



**DEPARTMENT of AGRICULTURE
and NATURAL RESOURCES**

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**RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT
APPLICATION NO. 8915-3, Joe Arthur**

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Program, Department of Agriculture and Natural Resources concerning Water Permit Application No. 8915-3, Joe Arthur, 46409 154th Street, South Shore SD 57201.

The Chief Engineer is recommending APPROVAL of Application No. 8915-3 because 1) there is reasonable probability that there is unappropriated water available for the applicant's proposed use, 2) the proposed diversion can be developed without unlawful impairment of existing domestic water uses and water rights, 3) the proposed use is a beneficial use and 4) it is in the public interest as it pertains to matters of public interest within the regulatory authority of the Water Management Board with the following qualifications:

1. The wells approved under Water Permit No. 8915-3 are located near domestic wells and other wells which may obtain water from the same aquifer. The well owner, under this Permit must control withdrawals so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.
2. The proposed wells authorized by Permit No. 8915-3 must be constructed by a licensed well driller and construction of the well and installation of the pump must comply with Water Management Board Well Construction Rules, Chapter 74:02:04 with the well casing pressure grouted (bottom to top) pursuant to Section 74:02:04:28.
3. This Permit is approved subject to the irrigation water use questionnaire being submitted each year.

See report on application for additional information.

Eric Gronlund, Chief Engineer
March 6, 2025

Report to the Chief Engineer
On Water Permit Application No. 8915-3

Joe Arthur

2/28/2025

Water Permit Application No. 8915-3 proposes to irrigate 160 acres located in the SE ¼, S ½ NE ¼ Section 3 at a maximum pump rate of 1.67 cubic feet of water per second (cfs) from up to two wells to be completed into the Antelope Valley aquifer (approximately 50-100 feet deep) located near the approximate center of Section 3; all in T119N-R51W. This site is located in Codington County approximately two miles north of South Shore, SD.

AQUIFER: Antelope Valley (AV)

HYDROGEOLOGY:

The Antelope Valley aquifer is a glacial outwash aquifer that is composed of very coarse sand to coarse gravel (Hansen, 1990 and 1994). Hedges and others (1982) estimated the areal extent and amount of recoverable water stored in the Antelope Valley aquifer (Table 1). Figure 1 displays the delineation of the Antelope Valley aquifer based on the study completed Hedges and others (1982).

Table 1. Estimated areal extent and amount of recoverable water stored in the Antelope Valley aquifer (Hedges et al., 1982)

County	Codington	Grant	Deuel	Total:
Areal Extent (acres)	6,800	14,500	7,400	28,700
Recoverable Water in Storage (acre-feet)	15,300	32,630	16,650	64,580

The Antelope Valley aquifer is located in the axis of the drainage divide between the Big Sioux and Minnesota Rivers and is hydrologically connected to numerous small lakes and sloughs that overlie or are directly adjacent to the aquifer (Hansen, 1990). The aquifer is generally under unconfined conditions; however, there are locations where the aquifer is buried under up to 50 feet of till where it is generally under confined conditions (Hansen, 1990). In Grant and Codington Counties, the depth to the top of aquifer materials ranges from land surface to 57 feet below grade (Hansen, 1990). The average thickness of Antelope Valley aquifer materials is 34 feet with a documented maximum thickness of 52 feet (Hansen, 1990).

No water well or test hole completion report was submitted with Water Permit Application No. 8915-3. Water well completion reports on file with the DNR-Water Rights Program for wells completed into the Antelope Valley aquifer within approximately one mile of the proposed diversion point indicate saturated aquifer thicknesses ranging from approximately 8 to 44 feet, with the depth to the top of aquifer materials ranging from approximately 10 to 55 feet below the ground surface, and static water levels at well completion varying from approximately 10 to 18 feet below the ground surface (SDGS, 2025; Water Rights, 2025b and Water Rights, 2025d).

Based on the water well completion reports on file for nearby wells completed into the aquifer, and the lithologic logs on file for nearby observation wells, the Antelope Valley aquifer is expected to be unconfined near the proposed diversion point (SDGS, 2025; Water Rights, 2025b and 2025d).

South Dakota Codified Law (SDCL) 46-2A-9

Pursuant to SDCL 46-2A-9, “A permit to appropriate water may be issued only if there is a reasonable probability that there is unappropriated water available for the applicant’s proposed use, that the diversion point can be developed without unlawful impairment of existing domestic water uses and water rights, and that the proposed use is a beneficial use and in the public interest as it pertains to matters of public interest within the regulatory authority of the Water Management Board as defined by SDCL 46-2-9 and 46-2-11.” This report will address the availability of unappropriated water and the potential for unlawful impairment of existing domestic water uses and water rights within the Antelope Valley aquifer.

WATER AVAILABILITY:

Water Permit Application No. 8915-3 proposes to appropriate water from the Antelope Valley aquifer. The probability of unappropriated water being available from the aquifer can be evaluated by considering SDCL 46-6-3.1, which requires “No application to appropriate groundwater may be approved if, according to the best information reasonably available, it is probable that the quantity of water withdrawn annually from a groundwater source will exceed the quantity of the average estimated annual recharge of water to the groundwater source. An application may be approved, however, for withdrawals of groundwater from any groundwater formation older than or stratigraphically lower than the greenhorn formation in excess of the average estimated annual recharge for use by water distribution systems.” The Antelope Valley aquifer is not older than or stratigraphically lower than the Greenhorn Formation (Fahrenbach et al., 2010), and the applicant’s proposed use is not for use in a water distribution system as defined by SDCL 46-1-6(17). Therefore, the average annual recharge and average annual withdrawal rates to and from the Antelope Valley aquifer must be considered.

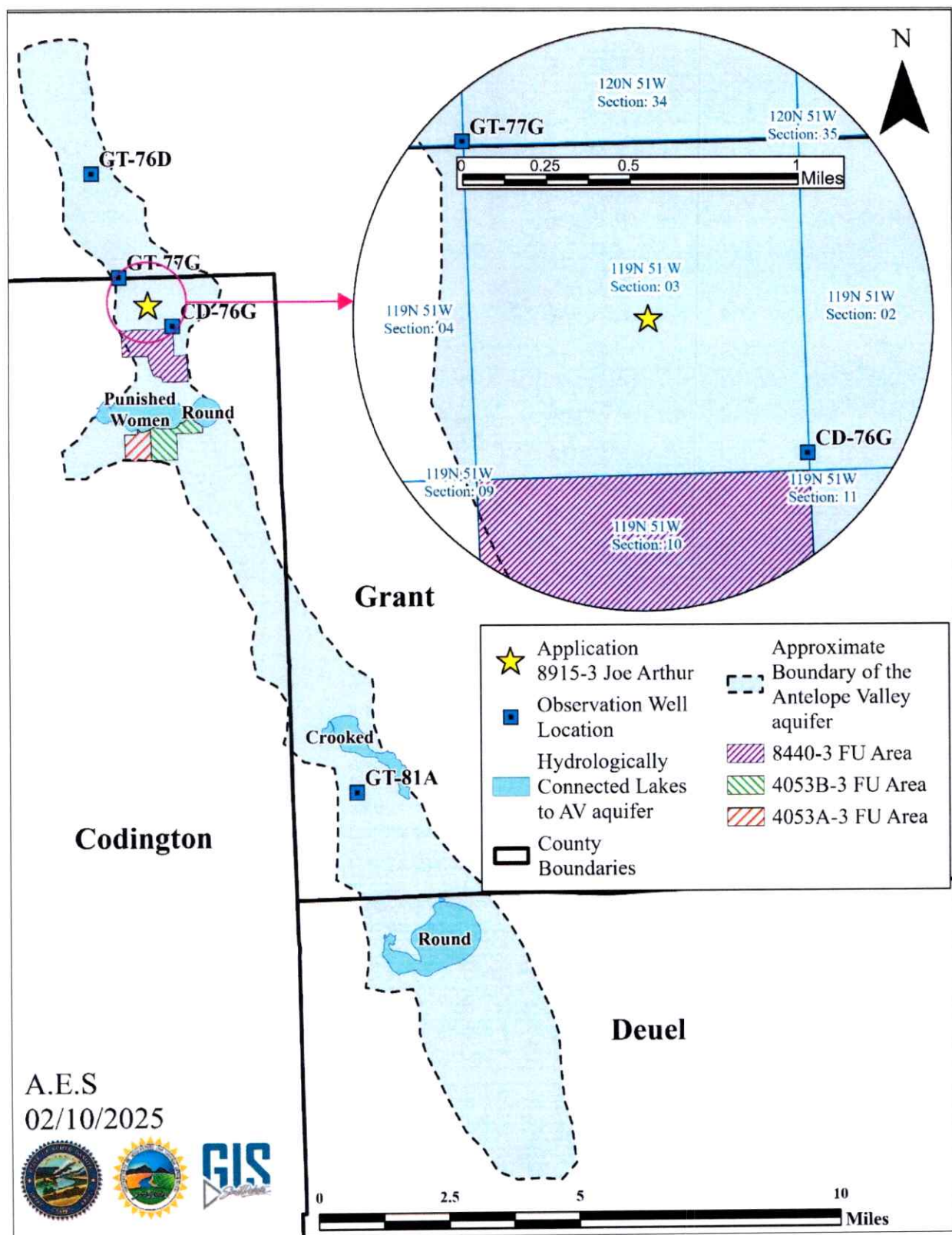


Figure 1. Map of the approximate areal extent of the Antelope Valley aquifer in eastern South Dakota (modified from Hedges et al., 1982) and the Antelope Valley aquifer observation wells (Water Rights, 2025b)

HYDROLOGIC BUDGET:

Recharge

Recharge to the Antelope Valley aquifer is primarily through direct infiltration and subsequent percolation of rainfall and snowmelt where the aquifer is near or at land surface (Hansen, 1990). Using observation well analysis, Hedges and others (1985) estimated a recharge rate of 2.3 inches per year to the Antelope Valley aquifer. The Antelope Valley aquifer has an estimated areal extent of approximately 28,700 acres (Hedges et al., 1982); therefore, the estimated average annual recharge rate (based on Hedges et al., 1982 and 1985) is approximately 5,500 acre-feet per year. The observation well analysis method used by Hedges and others (1985) assumed a rise in water level in the aquifer as the only product of recharge to the aquifer. A rise in water level in the aquifer is the result of recharge to the aquifer exceeding discharge from the aquifer, indicating the observation well analysis method may be conservative when estimating a recharge rate because it does not necessarily account for recharge that occurs when discharge from the aquifer exceeds recharge.

Discharge

Discharge from the Antelope Valley aquifer is through well withdrawals and evapotranspiration where the aquifer is near or at land surface. Additional discharge from the aquifer is through outflow to hydraulically connected lakes and sloughs, including Punished Woman, Round and Crooked Lakes (Hansen, 1990; Water Rights, 2025d).

Currently, there are 15 water rights/permits authorized to appropriate water from Antelope Valley aquifer (Water Rights, 2025c). Additionally, there are three future use permits (Nos. 4053-3 and 4053B-3 for the Town of South Shore, and 8440-3 for Grant-Robert RWS) reserving a combined 959 acre-feet of water annually from the Antelope Valley aquifer (Water Rights, 2025c)

Table 2 summarizes the three non-irrigation water rights/permits authorized to appropriate water from the Antelope Valley aquifer with the estimated annual use for each water right/permit as determined by their permitted maximum diversion rate or annual volume. Historically, average water use by non-irrigation appropriations limited by an instantaneous diversion rate have been assumed to be pumping 60% of full time at the respective permitted diversion rate. Water rights/permits limited by an annual volume are assumed to withdraw their entire respective annual volume limitation. This is a standard method used by the DANR-Water Rights Program for estimating annual withdrawals by non-irrigation appropriations from an aquifer and is likely an overestimation of average annual withdrawals (Water Rights, 2025c). Overall, the estimated average annual withdrawal rate for the Antelope Valley aquifer non-irrigation water rights/permits is approximately 2,286 acre-feet per year (Table 2) (Water Rights, 2025c).

Table 2. Summary of the non-irrigation water permits/rights in Antelope Valley aquifer.

Permit No.	Name	Status	Use	Authorized Diversion Rate (cfs)	Authorized Annual Volume (acre-feet)	Estimated Use (acre-feet/year)
4053-3	TOWN OF SOUTH SHORE	LC	MUN	0.58		251.95
5520-3	TOWN OF SOUTH SHORE	LC	MUN	0.09		39.1
8439-3	GRANT-ROBERTS RWS	LC	RWS	5.14	1995	1,995
					TOTAL:	2,286

LC: Licensed Water Right; MUN: Municipal; RWS: Rural Water System

Grant-Roberts Rural Water System currently holds Water Right No. 8439-3, which incorporated Water Permit No. 6654-3 and Water Permit No. 8321-3, and is required to annually report the volume of water pumped from the Antelope Valley aquifer (Water Rights, 2025c). The reported historic annual use from the Grant-Roberts Rural Water System over the period of record (2003 to 2024) on file with the DANR – Water Rights Program is listed in Table 3 (Water Rights, 2025c). The Grant-Roberts Rural Water System, on average, uses less than their permitted volume each year; therefore, the assumed maximum permitted use shown in Table 2 is a higher annual withdrawal rate estimate than what is actually being withdrawn each year from the Antelope Valley aquifer from the non-irrigation water rights/permits. However, this conservative method of estimating average annual withdrawals is used because Grant-Roberts Rural Water System has shown some increase in annual pumpage over the period of record as shown in Table 3 and currently holds a future use permit for potential future growth.

Table 3. Reported historic use from the Grant-Roberts Rural Water System rights/permits (Water Rights, 2025c)

Year	Permitted (acre-feet/year)	Reported (acre-feet/year)	Year	Permitted (acre-feet/year)	Reported (acre-feet/year)
2003 (5576-3, 5576A)	1,074	761	2014 (5576-3, 5576A, 6654-3)	1,074	963
2004 (5576-3, 5576A, 6654-3)	1,074	792	2015 (5576-3, 5576A, 6654-3)	1,074	1,043
2005 (5576-3, 5576A, 6654-3)	1,074	645	2016 (5576-3, 5576A, 6654-3)	1,074	967
2006 (5576-3, 5576A, 6654-3)	1,074	835	2017 (5576-3, 5576A, 6654-3)	1,074	983
2007 (5576-3, 5576A, 6654-3)	1,074	875	2018 (6654-3, 8321-3)	1,074	1,154
2008 (5576-3, 5576A, 6654-3)	1,074	890	2019 (6654-3, 8321-3)	1,074	1,183
2009 (5576-3, 5576A, 6654-3)	1,074	874	2020 (6654-3, 8321-3)	1,995	1,157.8
2010 (5576-3, 5576A, 6654-3)	1,074	881	2021 (6654-3, 8321-3)	1,995	1,036.5
2011 (5576-3, 5576A, 6654-3)	1,074	844	2022 (6654-3, 8321-3)	1,995	1,077
2012 (5576-3, 5576A, 6654-3)	1,074	887	2023 (6654-3, 8321-3)	1,995	1,021.8
2013 (5576-3, 5576A, 6654-3)	1,074	920	2024 (6654-3, 8321-3)	1,995	1,063.1
			AVERAGE:		947.9

There are domestic wells completed into the Antelope Valley aquifer that do not require a water right/permit, so the withdrawal amount is unknown (Water Rights, 2025d). Due to their relatively low diversion rates, withdrawals from domestic wells are not considered to be a significant portion of the hydrologic budget. Additionally, with the development of rural water systems in areas where the Antelope Valley aquifer is the uppermost aquifer available, domestic users may have transitioned to rural water. Therefore, the quantity of water withdrawn annually by domestic wells is estimated to be negligible to the hydrologic budget of the Antelope Valley aquifer.

Currently, there are 12 irrigation water rights/permits authorized to appropriate water from the Antelope Valley aquifer (Water Rights, 2025c). Irrigation water rights/permits have been typically required to report their annual usage on an irrigation questionnaire since 1979. The estimated average annual withdrawal rate for the Antelope Valley aquifer irrigation water rights/permits that have reported over the period of record (1979 to 2023) is approximately 1,118 acre-feet per year (Table 4) (Water Rights, 2025a). To reflect the current level of development for irrigation water rights/permits more accurately, the average annual withdrawal rate for irrigation appropriations from 2014 to 2023 is approximately 1,308 acre-feet per year and will be used as the estimated average annual irrigation withdrawals for review of water availability (Table 4) (Water Rights, 2025a).

Table 4. Reported historic irrigation use from the Antelope Valley aquifer (Water Rights, 2025a)

Year	No. of Permits Reporting	Reported Pumpage (acre-feet)
1979	7	73
1980	8	435
1981	7	513
1982	5	60.75
1983	6	542.79
1984	6	136
1985	6	49
1986	6	41
1987	6	645
1988	7	1,826.8
1989	7	1,427
1990	10	1,606
1991	12	988.5
1992	11	650
1993	11	310
1994	10	699.46
1995	10	469.31
1996	8	1,029.32
1997	8	932
1998	9	1,136.25
1999	9	1,378.77
2000	9	1,608.24
2001	9	1,808.88
2002	9	1,533.72
2003	9	2,000.65
2004	9	1,595.86
2005	9	1,740.32
2006	9	1,937.34
2007	9	1,299.29
2008	9	989.29
2009	9	1,281.3
2010	10	1,419.22
2011	10	886.68
2012	10	2,163.54
2013	12	2,003.03
2014	14	748.91
2015	14	569.6
2016	14	2,019.07
2017	14	1,404.82
2018	14	1,403.25
2019	14	227.7
2020	14	1,297.61
2021	14	1,582.56
2022	14	2,034.7
2023	12	1,787.47
Min	5	41
Max	14	2,163.5
Avg (1979-2023)	10	1117.60
Avg (2014-2023)	14	1307.57

Hydrologic Budget Summary

The estimated average annual recharge rate to the Antelope Valley aquifer is approximately 5,500 acre-feet per year. The estimated average annual withdrawal rate from the Antelope Valley aquifer is approximately 4,713 acre-feet per year (non-irrigation: 2,286 acre-feet/year; irrigation: 1,308 acre-feet/year (2014 to 2023); Future Use Reservations: 959 acre-feet/year; Water Permit Application No. 8915-3 (if approved, assuming application rate of one foot of water per authorized acre): 160 acre-feet/year). Based on the hydrologic budget, there is a reasonable probability unappropriated water is available from the Antelope Valley aquifer for the proposed appropriation.

OBSERVATION WELL DATA:

Administrative Rule of South Dakota (ARSD) 74:02:05:07 requires that the Water Management Board shall rely upon the record of observation well measurements in addition to other data to determine that the quantity of water withdrawn annually from the aquifer does not exceed the estimated average annual recharge of the aquifer.

Observation wells provide data on how the aquifer reacts to regional climatic conditions and local pumping. The DANR-Water Rights Program monitors four observation wells completed into the Antelope Valley aquifer (Water Rights, 2025b). The four observation wells in order of proximity to the proposed diversion point are CD-76G (approximately 0.62 miles southeast), GT-77G (approximately 0.75 miles northwest), GT-76D (approximately 2.7 miles northwest), and GT-81A (approximately 10 miles southeast) (Water Rights, 2025b). The hydrographs for the observation wells are displayed in Figure 2 (Water Rights, 2025b). The data points utilized to construct the hydrographs are measurements of the static water level in the observation wells from the top of the well casing which were then converted to elevation in feet from the NGVD29 datum.

The hydrographs for the observation wells display stable to increasing water levels over their respective periods of record. The hydrographs for the Antelope Valley aquifer indicate that the aquifer responds well to climatic conditions because water levels are rising during wetter periods and declining to a stable water level during drier periods. Additionally, the water levels in the observation wells display that the amount of recharge to and natural discharge from the aquifer greatly exceeds pumping with the aquifer returning to pre-pumping conditions between irrigation seasons. Aquifer recovery indicates that climatic conditions and therefore, the effects of recharge to and natural discharges from the aquifer govern the long-term fluctuations of waters levels in the aquifer rather than the impacts of pumping from the Antelope Valley aquifer. By recognizing that both recharge to and natural discharge from an aquifer can be captured for pumping, the observation well hydrographs demonstrate unappropriated water is available for the proposed appropriation.

DANR-Water Rights Observation Wells: CD-76G, GT-77G, GT-76D & GT-81A

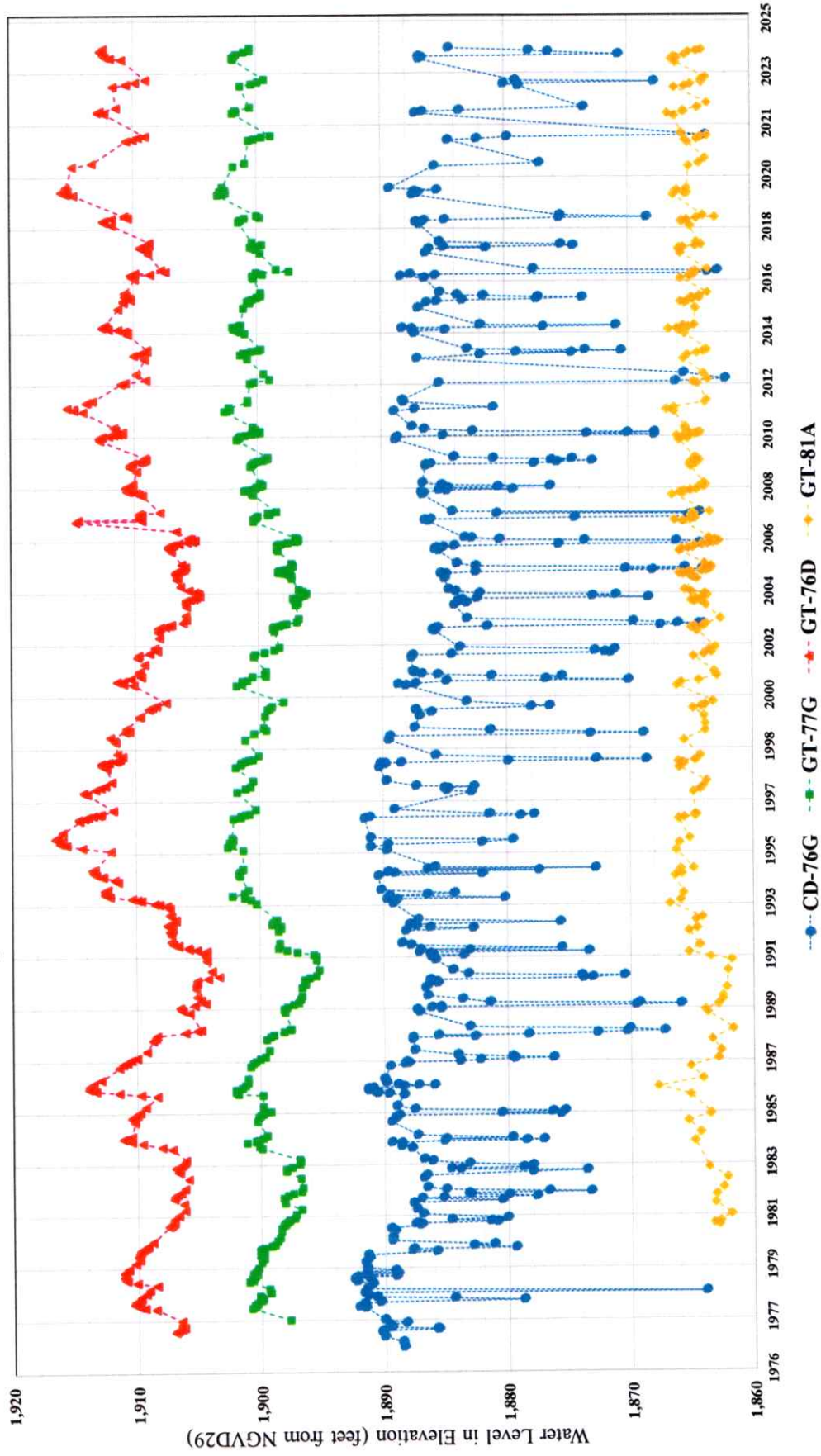


Figure 2. A graph showing the elevation of water levels for observation wells: CD-76G, GT-77G, GT-76D & GT-81A (Water Rights, 2025b)

POTENTIAL FOR UNLAWFUL IMPAIRMENT OF EXISTING WATER RIGHTS:

Currently, there are 15 water rights/permits authorized to appropriate water from the Antelope Valley aquifer (Water Rights, 2025c). The closest water right/permit to the proposed diversion point is Water Permit No. 7975-3 which is held by Jim and Dan Thyen. The diversion point for Water Permit No. 7975-3 is located approximately 0.4 miles northwest of the proposed diversion point for this application (Table 5) (Figure 3) (Water Rights, 2025c). The diversion point for this application is also 0.47 miles north of future use area 8440-3 and 0.62 miles northeast of Water Permit No. 8439-3, which are both currently held by Grant-Roberts County Rural Water System.

There are domestic wells on file with the DANR-Water Rights Program that are completed into the Antelope Valley aquifer, with the closest domestic well on file (not held by the applicant) located approximately 0.3 miles north of the proposed diversion point (Water Rights, 2025d). There could potentially be other domestic wells completed into the Antelope Valley aquifer near the well sites the applicant proposes to use that are not on file with the DANR-Water Rights Program. The location of the domestic wells in the well completion report database maintained by the Water Rights Program is based on the location listed by the driller on the well completion report. Since the Antelope Valley aquifer is expected to be unconfined at the proposed well sites, drawdown from pumping is not expected to extend far from the pumping wells; however, the exact drawdown behavior of a well cannot be known without an aquifer performance test.

The hydrographs (Figure 2) for nearby observation wells, GT-77G (unconfined) and CD-76G (confined) provide some general insight into drawdown behavior at the current level of pumpage. Both wells are within one mile of several irrigation or rural water system wells and are approximately 1.4 miles apart (Figure 3). However, the magnitude of the response to regional pumping is notably different between the two wells. In CD-76G, the lowest recorded water level (August 2016) was still 19.75 ft above the top of the aquifer, while in GT – 77G, the lowest water level (October 1990) left 17.5 ft of saturated thickness remaining in the aquifer.

The Water Management Board recognizes that putting water to beneficial use requires a certain amount of drawdown to occur. The Board has developed rules to allow water to be placed to maximum beneficial use without the necessity of maintaining artesian head pressure for domestic use. The Water Management Board defined an “adversely impacted domestic well” in ARSD 74:02:04:20(7) as:

“A well in which the pump intake was set at least 20 feet below the top of the aquifer at the time of construction or, if the aquifer is less than 20 feet thick, is as near to the bottom of the aquifer as is practical and the water level of the aquifer has declined to a level that the pump will no longer deliver sufficient water for the well owner’s needs.”

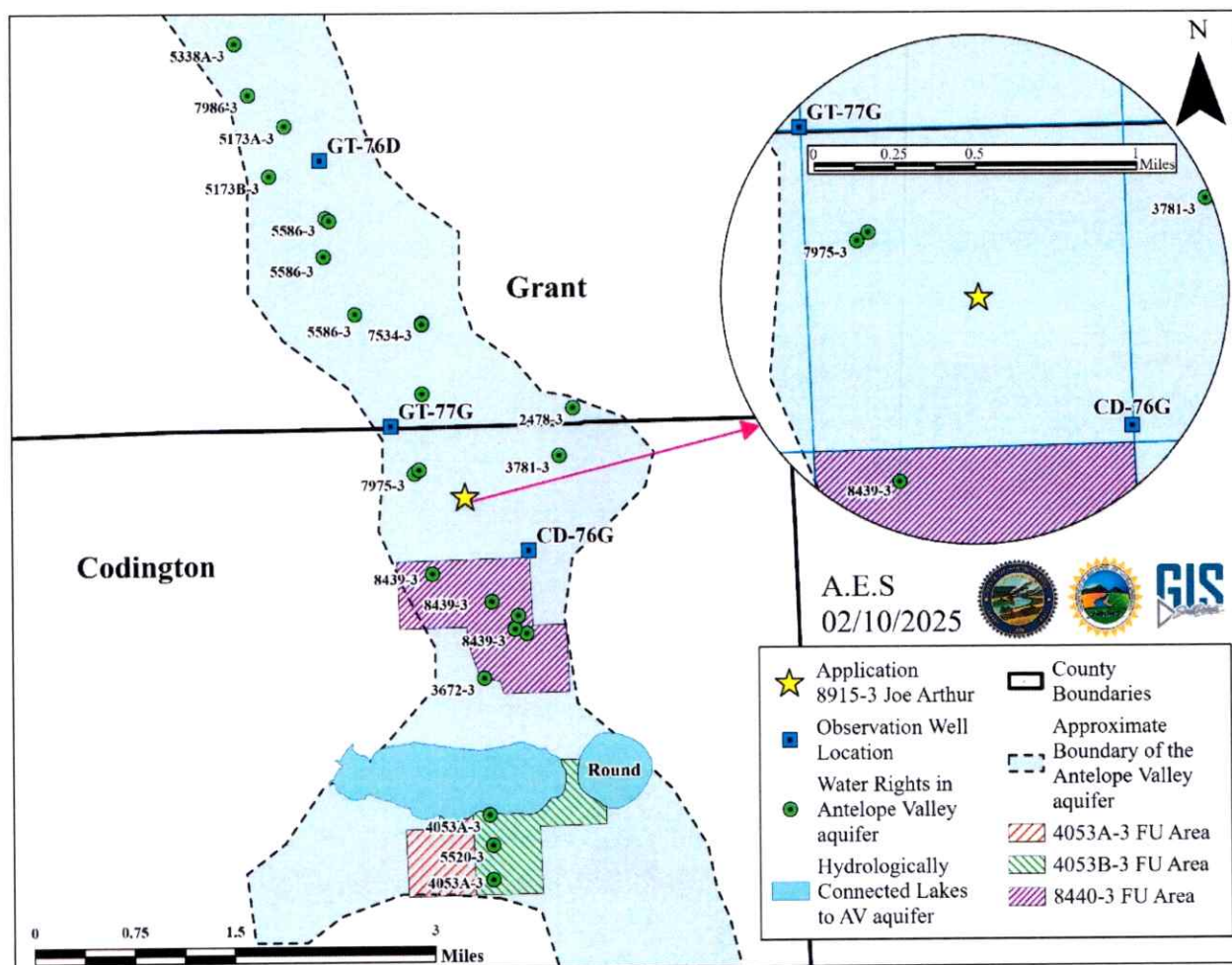


Figure 3. An approximate boundary of the Antelope Valley aquifer (modified from Hedges et al., 1982), the location of the proposed diversion points for Water Permit Application No. 8915-3, and the nearby Antelope Valley aquifer water rights/permits and observation wells (Water Rights, 2025b and 2025c)

Table 5. Water rights/permits authorized to withdraw or reserve water from the Antelope Valley aquifer as shown in Figure 3 (Water Rights, 2025c)

Permit No.	Name	Status	Use Type	Authorized Diversion Rate (cfs)	Authorized Acres (ac-ft/yr)
2478-3	JOE & JOHN ARTHUR	LC	IRR	1.07	75
3672-3	COAST PROPERTIES INVESTORS LLC	LC	IRR	1.78	132
3781-3	JOE & JOHN ARTHUR	LC	IRR	3.75	264
4053A-3	TOWN OF SOUTH SHORE	LC	MUN	0.58	
4053B-3	TOWN OF SOUTH SHORE	FU	MUN		192
5173A-3	WILLOW RUN FARMS FLP	LC	IRR	2.44	166
5338A-3	WILLOW RUN FARMS FLP	LC	IRR	1.78	130
5520-3	TOWN OF SOUTH SHORE	LC	MUN	0.09	
5586-3	WILLOW RUN FARMS FLP	LC	IRR	6	1,260
7534-3	JOE & JOHN ARTHUR	LC	IRR	7.02	555
7975-3	JIM AND DAN THYEN	LC	IRR	1.67	117
7986-3	PAUL FEHR	LC	IRR	1.14	135
8439-3	GRANT-ROBERTS RWS INC	LC	RWS	5.14	
8440-3	GRANT-ROBERTS RWS INC	FU	RWS		767

LC: License; FU: Future Use; IRR: Irrigation; MUN: Municipal; RWS: Rural Water System

The Antelope Valley aquifer is under unconfined conditions near the applicant's proposed diversion point based on the well completion reports on file with the DANR-Water Rights Program and the lithologic logs on file for nearby Antelope Valley observation wells (SDGS, 2025; Water Rights, 2025b, 2025c, 2025d). Since the Antelope Valley aquifer is expected to be unconfined at the proposed well sites, drawdown from pumping is not expected to extend far from the pumping wells.

Water well completion reports on file with the DANR-Water Rights Program for wells completed into the Antelope Valley aquifer within approximately one mile of the proposed diversion point indicate saturated aquifer thicknesses ranging from approximately 8 to 44 feet, with the depth to the top of aquifer materials ranging from approximately 10 to 55 feet below the ground surface (SDGS, 2025; Water Rights, 2025b and Water Rights, 2025d). This would generally allow for enough thickness for a pump to be placed 20 feet below the top of the aquifer, which is required for the well to be considered adequate under Administrative Rule of South Dakota (ARSD) 74:02:04:20(6). ARSD 74:02:04:20(6) defines an adequate well as:

...a well constructed or rehabilitated to allow various withdrawal methods to be used, to allow the inlet to the pump to be placed not less than 20 feet into the saturated aquifer or formation material when the well is constructed, or to allow the pump to be placed as near to the bottom of the aquifer as is practical if the aquifer thickness is less than 20 feet

Any drawdown as a result of the proposed diversion for this application is not expected to unlawfully impair nearby adequate wells. In Grant, Codington, and Deuel Counties, there are no substantiated complaints on file with the DANR-Water Rights Program regarding well interference for adequate wells completed into the Antelope Valley aquifer (Water Rights, 2025e).

When considering the saturated thickness of the Antelope Valley aquifer near the proposed diversion point, the observation well data (Figure 2), and the lack of well interference complaints for adequate wells completed into the Antelope Valley aquifer, any drawdown created from the proposed diversion is not expected to cause an unlawful impairment to existing water right/permit holders or domestic users with adequate wells. Therefore, there is a reasonable probability that any interference from the proposed appropriation will not impose unlawful impairments to existing users with adequate wells.

CONCLUSIONS:

1. Water Permit Application No. 8915-3 proposes to irrigate 160 acres located in the SE $\frac{1}{4}$, S $\frac{1}{2}$ NE $\frac{1}{4}$ Section 3 at a maximum pump rate of 1.67 cfs from up to two wells to be completed into the Antelope Valley aquifer (approximately 50-100 feet deep) located near the approximate center of Section 3; all in T119N-R51W. This site is located in Codington County approximately two miles north of South Shore SD.
2. Based on the hydrologic budget and observation well data, there is a reasonable probability that unappropriated water is available from the Antelope Valley aquifer to supply the proposed appropriation.
3. There is reasonable probability that the proposed diversion by Water Permit Application No. 8915-3 will not unlawfully impair adequate wells for existing water rights/permits and domestic users.



Austin Settje
Natural Resources Engineer I
SD DANR - Water Rights Program



Adam Mathiowetz, PE
Natural Resources Engineer IV
SD DANR - Water Rights Program

References

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