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DEPARTMENT OF
WATER RESOURCES

IDAHO DEPARTMENT OF WATER RESOURCES

IN RE IGWA'S AMENDED THIRD PLAN TO MITIGATE MATERIAL INJURY TO WATER RIGHT NOS. 36-02551 & 36-07694 HELD BY RANGEN, INC., AND OTHER WATER RIGHTS IN WATER DISTRICT 36A.	Docket No. CM-MP-2014-005 **IGWA's Amended Third Mitigation Plan and Request for Hearing**

PLAN OVERVIEW

Idaho Ground Water Appropriators, Inc. (IGWA), acting for and on behalf of its members and non-member participants in mitigation activities, submits this mitigation plan pursuant to rule 43 of the Rules for Conjunctive Management of Surface and Ground Water Resources[1] ("CM Rules").

The *Final Order Regarding Rangen, Inc.'s Petition for Delivery Call; Curtailing Ground Water Rights Junior to July 13, 1962* ("Curtailment Order") issued by the Idaho Department of Water Resources (IDWR) in Docket No. CM-DC-2011-004 requires holders of junior-priority groundwater rights to provide mitigation to Rangen, Inc., or suffer curtailment. In addition, there are pending and threatened delivery calls from other water users in the Water District 36A, which may produce additional mitigation obligations. This plan provides means of providing mitigation to Rangen and other water users in the Water District 36A.

[1] IDAPA 37.03.11.043.

GENERAL INFORMATION

I. Sandy Ponds Recharge and Sandy Pipe Delivery.

IGWA's member North Snake Ground Water District (NSGWD) owns and operates the Sandy Ponds which receive water from North Side Canal Company. NSGWD has filed an application for permit (application no. 36-17011) to utilize the Sandy Ponds to recharge the Eastern Snake Plain Aquifer (ESPA). The Coalition of Cities also proposes to use the Sandy Ponds for recharge and mitigation credit to Rangen pursuant to their pending mitigation plan in IDWR Docket No. CM-MP-2014-003CM-MP.

IGWA's First Mitigation Plan requested mitigation credit for past recharge that has occurred via the Sandy Ponds. The IDWR denied the request due to inadequate measurement of the amount of water diverted out of the Sandy Ponds.

To resolve the IDWR's measurement concern, IGWA and the Coalition of Cities are collaborating to install new measuring devices on the Sandy Pipeline to accurately determine the amount of recharge through the Sandy Ponds, which has and will continue to enhance flows to Rangen and other water users in the Water District 36A. The amount of water recharged into the ESPA from the Sandy Ponds can be calculated by subtracting pond outflows (including evaporation) from pond inflows. The benefit to Rangen and other Hagerman Valley water users from this recharged can then be determined using the ESPA Model.

The measuring devices will also enable accurate measurement of water delivered from the Sandy Ponds through the Sandy Pipeline to provide mitigation to the holders of senior water rights from the Curren Tunnel, Hoagland Tunnel, Billingsley Creek, and other water sources in the Water District 36A.

Attached as ***Exhibit 1*** is a preliminary design and engineering memo by SPF Water Engineering describing measuring devices proposed to be installed on the intake and discharge of the Sandy Pipeline. Design and engineering of these new measuring devices is ongoing and will be completed to a higher level in the near future, at which time updated engineering work will be provided.

IGWA requests approval of the proposed measuring devices, and, once the measuring devices are installed, mitigation credit for recharge that occurs via the Sandy Ponds and direct delivery to other senior water users via the Sandy Pipeline.

II. Improvements to Curren Tunnel diversion.

The CM Rules list several factors the Director may consider when determining whether a senior water right holder is suffering material injury in the context of a water delivery call, including whether "the requirements of the senior-priority surface water right could be met using alternate reasonable means of diversion or alternate points of diversion, including the construction of wells or the use of existing wells to divert and use water from the area having a common ground water supply...." The Idaho Supreme Court affirmed the IDWR's right to require senior water users to improve their means of diversion in its recent *American Falls Reservoir District No. 2* and *A& B Irrigation District* decisions.[2]

The Curren Tunnel is a man-made diversion structure constructed to enhance the discharge of groundwater from the ESPA at that location. Testimony and evidence presented at the hearing on IGWA's First Mitigation Plan indicate that deepening, widening, or lowering the elevation of the Curren Tunnel is expected to increase the amount of water discharged from the ESPA.

IGWA's First Mitigation Plan proposed to improve the Tunnel at its expense, in exchange for mitigation credit for additional water that discharges from the Tunnel as a result. The IDWR refused to allow these improvements of this nature without IGWA providing "specifics on exactly how it propose[s] to 'enlarge' or 'deepen' the Curren Tunnel," and "information to quantify the expected results."[3]

Accordingly, SPF Water Engineering has completed preliminary design and engineering work to improve the Curren Tunnel diversion, attached hereto as ***Exhibit 2***. Groundwater modelling indicates that deepening or lowering the Curren Tunnel may increase the net discharge from the Tunnel and the springs at the head of Billingsley Creek by 12.1 cfs or more. Engineering work is ongoing and will be completed to a higher level in the future, at which time the more detailed engineering plans will be provided.

IGWA proposes to pay the cost of engineering and construction to deepen, widen, or lower the Curren Tunnel to meet the mitigation obligation imposed by the Curtailment Order. IGWA requests approval of mitigation credit for additional water received by Rangen or other Hagerman Valley water users as a result of improvements to the Curren Tunnel.

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[2] *Am. Falls Reservoir Dist. No. 2 v Idaho Dep't of Water Res.*, 143 Idaho at 876-877 (2007); *A& B Irrigation District, et al. v Spackman, et al.*, 315 P.3d at 840 (2013 Ida. LEXIS 368).

[3] Final Order on Reconsideration p. 12.

Cooperation from Rangen is required to perform on-the-ground work required to advance engineering plans to the next level, as explained in Exhibit 2. Considering Rangen could have improved the Curren Tunnel diversion on its own, IGWA requests relief from the full 9.1 cfs mitigation imposed by the Curtailment Order if Rangen refuses to provide access to its property to perform on-the-ground engineering work necessary to further develop and implement this mitigation solution.

If Rangen refuses to cooperate, and the IDWR refuses to suspend the mitigation obligation of groundwater users, IGWA requests approval of this mitigation proposal based on the engineering work completed without access. IGWA's Ground Water District members have a statutory right to condemn easements to access Rangen's property for mitigation purposes. However, to exercise this right requires showing the district court that the proposed use of Rangen's property is authorized by law. This likely requires approval from IDWR that deepening or lowering the Curren Tunnel is permissible for mitigation purposes. Therefore, if Rangen refuses to provide access to its property, IDWR approval of this mitigation proposal, based on the engineering work that can be completed without access, is necessary to enable IGWA to proceed with a condemnation proceeding.

Evidence presented in the Rangen delivery call hearing in May of 2013 shows the ESPA is stable and has an abundant supply of groundwater in the Hagerman area; therefore, no injury is anticipated to groundwater rights. Initial hydrologic analysis of potential impacts to other spring sources indicates it will be miniscule. This analysis is ongoing, and to the extent such impacts create material injury to other water users, will be addressed.

III. Direct Delivery of Water Right No. 36-16976.

IGWA's member groundwater districts currently have pending before the IDWR Application for Permit no. 36-16976 to appropriate 12 cfs of water from Springs/Billingsley Creek for non-consumptive purposes of mitigation for irrigation and fish propagation, a copy of which is attached as ***Exhibit 3***. As explained in the Application, the purpose of this water right is to mitigate material injury to Rangen. If the Application is approved, IGWA will deliver water directly to Rangen either by diverting it at the Bridge Diversion or pumping water from Billingsley Creek to the Hatch House, Small Raceways, and/or Large Raceways.

IGWA's First Mitigation Plan proposed to assign its Application for Permit for water right 36-16976 to Rangen for mitigation credit. The IDWR denied that proposal on the basis that it was speculative. This proposal differs in that IGWA is not asking the Director to approve the assignment of Application to Rangen for mitigation credit; rather, IGWA is simply asking for mitigation credit for water IGWA actually delivers to Rangen under water right 36-16976, if and when it is approved.

Pre-approval of this proposal is important so mitigation water can be delivered to Rangen immediately upon approval of water right 36-16976, without being delayed by another mitigation proceeding. Because fish propagation is a non-consumptive use of water, this will have no adverse impact on downstream water rights.

IV. Recirculation of Rangen Water Rights.

Rangen presently owns water rights to use water from the Curren Tunnel for fish propagation purposes. IGWA has filed Application for Permit no. 36-16976, and Rangen has filed Application for Permit no. 36-17002, which, if approved, will allow Rangen to utilize water from Billingsley Creek for fish propagation.

IGWA proposes to pump water from the bottom of Rangen's aquaculture facility back to the top where it can be re-used for fish propagation. The pump-back facility will be located at the west end of the Rangen property below the CTR Raceways, or on a ½ acre parcel of adjacent land that belongs to the Musser family. It will be designed to capture and recirculate up to 9.1 cfs of water to the head of the Rangen hatchery.

Under this alternative, IGWA will pay the costs to engineer, construct, and operate a pump-back system to re-circulate water discharged from the Rangen hatchery, including filtration, disinfection, and aeration systems as needed, to deliver water of suitable quality to raise fish in an amount to meet the full phased-in mitigation obligation. Redundant power and pumps will be included to protect against power or pump failure, similar to the system described in the engineering plans prepared by SPF Water Engineering for IGWA's Second Mitigation Plan (Tucker Springs Project).

SPF Water Engineering has completed preliminary design and engineering work to pump water from the bottom of Rangen's facilities to the top, attached as ***Exhibit 4***. This engineering work is ongoing and will be completed to a higher level in the near future, at which time the more detailed engineering work will be provided. Because fish propagation is a non-consumptive use of water, this will have no adverse impact on downstream water rights.

IGWA requests mitigation credit for water it pumps back to the head of the Rangen facility. Considering Rangen could have implemented a pump-back system on its own, if Rangen refuses to provide access to its property for IGWA to further engineer and install a pump-back system, the 9.1 cfs mitigation obligation to Rangen should be suspended.

V. Aqua Life Project.

Under this proposal, IGWA will secure by lease or purchase the right to pump water from the Aqua Life Hatchery owned and operated by Idaho Water Resource Board a distance of approximately 3.2 miles to Rangen's place of use near the head of Billingsley Creek. This would enable spring water discharge from the ESPA at Big Springs, which supplies the Aqua Life Hatchery and is currently used for fish production, to be delivered to Rangen's facilities for fish production, or to meet other mitigation obligations that may arise in the Water District 36A.

Completion of the Aqua Life Project will require the following which would be completed by IGWA at its expense: (1) lease or purchase of water rights owned by the State of Idaho at the Aqua Life Hatchery; (2) design and construction of the pump station and pipeline to transport water from Aqua Life to Rangen; (3) acquisition of easements for the pump station and pipe; and (4) permission from Rangen to access its property for engineering, design, and construction purposes.

SPF Water Engineering has completed preliminary design and engineering work for the Aqua Life Project, attached as ***Exhibit 5***. Engineering work is ongoing and will be completed to a higher level in the near future, at which time the updated engineering work will be provided.

IGWA requests mitigation credit for water it delivers from Big Springs to Rangen or other Water District 36A water users. If Rangen refuses to provide access to its property for IGWA to further engineer and install this delivery system, IGWA again asks that its mitigation obligation to Rangen be suspended.

REQUEST FOR HEARING

Pursuant to CM Rule 43.02, IGWA requests that this Mitigation Plan be promptly processed and advertised, and that an expedited Scheduling Conference be set with notice given to the parties to discuss the mitigation alternatives identified in this plan; and, to schedule necessary hearings.

RESPECTFULLY SUBMITTED this 10th day of June, 2014.

RACINE OLSON NYE BUDGE &
BAILEY, CHARTERED

By: Thomas J. Budge
Randall C. Budge
Thomas J. Budge

CERTIFICATE OF MAILING

I certify that on this 10th day of June, 2014, the foregoing document was served on the following persons in the manner indicated.

Thomas J. Budge
Signature of person mailing form

Director, Gary Spackman Idaho Department of Water Resources PO Box 83720 Boise, ID 83720-0098 Deborah.Gibson@idwr.idaho.gov	☐ U.S. Mail/Postage Prepaid ☐ Facsimile ☐ Overnight Mail ☒ Hand Delivery ☒ E-mail
Garrick Baxter Emmi Blades Idaho Department of Water Resources P.O. Box 83720 Boise, Idaho 83720-0098 garrick.baxter@idwr.idaho.gov emmi.blades@idwr.idaho.gov	☐ U.S. Mail/Postage Prepaid ☐ Facsimile ☐ Overnight Mail ☐ Hand Delivery ☒ E-mail
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Exhibit 1

Sandy Ponds / Sandy Pipe

MEMORANDUM

DATE: May 29, 2014

TO: Randy Budge
Rob Williams

FROM: Scott King, P.E.

CC: Bob Hardgrove, P.E.
Jason Thomson, P.E.
SPF files (535.0110, 1093.0010)

RE: IGWA's 3rd Mitigation Plan: Flow Measurements at Sandy Ponds and Aquifer Recharge Measurement, 10% Preliminary Submittal

The Idaho Ground Water Appropriators, Inc. (IGWA) and Coalition of Cities (CoC) are reviewing legal and technical options related to water management stemming from the Rangen Water Call. IGWA and CoC have requested through their legal counsel that SPF provide a conceptual design for determining aquifer recharge occurring at Sandy Ponds in Gooding County, located approximately 1.3 miles south of Curren Tunnel. This memorandum describes recommended protocol for determining aquifer recharge at Sandy Ponds.

1. Site Conditions

1.1. Introduction

Scott King and Jason Thompson of SPF Water Engineering, LLC toured the Sandy Ponds system with Butch Morris on May 7, 2014. Sandy Ponds are located above the Snake River Canyon rim in Gooding County at T08S R14E Section 5, B.M. The pond receives water from the end of North Side Canal Company's W-26 Lateral[1]. Pond discharge enters the Sandy Pipeline to supply farmed properties owned by the Morris, Musser, and Candy families. Butch Morris currently farms all of these properties and pumps from the Sandy Pipe Vault, and ultimately discharges unused water to the Curren Ditch (see Figure 1). The pond incurs significant seepage loss, estimated to be in the range of six cfs in Ponds

[1] Personal communication with Alan Hansten, May 7, 2014

1 and 2, and up to 35 to 40 cfs in one portion to the north referred to as the Recharge Area[2].

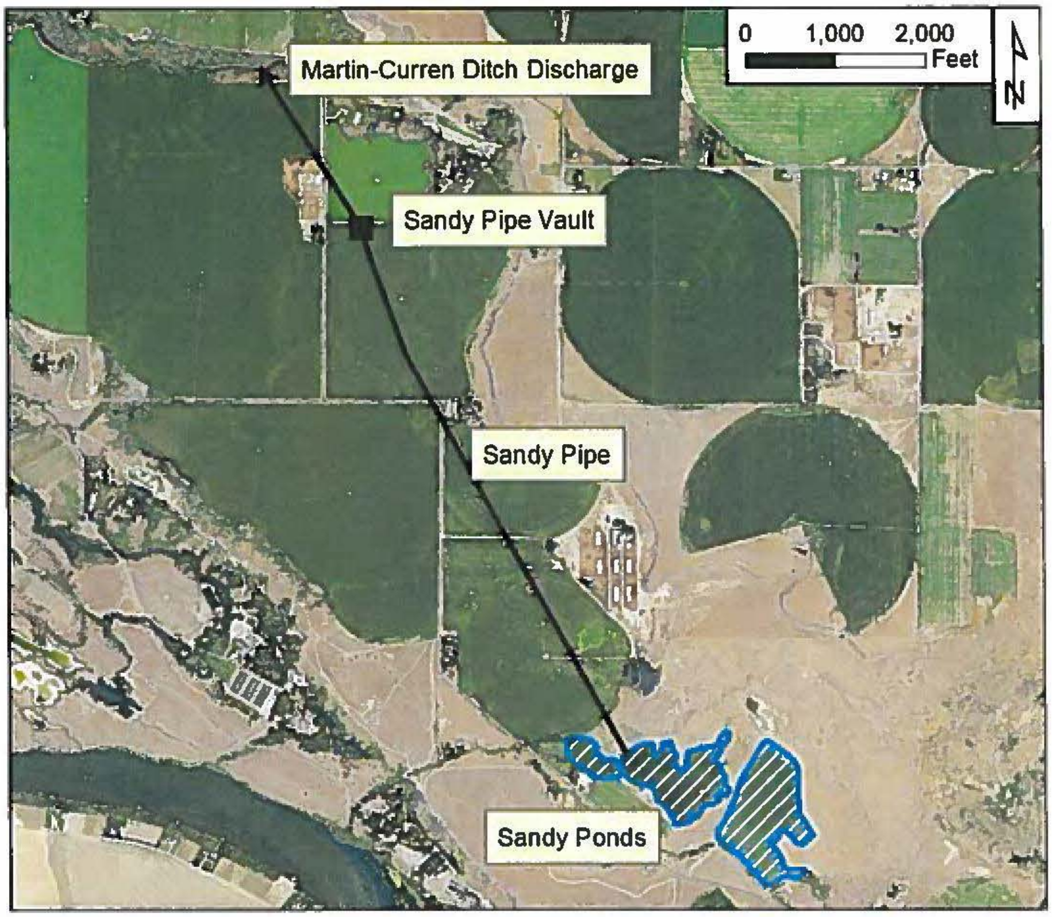

Figure 1: Sandy Ponds, Sandy Pipe, Vault, and discharge to Curren Ditch.

Components of the pond system are referred to as Pond 1, Pond 2, Pond 3 and Recharge Pond (Figure 2). Flow enters Pond 3 from NSCC Lateral W-26 where it subsequently flows to Pond 2 and Pond 1. A gate controls flow from Pond 3 to Pond 2, providing water level control in Pond 3 (Figure 3). When Pond 3 levels are sufficient, Pond 3 will overflow to the Recharge Pond (Figure 4 & Figure 5), and if water levels are sufficiently high, the

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[2] Butch Morris, personal communication, May 7, 2014.

Recharge Pond will overflow to Pond 2 via three large steel pipes (Figure 6). Butch Morris stated the Recharge Pond will lose approximately 35 to 40 cfs to seepage. Pond 2 feeds the Sandy Pipe which provides water to Musser, Morris, and Martin-Curren Ditch (Figure 7). A gate controls flow from Pond 2 to Pond 1 (Figure 8). One pump diverts from Pond 1. Also, Pond 1 can overflow to a lateral conveying water over the rim to the Snake River, although we understand overflow is rare[3]. Ponds 1, 2, a portion of Pond 3, and the Recharge Pond are located within row 43, column 13 of the ESPAM2 model grid. Pond 3 is primarily located within ESPAM2 model grid row 44, column 13.

[3] Personal communication with Butch Morris.

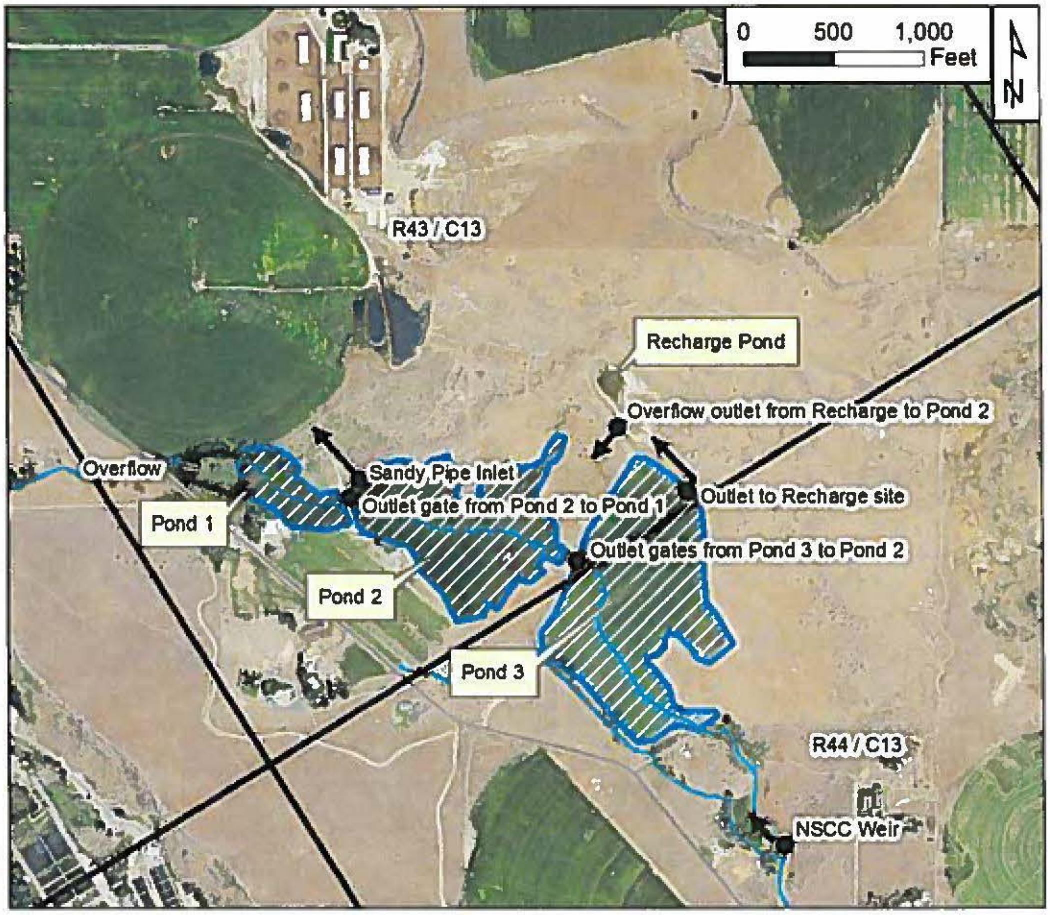

Figure 2: Sandy ponds.

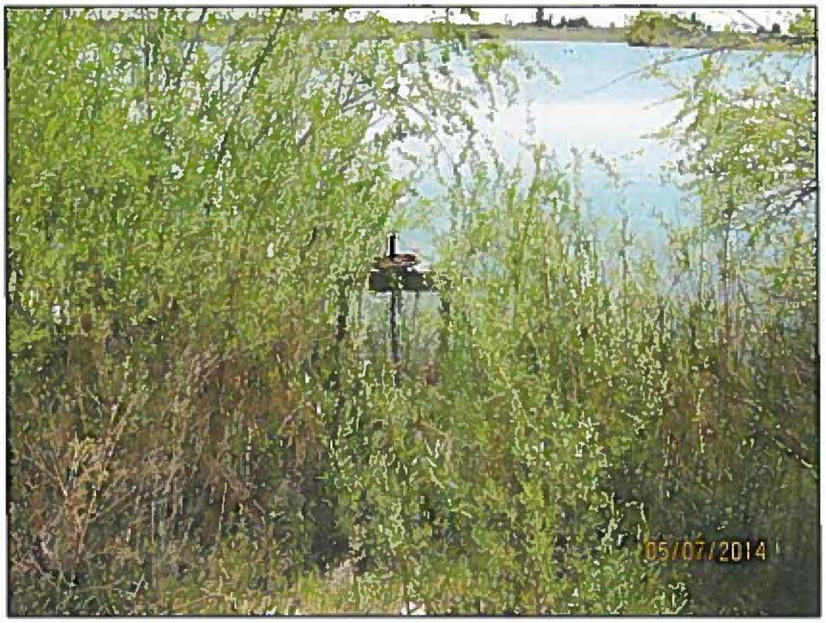

Figure 3: Pond 3 outlet to Pond 2 control gate.

Figure 4: Overflow from pond 3 exits through a concrete box culvert to Recharge Pond.

Figure 5: Overflow exiting Pond 3 is conveyed to the Recharge Pond, shown in the distance.

Figure 6: Recharge Pond on photo right. Overflow pipes on left embankment, near photo center, convey water to Pond 2.

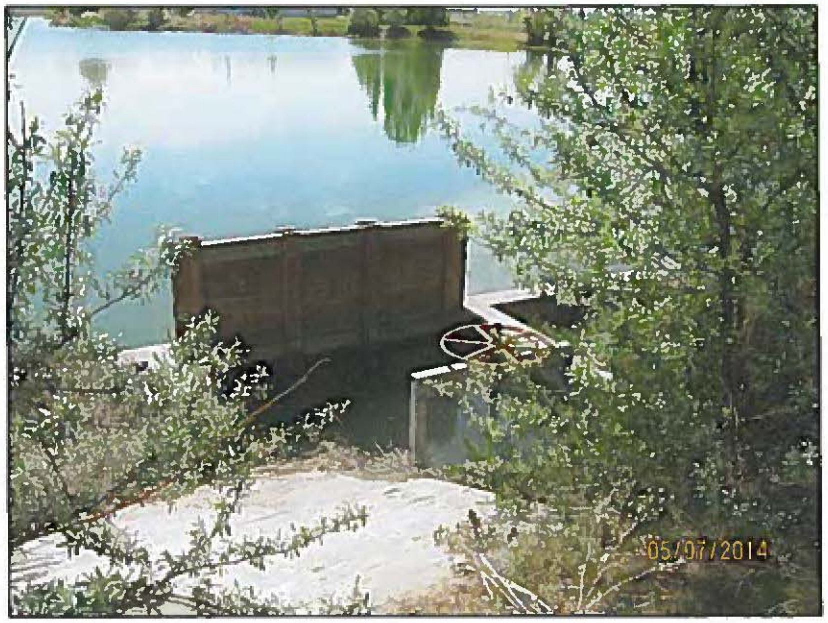

Figure 7: Sandy Pipe headgate (entrance) from Pond 2.

Figure 8: Pond 2 outlet to Pond 1 control gate.

1.2. Measurement

Flow entering the ponds is measured by NSCC with a rectangular contracted weir located approximately 0.2 miles upstream of the first pond, Pond 3 (Figure 9). Alan Hansten with NSCC explained that canal level upstream of the weir is measured with an ultrasonic sensor and data relayed to the NSCC telemetry system.

Figure 9: NSCC measures flow to the ponds with a rectangular contracted weir.

Flow exiting Pond 2 to the Sandy Pipe was measured during 2006 (Figure 10)[4]. These measurements were made using a submerged orifice installed upstream of the pipeline entrance structure. A submerged orifice could be used for future measurement of flow into the pipeline. However, submerged orifice measurement accuracy suffers when flows are low and thus head differences across the orifice are small and difficult to measure accurately. In addition, vegetation and other debris collecting on the orifice reduces measurement accuracy.

[4] Personal communication with Tim Luke.

The Sandy Pipeline discharges to a vault located in T07S R14E Section 31, NESE (Figure 11). SPF recommends measuring discharge from the Sandy Pipe into the vault with a flowmeter installed on the pipeline upstream of the vault. The recommended measurement device is a non-intrusive ultrasonic-type flowmeter. Power is available at the vault for powering the flowmeter and providing telemetry communication if required.

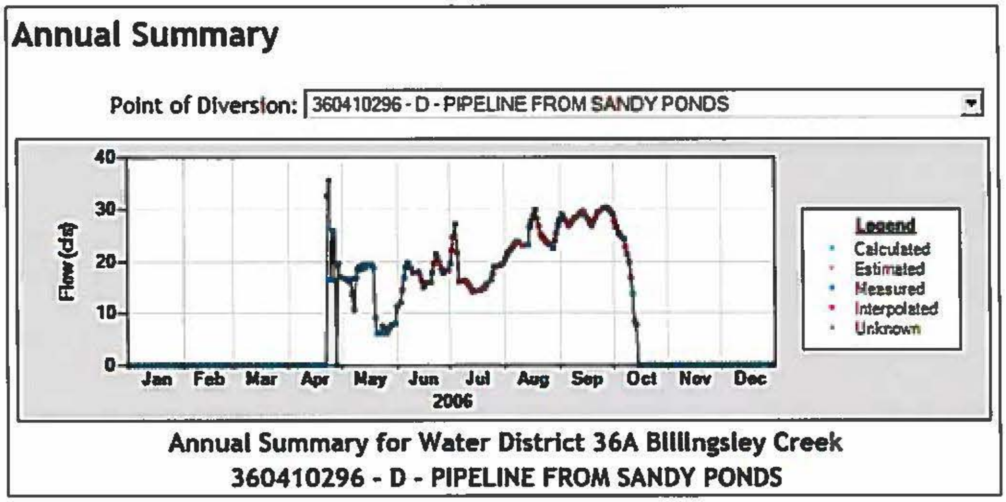

Figure 10: IDWR measurement records of flow into the Sandy Pipeline.

Figure 11: Sandy Pipe Vault. Flow enters the vault below grade from the south (near side of photo) and exits on the north side flowing to Curren Ditch.

1.2.1. Water Balance and Recharge Calculations

Aquifer recharge resulting from pond seepage can be calculated based on subtracting pond outflows (to Sandy Pipe, the pump from Pond 1, Pond 1 overflow, and pond evaporation) from pond inflows (from NSCC). Pond inflows are measured by NSCC as described above. Measurement of pond outflow to Sandy Pipe is recommended to be measured just upstream of the Sandy Pipe Vault (as described above). If not already installed, a flowmeter is recommended to measure pumping from Pond 1. Peak summertime pond evaporation is estimated to be approximately 0.41 cfs (see below). Overflow from Pond 1 is very rare. If overflow measurement is required, a weir could be installed at the overflow location for measurement.

1.2.2. Pond Evaporation

Total pond area is approximately 44 acres when all ponds are at maximum stage. Peak summertime evaporation for ponds is approximately 5.6 mm per day[5]. For 44-acres of open pond surface area, this equates to a daily evaporation of approximately 35,000 cubic feet and an average flow rate of 0.41 cubic feet per second (cfs). Evaporation data are attached.

1.2.3. Discharge to Curren Ditch

Although not required to determine aquifer recharge, discharge from the Sandy Pipe to Curren Ditch may be desired. The recommended measurement strategy is to install a weir in the Sandy Vault to measure the water flowing past the pump intakes and into the pipeline conveying flow to Curren Ditch. This weir would be installed on the existing concrete baffle in the vault with upstream level measurements for flow calculation based on weir size. The appropriate weir size is currently unknown and we recommend observing typical flow depths across the existing concrete baffle to estimate typical flow ranges.

An alternative measurement method is installation of a flowmeter on the pipeline exiting the vault. However, this pipeline is typically not flowing full and other improvements would be required to ensure a full pipe. If this alternative is selected, the flowmeter could be an ultrasonic device as recommended above for vault inflows.

In addition to the two pumps drawing directly from the vault and one submerged outlet to a remote pump, one pipeline historically conveyed water from the Curren Tunnel into the vault. It is understood this pipe will no longer feed water from the Curren Tunnel into the vault, but if measurement of this unlikely flow is required, a magnetic or ultrasonic flowmeter could be installed on the pipeline upstream of the discharge point.

2. Summary

1. Aquifer recharge resulting from seepage at Sandy Ponds can be determined with a water balance by measuring pond inflows and outflows.

2. Inflow to Sandy Ponds is already measured by NSCC.

[5] ET$_{Idaho}$ 2012, ponds and streams for the Hagerman climate station.

3. Outflow from Sandy Ponds can be measured with flow meters installed on the Sandy Pipeline and the pump from Sandy Pond 1. Evaporation losses can be calculated using ET_{Idaho} 2012; peak summertime evaporation is estimated to be approximately 0.41 cfs.

3. References

Allen, Richard G. and Clarence W. Robison, 2012. ***Evapotranspiration and Consumptive Irrigation Water Requirements for Idaho: Supplement updating the Time Series through December 2008****, Research Technical Completion Report, Kimberly Research and Extension Center, University of Idaho, Moscow, ID.*

ET_{Idaho} 2012 -- Evapotranspiration and Consumptive Irrigation Water Requirements for Idaho

Please send suggestions for improving this site to robison at kimberly dot uidaho dot edu Copyright 2012. University of Idaho.

Hagerman 2 SW (NWS -- 103932)

Statistics based on thirty year normal spans 1983 to 2010 years

For a different land cover or crop click on the above link.

You can highlight this table and copy via the clipboard to a Mircosoft Excel or OpenOffice spreadsheet to plot or otherwise work with this data.

Open water - shallow systems (ponds, streams)
Actual Evapotranspiration (Click here for a graph)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Growing Season[a]	Non Growing Season[b]	Annual
Mean[j]	mm/day												mm		
Monthly[c]	0.69	1.23	2.35	3.55	4.46	5.19	5.56	4.96	4.11	2.90	1.28	0.61	1125	0	1125
15-Day Moving Average[d]	0.69	1.18	2.36	3.59	4.48	5.18	5.60	4.95	4.04	2.92	1.28	0.61			
7-Day Moving Average[e]	0.70	1.20	2.35	3.56	4.47	5.18	5.58	4.96	4.07	2.92	1.28	0.61			
3-Day Moving Average[f]	0.69	1.22	2.34	3.55	4.46	5.19	5.57	4.96	4.10	2.90	1.28	0.61			
Standard Deviation[k]	mm/day												mm		
Monthly[c]	0.27	0.37	0.60	0.47	0.67	0.38	0.50	0.41	0.36	0.56	0.26	0.28	77	0	77
15-Day Moving Average[d]	0.21	0.38	0.48	0.59	0.68	0.55	0.42	0.39	0.45	0.49	0.37	0.21			
7-Day Moving Average[e]	0.27	0.46	0.58	0.78	0.94	0.77	0.48	0.51	0.59	0.66	0.46	0.27			
3-Day Moving Average[f]	0.33	0.56	0.73	1.03	1.16	0.98	0.66	0.70	0.79	0.84	0.57	0.33			
20% Exceedance[l]	mm/day												mm		
Monthly[c]	0.83	1.46	2.73	3.90	4.70	5.48	5.86	5.08	4.38	3.13	1.45	0.70	1161	0	1161
15-Day Moving Average[d]	0.92	1.76	3.20	4.57	5.52	6.06	5.99	5.51	4.64	3.52	1.85	0.91			
7-Day Moving Average[e]	1.18	2.13	3.54	5.00	6.25	6.35	6.48	5.92	5.11	4.16	2.28	1.14			
3-Day Moving Average[f]	1.46	2.39	4.14	5.89	6.78	6.92	6.84	6.31	5.57	4.60	2.62	1.48			
80% Exceedance[m]	mm/day												mm		
Monthly[c]	0.47	0.88	1.93	3.06	3.97	4.81	5.01	4.63	3.85	2.54	1.01	0.40	1066	0	1066
15-Day Moving Average[d]	0.35	0.70	1.58	2.48	3.15	4.03	4.75	4.25	3.15	1.99	0.75	0.32			
7-Day Moving Average[e]	0.22	0.62	1.25	2.16	2.79	3.46	4.54	3.86	2.86	1.55	0.56	0.22			
3-Day Moving Average[f]	0.06	0.34	1.01	1.61	2.21	3.05	3.82	3.18	2.28	1.04	0.35	0.07			
Ave Highest ET_{act}	mm/day												--		
15-Day Moving Average[g]	0.82	1.44	2.72	3.97	5.04	5.74	5.83	5.31	4.46	3.36	1.57	0.73			
7-Day Moving Average[h]	1.03	1.75	3.03	4.66	5.77	6.18	6.13	5.66	4.86	3.76	1.93	0.90			
3-Day Moving Average[i]	1.26	2.02	3.62	5.41	6.41	6.69	6.59	6.02	5.28	4.25	2.30	1.14			
Ave Lowest ET_{act}	mm/day												--		
15-Day Moving Average[g]	0.54	0.99	2.01	3.11	3.91	4.64	5.30	4.60	3.68	2.51	1.00	0.49			
7-Day Moving Average[h]	0.42	0.81	1.69	2.60	3.32	4.11	4.99	4.30	3.33	2.09	0.79	0.35			
3-Day Moving Average[i]	0.25	0.60	1.35	2.10	2.71	3.46	4.36	3.66	2.80	1.59	0.55	0.19			
Special normal distribution parameters for monthly, seasonal, and annual intervals															
Skew[n]	0.37	1.15	0.22	0.72	0.12	-0.55	-0.10	0.20	-0.32	0.16	0.41	0.27	0.72	0.00	0.72
Kurtosis[o]	1.16	4.54	0.66	2.47	0.92	3.35	0.65	0.69	3.42	0.88	2.53	0.75	3.24	0.00	3.24

[a] Growing Season: This is usually the time from green up or planting in the spring to a killing frost or harvest in the fall. It is not applicable for entries without a growing season and will be blank.

[b] Nongrowing Season: This is usually the time from a killing frost or harvest in the fall to the of green up in the spring. It is not applicable for entries without a growing season.

[c] Mean of the average daily value for month

[d] Mean of the fourteen 15-day period averages contained in the month

[e] Mean of the twenty three 7-day period averages contained in the month

[f] Mean of the twenty seven 3-day period averages contained in the month

[g] Mean of the highest/lowest 15-day period average in month

[h] Mean of the highest/lowest 7-day period average in month

[i] Mean of the highest/lowest 3-day period average in month

[j] This value represents the *mean value* for the parameter for the month over the 'normal' period of record. Generally, the 'normal' period is the last thirty years with data.

[k] This value represents the *standard deviation* for the parameter for the month over the 'normal' period.

[l] This value represents the *value* for the parameter that has a 20% chance of being exceeded that month durning any particular year. Conversely, there is an 80% chance that the parameter value will be less than the *value* shown.

[m] This value represents the *value* for the parameter that has a 80% chance of being exceeded that month durning any particular year. Conversely, there is an 20% chance that the parameter value will be less than the *value* shown.

[n] This value represents the *skewness (asymmetry) of the distribution of the parameter values* for the month (year) over the 'normal' period. A value near zero indicates that the distribution approximates a normal (Gaussian) and symmetrical distribution. A negative skew indicates that the parameter distribution has relatively few low values compared to high values. A positive skew indicates that the distribution has relatively few high values compared to the number of low values. A skew value near 1 indicates that the underlying distribution approximates a lognormal distribution.

[o] This value represents the *kurtosis* of the parameter value distribution for the month (year) over the 'normal' period. Kurtosis is a measurement of the height to width ratio of the probability distribution, or the *peakedness (slenderness)*. A normal (Gaussian) distribution has a kurtosis of 3. A high kurtosis distribution has a sharper peak and longer tails, while a low kurtosis distribution has a more rounded peak and shorter tails.

This work and report were prepared by the University of Idaho Research and Extension Center at Kimberly, Idaho under contract with the Idaho Department of Water Resources. Work was supported by funding from IDWR and the Idaho Agricultural Experiment Station and Idaho Engineering Experiment Station. The authors gratefully acknowledge the long-term evapotranspiration data collection and long-standing advice provided by Dr. James L. Wright, USDA-ARS Kimberly (ret.), the more than two decades of high quality agricultural weather data collection by the U.S. Bureau of Reclamation AgriMet system, and the very long-standing, routine data collection by the hundreds of cooperative weather station volunteers across the state who, for more than one-hundred years, have faithfully observed daily air temperature and precipitation.

The citation for the evapotranspiration data used from this site should be: *Allen, Richard G. and Clarence W. Robison, 2012. **Evapotranspiration and Consumptive Irrigation Water Requirements for Idaho: Supplement updating the Time Series through December 2008**, Research Technical Completion Report, Kimberly Research and Extension Center, University of Idaho, Moscow, ID.*

Questions regarding the data should be addressed to Clarence W. Robison or Richard G. Allen, University of Idaho, Kimberly Research and Extension Center, 3793 North 3600 East, Kimberly, ID 83341. Telephone (208)-423-6610

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ETIdaho web site powered by Debian, Apache, Firebird DBMS, Python, with matplotlib, and kinterbasdb.

Exhibit 2

Improvements to Curren Tunnel

SPF WATER ENGINEERING

TECHNICAL MEMORANDUM

DATE: May 29, 2014

TO: Randy Budge

FROM: Jason Thompson, P.E.
Terry Scanlan, P.E., P.G.

CC: Bob Hardgrove, P.E
Bern Hinckley, P.G.
SPF file (535.0090)

RE: IGWA's 3rd Mitigation Plan: Curren Tunnel Enhancement Project,
10% Preliminary Submittal

The Idaho Ground Water Appropriators, Inc. (IGWA) is reviewing legal and technical options related to water management stemming from the Rangen Water Call. IGWA has requested through its water rights legal counsel that SPF provide a conceptual design of enhancements to the Curren Tunnel to increase groundwater discharge at Rangen by approximately 10 cfs. IGWA has also requested that SPF assess the technical feasibility of this concept. This memorandum describes potential tunnel enhancements.

1. Site Hydrogeology

1.1. Introduction

The Rangen, Inc. (Rangen) aquaculture facility is located along the western edge of the Eastern Snake Plain Aquifer. Rangen utilizes groundwater discharging from the slope east of the facility. Groundwater discharges from the slope in two primary areas consisting of (1) a constructed facility, referred to as the "Curren Tunnel", that functions as a horizontal well and (2) natural springs referred to as the "lower springs".

This section provides a summary of the hydrogeology of the vicinity of Rangen, with an emphasis on the Curren Tunnel and the natural springs that provide groundwater supply to Rangen. The summary is based on the current understanding of the site hydrogeology, and primarily references *Rangen Groundwater Discharge and ESPAM2.1 Hydrogeologic Investigation* prepared by Bern Hinckley, P.G. (Hinckley 2012) and *Review of Hydrogeologic Conditions Located at and Adjacent to the Spring at Rangen Inc.* prepared by C. Neal Farmer (Farmer 2009).

1.2. Hydrogeological Characterization

The primary aquifer of the Eastern Snake River Plain is comprised of Quaternary-age basalts of the Snake River Group. Groundwater flow is generally from east to the west. This primary aquifer is the source of all the major springs from Buhl to Lower Salmon Falls, including springs at Rangen. Tertiary-age sediments typically underlay the basalts in the vicinity of Rangen. These sediments are characterized as the Tuana Gravel, consisting of gravel interbedded with layers of sand and silt, overlying poorly consolidated lake and stream deposits of the Glenns Ferry Formation.

At the slope east of Rangen, the basalt forms a cap approximately 70 feet thick above alluvial deposits. Downhill from this cap, basalt talus and colluvial deposits obscure the Tuana Gravel and Glenns Ferry Formation.

It is postulated that the Tuana Gravel is highly permeable at Rangen, with permeability similar to the overlying basalt (Farmer 2009). The sediments of the Glenns Ferry Formation are of a lower permeability and generally define the bottom of the primary aquifer east of Rangen and north and south along the Hagerman Rim.

Groundwater discharges to the surface as springs along the Hagerman Rim, including at Rangen, where the water table is exposed at topographic low areas and further downward movement of groundwater through the permeable basalt/Tuana Gravel is impeded by the underlying low-permeability Glenns Ferry Formation .

Additionally, the Glenns Ferry Formation along the Hagerman Rim is intersected by paleochannels, oriented in a roughly east-west direction. These paleochannels are occupied by highly permeable pillow basalt that formed when lava flowed into water resulting in rapid cooling. It is common along the Snake River Canyon for the largest springs to emerge from pillow basalt occupying ancestral Snake River canyons (Whitehead 1992). These channels may also contain or be underlain by highly permeable sediments of the Tuana Gravel.

The saturated thickness of the primary aquifer is the difference between elevation of the groundwater level in the aquifer and the elevation of the bottom of the aquifer. At Rangen and elsewhere along the Hagerman Rim, the saturated thickness is small relative to the saturated thickness of the aquifer east of the rim, and is often maintained only where paleochannels have effectively lowered the base of the primary aquifer. The paleochannels function as drain points from the aquifer.

1.3. Curren Tunnel

The Curren Tunnel (tunnel) is one of two groundwater discharge locations that serve Rangen, the other being the lower springs discussed below. A map showing the Curren Tunnel and lower springs is provided as Figure 1. The tunnel is essentially a horizontal flowing well, bored into the slope above Rangen and intercepting the sloping water table within the pillow basalt facies above the Tuana Gravel. Groundwater discharge into the tunnel is directly related to the difference in the elevation of the tunnel compared to the elevation of the water table in the surrounding aquifer; as the difference increases the discharge also increases.

The entrance of the tunnel is lined with 6-foot diameter corrugated steel pipe; this pipe is reported to be approximately 50 feet in length. The tunnel beyond the pipe is an open excavation, presumably in pillow basalt. Groundwater likely enters the tunnel at numerous locations, flowing by gravity to the entrance.

Tunnel construction date and details are ambiguous. A water-right priority date associated with the tunnel indicates construction at or prior to 1884. The tunnel has been reported to be approximately 180 feet long before forking; the south fork is described as being 120 feet long and contributes 75% of the flow. The north fork is described as being 105 feet long and contributes 25% of the flow. The tunnel is also reported to have a fairly constant elevation, approximately 70 feet below the rim elevation. The rim of the plateau above Rangen is at an elevation of approximately 3220 feet. The eastern end of the Rangen fish hatchery facility at the base of the slope is at an elevation of approximately 3080 feet.

The tunnel was originally constructed at an elevation to supply irrigation water to nearby lands by gravity. It is not known if (1) there were existing springs at the site of the tunnel from which the tunnel was meant to extract additional water or (2) if the tunnel was constructed at a dry location with the purpose of developing a new groundwater supply at the highest practical elevation.

The elevation of the tunnel is currently not ideal for maximum groundwater supply in that it provides minimal available groundwater drawdown. The tunnel outlet is reported at an elevation of 3150 feet. Groundwater elevation measured in the Rangen monitoring well located approximately 600 feet east of the tunnel outlet varied between 3153 and 3158 feet from 2008 to 2012. Therefore available drawdown is only 3 to 8 feet, assuming the tunnel is at a constant elevation along its length. This minimal available drawdown makes discharge from the tunnel very susceptible to even minor groundwater level declines, as discharge is directly related to available drawdown (i.e. difference in head). Despite the minimal available drawdown, the amount of water that discharges from the tunnel demonstrates the effectiveness of the tunnel as a conduit for groundwater flow.

Figure 1. Vicinity Map of Rangen Springs

1.4. Lower Springs

The lower springs are natural springs that emerge from the talus slope at an elevation below the Curren Tunnel, immediately east of Rangen. The lower springs occur at an approximate elevation of 3100 feet. Flow data presented graphically as Figure 14 in Hinckley (2012) demonstrates that between March 2001 and March 2008, average monthly flow from the lower springs was about 10 cfs, flow from the tunnel was roughly 5 cfs. Given the lower elevation of these springs relative to the tunnel and the resulting greater hydraulic gradient relative to the surrounding aquifer, discharge from the springs is less impacted by changes in aquifer water levels.

1.5. Conceptual Hydrostratigraphic Model

Farmer (2009, Fig. 24) presents a conceptual hydrostratigraphic model for the area immediately east of Rangen from which the Curren Tunnel groundwater and lower springs emerge. In this model, there is a paleochannel below the Quaternary basalt that is cut into the underlying sediments: the Tuana Gravel and Glenns Ferry Formation sediments. The paleochannel is filled with highly permeable pillow basalt. The Curren Tunnel was constructed in the bottom of this paleochannel, following it in an easterly direction. The tunnel captures groundwater flowing within the pillow basalt, with underlying sediments likely forming some degree of a less permeable zone. Farmer (2009) describes pillow basalt outcrops upslope of the tunnel entrance.

The lower springs occur where groundwater in the Tuana Gravel (beneath the paleochannel pillow basalt, but above the much less permeable, predominantly clay sediments of the Glenns Ferry Formation) discharges at the face of the slope.

Hinckley (2012) presents additional stratigraphic (Fig. 8) and potentiometric (Fig. 16) evidence for a zone of high permeability extending eastward from the Rangen location.

2. Conceptual Design Approach

The Curren Tunnel is constructed at an elevation that limits the available drawdown relative to the surrounding aquifer. The saturated thickness of the aquifer along the Hagerman Rim is relatively small, and the high elevation of the tunnel reduces the thickness available to the tunnel even more. Minor water-level declines in the aquifer create a disproportionately large change in the hydraulic gradient to the tunnel, which in turn has a significant impact on discharge from the tunnel.

The conceptual design approach has two major objectives: (1) increase flow to Rangen and (2) provide a more stable water supply that is less vulnerable to future water-level declines. The design approach involves accomplishing these objectives by modifying the Curren Tunnel diversion system and presents two primary options for this: (1) lengthening the existing tunnel and (2) lowering the tunnel by reconstruction at a lower elevation, near the lower springs. The tunnel lowering concept can be further subdivided into two approaches: (1) a strictly horizontal well with a consistent elevation and (2) a well with both horizontal and vertical components.

Both approaches would theoretically increase discharge rates by increasing available drawdown and, accordingly, the hydraulic gradient to the tunnel. The available drawdown increases going east, as aquifer water-level elevation rises in the same direction. A well with more available drawdown will produce more water and is also less sensitive to water-level declines in the aquifer. With more available drawdown, a given decline in water level makes up proportionally less of the overall available drawdown, and discharge rates are impacted to a lesser degree.

Both approaches would target highly permeable water-bearing zones. The tunnel lengthening approach would target the same zone as the existing Curren Tunnel, the pillow basalt occurring in the paleochannel hypothesized by Farmer (2009). The tunnel lowering approach would target one or both highly permeable zones depending upon the specific approach taken: the Tuana Gravel that feeds the lower springs as postulated by Farmer (2009) and the pillow basalt occupying the paleochannel.

The Rangen monitoring well was drilled through basalt to a depth of about 68 feet, and then through sediments to a total depth of 165 feet. Drilling did not encounter groundwater within the basalt, and the water level in the completed well was found at the contact between the basalt and underlying sediments. Therefore it appears that the Quaternary basalt that serves as the primary aquifer to the east is not water-bearing at the monitoring well location at current water levels. The basalt may be water-bearing nearby if pillow basalts are present at lower elevation within the hypothesized paleochannel (assuming that the monitoring well is outside of the center of the paleochannel). Therefore, determination of the location and geometry of the paleochannel is critical for a successful tunnel lengthening project.

Tunnel lowering could potentially target groundwater occurring in any permeable zone above the Glenns Ferry Formation sediments, while the well lengthening concept is more dependent on the existence of the hypothesized paleochannel and the high permeability pillow basalt. Additional investigation must be performed to evaluate and locate this channel as described below.

3. Initial Recommended Investigations

3.1. Numerical Model

A simple MODFLOW-based groundwater model has been developed to provide a reconnaissance-level quantification of the potential discharge from a tunnel constructed at a lower elevation (Hinckley, 2014). The hypothesized paleochannel is simulated as an aquifer prism with a rectangular cross-section (600 feet wide and 1,000 feet long). The existing Curren Tunnel is simulated as a horizontal string of drain cells, 300 feet long, extending eastward into the aquifer prism at elevation 3150 feet. The lower spring is simulated as a single drain cell at elevation of 3100 feet. The regional aquifer is represented as a constant head of 3160 feet located at the east face of the aquifer prism. A permeability value of this aquifer is obtained by adjusting the value to produce the approximate flows of the two groundwater discharge features: 5 cfs from the Curren Tunnel and 10 cfs from the lower spring. A horizontal hydraulic conductivity value (Kx = Ky) of approximately 5,000 ft/day, with a 10-fold reduction in vertical hydraulic conductivity (Kz = 500 ft/day) approximates the observed discharge and partitioning of discharge between the tunnel and the lower spring. The drain cell "conductance" parameters are set to a sufficiently high value (60,000 ft3/day) that they reflect no additional constraints on groundwater entry to the drain cells.

To simulate the recompletion of the Curren Tunnel near the bottom of the hypothesized paleochannel, a horizontal string of drain cells at lower elevation is extended into the aquifer prism. The lowest elevation modeled for the recompletion of the Curren Tunnel is elevation 3100 feet, the apparent exit elevation of the "lower spring".

At steady-state, this schematic model indicates that at an elevation of 3100 feet, a tunnel 30 feet long would eliminate the 5 cfs flow from the existing tunnel, but would generate a groundwater discharge of 31.5 cfs. Thus, the net gain over the combined flow of the higher-elevation tunnel and the "lower spring" would be 15.4 cfs. (31.5 cfs - 5.1 cfs - 11.1 cfs = 15.4 cfs).

To assess an alternative hydrogeologic model, in which the hypothesized paleochannel extends to a bottom elevation of only 3122 feet, the same modeling approach was used. The "calibrated" hydraulic conductivities in this case are Kx = Ky = 5,500 ft/day, and Kz = 550 ft/day. Under this scenario, the apparent elevation of the "lower spring" is a function of water running downhill in the scarp-mantling rubble, with the hydraulic exit point from the aquifer actually occurring at a higher elevation than that of the appearance of discharge at the ground surface. In this case, a recompleted tunnel at elevation 3122 feet (approximately 28 feet below the outlet of the existing tunnel) must be 60 feet long to produce a net increase in groundwater discharge of 12.1 cfs.

3.2. Geophysical Investigation

A surface geophysical investigation is proposed to further investigate the feasibility of delineating a paleochannel or other subsurface hydrostratigraphic features. Such an investigation would be conducted by the Boise State University Center for the Geophysical Investigation of the Shallow Subsurface (BSU-CGISS) using a multi-component seismic land streamer method. This non-invasive seismic method utilizes vertical and horizontal in-line components to capture both shear-wave and body-wave data. It is anticipated that this method can successfully overcome the challenge of seismic reflection through a dense cap rock (i.e., basalt) into underlying, less-dense, unconsolidated sediments. If effective, the investigation will define the location of the paleochannel, and provide guidance for confirmatory vertical exploration drilling. The investigation would require access to the Rangen-owned lands on the plateau between the rim and the Rangen monitoring well.

3.3. Vertical Test Wells

Vertical exploratory drilling is proposed to delineate or confirm stratigraphy (e.g., paleochannel geometry) and groundwater elevations. Test borings would be made along northwest-southeast transects parallel to the rim, between the rim and the Rangen monitoring well. A map showing tentative test well locations is included as Figure 2. Most of the drilling would occur on property owned by Rangen, and permission would be needed from Rangen to proceed with the drilling operation. One test well is shown on property owned by Walter Candy south of the Rangen property. Permission would also be needed from Mr. Candy to drill this well; if permission could not be obtained then this well could be drilled on Rangen property just to the north.

Drilling could be conducted during the non-irrigation season to minimize impacts to farming operation (although the area was not being irrigated or farmed as of May 7, 2014). All boreholes locations would be surveyed. Special consideration would be given to identifying the (1) bottom of basalt, (2) first water-bearing interval, (3) presence and location of pillow basalt, and (4) nature of sediments beneath the basalt, with attention to gravels (Tuana Gravel) and clays of the Glenns Ferry Formation. Cuttings would be collected and referenced for future evaluation. Water produced during drilling would be measured and recorded.

In addition to collecting information to delineate the stratigraphy, testing is proposed at several of the wells to define aquifer hydraulic characteristics including transmissivity, storativity, and hydraulic conductivity and for identifying aquifer boundaries. Testing may include short-term test pumping using a temporary pump or a slug test using a bailer. Other test wells would serve as monitoring wells during testing. Tracer tests may be performed at several of the wells to calculate groundwater flow rates and directions. Information collected during testing would be used to better define the conceptual groundwater model of the system.

Wells would be constructed with 6-inch or 8-inch boreholes using the air-rotary method of drilling through the upper basalt. If necessary, 6-inch steel casing would be placed to the bottom of the gravel using the "drill and drive" method of well construction to maintain borehole stability. After completion and testing of the well, the steel casing would be removed or cut off 4 feet below ground surface. The borehole would be plugged and the surface restored for farming. Drill holes will range in depth from 100 to 150 feet in depth. Some wells could be retained as monitoring wells if acceptable to landowners. Up to 10 drill holes are anticipated, with initial borehole locations based on geophysical survey results, and subsequent borehole locations guided by drilling results.

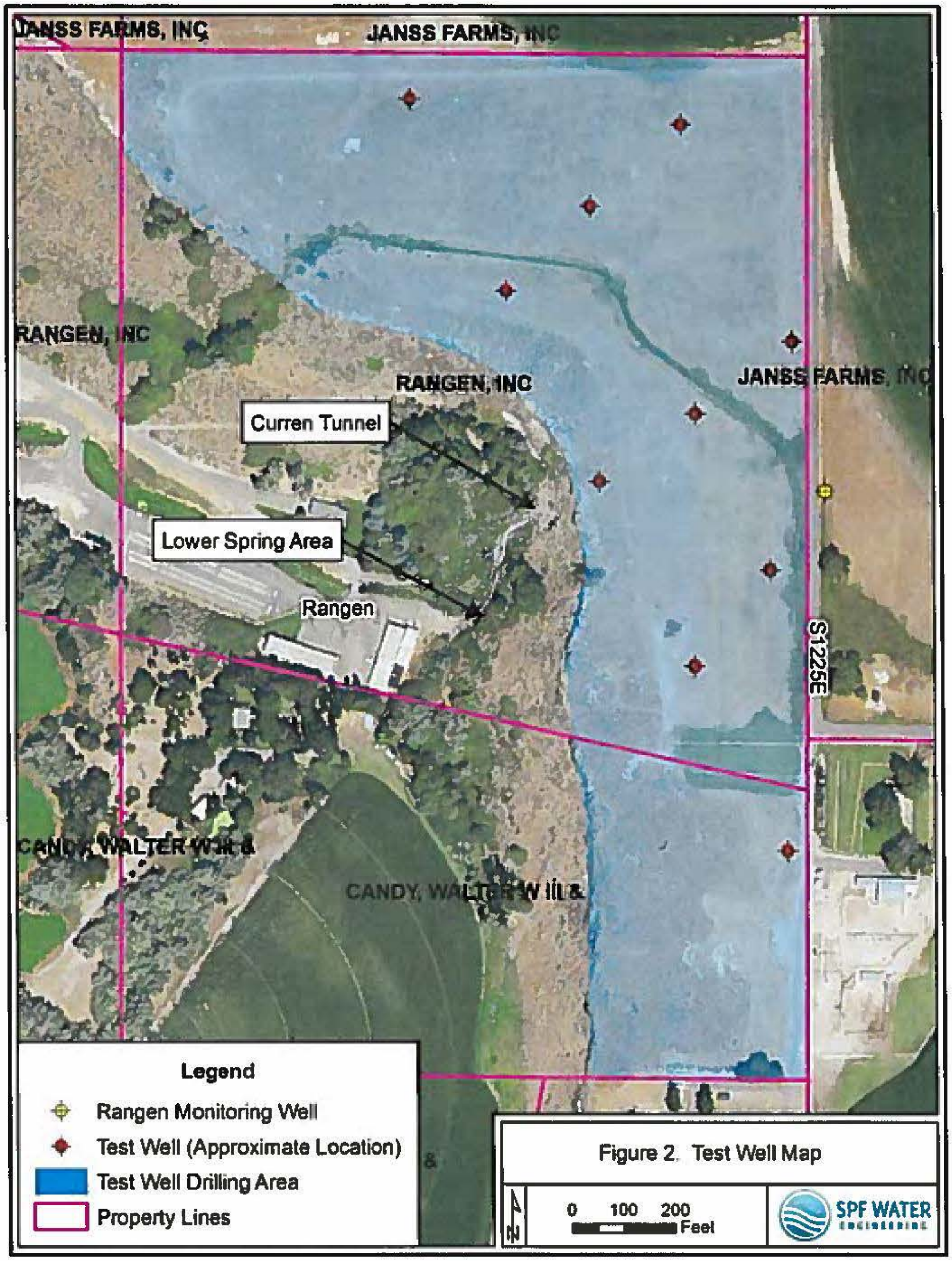

Figure 2. Test Well Map

3.4. Development of Options

The field data collected and modeling output generated will be examined to further evaluate and refine the Curren Tunnel enhancement concept. One or more preferred options for tunnel construction would be generated assuming the concept appears feasible. Options may include lengthening or otherwise enhancing the existing tunnel or lowering/replacing the tunnel. Alignments for both lengthening and lowering will be developed. At this stage, other factors will be taken into consideration, including construction cost and feasibility, to identify a preferred option.

4. Additional Recommended Investigations

4.1. Additional test holes

After the preferred alternative is developed, then additional vertical exploratory drilling (drill and fill) would be performed at approximate 50- to 100-foot spacing along the proposed tunnel alignment to confirm the geologic concept. A similar drilling and testing approach as described in Section 3.3 would be undertaken. Based on the results of this drilling program, the concept or alignment may be confirmed or revised if necessary.

4.2. Modeling

Once additional field information is gathered to characterize the subsurface lithology, specifically the hypothesized paleochannel, this information would be integrated into the initial conceptual numerical model to reflect available data. The potential discharge from the selected preferred alternative would then be re-evaluated using the best available information to confirm the project approach.

5. Conceptual Tunnel Enhancement Design

5.1. Introduction

This section of the report describes two general approaches for modifying the Curren Tunnel: (1) lengthening the existing tunnel and (2) lowering the tunnel by constructing a replacement tunnel at a lower elevation near the lower springs. At this time the approaches are presented in a conceptual manner, a more detailed design will be developed after completion of the field data collection program described above.

The final tunnel construction approach will be developed using information gathered from a number of different sources, including test hole drilling, geophysical investigations, and numerical modeling. The final approach will also take into account construction cost, feasibility, contractor availability, site limitations, permitting and regulations, and additional considerations.

5.2. Lengthening of Existing Curren Tunnel

5.2.1. Overview

This construction concept involves extending the existing Curren Tunnel in an easterly direction, following the hypothetical paleochannel filled with water-bearing pillow basalt. The ultimate alignment of the tunnel would depend upon the orientation of the paleochannel as determined by drilling and/or geophysical investigations. This approach would theoretically increase discharge into the tunnel by increasing drawdown at a further distance away from the mouth of the tunnel, although the amount of increased drawdown for a given horizontal distance is limited at this elevation. The water level in the Rangen monitoring well located approximately 600 feet east of the tunnel outlet varied between 3153 and 3158 feet from 2008 to 2012. Assuming the tunnel extension was constructed at the same elevation of the existing tunnel (3150 feet), available drawdown is 3 to 8 feet. With this small amount of available drawdown, the extended tunnel would continue to be sensitive to minor groundwater declines.

5.2.2. Jack and Bore Construction Techniques and Limitations

Lengthening the existing tunnel could be accomplished by jack and bore or directional drilling.

With jack and bore, casing is typically hammered into the substrate as far as possible. Then an auger and drill bit are used to remove material, with casing pushed along with the drilling. Extending the tunnel by jack and bore might be possible if tunnel length, alignment, and diameter allow casing to be rammed and the auger to be placed and operated from the portal of the existing tunnel. Access to and operating from within the existing tunnel would likely pose more significant logistical problems. Figure 3 depicts the jack and bore concept for lengthening the tunnel. This approach contemplates extending the tunnel by 300 feet, placing perforated steel casing. The length of the extended tunnel may ultimately depend on the location and orientation of the paleochannel or other suitable materials with high permeability.

5.2.3. Directional Drilling Construction Techniques and Limitations

With directional drilling, a small pilot hole (often 4-inch or 6-inch diameter) is initially drilled to the terminus. Then a back-reamer with a larger bit is installed on the drill steel, and pulled back to enlarge the pilot hole. These machines enlarge holes by pulling the reamer back; they cannot effectively drill large diameter holes moving forward. Generally several passes are required to achieve the desired borehole diameter. To make the process more efficient, often another length of drill steel is pulled back with the reamer so steel is already present in the hole for the next pass through. Therefore access to the terminus is required to change the reamer, as well as to add drill steel as the reamer is pulled back. Once the desired borehole diameter is achieved, then steel or HDPE casing can be pulled through the hole with the reamer. Casing can be pre-perforated for placement through the water-bearing zones. Directional drilling requires drilling fluid to maintain borehole stability. Drilling fluids are typically bentonite based, but can also be bio-degradable polymers.

The existing tunnel could be lengthened by directional drilling; either initiating drilling from the plateau east of the rim and intercepting the end of the tunnel, or by starting at the end of the tunnel and terminating the hole on the plateau. This approach is depicted on Figure 4. Initiating drilling from the plateau down to the tunnel provides better access for the drill equipment, but the end of the tunnel would have to be accurately located for the driller to be able to intercept it. With this approach, the drill bit could be guided to the entrance of the tunnel where the reamer could be changed, and work would not have to be conducted within the tunnel. If drilling were initiated within the tunnel, the drill bit could be guided to the end of the tunnel where drilling would start. With this approach, the exact location for terminating the hole may be less critical and changing the reamer and adding drill steel could be easier. The lengthened tunnel could range in diameter from 2 feet to 3 feet, with perforated casing placed through the target water-bearing zone.

With directional drilling, drilling fluid is required. Although drilling fluid can be contained within starter casings, some fluid is expected to escape and discharge from the existing tunnel regardless of where drilling starts. This drilling fluid, along with intercepted groundwater, would have to be contained and piped by gravity or pumped to a suitable disposal or settling location. The existing raceways at Rangen could serve as temporary settling/containment basins during the drilling operation. The entrance to the tunnel could potentially be modified to provide a means to control flow and sediment produced during drilling.

5.3. Lowering of the Curren Tunnel

5.3.1. Overview

The Curren Tunnel lowering concept involves constructing a replacement tunnel at a lower elevation on the slope. The replacement tunnel could be drilled horizontally into the slope, parallel to, and below, the existing Curren Tunnel. Alternatively, the replacement tunnel could start at a lower elevation and be drilled at an angle upward to the plateau. The schematic model discussed in Section 3.1 predicts that tunnel lowering would dry up the existing tunnel but result in an overall net increase in flow from the lowered tunnel by increasing available head and the hydraulic gradient to the tunnel. The lower-elevation tunnel would theoretically also be less sensitive to minor water-level declines as the overall available drawdown would be greater.

5.3.2. Jack and Bore Horizontal Tunnel Construction and Limitations

The jack and bore method of drilling could be used to construct a replacement tunnel in the vicinity of the lower springs. This method could produce a horizontal well at this location, and would target the highly permeable zones that feed the lower springs, identified as the Tuana Gravel by Farmer (2009). This concept is depicted in Figure 5. With this approach, a large diameter (4-foot?) casing would be hammered through the face of the slope into the sediments, and cemented in place to provide a stable and controlled starting point for drilling. If saturated sediments and/or groundwater flow prevents placement of this casing at the spring elevation, then an alternative jack and bore approach may be appropriate as described in Section 5.3.3.

Assuming the surface casing can be installed and sealed in place, then an auger and drill would be used to remove material, with casing pushed along with the auger. Drilling fluid is typically used to lubricate the auger. The modeling described above suggests such a tunnel would not have to be as long as the existing tunnel, perhaps less than 100 ft. This approach contemplates drilling a tunnel and placing perforated steel casing through the saturated gravels.

As with the tunnel lengthening, groundwater produced during the drilling and development process would have to be contained and piped or pumped to a suitable disposal or settling location.

5.3.3. Jack and Bore Angled Tunnel Construction and Limitations

If drilling by jack and bore proves difficult at the elevation of the lower springs due to groundwater flow, then the tunnel could be started below the springs where there may be more potential for intercepting less permeable materials (i.e., Glenns Ferry Formation sediments, anticipated to be primarily silt and clay). The less permeable sediments could provide a convenient and stable starting point for drilling, with surface casing sealed into the sediments. With this approach, shown on Figure 5, the tunnel would be constructed at an upward angle to intercept the saturated gravels.

5.3.4. Directional-Drilled Tunnel Construction and Limitations

Another approach to deepen the tunnel would be to directional drill, starting at a location below the springs and terminating on the plateau, as shown on Figure 6. The jack and bore method could be used to set the surface casing, and directional drilling could then be used to extend the tunnel. This approach could target both the saturated gravels as well as the pillow basalt expected to be present in the paleochannel overlying the gravels.

Directional drilling could be started at either end of the tunnel: on the plateau or below the lower springs. Regardless of the approach, drilling fluid and groundwater would flow to the bottom of the tunnel and would have to be contained for settling or treatment.

6. Summary

1. Net groundwater discharge can be increased at the Rangen site by Curren Tunnel enhancements.

2. Preliminary numerical modeling indicates that lowering the tunnel could provide significant benefits. For example, a 60-foot long tunnel at an elevation 28 feet below the existing tunnel results in a calculated 12 cfs net benefit. Longer tunnels or lower elevation tunnels increase the benefit. Modeling can be refined with additional information regarding local aquifer geometry and hydraulic characteristics.

3. Additional information related to aquifer geometry can be developed through surface geophysical investigations and vertical exploration drilling. These investigations would define the optimum location, alignment, and depths for tunnel enhancements.

4. Both lengthening of the tunnel and lowering the tunnel (i.e., replacement tunnel construction) are potential approaches to improving flow at the Rangen site. A lower-elevation replacement tunnel will likely be more effective than lengthening of the existing tunnel due to the ability to increase the aquifer drawdown associated with the tunnel.

7. References

Farmer, C. Neal; March 4, 2009; *Review of Hydrogeologic Conditions Located at and Adjacent to the Spring at Rangen Inc.*; IDWR Open File Report.

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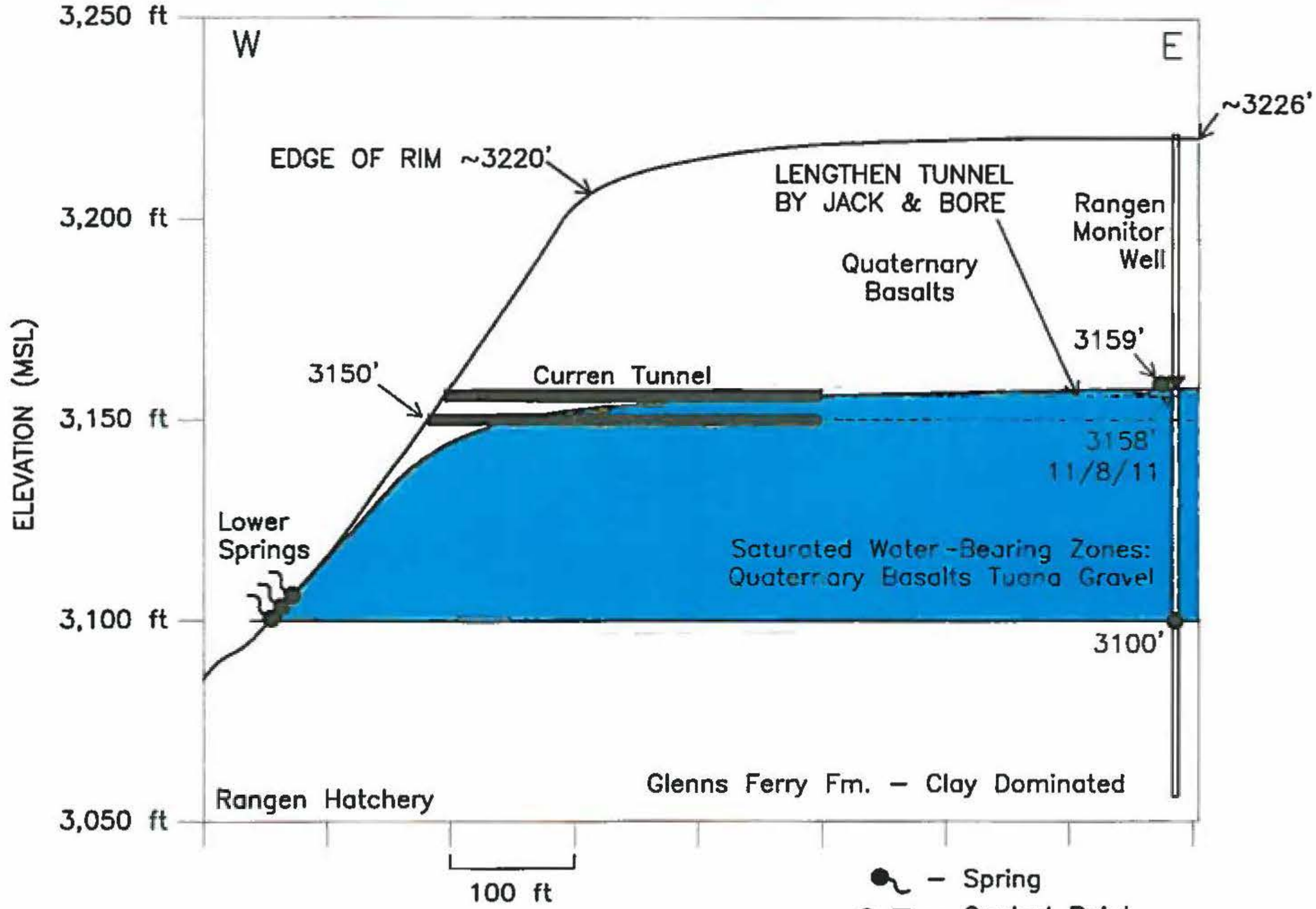
Hinckley, Bern; May 21, 2014; Memorandum – Curren Tunnel enhancements "mini-model".

Whitehead, R.L.; 1992; Geohydrologic Framework of the Snake River Plain Regional AquiferSystem, Idaho and Eastern Oregon; U.S. Geological Survey Professional Paper 1408-B.



Topographic Profile from USGS Tuttle 7.5min Topographic Map

Adapted from: Hinckley 2012

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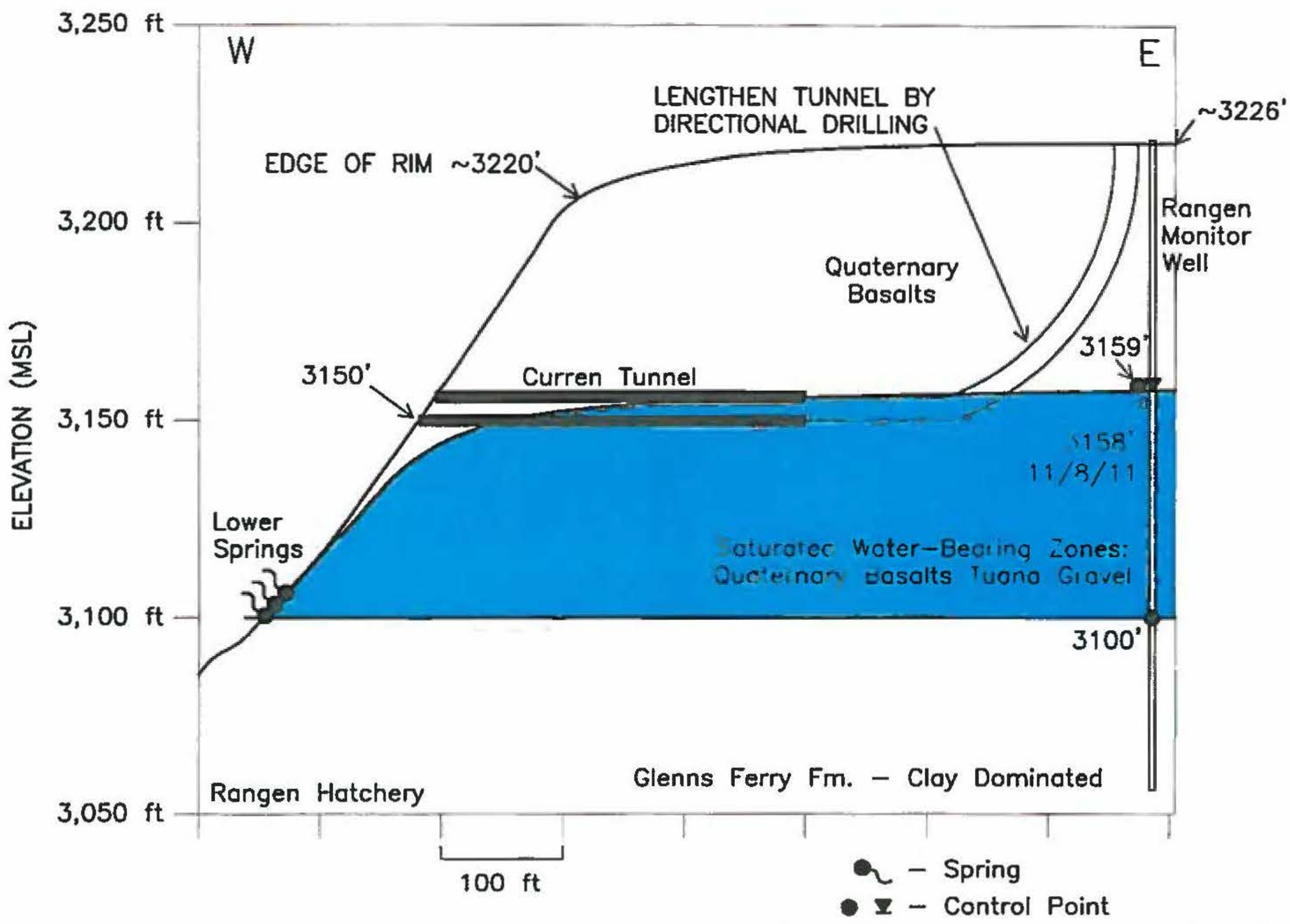
FIGURE 3
CURREN TUNNEL HORIZONTAL LENGTHENING,
JACK AND BORE

SCALE: NTS	PROJECT NO. 535.0090
DRAWN BY: SCB	



Topographic Profile from USGS Tuttle 7.5min Topographic Map

Adapted from: Hinckley 2012

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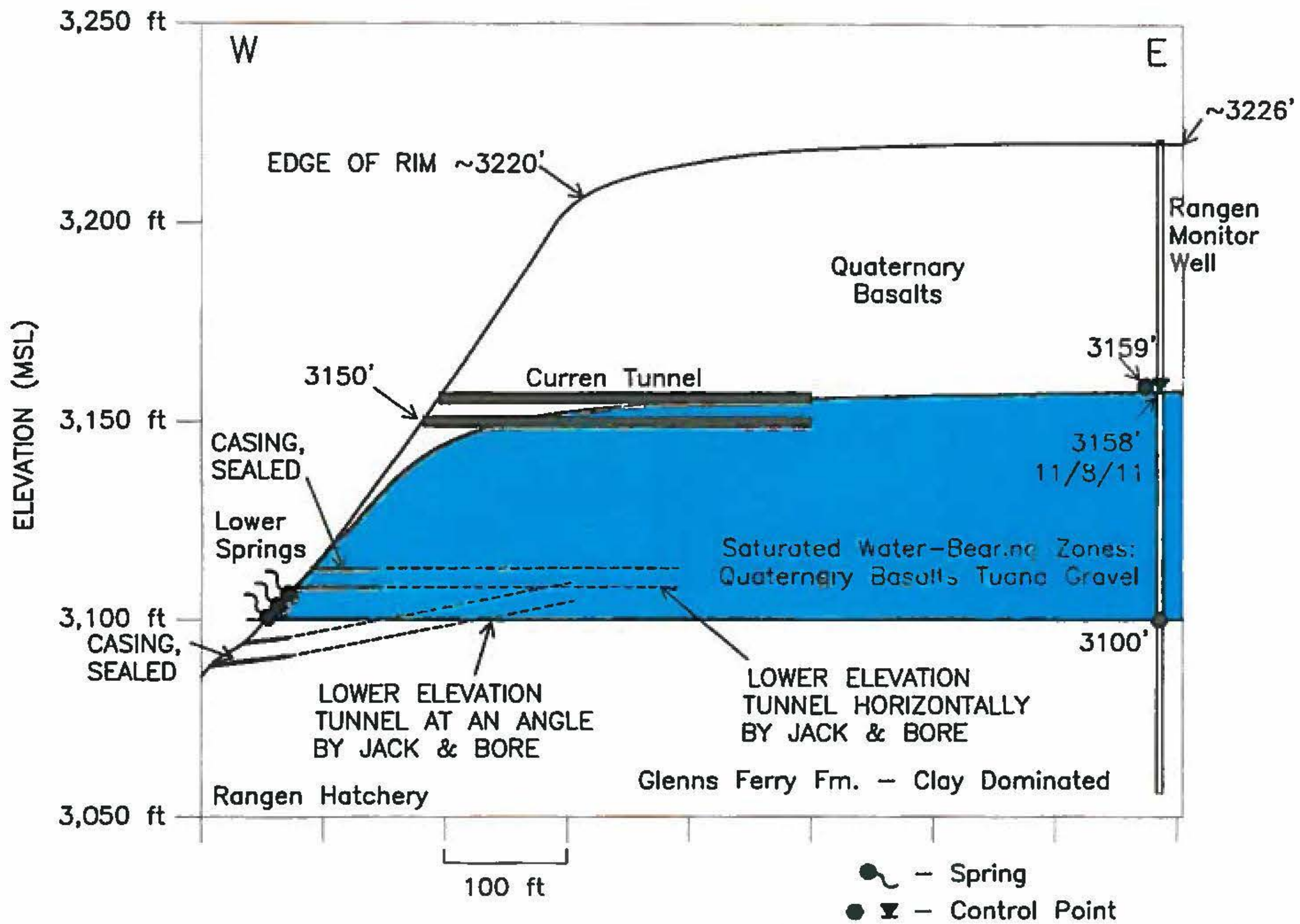
FIGURE 4
CURREN TUNNEL HORIZONTAL LENGTHENING,
DIRECTIONAL DRILL

SCALE: NTS
DRAWN BY: SCB
PROJECT NO. 535.0090



Topographic Profile from USGS Tuttle 7.5min Topographic Map

Adapted from: Hinckley 2012

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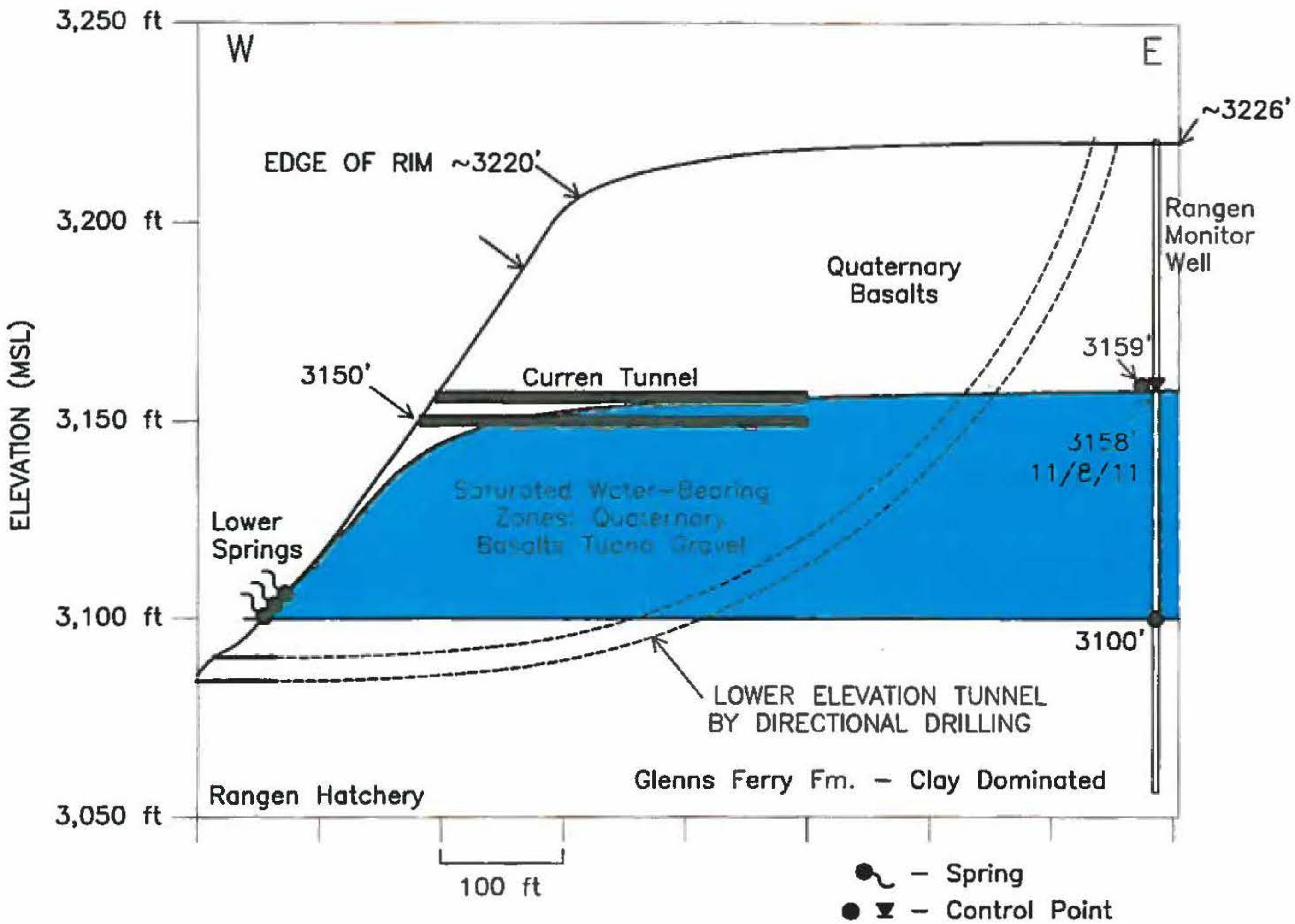
Boise, Idaho 83706
Tel (208) 383-4140 Fax (208) 383-4156

FIGURE 5
CURREN TUNNEL LOWERING
BY JACK AND BORE

SCALE: NTS	PROJECT NO. 535.0090
DRAWN BY: SCB	



Topographic Profile from USGS Tuttle 7.5min Topographic Map

Adapted from: Hinckley 2012

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FIGURE 6
CURREN TUNNEL LOWERING
BY DIRECTIONAL DRILLING

SCALE: NTS	PROJECT NO. 535.0090
DRAWN BY: SCB	

Exhibit 3

Application for Permit

36-16976

FORM 202 11/13

Ident. No. 36-16976

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

APPLICATION FOR PERMIT

To appropriate the public waters of the State of Idaho

RECEIVED
FEB 1 1 2014
DEPT. OF WATER RESOURCES
SOUTHERN REGION

1. Name of applicant(s) North Snake GWD, Magic Valley GWD, et al. Phone 208-232-6101 232-6101
   Name connector (check one) ☑ and ☐ or ☐ and/or
   Mailing address c/o Randall C. Budge, T.J. Budge, 201 E Center Street, PO Box 1391 City Pocatello
   State ID Zip 83204 Email rcb@racinelaw.net, tcb@racinelaw.net
2. Source of water supply Springs; Billingsley Creek which is a tributary of Snake River
3. Location of point(s) of diversion:

TWP	RGE	SEC	Govt Lot	¼	¼	¼	County	Source	Local name or tag #
7S	14E	32		SE	SW	NW	Gooding	Springs; Billingsley Creek	
7S	14E	32		SW	SW	NW	Gooding	Springs; Billingsley Creek	

4. Water will be used for the following purposes: TJB 5/27/14
   Amount 12 cfs (cfs or acre-feet per year) for mitigation[redacted] purposes from 1/1 to 12/31 (both dates inclusive)
   Amount 12 cfs (cfs or acre-feet per year) for fish progagation purposes from 1/1 to 12/31 (both dates inclusive)
   Amount ______ (cfs or acre-feet per year) for ______ purposes from ______ to ______ (both dates inclusive)
   Amount ______ (cfs or acre-feet per year) for ______ purposes from ______ to ______ (both dates inclusive)
5. Total quantity to be appropriated is (a) 12 cubic feet per second (cfs) and/or (b) ______ acre feet per year (af).
6. Proposed diverting works:
   a. Describe type and size of devices used to divert water from the source. Hydraulic pump(s) (size TBD); screw-operated headgate on Billingsley Creek
   b. Height of storage dam N/A feet; active reservoir capacity ______ acre-feet; total reservoir capacity ______ acre-feet. If the reservoir will be filled more than once each year, describe the refill plan in item 11. For dams 10 feet or more in height OR reservoirs with a total storage capacity of 50 acre-feet or more, submit a separate Application for Construction or Enlargement of a New or Existing Dam. Application required? ☐ Yes ☐ No
   c. Proposed well diameter is N/A inches; proposed depth of well is ______ feet.
   d. Is ground water with a temperature of greater than 85°F being sought? ☐ Yes ☑ No
   e. If well is already drilled, when? N/A ; drilling firm ______; well was drilled for (well owner) ______; Drilling Permit No. ______.
7. Description of proposed uses (if irrigation only, go to item 8):
   a. Hydropower; show total feet of head and proposed capacity in kW. N/A
   b. Stockwatering; list number and kind of livestock. N/A
   c. Municipal; complete and attach the Municipal Water Right Application Checklist.
   d. Domestic; show number of households N/A
   e. Other; describe fully. mitigation[redacted]; fish propagation
   TJB 5/27/14

8. Description of place of use:

a. If water is for irrigation, indicate acreage in each subdivision in the tabulation below.

b. If water is used for other purposes, place a symbol of the use (example: D for Domestic) in the corresponding place of use below. See instructions for standard symbols.

TWP	RGE	SEC	NE				NW				SW				SE				TOTALS
			NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	
7S	14E	31			M/F	M/F													
7S	14E	32							M/F										

Total number of acres to be irrigated: N/A

9. Describe any other water rights used for the same purposes as described above. Include water delivered by a municipality, canal company, or irrigation district. If this application is for domestic purposes, do you intend to use this water, water from another source, or both, to irrigate your lawn, garden, and/or landscaping?
None for mitigation. Water right nos. 36-2551 and 36-7694 are used for fish propagation purposes at Rangen.

10. a. Who owns the property at the point of diversion? Rangen, Inc.

b. Who owns the land to be irrigated or place of use? Rangen, Inc.; members of applicant Ground Water Districts

c. If the property is owned by a person other than the applicant, describe the arrangement enabling the applicant to make this filing:
Idaho Code Section 42-5224(13)

11. Describe your proposal in narrative form, and provide additional explanation for any of the items above. Attach additional pages if necessary.
The GW Districts will use this water for mitigation purposes to protect groundwater use on the Eastern Snake Plain to mitigate for Rangen's apparent material injury and to provide mitigation for the curtailment of junior groundwater users as specified in the Director's Final Order dated 1/29/14 for Rangen's delivery call. Mitigation water will be provided to Rangen for its Curren Tunnel rights for fish propagation purposes. If unable to secure proper consent, the GWDs will use their power of eminent domain as set forth in I.C. Sec. 42-5224(13) to secure easements, as necessary.

12. Time required for completion of works and application of water to proposed beneficial use is 5 years (minimum 1 year).

13. **MAP OF PROPOSED PROJECT REQUIRED** - Attach an 8½" x 11" map clearly identifying the proposed point of diversion, place of use, section #, township & range. A photocopy of a USGS 7.5 minute topographic quadrangle map is preferred.

The information contained in this application is true to the best of my knowledge. I understand that any willful misrepresentations made in this application may result in rejection of the application or cancellation of an approval.

Thomas J Budge

Signature of Applicant

Signature of Applicant

Thomas J. Budge, Attorney

Print Name (and title, if applicable)

Print Name (and title, if applicable)

For Department Use:

Received by DM Date 2-11-2014 Time ____ Preliminary check by ____

Fee $ See Original Receipted by ____ Receipt No. ____ Date ____

Attachment for Item 1

Name of Applicants
Amended Application for Permit
Submitted 2/5/2014

PERMIT APPLICANTS
GROUND WATER DISTRICTS

Aberdeen American Falls Ground Water District
Bingham Ground Water District
Bonneville-Jefferson Ground Water District
Madison Ground Water District
Magic Valley Ground Water District
North Snake Ground Water District
Clark Jefferson Ground Water District

36-16976

Exhibit 4

Pump-Back

SPF WATER
ENGINEERING

TECHNICAL MEMORANDUM

DATE: May 29, 2014

TO: Randy Budge

FROM: David Keil, P.E.

CC: Bob Hardgrove, P.E.; SPF file (535.0100)

RE: IGWA's 3rd Mitigation Plan: Billingsley Creek Pump Back Options, 10% Preliminary Submittal

---

The Idaho Ground Water Appropriators, Inc. (IGWA) is reviewing legal and technical options related to water management stemming from the Rangen Water Call. IGWA has requested through its water rights legal counsel that SPF provide a conceptual design of a pump back system which returns water from downstream of portions or all of the Rangen Aquaculture Research Center (Hatchery) to the point of diversion upstream of the Hatchery. IGWA has also requested that SPF assess the concepts' technical feasibility, including impediments and impacts. This memorandum describes the two pump back options under consideration and two prospective facility sites for each option.

A. Existing Water Supply Configuration

Figure 1 is an aerial photo which shows major water supply features associated with the Hatchery. A schematic of the water supply for this facility is shown in Figure 2. Generally, water is diverted from spring sources at Rangen in the following ways:

1. From within the Curren Tunnel;
2. From the Farmers Box, which is fed from the Curren Tunnel;
3. From the Rangen Box, which is fed from the Farmers Box; or
4. From the Bridge Diversion, which is fed from Hatch House overflows, Rangen Box overflows, and various springs at elevations lower than the Curren Tunnel (sometimes referred to as the "talas slope" water).

Any water not diverted by Rangen or the Farmers (Morris, Musser, and Candy) will flow into Billingsley Creek downstream of the Bridge Diversion. Billingsley Creek also receives the water that flows through the Hatchery. This water is typically discharged from the Hatchery at the CTR Raceways. Discharges from the Hatchery to Billingsley Creek can also occur at overflows from the small raceways and the large raceways, but these are non-typical discharges.

Water Quality Parameters

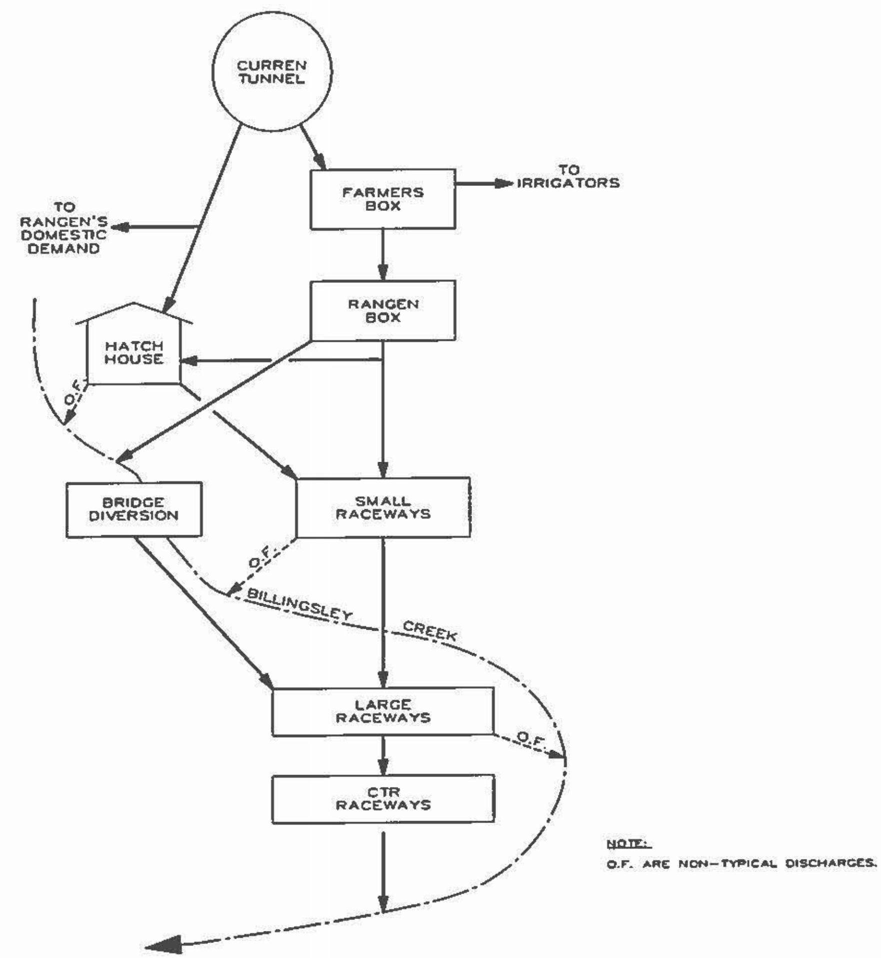
An understanding of Hatchery water quality parameters is necessary to determine appropriate pump back strategies and to plan associated facilities. Assumed or estimated Hatchery water quality parameters are shown in Appendix A. These water quality parameters are based upon readily available reports, such as the Hatchery's Discharge Monitoring Reports (DMR's) under the United States Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) permitting program, expert witness testimony from Thomas L. Rogers on December 21, 2012 (corrected January 24, 2013), the Idaho Waste Management Guidelines for Aquaculture Operations, and other sources.

The Hatchery NPDES permit identification number is IDG130015. The EPA's online DMR Pollutant Loading Tool (http://cfpub.epa.gov/dmr/index.cfm) reports that the actual average facility flow is 9.0 million gallons per day (mgd) (13.9 cfs) and the 2011 total suspended solids (TSS) and phosphorus (P) loadings were 10,410 pounds per year (lbs/yr) and 355 lbs/yr, respectively. No DMR data are reported for dissolved oxygen (DO), ammonia-nitrogen (NH_3-N), nitrite-nitrogen (NO_2-N), biochemical oxygen demand (BOD), or temperature (T).

Hatchery water quality parameters are affected by the addition of fish food, fish feces, and windblown material; the fish production, growth, mortality, and decay; and the frequency of hatchery maintenance and cleaning. Additional NH_3-N, CO_2, and NO_2-N are produced, and DO is reduced, across each Hatchery stage (e.g., small, large, and CTR raceways). The DO concentration of water flowing to the large raceways is reportedly as high as 9.4 mg/L and the DO concentration at the discharge to Billingsley Creek from the CTR raceways can be as low as 6.3 mg/L. Temperature reportedly remains constant through the Hatchery (Rogers, 2014).

NH_3-N, above certain concentration and temperature, is acutely toxic to fish. Other parameters, such as metals, also contribute to fish acute and chronic toxicity and can affect hatchery production or quality. However, concentrations of these other parameters are assumed to not increase above natural background through hatchery production.

Figure 1. Aerial Photo of Major Water Supply Features for Rangen Aquatic Research Center



NOTE:
O.F. ARE NON-TYPICAL DISCHARGES.

WATER SUPPLY DIAGRAM

SPF WATER ENGINEERING
300 East Mallard Drive, Suite 350
Boise, Idaho 83706
Tel (208) 383-4140 Fax (208) 383-4156

IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS

WATER SUPPLY DIAGRAM

PRELIMINARY DRAFT NOT FOR CONSTRUCTION

REVISIONS		
ITEM	DESCRIPTION	DATE
A	10% CONCEPT	5/8/14

VERIFY SCALE
0 1/2 1
BAR MEASURES ONE-INCH ON FULL SIZE DRAWING

PROJECT:	535.0100
DESIGNED:	DPK
DRAWN:	SCB
CHECKED:	RSH

FIGURE 2

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Xref Filename: | 535.0100-XR-TITLE BLOCK |

B. Pump Back Options for Consideration

Two concepts for pump back are being considered in this memo:

Option A – Billingsley Creek Pump Back; and

Option B – Billingsley Creek and Hatchery Pump Back.

Option A – Billingsley Creek Pump Back

This option consists of water collection of Billingsley Creek water immediately up creek of the confluence with Billingsley Creek and the CTR raceway discharge, and pump back to the Diversion Bridge or to the head of the large raceways.

Design Criteria

The design criteria for Option A are very limited since the facilities included with this option consist of a screened collection box, a pumping station, a pipeline, and a discharge. The key design criterion for these facilities is flow rate. At this concept stage, a constant flow rate of 9.1 cfs is envisioned for these facilities. The 2012 minimum daily flow at the Diversion Bridge (Site ID 360410089) according to the Idaho Department of Water Resources water rights accounting system was 11.6 cfs (July 23, 2012).

Process Flow Diagram

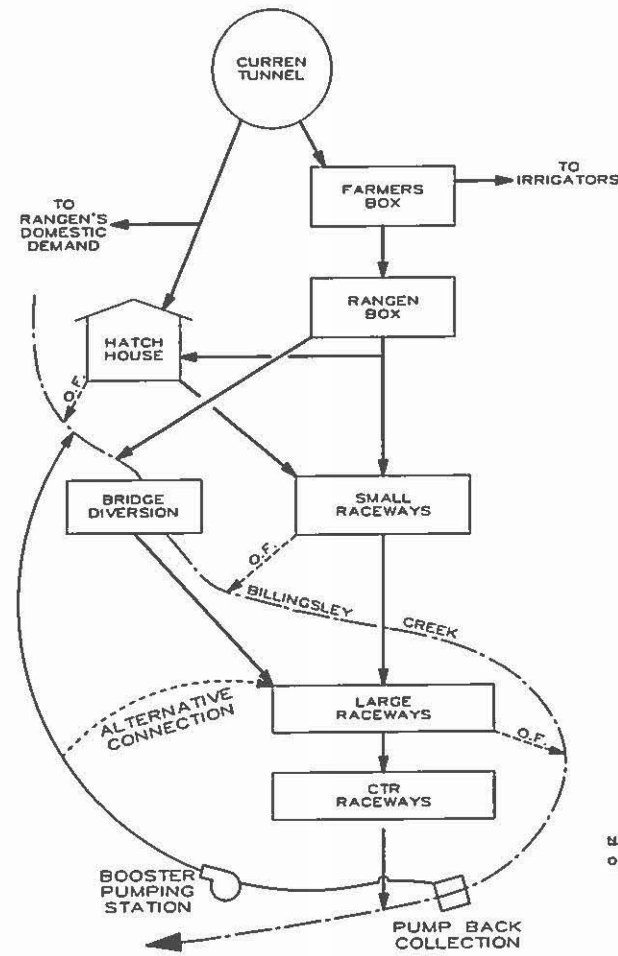
The water supply diagram for Option A is shown in Figure 3. The conceptual process flow diagram for Option A is shown in Figure 4. This option consists of a screened collection box, suction piping, pumping system, discharge and conveyance piping, backup power generation, and point of discharge to the Diversion Bridge or to the head of the large raceways. Since Billingsley Creek water is considered surface water at the pump back point of collection, and surface water is rarely used in hatchery egg fertilization and development areas, the pump back water point of discharge would preclude the Hatch House. However, since the source water for Billingsley Creek is a spring, water quality is expected to continue to exceed aquaculture requirements.

Generally for this option, the volumetric rate of water available for pump back will be limited to the volumetric rate of water in Billingsley Creek at the point of collection. For the purposes of this memo, a total volumetric flow rate of 12 cfs is assumed to be available at the point of collection. A total volumetric flow rate of 9.1 cfs is desired for pump back to Diversion Bridge.

One advantage of the Option A concept is that it is expected to require no treatment to improve water quality before being returned to Billingsley Creek at the Diversion Bridge. Rangen does have the ability to discharge water into Billingsley Creek from their facilities upstream of the CTR raceways. They would have to make a conscious decision to do this, knowing that they could affect the quality of the pump back water.

Site Plan

SPF was provided with two potential locations for this option's facilities – called the "Musser" Site and the "Rangen" Site for the purposes of this memorandum. The facilities for this option at each location are shown on Figure 5 and Figure 6, respectively.



NOTE:
O.F. ARE NON-TYPICAL DISCHARGES.

WATER SUPPLY DIAGRAM – OPTION A

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IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS

WATER SUPPLY DIAGRAM – OPTION A

PRELIMINARY DRAFT NOT FOR CONSTRUCTION

ITEM	REVISIONS DESCRIPTION	DATE
A	10% CONCEPT	5/8/14

VERIFY SCALE
PROJECT: 535.0100
DESIGNED: DPK
DRAWN: SCB
CHECKED: RRH

FIGURE 3

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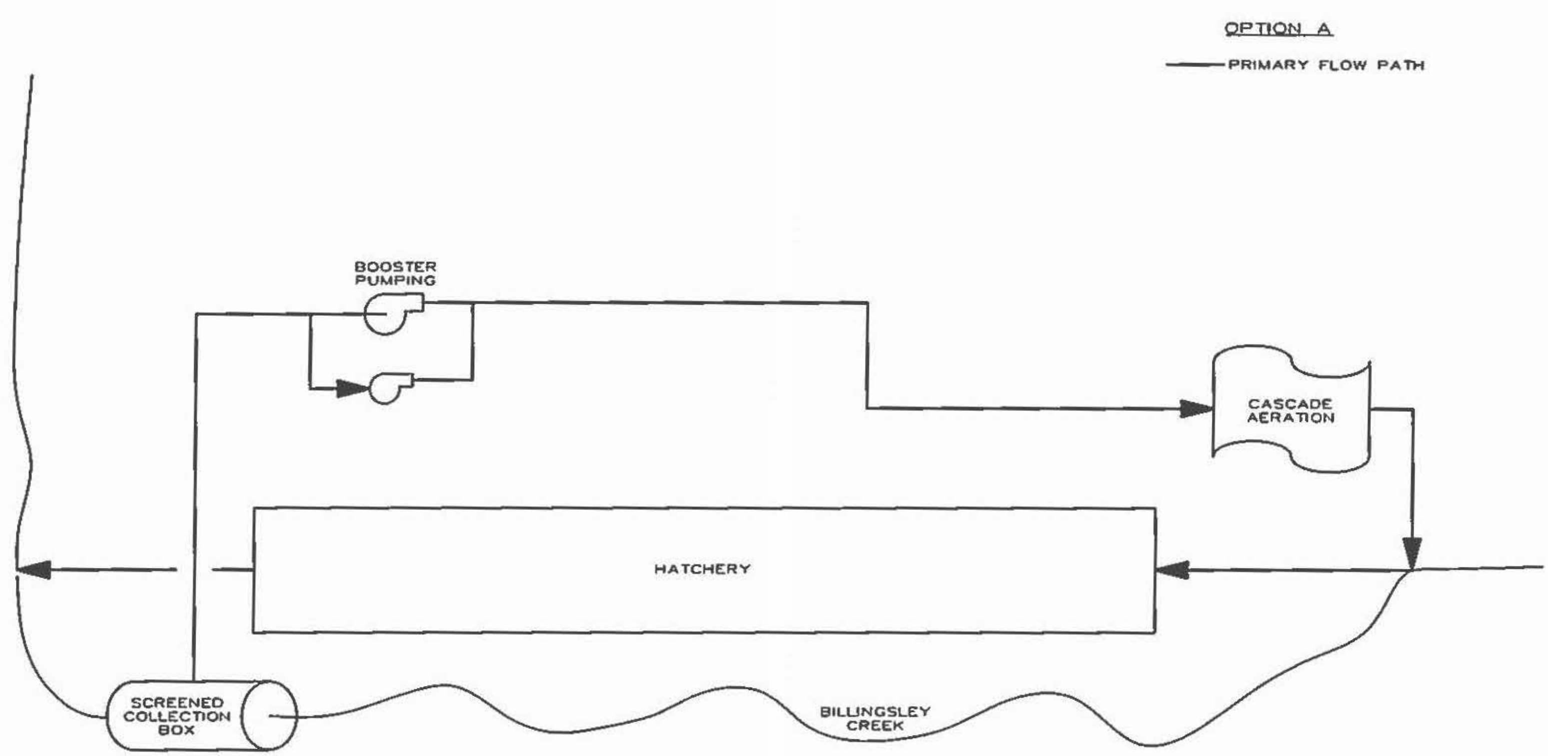

CONCEPTUAL PROCESS FLOW DIAGRAM – OPTION A

IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS
CONCEPTUAL PROCESS FLOW DIAGRAM – OPTION A

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PRELIMINARY DRAFT NOT FOR CONSTRUCTION

REVISIONS

ITEM	DESCRIPTION	DATE
A	10% CONCEPT	5/8/14

VERIFY SCALE
0 1/2 1
BAR MEASURES ONE-INCH ON FULL SIZE DRAWING

PROJECT: 535.0100
DESIGNER: DPK
DRAWN: SCB
CHECKED: RRH

FIGURE 4

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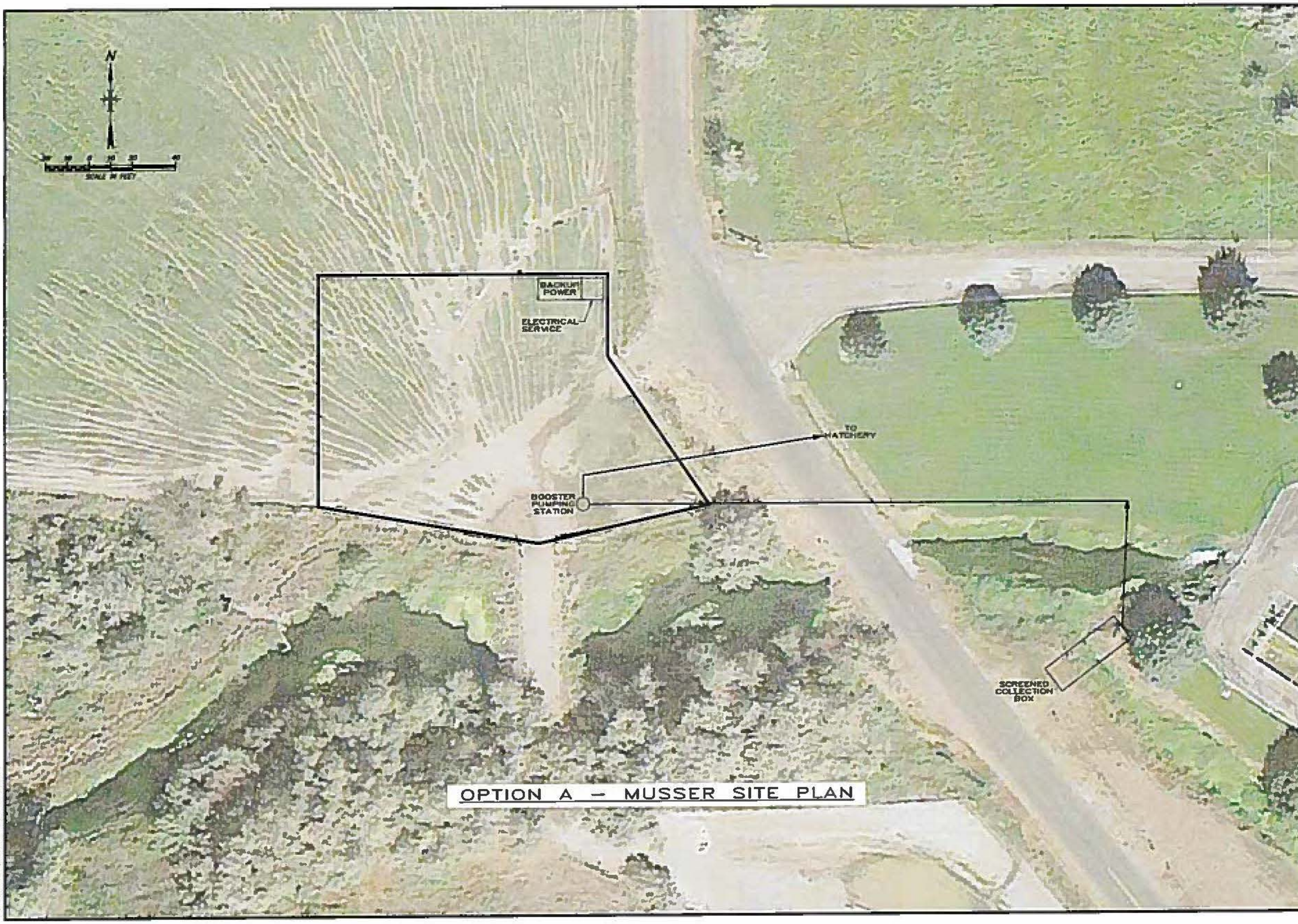

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IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS

OPTION A – MUSSER SITE PLAN

PRELIMINARY DRAFT NOT FOR CONSTRUCTION

REVISIONS

ITEM	DESCRIPTION	DATE
A	10% CONCEPT	5/8/14

VERIFY SCALE

PROJECT:	535.0100
DESIGNED:	DPK
DRAWN:	SCB
CHECKED:	RRH

FIGURE 5

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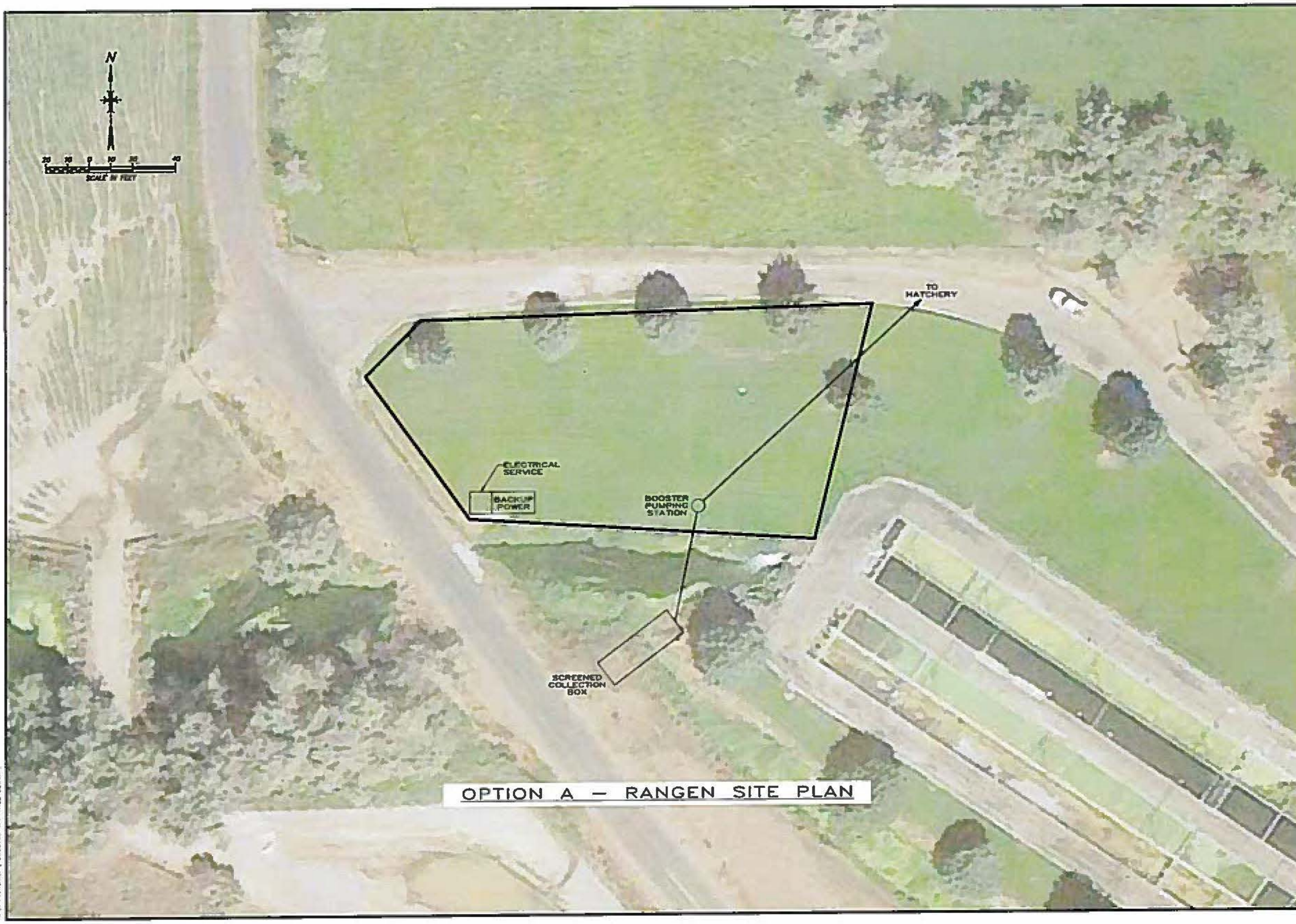

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IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS

OPTION A — RANGEN SITE PLAN

PRELIMINARY DRAFT NOT FOR CONSTRUCTION

VERIFY SCALE

PROJECT:	535.0100
DESIGNED:	DPK
DRAWN:	SCB
CHECKED:	RRH

FIGURE 6

Option B – Billingsley Creek and Hatchery Discharge Pump Back

This option consists of water collection <u>down</u>stream of the confluence between Billingsley Creek and the CTR raceway discharge, and pump back to the Diversion Bridge or back to the head of the large raceways. Since Billingsley Creek water is considered surface water at the point of collection, the pump back water point of discharge would preclude the Hatch House. Since the collection will occur downstream of the CTR raceway discharge, the water quality at this location will not be equivalent to the upstream Hatchery water quality. To improve water quality, a water treatment system is included with this option.

Design Criteria

The design criteria for Option B are more extensive than for Option A. As with Option A, the key design criterion for conveyance facilities is flow rate. The volumetric rate for pump back is limited only by the hydraulic capacity of the Hatchery and recirculation treatment capacity. A volumetric flow rate of 9.1 cfs is desired for pump back.

Option B design criteria also include water quality parameters since the facilities included with this option consist of both treatment and conveyance facilities. The water quality design criteria for these facilities are shown in Table 1. The water temperature and dissolved oxygen criteria are based upon commonly observed temperature and dissolved oxygen operating ranges for rainbow trout.

The water quality design criteria in Table 1 are contrasted with the assumed Hatchery water quality values. Hatchery data are not available for every water quality criterion. However, the assumed or estimated Hatchery water quality data summarized for this memorandum are within the ranges of water quality design criteria for salmonid (including trout) aquaculture facilities.

Table 1. Water quality design criteria for salmonid aquaculture facilities[1]

Parameter	Minimum Criteria	Maximum Criteria	Assumed or Estimated Hatchery Value	Units
Ammonia (un-ionized form)	-	0.0125	0.00505	mg/L
Carbon Dioxide	0	10	1.49	mg/L
Chlorine	-	0.03	N/A	mg/L
Copper	-	0.006	N/A	mg/L
Mercury (organic or inorganic)	0.0001	0.002	N/A	mg/L
Nitrate (NO_3^-)	0	3.0	0.17	mg/L
Nitrite (NO_2^-)	-	0.2	0.17	mg/L
Ozone	-	0.005	N/A	mg/L
pH	6.5	8.0	7.23	SU
Phosphorus	0.0100	3.0	0.012	mg/L
Total Suspended Solids	-	80.0	0.355	mg/L
Total Alkalinity (as $CaCO_3$)	10	400	N/A	mg/L
Total Hardness (as $CaCO_3$)	10	400	N/A	mg/L
Zinc	-	0.03	N/A	mg/L
Water Temperature				
Tolerance Range	0.5	25.5	15.8	°C
Optimal Rearing Range	10.0	15.5	15.8	°C
Preferred Egg Development Range	8.0	12.0	N/A	°C
Dissolved Oxygen				
Lethal if exposure lasts longer than a few hours	-	3.0	8.3	mg/L
Normal hatchery range	4.0	7.0	8.3	mg/L
Minimum	5.0	-	8.3	mg/L
Optimum	7.0	-	8.3	mg/L

See Appendix A for sources and comments related to the assumed or estimated Hatchery values.

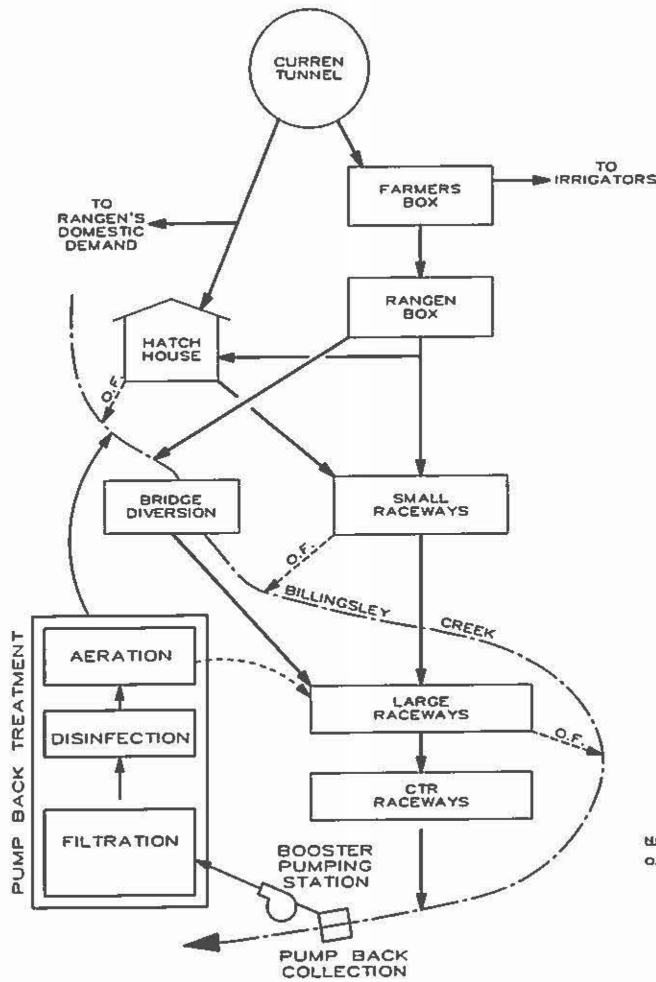
[1] Aquaculture Waste Guidelines Advisory Committee. *Idaho Waste Management Guidelines for Aquaculture Operations*. 1996. State of Idaho Department of Environmental Quality. p. 62

Process Flow Diagram

Even though the assumed or estimated Hatchery water quality data are within the minimum and maximum design criteria for salmonid aquaculture facilities, water treatment facilities are included with this option. The reason for including water treatment facilities with this option is that surface water is at greater risk of exposure to external sources of contamination (e.g., surface or biotic contaminants from animal waste) and surface water treatment helps to minimize this risk.

The water supply diagram for Option B is shown in Figure 7 and Figure 8 shows a water recycling concept for pump back and the relationship between flow through the hatchery and treatment capacity. The conceptual process flow diagram for Option B is shown in Figure 9. This option consists of a screened collection box, pumping system, treatment system, conveyance piping, and point of discharge to the Bridge Diversion or back to the head of the large raceways. The pumping and treatment system is intended to be located on a ½ acre site or smaller.

The treatment system is expected to consist of solids filtration for TSS removal, ultraviolet (UV) disinfection to inactivate pathogens without adding chemicals, packed tower aeration for degasification of CO_2 and to increase dissolved oxygen (DO) concentrations, and cascade aeration for additional oxygenation to approach or achieve DO saturation. Even though Hatchery TSS concentration is estimated to be well below the maximum criteria, solids filtration is included with this preliminary option since the influent will include Hatchery effluent and filtration provides a direct barrier to waste solids.



NOTE:
O.F. ARE NON-TYPICAL DISCHARGES.

WATER SUPPLY DIAGRAM – OPTION B

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IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS
WATER SUPPLY DIAGRAM – OPTION B

PRELIMINARY DRAFT NOT FOR CONSTRUCTION

REVISIONS

ITEM	DESCRIPTION	DATE
A	10% CONCEPT	5/6/14

VERIFY SCALE
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PROJECT: 535.0100
DESIGNED: DPK
DRAWN: SCB
CHECKED: RRH

FIGURE 7

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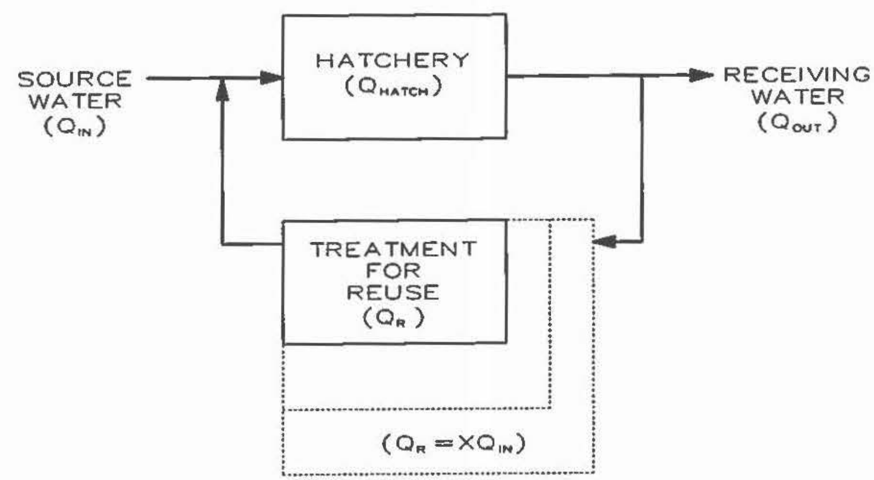

$$Q_{HATCH} = Q_{IN} + Q_R$$

WATER RECYCLING CONCEPT FOR PUMP BACK OPTION B

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IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS
WATER RECYCLING CONCEPT FOR PUMP BACK OPTION B

PRELIMINARY DRAFT NOT FOR CONSTRUCTION

REVISIONS		
ITEM	DESCRIPTION	DATE
A	10% CONCEPT	5/8/14

VERIFY SCALE
0 1/2 1

PROJECT: 535.0100
DESIGNED: DPK
DRAWN: SCB
CHECKED: RNH

FIGURE 8

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Xref Filename: | 535C100-XR-TITLE BLOCK |

A biological filtration (biofilter) technology could also be selected to nitrify ammonia-nitrogen to nitrite and subsequently nitrate. Biofilters are classified into several categories and types for recirculating aquaculture systems as shown in Table 2 (Ebeling, 2006). When determining the most appropriate specific technology, one should consider multiple factors, including but not limited to cost, performance history, influent loading, effluent water quality objectives, hydraulics, and operation and maintenance issues. Consideration should also be given to the initial setup, seeding and balance of microorganisms, and availability of operation and maintenance staffing and resources. Since a biofilter could also remove total suspended solids (TSS), depending on the type of biofilter, it could be included in lieu of separate solids filtration.

Biofilters with solids removal generally have greater operational complexity, could be much larger in size, and require greater capital and operational costs than separate solids filtration. Furthermore, the Hatchery un-ionized ammonia concentration is assumed to be below the maximum water quality design criterion. Some ammonia removal is anticipated across the packed tower aeration, but only minimally, due to the relatively low Henry's Law constant for ammonia and narrow acceptable pH range. Nonetheless, additional ammonia removal is not anticipated to be specifically required in the treatment process.

Table 2. Biofilter Classification

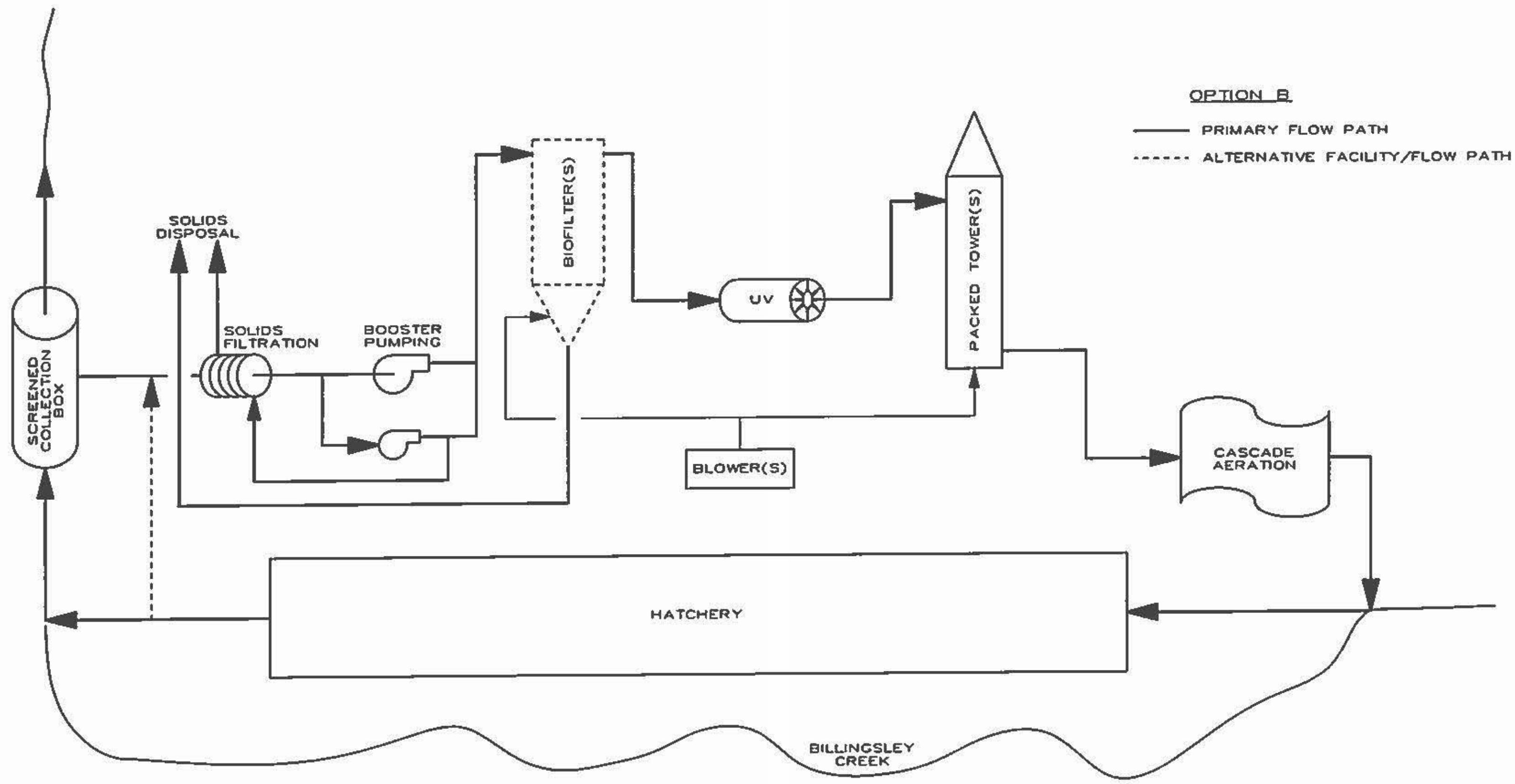
Process	Classification	Media Location	Type of Technology	Specific Technology
Biofiltration	**Suspended Growth (Hetertrophic Bacteria)**			
	Fixed Film (Autotrophic Bacteria)		**Emergent**	**Rotating Biological Contactor**
				Trickling Tower
		Submerged	**Expanded**	**Fluidized Sand Filter**
				Moving Bed Bioreactor
				Downflow Microbead
			Expandable	**Foam Filters**
				Floating Bead Bioclarifiers
				Upflow Sand Filters
			Packed	**Submerged Rock**
				Plastic Packed Bed
				Shell Filters

The treatment process sizing parameters for the Option B process stages are shown in Table 3.

Table 3. Treatment Process Sizing Parameters

Parameter	Minimum Criteria	Maximum Criteria	Units
Disc Filter Hydraulic Loading Rate	**6**		**gpm/sf**
Booster Pumping Total Dynamic Head	**12**	**16**	**ft**
Packed Tower (Air Stripper) Hydraulic Loading Rate	**100**	**25**	**gpm/sf**
Packed Tower (Air Stripper) Air-to-Water Ratio	**0.3**	**0.5**	**gpm/cfm**
UV Transmittance	**70**	**100**	
UV Dose	**5**	**300**	**mJ/cm2**

The conceptual process flow diagram for Option B in Figure 9 shows a biofilter stage as an alternative. Filtered solids from either the solids filtration (i.e., disc filters) or the biofilters are expected to be returned to Billingsley Creek. Should solids disposal to Billingsley Creek not be allowed, alternative solids handling and disposal, such as with drying beds or land application, might be necessary.



CONCEPTUAL PROCESS FLOW DIAGRAM – OPTION B

SPF WATER ENGINEERING
300 East Mallard Drive, Suite 350
Boise, Idaho 83706
Tel (208) 383-4140 Fax (208) 383-4156

IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS
CONCEPTUAL PROCESS FLOW DIAGRAM – OPTION B

PRELIMINARY DRAFT NOT FOR CONSTRUCTION

REVISIONS

ITEM	DESCRIPTION	DATE
A	10% CONCEPT	5/8/14

VERIFY SCALE

PROJECT:	535.0100
DESIGNED:	DPK
DRAWN:	SCB
CHECKED:	RAH

FIGURE 9

Path: Y:\PROJECTS\535.0100\SH Filename: 535C00-aRC Plot date: May 22, 2014-02:13:43pm CAD User: SBennett
X-ref Filename: | 535O100-XR-TITLE BLOCK |

Site Plan

The facilities for this option at each of the two site locations are shown on Figure 10 and Figure 11, respectively. Biolfilters are also shown on these figures for reference should additional ammonia removal become necessary as development of this concept progresses. The recirculation water treatment and pump back facilities are expected to fit within a ½ acre site.

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IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS

OPTION B – MUSSER SITE PLAN

PRELIMINARY DRAFT NOT FOR CONSTRUCTION

REVISIONS

ITEM	DESCRIPTION	DATE
A	1ST CONCEPT	3/8/16

VERIFY SCALE
BAR MEASURES ONE INCH ON FULL SIZE DRAWING

PROJECT: 535.0100
DESIGNED: DPK
DRAWN: SCB
CHECKED: RRH

FIGURE 10

Path: F:\PROJECTS\535.0100\SH Filename: 5350100-CIVL SITE Plot date: May 22, 2014-02:18 17pm CAD User: SBennett
Xref Filename: | 5350100-XR-TITLE BLOCK

Path: Y:\PROJECTS\533.0100\SH Filename: 5330100-CIVIL SITE Plot date: May 22, 2014-02:16:38pm CAD User: SBennett
Xref Filename: | 5330100-XR-TITLE BLOCK |

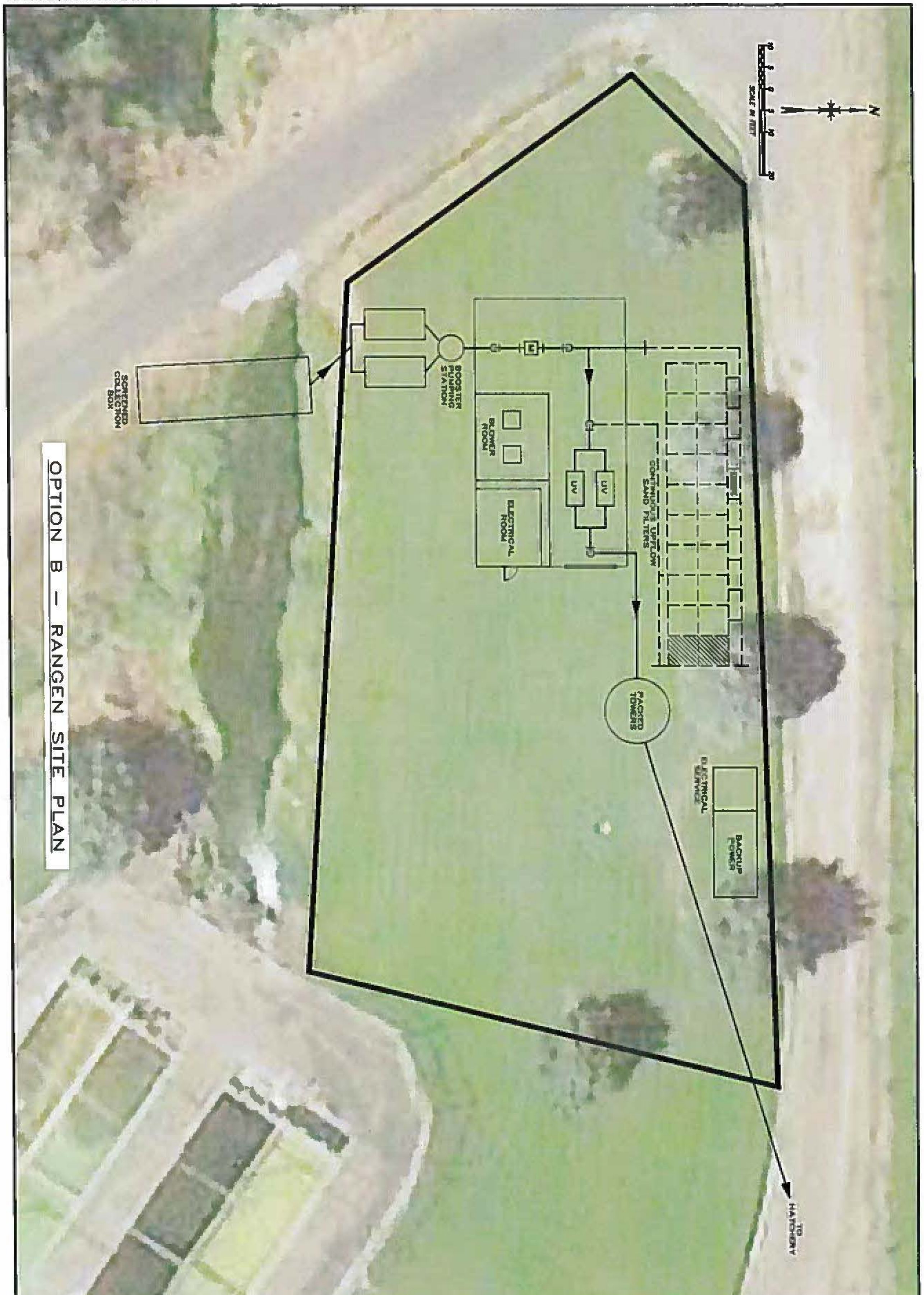

FIGURE 11				
PROJECT:	533.0100			
DESIGNED:	DPK			
DRAWN:	SCB			
CHECKED:	BBH			

VERIFY SCALE

REVISIONS		
ITEM	DESCRIPTION	DATE
A	10% CONCEPT	5/9/14

PRELIMINARY DRAFT NOT FOR CONSTRUCTION

IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS

OPTION B – RANGEN SITE PLAN

SPF WATER ENGINEERING
300 East Mallard Drive, Suite 350
Boise, Idaho 83706
Tel (208) 383-4140 Fax (208) 383-4156

C. References

Aquaculture Waste Guidelines Advisory Committee. *Idaho Waste Management Guidelines for Aquaculture Operations*. 1996. State of Idaho Department of Environmental Quality. p. 62

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Appendix A. Rangen Aquaculture Research Center - Assumed or Estimated Water Quality Data

Rangen Aquaculture Research Center Recirculation Treatment Design Criteria

Hatchery Water Quality Parameters (2011 reference year)	Value	Units	Source/Comments
Annual Fish Production @ Rangen Aquaculture Research Center	141,749	lbs/yr	2011 production reported by Sullivan 2012 and referenced in Rogers 12/21/2012 testimony.
Flow			
Annual Average	14.9	cfs	2011 flows reported in Rogers 12/21/2012 testimony.
Annual Average	9.63	mgd	2011 flows reported in Rogers 12/21/2012 testimony.
Annual Average	6,687	gpm	2011 flows reported in Rogers 12/21/2012 testimony.
Minimum Month	12.3	cfs	2011 flows reported in Rogers 12/21/2012 testimony.
Minimum Month	7.95	mgd	2011 flows reported in Rogers 12/21/2012 testimony.
Minimum Month	5,520	gpm	2011 flows reported in Rogers 12/21/2012 testimony.
Peaking Factor (Minimum Monthly Flow:Annual Average Flow)	0.83	-	Calculated
Maximum Month	21.5	cfs	2011 flows reported in Rogers 12/21/2012 testimony.
Maximum Month	13.90	mgd	2011 flows reported in Rogers 12/21/2012 testimony.
Maximum Month	9,649	gpm	2011 flows reported in Rogers 12/21/2012 testimony.
Peaking Factor (Maximum Monthly Flow:Annual Average Flow)	1.44	-	Calculated.
Feed Conversion	1.1	lb/lb	http://www.mresourcegroup.com/rangen/companyhistory.htm
Annual Feed Utilization	155,924	lbs	2011 fish production multiplied by published feed conversion factor.
Dissolved Oxygen			
DO Saturation	9.1	mg/L	58 degrees Farenheit & 3,000 ft elevation
Upstream DO	8.6	mg/L	Single field measurement on May 7, 2014.
Upstream DO Saturation	96	%	Single field measurement on May 7, 2014.
Downstream DO	8.3	mg/L	Single field measurement on May 7, 2014.
Downstream DO Saturation	92	%	Single field measurement on May 7, 2014.
Oxygen Consumption	0.25	lb/lb	lbs O_2 consumed/lb of feed (Colt, J., et al. 1990. Feasibility Report for the Mora National Fish Hatchery, USFWS, Region Two, Albuquerque, New Mexico.)
Oxygen Consumption	38,981	lbs/yr	Calculated from Colt production factor.
Oxygen Consumption	1.33	mg/L	Calculated fom Colt production factor and Rogers flow.
Total Suspended Solids			
Settleable and Total Suspended Solids Generated	46,777	lbs/yr	Idaho Waste Management Guidelines for Aquaculture Operations, p. 60
Settleable and Total Suspended Solids Generated	1.595	mg/L	Calculated from IWMGAO and Rogers flow.
Effluent Total Suspended Solids	10,410	lbs/yr	2011 DMR Pollutant Loading Tool
Effluent Total Suspended Solids	0.355	mg/L	Calculated from DMR load and Rogers flow.
Total Phosphorus Generation			
Total Phosphorus Generation	1,185	lbs/yr	Idaho Waste Management Guidelines for Aquaculture Operations, p. 60
Total Phosphorus Generation	0.040	mg/L	Calculated from IWMGAO and Rogers flow.
Settleable and Suspended Phosphorus	842	lbs/yr	Using factor from Idaho Waste Management Guidelines for Aquaculture Operations, p. 60
Dissolved Phosphorus Generation	343	lbs/yr	Using factor from Idaho Waste Management Guidelines for Aquaculture Operations, p. 60
Effluent Phosphorus	355	lbs/yr	2011 DMR Pollutant Loading Tool
Effluent Phosphorus	0.012	mg/L	Calculated from DMR load and Rogers flow.

Rangen Aquaculture Research Center Recirculation Treatment Design Criteria

Hatchery Water Quality Parameters (2011 reference year)	Value	Units	Source/Comments
Nitrogen			
Settleable and Suspended Nitrogen	998	lbs/yr	Using factor from Idaho Waste Management Guidelines for Aquaculture Operations, p. 60
Settleable and Suspended Nitrogen	0.034	mg/L	Calculated from IWMGAO and Rogers flow.
Dissolved Nitrogen	4,943	lbs/yr	Using factor from Idaho Waste Management Guidelines for Aquaculture Operations, p. 60
Dissolved Nitrogen	0.17	mg/L	Calculated from IWMGAO and Rogers flow.
Effluent Ammonia	5,972	lbs/yr	Using factor from Idaho Waste Management Guidelines for Aquaculture Operations, p. 60
Effluent Ammonia	0.204	mg/L	Calculated from IWMGAO and Rogers flow.
Remaining Nitrogen Fraction	31.18	lbs/yr	Used to complete TN
Remaining Nitrogen Fraction	0.0011	mg/L	Used to complete TN
Maximum Un-ionized Ammonia	0.0125	mg/L	Assumed for production raceways (Colt, J., et al. 1990. Feasibility Report for the Mora National Fish Hatchery, USFWS, Region Two, Albuquerque, New Mexico.)
Effluent Un-ionized Ammonia	0.005	mg/L	Calculated using percentage unionized ammonia from IWMGAO p. 64.
Carbon Dioxide			
Carbon Dioxide Production Factor	0.28	lb/lb	lbs of CO_2 produced/lb of feed (Colt, J., et al. 1990. Feasibility Report for the Mora National Fish Hatchery, USFWS, Region Two, Albuquerque, New Mexico.)
Effluent Carbon Dioxide	43,659	lbs/yr	Calculated from Colt production factor.
Effluent Carbon Dioxide	1.49	mg/L	Calculated fom Colt production factor and Rogers flow.
Temperature			
Upstream Temperature	15.5	°C	Single field measurement on May 7, 2014.
Downstream Temperature	15.8	°C	Single field measurement on May 7, 2014.
pH			
Upstream pH	7.52	SU	Single field measurement on May 7, 2014.
Downstream pH	7.23	SU	Single field measurement on May 7, 2014.
Specific Conductance			
Upstream Conductivity	325.5	µS/cm	Single field measurement on May 7, 2014.
Downstream Conductivity	325.2	µS/cm	Single field measurement on May 7, 2014.

Exhibit 5

Aqua Life Project

SPF WATER ENGINEERING

TECHNICAL MEMORANDUM

DATE: May 29, 2014

TO: Randy Budge

FROM: Bob Hardgrove, P.E.
Jason Thompson, P.E.

CC: SPF file (535.0120)

RE: IGWA's 3rd Mitigation Plan: Aqua Life Project
10% Preliminary Submittal

The Idaho Ground Water Appropriators, Inc. (IGWA) is reviewing legal and technical options related to water management stemming from the Rangen, Inc. (Rangen) Water Call. IGWA has requested through its water rights legal counsel that SPF Water Engineering (SPF) provide a conceptual design to deliver 9.1 cfs of direct flow to Rangen from the Aqua Life Aquaculture Facility (Aqua Life) owned and operated by the Idaho Water Resources Board (IWRB). This memorandum presents this conceptual design at a preliminary 10% level.

1. Aqua Life Project Summary

SPF Water Engineering, LLC (SPF) was hired to design the infrastructure required to implement IGWA's Third Mitigation Plan, one alternative of which is the direct delivery of water from Aqua Life to Rangen, referred to as the Aqua Life Project (Project). The Project concept proposes construction of a pumping station and pipeline from Aqua Life on IWRB property to Rangen. To date, the engineering required to construct the Project has been completed to a preliminary 10% level.

2. Water Rights

The Project is designed to pump up to 9.1 cfs of groundwater associated with water right 36-2338 to Rangen. Water right 36-2338 authorizes the diversion of 54.68 cfs for fish propagation purposes at Aqua Life from "springs" with a priority date of August 5, 1954. Spring water delivered to Rangen will be utilized in Rangen's facilities and thereafter be discharged to Billingsley Creek providing an enhanced supply and additional benefit for downstream users.

3. Project Design

3.1. Preliminary Pipeline Alignment

IGWA asked SPF to design a 10-cfs pumping and pipeline system to reliably deliver 9.1 cfs from Aqua Life to the Rangen facility. A preliminary alignment for the pipeline has been developed primarily based on an initial evaluation of construction feasibility and topography. This alignment is shown in Figure 1. Alternate alignments may be investigated as part of future design efforts.

Elevations for the alignment were derived from Google Earth; a topographical survey will be performed to develop the 60% design. The 60% design alignment will also take into account Hagerman Highway District (HHD) review and input, existing infrastructure, property ownership, and survey topography.

From Aqua Life, the preliminary alignment travels up to the Hagerman Rim, primarily along the course of an existing dirt road. The pipeline then crosses E 2700 S (Tupper Grade Road) and travels south across irrigated fields to cross E 2800 S. Then the alignment continues south, with the preferred location just to the west of irrigated fields for easier installation. The alignment then turns east and crosses E 2900 S (Vader Grade), then turns south, crossing S 1175 E twice, before entering Rangen property.

The preliminary alignment is approximately 3.2 miles long, with an elevation of approximately 3002 feet at Aqua Life and a maximum pipeline elevation of 3228 feet. These elevations are derived from Google Earth and are considered approximate but appropriate for a 10% level of design. More accurate elevations will be obtained by a topographical survey prior to 60% design.

A profile of the preliminary alignment was generated using Google Earth. This profile is shown in Figure 2. The profile generally shows that after the pipeline leaves Aqua Life and climbs to the rim, the anticipated route is fairly flat. The pipeline then drops across the Vader Grade to Rangen. Although this profile is based on approximate, readily-available elevation data, it demonstrates that construction of the pipeline is feasible. The pipeline route does not include numerous high and low points, which minimizes venting requirements. Once a survey is complete, the alignment will be modified to minimize minor high and low points.

The preliminary alignment avoids the Hagerman Highway District (HHD) right-of-way per HHD preference, with the exception of at least three unavoidable road crossings. SPF anticipates that HHD would approve these road crossings based on an initial approval granted by the HHD for the Tucker Springs Project pipeline presented in IGWA's Second Mitigation Plan. If the Aqua Life Project moves forward, the pipeline contractor would be required to obtain a permit from the HHD.

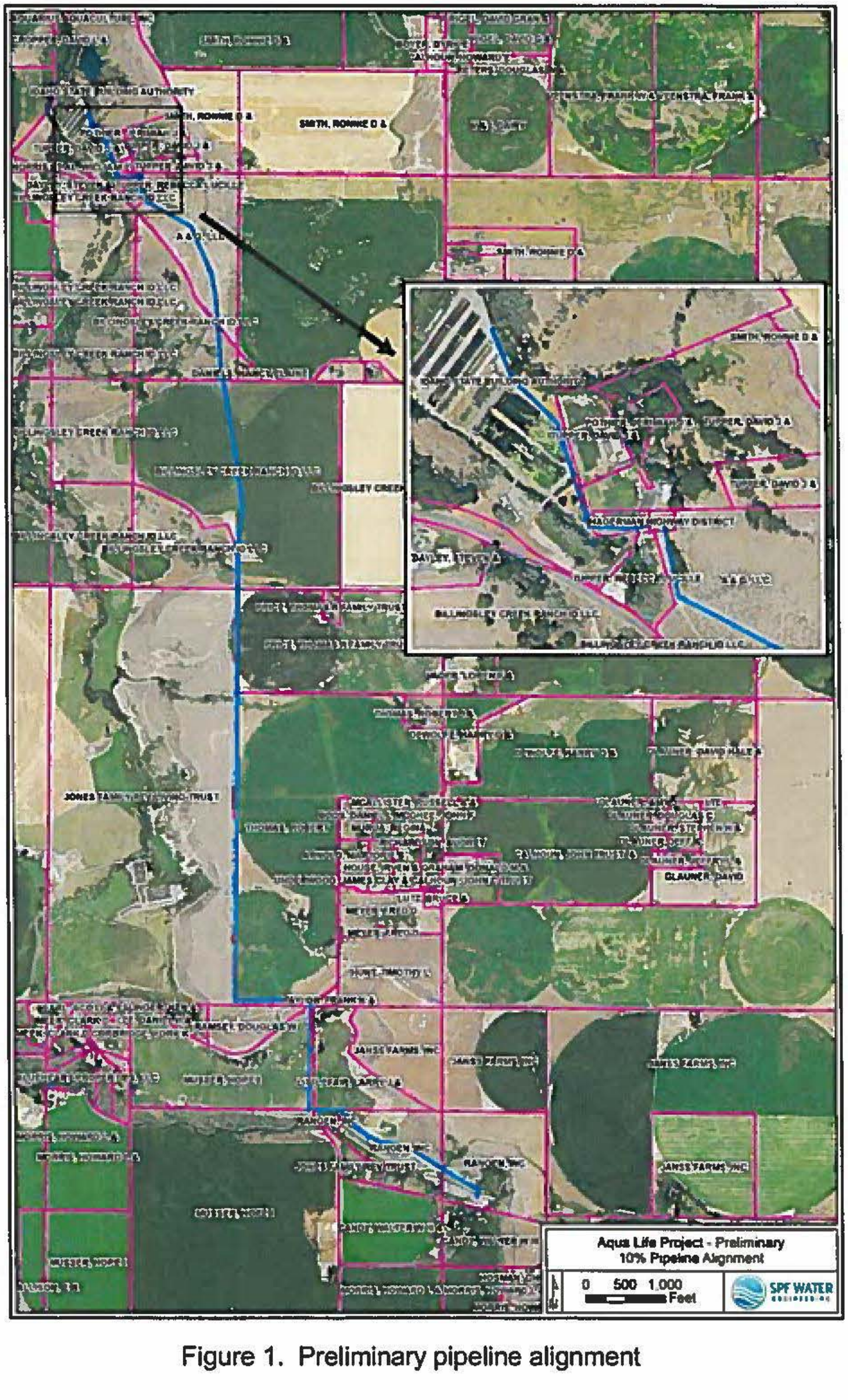

Figure 1. Preliminary pipeline alignment

Figure 2. Elevation profile of preliminary alignment

3.2. Spring Intake Design

The 10% design contemplates diverting water at Aqua Life directly from a spring source. A site visit was made to Aqua Life on May 21, 2014, for a cursory investigation of potential diversion locations. A potential diversion location on the slope east and upgradient of the existing lake was found, and is identified as Option 1 in Figure 3. A photograph is included in Figure 4. Flow at this location was visually estimated by SPF to be at least 10 cfs. A flow measurement in the spring channel would occur prior to 60% design to verify flow rates. Water quality samples could also be collected.

The elevation of this spring diversion location is approximately 3055 feet according to Google Earth. This elevation would allow for gravity flow between the diversion location and a pump station located at an approximate elevation of 3003 feet near the raceways, as shown in Figure 3. This pump station location is preliminary; the final location for the pump station would take into account elevation, power availability, existing site infrastructure, constructability, and other factors.

An elevation profile of the gravity line between the spring diversion and pump station was generated using Google Earth and is shown in Figure 5. The profile demonstrates that water can be delivered from the spring to the pump station by gravity with a minimal amount of cut. Once a survey is complete, the gravity line profile will be better defined.

Figure 3. Preliminary Aqua Life diversion locations

Figure 4. Photograph of potential Aqua Life spring diversion location

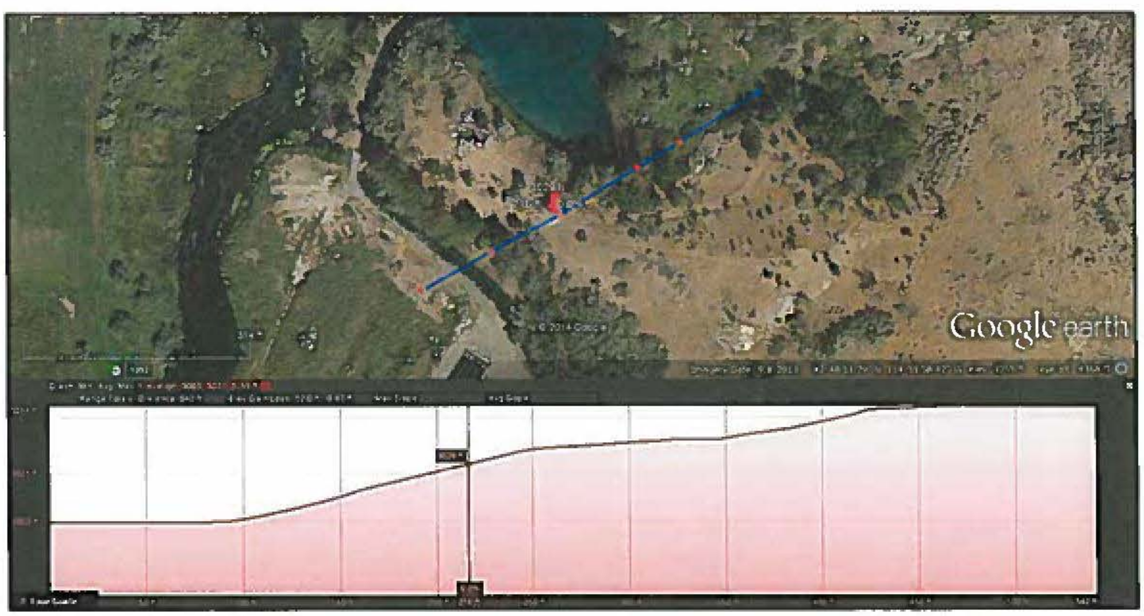

Figure 5. Elevation profile of gravity line between spring and pump station

This preliminary design identifies the spring diversion location described as Option 1 as the preferred diversion at Aqua Life, primarily because it allows for the diversion of spring water closest to the spring source. If this location is determined to not be feasible after additional investigation, then an alternative diversion location identified as Option 2 in Figure 3 may be pursued. This diversion would be located on the channel downstream of Fisher Lake. A gravity line would be installed between this diversion location and the pump station.

Per the letter of intent (LOI) between IGWA and the State of Idaho through the IWRB, IGWA will be allowed to divert up to 10 cfs from Aqua Life by lease or purchase of State of Idaho water rights. The LOI states that the IWRB will grant a permanent easement to IGWA to access, design, construct, operate and maintain the water intake and collection facilities, pump station, pipeline, and other facilities as necessary to divert and deliver the 10 cfs to Rangen.

The 10% design anticipates using a precast collection box with bar grate and expanded metal cover. A gravity pipeline would deliver water from the collection box to the pump station. A head gate would be installed on the upstream end of the gravity line to isolate the feed to the pump station for maintenance. Check boards slots would be included on the upstream side of the collection box to make it possible to isolate flow for sediment removal within the collection box. Alternative design options may be pursued following a more detailed engineering evaluation of the site.

3.3. Pump Station Design

The 10% design set contemplates utilizing a skid-mounted packaged pump station; including pumps, mechanical piping, valves, flow meter, variable frequency drives (VFDs), and associated controls, generator, and enclosure. The pump station would include three short-set line-shaft turbine pumps. Two of the pumps would be duty pumps and one would be on standby to ensure that two pumps can operate at all times should one be taken out of service for maintenance. The turbine pumps could be installed in a single precast concrete wet well or in individual pump cans. The wet well or cans would be fed from the gravity line from the spring collection box. The wet well or cans would be designed to be watertight under static pressure conditions from the spring box.

To deliver 10 cfs from Aqua Life to Rangen, the pump station will have to generate approximately 285 feet of total dynamic head (TDH). The TDH calculation assumes:

- 3,000 feet of 24-inch fused high density polyethylene (HDPE) pipe (DIPS, SDR 11, 20.83-inch I.D.)
- 14,000 feet of 24-inch HDPE pipe (DIPS, SDR 17, 22.58-inch I.D.)
- Pumping water elevation of 3,000 feet at Aqua Life
- A maximum pipeline elevation of 3,228 feet
- A pressure sustaining valve to maintain backpressure equal to 25 feet over the maximum elevation of the pipeline, equal to 3,253 feet

- Connection to Rangen's existing 14-inch buried steel pipe between the hatch house and the small raceway
  - Assumed design flow of 4 cfs (1,800 gpm) to Rangen's small raceway
  - Assumed design flow of 6 cfs (2,700 gpm) to the Rangen box

With a TDH of 285 feet and a delivery rate of 10 cfs (4,488 gpm), total brake horsepower (hp) required is 382 hp, or 191 hp per pump with two pumps running. The pumps would require nominal 200-hp motors. All three 200-hp pumps would be controlled by VFDs and paced off flow to maintain any operator-adjustable flow rate up to 10 cfs. System operation would be controlled by a programmable logic controller with remote monitoring and auto-restart capabilities. The packaged pump station would include an isolation and check valve on each pump, a mainline butterfly valve, pressure relief valve, combination air valve, and a flow meter. A generator is anticipated to provide emergency power. The pump station would be enclosed for protection from weather and to provide sound attenuation. The insulated enclosure would be heated and ventilated.

The pump station would be designed to deliver a maximum flow of 10 cfs at 285 feet of TDH. Because the pump station would include two VFD-controlled pumps paced off of flow, it could be programmed to deliver the phased-in lower direct flows identified by the Idaho Department of Water Resources (IDWR) in the Rangen curtailment order. These flows were determined to be:

- 1st Year: 3.4 cfs (1,525 gpm)
- 2nd Year: 5.2 cfs (2,335 gpm)
- 3rd Year: 6.0 cfs (2,695 gpm)
- 4th year: 6.6 cfs (2,965 gpm)
- 5th year: 9.1 cfs (4,085 gpm)

A tentative location for the pump station is identified in Figure 3. A final location would be identified in the 60% design documents. The final location will depend on the topographical survey, power availability, existing site infrastructure, constructability, and other factors. Idaho Power will be contacted to determine power availability at Aqua Life and to identify any distribution system upgrades necessary to supply the 600-hp pump station.

The pump station would be designed to be a reliable, year-round facility and would include: (1) a redundant pump, (2) remote monitoring and alarming capabilities, (3) auto-restart, and (4) a proposed standby power generator and auto-transfer switch. The pump station VFDs would be controlled by discharge rate, allowing them to automatically adjust their speed to deliver a constant flow to Rangen without the need for manual adjustments. The pump station enclosure would be lockable and durable to prevent vandalism or unauthorized entry. All these items would make the pump station dependable, biologically and physically secure, and would minimize downtime due to maintenance and power outages.

3.4. Pipeline Design

The preliminary alignment is approximately 3.2 miles long. The 10% design anticipates using HDPE pipe, with approximately 3,000 feet of SDR 11 (200 psi) HDPE pipe and approximately 14,000 feet of SDR 17 (125 psi) HDPE pipe. HDPE is a very durable and low-friction pipe. It has a better friction coefficient than PVC, which minimizes head loss due to friction and is less susceptible to any build-up on the interior surface of the pipe. Subsequent design work would verify the selected pipe could accommodate pressure surges, or water hammer, that may occur due to pressure transients in the system resulting from power outages or rapid valve closures.

The preliminary alignment has five road crossings: E 2700 S, E 2800 S, E 2900 S, and two crossings of S 1175 E. These roads may be crossed using open-trench construction methods, although the crossing of E 2900 S (Vader Grade) may be most effectively crossed using a horizontal directional bore to minimize disturbance and impacts to traffic. HHD would be consulted on any proposed Project activities within HHD jurisdiction.

The pipeline would be equipped with combination air valves at defined high points that release air during pipeline filling, let air enter the pipe when it is being drained, and release small amounts of accumulated air when the pipe is under pressure. These valves help protect the pipe during filling and draining events and minimize the amount of air in the line, which reduces the friction losses in the pipeline. In areas that are safe from vehicles or farm equipment, air valves would be placed directly over the pipe with access via a manhole. Where the pipeline is in a road or a farmed field, the air valve would be located remotely in a vault and fed from the pipeline with a small diameter lateral line.

3.5. Rangen Tie-In Design

The proposed alignment would enter Rangen property near the main entrance; the pipeline would be installed under their paved roadway for a distance of approximately 2,500 feet to the anticipated tie-in location at the existing 14-inch pipeline between the hatch house and the small raceway. A pressure sustaining valve would be provided immediately upstream of the tie-in point to maintain a minimum upstream pressure in the pipeline under all static and operating conditions. The pressure sustaining valve would ensure a full pipeline upstream of the valve and that enough pumping head is developed to transport water over the mainline high-point without creating a vacuum condition. Isolation valves would be installed on either side of the pressure sustaining valve to allow for maintenance. A bypass line with an isolation valve would be installed around the pressure sustaining valve so delivery could be maintain to Rangen even if the pressure sustaining valve is out of service for maintenance or repair. The pressure sustaining valve would be housed in a buried vault on Rangen property.

Directly downstream of the valve vault, the new pipeline would connect by tee to the existing 14-inch buried steel pipeline that exists between the hatch house and the small raceway. A 14-inch butterfly valve would be installed on the small raceway leg of the tee to allow control of flow to the small raceway. There is an existing 14-inch valve located in a vault near the hatch house that could be used to control flow from or to the Rangen Box. In addition, there is an existing valve and lateral that can be used to direct flow from the 14-inch pipeline to the hatch house.

The existing 14-inch pipeline transports water from the Rangen Box to the small raceways. The pipe from Aqua Life would tie-in to this 14-inch pipe, allowing flows to be directly delivered to the small raceways through the 14-inch pipe, or to the large raceways in two ways: (1) after water flows through the small raceways via an existing 18-inch diameter pipeline and (2) through the Bridge Diversion in Billingsley Creek which can receive water spilled from the Rangen Box. The 10% design assumes 4 cfs would be delivered to the small raceways and 6 cfs would be delivered to the Rangen Box. However, if the small raceways can take additional flow, a larger portion of the 10 cfs can be sent that direction. The distribution of water between the small raceways and the Rangen Box would be adjusted by opening or closing a 14-inch butterfly valve that would be installed on the small raceway leg of the tee.

The current design is conservative in nature and allows some flexibility for delivery at the Rangen site. With approval of the Project, the design will be completed to a 60% level, and adjustments could be made to the delivery at Rangen based on their input and preferred use of the delivery. Minor changes to the 14-inch tie-in could be made to allow direct discharge into Billingsley Creek upstream and/or downstream of the Bridge Diversion, if approved by IDWR.