MEMORANDUM

BBA water consultants

BISHOP-BROGDEN ASSOCIATES, INC.

To: Joe Lamanna

From: Timothy A. Crawford

Subject: Ready Mixed Concrete Company – Holton-Morton Lakes Site – A&W Pumping Test Summary

Job: 0430.11

Date: February 23, 2018

This memorandum presents a summary of the pump testing of the A&W Water Service, Inc. (A&W) well (Permit No. 61793-F) located north of the Ready Mixed Concrete Company (RMCC) Holton-Morton Lakes Site Stage 6A and 6B gravel pits, as presented in Figure 1. The purpose of the pump testing was to collect actual measurements of the well and well equipment and to complete a test to document current well performance. This includes measurements of the total depth of the well, the pump setting depth and static and pumping water levels. In addition, we observed the use and operation of the well. This effort includes an analysis of the water level data to calculate aquifer characteristics and project achievable yields for the A&W well.

Executive Summary

- The total depth of the A&W well is measured at 39 feet below the ground surface.
- The top of the pump impeller assembly is estimated to be at 31 feet below the ground surface.
- Pump cavitation conditions reported by the operator of the A&W well were confirmed at pumping rates higher than 400 gallons per minute.
- Monitoring tube equipment has been installed in the A&W well to allow for future static and pumping water level monitoring.
- The A&W well can be operated with rates as high at 350 gallons per minute for short periods of time without pump cavitation.
- Based on the testing, the A&W well can be operated at projected long-term pumping rates of up to approximately 312 gallons per minute for up to a 30-day pumping period.

Well Information

The A&W well (Permit No. 61793-F) was completed on July 3, 1961 (approximately 56 years old) under Permit No. 3250-F with a 36-inch diameter borehole drilled to a total depth of 39.5 feet. The permit file information for the well indicates that solid 18-inch diameter casing was installed from the ground surface to a depth of 15 feet and 18-inch louvered perforated casing was installed between the depths of 15 and 30 feet. The total depth of the well is reported to be 39.5 feet. The A&W well is constructed in the alluvial aquifer of the South Platte River and the borehole for the

well penetrated top soil, gravel, clay and shale. The bedrock shale was encountered at a depth of 39 feet.

In 2004, the well was repermitted under Permit No. 61793-F to allow for the current industrial and commercial uses at a pumping rate of 500 gallons per minute (gpm) with an annual amount of 252 acre-feet per year. The well pumping is limited to 8.5 acre-feet per week pursuant to a stipulation with objectors entered in Water Court Case No. 03CW416.

Prior to February of 2018, no water level information was available for the A&W well from the permit file or from A&W, no pump setting information was available and there were uncertainties regarding the actual construction of the well. On February 2, 2018, A&W verbally provided information from Quality Well and Pump which indicated a static water level of 8 feet in April of 2014, a total well depth of 34 feet, a well rating of 424 to 443 gpm and a pump setting depth at "the bottom of the well".

A pump testing investigation was completed to better understand the well construction and current operations, as described below.

Pump Testing Investigation

On February 12, 2018, Bishop-Brogden Associates, Inc. (BBA) accessed the A&W well with Colorado Water Well (CWW) for an initial investigation of the well head and pumping operations to prepare for the pump testing efforts. The onsite representative with A&W (Randy Wright) confirmed that the well operates on a float system connected to onsite, above ground storage tanks and that the pump discharges to the top of the tanks when the float system is triggered. The onsite representative could not confirm the total storage volume of the storage tanks, but did indicate that not all of the tanks were used for water storage. BBA estimates a minimum storage volume of approximately 130,000 gallons. The tanks are connected and operate as a single storage vessel. The tanks are used to fill water trucks ranging in size from 500 up to 6,000 gallons at a sporadic demand schedule via a manifold and booster pump. The well was operated during this initial site investigation. Initial pumping rates were as high as approximately 700 gpm, but the pump equipment cavitated approximately 30 seconds after the pump was turned on. It was observed that the valve installed on the discharge for the well was completely open.

On February 16, 2018, BBA accessed the A&W well with CWW to access the well casing, confirm depths, install measurement tubes and observe the operation of the well, with the collection of static and pumping water levels, at multiple pumping rates (step-test). The outside casing of the well was accessed and a smaller inside casing was discovered. This smaller casing was accessed and a measurement tube was installed in the well. A static water level of 18.4 feet below the ground surface water measured in the well. The total depth of the well was measured at a depth of approximately 39 feet below the ground surface. The top of the pump impeller assembly was estimated at a depth of 31 feet below the ground surface. The intake depth for the pump could not be confirmed, but was estimated at a depth of 34 feet below the ground surface. The well was operated at pumping rates of approximately 200 gpm, 300 gpm, 350 gpm and 400 gpm. No pump cavitation was observed at the 200 gpm, 300 gpm or 350 gpm pumping rates. Minor pump

cavitation was observed at the 400 gpm pumping rate and major pump cavitation was observed when pumping rates above 400 gpm were attempted. Based on the initial pumping of the well and the water levels collected in the well a pumping rate of 300 gpm was chosen for a constant discharge pumping test for the well.

During the testing of the well, the existing pump equipment, discharge and totalizing flow meter were utilized. The valve for the discharge is a butterfly valve with limited settings providing for limited flexibility in pumping rate of the well. The totalizing flow meter installed on the well reads in units of acre-feet * 0.001. Water levels in the pumping water and a monitoring well located approximately 151.5 feet to the northeast of the pumping well were measured using electronic water level indicators (m-scopes) and pressure transducers.

On February 20, 2018, BBA accessed the A&W well with CWW to complete a constant discharge pumping test for the well. The A&W well had not been operated for approximately 12 hours before the start of the testing. Prior to the pumping test, the static water level in the pumping well was approximately 18.09 feet below the ground surface. During the constant discharge test, the well was operated at a rate of approximately 291 gpm for a period of 8 hours. At the end of the constant discharge test, the water level in the pumping well was approximately 28.29 feet below the ground surface. During the testing, a total of approximately 139,500 gallons were pumped from the well.

Prior to the pumping test, the static water level in the observation well was approximately 15.17 feet below the ground surface. At the end of the constant discharge test, the water level in the observation well was approximately 15.68 feet below the ground surface.

The water level data collected from the pumping and observation wells during the testing are presented in the attached Table 1 and Table 2, respectively.

Data Analysis and Well Performance Projection

The pumping test data were analyzed to determine aquifer characteristics and identify achievable pumping scenarios for the A&W well using the Theis type-curve method, as presented in the attached Figures 2 and 3. Analysis of the corrected pumping well drawdown data (corrected to determine the true aquifer characteristics) indicates an aquifer transmissivity of approximately 185,270 gallons per day per foot and a storage coefficient, representative of conditions in the pumping well, of approximately $1.2 * 10^{-14}$.

Projections of well yield were completed using the aquifer characteristics determined from the pump testing efforts, a static water level 18.09 feet below the ground surface, an assumed pump intake setting depth of 34 feet below the ground surface, a net positive suction head requirement of 1.6 feet and a maximum pumping water level of 32.4 feet. Projections of potential well yields are presented in the table below.

Summary of Well Yield Projections			
Pumping Period (day):	1	7	30
Pumping Rate (gpm):	336	322	312

Based on the well yield projections, the A&W well should be capable of producing up to:

- 483,840 gallons or 1.48 acre-feet per day
- 3,245,760 gallons or 9.96 acre-feet per week, which exceeds the weekly pumping limit of 8.5 acre-feet
- 13,478,400 gallons or 41.36 acre-feet per month, which exceeds the monthly pumping allowed under the weekly pumping limit of 8.5 acre-feet

The projections presented above represent potential operational scenarios achievable under current aquifer conditions and characteristics based on the data collected during the 8-hour pumping test. The South Platte River alluvial aquifer is a dynamic system at this location affected by many factors including, but not limited to, stream flow conditions in the South Platte River, Big Dry Creek and Little Dry Creek, irrigation practices and nearby ditch flow (especially flow in the Lupton Bottom Ditch), precipitation, nearby well operation and the dewatering operations currently performed by RMCC at the Stage 6A and 6B gravel pits. The pumping test was performed at a time when water levels in the alluvial aquifer are expected to be at the lowest level for the year and when the water level in the Stage 6A and 6B gravel pits is the lowest level for its dewatering operations. Accordingly, the test should be representative of worst-case or near worst-case conditions for the A&W well. A monitoring program for the A&W well including the collection of pumping rates, weekly and monthly production and static and pumping water levels should be implemented to confirm actual operational conditions for the well into the future.

Figure 1
Holton-Morton Lakes Site
General Location Map

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Legend

- A&W Well (Permit No. 61793-F)
- Monitoring Well

Aerial Photo Date: 8/28/2017
Data Source: DWR, RMCC, CDOT, USGS, BLM

Colorado

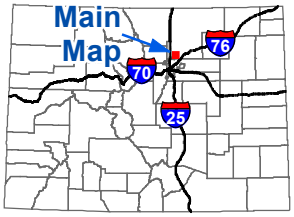

Table 1

Ready Mixed Concrete Company

A&W Well (Permit No. 61793-F)

Constant Discharge Test - Pumping Well Data

Time Since Pumping Began (min)	M-scope Reading (ft)	Water Level below Ground Surface (ft)	Drawdown (ft)	Corrected Drawdown (ft)	Transducer Reading (ft)	Water Level below Ground Surface (ft)	Drawdown (ft)	Corrected Drawdown (ft)
0	18.84	18.09	0.00	0.00	11.47	18.84	0.00	0.00
1	27.90	27.15	9.06	7.10	2.70	27.61	8.77	6.93
2	27.98	27.23	9.14	7.14	2.69	27.62	8.78	6.94
3	27.99	27.24	9.15	7.15	2.70	27.61	8.77	6.93
4	27.99	27.24	9.15	7.15	2.71	27.60	8.76	6.92
8	28.05	27.30	9.21	7.18	2.63	27.68	8.84	6.97
9	28.05	27.30	9.21	7.18	2.64	27.67	8.83	6.96
10	28.07	27.32	9.23	7.19	2.62	27.69	8.85	6.98
15	28.12	27.37	9.28	7.22	2.57	27.73	8.89	7.00
16	28.13	27.38	9.29	7.23	2.58	27.73	8.89	7.00
17	28.15	27.40	9.31	7.24	2.57	27.74	8.90	7.01
18	28.16	27.41	9.32	7.24	2.53	27.78	8.94	7.03
20	28.18	27.43	9.34	7.25	2.51	27.80	8.96	7.04
22	28.19	27.44	9.35	7.26	2.49	27.82	8.98	7.05
25	28.22	27.47	9.38	7.28	2.47	27.84	9.00	7.06
29	28.25	27.50	9.41	7.29	2.46	27.84	9.00	7.07
30	28.26	27.51	9.42	7.30	2.45	27.86	9.02	7.07
35	28.30	27.55	9.46	7.32	2.39	27.92	9.08	7.11
38	28.33	27.58	9.49	7.34	2.37	27.94	9.10	7.12
40	28.33	27.58	9.49	7.34	2.40	27.91	9.07	7.10
45	28.36	27.61	9.52	7.35	2.35	27.96	9.12	7.13
50	28.40	27.65	9.56	7.37	2.29	28.01	9.17	7.16
55	28.43	27.68	9.59	7.39	2.27	28.04	9.20	7.17
59	28.43	27.68	9.59	7.39	2.27	28.04	9.20	7.17
60	28.43	27.68	9.59	7.39	2.27	28.04	9.20	7.18
65	28.46	27.71	9.62	7.41	2.25	28.06	9.22	7.19
70	28.48	27.73	9.64	7.42	2.23	28.08	9.24	7.20
75	28.49	27.74	9.65	7.42	2.22	28.09	9.25	7.20
80	28.50	27.75	9.66	7.43	2.20	28.10	9.26	7.21
85	28.49	27.74	9.65	7.42	2.20	28.11	9.27	7.21
90	28.52	27.77	9.68	7.44	2.19	28.12	9.28	7.22
95	28.52	27.77	9.68	7.44	2.17	28.14	9.30	7.23
102	28.56	27.81	9.72	7.46	2.17	28.14	9.30	7.23
105	28.56	27.81	9.72	7.46	2.15	28.16	9.32	7.24
110	28.57	27.82	9.73	7.47	2.14	28.17	9.33	7.25
115	28.59	27.84	9.75	7.48	2.12	28.19	9.35	7.26
120	28.60	27.85	9.76	7.48	2.12	28.19	9.35	7.26
125	28.61	27.86	9.77	7.49	2.09	28.22	9.38	7.28
130	28.60	27.85	9.76	7.48	2.12	28.19	9.35	7.26
135	28.62	27.87	9.78	7.49	2.10	28.21	9.37	7.27
140	28.63	27.88	9.79	7.50	2.06	28.25	9.41	7.29
145	28.64	27.89	9.80	7.50	2.08	28.23	9.39	7.28
150	28.68	27.93	9.84	7.52	2.05	28.25	9.41	7.29
155	28.67	27.92	9.83	7.52	2.05	28.26	9.42	7.30
160	28.68	27.93	9.84	7.52	2.03	28.27	9.43	7.31
165	28.70	27.95	9.86	7.54	2.03	28.28	9.44	7.31
170	28.71	27.96	9.87	7.54	2.01	28.30	9.46	7.32
175	28.73	27.98	9.89	7.55	1.98	28.32	9.48	7.33
180	28.72	27.97	9.88	7.55	1.99	28.32	9.48	7.33
185	28.75	28.00	9.91	7.56	1.98	28.33	9.49	7.34
190	28.74	27.99	9.90	7.56	1.96	28.35	9.51	7.35
195	28.76	28.01	9.92	7.57	1.95	28.36	9.52	7.35
200	28.77	28.02	9.93	7.57	1.96	28.35	9.51	7.35
210	28.78	28.03	9.94	7.58	1.95	28.36	9.52	7.35
220	28.79	28.04	9.95	7.58	1.91	28.40	9.56	7.38
230	28.81	28.06	9.97	7.59	1.90	28.41	9.57	7.38
240	28.82	28.07	9.98	7.60	1.88	28.43	9.59	7.39
250	28.83	28.08	9.99	7.60	1.89	28.42	9.58	7.39
260	28.84	28.09	10.00	7.61	1.88	28.43	9.59	7.39
270	28.84	28.09	10.00	7.61	1.88	28.43	9.59	7.39
280	28.85	28.10	10.01	7.61	1.86	28.44	9.60	7.40
290	28.89	28.14	10.05	7.63	1.83	28.48	9.64	7.42
300	28.90	28.15	10.06	7.64	1.84	28.47	9.63	7.41
310	28.90	28.15	10.06	7.64	1.84	28.47	9.63	7.41
320	28.90	28.15	10.06	7.64	1.84	28.46	9.62	7.41
330	28.90	28.15	10.06	7.64	1.81	28.49	9.65	7.43
340	28.91	28.16	10.07	7.65	1.83	28.48	9.64	7.42
350	28.92	28.17	10.08	7.65	1.81	28.50	9.66	7.43
360	28.94	28.19	10.10	7.66	1.79	28.52	9.68	7.44
370	28.93	28.18	10.09	7.66	1.81	28.49	9.65	7.43
380	28.96	28.21	10.12	7.67	1.77	28.54	9.70	7.45
390	28.98	28.23	10.14	7.68	1.77	28.54	9.70	7.45
400	28.99	28.24	10.15	7.69	1.75	28.56	9.72	7.46
410	29.00	28.25	10.16	7.69	1.74	28.57	9.73	7.47
420	29.01	28.26	10.17	7.70	1.72	28.58	9.74	7.47
430	29.03	28.28	10.19	7.71	1.71	28.60	9.76	7.48
440	29.02	28.27	10.18	7.70	1.72	28.59	9.75	7.48
450	29.03	28.28	10.19	7.71	1.72	28.58	9.74	7.47
460	29.01	28.26	10.17	7.70	1.75	28.56	9.72	7.46
470	29.02	28.27	10.18	7.70	1.71	28.60	9.76	7.48
480	29.04	28.29	10.20	7.71	1.70	28.61	9.77	7.49

Notes:
Constant discharge pumping test completed on February 20, 2018.
Water levels measured with an m-scope and a pressure transducer.
Pumping rates measured using A&W's existing totalizing flow meter (units = acre-feet * 0.001).
The pumping rate during the test averaged 291 gallons per minute.
Corrected drawdown based on a saturated thickness of 20.91 feet.
min = minutes.
ft = feet.

Figure 2

Constant Discharge Pumping Test - Pumping Well Data

Ready Mixed Concrete Company - A&W Well (Permit No. 61793-F)

Q = 291 gpm, Date of test: February 20, 2018

Pumping Well: 18-inch well screen and casing, 36-inch borehole diameter

Theis Type-Curve Match Point

1/u = 100 = 0.00000000000001 min

W(u) = 1 s = 0.18 feet

T = 185270 gpd/ft S = 0.000000000000012

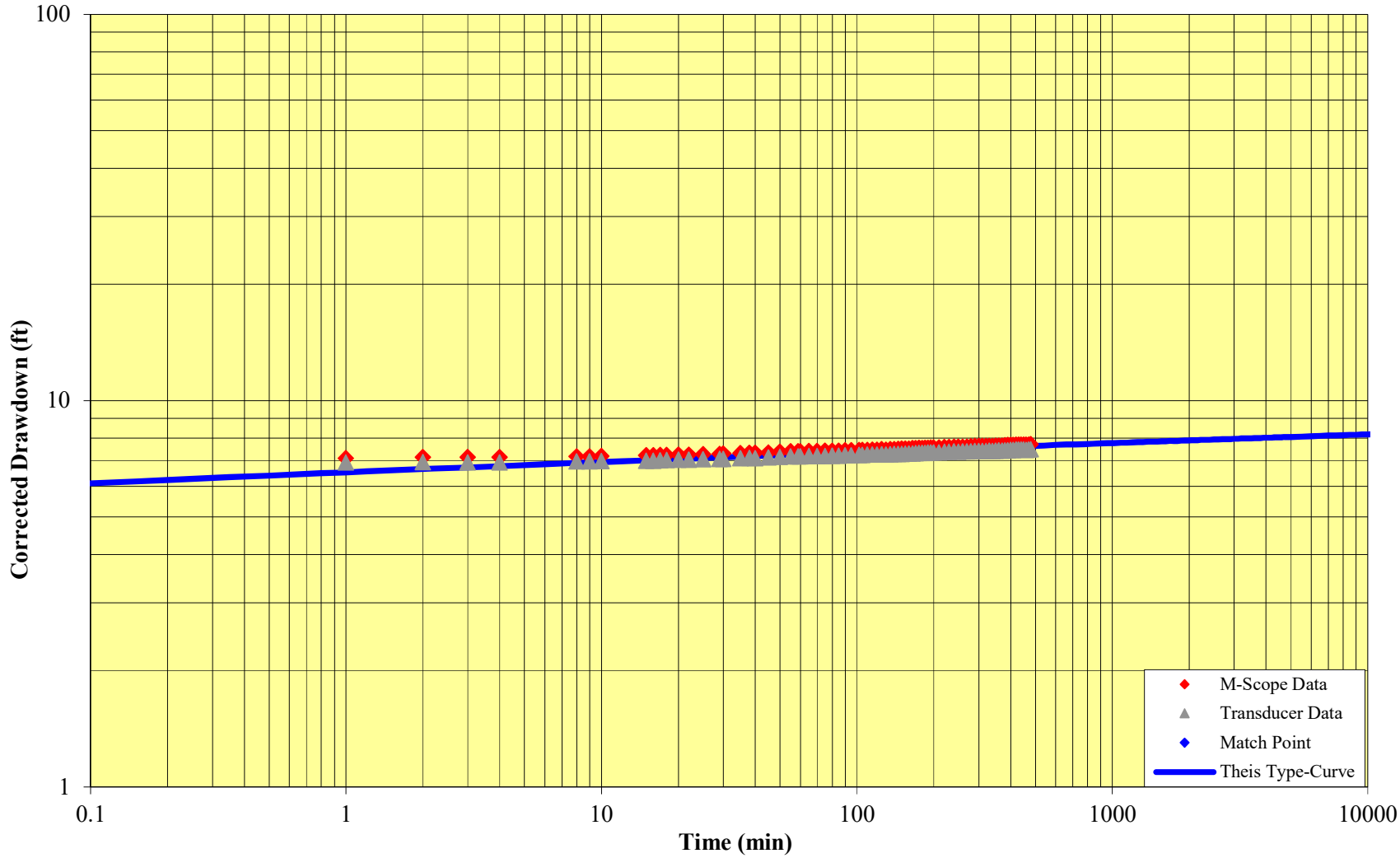

Table 2

Ready Mixed Concrete Company

A&W Well (Permit No. 61793-F)

Constant Discharge Test - Monitoring Well Data

Time Since Pumping Began (min)	M-scope Reading (ft)	Water Level below Ground Surface (ft)	Drawdown (ft)	Transducer Reading (ft)	Water Level below Ground Surface (ft)	Drawdown (ft)
0	17.170	15.170	0.000	6.31	17.17	0.00
5	17.210	15.210	0.040	6.24	17.24	0.07
6	17.215	15.215	0.045	6.24	17.24	0.07
7	17.220	15.220	0.050	6.22	17.25	0.08
11	17.230	15.230	0.060	6.22	17.26	0.09
12	17.230	15.230	0.060	6.21	17.27	0.10
13	17.235	15.235	0.065	6.22	17.26	0.09
19	17.250	15.250	0.080	6.21	17.27	0.10
24	17.270	15.270	0.100	6.21	17.26	0.09
27	17.270	15.270	0.100	6.19	17.28	0.11
37	17.290	15.290	0.120	6.18	17.30	0.13
43	17.300	15.300	0.130	6.18	17.30	0.13
48	17.310	15.310	0.140	6.17	17.30	0.13
53	17.310	15.310	0.140	6.15	17.33	0.16
57	17.320	15.320	0.150	6.16	17.32	0.15
62	17.320	15.320	0.150	6.15	17.32	0.15
73	17.340	15.340	0.170	6.15	17.33	0.16
78	17.350	15.350	0.180	6.14	17.33	0.16
83	17.350	15.350	0.180	6.14	17.34	0.17
88	17.360	15.360	0.190	6.13	17.35	0.18
103	17.380	15.380	0.210	6.12	17.36	0.19
112	17.390	15.390	0.220	6.11	17.36	0.19
118	17.395	15.395	0.225	6.11	17.37	0.20
124	17.400	15.400	0.230	6.12	17.36	0.19
132	17.405	15.405	0.235	6.11	17.37	0.20
143	17.415	15.415	0.245	6.09	17.39	0.22
152	17.420	15.420	0.250	6.09	17.38	0.21
162	17.440	15.440	0.270	6.08	17.39	0.22
172	17.445	15.445	0.275	6.07	17.41	0.24
178	17.455	15.455	0.285	6.08	17.40	0.23
187	17.460	15.460	0.290	6.07	17.41	0.24
197	17.470	15.470	0.300	6.06	17.41	0.24
218	17.490	15.490	0.320	6.03	17.44	0.27
233	17.505	15.505	0.335	6.03	17.45	0.28
251	17.520	15.520	0.350	6.02	17.46	0.29
267	17.530	15.530	0.360	6.01	17.47	0.30
272	17.535	15.535	0.365	6.01	17.47	0.30
287	17.550	15.550	0.380	5.99	17.49	0.32
294	17.555	15.555	0.385	6.00	17.48	0.31
302	17.560	15.560	0.390	5.98	17.50	0.33
312	17.570	15.570	0.400	5.98	17.50	0.33
328	17.575	15.575	0.405	5.97	17.50	0.33
337	17.580	15.580	0.410	5.96	17.52	0.35
355	17.600	15.600	0.430	5.94	17.53	0.36
367	17.600	15.600	0.430	5.95	17.52	0.35
376	17.610	15.610	0.440	5.94	17.54	0.37
385	17.620	15.620	0.450	5.94	17.54	0.37
396	17.625	15.625	0.455	5.93	17.54	0.37
405	17.630	15.630	0.460	5.93	17.55	0.38
415	17.640	15.640	0.470	5.93	17.55	0.38
426	17.645	15.645	0.475	5.91	17.57	0.40
434	17.650	15.650	0.480	5.91	17.57	0.40
442	17.655	15.655	0.485	5.90	17.58	0.41
454	17.660	15.660	0.490	5.90	17.58	0.41
464	17.670	15.670	0.500	5.88	17.60	0.43
474	17.670	15.670	0.500	5.90	17.58	0.41
481	17.680	15.680	0.510	5.89	17.58	0.41

Notes:
Constant discharge pumping test completed on February 20, 2018.
Water levels measured with an m-scope and a pressure transducer.
Pumping rates measured using A&W's existing totalizing flow meter (units = acre-feet * 0.001).
The pumping rate during the test averaged 291 gallons per minute.
Monitoring well located 151.5 feet from pumping well.
min = minutes.
ft = feet.

Figure 3

Constant Discharge Pumping Test - Monitoring Well Data
Ready Mixed Concrete Company - A&W Well (Permit No. 61793-F)
Q = 291 gpm, Date of test: February 20, 2018
Monitoring Well: 151.5 feet from pumping well

Theis Type-Curve Match Point
1/u = 100 t = 280 min
W(u) = 1 s = 0.065 feet
T = 513055 gpd/ft S = 0.02