PUBLIC INTEREST REVIEW FOR GROUNDWATER APPLICATIONS

TO: Water Rights Section Date 5/14/2015

FROM: Groundwater Section Gerald H. Grondin (Darrick E. Boschmann)
Reviewer's Name

SUBJECT: Application G- 17916 Supersedes review of 3/24/2015
Date of Review(s)

PUBLIC INTEREST PRESUMPTION; GROUNDWATER

OAR 690-310-130 (1) *The Department shall presume that a proposed groundwater use will ensure the preservation of the public welfare, safety and health as described in ORS 537.525.* Department staff review ground water applications under OAR 690-310-140 to determine whether the presumption is established. OAR 690-310-140 allows the proposed use be modified or conditioned to meet the presumption criteria. **This review is based upon available information and agency policies in place at the time of evaluation.**

A. GENERAL INFORMATION: Applicant's Name: Phillip and Lorissa Singhose County: Harney

A1. Applicant(s) seek(s) 11.25* cfs from 3 well(s) in the Malheur Lake Basin, Lower Silver Creek subbasins Quad Map: Oakerman Lakes / Moon Reservoir

A2. Proposed use: Irrigation (900 acres primary) Seasonality: March 1 to October 31

A3. Well and aquifer data **(attach and number logs for existing wells; mark proposed wells as such under logid)**:

Well	Logid	Applicant's Well #	Proposed Aquifer*	Proposed Rate(cfs)	Location (T/R-S QQ-Q)	Location, metes and bounds, e.g. 2250' N, 1200' E fr NW cor S 36
1	Proposed	18	Basalt/tuffaceous sediment	4.68*	24/27-15 SW	none provided
2	Proposed	19	Basalt/tuffaceous sediment	4.68*	24/27-10 SE	none provided
3	Proposed	20	Basalt/tuffaceous sediment	4.68*	24/27-3-SW	none provided
4						
5						

* Alluvium, CRB, Bedrock

Well	Well Elev ft msl	First Water ft bls	SWL ft bls	SWL Date	Well Depth (ft)	Seal Interval (ft)	Casing Intervals (ft)	Liner Intervals (ft)	Perforations Or Screens (ft)	Well Yield (gpm)	Draw Down (ft)	Test Type
1	?	?	?	?	500	0-60	0-100±	None	None	?	?	?
2	?	?	?	?	500	0-60	0-100±	None	None	?	?	?
3	?	?	?	?	500	0-60	0-100±	None	None	?	?	?

Use data from application for proposed wells.

A4. **Comments:**

The proposed wells are in Harney County within Silver Creek Valley and range from about 2.5-4 miles southeast of the town of Riley. The area is surficially mapped as Qal (alluvium: sand, gravel, and silt) overlying QTb (basalt) by Greene and others (1972), which is equivalent to QTb (Upper Pliocene basalt) of Brown and others (1980). Unit QTb of Brown and others (1980) is described as a series of thin flows generally overlying QTst (tuffaceous sedimentary rocks) in the northwest part of the study area, north and west of Dog Mountain.

The water well report for HARN 753 located in 24/27-10 indicates gravel and clay to 85 feet (Qal), underlain by decomposed rock/hard rock/lava with a minor clay interbed (QTb) from 85-150 feet, underlain by sandstone, gravel, and clay (QTst) to 408 feet (TD).

The water well report for HARN 761 located in 24/27-15 NE-NW indicates gravel, sand, and clay to 33 feet (Qal), underlain by hard black and red rock (QTb) from 33-70 feet, underlain by sand, sandstone, clay, and gravel (QTst) to 400 feet (TD).

It is likely that the proposed well will penetrate through the unconsolidated basin fill sediment (Qal) into the underlying basalt and tuffaceous sedimentary rocks (QTb/QTst).

*Note: The application lists a maximum requested rate of "900 AF", which is not an applicable value. Additionally, the well specific rate listed on the application is 2100 gpm (4.68 cfs) per well; which totals 14.04 cfs. This is more than the 1/80 cfs/acre that is typically allowed (900/80 = 11.25 cfs). It is unclear what maximum rate is intended, or if the well specific rate listed was the intent of the applicant. For the purposes of this review the well specific rates are not considered, and the total maximum rate used is 11.25 cfs which is the typical rate allowed for 900 acres.

A5. ☒ **Provisions of the** Malheur Lake Basin rules relative to the development, classification and/or management of ground water hydraulically connected to surface water ☐ **are,** *or* ☒ **are not,** activated by this application. (Not all basin rules contain such provisions.)
Comments:

OAR 690-512-0040
The rule states: "(1) Except as provided in section (3) of this rule, the Department shall not accept an application for permit, or issue a permit, for any use of surface water, or of groundwater the use of which has the potential to substantially interfere with surface water, in the Malheur Lake Basin unless the applicant shows, by a preponderance of evidence, that unappropriated water is available to supply the proposed use at the times and in the amounts requested. The evidence provided shall be prepared by a qualified hydrologist or other water resources specialist and shall include:

(a) Streamflow measurements of gage records from the source or, for use of groundwater, the stream in hydraulic connection with the source; or

(b) An estimate of water availability from the source or, for use of groundwater, the stream in hydraulic connection with the source which includes correlations with streamflow measurements or gage records on other, similar streams and considers current demands for water affecting the streamflows."

This review does not find a potential for substantial interference with surface water.

A6. ☐ **Well(s) #** _____, _____, _____, _____, _____, tap(s) an aquifer limited by an administrative restriction.
Name of administrative area:
Comments:

Currently no administrative area.

B. GROUND WATER AVAILABILITY CONSIDERATIONS, OAR 690-310-130, 400-010, 410-0070

B1. **Based upon available data**, I have determined that ground water* for the proposed use:

a. ☒ **is** over appropriated, ☐ **is not** over appropriated, *or* ☐ **cannot be determined to be** over appropriated during any period of the proposed use. * This finding is limited to the ground water portion of the over-appropriation determination as prescribed in OAR 690-310-130;

b. ☒ **will not** *or* ☐ **will** likely be available in the amounts requested without injury to prior water rights. * This finding is limited to the ground water portion of the injury determination as prescribed in OAR 690-310-130;

c. ☒ **will not** *or* ☐ **will** likely to be available within the capacity of the ground water resource; or

d. ☐ **will, if properly conditioned**, avoid injury to existing ground water rights or to the ground water resource:
   i. ☐ The permit should contain condition #(s) _____;
   ii. ☐ The permit should be conditioned as indicated in item 2 below.
   iii. ☐ The permit should contain special condition(s) as indicated in item 3 below;

B2. a. ☐ **Condition** to allow ground water production from no deeper than _____ ft. below land surface;
b. ☐ **Condition** to allow ground water production from no shallower than _____ ft. below land surface;
c. ☐ **Condition** to allow ground water production only from the _____ ground water reservoir between approximately_____ ft. and_____ ft. below land surface;
d. ☐ **Well reconstruction** is necessary to accomplish one or more of the above conditions. The problems that are likely to occur with this use and without reconstructing are cited below. Without reconstruction, I recommend withholding issuance of the permit until evidence of well reconstruction is filed with the Department and approved by the Ground Water Section.

Describe injury –as related to water availability– that is likely to occur without well reconstruction (interference w/ senior water rights, not within the capacity of the resource, etc): _____

B3. **Ground water availability remarks:**

The proposed well(s) for this application is within the greater Harney Valley area where observed groundwater level declines are occurring in most areas (see attached map). The decline indicates that demand for groundwater is exceeding the average annual recharge. An analysis by the Department confirms the volume of groundwater permitted for annual use exceeds the average annual volume of recharge to groundwater. The Department also estimates that approximately 30 percent of the total acreage permitted for groundwater use has yet to be developed. Groundwater development for these acres under already-existing permits will further increase the groundwater level decline rate. Based on the location of the proposed POA(s), the Department finds that the proposed groundwater use will occur from the same groundwater source exhibiting groundwater level declines. Groundwater is therefore determined to be over-appropriated [see OAR 690-400-0010(11)(a)(B)] and the proposed use for this application is not within the capacity of the resource.

If a permit is issued, the following conditions are recommended:

Special Permit Condition:
The permittee shall construct one (1) minimum six-inch diameter observation well to penetrate the same aquifer as the production wells. The well shall meet the Department's minimum well construction standards and shall be cased and sealed to the same depth as the production wells. The well shall be constructed at a location approved by the Department for the purpose of instrumentation with continuous water-level monitoring equipment. The landowner or permittee shall provide access to Department staff to install and maintain the monitoring equipment. The well shall not be used for any other purpose while the Department is monitoring water levels. The well shall be completed prior to water use under the terms of any permit issued.

7B: Interference Condition

7F: Proposed Well location Condition

7N: Annual Measurement and Decline Condition

7P: Well Tag Condition

7T: Dedicated Measuring Tube Condition for all POA wells

Flow meter condition: Use the water rights "large" permit condition requiring a totalizing flow meter and reporting

7K: The proposed wells shall be continuously cased and continuously sealed a minimum of five (5) feet into the basalt/tuffaceous sediment unit beneath the predominantly basin fill unit. The wells may not be completed in such a manner that they allow ground water to be developed from the overlying basin fill. If during well construction, it becomes apparent that the wells can be constructed to eliminate interference with nearby shallow wells or hydraulically connected streams in a manner other than specified in this permit, the permittee can contact the Department Hydrogeologist for this permit or the Ground Water/Hydrology Section Manager to request approval of such construction. The request shall be in writing, and shall include a rough well log and a proposed construction design for approval by the Department. The request can be approved only if it is received and reviewed prior to placement of any permanent casing and sealing material. If the well is constructed first and then the request made, requested modification will not be approved. The new well depth and construction specifications will be incorporated into any certificate issued for this permit.

C. GROUND WATER/SURFACE WATER CONSIDERATIONS, OAR 690-09-040

C1. **690-09-040 (1):** Evaluation of aquifer confinement:

Well	Aquifer or Proposed Aquifer	Confined	Unconfined
All	basalt/tuffaceous sediments	☐	☒
		☐	☐
		☐	☐
		☐	☐
		☐	☐

Basis for aquifer confinement evaluation:

Some local well logs report static water levels that are somewhat above the depth that groundwater was first encountered. However, well HARN 761 reports a constant static water level from 10 feet to 400 feet (TD). The regional aquifer is likely unconfined to poorly confined.

C2. **690-09-040 (2) (3):** Evaluation of distance to, and hydraulic connection with, surface water sources. All wells located a horizontal distance less than ¼ mile from a surface water source that produce water from an unconfined aquifer shall be assumed to be hydraulically connected to the surface water source. Include in this table any streams located beyond one mile that are evaluated for PSI.

Well	SW #	Surface Water Name	GW Elev ft msl	SW Elev ft msl	Distance (ft)	Hydraulically Connected? YES	NO	ASSUMED	Potential for Subst. Interfer. Assumed? YES	NO
1	1	Silver Creek	4143±	4160	17160±	☒	☐	☐	☐	☒
2	1	Silver Creek	4143±	4160	19800±	☒	☐	☐	☐	☒
3	1	Silver Creek	4143±	4160	25600±	☒	☐	☐	☐	☒
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐

Basis for aquifer hydraulic connection evaluation:

This evaluation considers perennial reaches of surface water only (see memo by Ivan Gall, 1/15/2008).

The groundwater elevation cited above is derived from the static water level reported on the water well report for deepening log HARN 50785 dated 4/1/2002. The location for HARN 50785 is a GPS location reported by the eastern region well inspector and falls in 24/27-15 SE-SW.

The reach of Silver Creek nearest to the proposed wells is intermittent. The nearest perennial reach of Silver Creek is the reach near Moon Reservoir ~3 miles to the southeast.

Within the uncertainty of the groundwater elevation estimate, the groundwater elevation is roughly coincident with the elevation of the closest perennial reach of Silver Creek, suggesting that groundwater likely provides baseflow to this surface water body at this location.

Water Availability Basin the well(s) are located within: SILVER CR > HARNEY L - AB UNN STR

C3a. **690-09-040 (4):** Evaluation of stream impacts for each well that has been determined or assumed to be **hydraulically connected and less than 1 mile** from a surface water source. Limit evaluation to instream rights and minimum stream flows that are pertinent to that surface water source, and not lower SW sources to which the stream under evaluation is tributary. Compare the requested rate against the 1% of 80% *natural* flow for the pertinent Water Availability Basin (WAB). If Q is not distributed by well, use full rate for each well. Any checked ☒ box indicates the well is assumed to have the potential to cause PSI.

Well	SW #	Well < ¼ mile?	Qw > 5 cfs?	Instream Water Right ID	Instream Water Right Q (cfs)	Qw > 1% ISWR?	80% Natural Flow (cfs)	Qw > 1% of 80% Natural Flow?	Interference @ 30 days (%)	Potential for Subst. Interfer. Assumed?
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐

C3b. **690-09-040 (4):** Evaluation of stream impacts by total appropriation for all wells determined or assumed to be **hydraulically connected and less than 1 mile** from a surface water source. **Complete only if Q is distributed among wells**. Otherwise same evaluation and limitations apply as in C3a above.

	SW #		Qw > 5 cfs?	Instream Water Right ID	Instream Water Right Q (cfs)	Qw > 1% ISWR?	80% Natural Flow (cfs)	Qw > 1% of 80% Natural Flow?	Interference @ 30 days (%)	Potential for Subst. Interfer. Assumed?
			☐			☐		☐		☐
			☐			☐		☐		☐
			☐			☐		☐		☐
			☐			☐		☐		☐

Comments:

C3a./C3b. No analysis here. All wells are located at a distance greater than 1 mile from perennial reaches of hydraulically connected surface water.

C4a. **690-09-040 (5):** Estimated impacts on **hydraulically connected surface water sources greater than one mile** as a percentage of the proposed pumping rate. Limit evaluation to the effects that will occur up to one year after pumping begins. This table encompasses the considerations required by 09-040 (5)(a), (b), (c) and (d), which are not included on this form. Use additional sheets if calculated flows from more than one WAB are required.

Non-Distributed Wells													
Well	SW#	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1	0.23 %	0.31 %	0 %	0 %	0 %	0 %	0 %	0.01 %	0.03 %	0.06 %	0.11 %	0.16 %
Well Q as CFS		0	0	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56	0	0
Interference CFS		0.013	0.017	0	0	0	0	0	0.001	0.002	0.004	0.006	0.009
Distributed Wells													
Well	SW#	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
		%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
(A) = Total Interf.		0.013	0.017	0	0	0	0	0	0.001	0.002	0.004	0.006	0.009
(B) = 80 % Nat. Q		5.66	13.4	40.9	115.0	44.7	20.9	5.33	2.26	2.22	2.91	4.24	5.11
(C) = 1 % Nat. Q		0.056 6	0.134	0.409	1.15	0.447	0.209	0.0533	0.022 6	0.022 2	0.029 1	0.042 4	0.0511
(D) = (A) > (C)		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
(E) = (A / B) x 100		0.23%	013 %	0 %	0 %	0 %	0 %	0 %	0.44%	0.09%	0.09%	0.14%	018 %

(A) = total interference as CFS; (B) = WAB calculated natural flow at 80% exceed. as CFS; (C) = 1% of calculated natural flow at 80% exceed. as CFS; (D) = highlight the checkmark for each month where (A) is greater than (C); (E) = total interference divided by 80% flow as percentage.

Basis for impact evaluation:

C4a. Hunt (2003) was used to calculate the interference between Well 1 and SW #1. The values used for the calculation are conservative and appropriate until better values become available. The calculations used a transmissivity of ~18,000 ft2/day, which is the value derived from a pump test on HARN 753 located in 24/27-3-SE. Additionally, the calculation used an assumed intermediate storage coefficient (0.001). The pumping rate used represents the maximum allowable duty prorated over the irrigation season (5.56 cfs). See reports attached.

Interference is determined to be less than 1% of the 80% flow in all months evaluated.

C4b. **690-09-040 (5) (b) The potential to impair or detrimentally affect the public interest is to be determined by the Water Rights Section.**

C5. ☐ **If properly conditioned,** the surface water source(s) can be adequately protected from interference, and/or ground water use under this permit can be regulated if it is found to substantially interfere with surface water:

i. ☐ The permit should contain condition #(s)_____;

ii. ☐ The permit should contain special condition(s) as indicated in "Remarks" below;

C6. **SW / GW Remarks and Conditions**_____

C1. 690-09-040 (1)

It is determined that all wells will produce water from an unconfined aquifer.

C2. 690-09-040 (2) (3)

It is determined that all wells are hydraulically connected with Silver Creek.

C3a. 690-09-040 (4)

No analysis here. All wells are located at a distance greater than 1 mile from perennial reaches of hydraulically connected surface water.

C3b. 690-09-040 (4)

No analysis. This application does not request a distributed pumping rate.

C4a. 690-09-040 (5)

It is determined that interference for all wells will be less than 1% of the 80% flow in all months evaluated.

If a permit is issued, the following conditions are recommended:

Special Permit Condition:

The permittee shall construct one (1) minimum six-inch diameter observation well to penetrate the same aquifer as the production wells. The well shall meet the Department's minimum well construction standards and shall be cased and sealed to the same depth as the production wells. The well shall be constructed at a location approved by the Department for the purpose of instrumentation with continuous water-level monitoring equipment. The landowner or permittee shall provide access to Department staff to install and maintain the monitoring equipment. The well shall not be used for any other purpose while the Department is monitoring water levels. The well shall be completed prior to water use under the terms of any permit issued.

7B: Interference Condition

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Flow meter condition: Use the water rights "large" permit condition requiring a totalizing flow meter and reporting

7K: The proposed wells shall be continuously cased and continuously sealed a minimum of five (5) feet into the basalt/tuffaceous sediment unit beneath the predominantly basin fill unit. The wells may not be completed in such a manner that they allow ground water to be developed from the overlying basin fill. If during well construction, it becomes apparent that the wells can be constructed to eliminate interference with nearby shallow wells or hydraulically connected streams in a manner other than specified in this permit, the permittee can contact the Department Hydrogeologist for this permit or the Ground Water/Hydrology Section Manager to request approval of such construction. The request shall be in writing, and shall include a rough well log and a proposed construction design for approval by the Department. The request can be approved only if it is received and reviewed prior to placement of any permanent casing and sealing material. If the well is constructed first and then the request made, requested modification will not be approved. The new well depth and construction specifications will be incorporated into any certificate issued for this permit.

References Used:

Piper, A.M., Robison, T.W., and Park C.F. 1939. Geology and Ground Water Resources of the Harney Basin, Oregon. USGS Water Supply Paper 841.

Leonard, A.R. 1970. Ground-Water Resources in Harney Valley, Harney County, Oregon. Ground Water Report 16, Oregon Water Resources Department, Salem, Oregon.

Greene, R.C., Walker, G.W., and Corcoran, R.E. 1972. Geologic Map of the Burns Quadrangle, Oregon. USGS Miscellaneous Geologic Investigations Map I-680.

OWRD water well reports, water level data, and/or hydrographs

Hubbard, Larry. L. 1975. Hydrology of Malheur Lake, Harney County, Southeastern Oregon. USGS Water Resources Investigation 75-21.

Memo by Ivan Gall, 1/15, 2008

Hunt, Bruce. "Unsteady stream depletion when pumping from semiconfined aquifer." Journal of Hydrologic Engineering 8.1 (2003): 12-19.

Oregon Administrative Rules

D. WELL CONSTRUCTION, OAR 690-200

D1. **Well #:** _____ **Logid:** _____

D2. **THE WELL does not appear to meet current well construction standards based upon:**

a. ☐ review of the well log;
b. ☐ field inspection by _____;
c. ☐ report of CWRE _____;
d. ☐ other: (specify) _____

D3. **THE WELL construction deficiency or other comment is described as follows:** _____

D4. ☐ **Route to the Well Construction and Compliance Section for a review of existing well construction.**

Water Availability Tables

Water Availability Analysis
Detailed Reports

SILVER CR > HARNEY L - AB UNN STR
MALHEUR LAKE BASIN
Water Availability as of 3/20/2015

Watershed ID # 31200408 (Map)
Date 3/20/2015

Exceedance Level 80%
Time 1:05 PM

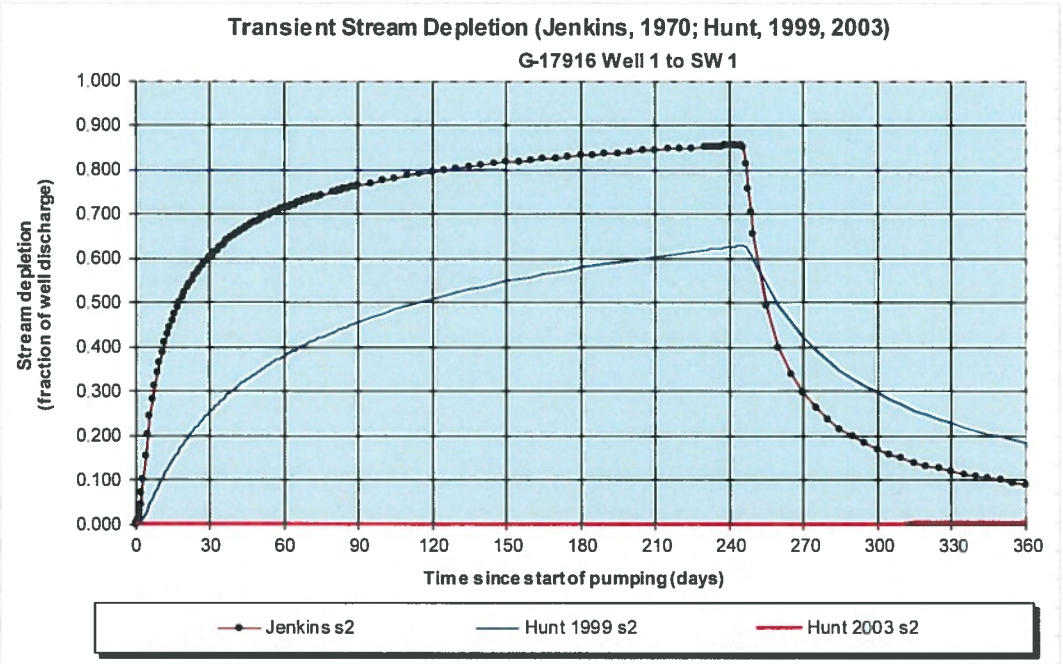
Water Availability Calculation | Consumptive Uses and Storages | Instream Flow Requirements | Reservations
Water Rights | Watershed Characteristics

Water Availability Calculation

Monthly Streamflow in Cubic Feet per Second
Annual Volume at 50% Exceedance in Acre Feet

Month	Natural Stream Flow	Consumptive Uses and Storages	Expected Stream Flow	Reserved Stream Flow	Instream Flow Requirement	Net Water Available
JAN	5.66	2.96	2.70	0.00	0.00	2.70
FEB	13.40	7.60	5.80	0.00	0.00	5.80
MAR	46.90	34.20	6.72	0.00	0.00	6.72
APR	115.00	89.00	26.00	0.00	0.00	26.00
MAY	44.70	141.00	-96.10	0.00	0.00	-96.10
JUN	29.90	109.00	-88.10	0.00	0.00	-88.10
JUL	5.33	36.10	-30.80	0.00	0.00	-30.80
AUG	2.26	14.69	12.46	0.00	0.00	12.43
SEP	2.22	7.79	-5.57	0.00	0.00	-5.57
OCT	2.91	4.27	-1.36	0.00	0.00	-1.36
NOV	4.24	1.15	3.09	0.00	0.00	3.09
DEC	5.11	1.77	3.34	0.00	0.00	3.34
ANN	39,500.00	27,200.00	21,800.00	0.00	0.00	21,800.00

Stream Depletion (Hunt, 2003)



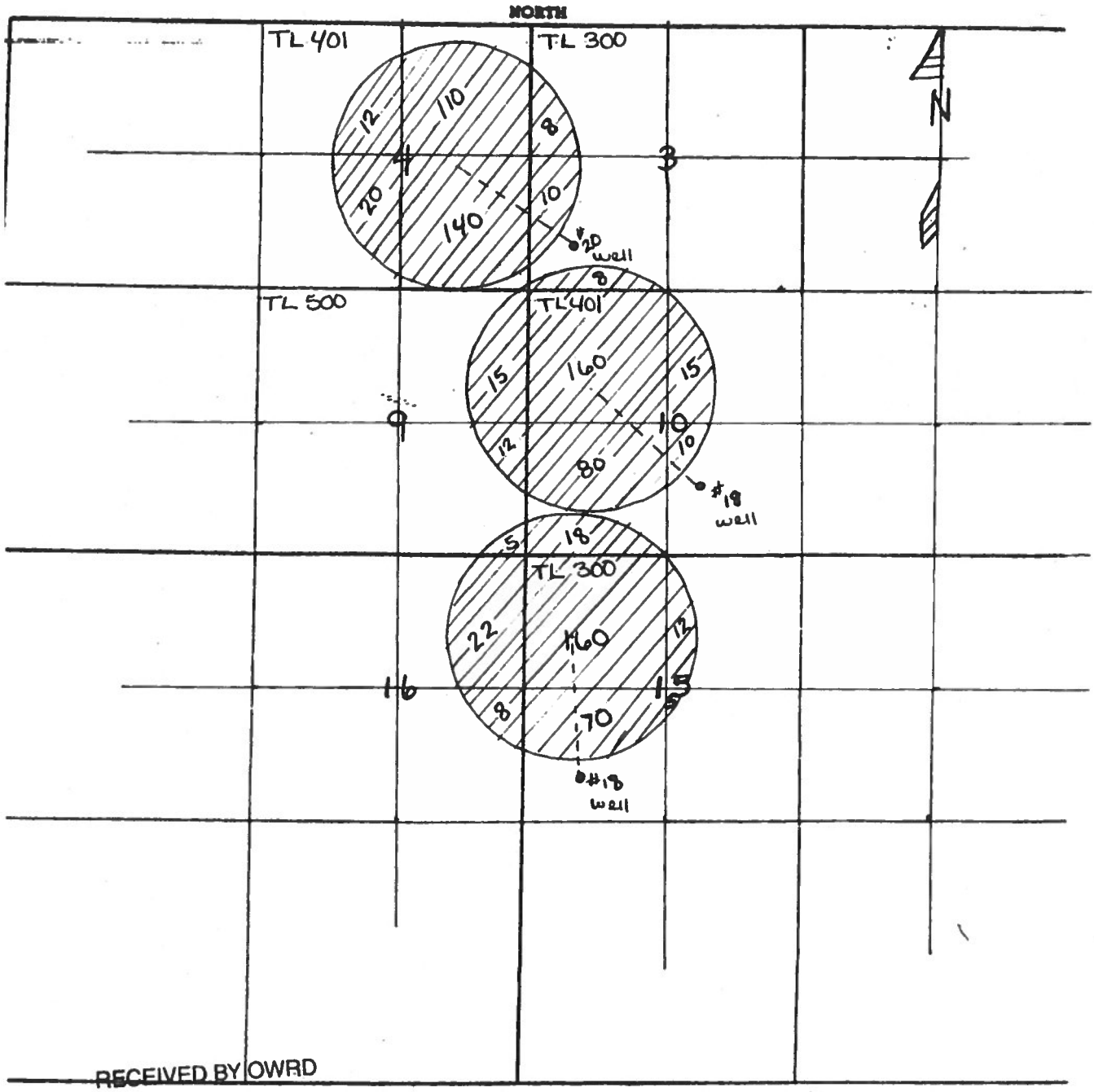
Output for Stream Depletion, Scenerio 2 (s2):						Time pump on (pumping duration) = 245 days						
Days	30	60	90	120	150	180	210	240	270	300	330	360
J SD	60.2%	71.2%	76.3%	79.4%	81.5%	83.1%	84.4%	85.4%	29.5%	16.9%	11.8%	9.0%
H SD 1999	25.3%	38.0%	45.6%	50.8%	54.7%	57.8%	60.3%	62.5%	42.0%	29.5%	22.7%	18.4%
H SD 2003	0.00%	0.00%	-0.01%	0.00%	0.00%	0.01%	0.03%	0.06%	0.11%	0.16%	0.23%	0.31%
Qw, cfs	5.560	5.560	5.560	5.560	5.560	5.560	5.560	5.560	5.560	5.560	5.560	5.560
H SD 99, cfs	1.409	2.112	2.533	2.825	3.043	3.215	3.355	3.473	2.336	1.638	1.262	1.021
H SD 03, cfs	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.009	0.013	0.017

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate of well	Qw	5.56	5.56	5.56	cfs
Time pump on (pumping duration)	tpon	245	245	245	days
Perpendicular from well to stream	a	17160	17160	17160	ft
Well depth	d	500	500	500	ft
Aquifer hydraulic conductivity	K	60	60	60	ft/day
Aquifer saturated thickness	b	300	300	300	ft
Aquifer transmissivity	T	18000	18000	18000	ft*ft/day
Aquifer storativity or specific yield	S	0.001	0.001	0.001	
Aquitard vertical hydraulic conductivity	Kva	2.3	2.3	2.3	ft/day
Aquitard saturated thickness	ba	50	50	50	ft
Aquitard thickness below stream	babs	50	50	50	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	25	25	25	ft
Streambed conductance (lambda)	sbc	1.150000	1.150000	1.150000	ft/day
Stream depletion factor	sdf	16.359200	16.359200	16.359200	days
Streambed factor	sbf	1.096333	1.096333	1.096333	
input #1 for Hunt's Q_4 function	t'	0.061128	0.061128	0.061128	
input #2 for Hunt's Q_4 function	K'	752.523200	752.523200	752.523200	
input #3 for Hunt's Q_4 function	epsilon'	0.005000	0.005000	0.005000	
input #4 for Hunt's Q_4 function	lamda'	1.096333	1.096333	1.096333	

SECTION PLAT

Section 4, 3, 9, 10, 16, 15 Township 24 S Range 27 E

County of Harney State of Oregon



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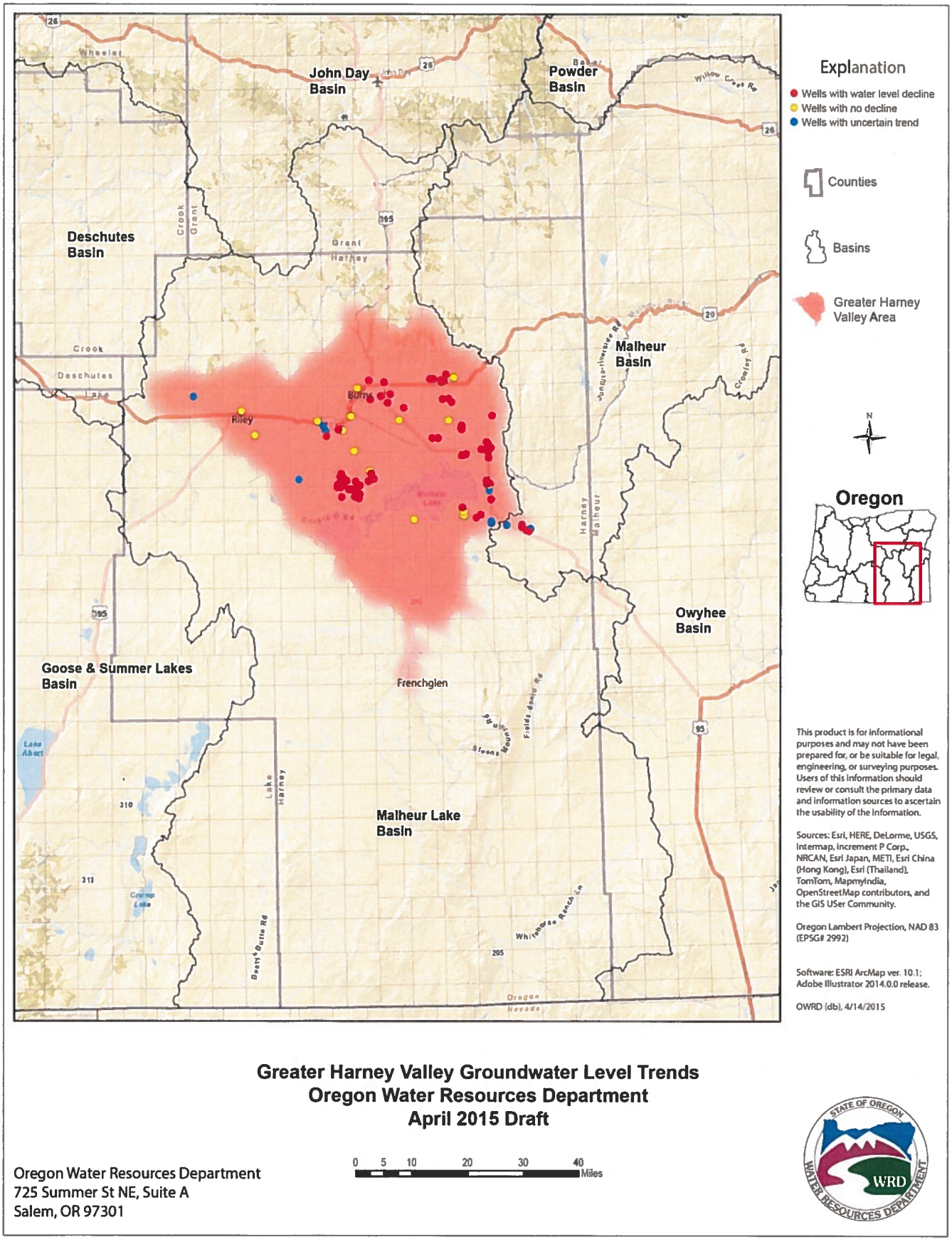
SALEM, OR



Greater Harney Valley Groundwater Level Trends
Oregon Water Resources Department
April 2015 Draft

Oregon Water Resources Department
725 Summer St NE, Suite A
Salem, OR 97301