APPENDIX D

PUMPING TEST ANALYSIS MEMORANDUM & MODEL OUTPUTS

DATE 20 March 2017 **PROJECT No.** 1656790

TO Justin White
Golder Associates Inc.

CC Project Files

FROM John Wozniewicz **EMAIL** jwozniewicz@golder.com

WELL TEST ANALYSIS OF 2016 MULBERRY WELL PUMPING TEST
FORMER HULETT LAGOON SITE, CAMDENTON, MISSOURI

1.0 INTRODUCTION

A pumping test was performed in the Mulberry Well, started on 24 October 2016. The test was performed at a nominal rate of 105 gallons per minute (gpm) for 92 hours and followed by 168 hours of recovery. Water levels were monitored in the pumping well and in select observations wells (MW-2, -9, -13, -14, -16, -17, and -23). This memorandum presents the analysis of pumping test data for the flow model and hydraulic parameters.

2.0 PUMPING WELL AND OBSERVATION WELL INFORMATION

The well construction information is provided in Table 1 and the vertical separation between the mid-point of the production zone in the Mulberry Well and midpoint of the screen interval in the observation wells is provided in Table 2. The Mulberry Well is completed with 12-inch open hole from a nominal 400 to 900 feet below ground surface (ft bgs). Flow logging performed by Golder Associates Inc. (Golder) in September 2016 indicated that majority of inflow to the well occurs in multiple discrete zones between 400 and 600 ft bgs with negligible flow from 600 to 900 ft bgs. Accordingly, the production zone (i.e. aquifer zone) in the Mulberry Well is considered 400 to 600 ft bgs with the majority of flow occurring in discrete zones that likely comprise a small percent of the 200 ft interval. As shown on Figure 1 and in Table 2, the observation wells are spatially distributed as follows:

- The five (5) Deep Aquifer observation wells monitored during the test are completed to elevations some 290 to 330 ft above the Mulberry Well production zone, mid-point (500 ft bgs), at distances between 600 and 1400 ft.

The two (2) Perched Aquifer observation wells monitored during the test are completed to elevations some 360 to 380 ft above the Mulberry Well production zone, mid-point (500 ft bgs), at distances between 500 and 800 ft.

3.0 ANALYSIS METHODS

3.1 Analytical Analysis of the Pumping Well Data (Mulberry Well)

The pumping well test data was analyzed with SAPHIR, distributed by Kappa Engineering Inc. SAPHIR is an analytical well test analysis software package that includes multiple near well, formation and boundary flow models.

It also includes the semi-log pressure derivative data to improve the diagnosis of the flow model on the log-log plot. Because the storativity and skin (i.e. near well permeability) are highly correlated, the approach is to input the storativty and match for the skin value. The storativity was assumed to be 1 x 10^{-4}, consistent with a confined aquifer. The workflow to analyze the test data is as follows:

- Input rate and pressure data and confirm data integrity.
- Diagnose the flow model on the log plot using the semi-log pressure derivative.
- Perform type curve matching.
- Iterate between log log and entire simulation plots until an optimized set of hydraulic parameters was derived.

3.2 Diffusivity Estimates

Hydraulic diffusivity or simply diffusivity (transmissivity (T)/Storativity (S)) is the ratio of the flow conductivity properties (T) and storage properties (S). Diffusivity, *n*, can be assessed from a lag time, t, between the location of pressure perturbation and observation point *r* distance away using the radius of investigation equation (Stretsolva 1988), $n = r^2/4t$. The time lag used for the pumping test data set was the duration 1) between the start of pumping and first response to pumping in the observation well and 2) start of recovery in pumping well and first response to recovery in the observation well. The diffusivity provides an indication for the degree of hydraulic connection between the pumping and the Deep Aquifer observation wells; typical diffusivity for conductive fractures are 1 to 10 m^2/s and extremely open fractures have diffusivity greater than 100 m^2/s (Golder 2010).

3.3 Numerical Modelling

Because the Deep Aquifer observation wells are some 300 ft above the pumping well, a layer-cake or model comprised of horizontal layers was constructed to analyze the Deep Aquifer observation well data using the numerical model package in SAPHIR. A five layer model was developed as shown in Table 3. The properties of the layer that included Mulberry Well were set based on the analytical analysis of the pumping well test data.

The storativity and hydraulic parameters of the layers above and below the layer that includes the Mulberry Well production zone were adjusted to match the observation well responses.

The vertical boundaries of the model were set far enough from the pumping well such that they would have no influence on the test data. Top and bottom boundaries were set to no-flow.

4.0 RESULTS

4.1 Measured Data

The drawdown measured at the end of pumping in the pumping and observation wells are shown on Figure 1 and summarized in Table 4. The distribution of responses show significant upward attenuation of pressure propagations with drawdowns on the order of 1 ft in the Deep Aquifer observation wells compared to 20 feet in the Mulberry Well; as discussed, the Deep Aquifer observation wells are completed some 300 feet above the mid-point of the Mulberry Well production zone (500 ft bgs) (See Table 2). The Deep Aquifer observation wells are located at distances between 600 and 1400 ft from the Mulberry Well (Table 4), yet show no distinct lateral variation in drawdown over these distances. This suggests that the cone of depression in the underlying aquifer is relatively "flat" and broad versus steep and areally constrained, consistent with high transmissivity and low storativity for the aquifer (encountered between 400 and 600 ft bgs in the Mulberry Well) discussed below.

No drawdown was observed in the two Perched Aquifer observation wells, MW-9 and MW-13 (Figure 1).

4.2 Mulberry Well Test Analysis Results

The log log pot of recovery data is shown on Figure 2. The analysis of the flow model from the shapes and slopes of the semi-log pressure derivative data (lower data set on Figure 2) is summarized below:

- **Up to 0.1 hours**: there is no hump in the derivative data and little separation between pressure and pressure derivative data that indicates negative skin, or local well permeability that is higher than the aquifer permeability. A negative skin is often attributed to water conductive fractures connected to the wellbore that is consistent with flow logging results that shows discrete zones in the interval 400 to 600 ft bgs in the Mulberry Well contributing majority of the flow to the well.
- **0.1 to 50 hours**: the flat derivative data is indicative of radial flow to the well. This suggest that flow is being controlled by bedding planes fractures that are flat lying that results in the radial flow geometry. If flow was occurring in vertical to sub-vertical tectonic structures, the resulting flow geometry would likely be between one-dimensional flow (i.e. flow geometry of 1) and radial flow (i.e. flow geometry of 2).
- **50 to 91 hours**: end effect that is common in well test data, i.e. noise in the data that approaches the small pressure change at the end of recovery that masks the flow model.

Matches on the log and entire simulation plots are shown on Figures 3A and 3B, respectively. Good matches confirms the selection of the flow model and hydraulic parameters that are summarized below:

- Skin: -4.2.
- Transmissivity: 1 x 10^{-3} m^2/s.
- Hydraulic conductivity: 2 x 10^{-5} m/s (assumes even distribution of flow in the interval 400 to 600 ft bgs).
- Boundaries: none detected within the radius of influence.
- Radius of influence: 2 miles (4 km).

The assumed storativity is 1 x 10^{-4} and with a saturated thickness of 61 m, the specific storage is computed as 2 x 10^{-6} 1/m. As a sensitivity, the storativity was reduced to 1 x 10^{-5} and with a saturated thickness of 61 m, the specific storage is computed as 2 x10^{-7} 1/m; within the range reported for *dense rock (*Singhal and Gupta, 1999*).* With the lower assumed storativity, the radius of influence is computed as 9 miles (14 km) and the skin is -5.2.

4.3 Diffusivity Estimates

The diffusivity estimates based on lag time ranges between 1 and 11 m^2/s, based on lag times of up to a few hours measured in the Deep Aquifer observation wells. The magnitude of diffusivity suggests good connectivity between the pumping well and Deep Aquifer observation wells but the muted drawdown suggests there is also low permeability zones in the pathway that is attenuating (i.e. acting as a choke) the pressure propagation. This is consistent with lack of any significant vertical flux influencing the pumping well data; otherwise partial penetration effects or double porosity flow model would have been observed.

4.4 Numerical Model Analysis of the Pumping Test Response.

The lack of a partial penetration and double porosity effect in the pumping well response indicates a relatively small downward vertical flux, due to relatively low vertical hydraulic conductivity in zones above and below the aquifer, compared to the horizontal flow in the aquifer encountered in the Mulberry Well. Conversely, the higher diffusivity from lag time measured in observations wells suggests good connectivity that is likely controlled by a low storativity connection that allows pressures to propagate in lower hydraulic conductivity strata.

The layer-cake numerical model was used to evaluate order-of-magnitude properties between the pumping well and observation wells. Because the magnitude of drawdown responses were similar between wells, to streamline the analysis for reporting, the description below is limited to MW-2.

For the layers in the model above and below the simulated production zone encountered in the Mulberry Well (i.e. 400 to 600 ft bgs), the parameters were initially set (Table 5) such that the vertical flux would not influence the pumping well response as measured while allowing for a drawdown response in the overlying layer corresponding to the elevation of the observation wells. The simulated drawdown of 1 ft shows good consistency with measured drawdown on 1 ft (Figure 4); however, the recovery is greater in the measured data and there is a longer lag to the start of pumping and recovery then measured. Part of the mis-match may be attributed to more discrete pathways hydraulically connecting the pumping well to the observation wells then assumed in the model. However, overall, the simulation indicates a low storativity (10^{-6} to 10^{-5})/low hydraulic conductivity (10^{-11} to 10^{-10} m/s) connection. This is also consistent with the limited recovery measured in the Deep Aquifer observation wells.

5.0 SUMMARY

A summary of the interpretation of the hydraulic response to the Mulberry Well pumping test that started in October 2016 is provided below:

- Flow logging indicates that majority of the inflow to the Mulberry Well is occurring between 400 ft and 600 ft bgs and primarily in discrete zones within the interval, including localized zones centered near 450, 525, 557 and 575 ft bgs.
- A pumping test was performed at a nominal rate of 105 gallons per minute (gpm) for 92 hours and followed by 168 hours of recovery. Water levels were monitoring in the pumping well and in select observations wells.
- A drawdown of 20 ft was measured in the pumping well (Mulberry Well) compared to nominal drawdown of 1 ft in the five (5) Deep Aquifer observation wells (Figure 1). No drawdown was measured in the (2) Perched Aquifer observation wells. The observation wells are located some 300 to 400 ft above the elevation of the production zone (mid-point 500 ft bgs) in the Mulberry Well, at radial distances between 500 and 1400 ft (Tables 1, 2 and 4).
- The Deep Aquifer observation wells are located at distances between 600 and 1400 ft from the Mulberry Well (Table 4), yet show no distinct lateral variation in drawdown over these distances. This suggests that the cone of depression in the underlying aquifer is relatively "flat" and broad versus steep and areally constrained,

consistent with high transmissivity and low storativity for the aquifer (encountered between 400 and 600 ft bgs in the Mulberry Well) discussed below.

- The flow model for the pumping well data shows good connection to the aquifer (negative skin) and radial flow to the well; this suggests flow is likely constrained to bedding planes versus flow in sub-vertical tectonic features and the vertical flow component is minor compared to the horizontal flow in the aquifer (otherwise the pumping well response would have shown a different flow model).

- A well-constrained transmissivity of 1 x 10^{-3} m^2/s was derived from the analytical type curve match, and dividing by the saturated thickness of 200 ft (61 m), results in a bulk (assumes flow is evenly distributed in the 200 ft interval) hydraulic conductivity of 2 x 10^{-5} m/s. In reality, majority of the flow in the Mulberry Well production interval 400 to 600 ft bgs is more likely to be constrained to bedding planes influenced by karst such that there are zones with significantly higher and lower hydraulic conductivity compared to the bulk hydraulic conductivity. Packer testing (nominal spacing of 36 ft) through the production interval showed at the scale of the test interval, flow is relatively evenly distributed; i.e. suggests that the bedding planes controlling flow are relatively evenly distributed between the intervals tested in the production zone, i.e. 400 to 600 ft bgs.

- For the duration of the test, the computed or theoretical radius of influence is between 2 and 9 miles (4 and 14 km) with the range attributed to uncertainty in the storativity that is assumed in the calculation (the radius of influence will increase with the pumping duration). For models that assume flow is evenly distributed over relatively large thicknesses, versus discrete zones as the case for the aquifer encountered by the Mulberry Well, the cone of depression from pumping will be underestimated.

- The five (5) Deep Aquifer monitoring observation wells, some 300 ft above the pumping well mid-point for production zone in the Mulberry Well (500 ft bgs), between 600 ft and 1400 ft radial distance from the pumping well, all responded that indicates a degree of hydraulic connection and that the pumping rate was sufficient to induce downward flow toward the productive aquifer connected to the Mulberry Well (with additional pumping the magnitude of downward flow will increase).

- The drawdown characteristics of the Deep Aquifer monitoring observation wells, high diffusivity estimated from lag time and relatively small drawdowns (1 ft compared to 20 ft in the pumping well) suggests a low storativity (10^{-6} to 10^{-5})/low hydraulic conductivity (10^{-11} to 10^{-10} m/s) connection.

- Part of the mis-match between measured and simulated observation well data may be attributed to more discrete pathways hydraulically connecting the pumping well to the observation wells then assumed in the layer-cake numerical model. One possibility is that that there is a discrete pathway that allows for rapid propagation of pressure transients but does not directly connect the pumping well to the observation well; however, there is also lower permeability strata within the pathway (i.e. acting as a choke) that attenuates the pressure transients such that the drawdown is relatively muted and only partial recovery is attained after a similar duration as pumping.

- No responses were measured in the two (2) monitoring wells completed across the Perched Aquifer within the area that responses were measured in the Deep Aquifer monitoring observation wells suggesting relatively poor vertical hydraulic connection to this zone.

We trust that this document provides the information required at this time. Should there be any questions or comments please contact the undersigned.

GOLDER ASSOCIATES LTD

John Wozniewicz
Principal, Senior Hydrogeologist

JVW/ml

6.0 REFERENCES

Golder, 2010. Fractured Bedrock Field Methods and Analytical Tools Volume II: Appendices. Report submitted the BC Ministry of Environment in April 2010.

Singhal, B.B.S., and R.P. Gupta, 1999. Applied Hydrogeology of Fractured Rocks. Kluwer Academic Publishers.

Stretsolva, T., 1988. Well Testing in Heterogeneous Formations, Wiley, New York.

TABLES

Table 1: Well Construction Details

Well ID	Date Drilled	Ground Surface Elevation (feet amsl)	Top of Casing Elevation (feet amsl)	Top of Screen Elevation (feet amsl)	Bottom of Screen Elevation (feet amsl)	Top of Screen Elevation (feet bgs)	Bottom of Screen Elevation (feet bgs)	Screened Interval (feet)	Total Depth* (feet bgs)	Coordinates MO State Plane Central US Foot	
										Northing	Easting
Mulberry Well	1986	~950							900	791,908.20	1,566,990.35
MW-1	1999	942.1	945.35	804.1	764.1	138	178	40	178	792,306.50	1,565,969.34
MW-2	1999	960.9	962.99	803.9	763.9	157	197	40	197	792,317.76	1,566,532.35
MW-9	2000	965.5	965.28	848.5	818.5	117	147	30	150	792,247.76	1,566,614.23
MW-13	2000	994.9	994.58	829.9	789.9	165	205	40	205	792,675.75	1,567,150.76
MW-14	1999	995.77	995.44	781.77	741.77	214	254	40	254	792,669.46	1,567,160.87
MW-16	2002	936.77	936.58	776.77	736.77	160	200	40	200	793,318.85	1,567,013.95
MW-17	2002	1005.26	1004.96	754.26	728.26	251	277	26	280	792,320.82	1,567,381.11
MW-23	2007	952.3	955.0	792.3	752.3	160	200	40	200	791,898.66	1,566,197.61

Notes:
*Well depth at time of completion

Table 2: Vertical Separation between Pumping and Observation Wells

	Top [ft amsl]	Bottom [ft amsl]	Interval [ft]	Midpoint [ft amsl]	Distance Above Pump Mid-Point [ft]
Pumping Well	550	350	200	450	0
MW-1	804.1	764.1	40	784	334
MW-2	803.9	763.9	40	784	334
MW-9	848.5	818.5	30	834	384
MW-13	829.9	789.9	40	810	360
MW-14	781.8	741.8	40	762	312
MW-16	776.8	736.8	40	757	307
MW-17	754.3	728.3	26	741	291
MW-23	785.0	745.0	40	765	315

Note:

Modelling Appendix

Base of argillaceous layer between 690 and 790 ft amsl

Table 3 Numerical Model Set-Up

Layer	top [ft amsl]	bottom [ft amsl]	Thickness [ft]	Thickness [m]	Basis
Shallow Zone	900	805	95	29.0	Approximate depth to top of bedrock
Deep Aquifer Monitoring Well Zone	805	730	75	22.9	Includes the observation well intervals
Intermediate Zone	730	550	180	54.9	Intervening interval between observation wells and Mulberry well
Mulberry Well Aquifer Zone	550	350	200	61.0	Include the production zone in Mulberry Well (400 to 600 ft depth)
Deep Zone	350	0	350	106.7	Approximate depth to base of Ozark Aquifer

Table 4: Summary of Measured Responses

Well	Aquifer	Lateral distance from Pumping Well		Vertical Distance Between Midpoint of Observation Well Screen and Midpoint of Mulberry		Drawdown at End of Pumping	
		[feet]	[meters]	[feet]	[meters]	[feet]	[meters]
Mulberry Well	Deep	n/a	n/a	n/a	n/a	20.0	6.1
MW-2	Deep	620	189	333.9	101.8	1.0	0.3
MW-9	Perched	507	154	383.5	116.9	0.0	0.0
MW-13	Perched	784	239	359.9	109.7	0.0	0.0
MW-14	Deep	780	238	311.8	95.0	1.2	0.4
MW-16	Deep	1420	433	306.8	93.5	1.2	0.4
MW-17	Deep	780	238	291.3	88.8	1.3	0.4
MW-23	Deep	820	250	315.0	96.0	1.3	0.4

Table 5 Numerical Model
Hydraulic Parameters

Layer	Thickness [m]	Hydraulic Conductivity [m/s]	Vertical to Horizontal Hydraulic Conductivity Ratio	Storativity	Notes
Shallow Zone	29.0	8.E-11	1	1.E-04	Higher storativity needed compared to underlying layers, otherwise limited recovery.
Deep Aquifer Monitoring Well Zone	22.9			1.E-06	match the observation well data wile not changing the measured flow model observed in log-log plot of pumping well data.
Intermediate Zone	54.9			1.E-06	
Mulberry Well Aquifer Zone	61.0	2.E-05		1.E-04	Hydraulic parameters based on analytical analysis of the pumping well.
Deep Zone	106.7	5.E-10		1.E-06	Adjusted to be consistent with layers above Mulberry Well Aquifer Zone for simplicity.

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FIGURES

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LEGEND

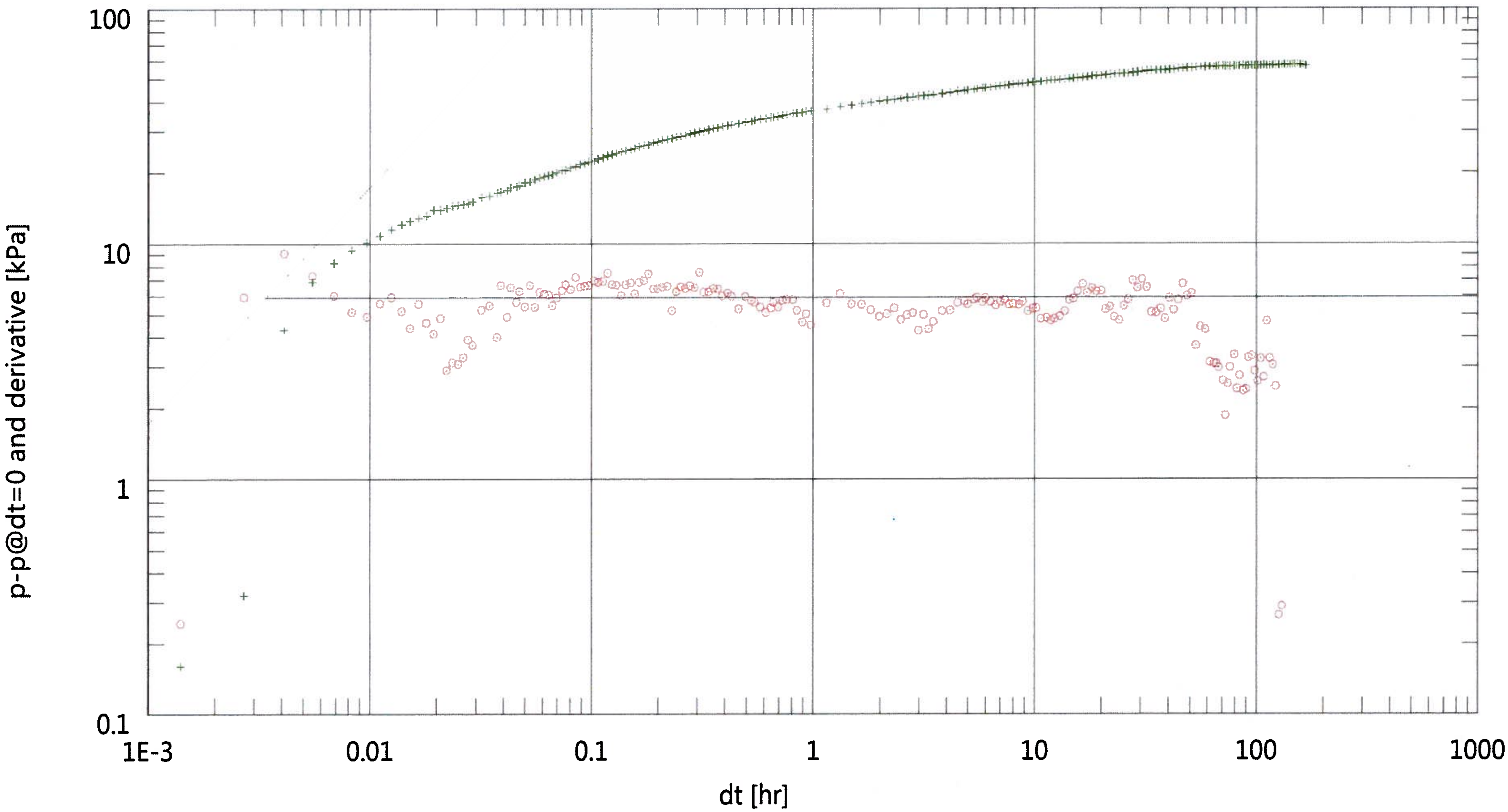
MW-2 1.0' — MONITORING WELL LOCATION AND OBSERVED DRAW DOWN IN FEET

NOTE(S)

1. DEEP AQUIFER WELLS MONITORED DURING THE 2016 PUMPING TEST INCLUDED MW-2, MW-14, MW-16, MW-17, AND MW-23.
2. PERCHED ZONE WELLS MONITORED DURING THE 2016 PUMPING TEST INCLUDED MW-9 AND MW-13.
3. DRAW DOWN SHOWN ON FIGURE WAS OBSERVED DURING THE 2016 PUMPING TEST.

0 150 300
1" = 300' FEET

CLIENT CITY OF CAMDENTON			PROJECT SUPPLEMENTAL RI/ FS EVALUATION FORMER HULETT LAGOON SITE CAMDENTON, MO
CONSULTANT Golder Associates	YYYY-MM-DD	2017-02-23	TITLE **2016 MULBERRY WELL PUMPING TEST MONITORING LOCATIONS**
	DESIGNED	JCW	
	PREPARED	JCW	
	REVIEWED	XXX	PROJECT NO 1656790 · CONTROL · REV. — · FIGURE 1
	APPROVED	XXX	



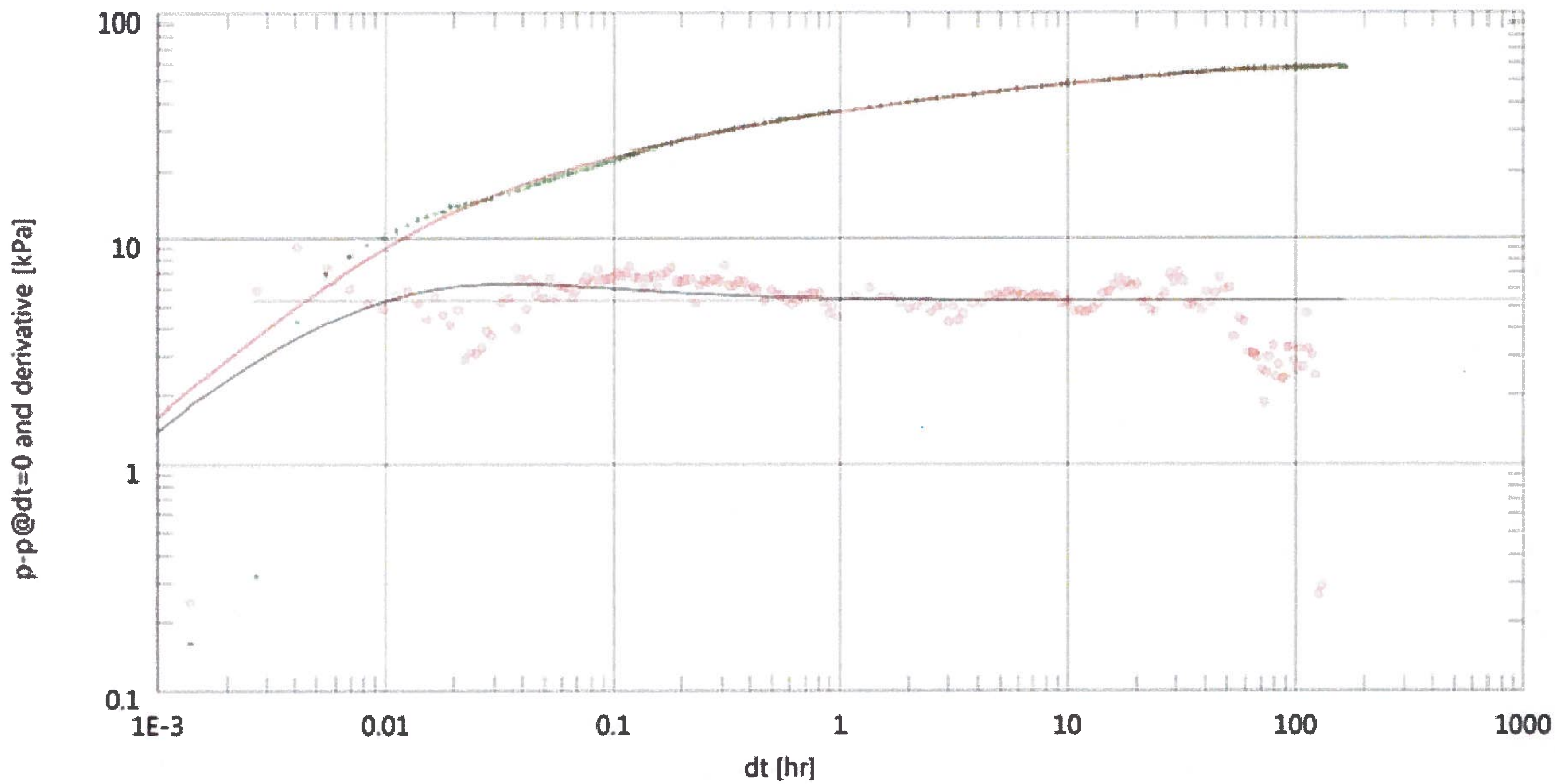
CLIENT	PROJECT
MISSOURI DEPARTMENT OF NATURAL RESOURCES	FORMER HULETT LAGOON SITE, CAMDENTON, MISSOURI

CONSULTANT: Golder Associates

YYYY-MM-DD	2017/02/16
PREPARED	ML
DESIGN	JW
REVIEW	JW
APPROVED	

TITLE
LOG LOG DIAGNOSTIC PLOT OF PUMPING WELL RECOVERY DATA (MULBERRY WELL)

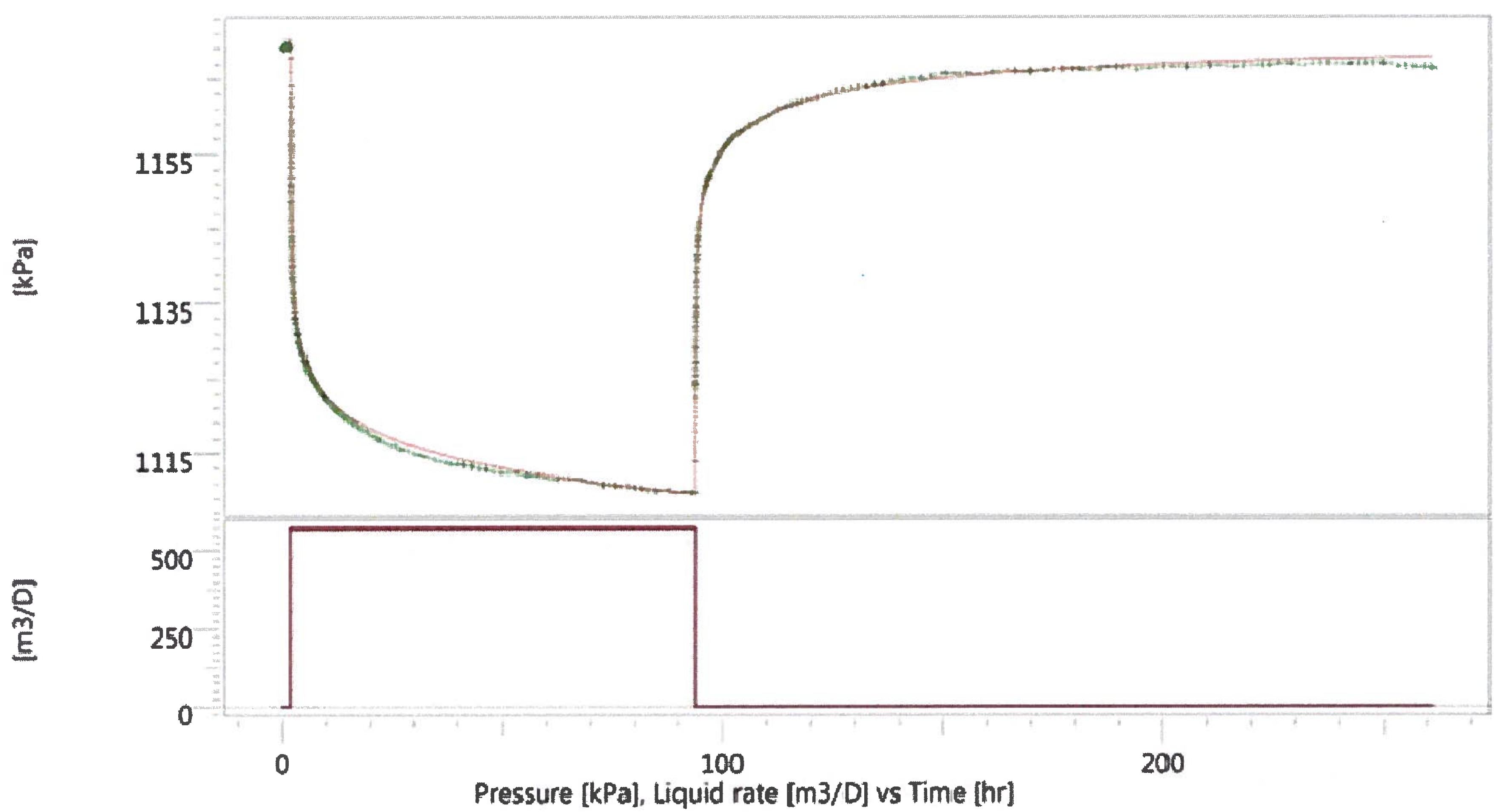
PROJECT No. **1656790** | Rev. | Figure **2**



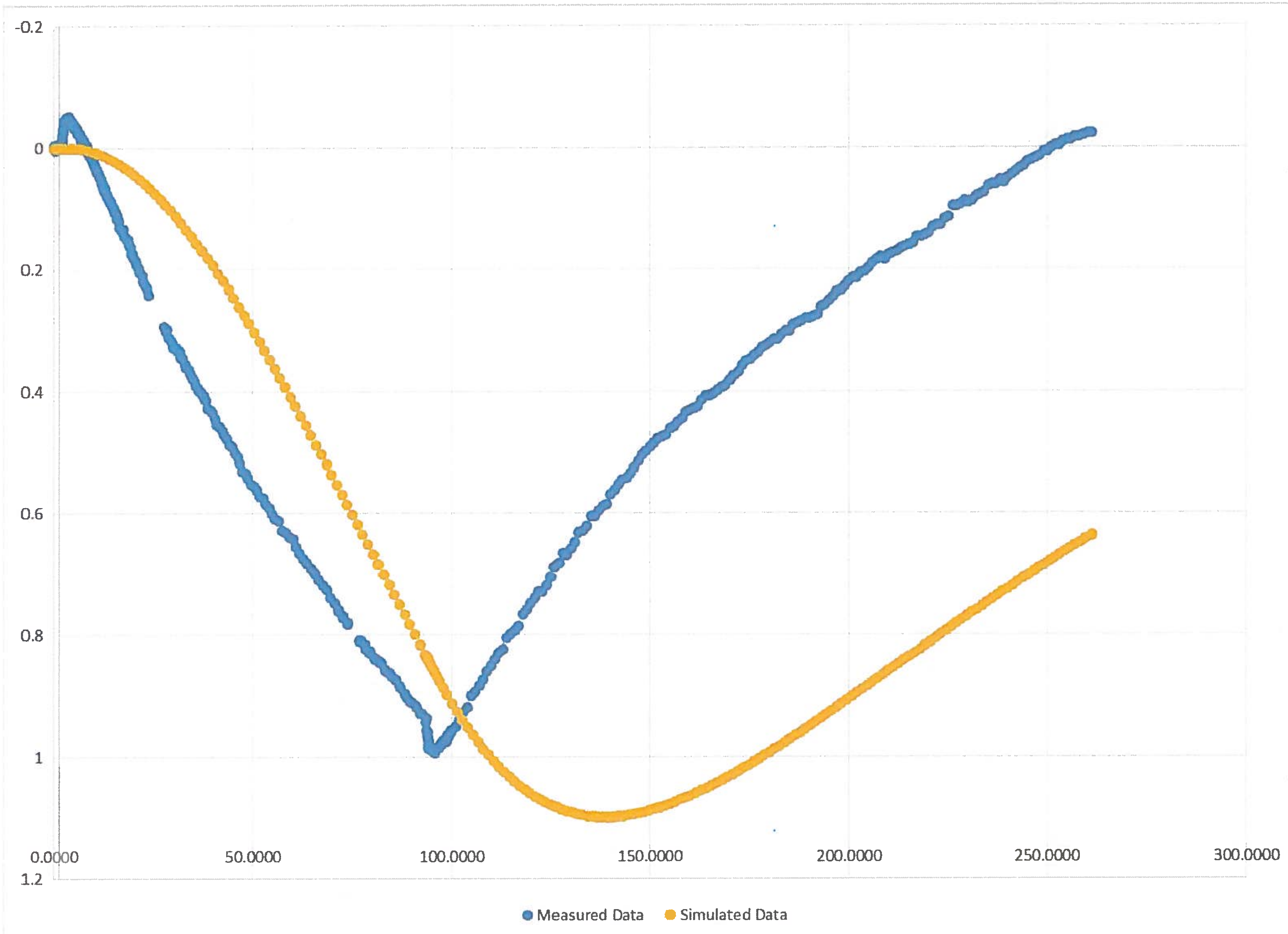
CLIENT **MISSOURI DEPARTMENT OF NATURAL RESOURCES**	PROJECT FORMER HULETT LAGOON SITE, CAMDENTON, MISSOURI
CONSULTANT Golder Associates	TITLE **LOG LOG MATCH OF PUMPING WELL RECOVERY DATA (MULBERRY WELL)**

YYYY-MM-DD	2017/02/16
PREPARED	ML
DESIGN	JW
REVIEW	JW
APPROVED	

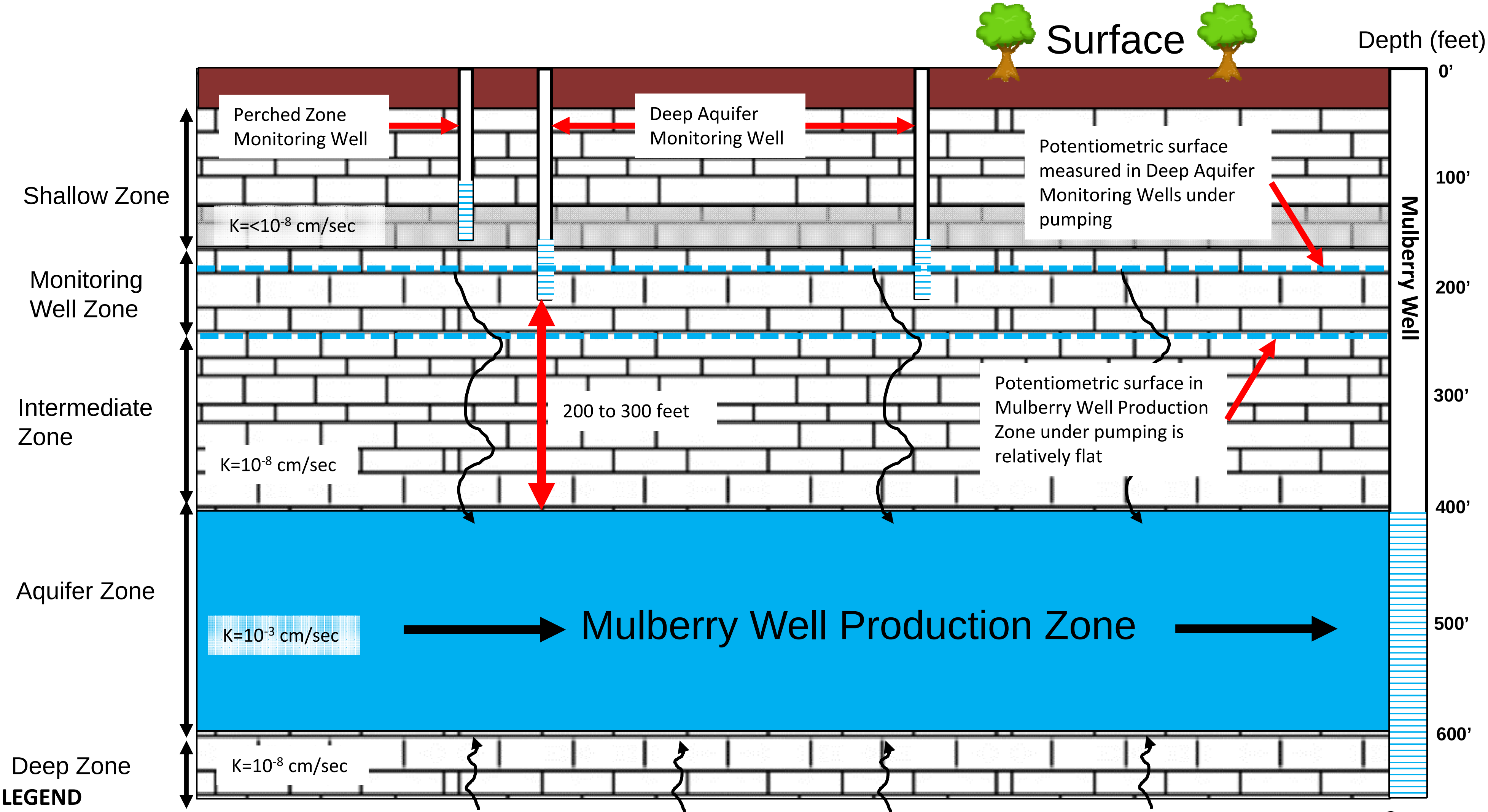
PROJECT No. **1656790** Rev. Figure **3A**



CLIENT **MISSOURI DEPARTMENT OF NATURAL RESOURCES**			PROJECT FORMER HULETT LAGOON SITE, CAMDENTON, MISSOURI
CONSULTANT Golder Associates	YYYY-MM-DD	2017/02/16	TITLE **ENTIRE SIMULATION MATCH OF PUMPING WELL DATA (MULBERRY WELL)**
	PREPARED	ML	
	DESIGN	JW	
	REVIEW	JW	PROJECT No. **1656790** Rev. Figure **3B**
	APPROVED		



CLIENT **MISSOURI DEPARTMENT OF NATURAL RESOURCES**	PROJECT FORMER HULETT LAGOON SITE, CAMDENTON, MISSOURI
CONSULTANT: Golder Associates YYYY-MM-DD: 2017/02/16 PREPARED: ML DESIGN: JW REVIEW: JW APPROVED:	TITLE **MW-2; MEASURED VERSUS SIMULATED OBSERVATION WELL RESPONSE**
	PROJECT No. **1656790** Rev. Figure **4**



LEGEND


Advection Dominates, Drain to Mulberry Well Under Pumping

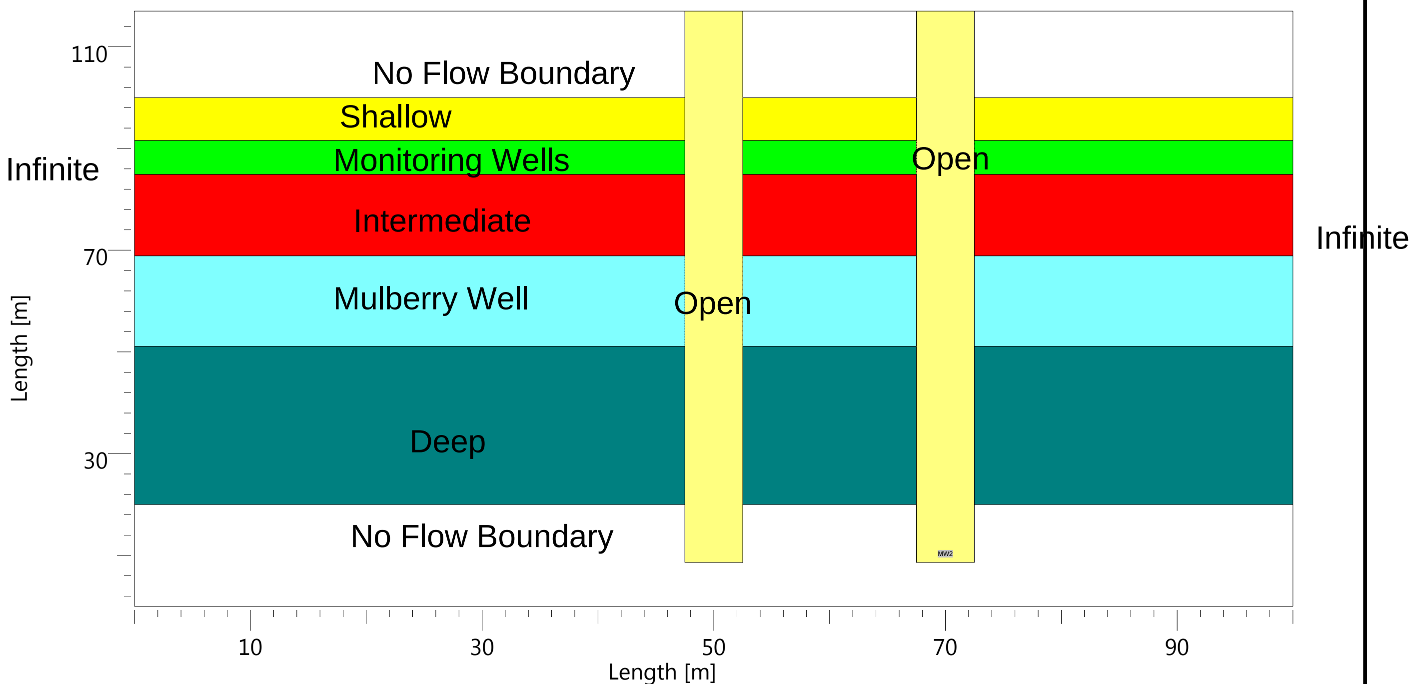

Diffusion Dominates, Low Conductivity

CLIENT CITY OF CAMDENTON	PROJECT SUPPLEMENTAL RI REPORT/ADDENDUM FORMER HULETT LAGOON SITE CAMDENTON, MO
CONSULTANT Golder Associates	TITLE Discretization Used in Numerical Model – Set-Up for Purpose of Matching Test Response

YYYY-MM-DD	2017-04-03
PREPARED	JS
DESIGN	JS
REVIEW	JW
APPROVED	JW

PROJECT No.	CONTROL	Rev	FIGURE
165-6790			D5

	Multi-layer diagram	Multi-K 1	
KAPPA	Company Well Mulberry Well	Field Test Name / #	



Test date / time	
Formation interval	
Perforated interval	
Gauge type / #	
Gauge depth	
Analyzed by	
Analysis date / time	
TEST TYPE	Standard
Porosity Phi (%)	10
Well Radius rw	0.1 m
Pay Zone h	274.31 m
Form. compr.	4.35113E-10 Pa-1
Reservoir T	100 °C
Reservoir P	34473.8 kPa
Fluid type	Water
Volume Factor B	1 m3/stm3
Viscosity	1 cp
Total Compr. ct	4E-10 Pa-1

Default values are used!

Selected Model

Model Option	Multi-Layer, Numerical, Crossflow, Other Wells Included
Well	Vertical
Reservoir	Homogeneous
Boundary	Polygonal, No flow

Main Model Parameters

TMatch	10000 [hr]-1
PMatch	0.097 [kPa]-1
Mulberry Well - C	2.31E-7 m3/Pa
Total Skin	-5
Total Skin (pss)	-1.21
T	1E-3 m2/s
K	3.64E-6 m/s
Pi	1169 kPa

Model Parameters

Shallow Zone

Vertical - Homogeneous - Numerical

Wells Connected:

K	8E-11 m/s
h	28.9 m
S	1E-4
kz/kr	1
leakage	1
krw(Swmax)	N/A

Monitoring wells

Vertical - Homogeneous - Numerical

Wells Connected: MW2

MW2 - Skin	0
K	8E-11 m/s
h	22.9 m
S	1E-6
kz/kr	1
leakage	1
krw(Swmax)	N/A

Intermediate Zone

Vertical - Homogeneous - Numerical

Wells Connected:

K	8E-11 m/s
h	54.9 m
S	1E-6
kz/kr	1
leakage	1
krw(Swmax)	N/A

Mulberry Well

Vertical - Homogeneous - Numerical

Wells Connected: Mulberry Well

Mulberry Well - Skin	-5
K	1.64E-5 m/s
h	61 m
S	1E-4
kz/kr	1
leakage	1
krw(Swmax)	N/A

Deep Zone

Vertical - Homogeneous - Numerical

Wells Connected:

K	8E-11 m/s
h	107 m
S	1E-6
kz/kr	1
krw(Swmax)	N/A

Wellbore & other reservoir parameters

Mulberry Well - C	2.31E-7 m3/Pa
MW2 - C	2.31E-7 m3/Pa
Pi	1169 kPa

Derived & Secondary Parameters

Delta P (Total Skin)	-51.5529 kPa
Delta P Ratio (Total Skin)	-1.00418 Fraction

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

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Golder Associates

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