Expert Witness Report by Thomas L. Rogers

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December 21, 2012

Corrected January 24, 2013

Prepared on Behalf of the

Idaho Ground Water Appropriators, Inc.

In the Matter of Distribution of Water to

Water Right Nos. 36-02551 and 36-07694

ERRATA SHEET FOR TOM ROGERS EXPERT REPORT WITH STRIKEOUT/UNDERLINE

4.6 Small Raceways

On October 14, 2011 According to the Hatchery Production Report for IPC Triploid Rainbow Trout, the small raceways received approximately 114,244 fish or 1,007 pounds of fish at an average of 2.67 inches in length. Density and Flow Indices were estimated at 0.058 and 0.079 respectively, below maximum levels of 0.3 Density and 0.8 Flow Indices. (Rangen, 2011)

According to the November 23, 2011 Hatchery Production Report for IPC Triploid Rainbow Trout, fish were transferred to the large raceways, approximately 113,587 fish or 7,202 pounds which reflects additional mortality or unseen losses. Records indicate the small raceway Density Index at 0.22 and the Flow Index at 0.31. Total flow through the small raceways was reported to be 4,610 GPM or 10.3 CFS. Density was below the 0.3 maximum and the Flow Index well below the maximum of 0.8 required by the IPC contract. (Rangen, 2011)

Based on acceptable Density and Flow Indices using the conservation hatchery maximum Density Index (.3) and Flow Index (.8), along with the maximum available rearing space of ~~13,016~~ 6,508 cubic feet, a total of ~~287,700~~ 151,538 fish could be reared during this same period (~~151,538~~ 38,000 more fish than were produced).

Table 5.4 Summary of Hypothetical Scenarios.

	Troughs	Small Raceways	Large Raceways	C.T.R . Raceways
Flow Index				
		Number of Fish		
0.5	47,536	~~156,458~~107,897	58,410	106,139
0.8	75,924	179,825	98,736	169,822
1.5	138,738	287,720	185,130	318,417
Density Index				
0.3	~~316.692~~ 18,582	151,536	97,416	187,110
0.5	~~532,380~~ 31,008	260,760	160,160	311,850
0.8	~~844,512~~ 49,704	417,216	259,776	498,960
1.0	~~1,055,590~~ 62,130	521,525	324,720	623,700

*Based on a minimum flow of 12.3 CFS (2011)

ERRATA TOM ROGERS EXPERT REPORT – CORRECTED CALCULATIONS WITH STRIKEOUT/UNDERLINE

Density Index (Max .3)

W=D x V x L

W: Weight of fish (lbs)

D: Density Index

L: length of fish (inches)
Range=.4 - 1.0

Flow Index (Max .8)

F=W/L x I

W = F x L x I
W: Weight of fish (lbs)

F: Flow Index

L: length of fish (inches)

I: Inflow (GPM)
Range=0.5 - 1.5

Rearing Troughs*

~~3,468~~ 204 Cu. Ft. total rearing space

(12 troughs at 17 cu ft per tough)

Flow = 26 GPM per trough or 312 GPM

2.67 inch fish

Flow = 26 GPM per trough or 312 GPM
Density index calculation

Density of .3

.3 x ~~3,468~~ 204 x 2.67"= ~~2,778~~ 163 pounds fish

~~2,778~~ 163 x 114 fpp=~~316,692~~ **18,582 fish**

Density of .5

.5 x ~~3,468~~ 204 x 2.67=~~4,670~~ 272 pounds fish

~~4,670~~ 272 x 114 fpp=~~532,380~~ **31,008 fish**

Density of .8

.8 x ~~3,468~~ 204 x 2.67=~~7,408~~ 436 pounds fish
~~7,408~~ 436 x 114 fpp= ~~**844,512**~~ **49,704 fish**

Density of 1.0
1.0 X ~~3,468~~ 204 X 2.67" = ~~9,260~~ 545 pounds fish
~~9,260~~ 545 X 114 fpp = ~~1,055,590~~ **62,130 fish**

Flow index calculations

.5 Flow index calculation

.5 x 2.67 x 312=417 pounds fish

417 x 114 fpp=**47,538 fish**

.8 Flow index calculation

.8 x 2.67 x 312=666 pounds fish

666 x 114 fpp=**75,924 fish**

1.5 Flow index calculation

1.5 x 2.67 x 312=1,216 pounds fish

1217 x 114 fpp=**138,738 fish**

* maximum flow unknown

Small Raceways**

6,508 Cu Ft. total rearing space

Flow = 10 CFS or 4,488 GPM

5.04 inch fish

4,488 GPM total flow

Flow = 4,488 GPM or 10 CFS
Density index calculation

Density of .3

.3 x 6,508 x 5.04"=9,840 pounds fish

9,840 x 15.4 fpp=**151,538 fish**

Density of .5

.5 x 6,508 x 5.04"=16,400 pounds fish

11,309 x 15.9 fpp=**260,760 fish**

Density of .8

.8 x 6,508 x 5.04"=26,240 pounds fish

26,240 x 15.9 fpp=**417,216 fish**

Flow index calculations

.3 Flow index calculation
.3 x ~~6,508~~ 4,488 x 5.04"=~~9,840~~ 6,786 pounds fish
~~9,840~~ 6,786 x 15.9fpp=~~156,458~~ **107,897 fish**

.5 Flow index calculation

.5 x 4,488 x 5.04"= 11,309 pounds fish

11,309 x 15.9 fpp=**179,825 fish**

.8 Flow index calculation

.8 x 4,488 x 5.04"=18,095 pounds fish

18,095 x 15.9 fpp=**287,720 fish**

** Rearing space as per current use of
8 single sections and 2 wide sections

Large Raceways***

14,760 Cu Ft. total rearing space

Flow = 12.5 CFS or 5,610 GPM

2.2 fish per pound or 10 inch fish

Flow = 9,649 GPM or 12.5 CFS
Density index calculation

Density of .3

.3 x 14,760 x 10"=44,280 pounds fish

44,280 x 2.2 fpp=**97,416 fish**

Density of .5

.5 x 14,760 x 10"=73,800 pounds fish

73,800 x 2.2 fpp=**160,160 fish**

Density of .8

.8 x 14,760 x 10"=118,080 pounds fish

118,080 x 2.2 fpp=**259,776 fish**

Density of 1.0

1.0 x 14,760 x 10"=147,600 pounds fish

147,600 x 2.2 fpp=**324,720 fish**

Flow index calculations

.5 Flow index calculation

.5 x 10" x 5,610=26,550 pounds fish

26,550 x 2.2 fpp=58,410 **fish**

.8 Flow index calculation

.8 x 10" x 5,610=44,880 pounds fish

44,880 x 2.2 fpp=98,736 **fish**

1.5 Flow index calculation

1.5 x 10 x 5,610=84,150 pounds fish

84,150 x 2.2 fpp=**185,130 fish**

*** 1640 cu. Ft. per section

9 sections used = 14,760 total Cu. Ft

CTR Raceways****

28, 350 cu. Ft. total rearing

Flow = 12.5 CFS or 9,649 GPM

2.2 fish per pound or 10 inch fish

Flow = 9,649 GPM or 12.5 CFS
Density index calculation

Density of .3

.3 x 28,350 x 10"=85,050 pounds fish

85,050 x 2.2 fpp=**187,110 fish**

Density of .5

.5 x 28,350 x 10"=141,750 pounds fish

141,750 x 2.2 fpp=**311,850 fish**

Density of .8

.8 x 28,350 x x10 "=226,800 pounds fish

226,800 x 2.2 fpp=**498,960 fish**

Flow index calculations

.5 Flow index calculation

.5 x 9,649 x 10"=48,245 pounds fish

48,245 x 2.2 fpp=**106,139 fish**

.8 Flow index calculation

.8 x 9,649 x 10"=77,192 pounds fish

77,192 x 2.2 fpp=**169,822 fish**

1.5 Flow index calculation

1.5 x 9,649 x 10"=144,735 pounds fish

144,735 x 2.2 fpp=318,417 fish

****number of ponds used = 9 for rearing

3 for Cleaning Waste

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Tables and Figures

Addendum

1.0 Introduction

1.1 Objective

I have been retained to analyze whether and to what extent reduced water flows to the Rangen Research Facility (Rangen) may have impacted its operation. Additional analysis includes possible improvements to maximize use of available water flows.

1.2 Basis for Report

The opinions presented in this report are based on information obtained from personal inspections of Rangen's facility on June 19, 2012, and October 8, 2012; review of documents produced by Rangen in response to discovery requests, including research reports, production reports, and Rangen's contract with Idaho Power Company (IPC); attending depositions of Rangen personnel September 10-12 and November 13, 2012; and 37 years of experience in the aquaculture industry. I have also consulted aquaculture hatchery management reference books and other experts and consultants retained by the groundwater users and the City of Pocatello.

1.3 Qualifications

I earned a Bachelor of Science degree in Forestry with Wildlife/Fisheries Resource from the University of Idaho. My professional career includes 37 years with the Idaho Department of Fish and Game (IDFG) as a fish culturist and manager of trout, salmon and steelhead hatchery programs. For 22 of those years I supervised 9 anadromous fish hatcheries as a Fish Hatchery Supervisor for IDFG. My experience with IDFG also included input on design and construction work at Sawtooth, Clearwater, Eagle, and Pahsimeroi Fish Hatcheries.

2.0 General Overview of Fish Hatcheries

Coldwater raceway fish hatcheries of the type found at Rangen are generally operated to raise fish for one of three purposes: commercial, research, and conservation fish hatchery programs. The manner in which water is used differs depending on the purpose for which the facility is operated.

2.1 Commercial Fish Hatcheries

Commercial fish hatcheries are typically operated to maximize fish output. Such hatcheries may produce eggs, fry, fingerlings or adult sized fish for market. Commercial hatchery production utilizes intensive fish culture methods, rapid growth, and high density rearing. These hatcheries rear fish as a food fish to be processed and sold for profit or reared and sold to private pond operations which may include fish-out ponds, or other private pond stocking. This type of fish culture requires constant monitoring of feed rates, density indices, flow indices, oxygen levels, and metabolic waste production. Conversion rates of fish feed to fish weight gain is generally monitored closely. Brood stock may be kept and spawned for eggs for future production. Rearing Flow Indices can reach 1.5 and Density Indices at about 1.0.

2.2 Research Fish Hatcheries

Research fish culture may include intensive fish culture methods to mimic commercial production facilities, or may use lower density conservation hatchery program methods. Research hatcheries generally test for a variety of parameters including feed studies to determine feed rates, or feed ingredients, fish health studies, use of chemical treatments, antibiotic effectiveness, fish vaccine studies, feed additives, fish genetic studies, food fish flesh color studies, fish exercise research or other studies related to fish rearing and production. Rearing Flow Indices and Density Indices would vary based on the type of research being performed.

2.3 Conservation Fish Hatcheries

Conservation fish hatcheries generally use lower density fish culture using higher water flow rates, careful monitoring of fish growth rates to ensure fish are at the target size at release, and measures to ensure that fish are able to survive the rigors of a natural environment. These fish need to be able to fend for themselves in the wild, compete with native or other fish in the system, provide a viable sport fishery, supplement wild fish populations and/or enhance fish populations on the verge of extinction. Some hatchery fish are marked (by tagging or clipping fins) differently from wild fish to protect wild fish populations and provide information to biologists to determine how the hatchery product is performing. In Idaho, many of the conservation hatchery fish are reared under mitigation contracts which aim to provide fish to enhance populations affected by environmental degradation, construction of irrigation or hydroelectric dams, and other similar environmental processes. The final release size of fish may include fry to fingerlings to adult size fish. Brood stock may also be kept and spawned to produce eggs for future production. Flow Indices are generally kept at 1.0 or lower and Density Indices are typically 0.3 or lower. (Robert G. Piper, 1982) (Earl Leitritz, 1980) (N.N.Kutty, 2005)

2.4 Water Supplies

A number of Idaho hatcheries supplement or are completely dependent upon well water which can be provided using a number of redundant processes such as backup wells and power backups such as generators to maintain water flow during a power outage. Table 2.4 lists IDFG operated facilities which use partial or completely pumped fish production water. (Brent Snider, 2012)

Pumped well water is generally considered “disease free” due to the natural filtration by the substrate around the well, and is used in many hatchery programs for incubation and early rearing because of its disease free quality in preventing the transmission of egg and fish diseases. Surface water is often contaminated by birds, animals and other fish making it undesirable for early fish rearing when fish are most susceptible to disease as they have not developed immunity to a number of disease organisms. (N.N.Kutty, 2005)

Well water can also be used as a temperature moderator such as cooling or warming a surface water source. Several Idaho hatcheries use well water to either prevent icing in cold climates, use cooler well water during hot summer conditions to prevent lethal rearing water temperature or prevent disease outbreaks due to warm water conditions. (N.N.Kutty, 2005)

Well water can also improve water quality during periods of high runoff of surface water where high turbidity in the surface water may be detrimental to fish health and growth. The introduction of clean well water can improve the rearing environment and minimize disease issues caused by marginal water quality due to spring run-off or other environmental events.

3.0 Rangen Hatchery

3.1 Rangen Fish Hatchery

Rangen diverts its rearing water from water flowing at the Curren Tunnel, a man-made excavation dug into the basalt cliff located adjacent to and above the Rangen hatchery facility. The Curren Tunnel has a collection pipe in it which runs to the hatch house and greenhouse. Figure 3.1. is a depiction of the Rangen Hatchery provided by Rangen. The facility also captures water flowing from the talus slopes adjacent to the upper Curren Tunnel. The hatch house includes incubators and troughs for hatching and early rearing and relies on gravity flow to provide water to upwelling incubators, circular rearing containers and linear raceways. Figure 3.2. shows how the hatch house is currently configured as testified to by Rangen employee Doug Ramsey. The greenhouse was constructed to provide controlled research facilities, thereby reducing the variability inherent in outdoor raceways, as well as the challenges posed by contamination, predation and disease exposure. In addition, the greenhouse offers small and large rearing containers, and multiple rearing units for side by side research.

The small raceways, large raceways and C.T.R. raceways have multiple sections using serial reuse water spilling from upper sections to lower sections of the raceways. Curren Tunnel water is delivered to the hatch house and greenhouse, as well as for domestic use on the facility. The water enters the hatch house and greenhouse through a 4" PVC line. Water from the hatch house and greenhouse can be delivered to the small raceways; there is also a means to discharge to Billingsley Creek during times when these facilities are being cleaned (according to Doug Ramsey, once per day). The small raceways receive water that has been used in the hatch house and/or greenhouse, along with some "first use" water delivered to the middle of the raceway sections. (Doug Ramsey's November 13 deposition).

Talus slope spring water is captured at the lower diversion head box and currently may only be delivered to the large raceways and then, after use in the large raceways, to the C.T.R. raceways.

3.2 Incubation facilities

Rangen does not hatch its own fish eggs; rather, it purchases "eyed" Rainbow Trout eggs from other commercial hatcheries for use at Rangen's facilities. The eggs are hatched in Rangen's "hatch house". Heath (a brand name) type incubation trays, also known as vertical incubator system, were originally used to incubate and hatch eggs, and then later upwelling incubators were used to incubate and hatch eggs. As eggs are hatched, fish are allowed to exit the incubator and enter the troughs on which the upwelling incubators are mounted. (Wayne Courtney, 2012)

3.3 Early Rearing

After the eggs hatch and egg yolk is absorbed by the fry, they are called swim-up fry and begin feeding on their own. These swim-up fry rear in the hatchery troughs, the fry grow until they are large enough to be moved to the small raceways for additional rearing and growth.

3.4 Final Rearing

From the small raceways, fish may be transferred to the large raceways as they grow and approach maximum density or flow indices in the small raceways. Final rearing may also occur in the C.T.R. Raceways.

4.0 Rangen Operations

4.1 Past Operations

Rangen Research Hatchery was constructed in 1963. (Rangen, 2012). The facility has been used for fish feed research as an appendage of the Rangen aquaculture feed division. Rangen has tested experimental commercial feed diets, as well as research involving fish flesh color development, disease research, growth patterns, and other food fish aspects. When research was complete, many of the fish are sold to fish processing facilities in the local Magic Valley area or to IPC.

From the early 1970's through 1989, the Rangen Research Hatchery saw commercial levels of production. From 400,000 pounds of fish up to 772,000 pounds of fish were produced annually during this period. Water flows during this same period ranged from a high of 54.7 CFS to a low of 25.0 CFS (using June 30 End Fiscal Year). Over 655,600 pounds of fish were produced during a period of water flow averaging 25.0 CFS. Table 4.1 (Deposition Exhibit 47). According to the testimony of Rangen employees, the facility has determined that it is not a desirable business practice to compete on the commercial fish market with their feed customers. (Kinyon, Deposition, 2012) Securing more water supplies to rear additional fish as proposed by Rangen is in conflict with this policy.

4.2 Current Operations

Rangen's hatchery program is operated under a contract to IPC to rear Triploid (sterile) Rainbow Trout for release into Idaho waters for the purpose of sport fishing. The IPCO contract minimizes the ability to rear greater numbers of fish at this facility. Rangen also continues to perform research related to fish feed, fish flesh, color development and disease.

The fish are being reared under strict water flow and fish density guidelines consistent with a conservation hatchery program to help insure good quality fish and increase the ability of these fish to survive in the natural environment. Rangen provides facilities to monitor key water quality characteristics to maintain fish health and manage waste within governmental and environmental requirements (NPDES requirements). These conservation hatchery protocols are the primary concern of hatchery personnel in operating the hatchery, and take priority over Rangen's research.

4.3 Water Flow

Figure 4.3 shows available water flows to the Rangen Hatchery have shown seasonal fluctuations every year. In general, April through July is the period of low flow, and water flows increase through the period of August through January. These inter-annual fluctuations can be as much as 25 CFS some years. Annual fluctuations have also been dramatic over time, with the differences of as much as 8 CFS from one year to the next. The average annual flow rates have decreased from a high of 58.7 CFS in 1972 to a low of 13.7 CFS in 2009. During 2010 and 2011, average water flow has increased to 14.9 CFS with the annual cycle of a low of 12.3 CFS in August of 2011 to a high of 21.5 CFS the month of November 2011. Constraints on production due to water quantity, generally occur when fish are the largest in size, requiring the most water and space for rearing. This period of time occurs during final rearing of a group of fish.

However, even with the density restraints imposed by Rangen's contract with IPC to raise fish for conservation purposes, Rangen could raise more fish than is required under the contract with its current water flows. Rangen could then sell the excess fish on the spot market at the end of each rearing cycle. This is demonstrated by the following discussion where I followed one lot of fish through the rearing cycle in 2011.

4.4 Hatchery troughs

Rangen received 125,000 eggs in March, 125,000 eggs in August, and 69,000 eggs in November, of 2011. Rangen has purchased eggs each year since the IPC contracts became effective beginning in 2004. (Idaho Power Company, 2004-2010). The exact number of eggs received since 2004 is unknown.

The hatch house (Figure 3.2[1]) contains 12 rearing troughs starting at a water flow of 16 GPM per trough or a total of 192 GPM (0.43 CFS). The water flow can increase to 26 GPM or a total of 312 GPM if all the troughs are in use (.058 CFS). (Rangen, 2011)

Approximately 11,500 eggs are hatched in eleven troughs for a total of 126,896 eggs which were received on August 11, 2011. Rangen uses upwelling incubator jars to start triploid eyed eggs, and upwelling incubation uses minimal water to gently roll eggs until hatched. Fry are then allowed to enter a rearing trough to begin feeding and reared to an appropriate size for moving to the small raceways.

Fish numbers decrease when moved from one rearing container to the next for a number of reasons; egg and fish mortality, better estimates of the inventory, and unseen losses such as predation.

Using this initial information from the Hatchery Production Summary for IPC Triploid Rainbow Trout, and estimating length of fish by Rangen's production information, the Density Index was at the allowed 0.3 maximum (0.3 actual) and the Flow Index was below the maximum allowed of 0.8 maximum (0.3 actual). IPC Hatchery Production Summery reports (November 26, 2011). Hatchery egg production to fry is below capacity of existing water and container constraints if commercial rates of Flow and Density Indices were used. Eggs appear to hatch in 5 to 12 days. The current operation utilizes the hatch house for about 22 weeks each year for this production.

[1] The numbers taken from Rangen's reports and used in this report do not match perfectly throughout my example because the numbers are estimates as reported by Rangen; fish numbers decrease when moved from one rearing container to the next for a number of reasons; egg and fish mortality, better estimates of the inventory, and unseen losses such as predation.

Resulting fry are reared to approximately 2.8 inches in 6 to 8 weeks then moved to the small raceways.

There is currently sufficient water to operate the hatch house (rearing troughs) at any time of the year, even during low flow periods.

After taking into account mortality of eggs and early rearing fry, a total of 114,244 were moved out of the troughs to the small raceways. Rangen records indicate ending flow and density indices of a 2.2 Density Index (using ten troughs at a volume of 17 cu. ft. per trough) and a Flow Index of 1.45 Flow Index (using 26 GPM as shown in the October 14, 2011, Hatchery Production Summary).

Along with the 114,244 reared, an additional 23,000 fish (for a total of 137,244 fish) could be hatched and reared in the hatchery building troughs at the existing flow regime as two troughs and apparently 52 GPM of water were not utilized during the early rearing period of this group of fish according to the October 14, 2011 Hatchery Production Summary. (Rangen, 2011)

4.5 Greenhouse

Current water availability is sufficient to continue to use the "greenhouse" as a research unit. (Rogers S. M., 2012)

4.6 Small Raceways

On October 14, 2011 According to the Hatchery Production Report for IPC Triploid Rainbow Trout, the small raceways received approximately 114,244 fish or 1,007 pounds of fish at an average of 2.67 inches in length. Density and Flow Indices were estimated at 0.058 and 0.079 respectively, below maximum levels of 0.3 Density and 0.8 Flow Indices. (Rangen, 2011)

According to the November 23, 2011 Hatchery Production Report for IPC Triploid Rainbow Trout, fish were transferred to the large raceways, approximately 113,587 fish or 7,202 pounds which reflects additional mortality or unseen losses. Records indicate the small raceway Density Index at 0.22 and the Flow Index at 0.31. Total flow through the small raceways was reported to be 4,610 GPM or 10.3 CFS. Density was below the 0.3 maximum and the Flow Index well below the maximum of 0.8 required by the IPC contract. (Rangen, 2011)

Based on acceptable Density and Flow Indices using the conservation hatchery maximum Density Index (.3) and Flow Index (.8), along with the maximum available rearing space of 6,508 cubic feet, a total of 151,538 fish could be reared during this same period (38,000 more fish than were produced).

4.7 Large Raceways

The Hatchery Production Summary for November 23, 2011, indicates the large raceways received approximately 102,053 fish, from the small raceways totaling 6,460 pounds of fish. This again reflects lower fish numbers due to fish mortality or unseen losses. According to Rangen flow measurements, there was 9,649 GPM or 21.5 CFS of water flow. Density and Flow Indices remained well below maximum allowable reported to average a Density Index of 0.09

and a Flow Index of 0.19 reported in the Hatchery Production Summary dated November 26, 2011.

The December 2011 Report shows, after removing additional rearing mortality, 100,022 fish on hand with a weight of 19,094 total pounds at a mean length of 7.09 inches. Density and Flow Indices remain low at 0.18 and 0.48 respectively.

The January 2012 Report indicates 98,031 fish on hand with a weight of 43,062 pounds at a mean length of 9.95 inches. Density and Flow indices remain lower than maximum with a 0.22 Density Index and 0.58 Flow Index. Again, lower numbers of fish due to continued rearing mortality.

The final Hatchery Production Report for March 7, 2012 indicates 72,508 fish transferred out of the hatchery or 32,360 pounds of fish at a mean length of 9.95 inches. Water measurements in March indicate a flow of 13.3 CFS or 5,969 GPM of water utilized through the hatchery. The records do not account for the difference between fish moved to the large raceways and fish transferred to IPC which is approximately 26,400 fish. Estimates at the end of the rearing cycle in the large raceways noted a Density Index of 0.295 and a Flow Index of 0.74, below the maximum of .3 and .8 levels found in the contract for IPC. (Rangen, 2011)

Additional fish were reared through this rearing cycle and periodically sold on the spot market. According to fish sales receipts, a total of 222,280 fish were reared (141,749 pounds) of which a total of 160,983 fish (72,630 pounds) were transferred to IPC and 61,397 fish (69,119 pounds) were sold on the spot market. Utilizing the average CFS in 2011 of 14.9 and calculating the pounds of production for 1 CFS, it is estimated that Rangen produced 9,513 pounds of production for 1 CFS of water flow. This is well under past production years which has exceeded 20,000 pounds of production for 1 CFS of water flow. Sullivan, 2012 Report, Figure 4.2.

4.8 Maximizing Use of Water Supplies

There are a variety of methods to maximize the water supply for hatcheries. Specific to the Rangen Hatchery facility, several methods are available in addition to the water currently captured. Development of a pumping station located at either the diversion to the large raceways catching water from both overflow from the Curren Tunnel or from the talus slope adjacent to the Curren Tunnel, or at the head race of the large raceways is possible. Water could then be pumped to the small raceways for additional flow to those rearing containers, and then reused in the large and C.T.R. raceways. If not needed in the small raceways, it could be allowed to be used as first-use water in the large raceways.

Developing "over the rim" water using wells from above the rim using wells located above the Rangen property on the rim of the canyon. Well water, depending on the depth of the well, should generally be of the same quality and temperature of the existing production water at Rangen. (Third Mitigation Plan - Over the Rim, 2011).

As discussed above, well water is used as a primary supply or to supplement water supplies in many Idaho hatcheries.

5.0 Hypothetical rearing scenarios

Rangen's Aquaculture Division Manager, Joy Kinyon, testified at his deposition that Rangen does not try to maximize fish production because Rangen is averse to competing with the commercial fish producers to whom Rangen sells fish feed. Still, it is interesting to note that Rangen has the capability of producing up to 185,000 fish in the large raceways, 318,000 fish in the C.T.R raceways, (using the flow index maximums) in a single fish cycle with a minimum flow of 12.3 CFS during the low flow cycle. Using this as a minimum flow, estimates of potential fish production can be made using current available rearing space found at the Rangen hatchery facility. (Rangen, Total Flow through Rangen Hatchery, 2001-2011) The following discussion illustrates this.

5.1 Hatchery Building

The hatching of eyed eggs can be accomplished in small containers such as those found in the Rangen hatch house. Past records indicate higher levels of egg production can be undertaken at this facility utilizing existing water flow and containers. Depending on size, eggs, fry and fingerlings can be reared at higher Density and Flow Indices compared to larger fish. Currently, 125,000 eggs are being hatched twice a year (March and August), and 69,000 eggs being hatched once a year (October). This is under the capacity for this facility to produce eggs/fry especially if additional lots are produced throughout the year. I estimate the capacity of the hatchery incubators and troughs to be 138,000 eggs/fry per lot using a flow index of 1.5 which would be the limiting factor if only 26 GPM is available for each trough and using all 12 troughs. This amounts to an additional 13,000 fingerlings per lot. (138,000 fish capability minus 125,000 current egg requests = 13,000 additional fish)

Currently, the hatch house is only used 22 weeks a year.

5.2 The Greenhouse

The 24 – 4 foot in diameter containers in the greenhouse are approximately 200 gallons each and can take 8 GPM per container or a total flow of 192 GPM if all containers are used. There are 3 additional 400 gallon round tanks which would provide additional research or rearing space. Flow for these 400 gallon round tanks would require at least the 8 GPM flow and possibly more but has not been discovered through my inquiries. Although this unit was built for hatchery research, these containers could be used for early rearing.

5.3 Small Raceways

Small raceway production has the potential to be greater than current production levels since current production is being reduced by IPC contract requirements. Under current existing conditions, the production in the small raceways could be increased by the additional 13,000 fingerlings/lot (Section 5.1) available from the hatch house. Total flow to the small raceways has been found to exceed 10 CFS and rearing fish to a 5-inch size and using a more aggressive Flow Index of 0.5, would result in approximately 156,458 fish (9,840 pounds) being reared. Using a Density index of .5, without using additional rearing space, results in producing 260,760 fish. Since this higher number of fish would exceed the flow index, the lower number of 156,458 fish could be reared in this instance.

Another scenario is, again rearing fish to 5 inch size, using a Flow Index of 0.8, approximately 287,720 fish (18,095 pounds) could be reared. Additionally, again rearing fish to 5-inch size, using a Density Index of 0.8, approximately 417,216 fish (26,240 pounds) could be reared. Again, the flow index would be exceeded so the lower number of 287,720 fish could be reared.

5.4 Large Raceways

Trout production in the large raceways is influenced by the same factors as the small raceways; seasonal low flows (12.5 CFS), the IPC mandated Flow Index of 0.8 and the IPC mandated Density Index of 0.3. The Flow Index increases for a given number of trout as water flow decreases. The Density Index increases as numbers of fish increase for a given amount of rearing space. About 98,416 Rainbow Trout per lot could be reared to ten inches with a flow index of 0.8 while approximately 97,416 ten-inch Rainbow Trout per lot could be reared at a Density Index of 0.3, the current flow and density Indices. Both production levels exceed current numbers produced to meet the IPC contract (A maximum of 81,691 Rainbow Trout in March of 2011). (2011 fish sales receipts)

Additional fish could be reared from five inches to ten inches in length by utilizing a Flow Index and Density Index less restrictive than IPC limits. A more practical Flow Index of 0.8 would allow 98,736 trout to be reared in the large raceways while a density Index of 0.8 would allow 259,776 trout to be reared to a length of ten inches. The Flow Index in this option would be the constraint limiting production to 98,736 fish. (Robert G. Piper, 1982)

Production would be further increased if the Density Index of 1.0 and Flow Index of 1.5 were utilized to produce ten-inch fish in the large raceways at the minimum flow of 1.5 CFS. Approximately 324,720 fish (147,600 pounds) can be reared at the higher Density Index of 1.0 while approximately 185, 130 fish can be reared (84,150 pounds) at the higher Flow Index of 1.5. The Flow Index is the constraint in this case allowing a maximum of 185,130 fish to be reared in the large raceways at the current low flow level of 12.5 CFS. The IPC contract constraints are the factors limiting fish production in the large raceways, not the flow levels.

Large raceway production is limited by water flow and utilizing the minimum of 12.5 CFS (5,610 GPM) of water flow found during low flow periods, rearing fish to 10-inch size, and using a Flow Index of .5. Using these criteria, approximately 58,410 fish (26,550 pounds) could be reared. Also in the same vein, rearing fish to 10 inch size using a Density Index of .3, approximately 97,416 fish (44,280 pounds) can be reared, again somewhat conservative for commercial intensive fish culture. The constraint is the Flow Index but 58,410 fish could be reared.

A more intensive level, again rearing fish to 10-inch size, using a Flow Index of .8, approximately 98,736 fish (44,880 pounds) could be reared. Also in the same vein, rearing fish to 10-inch size, using a Density Index of .8, 259,776 fish (118,080 pounds) can be reared. The constraint is the Flow Index and allows up to 98,736 fish to be reared. (Robert G. Piper, 1982)

Using maximum levels of Density Index of 1.0 and Flow index of 1.5, again rearing fish to 10-inch size, approximately 324,720 fish (147,600 pounds) can be reared at the higher Density Index of 1.0. Rearing fish to 10 inch size and using the higher Flow Index of 1.5, approximately 185,130 fish can be reared (84,150 pounds). The constraint is the Flow Index allowing up to 185,130 fish to be reared. This would be a reasonable level of production. Table 5.4 summarizes this discussion.

Larger fish require more space, water and feed to maintain fish health and growth rates. Rearing to higher Flow and Density Indices will depend on species reared, Oxygen saturation levels of inflow water, and myriad of other fish culture variables such as feed methods, feed rates, overall fish health and careful monitoring of growth rates.

The last scenario to increase fish production deals with timing of the water cycle from low to higher flow rates. If eggs were received in February or March, low flows would occur during the time when smaller fish were on the station requiring less water and finishing to market size in November or December when water flows may be near 17 CFS or 7,630 GPM. Utilizing the entire rearing space of the large raceways (14,760 cu. ft.) and rearing fish to 2.2 fish per pound or 10-inch fish, a total of 251,790 fish (114, 450 pounds) could be produced.

6.0 Options for Rangen to produce additional fish

1. The timing of when the largest fish are on station has a great effect of how many fish and what size fish can be reared. Receiving eggs and producing the smallest fish during times of low water flows, allowing fish to grow during times of increasing water flow until the time when maximum water flow is encountered, would increase the number of fish that Rangen could produce. Standard Density and Flow Index calculations indicate up to 251,790 fish (114,450 pounds) may be produced at 17 CFS (7,630 GPM) when fish reach a marketable size of 2.2 fish per pound or 10-inch in length.

   This scenario, however, would negate the ability to meet the IPC contract since this timing would not coincide with contract requirement to release fish in the months of May through June. Continuing with the IPC contract is a business decision made by Rangen.

2. Additional water for hatchery use may be found as described in the "Over-the-Rim" opinion and recommendation concerning the Over-the-Rim mitigation plan as found in the Call for Water by Clear Springs Foods. This plan uses pumped water from existing ground water users, and piping the water to the intake structure of a hatchery facility, thus increasing the available water for fish production. This water may need to be degassed, depending on total gas saturation of the pumped well water, but should be of equal temperature and overall quality of existing intake water. It was determined water that would be delivered under the proposed Over-the Rim Plan would be from the same body of water that provides the spring water to the Snake River Farm facility, and presumably be so for the Rangen hatchery facility as well. The Over-the Rim system would have to meet the necessary standard of reliability with redundancy incorporated to provide backup to deliver the water in the event of power or mechanical failure. (Third Mitigation Plan - Over the Rim, 2011)

3. Pumping intake water to the small raceways from the talus slope source, a source currently only serving the large raceways, would be a reliable means to add flow to the small raceways and provide additional rearing capability in those units. Redundancy should be built into this option to prevent loss of this make-up water. (Earl Leitritz, 1980)

4. Recirculation of existing water is another viable option to maximize the operations at the Rangen facility. Water is picked up at the tailrace of the existing raceways or in the outflow of the hatchery and returned to the head end of the raceways or added to the first

use water entering the hatchery. This type of system requires filtering and re-oxygenation of this reuse water, but provides a process to increase water flows to the raceways and the ability to rear additional fish. Traditional recirculation systems use the recirculation water along with 2% to 10% new water (first use). On paper this could mean Rangen reusing up to 38 CFS and 12 CFS of new water to make a total flow of 50 CFS which meets or exceeds most average flows recorded back to 1966. This is approximately 32% new (first use) water which is much greater that some facilities which operate from 2% to 10% first use water. (Earl Leitritz, 1980)

7.0 Conclusions

1. If the greenhouse is utilized, sufficient water is available for use for research in that facility. Three 400 gallon round vats, twenty-four (24) 200 gallon round vats, forty-eight 50 gallon drums and numerous other smaller individual containers are available for research purposes.

2. Rangen has unused rearing space where they could rear additional fish.

3. Rangen's current fish production is constrained by a contract with IPC to furnish mitigation triploid Rainbow Trout. These trout are to be reared to specific Density and Flow Indices with monetary penalties for non-compliance. Additional fish could be reared, however, without violating the IPC contract requirements. Even more fish could be reared if Rangen was not under IPC contract constraints. (Idaho Power Company, 2004-2010)

4. Currently water from the talus slope source is only used in the large raceways because of how the hatchery is constructed. The talus slope water could be pumped to the small raceways to augment the amount of water in these rearing units. The addition of this pumped water would be a reliable means to augment flows to the small raceways thus increasing both the production capability in the small raceways and allowing for additional rearing units to be used for replicates in hatchery research. Redundancy could be built into this option to prevent loss of this make-up water.

5. If additional water is needed, recirculation (reuse) utilizing pumps, bio-filters, and makeup first use water is certainly an option. Many hatcheries in the west, including Idaho, use reuse systems and/or pump first use water. The engineering on these hatcheries is readily available. (Robert G. Piper, 1982) (Earl Leitritz, 1980)

6. Rangen production goals are to comply with the IPC contract requirements and not necessarily production schemes utilized by in the commercial aquaculture industry. (Maxwell, 2012)

7. Providing eggs at a different time of year (during the low flow period) would give the hatchery an opportunity to rear more fish at the larger size during times of high flows (November/December). This is feasible if the IPC contract is not in effect due to the contracts' rearing constraints found in the low, conservation levels of Density and

Flow Indices. Since low flows occur during spring and summer periods, and IPC fish are in final rearing stages or at the largest size, water flow limits production.

8. Given the practice of Rangen receiving only three lots of eggs annually, even under existing water flow conditions, additional fish may be reared at the Rangen facility than found under current operations.

8.0 References

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Deposition Exhibits used in the report

Exhibit 4 Idaho Power Contract Agreements 2004- 2010. (Idaho Power Company, 2004-2010)

Exhibit 13 various photographs and Advertising material. (Wayne Courtney, 2012)

Exhibit 26 Total Flow through Rangen Hatchery, 2001-2011 (Rangen, Total Flow through Rangen Hatchery, 2001-2011)

Exhibit 30 Spreadsheet of Fish Production November 2011 (Rangen, Spreadsheet of fish Production, 2011)

Exhibit 38 Hatchery Production Summary, Idaho Power Company Triploid Rainbow Trout (Rangen, 2011)

Exhibit 39-41 Hand drawn drawings of small, large and C.T.R. raceways (Tate, Rangen Research Hatchery Manager, 2012)

Exhibit 44 Rangen Research Hatchery Production Records, June 2011 (Tate, Rangen Research Production Records., 2011)

Exhibit 47 Rangen Research Hatchery, 1972-1989, Fish Production Records with Hand Fed, Blower Fed, and Demand Feeding methods. (Exhibit 47, 1972-1989)

Table 2.4 Idaho Fish and Game operated facilities that use partial or completely pumped fish production water.

Hatchery	Maximum Well Water Available for Production	Total Flow
Sawtooth Fish Hatchery	9.1 CFS	45 CFS
Nampa Fish Hatchery	31 CFS	31 CFS
Cabinet Gorge Hatchery	20.4 CFS	25 CFS
Eagle Fish Hatchery	6 CFS	7.2 CFS
Pahsimeroi Fish Hatchery	13.5 CFS	40 CFS
Springfield Fish Hatchery	50 CFS	50 CFS

[i] Phone conversations with hatchery managers 11/28/12.
[ii] Under construction.

Rangen Hatchery Overview

Figure 3.1 **Drawing of Rangen Aquaculture Research Service Unit**

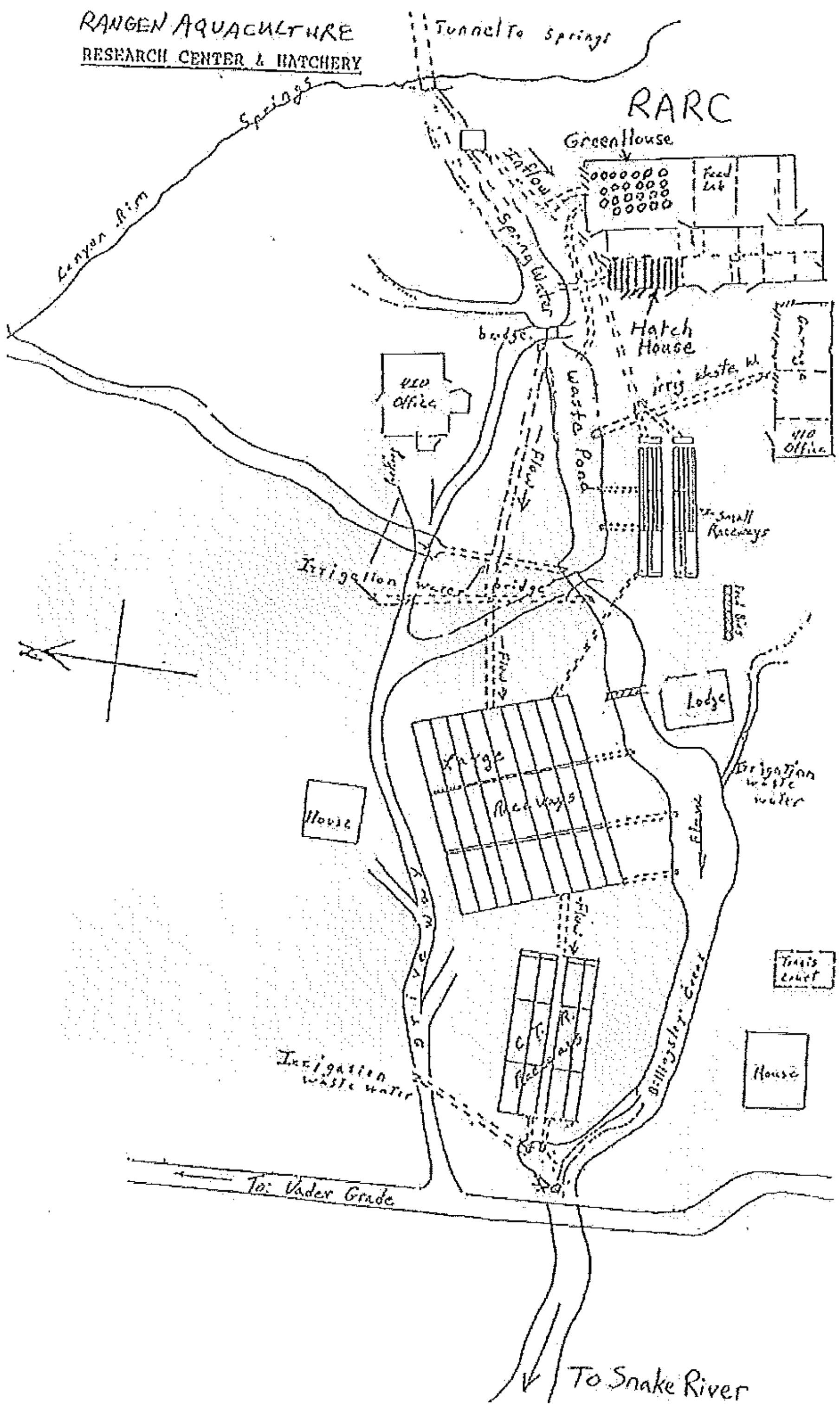


Figure 3.2 **Hatchery Building including Hatch House and Greenhouse**

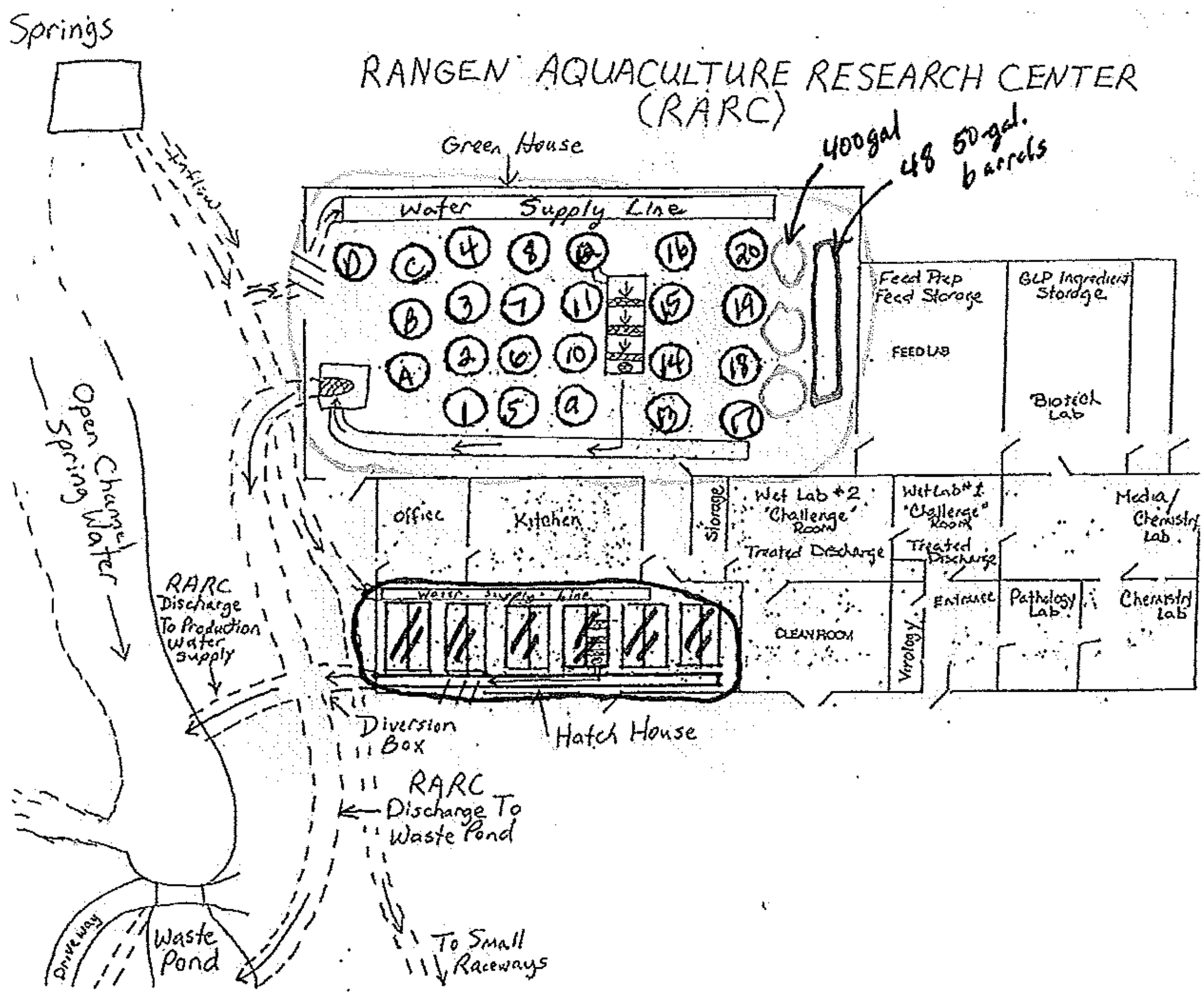


Table 4.1 Deposition Exhibit 47.

BEFORE DEPARTMENT OF WATER RESOURCES

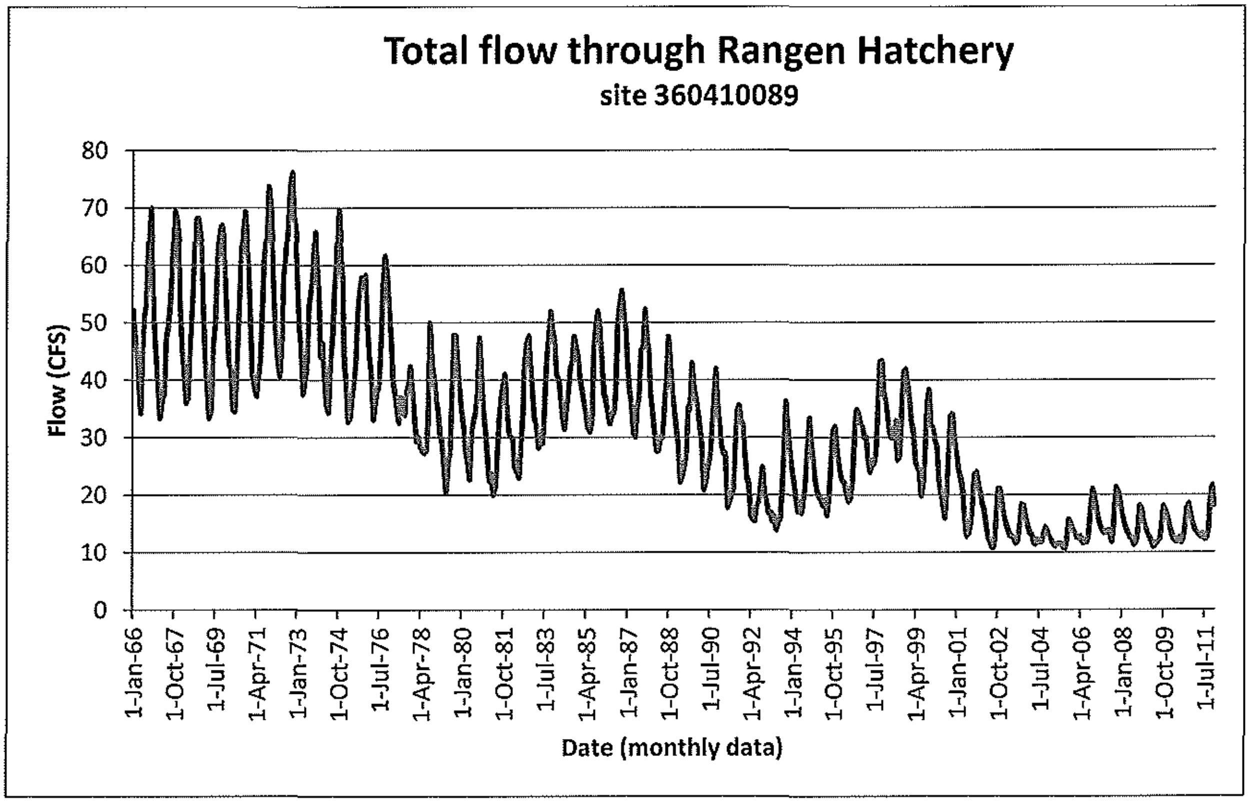
STATE OF IDAHO

IN THE MATTER OF DISTRIBUTION OF WATER TO WATER RIGHT NOS. 36-02551 & 36-07694	Docket No.: CM-DC-2011-004

CONFIDENTIAL INFORMATION

The enclosed is subject to the terms of the *Protective Order* entered on August 31, 2012 and is being disclosed pursuant to its terms. The enclosed documents may not be used other than in connection with the above-referenced delivery call.

Figure 4.3



(Rangen, Rangen Research Hatchery, total flow measurements, 2012) Graph created by Spronk Water Engineers, Inc.

Table 5.4 Summary of Hypothetical Scenarios.

	Troughs	Small Raceways	Large Raceways	C.T.R . Raceways
Flow Index				
		Number of Fish		
0.5	47,536	107,897	58,410	106,139
0.8	75,924	179,825	98,736	169,822
1.5	138,738	287,720	185,130	318,417
Density Index				
0.3	18,582	151,536	97,416	187,110
0.5	31,008	260,760	160,160	311,850
0.8	49,704	417,216	259,776	498,960
1.0	62,130	521,525	324,720	623,700

*Based on a minimum flow of 12.3 CFS (2011)

Density Index (Max .3)

W=D x V x L

W: Weight of fish (lbs)

D: Density Index

L: length of fish (inches)
Range=.4 - 1.0

Flow Index (Max .8)

F=W/L x I

W = F x L x I
W: Weight of fish (lbs)

F: Flow Index

L: length of fish (inches)

I: Inflow (GPM)
Range=0.5 - 1.5

Rearing Troughs*

204 Cu. Ft. total rearing space

(12 troughs at 17 cu ft per tough)

Flow = 26 GPM per trough or 312 GPM

2.67 inch fish

Flow = 26 GPM per trough or 312 GPM
Density index calculation

Density of .3

.3 x 204 x 2.67"= 163 pounds fish

163 x 114 fpp=**18,582 fish**

Density of .5

.5 x 204 x 2.67=272 pounds fish

272 x 114 fpp= **31,008 fish**

Density of .8

.8 x 204 x 2.67=436 pounds fish
436 x 114 fpp= **49,704 fish**

Density of 1.0
1.0 X 204 X 2.67" = 545 pounds fish
545 X 114 fpp = **62,130 fish**

Flow index calculations

.5 Flow index calculation

.5 x 2.67 x 312=417 pounds fish

417 x 114 fpp=**47,538 fish**

.8 Flow index calculation

.8 x 2.67 x 312=666 pounds fish

666 x 114 fpp=**75,924 fish**

1.5 Flow index calculation

1.5 x 2.67 x 312=1,216 pounds fish

1217 x 114 fpp=**138,738 fish**

* maximum flow unknown

Small Raceways**

6,508 Cu Ft. total rearing space

Flow = 10 CFS or 4,488 GPM

5.04 inch fish

4,488 GPM total flow

Flow = 4,488 GPM or 10 CFS
Density index calculation

Density of .3

.3 x 6,508 x 5.04"=9,840 pounds fish

9,840 x 15.4 fpp=**151,538 fish**

Density of .5

.5 x 6,508 x 5.04"=16,400 pounds fish

11,309 x 15.9 fpp=**260,760 fish**

Density of .8

.8 x 6,508 x 5.04"=26,240 pounds fish

26,240 x 15.9 fpp=**417,216 fish**

Flow index calculations

.3 Flow index calculation

.3 x 4,488 x 5.04"=6,786 pounds fish

6,786 x 15.9fpp=**107,897 fish**

.5 Flow index calculation

.5 x 4,488 x 5.04"= 11,309 pounds fish

11,309 x 15.9 fpp=**179,825 fish**

.8 Flow index calculation

.8 x 4,488 x 5.04"=18,095 pounds fish

18,095 x 15.9 fpp=**287,720 fish**

** Rearing space as per current use of
8 single sections and 2 wide sections

Large Raceways***

14,760 Cu Ft. total rearing space

Flow = 12.5 CFS or 5,610 GPM

2.2 fish per pound or 10 inch fish

Flow = 9,649 GPM or 12.5 CFS
Density index calculation

Density of .3

.3 x 14,760 x 10"=44,280 pounds fish

44,280 x 2.2 fpp=**97,416 fish**

Density of .5

.5 x 14,760 x 10"=73,800 pounds fish

73,800 x 2.2 fpp=**160,160 fish**

Density of .8

.8 x 14,760 x 10"=118,080 pounds fish

118,080 x 2.2 fpp=**259,776 fish**

Density of 1.0

1.0 x 14,760 x 10"=147,600 pounds fish

147,600 x 2.2 fpp=**324,720 fish**

Flow index calculations

.5 Flow index calculation

.5 x 10" x 5,610=26,550 pounds fish

26,550 x 2.2 fpp=58,410 **fish**

.8 Flow index calculation

.8 x 10" x 5,610=44,880 pounds fish

44,880 x 2.2 fpp=98,736 **fish**

1.5 Flow index calculation

1.5 x 10 x 5,610=84,150 pounds fish

84,150 x 2.2 fpp=**185,130 fish**

*** 1640 cu. Ft. per section

9 sections used = 14,760 total Cu. Ft

CTR Raceways****

28, 350 cu. Ft. total rearing

Flow = 12.5 CFS or 9,649 GPM

2.2 fish per pound or 10 inch fish

Flow = 9,649 GPM or 12.5 CFS
Density index calculation

Density of .3

.3 x 28,350 x 10"=85,050 pounds fish

85,050 x 2.2 fpp=**187,110 fish**

Density of .5

.5 x 28,350 x 10"=141,750 pounds fish

141,750 x 2.2 fpp=**311,850 fish**

Density of .8

.8 x 28,350 x x10 "=226,800 pounds fish

226,800 x 2.2 fpp=**498,960 fish**

Flow index calculations

.5 Flow index calculation

.5 x 9,649 x 10"=48,245 pounds fish

48,245 x 2.2 fpp=**106,139 fish**

.8 Flow index calculation

.8 x 9,649 x 10"=77,192 pounds fish

77,192 x 2.2 fpp=**169,822 fish**

1.5 Flow index calculation

1.5 x 9,649 x 10"=144,735 pounds fish

144,735 x 2.2 fpp=318,417 fish

****number of ponds used = 9 for rearing

3 for Cleaning Waste