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June 20, 2014

James Cefalo
Water Resource Program Manager
Idaho Department of Water Resources
900 N. Skyline Dr., Ste. A
Idaho Falls, ID 83402-1718

Sent Via Email

james.cefalo@idwr.idaho.gov

Re: Rule 40.05 Additional Information Request

James:

On May 20, 2014, you asked North Snake Ground Water District, Magic Valley Ground Water District, Aberdeen American Falls Ground Water District, Bingham Ground Water District, Bonneville-Jefferson Ground Water District, Madison Ground Water District, and Clark Jefferson Ground Water District ("Ground Water Districts") and Rangen, Inc. to submit "additional information under Rule 40.05 of the Department's Water Appropriation Rules" no later than June 20, 2014, regarding application for permit nos. 36-16976 and 36-17002. Enclosed herewith is the information submitted by the Ground Water Districts, concerning application for permit no. 36-16976.

If you have any questions, please do not hesitate to contact me.

Sincerely,

T.J. Budge

cc: Fritz Haemmerle (fxh@haemlaw.com)
Robyn Brody (robynbrody@hotmail.com)
J. Justin May (jmay&maybrowning.com)
Gary Lemmon (glemmon@northrim.net)
Craig Hobdey (hobdeycraig@gmail.com)

**GROUNDWATER DISTRICTS' RESPONSE TO
REQUEST FOR ADDITIONAL INFORMATION
IDAPA 37.03.08.040.05**

1. Effect on Existing Water Rights (40.05.c)

A. c.i

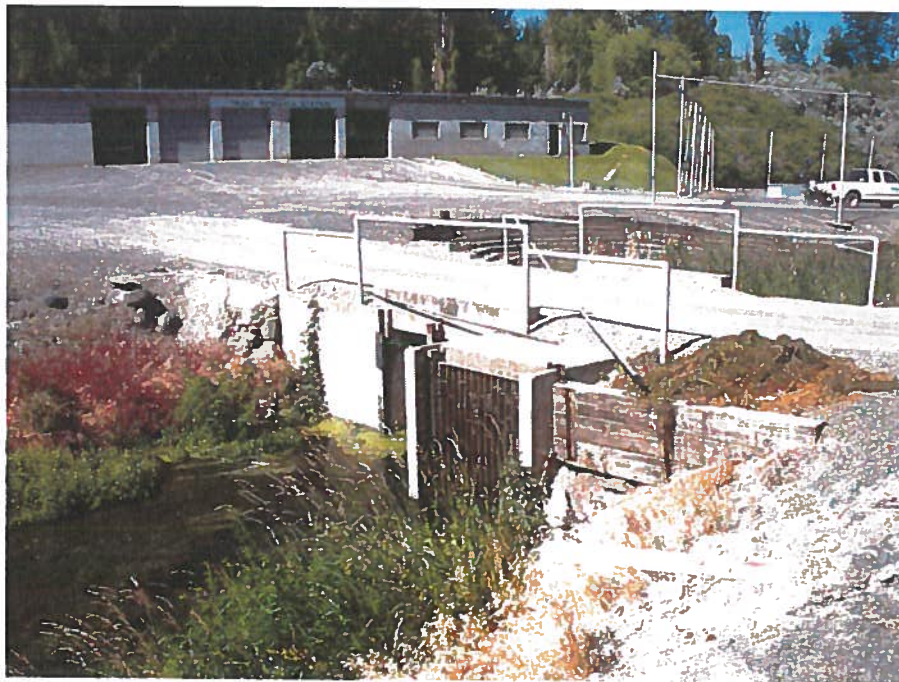
The source of supply for the Application is Springs; Billingsley Creek. There are more than five (5) water users on Billingsley Creek; therefore subpart c.i is not applicable. There are no other water rights from the Springs source, though Rangen has filed a junior-priority application to divert water from the same point of diversion under water right 36-17002.

B. c.ii

The source of supply for the Application is surface water; therefore, this section does not apply.

C. c.iii

Water will be delivered from the points of diversion either by gravity flow through an existing headgate (the "bridge diversion") on Billingsley Creek, shown below, or by pumping water from Billingsley Creek to various fish rearing facilities at the Rangen hatchery.



The use of the water is non-consumptive and there are no intervening water rights between the point of diversion and return flow to Billingsley Creek; therefore, there will be no impact to other water rights.

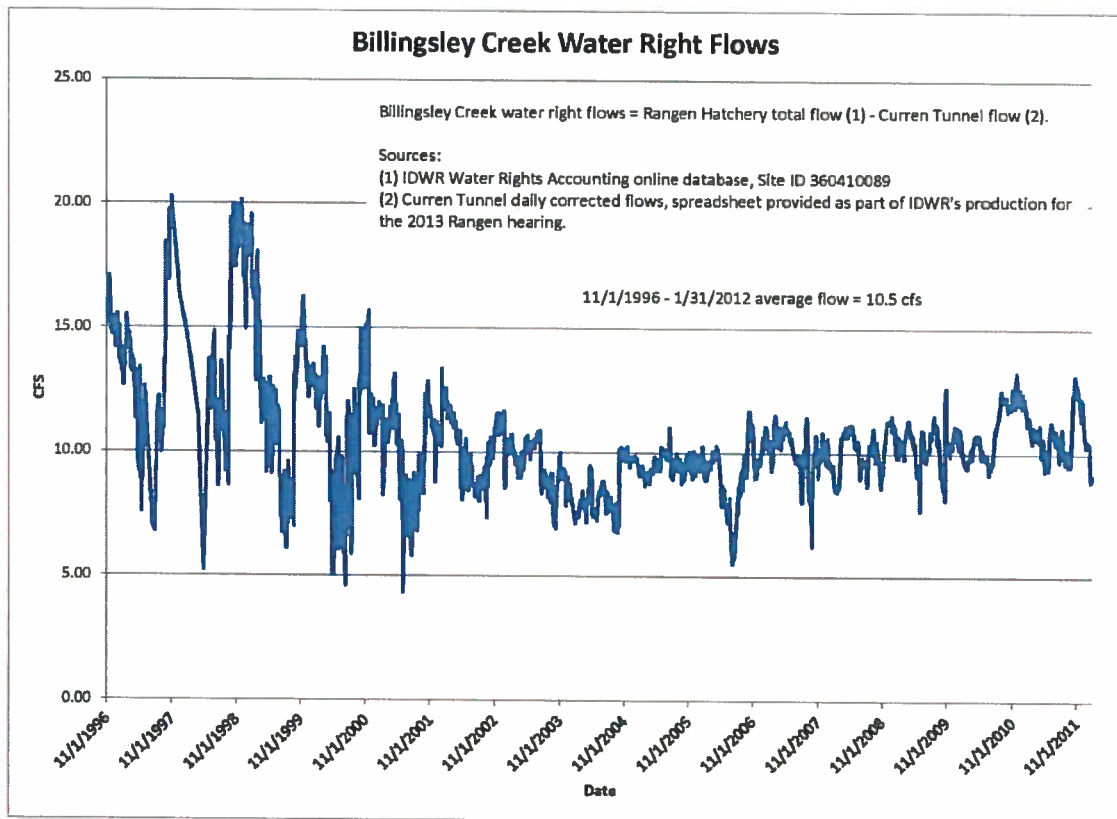
2. Sufficiency of Water Supply (40.05.d)

A. d.i

The amount of water applied for is 12 cfs from January 1 to December 31. Taken as an annual volume from January 1 to December 31, 12 cfs converts to 8,687.7 acre-feet. Annual consumptive use is zero.

B. d.ii

The following hydrograph depicts the flow record for the source of appropriation.



3. Good Faith, Delay, or Speculation (40.05.e)

A. e.i

If consent cannot be obtained from Rangen as to access its property, the Ground Water Districts will use their power of eminent domain. As stated in the Application, the Ground Water Districts have a statutory right to exercise eminent domain for mitigation purposes under Idaho Code § 42-5224(13).

B. e.ii

No “permits, licenses, and approvals” are necessary; therefore, this section does not apply.

4. Financial Resources (40.05.f)

A. f.i

Consistent with its statutory authority, the Ground Water Districts assess their members to pay costs associated with providing mitigation. Idaho Code § 42-5232. As the IDWR is aware, the Ground Water Districts have an extensive track record of acquiring water, water rights, and facilities to use for mitigation, without default. Consistent with past actions, the Ground Water Districts have the necessary financial resources to develop its Application.

B. f.ii

Various options are available for diversion water under this right. As mentioned above, an existing headgate on Billingsley Creek can be utilized to deliver water directly to Rangen’s Large Raceways and CTR Raceways. An alternative would be to pump water from Billingsley Creek to Rangen’s Small Raceways. **Appendix A** hereto contains engineering drawings for this pump station. Another alternative would be to pump water from the a point downstream on Billingsley Creek to the head of Rangen’s facility, as described in **Appendix B** hereto.

5. Comments Concerning the Local Public Interest (40.05.g)

In accordance with IDAPA 37.03.08.040.05.g, letters seeking comment were sent to Gooding County, the Idaho Department of Fish and Game, the Idaho Department of Environmental Quality, and Big Bend Irrigation and Mining Company.¹ Because of the June 20, 2014 deadline for the Ground Water Districts to

¹ IDAPA 37.03.08.040.05.g asks the applicant to seek comment from “any irrigation district or canal company which the proposed project is located” While Big Bend Irrigation and Mining Company is not an “irrigation district or canal company,” and it does not appear that Big Bend is located within the place of use or point of diversion legal descriptions for the Application, the Ground Water Districts, in the interest of being inclusive, and because Big Bend is located in the vicinity, have sought comment.

submit additional information under Rule 40.05 of the Department's Water Appropriation Rules, the foregoing entities were asked to return comments no later than June 16, 2014. Returned comments, if any, are on file with IDWR.

6. Reallocation of Trust Water Criteria (40.05.h)

The Application seeks to appropriate 12 cfs for fish propagation. Trust water reallocation does not apply because the Application seeks purposes of use that are non-consumptive, are not for irrigation, and do not seek to store water.

Appendix A

Pump Station Design



Memo

To **Chuck Brendeke**
 From **Coleman Miller**
 Date **December 3, 2012**

Subject **Fish Hatchery Surface Water Diversion**

This memo summarizes the feasibility analysis of diverting water from the Billingsley Creek to the small raceway of the Fish Hatchery. Attached is a drawing with a conceptual design of the diversion structure and pipe alignment. Also included is a feasibility level cost estimate of the improvements.

Design Assumptions

- Diversion location: Just upstream of the bridge at the same location as the existing diversion to the large raceway.
- Range of flowrates: 2 cfs – 10 cfs (900 gpm – 4,500 gpm)
- Normal flowrate: 7 cfs (3,000 gpm)
- Elevation of the bottom of the stream bed is approximately 10 feet below the small raceway elevation.

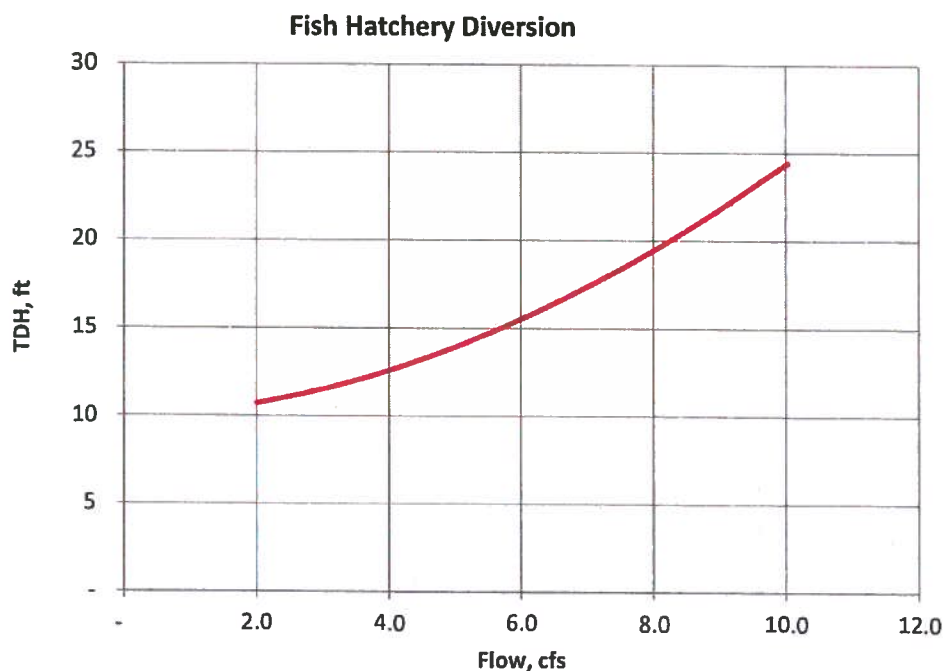
Hydraulic Calculations

Conceptual level hydraulic calculations were made in order to adequately estimate a pump size and pipe system requirements. A 14" pipe was found to be optimal for the pipe system. The following table and graph show the total dynamic head required for the water distribution system for the range of required flowrates.

Flow (cfs)	Calculated Dynamic Head (ft)	Static Head (ft)	Total Head (ft)
2.0	10.7	10	10.7
2.9	11.4	10	11.4
3.8	12.3	10	12.3
4.7	13.5	10	13.5
5.6	14.8	10	14.8
6.5	16.3	10	16.3
7.4	18.1	10	18.1
8.2	20.0	10	20.0
9.1	22.1	10	22.1
10.0	24.4	10	24.4

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www.amec.com



Summary of Conceptual Cost Estimate Items

- Precast concrete box installed in the river bank connected to a gated turnout situated such that it can collect low flow from the stream bed by gravity flow. A two-chamber box is recommended separated by a 3' high wall to allow sediments to drop out of the flow in the sediment trap before entering the sump which contains the pumps. A valve box to house the valves and fittings could be installed adjacent to the pump box.
- Ductile iron pipe (DIP) fittings for the pump and valve stations. Configuration of fittings is approximate, but typical of what is required for this type of pump station.
- Two 8" Gorman-Rupp ES 60Hz submersible pumps. Assuming a backup pump is required for emergency situations.
- Two variable frequency drives (VFD). A VFD is needed to accommodate the range of flowrates required.
- 200 linear feet of 14" HDPE pipe buried in an excavated trench from the pump station to the small raceway.
- Electrical work will be required for the setup of the pump motors.

Conceptual Cost Estimate

Item No	Description	Unit	Unit Cost (USD)	Quantity	Cost
1	Precast Concrete Box installed	ea	\$10,000	1	\$15,000
2	DIP fittings and valves				
2.1	8" Isolation Valve	ea	\$1,800	2	\$3,600
2.2	8" Check Valve	ea	\$2,100	2	\$4,200
2.3	8" 90° Bend	ea	\$1,000	4	\$4,000
2.4	8" DIP to 14" HDPE Coupling	ea	\$1,800	1	\$1,800
2.5	24" Sluice Gate	ea	\$1,500	1	\$1,500
2.6	8" DIP T Fitting	ea	\$1,400	1	\$1,400
2.7	DIP Coupling	ea	\$1,500	2	\$3,000
3	Vertical Turbine Pump	ea	\$35,000	2	\$70,000
4	Variable Frequency Drive	ea	\$14,000	2	\$28,000
5	14" HDPE buried pipe installed	l.f.	\$60	200	\$12,000
6	Electrical work	l.s.	\$7,000	1	\$10,000
Subtotal:					\$154,500
Total					\$154,500
20% Contingency					\$30,900
Grand Total					\$185,400

Appendix B

Pump-Back Options

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.

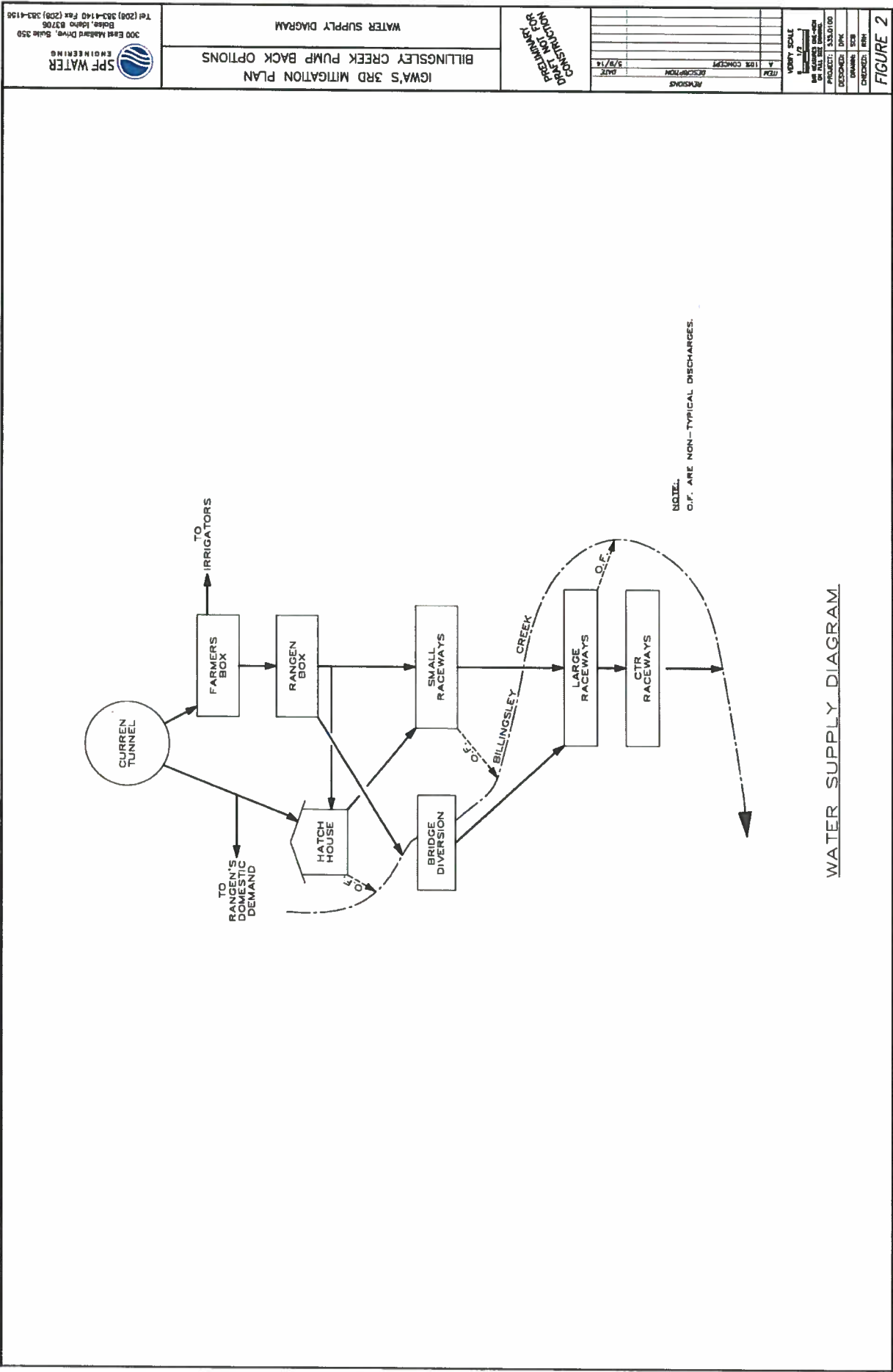
The Hatchery NPDES permit identification number is IDG130015. The EPA's online DMR Pollutant Loading Tool (<http://cfpub.epa.gov/dmr/index.cfm>) reports that the actual average facility flow is 9.0 million gallons per day (mgd) (13.9 cfs) and the 2011 total suspended solids (TSS) and phosphorus (P) loadings were 10,410 pounds per year (lbs/yr) and 355 lbs/yr, respectively. No DMR data are reported for dissolved oxygen (DO), ammonia-nitrogen (NH₃-N), nitrite-nitrogen (NO₂-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 NH₃-N, CO₂, and NO₂-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).

NH₃-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



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.

WATER SUPPLY DIAGRAM -- OPTION A

VERIFY SCALE	PROJECT: 535-0100
 1/2" = 1'-0"	DESIGNED: DPK
ALL DIMENSIONS IN FEET ON ALL SIZE DRAWINGS	DRAWN: SCB
	CHECKED: RWH

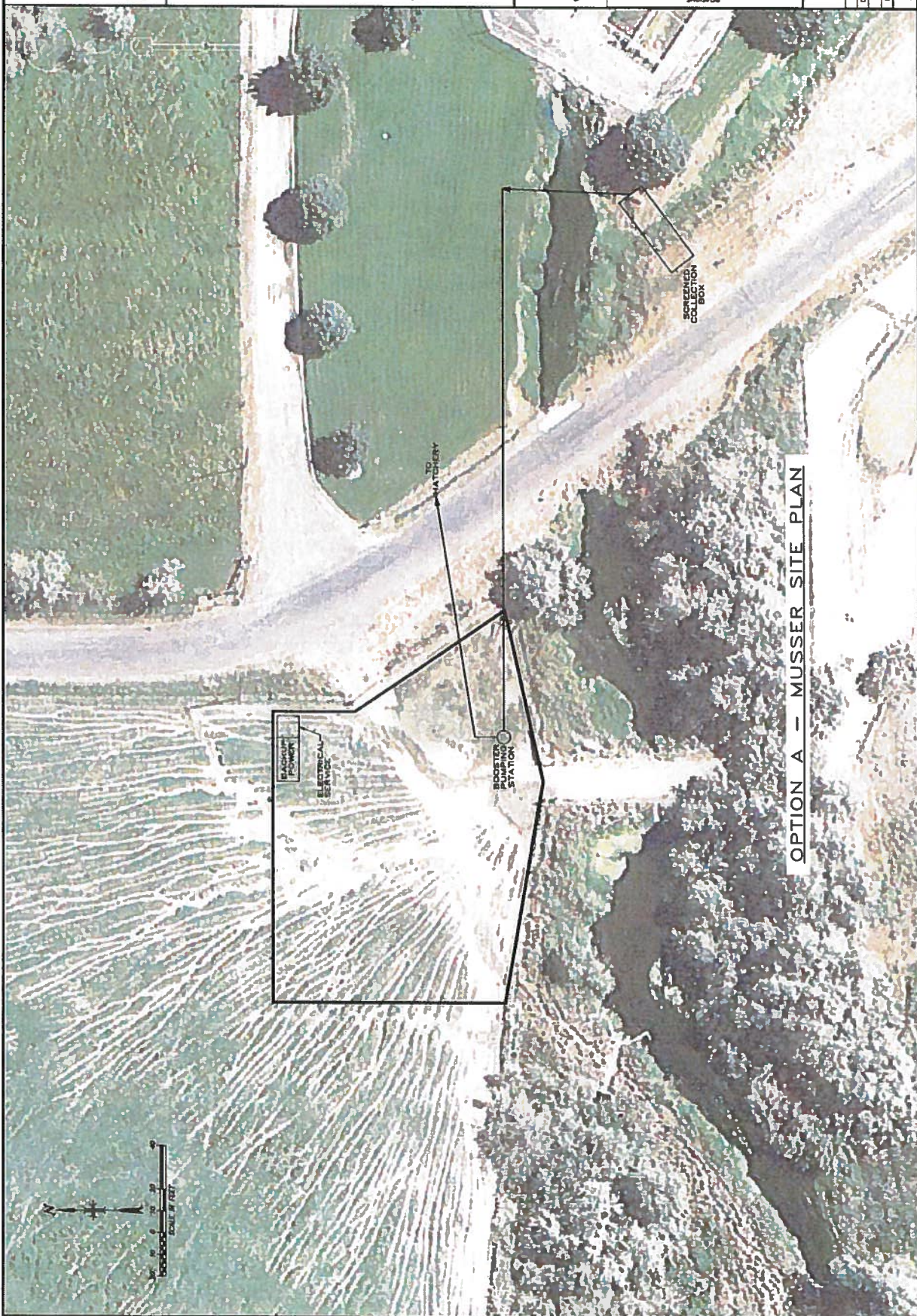
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3rd	HOLLANDS		PCB

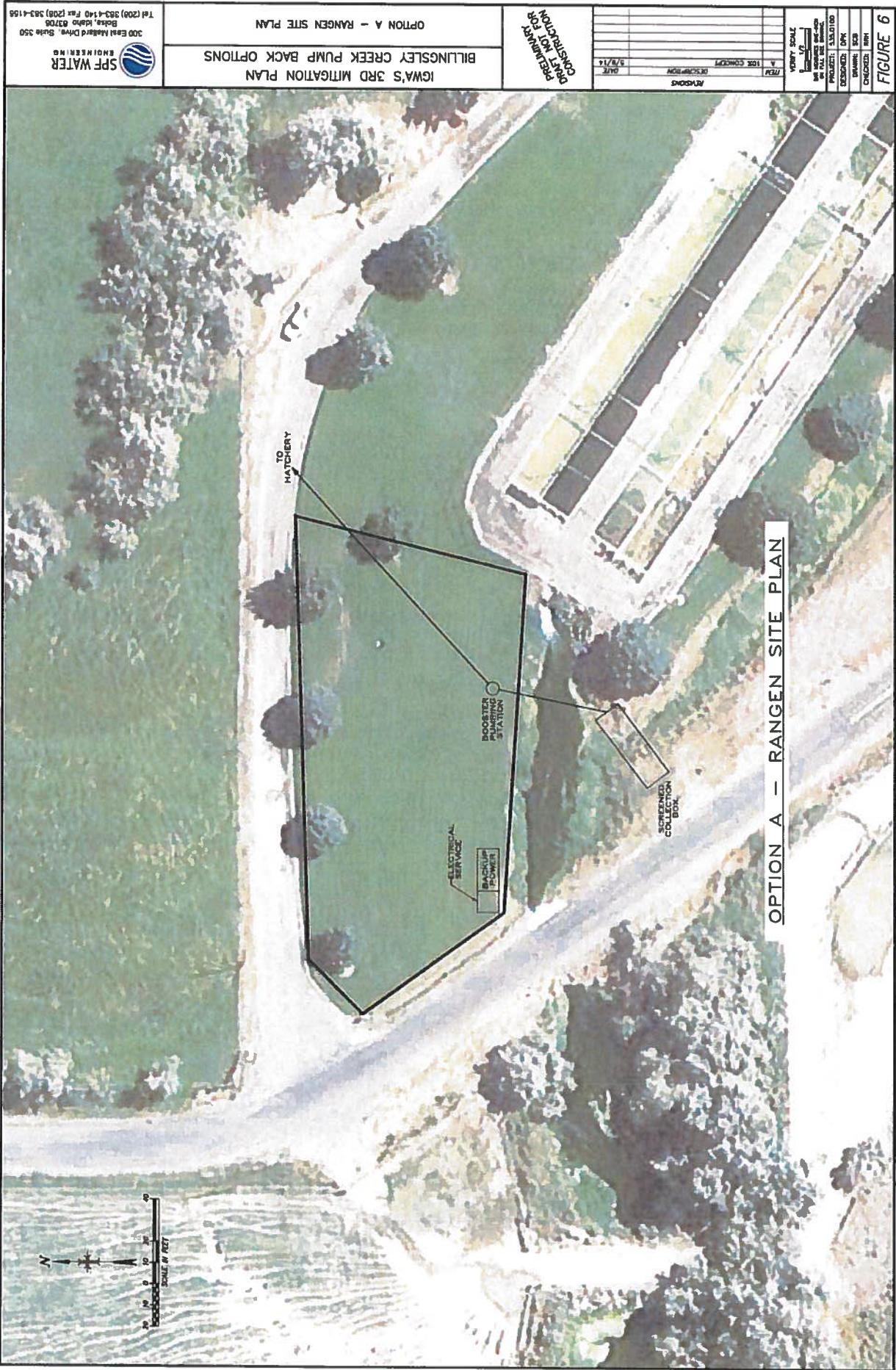
PRELIMINARY
DRAFT NOT FOR
CONSTRUCTION

OPTION A - MUSSEY SITE PLAN

ICGWA'S 3RD MITIGATION PLAN
GSLEY CREEK PUMP BACK OPTIONS

SPF WATER 
ENGINEERING
300 East Millard Drive, Suite 350
Boise, Idaho 83708
Tel (208) 383-4140 Fax (208) 383-4158





OPTION A – RANGEN SITE PLAN

FIGURE 6

PROJECT: 1530100	DESIGNED: DPK	DRAWN: ESK	CHECKED: BRK
DATE: 5/9/14	DESCRIPTION: A	DATE: 5/9/14	DATE: 5/9/14

VERY SCALE	DATE: 5/9/14
DATE: 5/9/14	DATE: 5/9/14

PRELIMINARY
DO NOT CONSTRUCT

IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS
OPTION A – RANGEN SITE PLAN

SPF WATER
ENGINEERING
300 East Hubbard Drive, Suite 350
Bozeman, Idaho 83708
Tel (208) 383-4149 Fax (208) 383-4156

Option B – Billingsley Creek and Hatchery Discharge Pump Back

This option consists of water collection downstream 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 facilities¹

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.

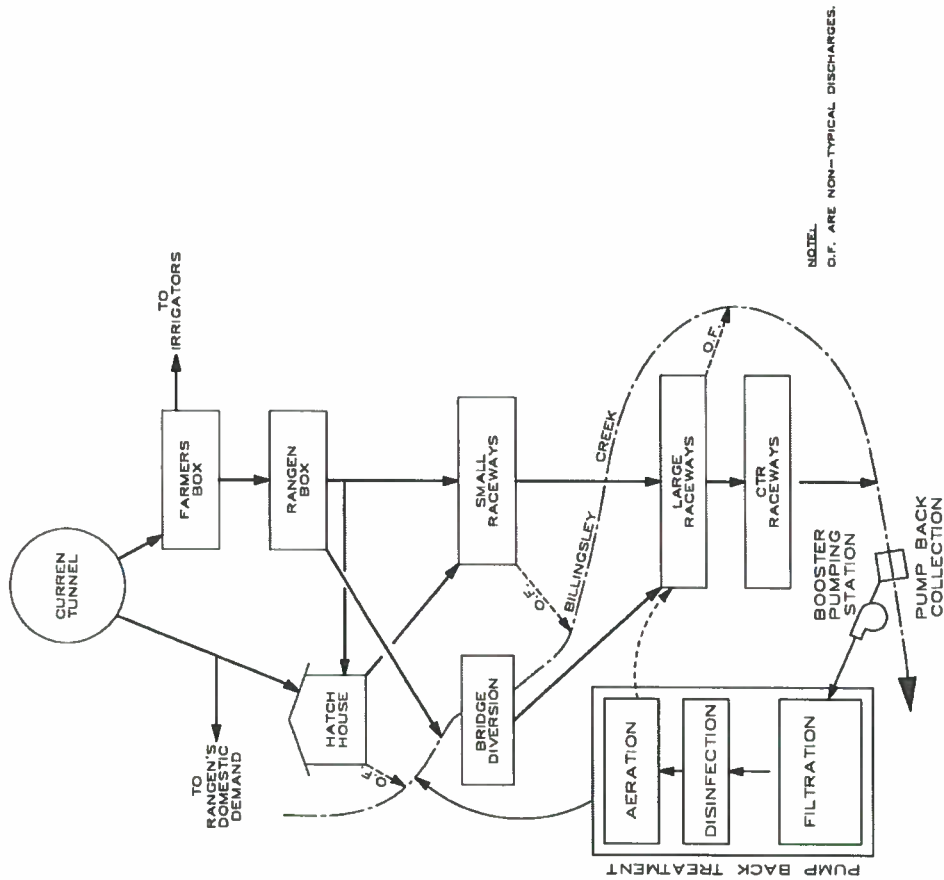
¹ Aquaculture Waste Guidelines Advisory Committee. *Idaho Waste Management Guidelines for Aquaculture Operations*. 1996. State of Idaho Department of Environmental Quality. p. 62

Process Flow Diagram

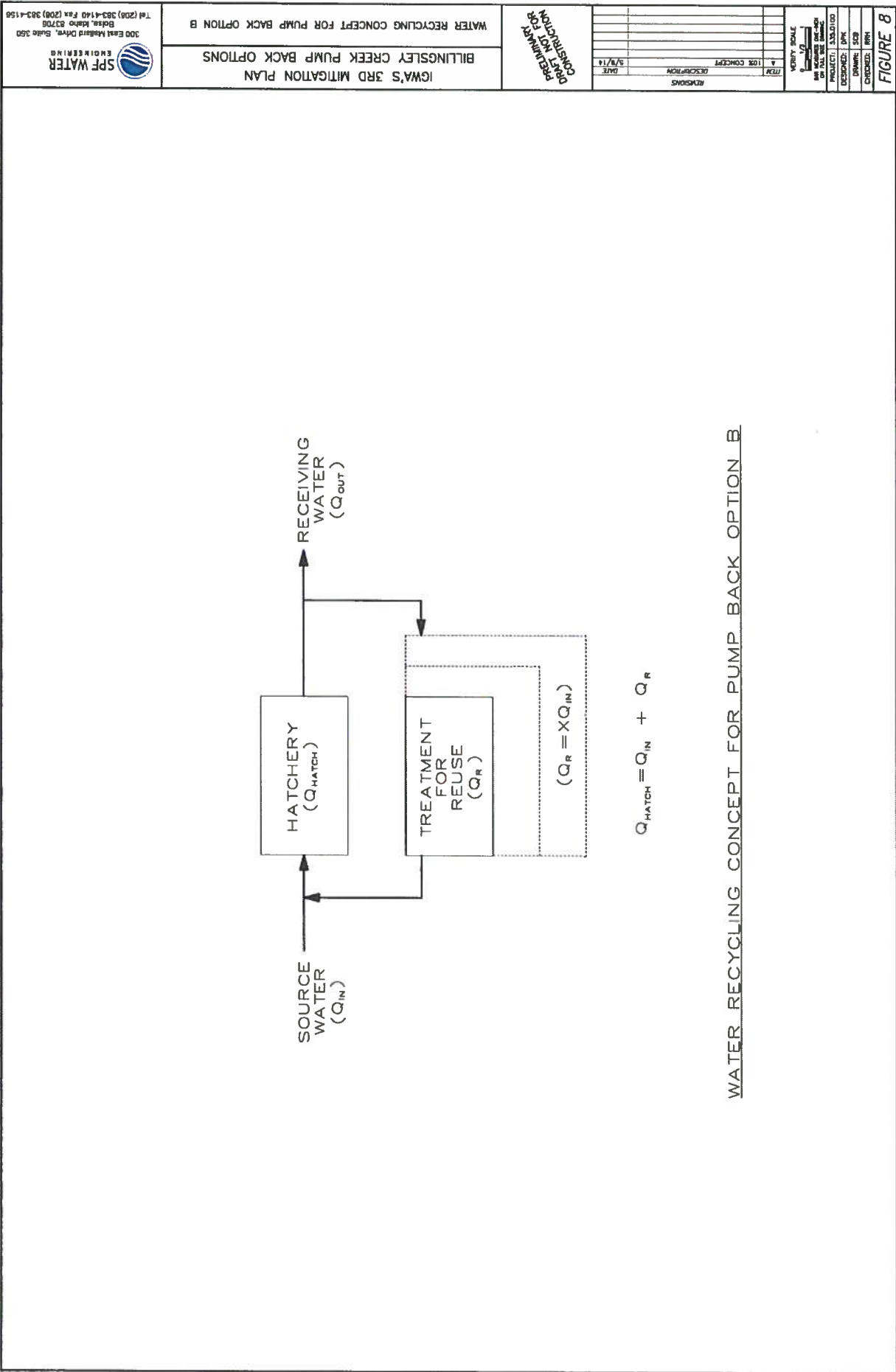
Even though the assumed or estimated Hatchery water quality data are within the minimum and maximum design criteria for salmonid aquaculture facilities, water treatment facilities are included with this option. The reason for including water treatment facilities with this option is that surface water 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 CO₂ 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.



WATER SUPPLY DIAGRAM - OPTION B



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

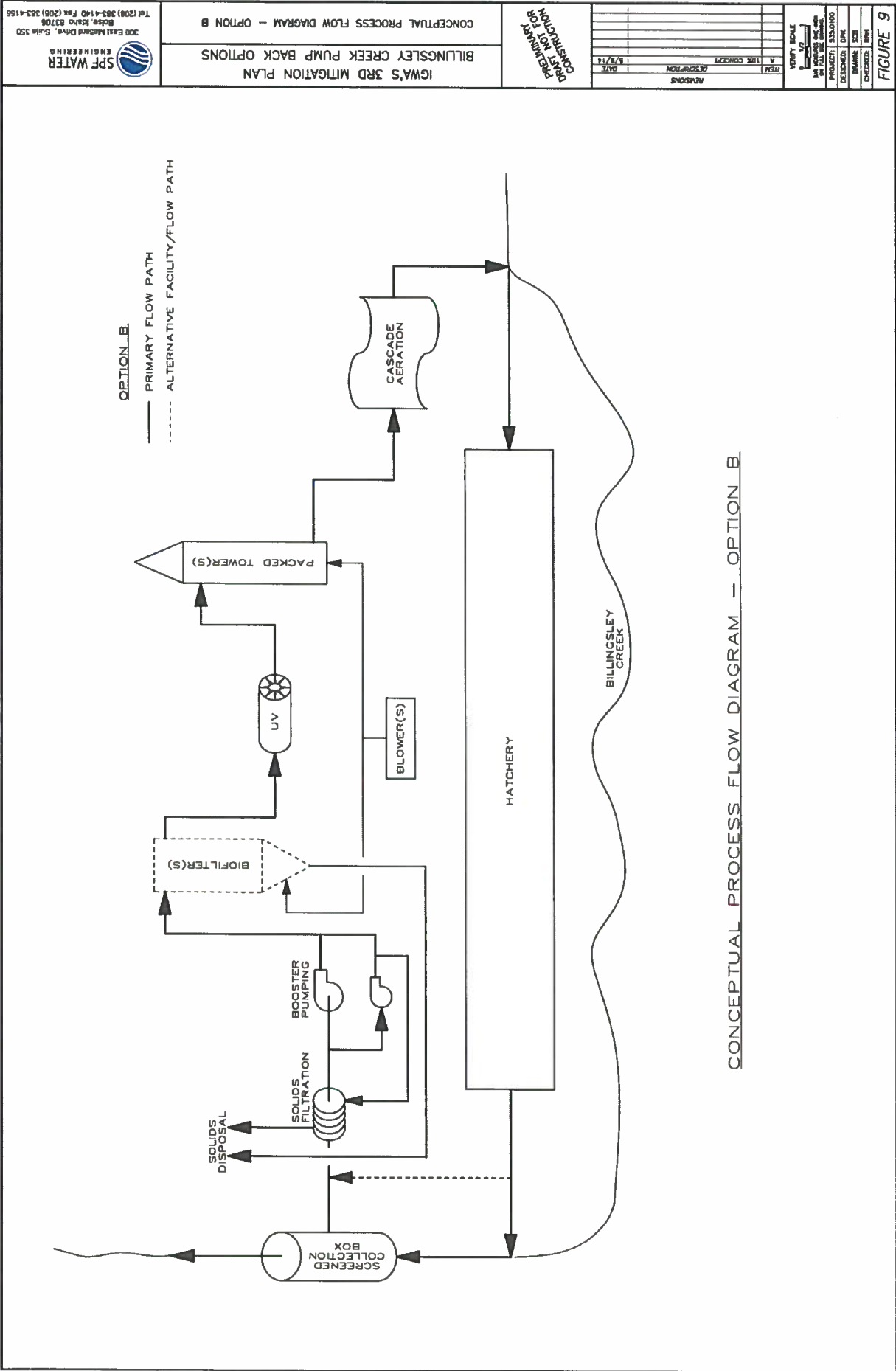
Process	Classification	Media Location	Type of Technology	Specific Technology
Biofiltration	Suspended Growth (Heterotrophic Bacteria)			
	Fixed Film (Autotrophic Bacteria)	Emergent		Rotating Biological Contactor
				Trickling Tower
		Submerged	Expanded	Fluidized Sand Filter
				Moving Bed Bioreactor
				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

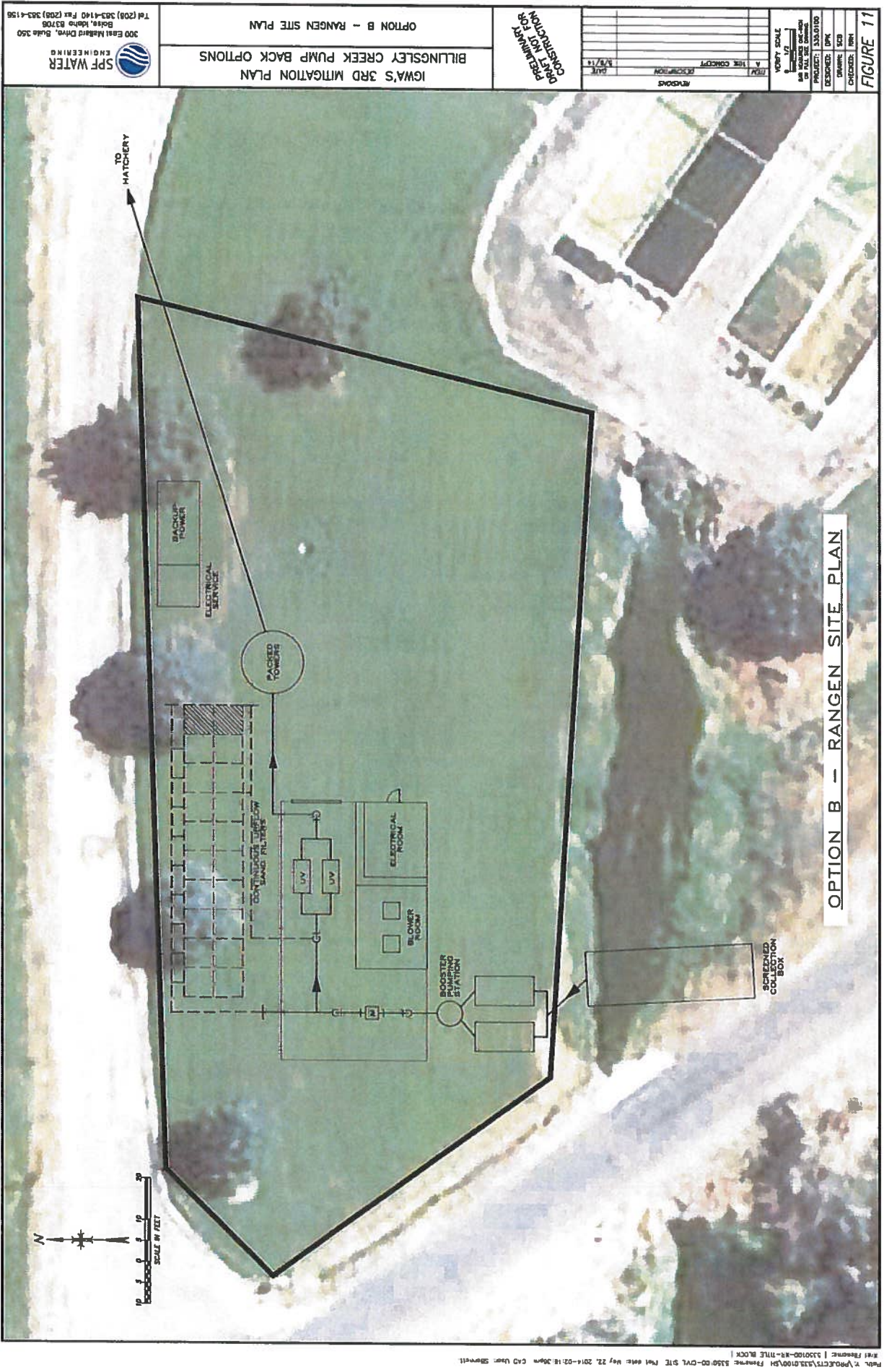
The conceptual process flow diagram for Option B in Figure 9 shows a biofilter stage as an alternative. Filtered solids from either the solids filtration (i.e., disc filters) or the biofilters are expected to be returned to Billingsley Creek. Should solids disposal to Billingsley Creek not be allowed,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



CONCEPTUAL PROCESS FLOW DIAGRAM — OPTION B

Site Plan

The facilities for this option at each of the two site locations are shown on Figure 10 and Figure 11, respectively. Biofilters 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.



OPTION B - RANGEN SITE PLAN

FIGURE 11

NO.	REVISION	DATE
1	1.00	11/1/11

DESIGNED BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE

DESIGNED BY
DATE
CHECKED BY
DATE
APPROVED BY
DATE

IGWA'S 3RD MITIGATION PLAN
BILLINGSLEY CREEK PUMP BACK OPTIONS
OPTION B - RANGEN SITE PLAN

SPF WATER
ENGINEERING
300 East Main Street, Suite 350
Boise, Idaho 83708
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

AWWA/ASCE. "Aeration and Air Stripping," *Water Treatment Plant Design*, 3rd Edition. New York. McGraw Hill. 1998. ch, 5, pp. 75.

Colt, J., et al. 1990. "Feasibility Report for the Mora National Fish Hatchery," USFWS, Region Two, Albuquerque, New Mexico.

Ebeling, J.M. "Biofiltration-Nitrification Design Overview," presented at Recirculating Aquaculture Systems Short Course. University of Arizona. New Orleans, LA. 2006.

Rogers, T.L. *Comments on the 10% Preliminary Submittal*. IGWA's 3 Mitigation Plan: Billingsley Creek Pump Back Options. May 17, 2014.

Rogers, T.L. *Expert Witness Report*, prepared on behalf of the Idaho Ground Water Appropriators, Inc. in the Matter of Distribution of Water to Water Right Nos. 36-02551 and 36-07694, December 21, 2012, Corrected January 24, 2013.

Idaho Department of Water Resources. 2012. *Water Rights Accounting*. <http://maps.idwr.idaho.gov/wraccounting/default.aspx>

Welch, E.B. "Fish," *Ecological Effects of Wastewater: Applied Limnology and Pollutant Effects*, 2nd Edition. London, U.K. Chapman & Hall. 1992. ch. 13, sec. 13.2, pp. 312, 317, 320, 336-337.

United States Environmental Protection Agency. 2014. *Discharge Monitoring Report (DMR) Pollutant Loading Tool*. Office of Water. Washington, D.C. <http://cfpub.epa.gov/dmr/>

United States Environmental Protection Agency. 2000. *Wastewater Technology Fact Sheet: Ammonia Stripping*. Office of Water. EPA 832-F-00-019. Washington, D.C.



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		9.53	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.mresourcesgroup.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 Fahrenheit @ 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 from 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 IWINGAO 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 IWINGAO 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 IWINGAO 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 IWINGAO 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		49,659	lbs/yr	Calculated from CO ₂ production factor.
Effluent Carbon Dioxide		1.49	mg/L	Calculated from CO ₂ 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.