TELUS

Update to previous reports to reflect change in usage.

Chloe Cartwright <chloec@telus.net>

Invoice 10641 - Chinook Ridge

Ken Hugo <khugo@gritltd.com> Wed, Feb 15, 2023 at 1:36 PM
To: Chloe Cartwright <chloec@telus.net>

Hi Chloe

I had a look at the conditions for the preliminary certificate. It says you will get a license upon submission of some more information - usually routine things. Specifically it says you have to submit as built drawings of the water pumping, treatment and distribution system - so "as built" means when the system is in place, not a design for what the system will look like. So you can get your license when Alberta Environment is convinced that your system is actually built.

A minor amendment to the preliminary certificate needs to be made - the water is stated to be used for "recreational and commercial purposes", which is a little vague. Section 3.3 of the conditions says that the water can only be used for these purposes. You would need to ask for a license amendment to change the use from "recreational and commercial purposes" to "residential community supply". A letter quoting the Preliminary Certificate No. and File No. to Alberta Environment and Protected Areas should do the trick (Alberta Environment does not really care what the water is used for, so they shouldn't mind amending the certificate). The preliminary certificate owner (that's you) has to submit the preliminary certificate amendment application.

Since you got the preliminary certificate a lot of these things are done on-line through the MADI-B and DRAS system - but as your application pre-dates the introduction of these systems perhaps paper copies and emails is still the way to go.

I do see that the conditions also want the usual water metering, water level measurement, etc. so that will all have to be done in due time. Other than that, in terms of water supply, I think when you do your application to RVC you just have to state that you are using a community source and you have already obtained a preliminary certificate from Alberta Environment saying you have secured 4134 cubic metres of water per year (sufficient for 10 lots).

Ken
[Quoted text hidden]

SOLSTICE
Environmental Management

Chinook Ridge
285049, Range Rd 35
Madden, AB T0M 0S0

October 11, 2020

Attention Ms. Cartwright,

Dear Ms. Cartwright:

RE: Results of the pumping test conducted on Water Supply Well for License (GIC Well 2090656) on September 15 – 19, 2020 and update to water supply requirements

WATER SUPPLY REQUIREMENTS

Groundwater usage for the site in based on an 81-stall full service RV Park, a 14 suite hotel and a 500 seat banquet hall. All facilities operate year-round.

Water demands for a full-service RV Park, based on Table 2.2.2.2.B in the Safety Codes Council Alberta Private Sewage Systems Standard of Practice (2014) is 180 litres per campsite per day, or a maximum of 5,325 m^3/year.

Water demands for the banquet hall, based on Golf Club usage of 113 litres per day per seat, is calculated at 20,637 m^3/year.

Hotel usage is calculated at 90 litres per bed per day. Assuming two beds per room water demands for the hotel is calculated at 920 m^3/year.

In addition to the above services a small amount of irrigation water will also be required on an annual basis of approximately 100 m^3.

The total annual water requirements for operating the RV park, hotel, banquet hall and for minor irrigation is 26,982 m^3.

PUMPING TEST

A 48-hour pumping test was conducted on Chinook Ridge's supply well (GIC ID 2090656) from September 15 – 19, 2020 by personnel from Wild Rose Water Wells. Water levels were measured in Chinook Ridge's supply well, two observation wells on Chinook Ridge property, one well on Jim Davies' property and one well on Karen Singer's property.

The purpose of the investigation was two fold: 1. A previous report undertaken by Stantec indicated a lower well productivity towards the end of the 24 hour test conducted in 2011 and this longer term test was undertaken to see if this trend continues, and; 2) To see if neighbouring wells are on the same aquifer as the aquifer utilized by Chinook Ridge and whether pumping of the water will adversely affect the neighbouring wells.

The location of the supply well and all observation wells are shown in Figure 1. The GPS location of all wells were measured by personnel from Solstice using a handheld Garmin64s. Well depths of the wells

on the Chinook Ridge property were measured to confirm the placement of the wells with respect to the well records. Elevation measurements were made with an optical transit of the Chinook Ridge and Davies wells.

Water level measurements were undertaken by placing Solinst pressure transducers in all wells with the exception of the Davies well as Mr. Davies requested nothing be placed down his well. Water levels were read in the Davies well with the aid of a Ravensgate Model 300 sonic water level device which measures water levels by sending a sound wave down the well. All transducers were cleaned with disinfectant and new rope was used prior to placement down the well.

A barometric transducer was installed at the site during the pumping test which allowed for barometric corrections of the wells that had pressure transducers in them. No large changes in barometric pressures were noted during the duration of the test.

The buildup period could have lasted longer however the readings show that buildup rates were very slow at the end of the 48 hour buildup period and no useful data would be obtained by further measurement.

An air photo showing well locations is as follows:

FIGURE 1. Aerial Image Showing Location of Supply and Observation Wells

The three Chinook Ridge wells are in close proximity with the Davies well being approximately twice the distance than the two Chinook Ridge monitoring well. The Singer well is located approximately 1300 m away from the Chinook Ridge well. Calculations based on the aquifer parameters in the Stantec report and utilizing the Cooper-Jacob formula indicated that the Singer well would see no response to pumping during the test.

The publicly available well details for all wells are summarized in Table 1. The Water Well Drilling Reports for each well are attached to this letter report.

TABLE 1. Supply and Observation Well Details

Parameters	Chinook Ridge Supply Well	Chinook Ridge South Obs Well	Chinook Ridge SW Obs Well	K. Singer Obs Well	J. Davies Obs Well
GIC Well ID	2090656	2090655	2090609	1240306	392001
GPS Location	51°25'57.32"N, 114°24'41.44"W	51°25'59.05"N, 114°24'50.50"W	51°25'57.90"N, 114°24'37.51"W	51°25'22.74"N, 114°23'56.56"W	51°25'58.33"N, 114°24'47.34"W
Well Depth (m BGS[1])	14.63	10.67	14.33	27.43	16.76
Aquifer Zone (m BGS)	9.45 – 15.24	8.23 – 10.67	8.53 – 14.33	20.12 – 21.95	10.67 – 16.76
Screened Interval (m BGS)	10.06 – 13.72	8.53 – 10.67	10.67 – 13.72	21.34 – 27.43	10.67 – 16.76
Surface Casing (m)	+0.75 - ?	+0.85 - ?	+0.62 - ?	+0.51 – 6.10	+0.3 – 6.10
Static water level after installation (m, BTC[2])	6.54	7.77	7.60	6.47	12.19
Static water level prior to pumping test (m, BTC)	5.40	5.05	6.30	6.13	3.78
Top of Casing Elevation (masl[3])	1212.00	1214.20	1213.07	1236.51	1212.71
Ground Elevation (masl)	1211.25	1213.35	1212.45	1236.00	1212.41

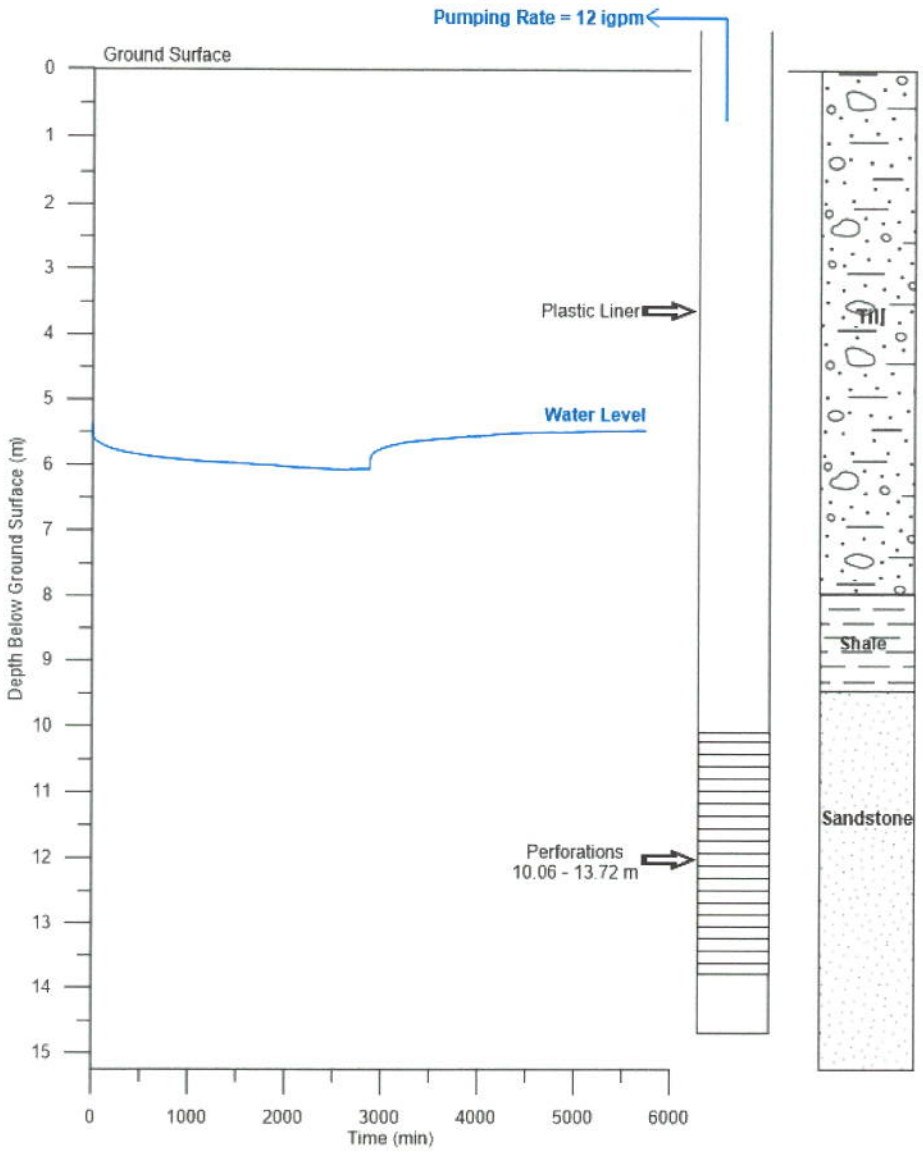
[1]BGS = below ground surface, [2]BTC = below top of casing, [3]masl = meters above sea level

DETIALS OF THE PUMPING TEST

The 48-hour pumping test started at 11:50 am on September 15, 2020, with the supply well being pumped at 12 imperial gallons per minute. Water levels were measured in the supply well and the four observation wells over the 2878 minute pumping period and for an additional 2862 minutes following pumping cessation.

A graph showing water levels with time and a schematic of the well construction and strata of the supply well is as follows:

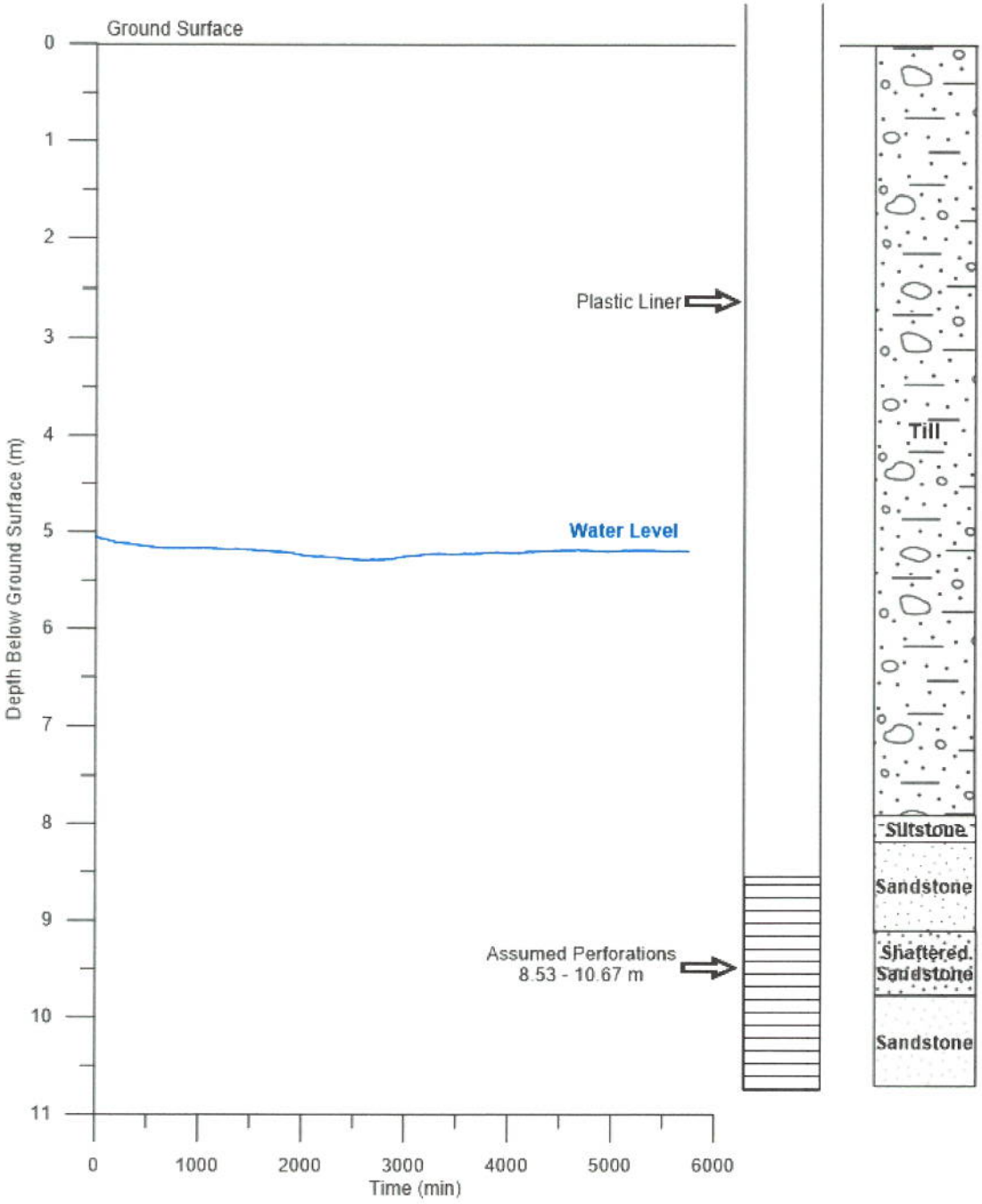
FIGURE 2. Pumping well schematic with water levels during the pumping test



The well had an initial static water level of 5.40 metres below ground surface (bgs) prior to pumping and drew down 0.67 metres to 6.07 metres bgs by the end of the pumping period. Water levels had built up to 5.48 metres at the end of the recovery period for an 88% recovery.

A graph showing water levels with time and a schematic of the well construction and strata of the south observation well is as follows:

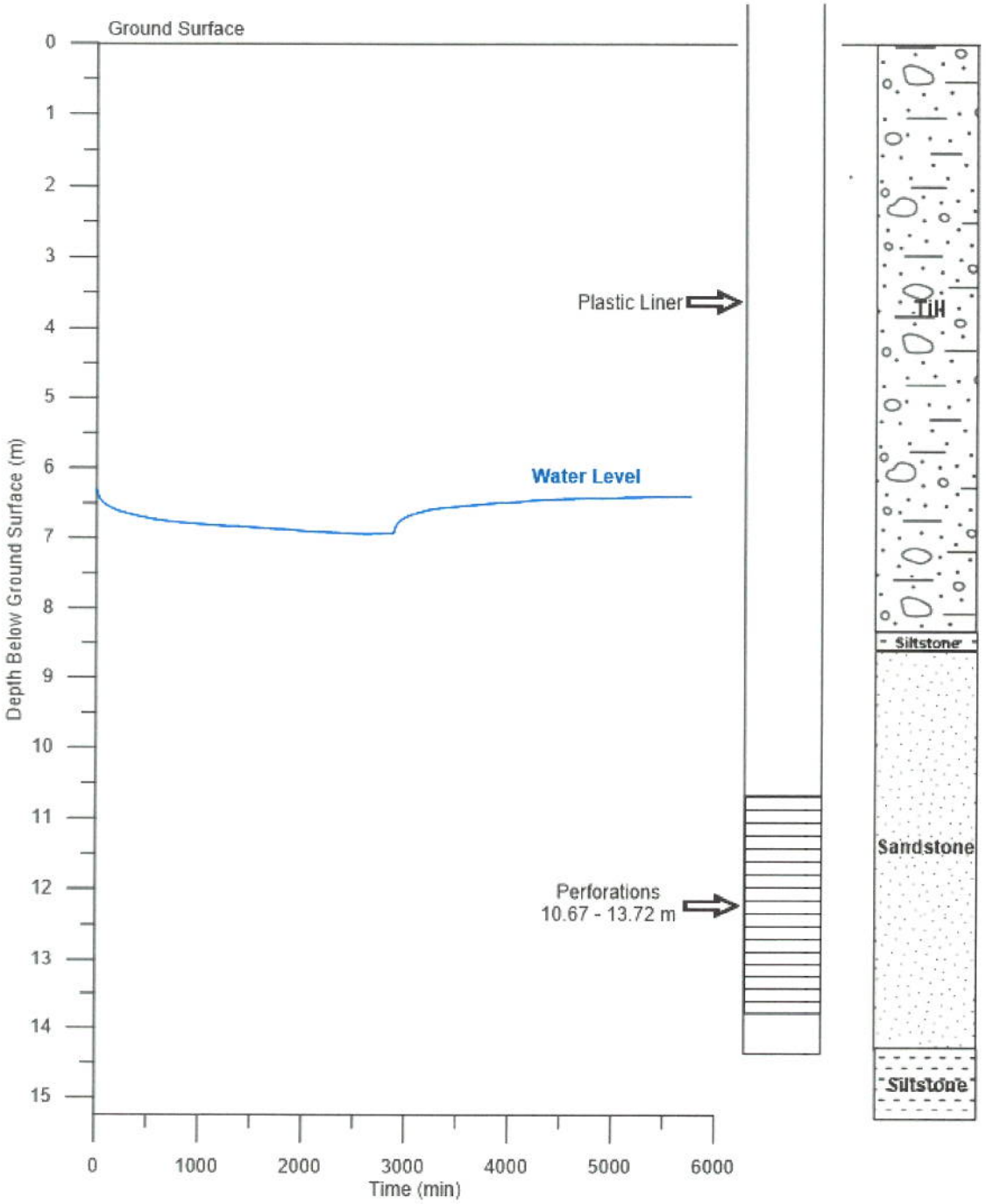
FIGURE 3. South observation well schematic and water level during the pumping test



The well had an initial static water level of 5.05 metres below ground surface (bgs) prior to pumping and drew down 0.23 metres to 5.28 metres bgs by the end of the pumping period. Water levels had built up to 5.20 metres at the end of the recovery period for a 35% recovery.

A graph showing water levels with time and a schematic of the well construction and strata of the southwest observation well is as follows:

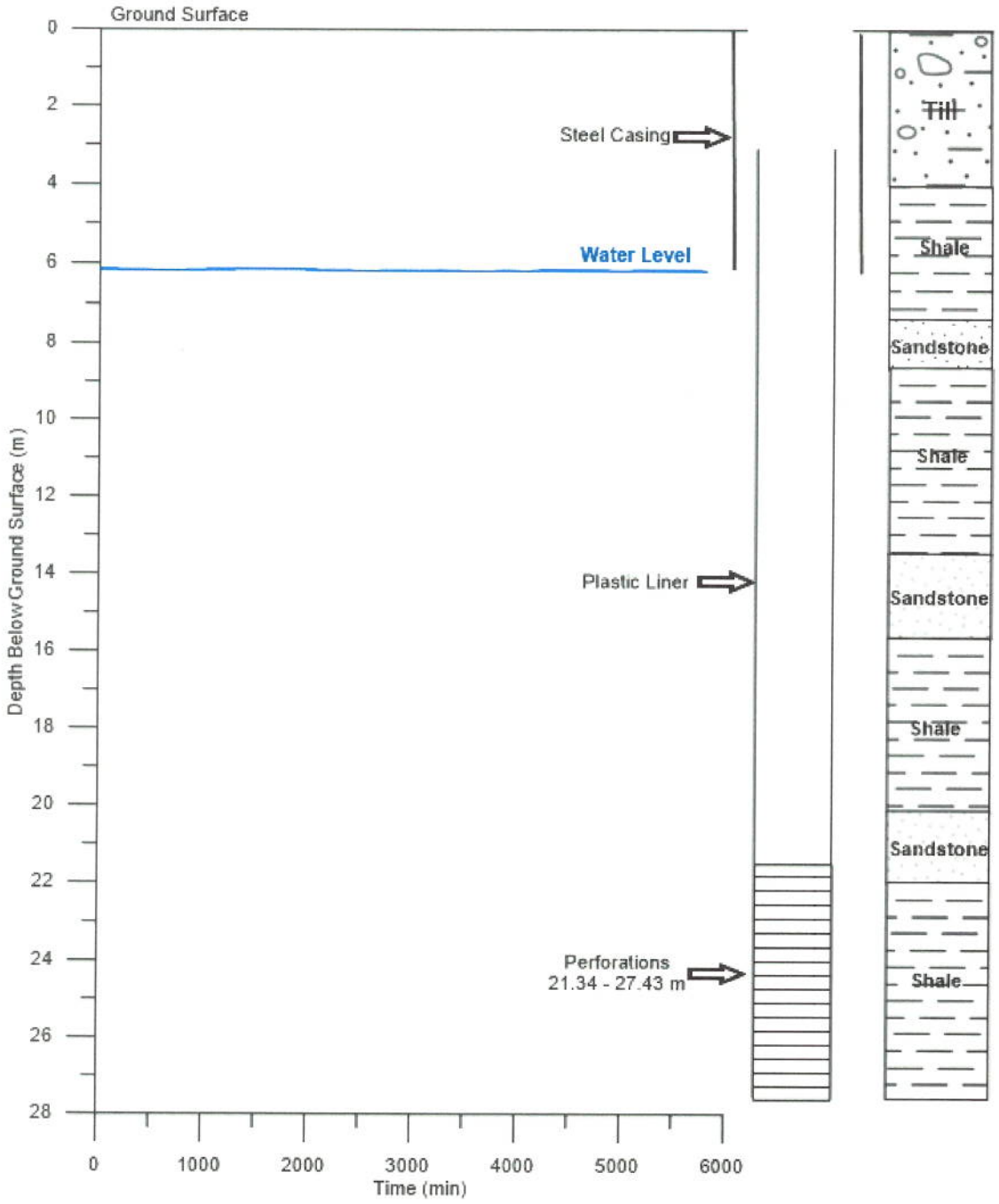
FIGURE 4. Southwest observation well schematic and water level during the pumping test



The well had an initial static water level of 6.30 metres below ground surface (bgs) prior to pumping and drew down 0.62 metres to 6.92 metres bgs by the end of the pumping period. Water levels had built up to 6.38 metres at the end of the recovery period for an 87% recovery.

A graph showing water levels with time and a schematic of the well construction and strata of K. Singer's observation well is as follows:

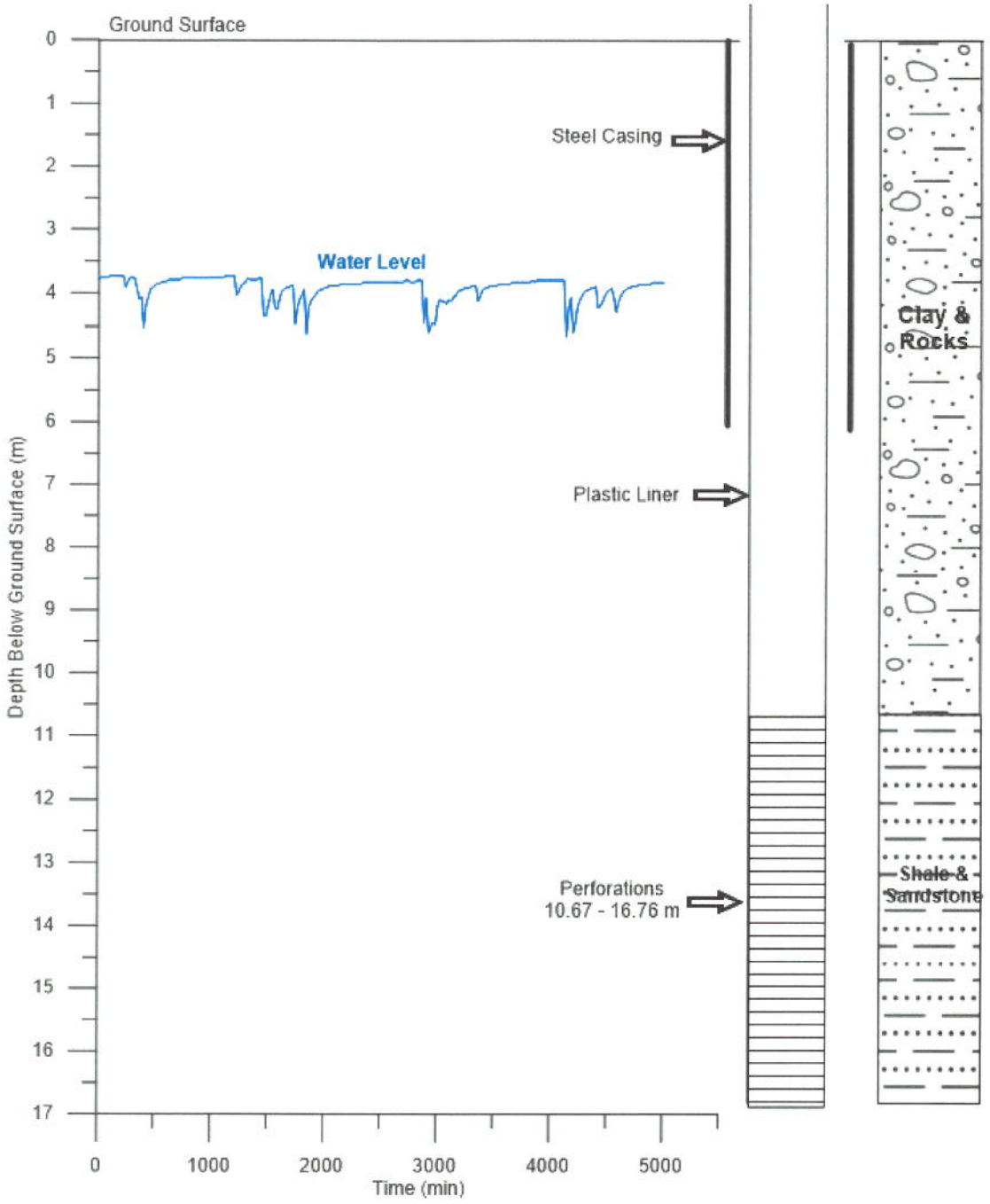
FIGURE 5. K. Singer well schematic and water level during the pumping test



The well had an initial static water level of 6.14 metres below ground surface (bgs) prior to pumping and drew down 0.01 metres to 6.15 metres bgs by the end of the pumping period. Water levels had built up to 6.15 metres at the end of the recovery period for a 100% recovery. The 0.01 meter fluctuation in water level is within the noise range of the pressure transducer used to record the water level in K. Singer's well.

A graph showing water levels with time and a schematic of the well construction and strata of J. Davies' observation well is as follows:

FIGURE 6. J. Davies well schematic and water level during the pumping test

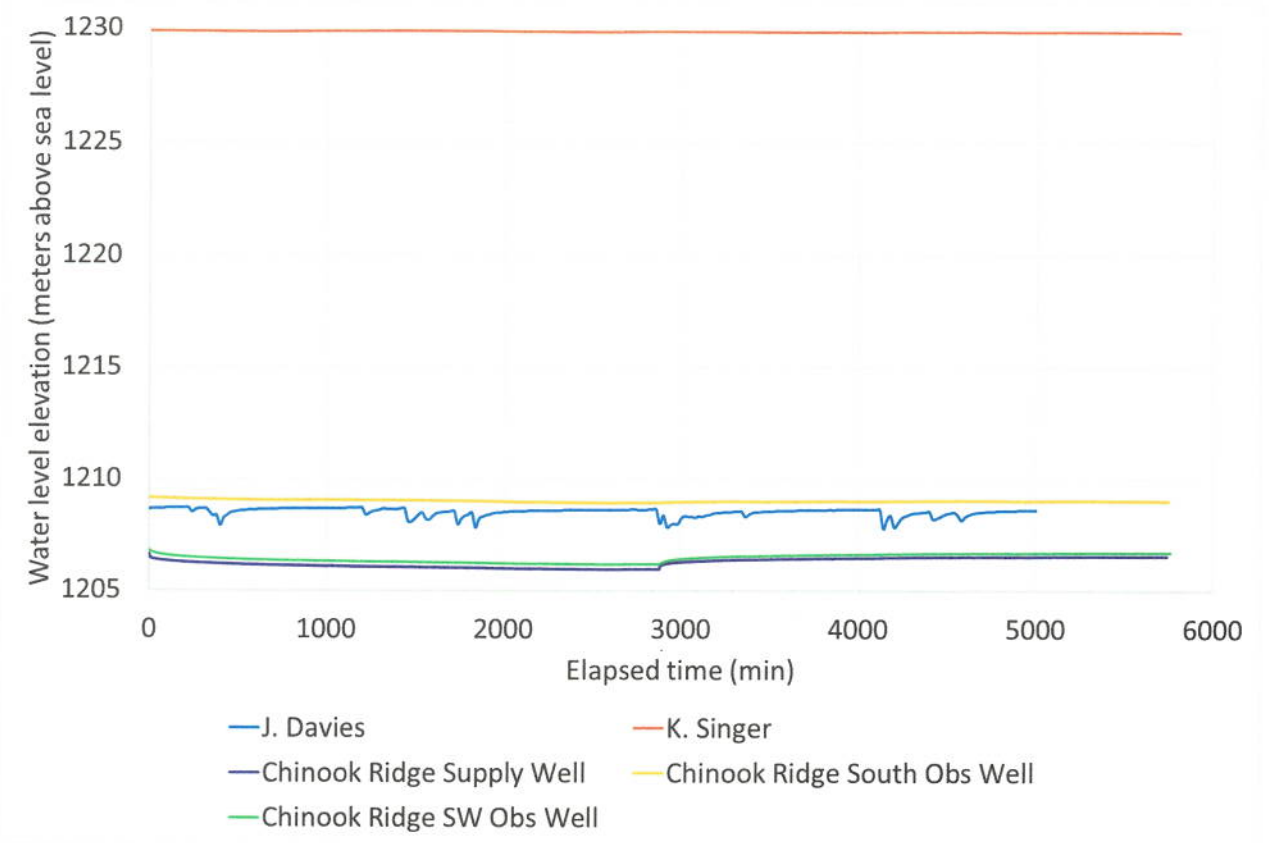


The well had an initial static water level of 3.78 metres below ground surface (bgs) prior to pumping. By the end of the recovery period the water level in the well was 3.81 meters bgs. The well was cycling in and out of use throughout the pumping test so water level changes attributed to pumping from the Chinook Ridge supply well are not able to be discerned. It appears that the pump is cycling in approximately 12 hour increments which would align with scheduled cattle feedings, likely using an automatic waterer.

WATER ELEVATION

The elevation in meters above sea level was determined for the top of casing for all 5 wells using a topographic map with a 2 meter contour interval and Leica optical transit survey to measure the relative elevation of the 3 Chinook Ridge wells and J. Davies well. The plot below shows the elevation of the water level in each well during the pumping test.

FIGURE 7. Elevation (meters above sea level) of the water level in each well



The water level in the Chinook Ridge supply well and southwest observation well track each other very closely, indicating they are producing from the same aquifer.

The Chinook Ridge wells and J. Davies' well are at similar elevations, while K. Singer's well has water levels that sit over 20 meters above the Chinook Ridge wells.

The elevation of the water level in the Chinook Ridge supply well compared to K. Singer's and other wells in the area can also be represented in a geologic cross section. A topographic map showing the location of the wells relative to each other is shown in Figure 8. The geologic cross section (A – A') is shown in Figure 9, with lithology and well completion details shown taken from each wells Water Well Drillers Report.

FIGURE 8. Topographic map showing location of wells and geologic cross section line

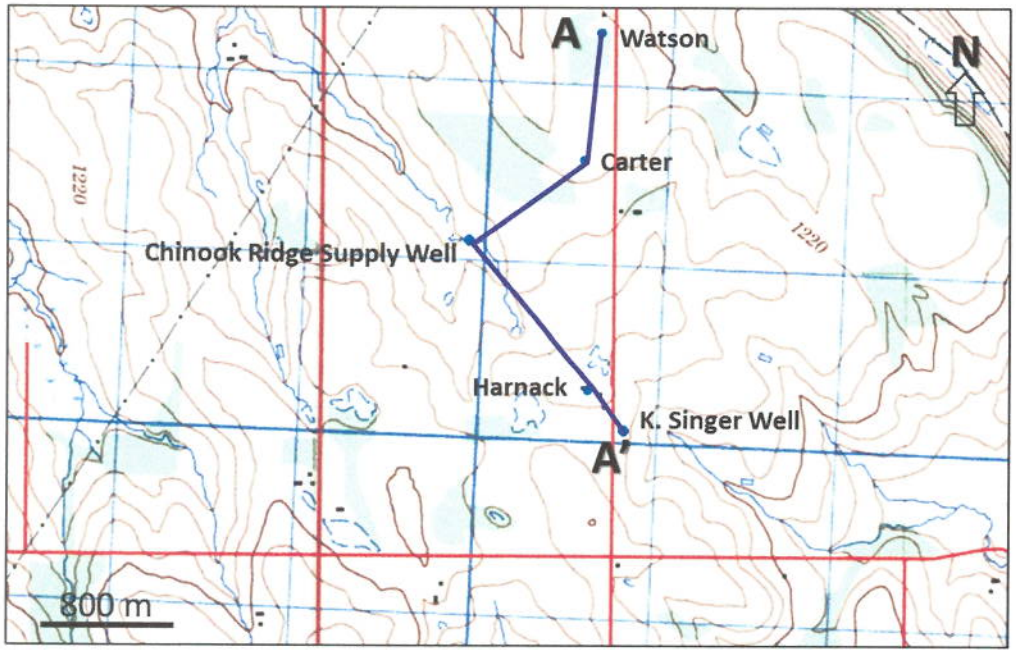
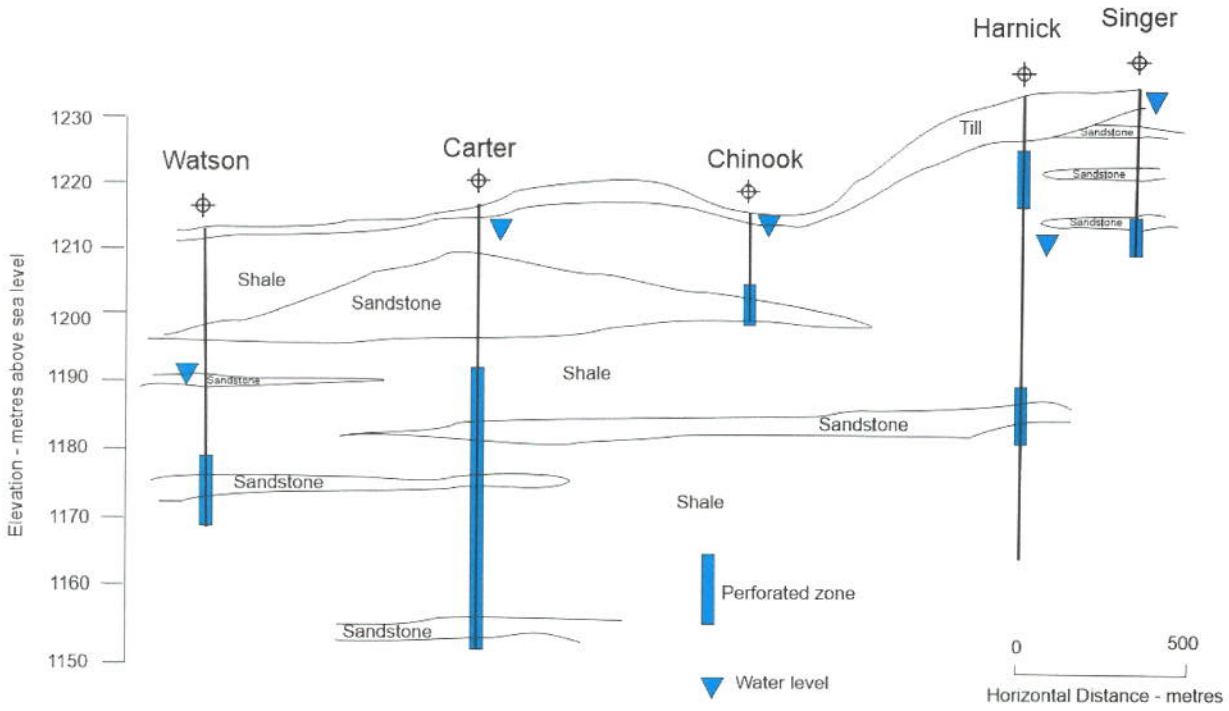


FIGURE 9. Geologic Cross Section A – A'

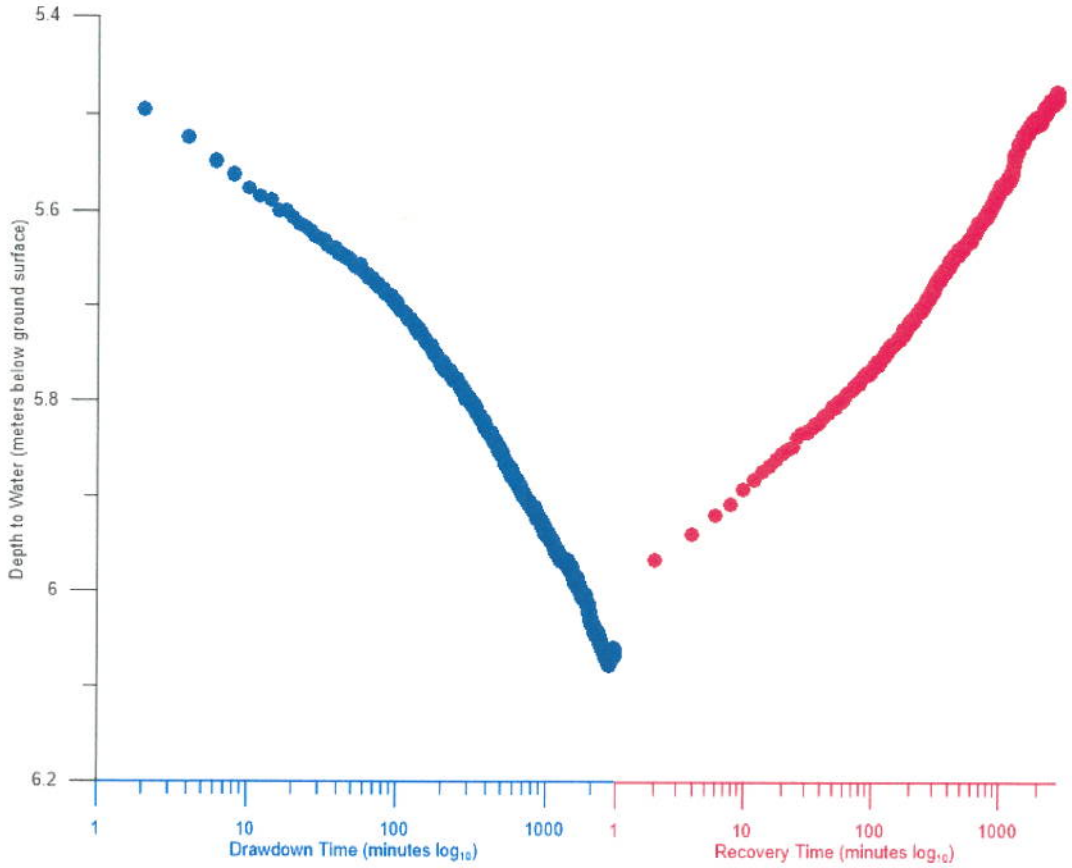


The static water levels shown in the cross section are those measured during the September 2020 pumping test of the Chinook Ridge supply well (see Table 1). K. Singer's well is not producing from the same aquifer as the Chinook Ridge supply well.

PUMPING TEST INTERPRETATION

A dual semi-log graph of the pumping test data in the Chinook Ridge supply well is shown below to illustrate the water level data during the pumping test more clearly.

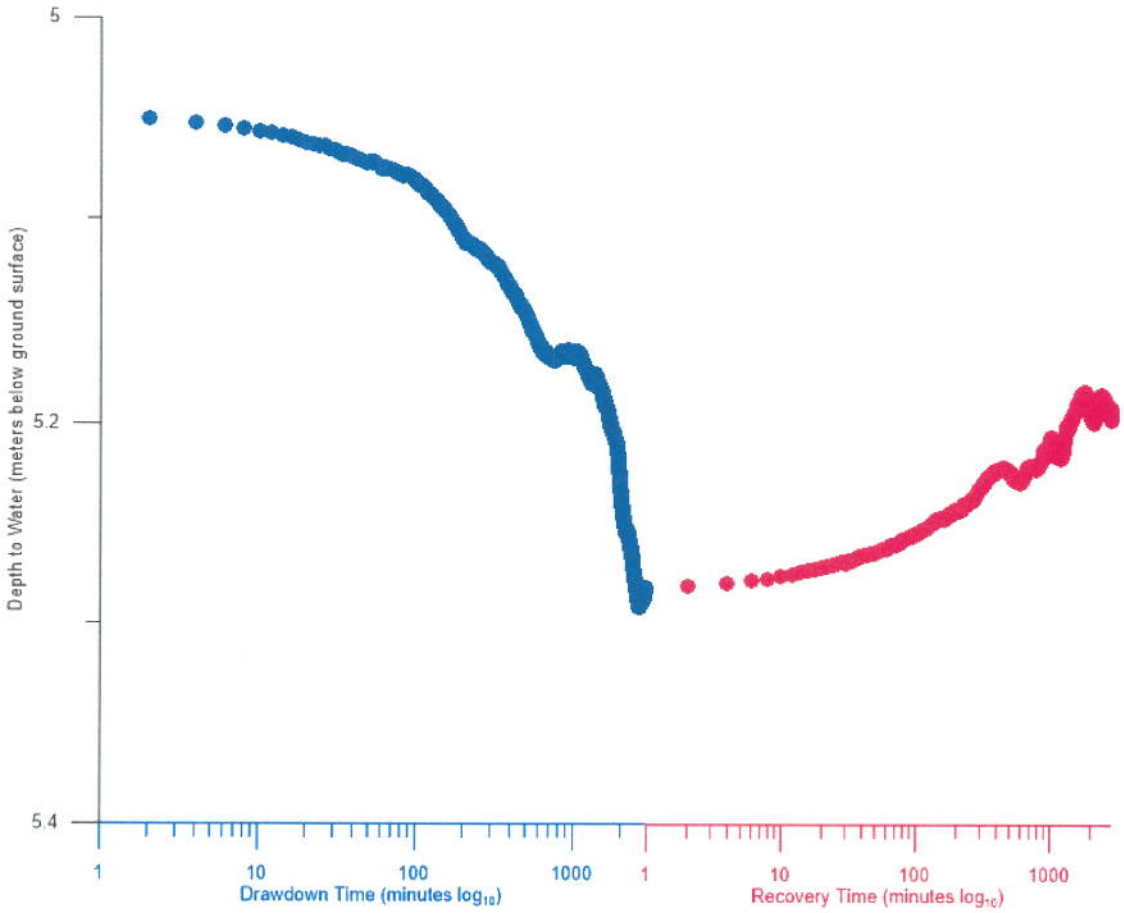
FIGURE 10. Dual semi-log graph of drawdown and recovery in the supply well



The rate of drawdown in the supply well declines at a constant rate over the first 100 minutes of pumping. From 100 minutes until the end of the pumping period the rate of drawdown in the pumping well increases (doubles) but remains relatively constant. The increase in drawdown rate likely indicates a limited aquifer extent, with an aquifer boundary being encountered in the subsurface around 100 minutes into pumping. A similar curve form is seen in the recovery data, with early recovery occurring at a slower rate before increasing around 100 minutes into the buildup period. This also indicates the aquifer the supply well is producing from is of limited lateral extent.

A dual semi-log graph of the pumping test data in the South observation well is shown below to illustrate the water level data during the pumping test more clearly.

FIGURE 11. Dual semi-log plot of drawdown and recovery in the South observation well

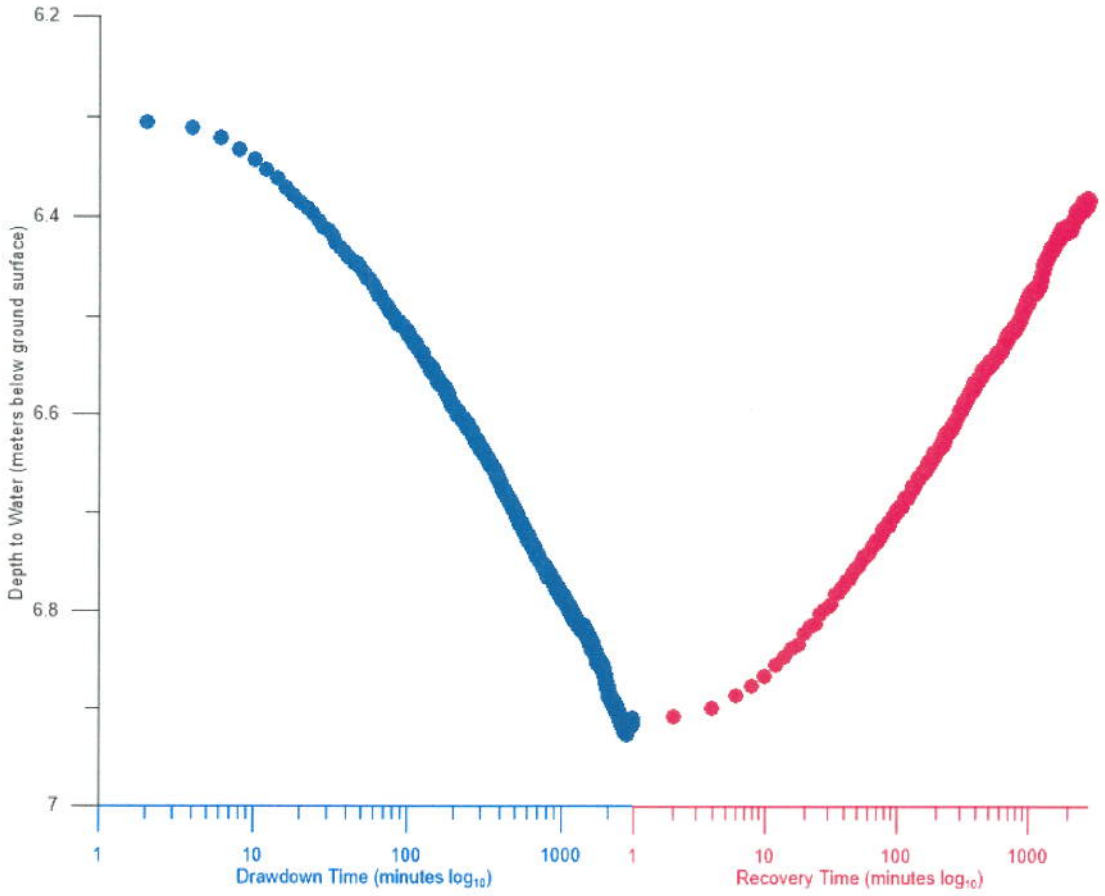


The south observation well begins responding to the pumping of the supply well within 2 minutes of the pump being turned on. The rate of drawdown begins to increase around 100 minutes (same as in supply well) into pumping and continues to increase until the end of the pumping period. Water levels in the well begin recovering after the pump is turned off but never reach static conditions by the end of the buildup period. Both the drawdown and recovery data indicate the observation well is in hydraulic connection with the supply well and that the aquifer the well is completed in is of limited lateral extent.

It is possible that the slight perturbations in the data are due to pumping from the Jim Davies wells. This observation along with the similar water elevations as shown in Figure 7 indicates these two wells might in partial hydraulic communication.

A dual semi-log graph of the pumping test data in the Southwest observation well is shown below to illustrate the water level data during the pumping test more clearly.

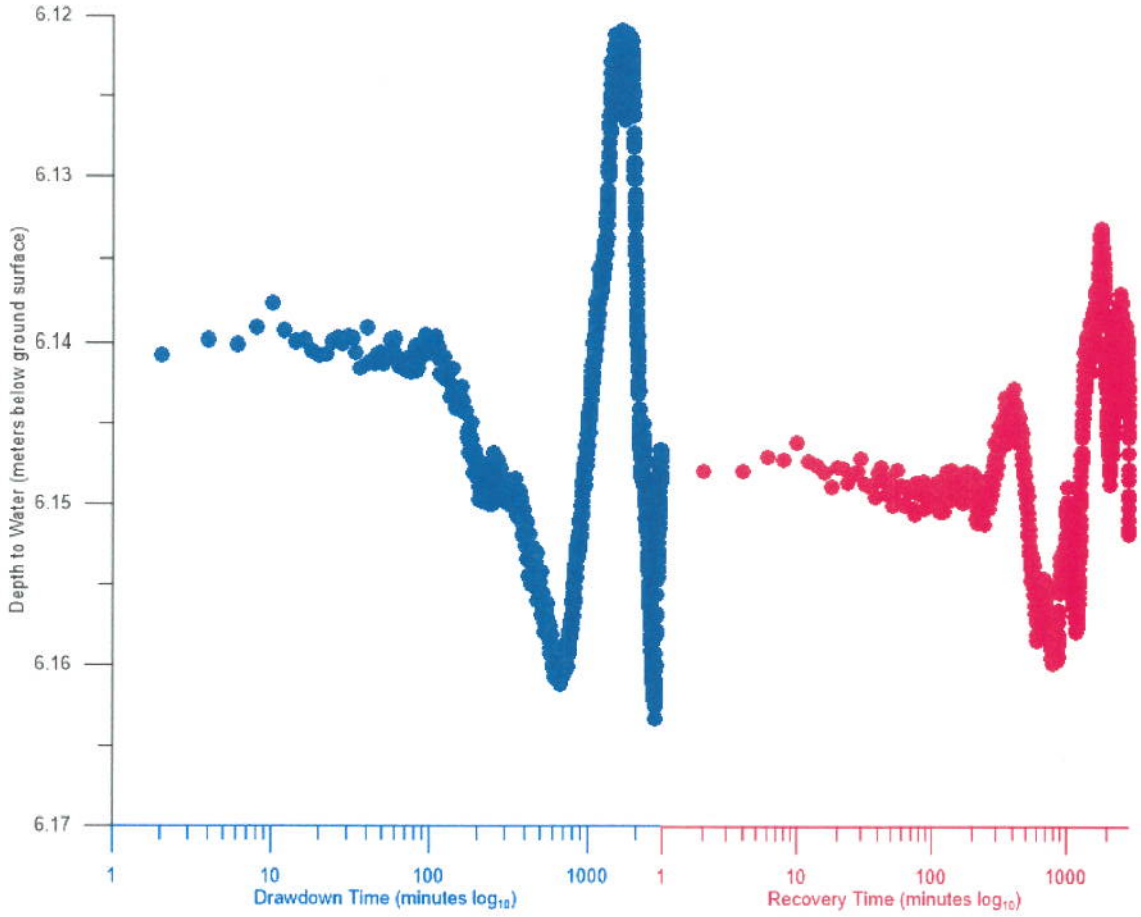
FIGURE 12. Dual semi-log plot of drawdown and recovery in the Southwest observation well



The southwest observation well begins responding to the pumping of the supply well within 3 minutes of the pump being turned on. The rate of drawdown begins to increase around 100 minutes (same as in supply well) into pumping, although the rate change is not as abrupt as in the pumping and south observation well. Water levels in the well begin recovering after the pump is turned off but never reach static conditions by the end of the buildup period. Both the drawdown and recovery data indicate the observation well is in hydraulic connection with the supply well and that the aquifer the well is completed in is of limited lateral extent.

A dual semi-log graph of the pumping test data in K. Singer's well is shown below to illustrate the water level data during the pumping test more clearly.

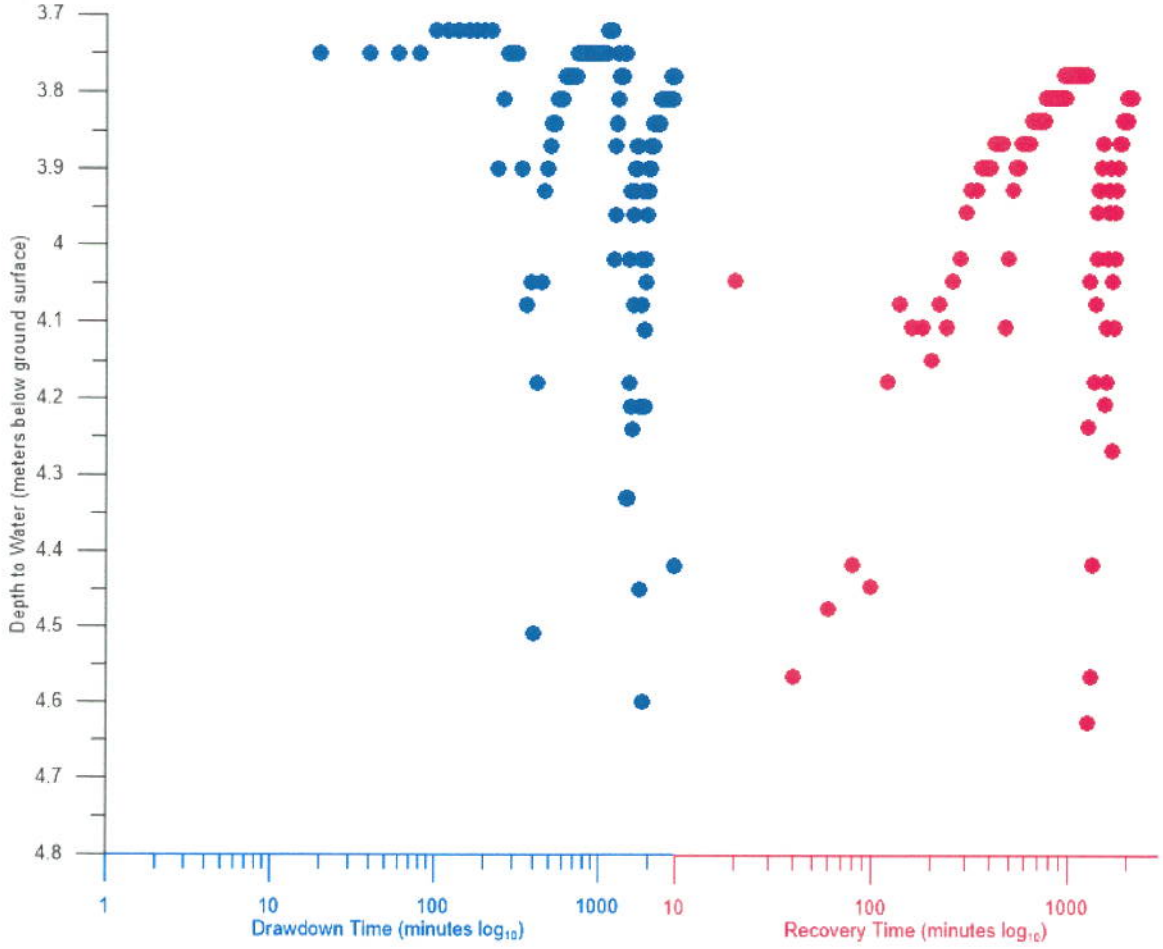
FIGURE 13. Dual semi-log plot of drawdown and recovery in K. Singer's well



There is no drawdown in the well until around 100 minutes into pumping at which point the water level in K. Singer's well begins to oscillate +/- 0.02 m from the static water level. A similar response is seen in the recovery data. The small change in water level is within the range of noise of the pressure transducer used to measure the change in water level in K. Singer's well. There is no trend in the water level data to indicate a hydraulic connection to the Chinook Ridge supply well, as water levels did not decline over the pumping period and did not increase during the buildup period, as is shown in the two nearby observation wells which are in hydraulic connection to the supply well (south and southwest observation wells).

A dual semi-log graph of the pumping test data in J. Davies' well is shown below to illustrate the water level data during the pumping test more clearly.

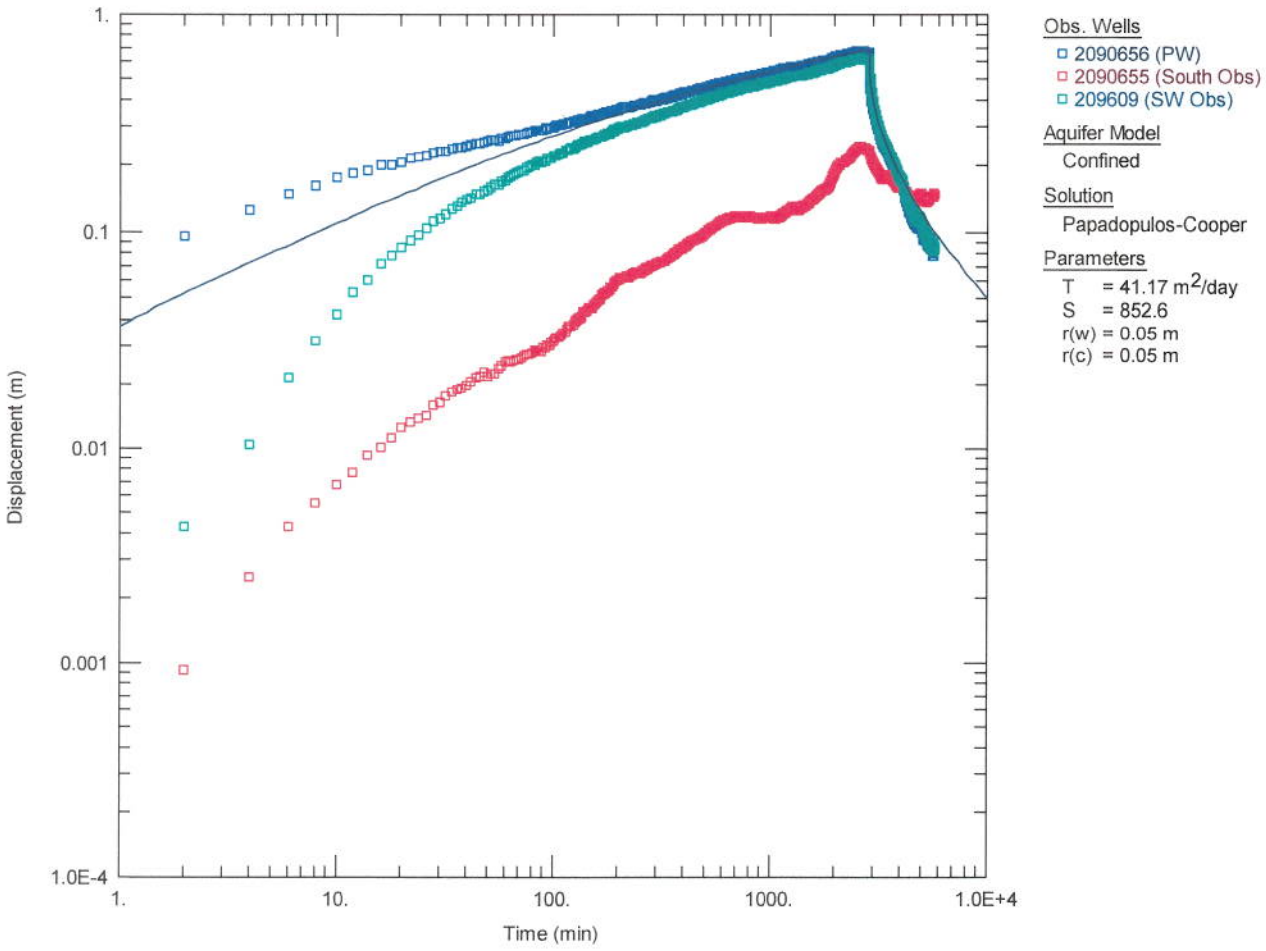
FIGURE 14. Dual semi-log plot of drawdown and recovery in J. Davies' well



It is clear that J. Davies' well was cycling on and off throughout the duration of the pumping test on the Chinook Ridge supply well. As it was in use it is not possible to determine which water level impacts are due to J. Davies' using the well and which may be due to pumping of the Chinook Ridge supply well. No lowering of water levels is noted during the pumping period and no increasing trend in water levels is noted during the recovery period, which would infer the wells are not connected.

The pumping test data was interpreted with the aid of the AQTESOLV program developed by Hydrosoft Inc. The Papadopulos-Cooper solution was used for a confined aquifer with radial groundwater flow. A graph showing water level displacement with time and a fitted curve is as follows:

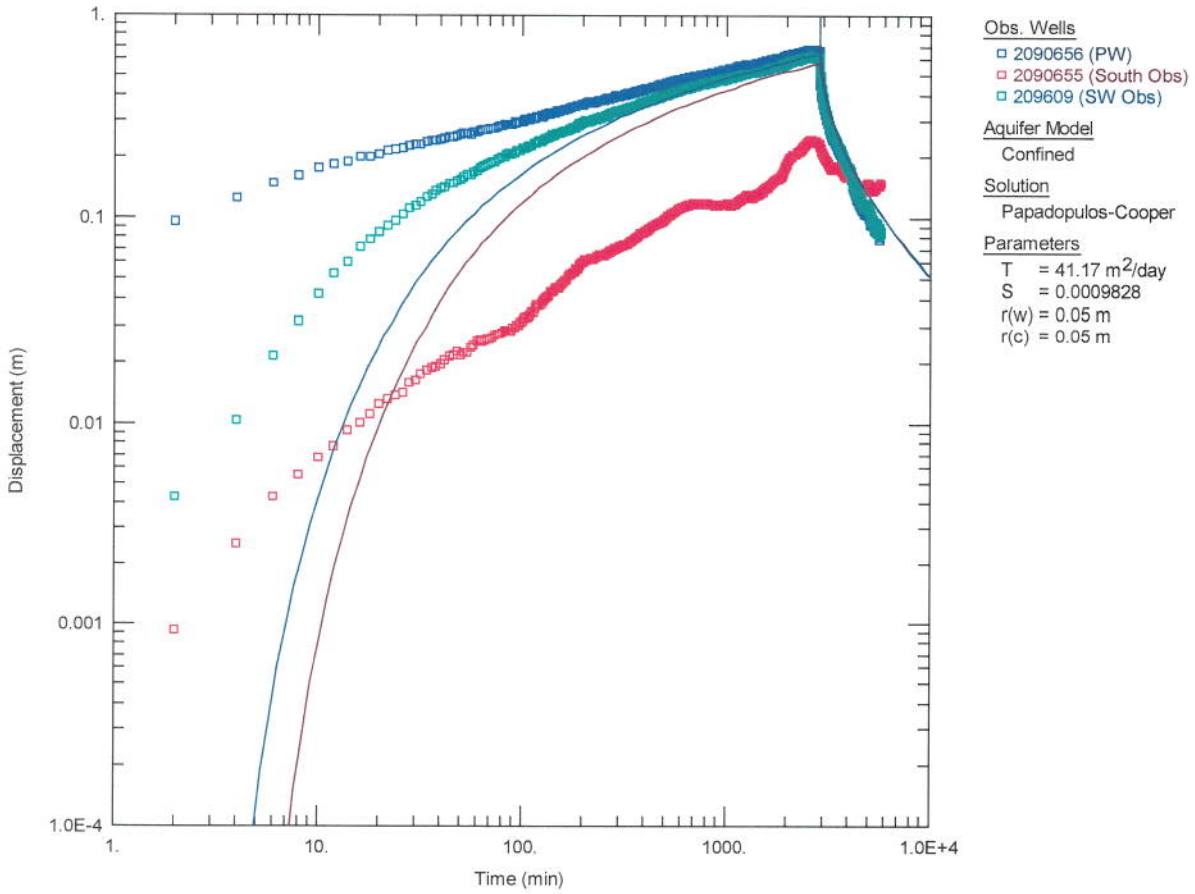
FIGURE 15. Papadopulos-Cooper solution fit to pumping well data



A good fit to the pumping test data is observed, indicating the solution is appropriate. The transmissivity of 41.17 m^2/day is calculated, indicating a high permeability aquifer. The previous Stantec report, which was thought to represent an overly optimistic transmissivity, reported an average transmissivity of 62.6 m^2/day. The Stantec report did not match much of the data set, especially late time data (after 1000 min) which is most representative of long term aquifer responses. In this case, Solstice matched pumping test data from 200 minutes until 3000 minutes, giving a much more representative assessment of long term aquifer response to pumping.

Using the same transmissivity value derived from the pumping test data the Papadopulos-Cooper solution was fit to the Southwest observation well data to determine aquifer storativity as follows:

FIGURE 16. Papadopulos-Cooper solution fit to Southwest observation well data



The storativity of the aquifer is 0.00098, which is within the typical range for shallow sandstone aquifers.

WELL YIELD

The twenty-year safe yield of the well (Q_{20}) can be calculated using the modified Moell method as suggested in Alberta Environments Guide to Groundwater Authorization (March 2011) as follows:

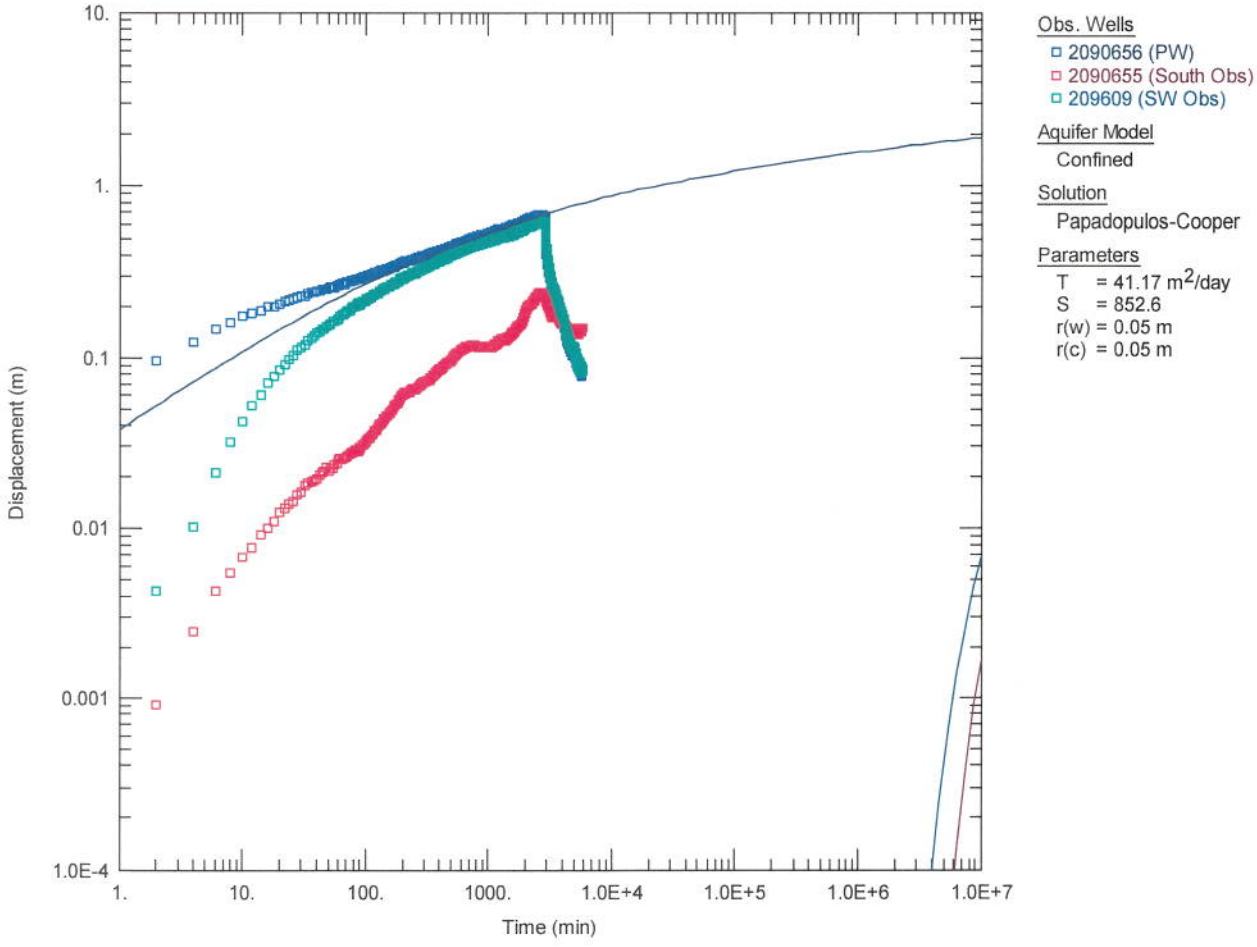
$$Q_{20} = \frac{(0.7 * Q * H_a)}{S_{100\text{min}} + (S_{20\text{yrs}} - S_{100\text{th}})}$$

Where

Q	-	Pump test flow rate = 78.6 m^3/day (54.6 litres/min)
H_a	-	Available Head = 4.8 m
$S_{100\ min}$	-	Observed drawdown at 100 minutes (0.30 m)
($S_{20yrs} - S_{100\ th}$)	-	Difference between drawdown at 20 years and 100 min (1.92 m – 0.27 m = 1.65 m)
0.7	-	Safety factor

The theoretical 20-year drawdown is determined by extrapolating the Papadopulos-Cooper solution curve as follows:

FIGURE 17. Papadopulos-Cooper solution extrapolated to 20 years of pumping



Substituting in the above values a 20-year safe yield (Q_{20}) of 135.4 m³/day (20.6 imperial gallons per minute or 49,455 m³/year) is calculated. The analysis indicates the well is capable of supplying water at a rate of 20.6 igpm, which is greater than the tested rate of 12.0 igpm. The safe yield for the well is nearly double the license application volume of 26,982 m³/year, allowing for potential growth in water demand at a later date.

The Stantec report used both the Farvolden Method and Moell Method to calculate the 20-year safe yield, coming up with 104.9 m³/day and 64.4 m³/day, respectively. A different formulation of the Moell Method was used by Stantec than was used in this report. The differences in the safe yield calculated by Stantec are due to the different formulas used (which had a difference of 40.5 m³/day between their two methods) and the different values inserted into the formulas. Solstice used a static water level of 5.40 meters in the pumping well (as measured prior to the start of the pumping test), where as Stantec used 6.54 m, the static water level from the 2010 Water Well Drillers Report. Stantec also used a different method of calculating available head (drawdown) in the well by measuring from the static water level to the top of the well completion zone, however, the Alberta Environment Guide to Groundwater Authorization (2011) guidelines state to measure the available head from the static water level to the top of the aquifer. The differences in available head values used to calculate the 20-year safe yield are compounded by the

difference in static water level between the Stantec report and this report.

EFFECT ON WATER LEVELS FOR EXISTING USERS

Using the Cooper-Jacob equation the expected drawdown in the aquifer at various time and distances due to pumping of the well can be calculated by the following formula:

$$s = \frac{(0.183 * Q)}{T} \quad x \quad Log\left(\frac{2.25 * T * t}{r^2 S}\right)$$

Where

s	-	Drawdown (m)
S	-	Storativity (0.00098)
Q	-	Tested Pump Rate (78.6 m^3/day)
T	-	Transmissivity (41.17 m^2/day)
t	-	Time (days)
r	-	Radial distance from pumping well (m)

A table showing water level drawdown with distance as a function of time is as follows:

TABLE 2. Cooper-Jacob distance drawdown calculations

Distance (m)/ Time (days)	Well	100	300	500	1000	1600	3000
1	2.65	0.34	0.01	-	-	-	-
7	2.94	0.64	0.30	0.15	-	-	-
30	3.16	0.86	0.52	0.37	0.16	0.02	-
365	3.54	1.24	0.90	0.75	0.54	0.39	0.20
1826	3.79	1.48	1.15	0.99	0.78	0.64	0.45
3652	3.89	1.59	1.25	1.10	0.89	0.74	0.55
7305	4.00	1.69	1.36	1.20	0.99	0.85	0.66

The following assumptions were included in the above calculation: No recharge is occurring, and all wells are screened over the same aquifer. From this table, we can infer that the most a neighboring well (≤ 100 m) in the same aquifer will experience in additional drawdown will be less than 2 meters overs a 20-year pumping period. The available head in nearby wells ranges from 4 to 6 meters, so additional drawdown of less than 2 meters will not be of concern for neighbouring groundwater users.

The two Chinook Ridge observation wells are located 65 m (South observation well) and 62 m (SW observation well) from the supply well. Drawdown in the south observation well was 0.23 m and was 0.62 m in the southwest observation well after 2 days of pumping. This is in line with drawdown expected at these distances based on the above table.

The available head in the pumping well is 4.8 meters. Thus, the additional drawdown in the well of 4.00 meters after 20 years of pumping would not hinder the wells performance, as long as the pump is placed low enough.

Effect on K. Singer's Well

K. Singer's well is located 1,405 meters southeast of the Chinook Ridge supply well. Using the Cooper-

Jacob equation the expected drawdown in K. Singer's well after 2 days (48-hours) due to pumping of the Chinook Ridge supply well can be calculated by the following formula:

$$s = \frac{(0.183 * Q)}{T} \quad x \quad Log\left(\frac{2.25 * T * t}{r^2 S}\right)$$

Where

s	-	Drawdown (m)
S	-	Storativity (0.00098)
Q	-	Tested Pump Rate (78.6 m^3/day)
T	-	Transmissivity (41.17 m^2/day)
t	-	Time (2 days)
r	-	Radial distance from pumping well (1,405 m)

A table showing water level drawdown in K. Singer's with distance as a function of time due to production from the Chinook Ridge supply well is as follows:

TABLE 3. Cooper-Jacob distance drawdown calculations for K. Singer's well

Distance (m)/ Time (days)	1405
2	-
7	-
30	0.05
365	0.43
1826	0.68
3652	0.78
7305	0.89

The following assumptions were included in the above calculation: No recharge is occurring, and both K. Singer's and the Chinook Ridge supply well are screened over the same aquifer.

From this table, we can infer that no drawdown would have been expected in K. Singer's well due to production from the Chinook Ridge supply well after 2 days of pumping. This matches with what was observed in K. Singer's well during the pumping test, with no measurable drawdown occurring in the well. Under the assumption that the wells are completed in the same aquifer an impact to K. Singer's well would not occur until 30 days into pumping, at which point a 0.05 meter change in water level would be observed. As the pumping test completed on the Chinook Ridge supply well indicates the aquifer it produces from is limited in lateral extent it is unlikely K. Singer's well is completed within the same aquifer as the Chinook Ridge supply well.

From this table, we can infer that the most K. Singer's well will experience in additional drawdown (under the assumption it is completed in the same aquifer as the Chinook Ridge supply well) will be 0.89 meters overs a 20-year pumping period. The available head in K. Singer's well is 14.50 meters, so additional drawdown of 0.89 meters will not impact the ability of the well to supply water.

Ms. Singer also requested measurements be made on an "artesian well" that she has on her property. This "well" was located approximately 300 m south-east of her well at a pumping oil well. The "well" is a horizontal drainage pipe placed under the lease pad to maintain sufficiently deep water levels at the lease.

A check of the flow rate was made immediately prior to the start of the pumping test and right at the end

of the pumping portion of the test with the bucket and stopwatch method. Both measurements showed the same flow rate (within error of the reading) at a rate of approximately 4 imperial gallons per minute and no reduction of flow was observed during the test.

Effect on J. Davies' Well

J. Davies' well is located 137 meters west of the Chinook Ridge supply well. Using the Cooper-Jacob equation the expected drawdown in J. Davies' well after 2 days (48-hours) due to pumping of the Chinook Ridge supply well can be calculated by the following formula:

$$s = \frac{(0.183 * Q)}{T} \quad x \quad Log\left(\frac{2.25 * T * t}{r^2 S}\right)$$

Where

s	-	Drawdown (m)
S	-	Storativity (0.00098)
Q	-	Tested Pump Rate (78.6 m^3/day)
T	-	Transmissivity (41.17 m^2/day)
t	-	Time (2 days)
r	-	Radial distance from pumping well (137 m)

A table showing water level drawdown in J. Davies' with distance as a function of time due to production from the Chinook Ridge supply well is as follows:

TABLE 4. Cooper-Jacob distance drawdown calculations for J. Davies' well

Distance (m)/ Time (days)	137
2	0.35
7	0.54
30	0.76
365	1.14
1826	1.38
3652	1.49
7305	1.60

The following assumptions were included in the above calculation: No recharge is occurring, and both J. Davies' and the Chinook Ridge supply well are screened over the same aquifer.

From this table, we can infer that 0.35 meters of drawdown would have been expected in J. Davies' well due to production from the Chinook Ridge supply well after 2 days of pumping. The water level data collected for J. Davies' well during the pumping test does not show a water level decline of 0.35 meters over the pumping period of the Chinook Ridge supply well. This indicates the wells are likely not in hydraulic connection. As the pumping test completed on the Chinook Ridge supply well indicates the aquifer it produces from is limited in lateral extent it is improbable J. Davies' well is completed within the same aquifer as the Chinook Ridge supply well.

From this table, we can infer that the most J. Davies' well could experience in additional drawdown (under the assumption it is completed in the same aquifer as the Chinook Ridge supply well) would be 1.60

meters overs a 20-year pumping period. The available head in J. Davies' well is 7.19 meters, so additional drawdown of 1.60 meters will not impact the ability of the well to supply water.

Yours truly,

Ken Hugo, P.Geol.

APEGA P12910

/att – Water Well Drillers Reports

supply well

Water Well Drilling Report

View in Metric | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 2090656
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2012/10/10

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
CARTWRIGHT, CHIOE	285049 Range Road 35	Madden	ALBERTA	CANADA	T0M 0S0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	31	28	3	5				SUPPLY WELL

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.25'57.32"N Longitude 114.24'41.44"W
How Location Obtained: Not Verified

Elevation 3982.94 ft
How Elevation Obtained: Garmin 64s

Drilling Information

Method of Drilling: Combination

Proposed Well Use: Other

Type of Work: New Well

Formation Log

Measurement in Imperial

Depth from ground level (ft)	Water Bearing	Lithology Description
15.00		Brown Till & Clay
26.00		Gray Till & Clay
31.00		Blue Gray Shale
36.00		Brown Fine Grained Sandstone
50.00		Brownish Gray Fine Grained Sandstone

Yield Test Summary

Measurement in Imperial

Recommended Pump Rate 10.00 igpm

Test Date	Water Removal Rate (igpm)	Static Water Level (ft)
2010/11/10	14.99	21.46

Well Completion

Measurement in Imperial

Total Depth Drilled	Finished Well Depth	Start Date	End Date
50.00 ft	48.00 ft	2010/11/05	2010/11/05

Borehole

Diameter (in)	From (ft)	To (ft)
8.00	0.00	28.00
6.50	28.00	50.00

Surface Casing (if applicable)
Size OD :
Wall Thickness :
Bottom at :

Well Casing/Liner: Plastic
Size OD : 4.94 in
Wall Thickness : 0.214 in
Top at : -2.46 ft
Bottom at : 48.00 ft

Perforations

From (ft)	To (ft)	Diameter or Slot Width(in)	Slot Length (in)	Hole or Slot Interval(in)
33.00	45.00	0.125		6.00

Perforated by: Saw

Annular Seal: Bentonite Chips/Tablets
Placed from 0.00 ft to 31.00 ft
Amount 150.00 Pounds

Other Seals

Type	At (ft)
Shale Trap	31.00

Screen Type
Size OD :

From (ft)	To (ft)	Slot Size (in)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: RORY WAGNER
Company Name: WILD ROSE WATER WELLS LTD.
Certification No: 14061Q
Copy of Well report provided to owner: Yes
Date approval holder signed: 2010/11/10

supply well

Water Well Drilling Report

View in Metric | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 2090656
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2012/10/10

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
CARTWRIGHT, CHIOE	285049 Range Road 35	MADDEN	ALBERTA	CANADA	T0M 0S0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Descrip
	SE	31	28	3	5				SUPPLY WELL

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51°25'57.32"N Longitude 114°24'41.44"W
How Location Obtained: Not Verified

Elevation 3982.94 ft
How Elevation Obtained: Garmin 64s

Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level 29.53 in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate 10.00 igpm
Recommended Pump Intake Depth (From TOC) 30.00 ft
Pump Installed
Type
Depth ft
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth ft
Gas
Depth ft
Well Disinfected Upon Completion Yes
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

DRILLING METHOD COMBINATION ROTARY AIR AND ROTARY MUD. 24 HOUR PUMP TEST WAS DONE. BOREHOLE DIAMETER BETWEEN 28 FEET AND 50 FEET ALSO 5.5 INCHES. PROPOSED WELL USE - LODGE, WATER DIVERTED FOR DRILLING FROM MUNICIPAL SOURCE

Yield Test

Taken From Top of Casing
Depth to water level

Measurement in Imperial

Test Date	Start Time	Static Water Level
2010/11/10	12:00 PM	21.46 ft

Method of Water Removal

Type Pump
Removal Rate 14.99 igpm
Depth Withdrawn From 29.98 ft

If water removal period was < 2 hours, explain why

SEE FILE FOR ADDITIONAL PUMP TEST READINGS

Pumping (ft)	Elapsed Time Minutes:Sec	Recovery (ft)
21.46	0:00	23.52
21.62	1:00	23.33
21.69	2:00	23.26
21.72	3:00	23.23
21.75	4:00	23.20
21.78	5:00	23.20
21.78	6:00	23.16
21.82	7:00	23.16
21.85	8:00	23.13
21.85	9:00	23.13
21.88	10:00	23.10
21.92	15:00	23.06
21.98	20:00	23.03
22.01	25:00	23.00
22.05	30:00	23.00
	35:00	22.97
22.08	40:00	22.97
22.15	50:00	22.97
22.18	60:00	22.90
22.21	70:00	22.90
22.24	80:00	22.87
22.28	90:00	22.83
22.31	100:00	
22.34	120:00	22.80
23.52	1440:00	21.95

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	ig	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
RORY WAGNER

Certification No
14061Q

Company Name
WILD ROSE WATER WELLS LTD.

Copy of Well report provided to owner
Yes

Date approval holder signed
2010/11/10

observation well

Water Well Drilling Report

View in Metric | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 2090655
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2012/10/10

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
CARTWRIGHT, CHLOE	285049 Range Road 35	Madden	ALBERTA	CANADA	TOM 0S0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	31	28	3	5				South Observation Well

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51°25'59.05"N Longitude 114°24'50.50"W
How Location Obtained
Not Verified

Elevation 3992.78 ft
How Elevation Obtained
Hand held autonomous Garmin 64s

Drilling Information

Method of Drilling
Combination

Proposed Well Use
Other

Type of Work
New Well

Formation Log

Measurement in Imperial

Depth from ground level (ft)	Water Bearing	Lithology Description
19.00		Brown Till & Clay
26.00		Gray Till & Clay
27.00		Brownish Gray Siltstone
29.00		Brown Fine Grained Sandstone
30.00		Gray Fine Grained Sandstone
32.00	Yes	Brown Shattered Sandstone
35.00		Brown Fine Grained Sandstone

Yield Test Summary

Measurement in Imperial

Recommended Pump Rate 5.00 igpm

Test Date	Water Removal Rate (igpm)	Static Water Level (ft)
2010/10/28	30.00	25.49

Well Completion

Measurement in Imperial

Total Depth Drilled	Finished Well Depth	Start Date	End Date
35.00 ft	35.00 ft	2010/10/28	2010/10/28

Borehole

Diameter (in)	From (ft)	To (ft)
8.00	0.00	26.00
6.00	26.00	35.00

Surface Casing (if applicable)
Size OD : in
Wall Thickness : in
Bottom at : ft

Well Casing/Liner
Plastic
Size OD : 4.94 in
Wall Thickness : 0.214 in
Top at : -2.66 ft
Bottom at : 35.00 ft

Perforations

From (ft)	To (ft)	Diameter or Slot Width(in)	Slot Length (in)	Hole or Slot Interval(in)

Perforated by Saw

Annular Seal Bentonite Chips/Tablets
Placed from 0.00 ft to 28.00 ft
Amount 150.00 Pounds

Other Seals

Type	At (ft)
Shale Trap	28.00

Screen Type
Size OD : in

From (ft)	To (ft)	Slot Size (in)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
RORY WAGNER

Certification No
14061Q

Company Name
WILD ROSE WATER WELLS LTD.

Copy of Well report provided to owner
Yes

Date approval holder signed
2010/11/07

observation well

Water Well Drilling Report

View in Metric | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 2090655
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2012/10/10

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
CARTWRIGHT, CHLOE	285049 Range Road 35	Madden	ALBERTA	CANADA	T0M 0S0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	31	28	3	5				South Observation Well

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51°25'59.05"N Longitude 114°24'50.50"W
How Location Obtained: Not Verified

Elevation 3992.78 ft
How Elevation Obtained: Garmin 64s

Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level: 33.46 in
Is Artesian Flow:
Rate: igpm
Is Flow Control Installed:
Describe:

Recommended Pump Rate: 5.00 igpm
Recommended Pump Intake Depth (From TOC): 28.00 ft
Pump Installed:
Depth: ft
Type:
Make:
H.P.:
Model (Output Rating):

Did you Encounter Saline Water (>4000 ppm TDS):
Depth: ft
Gas:
Depth: ft
Well Disinfected Upon Completion: Yes
Geophysical Log Taken:
Submitted to ESRD:
Sample Collected for Potability:
Submitted to ESRD:

Additional Comments on Well:

METHOD OF DRILLING - COMBINATION OF ROTARY AIR AND MUD. LITH: 30' - 32' ALSO FINE GRAINED. 7 INCH CASING WAS DRIVEN FROM 26 FEET TO BOTTOM. PVC WAS INSTALLED THEN 7 INCH CASING WAS REMOVED. PROPOSED WELL USE - LODGE, WATER DIVERTED FOR DRILLING FROM MUNICIPAL SOURCE

Yield Test

Measurement in Imperial

Test Date	Start Time	Static Water Level
2010/10/28	11:00 AM	25.49 ft

Method of Water Removal
Type: Air
Removal Rate: 30.00 igpm
Depth Withdrawn From: 28.00 ft

If water removal period was < 2 hours, explain why

Taken From Top of Casing
Depth to water level

Pumping (ft)	Elapsed Time Minutes:Sec	Recovery (ft)
25.49	0:00	28.00
	1:00	26.41
	2:00	26.31
	3:00	26.25
	4:00	26.21
	5:00	26.18
	10:00	26.08
	15:00	26.02

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	ig	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: RORY WAGNER
Certification No: 14061Q
Company Name: WILD ROSE WATER WELLS LTD.
Copy of Well report provided to owner: Yes
Date approval holder signed: 2010/11/07

observation well

Water Well Drilling Report

View in Metric | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 2090609
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2011/11/07

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
CARTWRIGHT, CHLOE	Range Road 35	Madden	ALBERTA	CANADA	T0M 0S0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	31	28	3	5				South Southwest Observation WELL

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.25'57.90"N Longitude 114.24'37.51"W
How Location Obtained: Not Verified

Elevation 1216.00 ft
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling
Combination

Type of Work
New Well

Proposed Well Use
Other

Formation Log

Measurement in Imperial

Depth from ground level (ft)	Water Bearing	Lithology Description
21.00		Brown Till & Clay
27.00		Gray Till & Clay
28.00		Brownish Gray Siltstone
31.00	Yes	Brown Fine Grained Sandstone
47.00	Yes	Brown Fine Grained Sandstone
50.00		Gray Siltstone

Yield Test Summary

Measurement in Imperial

Recommended Pump Rate 5.00 igpm

Test Date	Water Removal Rate (igpm)	Static Water Level (ft)
2010/11/03	20.00	24.93

Well Completion

Measurement in Imperial

Total Depth Drilled	Finished Well Depth	Start Date	End Date
50.00 ft	47.00 ft	2010/11/02	2010/11/03

Borehole

Diameter (in)	From (ft)	To (ft)
8.00	0.00	26.00
6.50	26.00	50.00

Surface Casing (if applicable)
Size OD : in
Wall Thickness : in
Bottom at : ft

Well Casing/Liner
Plastic
Size OD : 4.94 in
Wall Thickness : 0.214 in
Top at : -2.03 ft
Bottom at : 47.01 ft

Perforations

From (ft)	To (ft)	Diameter or Slot Width(in)	Slot Length (in)	Hole or Slot Interval(in)
35.00	45.00	0.125		6.00

Perforated by Saw

Annular Seal Bentonite Slurry
Placed from 0.00 ft to 30.00 ft
Amount 150.00 Pounds

Other Seals

Type	At (ft)
Driven	31.00
Shale Trap	30.00

Screen Type
Size OD : in

From (ft)	To (ft)	Slot Size (in)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
RORY WAGNER

Certification No
14061Q

Company Name
WILD ROSE WATER WELLS LTD.

Copy of Well report provided to owner: Yes

Date approval holder signed: 2010/11/07

observation well

Water Well Drilling Report

View in Metric | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 2090609
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2011/11/07

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
CARTWRIGHT, CHLOE	285049 Range Road 35	Madden	ALBERTA	CANADA	T0M 0S0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	31	28	3	5				Southwest OBSERVATION WELL

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.25'57.90"N Longitude 114.24'37.57"W
How Location Obtained: Not Verified

Elevation 1216.00 ft
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level: 24.41 in
Is Artesian Flow:
Rate: igpm
Is Flow Control Installed:
Describe:

Recommended Pump Rate: 5.00 igpm
Recommended Pump Intake Depth (From TOC): 35.00 ft
Pump Installed:
Depth: ft
Type:
Make:
H.P.:
Model (Output Rating):

Did you Encounter Saline Water (>4000 ppm TDS):
Depth: ft
Gas:
Depth: ft
Well Disinfected Upon Completion: Yes
Geophysical Log Taken:
Submitted to ESRD:
Sample Collected for Potability:
Submitted to ESRD:

Additional Comments on Well

COMBINATION ROTARY AIR & MUD DRILLING, PROPOSED WELL USE - LODGE, LITH: 28' - 31' ALSO SHATTERED, 31' - 47' SS & SILTSTONE STRINGERS, 7" WAS DRIVEN FROM 26' - 31', PVC CASING WAS INSTALLED AND 7" WAS REMOVED, BOREHOLE DIAMETER - RANGES FROM 6.5" TO 5.5" FROM 26' - 50', ANNULAR SEAL - ALSO BENTONITE CHIPS, WELL WAS PUMPED WITH AIR PRIOR TO USING SUB PUMP, RECOMMENDED PUMP RATE: 5 - 10 IGPM

Yield Test

Measurement in Imperial

Test Date	Start Time	Static Water Level
2010/11/03	11:00 AM	24.93 ft

Method of Water Removal
Type: Air
Removal Rate: 20.00 igpm
Depth Withdrawn From: 35.00 ft

If water removal period was < 2 hours, explain why
PUMP TEST @ 15 IGPM @ 35'

Taken From Top of Casing
Depth to water level

Pumping (ft)	Elapsed Time Minutes:Sec	Recovery (ft)
25.95	0:00	
	1:00	31.10
	2:00	30.38
	3:00	29.99
	4:00	29.69
	5:00	29.46
30.41	7:00	
30.58	8:00	
30.74	9:00	
30.87	10:00	28.71
31.89	20:00	27.79
32.55	30:00	27.26
33.10	40:00	26.90
33.37	50:00	26.67
33.63	60:00	26.44

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
WATER WELL (ON SITE)	700.00	ig	2010/11/01 6:00 PM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: RORY WAGNER
Certification No: 14061Q
Company Name: WILD ROSE WATER WELLS LTD.
Copy of Well report provided to owner: Yes
Date approval holder signed: 2010/11/07

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 392001
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1985/10/16

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
DAVIES, JIM	P.O. BOX 673 COCHRANE				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	31	28	3	5				Jim Davies Observation Well

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude ~~51.434780~~ Longitude ~~-114.417567~~
How Location Obtained
Map Latitude: 51°25'58.33"N
Longitude: 114° 24' 47.34" W

Elevation m
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Rotary

Proposed Well Use
Stock

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
10.67		Clay & Rocks
16.76		Shale & Sandstone

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 0.00 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1985/09/17	90.92	12.19

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
16.76 m		1985/09/17	1985/09/17

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	16.76

Surface Casing (if applicable)
Steel
Size OD : 14.12 cm
Wall Thickness : 0.396 cm
Bottom at : 6.10 m

Well Casing/Liner
Plastic
Size OD : 11.68 cm
Wall Thickness : 0.635 cm
Top at : 0.00 m
Bottom at : 16.76 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)
10.67	16.76	0.635		20.32

Perforated by Machine

Annular Seal Driven
Placed from 6.10 m to 0.00 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings Bottom Fittings

Pack
Type Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Company Name
DEN-ALTA DRILLING LTD.

Certification No
1

Copy of Well report provided to owner Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 392001
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1985/10/16

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
DAVIES, JIM	P.O. BOX 673 COCHRANE				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	31	28	3	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.434730 Longitude -114.417567
How Location Obtained
Map

Elevation m
How Elevation Obtained
Not Obtained

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 0.00 L/min
Recommended Pump Intake Depth (From TOC) 15.24 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Gas
Depth m
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

Yield Test

Taken From Ground Level
Depth to water level

Measurement in Metric

Test Date	Start Time	Static Water Level
1985/09/17	12:00 AM	12.19 m

Pumping (m)	Elapsed Time Minutes:Sec	Recovery (m)

Method of Water Removal
Type Air
Removal Rate 90.92 L/min
Depth Withdrawn From 0.00 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Company Name
DEN-ALTA DRILLING LTD.

Certification No
1

Copy of Well report provided to owner
Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 1240306
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2010/08/02

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
SINGER, PAT	P.O. BOX 54007 VILLAGE SQUARE	CALGARY	ALBERTA	CANADA	T1Y 3R6

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	5	29	28	3	5				K. Singer Observation Well

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.422967 Longitude -114.399083
How Location Obtained
Hand held autonomous GPS 20-30m

Elevation 1229.56 m
How Elevation Obtained
Hand held autonomous GPS 20-30m

Latitude: 51° 25' 22.74" N Longitude: 114° 23' 56.56" W

Drilling Information

Method of Drilling
Rotary - Air

Type of Work
New Well

Proposed Well Use
Domestic

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
3.96		Till
7.32		Gray Medium Grained Shale
8.53		Tan Tight Sandstone
13.41		Gray Medium Grained Shale
15.54		Gray Fine Grained Sandstone
20.12		Dark Gray Hard Shale
21.95		Gray Fine Grained Sandstone
23.77		Gray Shale
27.43		Black Hard Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 22.73 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
2010/07/18	22.73	6.47

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
27.43 m	27.43 m	2010/07/12	2010/07/12

Borehole

Diameter (cm)	From (m)	To (m)
21.59	0.00	6.10
13.34	6.10	27.43

Surface Casing (if applicable)
Steel
Size OD : 16.84 cm
Wall Thickness : 0.478 cm
Bottom at : 6.10 m

Well Casing/Liner
Plastic
Size OD : 11.43 cm
Wall Thickness : 0.602 cm
Top at : 3.05 m
Bottom at : 27.43 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)
21.34	27.43	13.335		0.00

Perforated by Saw

Annular Seal Bentonite Chips/Tablets
Placed from 0.00 m to 6.10 m
Amount 2.00 Bags

Other Seals

Type	At (m)

Screen Type
Size OD : cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
GREGG LEWIS

Company Name
DEN-ALTA DRILLING LTD.

Certification No
41140A

Copy of Well report provided to owner
Yes

Date approval holder signed
2010/08/02

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 1240306
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2010/08/02

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
SINGER, PAT	P.O. BOX 54007 VILLAGE SQUARE	CALGARY	ALBERTA	CANADA	T1Y 3R6

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	5	29	28	3	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.422967 Longitude -114.399083
How Location Obtained
Hand held autonomous GPS 20-30m

Elevation 1229.56 m
How Elevation Obtained
Hand held autonomous GPS 20-30m

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level 50.80 cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 22.73 L/min
Recommended Pump Intake Depth (From TOC) 25.91 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Gas
Depth m
Well Disinfected Upon Completion Yes
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability Yes
Submitted to ESRD

Additional Comments on Well

Yield Test

Taken From Top of Casing
Depth to water level

Measurement in Metric

Test Date	Start Time	Static Water Level
2010/07/18	9:00 AM	6.47 m

Method of Water Removal

Type Pump
Removal Rate 22.73 L/min
Depth Withdrawn From 25.30 m

If water removal period was < 2 hours, explain why

Pumping (m)	Elapsed Time Minutes:Sec	Recovery (m)
6.47	0:00	16.51
7.76	1:00	14.77
8.21	2:00	13.36
8.53	3:00	12.18
8.89	4:00	10.89
9.21	5:00	10.20
9.43	6:00	9.72
9.60	7:00	9.40
9.81	8:00	
9.92	9:00	8.96
10.03	10:00	8.81
10.26	12:00	8.58
10.44	14:00	8.38
10.58	16:00	8.22
10.82	20:00	7.98
11.07	25:00	7.82
11.26	30:00	7.67
11.67	35:00	7.54
12.22	40:00	7.42
12.98	50:00	7.32
14.46	60:00	7.23
15.89	75:00	
15.98	90:00	
16.37	105:00	
16.51	120:00	

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
GREGG LEWIS

Certification No
41140A

Company Name
DEN-ALTA DRILLING LTD.

Copy of Well report provided to owner
Yes

Date approval holder signed
2010/08/02

SOLSTICE
Environmental Management

Chinook Ridge Castle and RV Park
285049 Range Road 35
Madden, AB T0M 0S0

Date: July 30, 2020

Attention: Chloe Cartwright

Dear Ms. Cartwright:

RE: Response to Alberta Environment and Parks Letter of July 21, 2020
Water Act Application 001-00431063

We have been responding to Alberta Environment and Parks (AEP) and various landowners in the area. Part of the correspondence to the landowners was conducted prior to our most recent update letter of July 16, 2020 and it seemed prudent we incorporate our responses to their letters.

Firstly, with respect to our statement about the status of the Stantec report of 2011 we should re-iterate that the Stantec report followed analysis procedures as outlined in the current Alberta Environment Guide to Groundwater Authorization (2011) and the report was prepared by a respected firm and an experienced professional hydrogeologist.

As a result, it should be expeditious to submit this report in support of the license application and we have no issues with the report, with the exception of time sensitive matter of which we provided an update in our July 16, 2020 letter report. Further it is accepted industry and regulatory practice to use another consultants report.

AEP has let us know that they have already accepted at least part of the Stantec report (whether the water well is under the direct influence of surface water). Following our professional society (APEGA) guidelines, if AEP has concerns with other aspects of the Stantec report, APEGA requires that Stantec be provided with an opportunity to respond. Depending on the concern from AEP and the Stantec response we may be able to provide our own response, but until then I believe the Stantec report should be able to stand on its own merits.

With respect to individual Statements of Concern we offer the following clarifications:

Karen Farquharson – Pasture land owner 800 – 1600 m west of supply well

Boundary effects were observed in the Stantec pumping test report and interpretations (Section 2.3). As well the relative lack of response in Observation Well 1, which is completed over a shallower interval than the supply well (aquifer at 9.1 – 9.8 m in Obs Well 1 versus a completion zone of 11.0 – 15.2 m in the pumping well) also indicates a lack of vertical communication.

These results are consistent with the geological interpretation of the aquifers in the Paskapoo Formation consisting of sandstones deposited in relatively narrow river channels capped with relatively impermeable shales.

While longer pumping tests will provide more data, we do have water level data over 3.05 log cycles (Stantec report Figure 2.2). Increasing the pumping period to two days would provide water level data

over 3.3 log cycles, perhaps not a significant amount. I would note that the test length follows Alberta Environment guidelines so the authors of this guideline thought the test length was sufficient.

It should be noted that Karen Farquharson does not have a well on her land and does not appear to have a direct interest in groundwater supply.

Karen Singer – Neighbour to the SE approximately 1.6 km from Supply Well

The Stantec report on the uncertain nature of geological investigations and Ms. Singers concerns in her letter of June 10, 2020 (Points 3, 5 and 6) require an appreciation of the geological nature of the aquifers of which we tried to convey in our response letter of July 2, 2020. We will bring additional points here with the realization that our description might still not be satisfactory. In our opinion the questions raised require a geological specialist to appreciate the answers fully, which is likely why the Stantec report alluded to these factors without discussing them in detail.

If the aquifer that supplies the Chinook Ridge well is of limited size, as Stantec suggests and the geological interpretation supports, this feature would be favourable in that the aquifer would not be connected to other aquifers that other groundwater users in the area utilize. The aquifers consists of sandstone bodies formed from river channel deposits and as such are limited in size – however various river channels may be connected with each other in three dimensions, either as stacked channels or as channels that connect with each other horizontally in discontinuous locations.

Determining the distribution of the aquifers in three dimensions with the well log data is often difficult and uncertain. Seismic data may help, but of course would be cost prohibitive. Electric logs (SP, gamma, resistivity, etc.) would have provided further information but need to be run at the time of well drilling and AEP does not require electric logs.

It should be noted that in response to the uncertainties inherent in any geological investigation AEP has made for a provision for a safety factor in the calculations. The distance from the Singer well to the Chinook Ridge supply well is greater than 1.6 km and unlikely to be affected at this distance. AEP does not routinely require analysis of groundwater effects at this distance.

Maxine McArthur – Neighbour to the east

As we were not able to take measurements on the wells on Ms. McArthur's property during our field survey we will not add additional comments to our letter of July 3, 2020.

Don Farquharson – Neighbour to the south-west

Mr. Pentney is correct in that the letter of July 16, 2020 is in response to concerns of Mr. Farquharson that time sensitive material in the Stantec report needed updating. We have recompleted the field verified survey to ensure that accurate well locations and owners are shown. Mr. Farquharson has also noted several well reports in the AEP water well database but lesser amounts on the field survey. Some of the well reports are for decommissioned wells or are records of water chemistry and the number of well reports is not indicative of the number of wells on the Chinook Ridge property.

As the water supply well for Chinook Ridge is determined to not be in direct communication with surface water there should be no adverse affects to any impacts on dugouts on the Farquharson property.

Robert and Elaine Watson – Neighbour to the north

Our field survey has shown that the aquifer supplying the Watson well is at an elevation of 1180 – 1168 m above sea level. The Chinook Ridge supply well has an aquifer at an elevation of 1208 – 1204 m above sea level, considerably higher and indicative of separate aquifers.

The static water level in the Watson water well is at an elevation of around 1190 m above seal level whereas the elevation of the water level in the Chinook Ridge supply well is at an elevation of around 1212 m above sea level. These different water level elevations also provide support that the two wells obtain water from separate aquifers.

A north to south cross section from the Watson well through the Chinook supply well and south to the Harnack Well is attached. Some sandstone bodies can be correlated between wells. Most wells obtain water from deeper aquifers than the aquifer supplying the Chinook Lodge well.

Jim Davies – Neighbour to the west

As we were not able to investigate the Jim Davies well there is some question as to the details of the well location and depth. It appears, as our letter of June 16, 2020 indicates, that one of the wells on the Jim Davies property is relatively shallow and quite possibly obtains water from the same zone as the Chinook Ridge water supply well.

Access to the Davies well during the pumping test conducted on the Chinook Ridge water supply well in June of this year would have been beneficial.

If the assumption is made that the two aquifers are connected than some interference will occur. Calculations for the interference effect are shown in the Stantec report (Table 3.1). Distance between the two wells is not accurately known but likely on the order of 100 – 200 m. According to Table 3.1 an additional drawdown of less than 1 m should occur.

The total available drawdown in the Davies well is again uncertain but appears to be on the order of 3 – 4 m. As such an additional drawdown of 1 m will occur after 20 years due to pumping from the Chinook Ridge Supply Well. This additional drawdown may not cause an adverse affect, depending on the productivity of the Davies well and the demands of water from that well.

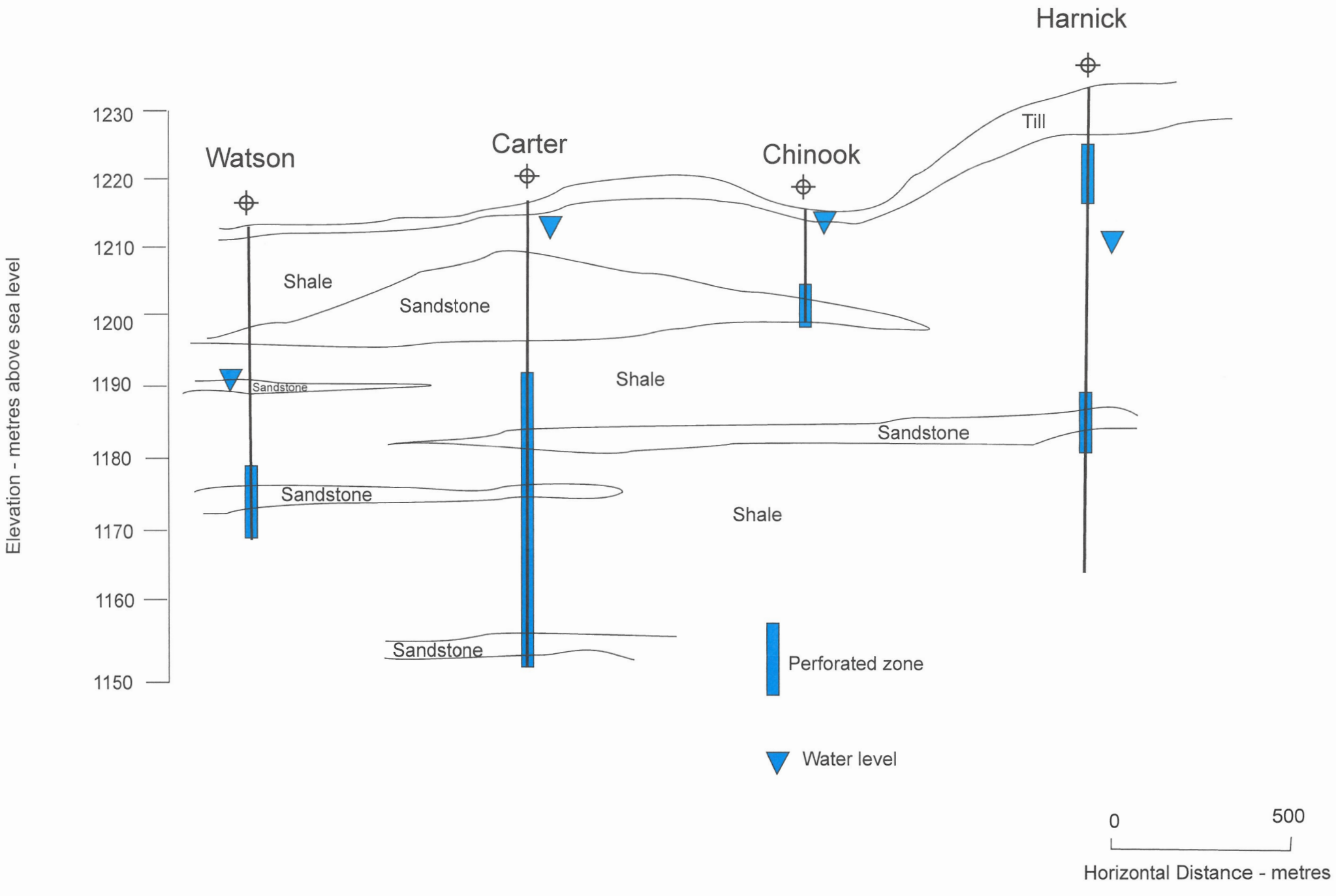
Sincerely,

K Hugo

PROFESSIONAL GEOLOGIST KEN HUGO ALBERTA July 30 2020

Ken Hugo, P.Geol.
Hydrogeologist
APEGA P12910

/att – cross sections


Harnick
Watson
Carter
Chinook
Till
1230
1220
1210
1200
1190
1180
1170
1160
1150
Elevation - metres above sea level
Shale
Sandstone
Sandstone
Shale
Sandstone
Sandstone
Shale
Sandstone
Perforated zone
Water level
0
500
Horizontal Distance - metres

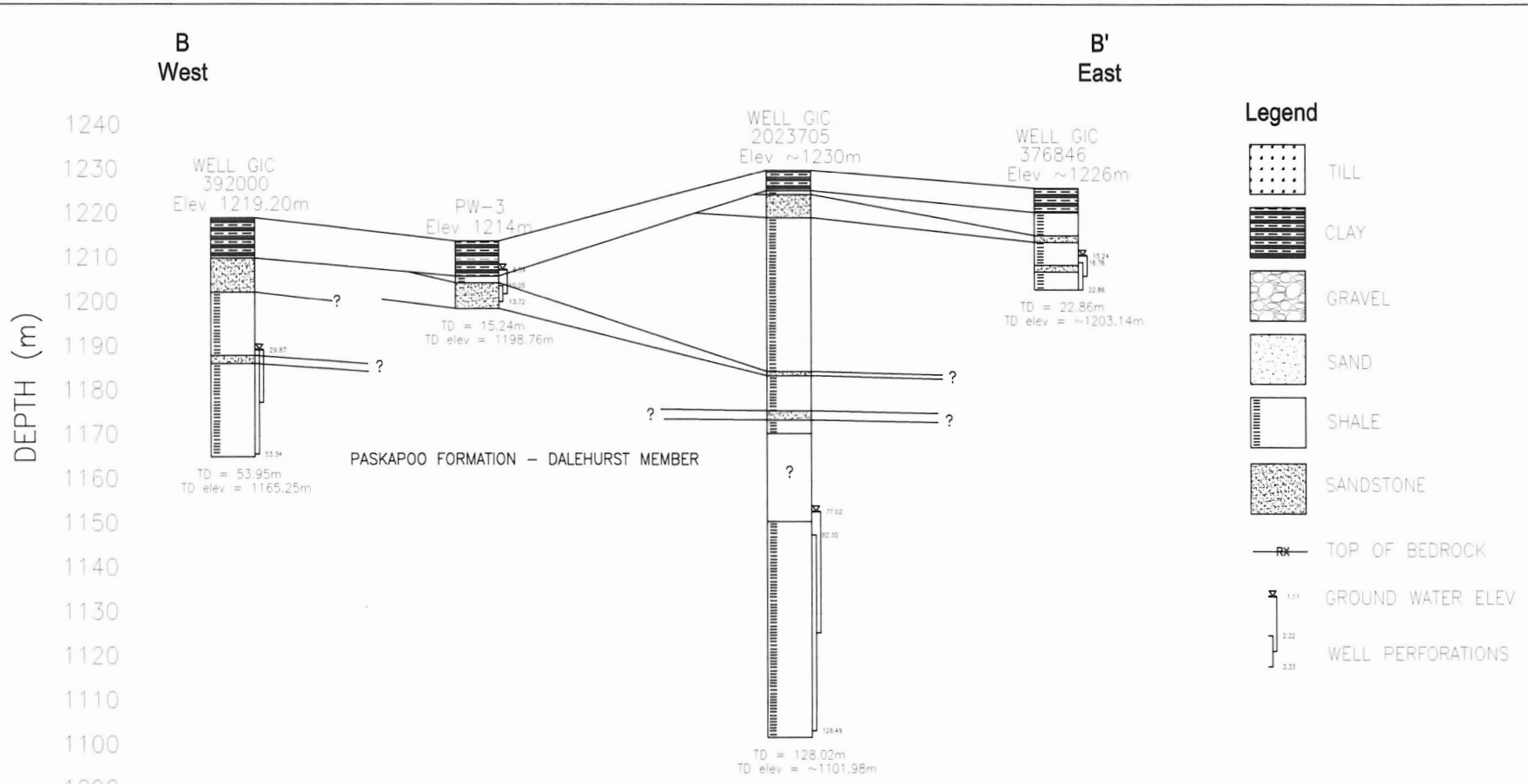


FIGURE 1.4

HYDROGEOLOGIC PROFILE - WEST TO EAST

NOTES:
VERTIAL SCALE 1:10
HORIZONTAL SCALE:
VERTICAL EXAGERATION 1X

Stantec Consulting Ltd.
600, 4808 Ross Street
Red Deer AB Canada
T4N 1X5
Tel. 403.341.3320
Fax. 403.342.0969
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SOLSTICE
Environmental Management

Chinook Ridge Castle and RV Park
285049, Range Rd 35
Madden, AB T0M 0S0

July 16, 2020

Attention: Chloe Cartwright

Dear Ms. Cartwright,

RE: Update to Report entitled "Groundwater Evaluation – Chinook Ridge Lodge and Golf Course, SE – 31 – 28 – 3W5"

A groundwater supply evaluation report was prepared by Stantec Consulting Ltd. in 2010 that determined that a groundwater supply well on the Chinook Ridge Lodge and Golf Course property (now called Chinook Ridge Castle & RV Park) is capable of supplying 64.4 cubic metres per day of water without causing adverse affects to nearby users. The aquifer supplying the well was determined to not have a direct connection with surface water. The report was prepared in a format as required by Alberta Environment and Parks for submission to AEP in support of a license application for the well.

As the report is now 10 years old and an update to the report was requested by some neighbours as they were concerned about possible changes since 2010. Aquifer properties such as aquifer transmissivity and storativity will not have changed, nor will the geological description of the various strata underlying the site. Four components of the report that could have changed since the initial investigation 10 years ago are:

1. Groundwater users in the area may have changed due to new wells installed or old wells abandoned, ownership changes, or change in groundwater use.
2. Water levels in the wells due to pumping or long term climatic trends
3. Well productivity changes due to biological or chemical encrustation of the well screen.
4. Water chemistry changes due to changes in precipitation or infiltration patterns

A new field verified survey was conducted in June of 2020 and a short term pumping test on the supply well was conducted in July of 2020.

Field Verified Survey

Prior to the field survey the landowners in the area were contacted to seek permission to measure water levels in their wells and locate the wells precisely. Landowners were contacted with delivery of a letter describing the field measurement procedure. Permission was not obtained from all land owners in the area. Seven wells were measured, four landowners twice refused offers to measure their wells.

Procedures of the field survey is as follows:

- Water levels of wells located in pits were not measured due to confined space entry restrictions.

- Water levels were measured with the aid of an RGI Model 300 Sonic Water Level Meter. This meter uses a sound wave to measure non-pumping water levels in the well. This meter avoids issues related to getting water level probes stuck in well and issues with cross contamination associated with using a water level probe in several wells.

- GPS locations of the wells were measured with a Garmin 64s hand held device.

- Notes were collected on well casing type and diameter to aid in determining which Water Well Drillers Report is associated with the well.

- Well elevations were obtained using LIDAR derived contour maps provided by Rockyview County. The survey is accurate to +/- 2 m.

Using the water level measurements, water well location, well owner and other available data collected in the field (well casing material, well casing diameter, name of driller, well depth etc.) the presumed well record for each well was accessed on the Government of Alberta Water Well Database. The well records included are our best possible estimate of the corresponding water well record based on available data given the available data.

An aerial photo showing the location of each well measured during the survey is included in Figure 1. Neighbors who did not grant access to measure their well water levels are not included on the air photo with the exception of Davies who provided a verbal description of his well location.

FIGURE 1. Aerial View of Well Locations

Water Well Details and Water Level Measurements

Map Identifier	#1	#2	#3	#4	#5
LSD Location	NW-32-28-3W5	NW-32-28-3W5	NW-32-28-3W5	16-31-28-3W5	SE-31-28-3W5
GPS Location	51.4416185°N, -114.398447°E	51.4450160°N, -114.3945032°E	Unknown	51.4426812°N, -114.4019048°E	51.4251492°N, -114.4022763°E
GIC Well ID	392004	2022505	Unknown	404736	416470
Well Owner	Scotts	L. Robertson	S. Robertson	Rob Watson	Harnack
Well Use	Domestic	Domestic	Unknown	Stock	Domestic & Stock
Well Elevation	1214	1190	1194	1214	1240
Well Depth (m)	15.2	33.5	Unknown	45.7	79.3
Completion Zone (m)	9.8 – 14.3	18.3 – 30.5	Unknown	33.5 – 45.7	19.8 – 24.4 54.9 – 59.4
Completion zone elevation	1204 - 1200	1172 - 1160	-	1180 - 1168	1220 – 1216 1185 - 1181
Date Drilled	1974/07/04	2004/09/09	Unknown	1995/04/25	1975/07/29
Original Static Water Level	8.84	12.60	Unknown	24.38	24.38
Original Static Water Elevation	1205	1177	-	1190	1216
Water Level Measured June 23, 2020	9.20	12.26	Well in pit, water level not measured	23.22	26.62

Map Identifier	#6	#7	#8	#9	Chinook Ridge
LSD Location	SE-31-28-3W5	SE-31-28-3W5	SE-31-28-3W5	SW-31-28-3W5	SE-31-28-3W5
GPS Location	51.431517°N, -114.402206°E	51.4380807°N, -114.1035202°E	51.4380803°N, -114.4034809°E	?	51.423259° N, -114.41151° E
GIC Well ID	2023705	399551	399552	392001?	2090656
Well Owner	Chloe Cartwright	Carter	Carter	Davies	Chinook Ridge
Well Elevation	1234	1218	1218	1218	1218
Well Use	Other	Domestic	Domestic	Livestock	Event Facility
Well Depth (m)	128.0	45.7	66.1	16.8?	14.6
Completion Zone (m)	82.3 – 126.5	28.7 – 44.2	24.4 – 65.2	10.7 -16.8	10.1 – 13.7
Completion Zone Elevation	1152 – 11 08	1189 – 1174	1194 - 1153	1207 - 1201	1208 - 1204
Date Drilled	2008/11/03	1994/11/28	1994/12/14	1985/09/17	2010/11/05
Original Static Water Level	77.02	28.65	24.38	12.2	6.54
Original Static Water Elevation	1157	1189	1194	1206	1212
Water Level Measured June 23, 2020	75.08	3.60	3.83	No permission	5.41

Points to consider from the survey are as follows:

- The well record for Scott's well is quite uncertain but the best possible match available on the Alberta Water Well Database.

- The water level in L. Roberson's domestic well has decreased by 0.34 meters from 2004 to 2020.

- R. Watson also had a second well located 5 meters north of the measured well, but the well was in a pit. The water level in the well that was measured has increased by 1.16 meters from 1995 to 2020.

- The water level in the Harnacks well that was not in a pit decreased by 2.24 meters from 1975 to 2020.

- The water level in Chloe Cartwrights barn well has increased by 1.94 meters from 2008 to 2020.

- The water level in both Carter wells appeared to have increased substantially since drilling in 1994. The large increase in water level may be due to the original static water level measured in 1994 being recorded before the water level in the well had fully recovered from drilling.

- Wells that have similar completion intervals as Chinook Ridge are Scott, and possibly Davies (#1 and #9). Wells that have similar water level elevations to Chinook Ridge is Harnack (#5). The Davies well is in close proximity to the Chinook Ridge supply well and possibly has a similar completion interval, but the historic static water levels are not similar and this water level indicates the two wells are not on the same aquifer. As permission was not obtained from Davies to measure water levels a comparison to recent water levels could not be made.

  The findings are in agreement with the Stantec findings that the aquifers are not regionally extensive.

  There does not appear to be any well that have similar completion zone elevations and water level elevations to the Chinook Ridge water supply well and it cannot be established that the aquifer supplying the Chinook Ridge aquifer is on the same aquifer as any of the neighbouring wells.

Chinook Ridge Water Supply Well Productivity

A short term pumping test was conducted on the water supply well on July 5, 2020 by personnel from Wild Rose Water Wells Ltd. The pumping test consisted of pumping the well at a rate of 15.7 imperial gallons per minute for 2 hours. Water levels were read for the two hours and for 90 minutes after pumping ceased. The pumping test report from Wild Rose is attached.

The pumping test data was evaluated with the aid of the AQTESOLV program developed by HydroSoft. As with the original pumping test interpretation undertaken by Stantec a dual porosity (fractured) model was used in the interpretation. A graph showing water displacement with time and the fitted model curve is also attached.

A very good fit to the data is observed. No indications of well damage are present as the early time data fits the model curve as well as the late time data. A comparison of this pumping test data and interpretation with the pumping test data and interpretation as presented in the Stantec report is as follows:

Pumping Test Comparison

Test Date	Static Water Level	Transmissivity	Specific Capacity @ 120 min pumping
11/10/2010	6.54 m	62.6 m^2/day	350 m^2/day
5/7/2020	5.41 m	91.3 m^2/day	256 m^2/day

Note: Transmissivity based on aquifer thickness from the Stantec report of 3.70 m (T = K x b)

The two transmissivities are similar with the recent pumping test showing a higher transmissivity, however as aquifer transmissivities often vary over one order of magnitude the 30% difference between these two tests is not significant. The Stantec report for the dual porosity model would likely have shown a different transmissivity value if only the data to 120 minutes was used.

The results show some decrease in specific capacity with time; however, the static water level is higher in 2020 such that the available head for the aquifer will be higher which would allow for similar long term yield calculations. Due to the relatively small amount of drawdown observed (less than 0.4 m) we would consider the calculated specific capacity values in 2010 and 2020 to be similar.

Water Chemistry

A water sample was collected during the pumping test on July 5, 2002 and submitted to WSH Labs (1992) Ltd. for analysis of routine dissolved parameters. The lab report is also attached. A summary of the results, with a comparison to the water chemistry data as presented in the Stantec report and drinking water quality guidelines is as follows:

Water Chemistry Analyses

Parameter	2010 Results	2020 Results	Drinking Water Quality Guidelines
Calcium	107	109	
Iron	0.12	0.03	0.3
Magnesium	37.9	37.8	
Manganese	0.01	0.01	0.05
Potassium	4.2	4.1	
Sodium	19	22	200
Bicarbonates	521	511	
Bromides	< 0.2	< 0.1	
Carbonates	0	0	
Chlorides	3.6	4.4	250
Fluorides	0.15	0.17	1.5
Nitrates	1.49	1.2	10
Nitrites	< 0.05	< 0.02	1

Sulphates	23	27	500
Electrical conductivity	808	796	
Total Dissolved Solids	452	457	500
pH	7.82	7.82	6.5 – 8.5

Note: all results in mg/L except electrical conductivity in µS/cm and pH in pH units

The water quality shows no change between 2010 and 2020.

Summary

The data and interpretations provided in this letter report are in agreement with the data collected and interpretations provided in the 2010 Stantec report. The data collected here provides no indications that the conclusions in the Stantec report would not be considered to still be valid.

This updated letter is to be used in conjunction with the original Stantec report as submitted to the client. No interpretation of the data or conclusions within the Stantec report is provided in this letter update and concerns with respect to the Stantec report will need to be addressed by Stantec Consulting Ltd.

Sincerely,

PROFESSIONAL GEOLOGIST KEN HUGO ALBERTA

Ken Hugo, P.Geol.
Senior Hydrogeologist
APEGA P12910

ATTACHMENTS: PUMPING TEST REPORT, WATER WELL CHEMICAL ANALYSIS REPORT

WILD ROSE WATER WELLS LTD.

Box 4028
Olds, AB T4H 1P6
Phone/Fax: (403) 556-6700

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Water Well Drilling - Repairs - Pumps & Pressure System - Environmental Drilling - Flow Testing - Well Abandonments

WATER WELL FLOW TEST

July 5/20 Tested By: R. Wagner
Water Well Driller

1/4 or LSD	SECTION	TWP	RANGE	W. MED.
SE	31	28	3	5

Well Owner: Chloe Cartwright
Address: RR 2,
Crossfield, AB
T0M 0S0
Location on Property: *North Pumping Well*

Elapsed time in Minutes	Depth to water level during Pumping	Depth to water level during Recovery
0	5.41	5.80
1		5.70
2	5.55	5.69
3		5.665
4	5.57	5.65
5	5.59	5.64
6		
7		
8		
9		
10	5.63	5.60
15		
20	5.68	5.55
25		
30	5.705	5.53
35		
40	5.72	5.52
45		
50		5.51
60	5.75	5.50
70	5.76	
80	5.77	5.49
90	5.78	5.485
100	5.79	
110		
120	5.80	

REMARKS

Measurements in: metres

Water samples were taken from the end of the discharge hose

Water samples were clear with no sediment or odour

Well ID #2090656

Well Depth is 50 feet

Test Requested by:

Name:
Address:
Email:
Phone No.:
Contact:

Flow Rate Information

Pumped at: 15.7 igpm
Pressure gauge reading:
Measured from:
Distance to ground level:

WSH Labs (1992) Ltd.

3851B – 21 Street NE • Calgary, Alberta, Canada • T2E 6T5

Phone: (403) 250-9164 • Fax: (403) 291-4597 • www.wshlabs.com

Wild Rose Water Well Ltd.
Box 4028
Olds, AB T4H 1P6

Phone: (403) 556-6700 **Lab Number:** 87971
Fax: (403) 556-6700
Email: waterwells@telusplanet.net **PO Number:**

Sample Info: Chloe Cartwright
Well ID #2090656

Sampled By:
Date Sampled: 7/5/2020
Date Received: 7/6/2020
Date Reported: 7/7/2020

TEST REPORT

Analyte	Units	Result	CDW Guideline Maximum	Detection Limit
Calcium	mg/L	107	No Guideline	0.02
Iron	mg/L	0.12	AO: 0.3	0.03
Magnesium	mg/L	37.9	No Guideline	0.02
Manganese	mg/L	0.01	AO: 0.02, MAC: 0.12	0.01
Potassium	mg/L	4.2	No Guideline	0.02
Sodium	mg/L	19	AO: 200	0.02
Bicarbonates	mg/L	521	No Guideline	-
Bromides	mg/L	<0.2	No Guideline	0.2
Carbonates	mg/L	0	No Guideline	-
Chlorides	mg/L	3.6	AO: 250	0.1
Fluorides	mg/L	0.15	MAC: 1.5	0.02
Nitrates as N	mg/L	1.49	MAC: 10	0.04
Nitrites as N	mg/L	<0.05	MAC: 1	0.05
$NO_3 + NO_2$ as N	mg/L	1.49	No Guideline	0.04
Sulfates	mg/L	23	AO: 500	0.9

Parameter	Units	Result	CDW Guideline Maximum	Detection Limit
Electrical Conductivity (at 25°C)	µS/cm	808	No Guideline	0.2
pH	pH	7.82	7.0 - 10.5	-
Hardness (as $CaCO_3$)	mg/L	423	No Guideline	0.1
Total Alkalinity (as $CaCO_3$)	mg/L	427	No Guideline	3
P-Alkalinity (as $CaCO_3$)	mg/L	0	No Guideline	-
Hydroxide (as $CaCO_3$)	mg/L	0	No Guideline	-
Total Dissolved Solids (calculated)	mg/L	452	AO: 500	4

WSH Labs (1992) Ltd. as per: KBW

Sum of Cations	9.37	TDS / EC Ratio	0.56
Sum of Anions	9.23	Sodium Adsorption Ratio	0.39
Ion Balance	1.01	Saturation Index	1.02

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Legalities

Lab Number: 87971

(1) The results above are related only to the items analyzed.
(2) Results apply to the sample(s) as received.
(3) Analytical determinations were performed in Calgary, AB. 3851B - 21 Street NE.
(4) Condition of sample(s) upon receipt:
Acceptable
(5) External provider(s) of laboratory results:

References

(1) Accredited by CALA to ISO/IEC 17025 for specific tests.
(2) Guidelines for Canadian Drinking Water Quality are provided courtesy of Health Canada, June 2019.
https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/sum_guide-res_recom-eng.pdf

Acronyms & Nomenclatures

< denotes less than detection limit
> denotes greater than
AO = Aesthetic Objective
CDW = Canadian Drinking Water
MAC = Maximum Acceptable Concentration
OG = Operational Guidance Value
TNTC = Too Numerous To Count (>80 colonies)

Standard Methods for the Examination of Water and Wastewater 23rd Edition (2017)

Alkalinity. 2320 B. Titration Method.
Ammonia Nitrogen. 4500-NH3 C. Titrimetric Method.
Anions. 4110 B. Ion Chromatography with Chemical Suppression of Eluent Conductivity.
Biochemical Oxygen Demand. 5210 B. 5-Day BOD Test.
Color. 2120 B. Visual Comparison Method.
Conductivity. 2510 B. Laboratory Method.
Fluoride. 4500-F⁻ C. Ion-Selective Electrode Method.
Hardness. 2340 B. Hardness by Calculation.
Metals. 3125 B. Inductively Coupled Plasma / Mass Spectrometry (ICP-MS) Method.
Organic Carbon. 5310 B. High-Temperature Combustion Method.
pH. 4500-H+ B. Electrometric Method.
Total Kjeldahl Nitrogen / Nitrogen (Organic). 4500-Norg B. Macro-Kjeldahl Method.
Total Suspended Solids. 2540 D. Total Suspended Solids Dried at 103-105°C.
Turbidity. 2130 B. Nephelometric Method.

Hach Methods

Chemical Oxygen Demand. Hach Method 8000.
Chlorine, Total & Free. As per Hach CN66 Test Kit Instructions.
Coliforms, Total and E. coli. (Membrane Filtration). Hach Method 10029.
Ortho-Phosphate. Hach Method 8048.
Sulfides. Hach Method 8131.
Tannin & Lignin. Hach Method 8193.
Total Phosphate. Hach Method 8190.