PUBLIC INTEREST REVIEW FOR GROUND WATER APPLICATIONS

TO: Water Rights Section **Date** **3 June 2009**

FROM: Ground Water/Hydrology Section **Gerald H. Grondin**
Reviewer's Name

SUBJECT: Application **G-17219** Supersedes review of **N.A.**
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: **Jeffrey & Sandi Hunter** County: **Klamath**

A1. Applicant(s) seek(s) **6.28 (2818 gpm)** cfs from **1** well(s) in the **Klamath** Basin, **Lost River** sub basin Quad Map: **Lost River**

A2. Proposed use: **Irrigation (supplemental 502.0 acres)** Seasonality: **1 March through 31 October (245 days)**

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	**KLAM 52973**	**1 ID#49301**	**Basalt**	**6.28**	**40S/10E-sec 8 ACC**	**2600' S, 2957' E fr NW cor S 8**
2						

* 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	**4090**	**249**	**11**	**08/09/01**	**558**	**0 – 240**	**+1 - 240**	**230-356**	**230 - 356**	**2500**	**110**	**P**
2												

Use data from application for proposed wells.

A4. **Comments:** **Well also under: G-15487 (permit G-15332), G-16221 (drought permit G-15603), LL-517, and LL-559.**

The application requests 2818 gpm (6.28 cfs) for supplemental irrigation of 502.0 acres. This is 1/80 cfs per acre.

The remarks box on page 5 of the application notes the applicant requests a primary water right until the Klamath adjudication is complete, then change from primary supplemental, "unless a supplemental water right can be obtained at this time.

File documents indicate water will be pumped from well KLAM 52973 in section 8 and conveyed via G-Canal and/or the Lost River to the places of use (POU) in T40S/R9E-sec 33 and in T40S/R10E-sec 21, 22, 27, 28.

The reported casing and seal in well KLAM 52973 extends from land surface through the predominant basin fill into the predominant basalt below the basin fill. The water well report (well log) indicates ground water in basalt only. However, ground water occurs in both the basin fill and the basalt. Other water well reports (well logs) for wells in the same section report water bearing zones in the basin fill with first water less than 100 feet below land surface. The ground water in the basin fill and basalt is hydraulically connected (see later comments).

A5. ☐ **Provisions of the** **N.A.** 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: **No basin rule applies. Only the Klamath River Compact ORS 542.610 to 542.630 applies to the Klamath Basin. However, that compact applies to surface water only, not ground water**

A6. ☐ **Well(s) #** **N.A.** , _____ , _____ , _____ , _____ , 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) **7B and 7N and 7K**
   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 **predominantly consolidated basalt below the predominantly basin fill**;

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:**

Recommend conditions 7B and 7N and the modified (shortened) condition checked in B2 (the proposed well (KLAM 52973) meets that condition).

Recommend condition saying: "The ground water reference level at well KLAM 52973 (well tag = L 49301) shall be 8.7 feet below land surface." This is the first March measurement at the well (26 March 2003).

Data from the eastern Lost River sub-basin ground water investigation (Grondin, 2004) and the USGS-OWRD cooperative Upper Klamath Basin ground water investigation (Gannett and others, 2007) indicate basin long-term ground water levels are generally controlled by climate and short-term (seasonal) ground water levels are controlled by ground water use.

Additionally, the USGS (2005) has documented annual ground water level declines in the basin south of Upper Klamath Lake since 2001, including wells in the vicinity of Spring Lake. The declines are greater than typically observed during drought periods. Gannett and others (2007) noted annual declines from 2001 to 2004 of 10 to 15 feet in the Spring Lake area. They appear related to the USBOR Klamath Project Water Bank. At this time, future ground water use for the USBOR water bank is uncertain, and it is uncertain whether the post-1999 ground water level declines in the Spring Lake vicinity will continue, stabilize at a lower level, or recover.

Ground water level measurements at the proposed well (KLAM 52973) in T40S/R10E-section 8, and two wells to the west in T40S/R09E-section 13 (KLAM 52824 and KLAM 52797) are on file at OWRD. Additionally, ground water level measurements at one well to the north in T40S/R10E-section 5 and one well to the south in T40S/R10E-section 29 are on file at the USGS. The data is primarily after the year 2000. The measurements show seasonal fluctuations of 2 to 10 feet and annual ground water level declines since 2001 consistent with the USGS (2005) and Gannett and others (2007) observations noted above. The measurements show a net decline of 5 to 10 feet since 2002. The annual decline moderated with decreased USBOR water bank activity. There was some recovery in 2008.

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
1	**Basalt**	☐	☒
2		☐	☐
3		☐	☐
4		☐	☐
5		☐	☐

Basis for aquifer confinement evaluation:

System is identified as generally unconfined with discontinuous low permeability layers causing local (discontinuous, limited) confinement. Generally, low transmissivity (low permeability) sediment of varying thickness overlies high transmissivity (high permeability) basalt. Ground water occurs in both the sediment and basalt.

Water well reports (well logs) for wells in the Spring Lake vicinity indicate the sediment thickness varies from less than 25 feet to more than 1000 feet.

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**	**Lost River**	**4080**	**4070**	**1,550**	☒	☐	☐	☐	☒
1	**2**	**Klamath River**	**4080**	**4085**	**42,200**	☒	☐	☐	☐	☒
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐
						☐	☐	☐	☐	☐

Basis for aquifer hydraulic connection evaluation:

Ground water elevation is based upon OWRD measurement at KLAM 52973 on 26 March 2003 (SWL = 8.69 ft blsd). Gannett and others (2007) indicate a ground water elevation of 4070 close to the well location,

The ground water elevation measurement used here occurred prior to a seasonal decline due to seasonal ground water use in the area, prior to annual ground water level declines in the area related to ground water use for the USBOR water bank, but after the onset of smaller annual ground water declines related to climate.

Gannett and others (2007) show ground water flow from the uplands north, west, and east of the Spring Lake vicinity toward the Lost River and Tule Lake. This includes flow across the proposed well site. Generally in the Upper Klamath Basin, ground water and surface water are hydraulically connected.

Given available data, it appears ground water at the proposed well (KLAM 52973) is hydraulically connected to the Lost River and the Klamath River. The connection with the Lost River appears to be primarily at the nearest reach and north. Further south towards Merrill, it appears the ground water elevation drops below the Lost River.

Water Availability Basin the well(s) are located within: LOST R > TULE L – AT STATE LINE
KLAMATH R > PACIFIC OCEAN - AB JOHN C BOYLE RES

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?
1	**1**	☐	☒	**N.A.**	**N.A.**	☐	**95.40**	☒	**1.5%**	☒
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐
		☐	☐			☐		☐		☐

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:

Well KLAM 52973 is less than 1.00 mile from the Lost River and more than 1.00 mile from the Klamath River.

Given available data, it appears ground water at the proposed well (KLAM 52973) is hydraulically connected to the Lost River.

Interference at the Lost River was calculated using Hunt (2003) given the well obtains ground water predominantly from basalt below basin fill. The basin fill thickness varies generally thickening toward the valley and thinning toward upland areas. The values used in the model were basalt transmissivity of 6,500 ft2/day (based upon specific capacity data for proposed well KLAM 52973 and is within the range of values in Gannett and others (2007)), an intermediate storage coefficient of 0.001, a basin fill thickness of 400 feet was used based on KLAM 52697 located in section 8 near the Lost River with a hydraulic conductivity of 2.09 ft/day based upon Upper Lost River sub-basin data.

A potential for substantial interference is assumed given the proposed maximum pumping rate is greater than 5 cfs and greater than one-percent of the natural flow (80% exceedance).

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	**2**	**0.0%**	**0.0%**	**0.1%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Well Q as CFS		**0.00**	**0.00**	**6.28**	**6.28**	**6.28**	**6.28**	**6.28**	**6.28**	**6.28**	**6.28**	**0.00**	**0.00**
Interference CFS		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
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													
(A) = Total Interf.		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
(B) = 80 % Nat. Q		**1470.**	**1530.**	**1710.**	**2240.**	**2110.**	**1670.**	**1180.**	**915.0**	**831.0**	**810.0**	**955.0**	**1240.**
(C) = 1 % Nat. Q		**14.70**	**15.30**	**17.10**	**22.40**	**21.10**	**16.70**	**11.80**	**9.150**	**8.310**	**8.100**	**9.550**	**12.40**
(D) = (A) > (C)		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
(E) = (A / B) x 100		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

(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:

Well KLAM 52973 is more than 1.00 mile from the Klamath River.

Given available data, it appears ground water at the proposed well (KLAM 52973) is hydraulically connected to the Klamath River.

Interference at the Klamath River was calculated using Hunt (2003) given the well obtains ground water predominantly from basalt below basin fill. The basin fill near the Klamath River is about 100 feet thick, but thickening toward the valley and thinning toward upland areas. The values used in the model were basalt transmissivity of 6,500 ft2/day (based upon specific capacity data for proposed well KLAM 52973 and is within the range of values in Gannett and others (2007)), an intermediate storage coefficient of 0.001, basin fill thickness of 100 based on well log data for wells near the nearest reach of the Klamath River with a hydraulic conductivity of 2.09 ft/day based upon Upper Lost River sub-basin data.

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**_____

A potential for substantial interference is assumed given the proposed well (KLAM 52973) is less than 1 mile from the Lost River, ground water is in hydraulic connection with the river, and the maximum pumping rate is greater than 5 cfs and greater than one-percent of the natural flow (80% exceedance).

If a permit is issued, include conditions 7B and 7N and the modified (shortened) condition checked in B2 (see page 2, the proposed well (KLAM 52973) meets that condition).

If a permit is issued, include condition saying: "The ground water reference level at well KLAM 52973 (well tag = L 49301) shall be 8.7 feet below land surface." This is the first March measurement at the well (26 March 2003).

If a permit is issued, include condition that requires metering and reporting well discharge, water conveyance, and water application to permitted lands. This is needed given application file documents indicating water will be pumped from well KLAM 52973 in T40S/R10E-sec 8 and conveyed via G-Canal and/or the Lost River to the places of use (POU) in T39S/R9E-sec 33 and in T40S/R10E-sec 21, 22, 27, 28.

References Used:_____

Gannett, M.W., Lite, K.E., La Marche, J.L., Fisher, B.J., and Polette, D.J. 2007. Ground-Water Hydrology of the Upper Klamath Basin, Oregon and California. USGS Scientific Investigations Report 2007-5050.

USGS, 2005. Assessment of the Klamath Project pilot water bank: a review from a hydrologic perspective. Prepared by the U.S. Geological Survey Oregon Water Science Center, Portland, Oregon for the U.S. Bureau of Reclamation Klamath Basin Area Office, Klamath Falls, Oregon, May 3, 2005.

Grondin, G.H., 2004. Ground Water in the Eastern Lost River Sub-Basin, Langell, Yonna, Swan Lake, and Poe Valleys of Southeastern Klamath County, Oregon. Ground Water Report 41, Oregon Water Resources Department, Salem, Oregon.

Leonard, A.R. and Harris, A.B. 1974. Ground water in selected areas in the Klamath Basin, Oregon. OWRD Ground Water Report No. 21, 104 pgs.

Hunt, B., 2003, Unsteady stream depletion when pumping from semiconfined aquifer: Journal of Hydrologic Engineering, January/February, 2003.

Theis, C.V. 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground water storage. American Geophysical Union Transactions, 16 annual meeting, vol. 16, pg. 519-524.

Hydrographs and ground water level data for wells KLAM 52973, KLAM 52824, KLAM 52797, KLAM 11059, and KLAM 10518

Water well reports (well logs) for wells within T40S/R10E-sec 8,

USGS Lost River quadrangle map (1:24,000 scale)

D. WELL CONSTRUCTION, OAR 690-200

D1. **Well #**: **1** **Logid:** **KLAM 52973**

D2. **THE WELL does not 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**:
- a. ☐ constitutes a health threat under Division 200 rules;
- b. ☐ commingles water from more than one ground water reservoir;
- c. ☐ permits the loss of artesian head;
- d. ☐ permits the de-watering of one or more ground water reservoirs;
- e. ☐ other: (specify) _____

D4. **THE WELL construction deficiency is described as follows:** _____

D5. **THE WELL**
- a. ☒ **was**, *or* ☐ **was not** constructed according to the standards in effect at the time of original construction or most recent modification.
- b. ☐ I don't know if it met standards at the time of construction.

Comment: _____

The proposed well (KLAM 52973) meets well construction standards and recommended well construction permit condition.

D6. ☐ **Route to the Enforcement Section.**

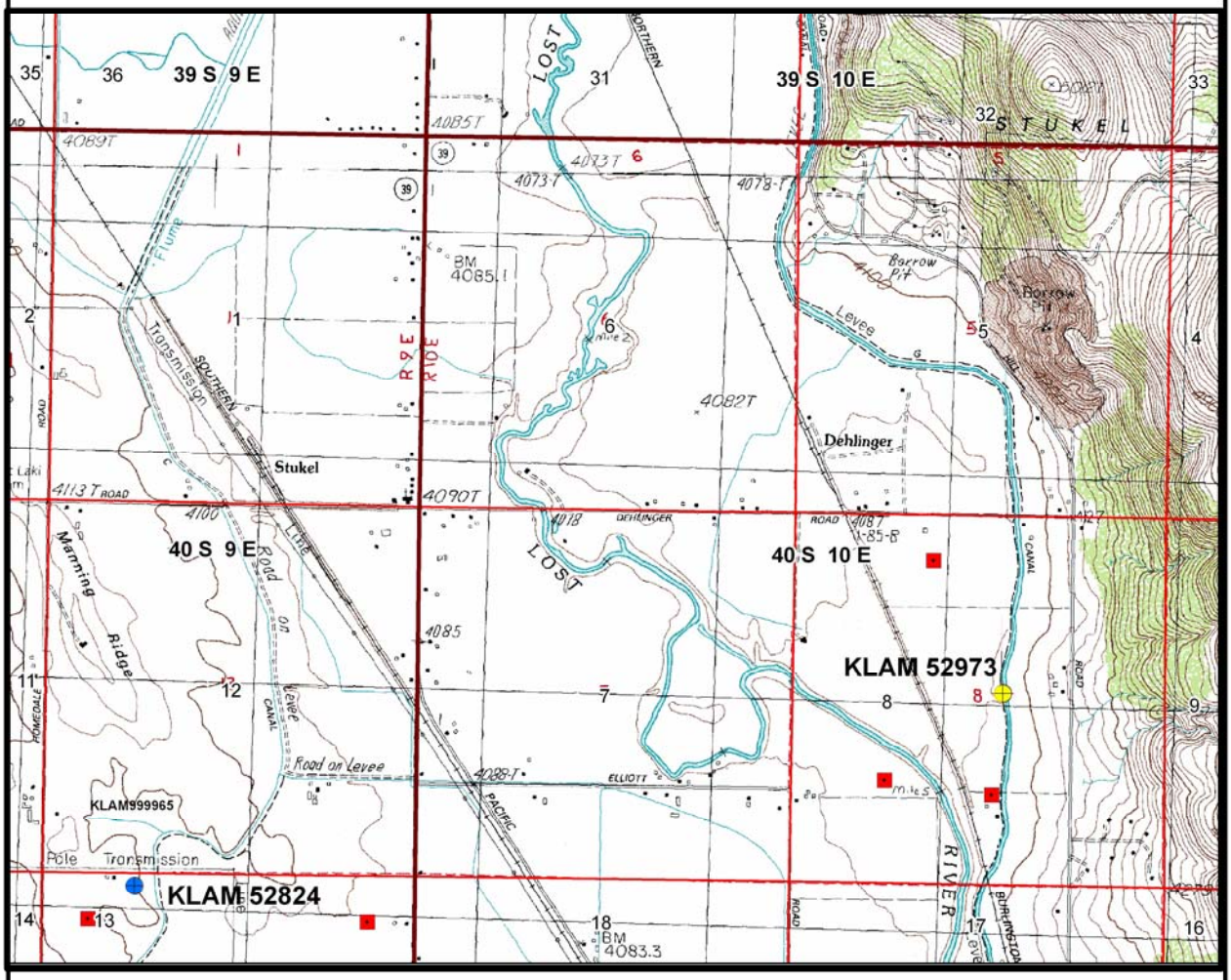
THIS SECTION TO BE COMPLETED BY ENFORCEMENT PERSONNEL

D7. ☐ Well construction deficiency has been corrected by the following actions: _____

_____ _____, 200____.
(Enforcement Section Signature)

D8. ☐ **Route to Water Rights Section (attach well reconstruction logs to this page).**

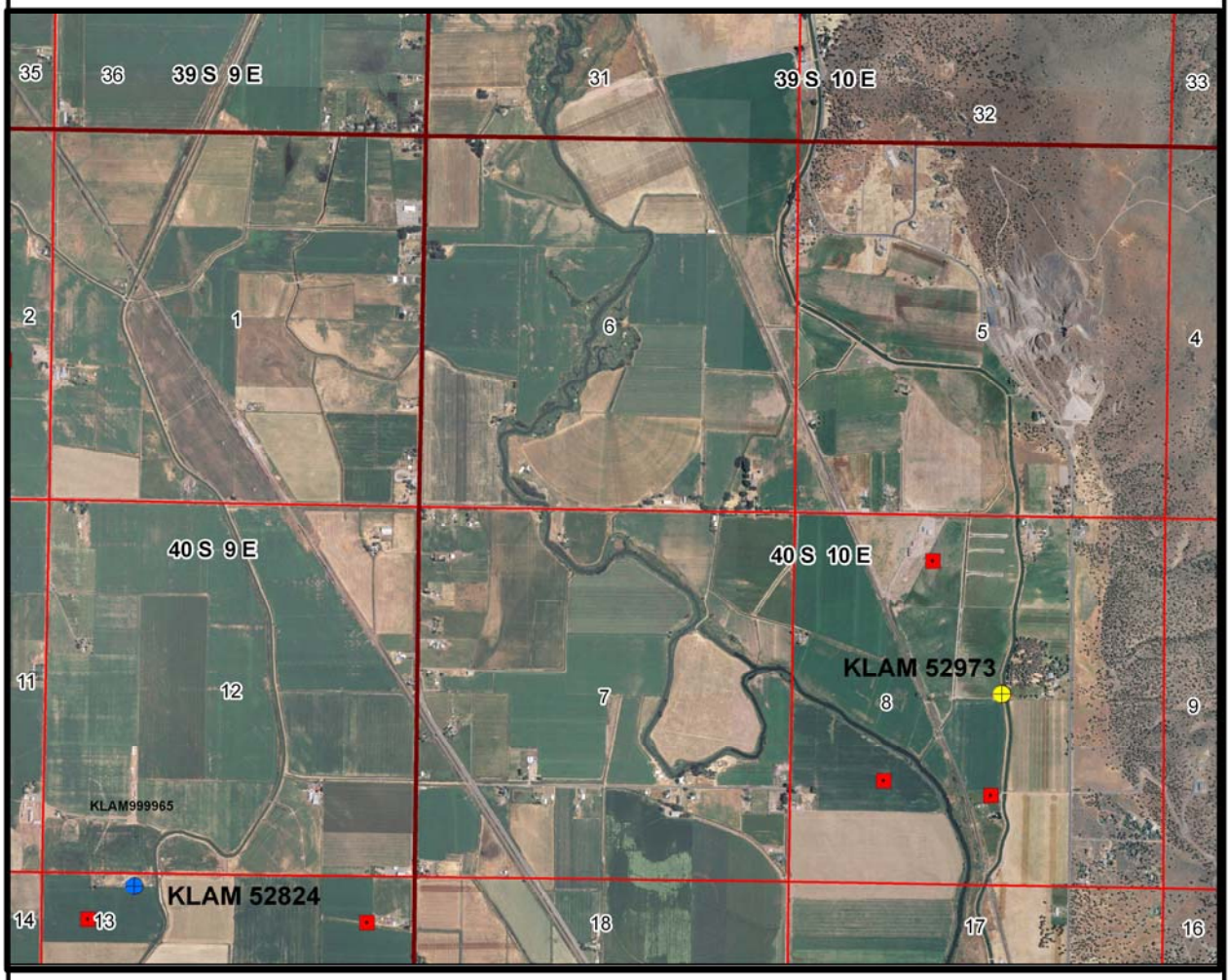
Ground Water Application G-17219
Jeffrey & Sandi Hunter



Yellow = Proposed Well = KLAM 52973
Red & Blue = Other Wells

Green = Surface Water Rights

Ground Water Application G-17219
Jeffrey & Sandi Hunter



0 0.25 0.5 1 1.5 2
Miles

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Yellow = Proposed Well = KLAM 52973
Red & Blue = Other Wells

Green = Surface Water Rights

KLAM 52973

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

WELL ID # L 49301
START CARD # 105327

(1) OWNER: Well Number: _____
Name: Jack & Connie Frank
Address: 9002 Dehlinger
City: Klamath Falls State: OR Zip: 97601

(2) TYPE OF WORK: ☒New Well ☐Deepening ☐Alteration (repair/recondition) ☐Abandonment

(3) DRILL METHOD:
☒Rotary Air ☒Rotary Mud ☐Cable ☐Auger
☐Other: _____

(4) PROPOSED USE:
☐Domestic ☐Community ☐Industrial ☒Irrigation
☐Thermal ☐Injection ☐Livestock ☐Other _____

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☐Yes ☒No
Depth of Completed Well 558'
Explosives Used ☐Yes ☒No Type --- Amount 0'

HOLE Diameter	From	To	Material	SEAL From	To	sacks or pounds
24'	0'	240'	Cement	0'	240'	175 Sacks
19"	240'	356'	---	---	---	---
12"	356'	558'	---	---	---	---

How was seal placed: Method ☐A ☐B ☒C ☐D ☐E
☐ Other _____
Backfill placed from --- to --- Material ---
from--- to --- Material ---
Gravel placed from--- to --- Size of gravel ---

(6) CASING/LINER:

CASING: Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
20"	+1	240'	.375	☒	☐	☒	☐
				☐	☐	☐	☐
				☐	☐	☐	☐
				☐	☐	☐	☐
LINER:							
16"	-230'	356'	.375	☒	☐	☒	☐
				☐	☐	☐	☐

Final location of Shoe(s): _____

(7) PERFORATIONS/SCREENS:
☒ Perforations Method: Fact Saw
☐ Screen Type: --- Material: ---

From	To	Slot Size	No.	Diameter	Tele/pipe size	Casing	Liner
230'	356	1/8x2	6210	16"		☐	☒
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gpm	Drawdown	Drill Stem at	Time
			1 hr.
2500	110		24 hrs

Temperature of water 68 Depth Artesian Flow Found ---
Was a water analysis done? --- By whom: ---
Did any strata contain water not suitable for intended use? (explain)

Depth of Strata: ---

(9) LOCATION OF WELL by legal description:
County: Klamath Latitude: _____ Longitude: _____
Township: 40S Range: 10E
Section: 8 SW ¼ SE ¼
Tax Lot: 00901 Lot: N/A Block: _____ Subdivision: _____
Street Address of Well (or nearest address) _____
9002 Dehlinger Klamath Falls OR

(10) STATIC WATER LEVEL:
11 Ft. below land surface Date 8/09/01
Artesian pressure --- lb. per sq. in. Date ---

(11) WATER BEARING ZONES:
Depth at which water was first found 249

From	To	Est. Flow Rate	SWL
249	260	1000	11
299	356	500	11
445	504	500	
504	558	1000	11

(12) WELL LOG: Ground Elevation: _____

Material	From	To	SWL
Soil Med Brn	0	2	
Sand Silty Clay	2	41	
Cinders Ash Pumi	41	66	
Clay Brn Soft	66	113	
Sand Brn Fine	113	126	
Clay Brn Med	126	210	
Cap Rock Weathered	210	230	
Basalt Blk Blue	230	249	
Basalt Weathered Brn	249	260	11
Basalt Blk Brn	260	299	
Cinders Red Loose	299	356	11
ClayStone Grey	356	445	
Basalt Loose Blk	445	504	
Basalt Blk Fract, Loose	504	558	11

RECEIVED
SEP 28 2001
WATER RESOURCES DEPT.
SALEM, OREGON

Date Started: 6/26/01 Completed: 8/09/01

(unbonded) Water Well Constructor Certification:
I certify that the work I performed on the construction, alteration,, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.
WWC Number 723
Signed _____ Date 8/30/01

(bonded) Water Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.
WWC Number 723
Signed _____ Date 8/30/01

ORIGINAL & FIRST COPY - Water Resources Department SECOND COPY - Constructor THIRD COPY - Customer

Transmissivity from Specific Capacity using the Theis Equation

Adapted from Vorhis (1979)

Theis Equation: T = [Q/(4*3.14)]W(u)

u = [r^1.5)(4*T)]

W(u) = (-ln u)-(0.5772157)+(u/1*1)-(u^u/2*2!))+(u^u^u/3*3!)-(u^u^u^u/4*4!))+...

T = transmissivity (L*L/T)
s = drawdown (L)
S = storage coefficient (dimensionless)
pi = 3.141592654

r = radial distance (L)
t = time (T)
u = dimensionless
W(u) = well function

Note: Transmissivity is derived using an iterative process

The calculations use a known or assumed Storage Coefficient (S) provided by the user
Specific Capacity (Q/s) is used to first approximate the Transmissivity (T) used to calculate u in the first Theis equation iteration
The Transmissivity of the previous iteration is used to calculate u in a given Theis equation iteration
Total Theis Equation iterations = 25 Iterations
Can accept answer if difference in calculated Transmissivity for the last 2 iterations is < 0.0001
Can accept answer if u in the last iteration is < 7.1

Note: Well efficiency is not included in the calculations

References:

Theis, C.V. 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground water storage. American Geophysical Union Transactions; 16 annual meeting, vol. 16, pg. 519-524

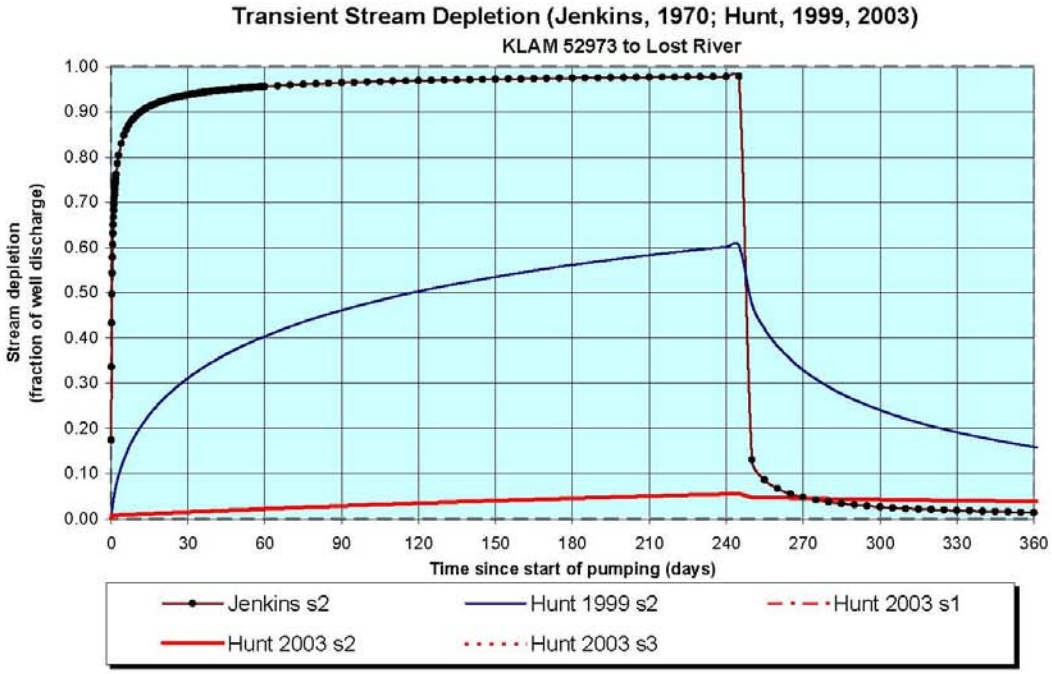
Vorhis, R.C. 1979. Transmissivity from pumped well data. Well Log, National Water Well Association newsletter, vol. 10, no. 11, Dec. 1979, pg. 50-52

Data Entry — Enter Data Below (yellow boxes only)

Well Log ID or Comment for Records	KLAM 52978	
Pumping Rate (gpm) = Q =	2,500.00	(gpm)
Drawdown (feet) = s =	110.00	(feet)
Time (hours) = t =	24.0000	(hours)
Storage Coefficient = S =	0.000650	(dimensionless)
Well Diameter (inches) = d =	12.0000	(inches)
	Press F9 to Calculate	

Calculated Results	Calculated Results	
Transmissivity (ft2/day) = T=	6,485.34	(ft2/day)
Transmissivity (gpd/ft) = T=	48,364.11	(gpd/ft)
Transmissivity Difference = (last 2 iterations)	0.0000E+00 okay to use T if diff < 0.0001	(ft2/day)
u = (last iteration)	4.8336E-09 okay to use T if u <7.1	

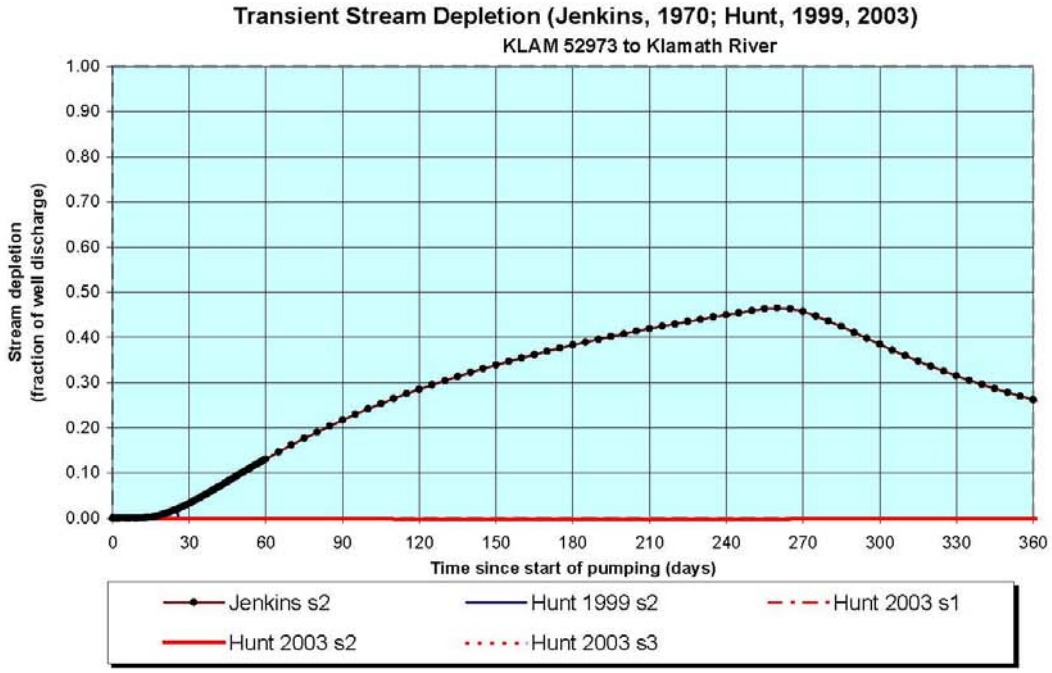
Drawdown s (feet)	Storage Coefficient S	Pumping Rate Q (gal/min)	Pumping Rate Q (ft3/sec)	Time t (days)	Distance r = d/2 (feet)	u	W(u)	Transmissivity T (ft2/day)	Transmissivity difference from previous	Comments	Theis Equation Iteration
Note: yellow grid areas are where values are calculated						Note : W(u) calculation valid when u < 7.1					
						7.0000	1.1645E-04			W(u) calculation test	
110.00	0.00050	2,500.00	5.57	1.00	0.50			4,375.00		T = Q/s	
110.00	0.00050	2,500.00	5.57	1.00	0.50	7.1429E-09	18.1799	6,329.37	1.9544E-03	T = Theis Equation	1.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.9373E-09	18.5492	6,457.94	1.2857E-02	T = Theis Equation	2.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8396E-09	18.5693	6,464.94	7.0012E-00	T = Theis Equation	3.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8338E-09	18.5704	6,465.32	3.7724E-01	T = Theis Equation	4.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	2.0314E-02	T = Theis Equation	5.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	1.0939E-03	T = Theis Equation	6.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	5.8906E-05	T = Theis Equation	7.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	3.1726E-06	T = Theis Equation	8.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	1.7081E-07	T = Theis Equation	9.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	9.1950E-09	T = Theis Equation	10.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	4.9550E-10	T = Theis Equation	11.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	2.6375E-11	T = Theis Equation	12.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	13.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	14.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	15.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	16.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	17.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	18.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	19.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	20.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	21.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	22.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	23.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	24.00
110.00	0.00050	2,500.00	5.57	1.00	0.50	4.8335E-09	18.5705	6,465.34	0.0000E+00	T = Theis Equation	25.00



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	93.7%	95.6%	96.4%	96.9%	97.2%	97.4%	97.6%	97.8%	4.8%	2.6%	1.8%	1.4%
H SD 1999	31.1%	40.4%	46.2%	50.3%	53.5%	56.1%	58.3%	60.2%	32.9%	24.0%	19.1%	15.9%
H SD 2003	1.5%	2.2%	2.9%	3.5%	4.0%	4.5%	5.0%	5.5%	4.6%	4.3%	4.1%	3.8%
Qw, cfs	6.280	6.280	6.280	6.280	6.280	6.280	6.280	6.280	6.280	6.280	6.280	6.280
H SD 99, cfs	1.956	2.536	2.898	3.159	3.361	3.525	3.662	3.779	2.066	1.509	1.202	1.000
H SD 03, cfs	0.096	0.139	0.179	0.217	0.252	0.285	0.317	0.347	0.286	0.270	0.255	0.241

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate of well	Qw	6.28	6.28	6.28	cfs
Time pump on (pumping duration)	tpon	245	245	245	days
Perpendicular from well to stream	a	1550	1550	1550	ft
Well depth	d	558	558	558	ft
Aquifer hydraulic conductivity	K	13	13	13	ft/day
Aquifer saturated thickness	b	500	500	500	ft
Aquifer transmissivity	T	6500	6500	6500	ft*ft/day
Aquifer storativity or specific yield	S	0.001	0.001	0.001	
Aquitard vertical hydraulic conductivity	Kva	2.09	2.09	2.09	ft/day
Aquitard saturated thickness	ba	400	400	400	ft
Aquitard thickness below stream	babs	400	400	400	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	75	75	75	ft
Streambed conductance (lambda)	sbc	0.391875	0.391875	0.391875	ft/day
Stream depletion factor	sdf	0.369615	0.369615	0.369615	days
Streambed factor	sbf	0.093447	0.093447	0.093447	
input #1 for Hunt's Q_4 function	t'	2.705515	2.705515	2.705515	
input #2 for Hunt's Q_4 function	K'	1.931240	1.931240	1.931240	
input #3 for Hunt's Q_4 function	epsilon'	0.005000	0.005000	0.005000	
input #4 for Hunt's Q_4 function	lamda'	0.093447	0.093447	0.093447	

G_17219_Hunter_Spring_Lake_sd_hunt_2003_1.01.xls



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	3.3%	13.1%	21.7%	28.5%	33.9%	38.3%	41.9%	45.0%	45.7%	38.5%	31.5%	26.2%
H SD 1999	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
H SD 2003	0.0%	-0.1%	-0.1%	-0.1%	-0.2%	-0.2%	-0.2%	-0.2%	-0.1%	-0.1%	0.0%	0.0%
Qw, cfs	6.280	6.280	6.280	6.280	6.280	6.280	6.280	6.280	6.280	6.280	6.280	6.280
H SD 99, cfs	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!
H SD 03, cfs	-0.002	-0.006	-0.008	-0.009	-0.010	-0.010	-0.010	-0.010	-0.008	-0.004	-0.002	0.000

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate of well	Qw	6.28	6.28	6.28	cfs
Time pump on (pumping duration)	tpon	245	245	245	days
Perpendicular from well to stream	a	42200	42200	42200	ft
Well depth	d	558	558	558	ft
Aquifer hydraulic conductivity	K	13	13	13	ft/day
Aquifer saturated thickness	b	500	500	500	ft
Aquifer transmissivity	T	6500	6500	6500	ft*ft/day
Aquifer storativity or specific yield	S	0.001	0.001	0.001	
Aquitard vertical hydraulic conductivity	Kva	2.09	2.09	2.09	ft/day
Aquitard saturated thickness	ba	100	100	100	ft
Aquitard thickness below stream	babs	75	75	75	ft
Aquitard porosity	n	0.2	0.2	0.2	
Stream width	ws	900	900	900	ft
Streambed conductance (lambda)	sbc	25.080000	25.080000	25.080000	ft/day
Stream depletion factor	sdf	273.975385	273.975385	273.975385	days
Streambed factor	sbf	162.827077	162.827077	162.827077	
input #1 for Hunt's Q_4 function	t'	0.003650	0.003650	0.003650	
input #2 for Hunt's Q_4 function	K'	5726.085538	5726.085538	5726.085538	
input #3 for Hunt's Q_4 function	epsilon'	0.005000	0.005000	0.005000	
input #4 for Hunt's Q_4 function	lamda'	162.827077	162.827077	162.827077	

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