THE IDAHO GROUND WATER APPROPRIATOR'S INC.
NORTH SNAKE GROUND WATER DISTRICT
MAGIC VALLEY GROUND WATER DISTRICT

Over The Rim Water Quality Analysis
Expert Report

September 11, 2009

ENGINEERING
SCIENCE
CONSTRUCTION

Prepared by:

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1.0 BACKGROUND

The North Snake and Magic Valley Ground Water Districts intend to provide up to 3.0 cubic feet per second (cfs) of groundwater to Clear Springs Food, Inc. (Clear Springs) at its Snake Rive Farm facility as mitigation for reduced spring flows at the Snake River Farm. This water would come from some combination of seven wells that are located immediately to the north of Snake River Farm. It should be noted that all wells within the proposed Over the Rim well field are not required to operate to produce 3.0 cfs of replacement water to the Snake River Farm. This provides reliability and flexibility to system operation. For example, if a well begins to exhibit poor water quality or suffers a mechanical failure, it can be taken off-line and replaced by another well. These relatively shallow wells (with depths of 70 to 200 ft) draw water from a series of basalt flows that are referred to as the Sand Springs Formation. This is the same formation that supplies spring water to the Snake River Farm. (See Terry Scanlan Testimony) The Over the Rim mitigation concept involves pumping one or more of the seven wells in the Sand Springs Formation through a 12-in. diameter buried pipeline that runs from the well field to its termination near the head of the spring supply at the Snake River Farm. A conceptual alignment is shown on the attached figure, **Exhibit 2201**.

This report focuses on the quality of water for rearing rainbow trout and other similar fish at the Snake River Farm from the well field. This report addressed this issue by a description of the existing spring source water quality at the Snake River Farm and comparing that water quality to the proposed well supply water quality.

2.0 SNAKE RIVER FARM WATER QUALITY

The water supply to Snake River Farm comes from springs immediately to the north of the site. The springs issue from the base of the Sand Springs Formation through an interbed and enter the headworks of the Snake River Farm. The spring water is then directed to various uses, including research raceways, brood stock holding, hatchery house and production raceways. In October of 2008, limited field and laboratory water quality analyses were made at the head of the production raceways by Engineering Science Construction, P.C. These samples were taken at the head of production raceway No. 7. These results are given in **Exhibit 2202**.

On September 1, 2009, a more complete set of field and laboratory water quality analyses were performed by Engineering Science Construction, P.C. on the spring source that supplies Snake River Farm. In this case the fountain immediately north of the Snake River Farm, referred to as the "Fred Nihart Fountain," was sampled. This sampling point was chosen since it was accessible and issued from the same source as the Snake River Farm spring water supply. The results of the analyses are presented in **Exhibit 2203**.

Inspection of the water quality results from September 1, 2009 and October 22, 2008 show identical or very similar results for nitrite, temperature, and pH. There is noticeable variability in the measurements of nitrate (2.6 mg/l on 9/1/2009 and 6.81 mg/l on 10/22/2008) and dissolved oxygen (6.81 mg/l on 9/1/2009 and 9.22 mg/l on 10/22/2008). The difference in dissolved oxygen concentrations is a result of the sampling point differences. The higher level reading on

October 22, 2008 was taken at the head of the Snake River Farm rearing raceway No. 7; this sampling point is some distance away from the spring source where it flows through an open channel and is exposed to the atmosphere and becomes aerated, thus increasing the dissolved oxygen concentration. The lower dissolved oxygen level reading taken from the Fred Nihart Fountain on September 1, 2009 is taken at the spring source where the water has not been exposed to the atmosphere. This suggests that the only difference between the dissolved oxygen readings is a result of sampling location. My field experience with dissolved oxygen measurements in open channels below springs agrees with this conclusion.

The difference in nitrate levels between the previous samples, 2.6 mg/l on 9/1/2009 at the Fred Nihart Fountain and 6.81 mg/l on 10/22/2008 at the head of Snake River Farm raceway No. 7, is a peculiarity of nitrate measurements. It is well understood that nitrate levels measured repeatedly in the same location produce varying results. In south central Idaho, large variations in nitrate levels are likely a result of agricultural activities which can have a seasonal impact on ground water quality. An example of nitrate variation is shown on **Exhibit 2204**.

The spring shown in Exhibit 2204 is located 2 miles west of the Snake River Farm. Over a period of three years, the nitrate + nitrite levels ranged from a low of 1.1 mg/l to a high of 4.2 mg/l, a nearly three fold change.

3.0 WELL FIELD WATER QUALITY

Beginning on September 1, 2009, a water quality sampling and analysis program was undertaken by Engineering Science Construction, P.C. The objective of the program was to determine if the water quality of the well field proposed for the Over the Rim alternative was of similar quality to the Snake River Farm spring source and if that water was suitable for rearing fish. This program has three phases of sampling and testing; the first phase involved Well Nos. 4, 7 and 8. The second and third phases involve sampling the entire well field, Well Nos. 1, 2, 4, 5, 6, 7 and 8, with approximately two weeks between sampling and testing. At the writing of this report, laboratory results were complete for only the first sampling and analysis phase. These results are presented on **Exhibit 2205**. In addition to the laboratory analyses, field water quality parameters were also measured; those results are also provided on **Exhibit 2205.**

Inspection of the water quality results for Well Nos. 4, 7 and 8 indicates that the results for all wells are very similar. Well No. 4 appears to be harder water as indicated by the alkalinity, hardness, dissolved solids, calcium and conductivity values. While Well No. 4 water is harder, it is not markedly different than the other wells. This variation in hardness is not uncommon in the Sand Springs Formation. Nitrate varies considerably between the wells with a low of 1.5 mg/l and a high of 13 mg/l. As indicated earlier, nitrate can vary considerably over time at the same location, and nitrate is frequently recorded at levels of 10 mg/l, and higher, in this region of south central Idaho[1]. The pesticide scan revealed only one compound, DDD at 0.000066 mg/l in Well No. 8. DDD is an insecticide that is no longer in use in the US. The lethal dose (96 hour LC50) as tested by the US Fish and Wildlife Service[2] for rainbow trout is 70 µg/l, or roughly 1,000

[1] Nitrate Results From the Statewide Program, 1991-2000, Idaho Department of Water Resources.
[2] Johnson, W.W. and Finley, M.T., Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates, US Fish and Wildlife Service Resource Publication 137, 1980.

times the concentration measured in Well No. 8. At this concentration, DDD does not present a water quality concern for fish culture at Snake River Farm.

The dissolved oxygen levels in the three wells ranged from 6.45 to 7.00 mg/l. These levels of dissolved oxygen are considered too low for efficient fish culture. While these levels are low, they are typical for ground water and do not represent a real concern. The dissolved oxygen levels can be raised to near saturation by simple aeration, a practice which is common in fish culture, and is indirectly practiced at Snake River Farm between the existing spring source and the various water uses as discussed above.

Exhibits 2206, 2207 and 2208 show an aeration and degassing structure that could be used at the Snake River Farm. The detailed design of the columns shown is not complete as all potential conditions on the Over the Rim plan will not be known until after hearing. Further, analysis of total dissolved gases in the Over the Rim well field must be performed before the column design is complete. That analysis will be complete with the third phase of water quality sampling and analyses described above and will be provided in a supplemental report and testimony.

In an effort to eliminate future confusion, a brief discussion on nitrate concentrations is necessary. Past, and outdated, criteria for fish culture have noted a preference for nitrate levels at or below 1 mg/l. This criterion is not accurate, nor is it necessary for trout culture. A clear example of this is the nitrate level measured in the spring source at Snake River Farm of 6.81 mg/l in October of 2008, which is substantially higher than the old criteria. At this nitrate level, Snake River Farm is able to raise high quality fish. Snake River Farm's practice and success agrees with more modern nitrate criteria which suggest fish can tolerate nitrate levels substantially higher than 1 mg/l, in fact over 100 mg/l[3].

4.0 COMPARISON OF SNAKE RIVER FARM SPRING AND WELL FIELD WATER QUALITY

Exhibit 2209 lists water quality testing results for the Snake River Farm spring supply and Well Nos. 4, 7 and 8; this is the same data presented in the previous sections. The data shows that the Snake River Farm's spring water and the well field water are essentially the same. The minor differences on a well by well basis are normal variations within the aquifer, and when the well data is combined, or averaged, the well data are even more similar to the spring data.

5.0 CONCLUSIONS

The Over the Rim well field can supply water to the Snake River Farm that is essentially the same water as the existing spring water supply to the Snake River Farm. The variations in well field and spring water quality and temperature are minor. The Over the Rim well field can be expected to perform as well as the existing Snake River Farm water supply for the culture of rainbow trout and other similar fish. The only treatment required before delivery of the water to the SRF will be aeration, which is a simple, non-mechanical practice that is used widely in aquaculture in Idaho and across the US and overseas.

[3] Wedemeyer, G., Editor, Fish Hatchery Management, Second Edition, American Fisheries Society, 2001.

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OVER THE RIM CONCEPTUAL LAYOUT
EXHIBIT 2201

Exhibit 2202 – Snake River Farms Spring Water Quality from October of 2008

Criteria	Units	Value	Source/Comments
Dissolved Oxygen	mg/l	9.22	Field analysis at head of RW No. 7 (10/22/08)
Temperature	F	58.2	Field analysis at head of RW No. 7 (10/22/08)
pH	SU	7.85	Grab sample (10/22/08)
Ammonia as N	mg/l	0.05	Grab sample (10/22/08)
Nitrite as N	mg/l	<0.01	Grab sample (10/22/08)
Nitrate as N	mg/l	6.81	Grab sample (10/22/08)
Suspended Solids	mg/l	3.0	Grab sample (10/22/08)

Exhibit 2203 – Snake River Farms Spring Water Quality from September 1, 2009

Parameter[1]	Detection Limit	Units	Results
Nitrate	0.10	mg/l	2.6
Nitrite	0.10	mg/l	BDL
Alkalinity	20	mg/l	160
Alkalinity, Carbonate	20	mg/l	BDL
Hardness	30	mg/l	280
Ammonia Nitrogen	0.10	mg/l	BDL
pH		su	7.6
Phosphate, Ortho	0.025	mg/l	BDL
Specific Conductance		umhos/cm	580
Kjeldahl Nitrogen, TKN	0.10	mg/l	0.79
Dissolved Solids	10	mg/l	360
Mercury	0.00020	mg/l	BDL
Cadmium	0.0050	mg/l	BDL
Calcium	0.50	mg/l	54.
Copper	0.020	mg/l	BDL
Iron	0.10	mg/l	BDL
Lead	0.0050	mg/l	BDL
Magnesium	0.10	mg/l	22.
Manganese	0.010	mg/l	BDL
Nickel	0.020	mg/l	BDL
Potassium	0.50	mg/l	4.8
Pesticides			
Aldrin	0.000050	mg/l	BDL
Alpha BHC	0.000050	mg/l	BDL
Beta BHC	0.000050	mg/l	BDL
Delta BHC	0.000050	mg/l	BDL
Gamma BHC	0.000050	mg/l	BDL
Chlordane	0.00050	mg/l	BDL
4, 4-DDD	0.000050	mg/l	BDL
4, 4-DDE	0.000050	mg/l	BDL
4, 4-DDT	0.000050	mg/l	BDL
Dieldrin	0.000050	mg/l	BDL
Endosulfan I	0.000050	mg/l	BDL
Endosulfan II	0.000050	mg/l	BDL
Endosulfan sulfate	0.000050	mg/l	BDL
Endrin	0.000050	mg/l	BDL
Endrin aldehyde	0.000050	mg/l	BDL
Endrin ketone	0.000050	mg/l	BDL
Hexachlorobenzene	0.000050	mg/l	BDL
Heptachlor	0.000050	mg/l	BDL
Heptachlor epoxide	0.000050	mg/l	BDL
Methoxychlor	0.000050	mg/l	BDL
Toxaphene	0.00050	mg/l	BDL
Field Parameters			
pH	n/a	SU	7.80
Temperature	n/a	°F	57.9
Dissolved Oxygen	n/a	mg/l	6.81
Conductivity	n/a	umhos/cm	472
Specific Conductance	n/a	umhos/cm	578
Turbidity	n/a	NTU	0.37

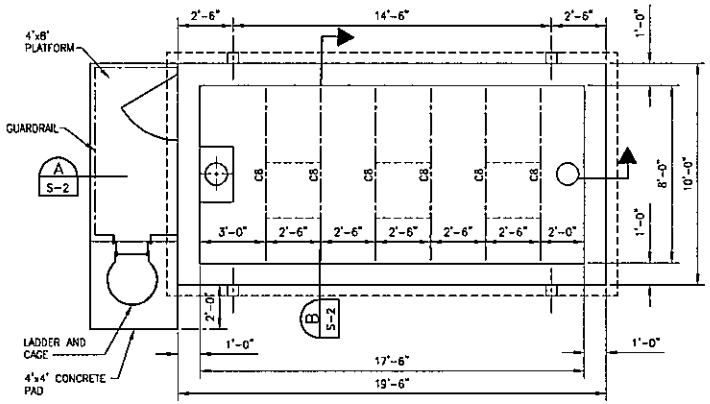
[1] Laboratory Analyses were performed by Environmental Sciences Corp. Field parameters were measured by Engineering Science Construction, P.C. staff and SPF Engineering staff.

Exhibit 2204 – USGS Water Quality Station 13095175, Briggs Springs near Buhl, Idaho

Sampling Date	Nitrate + Nitrite as N (mg/l)
3/7/1994	1.4
4/20/1994	1.1
10/4/1994	4.2
11/1/1994 (15:45 MST)	2.8
11/1/1994 (16:00 MST)	3.4
3/28/1995	1.7
8/2/1995	1.8
3/12/1996	1.9
6/17/1996	1.7

Exhibit 2205 – Over the Rim Well Field Water Quality Analysis Results, September 1, 2009

Parameter	Detection Limit	Units	Well 4	Well 7	Well 8
Nitrate	0.10	mg/l	13	2.7	1.5
Nitrite	0.10	mg/l	BDL	BDL	BDL
Alkalinity	20	mg/l	190	160	150
Alkalinity, Carbonate	20	mg/l	BDL	BDL	BDL
Hardness	30	mg/l	330	230	200
Ammonia Nitrogen	0.10	mg/l	BDL	BDL	BDL
pH		su	7.5	7.7	7.4
Phosphate, Ortho	0.025	mg/l	0.039	BDL	0.043
Specific Conductance		umhos/cm	820	580	470
Kjeldahl Nitrogen, TKN	0.10	mg/l	4.7	0.72	0.38
Dissolved Solids	10	mg/l	530	360	300
Mercury	0.00020	mg/l	BDL	BDL	BDL
Cadmium	0.0050	mg/l	BDL	BDL	BDL
Calcium	0.50	mg/l	70	54	43
Copper	0.020	mg/l	BDL	BDL	BDL
Iron	0.10	mg/l	BDL	BDL	BDL
Lead	0.0050	mg/l	BDL	BDL	BDL
Magnesium	0.10	mg/l	33.0	22.0	19.0
Manganese	0.010	mg/l	BDL	BDL	BDL
Nickel	0.020	mg/l	BDL	BDL	BDL
Potassium	0.50	mg/l	5.7	4.8	4.2
Pesticides					
Aldrin	0.000050	mg/l	BDL	BDL	BDL
Alpha BHC	0.000050	mg/l	BDL	BDL	BDL
Beta BHC	0.000050	mg/l	BDL	BDL	BDL
Delta BHC	0.000050	mg/l	BDL	BDL	BDL
Gamma BHC	0.000050	mg/l	BDL	BDL	BDL
Chlordane	0.00050	mg/l	BDL	BDL	BDL
4, 4-DDD	0.000050	mg/l	BDL	BDL	0.000066
4, 4-DDE	0.000050	mg/l	BDL	BDL	BDL
4, 4-DDT	0.000050	mg/l	BDL	BDL	BDL
Dieldrin	0.000050	mg/l	BDL	BDL	BDL
Endosulfan I	0.000050	mg/l	BDL	BDL	BDL
Endosulfan II	0.000050	mg/l	BDL	BDL	BDL
Endosulfan sulfate	0.000050	mg/l	BDL	BDL	BDL
Endrin	0.000050	mg/l	BDL	BDL	BDL
Endrin aldehyde	0.000050	mg/l	BDL	BDL	BDL
Endrin ketone	0.000050	mg/l	BDL	BDL	BDL
Hexachlorobenzene	0.000050	mg/l	BDL	BDL	BDL
Heptachlor	0.000050	mg/l	BDL	BDL	BDL
Heptachlor epoxide	0.000050	mg/l	BDL	BDL	BDL
Methoxychlor	0.000050	mg/l	BDL	BDL	BDL
Toxaphene	0.00050	mg/l	BDL	BDL	BDL
Field Parameters	n/a				
pH	n/a	SU	7.64	7.70	7.70
Temperature	n/a	°F	58.2	57.9	58.1
Dissolved Oxygen	n/a	mg/l	7.00	6.80	6.45
Conductivity	n/a	umhos/cm	677	471	380
Specific Conductance	n/a	umhos/cm	826	577	465
Turbidity	n/a	NTU	0.57	0.47	-



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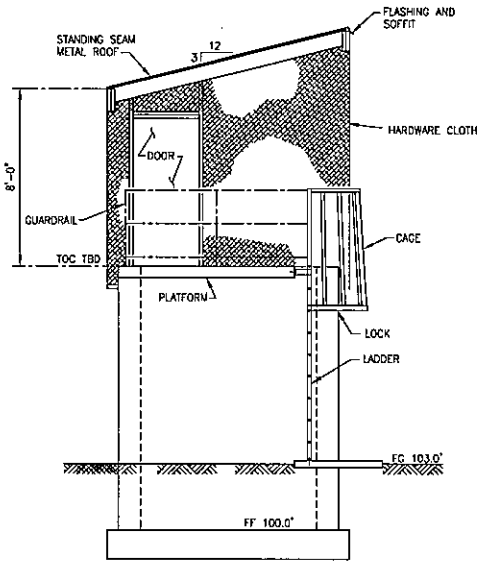

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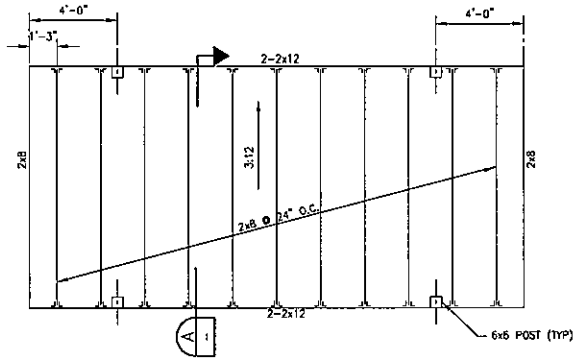

ROOF FRAMING PLAN
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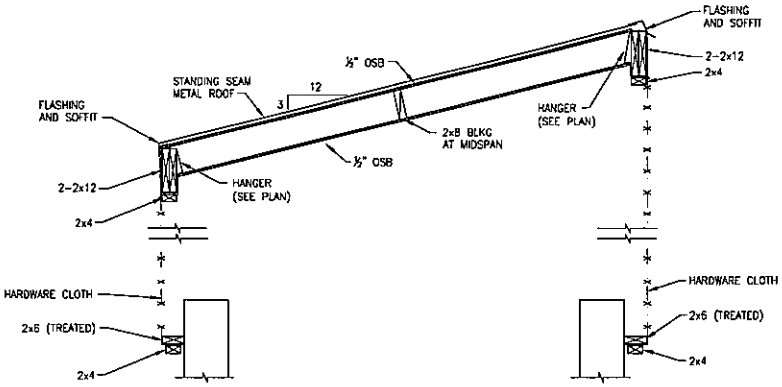

SECTION
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A
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PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE. (0, 1/2, 1)

DESIGNED: K. Fritz
DRAWN: P. HUNTER
CHECKED: S. Gilbert

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SNAKE RIVER FARM REPLACEMENT WATER
DEGASSING AND AERATION SYSTEM
STRUCTURAL
FOUNDATION AND FLOOR PLAN

SHEET S-1

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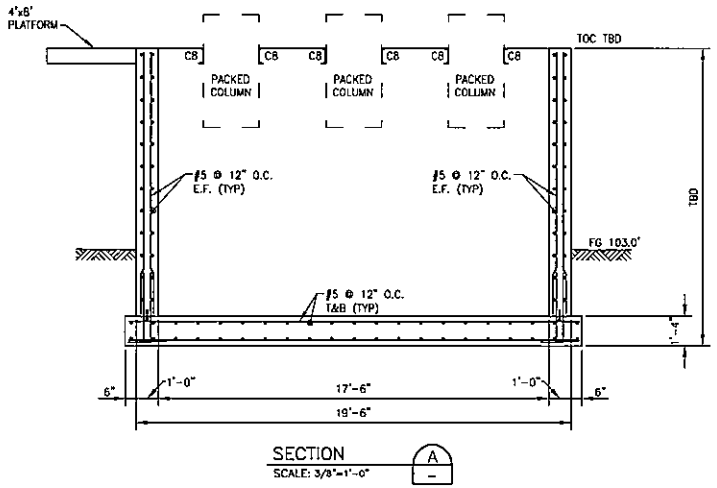
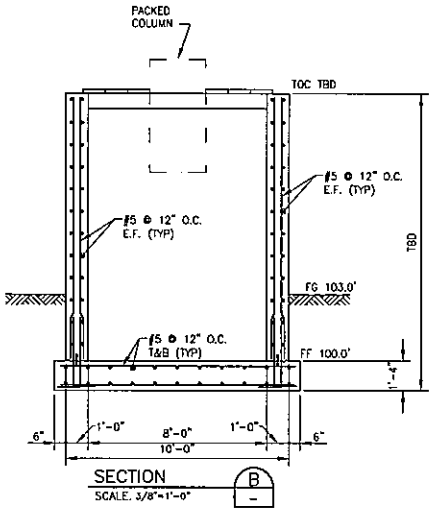
EXHIBIT 2206





PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION

SCALE: AS NOTED

WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

DESIGNED: K. Fritz
DRAWN: P. HUNTER
CHECKED: S. Gilbert

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SNAKE RIVER FARM REPLACEMENT WATER
DEGASSING AND AERATION SYSTEM
STRUCTURAL
SECTIONS AND DETAILS

SHEET S-2

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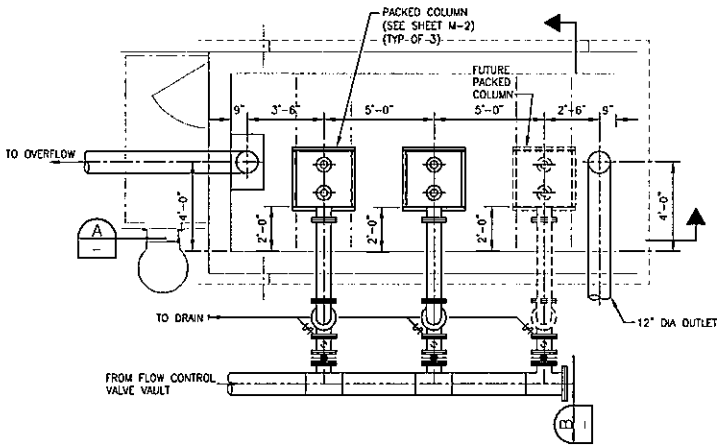
EXHIBIT 2207



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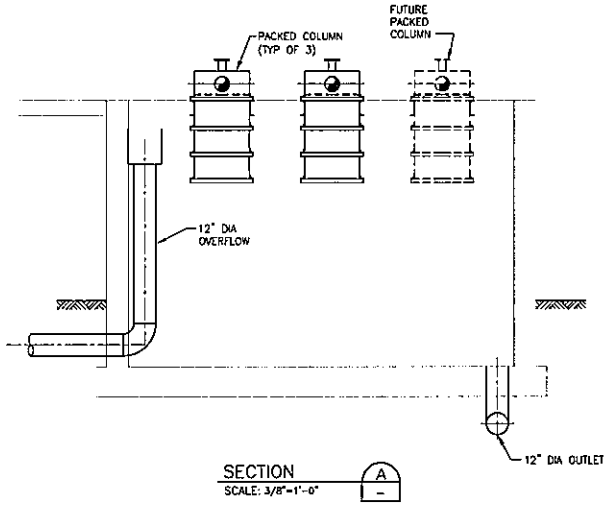

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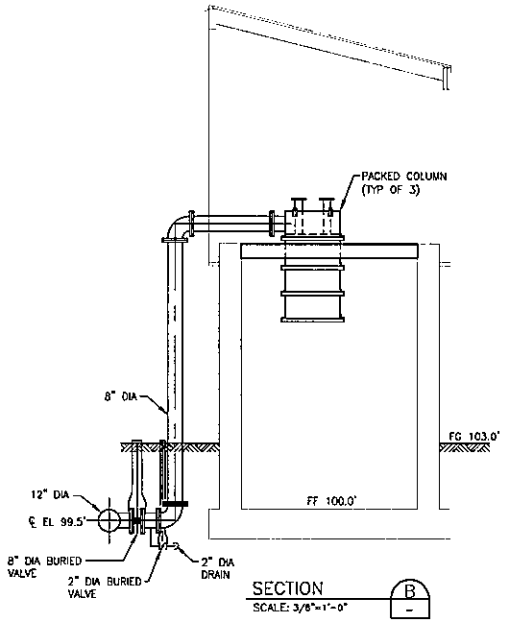

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PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION

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WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE. (0, 1/2, 1)

DESIGNED: S. Gilbert
DRAWN: P. HUNTER
CHECKED: R. Eldridge

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SNAKE RIVER FARM REPLACEMENT WATER
DEGASSING AND AERATION SYSTEM
MECHANICAL
PLAN AND SECTIONS

SHEET M-1

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EXHIBIT 2208

Exhibit 2209 – Snake River Farm Spring and Over the Rim Well Field Water Quality

Parameter	Detection Limit	Units	Well 4	Well 7	Well 8	SRF Spring	Average of Wells
Nitrate	0.10	mg/l	13	2.7	1.5	2.6	5.73
Nitrite	0.10	mg/l	BDL	BDL	BDL	BDL	BDL
Alkalinity	20	mg/l	190	160	150	160	167
Alkalinity, Carbonate	20	mg/l	BDL	BDL	BDL	BDL	BDL
Hardness	30	mg/l	330	230	200	280	253
Ammonia Nitrogen	0.10	mg/l	BDL	BDL	BDL	BDL	BDL
pH		su	7.5	7.7	7.4	7.6	7.53
Phosphate, Ortho	0.025	mg/l	0.039	BDL	0.043	BDL	
Specific Conductance		umhos/cm	820	580	470	580	623
Kjeldahl Nitrogen, TKN	0.10	mg/l	4.7	0.72	0.38	0.79	1.93
Dissolved Solids	10	mg/l	530	360	300	360	397
Mercury	0.00020	mg/l	BDL	BDL	BDL	BDL	BDL
Cadmium	0.0050	mg/l	BDL	BDL	BDL	BDL	BDL
Calcium	0.50	mg/l	70	54	43	54	56
Copper	0.020	mg/l	BDL	BDL	BDL	BDL	BDL
Iron	0.10	mg/l	BDL	BDL	BDL	BDL	BDL
Lead	0.0050	mg/l	BDL	BDL	BDL	BDL	BDL
Magnesium	0.10	mg/l	33	22	19	22	25
Manganese	0.010	mg/l	BDL	BDL	BDL	BDL	BDL
Nickel	0.020	mg/l	BDL	BDL	BDL	BDL	BDL
Potassium	0.50	mg/l	5.7	4.8	4.2	4.8	4.9
Pesticides							
Aldrin	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Alpha BHC	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Beta BHC	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Delta BHC	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Gamma BHC	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Chlordane	0.00050	mg/l	BDL	BDL	BDL	BDL	BDL
4, 4-DDD	0.000050	mg/l	BDL	BDL	0.000066	BDL	
4, 4-DDE	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
4, 4-DDT	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Dieldrin	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Endosulfan I	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Endosulfan II	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Endosulfan sulfate	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Endrin	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Endrin aldehyde	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Endrin ketone	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Hexachlorobenzene	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Heptachlor	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Heptachlor epoxide	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Methoxychlor	0.000050	mg/l	BDL	BDL	BDL	BDL	BDL
Toxaphene	0.00050	mg/l	BDL	BDL	BDL	BDL	BDL
Field Parameters	n/a						
pH	n/a	SU	7.64	7.70	7.70	7.80	7.68
Temperature	n/a	°F	58.2	57.9	58.1	57.9	58.1
Dissolved Oxygen	n/a	mg/l	7.00	6.80	6.45	6.81	6.75
Conductivity	n/a	umhos/cm	677	471	380	472	509
Specific Conductance	n/a	umhos/cm	826	577	465	578	622
Turbidity	n/a	NTU	0.57	0.47	-	0.37	0.52