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DEPARTMENT OF
WATER RESOURCES

February 14, 2012

Mat Weaver, P.E.
Idaho Department of Water Resources
322 East Front Street
P.O. Box 83720
Boise, ID 83720-0098

*Subject: City of Nampa, Well 16 Water Right Licensing
Permit No. 63-33022*

Dear Matt:

In your review of the beneficial use field examination for water right permit 63-33022, you questioned whether City of Nampa Well 16 is capable of producing a diversion rate of 8.50 cfs. Your concern was based on the fact that the well was test pumped at a peak rate of only 7.98 cfs, and for only 90 minutes. The pumping water level did not stabilize within the 90 minute test. You also noted that during a subsequent 24-hour constant-rate pumping test, the well produced only 6.72 cfs. This letter provides the basis for my belief that Well 16 can produce a sustainable diversion rate of 8.50 cfs, and that the only limitation to producing this rate is the capacity of the installed pump.

Well 16 was constructed in 2008, and is equipped with 16-inch casing to a depth of 390 feet and 10-inch casing and well screen from 390 to 520 feet. The well was test pumped in March 2008.

Test pumping consisted of a 7.5-hour step-rate pumping test on March 10, 2008 and a 24-hour constant-rate pumping test on March 11 and 12, 2008. The information gained from test pumping aids in prediction of long-term and short-term pumping water levels, which is used for proper selection of pumping equipment.

The purpose of the step-rate portion of a pumping test is to evaluate the water-level response in a well at various pumping rates. In an ideal well that is 100% efficient, the specific capacity (i.e., gpm per foot of drawdown) will remain constant for any pumping rate at any particular elapsed pumping time. In reality, no well is 100 percent efficient at all potential pumping rates because turbulence typically results in head losses as flow rates increase above some level. In the case of Nampa Well 16, the step-rate test demonstrated that the efficiency of Well 16 is essentially constant at all tested rates up to the maximum rate of 3570 gpm (7.98 cfs). This is shown in Figure 4-2 from the CH2M Hill Well Installation Report. Note that for each pumping rate step, the additional increment of drawdown is essentially constant at 23 gpm/ft. These test results demonstrate that the drawdown at any

reasonable pumping rate in this well, for a given time since the start of pumping, will be directly proportional to the pumping rate.

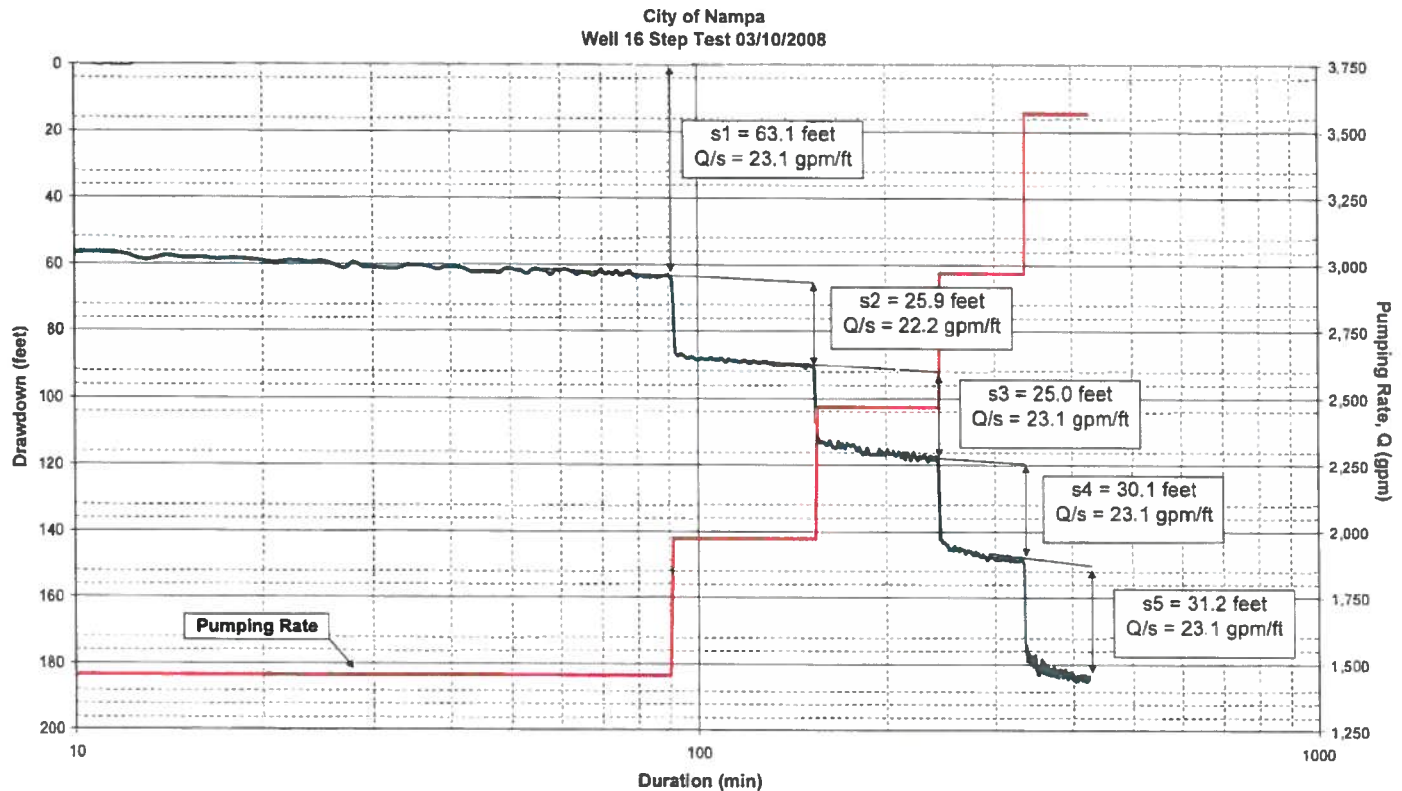
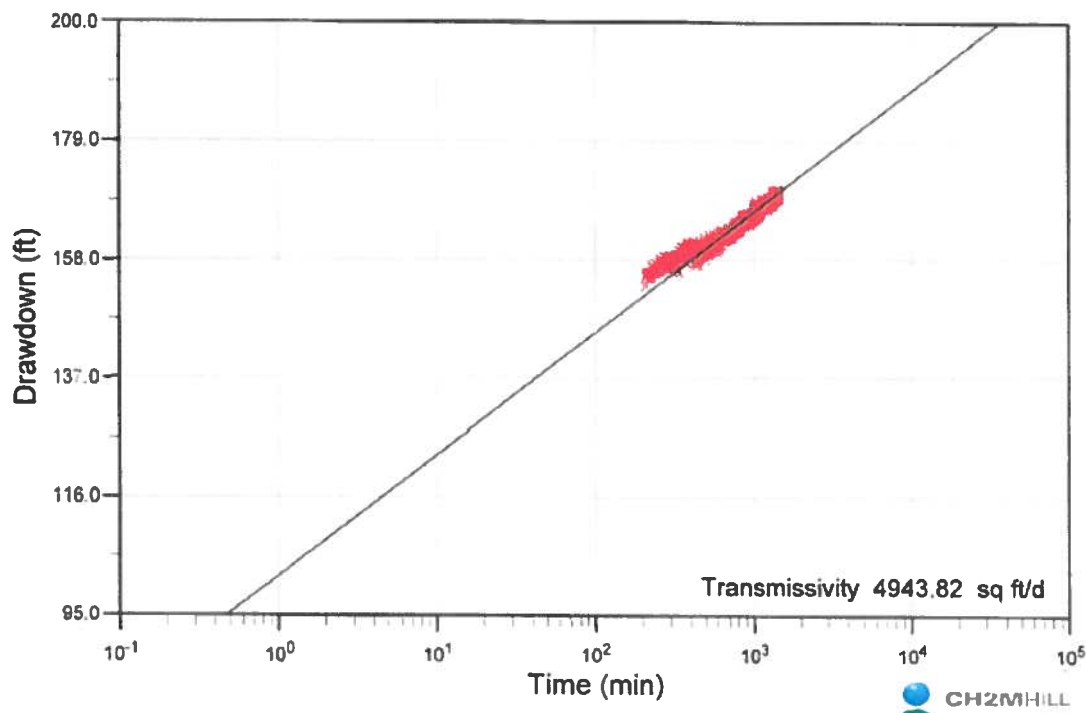


Figure 4-2
Well 16 Drilling Construction and Testing
City of Nampa

The purpose of the constant-rate portion of a pumping test is to evaluate the water-level response in a well to sustained pumping. The information gained after the first few minutes of the constant-rate test is related more to the hydraulics of the aquifer than to the hydraulics of the well. For example, in an ideal confined aquifer, the drawdown in a well under constant-rate pumping will follow a straight line plotted on a logarithmic time scale. In such a case, the water level in a well will continue to decline throughout a pumping period, but the rate of decline after weeks or months of pumping may be so small as to be undetectable. This response is to be expected of a fully confined aquifer of infinite extent. Although such a condition does not exist in nature, many wells in the Treasure Valley respond in such a manner, at least over a time period of days or weeks. In contrast, the constant-rate test pumping response for many wells does not plot a straight line due to negative aquifer boundaries (such as faults, or decreases in aquifer permeability or thickness at some distance from the well), positive aquifer boundaries (such as recharge from a surface water body, or an increase in aquifer thickness or permeability), or leakage of water into the aquifer from overlying or underlying aquifers or confining units. The constant-rate pumping test will demonstrate whether the response of a well to pumping over an extended period results in

more drawdown (i.e., negative boundaries) or less drawdown (positive boundaries or leakage) than predicted from short-term testing. In the case of the Nampa Well 16, drawdown during the 24-hour test period followed a straight line on a logarithmic time scale as shown on Figure 4-5 from the CH2M Hill Well Installation Report. Reported drawdown after 24-hours of pumping at 3,015 gpm (6.72 cfs) was 170 feet, resulting in a 24-hour specific capacity of 17.7 gpm/ft. The rate of water level decline during the test period is 21.5 feet per log cycle on Figure 4-5.

Figure 4-5 Well 16 Cooper-Jacob Analysis



The step-rate and constant-rate test responses allow prediction of pumping water levels for any elapsed time of continuous pumping at a reasonable pumping rate.

For time periods greater than the duration of the constant-rate test, predictive calculations assume that the test trend will continue. Such assumptions are customary and appropriate for predictions over reasonable time periods (10 to 100 times the constant-rate test length), particularly in aquifers without known nearby boundaries.

For pumping rates higher than the tested rate, the predictive calculations can either (1) assume that the specific capacity remains constant at the higher rate, or (2) assume that the specific capacity is lower at the higher pumping rate. The decision to use a constant specific capacity or a lower specific capacity is a judgment call, and typically depends on the step-

rate test response and on the percent increase in prediction pumping rate over the tested rate.

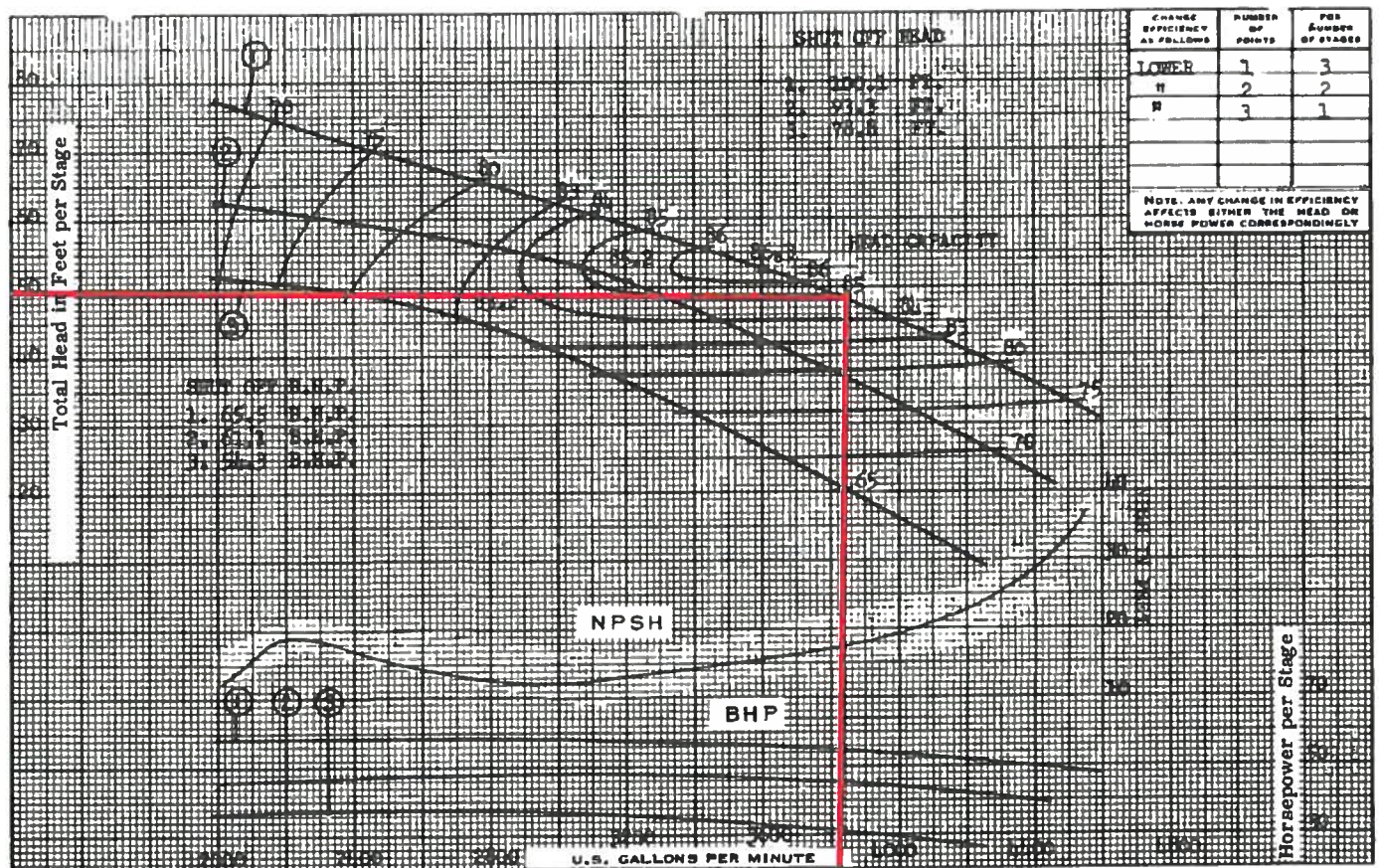
Predicted water levels for Well 16 under constant-rate pumping conditions are provided in the following table for flow rates of 3015 gpm (constant-rate pumping test rate), 3570 gpm (step-rate pumping test maximum rate) and 3815 gpm (8.5 cfs rate needed for full permit development). Predicted pumping water levels at the 8.5 cfs rate are 211, 238, and 266 feet for pumping durations of 1, 10, and 100 days, respectively.

Pumping Rate		Time		Drawdown	Static Water Level	Pumping Water Level
gpm	cfs	minutes	days	Feet	feet below ground surface	feet below ground surface
3015	6.72	1,440	1	170	-4	166
3015	6.72	14,400	10	192	-4	188
3015	6.72	144,000	100	213	-4	209
3570	7.95	1,440	1	201	-4	197
3570	7.95	14,400	10	227	-4	223
3570	7.95	144,000	100	252	-4	248
3815	8.50	1,440	1	215	-4	211
3815	8.50	14,400	10	242	-4	238
3815	8.50	144,000	100	270	-4	266

The specific capacity for the 3815 pumping rate was not adjusted downward for these predictions, because the 3815 gpm rate is only 6% greater than the 3570 gpm step-rate test maximum. Given that the tested specific capacity did not vary at step-rate tested flows up to the 3570 rate, there is no reason to anticipate a significant decline in specific capacity for such a small increment in additional flow. However, if the specific capacity did decline at the higher rate, I would not expect that the decline would add more than an additional 20 feet of drawdown.

Well 16 is constructed with 16-inch casing to a depth of 390 feet. As a result, it is possible to install a pump to a depth of more than 350 feet. Such a setting depth is more than sufficient to produce 8.5 cfs based on the pumping water level predictions above.

Perhaps the greatest challenge in producing 8.5 cfs from Well 16 would be to install a pump capable of producing such an amount from a 16-inch O.D. (15.25-inch I.D. well casing). This rate is near the maximum rate for nominal 14-inch turbine pumps at 1770 rpm. An example pump curve capable of producing 8.5 cfs (Peerless 14HH) is shown below. This rate would require a 500-hp motor if pumping directly into the distribution system at 70 psi or a 350-hp motor if pumping to a surface booster pump.



14HH

Curve No. 2846901 (10-74)

Impeller No. 2621959

1785 RPM

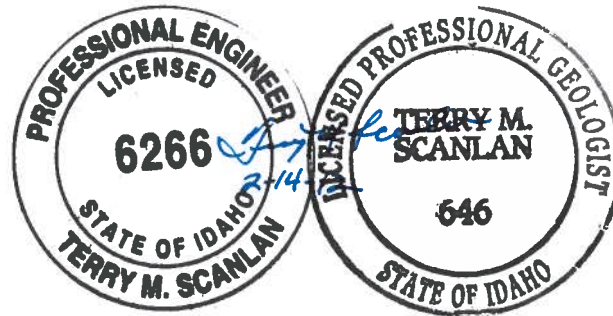
Note that the City could also decide to produce 8.5 cfs from two wells in the future, instead of one. The test pumping data also demonstrates that the aquifer is capable of producing such a rate, and two wells at the same site might provide more flexibility for varying water demands.

Please contact me with any questions.

Sincerely,



Terry M. Scanlan, P.E., P.G.
Principal Engineer/Hydrogeologist



cc: Michael Fuss, P.E. – City of Nampa
Chris Meyer – Givens Pursley

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