

**Water Right Conditions
Tracking Slip**

Ground Water/Hydrology Section

File No: G-17295

Routed To: Water Rights (Kewanagh)

Township/

Range-Section: 41S/14.5E-Sec 14

Conditions Attached? ☒ yes () no

Remarks or Further Instructions:

Conditions 7B, 7N, "large"

Connected to springs

Reviewer: Gerald H. Grandin

MEMO

10 February, ~~200~~2010

FROM: GW: GERALD H. GRONDIS
(Reviewer's Name)

SUBJECT: Scenic Waterway Interference Evaluation

YES

X NO

The source of appropriation is within or above a Scenic Waterway

YES

X NO

Use the Scenic Waterway condition (Condition 7J)

Per ORS 390.835, the Ground Water Section is **able** to calculate ground water interference with surface water that contributes to a Scenic Waterway. The calculated interference is distributed below.

X Per ORS 390.835, the Ground Water Section is **unable** to calculate ground water interference with surface water that contributes to a scenic waterway; **therefore, the Department is unable to find that there is a preponderance of evidence that the proposed use will measurably reduce the surface water flows necessary to maintain the free-flowing character of a scenic waterway.**

Calculate the percentage of consumptive use by month and fill in the table below. If interference cannot be calculated, per criteria in 390.835, do not fill in the table but check the "unable" option above, thus informing Water Rights that the Department is unable to make a Preponderance of Evidence finding.

Exercise of this permit is calculated to reduce monthly flows in _____ Scenic Waterway by the following amounts expressed as a proportion of the consumptive use by which surface water flow is reduced.

[illegible]

PUBLIC INTEREST REVIEW FOR GROUND WATER APPLICATIONS

TO: Water Rights Section Date 10 February 2010

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

SUBJECT: Application G- 17295 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: U.S. Bureau of Land Management County: Klamath

A1. Applicant(s) seek(s) (100 gpm) 0.22 cfs from 1 well(s) in the Klamath Basin,
Lost River subbasin Quad Map: Brady Butte (1:24,000 scale)

A2. Proposed use: Land Management (road maintenance, construction, fire training and suppression)
Seasonality: 1 April to 31 October (214 days)

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

Well 1	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	Not Drilled	1	Basalt	0.22	41S/14.5E-sec 14 CDC	557' N, 1436' E fr SW cor S 14
2						
3						

* 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	5025	Prop. 300	Prop 100	N.A.	Prop 375	Prop 0-40	Prop 0-40+	?	?	Prop 100	?	?

Use data from application for proposed wells.

A4. Comments: _____

The proposed use is 100 gpm (0.22 cfs), 0.6 mil gal/yr (1.84 ac-ft/yr) for road maintenance, construction, fire training and suppression.

The well is not drilled yet. The well elevation was derived from the Brady Butte (1:24,000 scale) quadrangle map.

The static water level is proposed. The water well report for the only nearby well (KLAM 56582, located north of the proposed well, "near the Brady Butte Cell Tower off of Willow Valley Road") indicates the first water and the static water level may occur more than 300 feet below land surface.

A5. ☐ Provisions of the (no basin rule for the Klamath Basin). 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.

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, 7N, "large" water use condition;
 - 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: _____

If a permit is issued, include: 7B, 7N, "Large" water use condition (flowmeter required).

The proposed well is located on a lava "plateau" above and east of the south Langell Valley sub-area of the eastern (upper) Lost River sub-basin as defined in Grondin (2004). It is located between 2 perennial streams. It is east of Antelope Creek/Willow Reservoir/East Branch Lost River and both west and north of Rock Creek. Both streams discharge to the Lost River between Clear Lake and Malone Dam. Ground water flows toward south Langell Valley.

Sherrod and Picthorn (1992) indicate the surface geology on the "plateau" at the proposed well site is basalt. To the west in south Langell Valley and other the eastern Lost River sub-basin valleys, basin fill sediment overlies basalt. Ground water occurs in both the sediment and basalt with the highest yield occurring in the basalt. Ground water in the sediments is hydraulically connected to ground water in the basalt. This observation is based upon current eastern Lost River sub-basin ground water investigation data, Grondin (2004), and Gannett and others (2007).

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.

The state observation well closest to the proposed well is state observation well SOW 295 (well KLAM 15130) located within south Langell Valley about 9.2 miles west of the proposed well. The water level data is from 1954 to 2008. The data shows seasonal and long term fluctuations. The seasonal fluctuations correspond to seasonal of ground water recharge and ground water use. The data show a larger seasonal drawdown occurred in 1992 and 2001. The long term fluctuation corresponds to long-term precipitation trend variations. The data indicates a possible water level decline in the sub-area. Ground water levels before the mid-1980s are generally 1 to 2 feet higher than afterward.

Limited ground water level data from 1993 through 2008 exists for well KLAM 10803 located on the "lava plateau" about 6.2 miles west of the proposed well and about 1.6 miles west of Willow Valley Reservoir. Eight measurements at the well show mostly 3 foot variability in the ground water level depending upon season. The lowest levels measured occurred during dry years. The ground water elevation at this well is upgradient, but close to the elevation of ground water within south Langell Valley, about 5 to 10 feet higher than at state observation well SOW 295 (well KLAM 15130). It appears to be within the relatively flat hydraulic ground water gradient within south Langell Valley. Conversely, the ground water elevation at this well (KLAM 10803) is downgradient of the proposed well, possibly more than 300 feet lower in elevation. The hydraulic gradient between the wells is steep.

Within Langell Valley, a larger seasonal ground water level drawdown occurred in 2001 and 2009 due to greater ground water pumping. This is notable and raises a concern given the larger drawdown interfered with discharge at springs having senior water rights and a request for regulation. The connection between ground water and the springs in south Langell Valley is documented in Grondin (2004).

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	☐	☒
		☐	☐
		☐	☐
		☐	☐

Basis for aquifer confinement evaluation: _____

At the proposed well on the "lava plateau", the likely aquifer is basalt given little to no sediment overlies the basalt in the area depending on location and given the information provided on the water well report for nearby well KLAM 56582. It is identified as unconfined given the information provided on the water well report for nearby well KLAM 56582, first water at 375 feet blsd and static water level of 370 feet blsd.

West of the "lava plateau" within south Langell Valley, current eastern Lost River sub-basin ground water investigation data indicates low yield basin fill sediments overlie higher yielding basalt in the valleys. Local irrigation wells typically produce from the basalt. Ground water occurs in both the sediments and the basalt. Ground water in the basalt is hydraulically connected to ground water in the sediments making an unconfined aquifer with different hydraulic conductivities. The average basin fill sediment thickness along the south Langell Valley axis is about 280 ft based upon the water well reports for multiple wells. The sediment thickness at Kilgore Spring and the other south Langell Valley springs is less.

- 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?			Potential for Subst. Interfer. Assumed?	
						YES	NO	ASSUMED	YES	NO
1	1	Rock Creek	4750	4750	13,600	☒	☐	☐	☐	☒
1	2	Duncan Spring/Antelope Creek/East Branch Lost River	4750	4735	15,200	☒	☐	☐	☐	☒
1	3	Kilgore Spring and other springs	4750	4136	51,500	☒	☐	☐	☐	☒
						☐	☐	☐	☐	☐

Basis for aquifer hydraulic connection evaluation: _____

Rock Creek is identified as a perennial stream that flows southwest across the "lava plateau" to the Lost River. The closest reach and downstream are downgradient from the proposed well site.

Duncan Spring/Antelope Creek/East Branch Lost River are all the same drainage. The stream is identified as perennial beginning at Duncan Spring. It also flows southwest across the "lava plateau" to the Lost River. The closest reach and downstream are downgradient from the proposed well site.

Kilgore Spring and other springs are located within south Langell Valley. Current eastern Lost River sub-basin ground water investigation data indicates basalt ground water in the south Langell Valley sub-area is hydraulically connected to the Lost River primarily via Kilgore and other springs and weakly elsewhere through overlying low hydraulic conductivity sediments. The springs are downgradient from the proposed well site.

The ground water elevation at the proposed well was derived by subtracting the static water level on the water well report for nearby well KLAM 56582 from the land elevation (Brady Butte quadrangle map, 1:24,000 scale) for that well location noted on the same well report.

The Rock Creek elevation was derived from the Sagebrush Butte quadrangle map (1:24,000 scale).

The elevation of Kilgore Spring and other springs were derived from the Langel Valley (1:24,000 scale) quadrangle map.

Water Availability Basin the well(s) are located within: Lost River Sub-Basin (LOST R > TULE L – AB MILLER CR)

[illegible]

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?
	☐			☐		☐		☐
	☐			☐		☐		☐
	☐			☐		☐		☐
	☐			☐		☐		☐

No evaluation. All surface water identified is more than one-mile from the proposed well site.

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	26.41%	21.69%	18.27%	8.82%	20.56%	29.01%	35.29%	40.17%	44.08%	47.32%	43.04%	33.20%
Well Q as CFS		0.0000	0.0000	0.0000	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0000	0.0000
Interference CFS		0.0011	0.0009	0.0008	0.0004	0.0009	0.0012	0.0015	0.0017	0.0019	0.0020	0.0019	0.0014
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.		0.0011	0.0009	0.0008	0.0004	0.0009	0.0012	0.0015	0.0017	0.0019	0.0020	0.0019	0.0014
(B) = 80 % Nat. Q		47.90	141.00	184.00	96.60	44.40	17.40	11.90	8.68	7.90	6.55	11.80	21.70
(C) = 1 % Nat. Q		0.4790	1.4100	1.8400	0.9660	0.4440	0.1740	0.1190	0.0886	0.0790	0.0655	0.1180	0.2170
(D) = (A) > (C)		No	No	No	No	No	No	No	No	No	No	No	No
(E) = (A / B) x 100		0.0023%	0.0006%	0.0004%	0.0004%	0.0020%	0.0069%	0.0126%	0.0196%	0.0241%	0.0305%	0.0161%	0.0065%

(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:

The Hunt (1999) model was used to calculate interference with Rock Creek given little to no sediment overlies the basalt on the lava "plateau" depending on location. Sediment is likely present in the vicinity of the stream.

The Hunt (1999) used a transmissivity of 2,000 ft²/day; a storage coefficient of 0.001 (an intermediate value); streambed conductivity of 0.20 ft/day (1/100 of the aquifer conductivity); and a streambed thickness of 10 feet. The transmissivity was derived from specific capacity data for well KLAM 54689 located on the lava "plateau" near Gerber reservoir. Other wells on the "plateau" with water well reports did not have specific capacity data. Like the proposed well, well KLAM 54689 is located where the ground water gradient is steep toward the valley to the west. The transmissivity of 2,000 ft²/day is much lower than the 600,000 ft²/day estimated for south Langell Valley (see Grondin, 2004). This difference is considered appropriate given the much steeper ground water gradient in the vicinity of the proposed well and the much flatter gradient within south Langell Valley.

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	26.95%	22.34%	18.93%	6.56%	17.28%	25.50%	31.77%	36.72%	40.73%	44.07%	41.86%	33.36%
Well Q as CFS		0.0000	0.0000	0.0000	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0043	0.0000	0.0000
Interference CFS		0.0012	0.0010	0.0008	0.0003	0.0007	0.0011	0.0014	0.0016	0.0018	0.0019	0.0018	0.0014
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													
(A) = Total Interf.		0.0012	0.0010	0.0008	0.0003	0.0007	0.0011	0.0014	0.0016	0.0018	0.0019	0.0018	0.0014
(B) = 80 % Nat. Q		47.90	141.00	184.00	96.60	44.40	17.40	11.90	8.68	7.90	6.55	11.80	21.70
(C) = 1 % Nat. Q		0.4790	1.4100	1.8400	0.9660	0.4440	0.1740	0.1190	0.0886	0.0790	0.0655	0.1180	0.2170
(D) = (A) > (C)		No	No	No	No	No	No	No	No	No	No	No	No
(E) = (A / B) x 100		0.0025 %	0.0007 %	0.0004 %	0.0003 %	0.0016 %	0.0063 %	0.0118 %	0.0184 %	0.0228 %	0.0290 %	0.0153 %	0.0065 %

(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:

The Hunt (1999) model was used to calculate interference with Antelope Creek/East Branch Lost River given little to no sediment overlies the basalt on the lava "plateau" depending on location. Sediment is likely present in the vicinity of the stream.

The Hunt (1999) used a transmissivity of 2,000 ft²/day; a storage coefficient of 0.001 (an intermediate value); streambed conductivity of 0.20 ft/day (1/100 of the aquifer conductivity); and a streambed thickness of 10 feet. The transmissivity was derived from specific capacity data for well KLAM 54689 located on the lava "plateau" near Gerber reservoir. Other wells on the "plateau" with water well reports did not have specific capacity data. Like the proposed well, well KLAM 54689 is located where the ground water gradient is steep toward the valley to the west. The transmissivity of 2,000 ft²/day is much lower than the 600,000 ft²/day estimated for south Langell Valley (see Grondin, 2004). This difference is considered appropriate given the much steeper ground water gradient in the vicinity of the proposed well and the much flatter gradient within south Langell Valley.

The Theis equation was used to calculate ground water drawdown at Duncan Spring at the end of 30 and 214 days of pumping. Interference with spring flow could not be calculated at this time. At the proposed rate of 100 gpm, the drawdown is 0.15 feet and 1.11 feet respectively at the end of 30 and 210 days of pumping. At a pro-rated pumping rate of 1.93 gpm (total proposed annual volume divided by 214 days), the drawdown is 0.003 feet and 0.021 feet respectively at the end of 30 and 210 days of pumping.

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	3	%	%	%	%	%	%	%	%	%	%	%	%
Well Q as CFS													
Interference CFS													
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.													
(B) = 80 % Nat. Q													
(C) = 1 % Nat. Q													
(D) = (A) > (C)													
(E) = (A / B) x 100		%	%	%	%	%	%	%	%	%	%	%	%

(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:

Both interference and drawdown at Kilgore Springs could not be calculated at this time. The aquifer characteristics appear to change from a lower transmissivity (2,000 ft²/day) in the vicinity of the proposed well site to a much higher transmissivity (600,000 ft²/day) in south Langell Valley where Kilgore Springs is located.

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:
- ☐ The permit should contain condition #(s) _____;
 - ☐ The permit should contain special condition(s) as indicated in "Remarks" below;

C6. SW / GW Remarks and Conditions _____

If a permit is issued, include: 7B, 7N, "Large" water use condition (flowmeter required).

The proposed well is hydraulically connected to two creeks that drain to the Lost River: Rock Creek and Duncan Springs/Antelope Creek/East Branch Lost River (same drainage). It is also connected to Kilgore Springs and other fault related springs in south Langell Valley.

At Duncan Springs, ground water level drawdown from the proposed use could be calculated, but interference with spring flow could not be calculated at this time.

At Kilgore Springs, both interference and drawdown could not be calculated at this time. The aquifer characteristics appear to change from a lower transmissivity (2,000 ft²/day) in the vicinity of the proposed well site to a much higher transmissivity (600,000 ft²/day) in south Langell Valley where Kilgore Springs is located.

Within Langell Valley, a larger seasonal ground water level drawdown occurred in 2001 and 2009 due to greater ground water pumping. This is notable and raises a concern given the larger drawdown interfered with discharge at springs having senior water rights, particularly Kilgore Springs, and caused a request for regulation. The connection between ground water and the springs in south Langell Valley is documented in Grondin (2004).

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.

Hunt, B., 1999, Unsteady stream depletion from ground water pumping: Ground Water, v. 37, no. 1, p. 98-102.

Jenkins, C.T., 1970, Computation of rate and volume of stream depletion by wells: U.S. Geol. Survey Techniques of Water- Resources Investigations of the United States Geological Survey, Chapter D1, Book 4, 17 p.

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.

Sherrod, D.R., and Pickthorn, L.G., 1992, Geologic map of the west half of the Klamath Falls 1° by 2° Quadrangle, south-central Oregon: U.S. Geological Survey Miscellaneous Investigations Series, Map I-2182, scale 1:250,000, 1 sheet.

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.

Theis, 1941, The effect of a well on the flow of a nearby stream: American Geophysical Union Trans., v. 22, pt. 3, p. 734-738.

Hydrographs and ground water level data for wells KLAM 15130 (state observation well 295), KLAM 14889, and KLAM 10803

Water well reports for wells KLAM 56582, KLAM 54689

USGS quadrangle maps (1:24,000 scale): primarily Langell Valley, Brady Butte, Sagebrush Butte

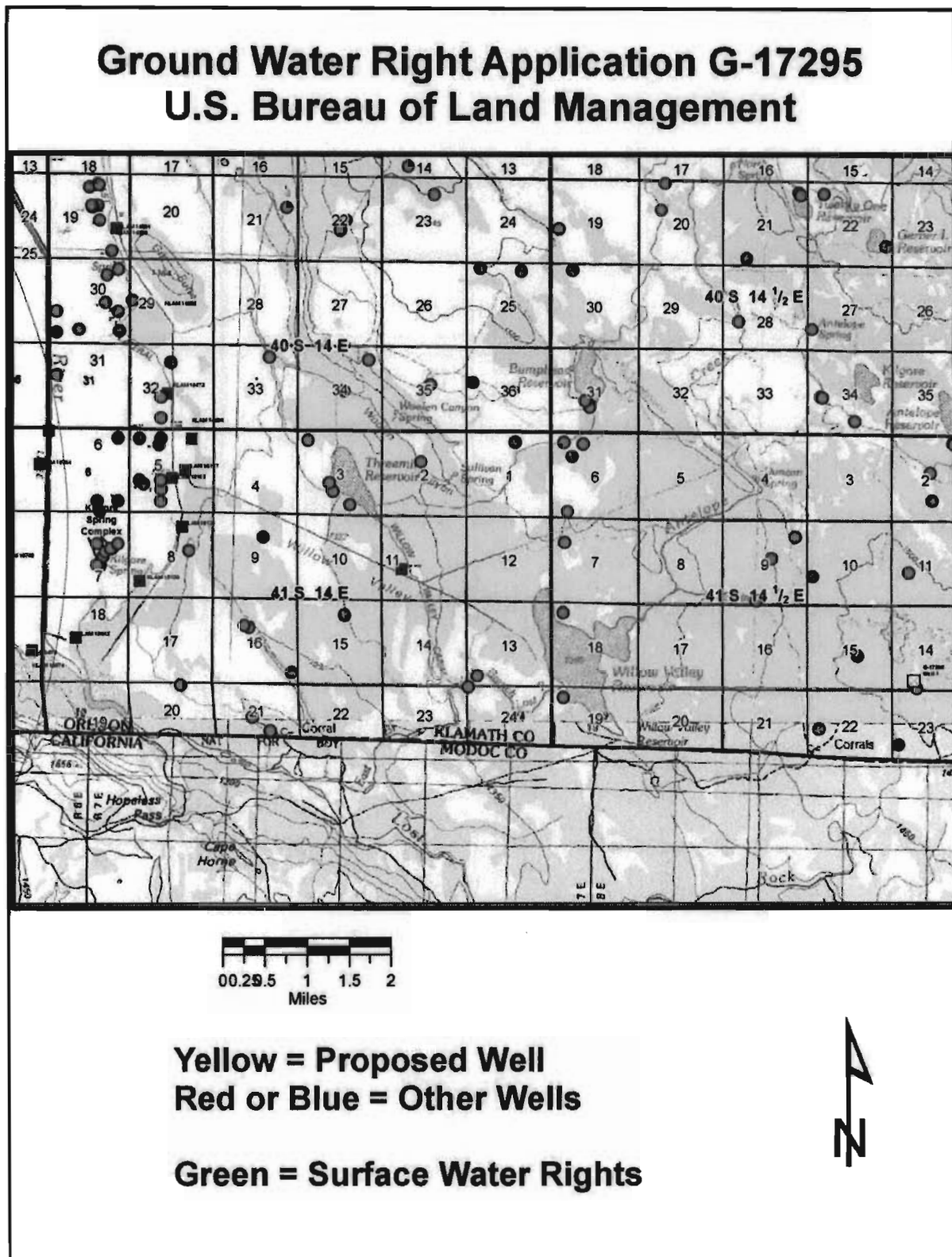
D. WELL CONSTRUCTION, OAR 690-200

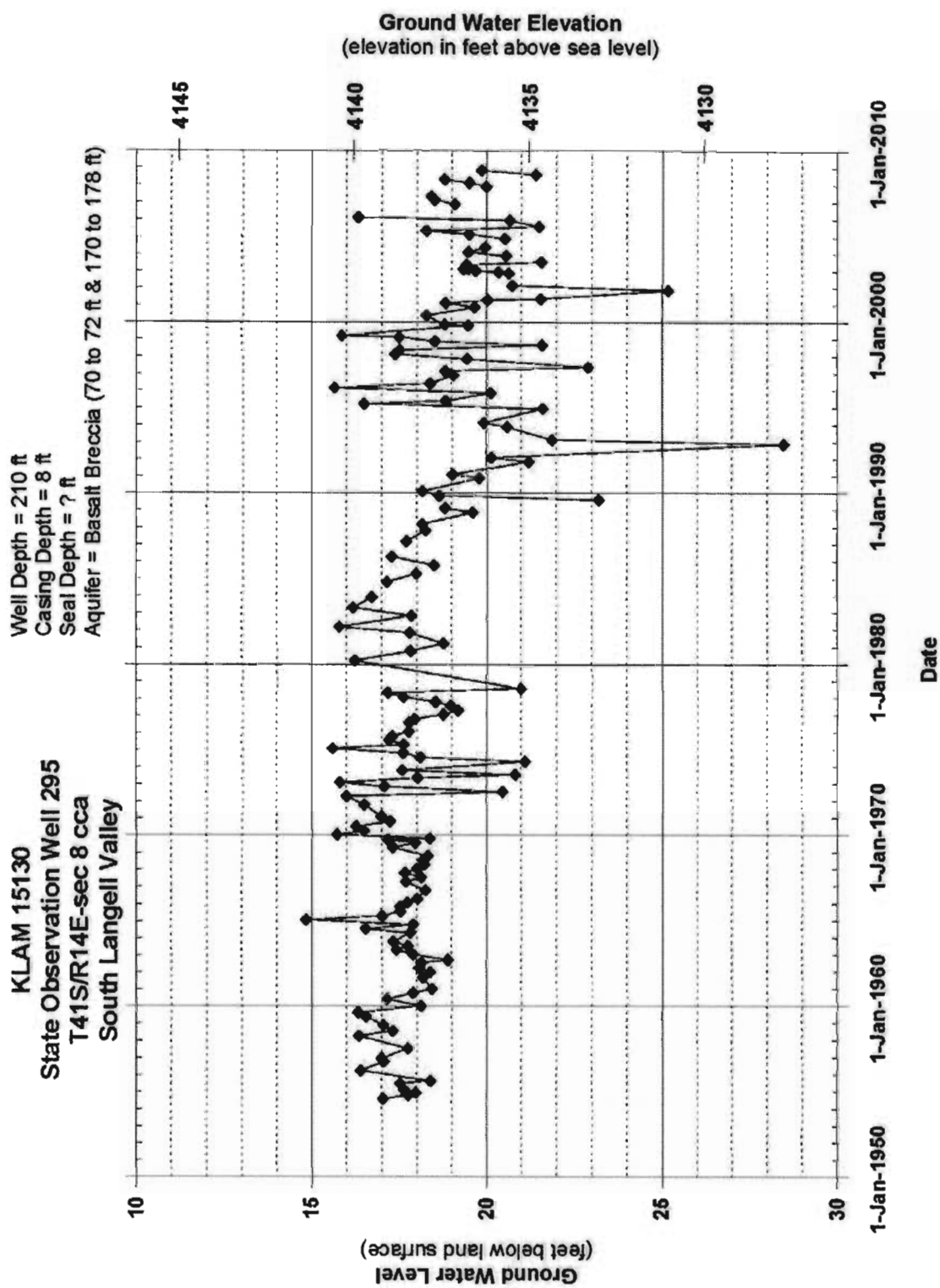
- D1. Well #: 1 Logid: Not Drilled Yet
- D2. **THE WELL does not meet current well construction standards based upon:**
- a. ☐ review of the well log;
 - b. ☐ field inspection by _____;
 - c. ☐ report of CWRE _____;
 - d. ☐ other: (specify) _____
- D3. **THE WELL construction deficiency:**
- a. ☐ constitutes 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:** N.A.
- D5. **WELL KLAM 14891** a. ☐ well 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.
- D6. ☐ **Route to the Enforcement Section.** I recommend withholding issuance of the permit until evidence of well reconstruction is filed with the Department and approved by the Enforcement Section and the Ground Water Section.

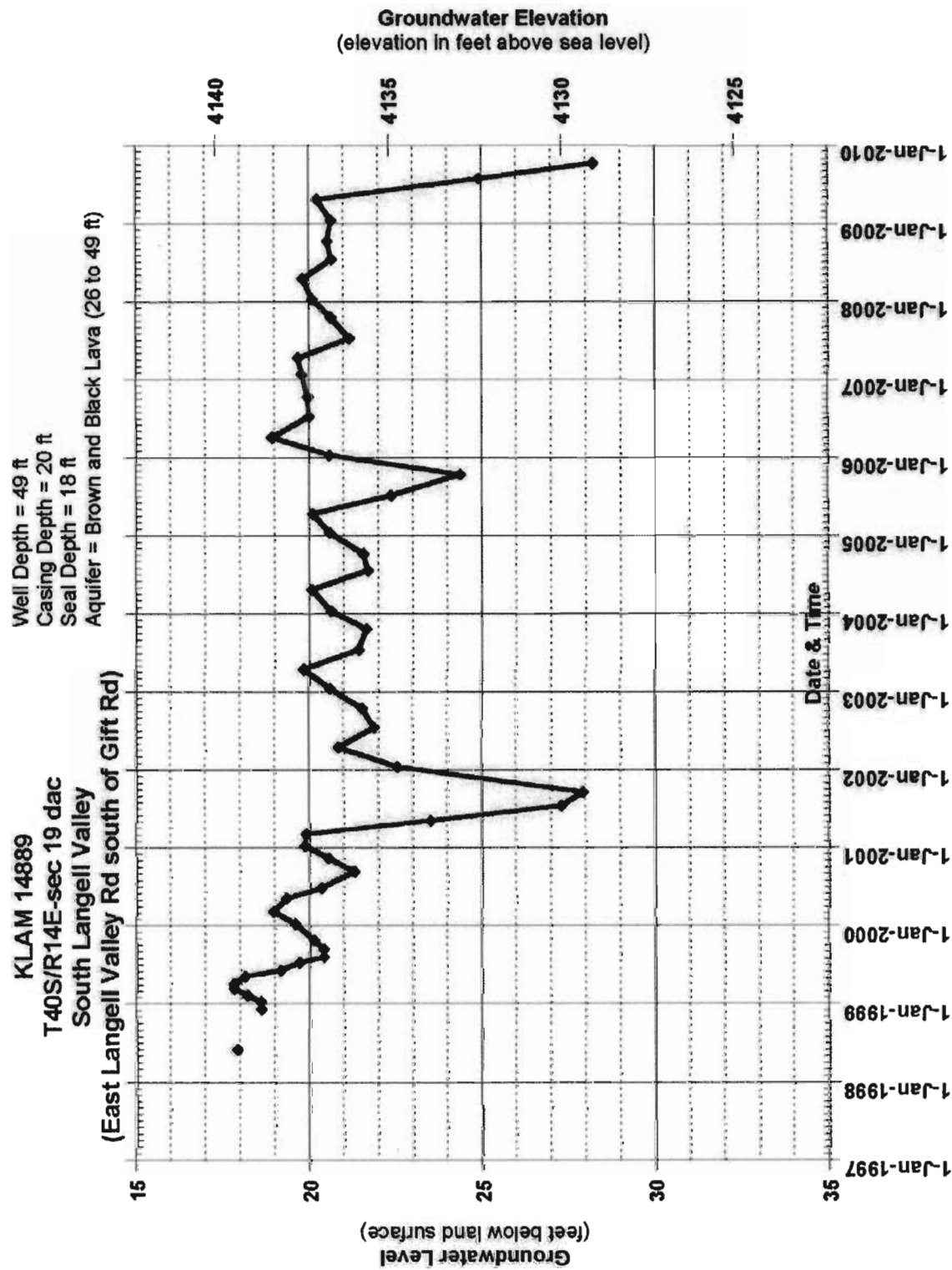
THIS SECTION TO BE COMPLETED BY ENFORCEMENT PERSONNEL

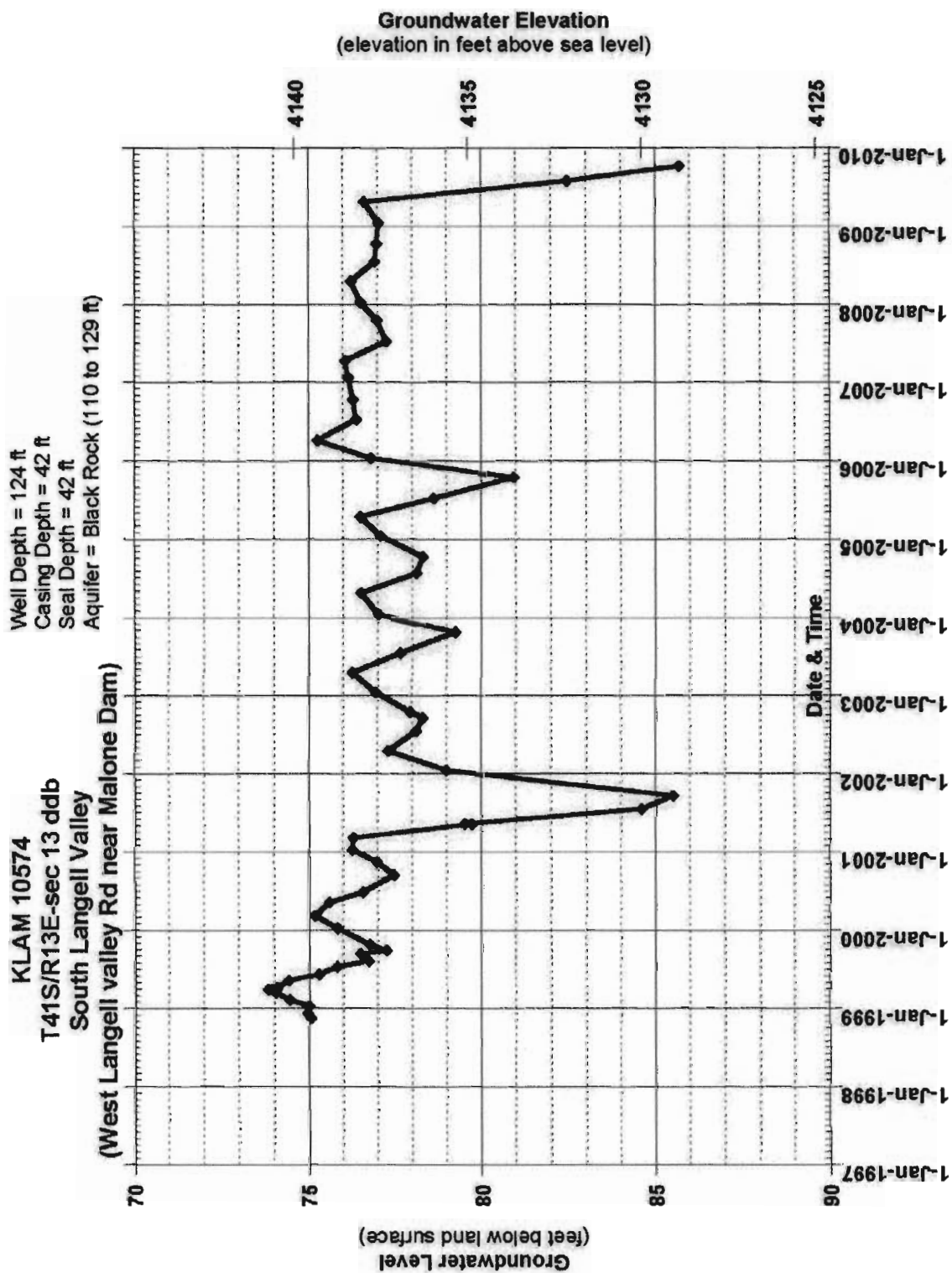
- D7. ☐ Well construction deficiency has been corrected by the following actions: _____
- _____, 200____.
- (Enforcement Section Signature)

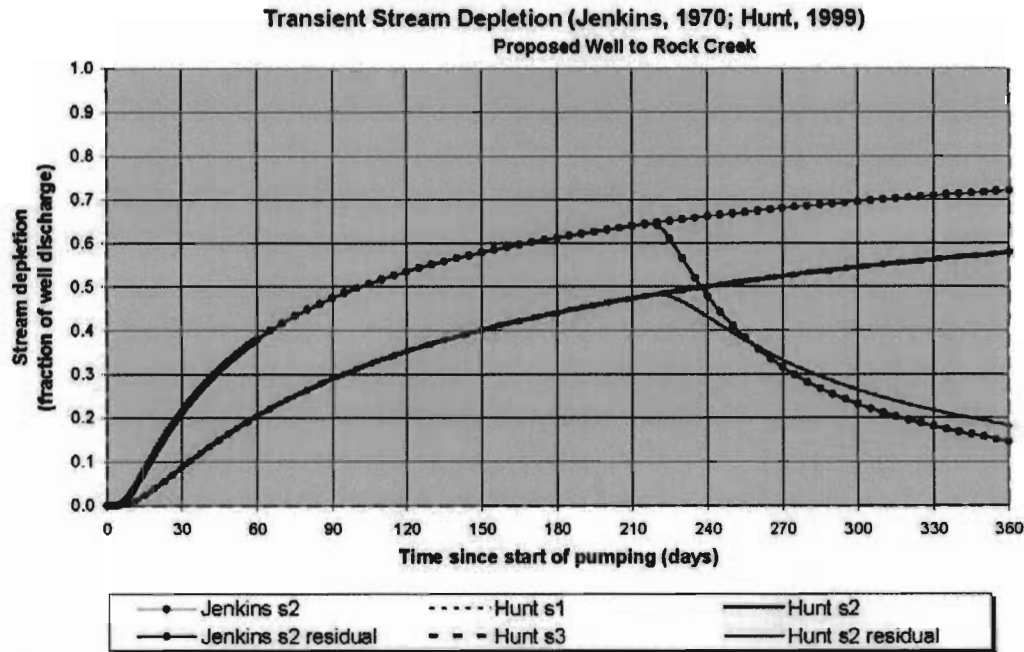
- D8. ☐ **Route to Water Rights Section** (attach well reconstruction logs to this page).











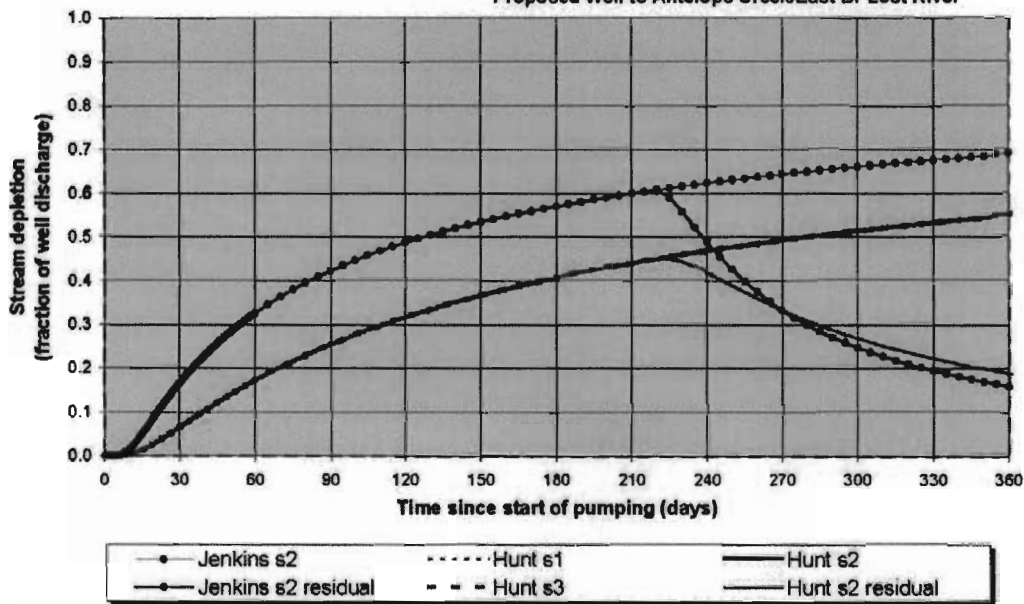
Output for Hunt Stream Depletion, Scenario 2 (s2): Time pump on = 214 days

Days	30	60	90	120	150	180	210	240	270	300	330	360
Hunt SD s2	0.0882	0.2056	0.2901	0.3529	0.4017	0.4408	0.4732	0.4304	0.3320	0.2641	0.2169	0.1827
Qw, cfs	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
H SD s2, cfs	0.000	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate	Qw	0.0043	0.0043	0.0043	cfs
Distance to stream	a	13600	13600	13600	ft
Aquifer hydraulic conductivity	K	20	20	20	ft/day
Aquifer thickness	b	100	100	100	ft
Aquifer transmissivity	T	2000	2000	2000	ft ² /day
Aquifer storage coefficient	S	0.001	0.001	0.001	
Stream width	ws	25	25	25	ft
Streambed hydraulic conductivity	Ks	0.2	0.2	0.2	ft/day
Streambed thickness	bs	10	10	10	ft
Streambed conductance	sbc	0.5	0.5	0.5	ft/day
Stream depletion factor (Jenkins)	sdf	92.48	92.48	92.48	days
Streambed factor (Hunt)	sbf	3.4	3.4	3.4	

Transient Stream Depletion (Jenkins, 1970; Hunt, 1999)

Proposed Well to Antelope Creek/East Br Lost River



Output for Hunt Stream Depletion, Scenario 2 (s2): Time pump on = 214 days

Days	30	60	90	120	150	180	210	240	270	300	330	360
Hunt SD s2	0.0656	0.1728	0.2550	0.3177	0.3672	0.4073	0.4407	0.4188	0.3336	0.2695	0.2234	0.1893
Qw, cfs	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
H SD s2, cfs	0.000	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001

Parameters:		Scenario 1	Scenario 2	Scenario 3	Units
Net steady pumping rate	Qw	0.0043	0.0043	0.0043	cfs
Distance to stream	a	15200	15200	15200	ft
Aquifer hydraulic conductivity	K	20	20	20	ft/day
Aquifer thickness	b	100	100	100	ft
Aquifer transmissivity	T	2000	2000	2000	ft ² /day
Aquifer storage coefficient	S	0.001	0.001	0.001	
Stream width	ws	25	25	25	ft
Streambed hydraulic conductivity	Ks	0.2	0.2	0.2	ft/day
Streambed thickness	bs	10	10	10	ft
Streambed conductance	sbc	0.5	0.5	0.5	ft/day
Stream depletion factor (Jenkins)	sdf	115.52	115.52	115.52	days
Streambed factor (Hunt)	sbf	3.8	3.8	3.8	

G_17295_BLM_S_Langell_Tule_Lake_Hunt_1999_depletion.xls

Drawdown Calculations Using Thies Equation

Thies Equation: $s = [Q(u^* \pi)] / [4T] W(u)$
 $u = (r^2 S) / (4Tt)$
 $W(u) = (-\gamma \ln u) - (0.5772157) + (\gamma \ln 2.2) + (u^* u^{0.5772157}) + (u^* u^{1.15427}) + (u^* u^{1.7618}) + (u^* u^{2.41549}) + \dots$
 s = drawdown (L)
 T = transmissivity (L²/T)
 S = storage coefficient (dimensionless)
 π = 3.141592654
 r = radial distance (L)
 t = time (T)
 u = dimensionless
 $W(u)$ = well function

Transmissivity T (gpd-ft)	Transmissivity T (m ² /day)	Storage Coefficient S	Pumping Rate Q (gal/min)	Pumping Rate Q (ft ³ /sec)	Time t (days)	Distance r (feet)	u	W(u)	Drawdown s (feet)	Comments
Note: yellow grid areas are where values are calculated										
Application G-17295 Proposed Well to Duncan Spring										
14,961.04	2,000.00	0.00100	100.0000	0.2228	30.00	16,000.00	3.14	0.1864	0.1504	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	60.00	16,000.00	3.14	0.5333	0.3893	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	90.00	16,000.00	3.14	0.3556	0.7631	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	120.00	16,000.00	3.14	0.2687	0.9944	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	150.00	16,000.00	3.14	0.2133	1.1702	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	180.00	16,000.00	3.14	0.1778	1.3202	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	210.00	16,000.00	3.14	0.1524	1.4509	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	240.00	16,000.00	3.14	0.1333	1.5667	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	270.00	16,000.00	3.14	0.1185	1.6706	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	300.00	16,000.00	3.14	0.1067	1.7647	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	330.00	16,000.00	3.14	0.0970	1.8506	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	360.00	16,000.00	3.14	0.0889	1.9301	Continuous Pumping at Full Rate
Note: W(u) calculation valid when u < 7.1										
							7.0000	1.1545E-04		W(u) calculation test
14,961.04	2,000.00	0.00100	100.0000	0.2228	30.00	16,000.00	3.14	0.1864	0.1504	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	60.00	16,000.00	3.14	0.5333	0.3893	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	90.00	16,000.00	3.14	0.3556	0.7631	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	120.00	16,000.00	3.14	0.2687	0.9944	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	150.00	16,000.00	3.14	0.2133	1.1702	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	180.00	16,000.00	3.14	0.1778	1.3202	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	210.00	16,000.00	3.14	0.1524	1.4509	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	240.00	16,000.00	3.14	0.1333	1.5667	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	270.00	16,000.00	3.14	0.1185	1.6706	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	300.00	16,000.00	3.14	0.1067	1.7647	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	330.00	16,000.00	3.14	0.0970	1.8506	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	100.0000	0.2228	360.00	16,000.00	3.14	0.0889	1.9301	Continuous Pumping at Full Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	30.00	16,000.00	3.14	0.1864	0.0029	Pro-Rated Pumping Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	60.00	16,000.00	3.14	0.5333	0.0077	Pro-Rated Pumping Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	90.00	16,000.00	3.14	0.3556	0.0116	Pro-Rated Pumping Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	120.00	16,000.00	3.14	0.2687	0.0147	Pro-Rated Pumping Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	150.00	16,000.00	3.14	0.2133	0.0173	Pro-Rated Pumping Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	180.00	16,000.00	3.14	0.1778	0.0196	Pro-Rated Pumping Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	210.00	16,000.00	3.14	0.1524	0.0214	Pro-Rated Pumping Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	240.00	16,000.00	3.14	0.1333	0.0232	Pro-Rated Pumping Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	270.00	16,000.00	3.14	0.1185	0.0247	Pro-Rated Pumping Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	300.00	16,000.00	3.14	0.1067	0.0261	Pro-Rated Pumping Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	330.00	16,000.00	3.14	0.0970	0.0274	Pro-Rated Pumping Rate
14,961.04	2,000.00	0.00100	1,9300	0.0043	360.00	16,000.00	3.14	0.0889	0.0285	Pro-Rated Pumping Rate

[illegible]