

Presented by:



2024 Long-Term Hydrogeologic Monitoring Report

CENTRAL MONTANA REGIONAL WATER AUTHORITY

UBet Wellfield, Judith Basin

March 2025



Client Commitment



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2024 Long-Term Hydrogeologic Monitoring (LTM) Report

UBet Wellfield, Judith Basin, Montana

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Judith Basin 2024 Long-Term Hydrogeologic Monitoring (LTM) Summary Report Central Montana Regional Water Authority

1. INTRODUCTION

1.1 Background

In 2023, the Central Montana Regional Water Authority (CMRWA) began operation of a portion of the Musselshell-Judith Regional Water System (MJRWS) in central Montana. Two deep water supply wells (CMRWA Wells 2 and 3) were previously completed in the Madison Aquifer approximately 3 miles west of Garneill, Montana. **Figure 1** is a location map. The wells are currently supplying water to Harlowton and select private property owners to the south. In 2024, two additional Madison wells (CMRWA Wells 4 and 5) were constructed immediately north of the existing wells. CMRWA wells in this area are collectively known as the UBet Wellfield (**Figure 2**).

Beginning in 2016, a Long-Term Hydrogeologic Monitoring (LTM) program was initiated by CMRWA to evaluate and monitor water resources in the Judith Basin, prior to and during production from the UBet Wellfield. Monitoring results have been summarized annually in previous years by Western Groundwater Services, LLC (WGS) under contract to Great West Engineering (GWE). This report presents historical LTM data along with more recent (through 2024) water production and groundwater monitoring data collected using the newly-commissioned on-site UBet Wellfield SCADA system.

1.2 Project Setting

As presented in a 2014 Water Resources Monitoring Plan¹ developed by WGS, the project area lies within the Judith River Basin in Central Montana. The basin is underlain by over 3000 feet of early-Mesozoic and late-Cenozoic sedimentary rocks; primarily shales, sandstones and carbonates. **Figure 3** is a generalized stratigraphic cross-section (**across A to A', Figure 1, [WGS. 2013]**).

Important aquifers in the basin include the Kootenai Formation and the deeper Madison Group. Most water supply wells in the basin are completed in aquifers and water-bearing units of the Kootenai, which ranges in depth from land surface to as much as approximately 700-1000 feet below ground surface (bgs) depending on the location. The Madison Group is deeper; ranging in depths from approximately 2,000 to 5,000 ft bgs, and as such is less frequently targeted for water production locally. CMRWA Wells 1 through 5 are all completed into the Madison.

Both the Kootenai and Madison aquifers are recharged regionally by precipitation and snow melt where outcropping occurs; the Kootenai at the margins of the basin, and the Madison where exposed in the adjacent mountains. **Figure 4** depicts mapped outcrops of the Kootenai and Madison in the Little Belt and Big Snowy Mountains proximal to the UBet Wellfield (Montana Bureau of Mines and Geology [MBMG], 2025).

1. Western Groundwater Services, LLC (2014) Water Resources Monitoring Plan, Central Montana Regional Water Authority, report to Great West Engineering, Inc.

2. LONG-TERM HYDROGEOLOGIC MONITORING (LTM)

2.1 Monitoring Objectives

The 2014 Water Resources Monitoring Plan was intended to develop baseline hydrogeologic data, and water resource trends in the Judith Basin over time. The LTM data has served to guide project development and inform the public of the relationships between the various surface and groundwater supplies in the Basin. One area of specific concern was how development of high-capacity wells completed in the deep Madison Group could potentially affect the more commonly utilized Kootenai aquifer, surface waters or springs in the area. The LTM has evolved over time from primarily baseline data collection and interpretation to include more recently, the specific hydraulic connection, or lack thereof, between the Kootenai aquifer and pumping of newly developed production wells in the U Bet Wellfield. **Sections 2.2 and 2.3** identify the historic and current LTM components. Details of LTM well constructions and depths have been provided in prior annual LTM summary reports and CMRWA well construction/testing reports authored by WGS, and **Appendix A** includes the MBMG Groundwater Information Center (GWIC) well driller's logs for the CMRWA wells and private wells included in the LTM.

2.2 Historic Monitoring

Pursuant to a written water resources plan¹ and associated monitoring program², and as illustrated on **Figure 1**, the historic scope of monitoring included:

- High-frequency (15-minute interval) monitoring of water levels and water temperature measurements in several area wells completed in both the Kootenai and Madison aquifers,
- High-frequency (15-minute interval) water level and water temperature measurements in completed (but idle) production wells CMRWA 2 and 3 until mid-2022, leading up to installation of submersible pumps and commissioning of the wells.
- Review of surface water discharge measurement data collected by FWP at Big Spring near Lewistown
- Review of meteorologic data recorded at the MDOT Judith Gap Road Weather Information System (RWIS) station, and
- Review of Judith River stream flow data collected by the USGS at the gauge station near Sapphire Village.

2.3 Current Monitoring

The current high-frequency LTM network consists of the following components:

- **Groundwater**
 - **Madison Aquifer Wells**
 - Production Wells CMRWA 2 and 3: water levels and water production are continuously recorded by the onsite SCADA system.
 - Sentinel Well CMRWA 1: located near the Town of Utica (water levels daily).

2. Western Groundwater Services, LLC (2020) Judith Basin Monitoring System, Final Report, Central Montana Regional Water Authority, report to Great West Engineering, Inc.

- o **Kootenai Aquifer Wells:**
 - Sentinel Well CMRWA MW-1: Located in the UBet Wellfield (water levels at 15-minute interval).
 - Nicholson Ranch Well: Located approximately 12 miles WNW of the UBet Wellfield (water levels daily).
 - Judith Gap/Mauws Well: Located approximately 4 miles SE of the UBet Wellfield (water levels daily).
- **Surface Water**
 - o Judith River USGS Gauge Station 06110020: Near Sapphire Village above Carr Creek. USGS monitoring of daily average stream discharge.
 - o Big Spring: Near Lewistown. FWP monitoring of spring and surface water discharges (daily average).
 - o Crystal Lake SNOTEL (427): Crystal Lake in Big Snowy Mountains. Daily precipitation data. Note: Discharge monitoring of the Big Spring is also applicable to groundwater conditions in the Madison Group.

Appendix A contains a brief summary of the LTM network wells and monitoring stations.

2.4 Data Archive

Well data are reported to MBMG and can be accessed on the GWIC website³. Big Spring data are collected by the Montana Fish Wildlife and Parks (FWP) and can be accessed on the Montana Department of Natural Resources (DNRC) Stream and Gauge Explorer (StAGE) website⁴ by searching “Big Springs”. Judith River stream flows are available at the USGS stream flow monitoring website⁵.

3. <http://mbmggwic.mtech.edu>

4. <https://gis.dnrc.mt.gov/apps/stage/gage-report>

5. https://waterdata.usgs.gov/mt/nwis/uv/?site_no=06110020

3. LTM RESULTS AND INTERPRETATION

This section presents and provides interpretations of LTM data through 2024, including Groundwater (**Section 3.1**), Water Production (**Section 3.2**), Surface Water and SNOTEL (**Section 3.3**).

3.1 Groundwater Monitoring Results

Groundwater levels and water temperature had been collected from LTM wells for several years using dedicated, downhole, data-logging pressure/temperature transducers recording at 15-minute intervals. The data have been included in previous reports, but the record has become unwieldy and redundant at 15-minute intervals. Beginning with the 2023 LTM Report, the historic well data record has been simplified to represent monthly average water levels in all wells *except* the 2023 UBet production wells (Madison wells CMRWA 2 and 3), and Kootenai monitoring well CMRWA MW-1, which continued in 2024 to collect water level data at a high frequency (10 or 15-minute intervals). The high frequency static and pumping water level data in production wells CMRWA 2 and 3 are archived in the UBet SADA system since production began in 2023.

Previously collected groundwater temperature values from the monitoring well network have shown that water temperatures are relatively stable. The historical temperature values have been archived but not carried forward in the reporting. Temperature measurements will continue to be collected and archived but not presented unless the results indicate trends of interest.

3.1.1 Madison Aquifer Wells

Per **Section 2.3**, the LTM includes wells completed into the Madison aquifer; currently UBet Wellfield production wells CMRWA 2 and 3, and sentinel well CMRWA 1 located near Utica.

3.1.1.1 Sentinel Well CMRWA 1

Madison well CMRWA 1 is located near Utica, Montana and serves as a sentinel well; it is not equipped with a pump and is not expected to be affected by pumping of UBet Madison wells CMRWA 2 and 3. **Figure 5** plots static water levels in well CMRWA 1. The graph presents average monthly water level elevation (amsl) and depth to water (DTW) in ft below top of well casing (TOC). The data shows 40 to 50-foot annual fluctuations trending upward from 2016 through 2020, followed by a steep decline (approximately 100 ft) in water levels through 2022. Water levels rebound in 2023 and maintain at more historic levels in 2024.

Note a data gap exists in the record from mid-Oct through December, 2024 when the transducer was replaced due to low battery. A new transducer was installed in January 2025 and is currently operating and recording water levels and temperature every 6 hours.

3.1.1.2 Production Wells CMRWA 2 and 3

Well CMRWA 2 has been the primary water source since operation of the UBet Wellfield began in 2023. Well CMRWA 3 is operated less frequently and for shorter durations, and the wells are typically not run simultaneously. This operational history is confirmed in the SCADA production records.

Figure 6a plots monthly average static (non-pumping) water levels in production well CMRWA 2 through 2024. The water levels are presented as both elevation (amsl) and depth to water (DTW) in ft below top of well casing (TOC). The transducer was removed from the well from July 2021 until July 2022, reportedly to facilitate well completion and pump installation. The historic annual fluctuation and trends in static water level in well CMRWA 2 is similar to sentinel well CMRWA 1 but less pronounced. The commissioning of well CMRWA 2 in 2023 is evident in the plot. **Figure 6b** illustrates both static and pumping water levels in well CMRWA 2 in response to pumping cycles. It is seen that water levels in the well decrease by approximately 50 ft in response to routine pumping rates of 550 gpm, and rapidly recover when pumping ceases.

Figure 7a plots monthly average static water levels recorded in production well CMRWA 3 through 2024. The water levels are presented as both elevation (amsl) and depth to water (DTW) in ft below top of well casing (TOC). Data gaps occur in the periods between November 2020-July 2021, and July 2022-July 2023; reportedly associated with well completion and pump installation. The well has a shorter period of record than wells CMRWA 1 and 2, but suggests a similar, natural decline in static water level occurred prior to commissioning of well in 2023. **Figure 7b** plots both static and pumping water levels in well CMRWA 3 in response to pumping cycles. It is seen that water levels in the well decrease on the order of 40 ft in response to routine pumping rates approaching 1300 gpm, and rapidly recover when pumping ceases.

The hydraulic relationship between these two production wells, and the UBet Kootenai sentinel well CMRWA MW-1 are discussed further in **Section 3.1.3**.

3.1.2 Kootenai Aquifer Wells

As mentioned in **Section 2.3**, Kootenai wells monitored in the current LTM program include Kootenai sentinel well CMRWA MW-1, the Nicholson Ranch Well and municipal Judith Gap/Mauws Well (**Figure 1**). Well CMRWA MW-1 is located in the UBet Wellfield near Madison production wells CMRWA 2 and 3 to observe water level trends in the Kootenai, and also importantly, monitor potential response in the Kootenai to pumping of the Madison wells.

Historic monitoring also included the Peterson Ranch and Jenni Ranch wells, but that monitoring was discontinued in 2021 due to installation of a pump in the Peterson Ranch well by the well owner, and also seasonal freezing issues in the Jenni Ranch well reportedly inhibiting pressure transducer operation⁶.

Figures 8 through 10 plot historic (September 2016 through 2024) average monthly water levels (elevation and DTW) in the current Kootenai monitoring well network as discussed further herein.

3.1.2.1 Sentinel Well CMRWA MW-1

Figure 8 plots the historic static water levels recorded in Kootenai well CMRWA MW-1. Water levels are shut-in values and are considered static water levels. (Note the DTW scale represents hydraulic head above top of casing, and as such are negative numbers ([ft above TOC])). A modest, seasonal water level fluctuation is overprinted on a rising, then declining 2020 through early 2023, and then rising again; a trend similar but subdued with respect to magnitude of the monitored Madison wells. There is no apparent decline in this Kootenai sentinel well related to production from nearby Madison production wells CMRWA 2 or 3, as explored further in **Section 3.1.3**.

3.1.2.2 Nicholson Ranch Well

Figure 9 plots water levels recorded in the Kootenai Nicholson Ranch Well. The well is an operating well used for household and stock water supply and as such is periodically pumped. However, drawdowns due to pumping are limited, and the data can be considered essentially static water levels over the duration and frequency of the plot. An interruption occurred for unknown reasons in transducer recording from September 2017-May 2018. The data suggests moderate seasonal fluctuations of water in the well on the order of 2 to 3 ft, upwards through 2020 with a downward trend reversed in early 2023 and slowly declining slightly in 2024. The overall trend is similar to the monitored Madison wells, but less pronounced.

6. Western Groundwater Services, LLC (2021) Judith Basin 2021 Monitoring Data Summary Report, Central Montana Regional Water Authority, report to Great West Engineering, Inc.

3.1.2.3 Judith Gap (Mauws) Well

Figure 10 is a historic plot of water levels recorded in the Kootenai Judith Gap (Mauws) well. The well is the municipal supply for the Town of Judith Gap, and as such, is frequently pumped. The high-frequency data set includes only resting, shut-in water levels, but are considered static water levels under some influence from pumping events. (Note the data are presented as DTW ft above TOC.) However, the data shows a trend not dissimilar to other Kootenai LTM wells; minor annual fluctuations of a few feet, increasing water levels through 2020 followed by perhaps a decrease in 2021-2022 and a rebound beginning in 2023, then slightly declining in 2024.

3.1.3 Response in Kootenai Aquifer to CMRWA Production Wells

As identified in **Section 3.1.2**, Kootenai sentinel Well CMRWA MW-1 is located in the UBet Wellfield near Madison production wells CMRWA 2 and 3 to observe water level trends in the Kootenai, and also importantly, monitor potential response in the Kootenai to pumping of the Madison wells.

A discrete set of data were selected to include consecutive days in August 2024 when both production wells were operated independently and with significant pumping and rest intervals-- in order to evaluate the response in the Kootenai sentinel well.

Figures 11a/11b compare water levels in Kootenai sentinel well CMRWA MW-1 with pumping rates and corresponding water levels (DTW above TOC) in well CMRWA 2. The resting/pumping regime in production well CMRWA 2 was 15 hours off/16 hours pumping/27hours off/14 hours pumping. No discernable response is seen in the Kootenai sentinel well water levels in response to pumping or cessation of pumping of Madison well CMRWA 2. In fact, the data indicate well CMRWA MW-1 water levels increased slightly (0.05 ft) over the duration.

Similarly, **Figures 12a/12b** compare water levels in Kootenai sentinel well CMRWA MW-1 with pumping rates and corresponding water levels in well CMRWA 3 (DTW above TOC). The resting/pumping regime in production well CMRWA 3 was 25 hours off/5 hours pumping/30hours off/3 hours pumping. (Note well CMRWA 3 pumps at much higher rates and run times are shorter than Well CMRWA 2.) Again, no discernable response is seen in the Kootenai sentinel well water levels to pumping or cessation of pumping of Madison well CMRWA 3. A similar, slight upward trend in the data indicate well CMRWA MW-1 water levels increased slightly (0.05 ft) over the duration.

Furthermore, as discussed in previous sections, historic water level trends in Kootenai LTM wells generally follow, but are more subdued than water levels in the Madison LTM wells. This includes several years of monitoring that pre-date any pumping of the Madison production wells CMRWA 2 or 3. While there may be some hydraulic connection between the shallower Kootenai aquifer and the much deeper Madison aquifer, it does not appear significant enough to result in a direct response in the Kootenai to pumping in the UBet Madison wells. However, the LTM will continue to evaluate potential hydraulic connections between the two aquifers over time.

3.2 Water Production

According to the CMRWA system operator, water production from U Bet Wells CMRWA 2 and 3 began effectively on September 10, 2023. With respect to the operation of the water wells, the SCADA system is recording the following information at high frequency (10-minute) intervals for each of the wells:

- Pumping and static water levels (depth to water and water elevation)
- Pump on/off cycles
- Pumping rates (gpm)

- Daily water production (gallons)

SCADA reports are currently being refined to auto-generate monthly reports summarizing this information. These reports will be appended to the annual long-term monitoring reports in the future and will be archived on the SCADA system.

Table 1 summarizes the SCADA- reported monthly and total production volumes (gallons) from each well during 2024. Just over a combined 70 million gallons were produced from the wells in 2024.

Table 1. 2024 Monthly Water Production (gallons)

Month	Well CMRWA 2 (gals)	Well CMRWA 3 (gals)	TOTAL (gals)
Jan	2,923,200	1,730,800	4,654,000
Feb	3,157,000	1,000	3,158,000
Mar	4,270,500	5,400	4,275,900
April	13,700	3,983,500	3,997,200
May	29,200	5,411,800	5,441,000
June	7,500,200	3,500	7,503,700
July	3,903,300	5,964,700	9,868,000
Aug	5,849,800	4,017,200	9,867,000
Sept	6,991,100	2,100	6,993,200
Oct	5,142,900	1,700	5,144,600
Nov	3,786,300	1,000	3,787,300
Dec	7,200	5,509,700	5,516,900
TOTAL	43,574,400	26,632,400	70,206,800

3.3 Surface Water and SNOTEL

This section presents the LTM surface water data reported by others including: the Montana FWP monitoring of spring discharge and surface water flows associated with the Big Spring near Lewistown (**Section 3.3.1**), precipitation recorded at the Crystal Lake SNOTEL station in the Big Snowy Mountains (**Section 3.3.2**) and the USGS gauging station on the Judith River near Sapphire Village (**Section 3.3.3**). Refer to **Figure 1** for LTM locations.

3.3.1 Big Spring

The Montana FWP monitors spring discharge and surface water flows in and immediately around the Big Springs near Lewiston, Montana. These discharges are useful in understanding both surface water flows in Big Spring Creek as well as groundwater discharge and a measure of dynamic hydraulic conditions in the Madison Aquifer.

Figure 13 is a plot of the reported historical discharge associated with the Big Springs complex from June 2017 through 2024. The discharge varies historically for the period plotted from average highs of approximately 95 cubic feet per second (cfs) to average lows of near 85 cfs. The overall trend of the data remains steady through 2020, after which flows decreased in the 2021 and 2022 interval and in 2023 and 2024 have returned to near average values. It is noted that on May 11, 2024 the site reported a spike record high (108 cfs) for the period of record.

3.3.2 Crystal Lake SNOTEL

Figures 14a and 14b plot of monthly precipitation recorded at the Crystal Lake SNOTEL station for calendar years 2017 to 2024. The station recorded an average precipitation of 40.4 inches (in) over the period of record. The wettest precipitation months are typically April, May and June. The wettest reported year for the period of record was 2024 (48.3 in), due in large part to heavy precipitation recorded in May (12.3 in) and an unusually wet September (9.3 in).

3.3.3 Judith River Streamflows

The USGS maintains a stream gauging station on the Judith River (USGS 06110020), just upstream of Carr Creek near Sapphire Village. The flows are an indicator of timing and magnitude of snowmelt in the Little Belt Mountains, and a metric of overall water surface water resources in the Judith Basin. **Figure 15** is a plot of recorded streamflows in cfs for the period from October 2014 through December 2024. Peak and low flows are typically recorded in May and February/March, respectively. The historical trend has generally been decreasing streamflows beginning in 2020, then increasing in 2023 to peak flows for the period of record (nearly 800 cfs). In 2024 the flows were more typical; peak flow at 191 cfs in May and low flow recorded in March (6.4 cfs).

4. SUMMARY

This report is the latest presentation of the results of the LTM program from its inception in 2016 through 2024. The record is robust and provides an understanding of the baseline and current surface and groundwater conditions within the UBet Wellfield and the broader LTM network.

From the hydrographs presented, it appears LTM wells in both the Madison and Kootenai aquifers follow similar, natural historic and seasonal water level trends, with Kootenai wells demonstrating more muted responses.

Production from UBet Wellfield began in September 2023, and monitoring and interpretation have begun to encompass water production from the UBet wells and focused groundwater monitoring of both the Madison and Kootenai Aquifers.

Production wells CMRWA 2 and 3 have reportedly been operated at rates on the order of 550 gpm and 1200 gpm, respectively. Annual production from the wells in 2024 was just over 70 million gallons. The wells are typically not operated simultaneously for production. Drawdown in the wells in response to pumping is considered negligible (on the order of 40 to 50 ft) in the aquifer, and recovery is rapid when pumping ceases. The current pumping rates are considered sustainable for these wells.

A review of static water levels in the Madison and Kootenai wells (and importantly the nearby Kootenai sentinel well CMRWA MW-1) suggests no decline in either aquifer in response to operation of the UBet Madison production wells.

Future monitoring will include planned UBet production Wells CMRWA 4 and 5, both currently completed but awaiting connection to the distribution system.

It is recommended LTM data and interpretation efforts continue and be documented in subsequent annual LTM reports, and the data archived as appropriate to the existing public databases and on-site SCADA system.

FIGURES

FIGURE 1 - LOCATION MAP

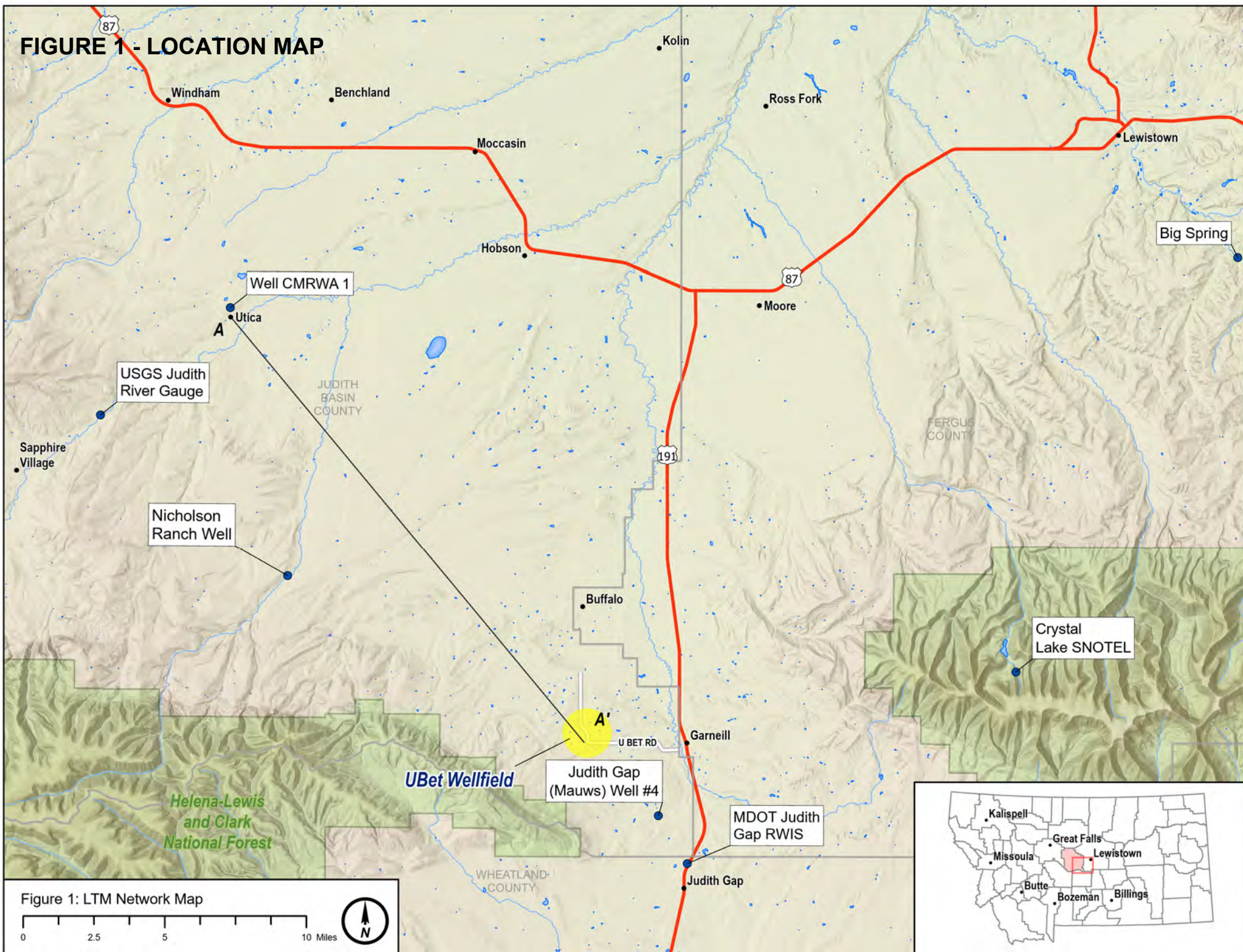


Figure 1: LTM Network Map

FIGURE 2 - UBET SITE MAP

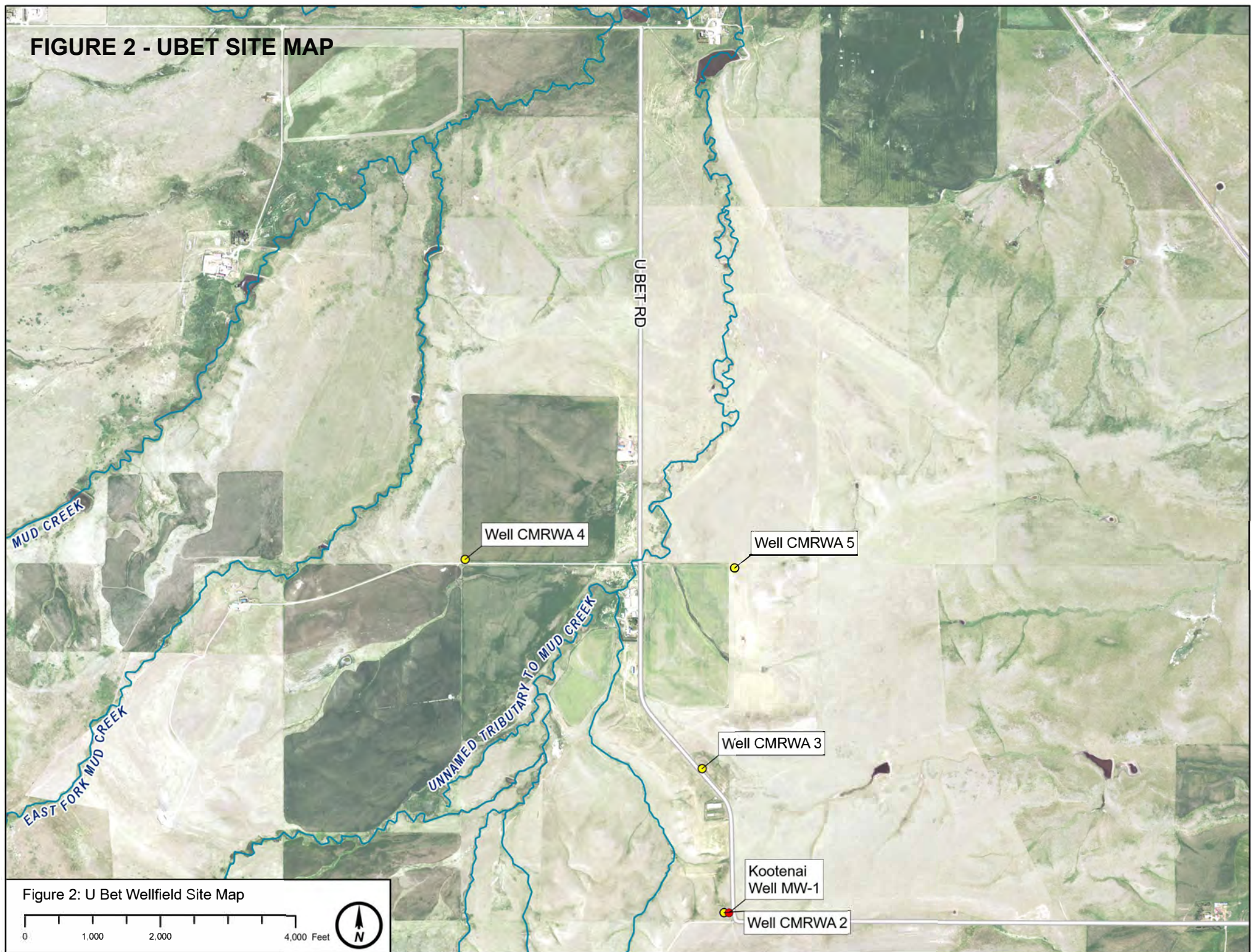
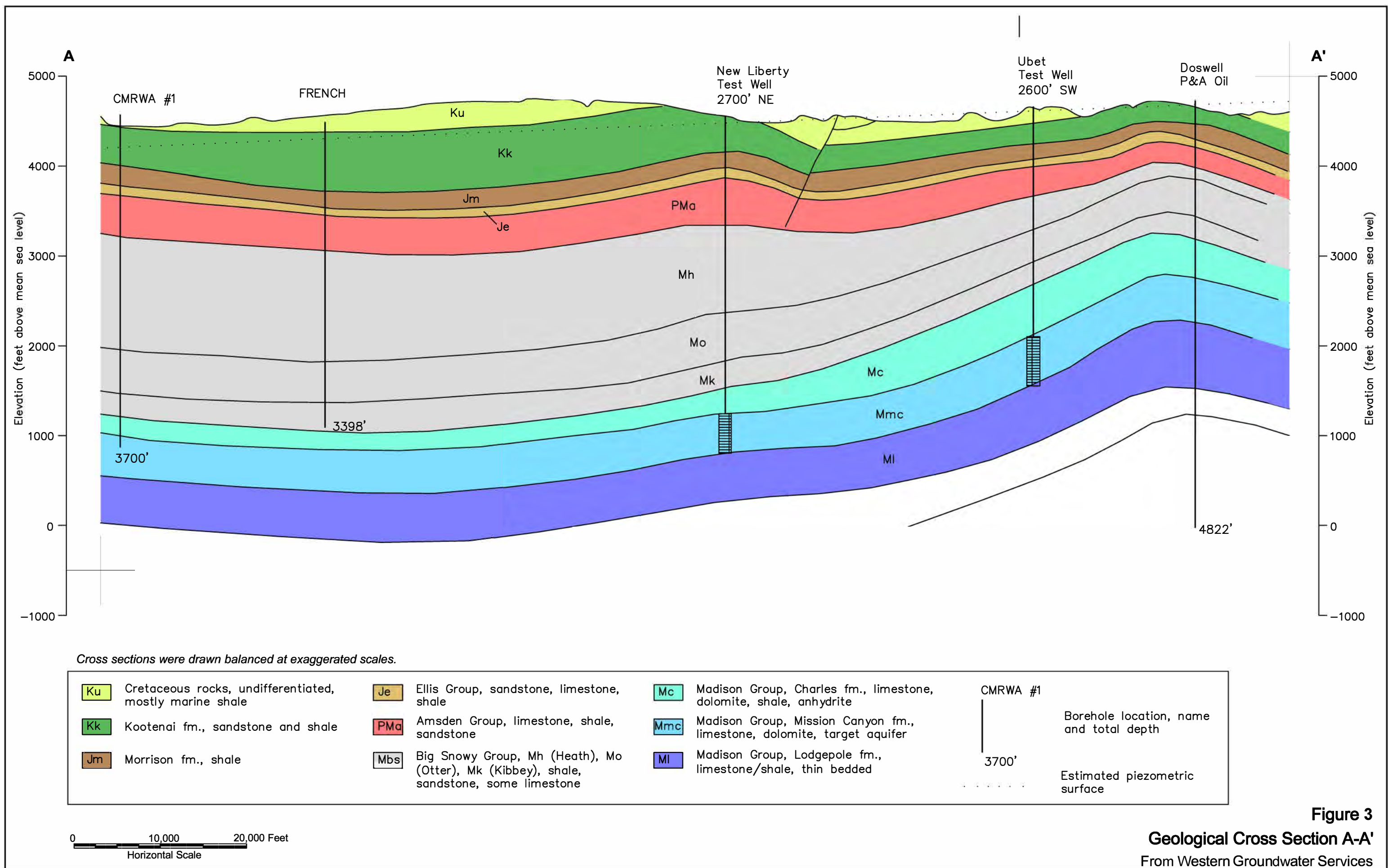


Figure 2: U Bet Wellfield Site Map



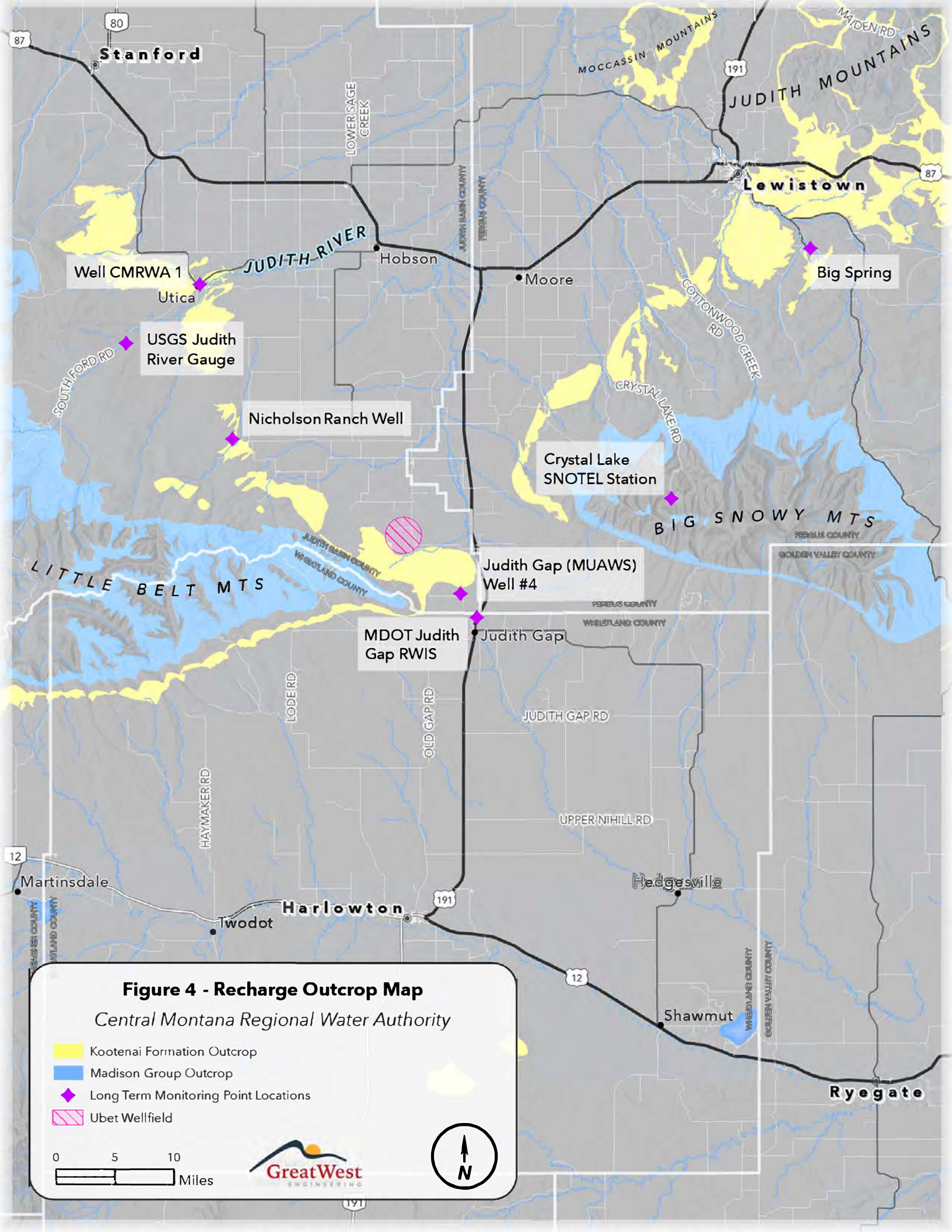


Figure 4 - Recharge Outcrop Map

Central Montana Regional Water Authority

-  Kootenai Formation Outcrop
-  Madison Group Outcrop
-  Long Term Monitoring Point Locations
-  Ubet Wellfield

0 5 10
Miles



Figure 5. Madison Sentinel Well CMRWA 1

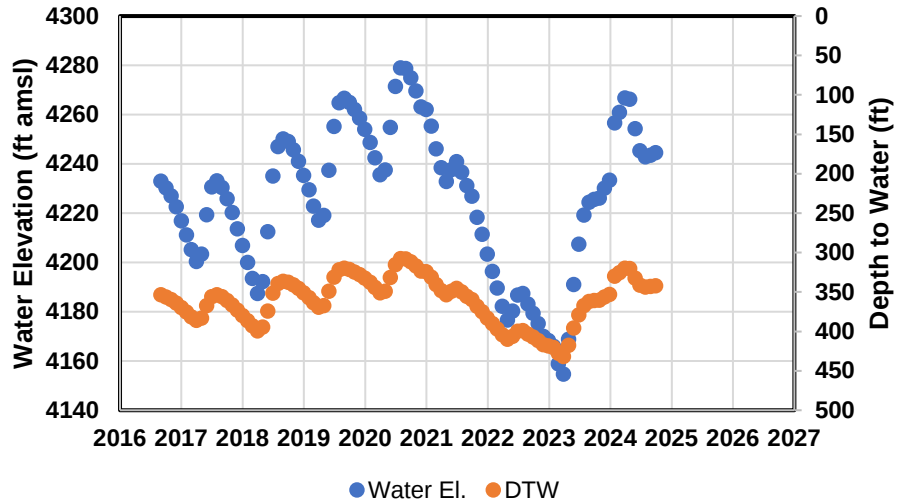


Figure 6a. Production Well CMRWA 2

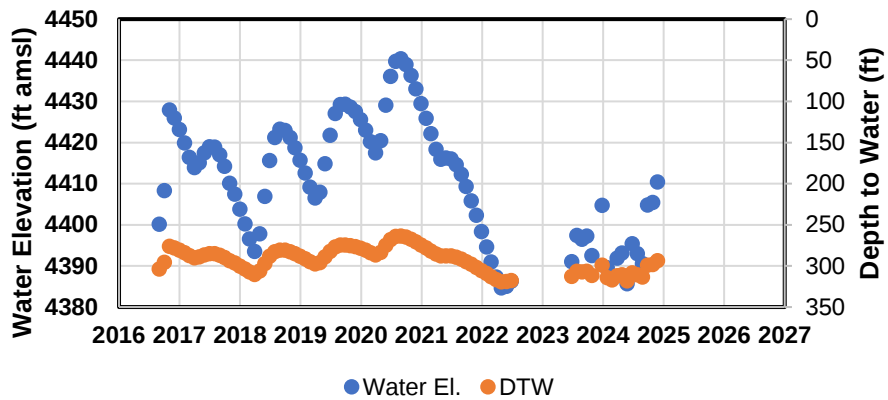


Figure 6b. Production Well CMRWA 2

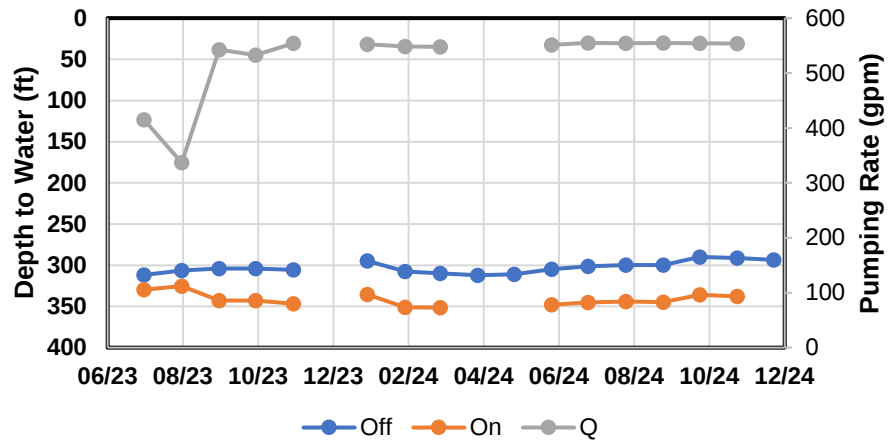


Figure 7a. Production Well CMRWA 3

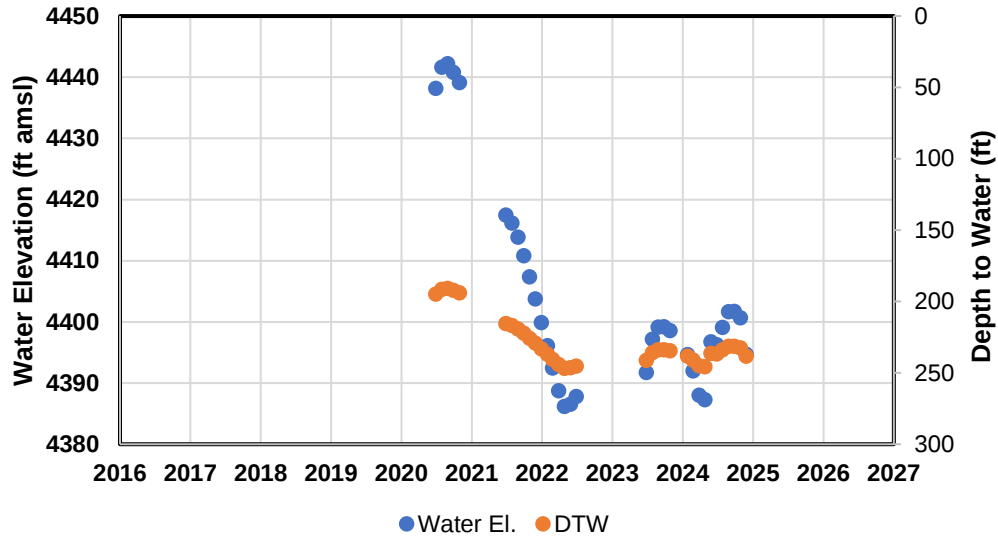


Figure 7b. Production Well CMRWA 3

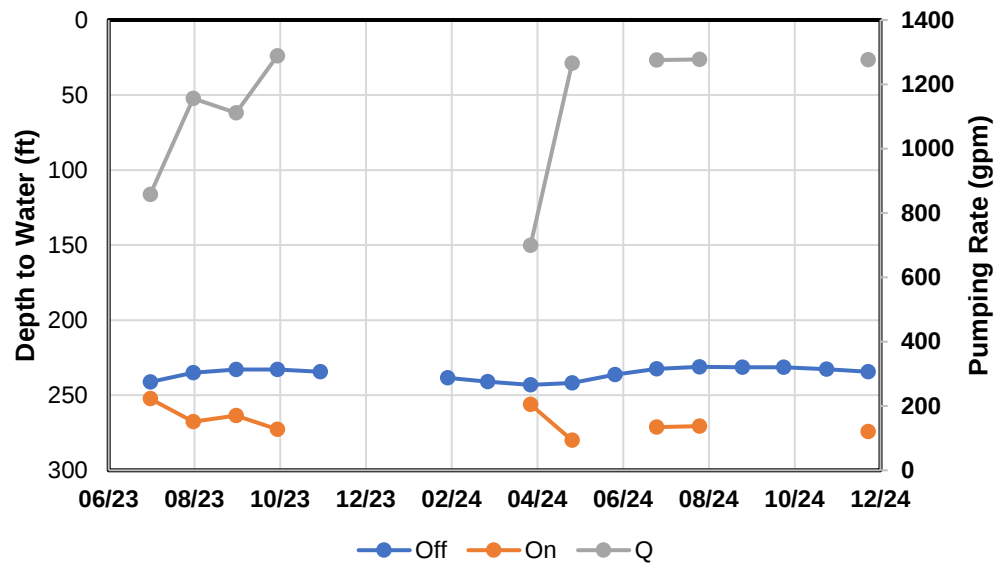


Figure 8. Kootenai Sentinel Well CMRWA MW-1

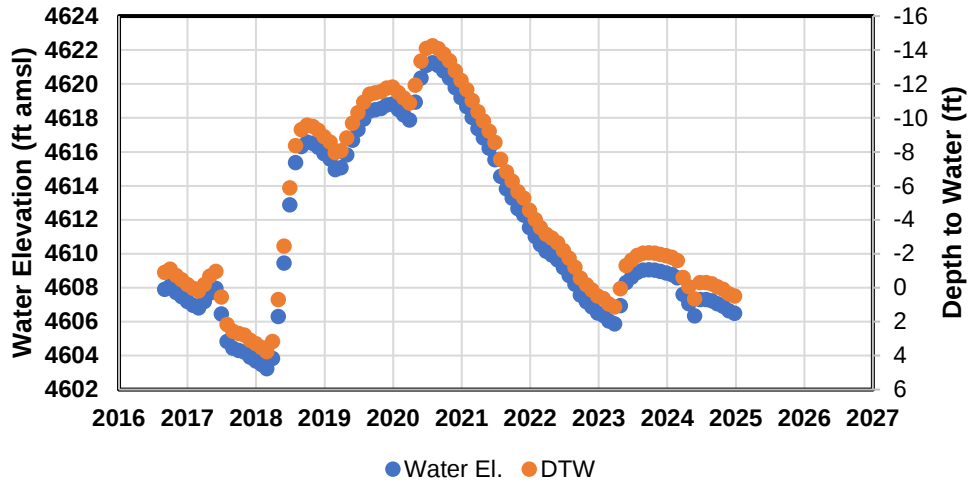


Figure 9. Nicholson Ranch Well

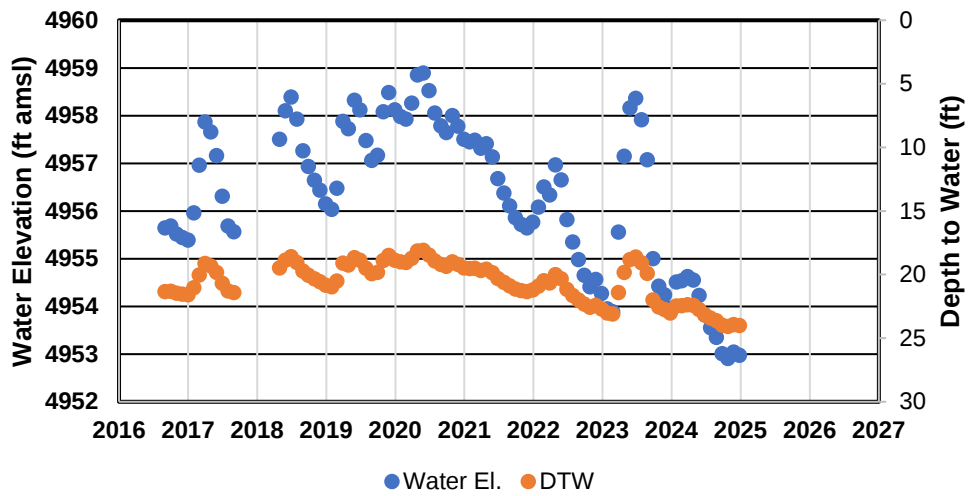


Figure 10. Judith Gap (Mauws) Well

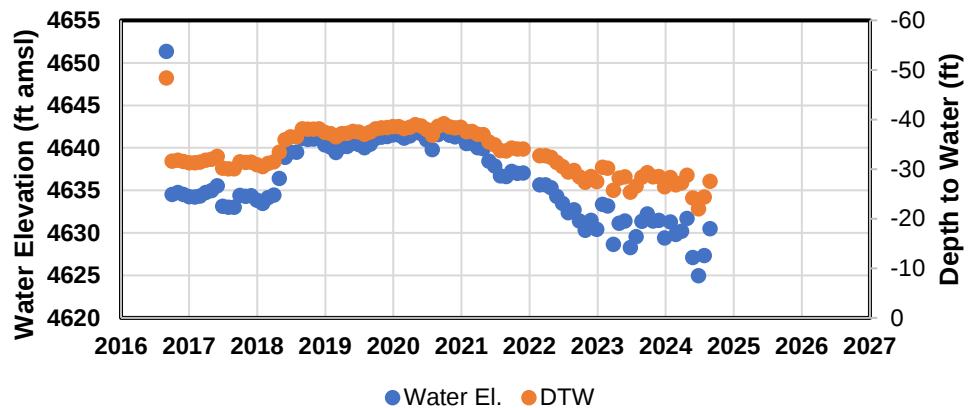


Figure 11a. Madison Pumping Well CMRWA 2

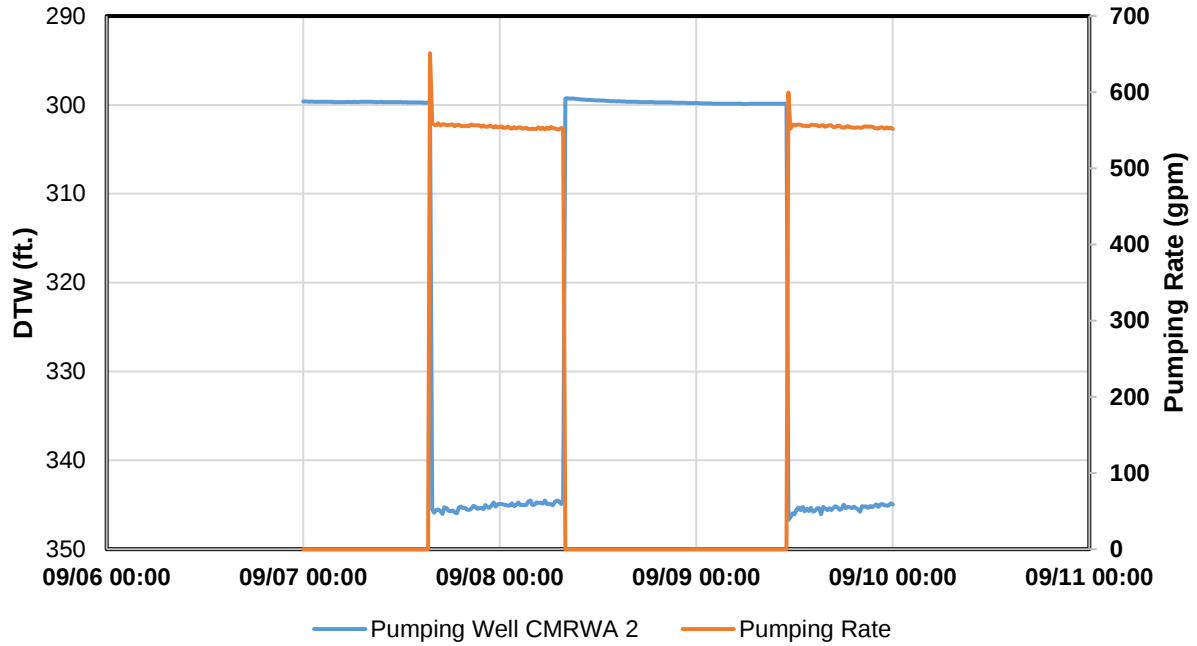


Figure 11b. Kootenai Sentinel Well CMRWA MW-1

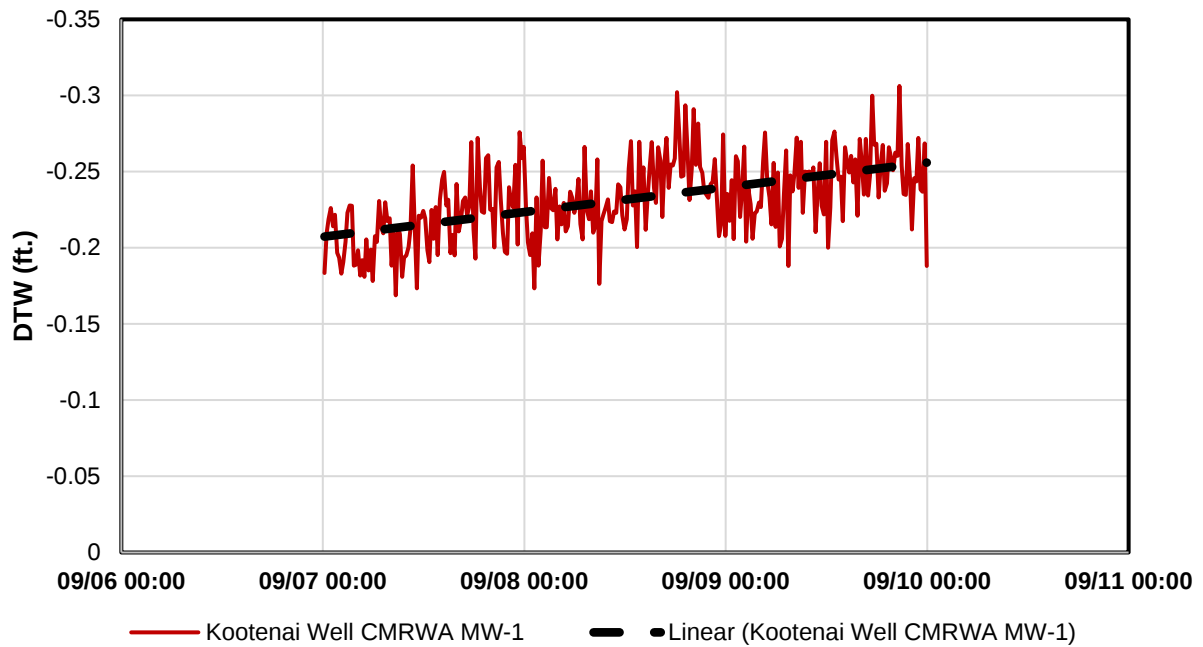


Figure 12a. Madison Pumping Well CMRWA 3

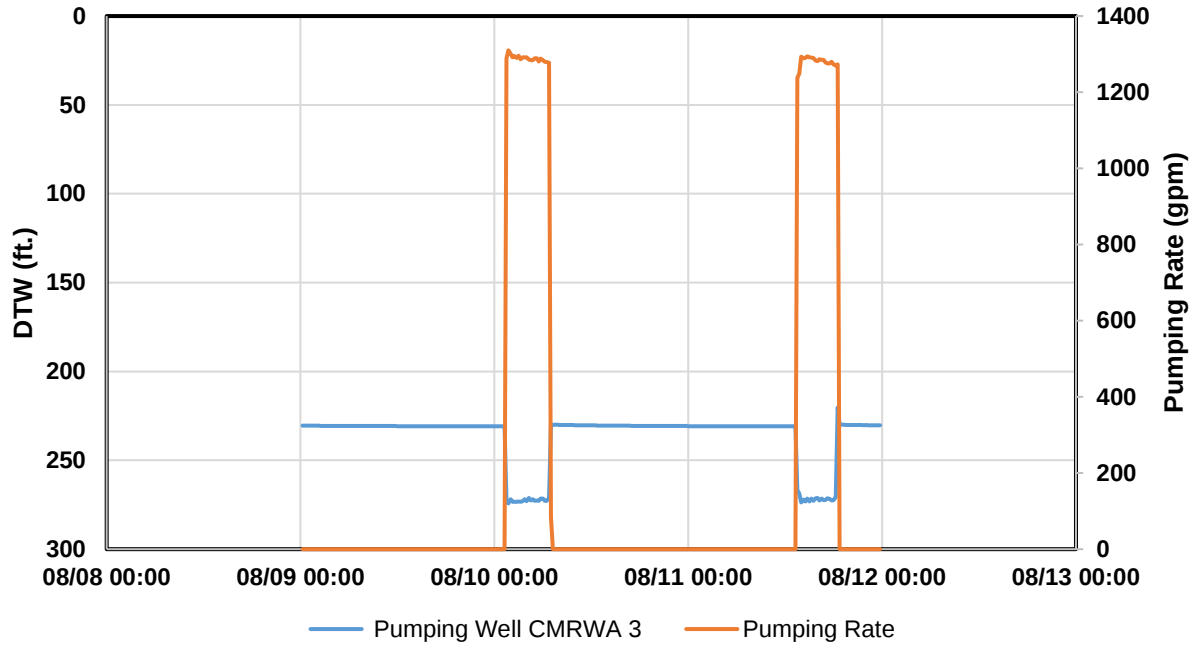
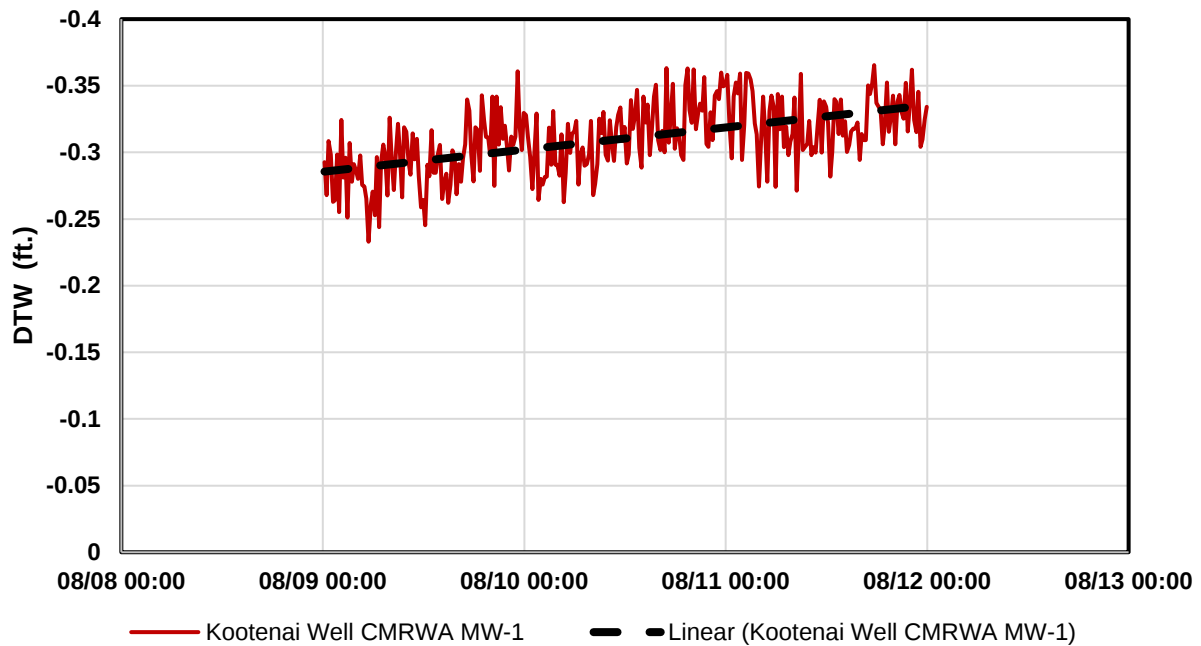


Figure 12b. Kootenai Sentinel Well CMRWA MW-1



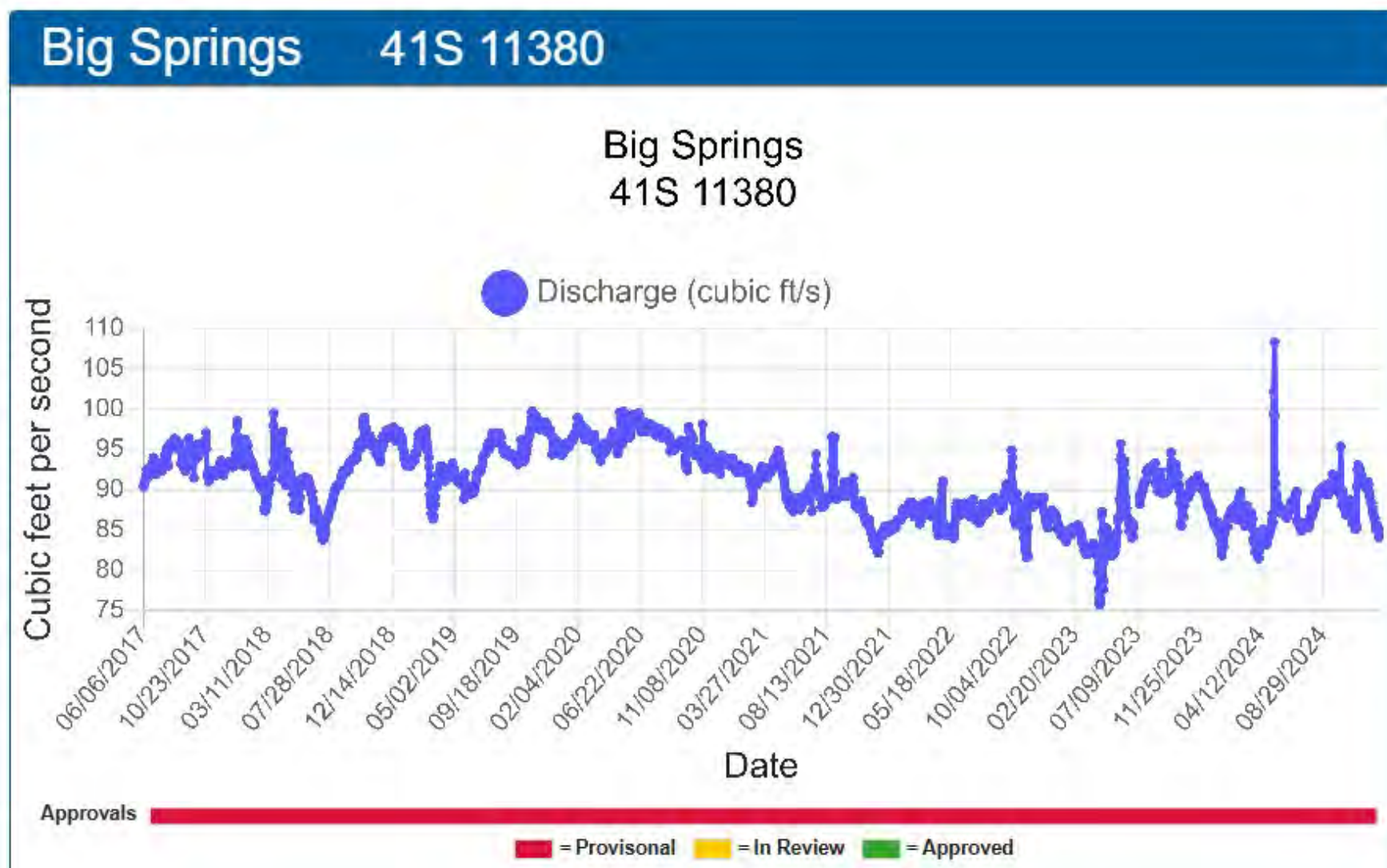


Figure 13. Big Springs Discharge Hydrograph

Figure 14a. Crystal Lake SNOTEL Precipitation

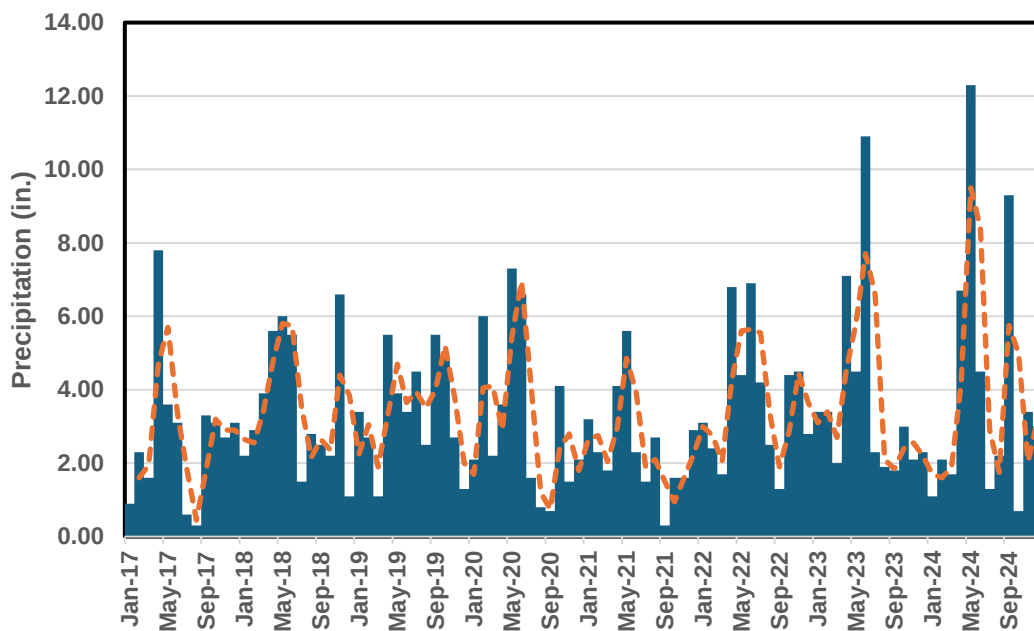
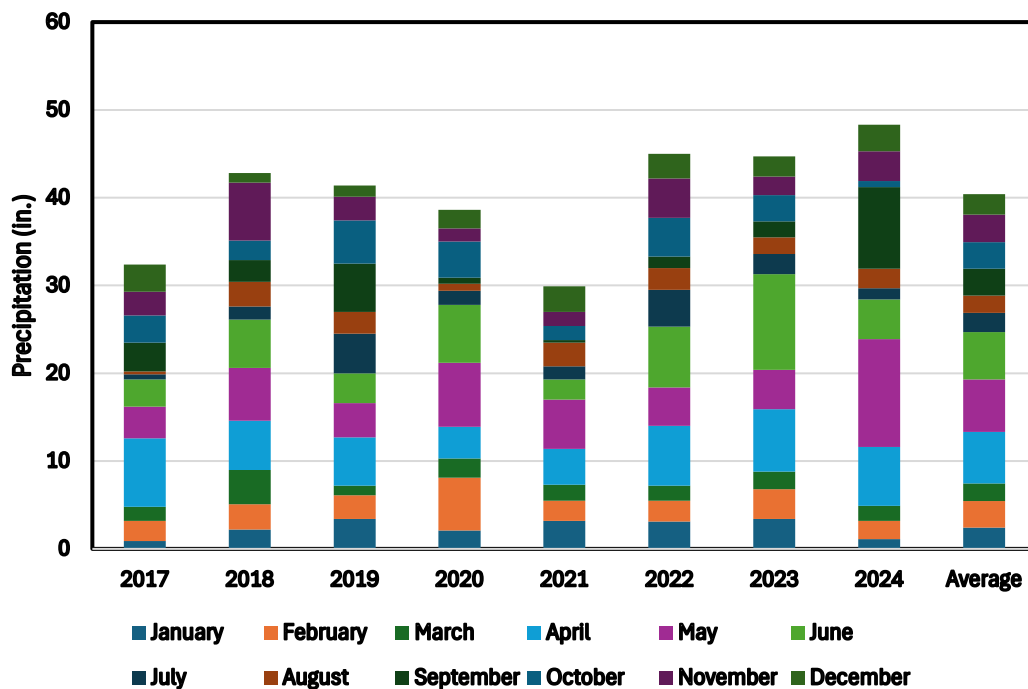


Figure 14b. Crystal Lake SNOTEL Precipitation



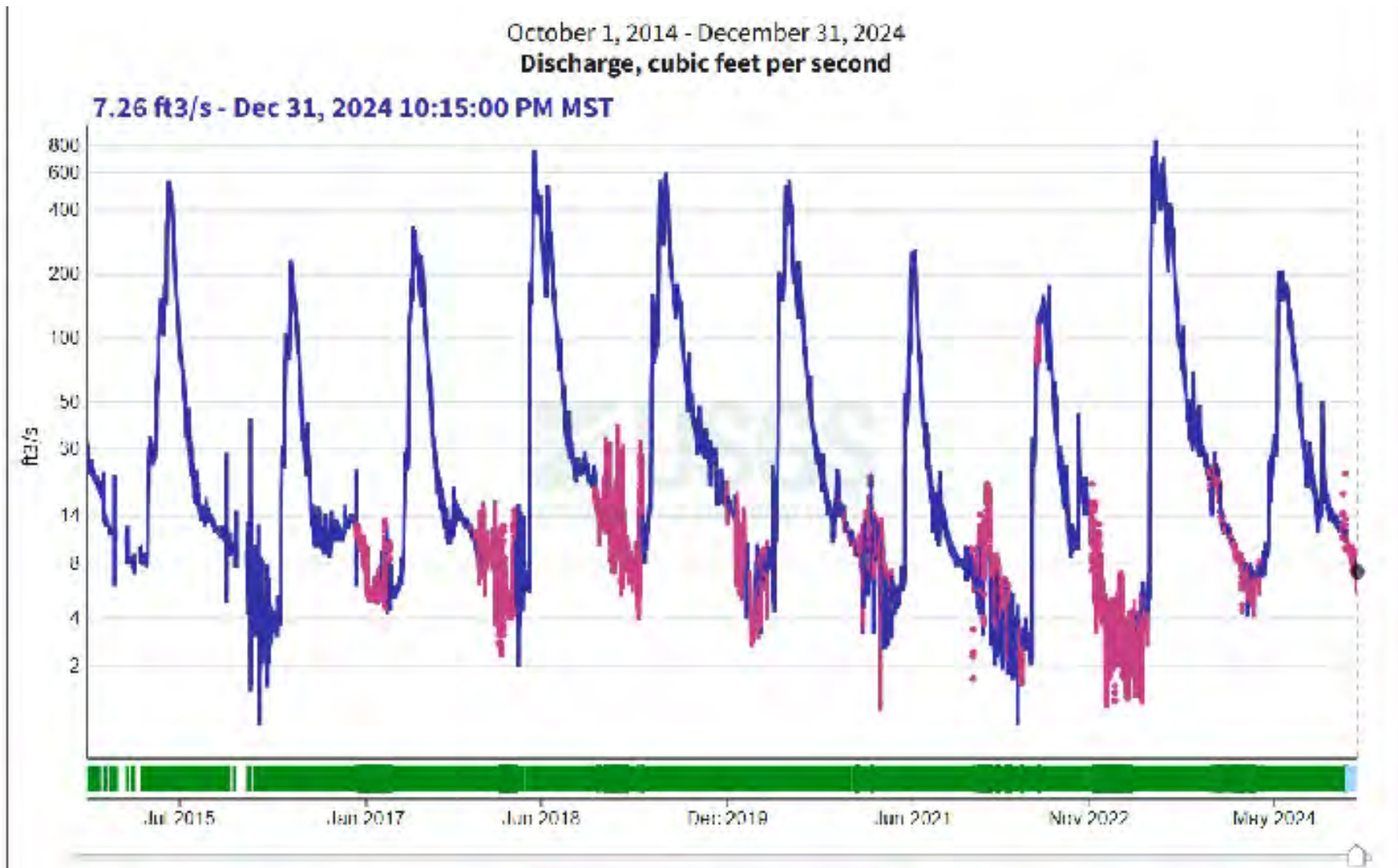


Figure 15. Judith River Hydrograph
USGS Gauge 06110020 near Utica, MT

APPENDIX A

GWIC Logs and Summary Table

MONTANA WELL LOG REPORT**Other Options**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

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Site Name: CENTRAL MONTANA REGIONAL WATER
AUTHORITY * SUPPLY WELL 1
GWIC Id: 257040
Section 1: Well Owner(s)

1) CMRWA (MAIL)

N/A

HOBSON MT 59452 [02/01/2006]

Section 2: Location

Township	Range	Section	Quarter Sections
14N	13E	16	SW¼ NW¼ SW¼
County			Geocode

JUDITH BASIN

Latitude	Longitude	Geomethod	Datum
46.973135	-110.092816	DIGITALMAP	WGS84
Ground Surface Altitude	Ground Surface Method	Datum	Date
4586.56	DEM	NAVD88	4/7/2020
Measuring Point Altitude	MP Method	Datum	Date Applies
4586.56	DEM	NAVD88	9/19/2016 6:30:00 PM
Addition	Block	Lot	

Section 7: Well Test Data

Total Depth: 3700

Static Water Level: 391.99

Water Temperature:

* During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.

Section 8: Remarks
Section 9: Well Log
Geologic Source

330MDSN - MADISON GROUP OR LIMESTONE

From	To	Description
0	40	BOULDERY TERRACE DEPOSITS; CALICHE AT TOP
40	135	BLACK SHALE; HARD BLACK SHALE BOTTOM 15 FT.
135	310	INTERBEDDED SHALE, SANDSTONE AND MUDSTONE
310	400	SECOND CAT CREEK SAND, SOFT WHITE SANDSTONE
400	495	VERY DARK REDDISH-BROWN MUDSTONE, TRACES OF SANDSTONE
495	556	THIRD CAT CREEK SAND, HARD SANDSTONE WITH SOME CHERTY LAYERS
556	614	SOFT SANDSTONE
614	805	MUDSTONE WITH A FEW INTERBEDS OF LIMESTONE AND SANDSTONE
805	850	SOFT BROWN SANDSTONE AND RED CLAY
850	895	GREENISH GRAY TO GRAY SHALE
895	1115	INTERBEDDED RED/WHITE SILTSTONE, WHITE SANDSTONE, AND GYPSUM
1115	1214	LIMESTONE AND SOFT RED SHALE
1214	1362	SOFT RED SILTSTONE
1362	1850	BLACK SHALE, SOFT, VERY PETROLIFEROUS, TRACE GYPSUM/ANHYDRITE AND LIMESTONE
1860	1880	BLACK SAND, FLOWS WATER

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:

Company:

License No: -

Date Completed: 1/1/2005

Section 3: Proposed Use of Water

DOMESTIC (1)

PUBLIC WATER SUPPLY (2)

Section 4: Type of Work

Drilling Method:

Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Saturday, January 1, 2005

Section 6: Well Construction Details
Borehole dimensions

From	To	Diameter
0	42	0
42	839	13.5
817	1500	8.75
1500	3700	6.25

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	42	16				STEEL
0	839	9				STEEL
817	1500	7				STEEL
1477	3565	4				STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
3565	3700	4			OPEN HOLE

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
807	817	7X9.625 CASING PACKER	

1460	1477	4.5X7 CASING HANGER PACKER	
------	------	----------------------------	--

Site Name: CENTRAL MONTANA REGIONAL WATER AUTHORITY		
GWIC Id: 257040		
Additional Lithology Records		
From	To	Description
1880	1910	WHITE SANDSTONE, HARD, SILICA CEMENT
1925	2615	BLACK SHALE INCLUDED PETROLIFEROUS ZONES
2615	2770	BLACK SHALE
2770	2800	LIMESTONE
2800	3102	BLACK SHALE
3102	3250	WHITE SILTSTONE INTERBEDDED WITH RED SILTSTONE AND ANHYDRITE
3250	3360	REDDISH-BROWN SOFT CLAY SHALE
3360	3398	SHALE WITH 30% ANHYDRITE
3398	3426	ANHYDRITE WITH TRACES OF SHALE
3426	3562	LIMESTON WITH FEW LAYERS OF SOFT CLAY/SHALE AND SHALEY LIMESTONE LAYERS
3562	3700	LIGHT GRAY, SOFT LIMESTONE WITH POROSITY ??? OF SOFT WHITE CLAY AND SOFT SPARRY CELCITE, LIGHT LIMESTONE

MONTANA WELL LOG REPORT**Other Options**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

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Site Name: CENTRAL MONTANA REGIONALWATER
AUTHORITY
GWIC Id: 269957

WELL-2

Section 1: Well Owner(s)

1) CENTRAL MONTANA REGIONALWATER AUTHORITY (WELL)
 2501 BELT VIEW DRIVE
 HELENA MT 59604 [10/14/2012]

Section 2: Location

Township	Range	Section	Quarter Sections
12N	15E	34	SE¼ SW¼ SW¼
County			Geocode
JUDITH BASIN			
Latitude	Longitude	Geomethod	Datum
46.7517783726	-109.826077447	TRS-SEC	NAD83
Ground Surface Altitude	Ground Surface Method	Datum	Date
Addition	Block	Lot	

Section 3: Proposed Use of Water

TEST WELL (1)

Section 4: Type of Work

Drilling Method: ROTARY
 Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Sunday, October 14, 2012

Section 6: Well Construction Details**Borehole dimensions**

From	To	Diameter
0	1000	12.25
1000	2225	8.75
2225	2250	6.125

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	998	9	0.375		THREADED	STEEL
950	2223	7	0.375		THREADED	STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
2223	2250	7			OPEN HOLE

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	2223	NEAT CEMENT	Y

Section 7: Well Test Data

Total Depth: 2223
 Static Water Level: 269.8
 Water Temperature:

Pump Test *

Depth pump set for test 562 feet.
541 gpm pump rate with 20.8 feet of drawdown after 72 hours of pumping.
 Time of recovery _ hours.
 Recovery water level _ feet.
 Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

PUMP TEST COMPLETED ON 11-28-12

Section 9: Well Log**Geologic Source**

Unassigned

From	To	Description
0	35	CLYST, TAN, THN LAM (THERMOPOLIS)
35	65	CLYST, GR & LT TAN, THN LAM
65	95	SH, BLK
95	125	CLYST, GY, THN LAM
125	155	SLTST, GY, ARG, HD, THN LAM
155	185	SLTST, GY, ARG, HD, THN LAM, SG, DK GY
185	215	SLTST, GY, ARG, HD, THN LAM
215	245	SS, LT GY, F, CALC CMT, POS KAO CMT, ANG, MED SRTG (KOOTENAI)
245	275	SH, RED BRN, SLTY, WKLY CALC; SH, GY
275	305	SLTST, RED BRN, GY, HD, ARG
305	335	SS, LT GY, F, ANG, MOD SRTG, CALC CMT
335	365	SS, LT GY, F, ANG, MOD SRTG, CALC CMT (POS SIL CMT), V HD; COAL, RR, BLK, VTR
365	395	CLYST, RES AND LY GY, MOT, SLTY, BENT
395	425	CLYST, LT GY W/ RED CTG, MOT, SLTY
425	455	SS, LT GY, WKLY CALC CMT, POS SIL CMT, HD, SUB ANG TO MD, PRLY SRTD (THIS AND PRIOR SANDSTONES INCLUDE +30% FELDSPAR AND QTZ, AND 10-15% OPAQUES)

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: FRED ROTHHAUGE
Company: HYDRO RESOURCES
License No: WWC-670
Date Completed: 10/14/2012

Site Name: CENTRAL MONTANA REGIONAL WATER AUTHORITY**GWIC Id: 269957****Additional Lithology Records**

From	To	Description
455	485	CLYST, RED
485	515	CLYST, RED AND LT GY, INTR-LAM, POS HD SS LAM/BDS
515	545	SS, LT GY, F, , SLTY, CALC CMT, HD
545	575	LS, WHT; CLYST, RED, (LAVENDER), INTR LAM; SH, BLK, FIS
575	605	SS, LT GY, F, SIL CMT, TR PYR, V HD; RED CLY CTGS ON CHPS GIVES LAV COLR
605	635	SS, LT GY, M, LSE GRNS, SOME CALC CMT CHIPS, QTZ, FLD, CHRT
635	665	SS, GY, M, LSE GRNS, TR PYR, ABNT OP GRNS; RR CHPS PRP, RED, GRN MUDST
665	695	SS, GY, C, LSE GRNS, S&P, PYR AND CALC CMT; ABNT F COAL CHPS
695	725	SS, GY, C, LSE GRNS, S&P, TR PYR
725	755	SLTST, GY, SIL, V HD (MORRISON)
755	785	SLTST, WH, CALC, V HD; CLYST, BRN, SLTY
785	815	SLTST, GY; CLYST, GY BRN; SS, WH, F, W/COAL LAM
815	845	SLTST, GY, ARG
845	875	CLYST, GY, SLTY
875	905	SLTST, LT GRN, ARG
905	935	CLYST, LT GRN GY, SLTY
935	965	CLYST, TAN, SFT; CLYST, LT GRN GY, SLTY; SILTST, CALC, HARD (POS DOL)
965	995	SLTST, LT GRN GY, CALC
995	1025	CLYST, LT GRN GY, TR SLTY
1025	1055	SS, LT GY, VF, SLTY, TR GLAU, CALC CMT (SWIFT)
1055	1085	LS, LT TAN, SPAR, THN LAM; LS, RED, ARG (AMSDEN) SPARRY CALCITE CHPS ARE MOST LIKELY FOSSILS
1085	1115	LS, RED-ORG, WHT, GY, ARG (RED CHP CTNGS) INTERLAMINATED/BEDDED LIMESTONE AND CLYSTONE. CLAYSTONE CHIPS SPARSELY REPRESENTED IN SAMPLES.
1115	1145	LS, LT TAN, SPAR, THN LAM; CLYST, RED-ORG
1145	1175	CLYST, RED; LS, LT TAN, WHT, GY, (RED CHP CTNGS)
1175	1205	LS, LT GY, TR ARG (LT RED CHP CTNGS)
1205	1235	LS, WHT, LT GY, TR ARG, SPAR; CLYST, RED, INTERLAM
1235	1265	LS, GY, LT GY SPAR; RR CLYST, RED (HEATH - MOST REASONABLE BASED ON SAMPLE COLOR)
1265	1295	LS, GY, LT GY SPAR; RR CLYST, RED
1295	1325	LS, GY, ARG; CLYST, RED, CALC
1325	1355	SH, DK GY, CALC, CARB, H2S ODOR IN HCL (ALT; LS, DK GY, CARB)
1355	1385	LS, GY, CARB, SLTY (H2S ODOR IN HCL)
1385	1415	SH, BLK
1415	1445	LS, GY, ARG
1445	1475	LS, LT GRN, ARG (OTTER)
1475	1505	CLYST, LT GRN, CALC
1505	1535	LS, LT GY GRN, ARG
1535	1565	CLYSTN, LT GRN, CALC
1565	1595	SH, GY, CALC
1595	1625	LS, GY, ARG
1625	1655	LS, GY, ARG, HD
1655	1685	ANHY, WHT; INTERLAM/INTERBED WITH LS, DK GY, ARG
1685	1715	CLYST, GY, SL CALC; DOL, GY, CALC; ANHY, WHT, SFT
1715	1745	LS, GY, ARG, TR ANHY
1745	1775	CLYST, GY, ARG, SLTY, CALC, ANHY
1775	1805	SLTST, GY BRN, ARG, CALC/DOL
1805	1835	SLTST, RED BRN, ARG, CALC
1835	1865	SLTST, RED BRN, ARG, ANHY
1865	1890	SLTST, RED BRN, ARG, CALC, ANHY; SH, GY, SFT
1890	1920	SH, OLV GRN; ANHY, WHT, SFT; SH, DK GY
1920	1955	SLTST, RED-BRN, CALC, DOL INTERLAM WITH ANHY, WHT, SFT; LS, DK GY, LAM, ARG
1955	1985	SLTST, RED BRN, CALC

1985	2015	LS, GY, ARG, LAM; CLYST, RED BRN, CALC
2015	2045	LS, WHT, BLKY AND TABLR CHPS (H2S ODOR IN HCL) (CHARLES)
2045	2075	LS, WHT; SH, GY, WHT MIC NODS
2075	2105	LS, TAN; LS, LT GY TO WHT
2105	2135	LS, TAN, FOS
2135	2165	LS, TAN, FOS
2165	2195	LS, TAN, FOS, HD; LS, WHT, SFT; SH, GY
2195	2225	LS, TAN, FOS, HD; LS, WHT, SFT, W/WHT RESID; SH, GY, CALC
2225	2235	LS, WHT, SFT; SH, GY, CALC; LS, TAN, FOS, HD
2235	2250	LOST CIRC. 2241' LS, WHT, TAN, DOL, TR ARG

MONTANA WELL LOG REPORT**Other Options**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

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Site Name: CENTRAL REGIONAL WATER AUTHORITY *CM
RWA-3
GWIC Id: 304761
Section 1: Well Owner(s)

1) CENTRAL REGIONAL WATER AUTHORITY (MAIL)
34 3RD AVE WEST
ROUNDUP MT 59072 [11/17/2019]

Section 2: Location

Township	Range	Section	Quarter Sections
12N	15E	34	NE¼ NW¼ SW¼
County			Geocode

JUDITH BASIN

Latitude	Longitude	Geomethod	Datum
46.757719	-109.82585	NAV-GPS	WGS84
Ground Surface Altitude	Ground Surface Method	Datum	Date
4629.49	DIGITALMAP	NAVD88	11/17/2019
Measuring Point Altitude	MP Method	Datum	Date Applies
4629.49	DIGITALMAP	NAVD88	7/2/2020 1:30:00 PM
Addition	Block	Lot	

Section 7: Well Test Data

Total Depth: 2163
Static Water Level: 205
Water Temperature:

Pump Test *

Depth pump set for test 890 feet.
1250 gpm pump rate with 39 feet of drawdown after 72 hours of pumping.
Time of recovery 0.92 hours.
Recovery water level 205 feet.
Pumping water level feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

PWL-246' ON PUMP TEST

Section 9: Well Log**Geologic Source**

330MDSN - MADISON GROUP OR LIMESTONE

From	To	Description
0	340	MUDDY SANDSTONE/THERMOPLIS SHALE. DARK GRAY SHALE. ARGILLACEOUS SANDSTONE OCCURS AT TOP OF INTERVAL TO A DEPTH OF APPROXIMATELY 80 FT.
115	1430	AMSDEN GP. CLEAN, LIGHT TAN LIMESTONE OCCURS IN THE TOP 100 FT OF INTERVAL. LOWER PART IS RED SILTSTONE AND INCLUDES DARK GRAY LIMESTONE NEAR BOTTOM.
340	780	KOOTENAI FM. UPPER PART OF FORMATION TO 700 FT CONSISTS OF INTERBEDDED SANDSTONE, SILTSTONE, CLAYSTONE, AND LIMESTONE
700	780	BASAL SANDSTONE FROM 700-780 FT IS 3RD CAT CREEK EQUIVALENT
780	1100	MORRISON FM. INTERBEDS OF SHALE, SANDSTONE, SILTSTONE, CLAYSTONE, AND LIMESTONE
1100	1185	SWIFT FM. PREDOMINANTLY CLEAN MEDIUM-GRAINED SANDSTONE WITH TRACE GLAUCONITE.
1430	1605	HEATH FM. DARK GRAY SHALE WITH OCCASIONAL LIMESTONE BEDS IN LOWER PART OF UNIT
1605	1965	OTTER FM. COMMON LIGHT GREEN CLAYSTONE, BUT ALSO INCLUDES BEDS OF LIMESTONE AND DARK GRAY SHALE. ANHYDRITE IS COMMON IN LOWER PART OF UNIT.
1965	2145	KIBBEY FM. MIXED LITHOLOGIES OF SANDSTONE, SILTSTONE, AND SHALE IN UPPER PART OF UNIT. LOWER PART OF UNIT IS REDDISH BROWN CLAYSTONE
2145	2850	CHARLES/MISSION CANYON FMS. PREDOMINANTLY LIGHT BROWN, TRANSLUCENT, PURE LIMESTONE WITH OCCURRENCES OF WHITE AND LIGHT PINK LIMESTONE. WATER ENTRY AT 2320-, 2400-, AND BELOW 2500-FT. DRILLING TERMINATED DUE TO PARTIAL CUTTING RETURNS AND CONCERN OF STUCK TOOL CONDITION.

Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

Section 4: Type of Work

Drilling Method: CAISSON RIG, MUD ROTARY, AND AIR ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Sunday, November 17, 2019

Section 6: Well Construction Details**Borehole dimensions**

From	To	Diameter
0	40	30
8.75	2165	2850
40	1000	17.5
1000	2165	12.25

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-1	40	20	0.375		THREADED	STEEL
-1	1000	14	0.35		WELDED	STEEL
947	2163	9.625	0.35		WELDED	STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
2163	2850	9.625			OPEN HOLE

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
525	525	CEMENT SEAL	
947	947	LINER HANGER PACKER	

1550	1550	CEMENT SEAL	
------	------	-------------	--

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company:
License No: -
Date Completed: 11/17/2019

MONTANA WELL LOG REPORT

Form No. 603 R2-04

Well ID# CMRWA Well #4

This log reports the activities of a licensed Montana well driller and serves as the official record of work done within the borehole and casing and describes the amount of water encountered. **This form is to be completed by the driller and filed with MBMG within 60 days of completion of the work.** Acquiring Water Rights is the well owner's responsibility and is not accomplished by the filing of this report.

Well log information is stored in the Groundwater Information Center at the Montana Bureau of Mines and Geology (Butte) and water right information is stored in the Water Rights Bureau records (Helena).

For fields that are not applicable, enter NA. Record additional information in the REMARKS section.

[illegible]

MONTANA WELL LOG REPORT

Form No. 603 R2-04

Well ID# CMRWA Well #5

This log reports the activities of a licensed Montana well driller and serves as the official record of work done within the borehole and casing and describes the amount of water encountered. **This form is to be completed by the driller and filed with MBMG within 60 days of completion of the work.** **Acquiring Water Rights is the well owner's responsibility and is not accomplished by the filing of this report.**

Well log information is stored in the Groundwater Information Center at the Montana Bureau of Mines and Geology (Butte) and water right information is stored in the Water Rights Bureau records (Helena).

For fields that are not applicable, enter NA. Record additional information in the REMARKS section.

1. WELL OWNER:

Name Central Montana Regional Water Authority

Mailing address PO Box 660

Roundup, MT 59072

2. WELL LOCATION:

List ¼ from smallest to largest
SE ¼ SE ¼ SW ¼ ¼, Section 29

Township 14 N N/S Range 15 E E/W County Judith Basin

Lot _____, Tract/Blk _____ Subdivision Name _____

Certificate of Survey _____

Well Address _____

GPS ☐ Yes ☐ No

Latitude 46.765639 N Longitude 109.823958 W

Error as reported by GPS locator (± feet) _____

Horizontal datum ☒ NAD27 ☐ WGS84

3. PROPOSED USE:

☐ Domestic ☐ Stock ☐ Irrigation

☒ Public water supply ☐ Monitoring Well

☐ Geothermal ☐ Closed System ☐ Open System ☐ Reinjection

☐ Extraction H₂O Temp _____ Number of Wells in System _____

☐ Other: _____

4. TYPE OF WORK:

☒ New well ☐ Deepen existing well ☐ Abandon existing well

Method: ☐ Cable ☐ Rotary ☐ Other: _____

5. WELL CONSTRUCTION DETAILS:

Borehole:

Dia. Nominal 17.5 in. from 0 ft. to 1000 ft.

Dia. Nominal 12.25 in. from 1000 ft. to 2300 ft.

Dia. Nominal 8.75 in. from 2300 ft. to 2997 ft.

Casing:

Steel: Wall thickness _____ ☐ Threaded ☐ Welded

Dia. ID 14 in. from +2 ft. to 1000 ft.

Dia. OD 9.625 in. from 941 ft. to 2300 ft.

Casing Shoe: ☐ Yes ☐ No

Plastic: Pressure Rating _____ lbs. ☐ Threaded ☐ Welded

Dia. _____ in. from _____ ft. to _____ ft.

Perforations/Slotted Pipe:

Type of perforator used _____

Size of perforations/slots _____ in. by _____ in.

_____no. of perforations/slots from _____ ft. to _____ ft.

_____no. of perforations/slots from _____ ft. to _____ ft.

Screens:

☐ Yes ☒ No

Material _____

Dia. _____ Slot size _____ from _____ ft. to _____ ft.

Dia. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel Packed:

☐ Yes ☒ No

Size of gravel _____

Gravel placed from _____ ft. to _____ ft.

Packer:

☒ Yes ☐ No

Type L/W Hangar Depth(s) 924 -935 ft

Grout:

Material used Neat Cement

Depth from 0 ft. to 2300 ft. OR ☐ Continuous feed

6. WELL TEST DATA:

A well test is required for all wells. (See details on well log report cover.)

☒ Static water level 171 ft. below top of casing or

☐ Closed-in artesian pressure _____ psi.

How was test flow measured:
bucket/stopwatch, weir, flume, flowmeter, etc Flowmeter

Yellowstone Controlled Groundwater Area - Water Temperature _____ °F

☐ AQUIFER TEST DATA FORM ATTACHED

Test - 1 hour minimum

Drawdown is the amount water level is lowered below static level.

All depth measurements shall be from the top of the well casing.

Time of recovery is hours/minutes since pumping stopped.

Air test*

_____ gpm with drill stem set at _____ ft. for _____ hours

Time of recovery _____ hrs/min. Recovery water level _____ ft.

OR Bailer test*

_____ gpm with _____ ft. of drawdown after _____ hours

Time of recovery _____ hrs/min. Recovery water level _____ ft.

OR Pump test*

Depth pump set for test 629 ft.

1400gpm pump rate with 238 ft. of drawdown after 72 hrs pumping

Time of recovery 70min hrs/min. Recovery water level 169 ft.

OR Flowing Artesian*

_____ gpm for _____ hours

Flow controlled by _____

**During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

7. WELL LOG:

Record depth(s) that water is encountered.

Depth, Feet		Material: color/rock and type/descriptor (example: blue/shale/hard, or brown/gravel/water, or brown/sand/heaving)
From	To	
<u>0</u>	<u>500</u>	<u>Gray and blk shale (Thermopolis)</u>
<u>500</u>	<u>940</u>	<u>Sandstone, red shale, limestone (Kootenai)</u>
<u>940</u>	<u>1220</u>	<u>Shale, sandstone, limestone (Morrison)</u>
<u>1220</u>	<u>1370</u>	<u>Sandstone and blk shale (Swift)</u>
<u>1370</u>	<u>1500</u>	<u>Limestone, sandstone, red shales (Amsden)</u>
<u>1500</u>	<u>1690</u>	<u>Limestone, red/blk/grn shales (Heath)</u>
<u>1690</u>	<u>2090</u>	<u>Grn/gray claystone, anhydrite limestone (Otter)</u>
<u>2090</u>	<u>2270</u>	<u>Red/gray siltstone, blk shale, anhydrite (Kibbey)</u>
<u>2270</u>	<u>3000</u>	<u>Lt gray limestone and anhydrite (Mission Cnyn)</u>

☐ ADDITIONAL SHEETS ATTACHED

8. DATE WELL COMPLETED:

9/13/2024

9. REMARKS:

Well completed open-hole into the Madison Limestone.

10. DRILLER/CONTRACTOR'S CERTIFICATION:

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name, firm, or corporation (print) _____

Address _____

Signature _____

Date _____ License no. _____

License type: ☐ MWC ☐ WWC ☐ WWD

Montana Bureau of Mines & Geology
The University of Montana
1300 West Park Street
Butte, MT 59701

MONTANA WELL LOG REPORT**Other Options**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

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Site Name: CENTRAL MONTANA REGIONAL WATER**AUTHORITY****GWIC Id: 289648**

MW-1

Section 1: Well Owner(s)

1) CENTRAL MONTANA REGIONAL WATER AUTHORITY (MAIL)
 34 3RD AVE. W
 ROUNDUP MT 59072 [05/21/2016]

Section 2: Location

Township	Range	Section	Quarter Sections	Geocode
12N	15E	34	SE¼ SE¼ SW¼ SW¼	
County				

JUDITH BASIN

Latitude	Longitude	Geomethod	Datum
46.751719	-109.824481	MAP	WGS84
Ground Surface Altitude	Ground Surface Method	Datum	Date
4698.11	DIGITALMAP	NAVD88	3/17/2023
Measuring Point Altitude	MP Method	Datum	Date Applies
4698.11	DIGITALMAP	NAVD88	9/20/2016 7:00:00 PM
Addition	Block	Lot	

Section 3: Proposed Use of Water

MONITORING (1)

TEST WELL (2)

Section 4: Type of Work

Drilling Method: ROTARY

Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Saturday, May 21, 2016

Section 6: Well Construction Details**Borehole dimensions**

From	To	Diameter
0	40	12.3
40	615	7.9
615	712	3.9

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-3	615	4.5	0.237		THREAD AND COLLAR	A53A STEEL
0	40	8.6	0.25		WELDED	A53A STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
587	712	2.5		.020	SCREEN-CONTINUOUS-STAINLESS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	40	CEMENT	
0	615	CEMENT	

Section 7: Well Test Data

Total Depth: 712

Static Water Level: -1.1

Water Temperature:

Air Test *25 gpm with drill stem set at 560 feet for 8 hours.Time of recovery hours.Recovery water level feet.Pumping water level feet.**Pump Test ***Depth pump set for test 300 feet.16 gpm pump rate with 71 feet of drawdown after 5 hours of pumping.Time of recovery 20 hours.Recovery water level -1 feet.Pumping water level feet.

* During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.

Section 8: Remarks**Section 9: Well Log****Geologic Source**

Unassigned

From	To	Description
0	5	BROWN CLAY WITH BROKEN TAN CLAYSTONE
5	11	CLAYSTONE, TAN, FRACTURED
11	36	CLAYSTONE, OLIVE
36	260	SHALE AND CLAYSTONE, DARK GRAY
260	325	SHALE AND CLAYSTONE, REDDISH BROWN
325	362	SANDSTONE, FINE, BROWNISH GRAY, ARGILLACEOUS
362	418	SHALE AND CLAYSTONE, LIGHT GRAY TO REDDISH BROWN, SILTY
418	504	SILTSTONE, REDDISH GRAY, ARGILLACEOUS, SANDY
504	610	SANDSTONE, FINE, REDDISH GRAY, ARGILLACEOUS, SILTY
610	710	SANDSTONE, FINE, GRAY (SALT & PEPPER)
710	712	BLACK SHALE OR COAL

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: TYREL HLAVNICKA
Company: AQUASOURCE
License No: WWC-199

MONTANA WELL LOG REPORT**Other Options**

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

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Site Name: TOWN OF JUDITH GAP * WELL #4
GWIC Id: 132756

Section 1: Well Owner(s)

1) TOWN OF JUDITH GAP (MAIL)
 N/A
 JUDITH GAP MT 59453 [03/07/1986]

Section 2: Location

Township	Range	Section	Quarter Sections	Geocode
11N	15E	13	NW¼ SE¼ SE¼	
JUDITH BASIN				
Latitude	Longitude	Geomethod	Datum	
46.714447	-109.771655	DIGITALMAP	NAD83	
Ground Surface Altitude	Ground Surface Method	Datum	Date	
4602.96	UNKNOWN	NAVD88	4/3/2023	
Measuring Point Altitude	MP Method	Datum	Date Applies	
4602.96	UNKNOWN	NAVD88	9/28/2016 11:30:00 AM	
Addition	Block	Lot		

Section 3: Proposed Use of Water

PUBLIC WATER SUPPLY (1)

Section 4: Type of Work

Drilling Method: AIR ROTARY
 Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Friday, March 7, 1986

Section 6: Well Construction Details**Borehole dimensions**

From	To	Diameter
0	220	12

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	220	12	0.375			STEEL
0	372	8	0.322			STEEL
365	405	6	0.25			STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
405	445	6			SCREEN-CONTINUOUS-STEEL

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	0	CEMENT	
0	0	NEOPRENE PACKER	

Section 7: Well Test Data

Total Depth: 445
 Static Water Level: 0
 Closed-in Pressure: 12 psi
 Water Temperature:

Pump Test *

Depth pump set for test _ feet.
 200 gpm pump rate with _ feet of drawdown after 24 hours of pumping.
 Time of recovery _ hours.
 Recovery water level _ feet.
 Pumping water level 78 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks**Section 9: Well Log****Geologic Source**

217KOTN - KOOTENAI FORMATION

From	To	Description
0	15	WEATHERED SANDSTONE
15	19	SANDY SHALE (REDDISH)
19	30	WEATHERED GRAY-GREEN SHALE
30	38	RED-GRAY WEATHERED SHALE
38	43	GRAY-BLUE SHALE
43	54	GRAY SHALE
54	60	RED SHALE
60	65	RED SANDSTONE
65	90	GRAY-GREEN SHALE
90	100	GRAY SANDSTONE
100	101	RED SANDSTONE
101	112	GRAY SANDSTONE
112	123	RED SHALE
123	127	GREEN SANDSTONE
127	129	RED SHALE

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: HERBERT A. POTTS
Company: POTTS DRILLING INC
License No: WWC-150
Date Completed: 3/7/1986

Site Name: TOWN OF JUDITH GAP**GWIC Id: 132756****Additional Lithology Records**

From	To	Description
129	133	GREEN SHALE
133	138	RED SHALE
138	146	GREEN-GRAY SHALE
146	150	MIXED RED AND GRAY SHALES
150	160	GRAY CLAYSTONE
160	170	GRAY SHALE- HARD
170	180	RED-GRAY SHALE
180	196	GREY-GREEN SHALE
196	199	RED-GRAY SHALE
199	200	GREEN SHALE
200	223	RED SHALE
223	235	BLUE-GRAY SHALE
235	253	GRAY SANDSTONE
253	261	RED SILTSTONE
261	298	GRAY SANDSTONE
298	301	DARK GRAY SANDSTONE
301	309	LIMESTONE
309	322	GRAY SANDSTONE
322	327	RED SHALE
327	347	GRAY SANDSTONE
347	364	BLUE SHALE
364	376	HARD FINE-GRAINED GRAY SHALE
376	385	GRAY SANDSTONE
385	387	REDDISH-GRAY SANDSTONE- HARD
387	392	GRAY SANDSTONE- HARD
392	405	RED SHALE
405	412	DARK RED SANDSTONE-INTERBLENDED W/BLACK & WHITE SECTIONS (GLASSIFIED)
412	445	FRACTURED DARK RED- WHITE & BLACK SANDSTONE

Other Options

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Section 7: Well Test Data

Total Depth: 120
Static Water Level: 25
Water Temperature:

Air Test *

60 gpm with drill stem set at 100 feet for 2 hours.
Time of recovery 0.17 hours.
Recovery water level 25 feet.
Pumping water level feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

217KOTN - KOOTENAI FORMATION

[illegible]

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: MARK A. SMITH
Company: CENTRAL DRILLING INC
License No: WWC-581
Date Completed: 11/20/2002

Borehole dimensions

Casing

Completion (Perf/Screen)

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	18	CEMENT	
55	55	RUBBER PACKER	

Appendix A CMRWA Well and LTM Network Summary

Well	GWIC ID	DATE COMPLETED	PURPOSE	AQUIFER	YIELD (gpm)	DEPTH (ft bgs)	COORDINATES LAT/LON	ELEVATION (toc AMSL)	SWL*	
									(ft TOC)	Elev (amsl)
Well CMRWA 1	257040	2005	Monitoring	Madison	NA	3700	46.97N/110.09W	4583	363	4220
Well CMRWA 2	269957	2012	Production	Madison	550	2250	46.75N/109.83W	4704	300	4404
Well CMRWA 3	304761	2019	Production	Madison	1280	2850	46.76N/109.83W	4633	231	4402
Well CMRWA 4	TBD	2024	Production	Madison	1400	3000	46.77N/109.84W	4565	172	4393
Well CMRWA 5	TBD	2024	Production	Madison	1400	3000	26.77N/109.82W	4563	161	4402
Well CMRWA MW-1	289648	2016	Monitoring	Kootenai	NA	712	46.75N/109.83W	4706	artesian	artesian
JUDITH GAP (MAUWS) Well #4	132756	2018	Monitoring	Kootenai	NA	445	46.71N/109.77W	4606	artesian	artesian
NICHOLSON RANCH Well	204169	2002	Monitoring	Kootenai	NA	120	46.84N/110.05W	5006	24	4982
Big Spring			Monitoring	Madison		NA	47.00N/109.34W	4184	NA	NA
MDOT Judith Gap RWIS			Monitoring		NA	NA	46.69N/109.75W		NA	NA
Crystal Lake SNOTEL Station			Monitoring		NA	NA	76.78N/109.52W	6130	NA	NA

* Measured August 28,2024