2016 FEATHER RIVER HATCHERY CHINOOK SALMON AND STEELHEAD SPAWNING AND RELEASE PROTOCOL

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List of Tables and Figures

General Comments:

1) Feather River Fish Hatchery is the original, "proper" name for this facility. Therefore, the correct acronym is FRFH, not FRH. This correction has been made in documents regarding the FRFH for about the last 10 years
2) Consider NOT including the two attachments.
    a. This makes for a very long annual Spawning and Release Protocol document.
    b. Some of the HSRG Recommendations conflict directly with this Spawning and Release Protocol document. Confusing.
    c. The San Joaquin Document has too much information for this Spawning and Release Protocol document? Isn't the Section 1.3 summary sufficient?
    d. If these two documents are attachments, should the other programs also be attachments, such as the Delta Fish Agreement and the Ocean Enhancement Program? Once approved, will the HGMP be attached as well?
3) Note: once approved, it is DWR's intent for the HGMPs to be the prevailing document used to direct how the FRFH will be operated. Don't know exactly how this fits in with this HSRG effort, but I want to make sure that everyone understands DWR's frame of reference on this.

Background:

The Feather River Hatchery, a facility of the California State Water Project, was constructed to mitigate for the spawning and rearing habitat eliminated due to construction of Oroville Dam. The Feather River Hatchery (FRH) conducts two artificial propagation programs for Central Valley (CV) Chinook salmon: CV spring-run and CV fall-run, and oneartificial propagation program for CV steelhead. CV spring-run Chinook are listed as threatened under both the California Endangered Species Act and the Federal Endangered Species Act. CV fall-run Chinook provide for economically important commercial fisheries as well as popular sport fisheries in the ocean and inland. CV steelhead are listed as threatened under the Federal Endangered Species Act.

The primary purpose of the spring-run program is to conserve and promote phenotypic spring-run Chinook salmon in the Feather River. A coequal purpose of the program is to mitigate for spawning and rearing habitat eliminated due to construction of Oroville Dam. Additionally, due to the threatened status of spring-run it is crucial that hatchery operations are conducted in a way that minimizes impacts to natural spawning populations of CV spring-run populations, including those in Mill, Deer, Clear, and Butte Creeks. Another spring-run program is currently being conducted at the FRH to support the San Joaquin River Restoration Program, and this has been occurring since 2012.

Due to past hatchery spawning practices and overlap in spawning habitat in-river, spring and fall runs on the Feather River are introgressed. In 2012, the California Hatchery Scientific Review Group (HSRG) released the California Hatchery Review Report that establishes specific recommendations for all California hatcheries, including the FRH. (See Attachment A) The report states, "Most hatcheries were producing fish for harvest primarily to mitigate for past

habitat loss (rather than for conservation of at- risk populations) and were not taking into account the effects of their programs on naturally spawning populations (CA HSRG 2012). With numerous species listed as threatened or endangered under the Endangered Species Act, Congress identified salmon conservation as a high priority." The document further states, "The goal of this hatchery program review initiative is to ensure that hatchery programs are managed and operated to meet one or both of the primary purposes for hatcheries:

- Helping recover and conserve naturally spawning salmon and steelhead populations, and
- Supporting sustainable fisheries with little or no deleterious consequence to natural populations."

Since 2012, spawning practices at FRH have been refined and reviewed annually to further meet HSRG recommendations and to specifically minimize introgression between runs on the Feather River.

The primary purposes of the fall-run program is to mitigate for spawning and rearing habitat eliminated due to construction of Oroville Dam and secondarily to support river and ocean fisheries. In years when funding and broodstock allow, FRH will produce additional fall-run Chinook for fishery enhancement. The enhancement program is funded through the Salmon Stamp program. Additionally, fall-run are produced for a small cold-water fishery in Lake Oroville.

The FRH steelhead program is implemented as an integrated hatchery mitigation program for spawning and rearing habitat eliminated due to the construction of Oroville Dam. Another program is currently being conducted at the FRH related to the Delta Fish Agreement, where an additional 50,000 steelhead smolts are released. This is an integrated production program and provides recreational fishing opportunities. Both hatchery and natural origin steelhead from the Feather River are considered part of the Central Valley steelhead ESU (NOAA 2006).

Chinook salmon

1.0 Spring-run Chinook Salmon Broodstock Collection and Spawning Protocol:

1.1 Broodstock Identification

Only early arriving Chinook salmon (phenotypic spring-run) will be used as broodstock for the spring-run Chinook program. Fish ascending the fish ladder April through June will be trapped and tagged regardless of whether they are hatchery or natural origin. The trapping and tagging process typically begins on or about April 1st and continues through June and consists of double tagging fish with two sequentially numbered and color coded Hallprint Dart tags on either side of the dorsal fin. Number sequences are unique to each fish. Water flow into the FRH ladder will be reduced on July 1st to prevent new fish from entering the ladder. Any mortality observed during the broodstock tagging will be documented and the heads will be removed for Coded Wire Tag (CWT) extraction from any fish with an adipose fin clip.

When tagging is complete, any remaining spring-run left in the FRH ladder will have no more than one week to ascend the ladder. The gathering tank will be used to remove any fish in the trap before dewatering the ladder. This process can be less than one week, but after a one-week period the ladder will be dewatered. Any fish still in the ladder prior to dewatering will be crowded back down the ladder into the river.

During spring of 2016, approximately, 2,917 fish where tagged with two yellow floy tags following the methods described above (Table 1). See table 2 for comparison to previous years.

Table 1- 2016 FRH Spring-run Broodstock Tagging

2016 FRH Spring-run broodstock tagging												
	5/18/2016	5/31/2016	6/7/2016	6/9/2016	6/14/2016	6/20/2016	6/29/2016	7/6/2016			Totals	% OF TOTAL
# Tagged	165	908	449	654	46	87	522	86			2917	
Single tags	0	16	5	16	1	2	2	1			43	1.5%
Recaps	0	7	24	66	11	15	151	56			330	11.3%
Wild	2	21	10	25	0	3	25	4			90	3.1%
Morts	0	0	0	0	0	0	0	0			0	0.0%
Acoustic tags	0	0	0	0	0	0	0	0			0	0.0%

Table 2- Spring-run broodstock tagging and adipose fin clip rate for returning adults collected in 2004-2016.

Total Spring Run Hallprint Tagged	Wild/clipped	Year
3650		2004*
6021	48.30%	2005
17438	76.50%	2006
9755	60.50%	2007
1915	54.30%	2008
1462	22.70%	2009
3502	9.80%	2010
6023	25.90%	2011
7494	14.20%	2012
20057	0.90%	2013
7289	7.50%	2014
5355	2.97%	2015
2917	3.09%	2016

* 2004 was the first year that juvenile spring-run were tagged at a 100% rate.
This likely influenced the adipose fin clip rate in returning adults for the subsequent four years.

1.2 Broodstock collection and spawning

For spring-run spawning, the FRH ladder will be opened on Monday, September 19th, 2016. Fish entering the hatchery will be sorted and all Hallprint tagged spring-run Chinook broodstock will be separated from all other Chinook and placed into round tanks for subsequent spawning. Spawning will occur whenever enough numbers of ripe spring-run broodstock (Hallprint Dart tagged fish) have accumulated in the round tanks of roughly equal sex ratio. If it is determined by hatchery staff that spring-run spawning can be conducted, hatchery staff will notify all individuals involved in tissue and scale

collection, and CWT recovery as to when spawning will commence. All other Chinook entering the hatchery during the spring-run spawning period will be excised and counted. No fish will be returned to the river to avoid issues of properly accounting for escapement totals and to reduce hatchery impacts to natural area spawners. Spring-run broodstock collection and spawning will start September 20th and continue through September 30th, 2016.

1. Fish are brought up on the lift and sorted by sex onto the table.

2. As fish are being pulled off the table to spawn, the front of house (FOH) data recorder will record sex, indicate if it is a jack or adult, adipose fin clip status, and the unique Hallprint number onto a data card. The data card will then be attached to an egg tub to track the parentage of the eggs in each tub.

    a. Grilse will be incorporated at 2%

    b. FRH staff will attempt to eliminate the reuse of males as much as possible, however if males are used multiple times, they will be treated as new fish each time they are spawned and will be recorded on the associated data card for each tub they are used for. If male is used again the card should be highlighted, so that it is easily identified as a multiple spawned fish.

    c. If two tubs of eggs are combined after fertilization both data cards will be attached to the tub of combined eggs. There will be a maximum of two females eggs combined in a tub to avoid confusion and data recording errors.

3. Once a tub is filled with fertilized eggs, the FOH data recorder will attach the data card(s) to the tub. The tub will then be brought back to the egg room by an egg runner. Eggs will be enumerated by taking a 1.1 oz sample of flaccid eggs from each tub and counted. The remaining eggs will then be measured and thoroughly rinsed in UV water, and placed into an incubator tray. The total number of eggs per tub will be extrapolated and entered onto both the data sheets (used by San Joaquin Restoration Program-SJRRP) and data cards (used by FRH). The data cards will be removed from the tub and given to the back of house (BOH) data recorder when the eggs are emptied into an incubation tray. Egg tubs will be rinsed thoroughly with UV water prior to being reused.

4. When the tub of fertilized eggs is emptied into an incubator tray, stack and tray number will be recorded on the data card by the BOH data recorder.

5. If eggs are determined to be overripe, all the eggs in the tub will be discarded, and the BOH data recorder will check the 'Discarded' box on the data card. The stack and tray information will be left blank on the data card.

6. When all data card fields are filled and complete, it will be grouped with the other cards from the day, scanned and sent to Ocean Salmon Project (OSP) for entry into a database.

7. Spawned fish carcasses will immediately be brought to the OSP/CWT sampling station. Fish Hallprint ID tag numbers from mating pairs will be recorded and removed. The fish will then be prepared for CWT sampling.

8. Broodstock collection will continue until 1,400 adults of roughly equal sex ratio have been collected or 3 million green eggs have been taken, this assumes about a 66% survival. These collection targets have been shown to allow for meeting production goal of 2 million (±10%) fish, though egg lot culling may be necessary if survival is better than expected. This also provides for some assurances against unforeseen mortality/disease issues. Any excess Hallprint Dart tagged broodstock will be excised and not returned to the river. In addition, any other salmon entering the hatchery during this period will be excised and counted. Spring-run spawning operations will be complete by September 30th.

Hallprint Dart tagged fish will be spawned using a true 1 male:1 female ratio; the milt from a single male will be placed in a container and then combined with the eggs from one female. Every attempt will be made to not reuse males, which may result in not meeting the daily or annual egg collection goal. The head will be removed from any adipose clipped (ad-clipped) fish for CWT processing. If CWT analysis shows that a FRH fall-run fish contributed to the egg collection, the stack and tray of eggs from that spawned pair will be identified and the eggs discarded.

If possible, CWT analysis will also be used to examine contribution rates of hatchery-origin strays from other CV hatcheries into individual egg trays. Trays that have positive identification of hatchery-origin strays will be discarded. Eggs will be collected to meet production goals according to the chart provided (Table 3, Figure 1). Infectious haematopoietic necrosis (IHN) samples will be collected from the first 60 females.

1.3 San Joaquin Collection

After FRH spring-run egg collection goals are met, eggs will be collected for the San Joaquin Restoration Program. The first collection is for broodstock. A total of 350 pairs will be mated and 2,760 eggs taken for broodstock. A single pair is kept in each tray. Data from each pair will be collected for the San Joaquin program and virology samples will be taken for IHN. In order to achieve sufficient genetic variability, staff collects eggs from 350 paired crosses. This will allow rejection of a significant number of crosses and yet provide substantial genetic variability in the future broodstock population. The second collection of 80,000 eggs will be taken for annual production release as pre-smolts.

Egg collection for the San Joaquin River Restoration Program will be secondary to collection for the spring run Chinook program for the FRH (Attachment B) and will be dependent on time constraints and available brood stock.

2.0 Fall-run Chinook Broodstock Collection and Spawning Protocol

2.1 Broodstock collection and spawning

Fall-run spawning will commence on October 10, 2016. All salmon entering the hatchery on or after this date that does not carry a Hallprint tag will be considered a candidate for inclusion in the fall-run broodstock. Broodstock collection and spawning will be

conducted in a manner that represents fish arriving from throughout the fall-run spawning period.

All fish entering the hatchery between the spring and fall-run spawning period (October 1 – October 9) will be excised with the exception of those fish spawned for the Lake Oroville cold water fishery program (see section 2.2). Culling all Chinook salmon entering the hatchery between the spring and fall-run spawning period is intended to increase the temporal separation between spring and fall runs, decrease the potential for spring-run introgression into fall-run lots, and reduce hatchery impacts to natural area spawners.

During fall-run spawning, broodstock can include all salmon (adipose fin intact and fin clipped) except Hallprint dart tagged salmon. Hallprint dart tagged salmon entering the hatchery during the fall-run spawning period will be excised and heads collected for CWT extraction. Spawning and egg collection will follow the egg collection model described in Table 4 unless run timing or numbers of fish are insufficient. Based on CWT analysis of previous years, spring-run contribution rates tend to be elevated in egg trays collected during the first two weeks of fall-run spawning. Targeting adipose fin intact fall-run broodstock, eliminates the potential for incorporating hatchery origin spring-run into fall-run lots but can reduce broodstock available for spawning. If fall-run spawning includes both adipose fin intact and fin clipped fish in the broodstock CWT analysis will be used to identify lots with high spring-run contribution rates (see below for discussion on contribution rates). Fall-run incubator trays containing CWT-identified spring-run parents will be culled in a manner that increases the temporal separation between spring and fall runs (i.e. earliest to latest in the fall-run spawning period). The Feather River Hatchery Operations Team (FRHOT) will review CWT data on spring-run contribution rates into fall-run trays in near real-time and determine the need for culling.

In previous years, fall-run broodstock included some fish that were collected during the spring-run spawning period and held until fall-run spawning had commenced. By limiting fall-run broodstock collection to the period after October 10th, it allows us to adhere to the conservation goals of increasing temporal separation between spring- and fall runs in the Feather River and limiting introgression.

As in the previous four years, implementing protocols to improve run separation and reduce gene flow between runs takes precedence over meeting fall-run production goals. Depending upon run size and egg collections, fall-run egg trays may be culled in a manner that decreases introgression of spring-run into fall-run trays even if this means not meeting production goals. Fall-run Chinook will be collected and held in round tanks until they are needed for spawning purposes. Every attempt will be made to spawn fall-run Chinook using a true 1 male:1 female ratio. Reuse of males will be avoided if possible and may result in not meeting egg collection goals some days. The head will be removed from any adipose clipped fish for coded-wire tag (CWT) processing. If needed CWT analysis will be done on broodstock for collected fall-run egg trays to determine spring/fall run contribution rates. Fall-run egg incubation trays with spring run contribution based on CWT analysis will be culled. CWT analysis will be used to examine contribution rates of hatchery-origin strays from other CV hatcheries into individual egg trays. Egg trays with confirmed out-of-basin strays will be discarded. The combined mitigation and enhancement program production goal is 7.06 million juveniles. No more than 12 million green eggs will be collected throughout the run. This target will allow for egg culling, if necessary, as well as for assurances against unforeseen mortality or disease issues. Eggs will be

collected to represent the spectrum of the run to meet production goals according to the chart provided (Figure 2).

1. Fish are lifted into the hatchery, sorted on the table by sex, and each **ad-clipped** fish is marked with a reusable tag (5 ¾ inch safety pin with uniquely numbered tag attached to the lower jaw or operculum.

2. As fish are pulled off the table to spawn, the front of house (FOH) data recorder will record sex, jack or adult, and ad-clip status of each spawned fish on the data card. For non-clipped fish, a line will be drawn through the 'ID Number' field. For ad-clipped fish, the spawner will read off the tag ID number to the data recorder. Completed data cards are attached to the egg tub. Each tub will have at least one and no more than two data cards associated with it.

    a. Every effort will be made to reduce the reuse of males, however, males that are used multiple times will be treated as new fish each time they are spawned and will be recorded on the associated data card for each tag they are used for.

    b. If two tubs of eggs are combined after fertilization, both data cards will be attached to the egg tub of combined eggs. There will be a maximum of two females combined in a tub to avoid confusion and data recording errors.

3. Once a tub is filled with fertilized eggs, the data card (s) will be attached to the tub by the FOH data recorder. The tub will then be brought back to the egg room by an egg runner.

4. When the tub is emptied into an egg tray, the BOH data recorder will remove the data card and record which stack and tray number the eggs went into on the data card. If the tub is split between two trays, the data recorder will write the numbers of both stacks and trays the eggs went into.

5. If eggs are determined to be overripe, all eggs in the tub will be discarded and the BOH data recorder will check the 'Discarded' box on the data card. The stack and tray information will be left blank on the data card. Once a data card has all fields filled out, it will be grouped with the rest of the daily cards, scanned and sent to Ocean Salmon Project (OSP) for entry into database.

6. Spawned fish carcasses will immediately be brought to the OSP sampling station in pairs that have been spawned with each other. The fish ID numbers will be recorded, and the ID tags will be removed and the fish prepared CWT sampling.

7. After all data and samples are collected, carcasses suitable for human consumption will be given to American Canadian Fisheries and Enterprise Rancheria for processing and distribution.

2.2 **Lake Oroville Coldwater Fishery**

Adult fall-run Chinook will be used as broodstock for the Lake Oroville cold-water fishery. Trays intended to be used for this program will be isolated immediately after

spawning in the inland hatchery building and will be subject to IHN evaluation and prevention measures. Eggs used for this program will be collected on October 3rd using only adipose intact fish. Using adipose intact fish will eliminate the potential for hatchery produced spring-run being incorporated into fall-run inland fish broodstock. This program is anticipated to require approximately 200,000 green eggs which will be culled as necessary to no more than 155,000 eyed eggs to meet an allotment of 125,000 fish.

2.3 Pathology Protocol

Fertilized eggs will be drained of ovarian fluid and milt in a colander, rinsed in UV water, and then hardened in incubation trays using 4 oz. iodophor for disinfection.

3.0 Chinook Salmon Production Goals:

During the 2016/2017 spawning season priority will be given to improving temporal separation between spring and fall runs.
The current production goals for release from FRH are as follows:

Spring-Run Chinook Salmon Mitigation:	Up to 2 million smolts
Fall-Run Chinook Salmon Inland:	Up to 125,000 yearlings
Fall-Run Chinook Salmon Mitigation:	Up to 6 million smolts
Fall-Run Chinook Salmon Enhancement:	Up to 1.06 million smolts and post smolts*

*Post smolts range in size between 30-45 fish per pound

For both spring and fall runs, assumed survival from green to eyed egg stage is assumed to be approximately 90 percent between green and eyed egg stage and 95 percent for eyed egg to ponding of fish. Total green egg take will be 2,000,000 over eyed egg stage goals. This egg take buffer over actual production goals allows for potential mortality in egg trays and culling of trays if necessary due to differential survival between trays. Culling will be done so that the last tally of eyed eggs prior to ponding fish represents no more than 10% over the actual production goals for release and an equal proportion is removed from each tray in order to reach the minimum needed egg take. This will again provide a buffer against any potential mortality while fish are in the raceways.

Table 3- Spring-run Eyed Egg Goal

	Feather River Hatchery 2016																
	Spring-run Eyed Egg Goal			2,000,000													
	Date	Status	Lot #	# of females (assume one spawning pair per incubation tray)	Actual Green Eggs Collection (assume 4,500 eggs/female)	Predicted Percent culling rate	Predicted Egg Collection after culling	Actual Percent culling rate	Actual Egg Collection after culling	Assumed 80% Survival to eyed after culling based on Predicted Egg collection	Assumed 85% Survival to eyed after culling	90% Survival to eyed after culling	Assumed 80% Survival to eyed after culling based on actual Egg collection	Assumed 90% Survival from eyed egg to ponded fish based on column L Predicted Egg collection	Assumed 90% Survival from eyed egg to ponded fish based on column M Predicted Egg collection	Assumed 95% Survival from eyed to ponded fish based on Predicted Egg collection	Actual estimate of ponded fish
1	9/19	Expected	1	67	301,500	1%	298,485			238,788	253,712	253,712		228,341	228,341	241,027	
2	*	Expected	2	133	598,500	1%	592,515			474,012	503,638	503,638		453,274	453,274	478,456	
3	*	Expected	3	222	999,000	1%	989,010			791,208	840,659	840,659		756,593	756,593	798,626	
4	*	Expected	4	178	801,000	1%	792,990			634,392	674,042	674,042		606,637	606,637	640,339	
5	9/29	Expected	5	133	598,500	1%	592,515			474,012	503,638	503,638		453,274	453,274	478,456	
6	9/30	SJRRP		175	787,500												
		Totals		908	4,086,000		3,265,515		0	2,612,412	2,775,688	2,775,688		2,498,119	2,498,119	2,636,903	

Figure 1- 2016 Predicted SRCS Egg Collection

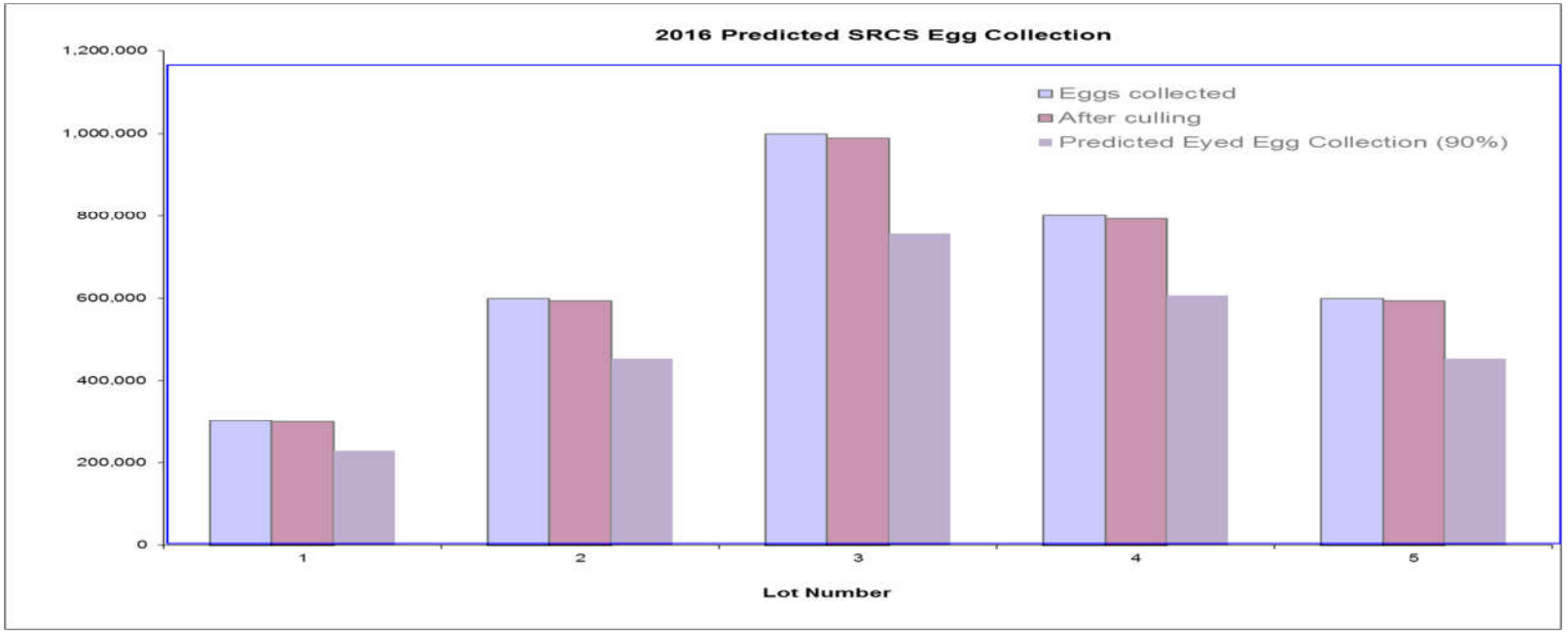
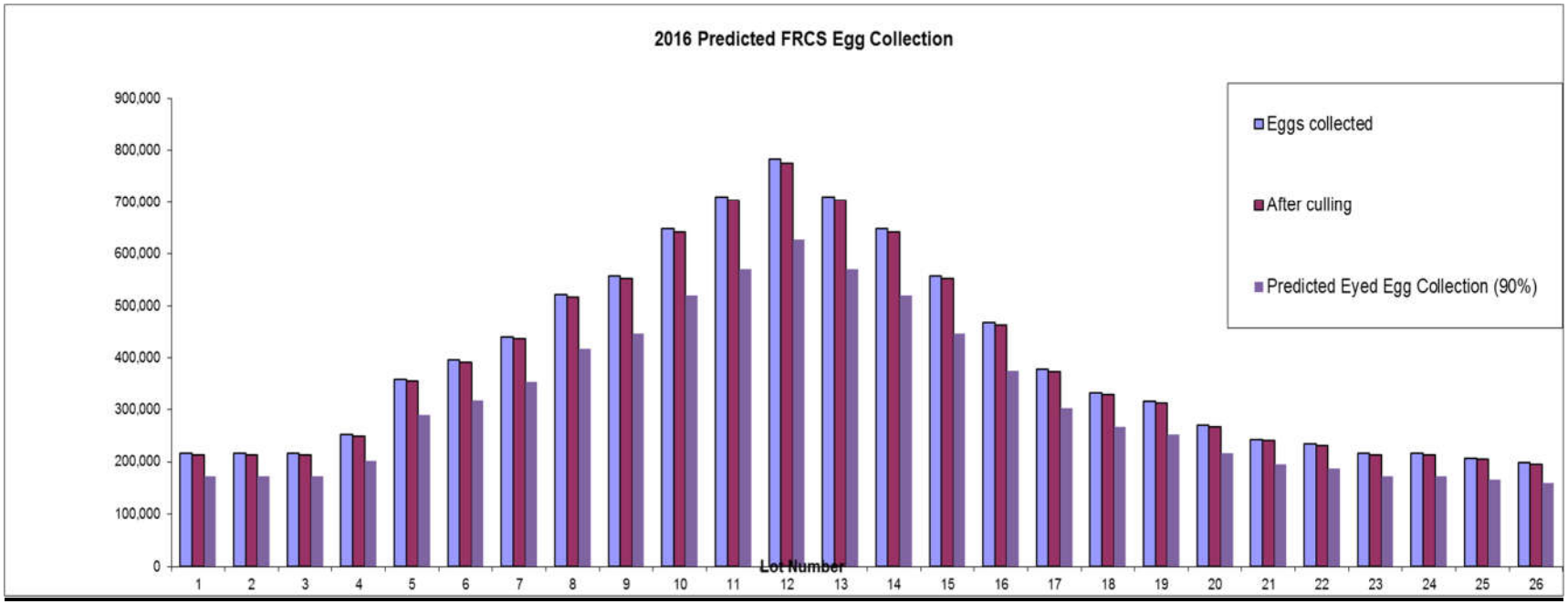


Table 4- FRCS Egg Collection

	Feather River Hatchery 2016														
	Fall-run Eyed Egg Goal		8,000,000 (6,000,000 mitigation & 2,000,000 enhancement)												
	Date	Status	# of females (assume two spawning pairs per incubation tray)	Expected Green Eggs Collection (assumes 4500 eggs/female)	Actual Green Eggs Collection	Predicted Percent culling rate	Predicted Egg Collection after culling	Actual Percent culling rate	Actual Egg Collection after culling	Assumed 80% Survival to eyed after culling based on Predicted Egg collection	Assumed 85% Survival to eyed after culling	90% Survival to eyed after culling	Assumed 80% Survival to eyed after culling based on actual Egg collection	Assumed 90% Survival from eyed egg to ponded fish based on column L Predicted Egg collection	Assumed 90% Survival from eyed egg to ponded fish based on column M Predicted Egg collection	Assumed 95% Survival from eyed to ponded fish based on Predicted Egg collection
1	10/11	Expected	48	216,000		1%	213,840			171,072	181,764	192,456	0	163,588	173,210	182,833
2	*	Expected	48	216,000		1%	213,840			171,072	181,764	192,456	0	163,588	173,210	182,833
3	*	Expected	48	216,000		1%	213,840			171,072	181,764	192,456	0	163,588	173,210	182,833
4	*	Expected	56	252,000		1%	249,480			199,584	212,058	224,532	0	190,852	202,079	213,305
5	*	Expected	80	360,000		1%	356,400			285,120	302,940	320,760	0	272,646	288,684	304,722
6	*	Expected	88	396,000		1%	392,040			313,632	333,234	352,836	0	299,911	317,552	335,194
7	*	Expected	98	441,000		1%	436,590			349,272	371,102	392,931	0	333,991	353,638	373,284
8	*	Expected	116	522,000		1%	516,780			413,424	439,263	465,102	0	395,337	418,592	441,847
9	*	Expected	124	558,000		1%	552,420			441,936	469,557	497,178	0	422,601	447,460	472,319
10	*	Expected	144	648,000		1%	641,520			513,216	545,292	577,368	0	490,763	519,631	548,500
11	*	Expected	158	711,000		1%	703,890			563,112	598,307	633,501	0	538,476	570,151	601,826
12	*	Expected	174	783,000		1%	775,170			620,136	658,895	697,653	0	593,005	627,888	662,770
13	*	Expected	158	711,000		1%	703,890			563,112	598,307	633,501	0	538,476	570,151	601,826
14	*	Expected	144	648,000		1%	641,520			513,216	545,292	577,368	0	490,763	519,631	548,500
15	*	Expected	124	558,000		1%	552,420			441,936	469,557	497,178	0	422,601	447,460	472,319
16	*	Expected	104	468,000		1%	463,320			370,656	393,822	416,988	0	354,440	375,289	396,139
17	*	Expected	84	378,000		1%	374,220			299,376	318,087	336,798	0	286,278	303,118	319,958
18	*	Expected	74	333,000		1%	329,670			263,736	280,220	296,703	0	252,198	267,033	281,868
19	*	Expected	70	315,000		1%	311,850			249,480	265,073	280,665	0	238,565	252,599	266,632
20	*	Expected	60	270,000		1%	267,300			213,840	227,205	240,570	0	204,485	216,513	228,542
21	*	Expected	54	243,000		1%	240,570			192,456	204,485	216,513	0	184,036	194,862	205,687
22	*	Expected	52	234,000		1%	231,660			185,328	196,911	208,494	0	177,220	187,645	198,069
23	*	Expected	48	216,000		1%	213,840			171,072	181,764	192,456	0	163,588	173,210	182,833
24	*	Expected	48	216,000		1%	213,840			171,072	181,764	192,456	0	163,588	173,210	182,833
25	*	Expected	46	207,000		1%	204,930			163,944	174,191	184,437	0	156,771	165,993	175,215
26	*	Expected	44	198,000		1%	196,020			156,816	166,617	176,418	0	149,955	158,776	167,597
		Totals	2,292	10,314,000			10,210,860		0	8,168,688	8,679,231	9,189,774	0	7,811,308	8,270,797	8,730,285
	* Specific spawning dates and lot sizes are variable and depend on availability of ripe fish.															

Figure 2- FRCS Egg Collection


2016 Predicted FRCS Egg Collection
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Eggs collected
After culling
Predicted Eyed Egg Collection (90%)
Lot Number
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
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19
20
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22
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26

4.0 Chinook Release Strategy

4.1 Spring-run Release Approach

In 2016, hatchery personnel will replicate the release strategy that was implemented in 2015. The first release of SRCS will be the "early" release, scheduled for mid to late-March. The target release weight is a minimum of 90 fish/lb. The second release will be the "late" release, scheduled for mid to late-April. Two groups of approximately 500,000 (1 million total) marked (CWT) SRCS will be released. The target release weight is a minimum of 60 fish/lb. The early release is being implemented to evaluate survival of spring-run released in-river at a smaller size than past releases (past releases have been approximately 60 fish/lb). Two in-river release sites (Gridley and Boyd's Pump Boat Launch) will be used to evaluate differences in survival and stray rate with release location.

Sentinel hatchery fish will be used during the releases and water quality samples will be collected to continue monitoring for the prevalence and severity of *Ceratonova shasta* and its effect on Feather River Chinook salmon.

Criteria and Contingencies In coordination with the National Marine Fisheries Service (NMFS) CDFW has developed the following criteria and triggers that will be used to inform decisions on the release strategy to be implemented in 2017. These criteria and triggers were developed based on review of water temperature, river flow, Delta Cross Channel Gate operations. The criteria identified below are designed to minimize the risk of exposing FRH produced FRCS salmon to river conditions that could result in extremely low survival. Each of the criteria indicated below are intended to be independent of the others, meaning that if any one or more of the criteria are anticipated to be met then FRH produced FRCS salmon should be transported to the acclimation net pens for release into San Pablo Bay. If none of the triggers are forecast to be met, then juveniles will be released into Feather River, as describe above in section 4.2.

Delta Cross-channel Gates operations – Survival of juvenile salmon is significantly reduced when gates are open and increased numbers of fish are diverted into the interior Delta.

- Cross-channel gates are forecast* to be open within 21 days** days of the date when the hatchery salmon are ready to be released.

Water Temperature – Increased water temperatures above 70 degrees has been shown to be detrimental to juvenile survival.

- Sustained Daily Average Water temperatures are expected to be greater than 74 F at Verona within 21** days of the date when the hatchery salmon are ready to be released.
- Sustained Daily Average Water temperatures are expected to be greater than 74 F at Freeport within 21** days of the date when the hatchery salmon are ready to be released.

Flow – Decreased flows in the Sacramento River lead to significantly reduced survival of juvenile salmon because of reduced travel times exposing the fish to increased predation and increased risk of diversion into the interior Delta where survival is significantly reduced.

- A Sacramento River flow at Verona of less than 4,000 cfs is forecast* to occur within 21** days of the date when the hatchery salmon are ready to be released.
- A Sacramento River Flow of less than 6,000 cfs at Freeport is forecast to occur within 21**

days of the date when the hatchery salmon are ready to be released.
• Delta Outflow is forecast* to be less than 3,000 cfs within 21** days of the date when the hatchery salmon are ready to be released.

If during any of these assessments, existing/predicted conditions are expected to meet the criteria triggering consideration of the alternative release strategy. Alternative release strategy would be an early release of all SRCS into the Feather River at Boyd's pump.

4.2 Fall-run Release Approach

One million juvenile fall-run Chinook salmon juveniles (mitigation salmon) will be release into the Feather River in Late April. An in-river release of one million juvenile fall-run Chinook salmon (FRCS) from the mitigation production will allow management to assess the behavior, condition, and survival of salmon as well as their return and stray rates. Like the SRCS releases, the FRCS in-river release will be a paired release evaluating survival at two locations (Gridley and Boyd's Pump Boat Launch). Each release will contain 500,000 FRCS marked (CWT and adipose fin-clipped) at a rate of 100%.

Criteria and Contingencies In coordination with the National Marine Fisheries Service (NMFS) CDFW has developed the following criteria and triggers that will be used to inform decisions on the release strategy to be implemented in 2017. These criteria and triggers were developed based on review of water temperature, river flow, Delta Cross Channel Gate operations. The criteria identified below are designed to minimize the risk of exposing FRH produced FRCS salmon to river conditions that could result in extremely low survival. Each of the criteria indicated below are intended to be independent of the others, meaning that if any one or more of the criteria are anticipated to be met then FRH produced FRCS salmon should be transported to the acclimation net pens for release into San Pablo Bay. If none of the triggers are forecast to be met, then juveniles will be released into Feather River, as describe above in section 4.2.

Delta Cross-channel Gates operations – Survival of juvenile salmon is significantly reduced when gates are open and increased numbers of fish are diverted into the interior Delta.

• Cross-channel gates are forecast* to be open within 21 days** days of the date when the hatchery salmon are ready to be released.

Water Temperature – Increased water temperatures above 70 degrees has been shown to be detrimental to juvenile survival.

• Sustained Daily Average Water temperatures are expected to be greater than 74 F at Verona within 21** days of the date when the hatchery salmon are ready to be released.
• Sustained Daily Average Water temperatures are expected to be greater than 74 F at Freeport within 21** days of the date when the hatchery salmon are ready to be released.

Flow – Decreased flows in the Sacramento River lead to significantly reduced survival of juvenile salmon because of reduced travel times exposing the fish to increased predation and increased risk of diversion into the interior Delta where survival is significantly reduced.

• A Sacramento River flow at Verona of less than 4,000 cfs is forecast* to occur within 21** days of the date when the hatchery salmon are ready to be released.
• A Sacramento River Flow of less than 6,000 cfs at Freeport is forecast to occur within 21** days of the date when the hatchery salmon are ready to be released.

• Delta Outflow is forecast* to be less than 3,000 cfs within 21** days of the date when the hatchery salmon are ready to be released.

If during any of these assessments, existing/predicted conditions are expected to meet the criteria triggering consideration of the alternative release strategy, then preparations will begin, continue, or be implemented to truck appropriate groups of fish to the acclimation net pens in San Pablo Bay as scheduled.

The remainder of the 5 million FRCS from the mitigation production will be marked at the standard constant fractional marking rate of 25% in groups of 1.0 million or 500,000 fish per tag code depending on raceway logistical needs. Batches of mitigation hatchery produced fish will be released when they reach target size of 60 fish/lb in April through June. Weight counts will be taken as fish are being loaded into transport trucks and recorded on release receipts following standard hatchery practices. Salt will be added to a level of ten parts per thousand to transport tank trucks prior to loading fish for transport. Transport equipment will not be allowed to make contact with receiving water to prevent the spread of aquatic invasive species.

The release location will be selected depending on weather, availability of net pens, and CDFW management review. Time of plant, temperature of receiving water and transport tank water, and the condition of the fish during release will be recorded on planting receipts. FRCS will be loaded into net pens at either Conoco Phillips or Mare Island then released into the San Pablo Bay. Mitigation production net pen releases will consist of ten groups of approximately 500,000 like CWT tagged fish.

1.06 million Enhancement FRCS salmon will be marked at the standard constant fractional marking rate of 25% with a single tag code and loaded into net pens at Fort Baker then released near the Golden Gate Bridge. Enhancement fish will be released April-June at approximately 45 fish/lb. The Fort Baker release site will only be used if all access permit approvals can be obtained from the National Parks Service prior to scheduled release. If permit approvals cannot be obtained in time to release fish at Fort Baker, the Enhancement fish will be released in the San Pablo Bay via Conoco Phillips or Mare Island net pens.

All net pen releases will be conducted on the outgoing tide and timed such that no more than two days of releases are scheduled in a row from the same location. Groups of 1.0 million like CWT fish may be split and released over two consecutive days from the same location as necessary to meet hatchery logistical constraints.

Steelhead

Background:

The FRH conducts an artificial propagation program for CV steelhead trout on the lower Feather River. Natural origin CV steelhead are listed as a threatened species by the National Marine Fisheries Service. CV steelhead provide a popular freshwater sport fishery.

The FRH is operated by the California Department of Fish and Wildlife (CDFW) The primary purpose of the steelhead hatchery program is to mitigate for salmon and steelhead spawning and rearing habitat eliminated due to construction of Oroville Dam in 1968, and secondarily to support the ocean and freshwater fisheries. Annual mitigation goals for steelhead in the

Feather River are to collect 1,000,000 eggs and release 400,000 yearlings (±10 percent) at 3 fish/pound for the mitigation program, and another 50,000 for the Delta Fish Agreement.

5.0 Steelhead Broodstock Collection and Spawning Protocol

The HSRG provided several recommendations for the FRH generally and for Steelhead specifically. CDFW continues to incorporate those recommendations when possible. Non-anadromous (resident) fish should not be used as broodstock and the current 16-inch minimum length for broodstock should be continued. We acknowledge that resident *O mykiss* may occasionally exceed 16" in length. Broodstock for the program should only come from native, locally adapted stocks. The target is to use 10-50% natural origin broodstock. The HSRG recommends 10% natural origin broodstock as a minimum, even if it requires alternate collection locations and methods. Currently FRH is limited to broodstock collection at the hatchery itself and the incorporation of natural origin fish is between 1-10%.

Out-of-sub-basin importation of eggs, juveniles or adults should not occur, unless from Mokelumne River which has been shown to be genetically similar to the FRH broodstock, even if it means juvenile production targets will not be achieved in some years. It is not surprising that the Mokelumne River Fish Hatchery broodstock is genetically like FRH since the MRFH Steelhead were derived from FRH Steelhead several years ago. There are no specific goals for the number of adult steelhead produced by these two programs; however, the juvenile production goal is to release 450,000 yearling steelhead annually at three fish/pound during November.

All natural-origin steelhead will be returned to the river (spawned or unspawned), all hatchery-origin females will be returned to the river (spawned or eggs removed), and all hatchery-origin males will be held at the hatchery in round tanks prior to out stocking at the Thermalito Afterbay or Feather River at Verona. Prior to release 50 males will be acoustically tagged and released. 25 steelhead will be put in the Afterbay and 25 steelhead in the Feather River at Verona. This study will help managers track behavior and survival of hatchery origin males released back to the River.

A partial factorial mating scheme will be used for the fall 2016 Steelhead spawning program to help improve effective size, create more different genotypes in offspring, and hedge against infertile males and females. Coupled with genetic relatedness data on the parents, this design will enable FRH to determine if there is also a correlation of egg hatch rate and survival with levels of relatedness between the parents.

1) Spawning will incorporate a 2x2 partial factorial mating scheme:
    a. Assuming two males and two females are available and ripe, the eggs from each female will be divided into two separate pans. Each male will be used to fertilize a separate pan. Thus, for two females (female A and B) and two males (male 1 and 2), a total of four pans are used, creating four individual families (A1, A2, B1, and B2).
    b. If there are an unequal number of males and females, FRH should perform a 2x3 or 3x2 partial factorial mating system.
    c. The 4 family groups (1A,1B,2A,2B) will be tracked separately by tray in the eachstack:

		Males	
		A	B
Females	1	1A	1B

	2	2A	2B

d. Individual males and females along with their gamete tray and stack information will be identified on the envelopes containing the fin clips for genetic samples. The individual egg trays will also be labeled with the parentage information linking back to the genetic sample. Eg. Females #1 and #2 and males #A and #B will each have a tissue sample collected from them, and the actual trays containing their eggs will be likewise labelled

2) Genetic tissue samples (fin clips) will be collected such that genetic profiles can be associated with individual broodstock and the actual crosses performed:
   a. Fin clips will be sent to the NOAA SWFSC genetics laboratory for genotyping each individual used for spawning.

3) Individual crosses will be separated and tracked in egg trays as long as time and space permit (estimated 30-45 days post-fertilization). FRH is in the process of acquiring dividers for trays:
   a. FRH will measure the approximate number of juveniles produced per family so that an accurate estimate of effective size can be calculated.

4) Consideration will be given to culling egg lots from highly related parents after calculating relatedness for the parental crosses. Prior to any culling CDFW geneticist and the FRHOT will meet to discuss ramifications and make a decision on which lots to cull if any. Depending on the genetic results obtained from the SWFSC laboratory the goal will be to balance effective size with relatedness control. It has been documented that hatchery progeny created from crosses between broodstock at the half sib level of relatedness or greater do not survive or return to the hatchery.

5) Limit male re-use:
   a. The number of times each male fish is spawned will be documented and tracked. The re-use of males will be limited wherever possible, outside of the 2x2 or 2x3 spawning events.

6) Non-FRH fish should be not be spawned
   a. Candidate broodstock identified as Nimbus or Coleman-produced fish will not be spawned, and will be euthanized

5.1 Steelhead Release

All FRH steelhead are marked with an adipose fin-clip prior to release. In 2015, low steelhead numbers entering the hatchery produced less than the 450,000-target goal. For 2016, due to the recent low production numbers, steelhead will all be released into the Feather River at the Boyd's Pump Boat Launch. In response to HSRG recommendations to release steelhead as far upstream as possible upstream (ie: Gridley boat launch) in-river release locations will be considered in future years.

If the FRH survival is good and production is greater than 450,000 steelhead at 3 fish/pound, a release of not more than 10,000 steelhead will be considered for the popular Thermalito Afterbay fishery.

Attachment A: HSRG recommendations

California Hatchery Scientific Review Group (California HSRG 2012) has established recommendations for the FRH. For reference some of the recommendations that pertain to production are included:

5.6.1 Recommendations for All Feather River Hatchery Programs

- Clear goals should be established for the program. Program production goals should be expressed in terms of the number of age-3 ocean recruits just prior to harvest (Chinook salmon), and the number of adults returning to freshwater (steelhead).

- Transporting and releasing juveniles to areas outside of the Feather River and near or downstream of the confluence of the Yuba River should be discontinued. Juvenile fish should be released at the hatchery, or if not possible, as far upstream in the Feather River from the confluence of the Yuba River as possible to reduce adult straying and increase the number of adult fish returning to the hatchery. Consider necessary facility modifications or equipment purchases that will facilitate onsite releases. Release locations for steelhead may take into consideration ecological and predation effects on other fish populations but should not compromise homing of adults to the hatchery.

- Managers should investigate the feasibility of collecting natural-origin adult fish at alternate locations. The existing trapping location is very limited in its ability to capture fish representing the entire spectrum of life history diversity. Only fish that migrate to the furthest upstream reaches are susceptible to capture.

- Adult holding facilities should be upgraded and/or expanded to provide adequate space, water flows and temperature regimes to hold the number of adults required for broodstock at high rates of survival (greater than 90 percent). In addition, because of a lack of adult holding space, fall Chinook are returned to the river to make room for late arriving spring Chinook. Evaluate the prospects of using the Thermalito Annex Facility for the long-term holding of spring Chinook broodstock. While the Annex water temperature is relatively high, a pilot study could be used to determine whether any associated increased holding mortality was sufficiently offset by the Annex's otherwise excellent water quality.
- Natural-origin fish should be incorporated into broodstock at a minimum rate of 10 percent to prevent divergence of the hatchery and natural components of the integrated population. This may require auxiliary adult collection facilities or alternative collection methods (e.g., seining or trapping).

- A Monitoring and Evaluation Program should be developed and implemented and a Hatchery Coordination Team formed for the program. Implementation of these processes will inform hatchery decisions and document compliance with best management practices defined in this report.

- Performance standards for each phase of the fish culture process should be established and tracked annually. Summaries of data collected with comparisons to established targets must be included in annual hatchery reports.

- CDFG should develop and promulgate a formal, written fish health policy for operation of its anadromous hatcheries through the Fish and Game Commission policy review process. Hatchery compliance with this policy should be documented annually as part of a Fish Health Management Plan. The current CDFG fish health policy is inadequate to protect native stocks.

- CDFG should develop an updated Hatchery Procedure Manual which includes performance criteria and culture techniques presented in IHOT (1995), Fish Hatchery Management (Wedemeyer 2001) or comparable publications. The fish culture manual (Leitritz and Lewis 1976) is outdated and does not reflect current research and advancements in fish culture.

5.6.2 Feather River Fall Chinook- Major Program Recommendations

The major recommendations of interest to resource managers for the Feather River fall Chinook salmon hatchery program are provided below. Those selected for presentation may represent major changes in operations, changes in approach or outcomes towards achieving harvest or conservation objectives, or will require substantial investment of resources. The California HSRG's evaluation of program compliance with standards and guidelines and the group's comments about this program are presented in their entirety in Appendix VIII.

- Use of the Feather River Annex for rearing should be discontinued unless juveniles are released in the vicinity of the Annex and an adult collection facility is installed in the downstream outlet of the Thermalito Afterbay.

- The program should limit the number of eggs taken to the number necessary to meet production goals (which would include a reasonable overage to account for egg loss and culling of spring x fall crosses). On average, the program takes about 20 million eggs to produce 6 million juveniles.

- Tag analysis should be used to determine the fall and spring hatchery-origin Chinook spawned during the suspected period of run overlap (e.g., fish spawned in the last two weeks of spring Chinook spawning and the first two weeks of fall Chinook spawning). Tags should be read and egg lots tracked and eliminated from production as appropriate to reduce introgression of the two runs. Incubation techniques should therefore allow for separation of eggs from individual parents/families (no more than two families per tray).
- Only unmarked fish should be spawned in the fall brood (FRH spring Chinook are 100 percent adipose fin-clipped, FRH fall Chinook are 25 percent adipose fin-clipped) to reduce the need for culling. Any spring x fall Chinook crosses of hatchery-origin fish (e.g., due to marking or mark detection errors) should be identified by coded wire-tag analysis and eggs should be culled soon after spawning.

- Until all off-site releases of Chinook salmon are eliminated in the entire Central Valley, coded wire tag analysis should be used to identify stray hatchery-origin fish among those fish selected for broodstock. Strays from other hatchery programs should not be used as broodstock, or if eggs are collected from or fertilized by such fish, they should be culled soon after spawning.

- Program fish should be 100 percent coded wire-tagged and 25 percent adipose fin-clipped.

5.6.3 Feather River Spring Chinook- Major Program Recommendations

The major recommendations of interest to resource managers for the Feather spring Chinook salmon hatchery program are provided below. Those selected for presentation may represent major changes in operations, changes in approach or outcomes towards achieving harvest or conservation goals, or will require substantial investment of resources. The California HSRG's evaluation of program compliance with standards and guidelines and the group's comments about this program are presented in their entirety in Appendix VIII.

- Tag analysis should be used to determine the number of fall and spring Chinook spawned during the suspected period of run overlap (e.g., fish spawned in the last two weeks of spring Chinook spawning and the first two weeks of fall Chinook spawning). Tags should be read and egg lots tracked and eliminated from production as appropriate to reduce introgression of the two runs. Incubation techniques should therefore allow for separation of eggs from individual parents/families (no more than two families per tray).

- Until all off-site releases of Chinook salmon are eliminated in the entire Central Valley, coded wire tag analysis should be used to identify stray hatchery-origin fish among those fish selected for broodstock. Strays from other hatchery programs should not be used as broodstock, or if eggs are collected from or fertilized by such fish, they should be culled soon after spawning.

5.6.4 Feather River Steelhead- Major Program Recommendations

The major recommendations of interest to resource managers for the Feather River steelhead hatchery program are provided below. Those selected for presentation may represent major changes in operations, changes in approach or outcomes towards achieving harvest or conservation goals, or will require substantial investment of resources. The California HSRG's evaluation of program compliance with standards and guidelines and the group's comments about this program are presented in their entirety in Appendix VIII.

- A Hatchery Coordination Team should be established to review the status of the FRH steelhead program.

- The number of eggs taken annually should be reduced to a level appropriate to produce 450,000 juveniles and the transfer of eggs to other programs terminated. Collection of excess eggs is permissible to increase effective population size as long as culling is done representatively.
- Broodstock for the program should only come from native, locally adapted stocks. Out-of-subbasin importation of eggs, juveniles or adults should not occur, even if it means juvenile production targets will not be achieved in some years.

- Non-anadromous (resident) fish should not be used as broodstock and the current 16-inch minimum length for broodstock should be continued.

- Hatchery-origin adult steelhead returns to the hatchery should be treated as follows: (1) unspawned males should be extended reconditioned and released; (2) unspawned females should be stripped of eggs, extended reconditioned and released; and (3) spawned fish should be removed from the system, or extended reconditioned and released.

- Natural-origin adult steelhead returns to the hatchery, whether spawned or unspawned, should be released. Fish may be reconditioned prior to release.

  - The program should limit the number of eggs taken to the number necessary to meet production goals (which would include a reasonable overage to account for egg loss and culling of spring x fall crosses). On average, the program takes about 20 million eggs to produce 6 million juveniles.

  - Tag analysis should be used to determine the fall and spring hatchery-origin Chinook spawned during the suspected period of run overlap (e.g., fish spawned in the last two weeks of spring Chinook spawning and the first two weeks of fall Chinook spawning). Tags should be read and egg lots tracked and eliminated from production as appropriate to reduce introgression of the two runs. Incubation techniques should therefore allow for separation of eggs from individual parents/families (no more than two families per tray). Only unmarked fish should be spawned in the fall brood (FRH spring Chinook are 100 percent adipose fin-clipped, FRH fall Chinook are 25 percent adipose fin-clipped) to reduce the need for culling. Any spring x fall Chinook crosses of hatchery-origin fish (e.g., due to marking or mark detection errors) should be identified by coded wire-tag analysis and eggs should be culled soon after spawning.

  - Until all off-site releases of Chinook salmon are eliminated in the entire Central Valley, coded wire tag analysis should be used to identify stray hatchery-origin fish among those fish selected for broodstock. Strays from other hatchery programs should not be used as broodstock, or if eggs are collected from or fertilized by such fish, they should be culled soon after spawning.

Attachment B: 2016 Donor Stock Collection Plan for the Reintroduction of Central Valley Spring-Run Chinook Salmon into the San Joaquin River

1.0 Introduction

The Donor Stock Collection Plan (DSCP) for the collection of broodstock and translocation source fish for the San Joaquin River Restoration Program (Program) is developed annually by a team of technical experts comprising the Donor Stock Collection Work Group (DSC). Recommendations from two technical subgroups, the Reintroduction Monitoring Subgroup (RM) and the Conservation Facility Subgroup, contribute to the DSCP. The process facilitates interagency collaboration between and among the donor watersheds and the Program, and the assimilation and evaluation of real time information on donor stock population status, Conservation Program status, San Joaquin River conditions, and the specifics of collection methods, and reintroduction methods to develop the DSCP.

The Conservation Facility Subgroup is responsible for recommending fish collections for the Program's Conservation Facility for broodstock development. The recommendation is based on the current and projected holding capacity at the facility. The Conservation Facility Subgroup includes representatives from State and Federal fisheries jurisdictional agencies (California Department of Fish and Wildlife [CDFW], National Marine Fisheries Service [NMFS] and US Fish and Wildlife Service [USFWS]) as well as Bureau of Reclamation (USBR) fisheries biologists.

The RM includes fisheries biologists from the Program, donor streams, and other interested parties. This subgroup is responsible for providing information on the donor stock populations (population status, potential impacts, collection protocols), collection and reintroduction plans (locations, life stages, timing, detailed protocols) to the interagency Donor Stock Collection Work Group.

This document describes the Program's recommendation for brood year 2016 spring-run Chinook salmon (*Oncorhynchus tshawytscha*) broodstock collection and reintroduction activities. The recommendation includes the number of individuals to be collected by life-stage, timing and methods of collection, proposed final disposition of fish, and recent population information for the recommended donor stock population. Detailed protocols covering all recommended activities are provided within the appendices.

The NMFS 10(a)1(A) Permit (Permit 14868) held by the USFWS authorizes take of Feather River Fish Hatchery (FRFH) spring-run Chinook salmon for broodstock collection during the five year term of the permit, which began with the 2012 broodstock collections. Collections are recommended to meet the needs of the Conservation Facility Program for broodstock development.

The NMFS 10(a)1(A) Permit (Permit 17781) held by the USFWS authorizes take of FRFH spring-run Chinook salmon for direct translocation of tagged fish into the San Joaquin River Restoration Area for the 5 year term of the permit, which began with the 2014 translocation releases. In 2014, CDFW provided a letter concurring with the permit and NMFS completed the

Nonessential Experimental Population ESA 10j/4d Rule. The reintroduction methodology provided for translocation incorporates an investigative approach to meet the needs of achieving our reintroduction goals. The short-term goal is to improve our knowledge of survival potential and refine methods for long term success.

2.0 Recommendation for Collections of Spring-run Chinook Salmon

2.1 Summary

Brood year 2016 spring-run Chinook salmon from the FRFH are being requested for use in two elements of the Program. The elements are: (1) collections for the Conservation Facility to develop a multiple year class of spring-run Chinook salmon broodstock for the reintroduction program; and (2) direct translocation of FRFH spring-run salmon to the San Joaquin River Restoration Area. Table 1 specifies the numbers of eyed eggs that are recommended for each purpose and the planned disposition of the fish.

Table 1. Donor Stock Collection Recommendations for Spring-run Chinook salmon brood year 2016.

Source	Life-stage	Number	Purpose	Disposition
Feather River Fish Hatchery (ALL)	Spring-run eyed eggs	60	Pathology	Sacrificed as juveniles
	Spring-run eyed eggs	2,700	Broodstock Development	Interim Facility in 2015 and 2016 Conservation Facility in
	Spring-run eyed eggs	80,000	Translocation*	San Joaquin River Restoration Area

*60 individuals of the 80,000 would be taken for pathology if translocation fish are to be reared at FRFH until juvenile stage.

2.2 Donor Population Status

Eggs and/or juveniles would only be collected after the FRFH has collected three million fertilized eggs to meet its production goal of two million spring-run Chinook salmon smolts, which occurs in most years (Table 2). The number of the fish in excess of those needed to meet the FRFH production target varies from year to year (Table 3). The number of adults that enter the FRFH during the fall spawning period can be estimated based on the number that enter the FRFH ladder in the spring when they are tagged with a Hallprint® tag and then returned to the river until they mature (Anna Kastner, personal communication). Based on tagging data from 2004 to 2015, a mean of 39.4% of the adult spring-run salmon tagged at the FRFH in May and June returned to the FRFH in the fall (Table 4).

Table 2. Feather River Fish Hatchery spring-run Chinook salmon returns and smolt production from 2004 to 2015 (Anna Kastner, personal communication, 21Jan2016).

Year	Male	Female	Jack/Jill	Smolts Released
2004	2,100	1,530	572	3,842,318
2005	927	824	23	1,801,748
2006	1,379	673	9	2,080,210
2007	866	980	3	2,686,808
2008	761	686	7	2,024,012
2009	383	484	122	2,122,131
2010	1,001	654	6	2,337,843
2011	855	976	138	2,244,989
2012	1,591	1,919	228	2,159,091
2013	2,959	1,291	44	2,296,788
2014	1,402	1,217	177	1,764,005
2015	1,761	1,703	136	--

Table 3. Adult spring-run Chinook salmon in excess of those needed to meet the FRFH juvenile production target at the Feather River Fish Hatchery from 2008 to 2015 (Anna Kastner, personal communication, 21Jan2016).

Year	Female	Male	Jack/Jill	Died in Tank
2008	250	334	No data	240
2009	4	14	34	76
2010	390	43	6	256
2011	447	326	No data	No data
2012	1247	907	228	0
2013	651	2,319	44	0
2014	826	419	36	0
2015	996	983	52	0

Table 4. Number of adult spring-run Chinook salmon tagged at the FRFH during the spring (Total Tagged) and the number that returned to the FRFH in the fall from 2004 to 2015 (Anna Kastner, personal communication, 21Jan2016). It is important to note reservoir release patterns and Chinook salmon fish regulations in the low flow channel of the Feather River influence the number of spring-run that return to the hatchery in the fall. Salmon fishing was closed in the low flow channel in the Feather River in 2008.

Year	Total Tagged	Fall Hatchery Returns	% Hatchery Returns
2004	3,650	834	22.8%
2005	5,960	1,835	30.8%
2006	10,179	1,768	17.4%
2007	9,756	1,849	19.0%
2008	1,915	1,058	55.2%
2009	1,462	989	67.6%
2010	3,502	1,661	47.4%
2011	6,023	1,969	32.7%
2012	7,465	3,738	50.1%
2013	20,057	4,294	21.4%
2014	7,289	2,776	38.1%
2015	5,335	3,717	69.7%

3.0 Conservation Facility Recommendation

3.1 Status of the Facility

The reintroduction plan for the Program relies on the Conservation Facility to develop a self-sustaining population of spring-run Chinook salmon for the San Joaquin River using genetic management and conservation hatchery techniques. Descriptions of these tools are provided in the Stock Selection Strategy (FMWG 2010), HGMP (Börk & Adelizi 2010) and GMP (Baerwald et al. 2011). The Program's Interim Conservation Facility (Interim Facility) first used Merced River fall-run Chinook salmon to refine experimental broodstock rearing practices. Rearing FRFH origin spring-run Chinook salmon for broodstock began in spring 2013 (Mahardja and Adelizi 2014). In 2015, the collection of eggs from the FRFH was increased from 560 to 1,935 eggs to meet the Program's objective of spawning up to 300 females in September 2018 after the construction of the full-scale conservation facility (SCARF).

The construction of the SCARF is now scheduled to be completed by November 2017. Until the facility is operational, the Program would continue to use the Interim Facility for fish production. The ability of the Interim Facility to rear the full 2016 collection through adulthood is dependent on the complete functionality of recently installed additional rearing tanks and water recirculation systems, completing associated permits, and completing the construction of the full-scale Conservation Facility by November 2017.

3.2 Recommendation for Collection

The Conservation Facility Subgroup recommends the collection of up to 2,760 eyed eggs from the FRFH during the 2016 spring-run spawning period to be used for captive rearing at the

Interim Facility and eventually the SCARF as allowed by the Section 10(a)1(A) permit (Permit 14868). However, if it is determined that there is insufficient capacity to rear the full collection of 2,760 individuals to maturity due to construction or permitting delays for the SCARF, the Conservation Facility Subgroup recommends that the Program collect 2,760 eggs and release excess broodstock to the San Joaquin River Restoration Area once the Interim Facility reaches maximum capacity in accordance to NMFS Permit #17781. To accommodate this recommendation, tagged excess broodstock from brood years 2013, 2014, and 2015 may be released to the Restoration Area as needed at a range of ages, including smolts through age-2^{+} fish. If juveniles are released, they will likely be released downstream of passage barriers. Conversely, adults may be released in reaches with access to suitable holding and spawning habitat. A final decision regarding the number of broodstock collected would be made prior to September 1, 2016.

3.3 Collection Methods

Throughout the 2016 spawning period, Program staff would segregate crosses from a minimum of 350 paired matings. This would (1) allow the rejection of a significant number of crosses and (2) provide substantial genetic variability in the future broodstock population. Parents selected for these crosses would be comprised of 5 percent or less (males and females) two year-old fish in total (as estimated by length data and later confirmed by coded-wire-tag [CWT] data) in accordance to NMFS Permit #14868. Fish with adipose fins (i.e. supposed wild origin spring-run) may be used in crosses in effort to reduce hatchery induced selection. Data to be tracked for each cross include: Hallprint® tag number, Hallprint® tagging date, adipose fin status, head tag number, CWT number, sex, fork length, ovarian fluid and kidney tissue sample number, volume of flaccid eggs per female, daily egg expansion factor, fecundity, tissue sample number and corresponding genetic analysis data. These data will be used to select eyed eggs from preferred crosses that meet Program criteria. In general, the collected eyed eggs will be transported to the Silverado Fisheries Base for hatching, quarantine, additional pathogen screening, and coded-wire tagging. All fish will be adipose-fin clipped and implanted with a CWT. Subsequently, juveniles will be transferred to the Interim Facility where they will be reared through adulthood. Once individuals reach a fork length of approximately 55mm in total length, they will be sampled for genotyping and sex, and implanted with a Passive Integrated Transponder. Specifics related to collection, segregation, transportation and pathology testing are included in Attachment A.

3.4 Recommended Research

The Conservation Subgroup recommends that the following research be considered for implementation in 2016:

1. Investigate methods to produce larger female broodstock to improve egg and juvenile quality;
2. Develop and implement a plan for releasing Interim Facility produced adults to the San Joaquin River Restoration Area in the spring or fall 2016;
3. Investigate methods for controlling water temperatures; and
4. Investigate conservation hatchery strategies to reduce hatchery induced selection.

All research projects would be reviewed and approved by the Fisheries Management Work Group and the National Marine Fisheries Service prior to initiation.

4.0 Translocation Recommendation

The objective of the translocation includes both fisheries research and the potential return of a small number of adult salmon to the San Joaquin River Restoration between 2018 and 2020. Some adults may return as age 2 fish in 2018 and age 4 fish in 2020, whereas most adults would be expected to return as age 3 fish in 2019. Through the reintroduction process, the Program will assess whether instream survival is adequate for juvenile salmon in the Restoration Area. Juvenile survival rates will be assessed during collection, transport, holding in pens, and downstream migration using count or mark-recapture data.

4.1 Existing Conditions in the River

The existing conditions in the San Joaquin River are an integral part of the decision process for the recommendation for collections to be used in translocation efforts (i.e., direct river reintroduction). Currently, Program staff are actively collecting data to help inform reintroduction, and other Program decisions. Questions regarding water year type, flow constraints, water temperature regimes, and passage impediments are still being investigated. Restoration Flow releases commenced on January 1, 2014. Flow and seepage easements to allow base flow releases to be made below Sack Dam are in progress and may be completed in 2016.

Restoration projects intended to provide passage for adult and juvenile salmon, listed in the San Joaquin Settlement Agreement Paragraph 11, are still in the permitting and design phase. As a result, passage impediments still exist at a number of structures and unscreened diversions still contribute to entrainment risk along the river corridor. The near term reintroduction strategy is to release all juvenile spring-run salmon into the San Joaquin River Restoration Area at a location that would balance the risk of straying with the expectation that there will be survival to the end of the Restoration Area and beyond. Prior to release, fish will be held for at least 72 hours to allow for acclimation and potential imprinting. Details on release strategies are described in Attachment B.

4.3 Recommendation for Collection

The RM recommends the collection of 80,000 eggs from Feather River Fish Hatchery from the 2016 spring-run Chinook salmon brood year for reintroduction to the San Joaquin River Restoration Area. The RM further recommends a reintroduction strategy with specific monitoring components included to evaluate the effectiveness of the reintroduction techniques. Techniques recommended by the RM for 2016 releases include improving the rearing and holding capacity of the California Department of Fish and Wildlife's (CDFW) auxiliary trailer near Friant Dam, translocating juveniles into holding pens or into streamside tanks, and releasing tagged juveniles into the river. Detailed protocols are described below and in Attachment B.

4.4 Collection Methods

Collections for translocation will follow the same collection methods and protocols as those for the Conservation Facility. Eggs will be selected from the same crosses developed for the broodstock program. After eyed eggs are selected for broodstock, the Program will select up to 80,000 eyed eggs by volume that will be segregated and quarantined at the FRFH. The preferred procedure is to incubate the 80,000 eyed eggs at the FRFH to the eyed stage, conduct pathology tests on a subset of eggs (n = 60), and then transfer the remaining individuals to CDFW's auxiliary trailer facility for rearing and imprinting in the San Joaquin River near Friant Dam. Prior to being placed in holding pens or stream-side tanks and released into the Restoration Area, juvenile salmon will be marked when they reach ~55-68mm in total length using an adipose fin clip and CWT. Until they are marked, they cannot be released into the San

Joaquin River or placed in holding pens in the river. If the holding capacity at CDFW's auxiliary trailer facility is not sufficient for holding up to 80,000 fry by early 2016, the eyed eggs will need to hatch and rear at the FRFH until they are marked. Attachment B contains additional details on the collection methods.

4.4 Reintroduction Methods

If juvenile salmon can be reared at the CDFW auxiliary trailer until they are ad-clipped and given CWTs, they could be directly released into the San Joaquin River after tagging. Otherwise, marked juveniles received from the FRFH or other offsite facilities (e.g., Silverado Fisheries Base) will be placed in holding pens or stream-side tanks for acclimation and imprinting prior to release. Juveniles used in tagging (e.g., acoustic) studies would be kept in the net pens or streamside tanks until they become large enough for study purposes. Specifics of reintroduction techniques can be found in Attachment B.

4.5 Final Disposition

All fish recommended for use in the translocation portion of the reintroduction will receive an adipose fin clip and coded wire tag before they are released alive into the Restoration Area. Releases will be made in the Restoration Area where their movements and survival will be monitored using count and mark-recapture data collected throughout the San Joaquin River basin. The selection of release sites will be made based on environmental conditions in the San Joaquin River just prior to release. Juveniles would be released only when and where conditions for passage are suitable (i.e., access to the San Francisco Estuary, passage at structures, and mean daily stream temperatures below 22°C). If conditions in the Restoration Area are unsuitable for juvenile salmon (i.e., mean daily stream temperatures exceeding 22°C) at the time marked juvenile salmon are to be received from either the FRFH or an offsite facility, the juveniles would not be transported to the San Joaquin River, but instead released in the Feather River. Attachment B contains additional details on the disposition of the translocated fish and the supplies needed to implement the translocation portion of the Program's reintroduction activities.

Currently, resources for the Program are available through existing staffing among the Implementing Agencies. Thus, the commitment to carry out the activities described is contingent on adequate funding to support the recommendation. Decisions regarding the allocation of funding to support the methodology and reintroduction activities described above are subject to Program Management Team review and revision.