon adipose fin is clipped or if the smelt is spent respectively. Abbreviate species names below (e.g. CS = Chinook Salmon).

Species	Collect Time	FL (mm)/ *TL(mm)	CS Run Winter=W Spring=S	Head Tag/ Coded Wire Tag #	Species	Collect Time	FL (mm)/ *TL(mm)	CS Run Winter=W Spring=S	Head Tag/ Coded Wire Tag #

Data Reviewed By: Updated: 3/11/2014

* Daylight Savings started, change time 1 hour ahead. 60 pumping/salvage minutes.

Appendix Q-1: Spring. Proper accounting for daylight savings in spring.

Operations and Counts Data Sheet - FEDERAL FACILITY

Facility #2 **Date: MM /DD /YYYY** **Daily Acre Feet Pumped:_____**

MM / DD /YYYY

Sample Time		0200	0400	0600	0800	1000	1200
Special Study Code							
Pumping Minutes		120	*60				
Salvage Minutes		120	*60				
Count Minutes		30	30				
Temperature (F)							
Bypasses Open							
Primary Depth (ft)							
Primary Flow (cfs)							
Secondary Depth Before (ft)							
Secondary Flow (cfs)							
Holding Tank Flow (cfs)							
Species Name	Code	Count	Count	Count	Count	Count	Count
Chinook Salmon	01						
Steelhead Trout	02						
Striped Bass	03						
White Catfish	04						
Channel Catfish	06						
American Shad	07						
Threadfin Shad	08						
Splittail	09						
Golden Shiner	13						
Black Crappie	18						
Bluegill	21						
Largemouth Bass	22						
Redear Sunfish	49						
Prickly Sculpin	29						
Yellowfin Goby	30						
Inland Silverside	31						
Delta Smelt	26						
Total Count	98						
Samplers Initials							

Data Reviewed By:

Daylight Savings start; change time 1 hour ahead. 60 pumping/salvage minutes.

Appendix Q-2: Fall. Proper accounting for daylight savings in fall.

Facility: #2 **Operations and Count Summary Data Sheet - FEDERAL FACILITY** Page:_____ of _____

Operations 209-836-6233, Biologists 209-836-6221

This table is for tracking numbers of endangered, threatened, and species of concern for CVO.

Fax to Central Valley Operations (USBR) FAX: **916-979-3080**; phone number: **916-979-2448**

DATE: _____ Daily Acre Feet of Water Pumped at Bill Jones Pumping Plant: _____

Chinook Salmon Run Fork Length Ranges Based On Date

Winter-Run Range (mm): **Spring-Run Range (mm):**

				Numbers of Chinook Salmon (CS)				**Number of Threatened and Species of Concern. Y or N after the numbers indicate whether fish <20 mm FL are present in the sample.**				
Time	Count Minutes	Pumping Minutes	Salvage Minutes	CS Winter Run (CSWR)	Running Tally CSWR	CS Spring Run	Other CS Runs	Steelhead (STH)	Longfin Smelt (LFS)	Delta Smelt (DS)	Splittail (SPT)	Green Sturgeon (GST)
*0200	45	180	180									
0400												
0600												
0800												
1000												
1200												
1400												
1600												
1800												
2000												
2200												
2400												
Total												

Fork lengths are measured to the nearest mm for all species. *In addition Total Length is measured for sturgeon. The letter "C" or "S" following the length measurement denotes that the salmon adipose fin is clipped or if the smelt is spent respectively. Abbreviate species names below (e.g. CS = Chinook Salmon).

Species	Collect Time	FL (mm)/ *TL(mm)	CS Run Winter=W Spring=S	Head Tag/ Coded Wire Tag #	Species	Collect Time	FL (mm)/ *TL(mm)	CS Run Winter=W Spring=S	Head Tag/ Coded Wire Tag #

Data Reviewed By: Updated: 3/11/2014

* Daylight Savings ended; change time 1 hour back. 180 pumping/salvage minutes; 45 count minute (25% of 180 min).

Appendix Q-2: Fall. Proper accounting for daylight savings in fall.

Operations and Counts Data Sheet - FEDERAL FACILITY

Facility #2 **Date: MM /DD /YYYY** **Daily Acre Feet Pumped:_____**

MM / DD /YYYY

Sample Time		0200	0400	0600	0800	1000	1200
Special Study Code							
Pumping Minutes		*180					
Salvage Minutes		*180					
Count Minutes		*45					
Temperature (F)							
Bypasses Open							
Primary Depth (ft)							
Primary Flow (cfs)							
Secondary Depth Before (ft)							
Secondary Flow (cfs)							
Holding Tank Flow (cfs)							
Species Name	Code	Count	Count	Count	Count	Count	Count
Chinook Salmon	01						
Steelhead Trout	02						
Striped Bass	03						
White Catfish	04						
Channel Catfish	06						
American Shad	07						
Threadfin Shad	08						
Splittail	09						
Golden Shiner	13						
Black Crappie	18						
Bluegill	21						
Largemouth Bass	22						
Redear Sunfish	49						
Prickly Sculpin	29						
Yellowfin Goby	30						
Inland Silverside	31						
Delta Smelt	26						
Total Count	98						
Samplers Initials							

Data Reviewed By:

Daylight Savings ended; change time 1 hour back. 180 pumping/salvage minutes; 45 count minute (25% of 180 min).

APPENDIX R. Species Codes and Common Names of Fish at the Tracy Fish Collection Facility.

Code	Species	Code	Species
1	Chinook Salmon	37	Surf Smelt
2	Steelhead	39	Pacific Staghorn Sculpin
3	Striped Bass	40	Riffle Sculpin
4	White Catfish	41	White Crappie
5	Brown Bullhead	42	Pacific Herring
6	Channel Catfish	43	Yellow Perch
7	American Shad	44	Black Bullhead
8	Threadfin Shad	45	Sacramento Perch
9	Sacramento Splittail	46	Tui Chub
10	Sacramento Pikeminnow	47	Silver Salmon
11	Threespine Stickleback	48	Pacific Brook Lamprey
12	Hardhead	49	Redear Sunfish
13	Golden Shiner	50	Sacramento Sucker
14	Common Carp	51	Fathead Minnow
15	Goldfish	52	California Roach
16	Hitch	53	Speckled Dace
17	Sacramento Blackfish	54	Pumpkinseed
18	Black Crappie	55	Blue Catfish
19	Green Sunfish	60	White Bass
20	Warmouth	61	Chameleon Goby
21	Bluegill	62	Pink Salmon
22	Largemouth Bass	63	Freshwater Eel
23	Bigscale Logperch	64	Red Shiner
24	Tule Perch	65	Wakasagi
25	Longfin Smelt	66	Shimofuri Goby
26	Delta Smelt	67	Rainwater Killifish
27	White Sturgeon	68	Northern Pike
28	Green Sturgeon	69	Shokihaze Goby
29	Prickly Sculpin	70	Spotted Bass
30	Yellowfin Goby	71	Large-scaled Loach
31	Inland Silverside	80	Mitten Crab
32	Starry Flounder	90	misc.
33	Lamprey (all spp.)	117	Striped Mullet
34	Western Mosquitofish	158	Pacific Lamprey
35	Yellow Bullhead	208	River Lamprey
36	Smallmouth Bass	256	Redeye Bass

APPENDIX S. Chain of Custody Forms.

Appendix S-1: Chain of Custody Form for DNA Tissue Transfer or Transport.

State of California - Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Wildlife & Fisheries Division / Marine Region

EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

CHAIN OF CUSTODY

Authority for possession per Fish & Game Code Sections 1002, 1002.5, 2080, 3511, 4700, 5050, 5515, California Code of Regulations Title 14 § 650

Original Collector:

Name:	U.S. Bureau of Reclamation
Address:	6525 Lindemann Rd.
City/State/Zip:	Byron, CA 94514
Phone No.:	(209) 836-6221 or (209) 836-6223
e-mail:	rreyes@usbr.gov OR bwu@usbr.gov

Authority of Original Collection (State and Federal Permits - if Applicable): 10(a)(1)

(A) or 4(d):	
CESA MOU:	
Scientific Collecting Permit:	
Biological Opinion:	2009 BiOp (Ref. No. 2008/09022) (BO)
Other:	CDFW Consistency Determination (Ref. No. 2080-2009-011-00)

Sample(s), Salvaged Animal(s), and/or Parts Thereof Information:

Line No.	ID(s)	Species	Collection			Sample Type	Preservation Type	No. of Samples
			Date(s)	Location	Method			

Transfer No. 1 -

Split Batch ☐ Yes ☐ No → If Yes, No. of Samples _____ ID(s) _____

Split Sample ☐ Yes ☐ No → If Yes, No. of Samples _____ ID(s) _____

Reliquished By Original Collector (Signature)	Print Name	Affiliation	Date
Recieved By (Signature)	Print Name	Affiliation	Date

Disposition of Samples:

Page ____ of ____

APPENDIX S. Chain of Custody Forms.

Appendix S-1: Chain of Custody Form for DNA Tissue Transfer or Transport.

Transfer No. ___ -
Split Batch ☐ Yes ☐ No → If Yes, No. of Samples ______ ID(s) ____________________
Split Sample ☐ Yes ☐ No → If Yes, No. of Samples ______ ID(s) ____________________

Reliquished By (Signature)	Print Name	Affiliation	Date
Recieved By (Signature)	Print Name	Affiliation	Date

Disposition of Samples:

Transfer No. ___ -
Split Batch ☐ Yes ☐ No → If Yes, No. of Samples ______ ID(s) ____________________
Split Sample ☐ Yes ☐ No → If Yes, No. of Samples ______ ID(s) ____________________

Reliquished By (Signature)	Print Name	Affiliation	Date
Recieved By (Signature)	Print Name	Affiliation	Date

Disposition of Samples:

Transfer No. ___ -
Split Batch ☐ Yes ☐ No → If Yes, No. of Samples ______ ID(s) ____________________
Split Sample ☐ Yes ☐ No → If Yes, No. of Samples ______ ID(s) ____________________

Reliquished By (Signature)	Print Name	Affiliation	Date
Recieved By (Signature)	Print Name	Affiliation	Date

Disposition of Samples:

Page ____ of ____

APPENDIX S. Chain of Custody Forms.

Appendix S-2: Chain of Custody Form for Coded Wire Tags Transfer or Transport.

U.S. Bureau of Reclamation Tracy Fish Collection Facility

Coded Wire Tag (CWT)—Chain of Custody

Head Number(s): _____

Name of TFCF Biologist: _____

Name of individual borrowing CWT(s): _____

Phone number of individual borrowing CWT(s):_____

Name of organization borrowing CWT(s): _____

Destination of CWT(s): _____

Estimated time of return of CWT(s): _____

TFCF Biologist signature	Method of transfer to borrower	/ / Date (dd/mm/yy)
Borrower's signature	Method of transfer to shipping stage	/ / Date (dd/mm/yy)
Shipper to destination signature	Method of transfer to destination	/ / Date (dd/mm/yy)
Receiver's signature		/ / Date (dd/mm/yy)

Each person in possession of the tag(s) must sign and date the form.

APPENDIX S. Chain of Custody Forms.

Appendix S-3: Chain of Custody Form for Specimen Transfer or Transport.

UNITED STATES BUREAU OF RECLAMATION

Tracy Fish Collection Facility
6525 Lindemann Road
Byron, CA 94514-9614

RECLAMATION
Managing Water in the West

CHAIN-OF-CUSTODY FORM

SECTION 1: Investigator Information		
Primary Investigator Name:		
Agency:		
Address:		
City/County:	State:	ZIP Code:
Phone No.:	Email:	
Project Name:		
Comments:		

SECTION 2: Transfer Information	
If transfering multiple species, please fill out species list and quantity on page 2	
Facility Contact (Print Name):	
Transfer Location:	Species:
Number Provided:	Preserved in:
Description: Include the number of containers, identification number(s) and a physical description of each sample submitted/received.	

SECTION 3: Chain of Custody		
Persons relinquishing and receiving samples/specimens must provide their signature, organization and date/time to document transfers.		
Relinquished By:	Organization:	Date/Time:
Signature:		
Received by:	Organization:	Date/Time:
Signature:		

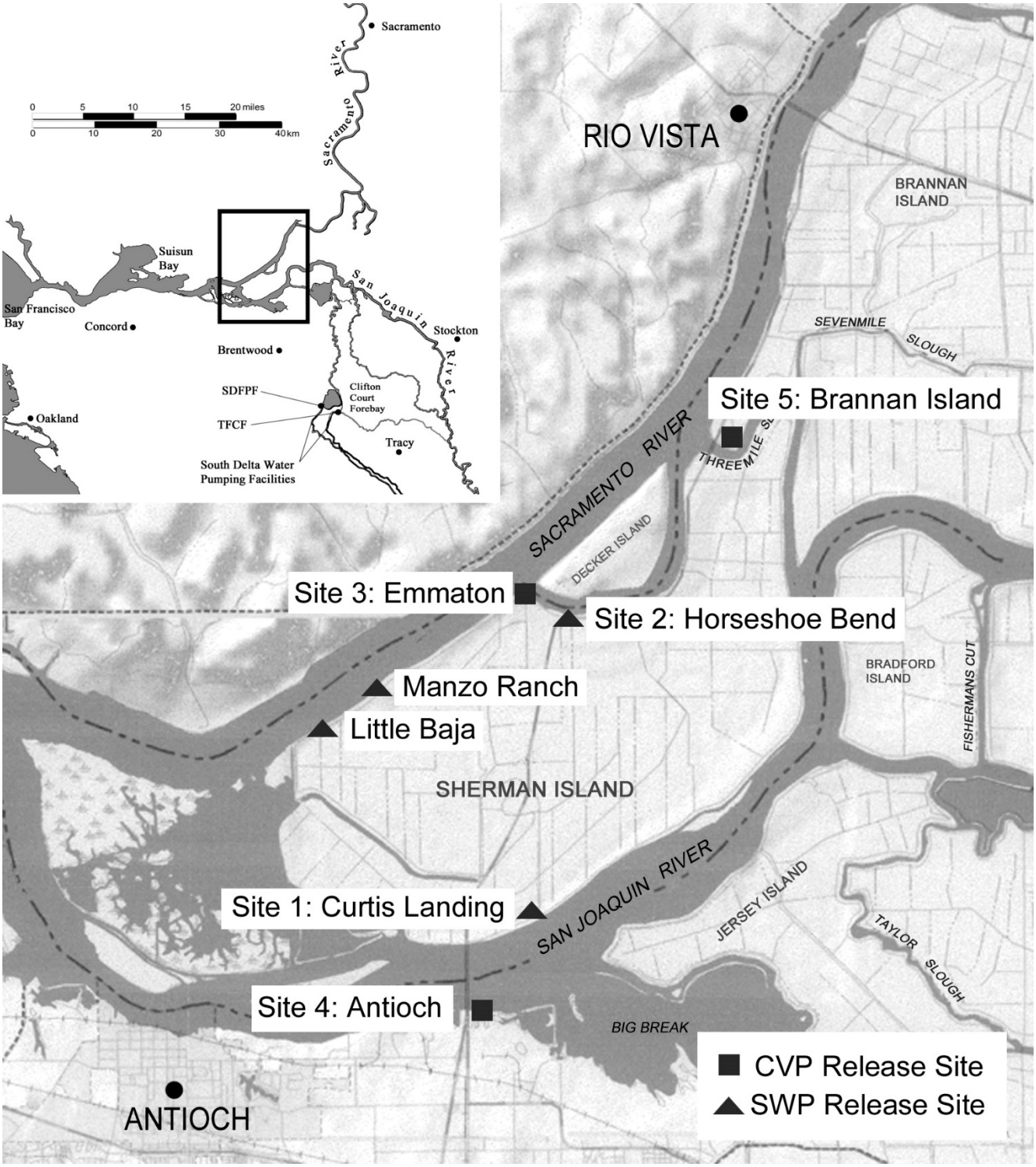
FOR OFFICIAL USE ONLY

Tracy Fish Collection Facility
6525 Lindemann Road
Byron, CA 94514-9614

RECLAMATION
Managing Water in the West

SECTION 4: Species List			
Species	Quantity	Species	Quantity
Chinook Salmon		Delta Smelt	
Striped Bass		Steelhead	
Green Sturgeon		White Sturgeon	
American Shad		Redear Sunfish	
Bigscale Logperch		Riffle Sculpin	
Black Bullhead		Sacramento Blackfish	
Black Crappie		Sacramento Perch	
Blue Catfish		Sacramento Pikeminnow	
Bluegill		Sacramento Sucker	
Brown Bullhead		Shimofuri Goby	
California Roach		Shokihaze Goby	
Chameleon Goby		Silver Salmon	
Channel Catfish		Smallmouth Bass	
Common Carp		Speckled Dace	
Fathead Minnow		Splittail	
Freshwater Eel		Staghorn Sculpin	
Golden Shiner		Starry Flounder	
Goldfish		Striped Bass	
Green Sunfish		Striped Mullet	
Hardhead		Surf Smelt	
Hitch		Threadfin Shad	
Inland Silverside		Threespine Stickleback	
Lamprey (all spp.)		Tui Chub	
Largemouth Bass		Tule Perch	
Longfin Smelt		Wakasagi	
Mitten Crab		Warmouth	
Northern Pike		Western Mosquitofish	
Pacific Brook Lamprey		White Bass	
Pacific Herring		White Catfish	
Pink Salmon		White Crappie	
Prickly Sculpin		Yellow Bullhead	
Pumpkinseed		Yellow Perch	
Rainwater Killifish		Yellowfin Goby	
Red Shiner		Other:	

APPENDIX T. Location of Release Sites.



APPENDIX U. Glossary

Bypass ratio. A unit-less value calculated by dividing the velocity of water at the primary or secondary bypass opening by the appropriate approach velocity.
cfs. Volume of water measured in cubic feet per second.
CO_2. Carbon dioxide.
Criteria. Mandated regulatory standards imposed on the TFCF depending on time of year.
Delta. Common name for the Sacramento-San Joaquin River Delta.
DO (ppm). Dissolved Oxygen measured in part per million.
DO (%L). Dissolved Oxygen measured in percent liter.
D-1485. State Water Resources Control Board Decision 1485.
Entrainment. A term used to define the influence of a project (e.g., SWP, CVP) to organisms, such as fish, by drawing them in by the flow of water for anthropogenic use.
Expansion factor. The value calculated by dividing the total minutes salvaging fish by the length of the fish count.
Fish count. The actual number of fish counted in the systematic counts. Fish counts are a sub-sample of a defined interval of time. Synonymous with “30-minute fish count” and “subsample”.
Fish loss. The removal of entrained fish from the facility either through the screens, predation, or mortality related to the salvage process.
Fish salvage. The act of diverting live and entrained fish into collection holding tanks for future release.
ft/sec. Velocity of water measured in feet per second.
Kg. Weight in kilogram.
Listed species. Fish species that are protected under the federal and California Endangered Species Act.
mm FL. Fork Length of fish in millimeters.
MS-222. Tricaine methanesulfonate, chemical used for anesthesia and euthanasia.
Outage. The inability to (1) properly screen the entire flow and (2) conduct fish salvage operations according to mandated operational criteria.
ppt. Parts per thousands.
Salinity (ppt). Salt content in a solution measured in parts per thousands.
Salvage. The process of collecting, holding, transporting, and releasing of entrained fish.
Salvage estimate. The value calculated by multiplying the total number of fish (by species) by an expansion factor.
Site 1. Curtis Landing Fish Release Site (SWP).
Site 2. Horse Shoe Bend Release Site (SWP).
Site 3. Emmaton Fish Release Site (CVP).
Site 4. Antioch Fish Release Site (CVP).
Site 5. Brannan Island Fish Release Site (CVP).

Specific Conductivity (µS/cm). Conductivity or ability of solution to conduct electricity measured in micro-Siemens per centimeter.

Temperature (°C or °F). Water temperature measured in degree Celsius or degree Fahrenheit.

"COLLECT". Influent pipe measuring 20-inches in diameter for filling a holding tank.

"DRAIN". Effluent pipe measuring 12-inches in diameter for draining a holding tank. Sometimes called "small drain".

"FILL". Effluent pipe measuring 18-inches in diameter used during fish sampling and continuous salvage of a holding tank. Sometimes called "large drain".

"JACK". Pneumatic control used to lift and lower the holding tank screen.

µS/cm. Micro-Siemens per centimeter.

8888. Special Study code.

9999. Predator Removal code.

APPENDIX V. Communications Directory

I. RESPONSIBLE OFFICES

A. BUREAU OF RECLAMATION SUPERVISORY OFFICE HAVING JURISDICTION

Tracy Administrative Office
16650 Kelso Rd.
Byron, CA 94514
8 am – 4 pm (Pacific Time)

Point of First Contact (for an emergency or an unusual occurrence):

O&M Division Chief (8-4:30)……..	(cell) 916-588-0827……..	(office) 209-836-6252
Fish Facility Chief (8-4:30)……..…	(cell) 209-597-1356…….……	(office) 209-836-6276
General Information: ……..…..	(office) 209-836-6244	
Administrative Supervisor……..……..	(cell) 925-390-8155…….……	(office) 209-836-6249
Local Security Official……..…	(cell) 209-608-2133…….……	(office) 209-836-6261
Local Security Official……..…	(cell) 916-893-2878…….……	(office) 209-836-6241
Local Security Official (backup)……..	(cell) 209-566-5569……..….	(office) 209-836-6212
Western Area Power Administration…	(WAPA) On site security……..……	(office) 209-597-2027

B. OPERATING OFFICE

Tracy Fish Collection Facility[1]
6525 Lindemann Rd.
Byron, CA 94514

Main Office……...	(office) 209-836-6244……..	(Fax) 209-836-6264
Equipment Operator Supervisor……..	(on-call) (cell) 209-601-5263……..	(office) 209-836-6217
Operations & Maintenance Office…..	(cell) 209-836-6233……..……	(office) 209-836-6206
Biological Resources Office……	(cell) 209-601-5821……..	(office) 209-836-6223
Biological Resources Office……	(office) 209-836-6222……..….	(Fax) 209-833-0387

[1] TFCF is manned 24 hours

South-Central California Area Office
1243 'N' Street
Fresno, CA 93721-1813
7:30 am – 4:30 pm (Pacific Time)

Main Office……..…	Phone# (VoIP 559-262-0300)……..	(Fax VoIP) 559-262-0371
Area Office Manager……..….	(office) 559-262-0300…….……..	
Deputy Area Manager……...……	(office) 559-262-0304…….……..	
Safety/Occupational Health Manager...	(cell) 559-374-9217……..……...	(office) 559-262-0316

California-Great Basin Regional Office, Interior Region 10
2800 Cottage Way
Sacramento, CA 95825

Central Valley Operations……..…	(office) 916-979-2197……..	(office) 916-979-2196
Bay-Delta Area Office Manager…….	(office) 916-414-2401……...	
Bay-Delta Science Division Chief.…	(office) 916-414-2405……...	

II. COOPERATING AGENCIES AND ENTITIES

A. CALIFORNIA STATE AGENCIES

California Department of Fish and Wildlife
Bay-Delta Region
2109 Arch Airport Rd
Stockton, CA 95206

Main Office……...…..	(office) 209-234-3420	
Native Fishes and Operations Monitoring Unit……....	(cell) 209-639-2750...…	(office) 209-234-3672

B. FEDERAL AGENCIES

National Marine Fisheries Service (NMFS)
NOAA Fisheries West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814-4706

California Central Valley Office…….	(office) 916-930-3629……..	(office) 916-930-3607

U.S. Fish and Wildlife Service (USFWS)
850 S. Guild Ave, Suite 105
Lodi, CA 95240

Main Office…….……..	(office) 209-334-2968……..
Delta Juvenile Monitoring Program.…	(office) 209-334-2968…….…….

C. DOWNSTREAM FACILITIES

“Bill” Jones Pumping Plant
Operated by San Luis & Delta-Mendota Water Authority (SLDMWA)
15990 Kelso Rd.
Byron, CA 94514

Operations and Maintenance Manager	(cell) 209-620-5377……..	(office) 209-832-6240
Operations Supervisor……..……	(cell) 209-996-8019…….….	(office) 209-832-6242
SLDMWA Control Room…….	(office) 209-832-6245…….…..	(office) 209-833-1040

III. Emergency Services

A. LAW ENFORCEMENT AND CIVIL EMERGENCY *In case of emergency, notify:*

Law Enforcement.....	Alameda Co. Sheriff's Dept. (For the TO Complex)…….	510-667-7721
Law Enforcement…..	Contra Costa Co. Sheriff's Dept. (For the TFCF)……..	925-646-2441

B. MEDICAL AID

Hospital with ER……	Tracy Sutter Hospital, 1420 N Tracy Blvd……..	209-832-6018
Poison Control……...	Poison Control Center……..	800-222-1222

C. FIRE PREVENTION AND PROTECTION

Fire……...	Alameda Co. Emergency Dispatch Center……..	510-881-8181
Fire……...	San Joaquin County…….	800-913-9113