

MEMORANDUM

Date: December 16, 2011
To: Water Right File 47-7964
From: medl
Re: license review

Additional information solicited in 2002 was not added to the file until my review. I was not able to document the source or the "received" date for many of them. I organized those documents by content for scanning and profiling into the file.

This permit has a lengthy history. For quick reference here is a short listing of key dates.

Time line

January 26, 1984 The permit was issued
August 15 - September 26, 1984 The geothermal well was drilled
October 1 - 2, 1984 A well pump was installed and the well was tested
November 28, 1984 Well log records show use of the well but the nature of the use is unclear
July 17, 1985 Well log records show heat exchangers were installed and tested. Both Twin Falls High School and Sawtooth Elementary School are places-of-use.

Early 1990's A geothermal pipe serving TFHS breaks and is not repaired or replaced.
March 16, 1995 The Proof of Beneficial Use statement was received
October 16, 2001 The Beneficial Use Field Exam was conducted

Applicant

Twin Falls School District No 411 is the permit holder. The school district's clerk-treasurer signed the application.

Source and POD

The geothermal source is a well is located on school district property. It is currently housed within the boiler room in the heating plant building at the Twin Falls High School. It is in the Twin Falls Ground Water Management Area (TFGWMA) and has the following identifiers:
USGS well #423421114270801 10S 17E 10 BDB1
IDWR Geowell #750; tag A0003157
POD shape was created by the field examiner and is based on his GPS coordinates of the location.

Water Use

Well capacity

According to a well pumping test conducted October 1 - 2, 1984, the source well was able to sustain a constant withdrawal of 195 gpm (~0.43 cfs). Pumping more than 195 gpm resulted in a drawdown of the well. There is evidence in the file that the school district regularly exceeded the sustainable rate during the school year.

The well log records show that the well level recovers during the summer months of 1986 – 1988 when the schools were out of session.

Well pump

The pump curve for the original submersible well pump was available in file documents. The curve shows that pump was capable of pumping more than the well could sustain and that the design point on the pump curve appears at 200 gpm.

The mechanical contractor provided Operating Sequence instructions which direct that the geothermal well pump run continuously 24 hours a day, during the heating season. If this instruction was followed, then the geothermal water was not always utilized to meet the actual heating demand.

For example: well records from Wednesday, October 2, 1985, indicate that 280 gpm was pumped

continuously during the previous day while the weather data from October 1 & 2, 1985 show temperatures averaged 65 and 66 deg F.

Space heating

Space heating use was found by the examiner but the contemporary space heating is the different than what was developed during the period that the permit was active. The geothermal water formerly circulated through 2 school district buildings: Twin Falls High School and Sawtooth Elementary School before discharging to the sewer. In the fall of 1985, the heating system had 4 heat exchangers in place. I don't have schematic of the system, but I believe that they were installed in series not in parallel. The largest heat exchanger used a geothermal flow rate of 170 gpm. The other 3 units were designed to operate at lower rates.

Domestic hot water

There is evidence in the file that in addition to the geothermal water circulating pumps (P1 and P2) there was another pump (P3), dedicated to supplying water to high school showers. The Operation Sequence instructions direct that "the domestic water pump should run only during the daytime when the showers are in use." I assumed that this was a direct use of the geothermal water and recommend some volume to account for this use. The curve for pump P3 is available in the supplemental and is shows the design point at 30 gpm.

Place of Use

The examiner found only Sawtooth Elementary School using the geothermal water for heat during a 2001 field exam. He recommended only that school as the place-of-use. File evidence indicates that both the Twin Falls High School and Sawtooth Elementary School had been heated by the geothermal water from the same well within the development period.

The high school was first user on the system in the 1984. Sawtooth Elementary School was added as a cascaded water user in October 1985.

The heat value of the water was not exhausted by the uses in the two schools and the municipal pool was added to the cascade of users in 1989. A 75-year lease agreement between the school district and the city is part of the backfile. Although the pool use shares the well/POD, its use is authorized through a separate, dedicated permit (47-7969).

According to Twin Falls School District operation and maintenance personnel, the geothermal distribution piping for the high school developed leaks in 1990. The under-floor location of the leaks proved cost-prohibitive to correct. The piping was not repaired or replaced. Although the High School continued to use some geothermal water, the use was less throughout the 1990s and 2000's than it had been in the 1980 s.

I created the POU shapes based on available aerial photography.

Point of Discharge

The space heating was accomplished through liquid-to-liquid heat exchangers. There is no evidence that the geothermal water comingled with the school building water. And there is no evidence that any chemicals were added to the geothermal water. Water quality test results from a sample retrieved on October 2, 1984 are included in the file. The test results show the geothermal water had few problems.

The school district appears to have applied for a NPDES permit. But based on a conversation with City of Twin Falls pool facilities manager, the discharge from schools entered the sewer system, not a nearby canal system or surface waters. When the pool use was added in May of 1989, the geothermal discharge from the schools was routed to the city municipal pool before entering the sewer system.

Season of Use

The heating season of use is the entire year. Initially the heating use was confined to the school season: Fall, Winter and Spring months. After 1988, through an agreement with the School District, the geothermal water use was extended into Summer months.

Status and Combined Use

The January 19, 1988 agreement between the School District and the City of Twin Falls states that the School District has developed and is using 0.5 cfs of geothermal water. This rate is more than the well could sustain. The license will be conditioned to recognize the limitation of the well.

The well sharing agreement is referenced in the conditions for 47-7969 which was authorized October 6, 1988. Combined volume and rate limits need to be applied to both 47-7964 and 47-7969.

Calculations

I disagree with the rate and the volume recommended by the examiner.

Records from the TFGWMA show that the contemporary rate and volume use of the geothermal water is less than the maximum rate and volume I found during the development period. I believe that the school system beneficially used more water for heating in the past than they do now.

Rate

Space Heating

Four plate and frame heat exchanger, built by Tranter Inc., were installed and utilized by the heating system in 1985. Three heat exchangers are located in Twin Falls High School tunnels and served separate wings of that school. They would have operated simultaneously, in series. The engineering firm responsible for the water balance, found that the three heat exchangers in the high school actually used a total of 180 gpm geothermal water at 89 deg F.

The heat exchanger with the highest performance capacity (168 gpm) is located in Sawtooth Elementary. That exchanger was expecting 85 deg F water, which is indicative of a cascaded use. This is also consistent with Dale Thornsberry's (director of facilities 1995) statement that water was piped to Sawtooth School for use in the heating system after it had been utilized at the high school. I recommend 180 gpm or 0.40 cfs for space heating.

Domestic hot water

Pumps 1 and 2 served the radiant heat system at the two schools. Pump 3 was dedicated to the showers at Twin Falls High School. That pump's curve shows 30 gpm as the design operating point. In October 1985, Felts-House Engineering balanced the system to match design conditions as closely as possible and he found the pump operating at 30 gpm.

Total rate

I recommend $180 + 30 = 210$ gpm (0.47 cfs) as the total rate beneficially used. Because this is more than the well can sustain, the license will be issued to recognize the well's production limit of 0.43 cfs.

Volume

Space Heating

The design heat load for each exchanger is listed on the Tranter equipment specs sheets.

Heat exchangers 1 and 3, (Superchanger model UX-296-UJ-017), can exchange 208737.2 BTU/hr/unit

Heat exchanger 2, (Superchanger model UX-296-UJ-013), can exchange 160035.3 BTU/hr/unit

Heat exchanger 4, (Superchanger model UX-296-UP-077), can exchange 1339365.0 BTU/hr/unit

In October 1985, Felts-House Engineering balanced the system to match these design conditions as closely as possible. For my volume calculation, I use the sum of the 4 individual heat loads (1,916,874.7 BTU/hr) as the total design heat load.

I calculated the space heating volume based on an ASHRAE method for estimating heat energy use.

The equation is: $Vol = (HL \times HDD \times hr/day \times Cd) / (\Delta T1 \times K \times C \times \Delta T2)$

HL = design heat load (1916874.7 BTU/hr)

HDD = heating degree day (7743)

Hr/day (24)

Cd = correction factor for standard construction and HDD range (0.65)

$\Delta T1$ = design indoor temperature minus design outdoor temperature (70 - 9.4 = 60.6 deg F)

K = correction factor to account for losses (0.9)

C = constant to correct for units (2.72×10^6 BTU/AF-deg F)



deltaT2 = temperature of incoming geothermal water minus temperature of outgoing (92 – 84 = 8 deg F)

1985 was the year with the most heating degree days (HDD) within the development period of the permit with 7743 HDD.

I used the design temperature ASHRAE has listed for Joslin Field-Magic Valley Regional Airport. I recommend 195.09 AF for space heating.

Domestic hot water

From the School District's NDPES application, I was able to assume 1500 students attended TFHS in 1985. Department reference documents recommend 3 gal/day/pupil. In the case of 1500 pupils the shower use is: $1500 \times 3 = 4500$ gpd (~ 0.007 cfs) for 180 school days. I recommend $2.48 \text{ AF} = 0.007 \text{ cfs} \times 180 \text{ days} \times 1.9835$ for this small additional use of the geothermal water.

Total volume

I recommend $197.6 \text{ AF} = (195.1 + 2.48)$ as the total volume beneficially used. Rounded to 3 significant figures the total volume = 198.0 AF

Meaning of acronym:
DB: Dry bulb temperature, °F
WB: Wet bulb temperature, °F
MCWB: Mean coincident wet bulb temperature, °F

Lat: Latitude, °
DP: Dew point temperature, °F
MCDB: Mean coincident dry bulb temperature, °F

Long: Longitude, °
HR: Humidity ratio, grains of moisture per lb of dry air
HDD and CDD: 65 Annual heating and cooling degree-days, base 65°F, °F-days

Elev: Elevation, ft
WS: Wind speed, mph
F-day: °F-days

Station	Lat	Long	Elev	Heating DB		Cooling DB/MCWB				Evaporation		Dehumidification				Extreme		Heat/Cool Degree-Days								
				99.6%	99%	DB/MCWB	DB/MCWB	1%	2%	WB/MCDB	WB/MCDB	1%	2%	DP/HR/MCDB	DP/HR/MCDB	1%	2.5%		5%							
VALDOSTA WB AIRPORT	30.78N	83.28W	197	27.5	30.9	95.4	77.4	93.4	76.6	91.8	76.1	80.4	89.8	79.3	88.6	78.3	148.0	83.4	77.1	142.2	82.5	17.1	14.9	13.1	1509	2532
WARNER ROBINS AFB	32.63N	83.60W	302	25.0	28.2	97.3	76.1	94.9	76.0	92.8	75.3	79.8	90.9	78.5	89.5	76.9	141.6	84.5	75.5	135.0	82.9	19.0	16.5	13.9	2135	2246
4 sites, 4 more on CDD-ROM																										
BARBERS POINT NAS	21.30N	158.07W	33	59.4	61.6	90.9	73.0	89.9	73.0	88.8	72.8	77.6	85.7	76.5	85.1	75.2	132.3	82.7	73.7	125.4	82.6	19.6	17.8	16.3	0	4418
HILO INTERNATIONAL AP	19.72N	155.05W	36	61.5	62.7	83.6	74.0	84.6	73.9	83.8	73.7	76.7	82.1	76.0	81.5	75.1	131.9	79.2	74.2	127.8	78.1	17.6	15.8	13.5	0	3258
HONOLULU INTL APRT	21.33N	157.94W	16	61.2	63.3	89.9	74.0	89.1	73.6	88.2	73.4	77.2	84.8	76.3	84.2	75.0	131.3	81.3	73.9	126.3	80.6	21.8	20.0	18.7	0	4649
KANEHOE BAY MCAS	21.45N	157.77W	20	64.3	66.2	85.3	74.6	84.3	74.2	83.6	73.9	77.4	82.2	76.4	81.7	75.6	133.9	80.5	74.6	129.7	80.1	19.3	17.6	16.2	0	4297
7 sites, 7 more on CDD-ROM																										
BOISE AIR TERMINAL	43.57N	116.22W	2867	2.7	10.5	98.1	64.2	95.0	63.1	91.9	62.1	66.3	91.7	65.0	90.0	57.8	79.4	72.2	55.5	72.8	72.3	21.8	19.0	17.1	5658	890
CALDWELL (AWOS)	43.63N	116.63W	2428	11.6	16.4	97.0	66.4	93.1	65.0	90.4	63.9	68.3	92.1	66.7	89.8	60.6	86.5	77.5	57.1	76.1	77.3	21.4	18.8	16.6	5698	638
COEUR D'ALENE(AWOS)	47.77N	116.82W	2320	6.7	11.6	91.4	62.8	88.5	62.3	84.2	60.8	65.6	86.3	63.9	83.8	57.4	76.6	70.9	55.4	71.2	69.6	22.4	19.2	18.4	6892	286
IDAHO FALLS FANNING FIELD	43.52N	112.07W	4744	-8.7	-2.4	91.7	61.4	89.4	60.8	86.3	59.8	64.9	83.6	63.2	82.2	58.9	88.5	70.9	56.6	81.5	69.2	27.2	24.3	20.7	7825	275
JOSLIN FLD MAGIC VA	42.48N	114.48W	4255	9.4	12.4	94.5	63.8	91.1	63.1	89.6	62.7	66.9	89.6	65.3	86.8	59.2	88.1	75.8	56.9	80.9	74.7	27.5	24.4	20.8	6157	700
LEWISTON NEZ PERCE CNTY AP	46.38N	117.01W	1437	10.2	17.5	97.8	65.4	94.3	64.5	90.7	63.3	67.7	92.1	66.0	89.8	59.6	80.3	72.8	57.3	73.9	72.0	20.6	17.6	14.8	5124	814
POCAATELLO REGIONAL AP	42.92N	112.57W	4478	-4.9	1.3	94.4	61.8	91.3	61.1	88.3	60.2	65.4	86.5	63.7	84.4	58.9	87.7	71.2	56.3	79.7	70.6	28.1	25.0	21.9	7035	419
14 sites, 6 more on CDD-ROM																										
AURORA MUNICIPAL	41.77N	88.47W	705	-2.0	1.4	90.8	74.4	88.4	73.5	85.7	71.8	77.7	87.2	75.9	84.3	74.8	133.9	83.2	73.0	125.6	80.9	25.9	22.8	19.8	6403	711
CAHOOKIAST LOUIS	38.57N	90.15W	413	9.5	14.2	93.5	77.3	91.4	76.4	90.3	76.0	80.4	90.3	78.8	89.1	77.5	145.1	85.1	75.3	134.9	83.9	20.6	18.4	16.5	4452	1396
CHICAGO MIDWAY AP	41.79N	87.75W	617	-1.6	4.3	92.1	74.9	89.6	73.3	86.5	71.9	78.0	88.3	76.2	85.4	75.0	134.1	84.3	73.0	125.5	82.2	24.4	21.2	19.2	5930	1022
CHICAGO O'HARE INTL AP	41.99N	87.91W	673	-4.0	2.2	91.9	74.6	89.0	73.4	86.1	71.9	77.9	88.2	76.1	85.2	74.9	134.2	84.1	73.2	126.3	81.9	24.8	21.1	19.2	6311	842
DECATUR	39.83N	88.87W	699	-0.4	4.6	93.0	76.7	90.5	75.7	88.2	74.3	79.3	89.6	77.7	87.7	76.2	140.2	85.8	74.7	133.4	84.1	24.8	21.7	19.7	5529	1065
GLENVIEW NAS	42.08N	87.82W	653	-4.6	2.1	93.2	76.3	90.6	75.1	87.7	73.5	79.1	89.7	77.4	87.5	76.1	139.5	85.3	74.4	131.7	83.1	24.6	20.7	18.7	6141	999
MOLINE QUAD CITY INTL AP	41.47N	90.52W	594	-6.2	0.0	93.5	76.3	90.6	75.1	87.7	73.5	79.1	89.7	77.4	87.5	76.1	139.5	85.3	74.4	131.7	83.1	24.6	20.7	18.7	6141	999
PEORIA GREATER PEORIA AP	40.67N	89.68W	663	-3.6	2.3	92.7	76.5	90.1	75.3	87.4	73.8	79.3	89.0	77.7	87.0	75.6	137.8	84.7	74.2	131.4	83.2	24.7	21.0	19.2	5552	1100
QUINCY MUNI BALDWIN FLD	39.94N	91.19W	768	-2.0	3.3	93.3	76.4	90.4	75.3	87.8	74.2	78.6	89.1	77.4	87.8	75.3	136.5	84.0	73.5	128.1	82.0	24.6	21.0	19.2	6694	779
ROCKFORD GREATER ROCKFORD AP	42.20N	89.09W	745	-8.4	-1.7	91.5	75.0	88.5	73.7	85.8	72.0	78.2	87.8	76.3	85.0	75.3	136.5	84.0	73.5	128.1	82.0	24.6	21.0	19.2	6694	779
SCOTT AFB/LEVEILL	38.55N	89.85W	443	4.5	10.3	95.1	71.4	92.7	76.6	90.4	75.6	80.2	90.4	78.8	88.9	77.3	144.6	85.7	75.8	137.4	84.1	21.5	18.8	16.7	4638	1428
SPRINGFIELD CAPITAL AP	39.85N	89.68W	614	-2.1	4.6	92.9	76.7	90.5	75.6	88.1	74.2	79.4	89.7	77.9	87.5	76.4	140.9	85.9	74.9	134.0	84.0	24.9	21.8	19.5	5429	1135
UNIV OF ILLINOIS WI	40.03N	88.27W	774	-1.0	4.4	92.5	76.4	90.1	75.4	87.7	74.4	79.8	89.1	77.9	86.7	77.1	145.0	86.3	75.1	135.8	83.5	27.4	24.6	22.0	5657	1010
W CHICAGO/DU PAGE	41.92N	88.25W	758	-5.4	0.6	90.5	74.9	88.1	73.8	85.1	72.0	78.3	87.3	76.4	84.7	75.3	136.5	84.4	73.4	127.6	81.6	24.5	21.0	19.0	6511	736
8 sites, 1 more on CDD-ROM																										
EVANSVILLE REGIONAL AP	38.04N	87.54W	387	5.6	12.1	93.9	76.2	91.6	75.7	89.5	74.9	79.4	89.8	78.1	88.1	76.4	139.9	85.2	75.3	134.4	83.6	20.7	18.5	16.6	4449	1410
FORT WAYNE INTL AP	41.01N	85.21W	827	-2.6	3.8	91.1	74.4	88.4	73.1	85.7	71.7	77.6	87.0	75.9	84.1	74.8	134.5	82.8	73.2	127.4	80.9	24.6	20.8	18.8	6011	831
GRISSOM ARB	40.65N	86.15W	830	-3.9	3.4	92.4	75.8	89.4	74.8	86.7	72.9	79.2	89.0	77.3	85.9	76.3	141.8	85.5	74.5	133.2	83.1	24.9	20.6	18.4	5761	1025
INDIANAPOLIS INTL AP	39.71N	86.27W	807	-0.5	6.4	91.1	75.3	88.6	74.4	86.3	73.1	78.2	87.6	76.9	85.5	75.4	137.1	83.4	74.1	131.2	82.1	24.5	20.8	18.7	5322	1055
LAFAYETTE PURDUE UNIV AP	40.41N	86.94W	636	-2.3	4.2	92.4	75.6	90.0	74.6	87.5	73.2	78.8	88.7	77.2	86.3	75.9	138.6	84.8	74.4	131.8	82.9	23.1	20.0	18.3	5577	1003
MONROE CO	39.13N	86.62W	866	4.8	10.2	90.6	76.0	89.6	76.1	87.5	74.7	78.9	86.7	77.6	86.0	76.7	143.8	83.7	74.9	135.1	82.3	19.5	17.5	15.8	4936	1009
SOUTH BEND MICHIANA RGNL AP	41.71N	86.33W	774	-1.5	4.5	90.9	74.3	88.1	72.7	85.3	71.3	77.4	86.8	75.6	84.0	74.6	133.2	83.3	72.9	125.7	81.0	24.1	20.5	18.6	6188	810
TERRE HAUTE/HULMAN	39.45N	87.32W	574	-0.3	6.6	92.1	76.6	90.1	75.9	87.8	74.6	79.6	88.9	78.0	86.9	76.9	143.2	85.4	75.2	134.9	83.5	22.8	19.5	17.9	5194	1085
9 sites, 19 more on CDD-ROM																										
AMES MUNI ARPT	42.00N	93.62W	955	-5.8	0.5	90.5	76.1	88.3	74.9	85.6	73.8	79.2	87.4	77.3	85.6	76.8	144.5	84.9	74.8	134.9	82.7	26.5	23.6	20.2	6388	794
ANKENY REGIONAL AP	41.68N	93.55W	902	-5.4	0.4	94.9	75.2	91.1	74.4	88.3	73.2	77.8	89.1	76.4	87.2	74.6	133.9	84.0	73.0	126.8	82.7	20.7	18.4	16.5	5954	1063
BOONE MUNI	42.05N	93.85W	1161	-5.8	0.4	91.3	77.8	89.8	76.7	86.2	74.4	81.0	89.0	78.9	86.1	79.0	157.4	86.2	76.8	146.1	84.6	26.4	23.5	20.3	6328	894
CEDAR RAPIDS MUNICIPAL AP	41.88N	91.71W	873	-9.6	-3.9	91.6	76.0	88.6	74.4	86.7	73.0	78.6	87.4	77.0	85.9	76.2	141.4	84.3	74.3	132.2	82.2	26.3	23.2	20.2	6703	807
DAYENPORT NEXRAD	41.62N	90.58W	830	-3.4	1.3	90.3	76.2	88.1	75.4	84.4	73.1	78.5	87.0	77.1	85.2	75.4	137.5	83.5	74.5	133.2	82.7	26.4	23.6	20.4	6188	808
DES MOINES INTL AP	41.54N	93.67W	965	-6.9	-1.6	93.4	76.2	90.2	75.0	87.3	73.5	78.4	88.9	77.1	87.3	75.4	138.1	84.7	73.9	131.1	83.4	25.6	22.8	19.9	6988	649
DUBUQUE REGIONAL AP	42.40N	90.70W	1079	-8.2	-2.6	89.3	74.8	86.3	73.3	83.5	71.2	77.6	86.0	75.5	83.1	75.1	137.3	83.1	73.9	128.3	83.6	25.6	22.8	19.9	6988	649
SIoux CITY SIOUX GATEWAY AP	42.39N	96.38W	1102	-8.8	-3.6	94.3	75.2	90.4	74.4	87.7	73.0	78.6	88.6	77.1	87.2	75.9	140.9	84.9	73.9	131.6	83.6	28.7	25.4	22.7	6721	921
WATERLOO MUNICIPAL AP	42.55N	92.40W	879	-12.7	-6.3	91.8	75.5	88.8	73.8	86.1	72.4	78.5	87.87													

History for Twin Falls, ID

January 1, 1985 through December 31, 1985 — View Current Conditions

January 1, 1985 through December 31, 1985

January 1 1985 - TO - December 31 1985

	Max	Avg	Min	Sum
Temperature				
Max Temperature	96 °F	55 °F	7 °F	
Mean Temperature	83 °F	46 °F	4 °F	
Min Temperature	71 °F	36 °F	-1 °F	
Degree Days				
Heating Degree Days (base 65)	62	21	0	7743
Cooling Degree Days (base 65)	18	2	0	635
Growing Degree Days (base 50)	33	7	0	2537
Dew Point				
Dew Point	64 °F	30 °F	-5 °F	
Precipitation				
Precipitation	0.00 in	0.00 in	0.00 in	0.00 in
Snowdepth	-	-	-	-
Wind				
Wind	69 mph	10 mph	0 mph	
Gust Wind	52 mph	28 mph	17 mph	
Sea Level Pressure				
Sea Level Pressure	31.14 in	30.09 in	29.38 in	