# Infrastructure and Operations Audit of Sawtooth Fish Hatchery 2022

**Sawtooth Fish Hatchery**
**Lower Snake River Compensation Plan**


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## Executive Summary

On August 26, 2022, Chris Starr, Facilities Coordinator, Nathan Wiese, Program Coordinator LSRCP, Tony Folsom, Hatchery Manager, Bob Becker, Salmon River Complex Manger, conducted a high-level one-day infrastructure and operations assessment of the Sawtooth Fish Hatchery. Cassie Sundquist, Beau Gunter, Chris Sullivan, and John Cassinelli, IDFG, provided review of this document.

The purpose of this document is to provide the Lower Snake River Compensation Plan (LSRCP) and other stakeholders ample conceptual-level information of the current infrastructure challenges. The goal is to incorporate audit findings into a 10-year strategic plan for LSRCP that will maximize in-house and external improvement opportunities by developing solutions that fit resources, budgets, and supportive programs in a logical sequence. These efforts are intended to significantly improve water quality, program capacity, efficiency, and flexibility at the facility and ultimately increase opportunities for LSRCP to meet adult mitigation targets.

The LSRCP plans to assess all spring/summer Chinook rearing facilities within the program prior to the 10-year spring/summer Chinook Program Review for the Independent Scientific Review Panel (ISRP) in December 2022. With this review, the LSRCP intends to identify strategies toward improving performance of achieving project area goals of 58,700 spring/summer Chinook salmon adult returns. From 2004-2017, the LSRCP averaged 29,115 spring/summer Chinook salmon adult returns and failed to achieve the project area goal on any year during the period.

The following actions are suggested to maximize smolt production at the Sawtooth Fish Hatchery:

| Program | Current Smolts | Proposed Smolts |
|---|---|---|
| Integrated/Segregated | 2,000,000 | 2,400,000 – Maximize all raceways. Increase YFK release, backfill Integrated raceways with segregated. Complete well rehabilitation. |
| Integrated/Segregated | 0 | 120,000 – Rebuild two early Rearing Vats |

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# 1 Scope

On August 26, 2022, Chris Starr, Facilities Coordinator, Nathan Wiese, Program Coordinator LSRCP, Tony Folsom, Hatchery Manager, and Bob Becker, Salmon River Complex Manger, conducted a high-level one-day infrastructure and operations assessment of the Sawtooth Fish Hatchery.

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This audit is a kick-off effort to assess all spring/summer Chinook rearing facilities within the LSRCP program prior to the 10-year spring/summer Chinook Program Review for the Independent Scientific Review Panel (ISRP) in December 2022. With this review, the LSRCP intends to identify strategies toward improving performance of achieving project area goals of 58,700 spring/summer Chinook salmon adult returns. From 2004-2017, the LSRCP averaged 29,115 spring/summer Chinook salmon adult returns and failed to achieve the project area goal on any year during the period.

# 2 Background

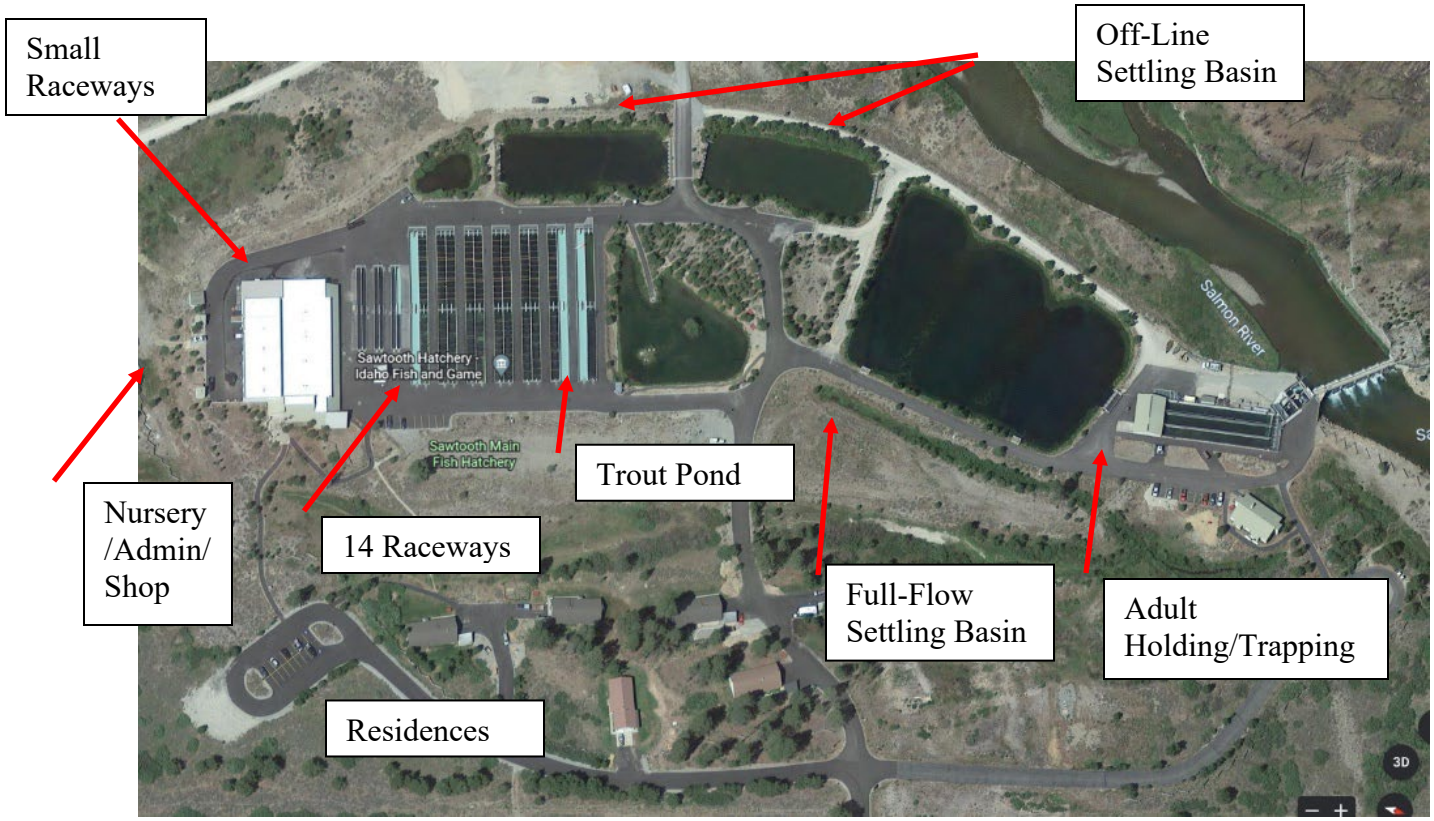
The Sawtooth Hatchery (Hatchery) is located near the headwaters of the Salmon River, approximately 400 river miles upstream from the mouth of the Salmon River. The facility collects spring Chinook, Sockeye and steelhead at the weir location.

The purpose of the Sawtooth spring Chinook salmon hatchery program is to mitigate for fish losses caused by the construction and operation of the four lower Snake River federal dams under the Lower Snake River Compensation Plan (LSRCP). This program, located at the Sawtooth Fish Hatchery, also includes a conservation component that is intended to increase the abundance of naturally spawning fish through an integrated supplementation effort. By integrating the hatchery broodstock, managers are attempting to let the natural environment drive selection in the hatchery population and therefore reduce risks associated with hatchery-origin fish spawning naturally.

The integration strategy provides demographic and genetic benefits by: 1) increasing the abundance of fish spawning naturally, 2) increasing the extent of available spawning habitat that is utilized, and 3) providing a genetic repository for natural fish in the hatchery environment. This strategy will be particularly advantageous during years of very low natural-origin abundance (HGMP 2011).

Sawtooth's mitigation goal is 19,445 adult spring Chinook salmon to stream reaches upstream of Lower Granite Dam. To meet the mitigation goals, the Hatchery rears up to 2.0 million spring Chinook yearling smolts. Of these releases, 1.7M (1.45M Segregated and 250K Integrated) are released into the Upper Salmon River at the Sawtooth Fish Hatchery. Additionally, this program rears approximately 300,000 smolts for release into the Yankee Fork of the Salmon River as part of a Shoshone Bannock supplementation program.

This mitigation program has never achieved the escapement goal of 19,445 adults to the project area since the inception of the program in 1985. Based on brood years 1992-2018 mean SAR (0.33%) to Lower Granite dam, the production capacity at this facility needs to be increased from 2.0 million to 5.8million yearling smolts to return 19,445 adults to the project area.




Sawtooth Fish Hatchery

Smolt to Adult Survival, Sawtooth Fish Hatchery

| Brood Year | SAR |
|---|---|
| 1992 | 0.03% |
| 1993 | 0.04% |
| 1995 | 0.71% |
| 1996 | 0.51% |
| 1997 | 1.09% |
| 2000 | 0.42% |
| 2001 | 0.16% |
| 2002 | 0.11% |
| 2003 | 0.16% |
| 2004 | 0.42% |
| 2005 | 0.69% |
| 2006 | 0.68% |
| 2007 | 0.23% |
| 2008 | 0.63% |
| 2009 | 0.13% |
| 2010 | 0.38% |
| 2011 | 0.40% |
| 2012 | 0.31% |
| 2013 | 0.16% |
| 2014 | 0.18% |
| 2015 | 0.06% |
| 2016 | 0.08% |
| 2017 | 0.13% |
| 2018 | 0.16% |
| **Average** | **0.33%** |

## 2.1 Biological Opinion

Sawtooth Fish Hatchery is permitted (BIOP 2017) for up to 2.0 M spring Chinook smolt releases onsite. An additional 600,000 smolts are permitted for the Yankee Fork and 400,000 smolts for Panther Creek from Crystal Springs (Table 7 – BIOP 2017). Yankee Fork Chinook smolts are intended to be trapped at Yankee Fork or backfilled with Sawtooth stock. Panther Creek smolts are intended to be trapped at Panther Creek or backfilled with Pahsimeroi stock. Discussions with NOAA personnel (Brett Farman, pers comm) indicate that changing rearing locations for these smolts until Crystal Springs rearing comes to fruition can be accomplished under the existing BIOP.

Table 7. Summary of Annual release groups (number and life stage), marking, egg incubation and rearing locations, acclimation, and release times at full production.

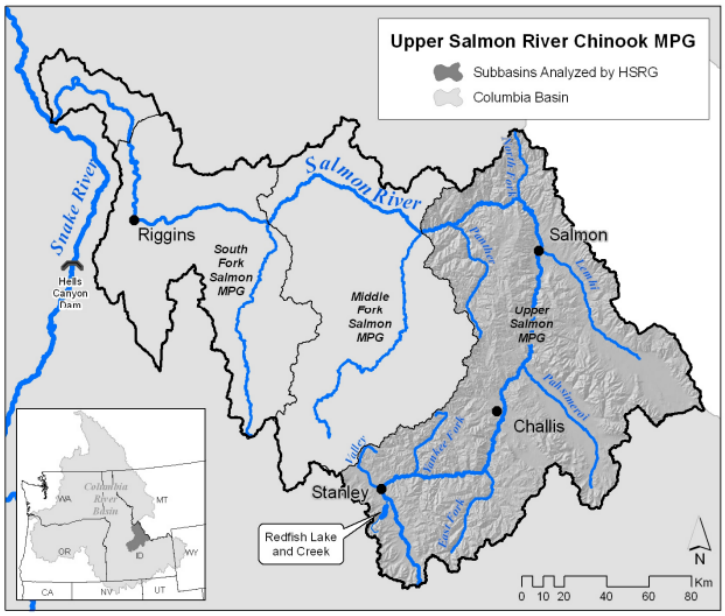
| Program | Annual release groups (number and life stage) | Marking[4] | Egg incubation/Rearing Location | Acclimation | Release Time |
|---|---|---|---|---|---|
| **Sawtooth Segregated** | 1.85 Million Smolt[1] | 100% Ad-clip, representative CWT (see Table 8) | Sawtooth | On-site | Late March-mid-April |
| **Sawtooth Integrated** | 150,000 Smolts[2] | 100% CWT (see Table 8) | Sawtooth | On-site | Late March-mid-April |
| **Pahsimeroi Integrated** | 65,000 Smolts | 100% CWT, no Ad-clip | Pahsimeroi | On-site | Late March-mid-April |
| **Pahsimeroi Segregated** | 935,000 Smolt | 100% Ad-clip, representative CWT | Pahsimeroi | On-site | Late March-mid-April |
| **Yankee Fork** | 600,000 Smolt | Ad-clip and CWT TBD | Crystal Springs | Yankee Fork acclimation ponds | Late March -April |
| | Up to 1,500 Adults[3] for natural spawning | TBD | N/A | N/A | June - September |
| **Panther Creek** | 400,000 Smolt | Ad-clip and CWT TBD | Crystal Springs | Acclimated Release, Panther Creek Satellite Facility | Late March - April |
| | 800,000 Eggs | Parental-based Tagging[4] | Pahsimeroi then Panther Creek eggbox | Panther Creek Egg Box | October - November |

[1]This includes Yankee Fork production (300K)

[2] Integrated program may be increased, concomitant with decreases in segregated program (total production rema 2M)

[3] Numbers will depend on the number of adults available that are not needed for production for the Sawtooth program, as well as the pHOS scale for adult management.

[4] All release groups are part of a parental-based tagging (PBT) strategy and will and include some level of PIT tagging to represent the groups.



## 2.2 Infrastructure

### 2.2.1 Hatchery Water Supply

The Sawtooth Fish Hatchery receives water from the Salmon River and from five wells. River water enters an intake structure located approximately 0.8 km upstream of the hatchery facility. River water flows from the collection site to a control box located in the hatchery building where it is screened to remove fine debris. River water can be distributed to indoor vats, outside raceways, or adult holding raceways. River water temperatures range from 32 F in the winter to 70 F in the summer. The hatchery water right for river water use is variable throughout the year.

| # | Description | January | February | March | April | May | June | July | August | Septembe | October | Novembe | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71-07079 | Main Intake | 35 | 35 | 35 | 35 | 15 | 28 | 20 | 20 | 20 | 15 | 35 | 35 |
| 71-2088 | Original Water Right | 0 | 0 | 0 | 0 | 25 | 25 | 25 | 25 | 25 | 25 | 0 | 0 |
| | **TOTAL CFS** | **35** | **35** | **35** | **35** | **40** | **53** | **45** | **45** | **45** | **40** | **35** | **35** |

Incubation and early rearing water needs are met by 5 primary wells (1, 1A, 5, 6 and 7). Well water temperatures range from 40 F in the winter to 52 F in the summer. The hatchery water right for well use is variable throughout the year.

| # | Description | January | February | March | April | May | June | July | August | Septembe | October | Novembe | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71-10934 | Wells 1, 1A, 6 and 7 | 9.1 | 9.1 | 9.1 | 9.1 | 5.8 | 5.8 | 5.8 | 5.8 | 5.8 | 9.1 | 9.1 | 9.1 |
| 71-10934 | Well 5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| | **TOTAL CFS** | **11.6** | **11.6** | **11.6** | **11.6** | **8.3** | **8.3** | **8.3** | **8.3** | **8.3** | **11.6** | **11.6** | **11.6** |

A sixth well (Well #3) provides tempering water to control the build-up of ice on the river water intake during winter months.

The seventh well (Well #4) provides domestic water for the facility.

### 2.2.2 Broodstock Collection

Depending on spring runoff conditions, ladder and trap operations will begin between mid-May and mid-June and continue through early-September. Generally, the weir can be fully placed into operation as a descending Salmon River USGS hydrograph located near the mouth of the Yankee Fork Salmon River discharge reading approaches 2,400 cfs.

The hatchery has three 167 ft long x 16 ft wide x 5 ft deep holding raceways and an enclosed spawning building. Each raceway has the capacity to hold approximately 1,300 adults.

The adult trap is worked up daily and all fish are measured for fork length and examined for marks, gender, injuries, and either placed into one of three adult holding ponds or released directly into the Salmon River above the hatchery intake, depending upon what mark or tag the fish may have. Unmarked Chinook not needed for Integrated broodstock are released above the hatchery intake after daily trap operations have ended.

### 2.2.3 Incubation

Eggs are rinsed with pathogen-free well water after fertilization, and disinfected with a 100 ppm buffered iodophor solution for -one hour before being placed in incubation trays.

Incubation facilities at the Sawtooth Fish Hatchery consist of a well water-supplied system of 80 stacks of incubator frames containing 640 incubation trays. The maximum incubation capacity at the Sawtooth Fish Hatchery is 2,688,000 million green Chinook eggs with single-trayed females.

Incubation flows are set at 5 per eight tray incubation stack. The minimum flow required for incubation is 400 gpm for 80 stacks. Typically, eggs from one female are incubated per tray (approximately 4200eggs).

### 2.2.4 Nursery Rearing

Eggs are typically held in incubation trays at the Sawtooth Fish Hatchery until they reach the swim-up stage of development, at approximately 2,000 FTUs. Ponding and rearing plans are generally developed to accommodate segregation groups (based on female ELISA optical density values) and whether juveniles are destined for supplementation or production (mitigation) releases.

At swim-up Chinook fry are transferred into 14 indoor vats, 1 display vat and 6 small outside raceways with screens initially placed at half length. Approximately 65,000 fry are set out in each vat. The remaining Chinook fry are transferred evenly, up to 180,000 per raceway, into one of six outside small raceways supplied with well water. Flows are set at 50 gpm for vats, 180 gpm for small raceways to start, then increased as needed to keep flow indices under recommended levels.

Fry are ponded directly into inside rearing vats. Vats are baffled to provide compartmentalized rearing space and to assist with cleaning. In addition, vats are covered to provide some degree of privacy from human activity and building lights. Starting flows are set at 50 gpm and increased to a maximum of 120 gpm per vat. Density indices are maintained to not exceed 0.3. Flow indices are maintained to not exceed the recommendations listed in Piper dependent on elevation and water temperatures (Piper et al. 1982). Fish are targeted to be reared to approximately 130 fish per pound in vats before being transferred to outside rearing raceways at marking.

Rearing capacity of the Hatchery is limited by the quantity of pathogen free well water available during early rearing (USFWS 2011) and river water must be used at times to complete early rearing in the six small outside raceways.

IDFG Fish Health recommends not introducing river water to the small raceways until the fish have reached 900 CTU's from hatch to reduce the risk of Whirling Disease exposure.

### 2.2.5 Outdoor Rearing

Outside rearing consists of 14 production raceways each with 6,120 cubic ft of rearing space. Each production raceway has a capacity to raise 180,000 Chinook to smolt stage for a total design capacity of 2.52 million fish.

Production raceways are provided with between 830 to 1,120 gpm of river water depending on the time of year for a maximum water usage of 35 cfs. Summer water temperatures commonly reach 65$^{o}$F+. Hatchery staff mitigate these extreme temperatures by feeding/cleaning early in the morning. Dissolved oxygen levels have been recorded as low as 5.0 ppm during the summer months.

Density indices are maintained to not exceed 0.3. Flow indices are maintained to not exceed the recommendations listed in Piper dependent on elevation and water temperatures (Piper et al. 1982).

Sawtooth Fish Hatchery Feeding Rates (HGMP 2011)

| Fish Per Pound | % body Wt/Day | Period |
|---|---|---|
| Swim-up to 800 | 3.5% | Nov-Jan |
| 800-500 | 3.3% | Jan-Feb |
| 500-400 | 2.5% | Feb-Mar |
| 400-350 | 2.5% | Mar-Apr |
| 350-300 | 2.3% | April |
| 300-250 | 2.2% | May-Jun |
| 250-150 | 2.4% | June |
| 150-110 | 2.4% | June-July |
| 110-90 | 2.5% | July-Aug |
| 90-50 | 2.2% | Aug-Sep |
| 50-17 | 2.0 | Sep-Oct |
| 17-relese | Maintenance | Oct-Release (April) |

### 2.2.6 Release

Target release size is 18 fpp for 2M smolts (AOP 2022).

A variety of transportation vehicles and equipment are available at the various facilities. Generally, adult transportation at both facilities is unnecessary as hatchery-produced adults are trapped and spawned on site. Disinfection protocols are in place for equipment, trucks and nets. All raceways are thoroughly chlorinated after fish have been transferred for release.

Transportation for upper Yankee Fork Salmon River supplementation production follows Integrated Hatchery Operations Teams (IHOT) transportation guidelines. Niel Ring Trucking is typically contracted to transport the Yankee Fork smolts.

### 2.2.7 IPDES

The Hatchery has two Off-line Settling Ponds and one Full-Flow Settling Pond for wastewater treatment. Idaho Pollution Discharge Elimination System (IPDES) permit requirements have been met in recent rearing cycles.

The Off-line Settling Ponds are approximately 80ft x 235ft.

The Full-Flow Settling Pond is divided into three cells for a combined volume of 515,440 cubic feet. It measures 2.34 acres in area and has a minimum detention time of 3.18 hours when approximately 30 cfs is entering the pond. The settling pond will filter all of the effluent water (35 cfs).

# 3 Operations

### 3.1.1 Marking

Approximately 490,000 smolts are coded-wire tagged annually along with adipose clipping the first week of June. Fish Marking currently takes 10 days to mark 2.0M Chinook (Appendix B).

### 3.1.2 PIT Tagging

30,000 Chinook smolts are PIT tagged annually the first week of October for Comparative Smolt Survival studies and LSRCP evaluation.

# 4 Operational/Infrastructure Changes for Program Efficiency

### 4.1.1 Add 20 Incubation Stacks

The “E” bank of incubation stacks were removed in the mid-2000s for use at the Pahsimeroi Hatchery for the Upper Salmon B-Steelhead program. The current incubation capacity could be increased from 2,688,000 single-female trayed green eggs to 3,360,000 eggs with the addition of the 20 “E” bank incubators at an average fecundity of 4,200. Although additional stacks are not needed to increase to 2.4M smolts, the additional stacks could provide additional green to eyed incubation space flexibility for both the Chinook and steelhead programs.

Cost for this project is estimated at $25,000 ($1,250 per half stack).


### 4.1.2 Add two additional incubation vats

To accommodate sockeye production, two rearing vats were removed from the early rearing area. Replacement of these vats would provide additional early rearing space for up to 154,000 Chinook fingerlings and will allow staff to reduce densities in the other 14 vats and is needed to increase to 2.4M while maintaining current rearing protocol DI and FI.

This space would increase early rearing vats from 14 to 16 and provide early rearing for 1,232,000 fingerlings to marking (120 fpp). Small raceways would provide early rearing for 1,590,000 fingerlings to marking (120 fpp) for a total of 2,822,000 of early rearing space.

Average survival is 94% meaning early rearing space would be adequate to start enough eggs/fish for smolt releases to 2.65M.

Cost for this project is estimated at $148,000.


### 4.1.3 Rehabilitate Existing Wells

Existing wells are used for incubation, de-icing, early vat-rearing, small raceways, domestic water, etc. A recent well inventory indicated that well capacity has fallen to 50% of design criteria. Well rehabilitation will improve water capacity for these uses. Well rehabilitation needs completed to maintain current production and rearing parameters.

Cost for this project is estimated at $470,000.

### 4.1.4 Maximize Existing Infrastructure

Rearing capacity for outside rearing is 180,000 Chinook smolts to 18 fpp. However, the Yankee Fork (300,000) and Integrated (250,000) rearing components do not fit the rearing capacity and leave significant space under-utilized.

The Yankee Fork program could increase to 360,000 smolts to maximize rearing space.

The Integrated program should remain at 250,000 Chinook smolts (started in small raceway at 265,000 with 94% survival), then marked out to two final rearing raceways, one loaded at 180,000 and one at 70,000 Int. This raceway could be backfilled with an additional 110,000 Segregated smolts. PIT tagging can occur in the 100% Segregated raceway for downstream and adult survival estimates.

Marking an additional 400,000 smolts will add two additional days of marking in May for a total of 12 days. The Marking Crew has concerns about their ability to accommodate two additional days of marking at Sawtooth due to the increased workload, 12-day stint for staff, increased production at other hatcheries and inability to hire adequate numbers of staff.

Annual operation costs for 400,000 smolts are $0.09 each for fish feed and $0.09 each for supplies, marking/tagging, fish health, etc.

Cost for implementation is $72,000.

### 4.1.5 Summary

Sawtooth staff can rear an additional 400,000 smolts as soon as BY2023 depending on stock availability and release location. Preference is to rear Pahsimeroi stock for Panther Creek releases and secondary Sawtooth stock depending on availability. LSRCP acknowledges some additional fish health risk with movement to river water earlier and more fish onsite during the summer months.

Harvest shares cannot be adjusted this year as it's too late in the season setting process for changes. Assuming agreement on a path forward, public input meetings would be needed this spring/summer for the BY24 collection season.

LSRCP is very interested in the additional 400K smolts, implementing well upgrades ($550K), and the two early rearing vats (up to $200K) to provide a possible additional 120K early rearing capacity and 2.52M smolt total. However, to add infrastructure and annual operating costs, LSRCP will need some commitment to future brood collection and more discussion on returns vs. brood - i.e low returns to the Upper Salmon.

Maximize Production at Sawtooth Fish Hatchery

| Program | Current Smolts | Proposed Smolts |
|---|---|---|
| Integrated/Segregated | 2,000,000 | 2,400,000 – Maximize all raceways. Increase YFK release, backfill Integrated raceways with segregated. Complete well rehabilitation. |
| Integrated/Segregated | 0 | 120,000 – Rebuild two early Rearing Vats |

# 5 Appendix A. Monthly Production Strategy–Sawtooth Fish Hatchery

## 5.1.1 January

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Vat Flow Rate | 50 | | | | | | | Flow Rate | 180 | | | | | | |
| | | Vat Volume | 210 | | | Max FI @ 44°F = 1.87 | | | | Volume | 702 | | | | | | |
| | | DV Flow Rate | 50 | | | | | | | Fish Length | 1.66 | | | | | | |
| | | DV Volume | 64 | | | Total CFS | 4.08 | | | Ending Fpp | 614 | | | | | | |
| | | Fish Length | 1.66 | | | | | | | | | | | | | | |
| | | Ending Fpp | 614 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | Vats | | | | | | | | Smalls | | | | | | | |
| | | | | | Wt | DI | FI | | | | | | | Wt | DI | FI | |
| 14 | | YF | | 73037 | 119 | 0.34 | 1.43 | | 1 | | | | 259509 | 423 | 0.36 | 1.41 | |
| 13 | | YF | | 73037 | 119 | 0.34 | 1.43 | | 2 | | | | 259509 | 423 | 0.36 | 1.41 | |
| 12 | | YF | | 73037 | 119 | 0.34 | 1.43 | | 3 | | | | 259509 | 423 | 0.36 | 1.41 | |
| 11 | | YF | | 73037 | 119 | 0.34 | 1.43 | | 4 | | | | 259509 | 423 | 0.36 | 1.41 | |
| 10 | | Seg | | 62553 | 102 | 0.29 | 1.23 | | 5 | | | | 259509 | 423 | 0.36 | 1.41 | |
| 9 | | Seg | | 62553 | 102 | 0.29 | 1.23 | | 6 | | | | 259509 | 423 | 0.36 | 1.41 | |
| 8 | | Seg | | 62553 | 102 | 0.29 | 1.23 | | | | | | | | | | |
| 7 | | Seg | | 62553 | 102 | 0.29 | 1.23 | | | | | | | | | | |
| 6 | | Seg | | 62553 | 102 | 0.29 | 1.23 | | | | | | | | | | |
| 5 | | Seg | | 62553 | 102 | 0.29 | 1.23 | | | | | | | | | | |
| | | | | | | | | | | | | 73037.135 | | | | | |
| 4 | | INT | | 70402 | 115 | 0.33 | 1.38 | | | | | | | | | | |
| 3 | | INT | | 70402 | 115 | 0.33 | 1.38 | | | | | | | | | | |
| 2 | | INT | | 70402 | 115 | 0.33 | 1.38 | | | | | | | | | | |
| 1 | | INT | | 70402 | 115 | 0.33 | 1.38 | | | | | | | | | | |
| | | | Display Vat | | | | | | | | | | | | | | |
| | | DV | YF | 30,000 | 48.8599349 | 0.14016046 | 0.588674 | | | | | | | | | | |

| | Eyed Eggs | Eye to Pond 98% | Release 94% |
|---|---|---|---|
| | | 3% | 3% |
| YF | 328,723 | 322,149 | 309,000 |
| Seg | 1,588,830 | 1,557,053 | 1,493,500 |
| INT | 287,356 | 281,609 | 250,000 |
| Seg | 382,979 | 375,319 | 360,000 |
| | 2,587,888 | 2,536,130 | 2,412,500 |

## 5.1.2 February

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Vat Flow Rate** | **50** | | | | | | | | **Flow Rate** | **200** | | | | | |
| | | **Vat Volume** | **210** | | | **Max FI @ 42°F = 2.02** | | | | | **Volume** | **702** | | | | | |
| | | **DV Flow Rate** | **50** | | | | | | | | **Fish Length** | **1.99** | | | | | |
| | | **DV Volume** | **64** | | | **Total CFS** | **4.34** | | | | **Ending Fpp** | **356** | | | | | |
| | | **Fish Length** | **1.99** | | | | | | | | **Mortality** | **0.0017** | | | | | |
| | | **Ending Fpp** | **356** | | | | | | | | | | | | | | |
| | | **Mortality** | **0.0017** | | | | | | | | | | | | | | |
| | | **Vats** | | | | | | | | | | **Smalls** | | | | | |
| | | | | | **Wt** | **DI** | **FI** | | | | | | | | **Wt** | **DI** | **FI** |
| **14** | YF | | 72913 | 205 | 0.49 | 2.06 | | 1 | | | | 259068 | | 728 | 0.52 | 1.83 | |
| **13** | YF | | 72913 | 205 | 0.49 | 2.06 | | 2 | | | | 259068 | | 728 | 0.52 | 1.83 | |
| **12** | YF | | 72913 | 205 | 0.49 | 2.06 | | 3 | | | | 259068 | | 728 | 0.52 | 1.83 | |
| **11** | YF | | 72913 | 205 | 0.49 | 2.06 | | 4 | | | | 259068 | | 728 | 0.52 | 1.83 | |
| **10** | Seg | | 62447 | 175 | 0.42 | 1.76 | | 5 | | | | 259068 | | 728 | 0.52 | 1.83 | |
| **9** | Seg | | 62447 | 175 | 0.42 | 1.76 | | 6 | | | | 259068 | | 728 | 0.52 | 1.83 | |
| **8** | Seg | | 62447 | 175 | 0.42 | 1.76 | | | | | | | | | | | |
| **7** | Seg | | 62447 | 175 | 0.42 | 1.76 | | | | | | | | | | | |
| **6** | Seg | | 62447 | 175 | 0.42 | 1.76 | | | | | | | | | | | |
| **5** | Seg | | 62447 | 175 | 0.42 | 1.76 | | | | | | | | | | | |
| **4** | INT | | 70283 | 197 | 0.47 | 1.98 | | | | | | | | | | | |
| **3** | INT | | 70283 | 197 | 0.47 | 1.98 | | | | | | | | | | | |
| **2** | INT | | 70283 | 197 | 0.47 | 1.98 | | | | | | | | | | | |
| **1** | INT | | 70283 | 197 | 0.47 | 1.98 | | | | | | | | | | | |
| | | **Display Vat** | | | | | | | | | | | | | | | |
| | DV | YF | 29,949 | 84.1264045 | 0.2013075 | 0.845492 | | | | | | | | | | | |

| | | **Eyed Eggs** | **Eye to Pond 98%** | **Release 94%** |
|---|---|---|---|---|
| | 3% | **YF** | 328,723 | 322,149 | 309,000 |
| | 3% | **Seg** | 1,588,830 | 1,557,053 | 1,493,500 |
| | | **INT** | 287,356 | 281,609 | 250,000 |
| | | **Seg** | 382,979 | 375,319 | 360,000 |
| | | | 2,587,888 | 2,536,130 | 2,412,500 |

## 5.1.3 March

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Vat Flow Rate** | **75** | | | | | | | **Flow Rate** | **250** | | | | | | |
| | | **Vat Volume** | **420** | | | **Max FI @ 41°F = 2.09** | | | | **Volume** | **1404** | | | | | | |
| | | **DV Flow Rate** | **50** | | | | | | | **Fish Length** | **2.28** | | | | | | |
| | | **DV Volume** | **160** | | | **Total CFS** | **5.85** | | | **Ending Fpp** | **237** | | | | | | |
| | | **Fish Length** | **2.28** | | | | | | | **Mortality** | **0.0023** | | | | | | |
| | | **Ending Fpp** | **237** | | | | | | | | | | | | | | |
| | | **Mortality** | **0.0023** | | | | | | | | | | | | | | |
| | | **Vats** | | | | | | | | **Smalls** | | | | | | | |
| | | | | | **Wt** | **DI** | **FI** | | | | | | | | **Wt** | **DI** | **FI** |
| **14** | YF | | 72745 | 307 | 0.32 | 1.79 | | **1** | | | | 258472 | 1091 | 0.34 | 1.91 | | |
| **13** | YF | | 72745 | 307 | 0.32 | 1.79 | | **2** | | | | 258472 | 1091 | 0.34 | 1.91 | | |
| **12** | YF | | 72745 | 307 | 0.32 | 1.79 | | **3** | | | | 258472 | 1091 | 0.34 | 1.91 | | |
| **11** | YF | | 72745 | 307 | 0.32 | 1.79 | | **4** | | | | 258472 | 1091 | 0.34 | 1.91 | | |
| **10** | Seg | | 62303 | 263 | 0.27 | 1.54 | | **5** | | | | 258472 | 1091 | 0.34 | 1.91 | | |
| **9** | Seg | | 62303 | 263 | 0.27 | 1.54 | | **6** | | | | 258472 | 1091 | 0.34 | 1.91 | | |
| **8** | Seg | | 62303 | 263 | 0.27 | 1.54 | | | | | | | | | | | |
| **7** | Seg | | 62303 | 263 | 0.27 | 1.54 | | | | | | | | | | | |
| **6** | Seg | | 62303 | 263 | 0.27 | 1.54 | | | | | | | | | | | |
| **5** | Seg | | 62303 | 263 | 0.27 | 1.54 | | | | | | | | | | | |
| **4** | INT | | 70121 | 296 | 0.31 | 1.73 | | | | | | | | | | | |
| **3** | INT | | 70121 | 296 | 0.31 | 1.73 | | | | | | | | | | | |
| **2** | INT | | 70121 | 296 | 0.31 | 1.73 | | | | | | | | | | | |
| **1** | INT | | 70121 | 296 | 0.31 | 1.73 | | | | | | | | | | | |
| | | **Display Vat** | | | | | | | | | | | | | | | |
| | DV | YF | 29880 | 126 | 0.13 | 0.74 | | | | | | | | | | | |

| | **Eyed Eggs** | | **Eye to Pond 98%** | **Release 94%** |
|---|---|---|---|---|
| | | 3% | | |
| **YF** | 328,723 | 3% | 322,149 | 309,000 |
| **Seg** | 1,588,830 | | 1,557,053 | 1,493,500 |
| **INT** | 287,356 | | 281,609 | 250,000 |
| **Seg** | 382,979 | | 375,319 | 360,000 |
| | 2,587,888 | | 2,536,130 | 2,412,500 |

## 5.1.4 April

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Vat Flow Rate** | **100** | | | | | | | **Flow Rate** | **300** | | | | | | |
| | | **Vat Volume** | **420** | | | **Max Fl @ 40°F = 2.16** | | | | **Volume** | **1404** | | | | | | |
| | | **DV Flow Rate** | **50** | | | | | | | **Fish Length** | **2.58** | | | | | | |
| | | **DV Volume** | **160** | | | **Total CFS** | **7.35** | | | **Ending Fpp** | **169** | | | | | | |
| | | **Fish Length** | **2.58** | | | | | | | **Mortality** | **0.0024** | | | | | | |
| | | **Ending Fpp** | **169** | | | | | | | | | | | | | | |
| | | **Mortality** | **0.0024** | | | | | | | | | | | | | | |
| | | **Vats** | | | | | | | | **Smalls** | | | | | | | |
| | | | | | **Wt** | **DI** | **Fl** | | | | | | | | **Wt** | **DI** | **Fl** |
| **14** | YF | 72571 | 429 | 0.40 | 1.66 | | | | **1** | | | 257852 | 1526 | 0.42 | 1.97 | | |
| **13** | YF | 72571 | 429 | 0.40 | 1.66 | | | | **2** | | | 257852 | 1526 | 0.42 | 1.97 | | |
| **12** | YF | 72571 | 429 | 0.40 | 1.66 | | | | **3** | | | 257852 | 1526 | 0.42 | 1.97 | | |
| **11** | YF | 72571 | 429 | 0.40 | 1.66 | | | | **4** | | | 257852 | 1526 | 0.42 | 1.97 | | |
| **10** | Seg | 62154 | 368 | 0.34 | 1.43 | | | | **5** | | | 257852 | 1526 | 0.42 | 1.97 | | |
| **9** | Seg | 62154 | 368 | 0.34 | 1.43 | | | | **6** | | | 257852 | 1526 | 0.42 | 1.97 | | |
| **8** | Seg | 62154 | 368 | 0.34 | 1.43 | | | | | | | | | | | | |
| **7** | Seg | 62154 | 368 | 0.34 | 1.43 | | | | | | | | | | | | |
| **6** | Seg | 62154 | 368 | 0.34 | 1.43 | | | | | | | | | | | | |
| **5** | Seg | 62154 | 368 | 0.34 | 1.43 | | | | | | | | | | | | |
| **4** | INT | 69953 | 414 | 0.38 | 1.60 | | | | | | | | | | | | |
| **3** | INT | 69953 | 414 | 0.38 | 1.60 | | | | | | | | | | | | |
| **2** | INT | 69953 | 414 | 0.38 | 1.60 | | | | | | | | | | | | |
| **1** | INT | 69953 | 414 | 0.38 | 1.60 | | | | | | | | | | | | |
| | **Display Vat** | | | | | | | | | | | | | | | | |
| DV | YF | 29808 | 176 | 0.16 | 0.68 | | | | | | | | | | | | |

| | | | |
|---|---|---|---|
| | **Eyed Eggs** | **Eye to Pond 98%** | **Release 94%** |
| | 3% | | |
| | 3% | | |
| **YF** | 328,723 | 322,149 | 309,000 |
| **Seg** | 1,588,830 | 1,557,053 | 1,493,500 |
| **INT** | 287,356 | 281,609 | 250,000 |
| **Seg** | 382,979 | 375,319 | 360,000 |
| | 2,587,888 | 2,536,130 | 2,412,500 |

## 5.1.5 May

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Vat Flow Rate** | **120** | | | | | | | | **Flow Rate** | **400** | | | | | | | |
| | | **Vat Volume** | **420** | | | **Max FI @ 40°F = 2.16** | | | | | **Volume** | **1404** | | | | | | | |
| | | **DV Flow Rate** | **50** | | | | | | | | **Fish Length** | **2.8** | | | | | | | |
| | | **DV Volume** | **160** | | | **Total CFS** | **9.36** | | | | **Ending Fpp** | **121** | | | | | | | |
| | | **Fish Length** | **2.8** | | | | | | | | **Mortality** | **0.0023** | | | | | | | |
| | | **Ending Fpp** | **121** | | | | | | | | | | | | | | | | |
| | | **Mortality** | **0.0023** | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | **Vats** | | | | | | | | | | **Smalls** | | | | | | | |
| | | | | | **Wt** | **DI** | **FI** | | | | | | | | **Wt** | **DI** | **FI** | | |
| 14 | YF | 72404 | 598 | 0.51 | 1.78 | | | | 1 | | | 257258 | 2126 | 0.54 | 1.90 | | | | |
| 13 | YF | 72404 | 598 | 0.51 | 1.78 | | | | 2 | | | 257258 | 2126 | 0.54 | 1.90 | | | | |
| 12 | YF | 72404 | 598 | 0.51 | 1.78 | | | | 3 | | | 257258 | 2126 | 0.54 | 1.90 | | | | |
| 11 | YF | 72404 | 598 | 0.51 | 1.78 | | | | 4 | | | 257258 | 2126 | 0.54 | 1.90 | | | | |
| 10 | Seg | 62011 | 512 | 0.44 | 1.53 | | | | 5 | | | 257258 | 2126 | 0.54 | 1.90 | | | | |
| 9 | Seg | 62011 | 512 | 0.44 | 1.53 | | | | 6 | | | 257258 | 2126 | 0.54 | 1.90 | | | | |
| 8 | Seg | 62011 | 512 | 0.44 | 1.53 | | | | | | | | | | | | | | |
| 7 | Seg | 62011 | 512 | 0.44 | 1.53 | | | | | | | | | | | | | | |
| 6 | Seg | 62011 | 512 | 0.44 | 1.53 | | | | | | | | | | | | | | |
| 5 | Seg | 62011 | 512 | 0.44 | 1.53 | | | | | | | | | | | | | | |
| 4 | INT | 69792 | 577 | 0.49 | 1.72 | | | | | | | | | | | | | | |
| 3 | INT | 69792 | 577 | 0.49 | 1.72 | | | | | | | | | | | | | | |
| 2 | INT | 69792 | 577 | 0.49 | 1.72 | | | | | | | | | | | | | | |
| 1 | INT | 69792 | 577 | 0.49 | 1.72 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | **Display Vat** | | | | | | | | | | | | | | | | | |
| | DV | YF | 29740 | 246 | 0.21 | 0.73 | | | | | | | | | | | | | |

| | | | |
|---|---|---|---|
| | **Eyed Eggs** | **Eye to Pond 98%** | **Release 94%** |
| 3% | **YF** | 328,723 | 322,149 | 309,000 |
| 3% | **Seg** | 1,588,830 | 1,557,053 | 1,493,500 |
| | **INT** | 287,356 | 281,609 | 250,000 |
| | **Seg** | 382,979 | 375,319 | 360,000 |
| | | 2,587,888 | 2,536,130 | 2,412,500 |

### 5.1.6 June

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Flow Rate | 660 | | | | |
| | | | | | | Volume | 3060 | | | Max FI @ 53°F = 1.29 | |
| | | | | | | Fish Length | 3.35 | | | | |
| | | | | | | Ending Fpp | 75 | | | total CFS | 20.58 |
| | | | | | | Mortality | 0.0029 | | | | |
| | | | | | | | | | | | |
| | | | | | Large | | | | | | |
| | | | | | | | | | Wt | DI | FI |
| | 1 | | int | | | | 139179 | | 1856 | 0.18 | 0.84 |
| | 2 | | int | | | | 139179 | | 1856 | 0.18 | 0.84 |
| | | | | | | | | | | | |
| | 3 | | yf | | | | 158125 | | 2108 | 0.21 | 0.95 |
| | 4 | | yf | | | | 158125 | | 2108 | 0.21 | 0.95 |
| | | | | | | | | | | | |
| | 5 | | SEG | | | | 192944 | | 2573 | 0.25 | 1.16 |
| | 6 | | SEG | | | | 192944 | | 2573 | 0.25 | 1.16 |
| | | | | | | | | | | | |
| | 7 | | SEG | | | | 192944 | | 2573 | 0.25 | 1.16 |
| | 8 | | SEG | | | | 192944 | | 2573 | 0.25 | 1.16 |
| | | | | | | | | | | | |
| | 9 | | SEG | | | | 192944 | | 2573 | 0.25 | 1.16 |
| | 10 | | SEG | | | | 192944 | | 2573 | 0.25 | 1.16 |
| | | | | | | | | | | | |
| | 11 | | SEG | | | | 192944 | | 2573 | 0.25 | 1.16 |
| | 12 | | SEG | | | | 192944 | | 2573 | 0.25 | 1.16 |
| | | | | | | | | | | | |
| | 13 | | SEG | | | | 186032 | | 2480 | 0.24 | 1.12 |
| | 14 | | SEG | | | | 186032 | | 2480 | 0.24 | 1.12 |

### 5.1.7 July

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Vat Flow Rate | 1000 | | | | |
| | | | | | | Vat Volume | 3060 | | | Max FI @ 59°F = 1.06 | |
| | | | | | | Fish Length | 3.92 | | | | |
| | | | | | | Ending Fpp | 47 | | | total CFS | 31.19 |
| | | | | | | Mortality | 0.003 | | | | |
| | | | | | | | | | | | |
| | | | | | Large | | | | | | |
| | | | | | | | | | Wt | DI | FI |
| | 1 | | int | | | | 138761 | | 2952 | 0.25 | 0.75 |
| | 2 | | int | | | | 138761 | | 2952 | 0.25 | 0.75 |
| | | | | | | | | | | | |
| | 3 | | yf | | | | 157650 | | 3354 | 0.28 | 0.86 |
| | 4 | | yf | | | | 157650 | | 3354 | 0.28 | 0.86 |
| | | | | | | | | | | | |
| | 5 | | SEG | | | | 192365 | | 4093 | 0.34 | 1.04 |
| | 6 | | SEG | | | | 192365 | | 4093 | 0.34 | 1.04 |
| | | | | | | | | | | | |
| | 7 | | SEG | | | | 192365 | | 4093 | 0.34 | 1.04 |
| | 8 | | SEG | | | | 192365 | | 4093 | 0.34 | 1.04 |
| | | | | | | | | | | | |
| | 9 | | SEG | | | | 192365 | | 4093 | 0.34 | 1.04 |
| | 10 | | SEG | | | | 192365 | | 4093 | 0.34 | 1.04 |
| | | | | | | | | | | | |
| | 11 | | SEG | | | | 192365 | | 4093 | 0.34 | 1.04 |
| | 12 | | SEG | | | | 192365 | | 4093 | 0.34 | 1.04 |
| | | | | | | | | | | | |
| | 13 | | SEG | | | | 185474 | | 3946 | 0.33 | 1.01 |
| | 14 | | SEG | | | | 185474 | | 3946 | 0.33 | 1.01 |

### 5.1.8 August

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Vat Flow Rate | 1120 | | | | |
| | | | | | | Vat Volume | 6120 | | | Max FI @ 57°F = 1.09 | |
| | | | | | | Fish Length | 4.4 | | | | |
| | | | | | | Ending Fpp | 33 | | | total CFS | 34.93 |
| | | | | | | Mortality | 0.0011 | | | | |
| | | | | | | | | | | | |
| | | | | | Large | | | | | | |
| | | | | | | | | | Wt | DI | FI |
| | 1 | | int | | | | 138608 | | 4200 | 0.16 | 0.85 |
| | 2 | | int | | | | 138608 | | 4200 | 0.16 | 0.85 |
| | | | | | | | | | | | |
| | 3 | | yf | | | | 157477 | | 4772 | 0.18 | 0.97 |
| | 4 | | yf | | | | 157477 | | 4772 | 0.18 | 0.97 |
| | | | | | | | | | | | |
| | 5 | | SEG | | | | 192153 | | 5823 | 0.22 | 1.18 |
| | 6 | | SEG | | | | 192153 | | 5823 | 0.22 | 1.18 |
| | | | | | | | | | | | |
| | 7 | | SEG | | | | 192153 | | 5823 | 0.22 | 1.18 |
| | 8 | | SEG | | | | 192153 | | 5823 | 0.22 | 1.18 |
| | | | | | | | | | | | |
| | 9 | | SEG | | | | 192153 | | 5823 | 0.22 | 1.18 |
| | 10 | | SEG | | | | 192153 | | 5823 | 0.22 | 1.18 |
| | | | | | | | | | | | |
| | 11 | | SEG | | | | 192153 | | 5823 | 0.22 | 1.18 |
| | 12 | | SEG | | | | 192153 | | 5823 | 0.22 | 1.18 |
| | | | | | | | | | | | |
| | 13 | | SEG | | | | 185270 | | 5614 | 0.21 | 1.14 |
| | 14 | | SEG | | | | 185270 | | 5614 | 0.21 | 1.14 |

### 5.1.9 September

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Vat Flow Rate** | **1120** | | | | |
| | | | | | | **Vat Volume** | **6120** | | | **Max Fl @ 52°F = 1.33** | |
| | | | | | | **Fish Length** | **4.78** | | | | |
| | | | | | | **Ending Fpp** | **26** | | | **total CFS** | **34.92983** |
| | | | | | | **Mortality** | **0.002** | | | | |
| | | | | | | | | | | | |
| | | | | | **Large** | | | | | | |
| | | | | | | | | | Wt | Dl | Fl |
| | **1** | | int | | | | 138331.2288 | | 5,320 | 0.18 | 0.99 |
| | **2** | | int | | | | 138331.2288 | | 5,320 | 0.18 | 0.99 |
| | | | | | | | | | | | |
| | **3** | | yf | | | | 157161.8571 | | 6,045 | 0.21 | 1.13 |
| | **4** | | yf | | | | 157161.8571 | | 6,045 | 0.21 | 1.13 |
| | | | | | | | | | | | |
| | **5** | | SEG | | | | 191769.126 | | 7,376 | 0.25 | 1.38 |
| | **6** | | SEG | | | | 191769.126 | | 7,376 | 0.25 | 1.38 |
| | | | | | | | | | | | |
| | **7** | | SEG | | | | 191769.126 | | 7,376 | 0.25 | 1.38 |
| | **8** | | SEG | | | | 191769.126 | | 7,376 | 0.25 | 1.38 |
| | | | | | | | | | | | |
| | **9** | | SEG | | | | 191769.126 | | 7,376 | 0.25 | 1.38 |
| | **10** | | SEG | | | | 191769.126 | | 7,376 | 0.25 | 1.38 |
| | | | | | | | | | | | |
| | **11** | | SEG | | | | 191769.126 | | 7,376 | 0.25 | 1.38 |
| | **12** | | SEG | | | | 191769.126 | | 7,376 | 0.25 | 1.38 |
| | | | | | | | | | | | |
| | **13** | | SEG | | | | 184899.7013 | | 7,112 | 0.24 | 1.33 |
| | **14** | | SEG | | | | 184899.7013 | | 7,112 | 0.24 | 1.33 |

## 5.1.10 October

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Vat Flow Rate | 1120 | | | | |
| | | | | | | Vat Volume | 6120 | | | Max FI @ 45°F = 1.80 | |
| | | | | | | Fish Length | 4.91 | | | | |
| | | | | | | Ending Fpp | 24 | | | total CFS | 34.93 |
| | | | | | | Mortality | 0.004 | | | | |
| | | | | | | | | | | | |
| | | | | | Large | | | | | | |
| | | | | | | | | | Wt | DI | FI |
| | 1 | | | | | | 137778 | | 5741 | 0.19 | 1.04 |
| | 2 | | | | | | 137778 | | 5741 | 0.19 | 1.04 |
| | | | | | | | | | | | |
| | 3 | | | | | | 156533 | | 6522 | 0.22 | 1.19 |
| | 4 | | | | | | 156533 | | 6522 | 0.22 | 1.19 |
| | | | | | | | | | | | |
| | 5 | | | | | | 191002 | | 7958 | 0.26 | 1.45 |
| | 6 | | | | | | 191002 | | 7958 | 0.26 | 1.45 |
| | | | | | | | | | | | |
| | 7 | | | | | | 191002 | | 7958 | 0.26 | 1.45 |
| | 8 | | | | | | 191002 | | 7958 | 0.26 | 1.45 |
| | | | | | | | | | | | |
| | 9 | | | | | | 191002 | | 7958 | 0.26 | 1.45 |
| | 10 | | | | | | 191002 | | 7958 | 0.26 | 1.45 |
| | | | | | | | | | | | |
| | 11 | | | | | | 191002 | | 7958 | 0.26 | 1.45 |
| | 12 | | | | | | 191002 | | 7958 | 0.26 | 1.45 |
| | | | | | | | | | | | |
| | 13 | | | | | | 184160 | | 7673 | 0.26 | 1.40 |
| | 14 | | | | | | 184160 | | 7673 | 0.26 | 1.40 |

## 5.1.11 November

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Vat Flow Rate | 1120 | | | | | | | | | | |
| | | | | | | Vat Volume | 6120 | | | Max FI @ 38°F = 2.16 | | FI chart doesn't go below 40°F so FI of 2.16 is based on 40°. | | | | | |
| | | | | | | Fish Length | 4.98 | | | | | | | | | | |
| | | | | | | Ending Fpp | 23 | | | total CFS | 34.93 | | | | | | |
| | | | | | | Mortality | 0.001 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | Large | | | | | | | | | | | | |
| | | | | | | | | | Wt | DI | FI | | | | | | |
| | 1 | | | | | | 137640 | | 5984 | 0.20 | 1.07 | | | | | | |
| | 2 | | | | | | 137640 | | 5984 | 0.20 | 1.07 | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | 3 | | | | | | 156377 | | 6799 | 0.22 | 1.22 | | | | | | |
| | 4 | | | | | | 156377 | | 6799 | 0.22 | 1.22 | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | 5 | | | | | | 190811 | | 8296 | 0.27 | 1.49 | | | | | | |
| | 6 | | | | | | 190811 | | 8296 | 0.27 | 1.49 | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | 7 | | | | | | 190811 | | 8296 | 0.27 | 1.49 | | | | | | |
| | 8 | | | | | | 190811 | | 8296 | 0.27 | 1.49 | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | 9 | | | | | | 190811 | | 8296 | 0.27 | 1.49 | | | | | | |
| | 10 | | | | | | 190811 | | 8296 | 0.27 | 1.49 | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | 11 | | | | | | 190811 | | 8296 | 0.27 | 1.49 | | | | | | |
| | 12 | | | | | | 190811 | | 8296 | 0.27 | 1.49 | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | 13 | | | | | | 183976 | | 7999 | 0.26 | 1.43 | | | | | | |
| | 14 | | | | | | 183976 | | 7999 | 0.26 | 1.43 | | | | | | |

## 5.1.12 December

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Flow Rate | 1120 | | | | | | | | | |
| | | | | | Volume | 6120 | | | Max FI @ 36°F = 2.16 | | FI chart doesn't go below 40°F so FI of 2.16 is based on 40°. | | | | |
| | | | | | Fish Length | 4.98 | | | | | | | | | |
| | | | | | Ending Fpp | 23 | | | total CFS | 34.93 | | | | | |
| | | | | | Mortality | 0.002 | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | Large | | | | | | | | | | | |
| | | | | | | | | Wt | DI | FI | | | | | |
| 1 | | | | | | 137365 | | 5972 | 0.20 | 1.07 | | | | | |
| 2 | | | | | | 137365 | | 5972 | 0.20 | 1.07 | | | | | |
| | | | | | | | | | | | | | | | |
| 3 | | | | | | 156064 | | 6785 | 0.22 | 1.22 | | | | | |
| 4 | | | | | | 156064 | | 6785 | 0.22 | 1.22 | | | | | |
| | | | | | | | | | | | | | | | |
| 5 | | | | | | 190429 | | 8280 | 0.27 | 1.48 | | | | | |
| 6 | | | | | | 190429 | | 8280 | 0.27 | 1.48 | | | | | |
| | | | | | | | | | | | | | | | |
| 7 | | | | | | 190429 | | 8280 | 0.27 | 1.48 | | | | | |
| 8 | | | | | | 190429 | | 8280 | 0.27 | 1.48 | | | | | |
| | | | | | | | | | | | | | | | |
| 9 | | | | | | 190429 | | 8280 | 0.27 | 1.48 | | | | | |
| 10 | | | | | | 190429 | | 8280 | 0.27 | 1.48 | | | | | |
| | | | | | | | | | | | | | | | |
| 11 | | | | | | 190429 | | 8280 | 0.27 | 1.48 | | | | | |
| 12 | | | | | | 190429 | | 8280 | 0.27 | 1.48 | | | | | |
| | | | | | | | | | | | | | | | |
| 13 | | | | | | 183608 | | 7983 | 0.26 | 1.43 | | | | | |
| 14 | | | | | | 183608 | | 7983 | 0.26 | 1.43 | | | | | |

## 5.1.13 January Year 2

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Flow Rate** | **1120** | | | | | | | | | |
| | | | | | | **Volume** | **6120** | | | **Max FI @ 35°F = 2.16** | | **FI chart doesn't go below 40°F so FI of 2.16 is based on 40°.** | | | | |
| | | | | | | **Fish Length** | **4.98** | | | | | | | | | |
| | | | | | | **Ending Fpp** | **23** | | | **total CFS** | **34.93** | | | | | |
| | | | | | | **Mortality** | **0.003** | | | | | | | | | |
| | | | | | **Large** | | | | | | | | | | | |
| | | | | | | | | | Wt | DI | FI | | | | | |
| | **1** | | | | | | 136953 | | 5954 | 0.20 | 1.07 | | | | | |
| | **2** | | | | | | 136953 | | 5954 | 0.20 | 1.07 | | | | | |
| | **3** | | | | | | 155596 | | 6765 | 0.22 | 1.21 | | | | | |
| | **4** | | | | | | 155596 | | 6765 | 0.22 | 1.21 | | | | | |
| | **5** | | | | | | 189858 | | 8255 | 0.27 | 1.48 | | | | | |
| | **6** | | | | | | 189858 | | 8255 | 0.27 | 1.48 | | | | | |
| | **7** | | | | | | 189858 | | 8255 | 0.27 | 1.48 | | | | | |
| | **8** | | | | | | 189858 | | 8255 | 0.27 | 1.48 | | | | | |
| | **9** | | | | | | 189858 | | 8255 | 0.27 | 1.48 | | | | | |
| | **10** | | | | | | 189858 | | 8255 | 0.27 | 1.48 | | | | | |
| | **11** | | | | | | 189858 | | 8255 | 0.27 | 1.48 | | | | | |
| | **12** | | | | | | 189858 | | 8255 | 0.27 | 1.48 | | | | | |
| | **13** | | | | | | 183057 | | 7959 | 0.26 | 1.43 | | | | | |
| | **14** | | | | | | 183057 | | 7959 | 0.26 | 1.43 | | | | | |

## 5.1.14 February Year 2

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Flow Rate | 1120 | | | | | | | | |
| | | | | | Volume | 6120 | | | Max FI @ 36°F = 2.16 | | FI chart doesn't go below 40°F so FI of 2.16 is based on 40°. | | | |
| | | | | | Fish Length | 4.98 | | | | | | | | |
| | | | | | Ending Fpp | 23 | | | total CFS | 34.93 | | | | |
| | | | | | Mortality | 0.004 | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | Large | | | | | | | | | | |
| | | | | | | | | Wt | DI | FI | | | | |
| 1 | | | | | | 136405 | | 5931 | 0.19 | 1.06 | | | | |
| 2 | | | | | | 136405 | | 5931 | 0.19 | 1.06 | | | | |
| | | | | | | | | | | | | | | |
| 3 | | | | | | 154973 | | 6738 | 0.22 | 1.21 | | | | |
| 4 | | | | | | 154973 | | 6738 | 0.22 | 1.21 | | | | |
| | | | | | | | | | | | | | | |
| 5 | | | | | | 189099 | | 8222 | 0.27 | 1.47 | | | | |
| 6 | | | | | | 189099 | | 8222 | 0.27 | 1.47 | | | | |
| | | | | | | | | | | | | | | |
| 7 | | | | | | 189099 | | 8222 | 0.27 | 1.47 | | | | |
| 8 | | | | | | 189099 | | 8222 | 0.27 | 1.47 | | | | |
| | | | | | | | | | | | | | | |
| 9 | | | | | | 189099 | | 8222 | 0.27 | 1.47 | | | | |
| 10 | | | | | | 189099 | | 8222 | 0.27 | 1.47 | | | | |
| | | | | | | | | | | | | | | |
| 11 | | | | | | 189099 | | 8222 | 0.27 | 1.47 | | | | |
| 12 | | | | | | 189099 | | 8222 | 0.27 | 1.47 | | | | |
| | | | | | | | | | | | | | | |
| 13 | | | | | | 182325 | | 7927 | 0.26 | 1.42 | | | | |
| 14 | | | | | | 182325 | | 7927 | 0.26 | 1.42 | | | | |

## 5.1.15 March Year 2

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Vat Flow Rate | 1120 | | | | | | | | | |
| | | | | | Vat Volume | 6120 | | | Max FI @ 39°F = 2.16 | | FI chart doesn't go below 40°F so FI of 2.16 is based on 40°. | | | | |
| | | | | | Fish Length | 5.17 | | | | | | | | | |
| | | | | | Ending Fpp | 20.5 | | | total CFS | 34.93 | | | | | |
| | | | | | Mortality | 0.003 | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | Large | | | | | | | | | | | |
| | | | | | | | | Wt | DI | FI | | | | | |
| 1 | | | | | | 135996 | | 6634 | 0.21 | 1.15 | | | | | |
| 2 | | | | | | 135996 | | 6634 | 0.21 | 1.15 | | | | | |
| | | | | | | | | | | | | | | | |
| 3 | | | | | | 154508 | | 7537 | 0.24 | 1.30 | | | | | |
| 4 | | | | | | 154508 | | 7537 | 0.24 | 1.30 | | | | | |
| | | | | | | | | | | | | | | | |
| 5 | | | | | | 188531 | | 9197 | 0.29 | 1.59 | | | | | |
| 6 | | | | | | 188531 | | 9197 | 0.29 | 1.59 | | | | | |
| | | | | | | | | | | | | | | | |
| 7 | | | | | | 188531 | | 9197 | 0.29 | 1.59 | | | | | |
| 8 | | | | | | 188531 | | 9197 | 0.29 | 1.59 | | | | | |
| | | | | | | | | | | | | | | | |
| 9 | | | | | | 188531 | | 9197 | 0.29 | 1.59 | | | | | |
| 10 | | | | | | 188531 | | 9197 | 0.29 | 1.59 | | | | | |
| | | | | | | | | | | | | | | | |
| 11 | | | | | | 188531 | | 9197 | 0.29 | 1.59 | | | | | |
| 12 | | | | | | 188531 | | 9197 | 0.29 | 1.59 | | | | | |
| | | | | | | | | | | | | | | | |
| 13 | | | | | | 181778 | | 8867 | 0.28 | 1.53 | | | | | |
| 14 | | | | | | 181778 | | 8867 | 0.28 | 1.53 | | | | | |

## 5.1.16 April Year 2

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Flow Rate | 1120 | | | | |
| | | | | | | Volume | 6120 | | | Max FI @ 43°F = 1.94 | |
| | | | | | | Fish Length | 5.4 | | | | |
| | | | | | | Ending Fpp | 18 | | | total CFS | 34.93 |
| | | | | | | Mortality | 0.002 | | | | |
| | | | | | | | | | | | |
| | | | | | Large | | | | | | |
| | | | | | | | | | Wt | DI | FI |
| | 1 | | | | | | 135724 | | 7540 | 0.23 | 1.25 |
| | 2 | | | | | | 135724 | | 7540 | 0.23 | 1.25 |
| | | | | | | | | | | | |
| | 3 | | | | | | 154199 | | 8567 | 0.26 | 1.42 |
| | 4 | | | | | | 154199 | | 8567 | 0.26 | 1.42 |
| | | | | | | | | | | | |
| | 5 | | | | | | 188154 | | 10453 | 0.32 | 1.73 |
| | 6 | | | | | | 188154 | | 10453 | 0.32 | 1.73 |
| | | | | | | | | | | | |
| | 7 | | | | | | 188154 | | 10453 | 0.32 | 1.73 |
| | 8 | | | | | | 188154 | | 10453 | 0.32 | 1.73 |
| | | | | | | | | | | | |
| | 9 | | | | | | 188154 | | 10453 | 0.32 | 1.73 |
| | 10 | | | | | | 188154 | | 10453 | 0.32 | 1.73 |
| | | | | | | | | | | | |
| | 11 | | | | | | 188154 | | 10453 | 0.32 | 1.73 |
| | 12 | | | | | | 188154 | | 10453 | 0.32 | 1.73 |
| | | | | | | | | | | | |
| | 13 | | | | | | 181414 | | 10079 | 0.30 | 1.67 |
| | 14 | | | | | | 181414 | | 10079 | 0.30 | 1.67 |

# 6 Appendix B. Water Quality Parameters

Water Quality Data - Source IDFG, 2021

| **Primary IOC Contaminants** | **Sawtooth** |
|---|---|
| Arsenic | 0.0025 |
| Barium | <0.05 |
| Cadmium | <0.0005 |
| Chromium | <0.0002 |
| Mercury | <0.0002 |
| Nickel | <0.02 |
| Selenium | <0.0005 |
| Sodium | 6.55 |
| Flouride | 1.010 |
| **Secondary and Other IOC Contaminants** | |
| Chloride | ND |
| Iron | <0.05 |
| Manganese | <0.005 |
| Dissolved Solids | ND |
| Zinc | <0.01 |
| Silver | <0.001 |
| Sulfate | 6.0 |
| Calcium | 28.2 |
| Hardness (as $CaCO_3$) | 79 |
| Magnesium | 2.0 |
| pH | 7.5 |
| Potassium | 0.500 |
| Lead | <0.005 |
| Copper | <0.01 |
| Alkalinity (mg/l) | 81.7 |
| Ammonia (mg/l) | ND |
| Gasoline (mg/l) | ND |
| Lube Oil (mg/l) | ND |
| Diesel (mg/l) | ND |
| Nitrate/N | <0.02 |
| Nitrite/N | <0.01 |
| Flow (cfs) | 13-34 |
| Temperature (°F) | 32-72 |

# 7 Appendix C. General Marking Schedule

- February 10th Pit tagging Spring-Run Chinook at Clearwater
- April 26th-May 24th Marking Spring-Run Chinook and Summer-Run Chinook at Clearwater
- May 11th-13th Marking Summer-Run Chinook at Pahsimeroi
- May 29th- June 3rd Marking Spring-Run Chinook at Sawtooth
- June 7th-22nd Marking Spring-Run Chinook at Rapid River
- June 14th-17th Marking Summer-Run Chinook at McCall
- June 26th-June 30th Marking Summer-Run Sockeye at Springfield
- July 12th- 20th Marking Summer-Run Chinook at McCall
- July 26th-August 5th Marking Summer-Run Steelhead at Clearwater
- July 28th- August 4th Marking Summer-Run Steelhead at Magic Valley
- August 12th-17th Marking Summer-Run Steelhead at Niagara Springs
- August 25th - August 30th Marking Summer-Run Steelhead at Hagerman National
- September 20th-September 23rd Pit tagging Spring-Run Chinook, Summer-Run Chinook, and Summer-Run Steelhead at Clearwater
- September 27th-September 30th Pit tagging Spring-Run Chinook at Rapid River
- October 5th and 6th Pit tagging Spring-Run Chinook at Sawtooth
- October 11th- 14th Pit tagging Summer-Run Chinook at McCall
- October 19th-21st Pit tagging Summer-Run Sockeye at Springfield
- October 28th and 29th Pit tagging Summer-Run Steelhead at Magic Valley
- October 30th-October 31st Pit tagging Summer-Run Steelhead at Niagara Springs
- November 9th and 10th Pit tagging Summer-Run Steelhead at Pahsimeroi
- November 16th and 17th Pit tagging Summer-Run Chinook at Hagerman National
- November 29th-December 2nd Pit tagging Spring-Run Chinook at Clearwater

# 8 Appendix D. Options Discussed

### 8.1.1 Reduce Fish Size to 20 fish per pound and total Hatchery to 2.8M

Spring/Summer Chinook are released at a large range of sizes within the LSRCP program. Smolts are commonly measured in fish per pound (fpp) at release and a condition factor is used to convert from fpp to fork length (in or mm). Average size at release varies from 12 fpp (Tucannon) to 25 fpp (Lookingglass) in LSRCP. Top adult return rates have ranged from 20 fpp (McCall FH) to 25 fpp (Lookingglass). Limited head to head release comparisons exist, but larger smolts have not necessarily returned more adults.

Shifting Sawtooth to 20 fpp smolts would increase the final rearing capacity from 2.52M to 2.8M smolts (200K per raceway), while maintaining a 0.30 Density Index. At an average 10-year SAR of 0.21, would provide an additional 424 adults above broodstock replacement (160 adults).

Early rearing space could be provided by starting two small raceways at 415,000 each and then splitting off 300,000 to a large raceway after Sockeye acclimation.

Overall feed costs remain the same, but marking/tagging/fish health, etc. is still estimated at $0.09/smolt.

Cost for implementation is $27,000.

This option was not pursued because additional research is needed to identify survival differences between 18 to 20 fpp Chinook smolts.

### 8.1.2 Construct New Rearing Ponds

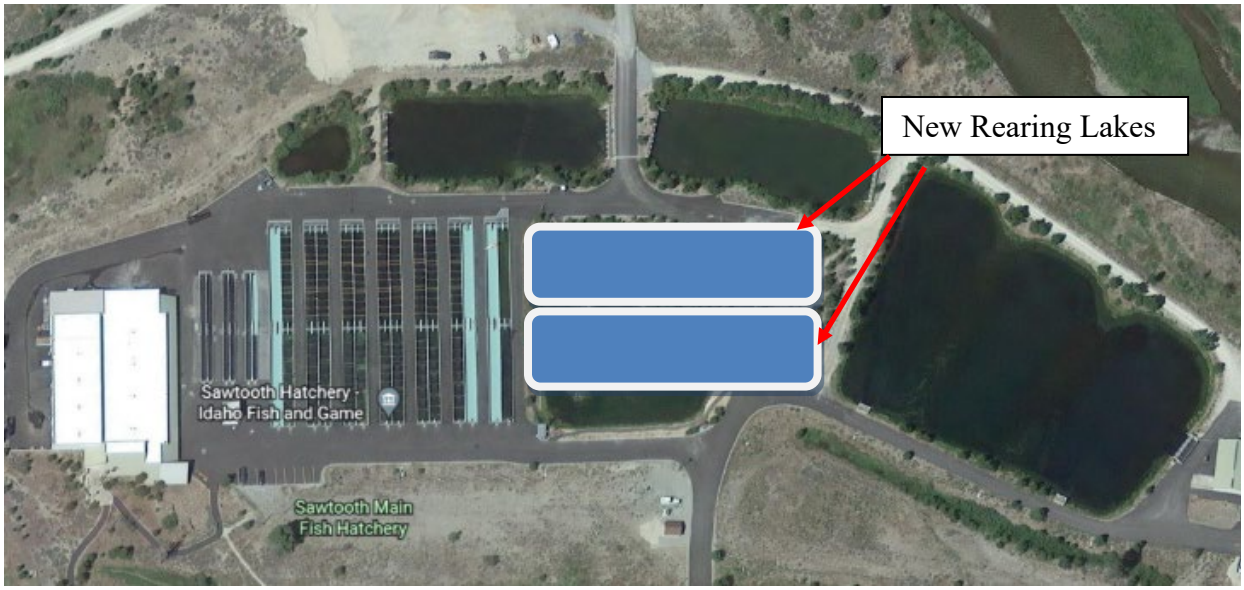
To expand Sawtooth capacity further and maximize smolt quality, construction of lined rearing ponds would be necessary. These ponds could be built in the existing “trout pond” footprint and utilize re-use water from the existing raceways. The project would mirror lined ponds at Lyons Ferry Fish Hatchery with collection basins and filtration to ensure efficient smolt collection.

With the current configurations, one rearing raceway (200,000 at 20 fpp) would have to be sacrificed for the “early rearing” bottleneck for the new “lakes”. Steelhead reared in Lyons Ferry lakes have a 2-fold survival to adult advantage based on “Reciprocal Study” (pers com Joe Bumgarner, WDFW) findings. If a similar advantage was realized in spring Chinook, the rearing lake addition would provide as many adults as the current 2M smolt program.

Each rearing lake would have the capacity to rear approximately 500,000 smolts to 20 fpp.

This option was not pursued because of winter freezing conditions onsite in existing raceways. Rearing lakes trying to use re-use water from the raceways would be prone to extreme ice up issues.

Cost for Implementation is $4M based on Lyons Ferry cost estimates.




### 8.1.3 Retrofit One Off-line Settling Basin for Acclimation

The Sockeye program has utilized Sawtooth Fish Hatchery as an acclimation site for young sockeye smolts from Springfield Fish Hatchery. Acclimation assists in homing, but as importantly provides a transition area for the smolts converting from 236 ppm CaCO3 to 79 ppm CaCO3 at Sawtooth Fish Hatchery. Currently, acclimation occurs after spring Chinook releases.

A new acclimation pond would provided Sockeye rearing, but could also provide acclimation (December to April) for a portion of steelhead reared from Hagerman National Fish Hatchery or Magic Valley Fish Hatchery (see Hagerman Infrastructure Audit).

The most cost-effective acclimation pond would by to retrofit one of the existing Off-line Settling ponds. One pond should be effective for collecting cleaning waste and can be "harvested" while solids are diverted to the Full-Flow settling pond.

Pond would need a liner and collection basin and would utilize re-used water from existing raceway production.

Anticipated cost of $1M for construction.

This option was not pursued because of winter freezing conditions onsite.


New Acclimation Pond
Sawtooth Hatchery - Idaho Fish and Game
Sawtooth Main Fish Hatchery