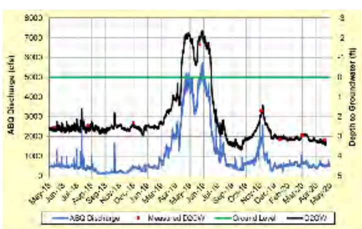

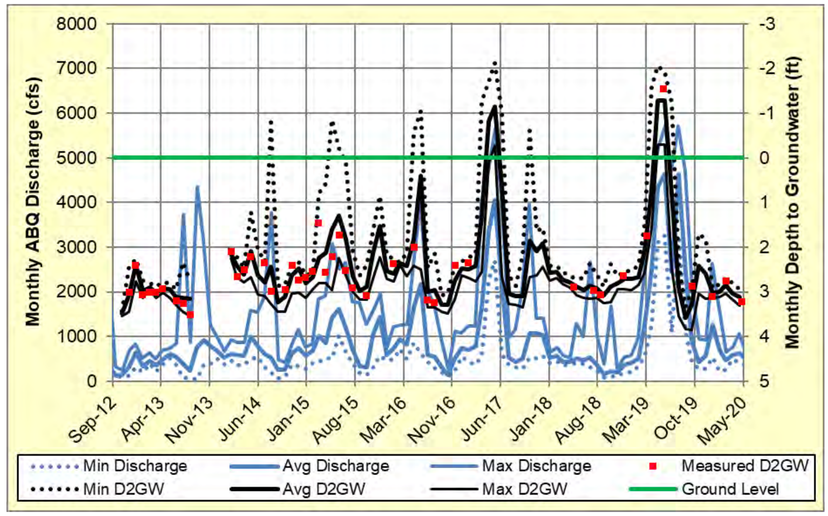

GSA GeoSystems Analysis, Inc.
Innovations and Solutions

Middle Rio Grande Riparian Groundwater Monitoring June 2019 - May 2020

Prepared for:
US Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza, NE
Albuquerque, NM 87109

Prepared by:
GeoSystems Analysis, Inc.
6300 Riverside Plaza NW
Ste 100 | PMB 1019
Albuquerque, NM 87120

Middle Rio Grande

Riparian Groundwater Monitoring

June 2019 – May 2020

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Name	**Affiliation**	**Project Role**
Todd Caplan	GeoSystems Analysis	Project Manager
Lindsey Bunting	GeoSystems Analysis	Database Manager
William Widener	GeoSystems Analysis	Field Data Collection
Chad McKenna	GeoSystems Analysis	GIS

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EXECUTIVE SUMMARY

The Albuquerque District of the U.S. Army Corps of Engineers (USACE) has invested considerable resources over the past two decades in improving habitat along the Albuquerque Reach of the Middle Rio Grande (MRG). This work has included improving the surface and groundwater connection between the river and floodplain to support diverse riparian-wetland habitats and the species that rely on them for meeting life-cycle requirements. Part of the USACE's focus has involved designing and implementing a long-term monitoring program focused on tracking alluvial groundwater conditions across the MRG bosque, particularly across the Albuquerque Reach where various habitat restoration efforts have been implemented.

GeoSystems Analysis, Inc. (GSA) has been under contract by the USACE since 2012 to manage the groundwater monitoring network established by the USACE in 2009. Monitoring reports have been developed annually or bi-annually since 2012 to summarize monitoring results and provide updates regarding the groundwater monitoring network. Network management has involved installing and instrumenting new monitoring wells, conducting monthly monitoring of all uninstrumented wells, quarterly monitoring of instrumented wells, maintaining and calibrating pressure transducers (PTs), and performing annual database management and reporting.

All riparian groundwater monitoring wells addressed in this and all previous reports are located within the Albuquerque reach of the MRG bosque from the Interstate 25 (I-25) Bridge crossing near Isleta Pueblo extending approximately 22-miles upstream to the northern boundary of the Village of Corrales. This current report provides groundwater monitoring methods and results for the June 1, 2019 through May 18, 2020 monitoring period. Automated monitoring data from the uncontracted February 2017 – May 2018 period is included in monthly summary figures, where available. Recommendations are also provided for ways to improve and/or apply the information from the monitoring program.

It is apparent from the monitoring results that alluvial groundwater levels in the Rio Grande bosque respond to changes in river discharge (elevation) rates and extended duration during the snowmelt runoff of 2019 (through mid-July). Based upon the magnitude of the change in groundwater level relative to an associated change in the river discharge, some wells are more hydrologically connected to the river than other wells. Wells located on elevated floodplain terraces are not as connected to surface water inputs from pulse flows or overbank flooding. Conversely, wells located within constructed habitat features such as willow swales or bankline terraces have shallow groundwater (typically less than 3 feet below

ground surface), which fluctuates greatly in response to changes in river discharge. Sustained river discharges of greater than 3,000 cfs starting April 23, 2019 and continuing through July 17, 2019 was sufficient to elevate groundwater above the ground surface in many constructed (excavated) habitat features (EHFs) that did not experience flooding in previous years despite similar discharge levels (e.g., 4c swale, GSA 2017, GSA 2019). The elevated groundwater levels in 2019 were likely due to the sustained snowmelt discharge and associated floodplain soil saturation compared to the similar magnitude, but abbreviated duration flood pulse in 2017 (GSA 2018). Recommendations include continuing to conduct PT calibrations as needed, re-surveying well casing heights following large and prolonged flood pulses, adjusting hang lengths to assure data is obtained when groundwater levels are at their deepest, and utilizing groundwater elevation data to calibrate/validate reach-wide riparian groundwater models and to support habitat restoration planning and management.

1.0 INTRODUCTION

In 2009, the US Army Corps of Engineers (USACE) developed a riparian groundwater database to store and process groundwater monitoring data collected from a number of shallow wells installed within the Middle Rio Grande (MRG) bosque. These wells are distributed from the I-25 Bridge in the south valley upstream to the northern boundary of the Village of Corrales. Data from some of these wells date back to 2004 when the USACE was implementing the Bosque Wildfire Program. Since the formal groundwater monitoring program began in 2009, a total of 63 wells have been installed throughout this approximately 22-mile segment of the Albuquerque Reach. Eleven wells have since been decommissioned for various reasons, mostly because the groundwater table has dropped below the well screens (of PVC wells) or because of semi-permanent flooding (e.g. Oxbow). This report summarizes data collected from the 64 wells monitored during the annual contract period from June 2019 through May 2020.

All wells installed after 2012 were placed within or directly adjacent to **excavated habitat features (EHF)** associated with Phase 1 and Phase 2 of the USACE's MRG Restoration Program. This includes fourteen wells installed in February 2016 to provide spatially comprehensive groundwater data for a USACE-GSA willow research study, and eight wells installed in September 2015 in newly constructed restoration features associated with Phase 2 restoration work. All EHF's were designed to have a maximum depth to groundwater of no greater than 3 feet below ground surface (bgs). A maximum groundwater depth of 3 feet was recommended because research performed for the Albuquerque District of USACE (Caplan et al, 2013) indicated that willows planted in floodplains with similar shallow groundwater conditions can promote dense canopy cover and tall stem heights considered desirable for nesting neotropical bird species, including the federally endangered Southwestern willow flycatcher. These EHFs include swales and bankline terraces designed to be inundated via Rio Grande surface water flooding and/or rising groundwater levels during moderate discharge levels (± 2,500 cubic feet per second [cfs]).

Wells installed prior to 2012 were placed on **elevated floodplain terraces (EFT)**, with the exception of the well at Oxbow, which was directly adjacent to a large backwater area that is frequently inundated by water delivered by an irrigation drain outfall. Because of long term inundation, the Oxbow well was not monitored during the annual monitoring period.

Manual groundwater monitoring was conducted monthly for the 34 un-instrumented wells and quarterly for the 30 wells instrumented with datalogging pressure transducers (PTs) between June 2019 and May 2020. These numbers reflect removal of non-functioning PTs from six previously instrumented wells (1A South Terrace, 1E South, Rt 66 Outlet, 5A North, 5B South, and 5C North). These non-functioning PTs were removed at the beginning of or during the annual monitoring period.

Automated data were downloaded quarterly from all instrumented wells and incorporated into the MRG groundwater database. Although the annual monitoring period began in June 2019, instantaneous (30 minute) automated data through the end of the previous annual monitoring period (June 2018 through May 2019) is included in this annual report, where available. Table 1 summarizes the number of sites currently monitored and what is monitored at each location. Information including the installation date, location, and instrumentation type is provided in Table 2. Figure 1 shows the well locations.

Table 1. Summary of monitoring well types and activities.

Monitoring Type	Geomorphic Feature	Number of Monitoring Sites	Instrumentation	Contracted Activity
Instrumented Well	EHF	30	In-Situ Rugged Troll groundwater PTs	• Quarterly groundwater depth measurement • Quarterly datalogger download • Input into database • Monitor hang lengths and casing height changes
Barometric Pressure	EFT	1	In-Situ Rugged Baro Troll barometric PT	• Quarterly datalogger download • Input into database
Un-Instrumented Well	EHF	14	None	• Monthly groundwater depth measurement • Input into database • Monitor casing height changes
	EFT	20		

Table 2. Groundwater monitoring well information, with coordinates in NAD83, Zone 13.

Database ID	Well ID[1]	Geomorphic Feature (EHF or EFT)[2]	Willow Study Well?	Associated River Gage[3]	Pipe[4]	Easting	Northing	Install Date	Installed by[5]	Instrumented June 2019 – May 2020?	Instrument Type (if current)
1	I-25 E[1]	EFT	No	ABQ	S	346,622	3,868,761	4/19/2005	USACE	No	Manual
2	Brown Burn West[1]	EFT	No	ABQ	S	345,749	3,872,221	12/30/2005	USACE	No	Manual
3	Brown Burn East[1]	EFT	No	ABQ	S	346,079	3,872,327	4/19/2005	USACE	No	Manual
4	Bridge Ave SW	EFT	No	ABQ	S	348,585	3,881,787	12/30/2005	AOS	No	Manual
6	RGNC Baro West (Barologger)	EFT	No	ABQ	P	346,124	3,888,425	Unknown	UNM	Yes	Solinst Barologger/In-Situ Rugged Baro Troll
8	Montano SW	EFT	No	ABQ	P	346,931	3,890,449	12/2/2005	UNM	No	Manual
9	La Orilla	EFT	No	ABQ	P	347,663	3,892,229	12/30/2005	AOS	No	Manual
10	Alameda NE	EFT	No	Alameda	S	350,733	3,896,327	1/3/2006	AOS	No	Manual
11	Corrales North	EFT	No	Alameda	S	350,648	3,896,822	1/3/2006	USACE	No	Manual
13	Corrales Dixon Rd	EFT	No	Alameda	S	354,561	3,899,282	Unknown	USACE	No	Manual
15	Corrales Harvey Jones	EFT	No	Alameda	S	354,618	3,903,613	4/29/2009	USACE	No	Manual
25	Central SW - New	EFT	No	ABQ	S	346,717	3,884,088	6/1/2009	AOS	No	Manual
26	Central NE	EFT	No	ABQ	S	346,318	3,884,779	2/14/2006	AOS	No	Manual
30	Corrales South	EFT	No	Alameda	S	350,425	3,896,406	9/11/2009	USACE	No	Manual
32	RGNC N	EFT	No	ABQ	S	346,566	3,889,224	9/11/2009	USACE	No	Manual
33	RGNC M	EFT	No	ABQ	S	346,424	3,888,989	9/11/2009	USACE	No	Manual
34	RGNC S	EFT	No	ABQ	S	346,239	3,888,792	9/11/2009	USACE	No	Manual
36	I-40 M	EFT	No	ABQ	P	346,050	3,887,269	9/11/2009	USACE	No	Manual
37	I-40 S	EFT	No	ABQ	P	345,992	3,886,680	9/11/2009	USACE	No	Manual
40	Rio Bravo	EFT	No	ABQ	P	348,856	3,880,331	9/11/2009	AOS	No	Manual
41	Zoo Burn	EFT	No	ABQ	P	348,163	3,882,791	9/11/2009	AOS	No	Manual
43	4B Bankline	EHF	No	ABQ	S	347,451	3,876,895	4/30/2012	GSA	No	Solinst New

Database ID	Well ID[1]	Geomorphic Feature (EHF or EFT)[2]	Willow Study Well?	Associated River Gage[3]	Pipe[4]	Easting	Northing	Install Date	Installed by[5]	Instrumented June 2019 – May 2020?	Instrument Type (if current)
44	4B	EHF	No	ABQ	S	347,486	3,876,829	4/30/2012	GSA	Yes	Solinst New/ In-Situ
45	4C North[1]	EHF	Yes	ABQ	S	347,415	3,875,764	5/2/2012	GSA	Yes	Solinst New/ In-Situ
46	4C South[1]	EHF	Yes	ABQ	S	347,247	3,875,598	5/2/2012	GSA	Yes	Solinst New
64	4C Bankline[1]	EHF	Yes	ABQ	S	347,232	3,875,730	5/2/2012	GSA	No	Manual
48	5C South[1]	EHF	Yes	ABQ	S	345,985	3,872,029	5/2/2012	GSA	No	Manual
49	5C Bankline[1]	EHF	Yes	ABQ	S	345,849	3,871,811	6/20/2012	GSA	No	Manual
50	5C North[1,6]	EHF	Yes	ABQ	S	346,503	3,875,180	5/2/2012	GSA	No	Manual
51	5C1	EHF	Yes	ABQ	S	346,267	3,868,598	6/20/2012	GSA	No	Manual
52	5D[1]	EHF	Yes	ABQ	S	346,224	3,869,125	6/20/2012	GSA	No	Manual
53	5A South[1]	EHF	Yes	ABQ	S	346,076	3,874,760	5/1/2012	GSA	No	Manual
54	5A North[1,6]	EHF	Yes	ABQ	S	346,503	3,875,180	5/4/2012	GSA	No	Manual
56	1G[1]	EHF	No	Alameda	S	350,627	3,896,715	6/20/2012	GSA	No	Manual
57	1E South[1,6]	EHF	No	Alameda	S	351,110	3,897,097	6/20/2012	GSA	Yes	Solinst New
58	1E Bankline[1]	EHF	No	Alameda	S	351,591	3,897,145	6/20/2012	GSA	No	Manual
59	5B North[1]	EHF	Yes	ABQ	S	346,252	3,874,544	4/30/2012	GSA	Yes	In-Situ
60	5B South[1,6]	EHF	Yes	ABQ	S	346,146	3,873,866	4/30/2012	GSA	Yes	In-Situ
61	5B Bankline[1]	EHF	Yes	ABQ	S	346,206	3,874,541	5/4/2012	GSA	No	Manual
62	1E North[1]	EHF	No	Alameda	S	351,186	3,897,099	6/20/2012	GSA	No	Manual
70	Rt 66 Inlet	EHF	No	ABQ	S	346,824	3,884,114	4/1/2014	GSA	Yes	In-Situ
71	Rt 66 Outlet[6]	EHF	No	ABQ	S	347,032	3,883,778	4/1/2014	GSA	No	In-Situ
73	4A New	EHF	No	ABQ	S	347,929	3,883,124	5/1/2014	GSA	Yes	In-Situ
72	Oxbow 2	EHF	No	ABQ	P	346,057	3,889,298	3/25/2014	GSA	Yes	In-Situ
74	1A N Terrace[1]	EHF	No	Alameda	S	355,163	3,902,107	9/23/2015	GSA	Yes	In-Situ
75	1A S Backwater[1]	EHF	No	Alameda	S	355,181	3,902,047	9/23/2015	GSA	Yes	In-Situ

Database ID	Well ID[1]	Geomorphic Feature (EHF or EFT)[2]	Willow Study Well?	Associated River Gage[3]	Pipe[4]	Easting	Northing	Install Date	Installed by[5]	Instrumented June 2019 – May 2020?	Instrument Type (if current)
76	1A S Terrace[1,6]	EHF	No	Alameda	S	355,243	3,901,810	9/23/2015	GSA	Yes	In-Situ
77	1C Swale[1]	EHF	No	Alameda	S	352,541	3,897,660	9/23/2015	GSA	Yes	In-Situ
78	1H Terrace[1]	EHF	No	Alameda	S	351,608	3,896,937	9/23/2015	GSA	Yes	In-Situ
79	1F Swale[1]	EHF	No	Alameda	S	352,253	3,897,152	9/23/2015	GSA	Yes	In-Situ
81	Oxbow N Scallop	EHF	No	ABQ	S	346,272	3,889,448	10/12/2015	GSA	Yes	In-Situ
82	5E1[1]	EHF	Yes	ABQ	S	346,366	3,868,712	2/24/2016	GSA	Yes	In-Situ
83	5E2[1]	EHF	Yes	ABQ	S	346,378	3,868,576	2/24/2016	GSA	Yes	In-Situ
84	5E3[1]	EHF	Yes	ABQ	S	346,230	3,868,531	2/24/2016	GSA	Yes	In-Situ
85	4C1[1]	EHF	Yes	ABQ	S	347,372	3,875,639	2/26/2016	GSA	Yes	In-Situ
86	5A1[1]	EHF	Yes	ABQ	S	346,127	3,874,815	2/24/2016	GSA	Yes	In-Situ
87	5A2[1]	EHF	Yes	ABQ	S	346,036	3,874,700	2/24/2016	GSA	Yes	In-Situ
88	5A3[1]	EHF	Yes	ABQ	S	346,015	3,874,780	2/26/2016	GSA	Yes	In-Situ
89	5B1[1]	EHF	Yes	ABQ	S	346,218	3,874,405	2/26/2016	GSA	Yes	In-Situ
90	5C1[1]	EHF	Yes	ABQ	S	346,047	3,872,066	2/26/2016	GSA	Yes	In-Situ
91	5C2[1]	EHF	Yes	ABQ	S	345,965	3,872,063	2/26/2016	GSA	Yes	In-Situ
92	5C3[1]	EHF	Yes	ABQ	S	345,966	3,871,988	2/26/2016	GSA	Yes	In-Situ
93	5D1[1]	EHF	Yes	ABQ	S	346,153	3,869,367	2/24/2016	GSA	Yes	In-Situ
94	5D2[1]	EHF	Yes	ABQ	S	346,344	3,868,884	2/24/2016	GSA	Yes	In-Situ
95	5D3[1]	EHF	Yes	ABQ	S	346,234	3,868,881	2/24/2016	GSA	Yes	In-Situ

[1]Well ground surface elevation surveyed in
[2] EHF = Excavated Habitat Feature, EFT = Elevated Floodplain Terrace
[3]ABQ is USGS gage 08330000, Alameda is USGS gage 08329918
[4]Pipe column refers to the material used to construct well. All wells are constructed with either 2-inch diameter PVC (P) or 2-inch diameter galvanized steel and a stainless steel drive point (S).
[5]Wells installed by either Corps of Engineers (USACE), University of New Mexico (UNM), City of Albuquerque Open Space (AOS), or GeoSystems Analysis, Inc (GSA).
[6] Datalogger retired at beginning of or during annual monitoring period due to malfunction or failure.

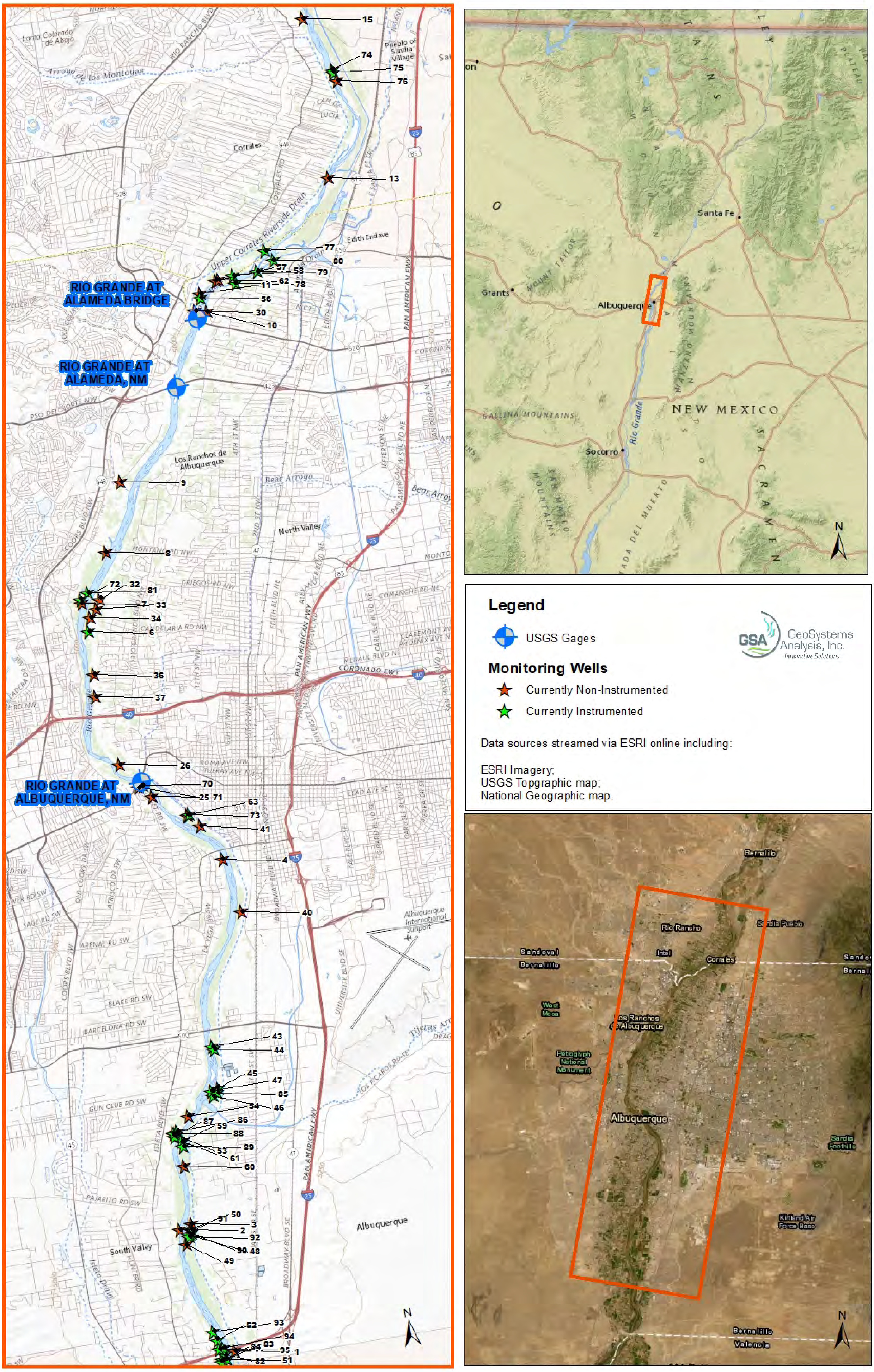

Figure 1. Location of monitored groundwater wells.

2.0 METHODS

Sixty-four shallow groundwater piezometers were monitored between June 2019 and May 2020. All wells were installed between 2004 and 2016 by the Corps of Engineers (USACE), University of New Mexico (UNM), the City of Albuquerque Open Space Division (AOS), or GeoSystems Analysis (GSA). Geographic coordinates (UTM, NAD83, Zone 13) and other well specifications are listed in Table 2. Data pre-processing and database import procedures are provided in Appendix B. Instructions for calibrating datalogging PTs are provided in Appendix C.

Prior to GSA's involvement with the MRG groundwater monitoring network, a total of 30 groundwater monitoring wells were installed within the bosque, some of which date as far back as 2004. Between 2006 and 2009, eleven of these wells were instrumented with Solinst Levelogger Model 3001 PTs, which measure and record water depth and temperature. In addition, the Rio Grande Nature Center West well was instrumented with a Solinst Barologger, which measures and records barometric pressure and air temperature. Data from the barometric PT are used to correct data from all groundwater monitoring PTs associated with this monitoring program. Between April and June of 2012, 20 more wells were installed by GeoSystems Analysis (GSA). In October 2012, fifteen of these wells were instrumented with the latest Solinst Leveloggers (Levelogger Junior Edge Model 3001). These newer generation dataloggers require alternative data processing methods as compared to older model Solinst dataloggers due to manufacturer changes to datalogger functions (GSA 2013). Over the course of the 2014-2015 monitoring period, all older generation Solinst Leveloggers suffered various malfunction errors and were subsequently removed from host wells. Because all older generation Solinst dataloggers were retired, the groundwater database was modified in September 2016 to utilize absolute pressure data inputs, update relevant queries, and include data summaries for groundwater elevation. PTs failed at six wells during the current annual monitoring period; none were replaced and wells were manually monitored instead.

2.1 Groundwater Well Installation and Instrumentation

During and immediately preceding the annual monitoring period, no wells were installed and instrumented. Eight wells were installed in Phase 2 restoration features in September 2015, and fourteen wells were installed in monitored swales in February 2016 as part of the USACE-GSA willow research study (GSA 2016b). Wells installed in 2012 and later were installed in EHFs, consisting of willow swales or bankline terraces constructed as part of the USACE MRG Restoration Project. Details on the well installation and instrumentation in late 2012 are provided in GSA 2013, and for wells installed in 2014 in GSA 2016a. All wells installed since 2012 were constructed from 2-inch diameter galvanized steel pipe and 2-inch stainless steel drive-points purchased from Rodgers and Company in Albuquerque, NM. The galvanized pipe was ordered pre-cut into four-foot segments and threaded on both ends. The stainless-steel drive point came in four-foot lengths and had a slot width of 0.12 mm.

All new wells were constructed at installation sites and were installed when the river was relatively low (i.e., less than approximately 600 cfs). Pipe material was carried to the install sites and was assembled in the field using two-inch galvanized steel couplers tightened by hand using pipe wrenches. At each installation location holes were hand augured approximately 3 feet to the water table and the assembled wells were installed vertically into the open hole. The well was firmly placed in the hole, a 4-inch drive cap was tightened to the top end of the pipe (to prevent stripping the threads) and a 50-lb fence post driver was slipped over the pipe and used to push the drive point tip approximately five feet below the top of the water table. Once the well was driven to the desired depth, the hole was backfilled and packed using an auger rod, the drive cap was removed, and a locking well cap was placed on each well. When completed, the "top of casing" height was measured and recorded. Casing heights were periodically re-measured at wells in EHFs following river flood events that caused sediment deposition in the EHF.

2.2 Groundwater Well Monitoring

Un-instrumented wells were manually monitored on a near monthly basis from June 2019 to May 2020. Instrumented wells were manually monitored on a quarterly basis during the annual monitoring period. The depth to groundwater was measured from the top of the casing using an electronic water level sounder (In-Situ Inc. Rugged Mini Tape 200). These data were used to compare manual measurements to those measured by groundwater PTs, and also to provide data on groundwater depths at un-instrumented well locations.

Data from instrumented piezometers were downloaded approximately every three months using a field laptop and appropriate docking station/communication device. Downloaded data were saved in .lev and .wsl formats for Solinst and In-Situ dataloggers, respectively. This allows for pre-processing of the data within the appropriate software program, if necessary, prior to input into the groundwater database.

2.3 Riparian Groundwater Database

The riparian groundwater database was developed to provide convenient access to the USACE's groundwater data for the MRG bosque. The database contains tables, queries, and reports that automate a number of data queries and analyses, and it also was designed so that it can be expanded without significant modifications. Specific instructions for data pre-processing and database import procedures are provided in Appendix B.

The MRG database was originally designed for older generation Solinst dataloggers which include a manufacturer barometric pressure offset. Because all older generation Solinst dataloggers were retired, the database was modified in September 2016 to minimize pre-processing necessary for import of data from absolute pressure dataloggers (newer generation Solinst and In-Situ PTs). Land surface elevation was surveyed at all EHF wells and a subset of EFT wells on March 18, 2016 (Table 2) and incorporated into the database to provide data on groundwater elevation throughout the monitored reaches of the bosque.

3.0 RESULTS

Groundwater data summaries for each well are provided in the following sections. Relevant data gaps are also identified. Barometric pressure data is provided in Section 3.1. EFT and EHF well summaries are provided in Section 3.2 and Section 3.3, respectively. The maximum and minimum groundwater depths observed at all instrumented wells during the annual monitoring period are provided in Table 3. Table 4 presents the status of all currently monitored instrumented groundwater wells, including data gaps where applicable. Groundwater data is plotted alongside MRG discharge data from the USGS gaging station closest downstream of each well (08329918 Alameda Bridge or 08330000 Rio Grande at Albuquerque). Tables A-1 through A-6 in Appendix A provide installation information, manual depth to groundwater measurements (D2GW), PT hang lengths, casing heights, and the monthly averages and statistics for discharge and depth to groundwater for each well during the annual monitoring period.

Table 3. 2019-2020 maximum and minimum depth to groundwater and associated dates for all instrumented wells.

Well Name	Well ID	Maximum D2GW		Minimum D2GW	
		Date	Ft bgs	Date	Ft bgs
1A N Terrace	74	12/25/2019	4.49	6/20/2019	-1.65
1A S Backwater	75	1/24/2020	2.89	6/20/2019	-3.22
1A S Terrace	76	12/25/2019	2.84	6/7/2019	-0.91
1C Swale	77	5/17/2020	3.13	6/20/2019	-1.96
1E South	57	10/2/2019	2.69	6/20/2019	-1.27
1F Swale	79	2/6/2020	6.53	6/20/2019	0.48
1H Terrace	78	12/31/2019	7.75	6/20/2019	2.89
Oxbow 2	72	9/9/2019	2.37	6/20/2019	0.69
Oxbow N Scallop	81	10/5/2019	1.24	6/21/2019	-2.69
Rt 66 Inlet	70	10/3/2019	2.50	6/20/2019	-2.55
Rt 66 Outlet	71	10/3/2019	2.34	6/20/2019	-2.30
4A_New	73	5/7/2020	4.69	6/20/2019	-0.93
4B	44	10/2/2019	3.61	6/19/2019	-2.32
4C Bankline	47	10/3/2019	3.20	6/20/2019	-1.94
4C North	45	10/2/2019	3.79	6/20/2019	-1.83
4C South	46	10/5/2019	3.93	6/20/2019	-2.41
4C1	85	10/5/2019	3.79	6/20/2019	-2.92
5A North	54	6/4/2019	0.13	6/5/2019	0.07
5A1	86	10/2/2019	3.24	6/20/2019	-1.78
5A2	87	10/2/2019	3.35	6/20/2019	-2.56
5A3	88	10/2/2019	6.63	6/20/2019	2.75
5B Bankline	61	12/25/2019	3.54	6/20/2019	-1.70

Well Name	Well ID	Maximum D2GW		Minimum D2GW	
		Date	Ft bgs	Date	Ft bgs
5B North	59	12/25/2019	3.06	6/20/2019	-2.27
5B South	60	8/26/2019	2.49	6/21/2019	-2.90
5B1	89	2/7/2020	2.63	6/20/2019	-4.38
5C Bankline	49	6/2/2019	-0.51	6/12/2019	-1.59
5C North	50	6/5/2019	-2.45	6/10/2019	-3.06
5C1	90	2/6/2020	2.66	6/20/2019	-4.64
5C2	91	2/7/2020	2.43	6/20/2019	-2.77
5C3	92	10/5/2019	2.66	6/13/2019	-4.96
5D1	93	10/5/2019	3.22	6/20/2019	-1.63
5D2	94	10/5/2019	3.63	6/20/2019	-1.37
5D3	95	10/5/2019	2.89	6/20/2019	-1.69
5E1	82	10/5/2019	2.83	6/20/2019	-1.95
5E2	83	10/2/2019	2.62	6/20/2019	-2.31
5E3	84	10/5/2019	2.85	6/20/2019	-3.56

Table 4. Status of instrumented wells monitored by GSA from June 2019 to May 2020.

Database ID	Well ID	Well Type	PT Model	Date Instrumented	Datalogger Functioning? (if no, date retired)	Periods of Data Loss June 2019 - May 2020	Well Status / Reason for Data Loss
6	RGNC Baro West	EFT	In-Situ Baro Troll	10/23/2005	Yes	None	Good
74	1A N Terrace	EHF	In-Situ	9/23/2015	Yes	None	Good
75	1A S Backwater	EHF	In-Situ	9/23/2015	Yes	None	Good
76	1A S Terrace	EHF	In-Situ	9/23/2015	No, 3/19/20	3/19/20-5/31/20	PT failed
77	1C Swale	EHF	In-Situ	9/23/2015	Yes	None	Good
80	1F N Terrace	EHF	In-Situ	9/23/2015	No, 6/1/18	All	Well damaged, no longer monitored
79	1F Swale	EHF	In-Situ	9/23/2015	Yes	None	Good
58	1E Bankline	EHF	Solinst New	10/26/2012	No, 12/10/18	All	PT failed
57	1E South	EHF	Solinst New	10/26/2012	No, 10/10/19	10/10/19-5/31/20	PT failed
78	1H Terrace	EHF	In-Situ	9/23/2015	Yes	None	Good
56	1G	EHF	Solinst New	10/26/2012	No, 5/31/18	All	PT failed
81	Oxbow N Scallop	EHF	In-Situ	10/12/2015	Yes	None	Good
72	Oxbow 2	EHF	In-Situ	3/27/2014	Yes	None	Good
70	Rt 66 Inlet	EHF	In-Situ	4/1/2014	Yes	None	Good
71	Rt 66 Outlet	EHF	In-Situ	4/1/2014	No, 3/24/20	3/24/20-5/31/20	PT failed
73	4A_New	EHF	In-Situ	5/1/2014	Yes	None	Good
43	4B Bankline	EHF	Solinst New	4/30/2012	No, 5/30/18	All	PT failed
44	4B	EHF	In-Situ	10/24/2012	Yes	None	Good
45	4C North	EHF	In-Situ	10/24/2012	Yes	None	Good
47	4C Bankline	EHF	In-Situ	10/24/2012	Yes	None	Good
85	4C1	EHF	In-Situ	2/26/2016	Yes	None	Good
46	4C South	EHF	Solinst New	10/24/2012	Yes	None	Good
54	5A North	EHF	Solinst New	10/25/2012	No, 6/4/19	All	PT failed
53	5A South	EHF	Solinst New	10/25/2012	No, 6/1/18	All	PT failed

Database ID	Well ID	Well Type	PT Model	Date Instrumented	Datalogger Functioning? (if no, date retired)	Periods of Data Loss June 2019 - May 2020	Well Status / Reason for Data Loss
86	5A1	EHF	In-Situ	2/25/2016	Yes	None	Good
87	5A2	EHF	In-Situ	2/25/2016	Yes	None	Good
88	5A3	EHF	In-Situ	2/26/2016	Yes	None	Good
59	5B North	EHF	In-Situ	2/26/2014	Yes	None	Good
89	5B1	EHF	In-Situ	2/26/2016	Yes	None	Good
61	5B Bankline	EHF	In-Situ	3/6/2016	Yes	None	Good
60	5B South	EHF	In-Situ	2/26/2014	No, 8/9/19	8/9/19-5/31/20	PT failed
50	5C North	EHF	Solinst New	10/24/2012	No, 6/11/19	6/11/19-5/31/20	PT failed
48	5C South	EHF	Solinst New	10/24/2012	No, 5/30/18	All	PT failed
49	5C Bankline	EHF	Solinst New	6/20/2012	No, 6/11/19	6/11/19-5/31/20	PT failed
90	5C1	EHF	In-Situ	2/26/2016	Yes	None	Good
91	5C2	EHF	In-Situ	2/26/2016	Yes	None	Good
92	5C3	EHF	In-Situ	2/26/2016	Yes	None	Good
52	5D	EHF	Solinst New	10/25/2012	No, 6/1/18	All	PT failed
93	5D1	EHF	In-Situ	2/25/2016	Yes	None	Good
94	5D2	EHF	In-Situ	2/25/2016	Yes	None	Good
95	5D3	EHF	In-Situ	2/25/2016	Yes	None	Good
51	5E	EHF	Solinst New	10/25/2012	No, 6/5/18	All	PT failed
82	5E1	EHF	In-Situ	2/25/2016	Yes	None	Good
83	5E2	EHF	In-Situ	2/25/2016	Yes	None	Good
84	5E3	EHF	In-Situ	2/25/2016	Yes	None	Good

3.1 Barometric Pressure Data

Figure 2. Location of barometric datalogger and RGNC S groundwater monitoring wells.

The barologger was installed within the Rio Grande Nature Center (RGNC) West groundwater well, which is located at 346,124 E; 3,888,425 N (UTM NAD83, Zone 13N) (Figure 2). The well installation date is unknown. This well is constructed of a 2-inch PVC pipe with a locked cap and was instrumented with a barometric pressure datalogger (Solinst Barologger Model 3001) on November 23, 2005 and programmed to collect data every 30 minutes. The Barologger was last successfully downloaded in March 2015. It was replaced with an In-Situ Rugged Baro Troll barometric pressure datalogger on August 11, 2015.

Monthly average barometric pressure and temperature as recorded by the barometric PT are presented in Figure 3. Between June 2019 and May 2020, average monthly barometric pressure at the site ranged from 84.45 kilopascals (kPa) and 85.19 kPa, and tended to be lowest in the spring and highest in the fall. All barometric data since monitoring began has been corrected and is presented in Figure 3 as absolute barometric pressure.

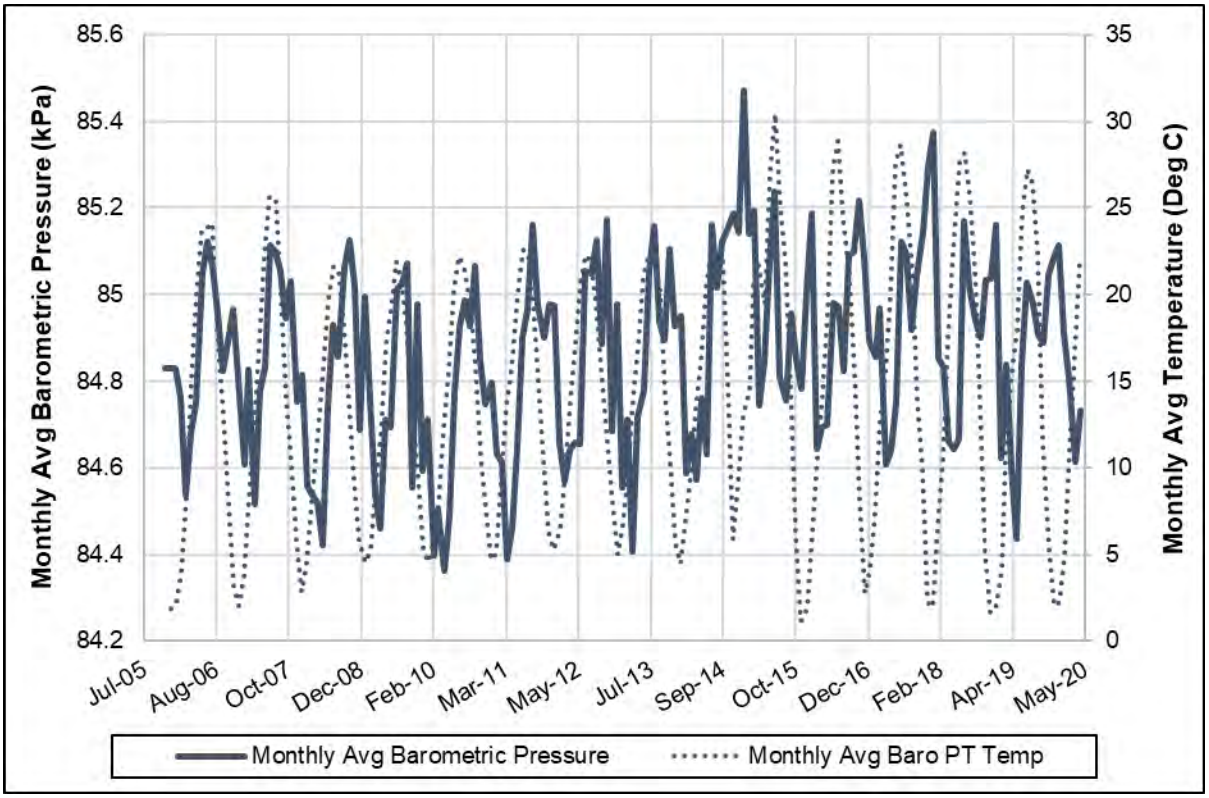

Figure 3. Monthly average barometric pressure (kPa) and air temperature as measured by the barometric pressure datalogger.

3.2 Elevated Floodplain Terrace (EFT) Wells

Depth to groundwater (D2GW), groundwater temperature, and MRG river discharge at the Albuquerque gaging station (ABQ) are summarized in the following sections for EFT wells monitored during the annual monitoring period. Data for EFT wells are presented for the entire period of record, not only for the annual monitoring period. Manual measurements are not available for the fifteen month period (March 2017 – May 2018) prior to the initiation of the 2018-2020 contract. As of the end of FY15, all previously instrumented EFT well dataloggers were retired due to repeated malfunctions; only manual well measurements are presented for this annual monitoring period. Historical D2GW data includes manual measurements for all wells, and monthly average, maximum and minimum D2GW for previously instrumented wells. Monthly average, maximum, and minimum values of river discharge (ABQ or Alameda gage) are calculated from average daily values, rather than from the 15-minute gage dataset.

3.2.1 Corrales Harvey Jones

Figure 4. Location of Corrales Harvey Jones groundwater well.

The Corrales Harvey Jones well was installed on April 29, 2009 at 354,618 E; 3,903,613 N (UTM NAD83, Zone 13N) (Figure 4). This un-instrumented well was constructed from 2-inch galvanized steel pipe. Groundwater levels were manually measured on a near-monthly basis from April 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place.

Monthly measured D2GW and monthly average, maximum, and minimum Alameda discharge for the monitoring period to date are presented in Figure 5. Groundwater levels on measurement dates fluctuated between approximately 6.59 to 7.93 feet bgs during the annual monitoring period.

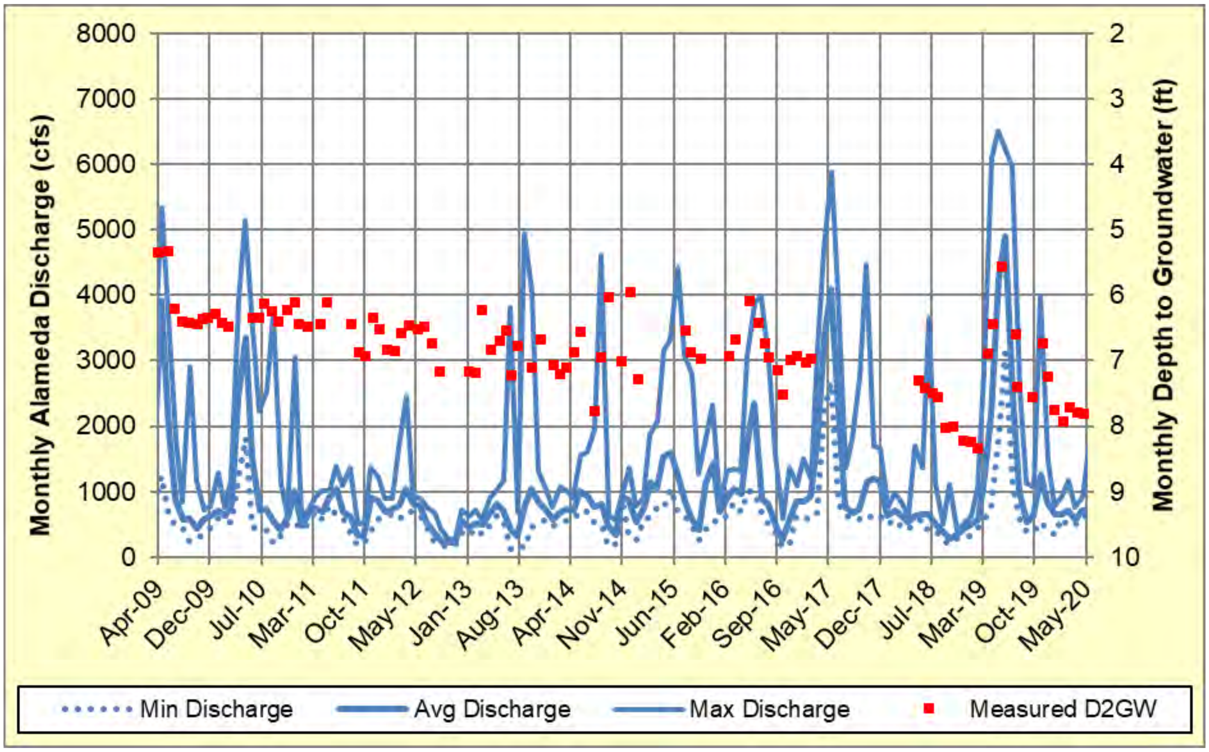

Figure 5. Corrales Harvey Jones well manually measured D2GW and monthly average, maximum and minimum Alameda discharge.

3.2.2 Corrales Dixon Road

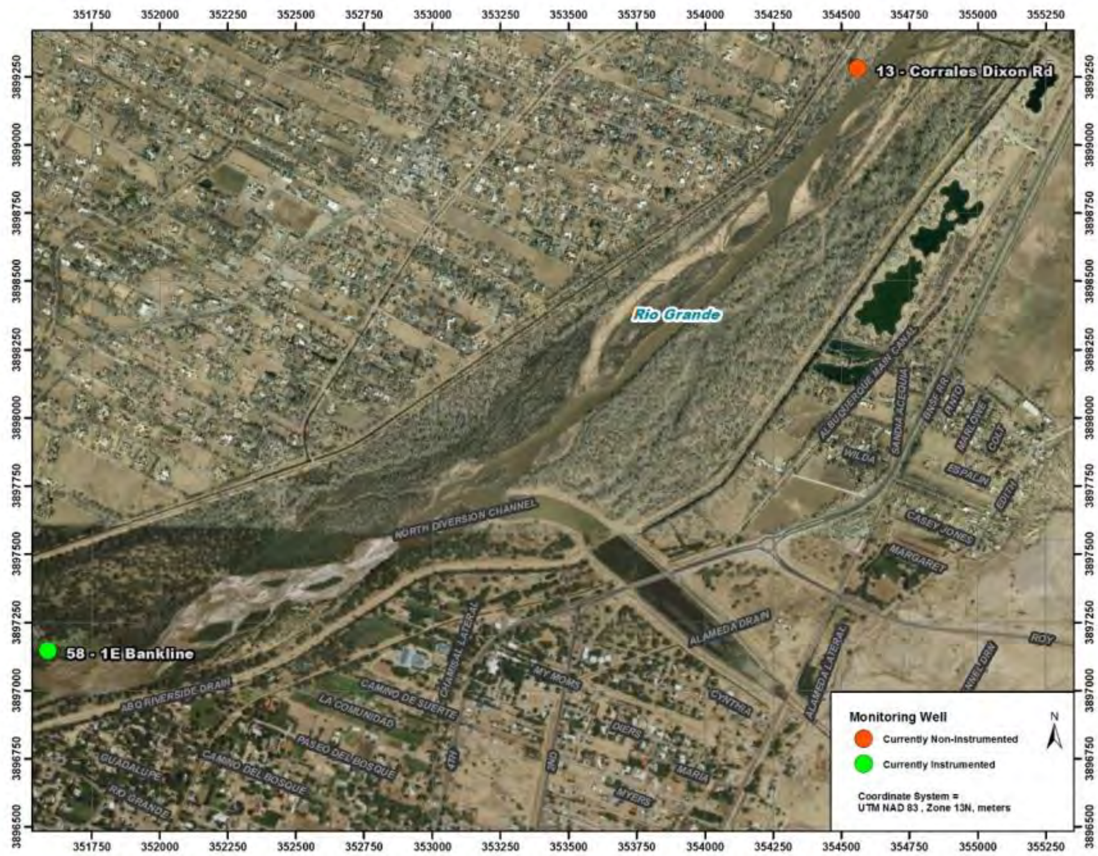

Figure 6. Location of Corrales Dixon Rd and 1E Bankline groundwater well.

The Corrales Dixon Road well was installed on an unknown date at 354,561 E; 3,899,282 N (UTM NAD83, Zone 13N) (Figure 6). This un-instrumented well was constructed from 2-inch galvanized steel pipe. Groundwater levels were manually measured on a near-monthly basis from April 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly measured D2GW and monthly average, maximum, and minimum Alameda discharge for the monitoring period to date are presented in Figure 7. D2GW on measurement dates was more variable at this location compared to other EFT wells, and fluctuated from 5.27 to 6.67 feet bgs during the annual monitoring period.

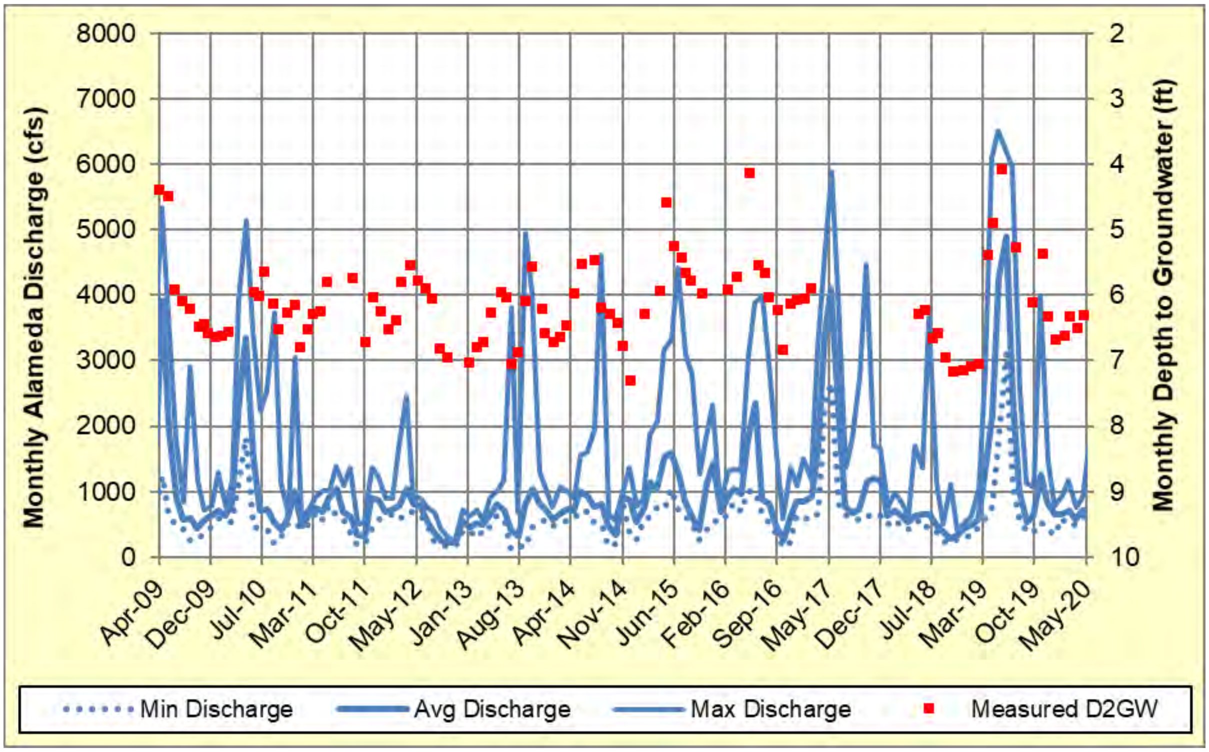

Figure 7. Corrales Dixon Road well manually measured D2GW and monthly average, maximum and minimum Alameda discharge.

3.2.3 Corrales North

Figure 8. Location of Corrales North and 1G groundwater monitoring wells.

The Corrales North well was installed on January 3, 2006 at 350,648 E; 3,896,822 N (UTM NAD83, Zone 13N) (Figure 8). This well was constructed from 2-inch galvanized steel pipe with a locked cap. In February 2006, it was instrumented with an older generation Solinst Levelogger Model 3001 that collected groundwater data every half hour. The logger was retired on August 22, 2013 after multiple failed download attempts. Groundwater levels were manually measured on a near-monthly basis from March 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and Alameda discharge for the complete monitoring period are presented in Figure 9. D2GW on measurement dates ranged from 1.09 to 4.62 feet bgs during the annual monitoring period.

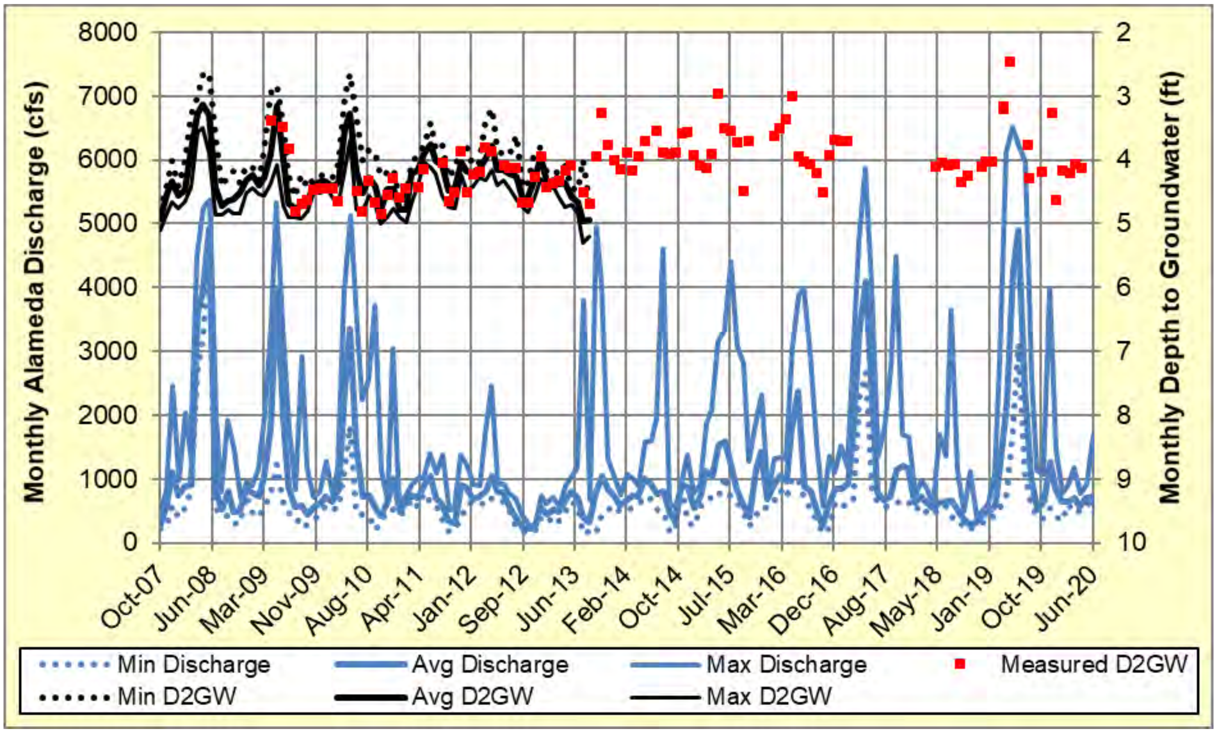

Figure 9. Corrales North well manually measured D2GW, monthly average, maximum and minimum D2GW and Alameda discharge.

3.2.4 Alameda NE

Figure 10. Location of Alameda NE and Corrales South groundwater monitoring wells.

The Alameda NE well is located at 350,733 E; 3,896,327 N (UTM NAD83, Zone 13N) (Figure 10). This well is constructed from 2-inch galvanized steel pipe with a locked cap, and was instrumented with a Solinst Levelogger Model 3001. The datalogger was installed in June 2006, and was retired in September 2014 after multiple failed download attempts. Groundwater levels were manually measured on a near-monthly basis from March 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and Alameda discharge for the complete monitoring period are presented in Figure 11. In general, groundwater levels were shallower in the springtime in response to higher river discharge. D2GW on the measurement dates ranged from approximately 7.96 to 8.58 feet bgs during the annual monitoring period.

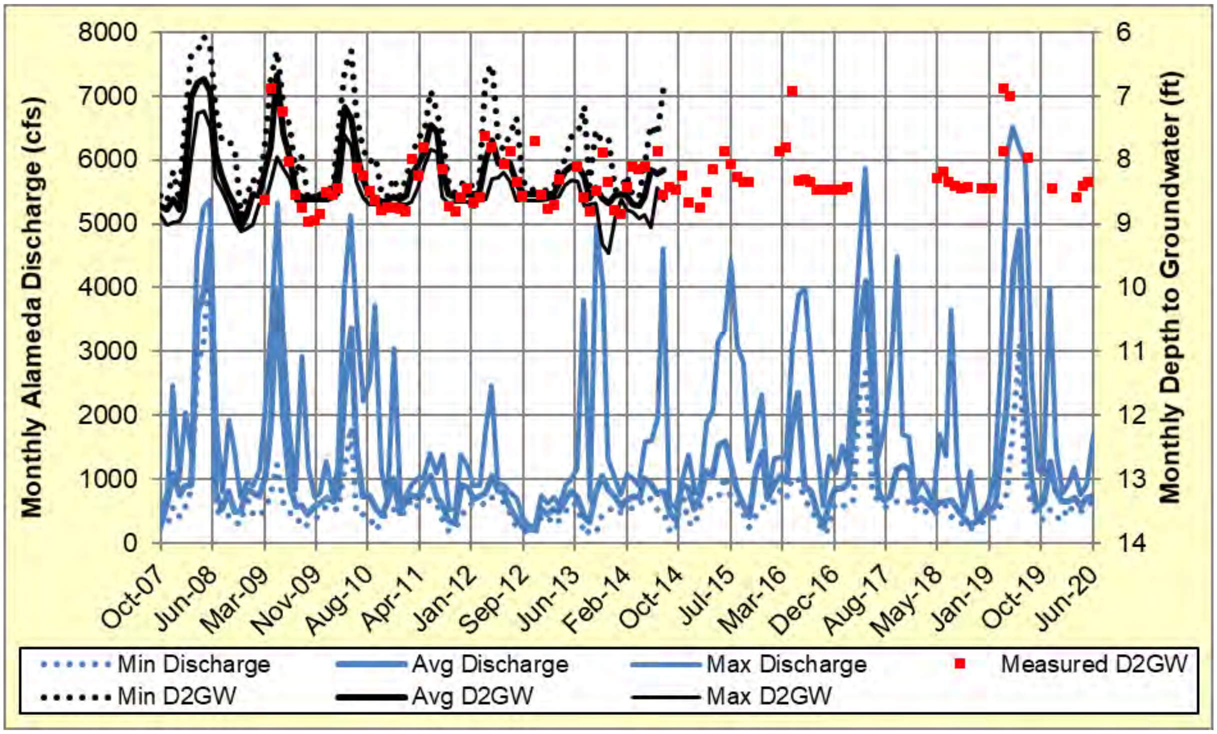

Figure 11. Alameda NE well manually measured D2GW and monthly average, maximum and minimum D2GW and Alameda discharge for the monitoring period to date.

3.2.5 Corrales South

The Corrales South well was installed at 350,425 E; 3,896,406 N (UTM NAD83, Zone 13N) (Figure 10). This un-instrumented well was constructed from 2-inch galvanized steel pipe. Groundwater levels were manually measured on a near-monthly basis from July 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly measured D2GW and monthly average, maximum, and minimum Alameda discharge for the monitoring period to date are presented in Figure 12. D2GW on the measurement dates ranged from 2.96 to 4.04 feet bgs during the annual monitoring period.

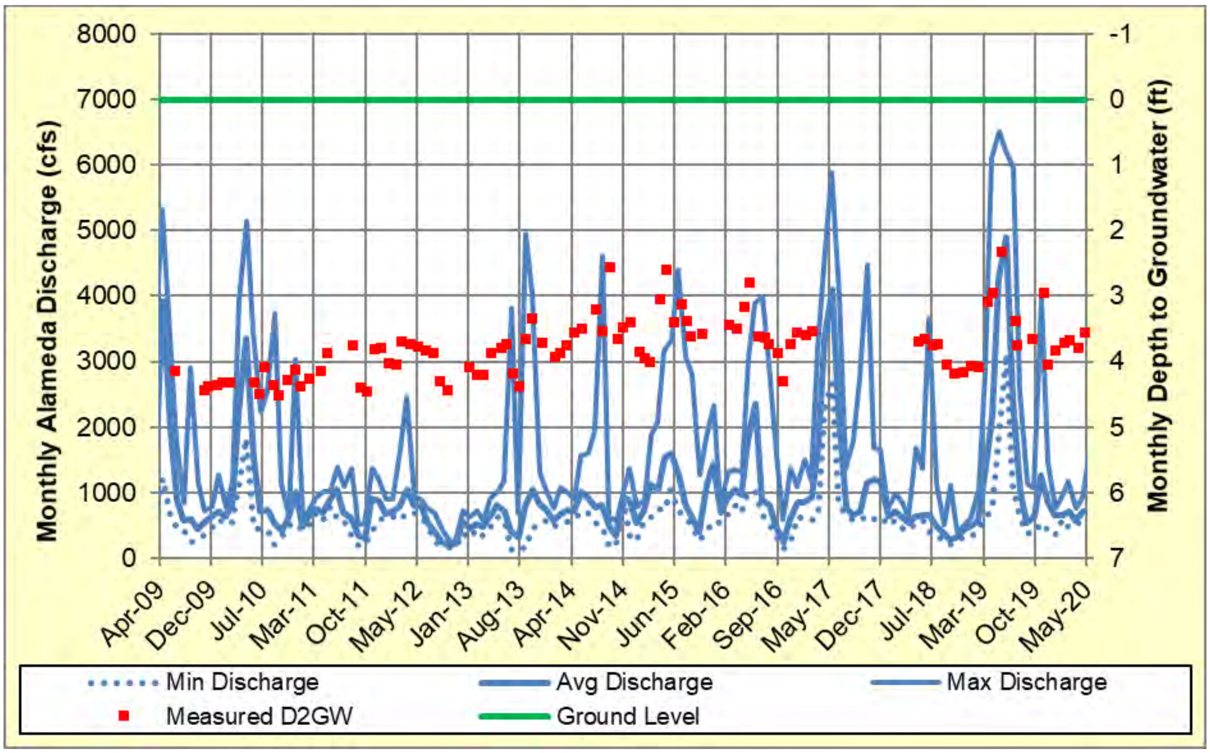

Figure 12. Corrales South well manually measured D2GW and monthly average, maximum and minimum Alameda discharge.

3.2.6 La Orilla

Figure 13. Location of La Orilla groundwater well.

The La Orilla well was installed on December 30, 2005 at 347,663 E; 3,892,229 N (UTM NAD83, Zone 13N) (Figure 13). This well was constructed from 2-inch PVC pipe with a locked cap. In February 2006, it was instrumented with an older generation Solinst Levelogger Model 3001 which collected groundwater data every half hour. The datalogger was retired on December 13, 2010 after multiple failed download attempts. Groundwater levels were manually measured on a near-monthly basis from March 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 14. D2GW on measurement dates fluctuated from 4.73 to 5.7 feet bgs during the annual monitoring period.

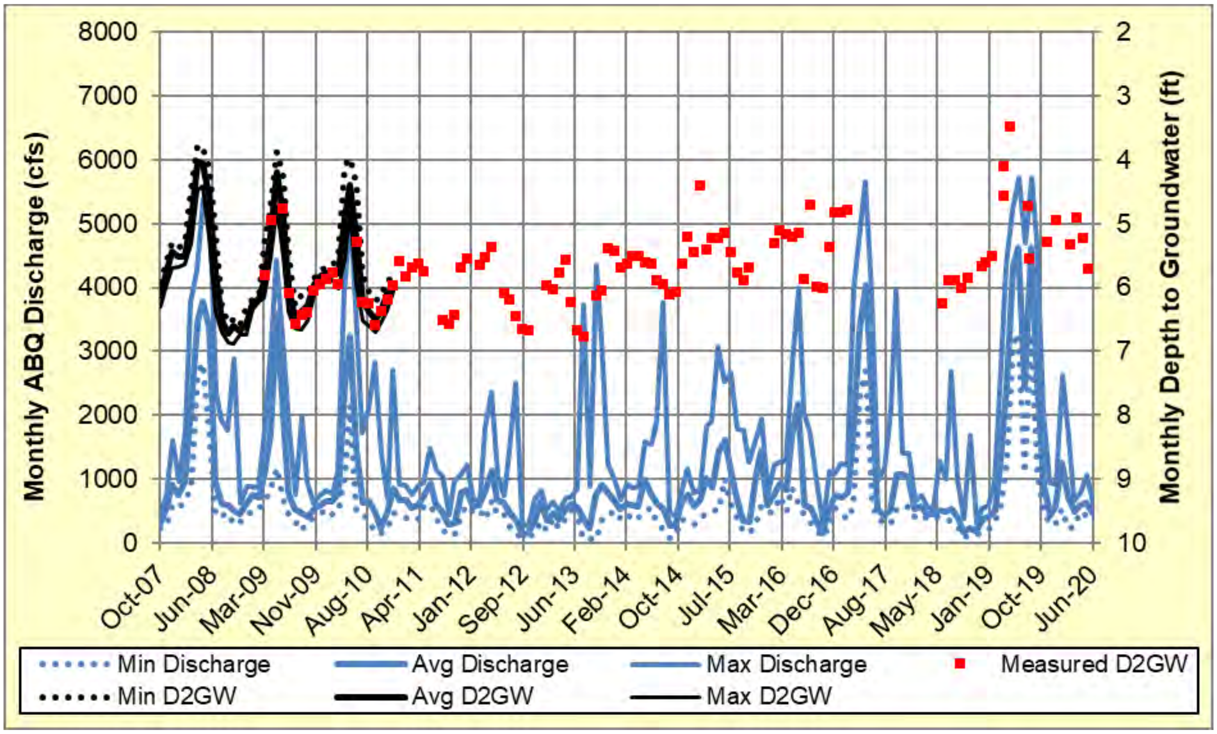

Figure 14. La Orilla well manually measured D2GW, monthly average, maximum and minimum D2GW and ABQ discharge.

3.2.7 Montaño SW

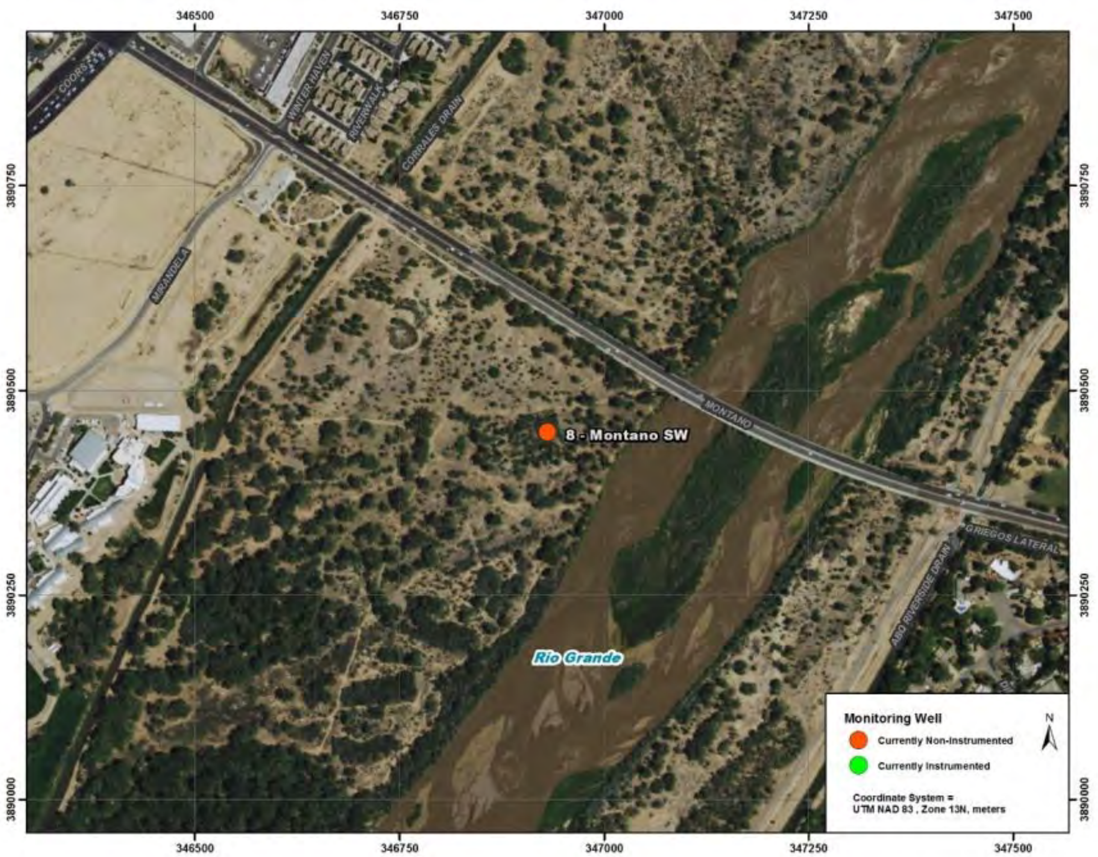

Figure 15. Location of Montaño SW groundwater well

The Montaño SW well was installed on December 2, 2005 at 346,931 E; 3,890,449 N (UTM NAD83, Zone 13N) (Figure 15). This well was constructed from 2-inch PVC pipe with a locked cap. In February 2006, it was instrumented with an older generation Solinst Levelogger Model 3001 which collected groundwater data every half hour. The datalogger was retired on June 29, 2015 after multiple failed download attempts. Groundwater levels were manually measured on a near-monthly basis from March 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 16. D2GW on measurement dates fluctuated from 4.49 to 5.36 feet bgs during the annual monitoring period.

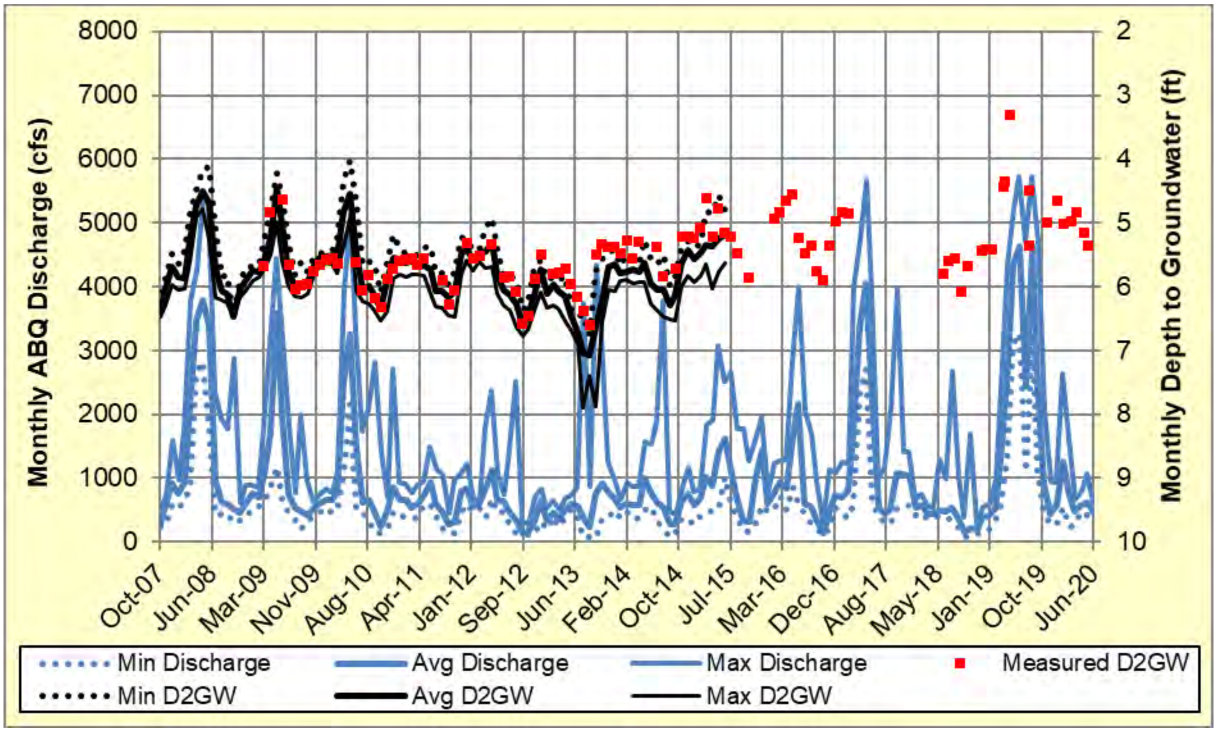

Figure 16. Montaño SW well manually measured D2GW, monthly average, maximum and minimum D2GW and ABQ discharge.

3.2.8 RGNC N

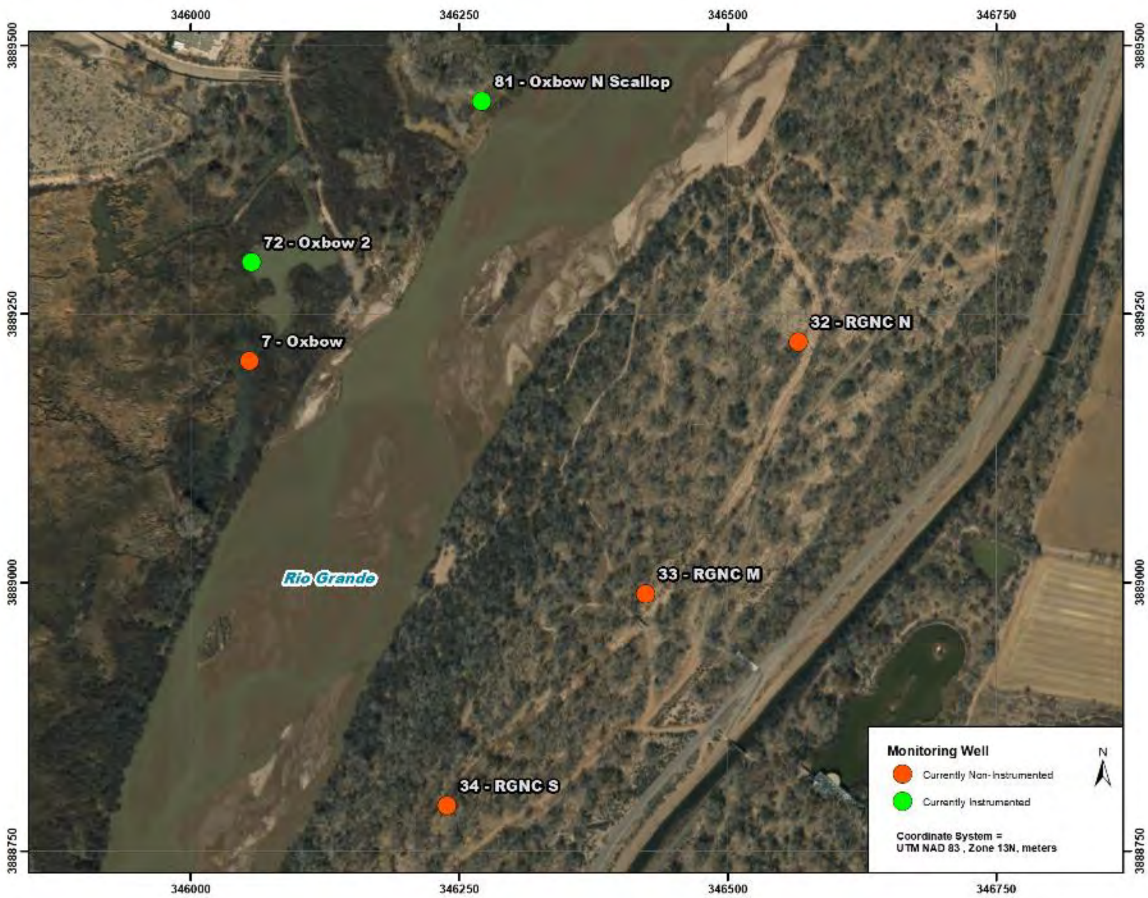

Figure 17. Location of RGNC-N, RGNC-M, Oxbow, Oxbow 2, and Oxbow North Scallop groundwater monitoring wells.

The Rio Grande Nature Center North (RGNC N) well was installed on September 11, 2009 at 346,566 E; 3,889,224 N (UTM NAD83, Zone 13N) (Figure 17). This un-instrumented well was constructed from 2-inch galvanized steel pipe. Groundwater levels were manually measured on a near-monthly basis from September 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly measured D2GW and monthly average, maximum, and minimum ABQ discharge for the monitoring period to date are presented in Figure 18. D2GW on measurement dates fluctuated from 5.8 to 7.08 feet bgs during the annual monitoring period. The shallowest measured D2GW (4.9 ft bgs) since monitoring began was documented on May 29, 2019, and corresponded to a river discharge of approximately 3,250 cfs.

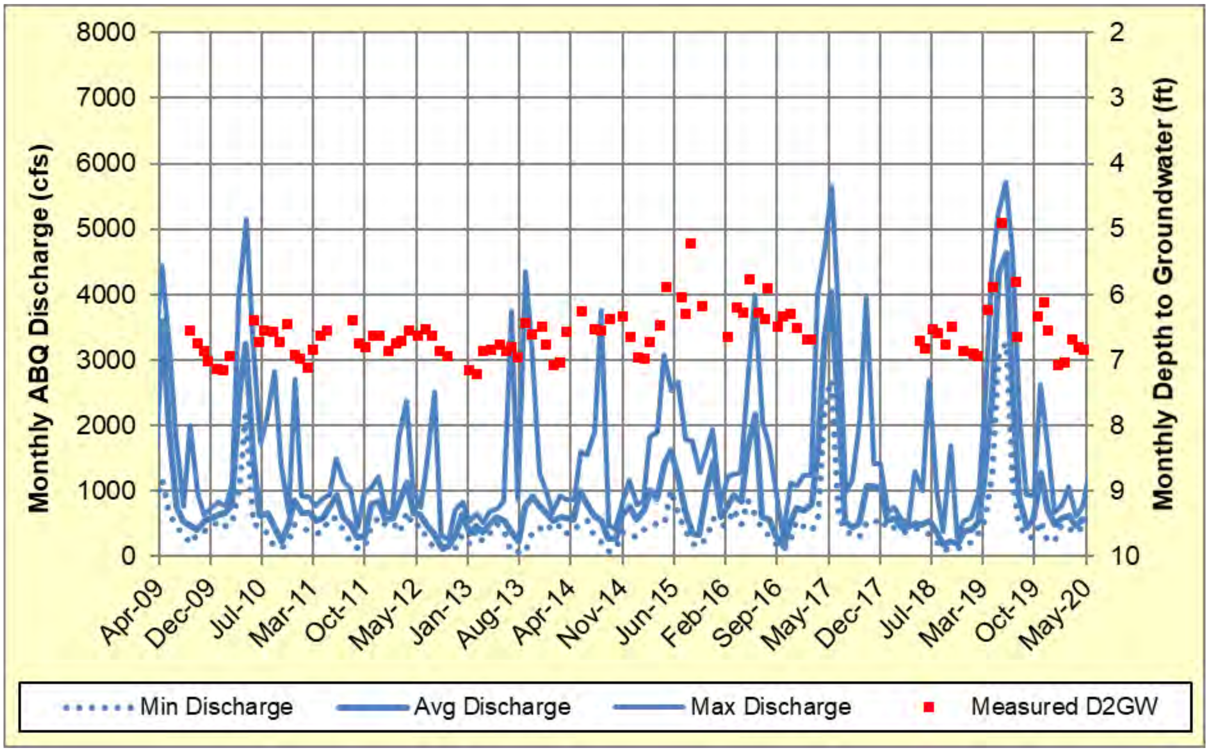

Figure 18. RGNC N well manually measured D2GW and monthly average, maximum and minimum ABQ discharge.

3.2.9 RGNC M

The Rio Grande Nature Center Middle (RGNC M) well was installed on September 11, 2009 at 346,424 E; 3,888,989 N (UTM NAD83, Zone 13N) (Figure 17). This un-instrumented well was constructed from 2-inch galvanized steel pipe. Groundwater levels were manually measured on a near-monthly basis from September 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly measured D2GW and monthly average, maximum, and minimum ABQ discharge for the monitoring period to date are presented in Figure 19. D2GW on measurement dates fluctuated from 6.08 to 7.07 feet bgs during the annual monitoring period. The shallowest measured D2GW (5.18 ft bgs) since monitoring began was documented on May 29, 2019, and corresponded to a river discharge of approximately 3,250 cfs.

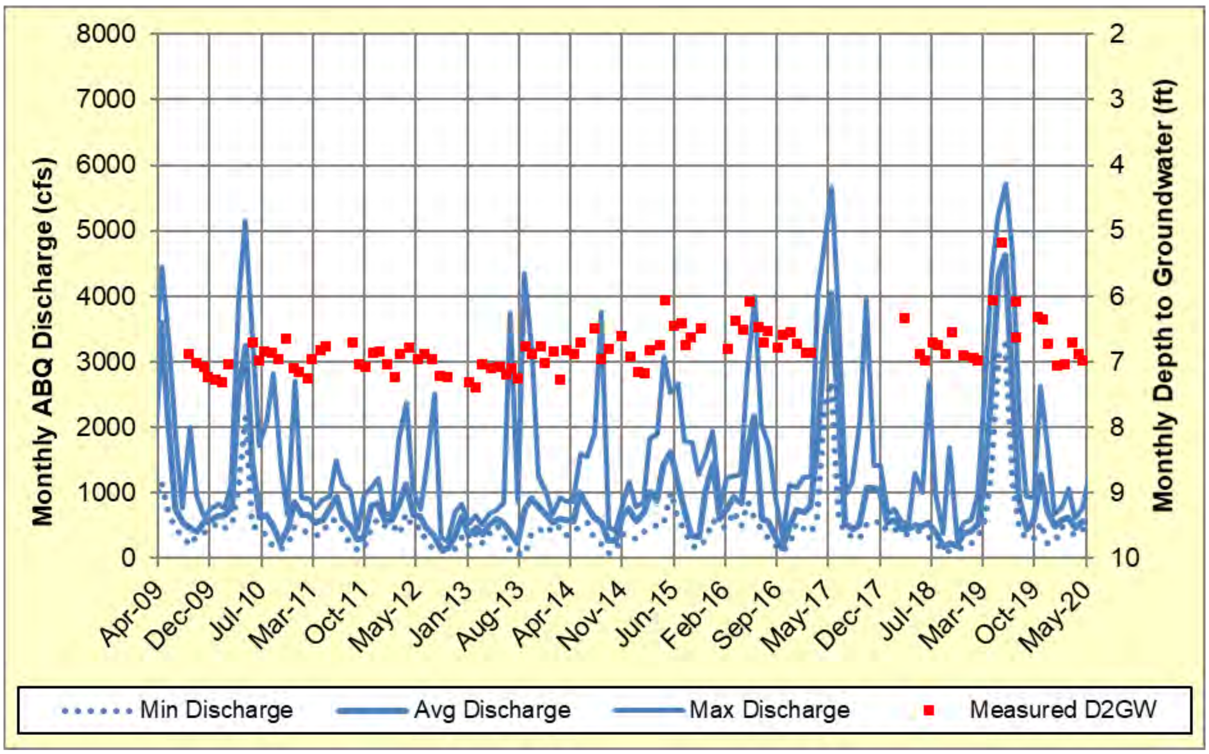

Figure 19. RGNC M well manually measured D2GW and monthly average, maximum and minimum ABQ discharge.

3.2.10 RGNC S

The Rio Grande Nature Center South (RGNC S) well was installed at 346,239 E; 3,888,792 N (UTM NAD83, Zone 13N) (Figure 17). This un-instrumented well was constructed from 2-inch galvanized steel pipe. Groundwater levels were manually measured on a near-monthly basis from September 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 as no contract was in place. Monthly measured D2GW and monthly average, maximum, and minimum ABQ discharge for the monitoring period to date is presented in Figure 20. D2GW on measurement dates fluctuated from 4.79 to 5.74 feet bgs during the annual monitoring period. The shallowest measured D2GW (3.98 ft bgs) since monitoring began was documented on May 29, 2019, and corresponded to a river discharge of approximately 3,250 cfs. The historically low variability in D2GW suggests that groundwater levels are not strongly influenced by river discharge at this location.

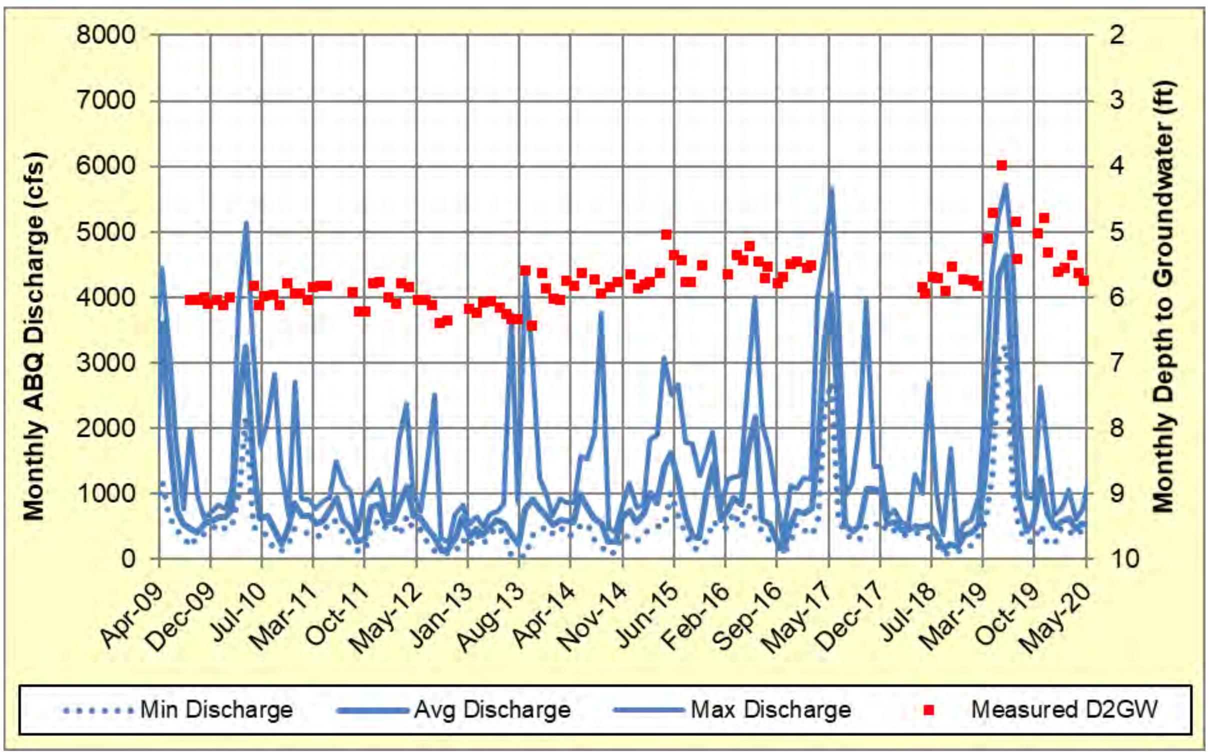

Figure 20. RGNC S well manually measured D2GW and monthly average, maximum and minimum ABQ discharge.

3.2.11 I-40 M

Figure 21. Location of I-40 M and I-40 S groundwater monitoring wells.

The I-40 M well was installed on September 11, 2009 at 346,050 E; 3,887,269 N (UTM NAD83, Zone 13N) (Figure 21). This un-instrumented well was constructed from 2-inch PVC pipe. Groundwater levels were manually measured on a near-monthly basis from September 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly measured D2GW and monthly average, maximum, and minimum ABQ discharge for the monitoring period to date are presented in Figure 22. D2GW on measurement dates showed little variability and fluctuated between 5.77 and 6.54 feet bgs during the annual monitoring period.

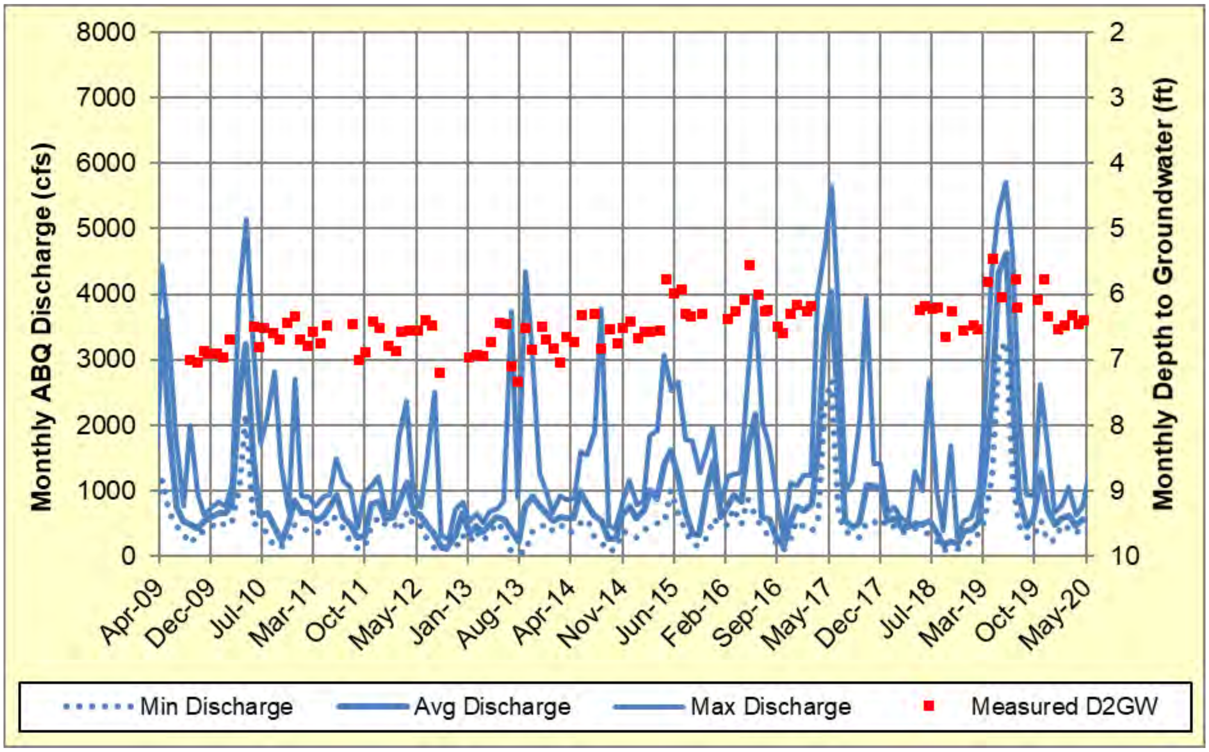

Figure 22. I-40 M well manually measured D2GW and monthly average, maximum and minimum ABQ discharge.

3.2.12 I-40 S

The I-40 S well was installed on September 11, 2009 at 345,992 E; 3,886,680 N (UTM NAD83, Zone 13N) (Figure 21). This un-instrumented well was constructed from 2-inch PVC pipe. Groundwater levels were manually measured on a near-monthly basis between September 2009 and May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly measured D2GW and monthly average, maximum, and minimum ABQ discharge for the monitoring period to date are presented in Figure 23. D2GW on measurement dates fluctuated between 6.38 and 7.35 feet bgs during the annual monitoring period. The shallowest measured D2GW (5.51 ft bgs) since monitoring began was documented on May 29, 2019, and corresponded to a river discharge of approximately 3,250 cfs.

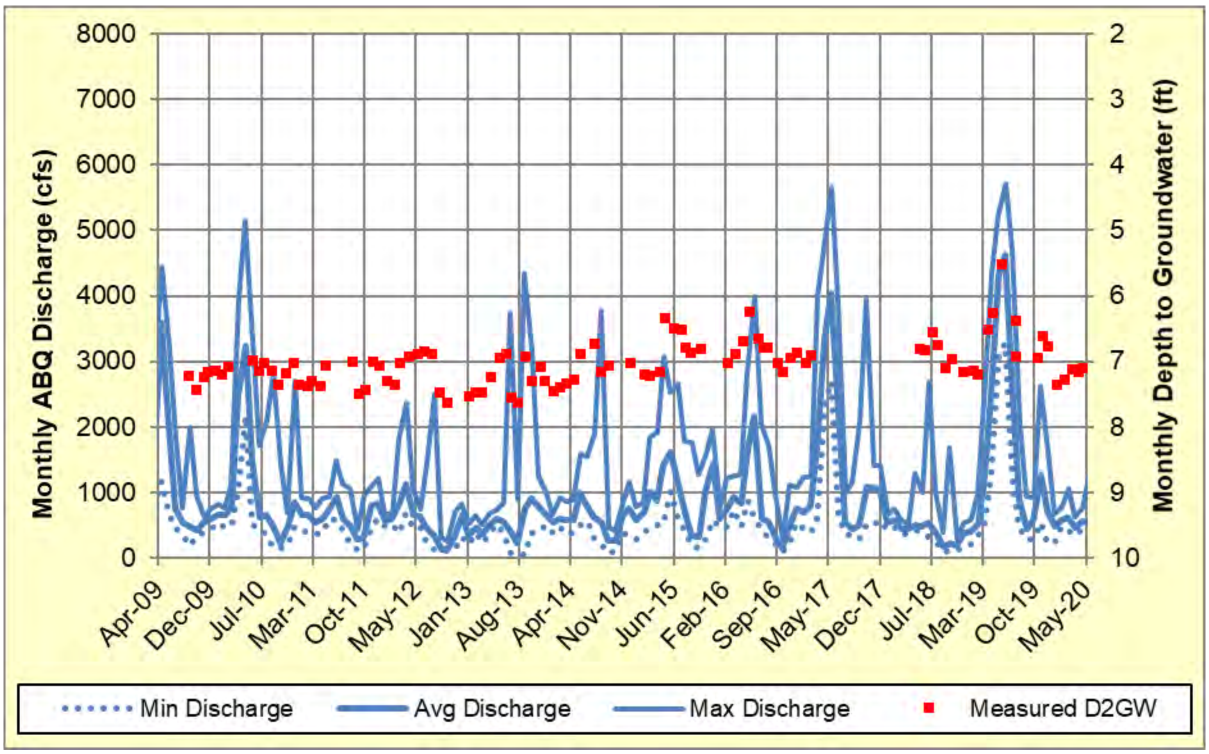

Figure 23. I-40 S well manually measured D2GW and monthly average, maximum and minimum ABQ discharge.

3.2.13 Central NE

Figure 24. Location of the Central NE groundwater monitoring well.

The Central NE well was installed at 346,318 E; 3,884,779 N (UTM NAD83, Zone 13N) (Figure 24). This un-instrumented well was constructed from 2-inch galvanized steel pipe. Groundwater levels were manually measured on a near-monthly basis from July 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly measured D2GW and monthly average, maximum, and minimum ABQ discharge for the monitoring period to date are presented in Figure 25. D2GW on the annual measurement dates ranged from 4.83 to 6.23 feet bgs.

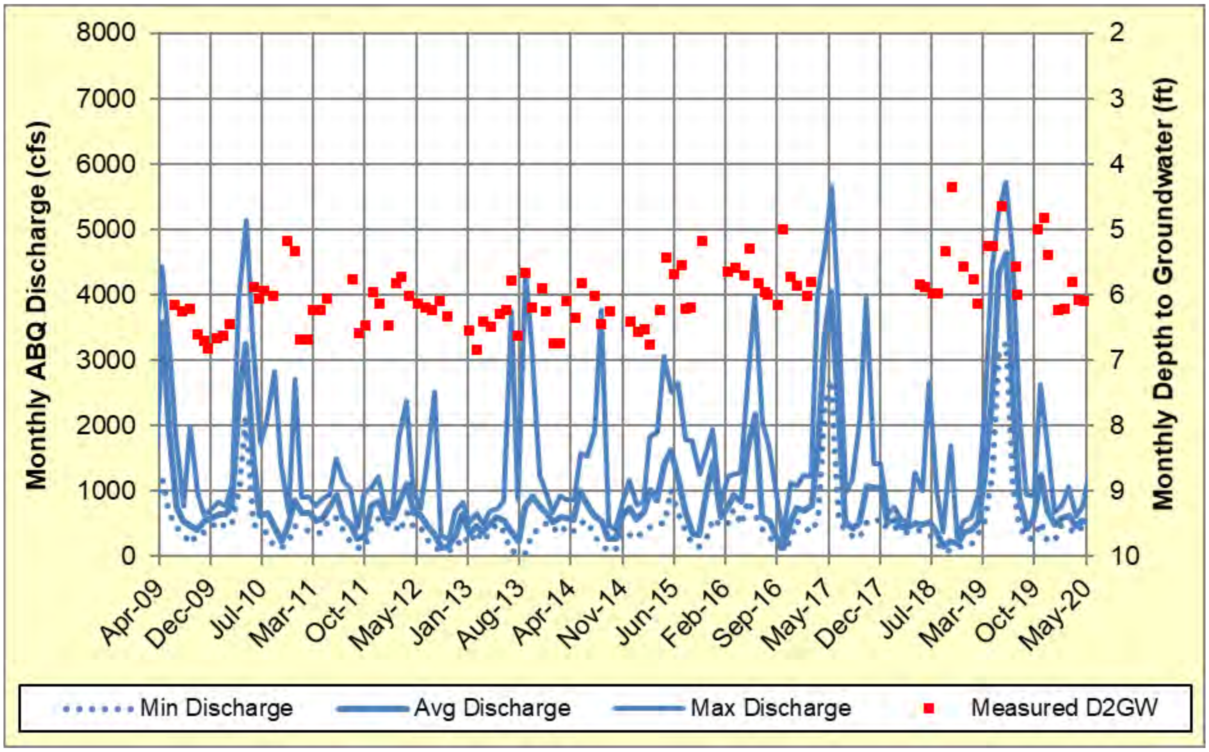

Figure 25. Central NE well manually measured D2GW and monthly average, maximum and minimum ABQ discharge.

3.2.14 Central SW New

Figure 26. Location of Central SW New, Zoo Burn, 4A Old, and 4A New groundwater monitoring wells.

The Central SW New well was installed on June 1, 2009 at 346,717 E; 3,884,088 N (UTM NAD83, Zone 13N) (Figure 26). This un-instrumented well was constructed from 2-inch galvanized steel pipe. Groundwater levels were manually measured on a near-monthly basis from July 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly measured D2GW and monthly average, maximum, and minimum ABQ discharge for the monitoring period to date are presented in Figure 27. Groundwater depth on measurement dates fluctuated from approximately 3.23 to 4.18 feet bgs during the annual monitoring period.

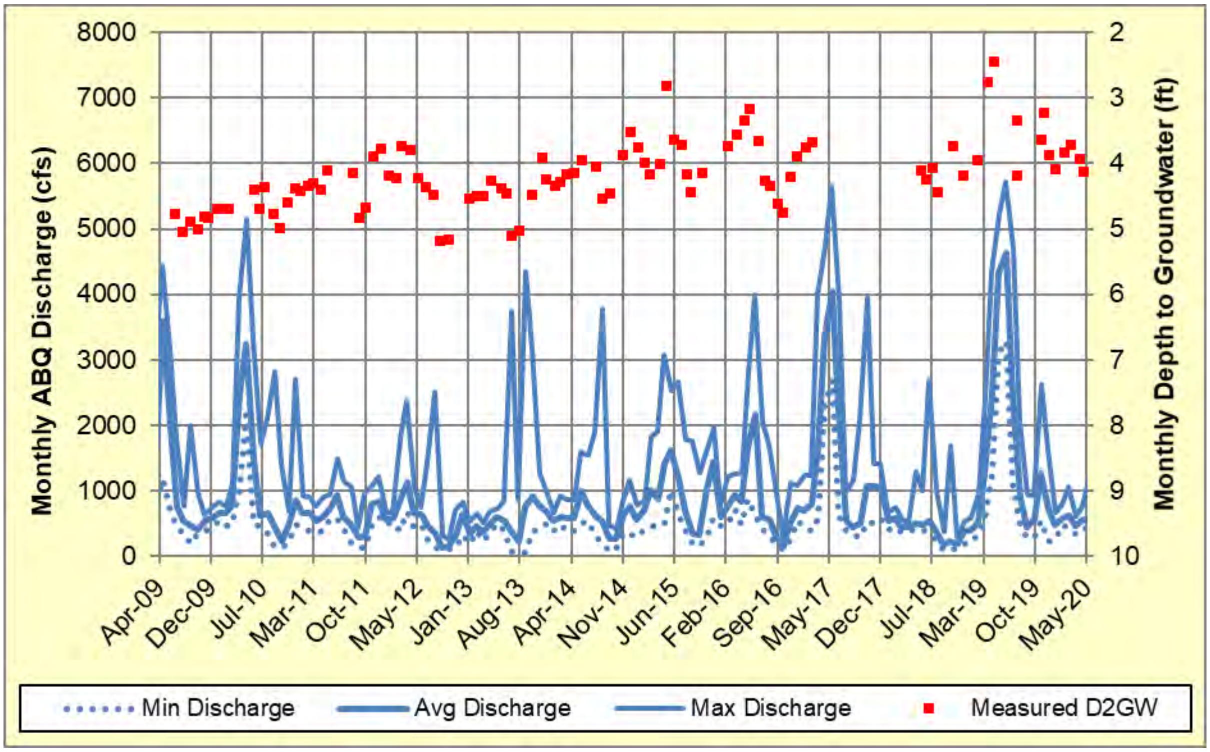

Figure 27. Central SW New well manually measured D2GW and monthly average, maximum and minimum ABQ discharge.

3.2.15 Zoo Burn

The Zoo Burn well was installed on September 11, 2009 at 348,163 E; 3,882,791 N (UTM NAD83, Zone 13N) (Figure 26). This un-instrumented well was constructed from 2-inch PVC pipe. Groundwater levels were manually measured on a near-monthly basis from September 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly measured D2GW and monthly average, maximum, and minimum ABQ discharge for the monitoring period to date are presented in Figure 28. D2GW on measurement dates fluctuated between 3.69 and 4.9 feet bgs during the annual monitoring period.

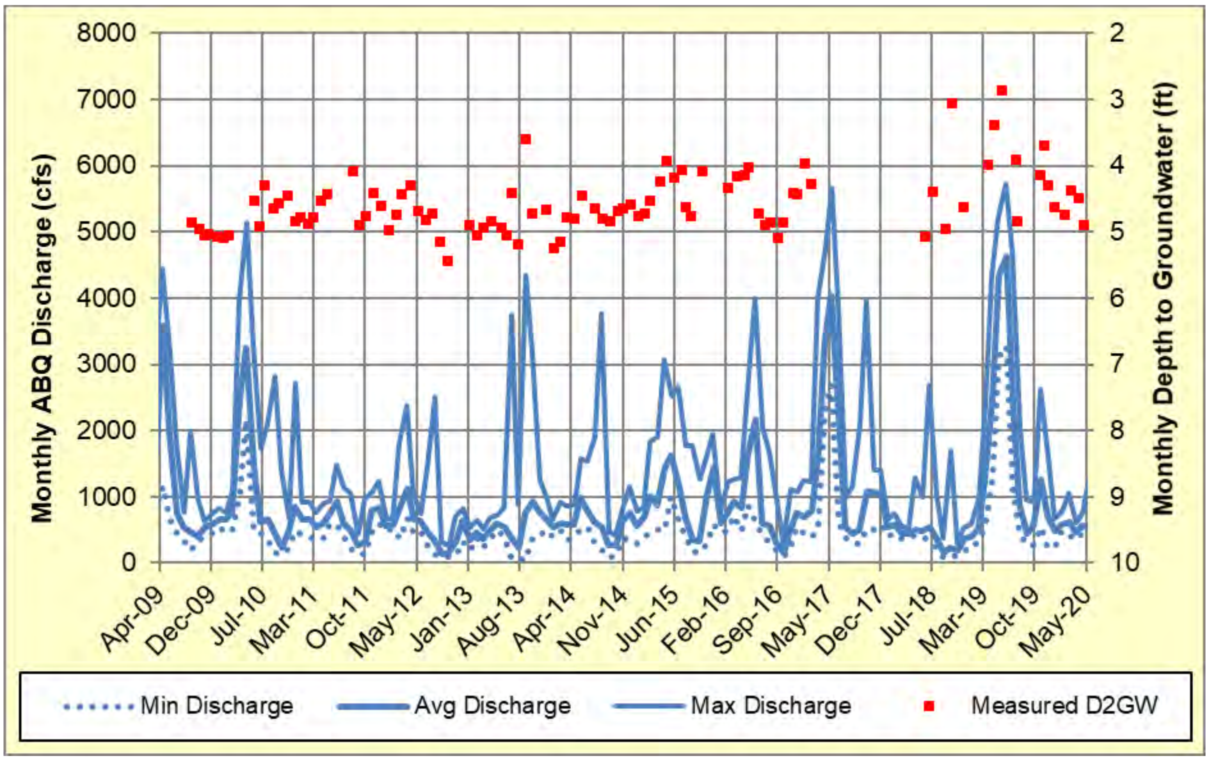

Figure 28. Zoo Burn well manually measured D2GW and monthly average, maximum and minimum ABQ discharge.

3.2.16 Bridge Ave SW

Figure 29. Location of Bridge Ave SW and Rio Bravo groundwater monitoring wells.

The Bridge Ave SW well (Figure 29) was installed in December 2005 at 348,585 E; 3,881,787 N (UTM NAD83, Zone 13N). This well was constructed from 2-inch galvanized steel pipe with a locked cap. The well was previously instrumented with an older generation Solinst Levelogger Model 3001 datalogger that collected groundwater data from February 2006 to October 2012. During the January 2013 monitoring visit, the datalogger was found to have fallen to the bottom of the well and was not retrievable. Groundwater levels were manually measured on a near-monthly basis from March 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 30. D2GW on the measurement dates fluctuated between 3.99 and 5.11 feet bgs during the annual monitoring period.

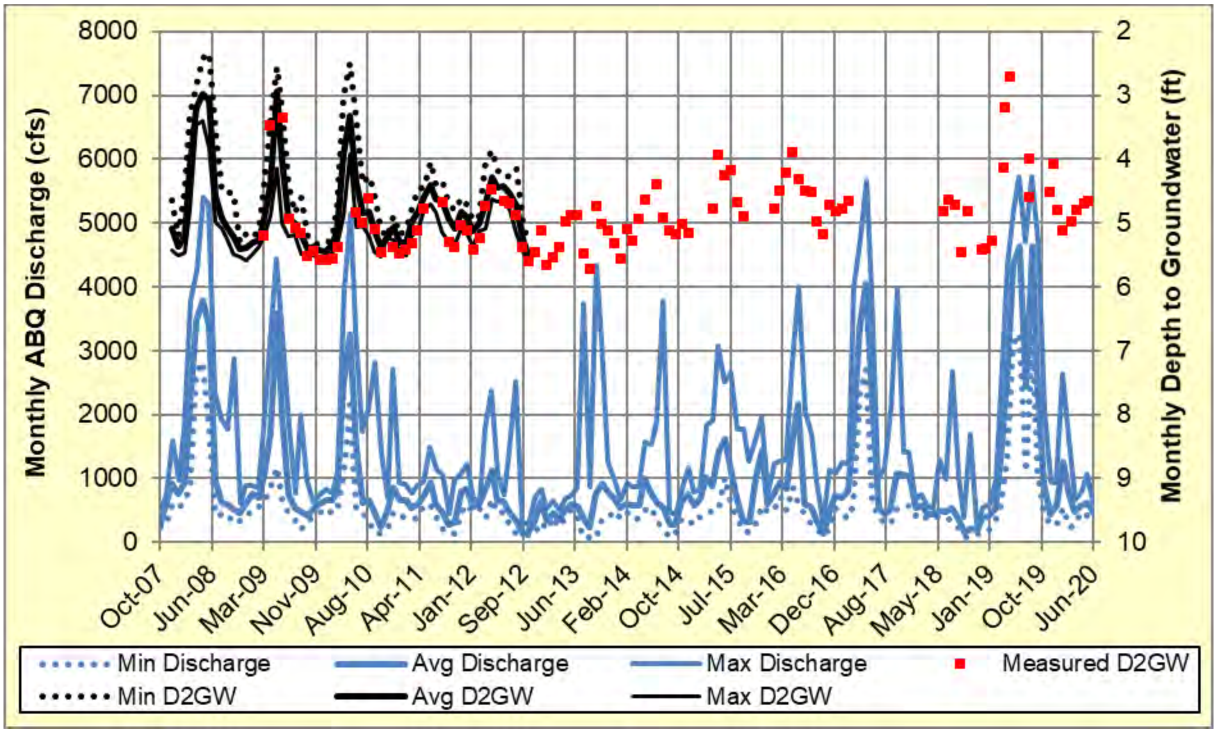

Figure 30. Bridge Ave SW well manually measured D2GW, monthly average, maximum and minimum D2GW and ABQ discharge.

3.2.17 Rio Bravo

The Rio Bravo well was installed at 348,856 E; 3,880,331 N (UTM NAD83, Zone 13N) (Figure 29). This un-instrumented well was installed in September, 2009 and was constructed from 2-inch PVC pipe. Groundwater levels were manually measured on a near-monthly basis from September 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly measured D2GW and monthly average, maximum, and minimum ABQ discharge for the monitoring period to date is presented in Figure 31. Groundwater was shallow during the annual monitoring period, fluctuating between 0.56 and 1.66 feet bgs on measurement dates.

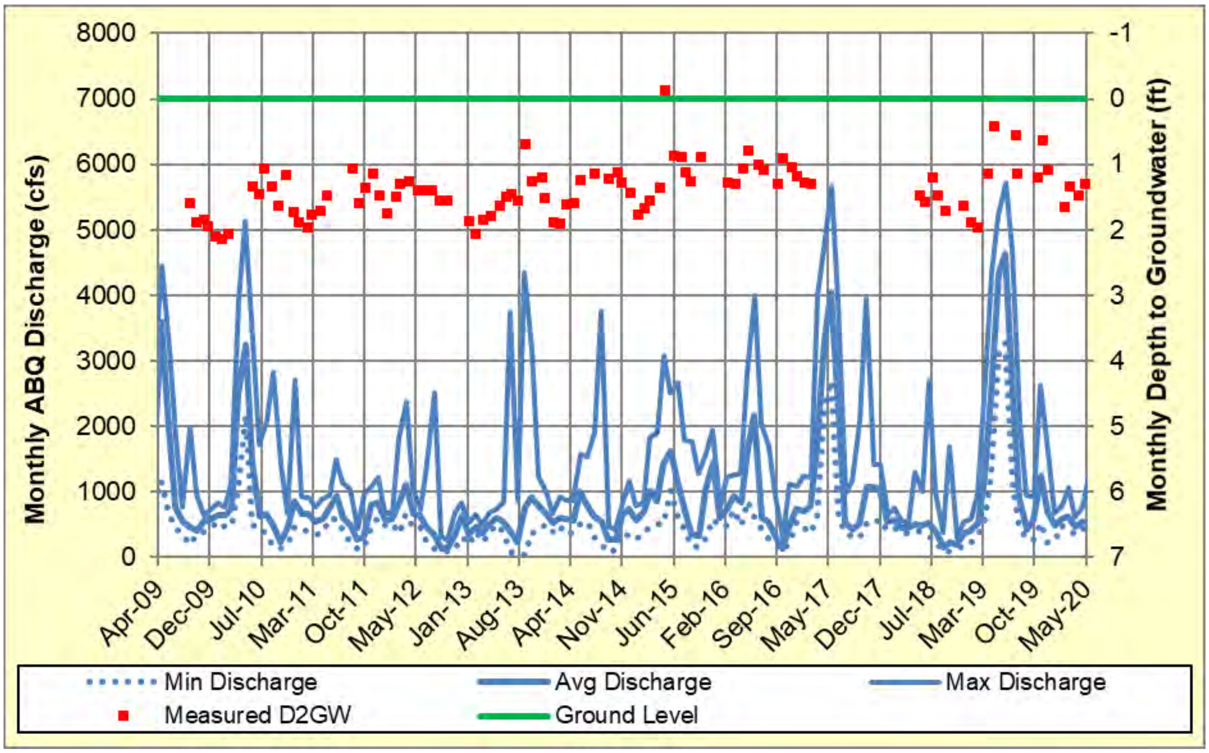

Figure 31. Rio Bravo well manually measured D2GW and monthly average, maximum and minimum ABQ discharge.

3.2.18 Brown Burn East

Figure 32. Location of Brown Burn East, Brown Burn West, and 5C Swale (5C North, 5C South, 5C Bankline, 5C1, 5C2, 5C3) groundwater monitoring wells.

The Brown Burn East well was installed in April 2005, at 346,079 E; 3,872,327 N (UTM NAD83, Zone 13N) (Figure 32). This well was constructed from 2-inch galvanized steel pipe with a locked cap. In February 2006, the well was instrumented with an older generation Solinst Levelogger Model 3001 that collected groundwater data every half hour. The datalogger was retired on August 25, 2013 after multiple failed download attempts. Groundwater levels were manually measured on a near-monthly basis from March 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 33. Depth to groundwater on measurement dates ranged from 3.53 to 5.15 feet bgs during the annual monitoring period, and fluctuated seasonally with changes in river discharge.

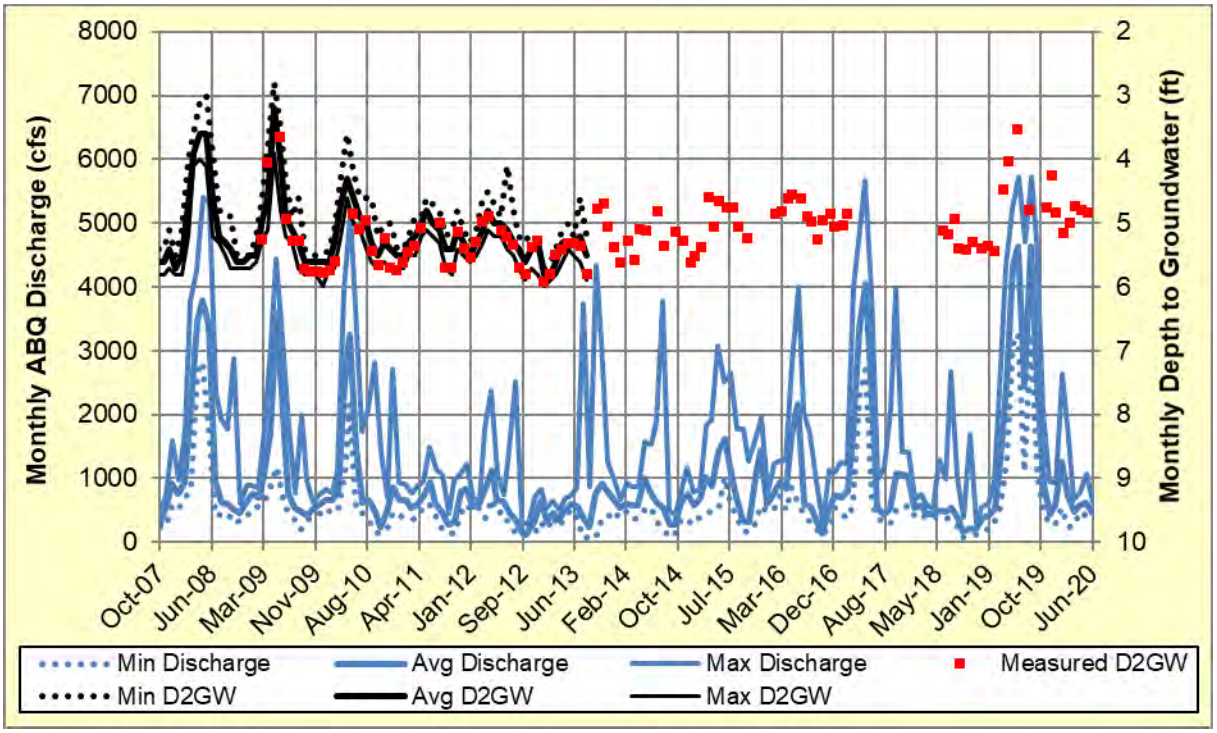

Figure 33. Brown Burn East well manually measured D2GW, monthly average, maximum and minimum D2GW and ABQ discharge.

3.2.19 Brown Burn West

The Brown Burn West well was installed in December 2005, at 345,749 E; 3,872,221 N (UTM NAD83, Zone 13N) (Figure 32). This well was constructed from 2-inch galvanized steel pipe with a locked cap. In February 2006, it was instrumented with an older generation Solinst Levelogger Model 3001 that collected groundwater data every half hour. The datalogger was retired on October 25, 2013 after multiple failed download attempts. Groundwater levels were manually measured on a near-monthly basis from March 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 34. D2GW on measurement dates fluctuated from 3.26 to 4.2 feet bgs during the annual monitoring period.

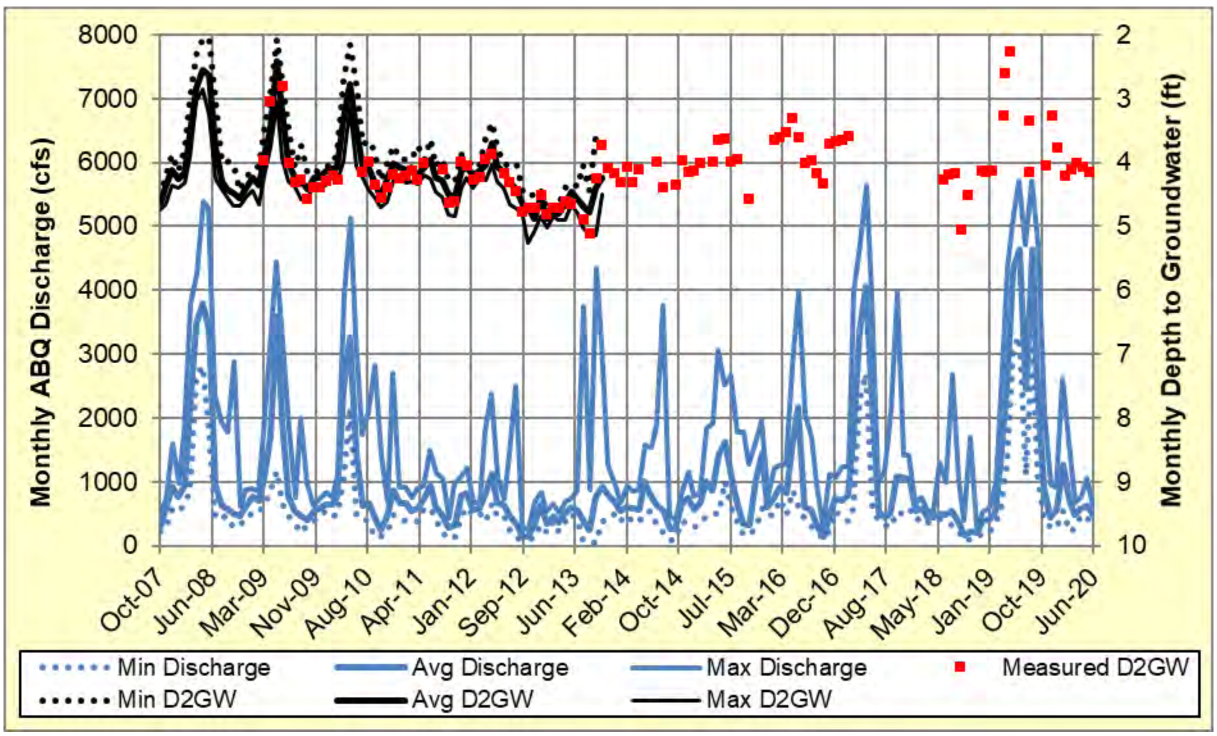

Figure 34. Brown Burn West well manually measured D2GW, monthly average, maximum and minimum D2GW and ABQ discharge.

3.2.20 I-25 E

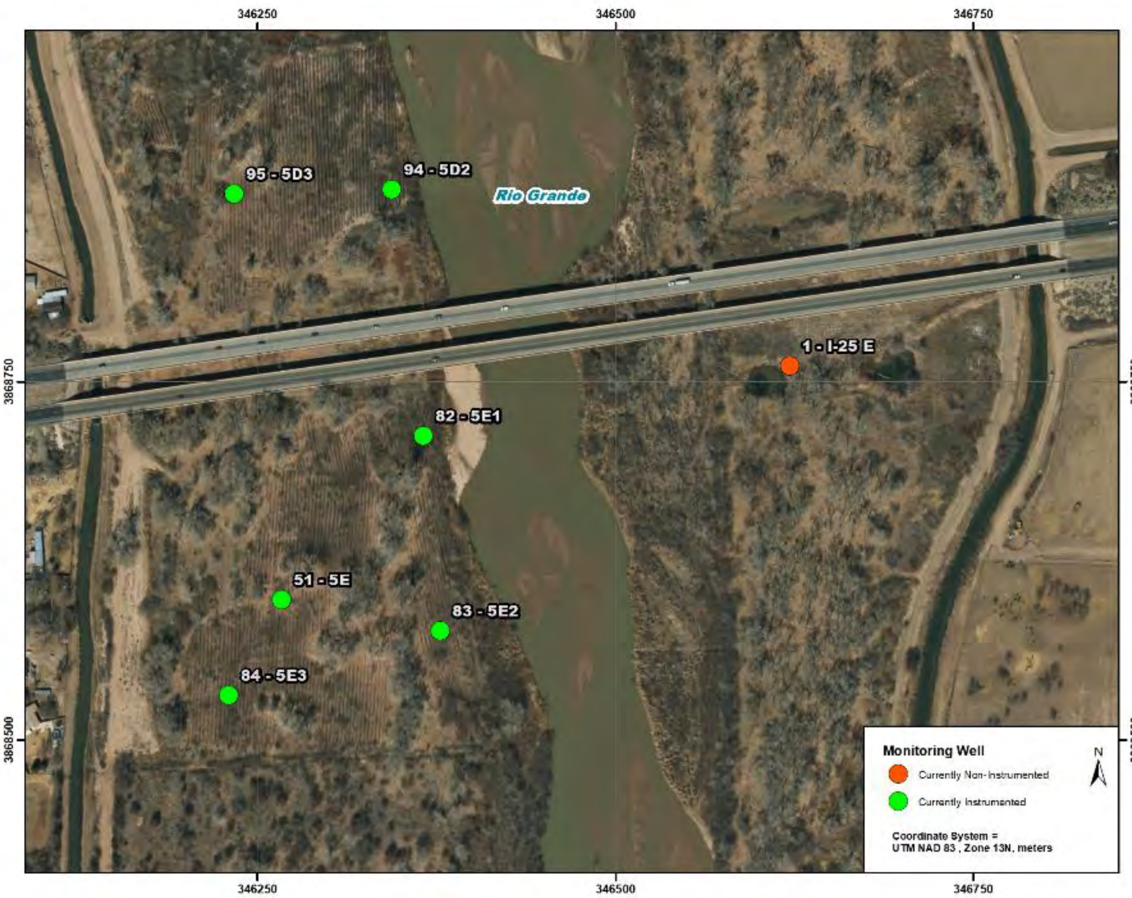

Figure 35. Location of I-25 E, 5D2, 5D3, 5E, 5E1, 5E2, and 5E3 groundwater monitoring wells.

The I-25 E well was installed in April 2005 at 346,622 E; 3,868,761 N (UTM NAD83, Zone 13N) (Figure 35). This well was constructed from 2-inch galvanized steel pipe with a locked cap. In February 2006, it was instrumented with an older generation Solinst Levelogger Model 3001 that collected groundwater data every half hour. The logger was retired on June 30, 2015 after multiple failed download attempts. Groundwater levels were manually measured on a near-monthly basis from March 2009 to May 2020. Groundwater levels were not measured between March 2017 and April 2018 as no contract was in place. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 36. D2GW on measurement dates ranged from 2.61 to 3.64 feet bgs during the annual monitoring period.

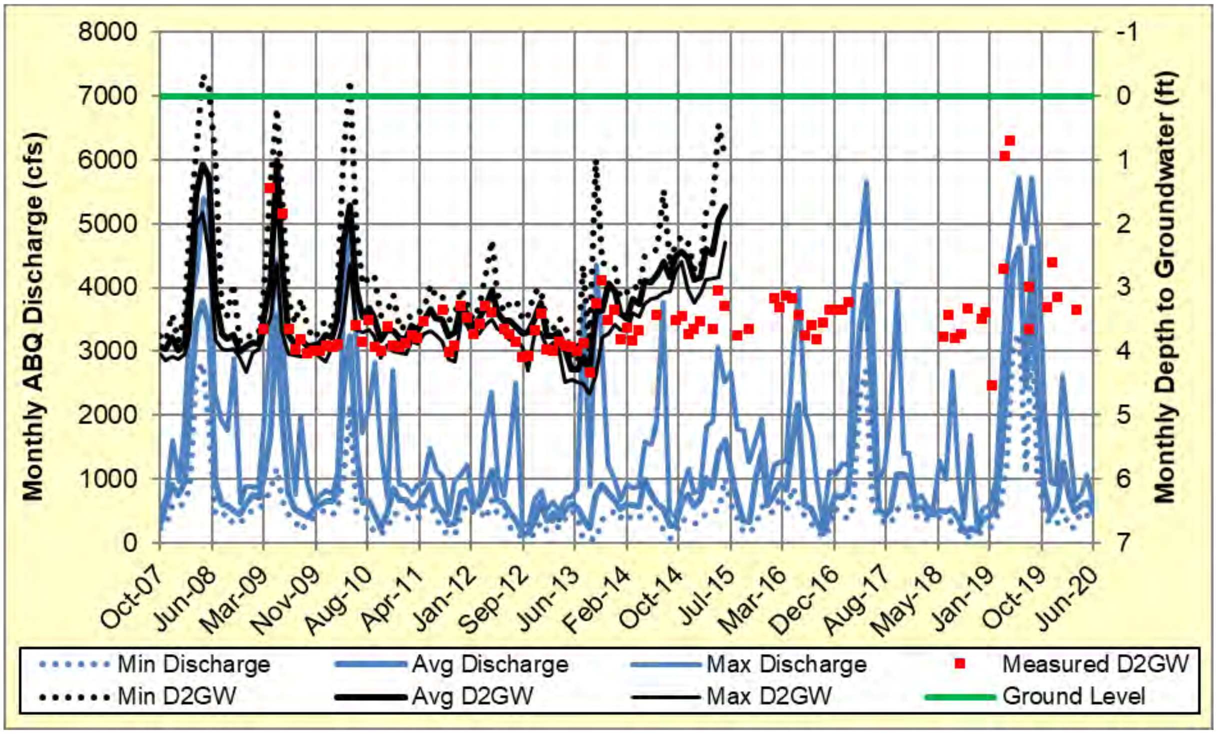

Figure 36. I-25 E well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

3.3 Excavated Habitat Feature (EHF) Wells

D2GW, groundwater temperature, and MRG river discharge are summarized in the following sections for EHF wells monitored during the annual monitoring period. Groundwater data presented includes manual D2GW measurements (all wells), monthly average, maximum, and minimum values for the period of record (instrumented wells), and instantaneous (30-minute) data for the contract monitoring period only (May 2018 – May 2020, instrumented wells). Monthly average, maximum, and minimum values of river discharge (Albuquerque and Alameda gage) are calculated from average daily values, rather than from 15-minute gage data.

3.3.1 1A North Terrace

Figure 37. Location of 1A North Terrace, 1A South Backwater, and 1A S Terrace groundwater monitoring wells.

The 1A North Terrace groundwater well was installed on September 23, 2015 at 355,163 E; 3,902,107 N (UTM NAD83, Zone 13N) (Figure 37). The well is located in a restoration feature constructed in winter 2014 during Phase 2 of the USACE MRG Restoration Project. The 1A North Terrace was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding facilitated by a constructed backwater channel as well as through overbank surface water inundation from the main stem of the Rio Grande.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On September 23, 2015 it was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not measured manually between March 2017 and April 2018 because no contract was in place.

Instantaneous Alameda discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 38. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and Alameda discharge for the complete monitoring period are presented in Figure 39. During the annual monitoring period, groundwater levels ranged from approximately 4.49 feet bgs to 1.65 feet ags. Groundwater remained ags from June 4, 2019 to July 6, 2019 in response to prolonged discharge of greater than 4,000 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Alameda gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 40 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 10 to 20 degrees C.

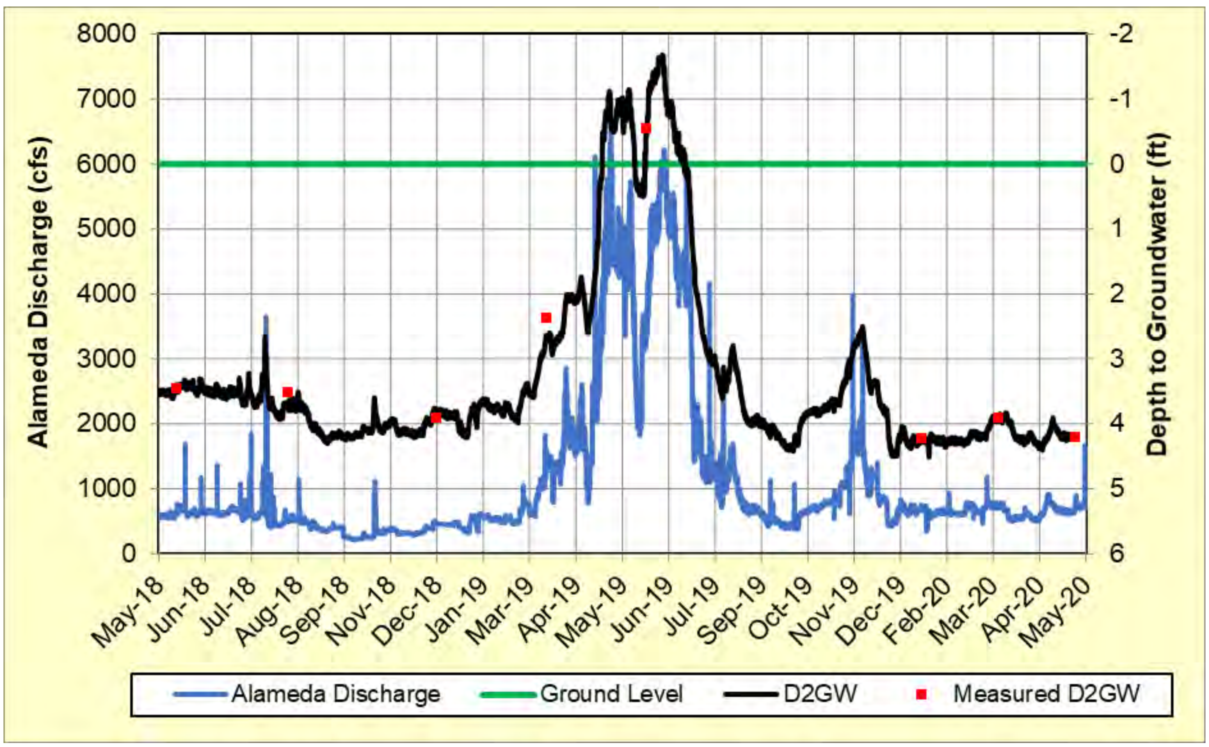

Figure 38. 1A North Terrace well manually measured D2GW, 30-minute D2GW, and 15-minute Alameda discharge data for the annual monitoring period.

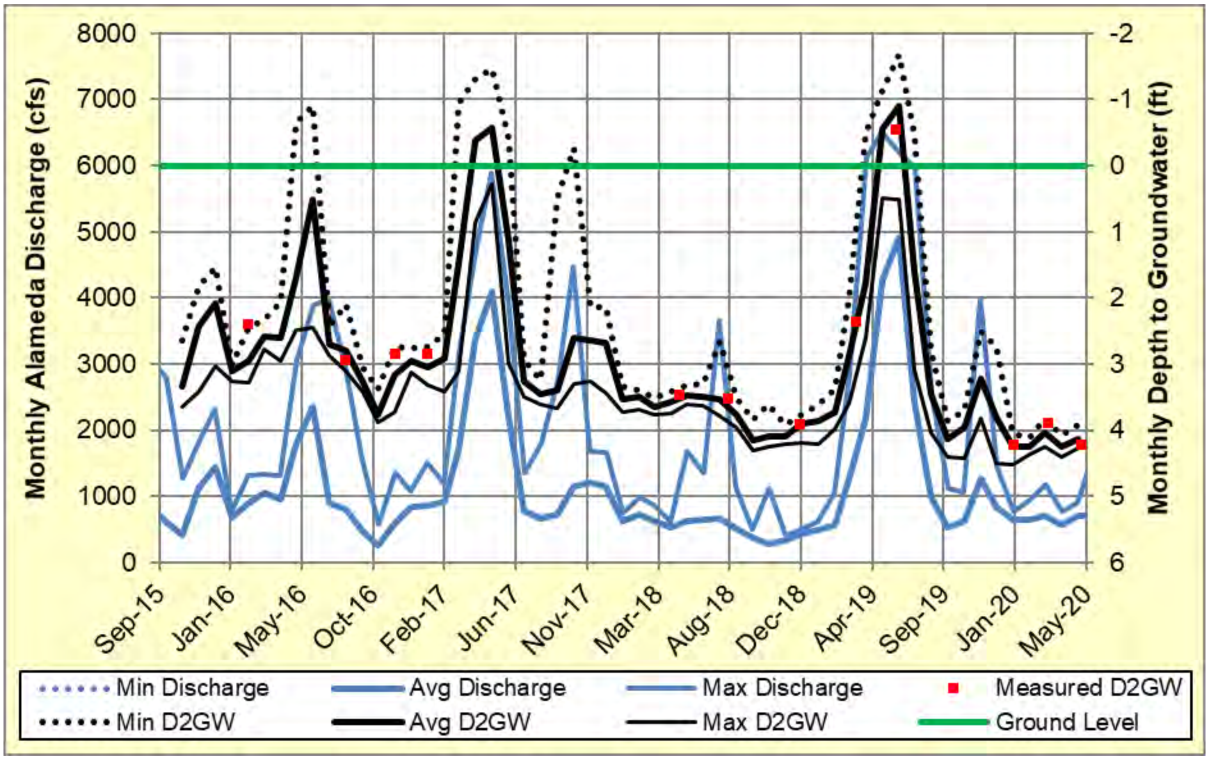

Figure 39. 1A North Terrace well manually measured D2GW and monthly average, maximum and minimum D2GW and Alameda discharge for the monitoring period to date.

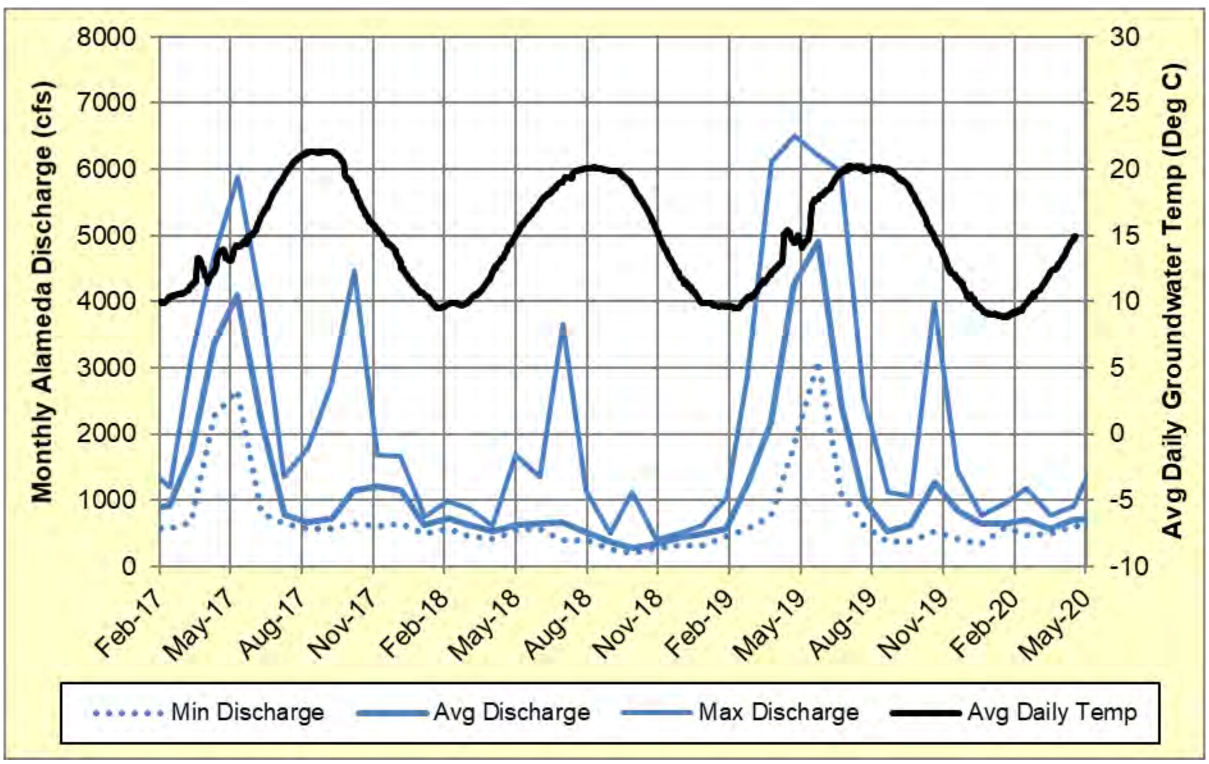

Figure 40. Monthly average, maximum and minimum Alameda discharge and average daily groundwater temperature at the 1A North Terrace well.

3.3.2 1A South Backwater

The 1A South Backwater groundwater well was installed on September 23, 2015 at 355,181 E; 3,902,047 N (UTM NAD83, Zone 13N) (Figure 37). The well was installed within a backwater channel designed to fully inundate when flows at the Alameda Gage exceed approximately 2,000 cfs. This well was constructed from 2-inch galvanized steel pipe with a locked cap. On September 23, 2015 it was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous Alameda discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 41. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and Alameda discharge for the complete monitoring period are presented in Figure 42. During the annual monitoring period, groundwater levels ranged from approximately 2.89 feet bgs to 3.22 feet ags. Groundwater remained ags from April 24, 2019 through July 14, 2019 in response to prolonged river discharge of greater than 1,800 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Alameda gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 43 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 9 to 18 degrees C. Both large seasonal and small temporary fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

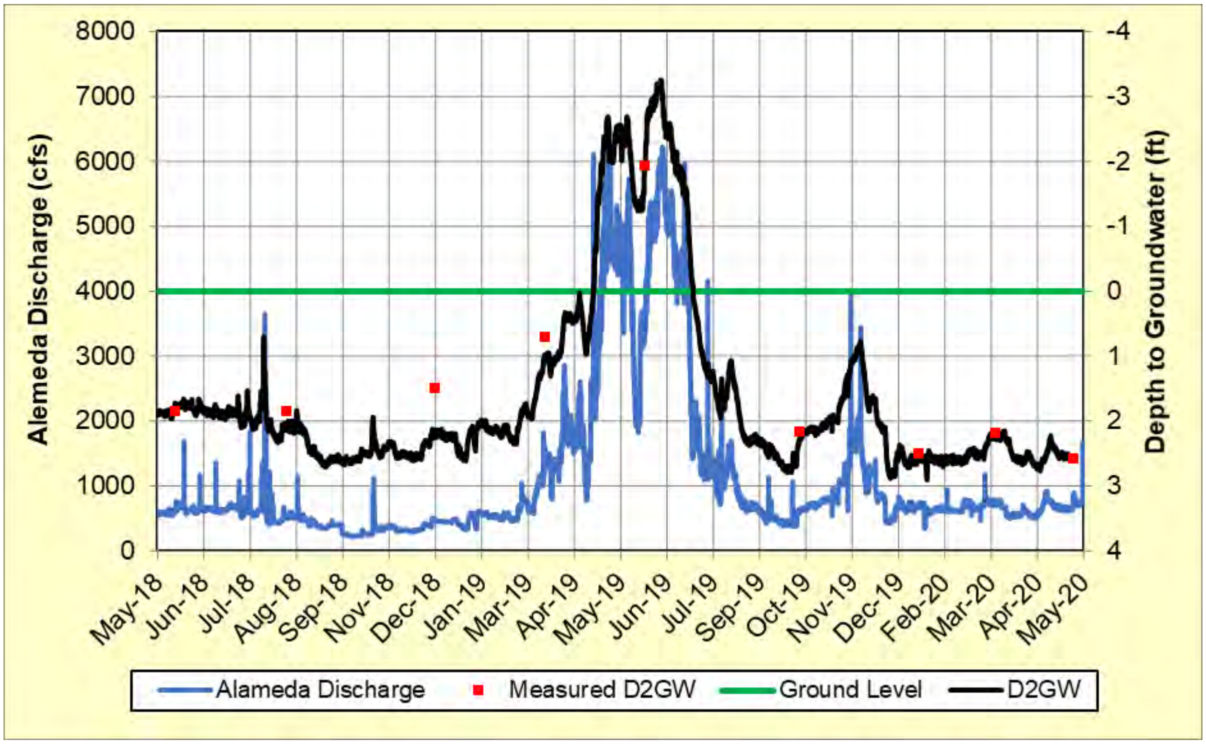

Figure 41. 1A South Backwater well manually measured D2GW, 30-minute D2GW, and 15-minute Alameda discharge data for the annual monitoring period.

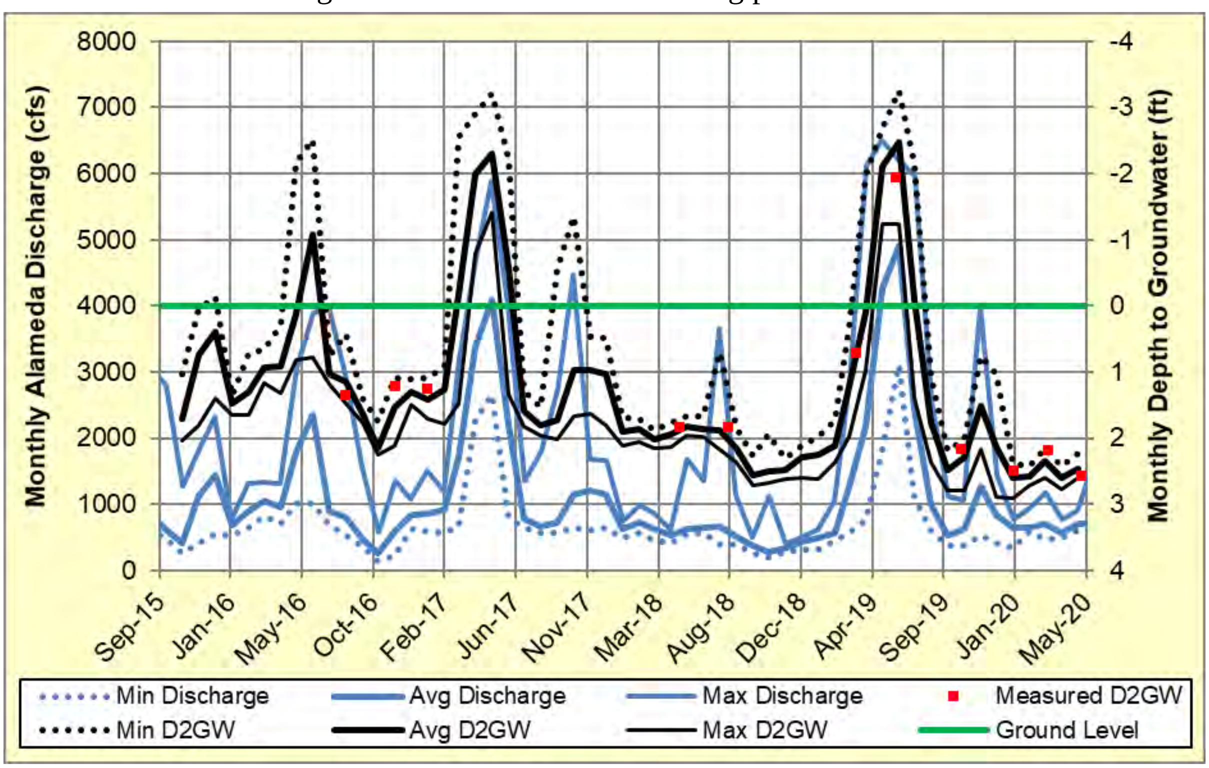

Figure 42. 1A South Backwater well manually measured D2GW and monthly average, maximum and minimum D2GW and Alameda discharge for the monitoring period to date.

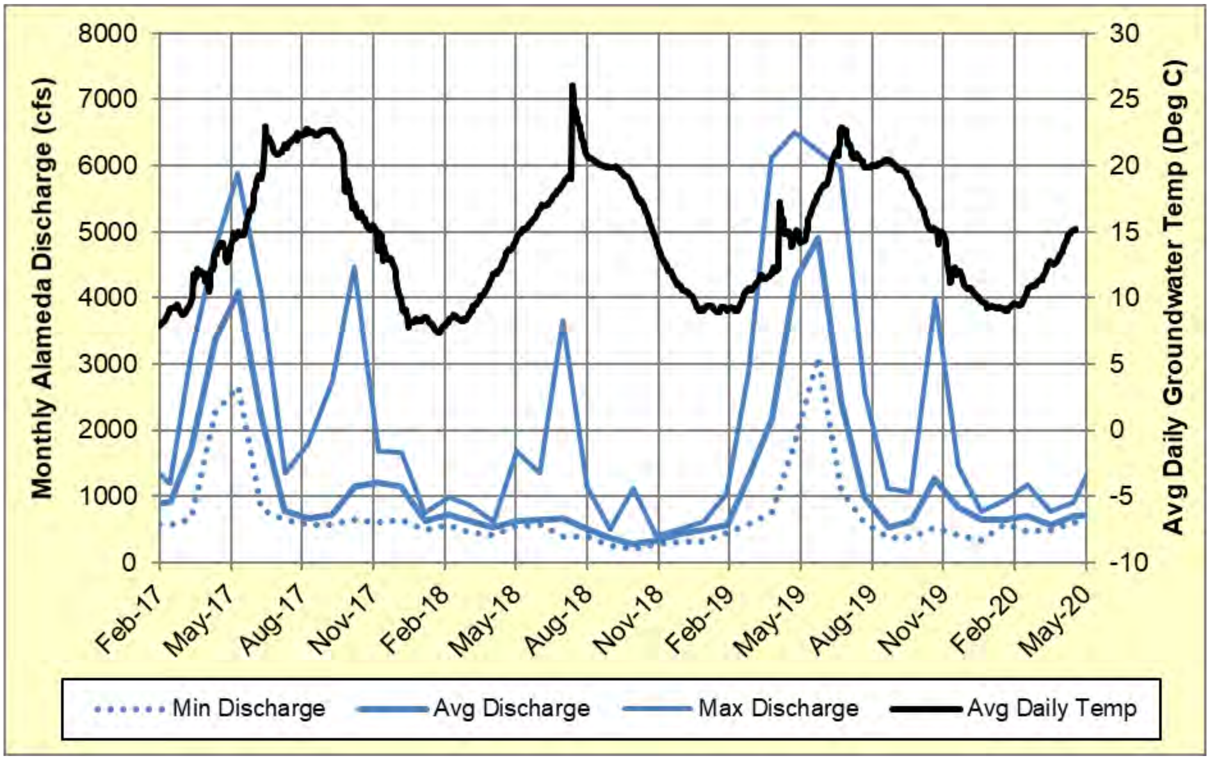

Figure 43. Monthly average, maximum and minimum Alameda discharge and average daily groundwater temperature at the 1A South Backwater well.

3.3.3 1A South Terrace

The 1A South Terrace groundwater well was installed on September 23, 2015 at 355,243 E; 3,901,810 N (UTM NAD83, Zone 13N) (Figure 37). The EHF at 1A South Terrace was constructed in winter 2014 during Phase 2 of the USACE MRG Restoration Project. This feature was designed to attain shallow seasonal groundwater depths no greater than approximately 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On September 23, 2015 it was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. During the May 2020 data download, the PT was found to have failed; therefore, the automated monitoring dataset ends on March 19, 2020. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous Alameda discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 44.

Monthly average, maximum, and minimum D2GW, manually measured D2GW, and Alameda discharge for the complete monitoring period are presented in Figure 45. During the annual monitoring period, groundwater levels ranged from approximately 2.84 feet bgs to 0.91 feet ags. There was a data gap between June 6 and August 7, 2019. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Alameda gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 46 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 2 to 22 degrees C.

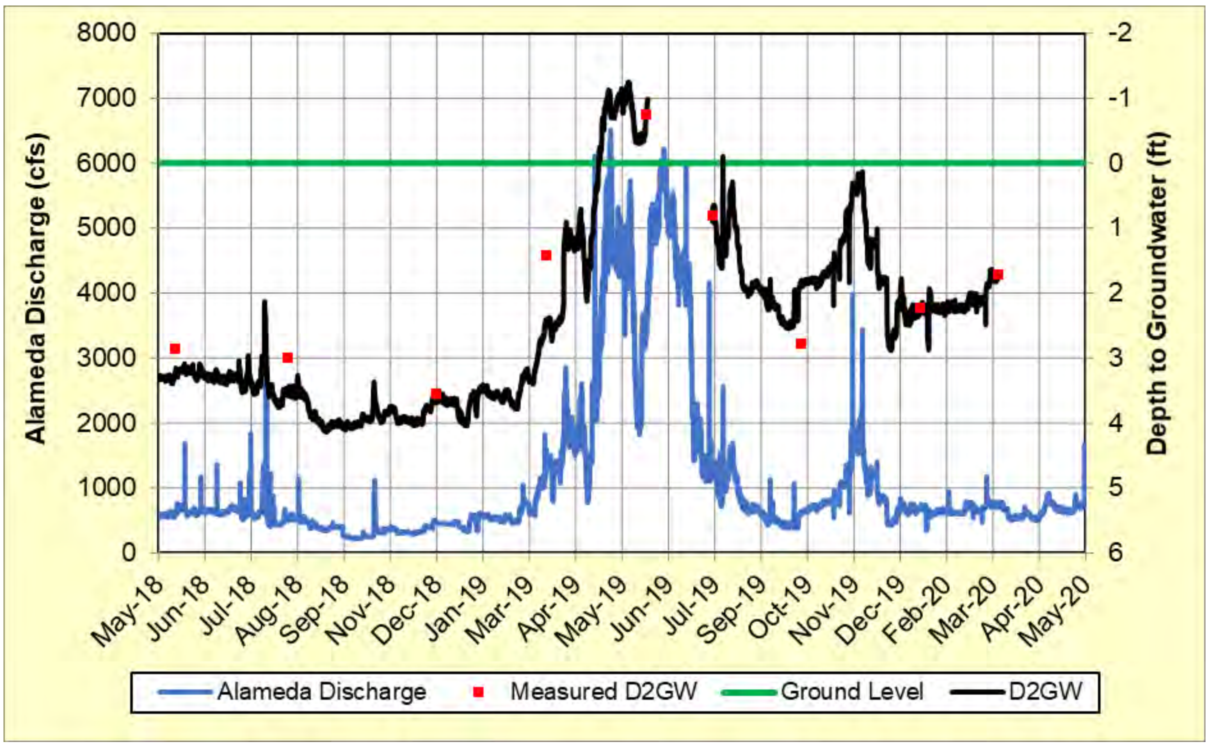

Figure 44. 1A South Terrace well manually measured D2GW, 30-minute D2GW, and 15-minute Alameda discharge data for the annual monitoring period.

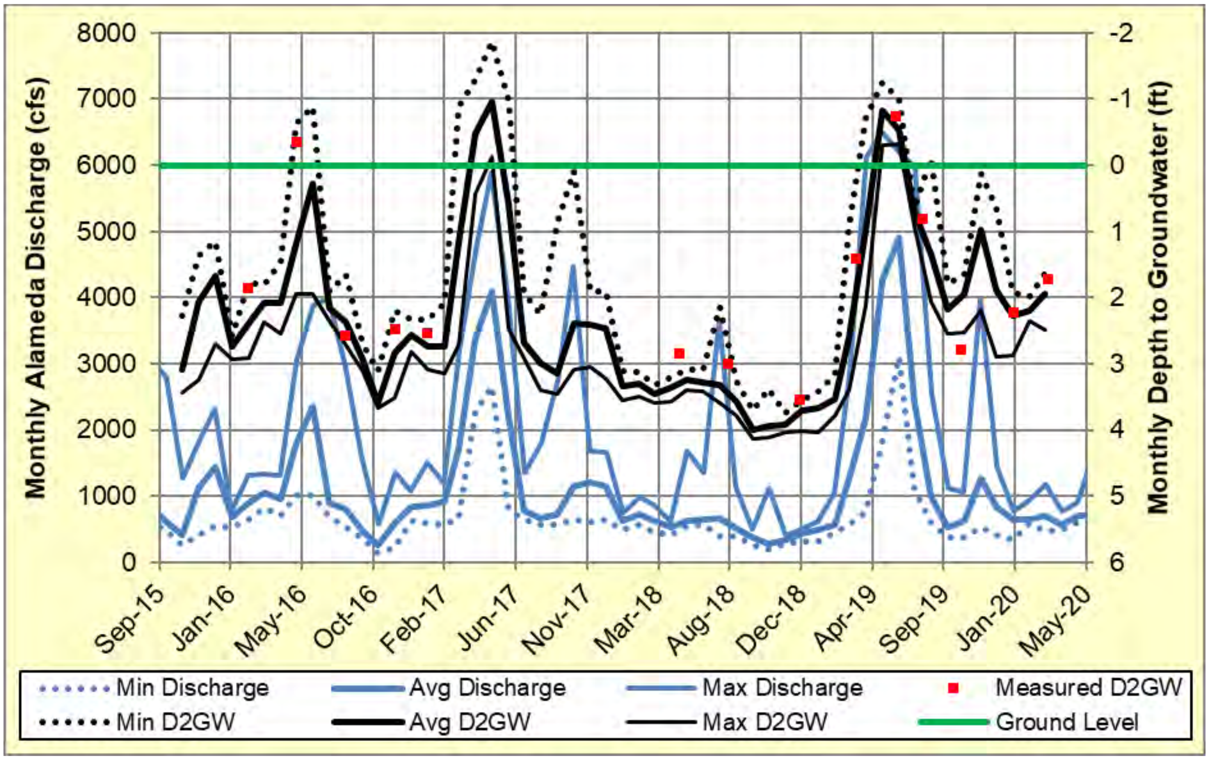

Figure 45. 1A South Terrace well manually measured D2GW and monthly average, maximum and minimum D2GW and Alameda discharge for the monitoring period to date.

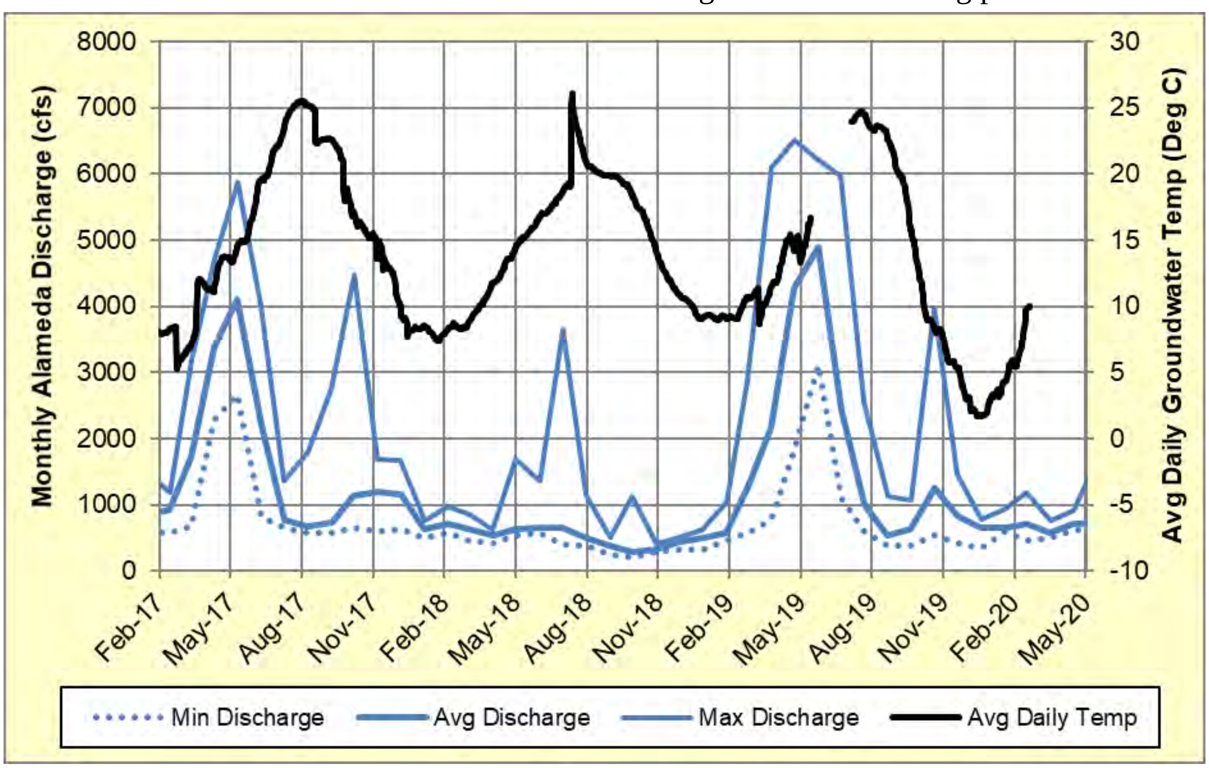

Figure 46. Monthly average, maximum and minimum Alameda discharge and average daily groundwater temperature at the 1A South Terrace well.

3.3.4 1C Swale

Figure 47. Location of 1C Swale, 1F Swale, and 1F North Terrace groundwater monitoring wells.

The 1C Swale groundwater well was installed on September 23, 2015 at 352,541 E; 3,897,660 N (UTM NAD83, Zone 13N) (Figure 47). The well is located in a new restoration feature constructed in winter 2014 during Phase 2 of the USACE MRG Restoration Project. The 1A North Terrace was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience periodic seasonal flooding via rising groundwater and surface water flooding facilitated by a constructed backwater channel that extends from the river to the swale.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On September 23, 2015 it was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous Alameda discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 48. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and Alameda discharge for the complete monitoring period are presented in Figure 49. During the annual monitoring period, groundwater levels ranged from approximately 3.13 feet bgs to 1.96 feet ags. Groundwater remained ags from April 26, 2019 through July 11, 2019 in response to prolonged river discharge of greater than 1,800 cfs.

Figure 50 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 8 to 21 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

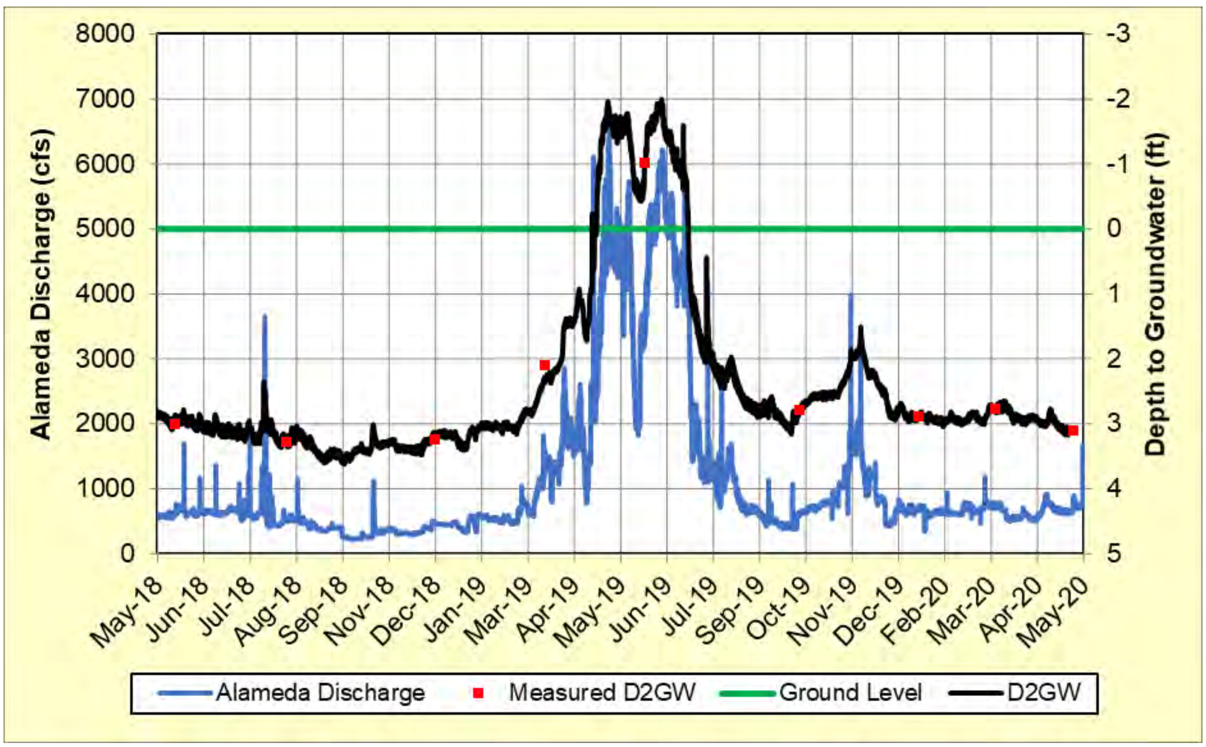

Figure 48. 1C Swale well manually measured D2GW, 30-minute D2GW, and 15-minute Alameda discharge data for the annual monitoring period.

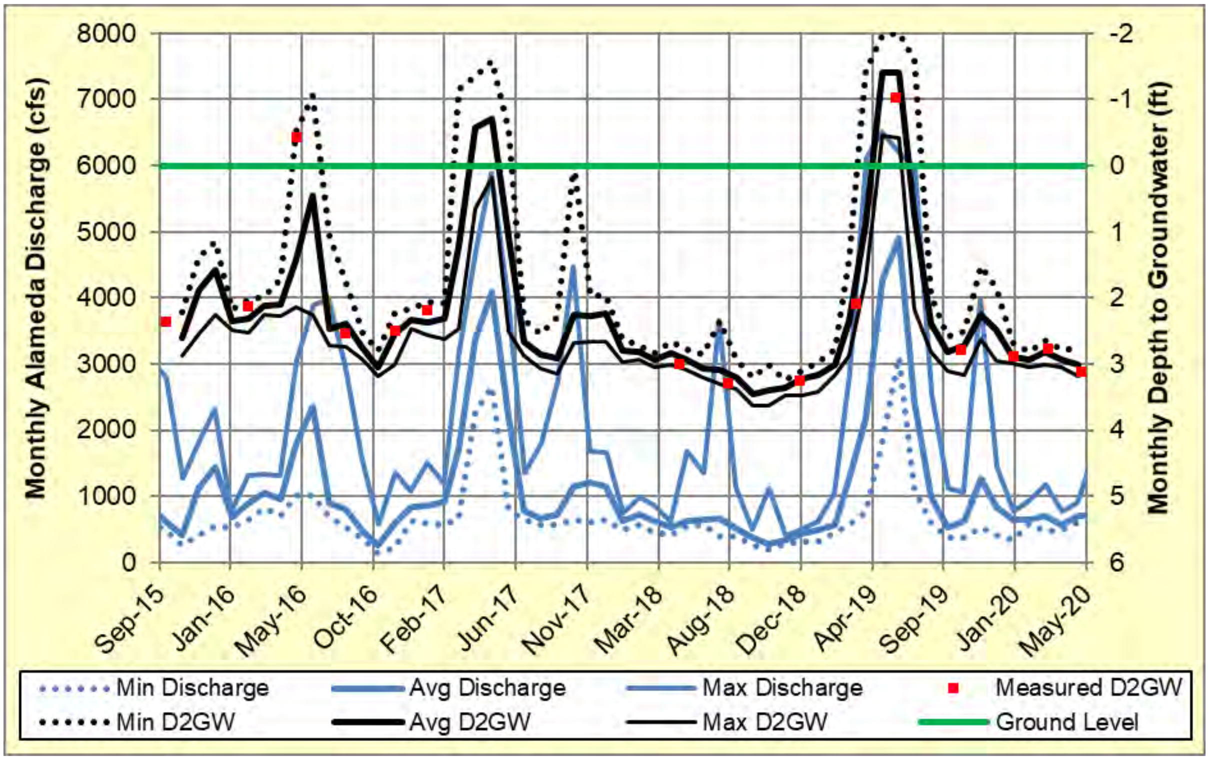

Figure 49. 1C Swale well manually measured D2GW and monthly average, maximum and minimum D2GW and Alameda discharge for the monitoring period to date.

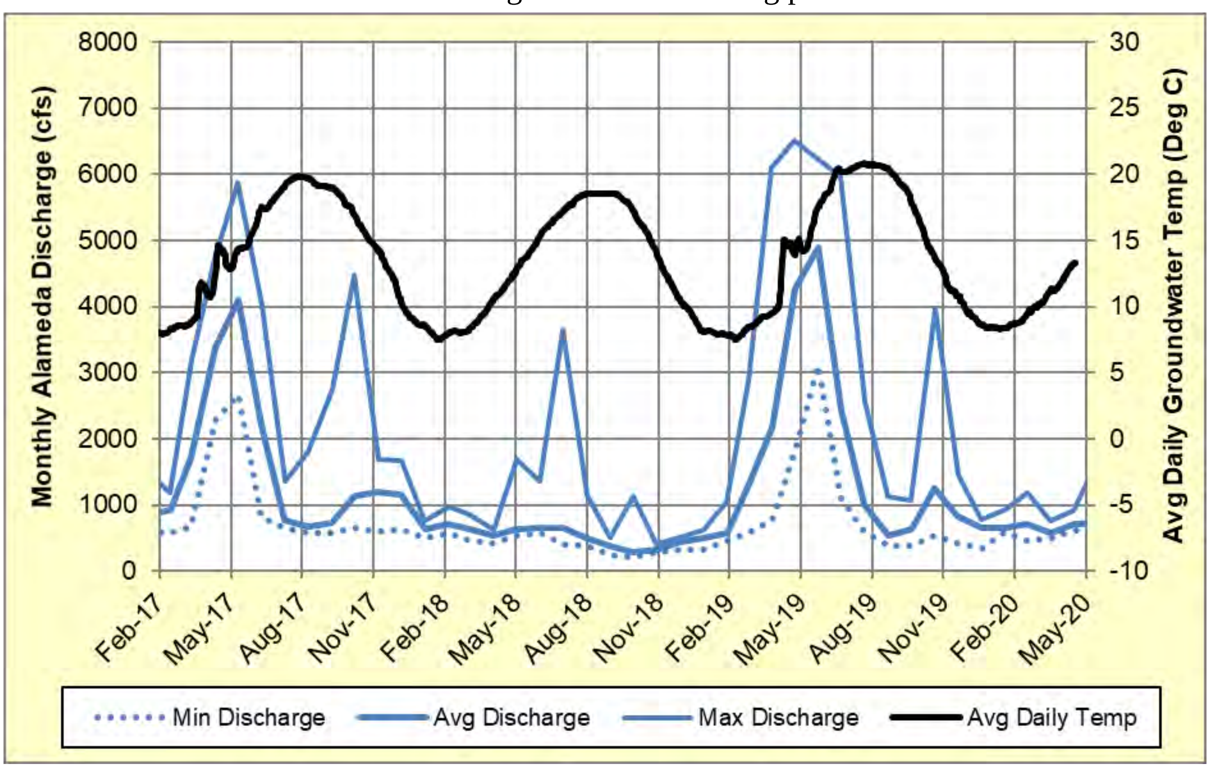

Figure 50. Monthly average, maximum and minimum Alameda discharge and average daily groundwater temperature at the 1C Swale well.

3.3.5 1F Swale

The 1F Swale groundwater well was installed on September 23, 2015 at 352,253 E; 3,897,152 N (UTM NAD83, Zone 13N) (Figure 47). The well is located in a restoration feature constructed in winter 2014 during Phase 2 of the USACE MRG Restoration Project. The 1F Swale was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience periodic seasonal flooding via rising groundwater and overbank flooding by the Rio Grande.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On September 23, 2015 it was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous Alameda discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 51. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and Alameda discharge for the complete monitoring period are presented in Figure 52. During the annual monitoring period, groundwater levels ranged from 0.48 to 6.53 feet bgs. Groundwater was not ags at any point during the monitoring period, despite periodic river discharge of greater than 5,000 cfs. As evidenced during previous monitoring periods, groundwater may be below ground surface despite surface water ponding. This is likely caused by a confining layer which restricts percolation and equilibration of surface water and groundwater.

Figure 53 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 3 to 26 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

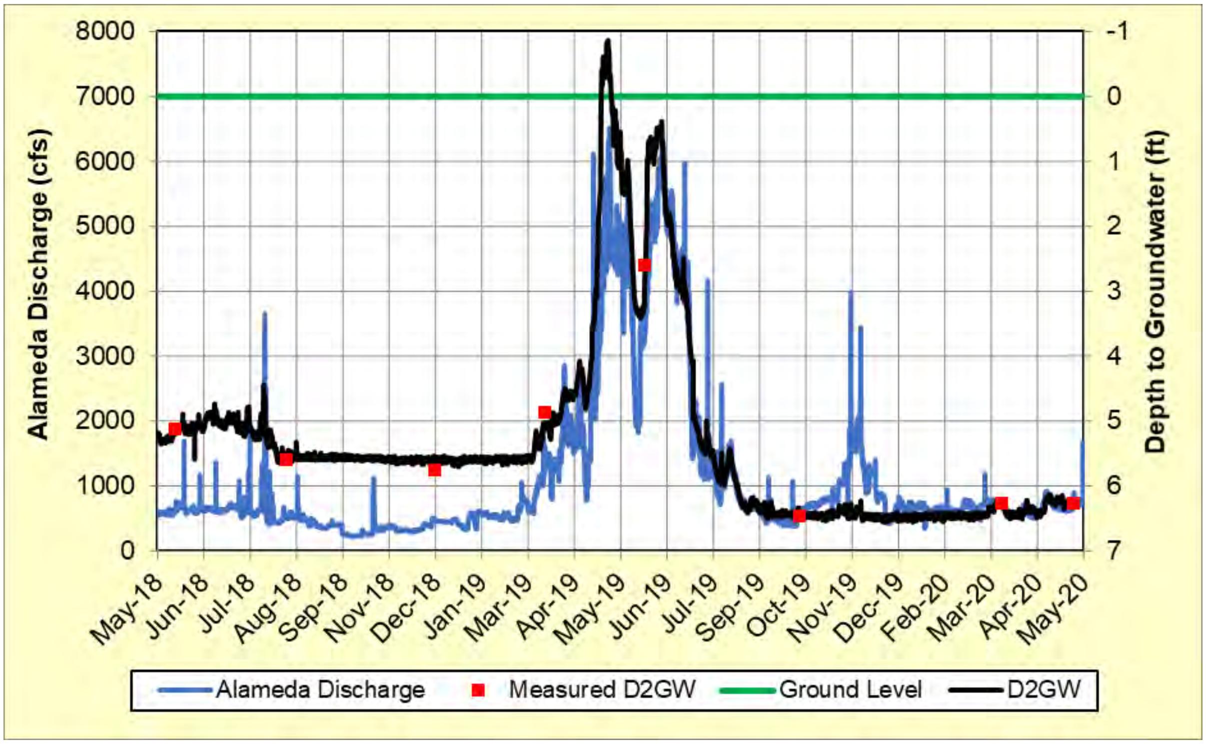

Figure 51. 1F Swale well manually measured D2GW, 30-minute D2GW, and 15-minute Alameda discharge data for the annual monitoring period.

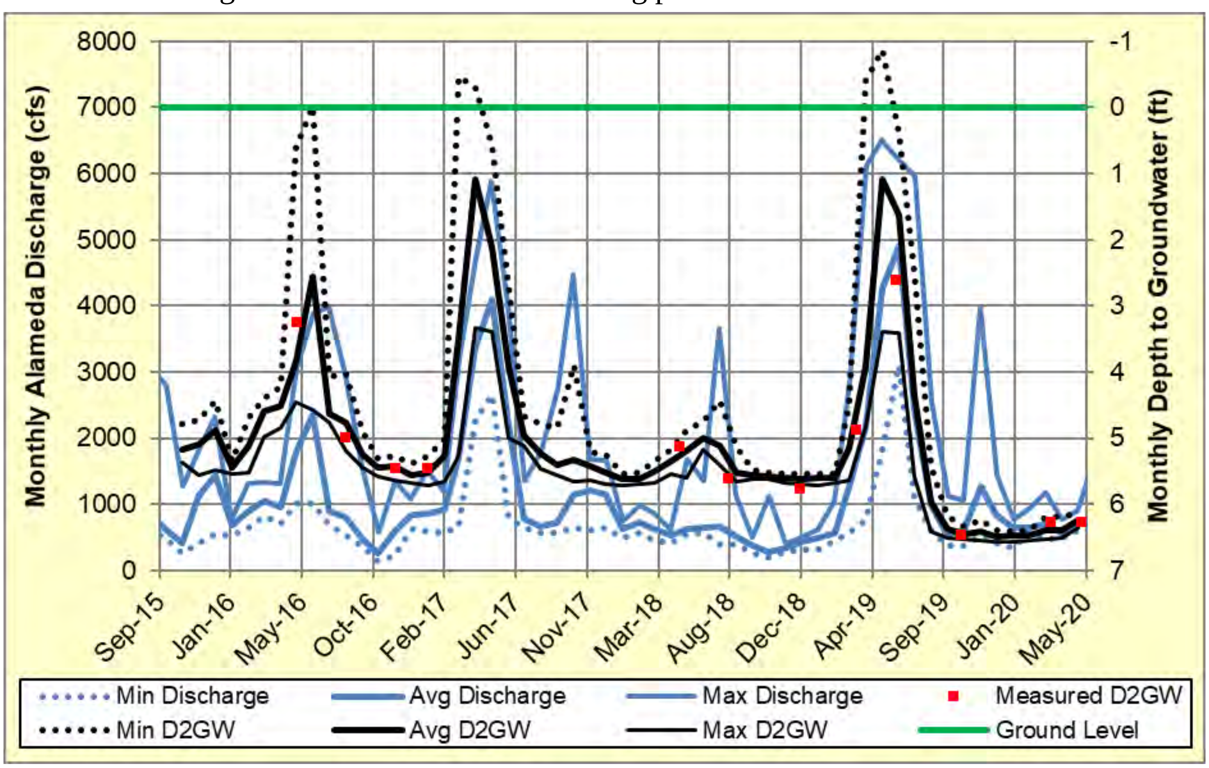

Figure 52. 1F Swale well manually measured D2GW and monthly average, maximum and minimum D2GW and Alameda discharge for the monitoring period to date.

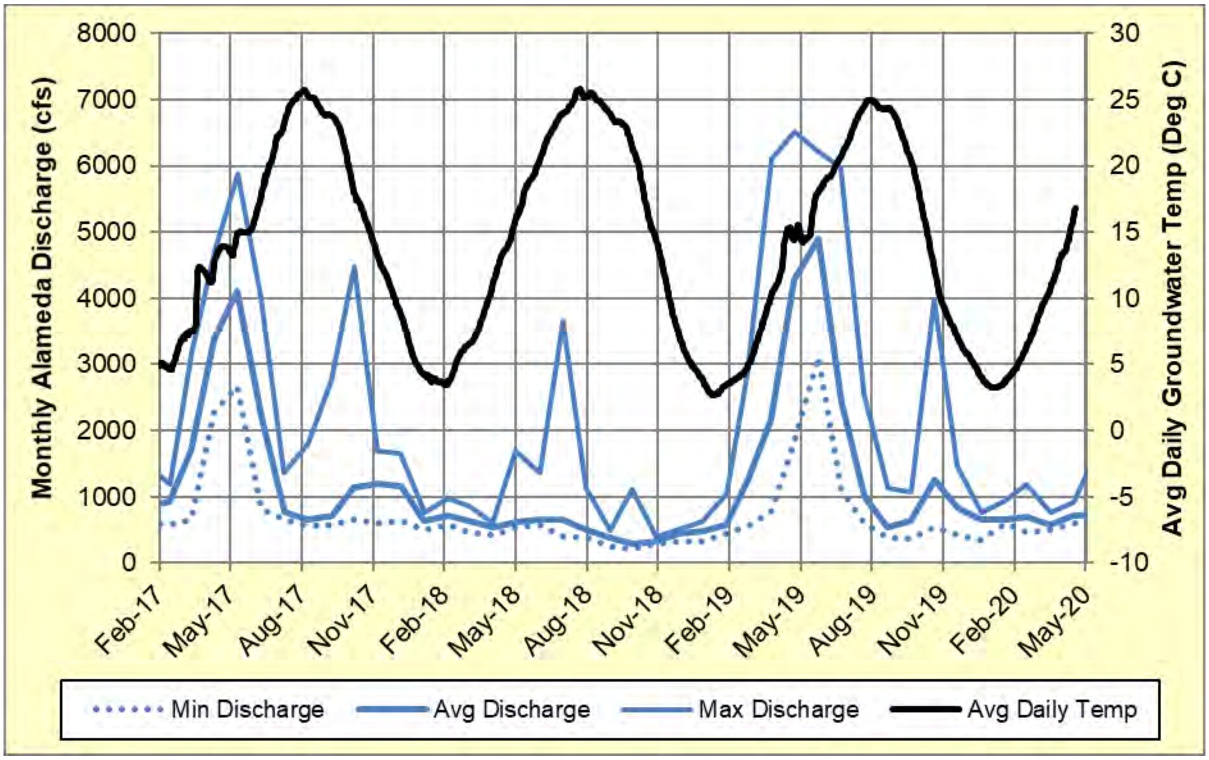

Figure 53. Monthly average, maximum and minimum Alameda discharge and average daily groundwater temperature at the 1F Swale well.

3.3.6 1E Bankline

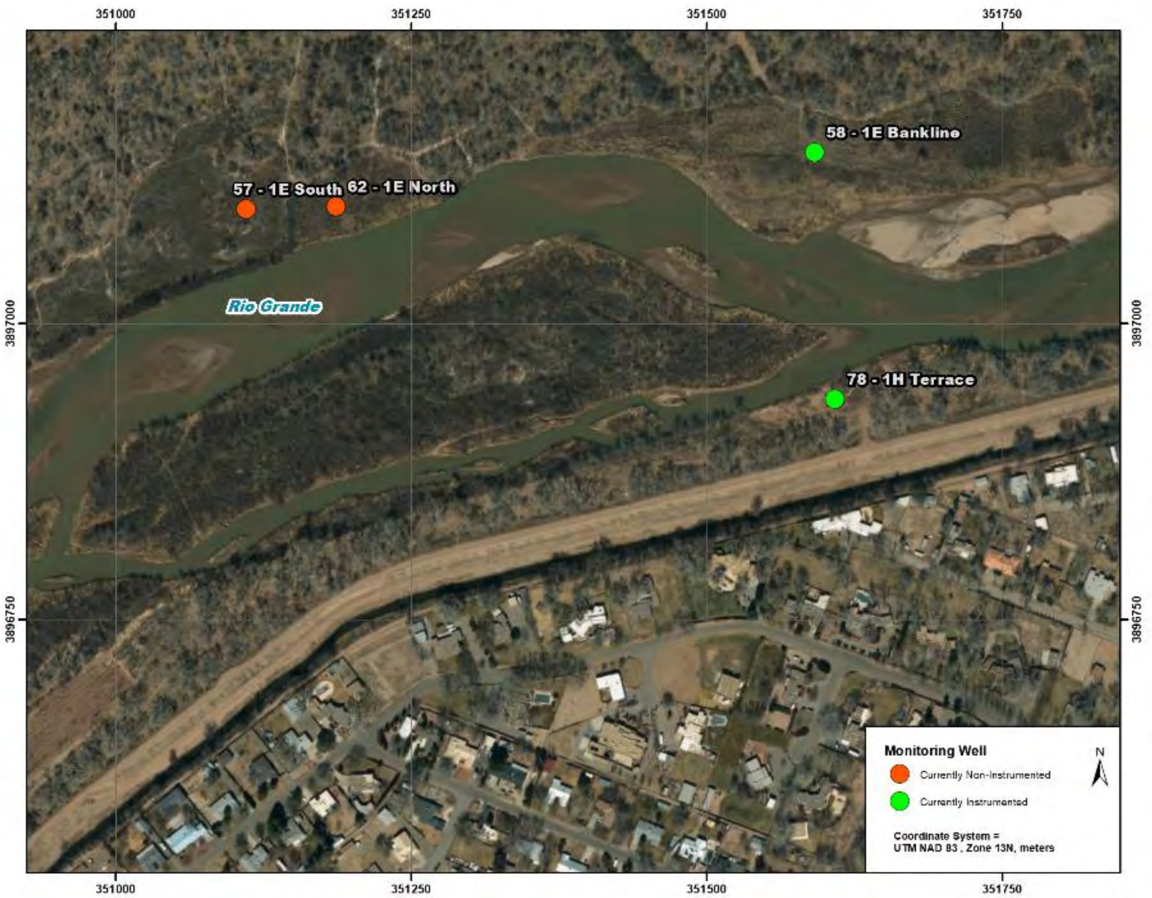

Figure 54. Location of 1E North, 1E South, 1E Bankline, and 1H Terrace groundwater monitoring wells.

The 1E Bankline groundwater well was installed on June 20, 2012 at 351,591 E; 3,897,145 N (UTM NAD83, Zone 13N) (Figure 54). The EHF at 1E Bankline was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 26, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. The PT was retired in December 2018 after repeated failed data download attempts. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015 and March 2019 to May 2020, and on a quarterly basis from February 2016 through December 2018.

Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Monthly average, maximum, and minimum D2GW, manually measured D2GW, and Alameda discharge for the complete monitoring period are presented in Figure 55. During the annual monitoring period, groundwater levels on the measurement dates ranged from approximately 0.96 to 2.12 ft bgs.

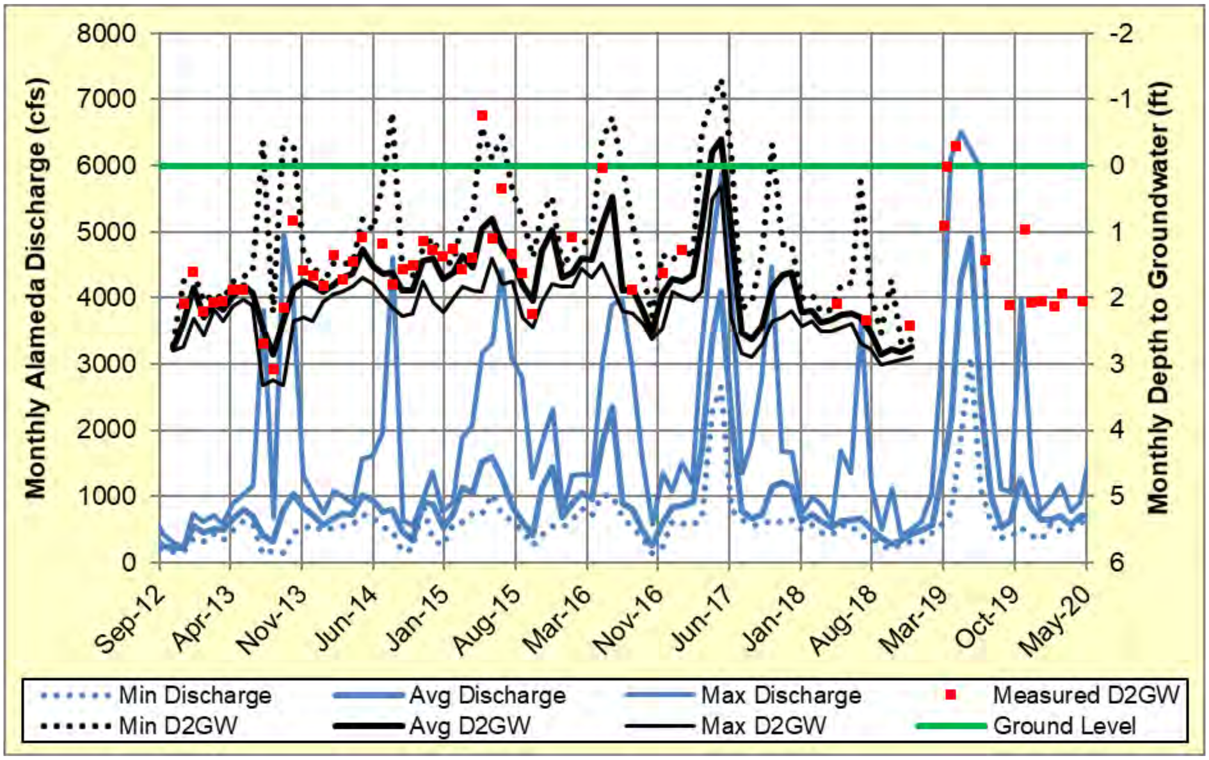

Figure 55. 1E Bankline well manually measured D2GW and monthly average, maximum and minimum D2GW and Alameda discharge.

3.3.7 1E North

The 1E North groundwater well was installed on June 20, 2012 at 351,186 E; 3,897,099 N (UTM NAD83, Zone 13N) (Figure 54). The EHF at 1E North was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This un-instrumented well was constructed from 2-inch galvanized steel pipe with a locked cap. Groundwater levels were manually measured on a near-monthly basis from October 2012 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Monthly measured D2GW and monthly average, maximum, and minimum Alameda discharge for the monitoring period to date are presented in Figure 56. Depth to groundwater on the annual measurement dates fluctuated between approximately 1.49 and 2.67 feet bgs.

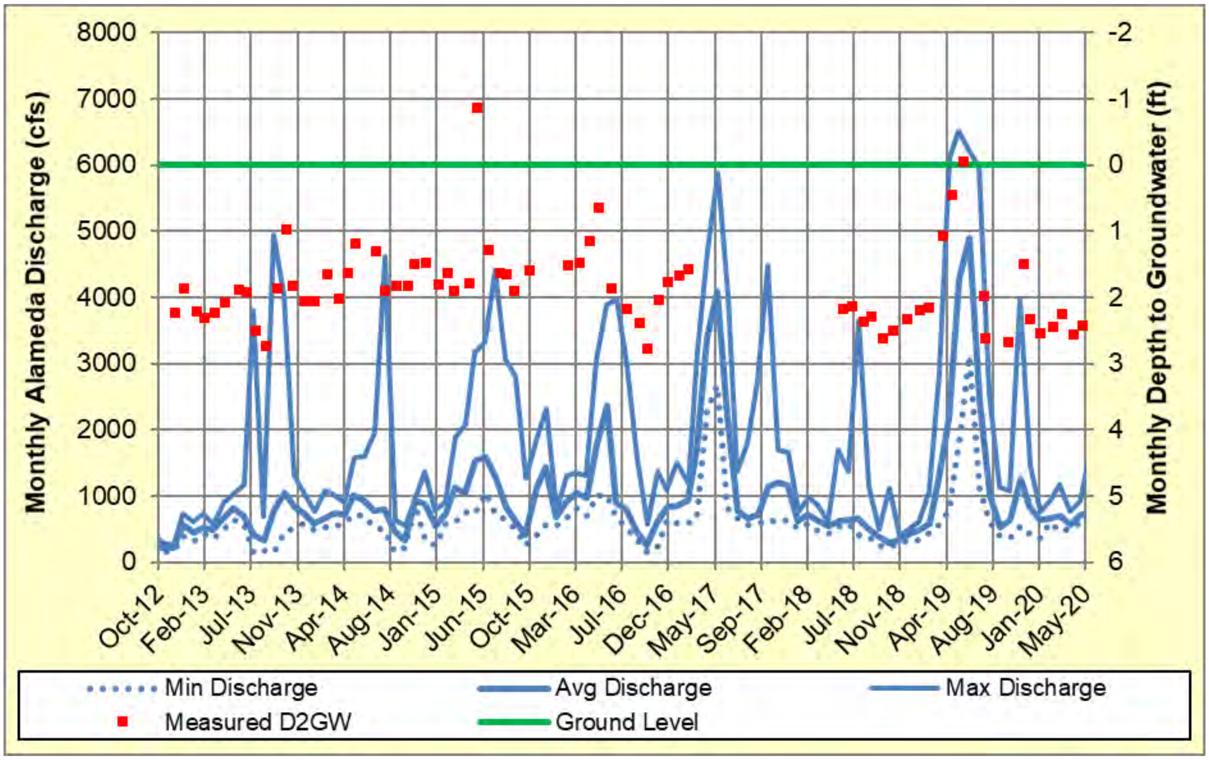

Figure 56. 1E North well manually measured D2GW and monthly average, maximum and minimum Alameda discharge.

3.3.8 1E South

The 1E South groundwater well was installed on June 20, 2012 at 351,591 E; 3,897,145 N (UTM NAD83, Zone 13N) (Figure 54). The EHF at 1E South was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 26, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. The data was not retrievable from the PT during the January 2020 well visit and the PT was retired; automated data is therefore only available through October 10, 2019. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015 and January 2020 to May 2020, and on a quarterly basis from February 2016 through January 2020.

Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous Alameda discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 57. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and Alameda discharge for the complete monitoring period are presented in Figure 58. During the annual monitoring period, groundwater levels ranged from approximately 1.97 feet bgs to 0.18 ft ags. Groundwater was ags from June 7, 2019 through July 7, 2019 in response to river discharge of greater than approximately 4,100 cfs.

Figure 59 shows the groundwater temperature relative to the discharge profile. Historically, temperature fluctuated seasonally from approximately 5 to 22 degrees C, although seasonal data is not available for the current monitoring period due to PT failure.

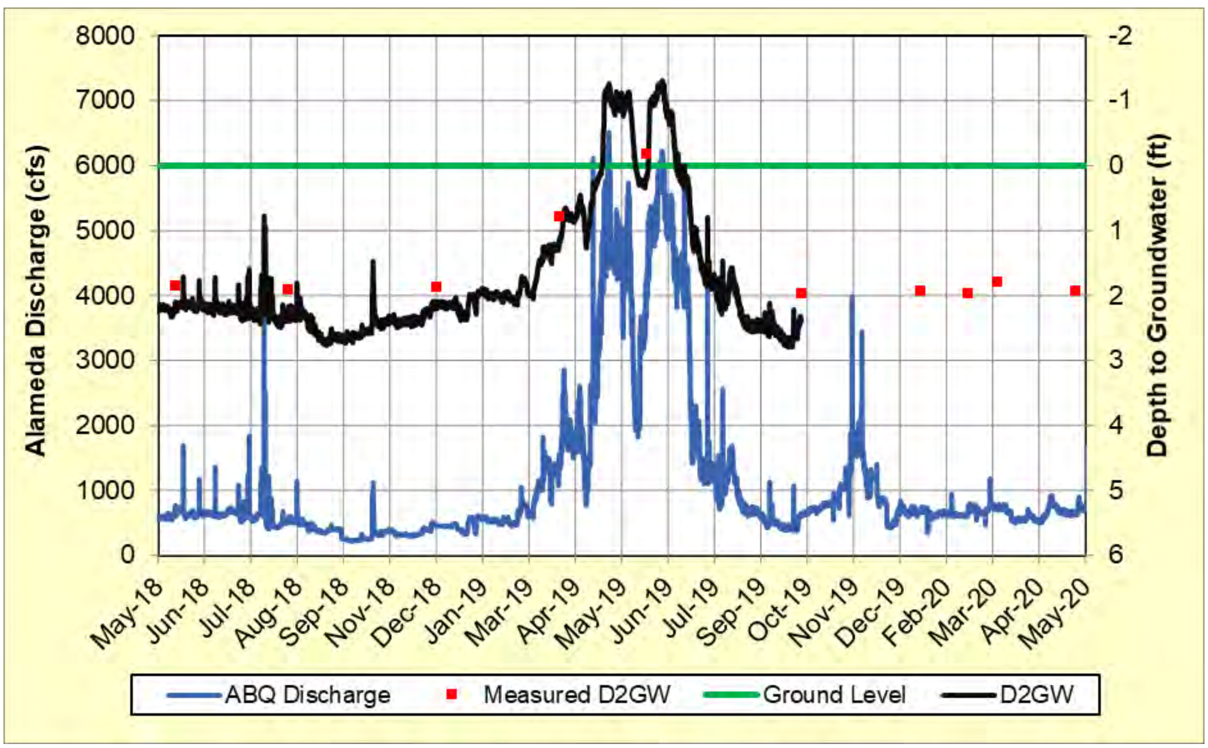

Figure 57. 1E South well manually measured D2GW, 30-minute D2GW, and 15-minute Alameda discharge data for the annual monitoring period.

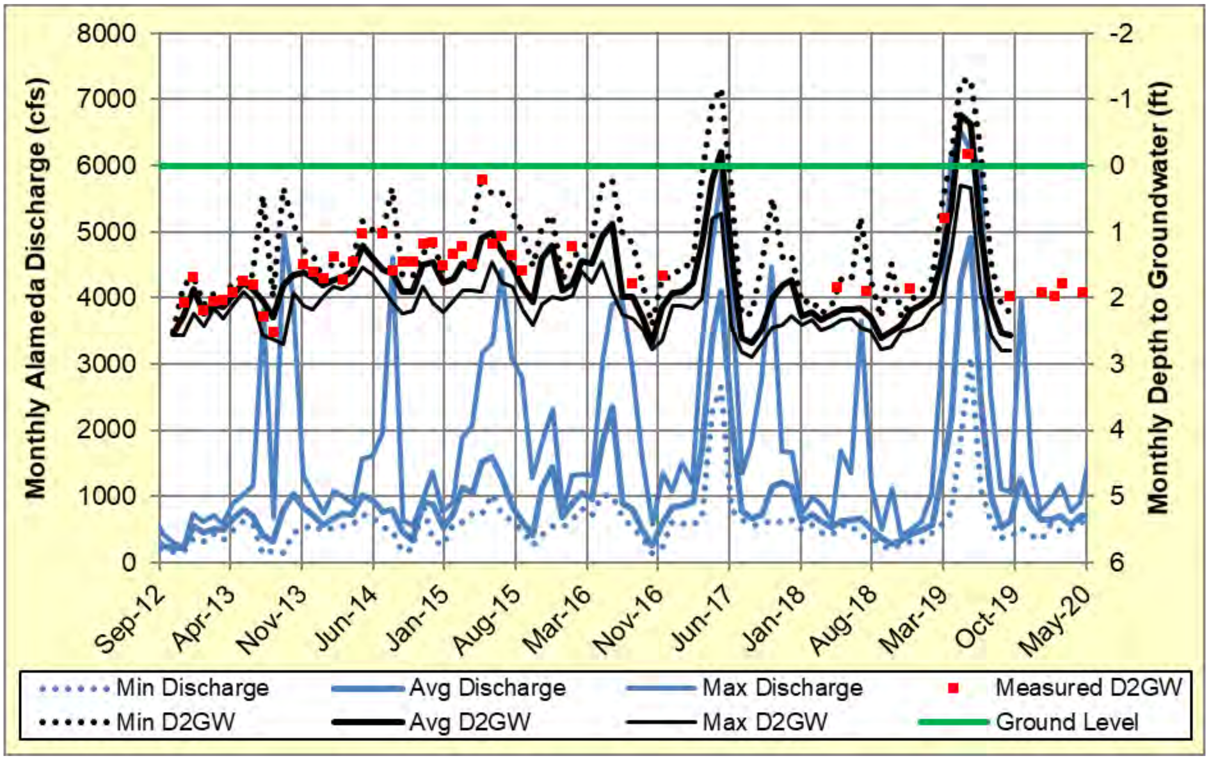

Figure 58. 1E South well manually measured D2GW and monthly average, maximum and minimum D2GW and Alameda discharge.

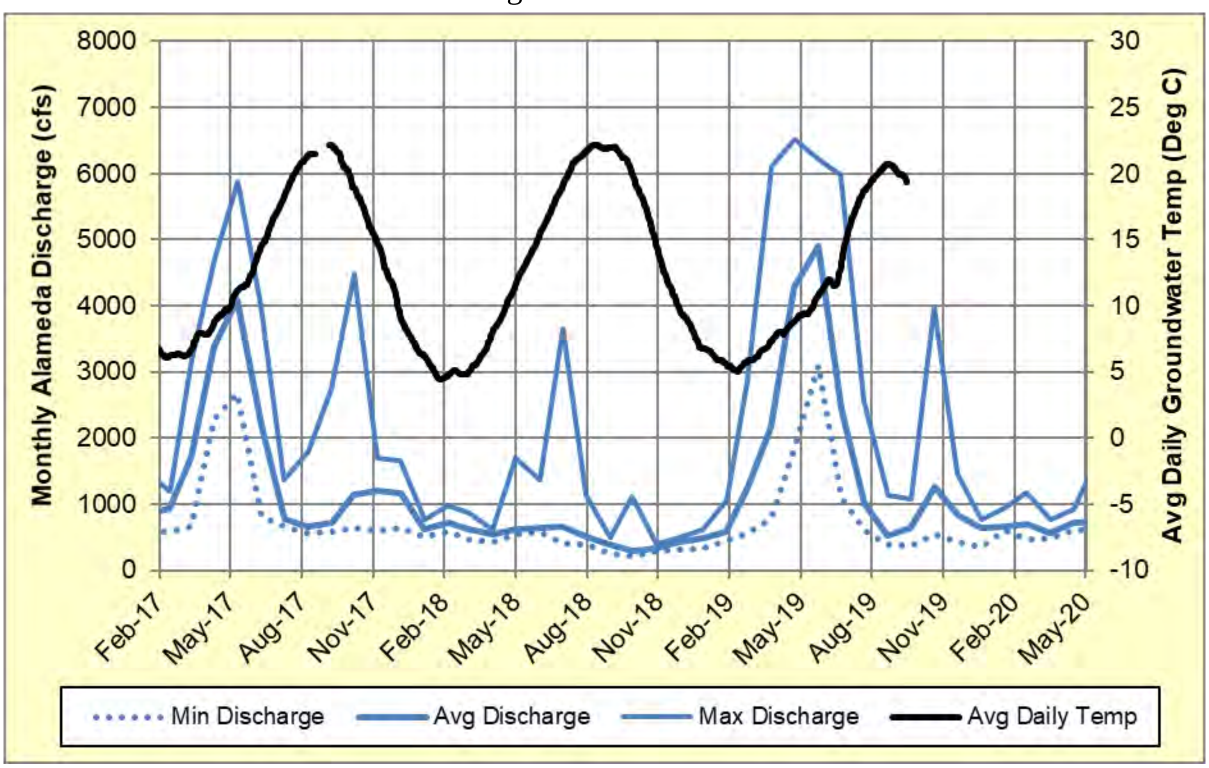

Figure 59. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 1E South well.

3.3.9 1H Terrace

The 1H Terrace groundwater well was installed on September 23, 2015 at 351,608 E; 3,896,937 N (UTM NAD83, Zone 13N) (Figure 54

Figure 54). The well is located in a new restoration feature constructed in winter 2014 during Phase 2 of the USACE MRG Restoration Project. The 1H Terrace was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience periodic seasonal flooding via rising groundwater and overbank flooding by the Rio Grande. This well was constructed from 2-inch galvanized steel pipe with a locked cap. On September 23, 2015 it was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous Alameda discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 60. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and

Alameda discharge for the complete monitoring period are presented in Figure 61. During the annual monitoring period, groundwater levels ranged from 2.89 to 7.75 feet bgs. Groundwater dropped below the PT from mid-September 2018 through mid-February 2019, as evidenced by flatlined data and a manual measurement which exceeded the PT estimated depth to groundwater. The hang length was extended during the current monitoring period to prevent water levels from dropping below the PT. Groundwater was not above ground surface at any point during the monitoring period.

Figure 62 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 3 to 23 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

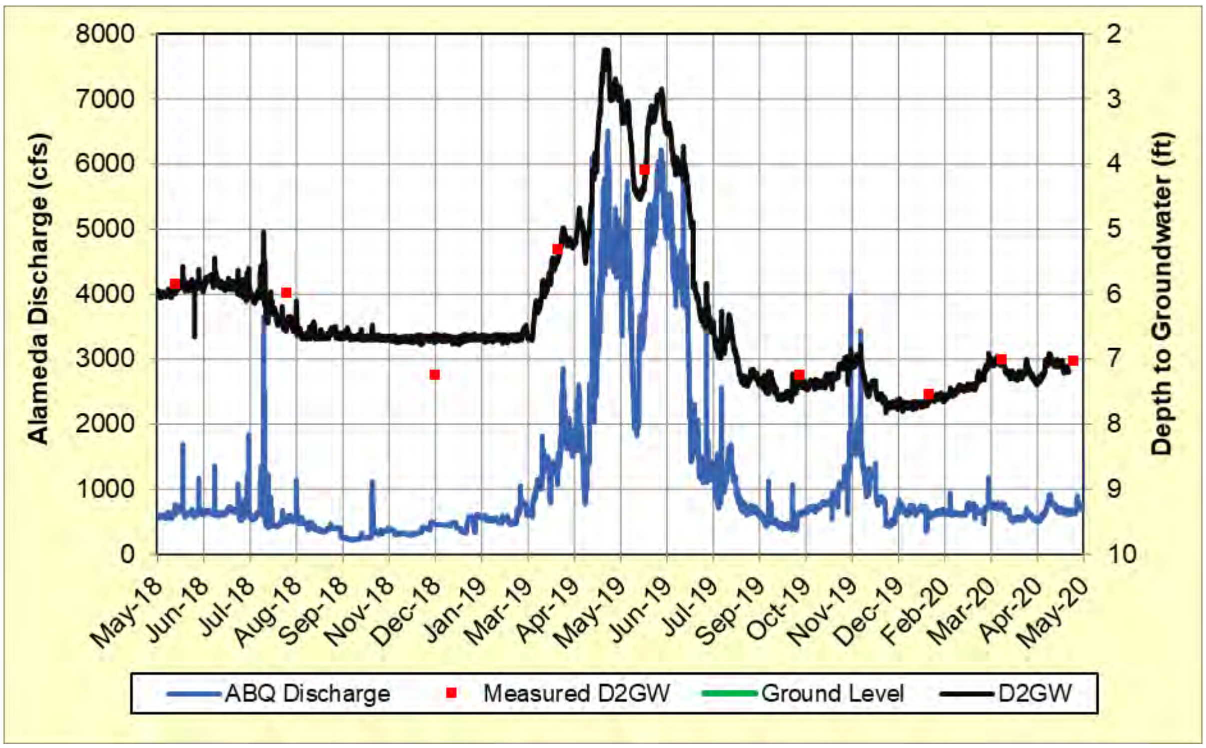

Figure 60. 1H Terrace well manually measured D2GW, 30-minute D2GW, and 15-minute Alameda discharge data for the annual monitoring period.

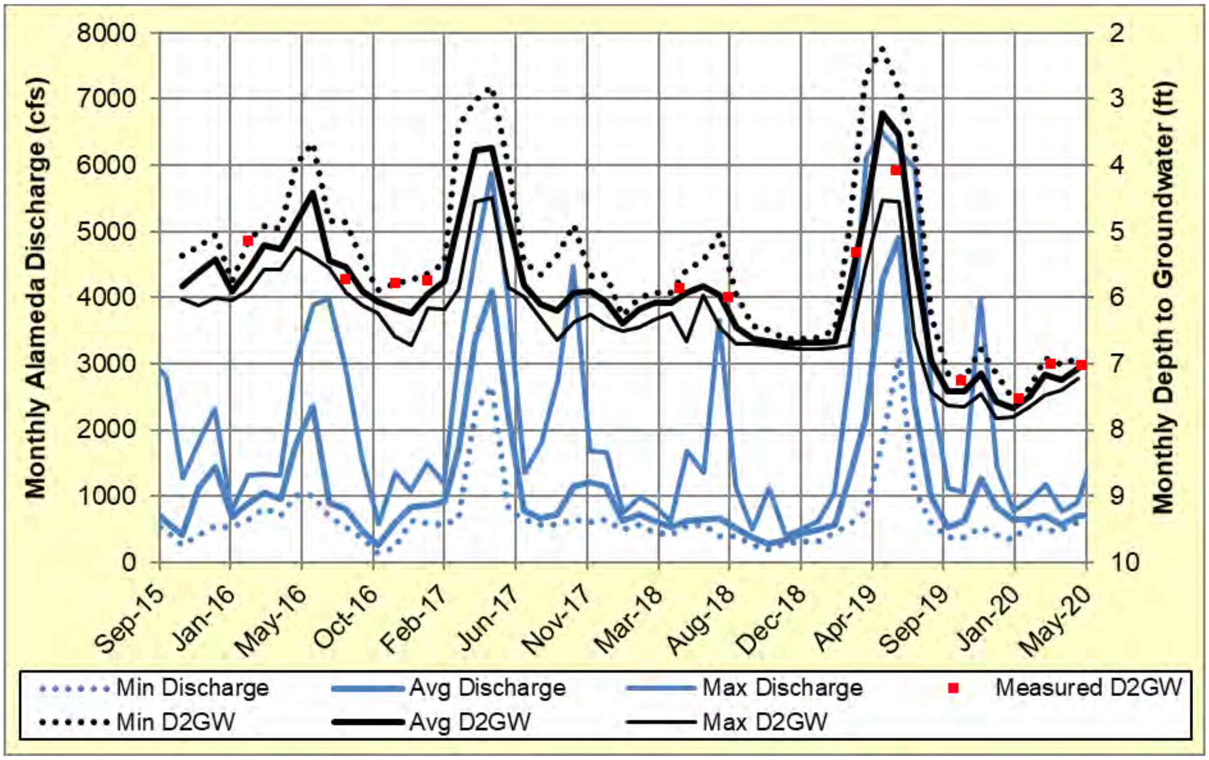

Figure 61. 1H Terrace well manually measured D2GW and monthly average, maximum and minimum D2GW and Alameda discharge for the monitoring period to date.

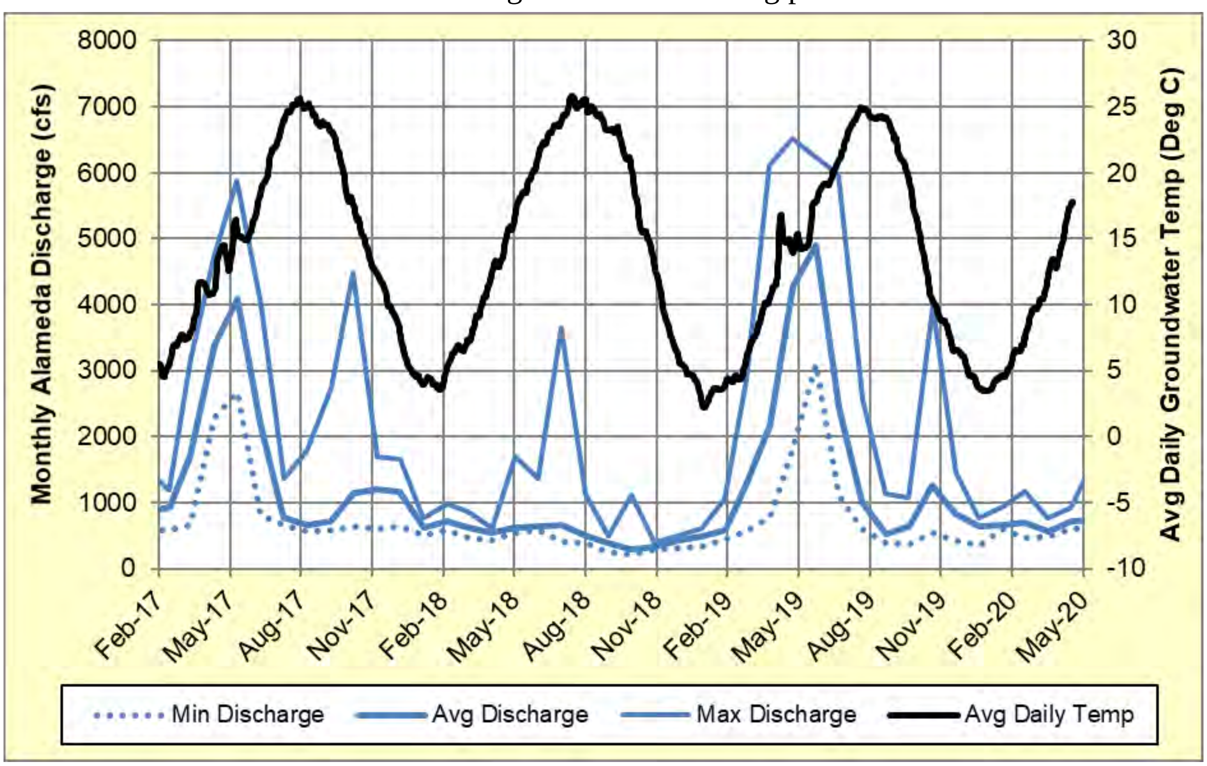

Figure 62. Monthly average, maximum and minimum Alameda discharge and average daily groundwater temperature at the 1H Terrace well.

3.3.10 1G

The 1G groundwater well was installed in June 2012 at 350,627 E; 3,896,715 N (UTM NAD83, Zone 13N) (Figure 8). The EHF at 1G was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 26, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. In May 2018, the datalogger was found to be non-functional and was removed from the well. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015 and June 2018 to May 2020, and on a quarterly basis from October 2015 through March 2017. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place. The May 2020 manual measurement was erroneous and omitted as an outlier.

Monthly average, maximum, and minimum D2GW, manually measured D2GW, and Alameda discharge for the complete monitoring period are presented in Figure 63. Groundwater levels ranged from approximately 1.12 to 2.17 feet bgs on the annual monitoring dates.

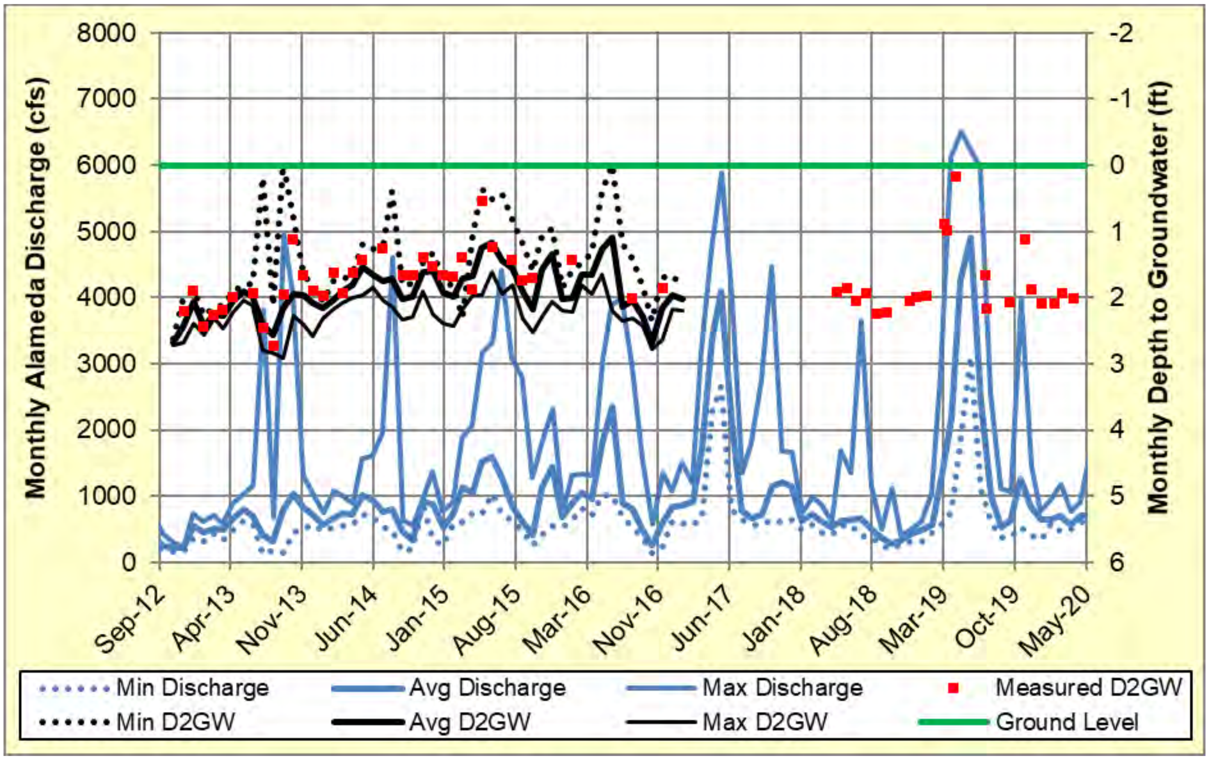

Figure 63. 1G well manually measured D2GW and monthly average, maximum and minimum D2GW and Alameda discharge.

3.3.11 Oxbow North Scallop

The Oxbow North Scallop groundwater well was installed on October 12, 2015 at 346,272 E; 3,889,448 N (UTM NAD83, Zone 13N) (Figure 17). The Oxbow North Scallop was designed to attain shallow seasonal groundwater depths no greater than 2-feet below the ground surface, and to experience periodic seasonal flooding via rising groundwater and overbank flooding by the Rio Grande. Groundwater levels are also influenced by an irrigation return drain that supplies water to the adjacent oxbow lake to the west.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 12, 2015 it was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 64. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 65. During the annual monitoring period, groundwater levels ranged from approximately 1.24feet bgs to 2.69 feet ags. Groundwater was ags from March 13, 2019 through August 7, 2019 in response to discharge of greater than approximately 1,400 cfs. Groundwater level fluctuations closely followed changes in river discharge. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 66 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 6 to 22 degrees C. Both large seasonal and small temporary fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

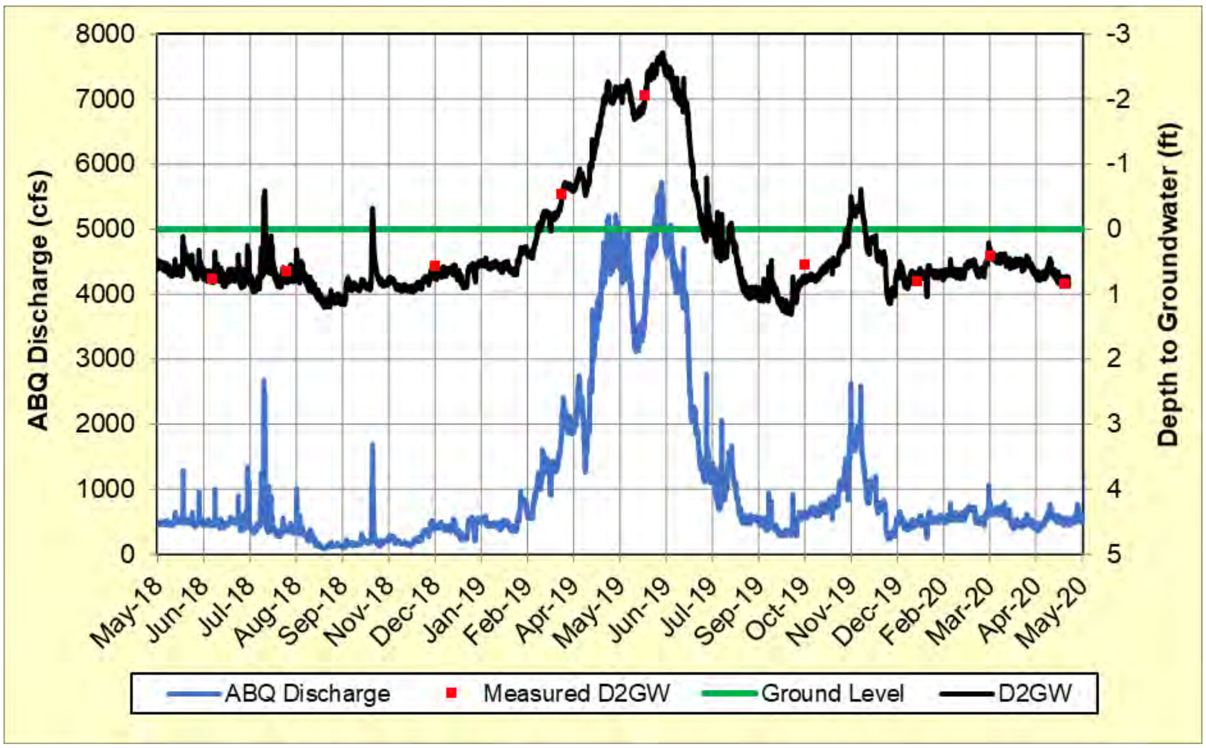

Figure 64. Oxbow North Scallop well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

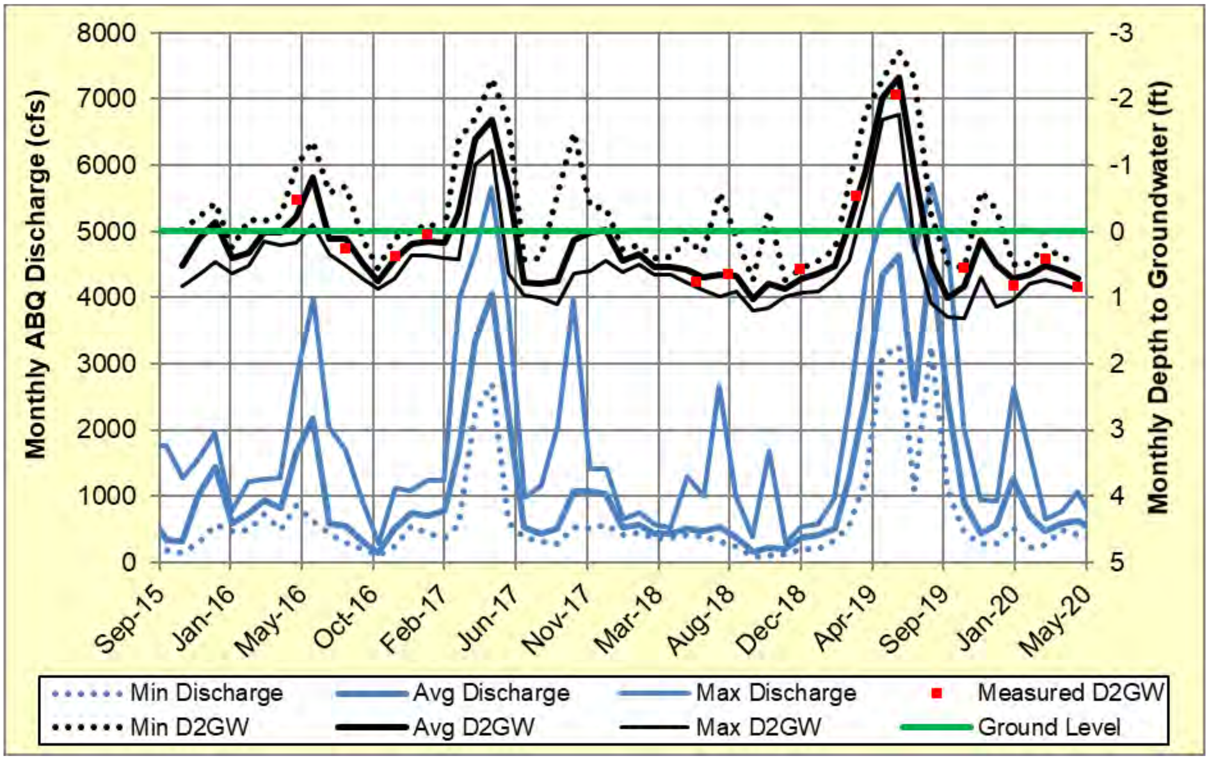

Figure 65. Oxbow North Scallop well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

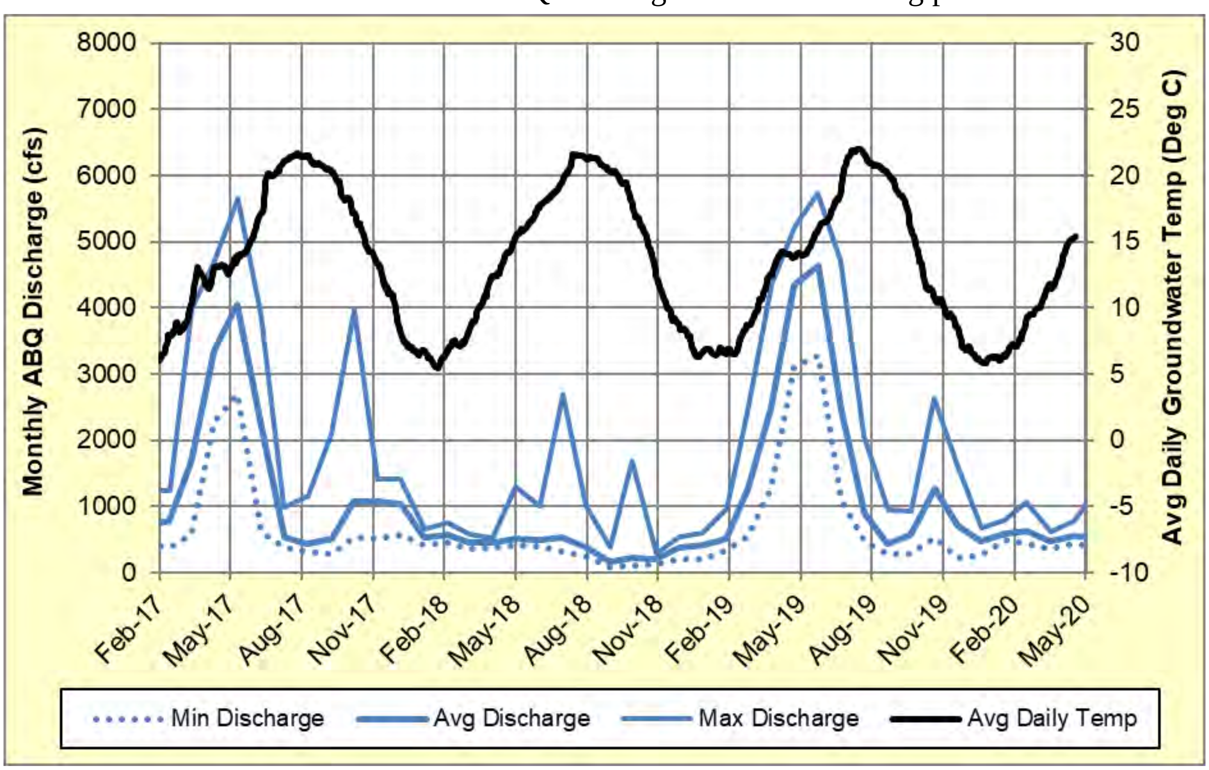

Figure 66. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the Oxbow North Scallop well.

3.3.12 Oxbow 2

The Oxbow 2 groundwater well was installed on March 25, 2014 at 346,057 E; 3,889,298 N (UTM NAD83, Zone 13N) (Figure 17). The well is located along the edge of a constructed pond that is inundated by rising groundwater levels and via surface flow from an irrigation return drain that supplies water to the adjacent oxbow lake to the north. This well was constructed from 2-inch pvc pipe with a locked cap and was installed by the USACE in approximately 2010. The well was previously un-instrumented and manual measurements were not collected as part of this riparian groundwater monitoring network until 2014. The well is instrumented with a datalogger (In-Situ Rugged Troll 100), which has been collecting groundwater data every half hour since its deployment on March 27, 2014. Groundwater levels were manually monitored on a near-monthly basis by GSA from March 2014 to October 2015, and on a quarterly basis from February 2016 through May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 67. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 68. During the annual monitoring period, groundwater levels ranged from approximately 0.69 to 2.37 feet bgs. Automated D2GW values fluctuated dramatically, although datalogger values corresponded to manually measured groundwater levels. Previous calibrations in 2016 confirmed proper datalogger functionality. It is anticipated that fluctuations are a result of discharge from the adjacent irrigation drain, rather than an association with river discharge. Additionally, there may have been minor sensor interference due to root growth within the piezometer casing, as evidenced by accumulated root masses on top of the datalogger upon removal. Groundwater at Oxbow 2 did not appear to fluctuate in response to large river discharges like at other EHF wells.

Figure 69 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 1 to 22 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

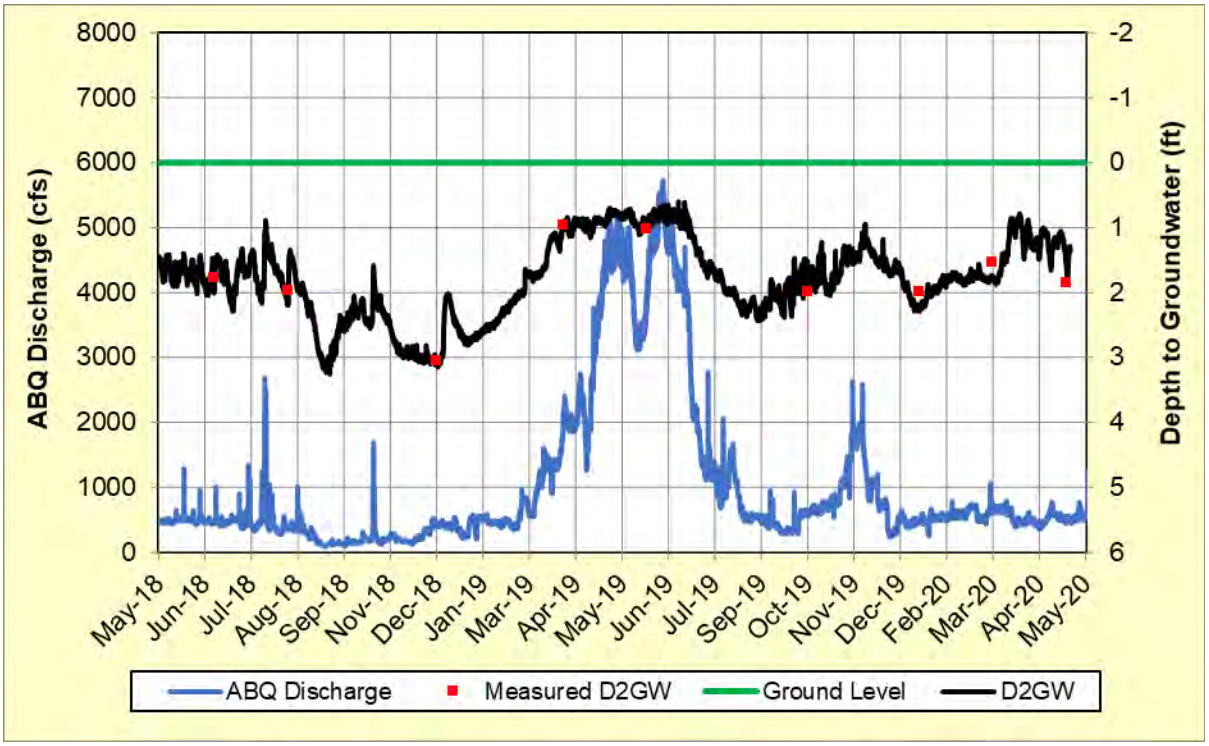

Figure 67. Oxbow 2 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

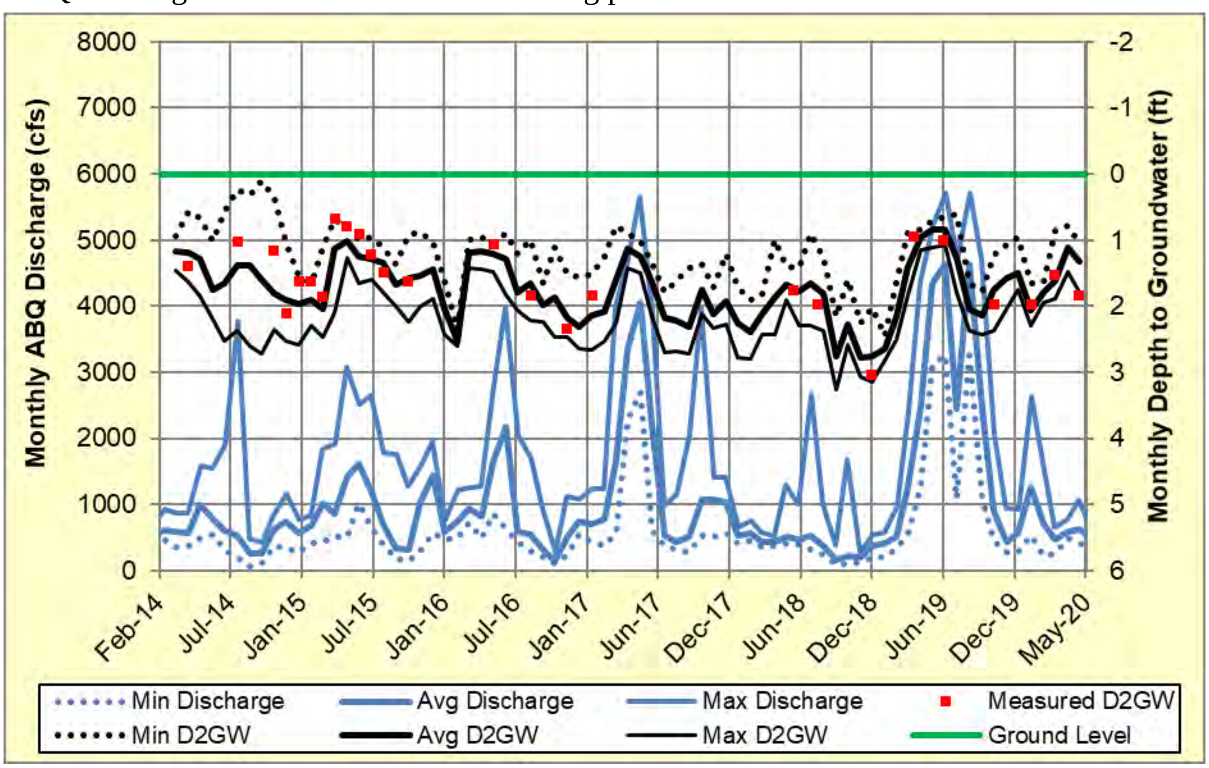

Figure 68. Oxbow 2 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

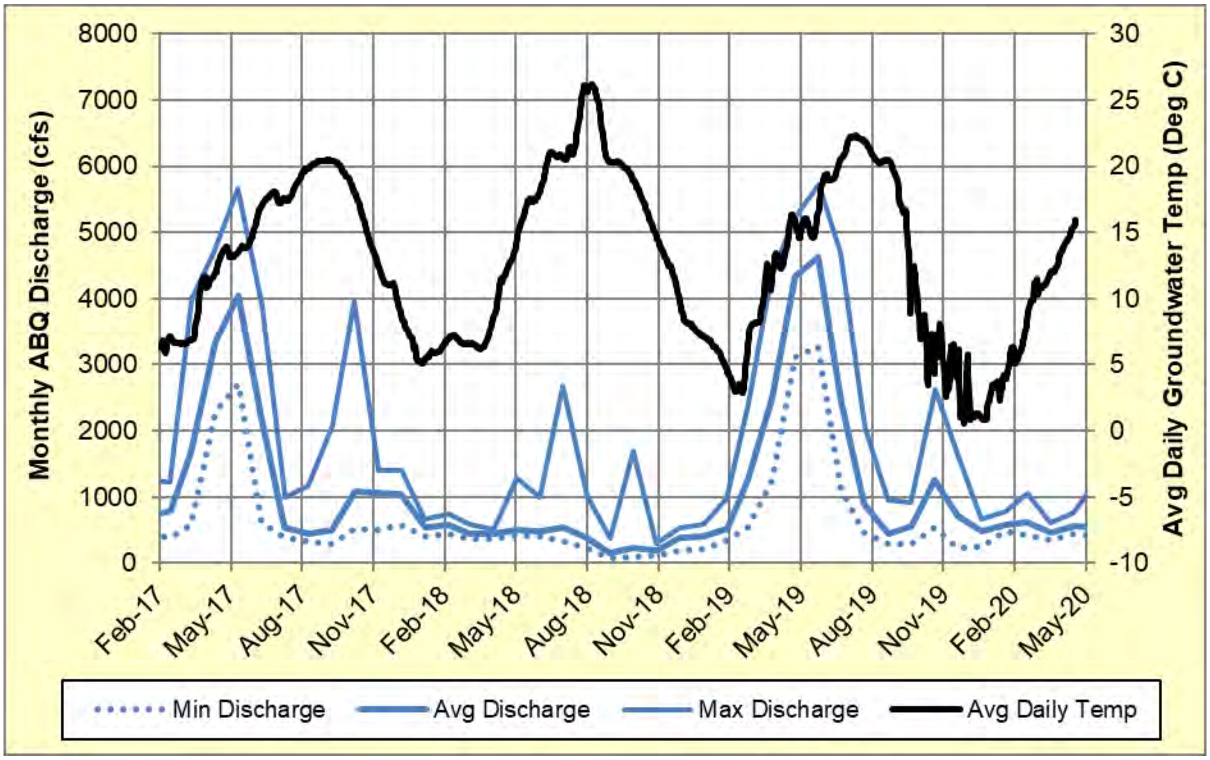

Figure 69. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the Oxbow 2.

3.3.13 Route 66 Inlet

Figure 70. Location of Route 66 Inlet and Route 66 Outlet groundwater monitoring wells.

The Route 66 Inlet groundwater well was installed on April 1, 2014 at 346,824 E; 3,884,114 N (UTM NAD83, Zone 13N) (Figure 70). The well is located within the inlet of a high-flow channel constructed in 2009 as part of the USACE's Route 66 Ecosystem Restoration project. This well was constructed from 2-inch galvanized steel pipe with a locked cap. On April 1, 2014, it was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a near-monthly basis from April 2014 to October 2015, and on a quarterly basis from February 2016 through May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 71. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 72. During the annual monitoring period, groundwater levels ranged from approximately 2.50 feet bgs to 2.55 feet ags. Groundwater remained ags from March 28, 2019 through July 15, 2019 in response to prolonged river discharge of greater than 1,700 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface. Manual measurements are consistently approximately 0.5 ft greater than PT measured depth to groundwater. Verification of hang length and casing height is needed to resolve the discrepancies and will be done during December 2020 maintenance work.

Figure 73 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 3 to 25 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

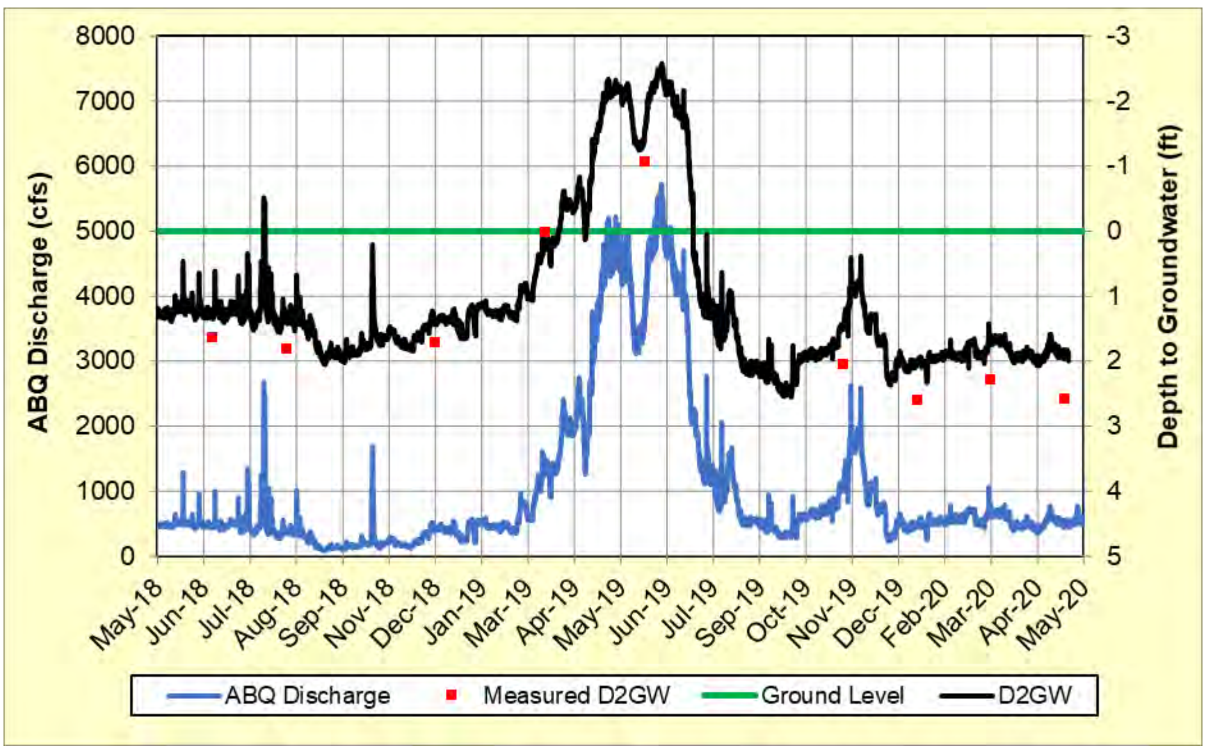

Figure 71. Rt 66 Inlet well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

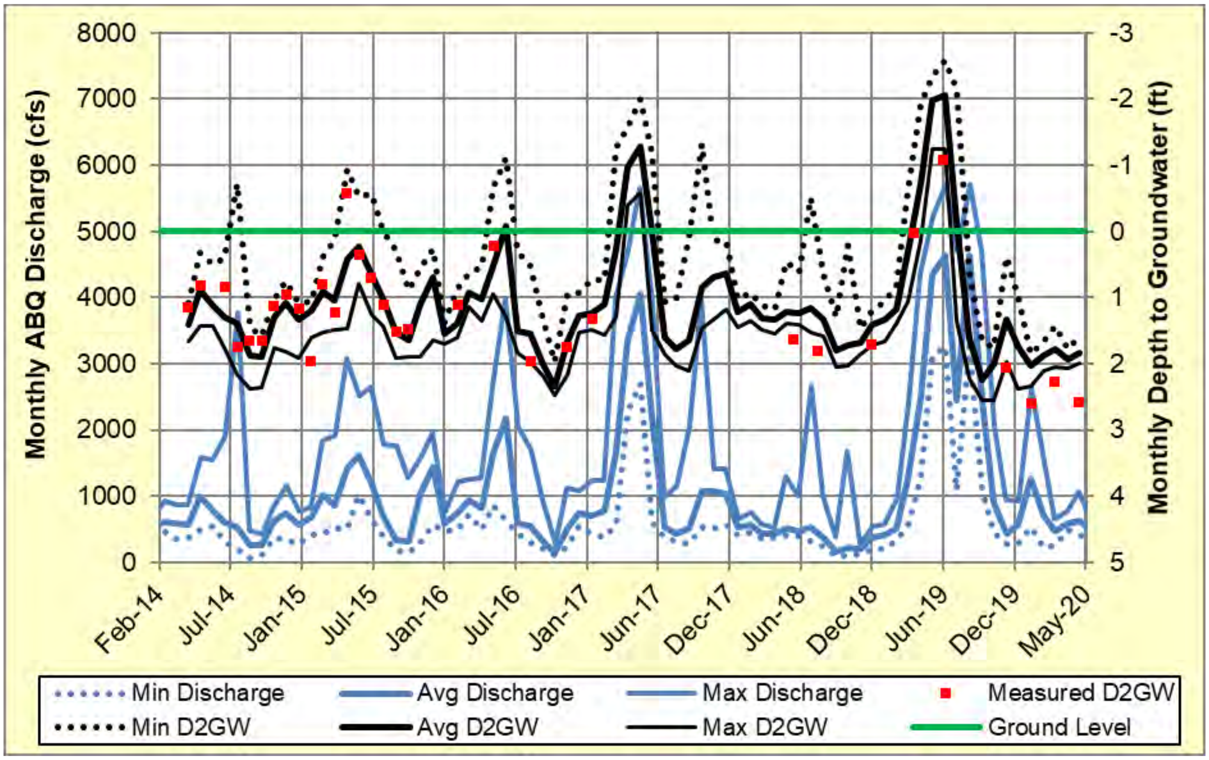

Figure 72. Rt 66 Inlet well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

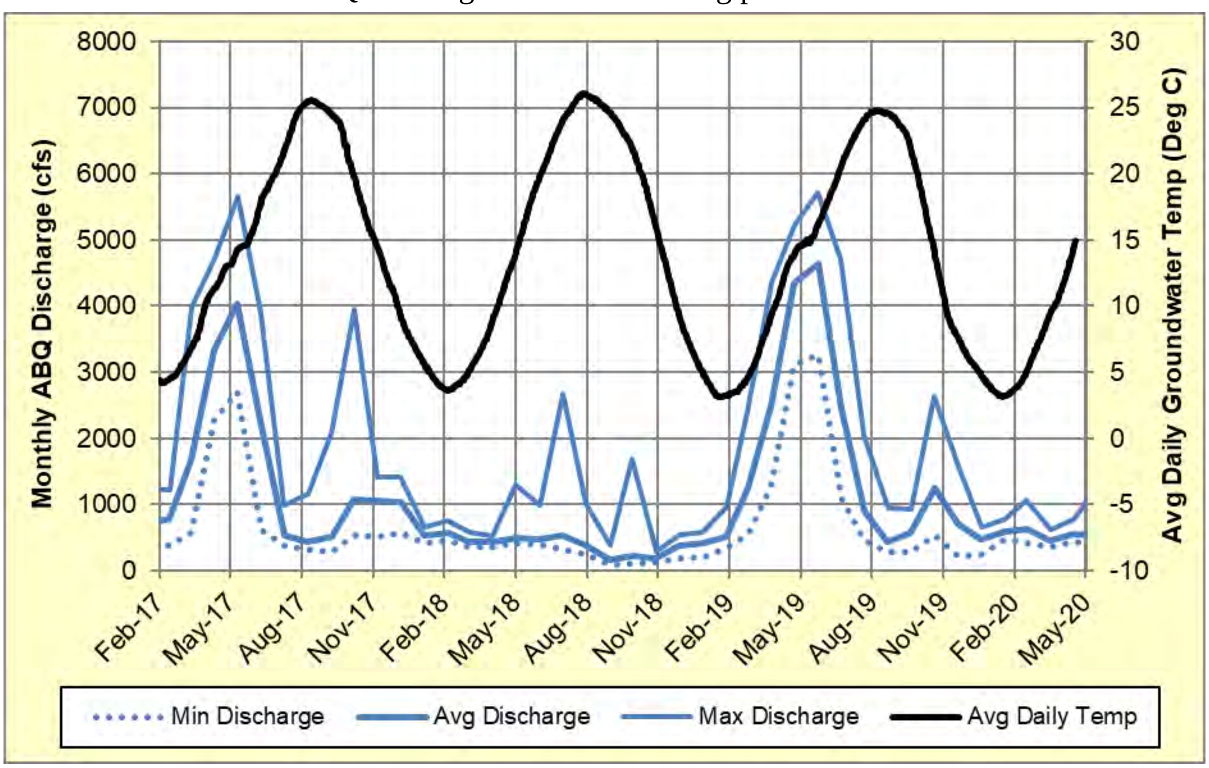

Figure 73. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the Rt 66 Inlet well.

3.3.14 Route 66 Outlet

The Route 66 Outlet groundwater well was installed on April 1, 2014 at 347,032 E; 3,883,778 N (UTM NAD83, Zone 13N) (Figure 70). The well is located near the downstream end of a high-flow channel constructed in 2009/2010 as part of the USACE's Route 66 Ecosystem Restoration project. This well was constructed from 2-inch galvanized steel pipe with a locked cap. On April 1, 2014, it was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. The PT was retired in January 2020 due to time stamp errors and invalid data. Automated data is available through November 14, 2019. Groundwater levels were manually measured on a near-monthly basis from April 2014 to October 2015, and on a quarterly basis from February 2016 through May 2020. Groundwater levels were not measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 74. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 75. During the annual monitoring period (prior to PT failure), groundwater levels ranged from approximately 2.34 feet bgs to 2.30 feet ags. Groundwater remained ags from March 28, 2019 through July 16, 2019 in response to prolonged river discharge of greater than 1,700 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 76 shows the groundwater temperature relative to the discharge profile. Historically, temperature fluctuated seasonally from approximately 2 to 26 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

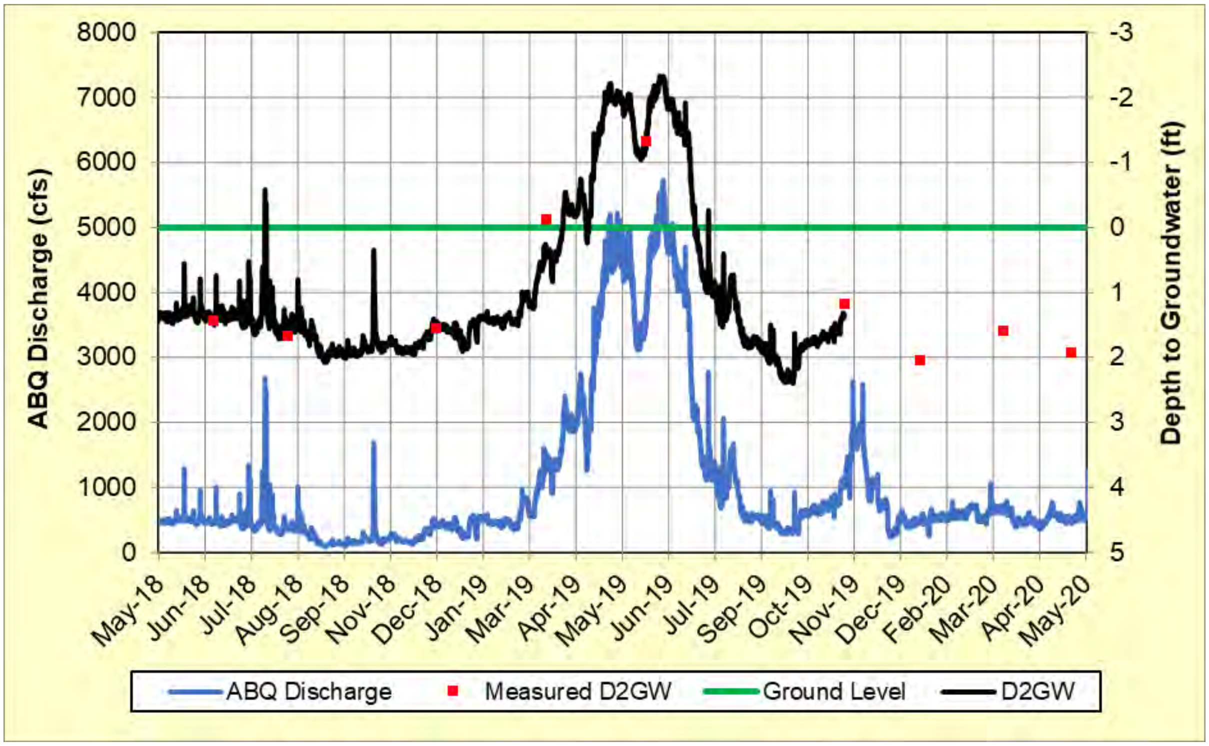

Figure 74. Rt 66 Outlet well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

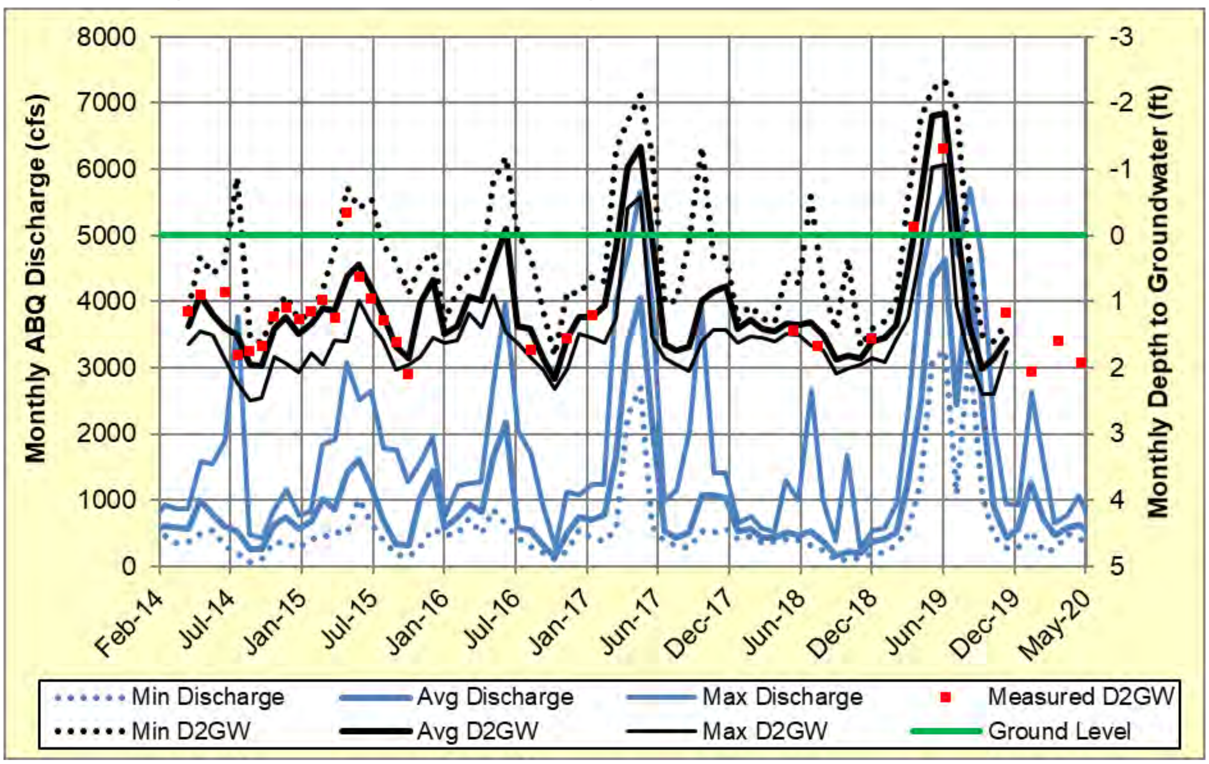

Figure 75. Rt 66 Outlet well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

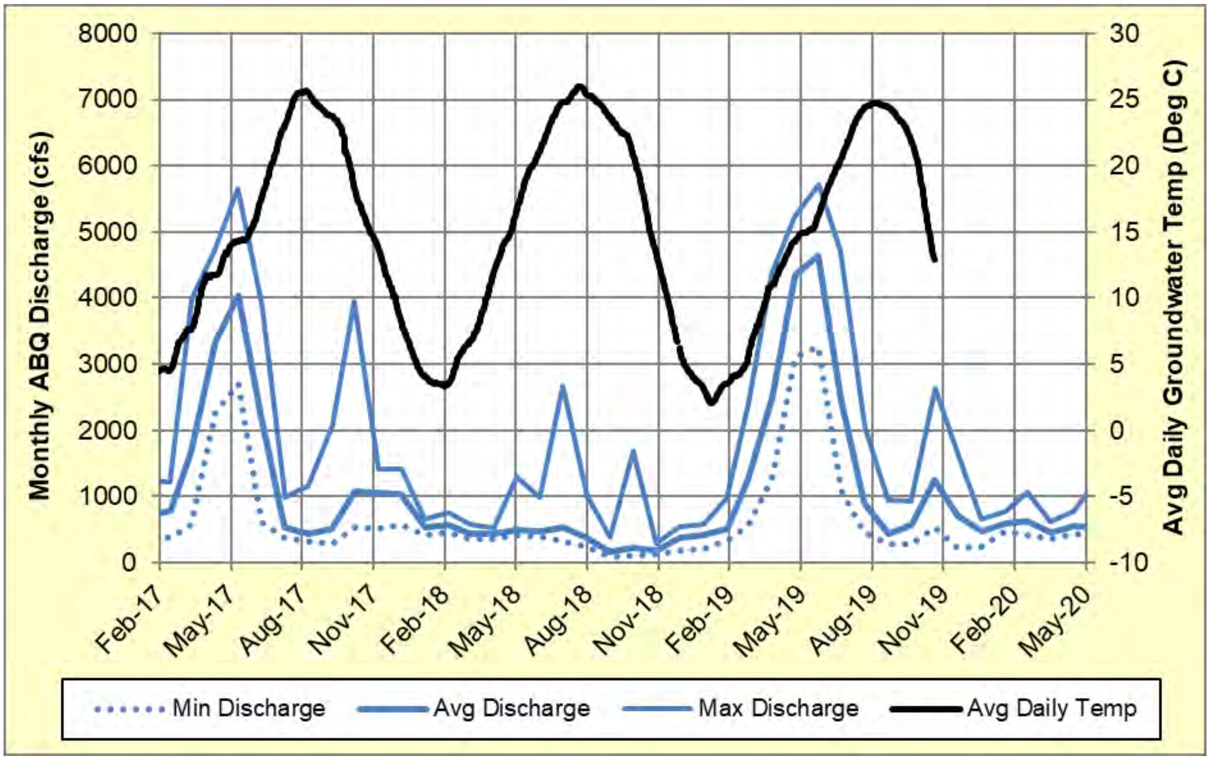

Figure 76. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the Rt 66 Outlet well.

3.3.15 4A New

The 4A New groundwater well was installed on May 1, 2014 at 347,929 E; 3,883,124 N (UTM NAD83, Zone 13N) (Figure 26). It was originally installed within an EFT as the “4A Old” well, which was decommissioned on May 1, 2014 and immediately re-installed within an adjacent EHF. The well is located within an excavated channel constructed to capture water discharged from a storm water outfall pipeline near Tingley Pond. This well was constructed from 2-inch galvanized steel pipe with a locked cap. It is instrumented with a datalogger (In-Situ Rugged Troll 100), which has been collecting groundwater data every half hour since its deployment on May 1, 2014. Groundwater levels were manually monitored on a near-monthly basis from May 2014 to October 2015, and on a quarterly basis from February 2016 through May 2020. Manual measurements were not taken from March 2017 through April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 77. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 78. During the annual monitoring period, groundwater levels ranged from approximately 4.69 feet bgs to 0.93 feet ags. While the well is located in a depression fed by water discharged from storm water outfall, it is also responsive to changes in river discharges.

Figure 79 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 4 to 25 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature. Rapid infiltration of surface water from the outfall pipeline at this well is evident due to small fluctuations in groundwater temperature in response to individual discharge events.

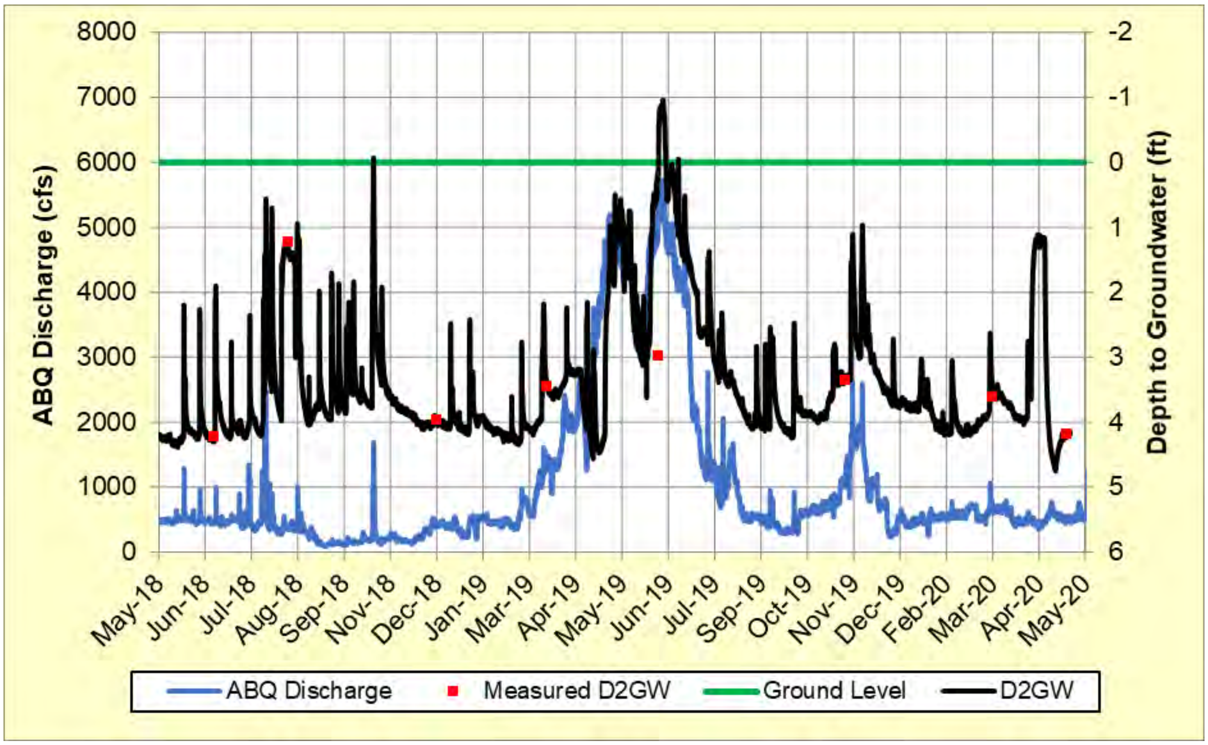

Figure 77. 4A New well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

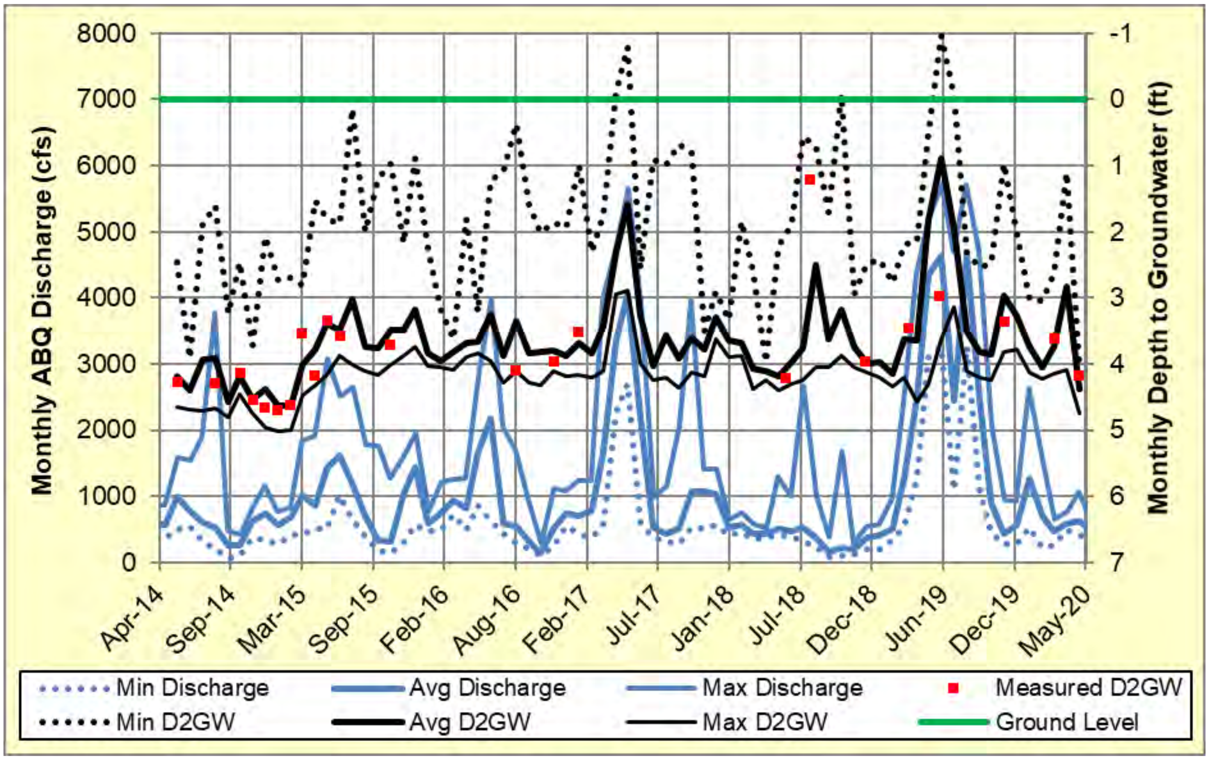

Figure 78. 4A New well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

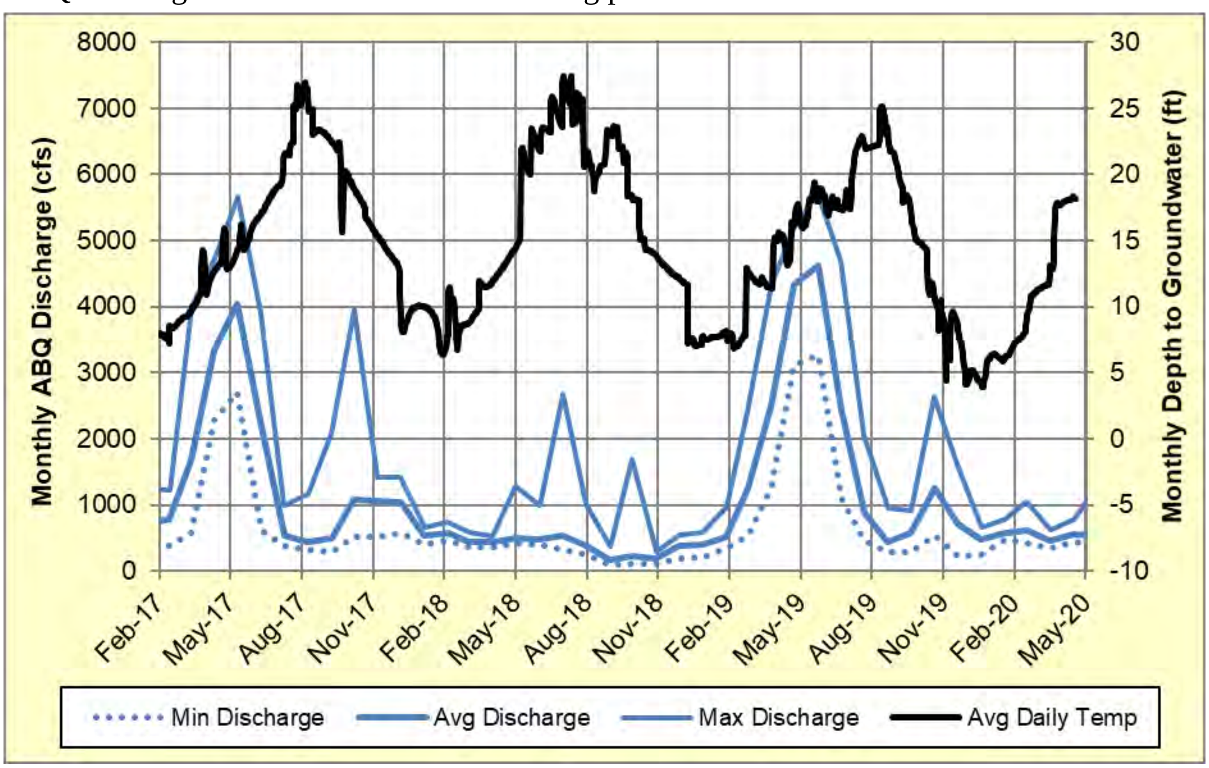

Figure 79. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 4A New well.

3.3.16 4B Bankline

Figure 80. Location of 4B and 4B Bankline groundwater monitoring wells.

The 4B Bankline groundwater well was installed on April 30, 2012 at 347,451 E; 3,876,895 N (UTM NAD83, Zone 13N) (Figure 80). The EHF at 4B Bankline was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 24, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. Data could not be retrieved from the datalogger during the site visit in May 2018 so it was removed from the well and has not be replaced with a new PT. Therefore, this well was not instrumented during the annual monitoring period. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015 and June 2018 to May 2020, and on a quarterly basis from February 2016 through January 2017. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 81. Depth to groundwater on the annual measurement dates fluctuated between approximately 3.84 feet bgs and 1.37 feet ags.

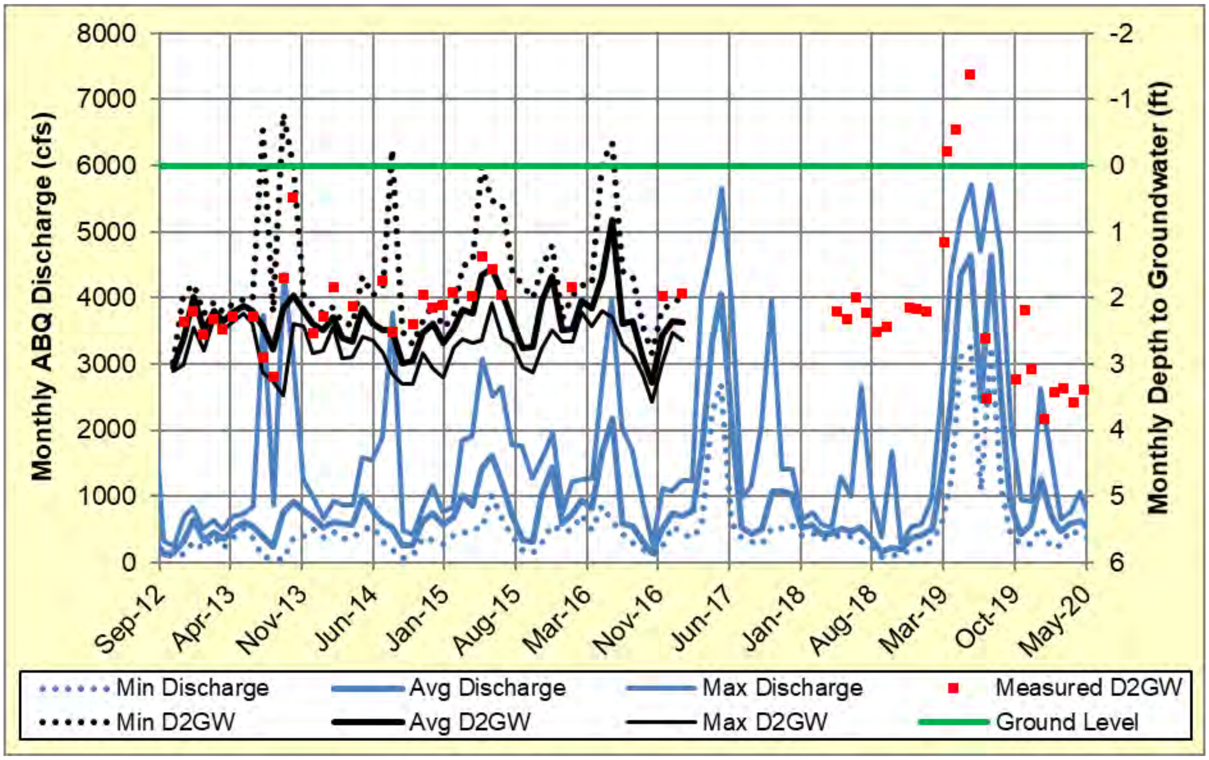

Figure 81. 4B Bankline well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

3.3.17 4B

The 4B groundwater well was installed on April 30, 2012 at 347,486 E; 3,876,829 N (UTM NAD83, Zone 13N) (Figure 80). The EHF at 4B was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. It was instrumented with a newer generation Solinst Levelogger Junior Edge Model 3001 from October 24, 2012 to August 23, 2013. In September 2013, the datalogger suspension cable was found to have broken, causing the transducer to fall to the bottom of the well. The cable assembly was retrieved, and several unsuccessful attempts were made to retrieve the datalogger. A replacement In-Situ Rugged Troll 100 was deployed in the well on February 18, 2014. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015, and on a quarterly basis from February 2016 through May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 82. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 83. During the annual monitoring period, groundwater levels ranged from approximately 3.61 feet bgs to 2.32 feet ags. Groundwater remained ags from April 23, 2019 through July 13, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 84 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 7 to 19 degrees C during the annual monitoring period. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

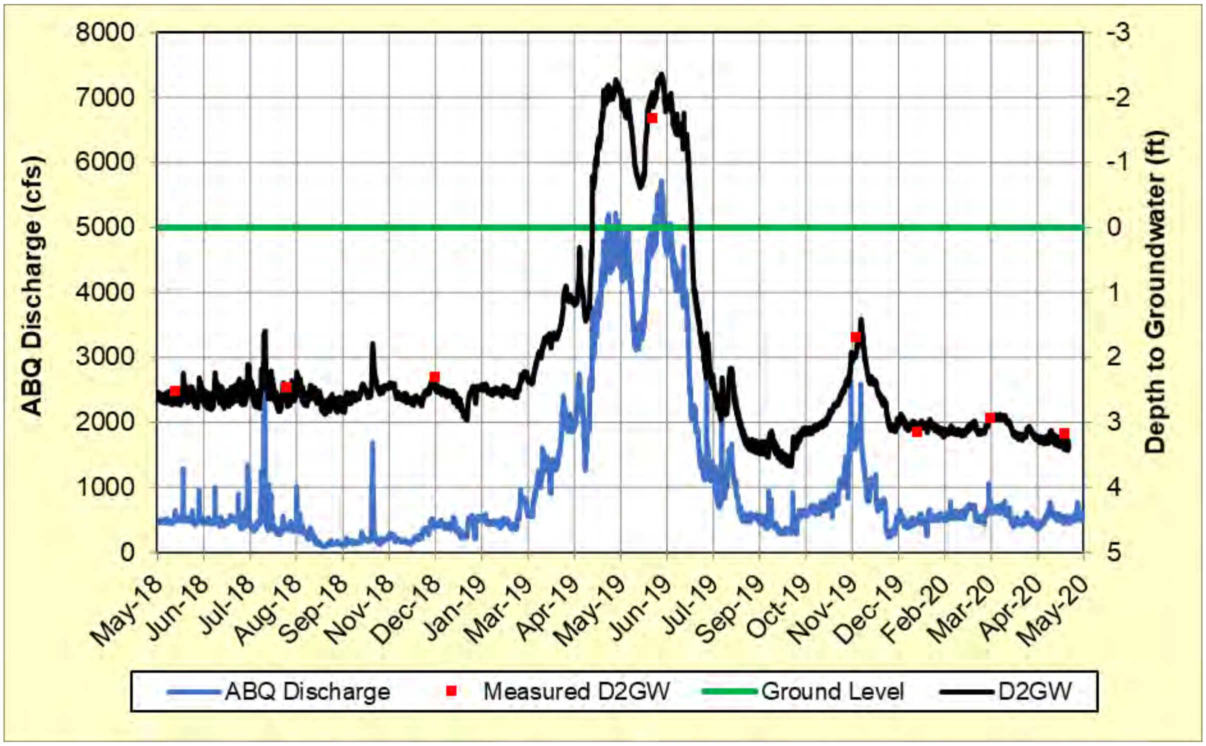

Figure 82. 4B well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

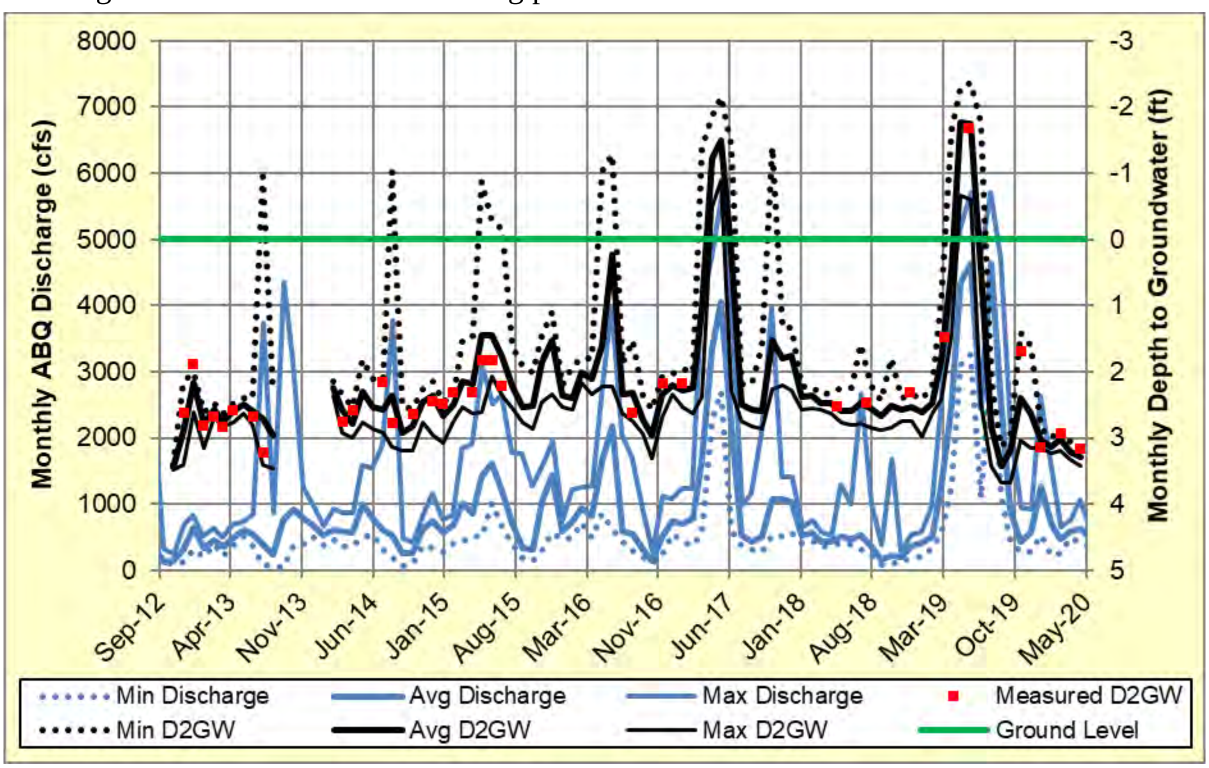

Figure 83. 4B well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

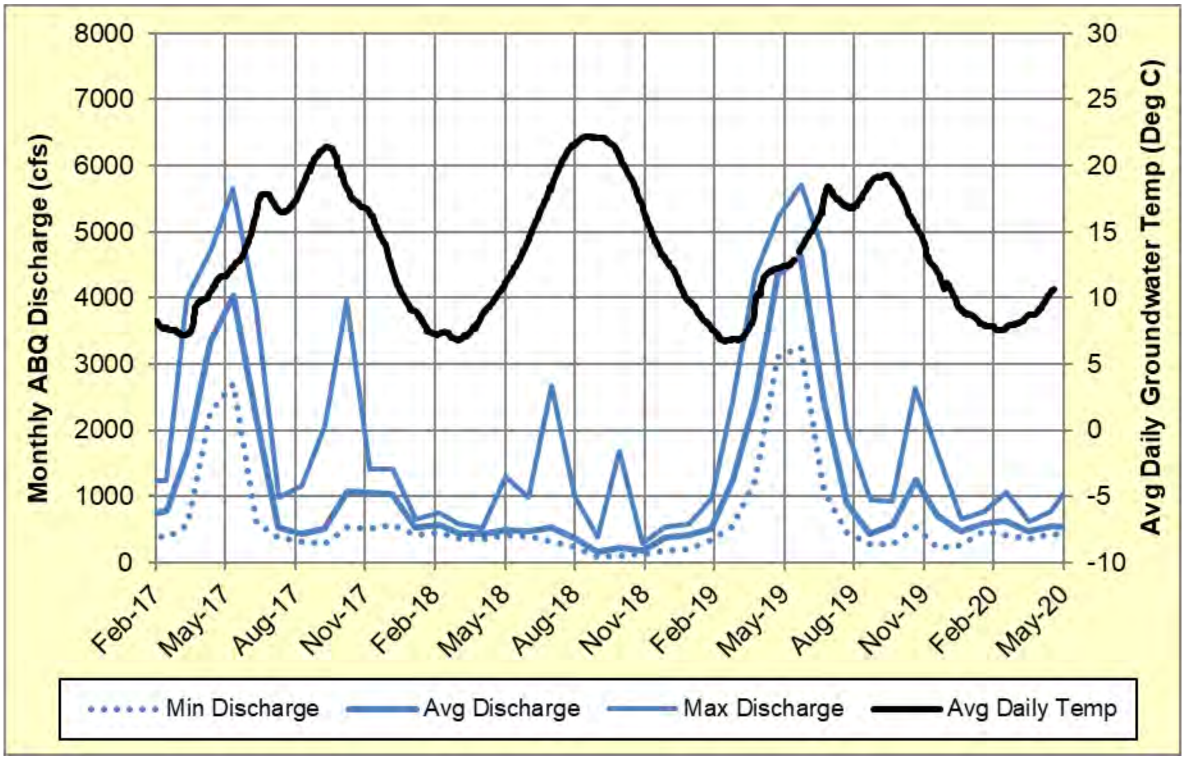

Figure 84. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 4B well.

3.3.18 4C North

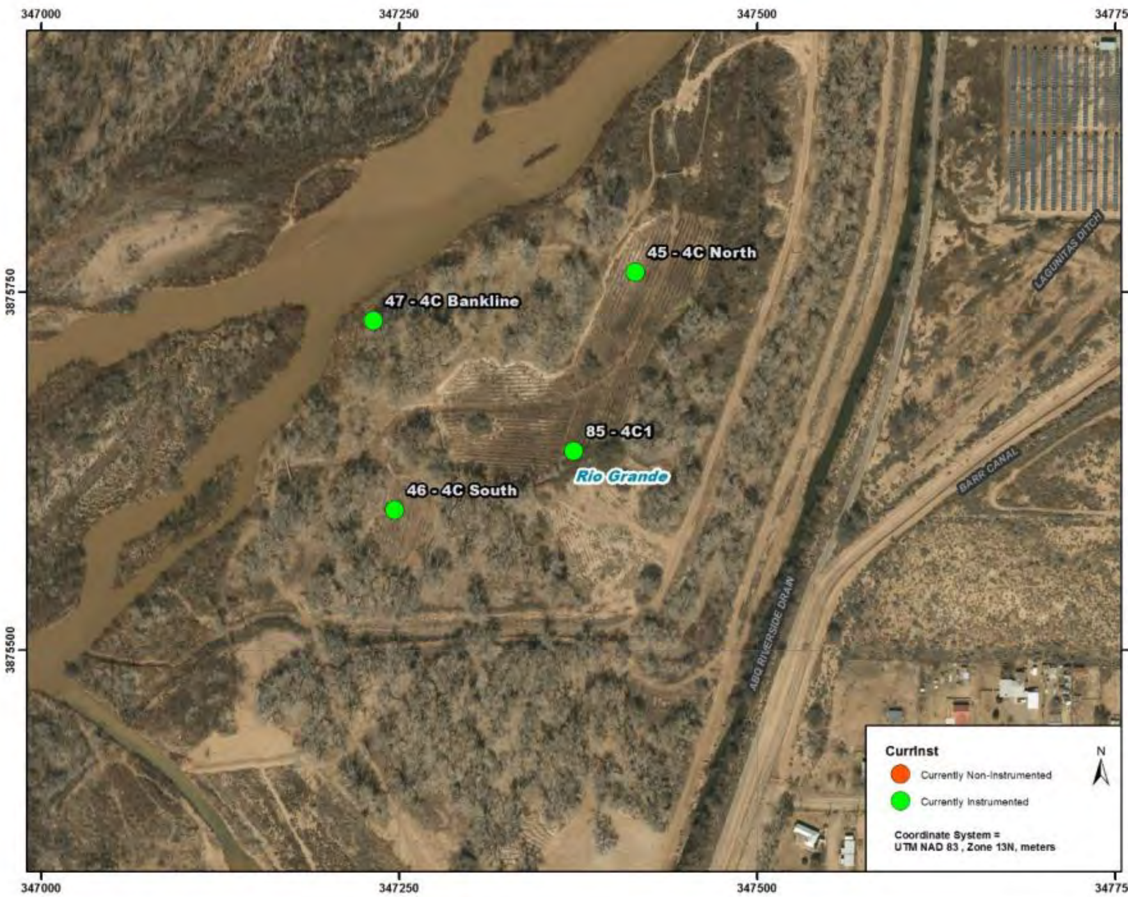

Figure 85. Location of 4C North, 4C South, 4C Bankline, and 4C1 groundwater monitoring wells.

The 4C North groundwater well was installed on May 2, 2012 at 347,415 E; 3,875,764 N (UTM NAD83, Zone 13N) (Figure 85). The well is located within a swale designed to inundate via rising groundwater and surface water flooding via a high-flow channel. The 4C swale was excavated to attain shallow seasonal groundwater depths no greater than 3-feet bgs. This well was constructed from 2-inch galvanized steel pipe with a locked cap. It was instrumented with a newer generation Solinst Levelogger Junior Edge Model 3001 from October 24, 2012 to August 23, 2013. In September 2013, the datalogger suspension cable was found to have broken, causing the transducer to fall to the bottom of the well. Several unsuccessful attempts were made to retrieve the datalogger. A replacement In-Situ Rugged Troll 100 was deployed in the well on February 18, 2014. Another replacement In-Situ Rugged Troll 100 was also deployed in March 2016 after the previous replacement PT experienced a terminal time stamp error. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015, and on a quarterly basis from

February 2016 through May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 86. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 87. During the annual monitoring period, groundwater levels ranged from approximately 3.79 feet bgs to 1.83 feet ags. Groundwater remained ags from April 23, 2019 through July 12, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum Spring 2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 88 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 12 to 20 degrees C during the annual monitoring period.

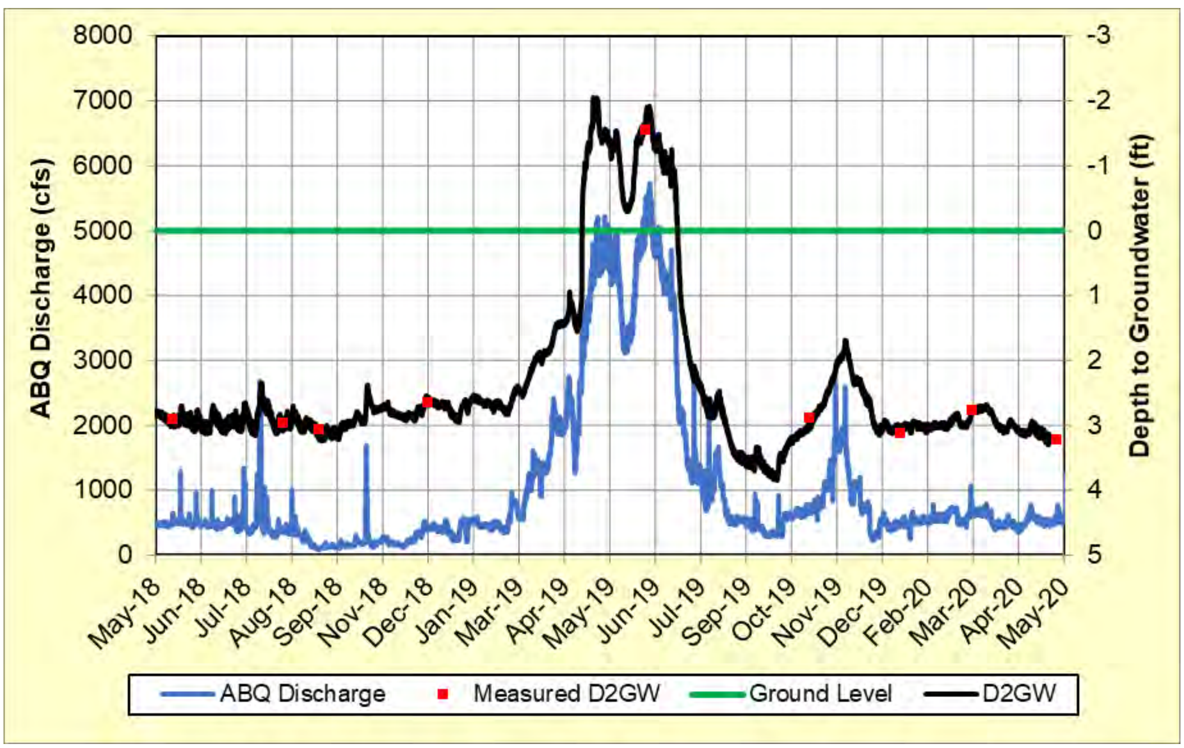

Figure 86. 4C North well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

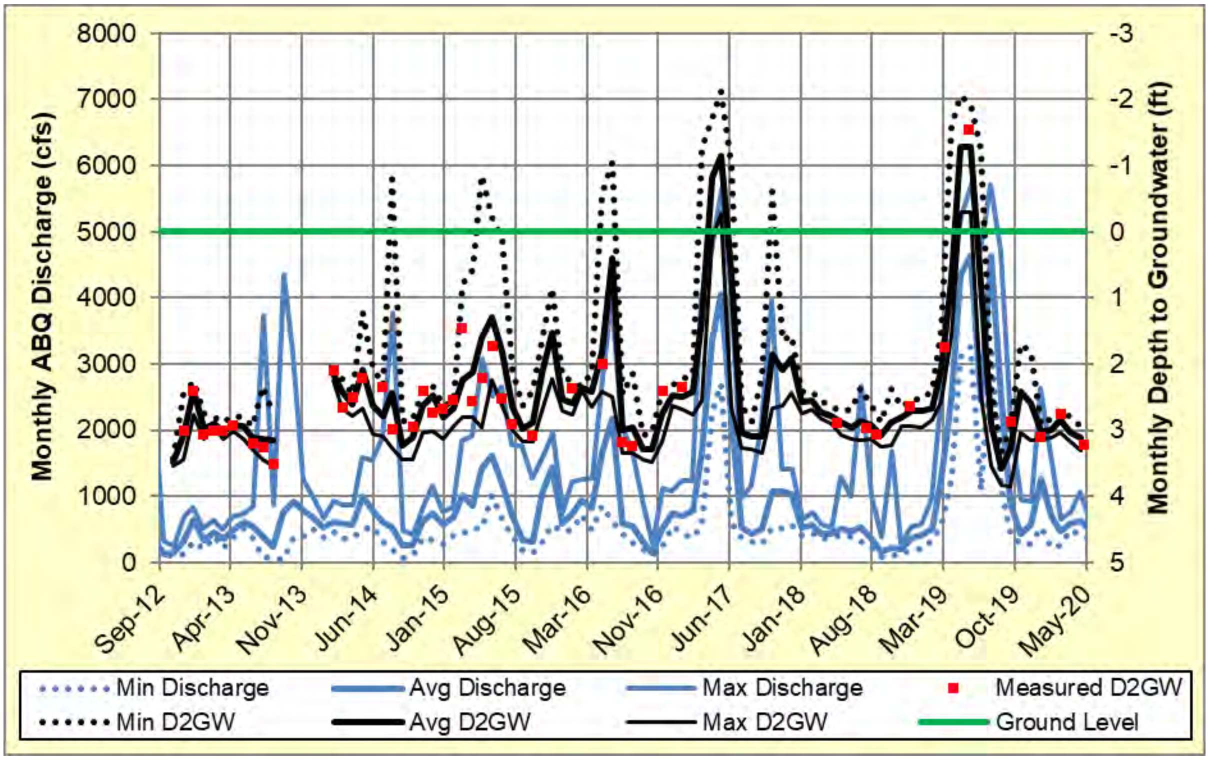

Figure 87. 4C North well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

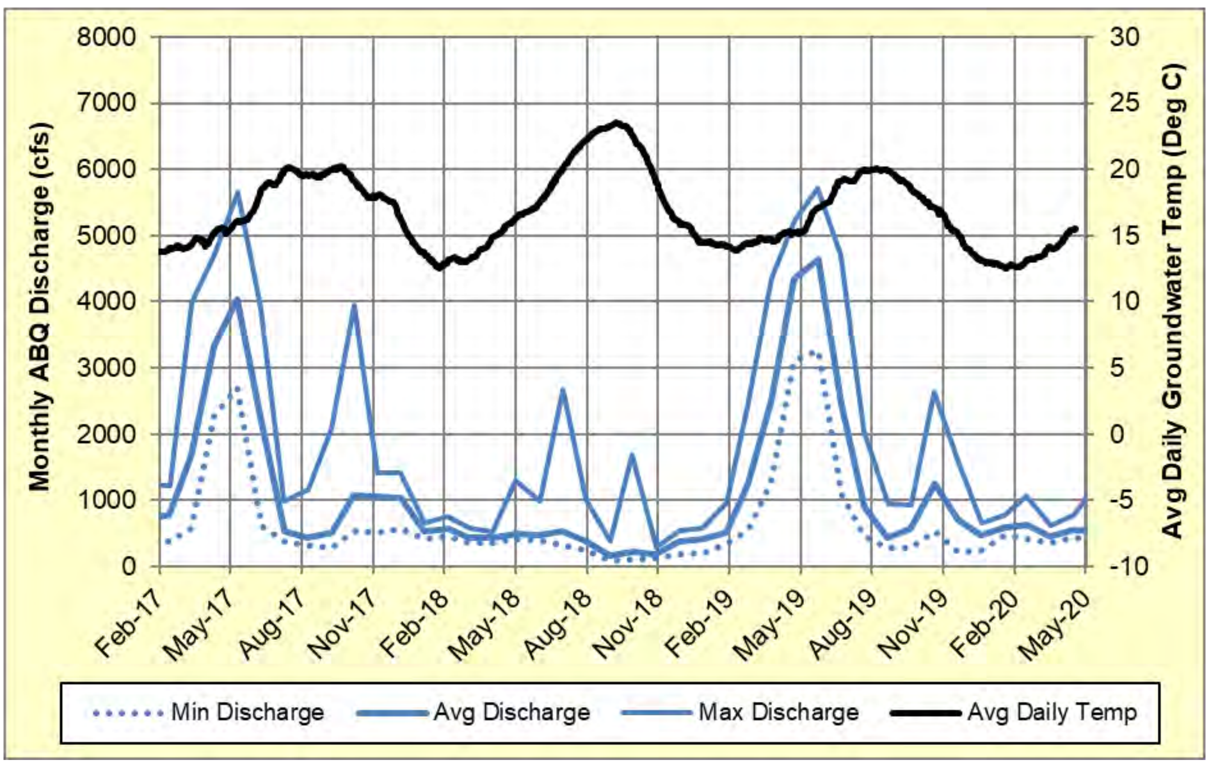

Figure 88. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 4C North well.

3.3.19 4C Bankline

The 4C Bankline groundwater well was installed on May 2, 2012 at 347,232 E; 3,875,730 N (UTM NAD83, Zone 13N) (Figure 85). The well is located within a lowered bankline terrace designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. It was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collected groundwater data every half hour from October 2, 2012 and January 22, 2013. During the April 2013 well download visit, the well casing lock was found broken and the transducer stolen. The well was re-instrumented on February 26, 2016 with an In-Situ Rugged Troll 100. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015, and on a quarterly basis from February 2016 through May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 89. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 90. During the annual monitoring period, manually measured groundwater levels ranged from 3.2 feet bgs to 1.94 feet ags. Groundwater remained ags from April 21, 2019 through July 12, 2019 in response to prolonged river discharge of greater than 2,500 cfs. As of May 31, 2020, maximum Spring 2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 91 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 7 to 23 degrees C, and is indicative of shallow groundwater influenced by surface water temperature.

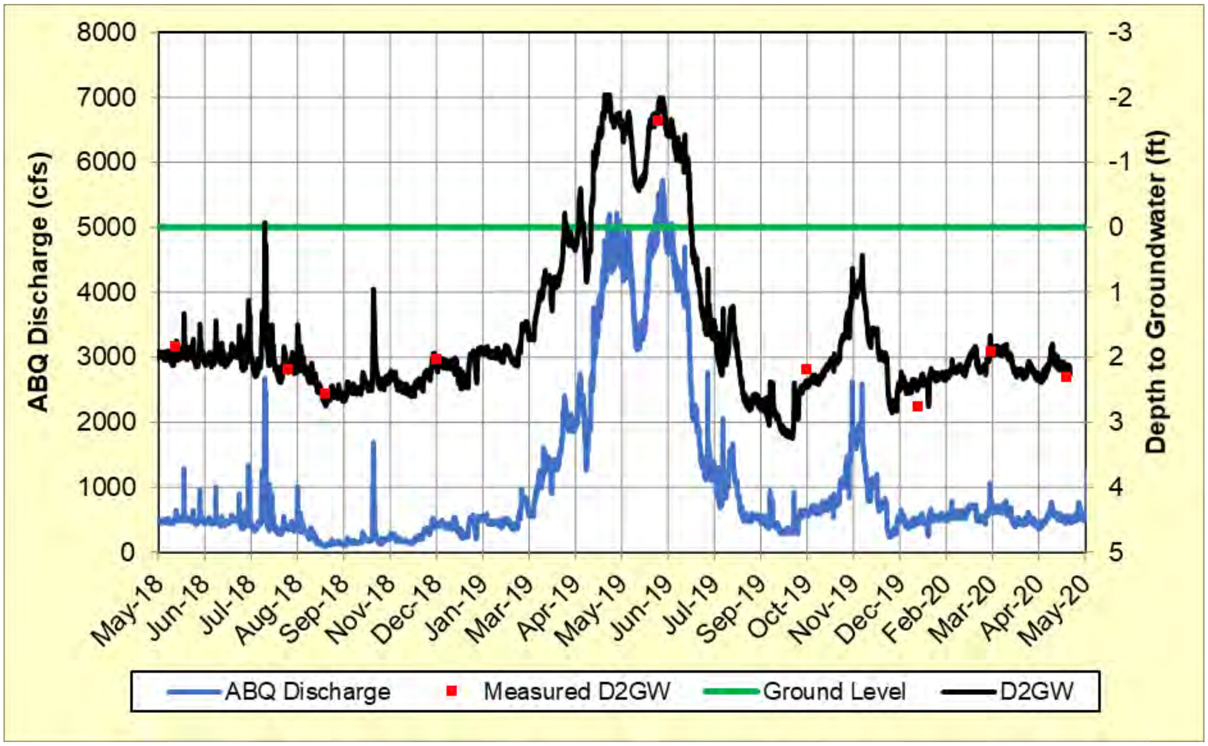

Figure 89. 4C Bankline well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

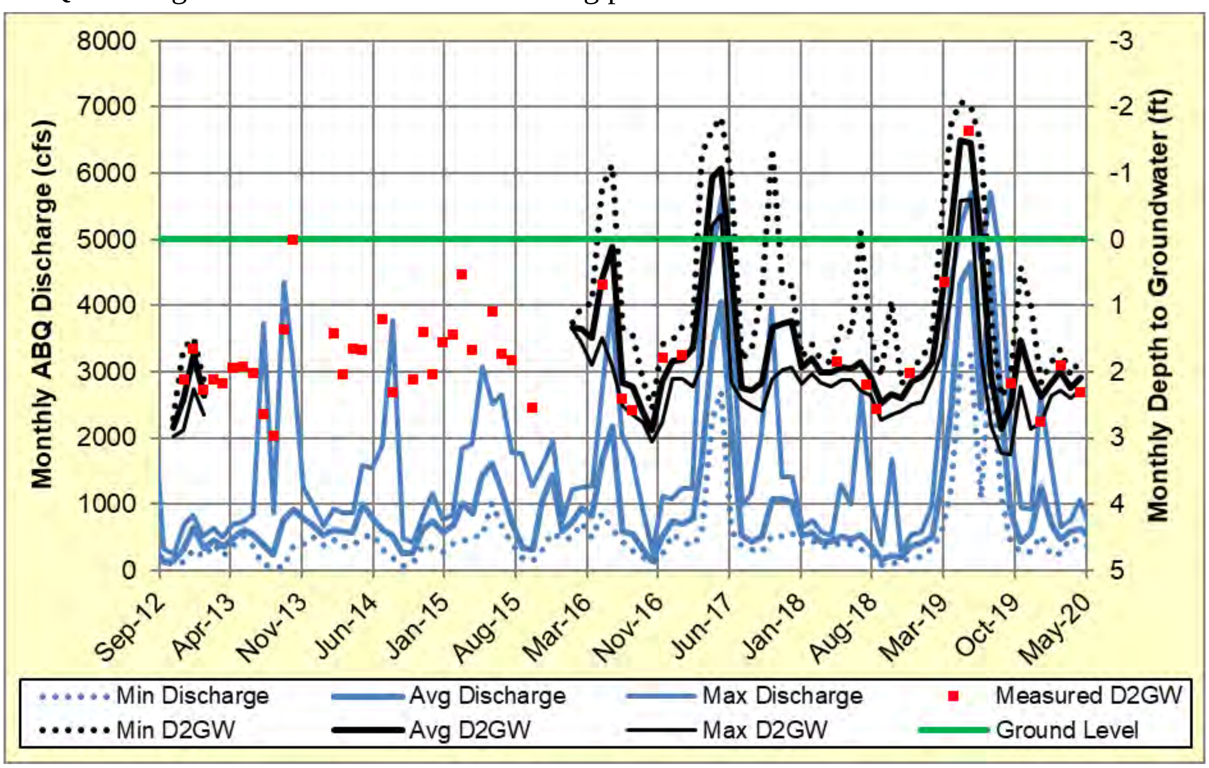

Figure 90. 4C Bankline well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

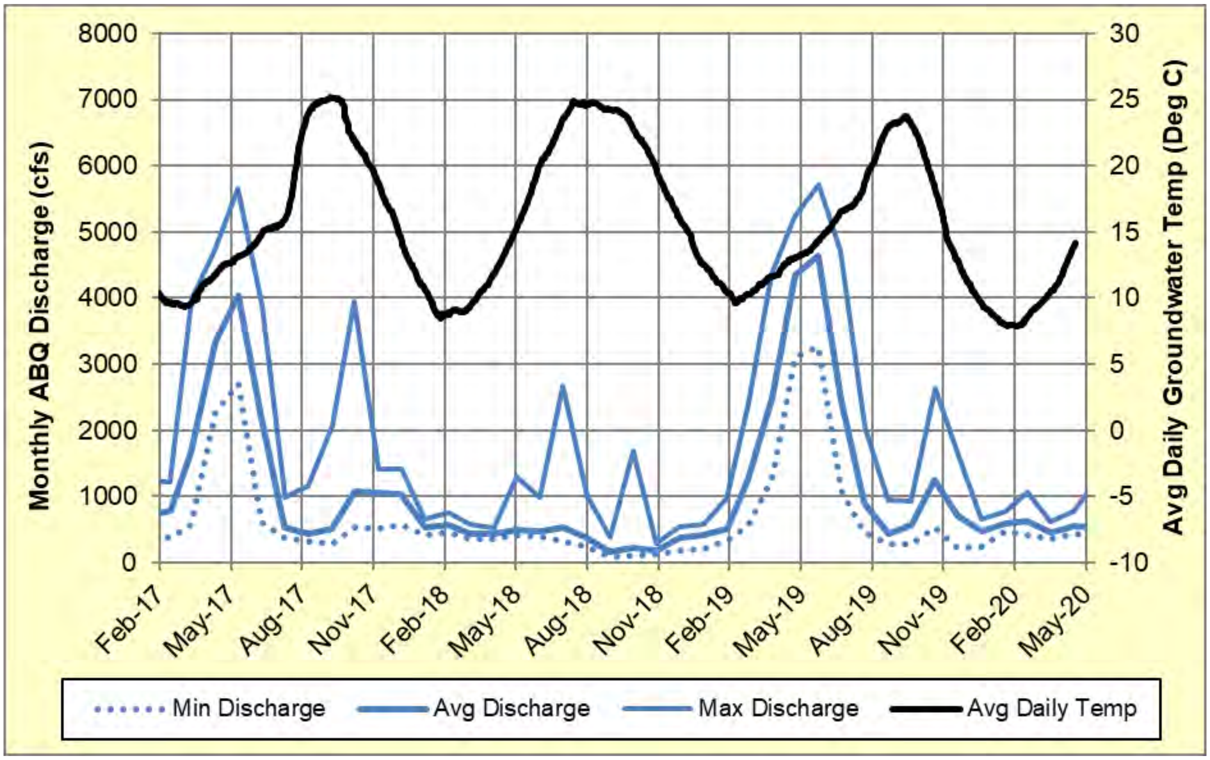

Figure 91. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 4C Bankline well.

3.3.20 4C1

The 4C1 groundwater well was installed on February 26, 2016 at 347,372 E; 3,875,639 N (UTM NAD83, Zone 13N) (Figure 85). The well is located in the central portion of swale 4C along what appears to be an outside meander bend of an old high-flow channel. This well was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 92. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 93. During the annual monitoring period, groundwater levels ranged from approximately 3.79 feet bgs to 2.12 feet ags. Groundwater remained ags from April 23, 2019 through July 14, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 94 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 7 to 23 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

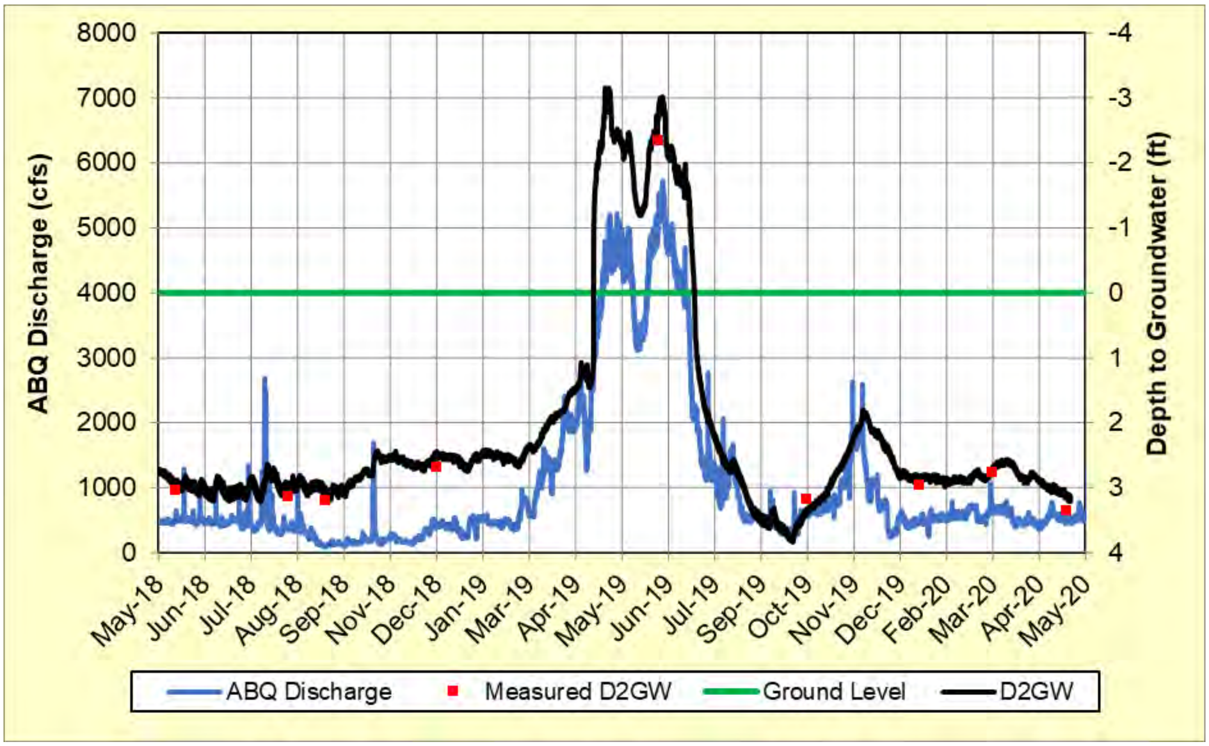

Figure 92. 4C1 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

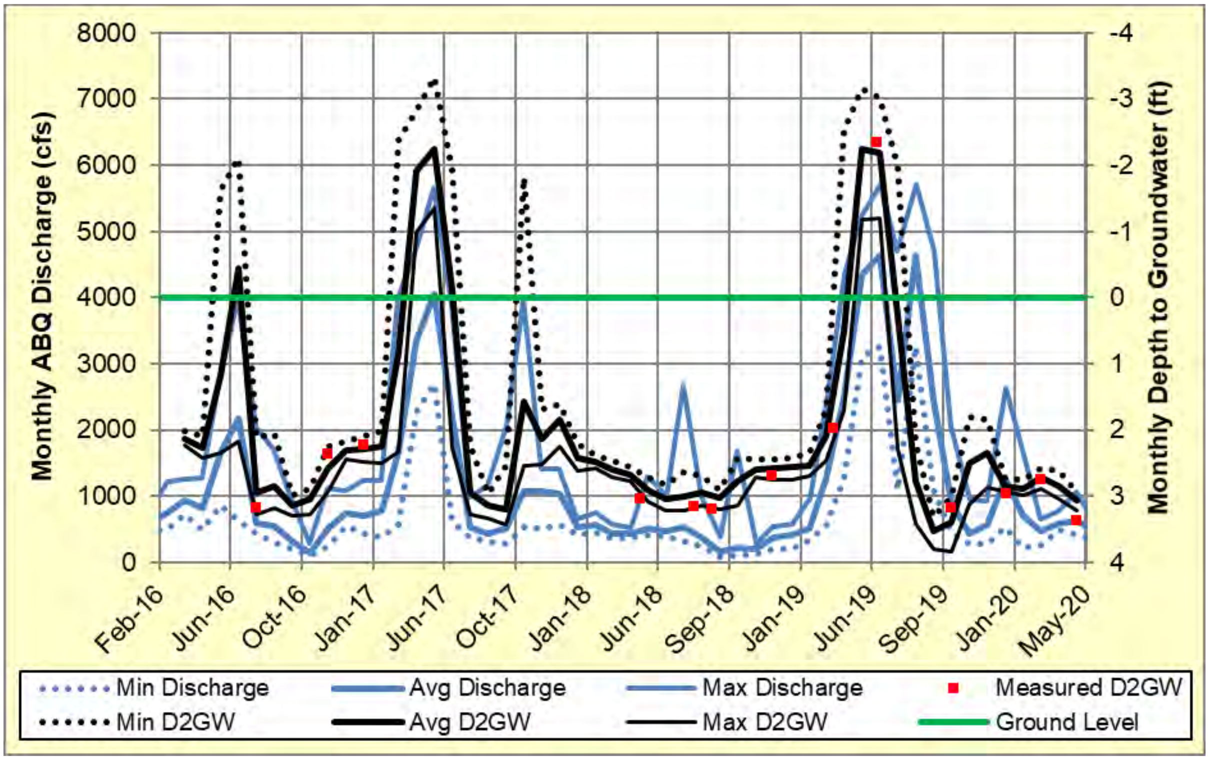

Figure 93. 4C1 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

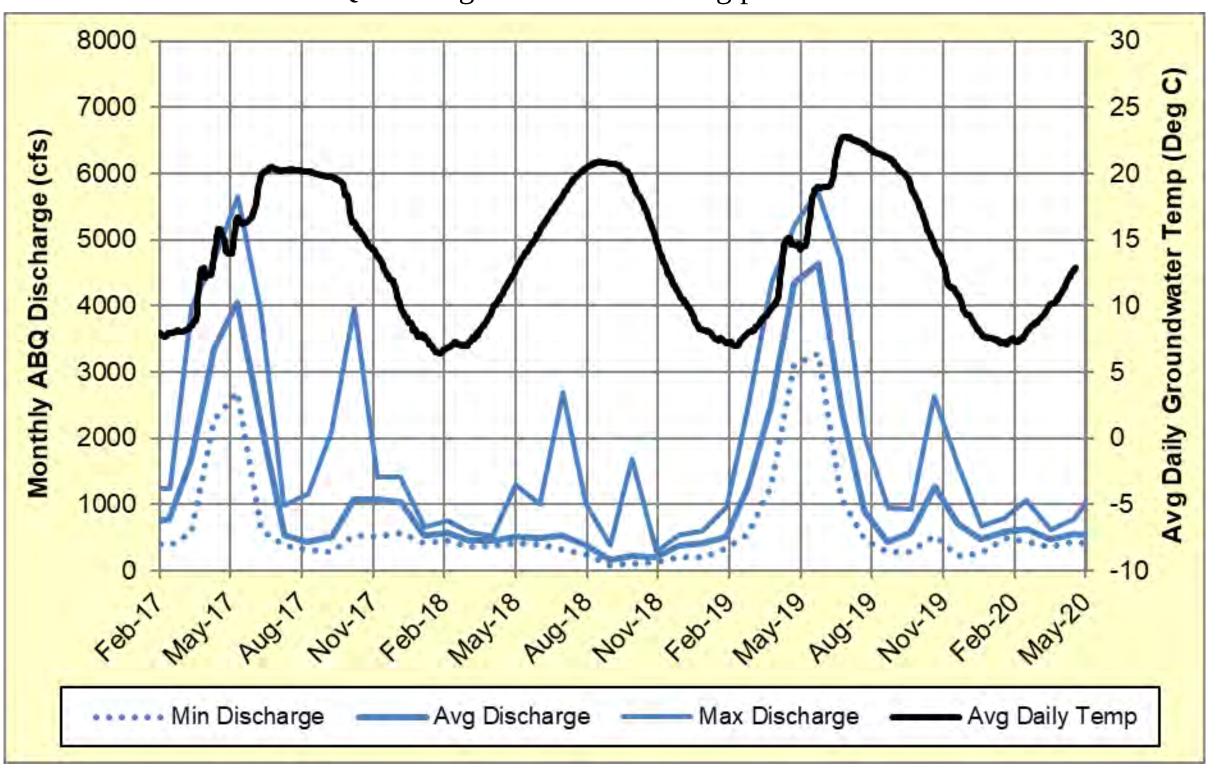

Figure 94. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 4C1 well.

3.3.21 4C South

The 4C South groundwater well was installed on May 2, 2012 at 347,247 E; 3,875,598 N (UTM NAD83, Zone 13N) (Figure 85). The EHF at 4C South was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 24, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. In August 2013, the cable was found to have corroded, causing the datalogger to fall to the bottom of the well. The datalogger was successfully retrieved and redeployed on February 25, 2014. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015, and on a quarterly basis from February 2016 through May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 95. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 96. During the annual monitoring period, groundwater levels ranged from approximately 3.93 feet bgs to 2.41 feet ags. Groundwater remained ags from April 23, 2019 through July 13, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 97 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 9 to 23 degrees C, and is indicative of shallow groundwater influenced by surface water temperature.

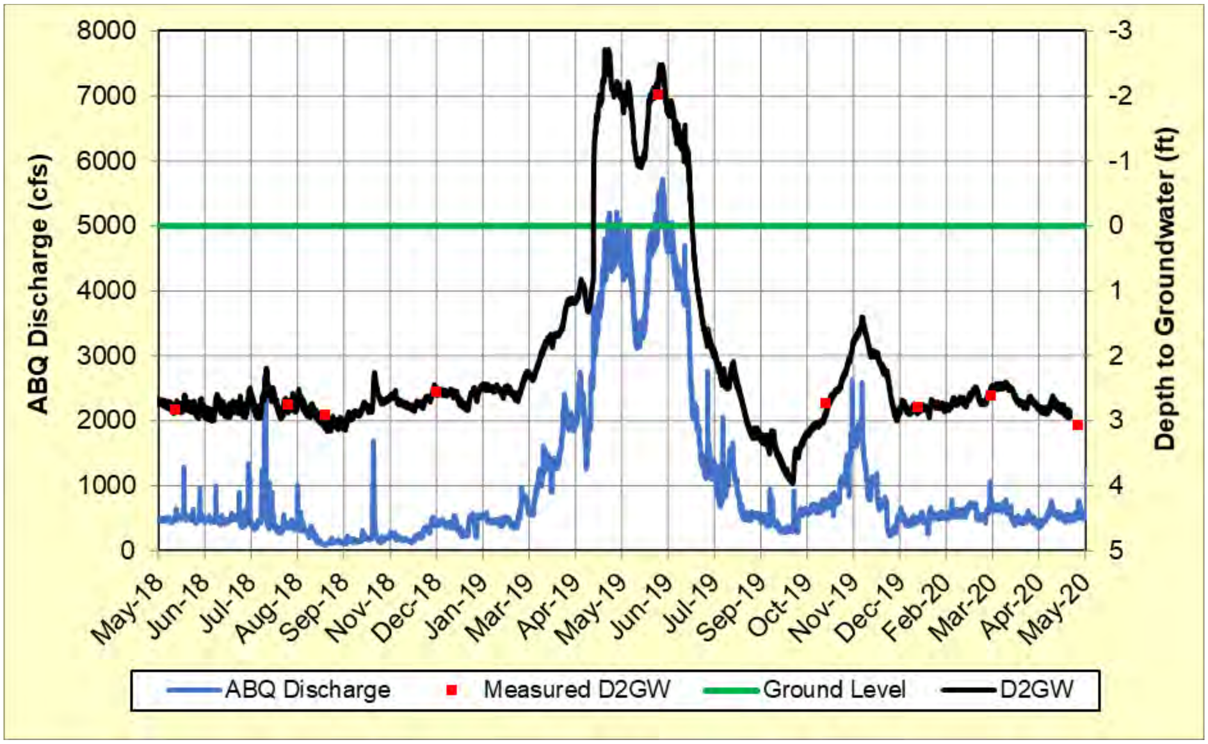

Figure 95. 4C South well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

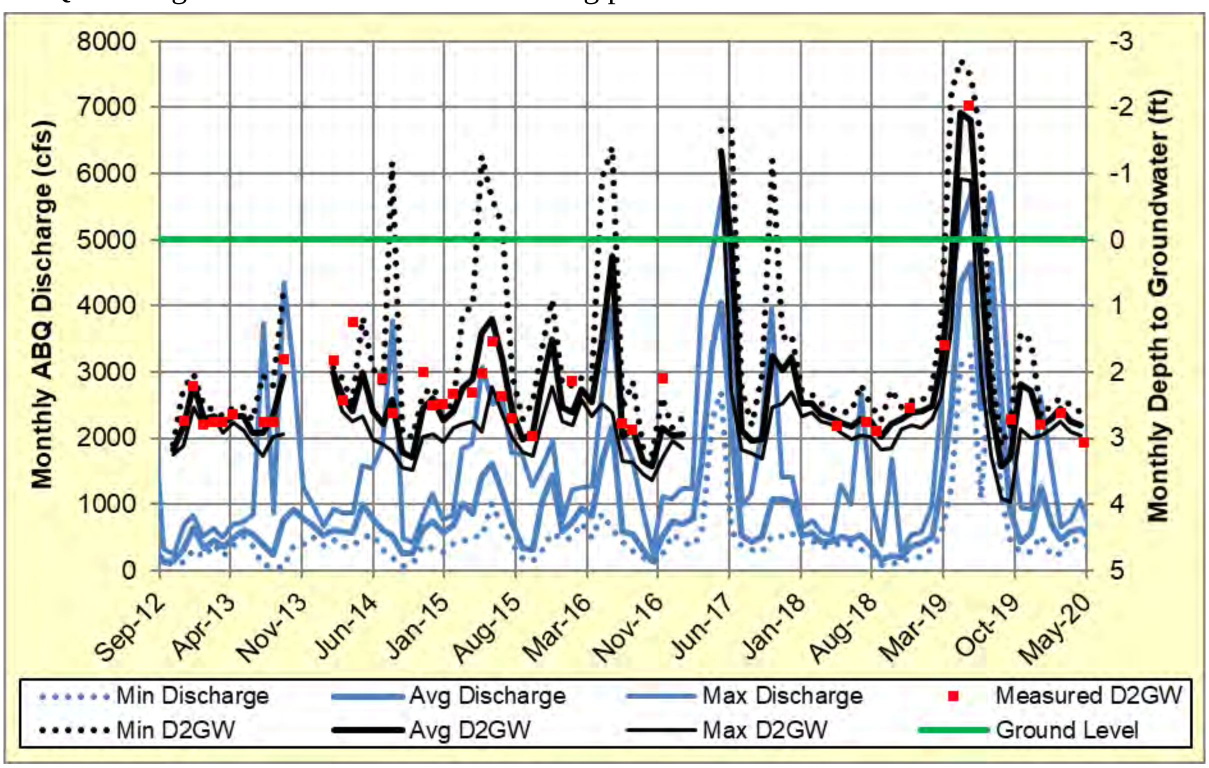

Figure 96. 4C South well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

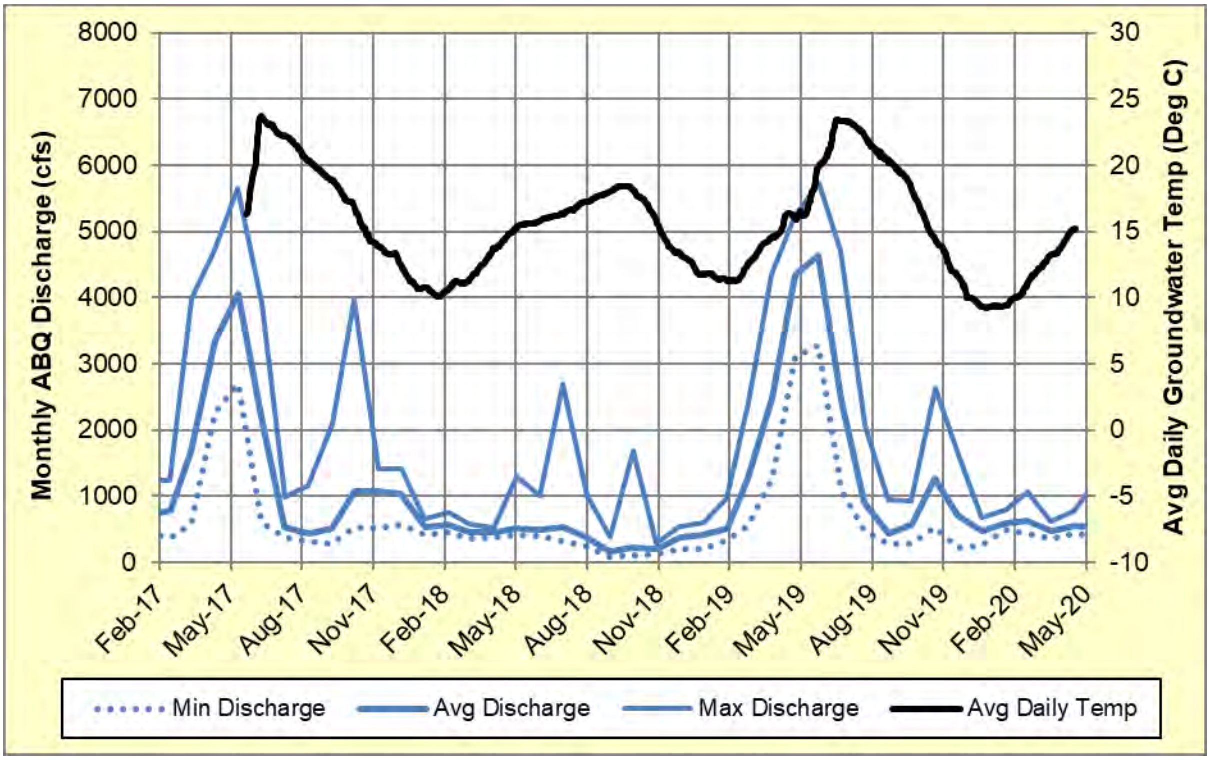

Figure 97. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 4C South well.

3.3.22 5A North

Figure 98. Location of 5A North, 5A South, 5A1, 5A2, and 5A3 groundwater monitoring wells.

The 5A North groundwater well was installed on May 4, 2012 at 346,503 E; 3,875,180 N (UTM NAD83, Zone 13N) (Figure 98). The EHF at 5A North was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 25, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. The datalogger was retired in October 2019 after multiple failed download attempts; the automated data record goes through June 4, 2019. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015 and October 2019 to May 2020, and on a quarterly basis from February 2016 through October 2019. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 99. D2GW on the measurement dates fluctuated between 3.84 feet bgs and 0.01 ft ags during the annual monitoring period.

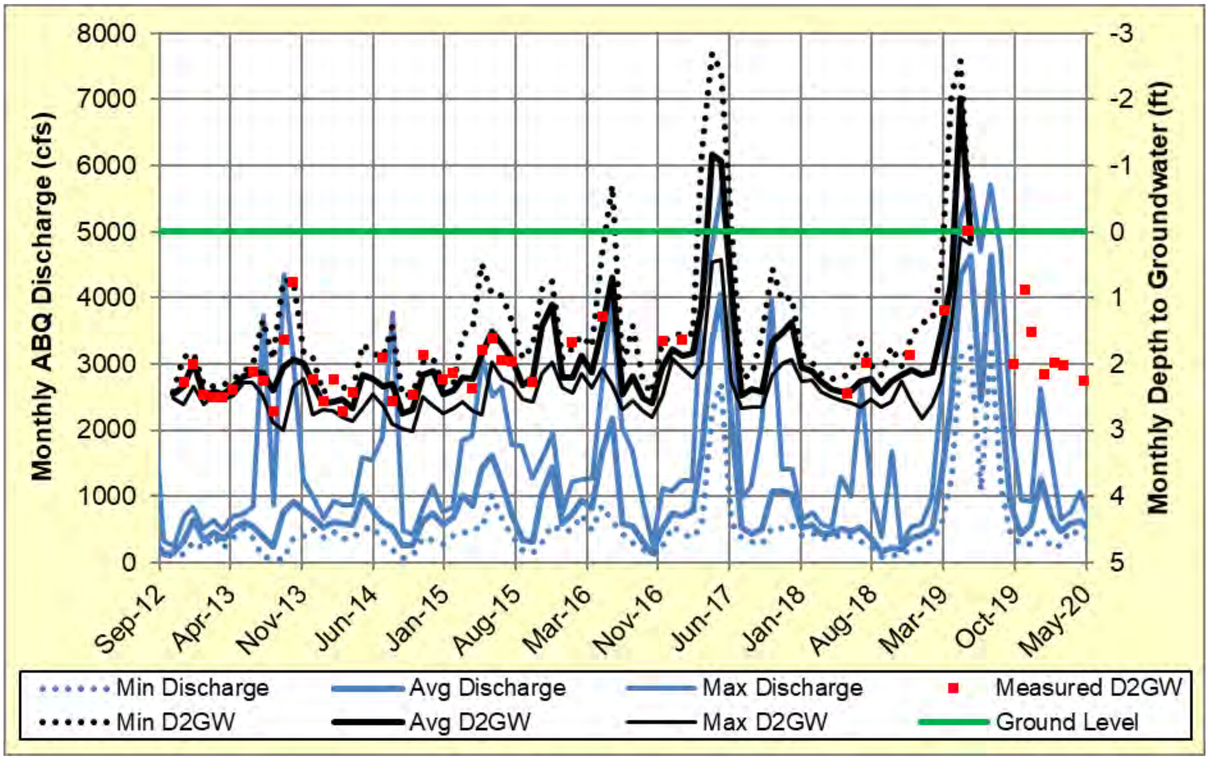

Figure 99. 5A North well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

3.3.23 5A South

The 5A South groundwater well was installed on May 1, 2012 at 346,076 E; 3,874,760 N (UTM NAD83, Zone 13N) (Figure 98). The well is located within a swale designed to inundate via rising groundwater and surface water flooding via a backwater channel. As with the other EHF's, 5A South was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 24, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. In May 2018, the datalogger was found to have failed and removed from the well. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015 and June 2018 to May 2020, and on a quarterly basis from February 2016 through January 2017.

Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 100. During the annual monitoring period, groundwater levels ranged from approximately 1.84 to 3.66 feet bgs on the measurement dates.

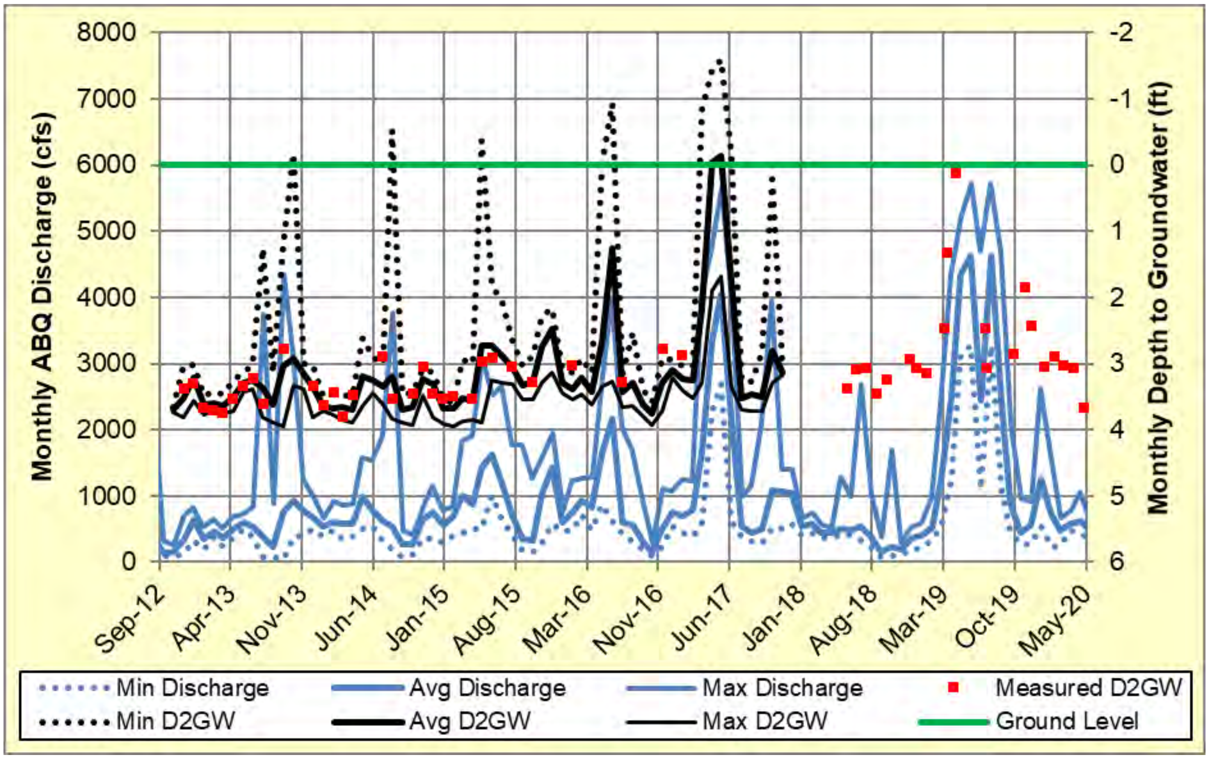

Figure 100. 5A South well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

3.3.24 5A1

The 5A1 groundwater well was installed on February 24, 2016 at 346,127 E; 3,874,815 N (UTM NAD83, Zone 13N) (Figure 98). The well is located in the northern (upstream) portion of swale 5A South, and was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 101. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 102. During the annual monitoring period, groundwater levels ranged from approximately 3.24 feet bgs to 1.78 feet ags. Groundwater was above ground surface from June 5, 2019 to July 7, 2019 in response to prolonged river discharge of greater than 3,750 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 103 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 11 to 22 degrees C. Large seasonal and event-based fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

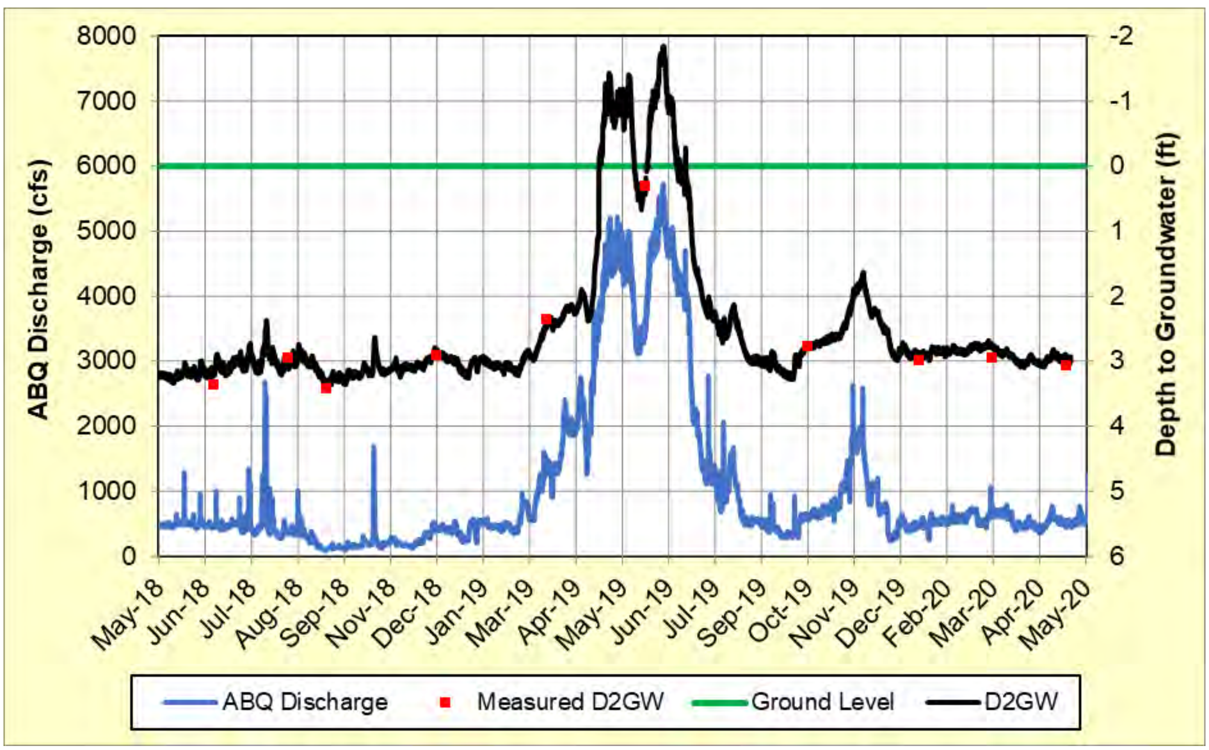

Figure 101. 5A1 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

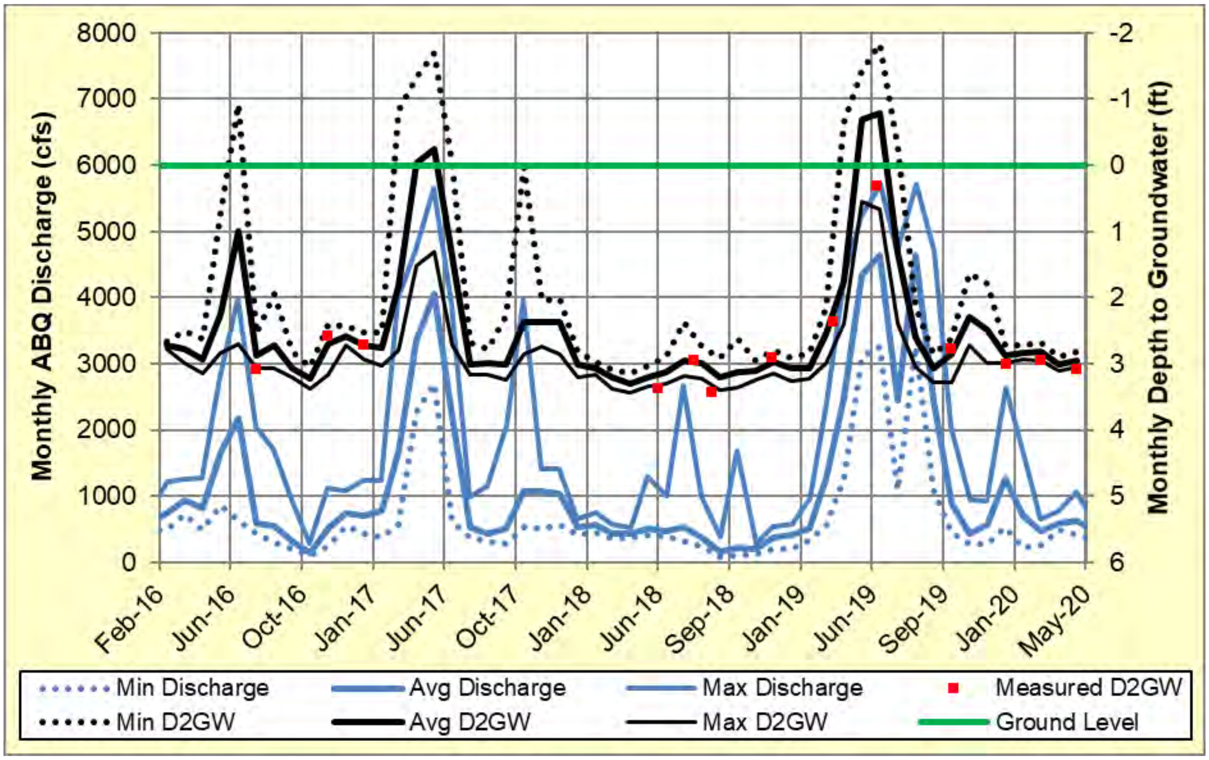

Figure 102. 5A1 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

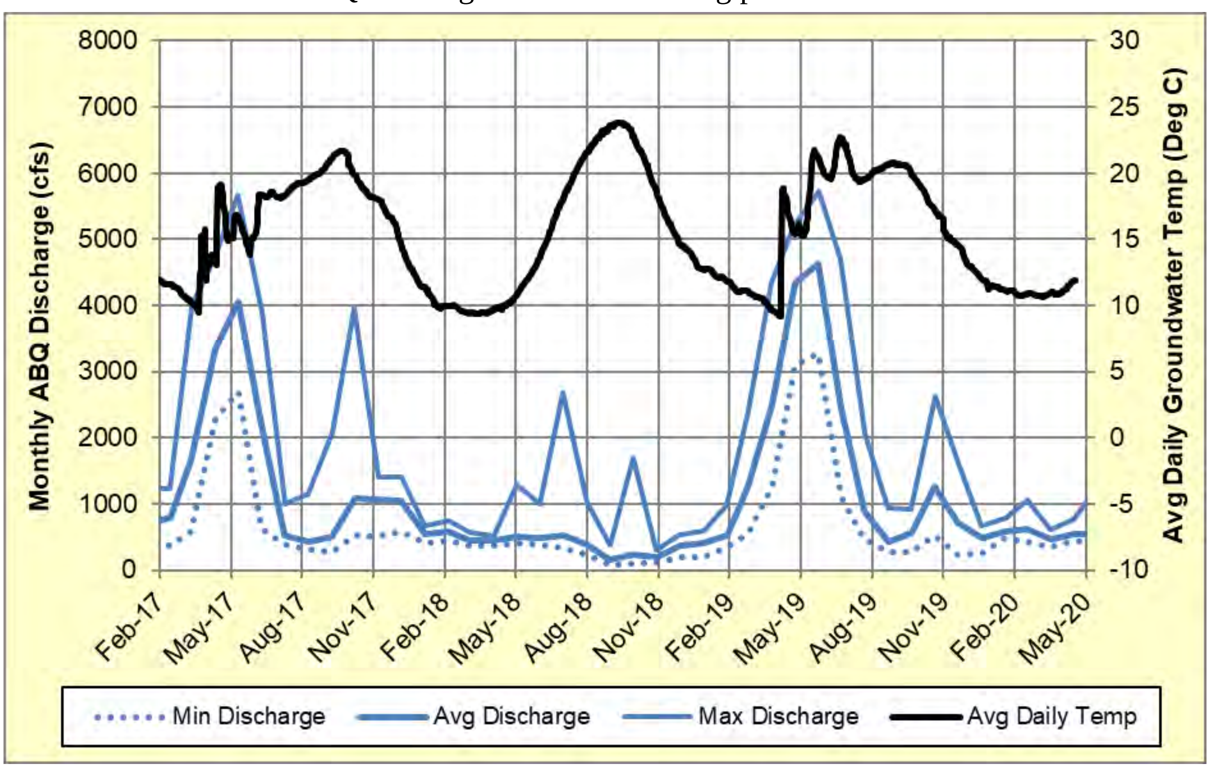

Figure 103. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5A1 well.

3.3.25 5A2

The 5A2 groundwater well was installed on February 24, 2016 at 346,036 E; 3,874,700 N (UTM NAD83, Zone 13N) (Figure 98). The well is located in the southern end of Swale 5A-South, and was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 104. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 105. During the annual monitoring period, groundwater levels ranged from approximately 3.35 feet bgs to 2.56 feet ags. Groundwater was above ground surface from June 5, 2019 through July 9, 2019 in response to prolonged river discharge of greater than 3,400 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 106 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 11 to 17 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

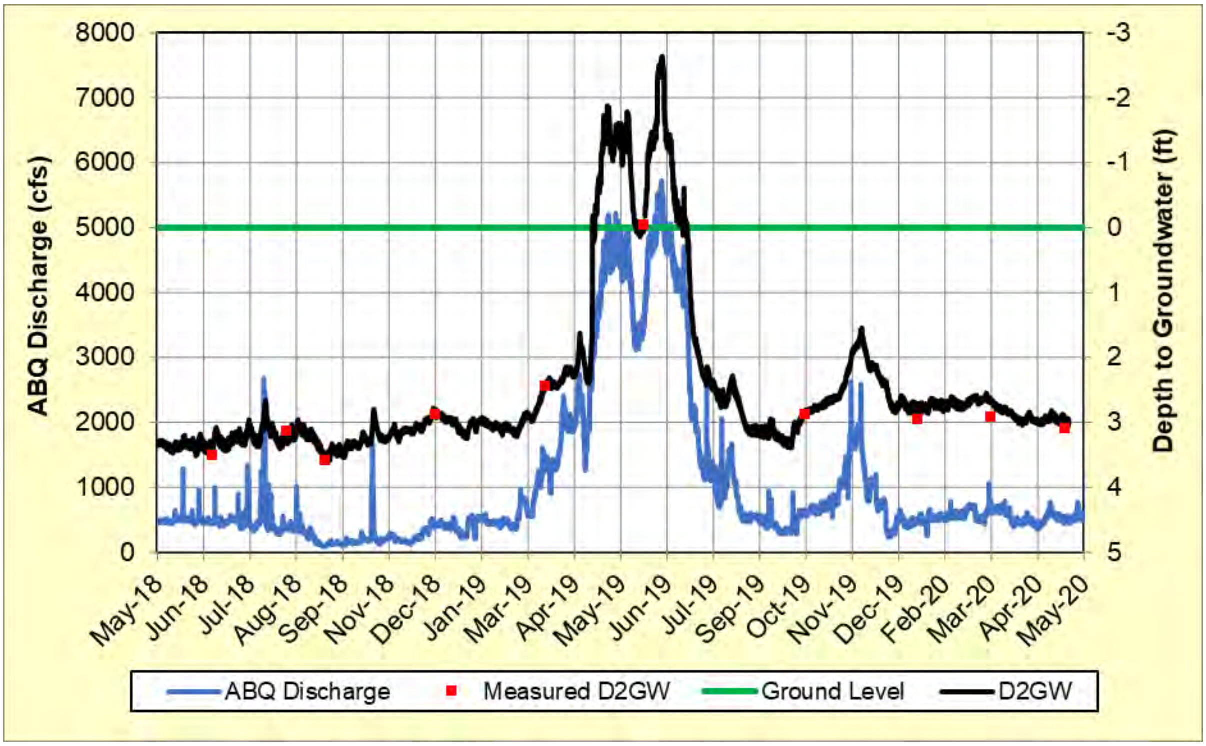

Figure 104. 5A2 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

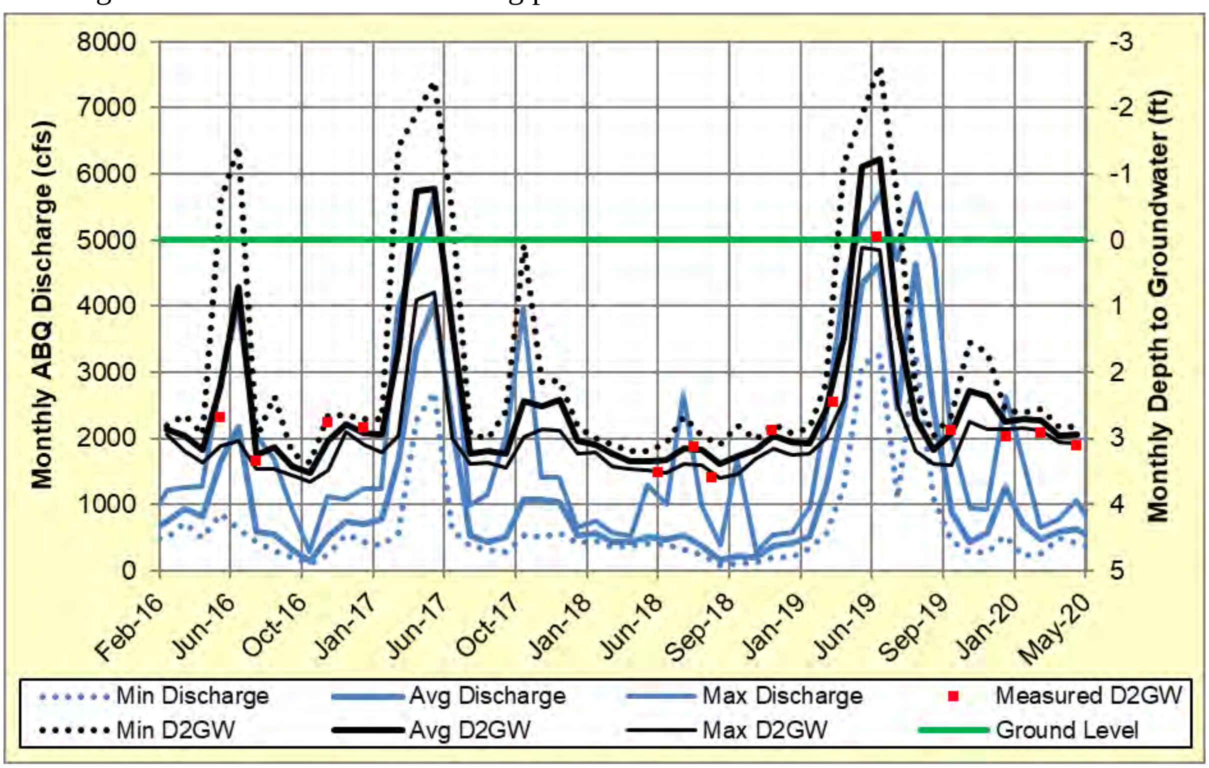

Figure 105. 5A2 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

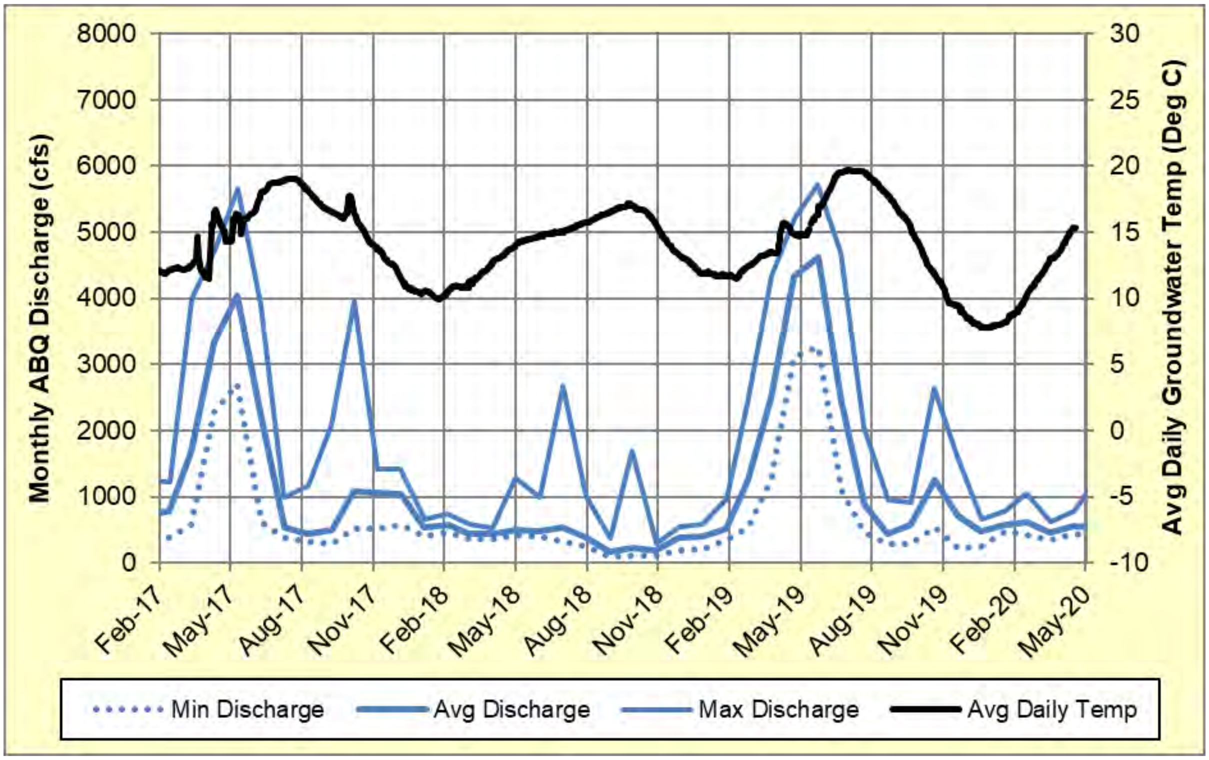

Figure 106. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5A2 well.

3.3.26 5A3

The 5A3 groundwater well was installed on February 26, 2016 at 346,015 E; 3,874,780 N (UTM NAD83, Zone 13N) (Figure 98). The well is located on an elevated floodplain terrace between the Atrisco Riverside Drain to the west and Swale 5A-South to the east. This well was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 107. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 108. During the annual monitoring period, groundwater levels ranged from approximately 2.75 to 6.63 feet bgs. Groundwater was not above ground surface at any point during the monitoring period.

Figure 109 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 13 to 21 degrees C. These temperature fluctuations are smaller than for other EHF wells, and are likely due to deeper groundwater that is less connected to the main river channel.

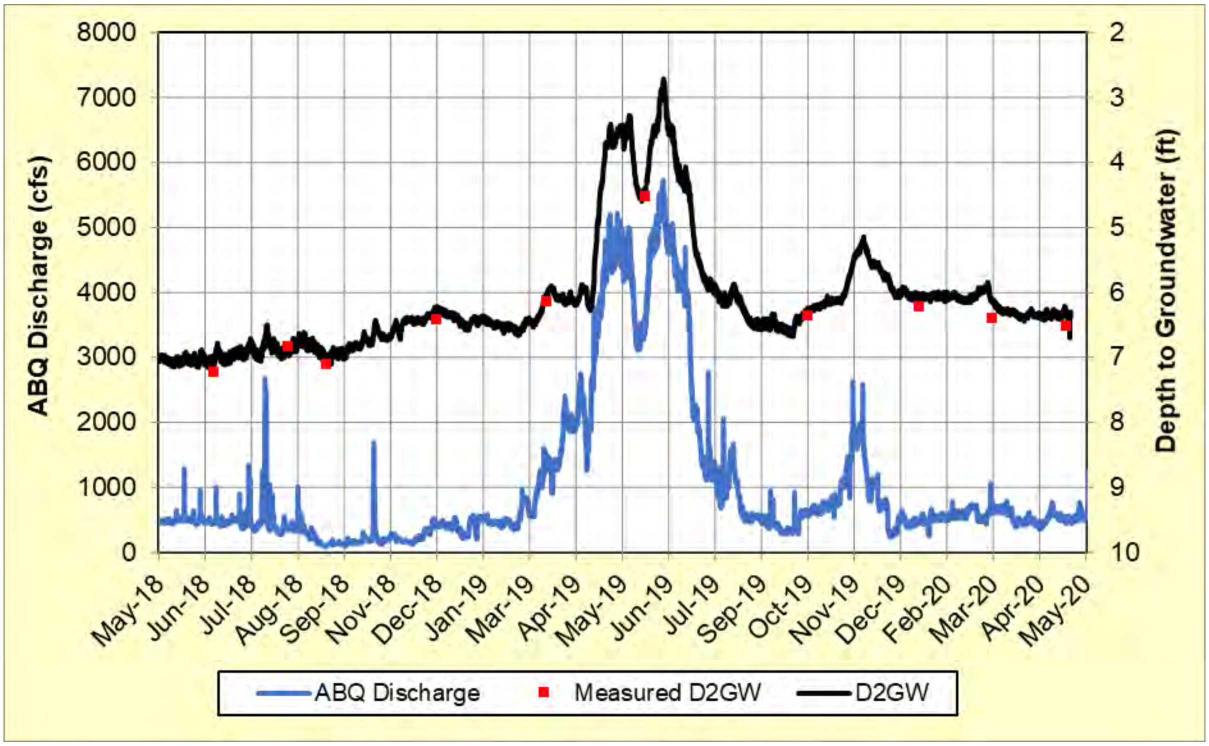

Figure 107. 5A3 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

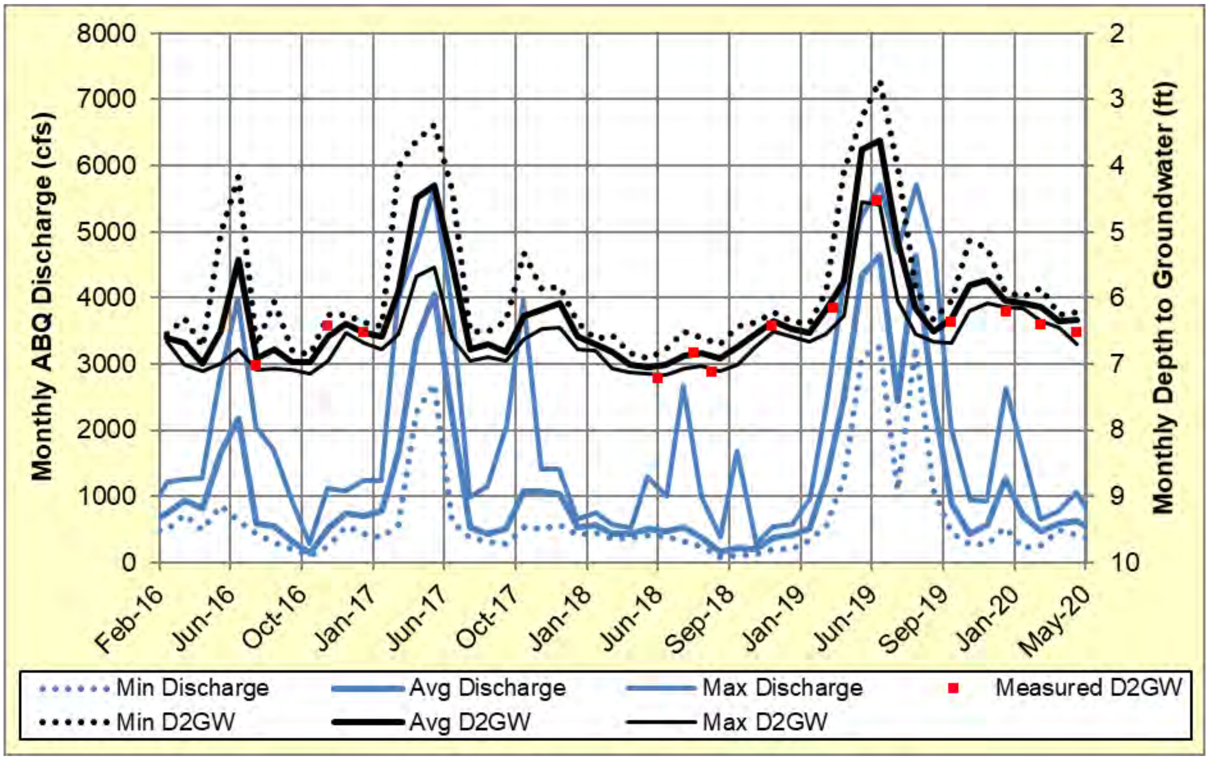

Figure 108. 5A3 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

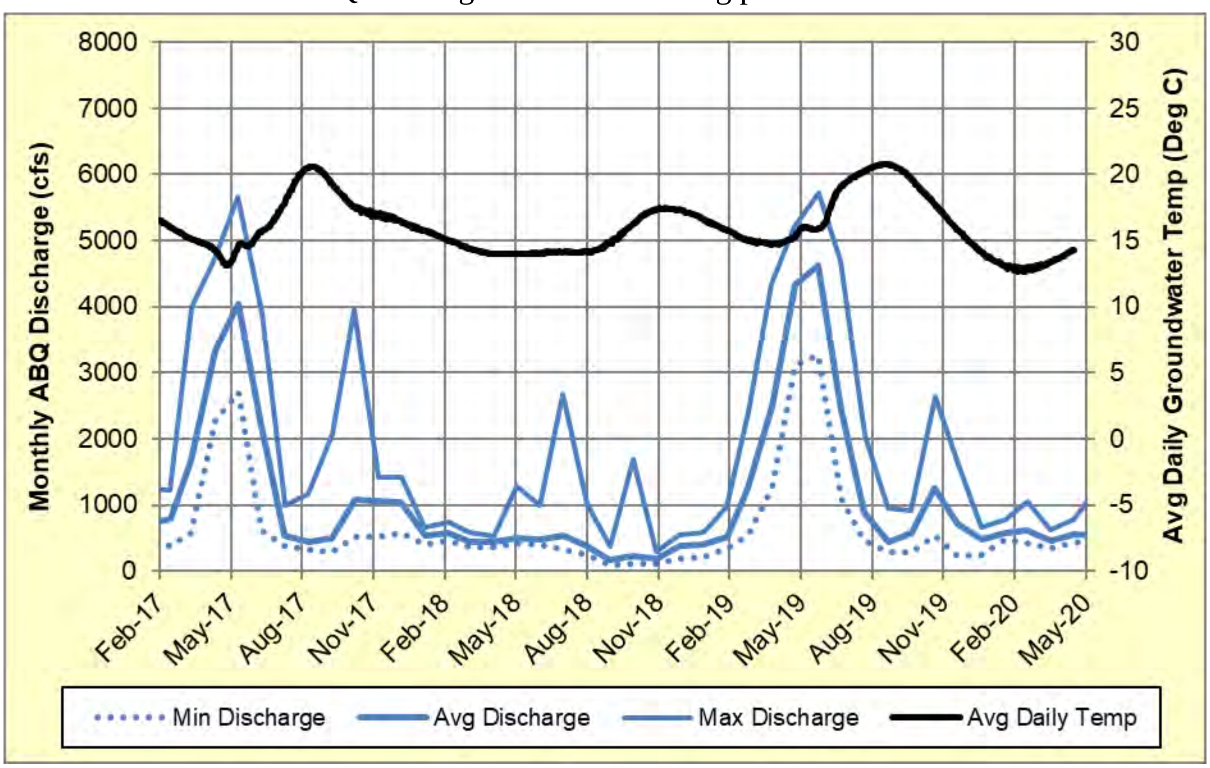

Figure 109. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5A3 well.

3.3.27 5B North

Figure 110. Location of 5B North, 5B South, 5B Bankline, and 5B1 groundwater monitoring wells.

The 5B North groundwater well was installed on April 30, 2012 at 346,252 E; 3,874,544 N (UTM NAD83, Zone 13N) (Figure 110). The well is located within a swale designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to inundate via rising groundwater and surface water flooding via a high-flow channel.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On February 26, 2014, it was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015, and on a quarterly basis from February 2016 through May 2020. The June 2019 manual measurement was erroneously high and omitted as an outlier. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 111. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 112. During the annual monitoring period, groundwater levels ranged from approximately 3.06 feet bgs to 2.27 feet ags. Groundwater remained ags from April 23, 2019 through July 12, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum Spring 2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 113 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 6 to 24 degrees C during the annual monitoring period. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

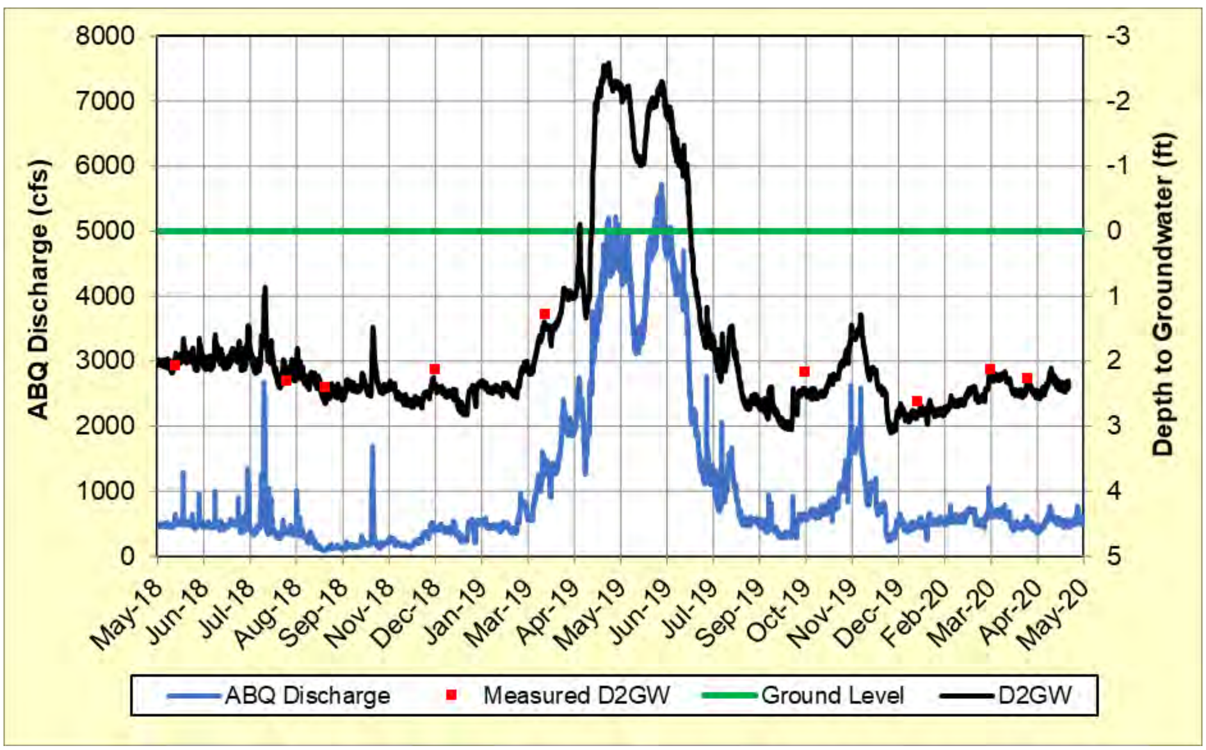

Figure 111. 5B North well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

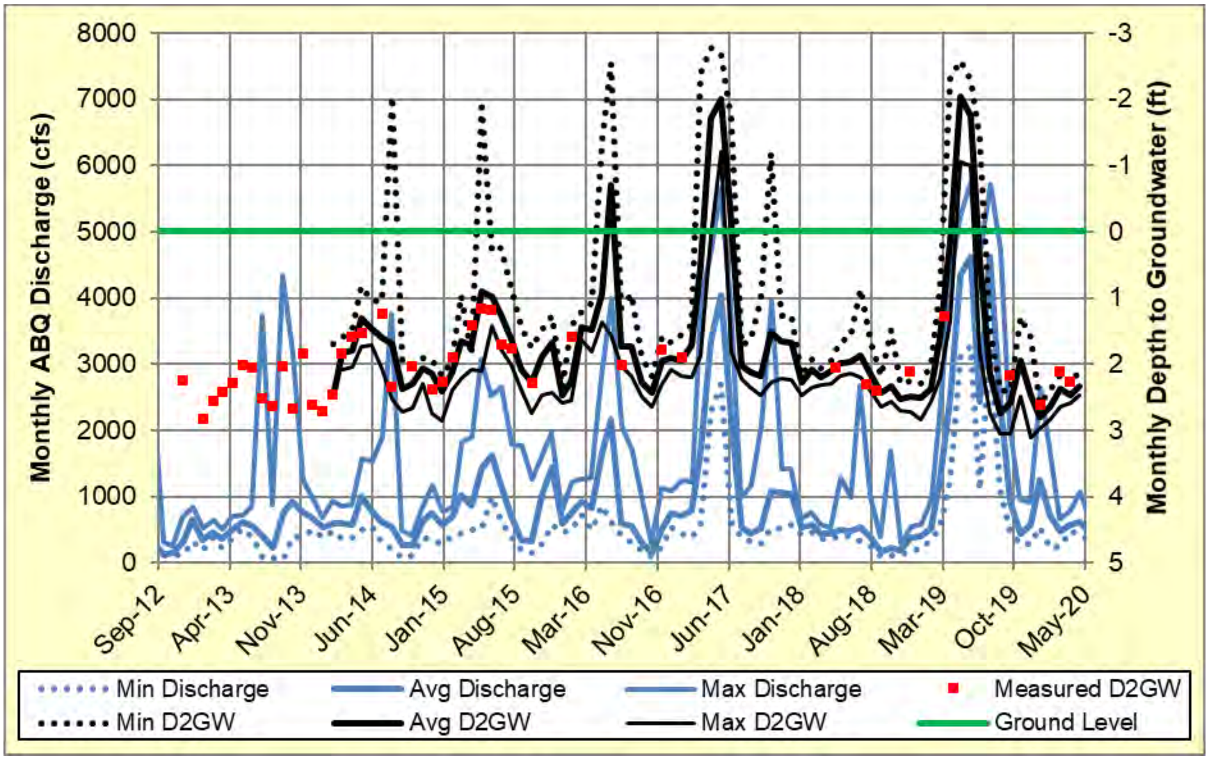

Figure 112. 5B North well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

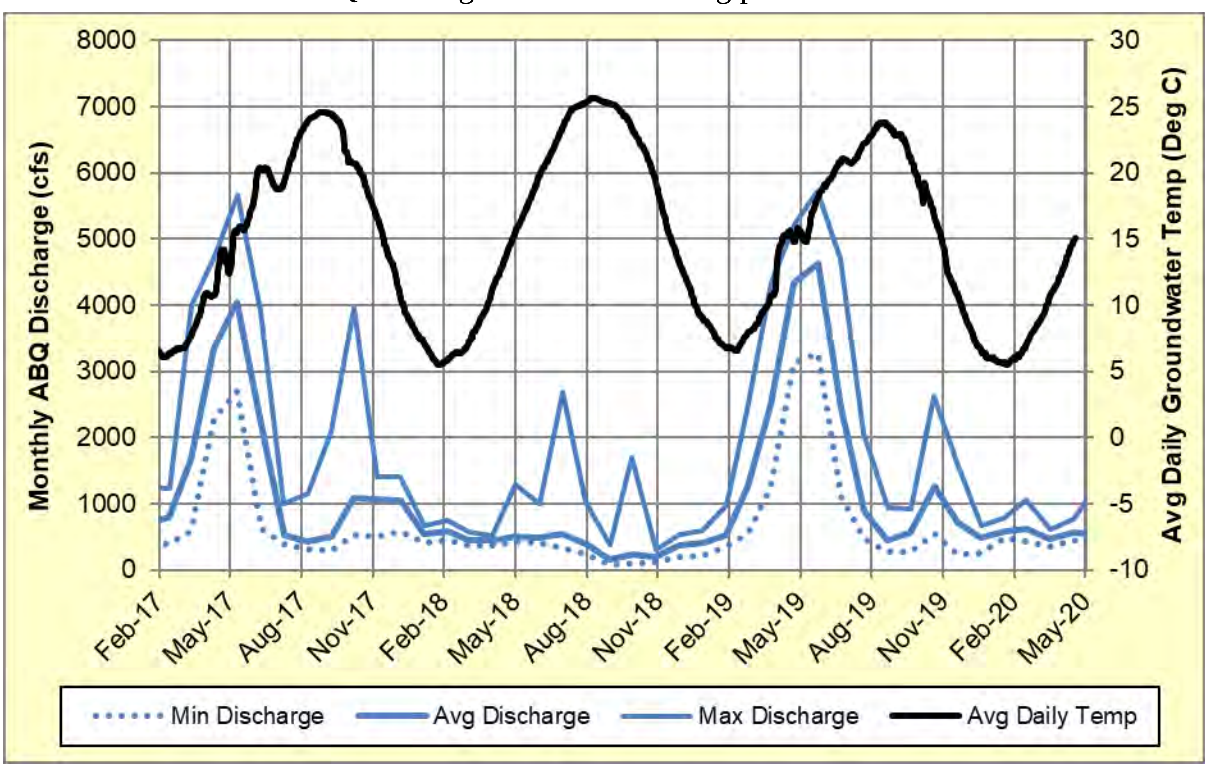

Figure 113. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5B North well.

3.3.28 5B1

The 5B1 groundwater well was installed on February 25, 2016 at 346,218 E; 3,874,405 N (UTM NAD83, Zone 13N) (Figure 110). The well is located near the southern end of Swale 5B-North, and was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 114. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 115. During the annual monitoring period, groundwater levels ranged from approximately 2.63 feet bgs to 4.38 feet ags. Groundwater remained ags from April 23, 2019 through July 15, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 116 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 6 to 24 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

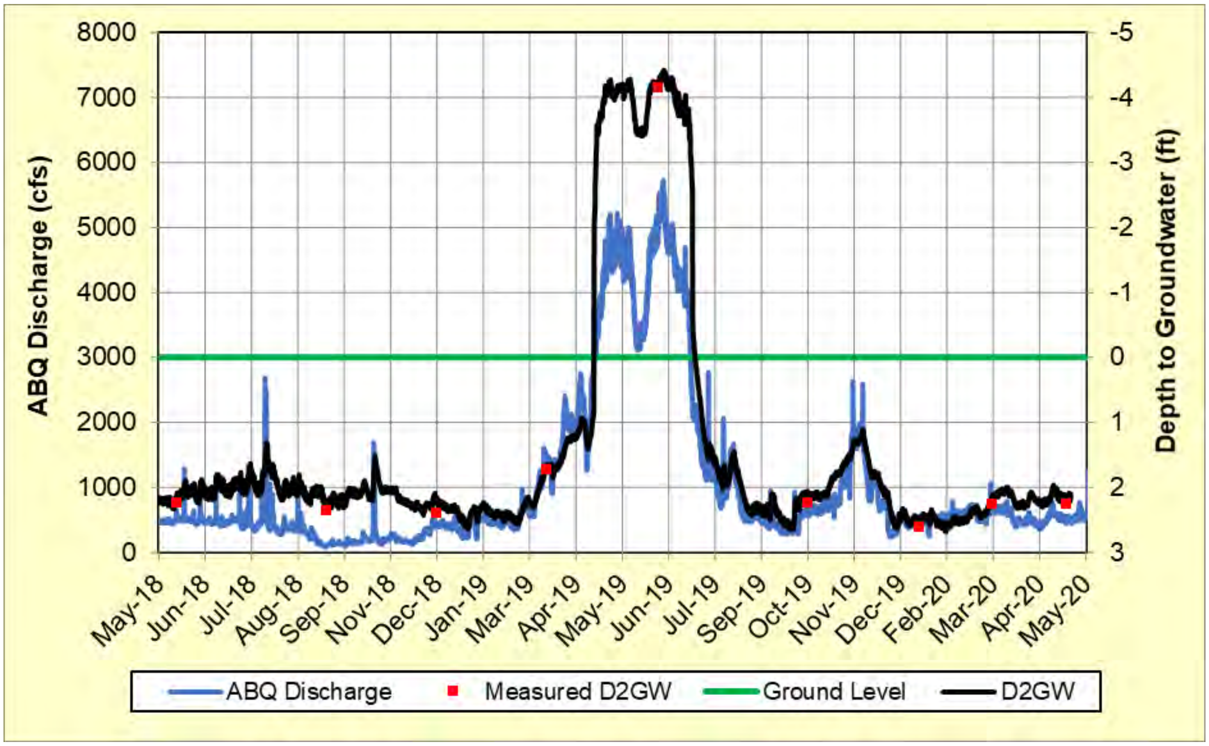

Figure 114. 5B1 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

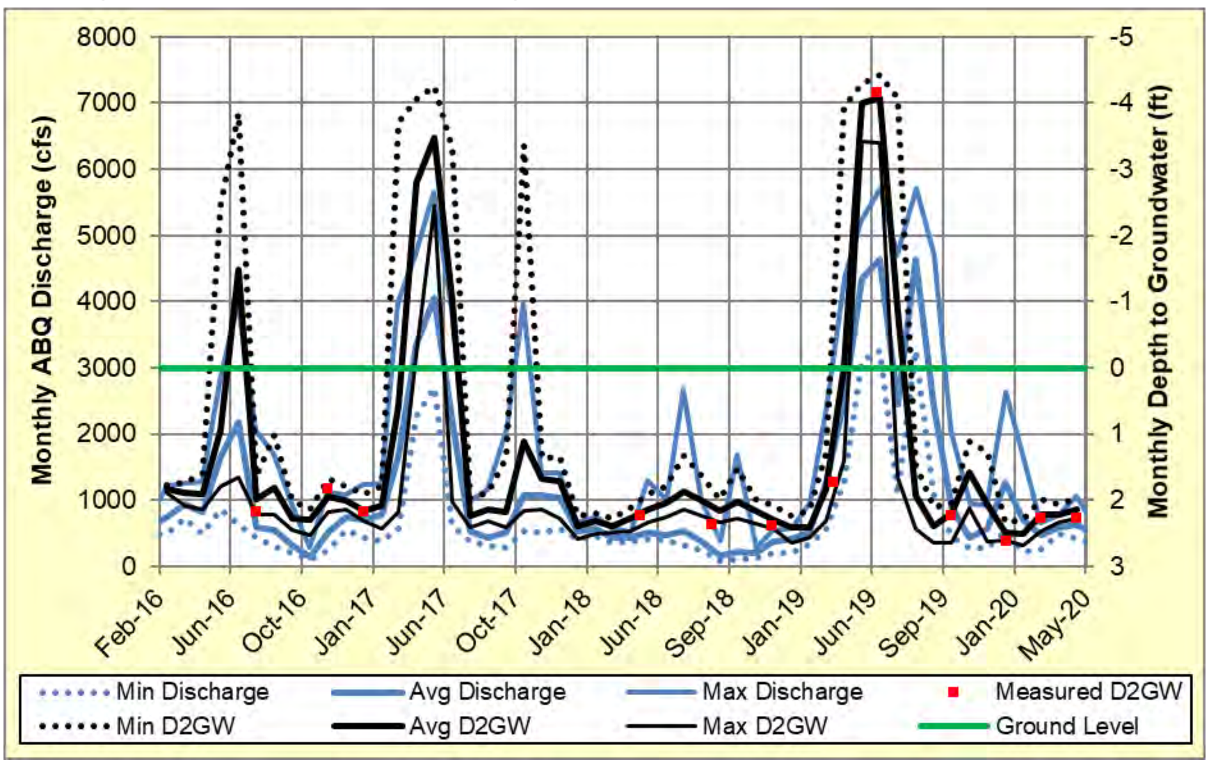

Figure 115. 5B1 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

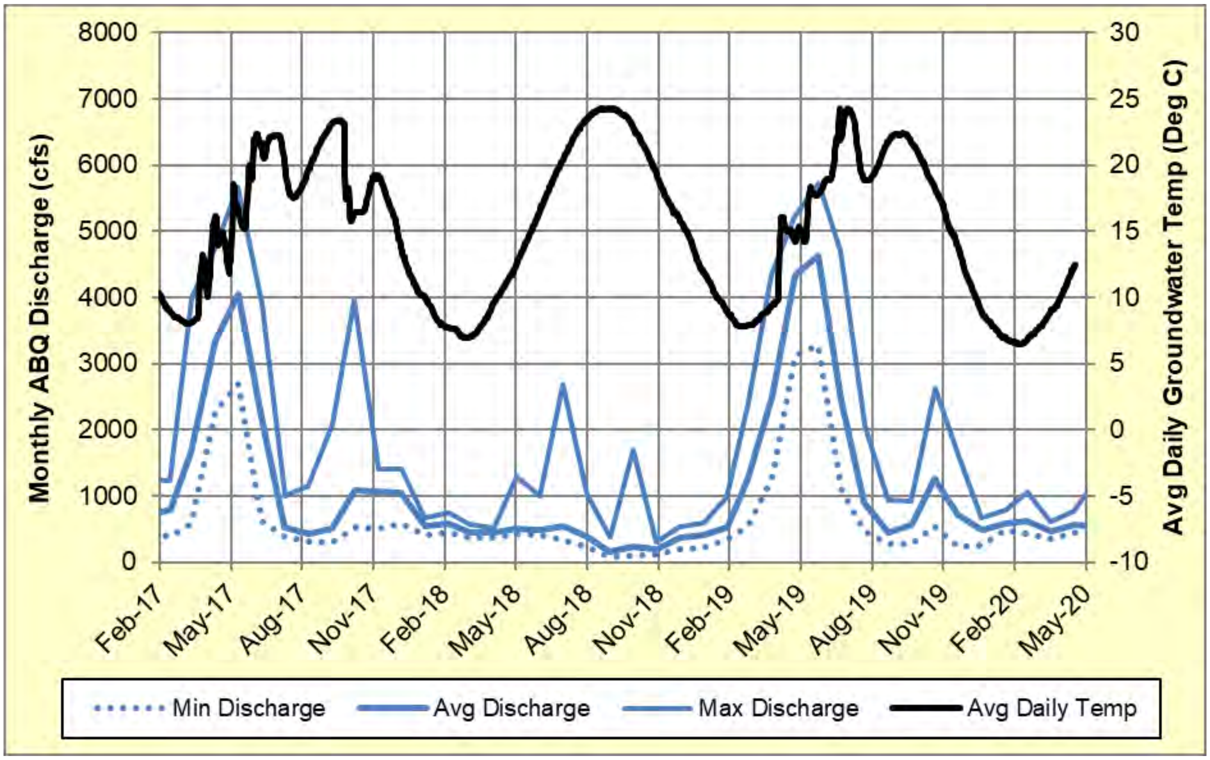

Figure 116. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5B1 well.

3.3.29 5B Bankline

The 5B Bankline groundwater well was installed on May 4, 2012 at 346,206 E; 3,874,541 N (UTM NAD83, Zone 13N) (Figure 110). The well is located within a lowered bankline terrace designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This well was constructed from 2-inch galvanized steel pipe, and was instrumented on February 26, 2016 with an In-Situ Rugged Troll 100 programmed to collect data every 30 minutes. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015, and on a quarterly basis from February 2016 through May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 117. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 118. During the annual monitoring period, groundwater levels ranged from 3.54 feet bgs to 1.70 feet ags. Groundwater remained ags from April 23, 2019 through July 11, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 119 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 5 to 26 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

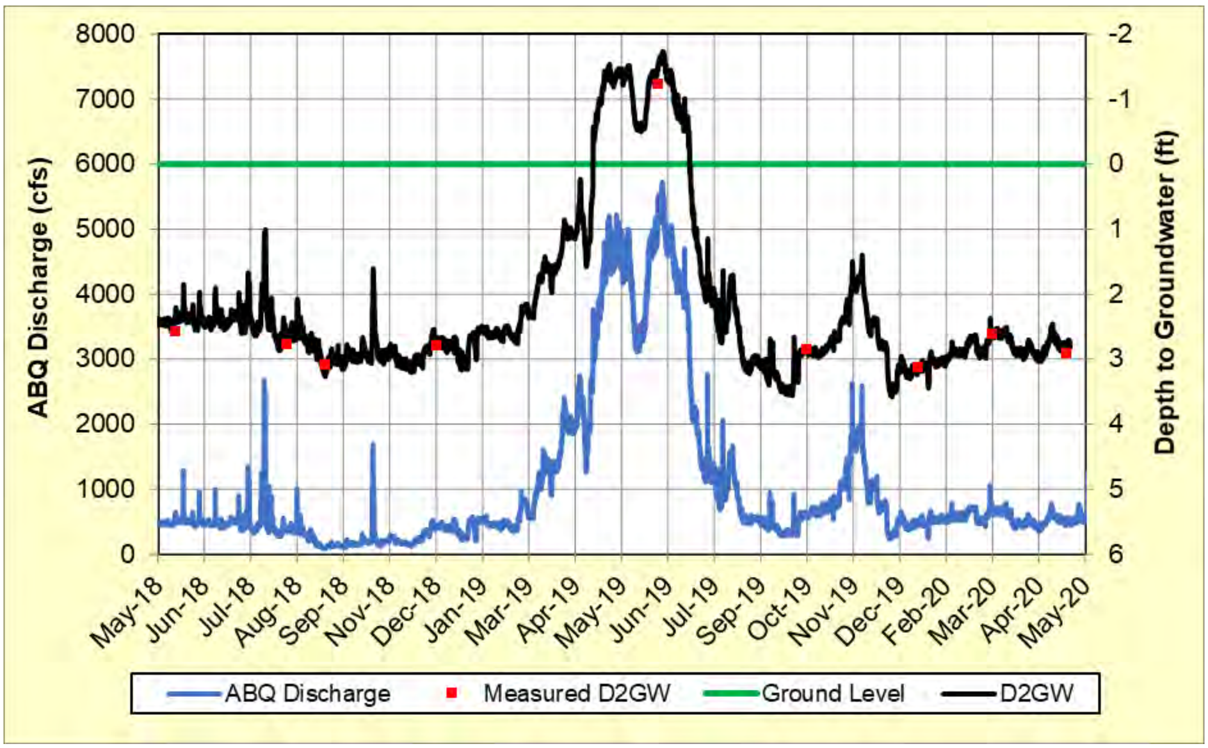

Figure 117. 5B Bankline well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

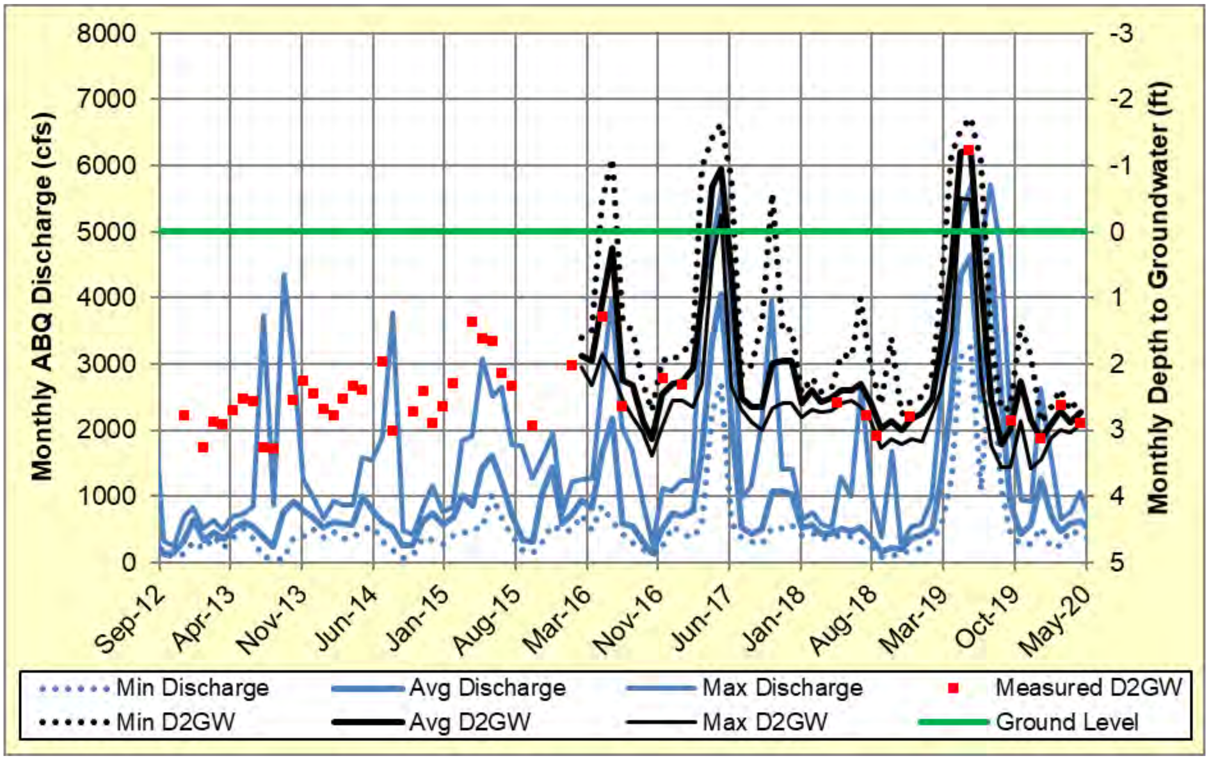

Figure 118. 5B Bankline well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

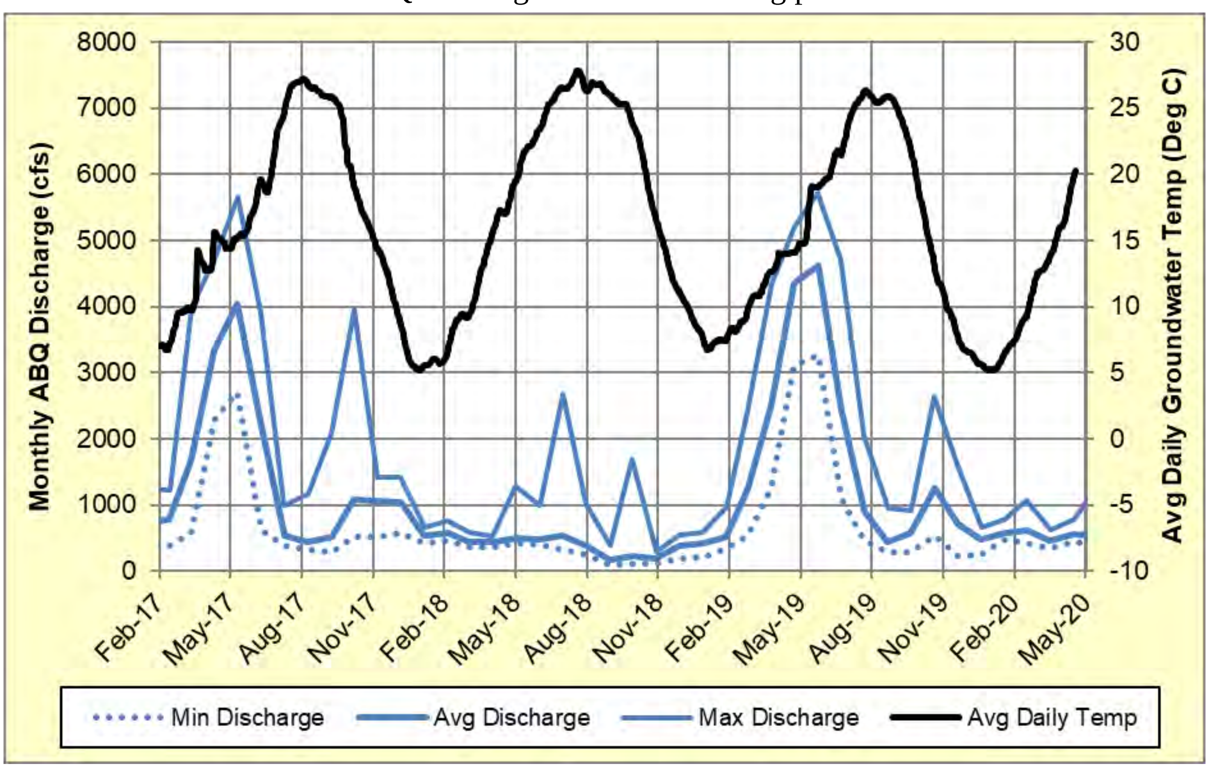

Figure 119. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5B Bankline well.

3.3.30 5B South

The 5B South groundwater well was installed on April 30, 2012 at 346,146 E; 3,873,866 N (UTM NAD83, Zone 13N) (Figure 110). The EHF at 5B South was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On February 26, 2014, it was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. The datalogger began recording sporadic and erroneous depths on August 10, 2019 and was retired. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015, and on a quarterly basis from February 2016 through May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 120. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 121. During the annual monitoring period, groundwater levels ranged from 2.49 feet bgs to 2.90 feet ags (prior to sensor failure). Groundwater remained ags from April 26, 2019 through July 12, 2019 in response to prolonged river discharge of greater than 3,500 cfs. As of May 31, 2020, maximum 2020 spring river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 122 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 10 to 20 degrees C prior to sensor failure. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

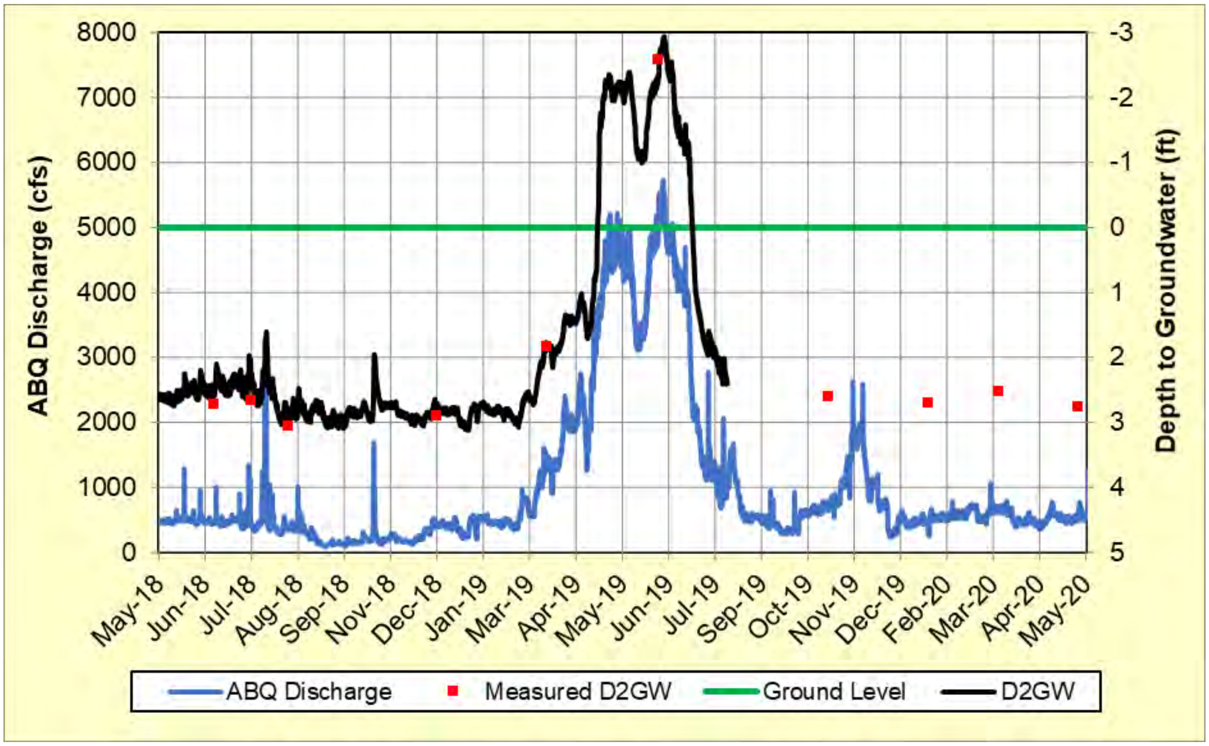

Figure 120. 5B South well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

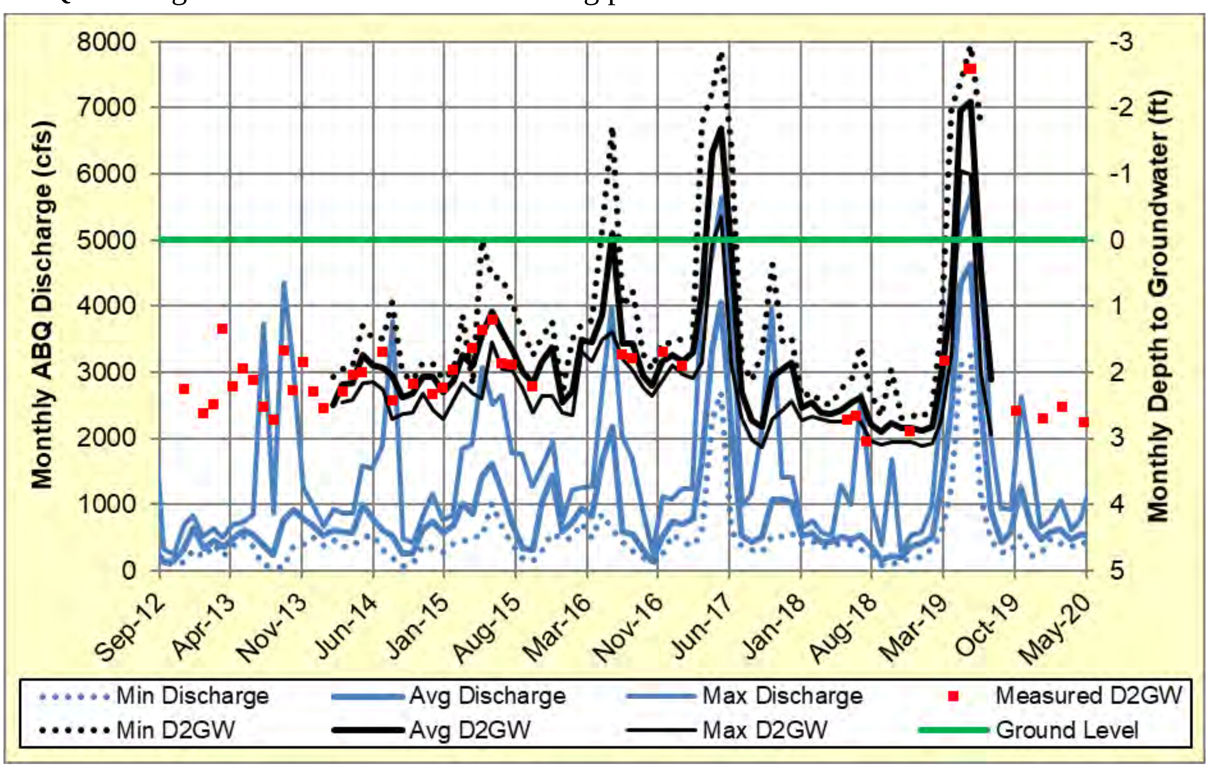

Figure 121. 5B South well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

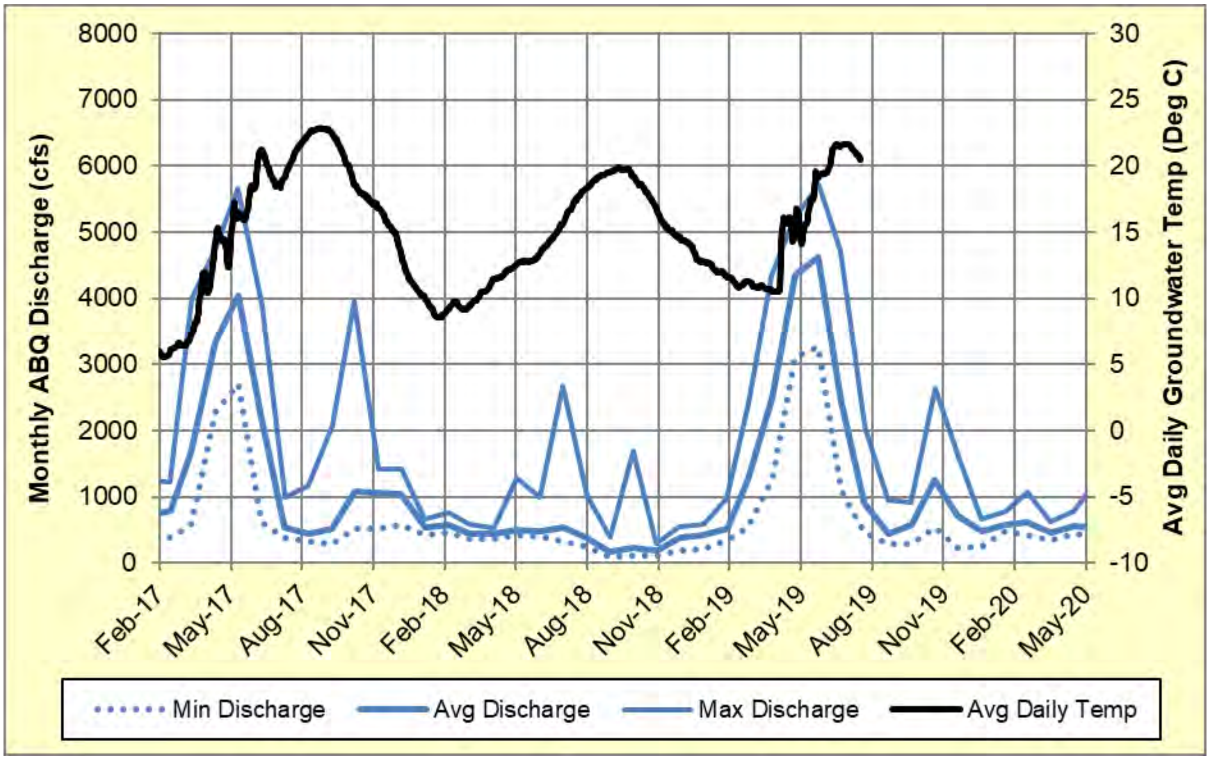

Figure 122. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5B South well.

3.3.31 5C North

The 5C North groundwater well was installed on May 5, 2012 at 346,503 E; 3,875,180 N (UTM NAD83, Zone 13N) (Figure 32). The EHF at 5C North was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater.

Groundwater inundation during the monitoring period corresponded with river discharges at the Albuquerque Gage at or above approximately 2,800 cfs (Figure 41). This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 24, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. The datalogger was removed from the well from September 22 – October 12, 2018 and December 11-21, 2018 due to difficulty downloading, and was retired after multiple failed download attempts in October 2019. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015 and October 2019 to May 2020, and on a quarterly basis from February 2016 through October 2019. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 123. During the annual monitoring period, groundwater levels on the measurement dates ranged from approximately 1.36 feet bgs to 4.47 feet ags. The duration of ponding at this well due to high 2019 spring runoff is unknown due to sensor failure.

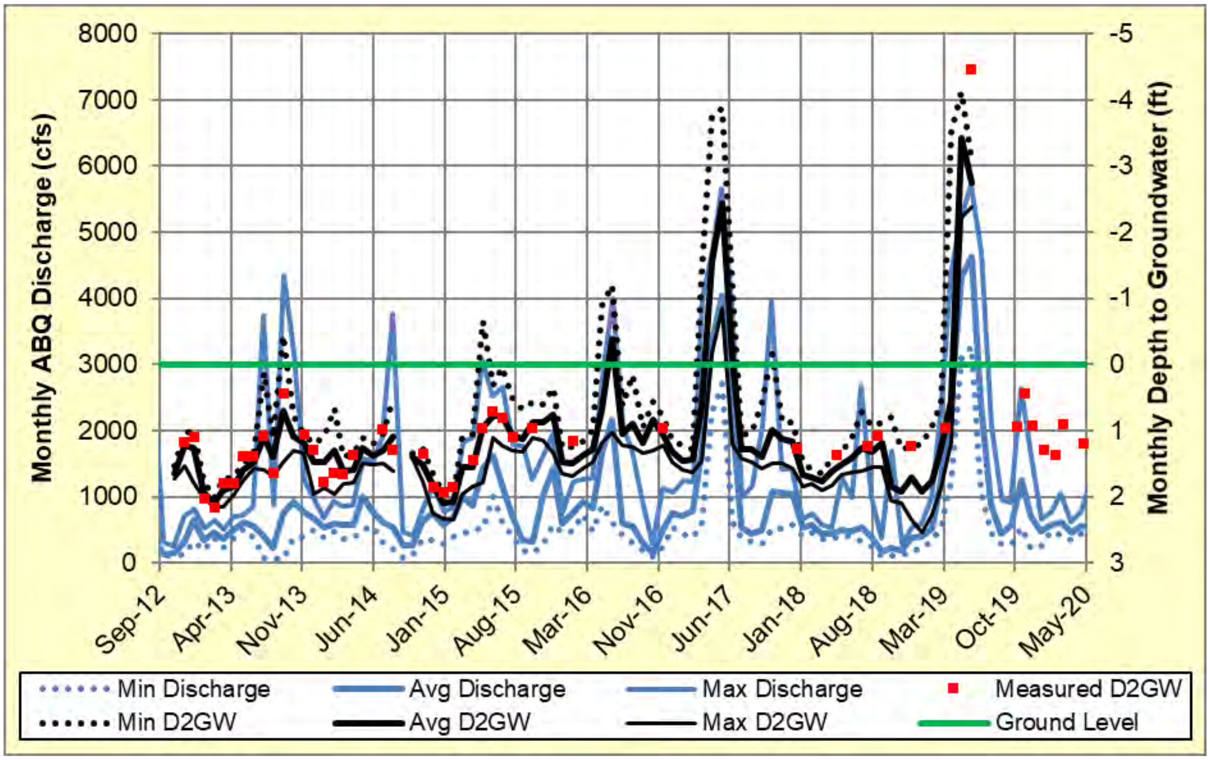

Figure 123. 5C North well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

3.3.32 5C South

The 5C South groundwater well was installed on May 2, 2012 at 345,985 E; 3,872,029 N (UTM NAD83, Zone 13N) (Figure 32). The EHF at 5C South was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 24, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. Data could not be retrieved from the logger during the August 2018 site visit, and the logger was removed from the well. Groundwater levels were manually measured on a near-monthly basis from

October 2012 to October 2015 and August 2018 through May 2020, and on a quarterly basis from October 2015 through March 2017. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 124. During the annual monitoring period, manually measured groundwater levels ranged from 1.01 to 2.03 feet bgs.

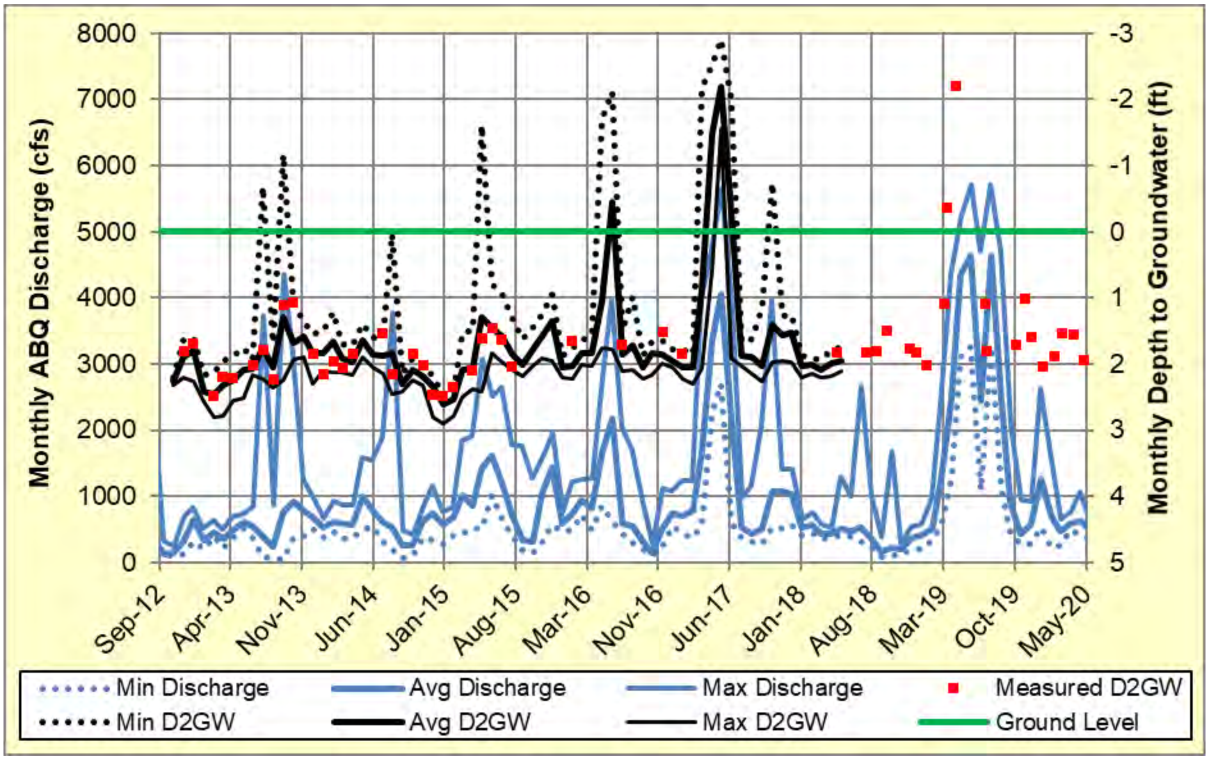

Figure 124. 5C South well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

3.3.33 5C Bankline

The 5C Bankline groundwater well was installed on June 20, 2012 at 345,849 E; 3,871,811 N (UTM NAD83, Zone 13N) (Figure 32). The well is located within a lowered bankline feature designed to attain shallow seasonal groundwater depths of no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 24, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. The datalogger was removed from the well from September 26, 2018 through October 12, 2018 and December 11-22, 2018 due to difficulty downloading, and was retired in October 2019 due to repeat failed download attempts. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015 and November 2019 to May 2020, and on a quarterly basis from February 2016 through June 2019. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 125. During the annual monitoring period, manually measured groundwater levels ranged from 2.76 feet bgs to 1.68 feet ags. The duration of ponding at this well due to high 2019 spring runoff is unknown due to sensor failure.

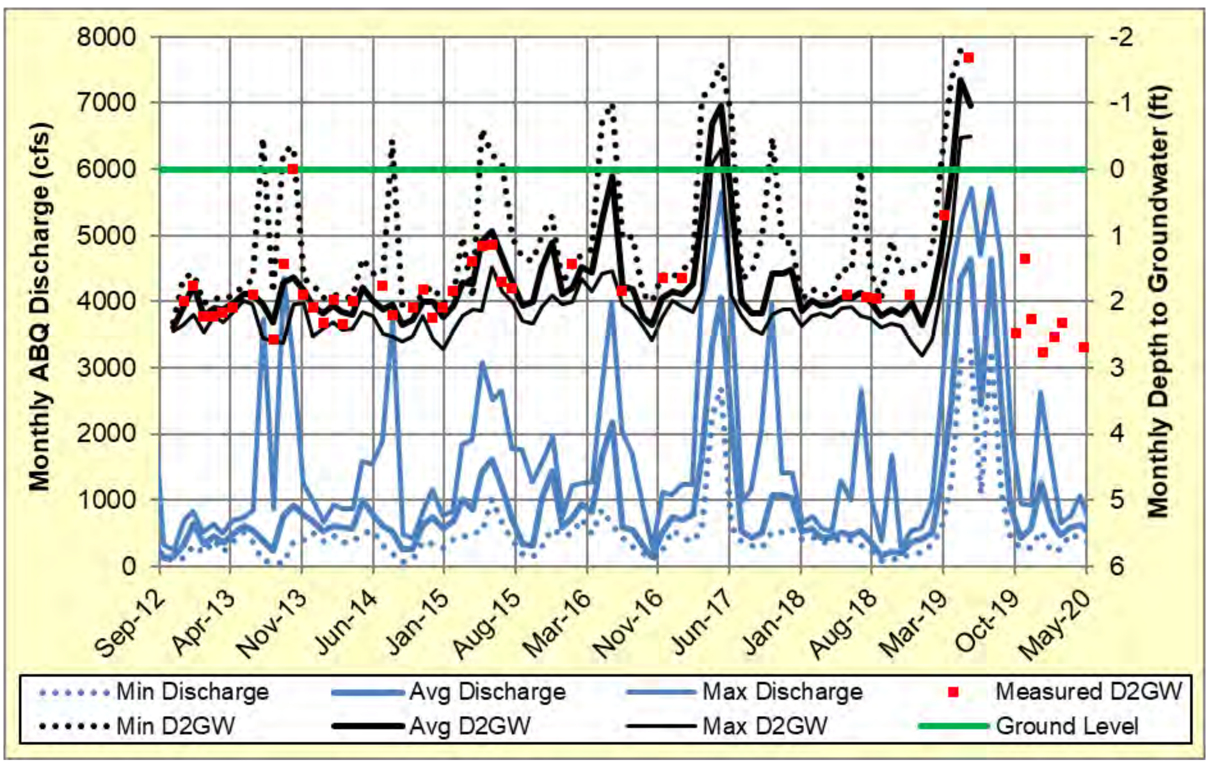

Figure 125. 5C Bankline well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

3.3.34 5C1

The 5C1 groundwater well was installed on February 26, 2016 at 346,047 E; 3,872,066 N (UTM NAD83, Zone 13N) (Figure 32). The well is located farthest inland (east) in Swale 5C South, and was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll

100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 126. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 127. During the annual monitoring period, groundwater levels ranged from approximately 2.66 feet bgs to 4.64 feet ags. Groundwater remained ags from April 24, 2019 through July 17, 2019 in response to prolonged river discharge of greater than 3,150 cfs. As of May 31, 2020, maximum Spring 2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 128 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 9 to 24 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

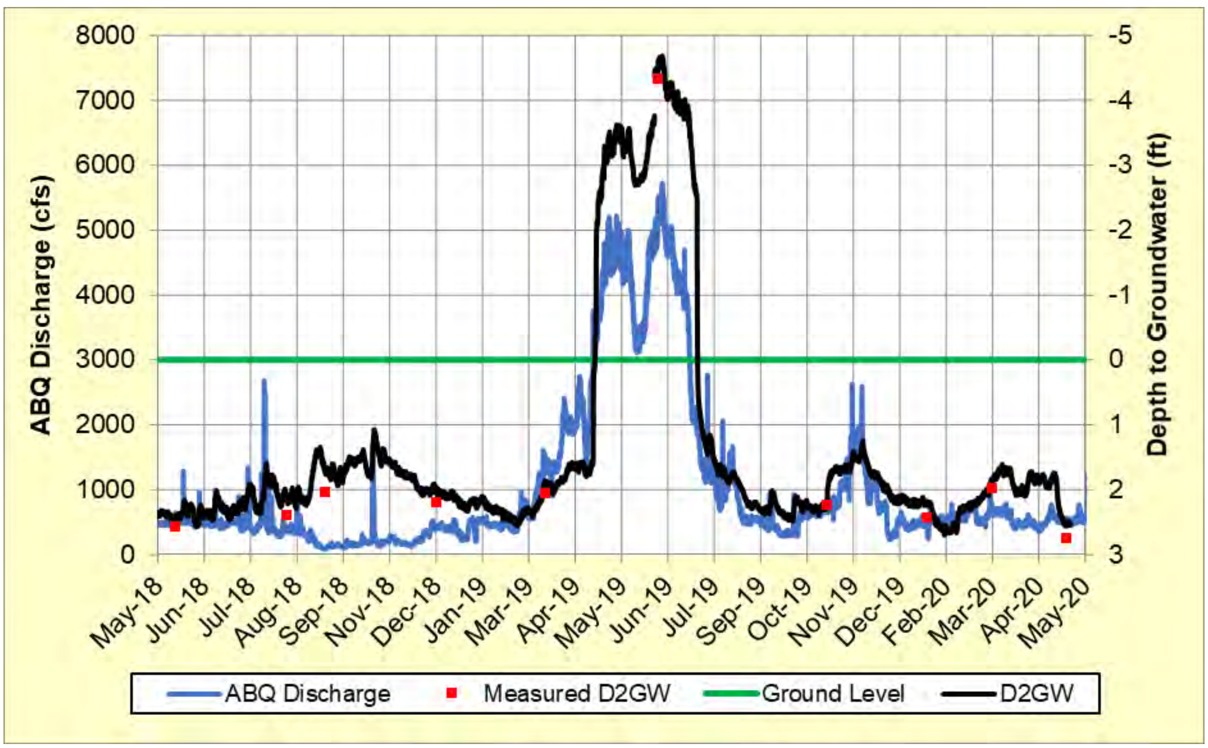

Figure 126. 5C1 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

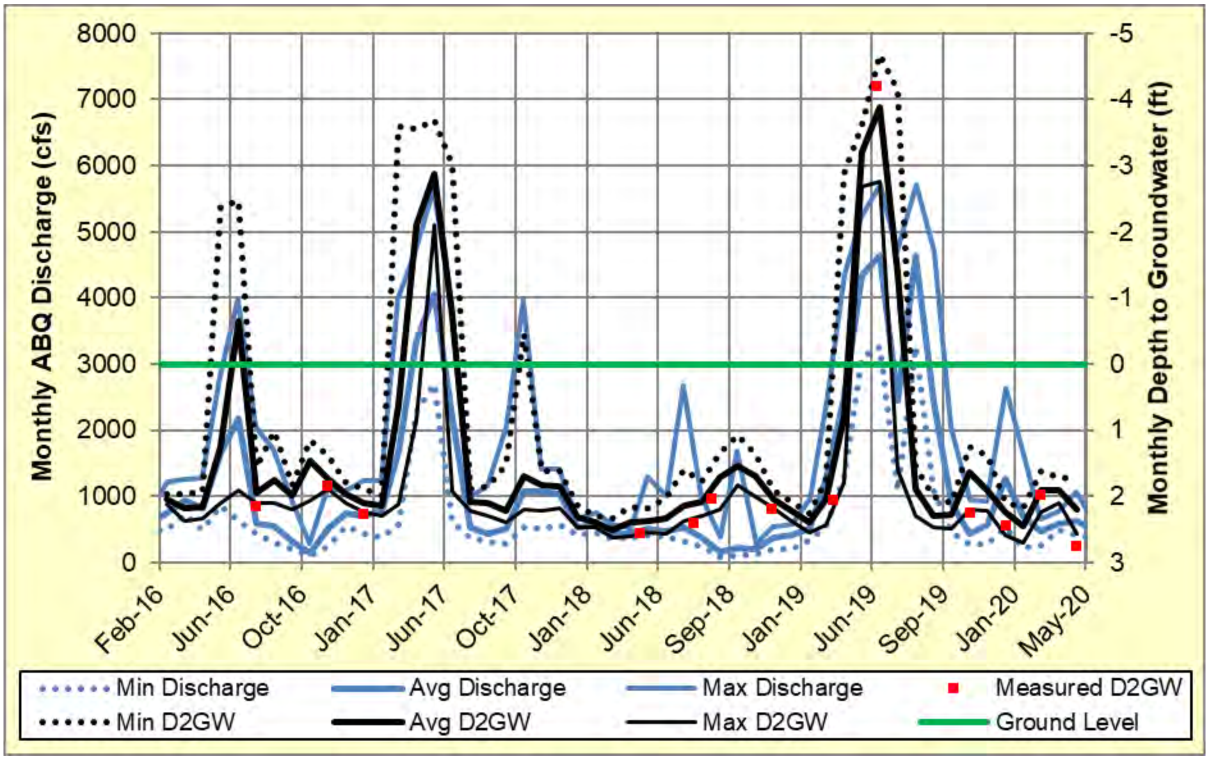

Figure 127. 5C1 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

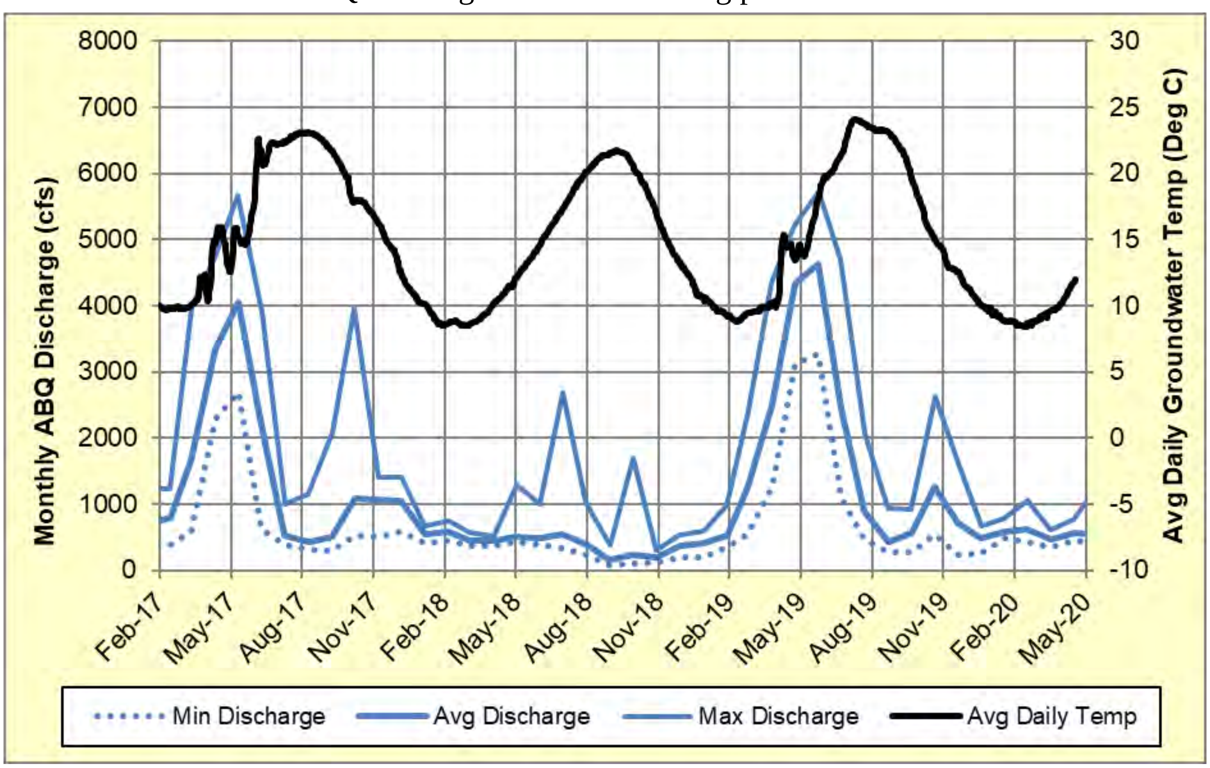

Figure 128. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5C1 well.

3.3.35 5C2

The 5C2 groundwater well was installed on February 26, 2016 at 345,965 E; 3,872,063 N (UTM NAD83, Zone 13N) (Figure 32). The well is close to the bankline in the northwest corner of Swale 5C South, and was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 129. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 130. During the annual monitoring period, groundwater levels ranged from approximately 2.43 feet bgs to 2.77 feet ags. Groundwater remained ags from April 24, 2019 through July 18, 2019 in response to prolonged river discharge of greater than 3,150 cfs. As of May 31, 2020, maximum Spring 2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 131 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 6 to 26 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

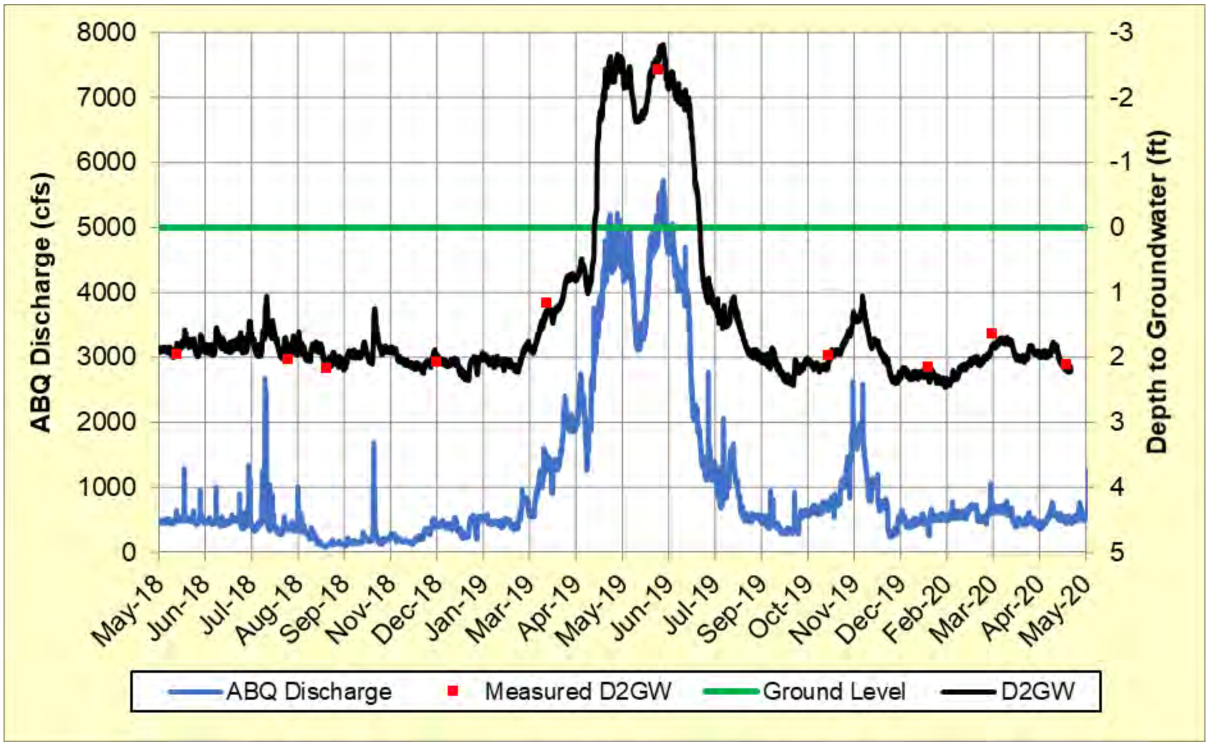

Figure 129. 5C2 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

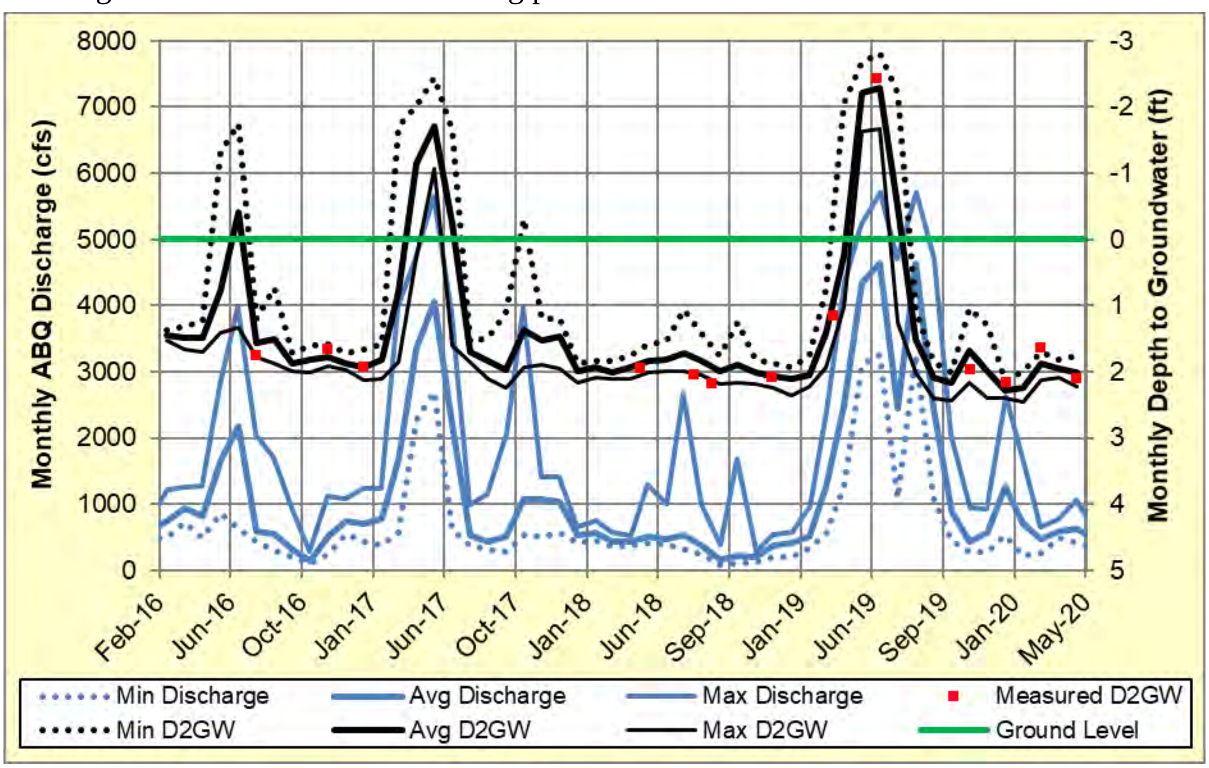

Figure 130. 5C2 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

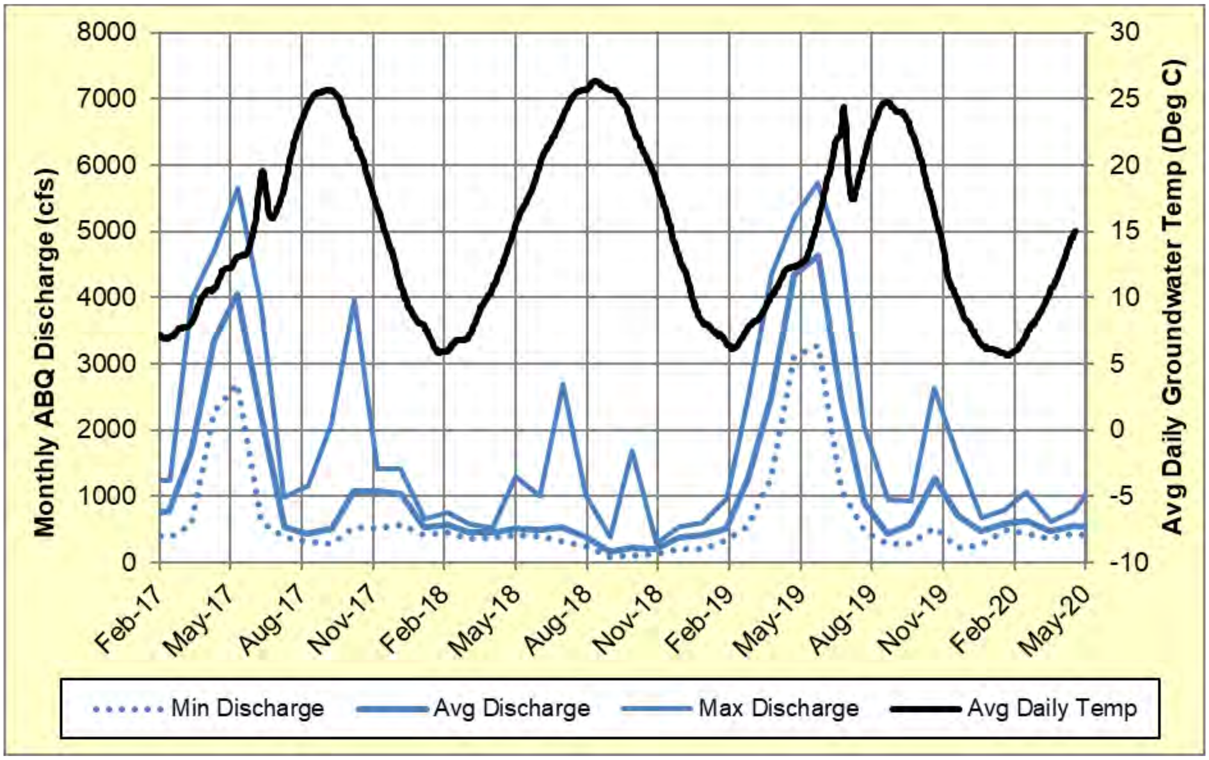

Figure 131. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5C2 well.

3.3.36 5C3

The 5C3 groundwater well was installed on February 26, 2016 at 345,966 E; 3,871,988 N (UTM NAD83, Zone 13N) (Figure 32). The well is located on the southern portion of Swale 5C-Sout, and was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 132. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 133. During the annual monitoring period, groundwater levels ranged from approximately 2.66 feet bgs to 4.96 feet ags. Groundwater remained ags from April 24, 2019 through July 16, 2019 in response to prolonged river discharge of greater than 3,150 cfs. As of May 31, 2020, maximum Spring

2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 134 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 7 to 24 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

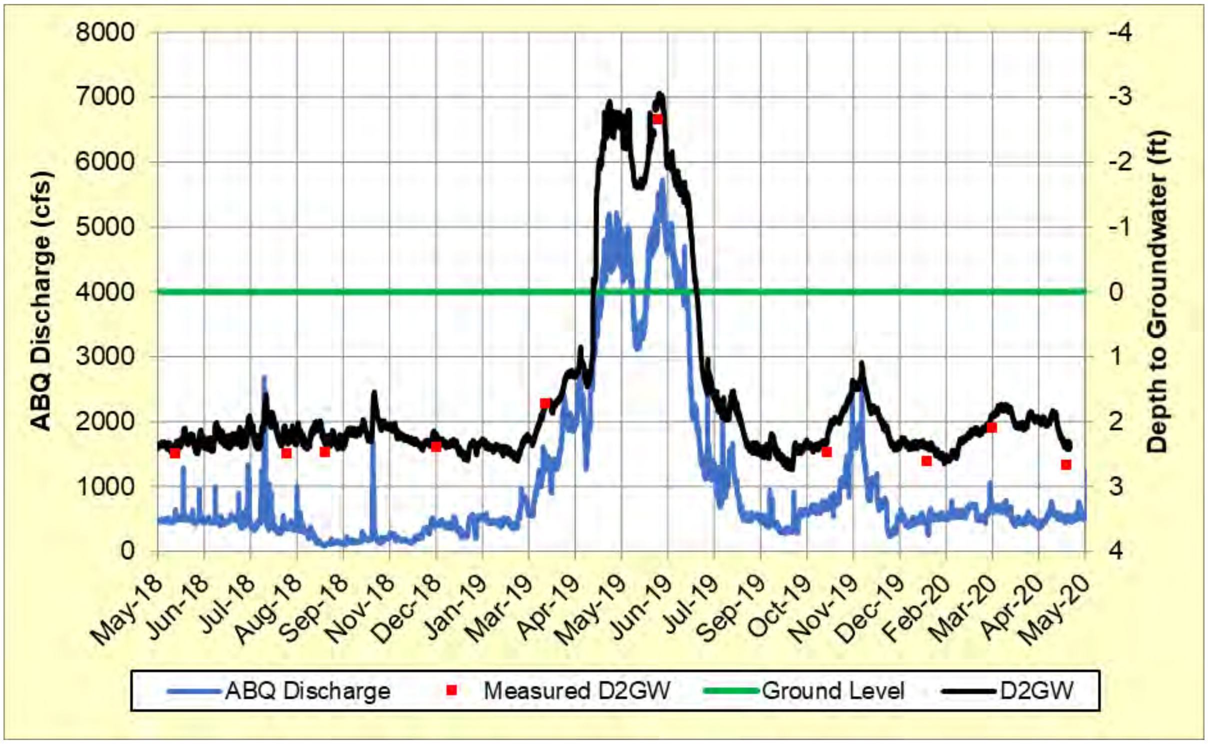

Figure 132. 5C3 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

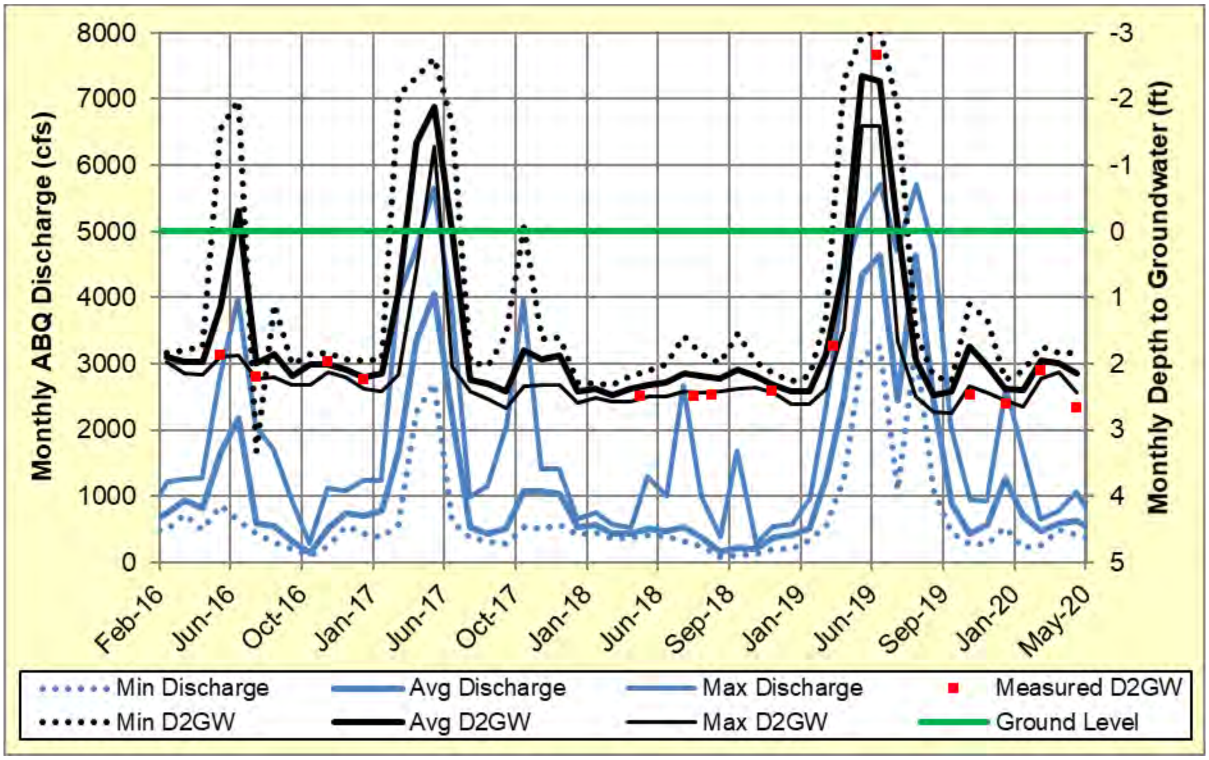

Figure 133. 5C3 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

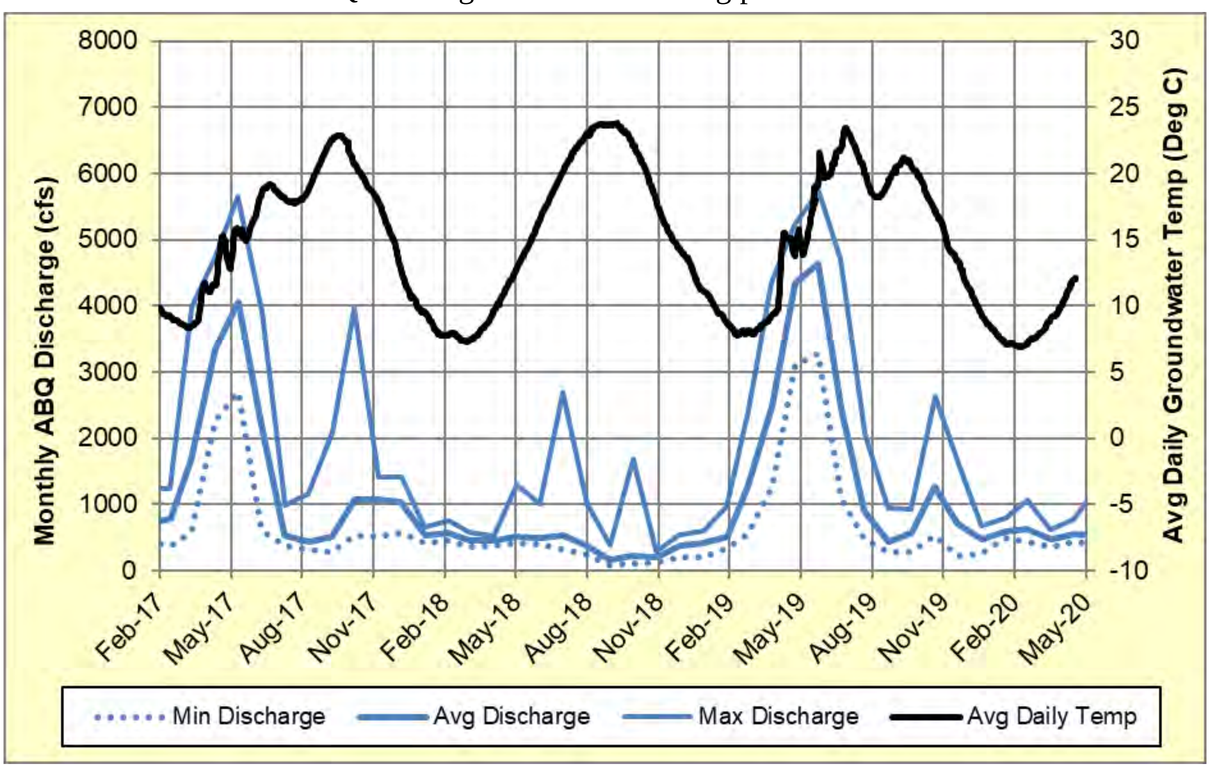

Figure 134. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5C3 well.

3.3.37 5D

Figure 135. Location of the 5D and 5D1 groundwater monitoring wells.

The 5D groundwater well was installed on June 20, 2012 at 346,224 E; 3,869,125 N (UTM NAD83, Zone 13N) (Figure 135). The EHF at 5D was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 25, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. The logger was retired in May 2018 after repeat failed download attempts. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015 and May 2018 to May 2020, and on a quarterly basis from February 2016 through February 2017. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 136. During the annual monitoring period, groundwater levels ranged from approximately 1.05 to 2.45 feet bgs on the measurement dates.

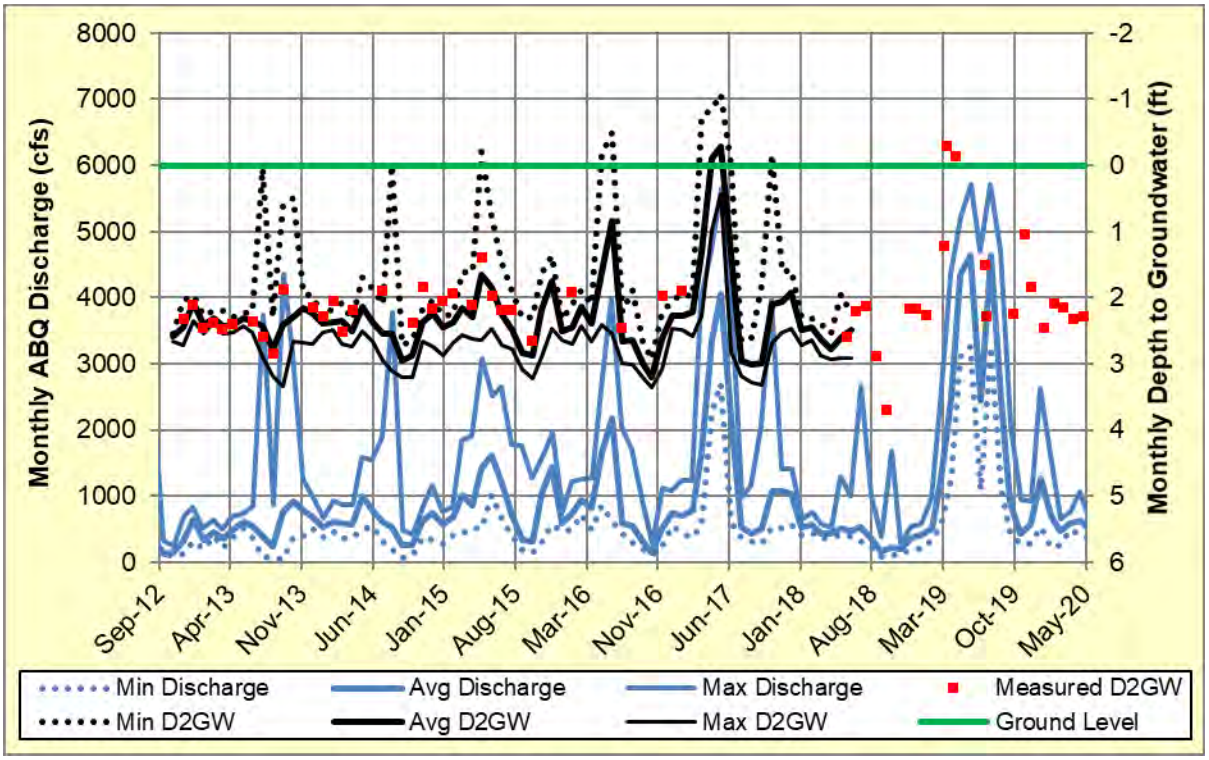

Figure 136. 5D well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

3.3.38 5D1

The 5D1 groundwater well was installed on February 24, 2016 at 346,153 E; 3,869,367 N (UTM NAD83, Zone 13N) (Figure 135). This well is located in the northern portion of Swale 5D, directly adjacent to the river channel, and was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 137. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 138. During the annual monitoring period, groundwater levels ranged from approximately 3.22 feet bgs to 1.63 feet ags. Groundwater remained ags from April 23, 2019 through July 11, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum Spring 2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 139 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 5 to 24 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

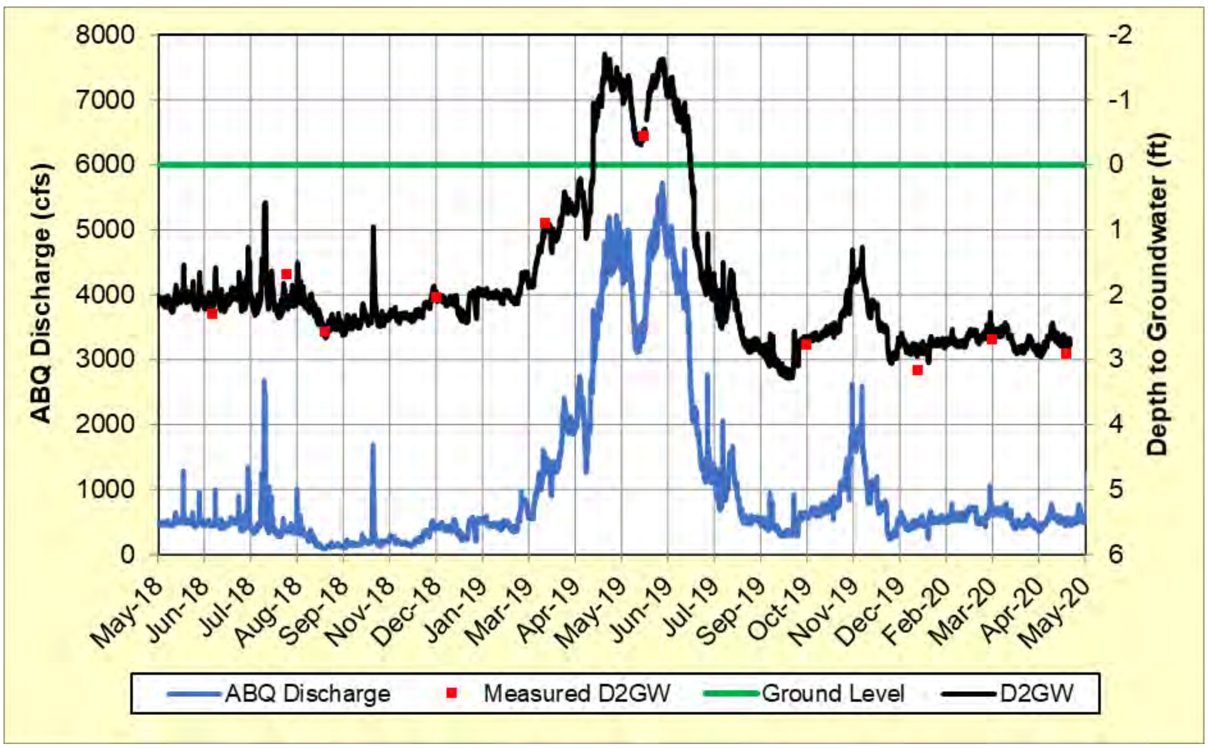

Figure 137. 5D1 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

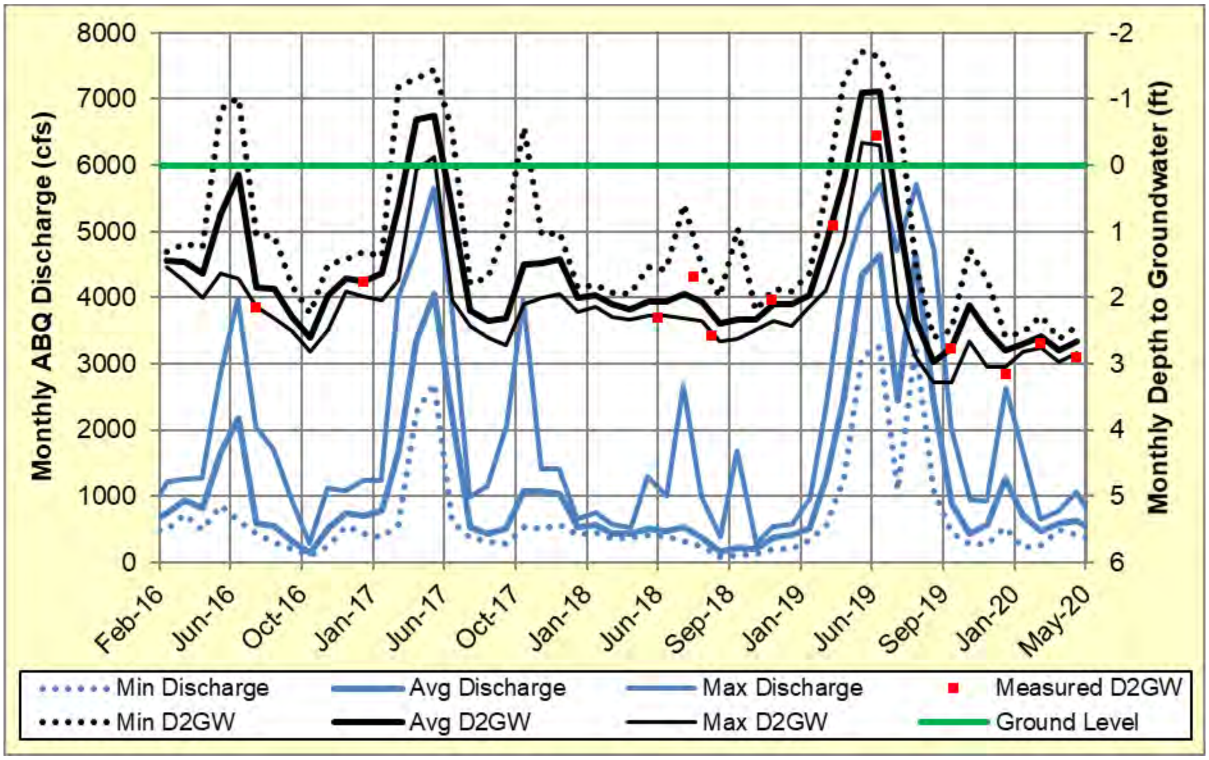

Figure 138. 5D1 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

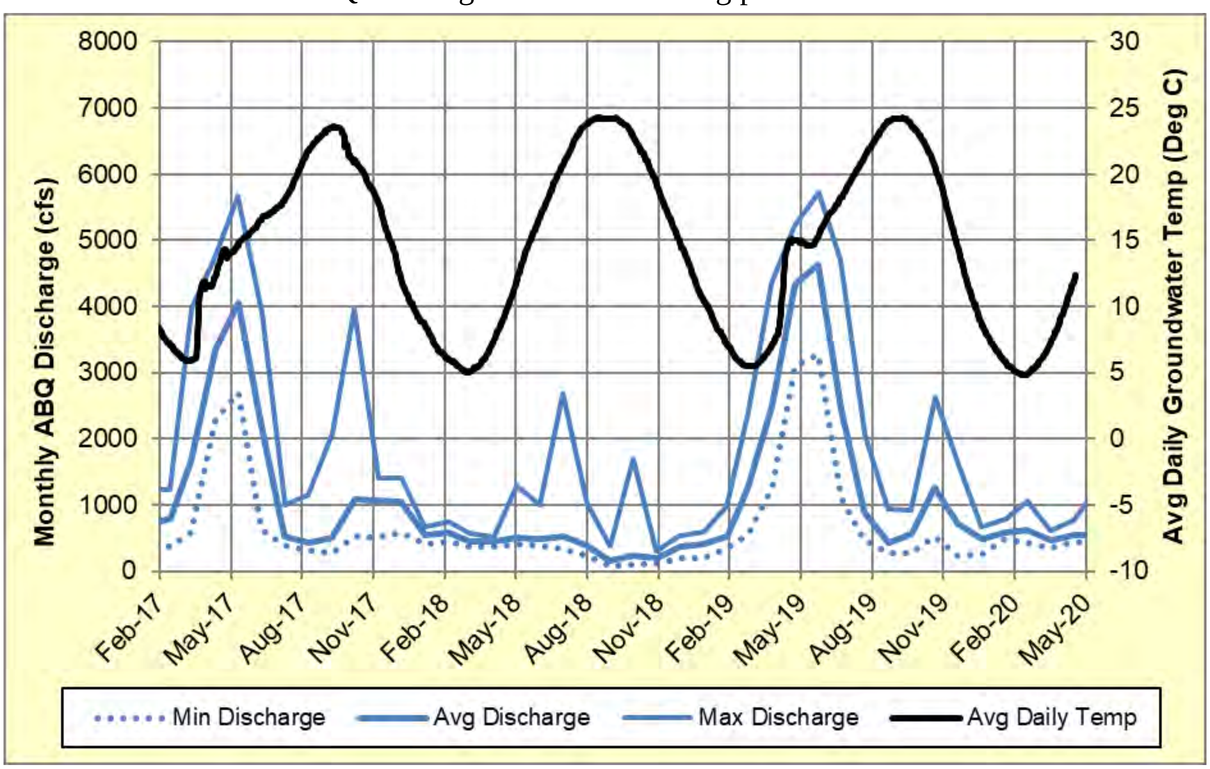

Figure 139. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5D1 well.

3.3.39 5D2

The 5D2 groundwater well was installed on February 24, 2016 at 346,344 E; 3,868,884 N (UTM NAD83, Zone 13N) (Figure 35). This well is located in the southern portion of swale 5D, directly adjacent to the river channel, and was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 140. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 141. During the annual monitoring period, groundwater levels ranged from approximately 3.63 feet bgs to 1.37 feet ags. Groundwater remained ags from April 23, 2019 through July 12, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum Spring 2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 142 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 5 to 25 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

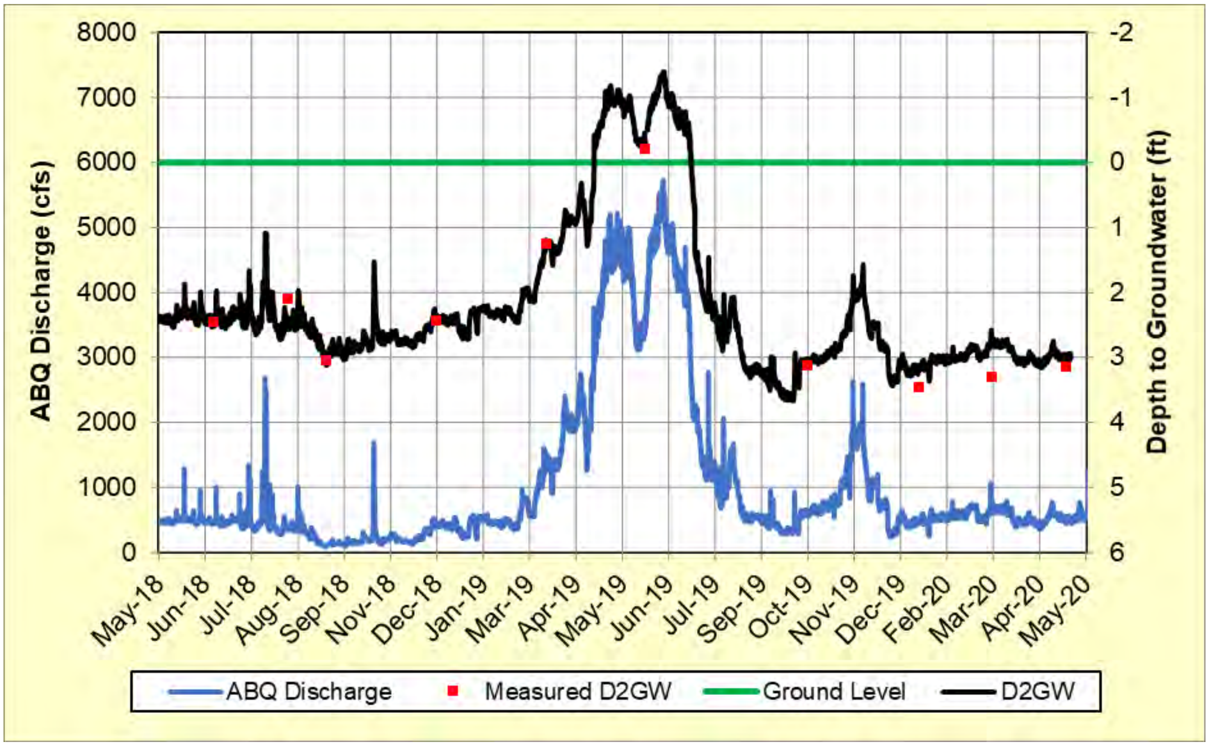

Figure 140. 5D2 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

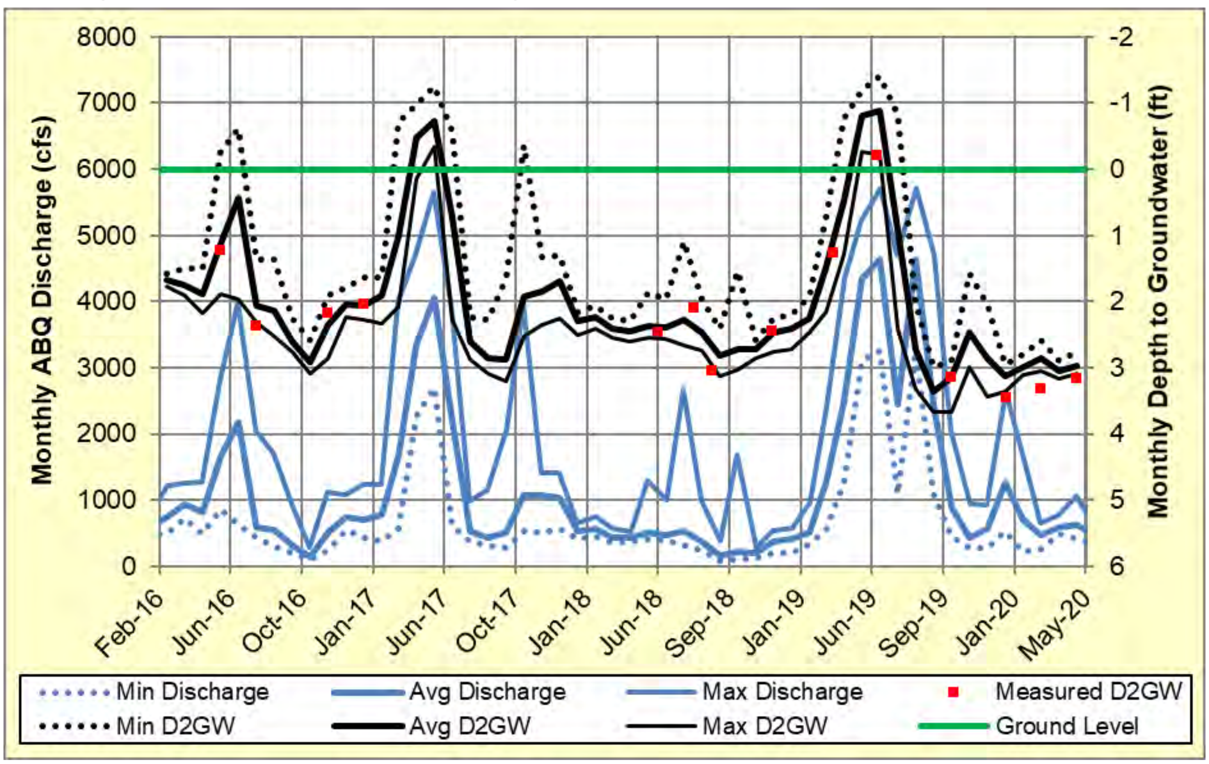

Figure 141. 5D2 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

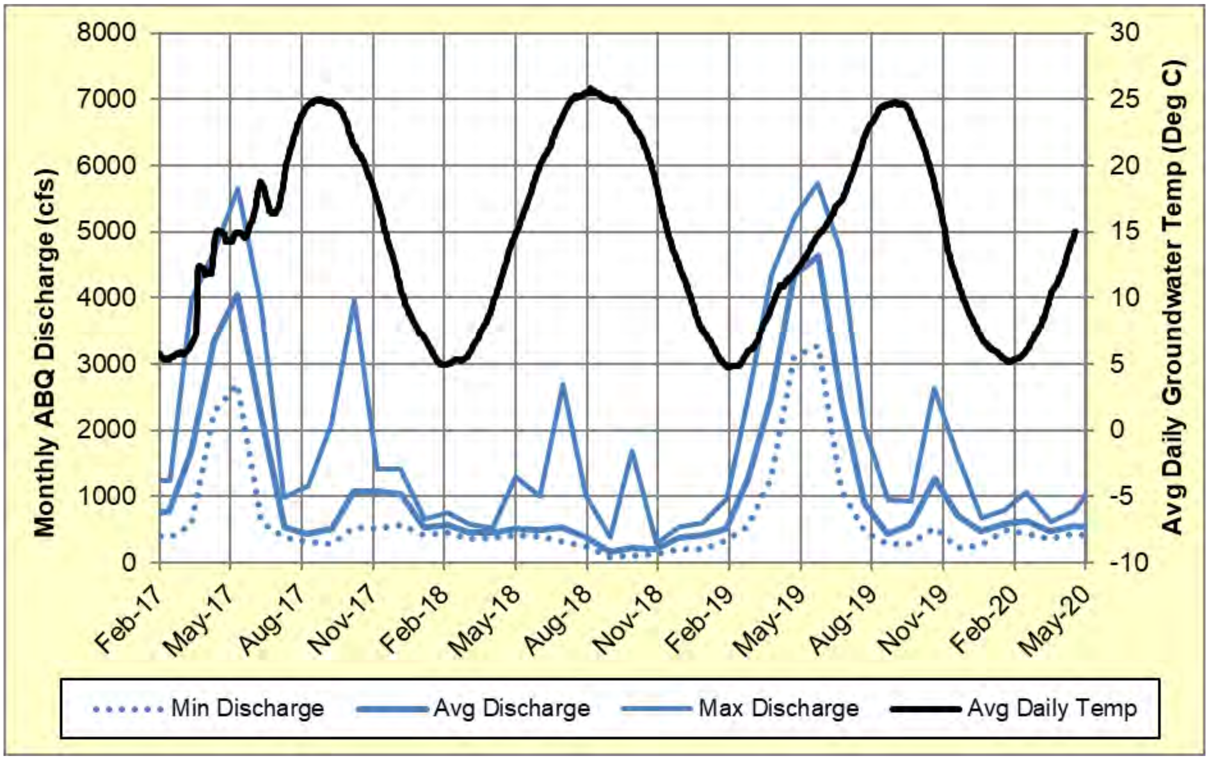

Figure 142. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5D2 well.

3.3.40 5D3

The 5D3 groundwater well was installed on February 24, 2016 at 346,234 E; 3,868,881 N (UTM NAD83, Zone 13N) (Figure 35). This well is located farther inland (west) from the river channel in the southern portion of swale 5D, and was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 143. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 144. During the annual monitoring period, groundwater levels ranged from approximately 2.89 feet bgs to 1.69 feet ags. Groundwater remained ags from April 23, 2019 through July 12. 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum Spring

2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 145 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 7 to 21 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

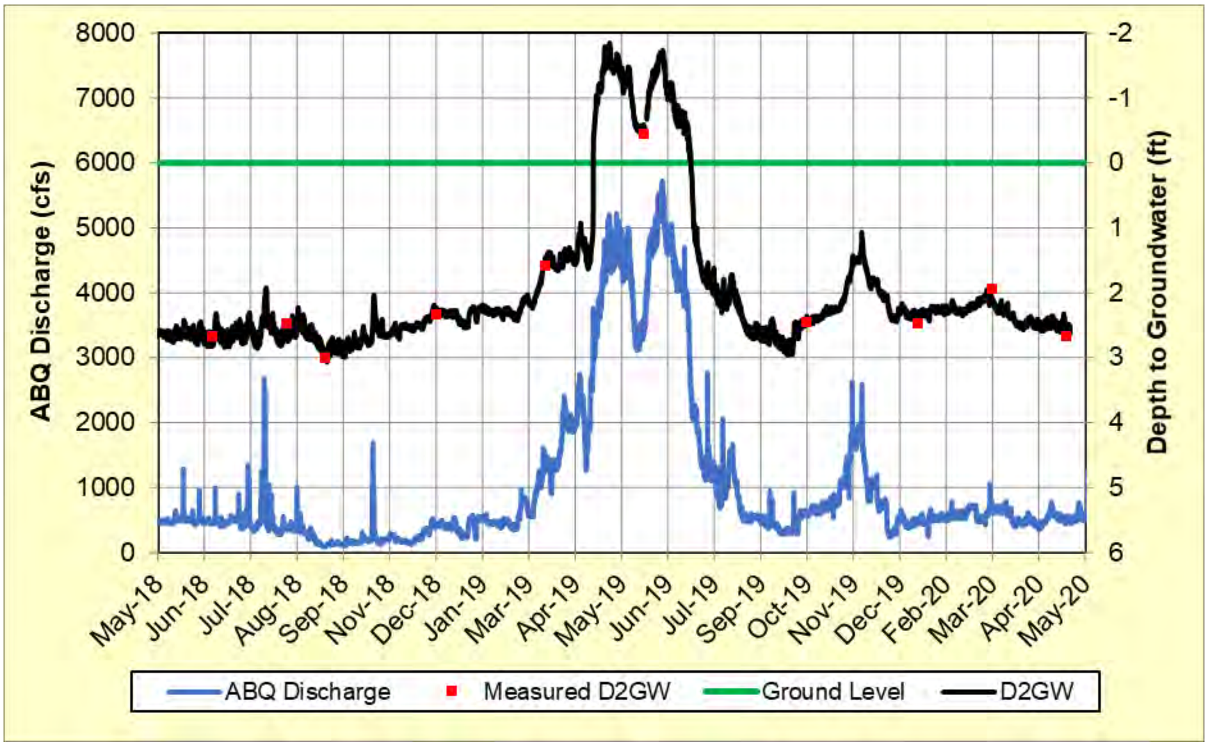

Figure 143. 5D3 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

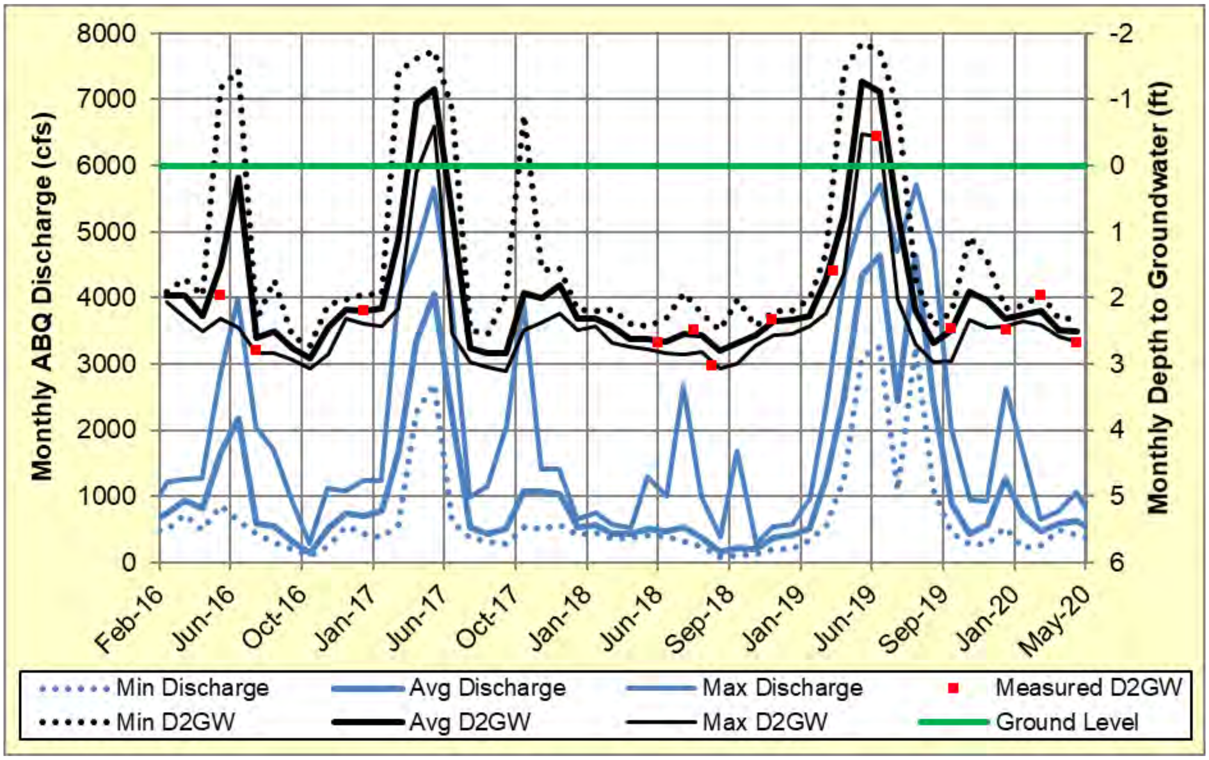

Figure 144. 5D3 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

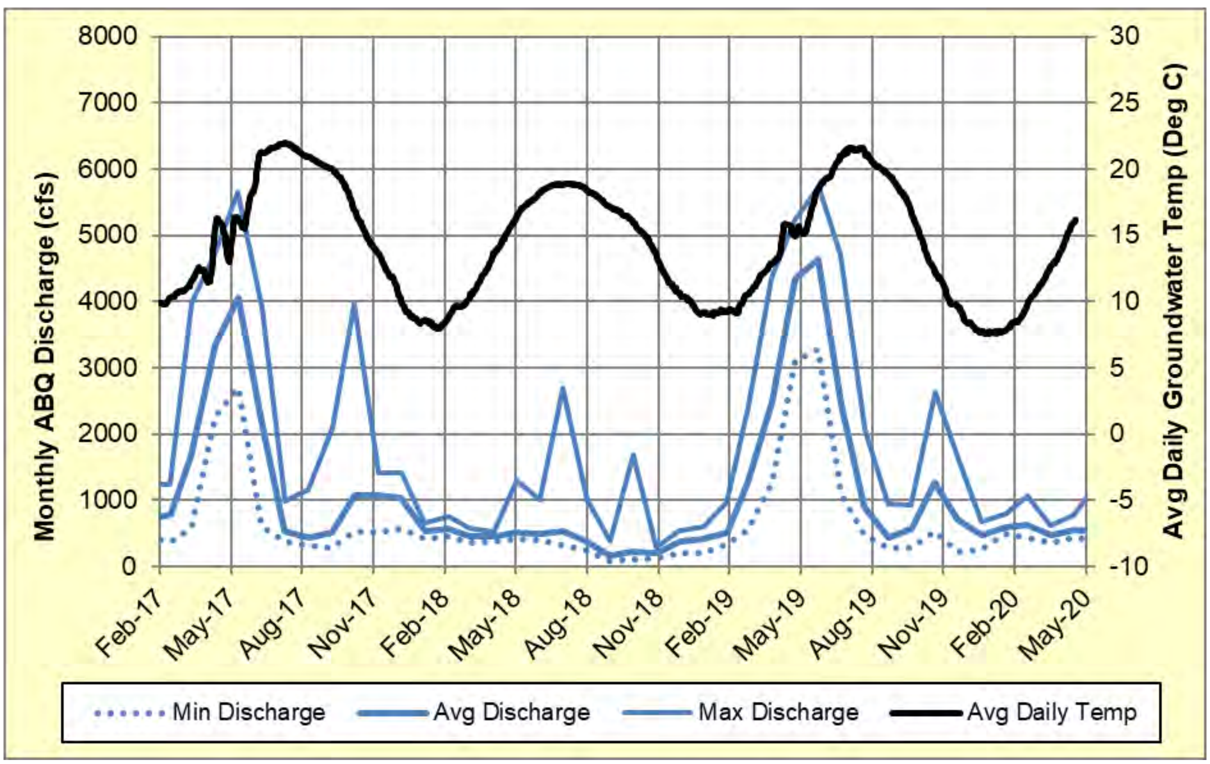

Figure 145. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5D3 well.

3.3.41 5E

The 5E groundwater well was installed on June 20, 2012 at 346,267 E; 3,868,598 N (UTM NAD83, Zone 13N) (Figure 35). The EHF at 5E was designed to attain shallow seasonal groundwater depths no greater than 3-feet below the ground surface, and to experience passive flooding via rising groundwater and active flooding via overbank surface water inundation.

This well was constructed from 2-inch galvanized steel pipe with a locked cap. On October 25, 2012, it was instrumented with a datalogger (newer generation Solinst Levelogger Junior Edge Model 3001), which collects groundwater data every half hour. The logger was retired in May 2018 after repeated failed download attempts. Groundwater levels were manually measured on a near-monthly basis from October 2012 to October 2015 and May 2018 through May 2020, and on a quarterly basis from February 2016 through February 2017. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 146. During the annual monitoring period, groundwater levels ranged from approximately 1.46 to 2.74 feet bgs on the measurement dates.

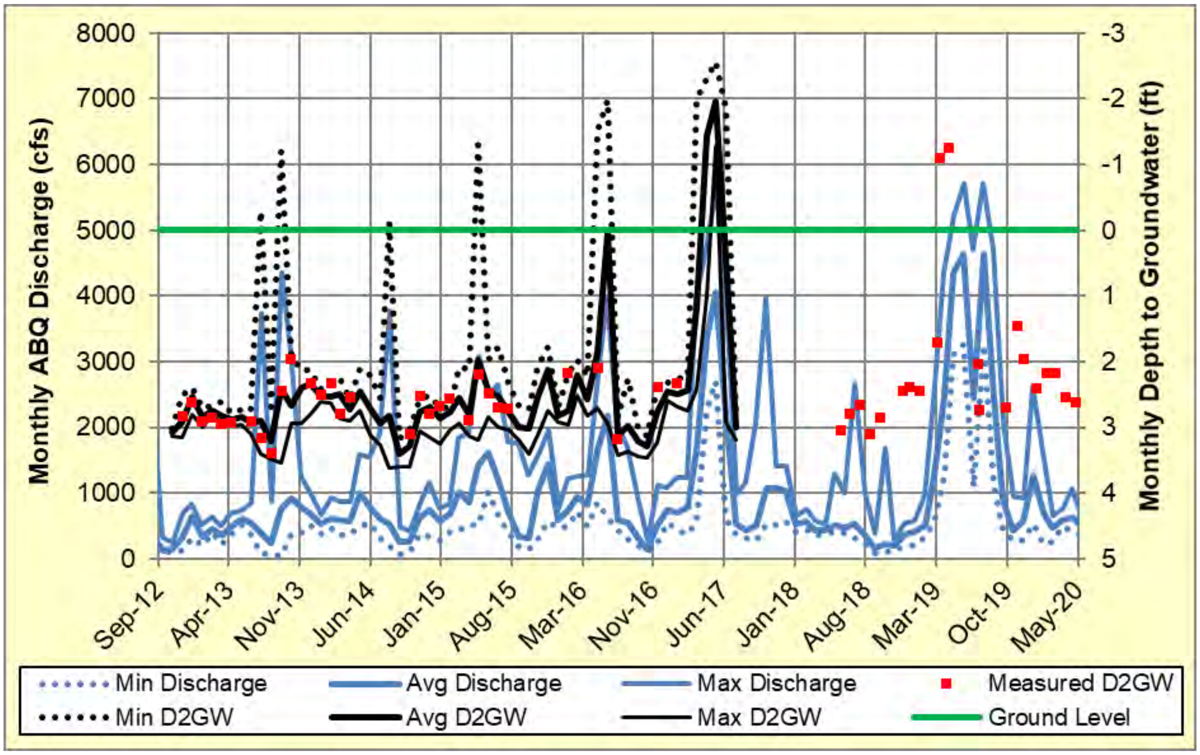

Figure 146. 5E well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge.

3.3.42 5E1

The 5E1 groundwater well was installed on February 24, 2016 at 346,366 E; 3,868,712 N (UTM NAD83, Zone 13N) (Figure 35). The well is located directly adjacent to the river channel near the northeastern boundary of swale 5E. Swale 5E is designed to have a maximum depth to groundwater of 3-feet bgs and to inundate by both rising groundwater and surface water inundation from the Rio Grande via bankline "notches".

This well was constructed from 2-inch galvanized steel pipe with a locked cap. It was instrumented immediately following installation with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 147. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 148. During the annual monitoring period, groundwater levels ranged from approximately 2.83 feet bgs to 1.95 feet ags. Groundwater remained ags from April 23, 2019 through July 13, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum Spring 2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 149 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 6 to 18 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

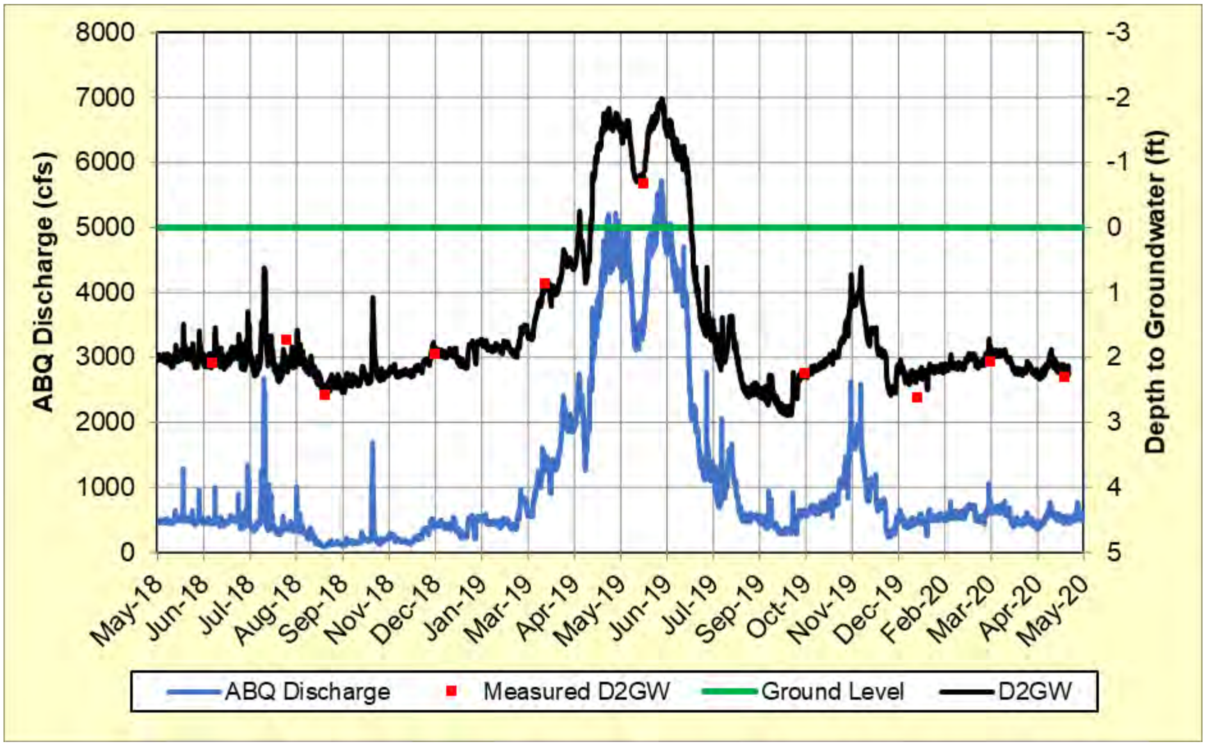

Figure 147. 5E1 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

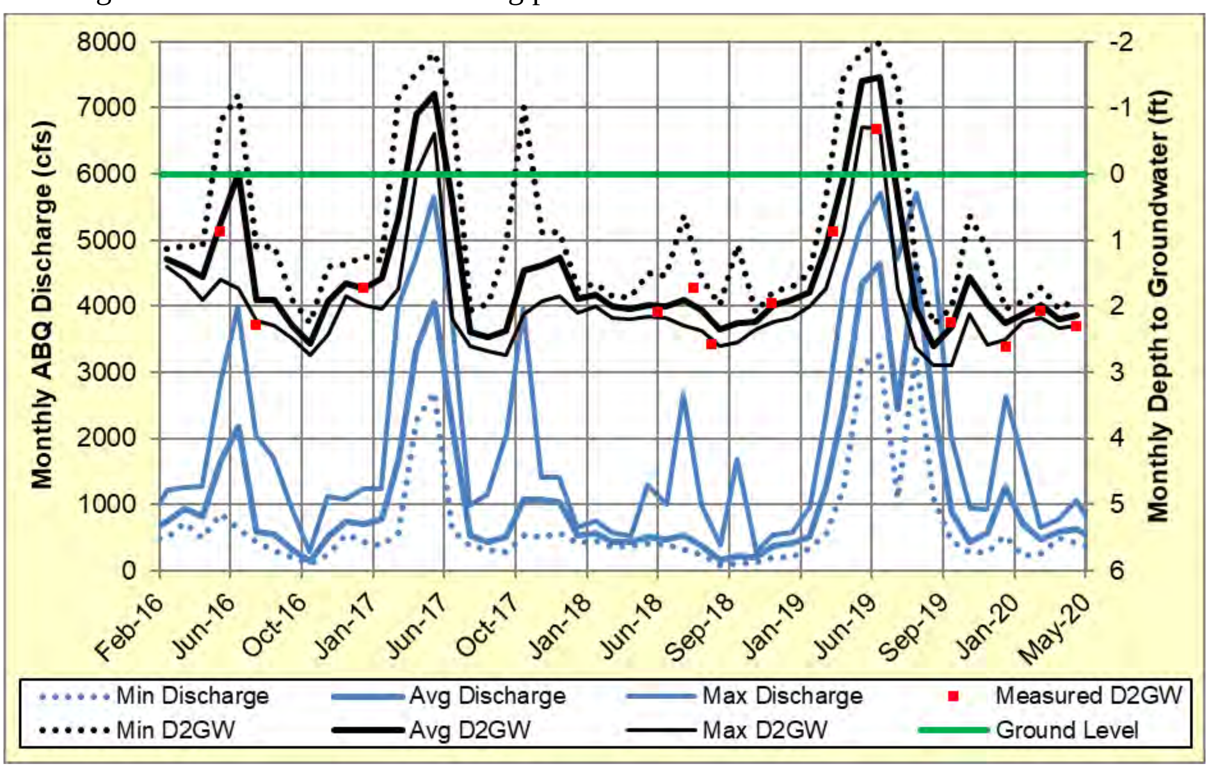

Figure 148. 5E1 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

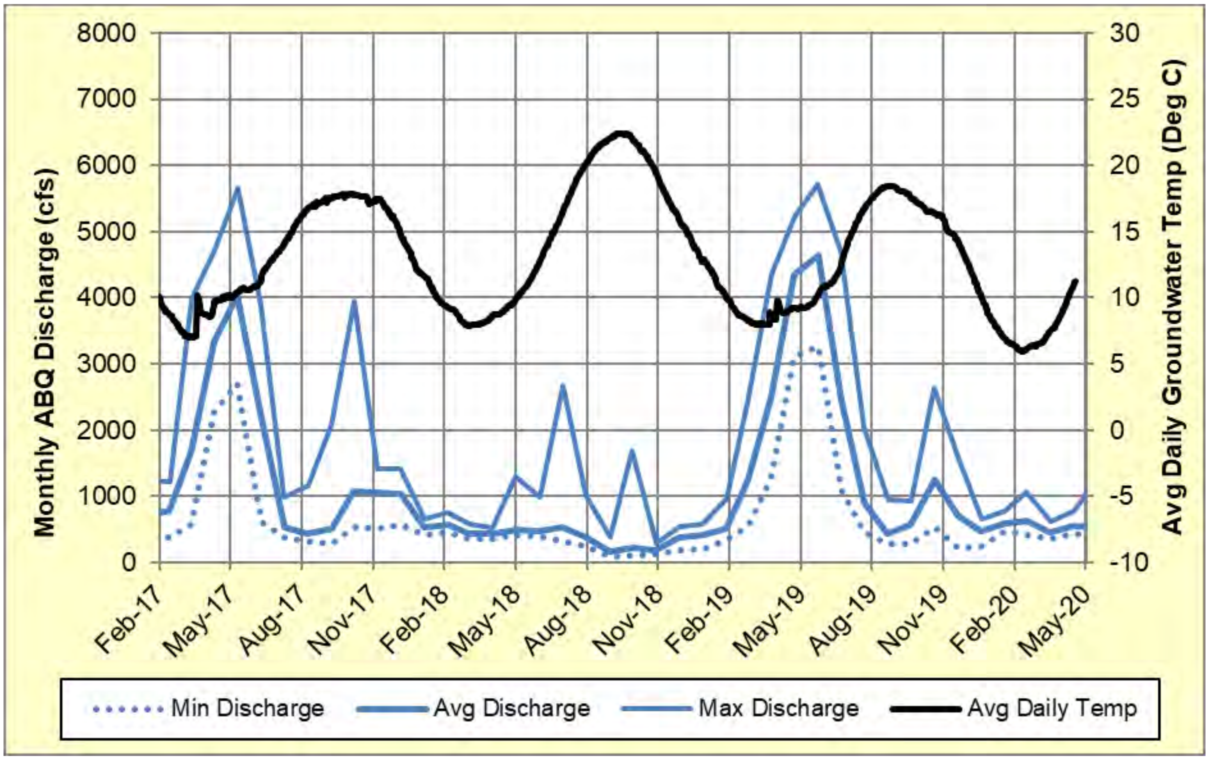

Figure 149. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5E1 well.

3.3.43 5E2

The 5E2 groundwater well was installed on February 24, 2016 at 346,378 E; 3,868,576 N (UTM NAD83, Zone 13N) (Figure 35). The well is located adjacent to the river channel on near the southeastern boundary of Swale 5E, and was constructed from 2-inch galvanized steel pipe with a locked cap. It was instrumented immediately following installation with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 150. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 151. During the annual monitoring period, groundwater levels ranged from approximately 2.62 feet bgs to 2.31 feet ags. Groundwater remained ags from April 23, 2019 through July 14, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum Spring

2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 152 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 7 to 21 degrees C. This peak in temperature and large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

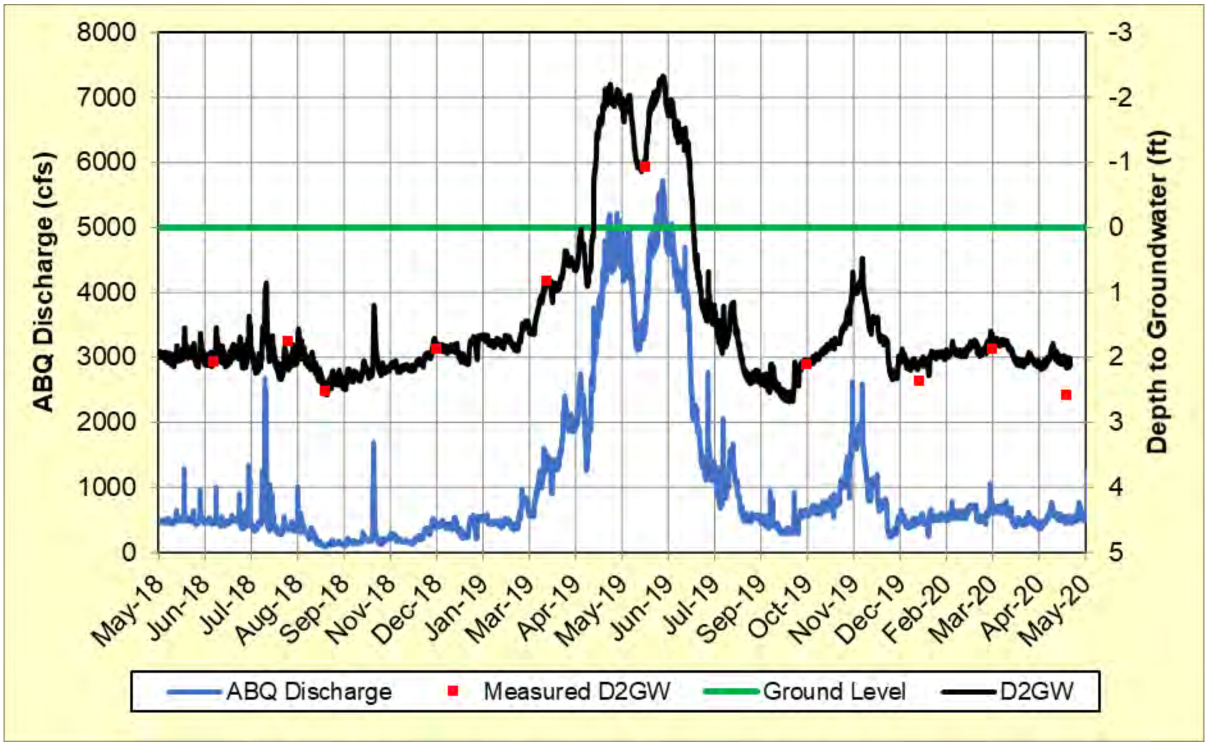

Figure 150. 5E2 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

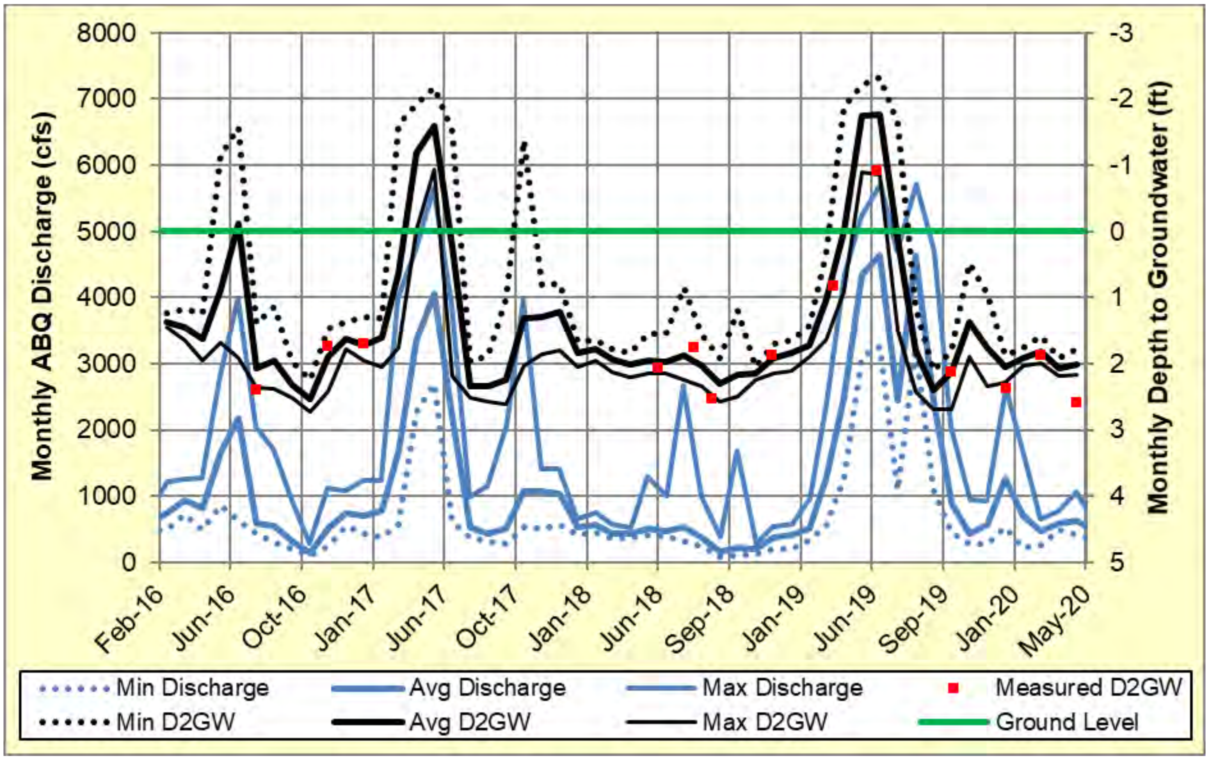

Figure 151. 5E2 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

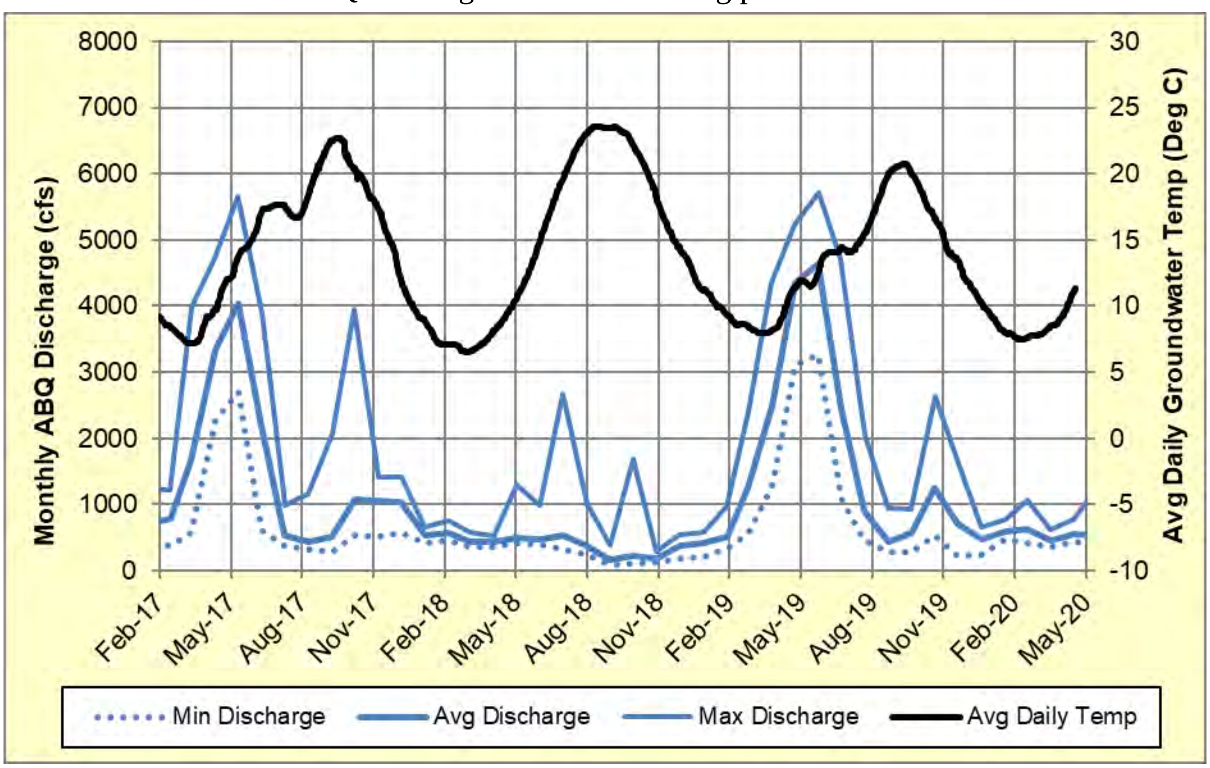

Figure 152. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5E2 well.

3.3.44 5E3

The 5E3 groundwater well was installed on February 24, 2016 at 346,230 E; 3,868,531 N (UTM NAD83, Zone 13N) (Figure 35). The well is located farthest from the river channel near the southwestern boundary of swale 5E, and was constructed from 2-inch galvanized steel pipe with a locked cap. Immediately following installation, the well was instrumented with an In-Situ Rugged Troll 100, which collects groundwater data every half hour. Groundwater levels were manually measured on a quarterly basis from February 2016 to May 2020. The September 2018 manual reading was erroneous and omitted as an outlier. Groundwater levels were not manually measured between March 2017 and April 2018 because no contract was in place.

Instantaneous ABQ discharge (15-minute) and D2GW (30-minute) data, along with manually measured D2GW for the contracted monitoring period are presented in Figure 153. Monthly average, maximum, and minimum D2GW, manually measured D2GW, and ABQ discharge for the complete monitoring period are presented in Figure 154. During the annual monitoring period, groundwater levels ranged from approximately 2.85 feet bgs to 3.56 feet ags. Groundwater remained ags from April 23, 2019 through July 15, 2019 in response to prolonged river discharge of greater than 3,200 cfs. As of May 31, 2020, maximum Spring 2020 river discharge was less than 700 cfs (Albuquerque gauge) and was therefore not sufficient to raise groundwater to near the ground surface.

Figure 155 shows the groundwater temperature relative to the discharge profile. Temperature fluctuated seasonally from approximately 7 to 22 degrees C. Large seasonal fluctuations in groundwater temperature are indicative of shallow groundwater influenced by surface water temperature.

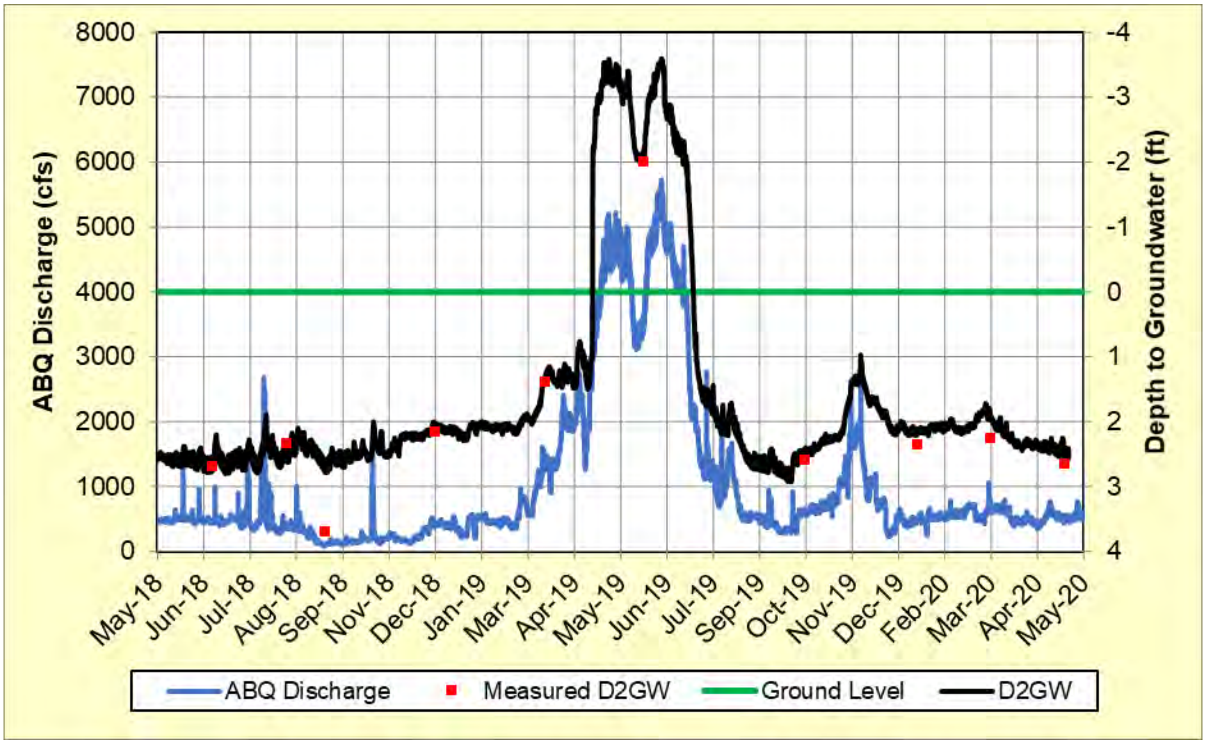

Figure 153. 5E3 well manually measured D2GW, 30-minute D2GW, and 15-minute ABQ discharge data for the annual monitoring period.

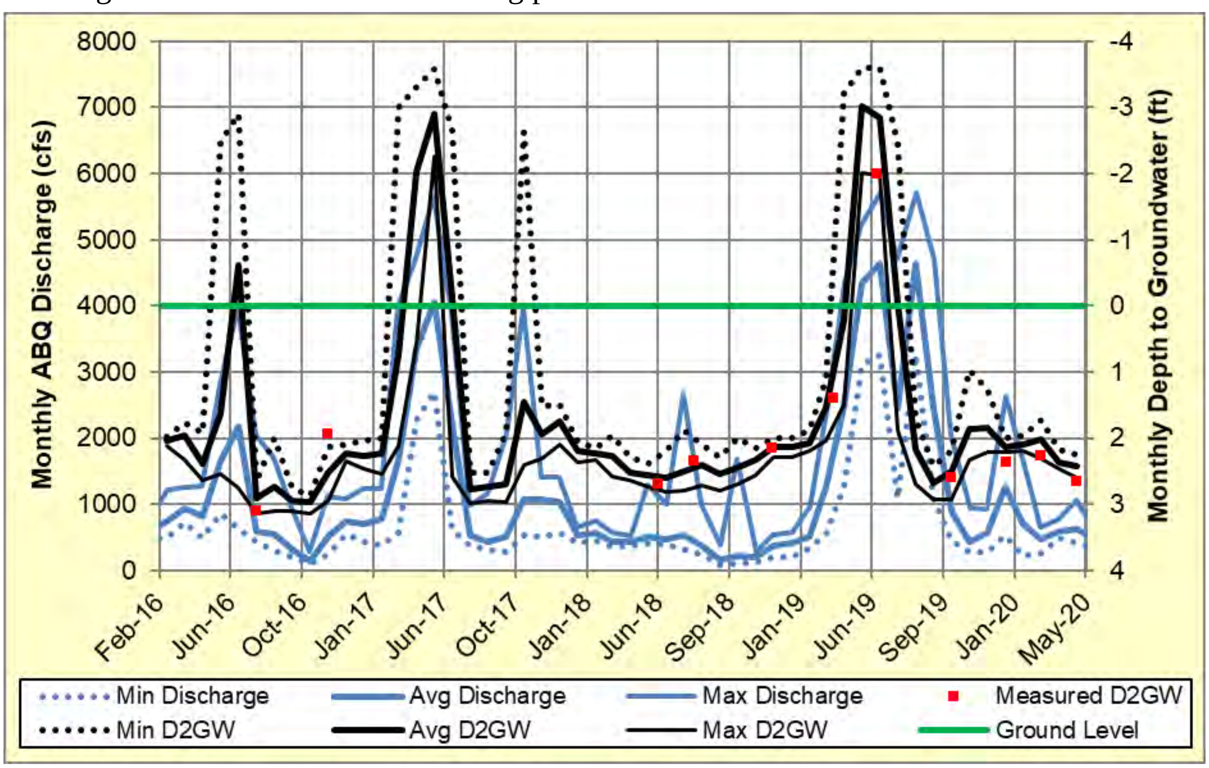

Figure 154. 5E3 well manually measured D2GW and monthly average, maximum and minimum D2GW and ABQ discharge for the monitoring period to date.

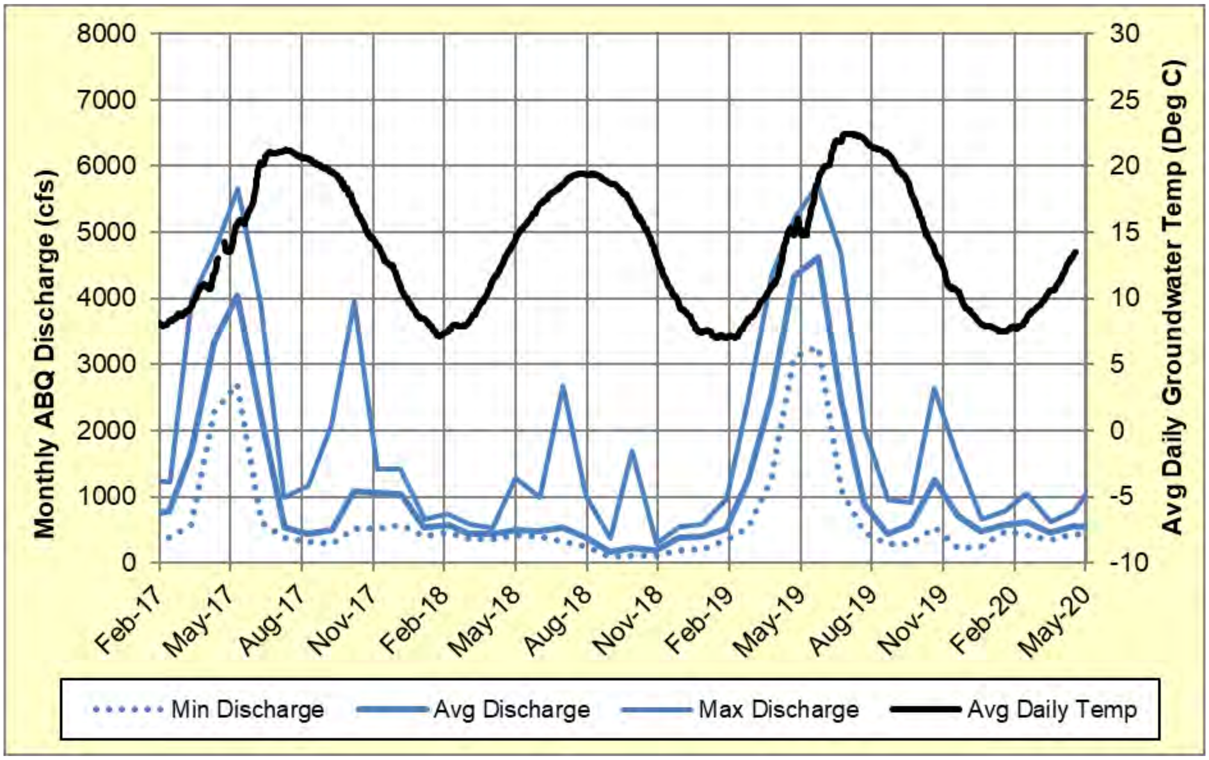

Figure 155. Monthly average, maximum and minimum ABQ discharge and average daily groundwater temperature at the 5E3 well.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The MRG groundwater monitoring network contains multiple years of data collected from piezometers installed across a 22-mile reach between the Village of Corrales and the Interstate 25 Bridge near Isleta Pueblo. Twenty of the wells monitored during the annual monitoring period were installed in elevated floodplain terraces (EFT's) prior to 2011. The remaining wells (44) were installed after 2011 almost exclusively in excavated habitat features (EHF's) constructed by the USACE to create moist-soil conditions and promote seasonal inundation via rising groundwater and/or surface water (river) flooding. Most of the EHF wells are located within project sites constructed during Phase 1 and 2 of the USACE Middle Rio Grande Restoration Program. The only exceptions were the Route 66 Inlet and Outlet wells, which were installed in the upstream and downstream ends of a high-flow channel constructed in 2009/2010 as part of the USACE Route 66 Ecosystem Revitalization Project. Fourteen new EHF wells were installed and monitored as part of the USACE-GSA Willow Research Study (GSA 2016b, GSA 2018).

Because all EFT wells were no longer instrumented during the annual monitoring period, maximum and minimum groundwater levels occurring during the monitoring period cannot be determined at these locations. However, manual measurements indicate similar overall trends as were seen in previous years. The shallowest groundwater depths typically occurred in the spring or early summer (May, June), and deepest groundwater depths occurred in the fall (September, October). The maximum observed depth to groundwater at most wells was comparable to the previous two monitoring years, and many EFT wells (e.g. Bridge Ave SW, Corrales North, Brown Burn East) experienced the most shallow groundwater in spring-summer 2019 since monitoring began nearly one decade ago. Although the term "elevated floodplain terrace" implies relatively deeper groundwater levels than would be expected in "excavated habitat features", several wells had groundwater within three feet of the ground surface (Bridge Ave SW, Brown Burn West, I-25E, Corrales North, Corrales South, Central SW, Rio Bravo, Zoo Burn). Conversely, several EFT wells had notably deeper groundwater depths (7 - 9 feet bgs) than others, most notably Alameda NE and I-40S.

With a few exceptions, the groundwater depths were consistently shallow (within 3 feet bgs) in the EHF wells. All EHF wells except 1F Swale, 1H Terrace, Oxbow 2, and 5A3 recorded groundwater at or above the ground surface during the prolonged high flow event associated with spring snowmelt runoff which, according to the USGS Gage at Albuquerque, peaked on June 18, 2019 at 5,720 cfs. However, analysis of the precise discharge required to inundate each feature was not possible due to differences in EHF design (surface flooding versus rising groundwater), duration of peak flows, an uneven distribution of discharge rates during the monitoring period (i.e. lack of 2,500 cfs flood pulses). In EHFs, data suggests that groundwater response has less to do with swale design and more to do with the duration of the elevated river discharge. For instance, groundwater was above ground surface at most EHF wells in response to prolonged snowmelt discharge greater than 3,000 cfs in 2019, but groundwater only reached ground surface at five wells in response to a short, summer monsoon events of similar discharge magnitude (e.g. 3,650 cfs on July 27, 2018; GSA 2019). Maximum spring discharge in 2020 was 1,260 cfs, and had minimal impact on groundwater levels.

Data collected during previous monitoring years (e.g., FY16-17) indicated that river discharges of approximately 2,500 cfs were not sufficient to bring groundwater to the surface, even though field observations indicated many EHF's contained standing water at those discharges (GSA 2017). During the annual monitoring period, there were three peak flow events of greater than 2,500 cfs (5,720 on June 18, 2019, 2,600 cfs on November 21, 2019, and 2,590 cfs on November 29, 2019). The November 2019 flood pulses were sustained above 2,500 cfs for only two to three hours and were not sufficient to raise groundwater near ground surface in any EHFs. River discharge was above 2,500 for approximately 82 days between April and July of 2019. Because the 2019 flood pulse was sustained for over three months, it is unclear at which point surface flooding and groundwater levels reached equilibrium, if ever. This discrepancy indicates that the instrumented piezometers are not a precise tool for documenting specific river discharges required to promote surface water flooding. If understanding relationships between surface water flooding and discharge is a management priority, then measurement devices other than groundwater piezometers (e.g. stilling wells instrumented with datalogging PTs) should be used.

Depth to groundwater data indicates that the EHF designs and construction effectively achieved the desired maximum groundwater target depth of 3 feet bgs at most sites during the annual monitoring period. Groundwater depths greater than 3 feet bgs were at least periodically observed at eighteen EHF wells. At most EHF wells, groundwater depths in excess of 3 feet bgs were only observed temporarily in the fall (September - November), although three wells consistently had groundwater as deep as 7 feet bgs (1H Terrace, 1F Swale, 5A3). At 1H Terrace, a subsurface confining layer is suspected to be responsible for the lack of groundwater level rise in response to prolonged ponded water. This confining layer is evident from a spring 2017 survey of ponded water depths adjacent to well casings, which revealed significantly deeper groundwater levels than surface water depths at this location. 5A3 is located on an elevated bankline which is approximately 3 feet higher than surrounding wells in the EHF, which explains the deeper groundwater depths. Data from most other EHF wells showed maximum depths to groundwater during Fall 2019 (the period of lowest prolonged river discharge) of 2 to 3 feet bgs (Table 3).

Nearly all of the instrumented EHF wells showed rapid response to changes in river discharge rates. The only exception was the well at Oxbow 2, which registered relatively small (~2 foot) changes in groundwater depth associated with the prolonged snowmelt event in spring/summer 2019 compared to the other wells due to the Oxbow 2 wells proximity to irrigation return drains. At other EHF wells, groundwater levels rose by approximately three to seven feet in response to prolonged runoff in the spring/summer of 2019. At peak river discharges, groundwater was frequently two to four feet above ground surface.

Analysis of the temporal relationships between peak groundwater levels at EHF wells and peak discharge was not conducted for this monitoring period because the annual dataset lacked shorter duration floods with steep hydrographs. For the prolonged discharge in excess of 2,000 cfs in from April – July 2019, the data indicates similar trends as for FY16-17, where peak groundwater lagged behind peak discharge by several hours at many wells. Groundwater at wells located on the bankline directly adjacent to the river responded almost immediately following peak discharge. Differences are likely due to proximity to the ABQ gage (i.e., all wells except Oxbow 2 are located several river miles downstream of the USGS Albuquerque gage), or because the lateral distance from the channel (i.e., 1E South and 5A-South) is greater than other wells, and groundwater at these locations could be less responsive (less transmissive) to changes in Rio Grande surface water discharge. Further evidence of this is provided by the groundwater temperature data at the different sites. Instrumented wells in areas more influenced by river discharge often had groundwater temperatures ranging from 5 to 25 degrees C on an annual basis, whereas other areas (e.g. 5A North, 5D, 5E) showed groundwater temperatures between 10 and 20 degrees C. Seasonal temperature variations in groundwater along the Rio Grande are affected primarily by proximity to the surface and the transmissivity of the aquifer. That is, deeper groundwater is more insulated from ambient temperature fluctuations and lower permeability soils will reduce the input of new surface water and subsequent temperature variation.

4.1 Recommendations

It is recommended that dataloggers be calibrated on an as needed basis to assure data integrity when malfunction is suspected (Appendix C). Monthly manual depth to groundwater measurements serve as a useful comparison against automated data, however discrepancies between the two measurements are more likely a result of human measurement error or PT drift rather than changes to cable hang length. Ex-situ datalogger calibrations will allow assessment of sensor functionality and assure a high-quality dataset is maintained.

Hang lengths may need to be adjusted based on maximum observed groundwater depths to make sure that water levels are not dropping below the installed PT depths. Finally, well casing heights should be re-surveyed during the next annual monitoring period due to the potential for substantial geomorphic changes (scour, sediment deposition) if long term flooding occurs in Spring 2021.

Significant differences have been observed between groundwater depths and surface water flooding in EHFs during peak flow events. The installation of stilling wells instrumented with datalogging PTs would allow for analysis of surface water/groundwater interactions and assessment of how long it takes for water levels to reach equilibrium, if ever. Surface inundation is not only determined by the size of the flood event (peak cfs), but by the flood duration as well. Such instrumentation would also provide insight into the size and duration of high river discharges necessary to inundate each swale. It is likely that these trends are affected by the initial depth to groundwater, the EHF design (passive flooding via groundwater rise, overflow through bankline notches, or into backwater habitats), and presence of restrictive soil layers due to sediment deposition.

Climate models (e.g., Bureau of Reclamation 2013) are predicting reduced snowpack, earlier snowmelt runoff, smaller spring peak discharges, and potentially larger monsoon storm events. We suggest that continuing to gather and analyze data from these wells (or a sub-set thereof) may prove invaluable to predicting and documenting the impact these events will have on groundwater elevations and potential shifts in bosque vegetation structure. All groundwater wells installed since September 2015 were surveyed (as elevation above mean sea level) in March 2016 (Appendix A, Table A-1).

The USACE groundwater monitoring network represents the most comprehensive riparian groundwater monitoring database in the MRG. Accordingly, we urge the USACE to continue monitoring at least of sub-set of these wells and to maintain the database. The New Mexico Interstate Stream Commission (NMISC) is in the process of developing an integrated surface water-groundwater model for the MRG, and the USACE riparian groundwater monitoring data will be invaluable for validating segments of the model covering the Albuquerque Reach. We urge the USACE to collaborate with NMISC to determine how to optimize the use of these long-term groundwater monitoring data (e.g., to calibrate/validate the model, determine which wells can be retired and which should be maintained, develop strategic plan for installing additional wells for model calibration in the Isleta and San Acacia Reaches, etc.).

5.0 REFERENCES

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Appendix A
Groundwater Monitoring Well Data

Table A-1. Summary of all monitored and discontinued wells.

Well Number	Well Name	Well Type	Easting (UTM NAD83)	Northing (UTM NAD83)	Elevation AMSL (ft)[1]	Current Status
1	I-25 E	EFT	346,622	3,868,761	4907.2	Monitored
2	Brown Burn West	EFT	345,749	3,872,221	4917.7	Monitored
3	Brown Burn East	EFT	346,079	3,872,327	4919.0	Monitored
4	Bridge Ave SW	EFT	348,585	3,881,787	NM	Monitored
5	RGNC Center	EFT	346,152	3,888,405	NM	Discontinued
6	RGNC Baro West	N/A	346,124	3,888,425	NM	Monitored
7	Oxbow	EHF	346,055	3,889,206	NM	Discontinued
8	Montano SW	EFT	346,931	3,890,449	NM	Monitored
9	La Orilla	EFT	347,663	3,892,229	NM	Monitored
10	Alameda NE	EFT	350,733	3,896,327	NM	Monitored
11	Corrales North	EFT	350,648	3,896,822	NM	Monitored
12	Central SW - Old	EFT	N/A	N/A	NM	Discontinued
13	Corrales Dixon Rd	EFT	354,561	3,899,282	NM	Monitored
14	Corrales North Bndy	EFT	354,579	3,904,583	NM	Discontinued
15	Corrales HarveyJones	EFT	354,618	3,903,613	NM	Monitored
24	Tingley	EFT	N/A	N/A	NM	Discontinued
25	Central SW - New	EFT	346,717	3,884,088	NM	Monitored
26	Central NE	EFT	346,318	3,884,779	NM	Monitored
30	Corrales South	EFT	350,425	3,896,406	NM	Monitored
31	Paseo SW	EFT	349,277	3,893,821	NM	Discontinued
32	RGNC N	EFT	346,566	3,889,224	NM	Monitored
33	RGNC M	EFT	346,424	3,888,989	NM	Monitored
34	RGNC S	EFT	346,239	3,888,792	NM	Monitored
35	I-40 N	EFT	346,153	3,887,751	NM	Discontinued
36	I-40 M	EFT	346,050	3,887,269	NM	Monitored

Well Number	Well Name	Well Type	Easting (UTM NAD83)	Northing (UTM NAD83)	Elevation AMSL (ft)[1]	Current Status
37	I-40 S	EFT	345,992	3,886,680	NM	Monitored
38	July 4 Burn	EFT	345,945	3,885,315	NM	Discontinued
39	Central W	EFT	345,895	3,884,865	NM	Discontinued
40	Rio Bravo	EFT	348,856	3,880,331	NM	Monitored
41	Zoo Burn	EFT	348,163	3,882,791	NM	Monitored
42	Atrisco	EFT	346,066	3,884,523	NM	Discontinued
43	4B Bankline	EHF	347,451	3,876,895	NM	Monitored
44	4B	EHF	347,486	3,876,829	NM	Monitored
45	4C North	EHF	347,415	3,875,764	4927.2	Monitored
46	4C South	EHF	347,247	3,875,598	4926.5	Monitored
48	5C South	EHF	345,985	3,872,029	4913.2	Monitored
49	5C Bankline	EHF	345,849	3,871,811	4914.2	Monitored
50	5C North	EHF	346,503	3,875,180	4912.1	Monitored
51	5E	EHF	346,267	3,868,598	4903.5	Monitored
52	5D	EHF	346,224	3,869,125	4905.1	Monitored
53	5A South	EHF	346,076	3,874,760	4921.5	Monitored
54	5A North	EHF	346,503	3,875,180	4922.3	Monitored
56	1G	EHF	350,627	3,896,715	5002.4	Monitored
57	1E South	EHF	351,110	3,897,097	5003.5	Monitored
58	1E Bankline	EHF	351,591	3,897,145	5004.9	Monitored
59	5B North	EHF	346,252	3,874,544	4921.3	Monitored
61	5B Bankline	EHF	346,206	3,874,541	4919.3	Monitored
62	1E North	EHF	351,186	3,897,099	4922.4	Monitored
63	4A_Old	EHF	347,872	3,883,126	5003.8	Discontinued
47	4C Bankline	EHF	347,232	3,875,730	4927.2	Monitored
65	Bridge Ave SW_New	EFT	348,585	3,881,787	NM	Monitored
69	5B south_New	EHF	346,146	3,873,866	NM	Monitored

Well Number	Well Name	Well Type	Easting (UTM NAD83)	Northing (UTM NAD83)	Elevation AMSL (ft)[1]	Current Status
70	Rt 66 Inlet	EHF	346,824	3,884,114	NM	Monitored
71	Rt 66 Outlet	EHF	347,032	3,883,778	NM	Monitored
72	Oxbow 2	EHF	346,057	3,889,298	NM	Monitored
73	4A_New	EHF	347,929	3,883,124	NM	Monitored
74	1A N Terrace	EHF	355,163	3,902,107	5024.9	Monitored
75	1A S Backwater	EHF	355,181	3,902,047	5025.2	Monitored
76	1A S Terrace	EHF	355,243	3,901,810	5024.7	Monitored
77	1C Swale	EHF	352,541	3,897,660	5008.3	Monitored
78	1H Terrace	EHF	351,608	3,896,937	5004.8	Monitored
79	1F Swale	EHF	352,253	3,897,152	5007.2	Monitored
80	1F N Terrace	EHF	352,717	3,897,375	5007.9	Discontinued
81	Oxbow N Scallop	EHF	346,272	3,889,448	NM	Monitored
82	5E1	EHF	346,366	3,868,712	4905.6	Monitored
83	5E2	EHF	346,378	3,868,576	4904.6	Monitored
84	5E3	EHF	346,230	3,868,531	4903.9	Monitored
85	4C1	EHF	347,372	3,875,639	4926.4	Monitored
86	5A1	EHF	346,127	3,874,815	4922.1	Monitored
87	5A2	EHF	346,036	3,874,700	4921.3	Monitored
88	5A3	EFT	346,015	3,874,780	4925.0	Monitored
89	5B1	EHF	346,218	3,874,405	4920.6	Monitored
90	5C1	EHF	346,047	3,872,066	4912.5	Monitored
91	5C2	EHF	345,965	3,872,063	4914.6	Monitored
92	5C3	EHF	345,966	3,871,988	4914.2	Monitored
93	5D1	EHF	346,153	3,869,367	4907.1	Monitored
94	5D2	EHF	346,344	3,868,884	4905.9	Monitored
95	5D3	EHF	346,234	3,868,881	4905.1	Monitored

[1] NM = Not measured

Table A-2. Hang length summary for all currently monitored instrumented wells.

Well Name	Well Number	Hang Length (ft)	Start Date and Time	Stop Date and Time
4B Bankline	43	6.44	10/24/12 12:00	11/10/13 23:59
		6.53	11/11/13 0:00	--
4B	44	6.58	10/24/12 12:00	2/13/14 12:00
		7.05	2/13/14 12:30	--
4C North	45	10.83	10/24/12 12:00	2/13/14 0:00
		6.85	2/13/14 12:30	--
4C South	46	7.29	10/24/12 12:00	11/10/13 23:59
		7.37	11/11/13 0:00	
4C Bankline	47	7.52	10/24/12 12:00	2/26/16 0:00
		7.68	2/26/16 0:00	--
5C South	48	7.29	10/24/12 12:00	11/2/13 23:59
		6.8	11/3/13 0:00	--
5C Bankline	49	7.33	10/24/12 12:00	--
5C North	50	7.23	10/24/12 12:00	11/2/13 23:59
		7.04	11/3/13 0:00	--
5E	51	6.36	10/25/12 9:00	11/2/13 23:59
		6.21	11/3/13 0:00	2/22/16 0:00
		5.94	2/22/2016 0:00	
5D	52	6.6	10/25/12 9:00	11/2/13 23:59
		6.42	11/3/13 0:00	--
5A South	53	6.97	10/25/12 9:00	11/2/13 23:59
		7.08	11/3/13 0:00	--
5A North	54	7.47	10/25/12 9:00	11/10/13 23:59
		7.5	11/11/13 0:00	--
1G	56	6.15	10/26/12 12:00	11/1/13 23:59
		6.12	11/2/13 0:00	--
1E South	57	7.04	10/26/12 12:00	11/1/13 23:59
		6.92	11/2/13 0:00	--
1E Bankline	58	6.58	10/26/12 12:00	11/1/13 23:59
		6.33	11/2/13 0:00	--
5B North	59	6.9	2/26/14 0:00	2/22/16 0:00
		6.48	2/22/16 0:00	--
5B South	60	6.75	2/26/14 0:00	2/22/16 0:00
		6.32	2/22/16 0:00	--
5B Bankline	61	6.54	3/6/16 0:00	--
Rt 66 Inlet	70	9.89	4/1/14 0:00	--
Rt 66 Outlet	71	10.08	4/1/14 0:00	--
Oxbow 2	72	8.95	3/25/14 0:00	--
4A_New	73	10.28	5/1/14 0:00	--
1A N Terrace	74	8.27	9/23/15 8:00	--
1A S Backwater	75	8.46	9/23/15 10:30	--

Well Name	Well Number	Hang Length (ft)	Start Date and Time	Stop Date and Time
1A S Terrace	76	8.42	9/23/15 11:30	--
1C Swale	77	7.87	9/23/15 12:30	--
1H Terrace	78	8.51	9/23/15 15:00	--
1F Swale	79	8.25	9/23/15 13:00	--
1F N Terrace	80	7.99	9/23/15 0:00	--
Oxbow N Scallop	81	7.68	10/12/15 16:00	--
5E1	82	7.75	2/25/16 0:00	--
5E2	83	7.78	2/25/16 0:00	--
5E3	84	7.71	2/25/16 0:00	--
4C1	85	7.67	2/26/16 0:00	--
5A1	86	8.71	2/25/16 0:00	--
5A2	87	7.94	2/25/16 0:00	--
5A3	88	13	2/26/16 0:00	--
5B1	89	7.85	2/26/16 0:00	--
5C1	90	8.15	2/26/16 0:00	--
5C2	91	8.17	2/26/16 0:00	--
5C3	92	8.1	2/26/16 0:00	--
5D1	93	8.05	2/25/16 0:00	--
5D2	94	7.9	2/25/16 0:00	--
5D3	95	7.72	2/25/16 0:00	--

Table A-3. Manual well measurements, datalogger measurements, and associated errors for instrumented wells during the annual monitoring period.

Well Name	Date and Time	Depth to Groundwater (ft)		Error (ft)
		Measured	Datalogger	
1A N Terrace	6/5/19 13:00	-0.54	-0.56	0.02
1A N Terrace	10/10/19 13:00	4.88	3.97	0.91
1A N Terrace	1/16/20 12:30	4.22	4.25	-0.03
1A N Terrace	3/19/20 16:00	3.9	3.93	-0.03
1A S Backwater	6/5/19 13:00	-1.94	-1.97	0.03
1A S Backwater	10/10/19 13:00	2.17	2.29	-0.12
1A S Backwater	1/16/20 12:30	2.5	2.60	-0.10
1A S Backwater	3/19/20 16:30	2.19	2.25	-0.06
1A S Terrace	6/5/19 13:30	-0.74	-0.75	0.01
1A S Terrace	10/10/19 13:30	2.78	1.85	0.93
1A S Terrace	1/16/20 13:00	2.22	2.25	-0.03
1A S Terrace	3/19/20 16:30	1.72	1.78	-0.06
1C Swale	6/5/19 11:30	-1.02	-1.03	0.01
1C Swale	10/10/19 14:00	2.78	2.82	-0.04
1C Swale	1/16/20 11:30	2.89	2.89	0.00

Well Name	Date and Time	Depth to Groundwater (ft)		Error (ft)
		Measured	Datalogger	
1C Swale	3/19/20 14:00	2.77	2.79	-0.02
1E South	6/5/19 11:00	-0.18	0.20	-0.38
1E South	10/10/19 15:00	1.97	2.35	-0.38
1F Swale	6/5/19 14:30	2.6	2.67	-0.07
1F Swale	10/10/19 12:00	6.46	6.44	0.02
1F Swale	1/24/20 16:30	7.06	6.46	0.60
1F Swale	3/24/20 15:30	6.26	6.24	0.02
1H Terrace	6/5/19 14:30	4.08	4.12	-0.04
1H Terrace	10/10/19 11:00	7.25	7.36	-0.11
1H Terrace	1/24/20 15:00	7.53	7.62	-0.09
1H Terrace	3/24/20 15:00	7	7.03	-0.03
4A_New	6/5/19 17:30	2.98	2.94	0.04
4A_New	11/14/19 11:00	3.36	3.38	-0.02
4A_New	3/23/20 17:30	3.61	3.60	0.01
4B	6/11/19 11:00	-1.68	-1.96	0.28
4B	11/26/19 10:30	1.69	1.85	-0.16
4B	1/23/20 9:30	3.14	3.16	-0.02
4B	3/23/20 17:00	2.93	2.92	0.01
4C Bankline	6/11/19 12:00	-1.6	-1.67	0.07
4C Bankline	6/11/19 12:00	-1.65	-1.72	0.07
4C Bankline	10/31/19 16:00	2.18	2.15	0.03
4C Bankline	1/23/20 10:30	2.76	2.73	0.03
4C Bankline	3/20/20 16:30	1.9	1.91	-0.01
4C North	6/11/19 11:30	-1.55	-1.49	-0.06
4C North	10/31/19 17:00	2.88	2.96	-0.08
4C North	1/23/20 10:00	3.11	3.10	0.01
4C North	3/20/20 17:00	2.76	2.75	0.01
4C South	6/11/19 12:30	-2.03	-2.08	0.05
4C South	10/31/19 16:00	2.72	2.81	-0.09
4C South	1/23/20 10:30	2.79	2.90	-0.11
4C South	3/20/20 16:30	2.62	2.46	0.16
4C1	6/11/19 12:30	-2.35	-2.41	0.06
4C1	10/31/19 15:30	3.17	3.07	0.10
4C1	1/23/20 11:00	2.96	2.84	0.12
4C1	3/20/20 16:00	2.75	2.66	0.09
5A1	6/4/19 18:30	0.3	0.25	0.05
5A1	10/22/19 14:30	2.77	2.71	0.06
5A1	1/23/20 15:00	2.99	2.98	0.01
5A1	3/23/20 15:00	2.95	2.90	0.05
5A2	6/4/19 18:30	-0.05	-0.04	-0.01
5A2	10/22/19 14:00	2.87	2.77	0.10

Well Name	Date and Time	Depth to Groundwater (ft)		Error (ft)
		Measured	Datalogger	
5A2	1/23/20 15:00	2.96	2.82	0.14
5A2	3/23/20 15:00	2.91	2.81	0.10
5A3	6/4/19 18:30	4.52	4.47	0.05
5A3	10/22/19 13:30	6.36	6.22	0.14
5A3	1/23/20 15:30	6.21	6.08	0.13
5A3	3/23/20 15:30	6.39	6.32	0.07
5B Bankline	6/11/19 16:00	-1.23	-1.42	0.19
5B Bankline	10/31/19 18:00	2.85	2.84	0.01
5B Bankline	1/22/20 12:30	3.12	3.13	-0.01
5B Bankline	3/20/20 11:00	2.62	2.61	0.01
5B North	10/31/19 17:30	2.16	2.46	-0.30
5B North	1/22/20 12:00	2.62	2.76	-0.14
5B North	3/20/20 10:30	2.12	2.25	-0.13
5B1	10/31/19 18:00	2.23	2.07	0.16
5B1	1/22/20 13:00	2.61	2.45	0.16
5B1	3/20/20 11:00	2.26	2.11	0.15
5C1	11/1/19 10:30	2.24	2.04	0.20
5C1	1/22/20 15:00	2.44	2.22	0.22
5C1	3/20/20 12:30	1.97	1.73	0.24
5C2	11/1/19 11:00	1.96	2.07	-0.11
5C2	1/22/20 15:30	2.15	2.30	-0.15
5C2	3/20/20 12:30	1.64	1.75	-0.11
5C3	11/1/19 11:30	2.46	2.24	0.22
5C3	1/22/20 15:30	2.6	2.35	0.25
5C3	3/20/20 13:00	2.09	1.83	0.26
5D1	6/4/19 17:30	-0.45	-0.58	0.13
5D1	10/22/19 13:00	2.76	2.62	0.14
5D1	1/23/20 12:30	3.16	3.04	0.12
5D1	3/23/20 12:30	2.69	2.58	0.11
5D2	6/4/19 11:30	-0.21	-0.36	0.15
5D2	10/22/19 12:00	3.13	3.00	0.13
5D2	1/23/20 13:30	3.45	3.34	0.11
5D2	3/23/20 12:30	3.3	2.80	0.50
5D3	6/4/19 10:30	-0.44	-0.52	0.08
5D3	10/22/19 12:30	2.46	2.39	0.07
5D3	1/23/20 13:00	2.48	2.40	0.08
5D3	3/23/20 13:00	1.95	2.24	-0.29
5E1	10/22/19 11:30	2.24	2.15	0.09
5E1	1/23/20 13:30	2.61	2.48	0.13
5E1	3/23/20 13:30	2.07	1.95	0.12
5E2	10/22/19 11:00	2.11	1.97	0.14

Well Name	Date and Time	Depth to Groundwater (ft)		Error (ft)
		Measured	Datalogger	
5E2	1/23/20 14:00	2.36	2.25	0.11
5E2	3/23/20 13:30	1.87	1.75	0.12
5E3	10/22/19 10:30	2.58	2.40	0.18
5E3	1/23/20 14:00	2.36	2.18	0.18
5E3	3/23/20 14:00	2.26	2.08	0.18
Oxbow 2	6/5/19 10:30	1.01	0.96	0.05
Oxbow 2	10/31/19 13:00	1.98	1.92	0.06
Oxbow 2	1/22/20 9:30	1.98	1.90	0.08
Oxbow 2	3/24/20 17:00	1.53	1.44	0.09
Oxbow N Scallop	6/5/19 10:00	-2.06	-2.02	-0.04
Oxbow N Scallop	10/31/19 13:00	0.55	0.59	-0.04
Oxbow N Scallop	1/22/20 10:00	0.81	0.79	0.02
Oxbow N Scallop	3/24/20 17:30	0.41	0.44	-0.03
Rt 66 Inlet	6/5/19 16:30	-1.08	-1.60	0.52
Rt 66 Inlet	11/14/19 9:30	2.05	1.47	0.58
Rt 66 Inlet	1/15/20 16:30	2.6	2.00	0.60
Rt 66 Inlet	3/24/20 10:30	2.28	1.69	0.59
Rt 66 Inlet	5/18/20 14:00	2.58	1.98	0.60
Rt 66 Outlet	6/5/19 17:00	-1.32	-1.46	0.14
Rt 66 Outlet	11/14/19 10:00	1.51	1.35	0.16

Table A-4. Manual well measurements for un-instrumented wells.

Well Name	Date/Time	Measured Depth to Groundwater (ft)
1E Bankline	7/29/19 11:30	1.44
1E Bankline	10/10/19 14:30	2.11
1E Bankline	11/25/19 14:30	0.96
1E Bankline	12/16/19 13:00	2.07
1E Bankline	1/16/20 10:30	2.06
1E Bankline	2/24/20 12:30	2.12
1E Bankline	3/19/20 13:00	1.94
1E Bankline	5/22/20 10:00	2.06
1E North	7/29/19 11:30	1.98
1E North	8/3/19 10:30	2.62
1E North	10/10/19 15:00	2.67
1E North	11/25/19 14:30	1.49
1E North	12/16/19 13:00	2.33
1E North	1/16/20 10:00	2.55
1E North	2/24/20 12:00	2.44

Well Name	Date/Time	Measured Depth to Groundwater (ft)
1E North	3/19/20 12:30	2.25
1E North	4/24/20 8:00	2.57
1E North	5/22/20 9:30	2.42
1E South	6/5/19 11:00	-0.18
1E South	10/10/19 15:00	1.97
1E South	1/16/20 10:30	1.92
1E South	2/24/20 12:00	1.97
1E South	3/19/20 12:30	1.78
1E South	5/22/20 9:30	1.92
1G	7/29/19 12:00	1.67
1G	8/3/19 11:00	2.17
1G	10/10/19 15:30	2.07
1G	11/25/19 14:00	1.12
1G	12/16/19 12:30	1.87
1G	1/16/20 10:00	2.08
1G	2/24/20 11:30	2.09
1G	3/19/20 11:30	1.93
1G	4/24/20 7:00	2.02
4B Bankline	6/11/19 10:30	-1.37
4B Bankline	7/30/19 13:00	2.61
4B Bankline	8/2/19 11:30	3.53
4B Bankline	10/31/19 15:00	3.24
4B Bankline	11/26/19 10:00	2.18
4B Bankline	12/17/19 11:30	3.07
4B Bankline	1/23/20 9:30	3.84
4B Bankline	2/25/20 17:00	3.43
4B Bankline	3/23/20 16:30	3.37
4B Bankline	4/23/20 14:30	3.58
4B Bankline	5/26/20 16:30	3.38
5A North	6/4/19 18:30	-0.01
5A North	10/22/19 15:00	2
5A North	11/26/19 15:30	0.87
5A North	12/17/19 10:30	1.52
5A North	1/23/20 15:30	2.15
5A North	2/26/20 14:00	1.98
5A North	3/23/20 15:30	2.02
5A North	5/24/20 12:00	2.25
5A South	7/30/19 12:30	2.46
5A South	8/2/19 9:30	3.06
5A South	10/22/19 13:30	2.86
5A South	11/26/19 15:30	1.84

Well Name	Date/Time	Measured Depth to Groundwater (ft)
5A South	12/17/19 10:30	2.42
5A South	1/23/20 15:00	3.05
5A South	2/26/20 14:00	2.89
5A South	3/23/20 15:00	3.03
5A South	4/23/20 12:00	3.06
5A South	5/24/20 11:30	3.66
5C Bankline	6/9/19 0:00	-1.68
5C Bankline	11/1/19 11:30	2.48
5C Bankline	11/26/19 13:00	1.35
5C Bankline	12/17/19 13:00	2.26
5C Bankline	1/22/20 16:00	2.76
5C Bankline	2/25/20 15:30	2.54
5C Bankline	3/20/20 13:00	2.32
5C Bankline	5/24/20 14:30	2.69
5C North	6/15/19 0:00	-4.47
5C North	11/1/19 10:30	0.95
5C North	11/26/19 13:00	0.43
5C North	12/17/19 12:30	0.92
5C North	1/22/20 14:30	1.3
5C North	2/25/20 15:30	1.36
5C North	3/20/20 12:30	0.91
5C North	5/24/20 14:00	1.2
5C South	7/30/19 13:30	1.09
5C South	8/2/19 11:00	1.8
5C South	11/1/19 11:00	1.7
5C South	11/26/19 13:00	1.01
5C South	12/17/19 12:30	1.59
5C South	1/22/20 15:30	2.03
5C South	2/25/20 15:30	1.89
5C South	3/20/20 13:00	1.54
5C South	4/23/20 14:00	1.55
5C South	5/24/20 14:00	1.95
5D	7/30/19 10:30	1.51
5D	8/2/19 9:00	2.29
5D	10/22/19 12:00	2.24
5D	11/26/19 15:00	1.05
5D	12/17/19 10:00	1.83
5D	1/23/20 12:30	2.45
5D	2/26/20 13:00	2.09
5D	3/23/20 12:00	2.14
5D	4/23/20 13:00	2.32

Well Name	Date/Time	Measured Depth to Groundwater (ft)
5D	5/24/20 10:30	2.29
5E	7/30/19 10:30	2.04
5E	8/2/19 8:30	2.74
5E	10/22/19 10:00	2.69
5E	11/26/19 15:00	1.46
5E	12/17/19 10:00	1.97
5E	1/23/20 14:30	2.4
5E	2/26/20 13:30	2.17
5E	3/23/20 14:00	2.18
5E	4/23/20 13:00	2.55
5E	5/24/20 9:30	2.61
Alameda NE	7/29/19 16:30	7.96
Alameda NE	11/25/19 16:30	8.44
Alameda NE	3/24/20 15:00	8.58
Alameda NE	4/24/20 9:30	8.4
Alameda NE	5/22/20 13:00	8.35
Bridge Ave SW	7/30/19 17:00	3.99
Bridge Ave SW	8/2/19 12:00	4.6
Bridge Ave SW	11/14/19 10:30	4.52
Bridge Ave SW	11/27/19 9:30	4.08
Bridge Ave SW	12/17/19 16:00	4.8
Bridge Ave SW	1/15/20 17:00	5.11
Bridge Ave SW	2/26/20 10:30	4.97
Bridge Ave SW	3/23/20 18:00	4.79
Bridge Ave SW	4/29/20 11:00	4.7
Bridge Ave SW	5/18/20 13:30	4.65
Brown Burn West	7/30/19 10:00	3.34
Brown Burn West	8/2/19 9:00	4.15
Brown Burn West	10/22/19 13:00	4.05
Brown Burn West	11/26/19 14:30	3.26
Brown Burn West	12/17/19 9:30	3.77
Brown Burn West	1/23/20 12:00	4.2
Brown Burn West	2/26/20 12:30	4.1
Brown Burn West	3/23/20 11:30	4.01
Brown Burn West	4/23/20 12:30	4.07
Brown Burn West	5/24/20 11:30	4.15
Central NE	7/30/19 15:30	5.56
Central NE	8/2/19 1:30	5.99
Central NE	11/1/19 13:00	5.01
Central NE	11/27/19 10:00	4.83
Central NE	12/17/19 14:30	5.40

Well Name	Date/Time	Measured Depth to Groundwater (ft)
Central NE	1/27/20 10:30	6.23
Central NE	2/26/20 15:30	6.21
Central NE	3/30/20 11:30	5.80
Central NE	4/29/20 12:00	6.07
Central NE	5/18/20 15:00	6.09
Central SW New	7/30/19 17:00	3.34
Central SW New	8/2/19 12:00	4.18
Central SW New	11/14/19 9:30	3.63
Central SW New	11/27/19 10:00	3.23
Central SW New	12/17/19 16:00	3.88
Central SW New	1/15/20 16:30	4.09
Central SW New	2/26/20 10:30	3.83
Central SW New	3/24/20 10:30	3.71
Central SW New	4/29/20 12:00	3.93
Central SW New	5/18/20 13:30	4.13
Corrales Dixon Rd	7/29/19 14:00	5.27
Corrales Dixon Rd	10/10/19 13:30	6.11
Corrales Dixon Rd	11/25/19 15:30	5.37
Corrales Dixon Rd	12/16/19 14:00	6.32
Corrales Dixon Rd	1/16/20 12:00	6.67
Corrales Dixon Rd	2/26/20 13:30	6.61
Corrales Dixon Rd	3/19/20 14:30	6.32
Corrales Dixon Rd	4/24/20 8:30	6.51
Corrales Dixon Rd	5/22/20 12:00	6.31
Corrales HarveyJones	7/29/19 15:00	6.59
Corrales HarveyJones	8/3/19 9:00	7.40
Corrales HarveyJones	10/10/19 12:30	7.55
Corrales HarveyJones	11/25/19 16:00	6.73
Corrales HarveyJones	12/16/19 14:30	7.24
Corrales HarveyJones	1/16/20 14:30	7.76
Corrales HarveyJones	2/24/20 14:00	7.93
Corrales HarveyJones	3/19/20 15:30	7.72
Corrales HarveyJones	4/24/20 9:00	7.80
Corrales HarveyJones	5/22/20 11:30	7.82
Corrales North	7/29/19 12:00	3.77
Corrales North	8/3/19 10:30	4.29
Corrales North	10/10/19 15:30	4.19
Corrales North	11/25/19 14:00	3.26
Corrales North	12/16/19 12:30	4.62
Corrales North	1/16/20 10:00	4.16
Corrales North	2/24/20 12:00	4.2

Well Name	Date/Time	Measured Depth to Groundwater (ft)
Corrales North	3/19/20 12:00	4.07
Corrales North	4/24/20 7:30	4.12
Corrales North	5/22/20 9:00	1.09
Corrales South	7/29/19 12:30	3.38
Corrales South	8/3/19 11:00	3.75
Corrales South	10/10/19 15:30	3.65
Corrales South	11/25/19 14:00	2.96
Corrales South	12/16/19 12:30	4.04
Corrales South	1/16/20 9:30	3.83
Corrales South	2/24/20 11:30	3.72
Corrales South	3/19/20 12:00	3.67
Corrales South	4/24/20 7:00	3.80
Corrales South	5/22/20 9:00	3.55
I-25 E	7/30/19 14:00	2.98
I-25 E	8/2/19 10:30	3.64
I-25 E	11/1/19 12:00	3.3
I-25 E	11/26/19 13:30	2.61
I-25 E	12/17/19 13:00	3.15
I-25 E	3/20/20 14:00	3.35
I-40 M	7/30/19 15:30	5.77
I-40 M	8/2/19 1:30	6.20
I-40 M	11/1/19 13:30	6.08
I-40 M	11/27/19 10:30	5.77
I-40 M	12/17/19 15:00	6.34
I-40 M	1/27/20 10:00	6.54
I-40 M	2/26/20 16:00	6.47
I-40 M	3/30/20 12:30	6.32
I-40 M	4/29/20 12:30	6.45
I-40 M	5/18/20 15:30	6.40
I-40 S	7/30/19 15:30	6.38
I-40 S	8/2/19 1:30	6.92
I-40 S	11/1/19 13:30	6.94
I-40 S	11/27/19 10:30	6.62
I-40 S	12/17/19 15:00	6.77
I-40 S	1/27/20 10:30	7.35
I-40 S	2/26/20 15:30	7.28
I-40 S	3/30/20 12:30	7.12
I-40 S	4/29/20 12:30	7.17
I-40 S	5/18/20 15:30	7.10
La Orilla	7/29/19 17:30	4.73
La Orilla	8/2/19 4:00	5.55

Well Name	Date/Time	Measured Depth to Groundwater (ft)
La Orilla	10/31/19 12:00	5.28
La Orilla	12/16/19 16:00	4.94
La Orilla	2/24/20 16:00	5.33
La Orilla	3/24/20 16:30	4.91
La Orilla	4/29/20 14:30	5.22
La Orilla	5/22/20 14:30	5.7
Montano SW	7/29/19 17:30	4.49
Montano SW	8/2/19 3:00	5.36
Montano SW	10/31/19 14:00	4.99
Montano SW	12/16/19 16:30	4.66
Montano SW	1/22/20 11:00	5.01
Montano SW	2/24/20 17:30	4.97
Montano SW	3/24/20 18:00	4.84
Montano SW	4/29/20 14:00	5.16
Montano SW	5/22/20 15:30	5.36
RGNC M	7/30/19 16:00	6.08
RGNC M	8/2/19 2:00	6.64
RGNC M	11/1/19 14:00	6.32
RGNC M	11/27/19 10:30	6.36
RGNC M	12/17/19 15:30	6.73
RGNC M	1/27/20 9:30	7.07
RGNC M	2/26/20 16:00	7.04
RGNC M	3/30/20 13:30	6.71
RGNC M	4/29/20 12:30	6.89
RGNC M	5/18/20 16:00	6.99
RGNC N	7/30/19 16:00	5.80
RGNC N	8/2/19 2:00	6.65
RGNC N	11/1/19 14:00	6.34
RGNC N	11/27/19 11:00	6.13
RGNC N	12/17/19 15:30	6.56
RGNC N	1/27/20 10:00	7.08
RGNC N	2/26/20 16:00	7.04
RGNC N	3/30/20 13:30	6.68
RGNC N	4/29/20 12:30	6.80
RGNC N	5/18/20 16:00	6.85
RGNC S	7/30/19 16:00	4.85
RGNC S	8/2/19 2:00	5.42
RGNC S	11/1/19 14:00	5.02
RGNC S	11/27/19 10:30	4.79
RGNC S	12/17/19 15:00	5.31
RGNC S	1/27/20 9:30	5.61

Well Name	Date/Time	Measured Depth to Groundwater (ft)
RGNC S	2/26/20 16:00	5.55
RGNC S	3/30/20 13:00	5.35
RGNC S	4/29/20 12:30	5.62
RGNC S	5/18/20 16:00	5.74
Rio Bravo	7/30/19 15:00	0.56
Rio Bravo	8/2/19 11:30	1.14
Rio Bravo	11/1/19 13:00	1.20
Rio Bravo	11/26/19 10:30	0.63
Rio Bravo	12/17/19 14:00	1.09
Rio Bravo	2/26/20 11:30	1.66
Rio Bravo	3/23/20 18:30	1.34
Rio Bravo	4/29/20 11:00	1.47
Rio Bravo	5/26/20 17:00	1.29
Zoo Burn	7/30/19 15:00	3.92
Zoo Burn	8/2/19 12:30	4.85
Zoo Burn	11/14/19 10:30	4.15
Zoo Burn	11/27/19 9:30	3.69
Zoo Burn	12/17/19 14:30	4.30
Zoo Burn	1/15/20 17:30	4.62
Zoo Burn	2/26/20 11:00	4.75
Zoo Burn	3/23/20 17:30	4.37
Zoo Burn	4/29/20 10:00	4.50
Zoo Burn	5/18/20 15:00	4.90

Table A-5. 2019-2020 Monthly Summary of Daily Average Discharge as Recorded at the USGS Albuquerque and Alameda Gaging Stations.

Year	Month	USGS Albuquerque Gage			USGS Alameda Gage		
		Min Daily Avg Discharge (cfs)	Avg Daily Discharge (cfs)	Max Daily Avg Discharge (cfs)	Min Daily Avg Discharge (cfs)	Avg Daily Discharge (cfs)	Max Daily Avg Discharge (cfs)
2019	June	3270	4631	5720	3110	4900	6220
2019	July	1100	2441	4700	1100	2438	5970
2019	August	463	896	2060	600	1001	2560
2019	September	279	436	948	382	533	1130
2019	October	279	568	922	373	638	1070
2019	November	534	1259	2630	536	1260	3980
2019	December	227	711	1620	422	836	1460
2020	January	252	480	665	345	649	770
2020	February	484	583	782	596	651	942
2020	March	423	623	1060	468	704	1180
2020	April	350	465	617	496	570	766
2020	May	440	554	771	604	713	918

Table A-6. Casing height summary for all wells monitored during 2018-2019.

Well Number	Well Name	Casing Height (ft)	Start Date/Time	Stop Date/Time
1	I-25 E	2.84	4/19/2005 0:00	11/12/2013 23:59
1	I-25 E	2.9	11/13/2013 0:00	10/6/2015 23:59
1	I-25 E	2.86	10/7/2015 0:00	--
2	Brown Burn West	3.42	12/30/2005 0:00	10/24/2012 23:59
2	Brown Burn West	3.16	10/25/2012 0:00	11/10/2013 23:59
2	Brown Burn West	3.53	11/11/2013 0:00	2/25/2020 11:59
2	Brown Burn West	3.45	7/15/2019 0:00	--
3	Brown Burn East	2.99	4/19/2005 0:00	7/14/2019 23:59
3	Brown Burn East	3.21	7/15/2019 0:00	--
4	Bridge Ave SW	3.38	12/30/2005 0:00	10/13/2012 23:59
4	Bridge Ave SW	3.38	10/14/2012 0:00	2/25/2020 11:59
4	Bridge Ave SW	3.5	7/15/2019 0:00	--
6	RGNC Baro West	3.18	12/2/2005 0:00	10/11/2015 23:59
6	RGNC Baro West	3.03	10/12/2015 0:00	7/14/2019 23:59
6	RGNC Baro West	3.07	7/15/2019 0:00	--
8	Montano SW	1.45	12/2/2005 0:00	10/24/2012 23:59
8	Montano SW	1.43	10/25/2012 0:00	10/11/2015 23:59
8	Montano SW	1.44	10/12/2015 0:00	7/14/2019 23:59
8	Montano SW	1.44	7/15/2019 0:00	--
9	La Orilla	1.81	12/30/2005 0:00	7/14/2019 23:59
9	La Orilla	1.65	7/15/2019 0:00	--
10	Alameda NE	2.85	1/3/2006 0:00	7/14/2019 23:59
10	Alameda NE	2.9	7/15/2019 0:00	--
11	Corrales North	3.24	1/3/2006 0:00	7/14/2019 23:59
11	Corrales North	3.41	7/15/2019 0:00	--
13	Corrales Dixon Rd	1.83	4/29/2009 0:00	7/14/2019 23:59
13	Corrales Dixon Rd	2.09	7/15/2019 0:00	--
14	Corrales North Bndy	1.94	4/29/2009 0:00	--
15	Corrales HarveyJones	2.14	4/29/2009 0:00	7/14/2019 23:59
15	Corrales HarveyJones	2.2	7/15/2019 0:00	--
25	Central SW - New	3.4	6/1/2009 0:00	7/14/2019 23:59
25	Central SW - New	3.32	7/15/2019 0:00	--
26	Central NE	3.05	2/14/2006 0:00	7/14/2019 23:59
26	Central NE	3.06	7/15/2019 0:00	--
30	Corrales South	3.7	9/11/2009 0:00	7/14/2019 23:59
30	Corrales South	3.95	7/15/2019 0:00	--
32	RGNC N	3.12	9/11/2009 0:00	7/14/2019 23:59
32	RGNC N	3.1	7/15/2019 0:00	--

Well Number	Well Name	Casing Height (ft)	Start Date/Time	Stop Date/Time
33	RGNC M	3.13	9/11/2009 0:00	7/14/2019 23:59
33	RGNC M	3.11	7/15/2019 0:00	--
34	RGNC S	3.56	9/11/2009 0:00	7/14/2019 23:59
34	RGNC S	3.68	7/15/2019 0:00	--
36	I-40 M	1.87	9/11/2009 0:00	7/14/2019 23:59
36	I-40 M	1.9	7/15/2019 0:00	--
37	I-40 S	1.88	9/11/2009 0:00	7/14/2019 23:59
37	I-40 S	1.73	7/15/2019 0:00	--
38	July 4 Burn	1.63	9/11/2009 0:00	--
39	Central W	3.69	9/11/2009 0:00	--
40	Rio Bravo	1.55	9/11/2009 0:00	7/14/2019 23:59
40	Rio Bravo	1.46	7/15/2019 0:00	--
41	Zoo Burn	3.27	9/11/2009 0:00	7/14/2019 23:59
41	Zoo Burn	3.25	7/15/2019 0:00	--
43	4B Bankline	2.04	4/30/2012 0:00	11/10/2013 23:59
43	4B Bankline	1.96	11/11/2013 12:00	8/20/2014 23:59
43	4B Bankline	1.88	8/21/2014 12:00	10/6/2015 23:59
43	4B Bankline	1.82	10/7/2015 0:00	7/14/2019 23:59
43	4B Bankline	0.72	7/15/2019 0:00	--
44	4B	2.07	4/30/2012 0:00	11/10/2013 23:59
44	4B	1.94	11/11/2013 12:00	8/20/2014 23:59
44	4B	1.9	8/21/2014 12:00	10/6/2015 23:59
44	4B	1.88	10/7/2015 0:00	7/14/2019 23:59
44	4B	1.74	7/15/2019 0:00	--
45	4C North	2.25	5/2/2012 0:00	11/10/2013 23:59
45	4C North	2.31	11/11/2013 12:00	8/20/2014 23:59
45	4C North	2.21	8/21/2014 12:00	10/6/2015 23:59
45	4C North	2.18	10/7/2015 0:00	7/7/2016 23:59
45	4C North	2.17	7/8/2016 0:00	7/5/2017 23:59
45	4C North	2.23	7/6/2017 0:00	7/14/2019 23:59
45	4C North	2.19	7/15/2019 0:00	--
46	4C South	2.25	5/2/2012 0:00	11/10/2013 23:59
46	4C South	2.23	11/11/2013 12:00	8/20/2014 23:59
46	4C South	2.16	8/21/2014 12:00	10/6/2015 23:59
46	4C South	2.17	10/7/2015 0:00	7/7/2016 23:59
46	4C South	2.29	7/8/2016 0:00	7/5/2017 23:59
46	4C South	2.16	7/6/2017 0:00	7/14/2019 23:59
46	4C South	2.23	7/15/2019 0:00	--
47	4C Bankline	2.21	5/2/2012 0:00	1/22/2013 23:59
47	4C Bankline	2.21	1/23/2013 0:00	11/10/2013 23:59
47	4C Bankline	2.29	11/11/2013 0:00	10/6/2015 23:59

Well Number	Well Name	Casing Height (ft)	Start Date/Time	Stop Date/Time
47	4C Bankline	2.16	10/7/2015 0:00	7/14/2019 23:59
47	4C Bankline	2.13	2/16/2016 0:00	7/7/2016 23:59
47	4C Bankline	2.06	7/8/2016 0:00	7/5/2017 23:59
47	4C Bankline	2.21	7/6/2017 0:00	7/14/2019 23:59
47	4C Bankline	2.14	7/15/2019 0:00	--
48	5C South	2.08	5/2/2012 0:00	11/10/2013 23:59
48	5C South	2.07	11/11/2013 12:00	8/20/2014 23:59
48	5C South	1.83	8/21/2014 12:00	10/6/2015 23:59
48	5C South	1.89	10/7/2015 0:00	7/7/2016 23:59
48	5C South	1.88	7/8/2016 0:00	7/5/2017 23:59
48	5C South	2.05	7/6/2017 0:00	7/14/2019 23:59
48	5C South	1.95	7/15/2019 0:00	--
49	5C Bankline	2.25	6/20/2012 0:00	11/10/2013 23:59
49	5C Bankline	2.05	11/11/2013 12:00	8/20/2014 23:59
49	5C Bankline	2.16	8/21/2014 12:00	10/6/2015 23:59
49	5C Bankline	2.13	10/7/2015 0:00	7/7/2016 23:59
49	5C Bankline	2.08	7/8/2016 0:00	--
49	5C Bankline	1.78	7/15/2019 0:00	--
50	5C North	2.15	5/2/2012 0:00	8/20/2014 23:59
50	5C North	2.06	8/21/2014 12:00	10/6/2015 23:59
50	5C North	2.08	10/7/2015 0:00	7/7/2016 23:59
50	5C North	2.07	7/8/2016 0:00	7/5/2017 23:59
50	5C North	2.07	7/6/2017 0:00	7/14/2019 23:59
50	5C North	2.2	7/15/2019 0:00	--
51	5E	2.08	6/20/2012 0:00	11/10/2013 23:59
51	5E	2.22	11/11/2013 12:00	8/20/2014 23:59
51	5E	2	8/21/2014 12:00	10/6/2015 23:59
51	5E	2.01	10/7/2015 0:00	7/7/2016 23:59
51	5E	1.96	7/8/2016 0:00	7/6/2017 23:59
51	5E	1.85	7/7/2017 0:00	7/14/2019 23:59
51	5E	2.01	7/15/2019 0:00	--
52	5D	1.23	6/20/2012 0:00	11/10/2013 23:59
52	5D	1.2	11/11/2013 12:00	8/20/2014 23:59
52	5D	1.16	8/21/2014 12:00	10/6/2015 23:59
52	5D	1.11	10/7/2015 0:00	7/7/2016 23:59
52	5D	1.13	7/8/2016 0:00	7/5/2017 23:59
52	5D	1.09	7/6/2017 0:00	7/14/2019 23:59
52	5D	1.21	7/15/2019 0:00	--
53	5A South	2.08	5/1/2012 0:00	11/10/2013 23:59
53	5A South	2.02	11/11/2013 12:00	8/20/2014 23:59
53	5A South	1.91	8/21/2014 12:00	10/6/2015 23:59

Well Number	Well Name	Casing Height (ft)	Start Date/Time	Stop Date/Time
53	5A South	1.96	10/7/2015 0:00	7/5/2017 23:59
53	5A South	1.9	7/6/2017 0:00	7/14/2019 23:59
53	5A South	1.94	7/15/2019 0:00	--
54	5A North	2.05	5/4/2012 0:00	11/10/2013 23:59
54	5A North	2.15	11/11/2013 12:00	8/20/2014 23:59
54	5A North	2.04	8/21/2014 12:00	10/6/2015 23:59
54	5A North	2.06	10/7/2015 0:00	7/14/2019 23:59
54	5A North	2.1	7/15/2019 0:00	--
56	1G	2.51	6/20/2012 0:00	11/10/2013 23:59
56	1G	2.58	11/11/2013 12:00	9/18/2014 23:59
56	1G	2.67	9/19/2014 0:00	10/11/2015 23:59
56	1G	2.49	10/12/2015 0:00	7/14/2019 23:59
56	1G	2.63	7/15/2019 0:00	--
57	1E South	2.13	6/20/2012 0:00	11/10/2013 23:59
57	1E South	2.27	11/11/2013 12:00	9/18/2014 23:59
57	1E South	2.29	9/19/2014 0:00	10/11/2015 23:59
57	1E South	2.12	10/12/2015 12:00	7/14/2019 23:59
57	1E South	2.28	7/15/2019 0:00	--
58	1E Bankline	2.185	6/20/2012 0:00	11/10/2013 23:59
58	1E Bankline	2.24	11/11/2013 12:00	9/18/2014 23:59
58	1E Bankline	2.29	9/19/2014 0:00	10/11/2015 23:59
58	1E Bankline	2.1	10/12/2015 0:00	7/14/2019 23:59
58	1E Bankline	2.19	7/15/2019 0:00	--
59	5B North	2.28	4/30/2012 0:00	8/20/2014 23:59
59	5B North	2.06	8/21/2014 12:00	10/6/2015 23:59
59	5B North	2.04	10/7/2015 0:00	7/7/2016 23:59
59	5B North	1.99	7/8/2016 0:00	7/5/2017 23:59
59	5B North	1.9	7/6/2017 0:00	7/14/2019 23:59
59	5B North	1.69	7/15/2019 0:00	--
60	5B South	2.17	4/30/2012 0:00	2/25/2014 23:59
60	5B South	2.17	2/26/2014 0:00	10/6/2015 23:59
60	5B South	2.12	10/7/2015 0:00	7/7/2016 23:59
60	5B South	2.08	7/8/2016 0:00	7/14/2019 23:59
60	5B South	2.04	7/15/2019 0:00	--
61	5B Bankline	2	5/4/2012 0:00	10/6/2015 23:59
61	5B Bankline	1.79	10/7/2015 0:00	2/25/2016 23:59
61	5B Bankline	1.8	2/26/2016 0:00	7/7/2016 23:59
61	5B Bankline	1.76	7/8/2016 0:00	7/5/2017 23:59
61	5B Bankline	1.75	7/6/2017 0:00	7/14/2019 23:59
61	5B Bankline	1.5	7/15/2019 0:00	--
62	1E North	2.01	6/20/2012 0:00	11/10/2013 23:59

Well Number	Well Name	Casing Height (ft)	Start Date/Time	Stop Date/Time
62	1E North	1.95	11/11/2013 12:00	9/18/2014 23:59
62	1E North	1.92	9/19/2014 0:00	10/25/2015 23:59
62	1E North	1.88	10/26/2015 0:00	7/14/2019 23:59
62	1E North	1.83	7/15/2019 0:00	--
70	Rt 66 Inlet	5.31	4/1/2014 0:00	9/18/2014 23:59
70	Rt 66 Inlet	5.29	9/19/2014 0:00	10/11/2015 23:59
70	Rt 66 Inlet	4.99	10/12/2015 0:00	7/14/2019 23:59
70	Rt 66 Inlet	4.12	7/15/2019 0:00	--
71	Rt 66 Outlet	5.29	4/1/2014 0:00	9/18/2014 23:59
71	Rt 66 Outlet	5.17	9/19/2014 0:00	10/11/2015 23:59
71	Rt 66 Outlet	5.12	10/12/2015 0:00	7/14/2019 23:59
71	Rt 66 Outlet	4.78	7/15/2019 0:00	--
72	Oxbow 2	3.1	3/25/2014 0:00	10/11/2015 23:59
72	Oxbow 2	3.11	10/12/2015 0:00	7/14/2019 23:59
72	Oxbow 2	3.11	7/15/2019 0:00	--
73	4A_New	3.27	5/1/2014 0:00	11/12/2015 23:59
73	4A_New	3.27	11/13/2015 0:00	--
74	1A N Terrace	2.16	9/23/2015 0:00	7/14/2019 23:59
74	1A N Terrace	1.92	7/15/2019 0:00	--
75	1A S Backwater	4.2	9/23/2015 0:00	7/14/2019 23:59
75	1A S Backwater	4.03	7/15/2019 0:00	--
76	1A S Terrace	2.73	9/23/2015 0:00	7/14/2019 23:59
76	1A S Terrace	4.12	7/15/2019 0:00	--
77	1C Swale	2.7	9/23/2015 0:00	7/14/2019 23:59
77	1C Swale	2.72	7/15/2019 0:00	--
78	1H Terrace	1.87	9/23/2015 0:00	7/14/2019 23:59
78	1H Terrace	0.85	7/15/2019 0:00	--
79	1F Swale	2.65	9/23/2015 0:00	7/14/2019 23:59
79	1F Swale	1.74	7/15/2019 0:00	--
81	Oxbow N Scallop	5	10/12/2015 0:00	7/14/2019 23:59
81	Oxbow N Scallop	4.67	7/15/2019 0:00	--
82	5E1	3.1	2/24/2016 0:00	7/8/2016 0:00
82	5E1	3.04	7/8/2016 0:00	7/6/2017 23:59
82	5E1	3	7/7/2017 0:00	7/14/2019 23:59
82	5E1	2.66	7/15/2019 0:00	--
83	5E2	2.59	2/24/2016 0:00	7/8/2016 0:00
83	5E2	2.57	7/8/2016 0:00	7/6/2017 23:59
83	5E2	2.58	7/7/2017 0:00	7/14/2019 23:59
83	5E2	2.39	7/15/2019 0:00	--
84	5E3	3.26	2/24/2016 0:00	7/8/2016 0:00
84	5E3	3.27	7/8/2016 0:00	7/6/2017 23:59

Well Number	Well Name	Casing Height (ft)	Start Date/Time	Stop Date/Time
84	5E3	3.28	7/7/2017 0:00	7/14/2019 23:59
84	5E3	3.2	7/15/2019 0:00	--
85	4C1	2.75	2/26/2016 0:00	7/8/2016 0:00
85	4C1	2.75	7/8/2016 0:00	7/5/2017 23:59
85	4C1	2.69	7/6/2017 0:00	7/14/2019 23:59
85	4C1	2.64	7/15/2019 0:00	--
86	5A1	2.5	2/24/2016 0:00	7/5/2017 23:59
86	5A1	2.35	7/6/2017 0:00	7/14/2019 23:59
86	5A1	2.33	7/15/2019 0:00	--
87	5A2	2.44	2/24/2016 0:00	7/5/2017 23:59
87	5A2	2.39	7/6/2017 0:00	7/14/2019 23:59
87	5A2	2.3	7/15/2019 0:00	--
88	5A3	3.32	2/26/2016 0:00	7/5/2017 23:59
88	5A3	3.26	7/6/2017 0:00	7/14/2019 23:59
88	5A3	3.21	7/15/2019 0:00	--
89	5B1	2.65	2/26/2016 0:00	7/8/2016 0:00
89	5B1	2.59	7/8/2016 0:00	7/5/2017 23:59
89	5B1	2.57	7/6/2017 0:00	7/14/2019 23:59
89	5B1	2.55	7/15/2019 0:00	--
90	5C1	2.52	2/26/2016 0:00	7/8/2016 0:00
90	5C1	2.56	7/8/2016 0:00	7/5/2017 23:59
90	5C1	2.53	7/6/2017 0:00	7/14/2019 23:59
90	5C1	2.45	7/15/2019 0:00	--
91	5C2	2.74	2/26/2016 0:00	7/8/2016 0:00
91	5C2	2.61	7/8/2016 0:00	7/5/2017 23:59
91	5C2	2.67	7/6/2017 0:00	7/14/2019 23:59
91	5C2	2.5	7/15/2019 0:00	--
92	5C3	2.63	2/26/2016 0:00	7/8/2016 0:00
92	5C3	2.62	7/8/2016 0:00	7/5/2017 23:59
92	5C3	2.56	7/6/2017 0:00	7/14/2019 23:59
92	5C3	2.51	7/15/2019 0:00	--
93	5D1	2.8	2/24/2016 0:00	7/8/2016 0:00
93	5D1	2.76	7/8/2016 0:00	7/5/2017 23:59
93	5D1	2.71	7/6/2017 0:00	7/14/2019 23:59
93	5D1	1.92	7/15/2019 0:00	--
94	5D2	2.36	2/24/2016 0:00	7/8/2016 0:00
94	5D2	2.35	7/8/2016 0:00	7/5/2017 23:59
94	5D2	2.24	7/6/2017 0:00	7/14/2019 23:59
94	5D2	1.5	7/15/2019 0:00	--
95	5D3	2.5	2/24/2016 0:00	7/8/2016 0:00
95	5D3	2.47	7/8/2016 0:00	7/5/2017 23:59

Well Number	Well Name	Casing Height (ft)	Start Date/Time	Stop Date/Time
95	5D3	2.47	7/6/2017 0:00	7/14/2019 23:59
95	5D3	2.47	7/15/2019 0:00	--

Appendix B

MRG Groundwater Database Data Import Procedures

STANDARD OPERATING PROCEDURE 13.3
[MRG Groundwater Database Data Import Procedures]

Version 1.1

Prepared by: Lindsey Bunting Date: 05/25/2017

Revised by: ______________ Date: __________

Approved by: Todd Caplan Date: 06/20/2017

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1.0 GENERAL STATEMENT

A riparian groundwater monitoring database was developed by the U.S. Army Corps of Engineers (USACE) in 2009 to provide convenient access to groundwater data collected from the middle Rio Grande (MRG) bosque. The Microsoft Access database contains data from over 75 wells, some of which were installed as early as 2005. Stored information includes manual groundwater measurements and automated groundwater data collected using datalogging water level pressure transducers (PT). The database was originally designed for older generation PTs (Solinst Levelogger model 3001), but was modified in 2016 to allow for import of absolute pressure logging dataloggers manufactured by both Solinst and In-Situ, Inc.

2.0 OBJECTIVE

This standard operating procedure (SOP) provides detailed instructions for the pre-processing and import of data from automated datalogging PTs (In-Situ, Solinst), manual depth to groundwater measurements, PT hang lengths, well casing heights, and USGS stream gaging data.

3.0 EQUIPMENT AND/OR INSTRUMENTATION

Software and equipment needed for pre-processing and import of data includes:

- Computer running Windows 7 or better
- Microsoft Excel software
- Microsoft Notepad
- MRG Groundwater Database (Microsft Access)
- Relevant datasets for import (PT data, manual well measurements, USGS gage data)

4.0 PREPARATION

Preparation activities are limited to acquiring necessary datasets, software, and equipment. Datasets should be examined prior to import to assure that all files are available and contain data from the time period of interest. The database should also be backed up regularly prior to data import.

5.0 PROCEDURES

5.1 Manual Well Measurement Data

Manual well measurement data can be pasted directly into the database table "tbl_ManualWellMeasurements" after formatting to database format. Data should be formatted into three columns as follows:

Column 1	Column 2	Column 3
Database well number	Date/Time to nearest 30 minutes (M/DD/YY HH:MM)	Measured Depth to Groundwater (in feet, from top of casing)

The date and time can be formatted in excel using the formula = Date (month/year of measurement) + MROUND(Time of measurement, “0:30”).

To paste, click on the * on the far left column of blank cell at the end of the Access table to highlight the entire row and paste (CTRL V). Check to verify that all rows of data have been pasted, and type in comments/notes as necessary.

5.2 Pressure Transducer Data

PT data is uploaded into the database without barometric data correction, as this is done in the database. Barometric PT data upload procedures are described in Section 5.2.1. Data import and pre-processing procedures for In-Situ and Solinst PTs are described in Section 5.2.2 and 5.2.3, respectively.

5.2.1 Barometric PT Data Import

1. Transfer the In-Situ (.wsl) file to the appropriate Win-Situ Site Data directory on the C drive (For example, *C:\Users\GSA\Documents\WinSitu Data\Site Data*).

2. Open WinSitu 5, and navigate to the file in the left view pane (newest files are at the bottom). Right click on the file and select “export as a .csv”.

3. Navigate to the exported data file location on the C drive (For example, *C:\Users\GSA\Documents\WinSitu Data\Exported Data*) and open the dataset in Excel.

4. In the database, open the table “tbl_BaroLogger” and scroll to the bottom to determine the most recent data point entered.

5. In the Excel file, navigate to this date/time and select and delete all data before this date (not including file header rows). This will prevent duplicates from being imported into the database.

6. Save the file as .txt tab delimited to the proper directory on the server. Click “Yes” when asked if you want to keep in the same format, and then close. When promoted

to save click “Yes”, and “Yes” again to format prompt. The file is now ready for import into the database.

7. Open the “Import and Load Data” Form in the database. Navigate to the file of interest, select “BaroTROLL” under load type, and click “Load TempData” button.

8. Under Step 2 subsection, select the associated well name from the drop down menu and click “Load Barometric Data”. Import may take 1-3 minutes, and is complete when the import complete window pops up.

9. Under Step 3 subsection, click the “Import Barometric Data” button.

10. Open the tbl_BaroLogger table to verify that data was successfully appended to the table.

5.2.2 In-Situ PT Data Import

1. Transfer the In-Situ (.wsl) files to the appropriate Win-Situ Site Data directory on the C drive (For example, *C:\Users\GSA\Documents\WinSitu Data\Site Data*).

2. Open WinSitu 5, and navigate to the files in the left view pane (newest files are at the bottom). Right click on the file and select “export as a .csv”. Repeat for each data file that will be imported into the database.

3. Navigate to the exported data file location on the C drive (For example, *C:\Users\GSA\Documents\WinSitu Data\Exported Data*) and open the first well dataset in Excel.

4. In the database, open the table “tbl_WellInfo” and determine the database ID associated with that well.

5. Open the table “tbl_Levelogger” (this is large and may take a minute). Click on the “Well_Num” drop down menu and uncheck the box next to “select all” to deselect all wells, then the box next to the well of interest. This will sort for all PT data existing in the database for that well.

6. Click on the “DateTime” dropdown menu and click “Sort oldest to newest”. Scroll to the bottom to determine the last date/time of well data for that well.

7. In the Excel file, navigate to this date/time and select and delete all data before this date (not including file header rows). This will prevent duplicates from being imported into the database.

8. Save the file as .txt tab delimited to the proper directory on the server. Click "Yes" when asked if you want to keep in the same format, and then close. When promoted to save click "Yes", and "Yes" again to format prompt. The file is now ready for import into the database.

9. Repeat steps 3 through 8 for each In-Situ file that will be imported into the database.

10. Open the "Import and Load Data" Form in the database. Navigate to the file of interest, select "InSitu" under load type, and click "Load TempData" button.

11. Under Step 2 subsection, select the associated well name from the drop down menu and click "Load InSitu Data". Import may take 1-3 minutes, and is complete when the import complete window pops up.

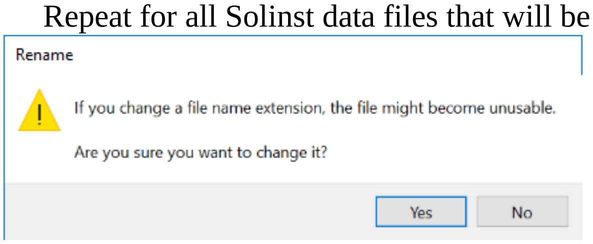
12. Repeat steps 10 and 11 for all In-Situ datasets that will be imported into the database.

13. Under Step 3 subsection, click the "Import Solinst/Insitu Data" button.

14. Open the tbl_levelogger table to verify that data was successfully appended to the table.

5.2.3 Solinst PT Data Import

1. In Windows explorer, click on the Solinst data file name, delete the existing file extension and change to .txt. Click "Yes" when prompted with a rename warning. Repeat for all Solinst data files that will be imported into the database.



2. In the database, open the table "tbl_Levelogger" (this is large and may take a minute). Click on the "Well_Num" drop down menu and uncheck the box next to "select all" to deselect all wells, then the box next to the well of interest. This will sort for all PT data existing in the database for that well.

3. Click on the "DateTime" dropdown menu and select "Sort oldest to newest". Scroll to the bottom to determine the last date/time of well data for that well.

4. Open the .txt file for the associated well, navigate to this date/time and select and delete all data before this date (not including file header rows). This will prevent duplicates from being imported into the database. Save the file.

5. Repeat steps 2 – 4 for all Solinst datasets that will be imported into the database.

6. Open the "Import and Load Data" Form in the database. Navigate to the file of interest, select "Solinst" under load type, and click "Load TempData" button.

7. Under Step 2 subsection, select the associated well name from the drop down menu and click "Load Solinst Data". Import may take 1-3 minutes, and is complete when the import complete window pops up.

8. Repeat steps 6 and 7 for all In-Situ datasets that will be imported into the database.

9. Under Step 3 subsection, click the "Import Solinst/Insitu Data" button.

10. Open the tbl_levelogger table to verify that data was successfully appended to the table.

NOTE: PT data files often include erroneous points collected when the PT was pulled from the well for data download. These points need to be deleted to properly calculate monthly average and minimum depth to groundwater. To do so, sort depth values in tbl_levelogger in ascending order for the well of interest, and delete any values that are significantly lower than others (approximately the same as barometric pressure, or ~27-29 feet).

5.3 USGS Stream Gage Data

Each groundwater monitoring well is associated with discharge from either the USGS Albuquerque (8330000) or Alameda (8329918) river gauge. This information can be found in the database table "tbl_WellInfo". Data import procedures are summarized below.

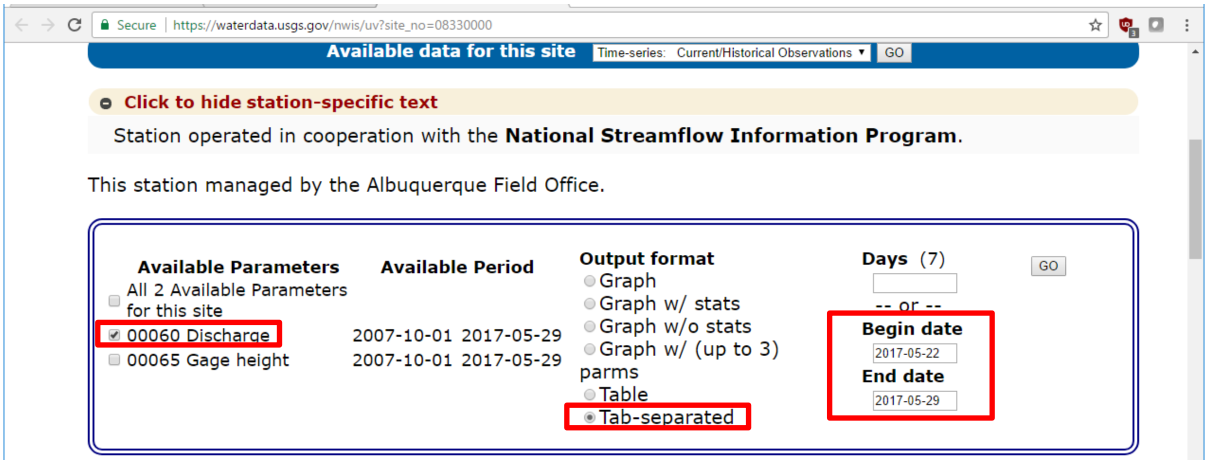
1. Open "tbl_USGS_Albuquerque" or "tbl_USGS_Alameda" and navigate to the most recent date of data imported.

2. Access published river gauge data online at:

ABQ (8330000): http://waterdata.usgs.gov/nwis/uv?site_no=08330000

Alameda (8329918):
http://waterdata.usgs.gov/nm/nwis/uv/?site_no=08329918&PARAmeter_cd=00065,00060

3. Select start date based on last date in database, select discharge, and tab-separated.



4. A table will be generated. Scroll to the first date/time not in the database, and select and copy all columns and rows to the end of the dataset.

5. Open a new text document, and paste the data. Do note delete any columns or otherwise format the dataset.

6. Save the data as a .txt file to an appropriate file location with the name of the gauge and date range of the dataset.

7. In the database, open the "Import and Load Data" form.

8. Open the "Import and Load Data" Form in the database. Navigate to the file of interest, select "USGS" under load type, and click "Load TempData" button.

9. Under Step 2 subsection, click the "Load USGS Data" button. A window will pop up indicating completion of the step.

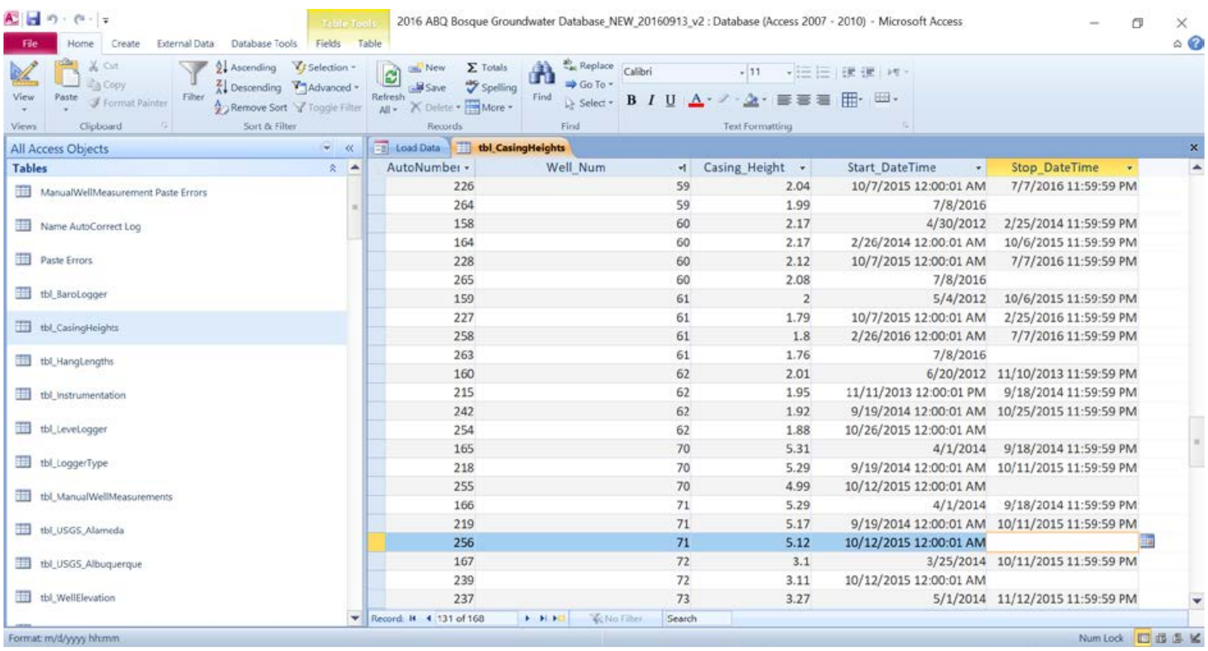
10. Under Step 3 subsection, click either "Import INSTANTANEOUS and DAILY USGS Albuquerque" or "Import INSTANTANEOUS and DAILY USGS Alameda" depending on the dataset being imported. Click "Yes" twice when prompted to import, as data is uploaded to two tables (instantaneous and daily).

11. Repeat steps 2 – 10 for the second river gage dataset.

5.4 Casing Height Changes

Casing heights are generally considered stable and not subject to change. However, casing heights at wells located in excavated habitat features along the middle Rio Grande need to be periodically re-measured because sediment deposition changes the elevation of the ground surface.

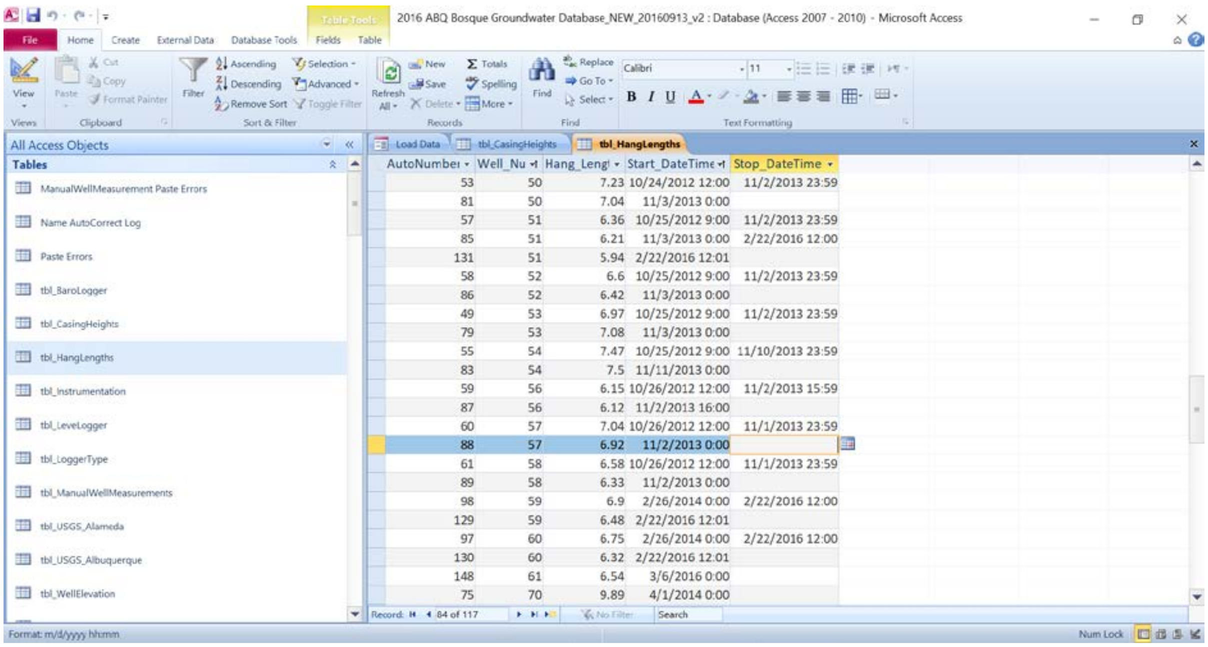
Casing height updates can be made by using the "tbl_CasingHeights" table in the Access database. Scroll to most recent record for the well ID of interest, and enter the measurement date/time as the "Stop_DateTime" for that record. At the base of the table, enter the well ID, new casing height, and measurement date/time as the "Start_DateTime".



5.5 Hang Length Changes

Hang lengths changes need to be entered into the database whenever alterations are made to the PT suspension cable length. These are often needed if a new PT is deployed, the PT is raised or lowered to remove it from the vicinity of murky water or root intrusions, or a PT is installed in a new or previously uninstrumented well. Hang lengths should be measured as the distance from the opening at the base of the PT to the top of the cable where it is level with the top of casing height.

Hang length changes can be made using the "tbl_HangLengths" table in the Access database. Scroll to most recent record for the well ID of interest, and enter the measurement date/time as the "Stop_DateTime" for that record. At the base of the table, enter the well ID, new hang length, and measurement date/time as the "Start_DateTime".



5.6 Additional Database Tables

There are additional tables used for storing information associated with each groundwater well. Updates should be made to these tables when new wells are added to the database, previously uninstrumented wells are instrumented, dataloggers and/or wells are retired from monitoring, or changes are made to instrumentation types.

Tbl_WellInfo: Lists the well number, well ID, geographic coordinates, associated river gage, and install and retirement date (if applicable). This table should be the first to update when new wells are added, as it will assign a well number used for various analyses within the database.

Tbl_Instrumentation: Lists the PT type (Solinst Old, Solinst New, In-Situ) associated with instrumented wells, in addition to the date it was installed and retired (if applicable).

Tbl_WellElevation: Lists the elevation above mean sea level, geographic coordinates, and start and stop date for all surveyed wells. This data is used to calculate groundwater elevation in associated queries and reports.

6.0 SAMPLE CONTAINERS, PRESERVATION, AND TRANSMITTAL

Not Applicable.

7.0 EQUIPMENT DECONTAMINATION AND DISPOSAL

Not Applicable.

8.0 DOCUMENTATION

Documentation shall be made that describes the date and time that data was processed, along with any relevant observations.

9.0 QUALITY ASSURANCE

Datasets should be spot checked prior to import into the database to assure that the proper dataset is assigned to each well and that no pasting errors have occurred. After import into the database, data should be plotted to allow for identification of sensor drift or erroneous readings. Any readings which occurred when the PT was pulled for downloading or maintenance should be deleted from the database to prevent errors in calculations of monthly and daily average, maximum and minimum values.

10.0 REFERENCES

GeoSystems Analysis 2013. Middle Rio Grande Riparian Groundwater Monitoring - FY 2013. Prepared for the U.S. Army Corps of Engineers, Albuquerque District. Prepared by GeoSystems Analysis, Inc., Albuquerque, NM. December 2013. URS Contract No. 25008873.

GeoSystems Analysis 2016. Middle Rio Grande Riparian Groundwater Monitoring – FY 2014-2015. Prepared for the U.S. Army Corps of Engineers, Albuquerque District. Prepared by GeoSystems Analysis, Inc., Albuquerque, NM. February 2016. URS Contract No. 25008873.

GeoSystems Analysis 2017. Middle Rio Grande Riparian Groundwater Monitoring – FY 2016. Prepared for the U.S. Army Corps of Engineers, Albuquerque District. Prepared by GeoSystems Analysis, Inc., Albuquerque, NM. June 2017. 3AE Green Contract No. P10380.

GSA, see GeoSystems Analysis, Inc.

Parametrix 2012. 2009-2012 Albuquerque Groundwater Database and Monitoring Report. Prepared for the U.S. Army Corps of Engineers, Albuquerque District. Prepared by Parametrix, Albuquerque, NM. December 2012.

Appendix C
Pressure Transducer Calibration SOP

STANDARD OPERATING PROCEDURE 13.3
[Pressure Transducer Calibration]

Version 1.1

Prepared by: __ Lindsey Bunting_ _ _ Date: __ 2/18/16 __

Approved by: ___ _Todd Caplan__________ Date: ______________

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1.0 GENERAL STATEMENT

The U.S. Army Corps of Engineers (USACE) implemented a groundwater monitoring project in 2005 to monitoring groundwater depth in restoration sites along the middle Rio Grande (MRG) bosque. As of October 2015, over 25 wells were instrumented with datalogging pressure transducers (In-Situ Rugged Troll 100s and Solinst Levelogger Juniors) which record the depth to groundwater on half hour intervals. Because these pressure transducers (PTs) are deployed constantly for many years, they are sometimes subject to sensor drift. For this reason, it is necessary to periodically verify that the pressure transducers are accurately measuring groundwater depth, and develop calibration offsets as needed to correct PT data.

2.0 OBJECTIVE

This standard operating procedure (SOP) provides detailed instructions for performing field or laboratory based calibration checks for In-Situ and Solinst PTs.

3.0 EQUIPMENT AND/OR INSTRUMENTATION

Equipment needed for performing calibration checks includes:

- Computer running Windows 7 or better
- In-Situ Rugged Troll 100 or Solinst Levelogger Junior pressure transducer
- In-Situ and Solinst PT docking stations
- 5 gallon bucket
- Clean water (relatively sediment free)
- Narrow plank to place across top of bucket
- Large clamps
- Tape ruler (with accuracy to 1/12 inch or 1/10 cm)
- Watch
- Software:
    - Solinst Levelogger 4.0.3
    - In-Situ Win-Situ 5
    - In-Situ BaroMerge
    - Microsoft Excel

4.0 PREPARATION

Calibration of multiple PTs deployed in geographically separated wells should be conducted in the laboratory (or office) setting to minimize time requirements. If calibration of a single PT is required and the potential for vandalism is low, it can be left in the field during the calibration procedure to facilitate rapid replacement in the well. This document will assume laboratory calibration procedures. To minimize the period of data loss, assure that calibration can be completed promptly and that PTs can be returned to their respective wells in a timely manner.

5.0 PROCEDURES

Procedures used for removing PTs from their well are as follows:

1. Prior to removing the PT from the well, follow standard field procedures for manually measuring groundwater depth.
2. Remove the PT from the well, and verify that it is clearly labeled (with permanent marker of plastic label) with the well location ID.
3. Carefully place the PT (including the suspension cable and well cap) in a container and safely transport it to the lab.

NOTE: To save time, do not download PT while in the field. This can be completed in the laboratory prior to calibration of the PT. Do not download data from the Barometric PT until calibration is complete and PTs have been returned to their respective wells.

Procedures for calibration of In-Situ and Solinst PTs are as follows:

1.

Procedures used for pre-processing of data are as follows:

1. Open the .wsl file in WinSitu 5 and export it as a .xls file.
2. Navigate to the .xls file in the exported data folder and copy and paste it to the relevant folder on computer.
3. Open the file in Microsoft Excel and reformat the date column as custom setting "yyyy/mm/dd hh:mm:ss.0".
4. Subtract 26.08625 feet from the water level column.
5. Copy and paste this column directly to the right of the date column.
6. Copy and paste the temperature column (degrees C) directly to the right of the water level column.
7. Delete all other columns and headers
8. Open MRG database and tbl_Levelogger. Sort the data to display only data from well of interest (tbl_WellInfo provides database well IDs). Navigate to the most recent data for that well. Delete all data prior to this date in the excel file (to prevent duplicate values from being input into the database).
9. In Excel, reformat the depth column to contain only three decimal places, and reformat the temperature column to contain two.
10. Open UltraEdit and copy and paste the data directly from Excel.
11. Select Macro → Load, and navigate to the macro "1247MacroInsitu.mac" in the server directory.
12. Click on column mode, then click on the space between the date and groundwater depth.
13. Select Macro→ Play Again (or press CTRL+M). Six additional spaces will be added between the columns. Repeat this process for the space between groundwater depth and temperature columns.
14. Save file as a text document .txt in the appropriate folder on the server and name it according to the well ID.
15. Follow database import and Load Data Form instructions for importing the data into the Levelogger table (GSA 2013).
    a. Note: If you receive an error "13-Type Mismatch", check that date, decimal places, and column spacing was formatted properly.

16. Re-open tbl_Levelogger in the database and check that the newly imported data has been appended to the table.

6.0 SAMPLE CONTAINERS, PRESERVATION, AND TRANSMITTAL

Not Applicable.

7.0 EQUIPMENT DECONTAMINATION AND DISPOSAL

Not Applicable.

8.0 DOCUMENTATION

Documentation shall be made that describes the date and time that data was processed, along with any relevant observations.

9.0 QUALITY ASSURANCE

Datasets should be spot checked prior to import into the database to assure that the proper dataset is assigned to each well and that no pasting errors have occurred. After import into the database, data should be plotted to allow for identification of sensor drift or erroneous readings. Any readings which occurred when the PT was pulled for downloading or maintenance should be deleted from the database to prevent errors in calculations of monthly and daily average, maximum and minimum values.

10.0 REFERENCES

GeoSystems Analysis 2013. Middle Rio Grande Riparian Groundwater Monitoring - FY 2013. Prepared for the U.S. Army Corps of Engineers, Albuquerque District. Prepared by GeoSystems Analysis, Inc., Albuquerque, NM. December 2013. URS Contract No. 25008873

GSA, see GeoSystems Analysis, Inc.