Objectives: Learn how to determine ground water flow direction, gradient, velocity and volume over time.
- Why are water levels measured?
- How to convert water levels to water elevations?
- How to plot water levels on a map?
- How to construct a ground water contour map?
- How to calculate flow direction, ground water velocity and volume over time?

Grades: 10–12

Materials:
- Calculator/spreadsheet
- Map
- Idaho Driller’s Reports

Water levels are measured in wells. The wells may have a pump in them and are used for pumping water or they maybe installed without any pump and are used only to collect water level and/or water quality data. A well that is installed only to measure water levels is called a piezometer.

There are a number of ways to measure the depth of water in a piezometer. The most common method is with the use of an electrical tape or e-tape. An e-tape consist of a battery activated two-lead wire with a weighted end. The wire is lowered down the well until the end makes contact with the water and completes a circuit. Once the circuit is completed a light or buzzer on the reel are activated. The depth is read from graduated markings on the wire.

The use of the e-tape will determine the depth of water from the surface or top of casing. In order to compare the water levels with other wells a common datum needs to be established. Generally the water levels are converted to a water elevation. This is done by determining the elevation of the ground surface at the well and subtracting the distance to the ground water.
The piezometers need to be located on a map so that the ground surface elevation can be determined. If you drill the piezometer you can locate it on the USGS topographic map or use a GPS to obtain the coordinates. Drilling wells can be expensive, so often times existing Driller’s Reports are used. When a new well is drilled the Idaho Department of Water Resources requires that a Well Driller’s Report be completed. The Well Driller’s Report contains information regarding the well owner, location, aquifer material (lithology) and well construction. A Well Driller’s report can be seen on Page 3.

The coordinate system that is used to locate water wells is called the Public Land Survey System (PLSS). The PLSS system was established by the Federal Government to convey land to private owners. The PLSS system divides the land into 6-mile by 6-mile blocks. The blocks are referenced by the Township and Range. The Township defines how far north-south above a base line you are, and the Range defines how far east-west from a base line you are. Each Township-range block is divided into 36 sections, which are one-mile square.

Each section is then divided into four equal area sections called quarter sections. Each quarter section is divided again into four equal area sections called quarter-quarter sections. A typical PLSS site description can be seen on the Well Driller’s Report on page 3. The PLSS description would be T.51 N., R. 5 W., Section 32, NE 1/4, NW 1/4. The well location can be seen on the map also on page 4.

Once you plot the well location on the map, you can determine the ground surface elevation. Measuring the depth to ground water, the ground water elevation can be calculated. By calculating the ground water elevation for at least three wells, the ground water flow direction and gradient can be determined.
Ground Water Contours

Lesson Plan #2: How do we determine ground water flow direction and gradient?

M. Smith
110 Pleasant View Dr.

Static Water

PLSS Well Location

Lithologic Description

Form 236-7
USE TYPEWRITER OR BALLPOINT PEN

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

1. WELL OWNER

Name
M. Smith

Address
110 Pleasant View Dr.

Drilling Permit No.
95-91-N-132

Water Right Permit No.

2. NATURE OF WORK

☐ New well
☐ Deepened
☐ Replacement
☐ Well diameter increase
☐ Abandoned (describe abandonment procedures such as materials, plug depths, etc. in lithologic log)

3. PROPOSED USE

☐ Domestic
☐ Irrigation
☐ Test
☐ Municipal
☐ Industrial
☐ Stock
☐ Water Disposal or Injection
☐ Other

(specify type)

4. METHOD DRILLED

☐ Rotary
☐ Air
☐ Hydraulic
☐ Reverse rotary

☐ Cable
☐ Dog
☐ Other

5. WELL CONSTRUCTION

Casing schedule: ☐ Steel ☐ Concrete ☐ Other

Thickness
2-50 inches

Thick

Diameter
6 inches

From

To

feet

2 feet

feet

Yes

No

Was casing drive shoe used?

Was a packer or seal used?

Perforated?

How perforated?

Factory

Drill

Torched

Gun

Size of perforation

holes by

holes

feet

feet

feet

feet

Yes

No

Manufacturer's name

Type

Diameter

Slit size

Set from

feet

feet

feet

feet

Yes

No

Gravel packed?

Size of gravel

Packed from

feet

feet

feet

feet

Surface seal depth

Material used in seal

Bentonite

Pudding clay

Sealing procedure used:

Sturdy pit

Temp. surface casing

Overtons to seal depth

Method of joining casing:

Threaded

Cemented between strata

Weld

Cemented between strata

Describe access port

Well Cap


11. DRILLERS CERTIFICATION

We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name: Bronson Water Well

Address: Spirit Lake, ID Date 8-23-1991

Signed by (Firm Official)

(Operator)
Ground Water Contours

Lesson Plan #2: How do we determine ground water flow direction and gradient?

Well Location T51N, R5W, NE 1/4, NW 1/4, Section 32

Ground Surface Elevation = 2,130 feet msl

From Driller’s log page 3:
Depth to water = 155 feet
Assume stick up = 0.0 feet

Ground Water Elevation:
= 2,130 ft - (155 ft - 0.0 ft)
= 2,130 ft - 155 ft
= 1,975 feet msl
An example can be seen above of three wells and the ground water elevations calculated for each plotted on a map. Ground water elevation contours with equal elevation change, also called the contour interval, were plotted. In this case the contour interval is 40 feet. The interval maybe smaller or larger depending on the ground water elevation change and the distance between wells.

The ground water flow direction is from the high ground water potential (2,980 ft) to the low potential (2,900 ft). The ground water flow direction can be represented by an arrow drawn perpendicular to the ground water contour lines.

The ground water gradient is a description of how steep the water table is sloping. The gradient is defined by the vertical change (decrease or increase) of the water table divided by the horizontal distance that the change occurs. The gradient can be calculated as follows using the numbers in the above figure:

$$\frac{2980 \text{ ft} - 2960 \text{ ft}}{3600 \text{ ft}} = \frac{20 \text{ ft}}{3600 \text{ ft}} = 0.006 \text{ ft/ft}$$

The ground water velocity (from Lesson #1) can be calculated;

$$V = K \frac{i}{n_e}$$

Where:
- $K$ = hydraulic conductivity (L/T)
- $i$ = ground water gradient (L/L)
- $n_e$ = effective porosity

$L$ = unit length (usually feet, centimeters, or meters)
$T$ = unit Time (usually seconds or days)

The volume of water that flows through the aquifer over a given time period can be calculated from the velocity and cross sectional area of the aquifer.
The aquifer material appears to be a sand and gravel (as described on the Driller’s Log on page 4). A representative hydraulic conductivity for a sand and gravel would be approximately 100 feet/day. A typical effective porosity for this material would be about 0.25. The ground water velocity would be:

\[
V = (100 \text{ ft/day})(0.006 \text{ ft/ft})/(0.25)
\]

\[
V = 2.4 \text{ ft/day.}
\]

The ground water velocity can range from a few feet a year to 50 feet per day. The ground water velocities observed in the Rathdrum Prairie Aquifer can be in the tens of feet per day.

The rate of water that flows through a portion of the aquifer per a given time period can be calculated as follows;

Rate per time period  = V * A

Where:
\(V\) = Ground water velocity (L/T)
\(A\) = Area of aquifer perpendicular to flow (L²).

If the aquifer in this exercise is 100 feet deep and 0.5 miles wide (2,640 feet) then the rate of ground water flow is;

\[
= (2.4 \text{ ft/day}) (100 \text{ ft} * 2,640 \text{ ft})
\]

\[
= (2.4 \text{ ft/day}) (264,000 \text{ ft²})
\]

\[
= 633,600 \text{ ft³/day}
\]

\[
= 633,600 \text{ ft³/day} * 7.48 \text{ gallons/ft}³
\]

\[
= 4,739,328 \text{ gallons per day}
\]

Exercises:

Using the map, driller’s logs and seismic cross section provided on the following pages:

A. Plot the location of each well as described in the driller’s logs using the PLLS.
B. Complete the table for each well with the following information:
   1. Determine the elevation of land surface at the location of each well.
   2. Determine the depth to static water level for each well from the driller’s logs.
   3. Calculate the ground water elevation for each well and plot on the map.
C. Construct a ground water contour map
D. The results from a seismic survey completed in 1951 are shown in the attached figure. The approximate cross sectional surface area of the aquifer is indicated.
E. Calculate the following:
   1. Ground water flow direction
   2. Ground water gradient
   3. Ground water velocity
   4. Rate of ground water flow across the Idaho-Washington State line.

Compare results with USGS 2004 ground water contour map of Spokane-Valley Rathdrum Prairie at [http://www.deq.state.id.us/water/prog_issues/ground_water/rathdrum_prairie_aquifer/reports_publications.cfm](http://www.deq.state.id.us/water/prog_issues/ground_water/rathdrum_prairie_aquifer/reports_publications.cfm)
<table>
<thead>
<tr>
<th>Well</th>
<th>Ground Surface Elevation</th>
<th>Depth to Water</th>
<th>Stickup</th>
<th>Ground Water Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**1. WELL OWNER**

Name: Harold Waits
Address: Box 127, Post Falls, Idaho
Owner's Permit No: 95-71-A-7.3

**2. NATURE OF WORK**

- New well  
- Deepened  
- Replacement  
- Abandoned (describe method of abandoning)

**3. PROPOSED USE**

- Domestic  
- Irrigation  
- Test  
- Municipal  
- Industrial  
- Stock

**4. METHOD DRILLED**

- Cable  
- Rotary  
- Drop  
- Other

**5. WELL CONSTRUCTION**

- Diameter of hole: 6 inches  
- Total depth: 160 feet
- Casing schedule: steel  
- Concrete
- Diameter: 6 inches  
- Thickness: 8 inches
- From  
- To

- Was a packer or seal used? Yes  
- No
- How perforated? Factory  
- Knife  
- Torch
- Size of perforation: 2 inches by 12 inches
- Number of perforations: 143
- From  
- To

- Well screen installed? Yes  
- No
- Manufacturer's name
- Type
- Model No.
- Diameter Slot size: 6 inches
- Diameter Slot size: 6 inches
- Gravel packed? Yes  
- No
- Size of gravel
- Placed from: 6 inches
- To what depth: 160 feet
- Surface seal? Yes  
- No
- To what depth: 16 feet
- Material used in well: Cement grout

**6. LOCATION OF WELL**

Sketch map location must agree with written location.

**7. WATER LEVEL**

- Static water level: 125 feet below land surface
- Flowing: Yes  
- No
- G.P.M flow
- Temperature: 72°F  
- Quality
- Artesian closed in pressure: 85 p.s.i.
- Controlled by: Valve  
- Cap  
- Plug

**8. WELL TEST DATA**

- Discharge: G.P.M  
- Draw Down: 1  
- Hours Pumped: 1

**9. LITHOLOGIC LOG**

<table>
<thead>
<tr>
<th>Hole</th>
<th>Depth From To (feet)</th>
<th>Material</th>
<th>Water Yes No</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>0 to 1</td>
<td>Top Soil</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>1 to 5</td>
<td>Large gravel</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>5 to 10</td>
<td>Boulder</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>10 to 16</td>
<td>Course sand &amp; gravel</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>16 to 20</td>
<td>Boulder</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>20 to 30</td>
<td>Course sand &amp; gravel</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>30 to 40</td>
<td>Boulder</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>40 to 45</td>
<td>Course sand &amp; gravel</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>45 to 50</td>
<td>Boulder</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>50 to 55</td>
<td>Boulder &amp; large gravel</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>55 to 60</td>
<td>Course sand &amp; gravel</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>60 to 65</td>
<td>Boulder</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>65 to 70</td>
<td>Course gravel</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>70 to 75</td>
<td>Large gravel</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>75 to 80</td>
<td>Course sand &amp; gravel</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>80 to 85</td>
<td>Course gravel</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>85 to 90</td>
<td>Course sand &amp; gravel</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>90 to 95</td>
<td>Course gravel</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>95 to 100</td>
<td>Course gravel 3/4 to 12</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>100 to 105</td>
<td>Course sand &amp; gravel</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>105 to 110</td>
<td>Course gravel</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>110 to 115</td>
<td>Course sand &amp; gravel</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>115 to 120</td>
<td>Course gravel</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>120 to 125</td>
<td>Course sand &amp; gravel</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>125 to 130</td>
<td>Course gravel</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>130 to 135</td>
<td>Course sand &amp; gravel</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>135 to 140</td>
<td>Course gravel</td>
<td>No</td>
</tr>
</tbody>
</table>

**10.**

Work started Sept. 29, 1971, finished Oct. 6, 1971

**11. DRILLER'S CERTIFICATION**

This well was drilled under my supervision and this report is true to the best of my knowledge.

**KINEGRAP WELL DRILLING CO.**

Driller or Firm's Name

Address

Signed By

Oct. 12, 1971
STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT
State law requires that this report be filed with the Director, Department of Water Resources, within 30 days after the completion or abandonment of the well.

1. WELL OWNER

Name: Fred F. Rago
Address: 5750 Beck Rd., Post Falls, Idaho
Owner's Permit No.: 95-20-2-N-17

2. NATURE OF WORK

☐ New well  ☐ Deepened  ☐ Replacement
☐ Abandoned (describe method of abandoning)

3. PROPOSED USE

☒ Domestic  ☐ Irrigation  ☐ Test  ☐ Municipal
☐ Industrial  ☐ Stock  ☐ Waste Disposal or Injection
☐ Other (specify type)

4. METHOD DRILLED

☒ Rotary  ☐ Air  ☐ Hydraulic  ☐ Reverse rotary
☐ Cable  ☐ Dug  ☐ Other

5. WELL CONSTRUCTION

Casing schedule:

<table>
<thead>
<tr>
<th>Dia. (in)</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Material:

| Depth (ft) | Material
|-----------|---------|
| 0-2       | top soil
| 2-14      | sand & large gravel
| 14-16     | a boulder
| 16-21     | large gravel
| 21-30     | sand gravel & silt
| 30-65     | gravel & silt
| 65-75     | cobble stones
| 75-80     | gravel 1 in. minus
| 80-100    | pebbles gravel
| 100-116   | gravel large 3/4 in. minus
| 116-126   | pebbles gravel
| 126-152   | sand / silt
| 152-155   | washed gravel
| 155-163   | 1 boulder
| 163-180   | washed gravel 1 1/4 in. minus

Other notes:

- Well screen installed: ☐ Yes ☐ No
- Manufacturer's name
- Diameter
- Slot size
- Gravel packed: ☐ Yes ☐ No  Size of gravel
- Surface seal depth
- Material used in seal
- Cement grout
- Puddying clay  Well cuttings
- Sealing procedure used: ☐ Blunny pit  ☐ Temp. surface casing
- Method of joining casing: ☐ Threaded  ☐ Welded  ☐ Solvent Weld
- Described between strata

6. LOCATION OF WELL

Sketch map location must agree with written location.

7. WATER LEVEL

Static water level 130 feet below land surface.
Flowing: ☐ Yes ☐ No  G.P.M. flow
Artesian closed-in pressure p.s.i.
Controlled by: ☐ Valve ☐ Cap ☐ Plug
Temperature ○F.  Quality

8. WELL TEST DATA

<table>
<thead>
<tr>
<th>Discharge G.P.M.</th>
<th>Pumping Level</th>
<th>Hours Pumped</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>132</td>
<td>3</td>
</tr>
</tbody>
</table>

9. LITHOLOGIC LOG

<table>
<thead>
<tr>
<th>Hole</th>
<th>Depth (ft)</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
<td>top soil</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>sand &amp; large gravel</td>
</tr>
<tr>
<td>14</td>
<td>16</td>
<td>a boulder</td>
</tr>
<tr>
<td>16</td>
<td>21</td>
<td>large gravel</td>
</tr>
<tr>
<td>21</td>
<td>26</td>
<td>sand gravel &amp; silt</td>
</tr>
<tr>
<td>26</td>
<td>30</td>
<td>gravel &amp; silt</td>
</tr>
<tr>
<td>30</td>
<td>65</td>
<td>cobble stones</td>
</tr>
<tr>
<td>65</td>
<td>75</td>
<td>gravel 1 in. minus</td>
</tr>
<tr>
<td>75</td>
<td>80</td>
<td>pebbles gravel</td>
</tr>
<tr>
<td>80</td>
<td>100</td>
<td>gravel large 3/4 in. minus</td>
</tr>
<tr>
<td>100</td>
<td>116</td>
<td>pebbles gravel</td>
</tr>
<tr>
<td>116</td>
<td>126</td>
<td>sand / silt</td>
</tr>
<tr>
<td>126</td>
<td>152</td>
<td>washed gravel</td>
</tr>
<tr>
<td>152</td>
<td>163</td>
<td>1 boulder</td>
</tr>
<tr>
<td>163</td>
<td>180</td>
<td>washed gravel 1 1/4 in. minus</td>
</tr>
</tbody>
</table>

10. Work started finished

11. DRILLER'S CERTIFICATION

I, the undersigned, do hereby certify that the above data were obtained in the performance of the work within the limits of the permit and in accordance with all requirements of the permit.

Firm Name: R.A. R. & L. A. DURING
Address: 501 S. First St., Post Falls, Idaho

Signed by (Printed Name):

Date: 6/5/80

Department of Water Resources
Northern District Office
Department

USE ADDITIONAL SHEETS IF NECESSARY — FORWARD THE WHITE COPY TO THE DEPARTMENT.
STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT
State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

1. WELL OWNER
Name: Jacklin Sewo Co
Address: Post Falls 8060
Owner's Permit No.: 95-08-572

2. NATURE OF WORK
Flow well  □  Deepened  □  Replacement  □
Abandoned (describe abandonment procedures such as materials, plug depths, etc. in lithologic log)

3. PROPOSED USE
□ Domestic  □ Irrigation  □ Test  □ Municipal
□ Industrial  □ Stock  □ Waste Disposal or Injection
□ Other  (specify type)

4. METHOD DRILLED
□ Rotary  □ Air Drilling  □ Hydraulic  □ Reverse rotary

5. WELL CONSTRUCTION
Casing schedule: □ Steel  □ Concrete  □ Other
Thickness From  □ 10 inches + □ 12 inches + □ 16 inches + □ 20 inches + □ 24 inches + □ 30 inches + □ 36 inches + □ 42 inches + □ 48 inches + □ 54 inches + □ 60 inches + □ 66 inches + □ 72 inches + □ 80 inches + □ 90 inches + □ 100 inches + □
Cementing required: □ Yes  □ No
Perforated? □ Yes  □ No
How perforated? □ Factory  □ Kolbe  □ Torch
Size of perforation inches by inches
Number of perforations From feet To feet
Well screen installed? □ Yes  □ No
Manufacturer's name Johnson
Type of screen: □ Steel  □ Plastic  □ Rod  □ Other
Model No.
Diameter of slot size Slot size Set from 170 feet to 190 feet
Gravel packed? □ Yes □ No
Size of gravel feet
Placed from feet to feet
Surface seal depth  □ 20  □ 25  □ 30  □ 35  □ 40  □ 45  □ 50  □ 55  □ 60  □ 65  □ 70  □ 75  □ 80  □ 85  □ 90  □ 95  □ 100 feet
Material used in seal: □ Cement grout  □ Bentonite  □ Puddling clay  □ Cubic
Sealing procedure used: □ Slurry pit  □ Temp. surface casing  □ Overbore to seal depth
Method of joining casing: □ Threaded  □ Welded  □ Solvent Weld
Describe access port

6. LOCATION OF WELL
Sketch map location must agree with written location.

W    E
1 2 3

Subdivision Name
Lot No.: Block No.

County

7. WATER LEVEL
Static water level 139 feet below land surface.
Flowing: □ Yes □ No
G.P.M.: Flow
Artesian closed in pressure
Controlled by: □ Valve  □ Cap  □ Plug
Temperature of Water  □ 40  □ 45  □ 50  □ 55  □ 60
Quality
Describe extension or temperature zones below

8. WELL TEST DATA
□ Pump  □ Bailer  □ Air  □ Other
Discharge G.P.M.
Pumping Level
Hours Pumped

9. LITHOLOGIC LOG

Bore Diam. From To Material Water


11. DRILLERS CERTIFICATION
I/we certify that all minimum well construction standards were complied with at the time the rig was removed.

Name of well: 30 well
Address: 6-21-88

Signed by (Firm Official): 30

(Operator):

USE ADDITIONAL SHEETS IF NECESSARY — FORWARD THE WHITE COPY TO THE DEPARTMENT

Page 11
Department of Environmental Quality
1. WELL TAG NO. D 54U20
   WELL DRILLER'S REPORT
   DRILLING PERMIT NO. 08531619
   Water Right or Injection Well No. 

2. OWNER:
   Name: CAB Inc.
   Address: PO Box 459
   City: Post Falls State: ID Zip: 83857

3. LOCATION OF WELL by legal description:
   You must provide address or lot, blk, sub, or direction to well.
   Twp: 35N Sec: 6 1/4 Rge: 6W
   Govt Lot: 1/4 County: Kootenai
   Lat: Long: Address of Well Site 6902 West 2nd Ave
   City: State: ID
   Lt: Blk: Sub: Name:

4. USE:
   ☐ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
   ☐ Thermal ☐ Injection ☐ Other

5. TYPE OF WORK check that apply
   ☑ New Well ☑ Modify ☐ Abandonment ☐ Other
   (Replacement etc.)

6. DRILL METHOD:
   ☑ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other

7. SEALING PROCEDURES
   Seal Material: Barite Chips
   From: 2 To: 187 Weight / Volume: 2.859 lbs
   Seal Placement Method: Pour Them Causing
   Was drive shoe used? ☑ Y ☐ N
   Was drive shoe seal tested? ☑ Y ☐ N
   Shoe Depth(s)

8. CASING/LINER:
   Diameter: 2" .5 Gauge: 110 Material: wifi
   Casing: ☑ ☐ Liner ☑ ☐ Welded ☑ ☐ Threaded: 
   Length of Headpipe
   Length of Tubing
   Packer ☑ Y ☐ N Type

9. PERFORATIONS/SCREENS PACKER TYPE
   Perforation Method: Factory
   Screen Type & Method of Installation: Johnsw
   From: 110 To: 139 Depth: 810 Material: 2" wifi
   Casing: ☑ ☐ Liner ☑ ☐ Welded ☑ ☐ Threaded: 

10. FILTER PACK
    Filter Material: Sand
    From: 10/23 To: 167 Weight / Volume: 950 lbs
    Placement Method: Pour Them Causing

11. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
    115 ft. below ground
    Artesian pressure: 15 lb.
    Depth flow encountered: 115 ft.
    Describe access port or control devices:

12. WELL TESTS:
    ☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
    Yield gal/min: Drained: Pumping Level: Tied:

13. LITHOLOGIC LOG: Describe repairs or abandonment)
    Water
    Store Date: From: To: Remarks: Lithology, Water Quality & Temperature
    Y N
    8' 0 133 Sandy gravel, chalk

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IDWR North

ENTERED

Date: Started 6/14/08 Completed 6/11/08

14. DRILLER'S CERTIFICATION
   We certify that all minimum well construction standards were complied with at the
time the rig was removed.
   Company Name: Eidekliff West Exp.
   Firm No: 489
   Principal Driller Date: 9-25-08
   and Dripple or Operator date: 9-25-08
   Operator I date:
   Principal Driller and Rig OperatorRequired.
   Operator I must have signature of Driller/Operator II.

SON OEW 01 FORWARD WHITE COPY TO WATER RESOURCES
1. DRILLING PERMIT NO. 95-94 N . 50
Other IDWR No.

2. OWNER: POE ASPHALT
Name: 
Address: PO BOX 449
City: LEWISTON State ID Zip: 83501

3. LOCATION OF WELL by legal description:
Sketch map location must agree with written location.

Twp. 51 North □ or South □
Rge. 05 East □ or West □
Sec. □ 30 1/4 SW 1/4 SW 1/4 SW 1/4
Govt Lt. □ or Claim Name

Address of Well Site: STATELINE BECK RD.
City: 
Lt. Bk. Sub. Name:

(Write or print name of land = Distance to Road or Landmark)

4. PROPOSED USE: X Domestic □ Municipal □ Monitor □ Irrigation
□ Thermal □ Injection □ Other: Industrial

5. TYPE OF WORK: X New Well □ Modify or Repair □ Replacement □ Abandonment

6. DRILL METHOD: □ Mud Rotary □ Air Rotary □ Cable □ Other

7. SEALING PROCEDURES

<table>
<thead>
<tr>
<th>SEAL/FILTER PACK</th>
<th>AMOUNT</th>
<th>METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>BENTONITE</td>
<td>0 40 GALS</td>
<td>SLURRY POURED</td>
</tr>
</tbody>
</table>

Was drive shoe used? □ Y □ N □ How? 
Was drive shoe seal tested? □ Y □ N □ How?

8. CASING/LINER:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>From</th>
<th>To</th>
<th>Gauge</th>
<th>Material</th>
<th>Casing</th>
<th>Liner</th>
<th>Welded</th>
<th>Threaded</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>+3</td>
<td>178</td>
<td>250</td>
<td>STEEL</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

Length of Headpipe Length of Tailpipe

9. PERFORATIONS/SCREENS

□ Perforations □ Method □ Screens Screen Type: STAINLESS STEEL

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Size</th>
<th>Number</th>
<th>Diameter</th>
<th>Material</th>
<th>Casing</th>
<th>Liner</th>
</tr>
</thead>
<tbody>
<tr>
<td>178</td>
<td>188</td>
<td>100</td>
<td>2-5'</td>
<td>8'</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

124' ft. below ground Artesian pressure ___ lb.
Depth flow encountered ______ ft. Describe access port or control devices:

SW 30 SW 5

11. WELL TESTS:

<table>
<thead>
<tr>
<th>Yield</th>
<th>Drawdown</th>
<th>Pumping Level</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>300+</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Water Temp. Bottom hole temp.
Water Quality test or comments:

12. LITHOLOGIC LOG: (Describe repairs or abandonment)

<table>
<thead>
<tr>
<th>Box No.</th>
<th>From</th>
<th>To</th>
<th>Remarks</th>
<th>Lithology, Water Quality &amp; Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 0 48</td>
<td></td>
<td></td>
<td></td>
<td>SAND &amp; GRAVEL W/Cobble W/ LIGHT BROWN SOILS</td>
</tr>
<tr>
<td>10 48 72</td>
<td></td>
<td></td>
<td></td>
<td>SAND &amp; GRAVEL COARSE CLEAN</td>
</tr>
<tr>
<td>10 72 115</td>
<td></td>
<td></td>
<td></td>
<td>SAND &amp; GRAVEL MEDIUM</td>
</tr>
<tr>
<td>10 115 131</td>
<td></td>
<td></td>
<td></td>
<td>SAND &amp; GRAVEL FINE W/LIGHT BROWN SOILS SEEMS</td>
</tr>
<tr>
<td>10 131 188</td>
<td></td>
<td></td>
<td></td>
<td>GRAVEL COARSE CLEAN SOME FINDS 3/4 MINIS MATERIALS 300+</td>
</tr>
</tbody>
</table>

13. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Date: Started ___ 03/21/94 __ 03/24/94

Firm Name: H2O WELL SERVICE INC
Firm No.: 448

Firm Official and Supervisor or Operator:

Date: ___ 4-8-94 ___ 4-5-94

For your further use:

§ 228-7

Received APP 27 1994

Department of Water Resources

NORTHERN REGION

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Feb 1994

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WELL DRILLER'S REPORT

1. WELL OWNER
Name: Stewart & Sylvia Coyne
Address: 6180 Hauser Lk Rd, Post Falls 83854
Drilling Permit No: 95-91-N-132
Water Right Permit No: 

2. NATURE OF WORK
☐ New well ☐ Deepened ☐ Replacement
☐ Well diameter increase
☐ Abandoned (describe abandonment procedures such as materials, plug depths, etc. in lithologic log)

3. PROPOSED USE
☐ Domestic ☐ Irrigation ☐ Test ☐ Municipal
☐ Industrial ☐ Stock ☐ Waste Disposal or Injection
☐ Other (specify type)

4. METHOD DRILLED
☐ Rotary ☐ Air ☐ Hydraulic ☐ Reverse rotary
☐ Cable ☐ Dug ☐ Other

5. WELL CONSTRUCTION
Casing schedule: ☐ Steel ☐ Concrete ☐ Other
Thickness: From - To
- 250 inches | 6 inches + 1 foot 184 feet
- inches inches
Was casing drive shoe used? ☐ Yes ☐ No
Was a packer or seal used? ☐ Yes ☐ No
Perforated? ☐ Yes ☐ No
How perforated? ☐ Factory ☐ Knife ☐ Torch ☐ Gun
Size of perforation in inches by in inches
Number of perforations from - to
- feet feet
- feet feet
Perforations from - to
- feet feet
- feet feet
Wall screen installed? ☐ Yes ☐ No
Manufacturer's name:
Type ☐ Model No.
Diameter Slot size Set from - to feet
- feet feet
Gravel packed? ☐ Yes ☐ No ☐ Size of gravel Placed from - to feet
Surface seal depth 18 Material used in seal: ☐ Cement grout ☐ Bentonite ☐ Puddling clay ☐ Other
Sealing procedure used: ☐ Slurry pit ☐ Temp. surface casing ☐ Overbore to seal depth Method of joining casing: ☐ Threaded ☐ Welded ☐ Solvent Weld
Describe access port: ☐ Well Cap ☐ Cemented between strata

6. LOCATION OF WELL
Sketch map location must agree with written location.

7. WATER LEVEL
Static water level 155 feet below land surface.
Flowing? ☐ Yes ☐ No ☐ G.P.M. Flow
Artesian confined p.i.l. ☐ARTISAN ☐ G.P.M. Flow
Controlled by: ☐ Valve ☐ Cap ☐ Plug
Temperature ☐ 90.0 Quality ☐
Describe condition or temperature zones below:

8. WELL TEST DATA
Discharge G.P.M. Pumping Level Hours Pumped
20 ☐ 18.8 ☐ 4

9. LITHOLOGIC LOG
Bore Depth Material
8 1 60 Large gravel
5 60 184 Sand & gravel X


11. DRILLERS CERTIFICATION
I/we certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name: Bronson Water Well
Address: Spirit Lake, ID 83869
Signed by (Firm Official) and (Operator)

USE ADDITIONAL SHEETS IF NECESSARY – FORWARD THE WHITE COPY TO THE DEPARTMENT
Results of Seismic Cross Section Near Idaho-Washington Border

- Soil
- Unsaturated Aquifer Sediments
- Saturated Aquifer Sediments
- Silt & Clay with Interbedded Basalt
- Bedrock

Approximate aquifer cross sectional area = 4.08 x 10^6 ft^2

From: Seismic Cross Sections Across the Spokane River Valley and the Hillyard Trough, Idaho and Washington. USGS, 1953