Appendix E

Cumulative Hydrologic Impact Analysis Report for Smith Ranch, North Butte and Gas Hills (Revised November 2014)

AQUI-VER, INC.

Cameco

Cumulative Hydrologic Impact Assessment

Cameco Resources
Smith Ranch-Highland and Reynolds Ranch Facilities
Converse County, Wyoming

January 26, 2012
(with revisions October 15, 2013 and June 5, 2014)

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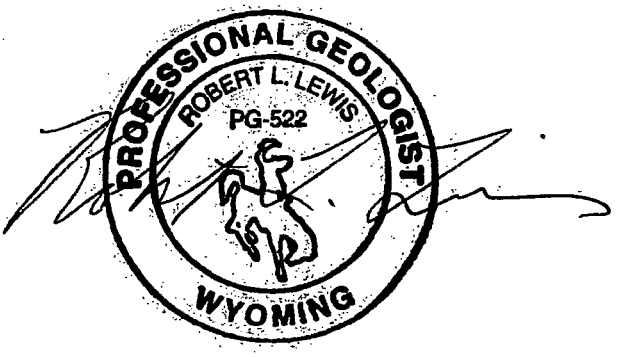
Signatures and Certifications:



Name : Robert L. Lewis, PG

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1. EXECUTIVE SUMMARY

Cameco Resources has conducted an assessment of the hydrologic impacts resulting from In-Situ Recovery (ISR) and Niobrara Shale fracking operations in Converse County, Wyoming. Hydrologic impacts (drawdown) resulting from the development of Cameco Resources Smith Ranch-Highland and Reynolds Ranch satellite ISR facility (SRH-RR) was included in this assessment. The hydrologic impact of the proposed Uranium One Ludeman ISR Project, ISR deep disposal wells (DDW's), and the Smith #1 irrigation well were also considered. Finally, the combined or cumulative hydrologic impact resulting from development activities were evaluated.

Hydrologic impacts due to SRH-RR ISR and Niobrara Shale fracking operations were simulated using a three-dimensional groundwater flow model over a 33-year ISR development and restoration period, and a two-year limited Niobrara Shale oil well development period. The drawdown computed by the groundwater flow model was evaluated at 287 stock and domestic well locations located within a 10-mile radius of the SRH-RR facilities. The hydrologic impacts of the Ludeman ISR Project, ISR deep disposal wells, the Smith #1 irrigation well, and additional fracking water supply wells were evaluated independently using a combination of analytical and numerical groundwater flow modeling techniques.

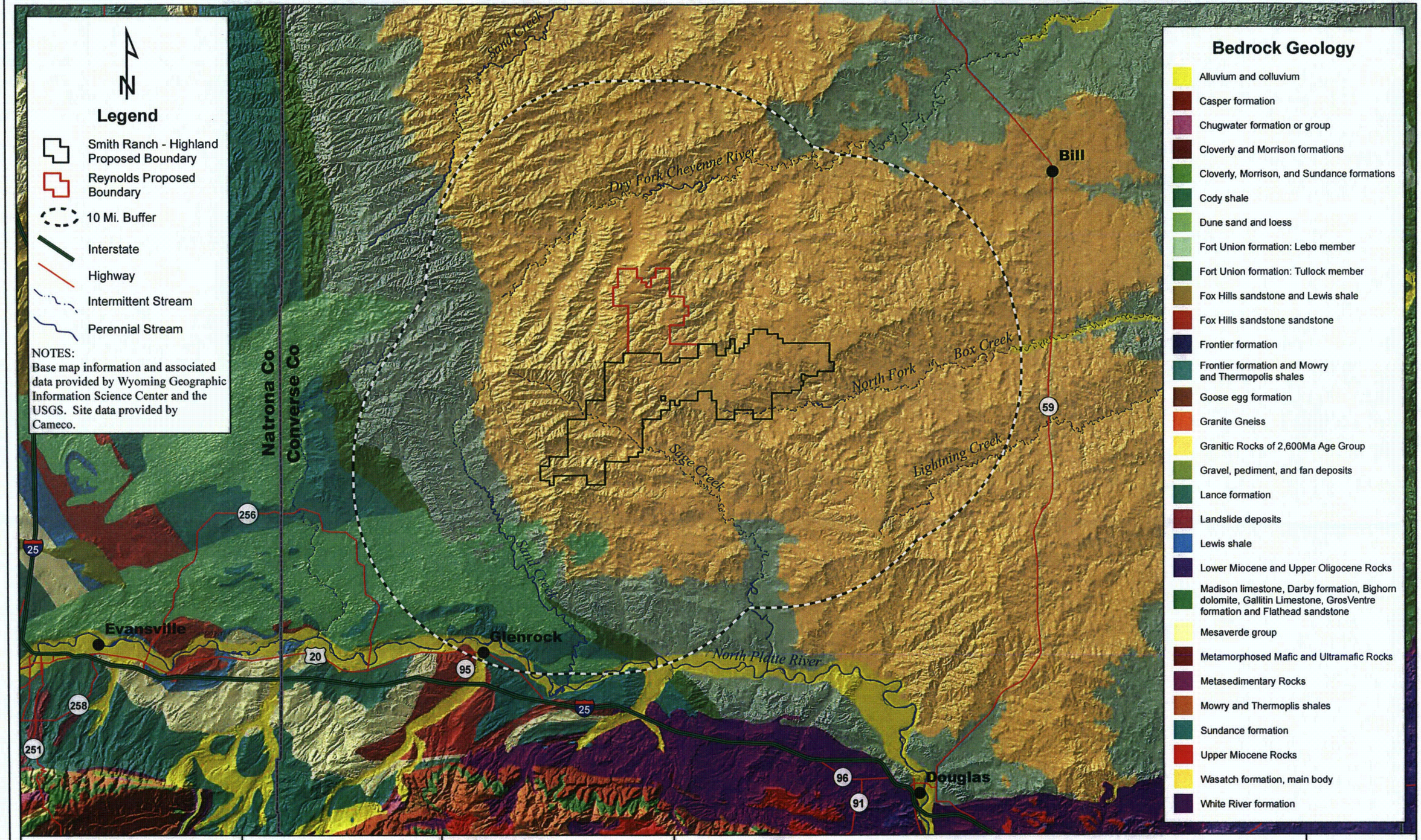
In general, maximum hydrologic impacts occur in wells closest to ISR facilities and completed within ISR production sand intervals (e.g. deeper wells). Drawdown in the shallow water-table aquifer due to ISR operations is predicted to be less than 10 feet at stock and domestic well locations over the life of the mine. ISR drawdown impacts greater than 10 feet are predicted in one stock watering and domestic supply well completed in the deeper production sand aquifers and located nearest to the SRH-RR facilities. Maximum impacts due to ISR development generally occur toward the end of the mine life. Results of the impact assessment demonstrate the ability of the production aquifer to sustain planned ISR development with minimal impact to water resources in the area.

Results of the Ludeman Project and SRH-RR ISR impact assessment indicates a small incremental increase in facility drawdown of less than 1-foot is predicted as a result of Ludeman and SRH-RR impacts on one another. Therefore, cumulative hydrologic impacts resulting from the combined Ludeman Project and SRH-RR ISR operations are minimal and similar to individual facility impacts, and should not adversely impact operations or water resources at either facility. Likewise, results of the ISR disposal well impact assessment indicates the operation of DDW's at the Ludeman Project and SRH-RR should not hydraulically influence or otherwise adversely impact one another.

Results of the Smith #1 irrigation well impact assessment indicates irrigation well operation should not adversely affect hydraulic control of mining solutions in neighboring mine units, as the drawdown and resulting radius of influence produced by irrigation pumping is insufficient to overcome the inward hydraulic gradient produced by the production bleed in MU-15A.

The withdrawal of groundwater to support Niobrara Shale drilling and fracking operations was simulated over a limited two-year development period for currently producing and permitted Niobrara Shale wells within a 10-mile radius of the SRH-RR ISR facilities. Drawdown impacts due to limited Niobrara Shale development are less than 1-foot at stock and domestic well locations over the limited two-year development period. It is likely, however, that Niobrara Shale development will be more extensive and of greater longevity than simulated in this study. Hydrologic impacts associated with shale oil development may therefore be more significant than predicted herein.

As a practical matter, predicted hydrologic impacts associated with ISR development, ISR deep disposal wells, irrigation wells, and fracking water supply wells should not adversely affect water resources or ISR operations. Predicted drawdown due to ISR and shale oil development is less than 10 percent of the available water column in all but one stock watering and domestic supply well. In the worse case, a small decrease in well yield may be observed due to a decreased pumping level in wells having the highest potential drawdown impacts. In the event this should cause a significant concern, the problem may be overcome by lowering the pump, or in the worse case, by installing an additional supply well (and pump) to make up for lost production.



AQUI-VER, INC.
Hydrogeology, Water Resources & Data Services

0 2.5 5 10
Miles

STATE PLANE ZONE EAST NAD27

PROJECT # 40100545
DATE: 9/12/11
DRAWN BY: CLIN
REVIEWED BY: BSMITH

DOCUMENT NAME AND PATH

Cameco

REGIONAL SITE OVERVIEW

SMITH RANCH-HIGHLAND/REYNOLDS RANCH FACILITIES
CONVERSE COUNTY - WYOMING

FIGURE:
2-1

2. INTRODUCTION

Cameco Resources (Cameco) has conducted an assessment of the hydrologic impacts resulting from In-Situ Recovery (ISR), ISR Deep Disposal Wells (DDW's), the Smith #1 irrigation well, and limited oil and gas well development operations in Converse County, Wyoming (**Figure 2-1**). The following specific tasks were accomplished as part of this work:

- Assessment of the hydrologic impact to stock and domestic wells resulting from the operation of Cameco's Smith Ranch-Highland and Reynolds Ranch satellite ISR facilities (SRH-RR),
- Assessment of the hydrologic impacts of Uranium One's proposed Ludeman ISR Project located approximately 4 miles south of SRH-RR,
- Assessment of the hydrologic impacts of SRH-RR and Ludeman Project ISR operations,
- Assessment of Ludeman Project and SRH-RR Deep Disposal Well (DDW) impacts,
- Assessment of the hydrologic impacts resulting from the withdrawal of groundwater to support existing and permitted Niobrara Shale oil well drilling and fracking operations,
- Assessment of the combined or cumulative hydrologic impacts of the aforementioned development operations, and
- Assessment of the ability of the production aquifer to sustain planned ISR development and any impacts to water resources in the area.

3. GROUNDWATER FLOW MODEL DEVELOPMENT

Potential hydrologic impacts resulting from ISR and Niobrara Shale oil well development in the region were simulated using MODFLOW-2000, a three-dimensional groundwater flow model developed by the United States Geological Survey (Harbaugh and others, 2000).

The groundwater flow model was constructed as a "superposition" or "impact" model. An impact model is designed to evaluate only the changes that occur in the aquifer system due to applied stress – in this case, drawdown due to ISR development and Niobrara Shale oil well development operations. Impact model output includes the observed changes in water level elevation (drawdown) and changes in aquifer flows due to aquifer stress. Hydraulic head or groundwater elevation is not explicitly simulated using an impact model. One advantage of the impact modeling approach is that drawdown impacts from individual ISR and Niobrara Shale oil well development operations can be simulated and the results can be superimposed or added together to estimate the cumulative impact of the combined operations.

3.1 Model Grid, Layering, and Boundary Conditions

The groundwater flow model domain consists of 26 layers, 291 rows, and 413 columns. The model domain is approximately 40 miles east to west and 35 miles north to south, and includes the southernmost portion of the Powder River Basin (**Figure 3-1**). The model domain extends to natural outcrop locations on the southern, western and eastern margins of the basin, which are represented by No-Flow boundaries (see **Figure 2-1** for location of geologic formation boundaries). General Head boundaries were assigned along the northern model boundary to allow groundwater flow into the model domain as flow conditions change over time. Specific boundary conditions for each model layer are included in **Attachment A**.

Table 3-1 and cross-sections provided in **Figures 3-2 through 3-5** summarizes the model layering and associated hydrostratigraphy. The uppermost layer of the groundwater flow model represents shallow saturated sands of the Lower Wasatch Formation (W/E/G-Sands). This layer represents the shallow water-table aquifer over much of the model domain. ISR production sands of interest to this study include a thick sequence of stacked sands separated by lower permeability claystone and siltstone of the Tongue River member of the Upper Fort Union Formation (Layers 2-25). The ISR production sands are labeled alphabetically from deepest (K-Sand) to shallowest (U-Sand). Underlying the ISR production sand interval is a thick sequence (>1,200 feet) of lower permeability siltstone, claystone, and lesser sandstone of the Lebo Shale and Tullock members of the Fort Union Formation (Layer 26). The bottom of the flow model is represented by the top of the Cretaceous Lance Formation.

3.2 Model Aquifer Characteristics

Aquifer properties were assigned to each model layer including horizontal and vertical hydraulic conductivity, specific storage, specific yield, and top and bottom elevation (depth below water table for impact model). A summary of model aquifer properties is provided in **Table 3-1**.

3.2.1 Hydraulic Conductivity and Storage

Representative average values of hydraulic conductivity and storage for each mine unit were developed from results of site-specific aquifer testing and provided by Cameco for this study (**Table 3-1**). These data were supplemented by regional aquifer studies where site-specific data were lacking (Brenneis, 1997; AHA, 2002). Aquifer properties for model layers above and below the production sand interval (e.g. Layer 1 and Layer 26) were assigned using values from regional aquifer studies (e.g. Brennis, 1997; AHA, 2002).

3.2.2 Model Layer Elevation (Depth)

Representative average values for production sand top and bottom elevation for each mine unit were provided by Cameco for this study. These data were used to construct elevation contour maps for each model layer as depicted on model cross-sections (**Figures 3-2 through 3-5**). The elevation of each model layer is provided in **Attachment A**.

The water-table elevation was utilized as the reference elevation (zero datum) for the impact modeling. The estimated elevation of the water-table was derived from static water level data provided in the State Engineers Office electronic well database and is illustrated in **Figure 3-6**. All layer elevations were transformed to represent depth below the water-table for impact modeling purposes.

3.3 Stock and Domestic Wells

The hydrologic impact (drawdown) from ISR and Niobrara Shale oil well development was evaluated at 287 stock and domestic well locations located within a 10-mile radius of the SRH-RR facility (**Figure 3-7 and Table 3-2**). Water well user information was compiled from mine permitting documents and the electronic well database maintained by the State Engineers Office. Some stock and domestic wells located in the extreme southeastern portion of the study area are completed in deeper Cretaceous aquifers (e.g. Lance Formation) and hydraulically isolated from the overlying Fort Union and production sand aquifers. These wells are therefore not included in this study. In addition, approximately 30 percent of wells included in the SEO well database did not include well construction information (e.g. depth and completion interval) or have well logs available for review. In these cases, well construction was estimated based on the construction of the nearest neighboring wells.

3.4 Oil and Gas (Niobrara Shale) Wells

Oil and Gas well data for this study was obtained from the Wyoming Oil and Gas Commission (WYOGC) electronic database (WYOGC, 2011). Conventional deep oil and gas wells do not use large volumes of fresh water (e.g. shallow groundwater) in the process of drilling and well completion, and therefore drawdown impacts associated with conventional oil and gas development are not significant. More recently, however, unconventional oil and gas development has expanded with the advance of hydraulic fracturing ("fracking") and horizontal well technology used to extract oil and gas from lower permeability organic shale (e.g. shale oil or shale gas). Unlike conventional oil and gas wells, the drilling and fracking of horizontal shale oil wells uses a significant amount of good quality water (estimated at 4-5 million gallons per well), often obtained from shallow groundwater in more remote locations (WyoFile, 2010, **Attachment B**). Of

relevance to this study is the expansion of non-conventional oil and gas exploration and production associated primarily with the Niobrara Shale oil play in the southern Powder River Basin and Converse County. Oil and gas well data for wells within a 10-mile radius of the SRH-RR facility are provided in **Attachment B.**

As of August 2011, the WYOGC database lists one Niobrara Shale oil well as producing oil and/or gas (Spillman Draw Unit, Purple Sage Field), and seven additional wells that have been permitted and which are expected to be completed within the next six months to one year, within a 10-mile radius of the SRH-RR facility. The SEO water well database lists eight groundwater supply wells that have been permitted to provide a water supply for existing and future drilling and fracking operations. It should also be noted that existing stock and domestic wells in the region are also being used to supply water for non-conventional oil and gas development, but the location of these wells is not available in public domain databases (WyoFile, 2010, **Attachment B**). The location of existing and permitted Niobrara Shale oil wells and associated water supply wells is shown in **Figure 3-8**.

Well construction/completion information for shale oil water supply development wells was not available at the time of this original report preparation (January 2012). Therefore, water supply wells used to support shale oil development were assumed to be completed within the shallow water table aquifer (MODFLOW layer 1) as a conservative measure (e.g. maximum impact to shallow domestic/stock wells). Fracking water leased from ranches in the Powder River Basin is typically obtained from existing shallow stock wells, so this assumption has precedent.

Table 3-1. Model Hydrostratigraphy and Aquifer Properties

Layer	SRH-RR Unit	Highland Unit	Kh (ft/day)	Kz (ft/day)	Specific Storage (ft^{-1})	Specific Yield	Source
1	W/E/G-Sands		0.17	0.02	5.00E-05	0.2	AHA (2002), Brennis (1997)
2	V-Shale		0.01	5.18E-05	2.00E-05	5.00E-02	AHA (2002), Brennis (1997)
3	U-Sand		0.86	0.26	5.00E-05	0.2	AHA (2002), Brennis (1997)
4	T-Shale		0.01	5.18E-05	2.00E-05	5.00E-02	AHA (2002), Brennis (1997)
5	S-Sand		0.86	0.26	5.00E-05	0.2	AHA (2002), Brennis (1997)
6	R-Shale		0.01	5.18E-05	2.00E-05	5.00E-02	AHA (2002), Brennis (1997)
7	Q-Sand	90 Sand	1.45	0.15	5.00E-05	0.2	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
8	P-Shale		0.004	4.00E-05	2.00E-05	5.00E-02	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
9	O4-Sand	80 Sand	3.20	0.30	7.50E-05	0.2	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
10	Shale		0.01	5.18E-05	5.00E-06	5.00E-04	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
11	O3-Sand	70 Sand	3.20	0.11	2.80E-04	0.1	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
12	Shale		0.01	5.18E-05	5.00E-06	5.00E-04	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
13	O3-Sand	60 Sand	3.20	0.86	2.80E-04	0.1	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
14	Shale		0.01	5.18E-05	5.00E-06	5.00E-04	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
15	O2-Sand	50 Sand	3.20	1.50	7.50E-05	0.2	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
16	Shale		0.01	5.18E-05	5.00E-06	5.00E-04	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
17	O2-Sand	40 Sand	3.20	1.50	7.50E-05	0.2	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
18	Shale		1.45	5.18E-05	5.00E-06	5.00E-04	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
19	O1-Sand	30 Sand	3.20	1.50	7.50E-05	0.2	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
20	Shale		0.01	5.18E-05	5.00E-06	5.00E-04	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
21	O1-Sand	20 Sand	1.50	1.50	1.00E-06	0.1	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
22	N-Shale		0.01	5.18E-05	5.00E-06	5.00E-04	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
23	M-Sand	10 Sand	1.50	1.50	1.00E-06	0.1	AHA (2002), Brennis (1997), Cameco Pumping Test Technical Reports
24	L-Shale		0.01	5.18E-05	5.00E-06	5.00E-04	AHA (2002), Brennis (1997)
25	K-Sand		1.65	1.50	7.30E-05	0.1	AHA (2002), Brennis (1997)
26	Lower Fort Union		0.86	0.26	1.00E-04	0.20	AHA (2002), Brennis (1997)

Table 3-2. Stock and Domestic Well User Information

Applicant	Easting (ft)	Northing (ft)	Owner	Uses	Surface Elevation (ft-MSL)	Static Water Level (ft)	Groundwater Elevation (ft-MSL)	Top Screen (ft-MSL)	Bot Screen (ft-MSL)	Water Column (ft)
Canon Land & Livestock Ltd.	461957	890800	SOUTHEAST BALLARD, #37-3	STK	4816	160	4656.0	4656.0	4606.0	50
Canon Land & Livestock Ltd.	459398	894824	BALLARD HOUSE #37-1	STK	4845	160	4685.4	4685.4	4635.4	50
Canon Land & Livestock Ltd.	453100	889494	BALLARD #5, #37-5	STK	4913	150	4762.9	4752.9	4722.9	40
Canon Land & Livestock Ltd.	449083	889408	BALLARD #6, #37-6	STK	4940	170	4769.8	4769.8	4719.8	50
Jake Johnson, Inc.	461999	885406	JAKE JOHNSON #7	STK	4790	20	4770.4	4650.4	4620.4	150
Jake Johnson, Inc.	464772	877391	JAKE JOHNSON #4	STK	4857	70	4786.6	4736.6	4696.6	90
Canon Land & Livestock Ltd.	456082	905345	BALLARD #9, #37-9	STK	5010	170	4840.1	4840.1	4790.1	50
USDA - National Forest Service	437179	930207	MORTON #T B 113	STK	4965	120	4844.6	4734.6	4695.6	149
Jake Johnson, Inc.	463363	873373	JAKE JOHNSON #5	STK	4910	40	4869.9	4509.9	4479.9	390
MART MADSEN SHEEP COMPANY	438625	921000	MADSEN #9	STK	4901	30	4870.5	4635.5	4605.5	265
MART MADSEN SHEEP COMPANY	456057	910619	MADSEN #6	STK	4984	110	4873.8	4838.8	4808.8	65
MEISNER INC.	464696	866698	PAXTON #1 NW	STK	4991	110	4880.9	4290.9	4260.9	620
MART MADSEN SHEEP COMPANY	419677	927420	MADSEN #1	STK	4919	30	4888.9	4718.9	4688.9	200
MICHAEL R. & THOMAS J. BOLAND	435392	879938	BOLAND #1	STK	4966	64	4902.1	4883.1	4838.1	64
Jake Johnson, Inc.	452756	871950	JAKE JOHNSON #6	STK	4953	50	4903.5	4103.5	4073.5	830
MART MADSEN SHEEP COMPANY	430453	924928	SCOTT/MEEKER	STK	5041	129	4911.7	4665.7	4644.7	267
Boner Brothers Partnership	442690	903911	BALLARD #7 #37-7	STK	5094	170	4923.5	4893.5	4863.5	60
FRED AND BETTY LUND	436678	887912	LUND #2	STK	5019	85	4934.2	4919.2	4889.2	45
SMITH SHEEP CO.	404775	817233	SMITH #52	STK	5137	200	4937.5	4937.5	4887.5	50
Hardy Enterprises, LP	383741	946805	SKY #1	STK	5221	270	4950.9	4885.9	4823.9	127
Boner Brothers Partnership	447368	855860	READ WELL #2	STK	5064	100	4963.6	3843.6	3813.6	1150
Boner Brothers Partnership	437254	899956	BALLARD #8 #37-8	STK	5125	160	4964.8	4874.8	4844.8	120
Boner Brothers Partnership	455372	863882	ANDERSON #1	STK	5022	50	4972.1	3832.1	3802.1	1170
ROBERT W. MANNING	375819	953426	MANNING B C 18	STK	5064	90	4973.8	4681.8	4634.8	339
Boner Brothers Partnership	447368	855860	READ WELL #1	STK	5064	85	4978.6	3843.6	3813.6	1165
USDA - National Forest Service	385074	948110	HARDY #T B 139	STK	5202	220	4981.7	5006.7	4889.7	92
WARREN A. MANNING	401042	913919	MANNING #10	STK	4999	15	4983.5	4734.5	4707.5	276
Canon Land & Livestock Ltd.	443470	894648	BALLARD #4, #37-4	STK	5141	150	4991.2	4971.2	4941.2	50
WARREN A. MANNING	407666	919339	MANNING #7	STK	5075	80	4995.2	4899.2	4895.2	100
SMITH SHEEP COMPANY	394195	817251	LAKE PASTURE #1	STK	5023	26	4996.6	4997.6	4988.6	8
USDA - National Forest Service	370528	953427	MANNING #T B 138	STK	5102	100	5001.7	5001.7	4975.7	26
Boner Bros. Partnership	412996	877069	NORTH BOX #2	STK	5211	206	5004.5	4520.5	4490.5	514
WARREN A. & JUDITH Y. MANNING	402352	915254	#3 G MANNING DOMESTIC WELL	DOM_GW; STK	5026	21	5005.0	4764.0	4729.0	276
SMITH SHEEP CO.	398232	815902	SMITH #3	STK	5066	60	5005.8	4995.8	4965.8	40
Boner Brothers Partnership	438004	854550	LIGHTNING CREEK	STK	5221	190	5030.8	4200.8	4170.8	860
Boner Brothers Partnership	449996	865213	MACHINE PASTURE #122	STK	5084	50	5033.6	4083.6	3593.6	1440
Boner Brothers Partnership	431232	867814	BOX CREEK #3	STK	5070	36	5033.9	5004.9	4992.9	41
Harold Carson	387771	952047	CARSON (PHILLIPS) #1	STK	5158	120	5038.1	4598.1	4568.1	470
SMITH LAND COMPANY	390273	833076	SMITH #38	DOM_GW; STK	5084	40	5044.5	4964.5	4920.5	124
Boner Brothers Partnership	428630	866444	BULL PASTURE	DOM_GW	5080	35	5045.2	5015.2	5003.2	42
WARREN A. MANNING	423717	918349	MANNING #8	STK	5141	96	5045.4	4982.4	4970.4	75
USDA, NATIONAL FOREST SERVICE	391747	949392	HARDY #T.B. 267	STK	5257	211	5046.4	4444.4	4422.4	624
Roy C. & Ferol Baker	381080	921772	BAKER 10 A	DOM_GW	5105	50	5055.1	4865.1	4805.1	250
SMITH SHEEP CO.	387666	830461	HILL TOP #1	DOM_GW	5198	140	5057.7	5027.7	4997.7	60
DUCK CREEK RANCHES INC.	382398	907307	DCR # 27 (37-73)	STK	5219	140	5079.3	4369.3	4219.3	860
EVERT L. BOURQUIN	357492	826546	BOURQUIN #2	STK	5261	170	5090.6	5090.6	5060.6	30
ULYSES H. & SHARON A. BERNARD	345528	824016	BERNARD #1	DOM_GW; STK	5241	150	5091.1	5031.1	5016.1	75
U.S.A. Exxon, Co.	402605	879692	ENL HIGHLAND #22	STK	5352	260	5092.0	4973.0	4820.0	272
EDWARD D. MOORE	373183	819947	ED MOORE, SPRING PASTURE WELL #1	STK	5166	71	5094.5	4914.5	4877.5	217
ROY C. BAKER	381073	923092	BAKER #1	DOM_GW.	5116	20	5096.4	4826.4	4796.4	300
Boner Bros. Partnership	420790	858420	SOUTH BOX #1	STK	5183	81	5102.0	4873.0	4843.0	259

Table 3-2 (Cont'd). Stock and Domestic Well User Information

Applicant	Easting (ft)	Northing (ft)	Owner	Uses	Surface Elevation (ft-MSL)	Static Water Level (ft)	Groundwater Elevation (ft-MSL)	Top Screen (ft-MSL)	Bot Screen (ft-MSL)	Water Column (ft)
SMITH LAND COMPANY	388985	835739	SMITH #13	STK	5132	30	5102.3	4972.3	4942.3	160
Hornbuckle Ranch	374451	940287	HORNBUCKLE #23	STK	5267	160	5106.9	5056.9	4996.9	110
L JOE WHITING	363901	811950	PACIFIC POWER & LIGHT #4	STK	5166	45	5121.2	5006.2	4966.2	155
Boner Brothers Partnership	419563	883754	NORTH BOX #130	STK	5203	82	5121.5	4153.5	4033.5	1088
Canon Land & Livestock Ltd.	415784	862520	MONUMENT #68	STK	5207	85	5122.2	4967.2	4937.2	185
JACOB S. NEGLEY	325811	824145	NEGLEY #4	DOM_GW	5222	100	5122.4	5122.4	5087.4	35
HARDY RANCH COMPANY	364009	956032	HARDY #13	STK	5165	40	5124.9	4794.9	4764.9	360
SMITH SHEEP CO.	379775	841082	SOUTH TOMMY #1	STK	5184	55	5128.7	5043.7	4988.7	140
HILDLEBRAND INC.	352122	818672	HILDEBRAND #1	DOM_GW; STK	5144	15	5128.8	4813.8	4783.8	345
AUBREY MANNING INC.	365245	949475	MANNING #11 B C	STK	5144	14	5129.6	4893.6	4863.6	266
WARREN A. & JUDITH Y. MANNING	406298	907350	MANNING #6	STK	5190	60	5130.0	5025.0	4980.0	150
Roy C. & Ferol Baker	360132	953428	BAKER #12	STK	5181	50	5131.3	4691.3	4631.3	500
James W. & Catherine M. Strock	406045	839835	DUGAN #1	STK	5213	80	5132.6	5092.6	5062.6	70
USDI - BLM	362698	944227	ORPHA TRAIL WELL #1	STK	5190	55	5134.9	5039.9	5009.9	125
SMITH LAND COMPANY	395554	839732	SMITH #14	STK	5186	48	5138.0	5006.0	4976.0	162
JOE PATTERSON RANCH CORP.	350834	950733	MAIL BOX	STK	5259	120	5139.0	4869.0	4839.0	300
ROBERT W. MANNING	357448	946856	MANNING B C 17	DOM_GW; STK	5210	70	5140.5	4806.5	4747.5	393
Boner Bros. Partnership	427378	891793	ANTONE #3	STK	5353	210	5143.1	4843.1	4813.1	330
Boner Brothers Partnership	439358	835861	EDWARDS #97	STK	5219	75	5144.5	4469.5	4439.5	705
WILLIAM J. SMITH	357464	822589	PN5 L314	MIS; STK	5245	99	5146.4	4710.4	4641.4	505
U.S.A. Exxon, Co.	403931	881020	ENL HIGHLAND #23	STK	5408	260	5147.5	4950.5	4757.5	390
HENRY LAND COMPANY	353380	925727	HENRY #9	DOM_GW	5183	35	5148.0	5023.0	5003.0	145
WARREN A. & JUDITH Y. MANNING	399882	903409	#1 G MANNING SOUTHWEST WINDMILL	STK	5277	126	5151.0	5097.0	5067.0	84
JACOB S. NEGLEY	325811	824145	NEGLEY #5	DOM_GW	5222	70	5152.4	5152.4	5102.4	50
MARK A. & ARDITH A. HICKERSON	356161	826555	HICKERSON #1	DOM_GW	5234	80	5154.1	5084.1	5049.1	105
SMITH LAND COMPANY	379739	835769	SMITH #10	STK	5195	38	5156.8	5014.8	4984.8	172
SMITH SHEEP COMPANY	389019	843725	EAST SHEARING PENS #1	STK	5251	90	5161.3	5056.3	5051.3	110
GARY & KAREN HUXTABLE	358812	823892	HUXTABLE #1	DOM_GW	5244	80	5163.6	5123.6	5083.6	80
James W. & Catherine M. Strock	407399	837161	DUGAN #2	STK	5244	80	5164.5	5134.5	5104.5	60
AUBREY MANNING INC.	357462	948168	MANNING 1 B C	DOM_GW; STK	5198	32	5165.7	4817.7	4787.7	378
MELVIN H. SR. & E. LOUISE SEIDEL	315491	844033	POPSKULL 28-2	DOM_GW; STK	5391	225	5165.9	5165.9	5115.9	50
FRED & BEVERLY RUNNION	319324	829507	RUNNION #1	DOM_GW; STK	5349	180	5168.7	5028.7	5013.7	155
Roy A Strock	406072	837163	Strock #2	STK	5223	54	5168.9	5132.9	5083.9	85
ROY A/SHIRLEY A STROCK	412662	834513	STROCK #1	STK	5324	155	5169.2	5133.2	5111.2	58
DAMON J & GRETCHEN C ENGEL	314179	842713	Hoyer #1	DOM_GW; STK	5395	225	5170.3	5170.3	5120.3	50
SMITH SHEEP CO.	363970	819888	SMITH #45 (DEEPENED)	STK	5323	150	5173.4	5163.4	5143.4	30
SMITH SHEEP CO.	375875	847697	SMITH #18	STK	5189	14	5175.2	5051.2	5034.2	141
Canon Land & Livestock Ltd.	415477	857029	EAST JENKINS #13	STK	5288	110	5177.7	5137.7	5112.7	65
AUBREY MANNING INC.	360096	946857	MANNING 7 B C	STK	5203	25	5178.0	5098.0	5088.0	90
TILLARD 55 RANCH	334141	826536	TILLARD RANCH 15	STK	5400	220	5179.8	4959.8	4919.8	260
ROY SHIDELER	314165	836109	ROY #1	DOM_GW; STK	5430	250	5180.2	5012.2	4980.2	200
JOE PATTERSON	342822	941538	Solar Well #1	DOM_GW; STK	5299	118	5180.5	5118.5	5098.5	82
J.S. NEGLEY	357492	826546	NEGLEY #1	DOM_GW; STK	5261	80	5180.6	5150.6	5120.6	60
SMITH SHEEP CO.	334945	818792	SMITH #6	DOM_GW; STK	5241	60	5180.8	4970.8	4940.8	240
EUGENE L. EVANOFF	344197	824040	EVANOFF #3	DOM_GW	5282	100	5182.1	5092.1	5062.1	120
James W. & Catherine M. Strock	407431	834490	CLARK DUGAN #1	STK	5263	80	5182.7	5132.7	5102.7	80
BRADLEY D. ANDERSON	358820	826534	ANDERSON #1	DOM_GW	5243	60	5183.4	5123.4	5093.4	90
J.S. NEGLEY	358812	823892	NEGLEY #2	DOM_GW; STK	5244	60	5183.6	5043.6	5013.6	170
HILDEBRAND INC.	348170	822657	HILDEBRAND #2	STK	5201	15	5185.9	4960.9	4930.9	255
EARL G. DOEGE	358817	825215	LUCK FIVE #2	DOM_GW	5286	100	5186.0	5146.0	5111.0	75
ELMER DOEGE	358817	825215	ELRU #1	DOM_GW	5286	100	5186.0	5151.0	5111.0	75

Table 3-2 (Cont'd). Stock and Domestic Well User Information

Applicant	Easting (ft)	Northing (ft)	Owner	Uses	Surface Elevation (ft-MSL)	Static Water Level (ft)	Groundwater Elevation (ft-MSL)	Top Screen (ft-MSL)	Bot Screen (ft-MSL)	Water Column (ft)
SMITH SHEEP CO.	392937	845040	SPENCER #2	STK	5327	140	5187.1	5112.1	5032.1	155
SMITH LAND COMPANY	386390	847696	#15 SMITH	STK	5354	165	5188.6	5053.6	5045.6	143
MERLE H. DUNHAM	358812	823892	HIGHWAY CORNER #1	DOM_GW	5244	55	5188.6	5043.6	5013.6	175
A.C. LAYTON	356153	825243	LAYTON #3	STK	5211	20	5190.9	5110.9	5100.9	90
PASTOR ROBT DAVIS	318033	830825	DAVIS #1	DOM_GW	5394	200	5193.8	5048.8	5033.8	160
ROY G. HOYER	316807	840020	HOYER #1	DOM_GW; STK	5360	165	5194.5	5194.5	5154.5	40
AUBREY MANNING INC.	354766	941566	MANNING 8 B C	STK	5285	90	5195.3	5047.3	5017.3	178
EVERT L. BOURQUIN	357492	826546	BOURQUIN #1	DOM_GW	5261	65	5195.6	5150.6	5145.6	50
HENRY J. KEENAN	348225	825273	HENRY KEENAN #1	DOM_GW; STK	5256	60	5196.5	5136.5	5106.5	90
Hornbuckle Ranch	359978	919128	HORNBUCKLE WELL #6	STK	5222	25	5197.0	5002.0	4982.0	215
MERLE H. DUNHAM	358812	823892	HIGHWAY CORNER #2	DOM_GW	5244	45	5198.6	5043.6	5013.6	185
L. RAYMOND ALLEMAND	344239	956038	CONOCO 30-4-38-74	STK	5379	180	5199.4	5039.4	4989.4	210
DUCK CREEK RANCHES	374440	903377	DUCK CREEK #28	STK	5311	110	5200.8	5180.8	5109.8	91
J. S. NEGLEY	358817	825215	NEGLEY #6	DOM_GW	5286	85	5201.0	5136.0	5106.0	95
AUBREY MANNING INC.	360043	935041	MANNING 4 B C	STK	5238	35	5203.3	4959.3	4953.3	250
JOE R. KEENAN	349548	825261	KEENAN #4	DOM_GW; STK	5246	42	5204.0	5154.0	5132.0	72
EARL G. DOEGE	358817	825215	LUCKY FIVE #1	DOM_GW	5286	80	5206.0	5166.0	5106.0	100
ROBERT D. HAUN	358817	825215	KT #1	DOM_GW	5286	80	5206.0	5166.0	5106.0	100
SMITH LAND COMPANY	381175	851695	SMITH #17	STK	5286	75	5211.5	5126.5	5110.5	101
James W. & Catherine M. Strock	411378	823894	LYNCH #1	STK	5292	80	5211.5	5111.5	5081.5	130
SMITH SHEEP CO.	362674	835837	SMITH #20	STK	5272	60	5211.8	5131.8	5106.8	105
JOE PATTERSON RANCH	344154	941536	BROOK # 1	DOM_GW; STK	5300	86	5213.5	4894.5	4879.5	334
Canon Land & Livestock Ltd.	419235	837189	WILLIAMS SPRINGS #102	STK	5414	200	5213.7	5173.7	5160.7	53
JOSEPH D. DONA	340339	825357	NORTH DONA #1	STK	5375	161	5214.1	5180.1	5150.1	64
ALLEN USREY	316799	842674	URSEY #1	DOM_GW	5364	150	5214.3	5204.3	5194.3	20
A.C. LAYTON	365274	834495	LAYTON #2	STK	5267	50	5216.9	5191.9	5176.9	40
E.L. EVANOFF	345528	824016	E EVANOFF #1	STK	5241	23	5218.1	5051.1	5021.1	197
TILLARD 55 LTD	324558	824564	TILLARD NO 11	STK	5232	12	5220.4	5182.4	5162.4	58
FOWLER RANCH PARTNERSHIP	416937	886377	COWGER 1	STK	5419	198	5220.9	4458.9	4428.9	792
AUBREY MANNING INC.	354743	932359	MANNING #15 B C	STK	5245	23	5221.5	4982.5	4969.5	252
Boner Bros. Partnership	424612	842524	MARY WHITE #1	STK	5462	240	5222.3	5012.3	4982.3	240
James W. & Catherine M. Strock	416623	830558	FLEMING #1	STK	5304	80	5224.0	5074.0	5044.0	180
HENRY J. KEENAN	348225	825273	HENRY #2	DOM_GW; STK	5256	32	5224.5	5136.5	5106.5	118
HENRY J. KEENAN	348225	825273	HENRY KEENAN #3	DOM_GW; STK	5256	32	5224.5	5136.5	5106.5	118
WILLIAM M. HENRY	356009	912520	HENRY #3	STK	5248	23	5224.7	5027.7	5014.7	210
DUCK CREEK RANCHES INC.	370465	899427	DUCK CREEK #32	STK	5469	240	5228.6	5228.6	5178.6	50
Hornbuckle Ranch	370498	913889	HORNBUCKLE WELL #7	STK	5331	100	5230.6	5100.6	5070.6	160
Hornbuckle Ranch	358645	912539	HORNBUCKLE WELL #10	STK	5323	90	5233.4	5238.4	5183.4	50
LEE FOWLER	411819	887687	FOWLER #1	DOM_GW	5416	182	5234.2	4666.2	4636.2	598
JACOB S. NEGLEY	325853	826784	NEGLEY #3	DOM_GW	5315	80	5234.8	5234.8	5194.8	40
HENRY J. KEENAN	342969	829296	HENRY KEENAN #5	STK	5295	60	5235.0	5165.0	5135.0	100
AUBREY MANNING INC.	354786	945506	MANNING #12 B C	STK	5253	18	5235.2	4883.2	4853.2	382
AUBREY MANNING INC.	353422	938921	MANNING 9 B C	STK	5373	138	5235.3	5280.3	5216.3	19
JERRY/CAROLINE MOOREN	315476	834772	MOOREN # 1	DOM_GW; STK	5396	160	5235.9	4935.9	4905.9	330
JOE PATTERSON RANCH	342822	941538	PATTERSON #9	DOM_GW; STK	5299	60	5238.5	5078.5	5048.5	190
ROBERT W. MANNING	352080	936277	STRANGE FED #1-27	STK	5450	210	5240.3	5060.3	4640.3	600
TILLARD 55 RANCH	327875	829397	TILLARD RANCH 16	STK	5361	120	5240.9	5080.9	5060.9	180
JAMES W. STROCK	413983	841155	STROCK #1	STK	5321	80	5240.9	5190.9	5178.9	62
DUCK CREEK RANCHES INC.	380930	894401	REYNOLDS NO. 3	STK	5263	21	5241.6	5158.6	5122.6	119
SMITH LAND COMPANY	345593	831924	SMITH #37	STK	5343	100	5243.4	5223.4	5200.4	43
James W. & Catherine M. Strock	412662	834513	DEIL #1	STK	5324	80	5244.2	5144.2	5114.2	130

Table 3-2 (Cont'd). Stock and Domestic Well User Information

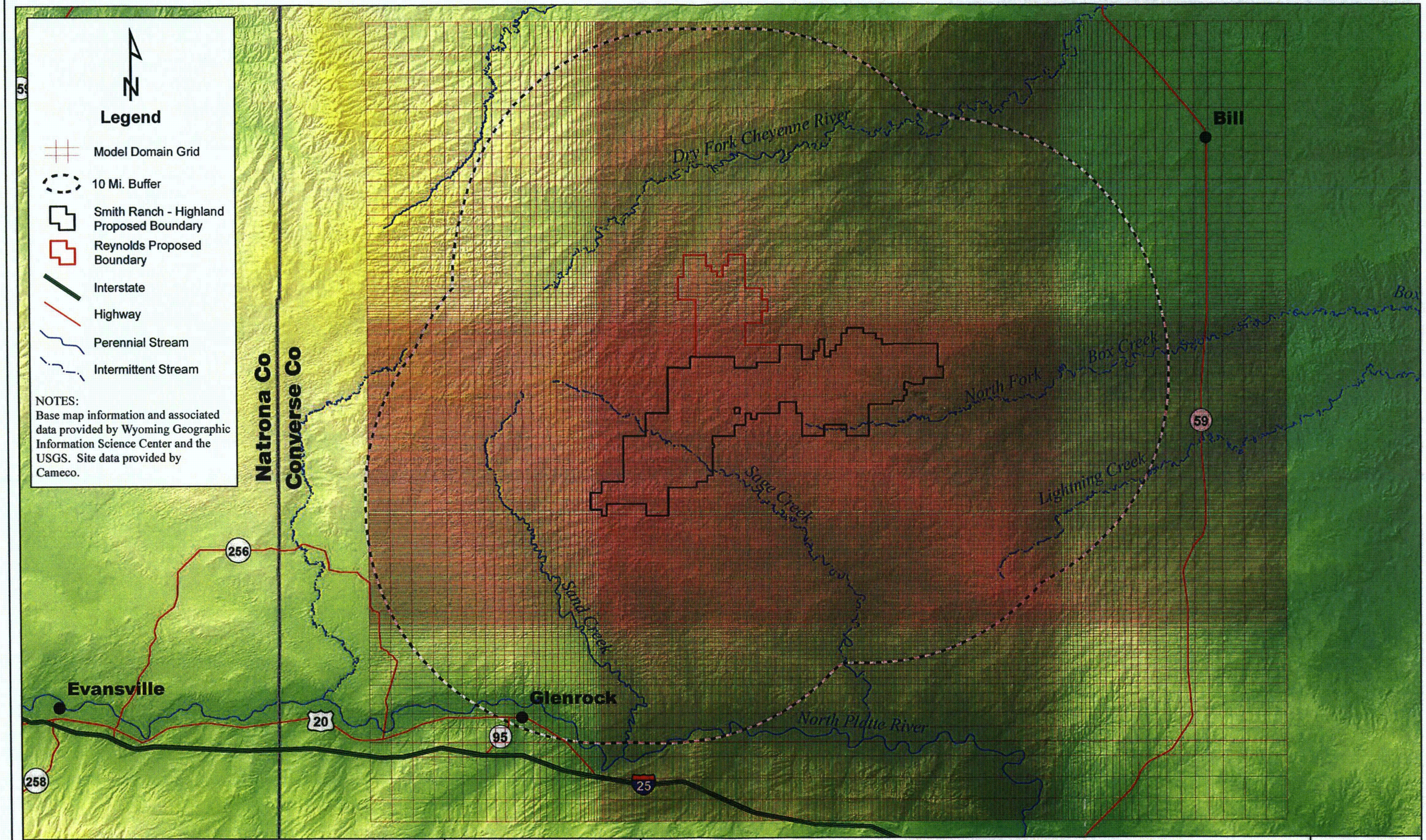
Applicant	Easting (ft)	Northing (ft)	Owner	Uses	Surface Elevation (ft-MSL)	Static Water Level (ft)	Groundwater Elevation (ft-MSL)	Top Screen (ft-MSL)	Bot Screen (ft-MSL)	Water Column (ft)
James W. & Catherine M. Strock	403488	846428	SHORTY SPEAR #1	STK	5326	80	5246.2	5166.2	5136.2	110
SMITH SHEEP CO.	378543	851695	SMITH #47	STK	5270	20	5249.5	5240.5	5234.5	15
A.C. LAYTON	360125	829176	LAYTON #5	STK	5325	75	5249.9	5130.9	5109.9	140
SMITH LAND COMPANY	356074	837176	SMITH #21	STK	5337	85	5251.9	5236.9	5206.9	45
GARY GURWELL	316796	836073	GURWELL #1	DOM_GW	5373	120	5253.4	5058.4	5048.4	205
VOLLMAN RANCHES INC.	365276	835825	WINSINGER #1	STK	5275	21	5253.9	5164.9	5099.9	154
SMITH SHEEP CO.	364029	826502	SMITH #4	STK	5328	70	5257.6	5177.6	5147.6	110
Hornbuckle Ranch	366511	908620	HORNBUCKLE WELL #4	STK	5352	90	5262.0	5262.0	5227.0	35
WM. VALENTINE & SONS INC.	320744	837415	SPENCER #15	STK	5363	100	5263.0	5213.0	5183.0	80
SMITH LAND COMPANY	369274	830499	SMITH #9	STK	5315	50	5265.2	5205.2	5175.2	90
J & J DEVELOPMENT COMPANY INC.	312807	833500	J & J 1 - 69	DOM_GW	5449	180	5269.3	5269.3	5189.3	80
WARREN A. MANNING	397485	898135	MANNING #9	STK	5290	20	5269.8	5209.8	5189.8	80
SMITH SHEEP CO.	371845	843739	SMITH #48	STK	5310	35	5274.9	5274.9	5261.9	13
WM. VALENTINE & SONS INC.	318108	834747	SPENCER PASTURE #16	STK	5367	90	5277.2	5077.2	5047.2	230
JOE PATTERSON RANCH CORP.	337554	934927	OLD BRANDING CORRALL	STK	5381	100	5280.7	5090.7	5060.7	220
SMITH LAND COMPANY	350857	846467	SMITH #24	STK	5423	140	5283.4	5283.4	5233.4	50
WILLIAM M. HENRY III	342769	909890	HOOPER HOUSE WELL	STK	5338	54	5283.8	5122.8	5092.8	191
A.C. LAYTON	358813	829184	LAYTON #1	DOM_GW; STK	5324	40	5284.2	5174.2	5144.2	140
WILLIAM R. VOLLMAN	352200	830531	LAYTON #1	STK	5364	80	5284.5	5264.5	5246.5	38
WILLIAM M. HENRY III	349447	920439	SOUTH PAST. SOLAR	STK	5325	39	5286.2	5208.2	5176.2	110
JOE PATTERSON RANCH CORP.	342818	940218	SPEAR K RANCH #1	DOM_GW; STK	5325	30	5295.3	5050.3	5035.3	260
JE PATTERSON RANCH CORPORATIC	329616	919120	BEAR CREEK	STK	5388	90	5297.6	5067.6	5037.6	260
JOE PATTERSON RANCH CORP.	342863	948131	TIN CAKE HOUSE	STK	5343	40	5303.1	5023.1	4993.1	310
AUBREY MANNING INC.	346752	928349	MANNING #13 B C	STK	5343	39	5304.2	4873.2	4793.2	511
HORNBUCKLE RANCH INC.	322910	900777	RESERVOIR PASTURE #1	STK	5426	120	5306.2	5276.2	5261.2	45
JOE PATTERSON RANCH CORP.	333648	946820	ELEC. WELL-RICK	STK	5395	87	5307.7	5054.7	5024.7	283
55 Ranch - Werner, Inc.	332218	917807	WIND #55 1	STK	5337	25	5311.7	5066.7	5036.7	275
DUCK CREEK RANCHES INC.	369055	897463	REYNOLDS #32	STK	5442	130	5311.7	5306.7	5278.7	33
Hornbuckle Ranch	326881	903388	HORNBUCKLE #18	STK	5455	140	5315.2	5255.2	5208.2	107
SMITH LAND CO.	357437	859673	SOLAR PANEL 2	STK	5328	12	5316.0	5304.0	5275.0	41
DAVID VAN BUSKIRK	315490	842695	VAN BUSKIRK #1	DOM_GW	5387	70	5317.3	5317.3	5267.3	50
TILLARD 55-LIMITED PARTNERSHIP	316867	892942	SAGE CREEK GAS PLANT WATER WELL #1	MIS; STK	5534	216	5318.3	5214.3	5194.3	124
WILLIAM R. VOLLMAN	390262	867587	VOLLMAN #3	STK	5334	15	5319.3	5114.3	5084.3	235
ARTHUR A. & SHIRLEY C. LEYRER	316807	840020	LEYRER #1	DOM_GW; STK	5360	40	5319.5	5239.5	5209.5	110
PEABODY COAL COMPANY (PRCC)	318981	906024	BUCK PASTURE #1	STK	5482	160	5321.9	4966.9	4861.9	460
JOE PATTERSON RANCH CORP.	336265	941538	RED WINDMILL-JANE	STK	5376	50	5325.7	5095.7	5065.7	260
Hornbuckle Ranch	323333	895467	HORNBUCKLE #22	STK	5567	236	5330.7	5286.7	5226.7	104
FIRST INTERSTATE BANK OF CASPER	318118	838694	SCHOLTZ #2	DOM_GW; IRR_GW; STK	5348	16	5331.9	5331.9	5305.9	26
FIRST INTERSTATE BANK OF CASPER	318118	838694	SCHOLTZ #1	IRR_GW	5348	15	5332.9	5334.9	5300.9	32
WILLIAM M HENRY III	338850	921691	WES DIPPING VAT	STK	5371	36	5335.0	5286.0	5256.0	79
NUMRICH RANCH	398647	887579	NUMRICH #3	STK	5405	70	5335.3	5325.3	5125.3	210
JOE PATTERSON RANCH CORP.	327074	929626	SCHOOL PATTERSON 36-1	STK	5522	185	5336.9	5101.9	5071.9	265
HORNBUCKLE RANCH, INC.	334807	904706	HORNBUCKLE #21	STK	5514	175	5338.5	5078.5	4928.5	410
SMITH LAND COMPANY	346922	847842	SMITH #36	STK	5480	140	5340.3	5260.3	5243.3	97
AMERICAN QUASAR PETROLEUM	332235	920424	FEDERAL 12 7	MIS; STK	5414	74	5340.3	5134.3	5046.3	294
SMITH SHEEP COMPANY	353436	846414	ONIEL #3	STK	5401	60	5341.5	5316.5	5300.5	41
James W. & Catherine M. Strock	399619	853034	STROCK #2	STK	5424	80	5343.5	5183.5	5173.5	170
SMITH LAND COMPANY	349515	839858	SMITH #22	STK	5419	75	5344.1	5299.1	5293.1	51
SMITH LAND COMPANY	354736	846406	SMITH #25	STK	5380	35	5344.6	5279.6	5249.6	95
MELVIN H. SEIDEL	315491	844033	SEIDEL #1	STK	5391	45	5345.9	5250.9	5220.9	125
SMITH SHEEP COMPANY	344280	839890	WEST DOWNS #1	STK	5482	135	5347.2	5267.2	5242.2	105

Table 3-2 (Cont'd). Stock and Domestic Well User Information

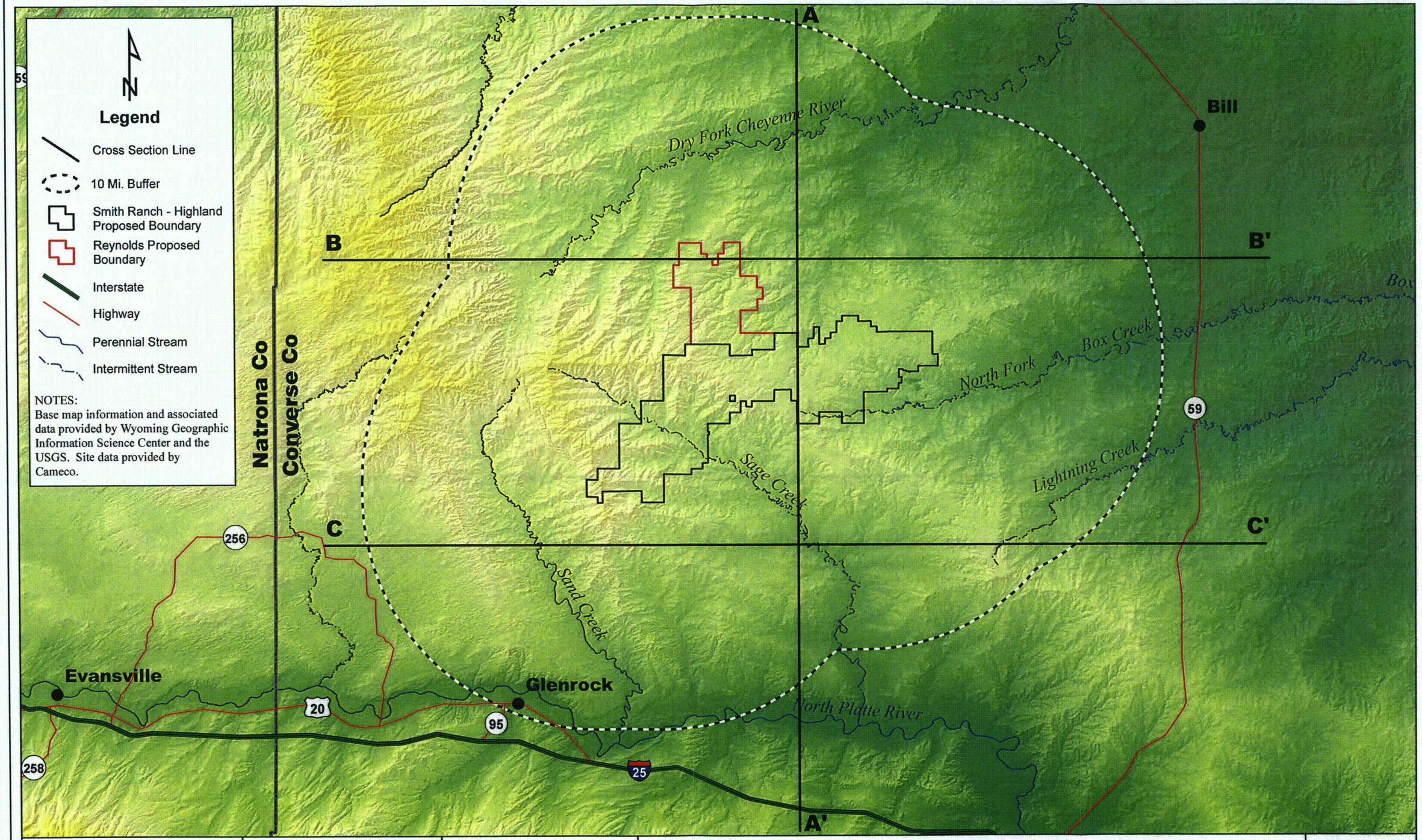
Applicant	Easting (ft)	Northing (ft)	Owner	Uses	Surface Elevation (ft-MSL)	Static Water Level (ft)	Groundwater Elevation (ft-MSL)	Top Screen (ft-MSL)	Bot Screen (ft-MSL)	Water Column (ft)
HENRY J. KEENAN	344246	834601	HENRY KEENAN #4	STK	5436	85	5351.4	5336.4	5306.4	45
NUMRICH RANCH	381112	882169	TERRELL NO. 1	STK	5437	85	5351.7	5321.7	5302.7	49
WILLIAM R. VOLLMAN	388958	874208	VOLLMAN #5	STK	5447	94	5353.3	5067.3	5037.3	316
AUBREY MANNING INC.	348082	932316	MANNING 6 B C	STK	5449	95	5354.5	5299.5	5288.5	66
SMITH SHEEP CO.	362648	850401	SMITH #30	DOM_GW; STK	5435	80	5354.8	5284.8	5254.8	100
DUCK CREEK RANCHES INC.	377148	880827	REYNOLDS #21-3	STK	5504	148	5355.6	5206.6	5186.6	169
GARY SHIDELER	315449	833463	SHIDELER #1	DOM_GW	5446	90	5356.2	5076.2	5046.2	310
A.C. LAYTON	364037	829156	LAYTON #4	DOM_GW; STK	5398	40	5357.6	5247.6	5227.6	130
LEON E. & BERTIE M. HOWE	314073	832188	HOWE #1	DOM_GW	5508	150	5357.9	5307.9	5177.9	180
DE PATTERSON RANCH CORPORATIC	325656	919122	JUDSON	STK	5451	90	5360.6	5130.6	5100.6	260
SMITH SHEEP COMPANY	352190	858774	POTTS #1	STK	5419	58	5361.4	5299.4	5259.4	102
TILLARD 55 LTD. PARTNERSHIP	315488	845356	TILLARD 55 #3	STK	5382	20	5362.0	5362.0	5322.0	40
ROBERT H. & ANNA MAE KEENAN	338984	833294	KEENAN #36	STK	5408	45	5362.7	5362.7	5327.7	35
DAMON J & GRETCHEN C ENGEL	312859	840093	EMVY #1	DOM_GW	5424	60	5363.7	5028.7	5003.7	360
55 Ranch - Werner, Inc.	325623	913877	DOM #55 1	DOM_GW; STK	5415	50	5365.0	5045.0	5015.0	350
SMITH SHEEP CO.	361327	850420	SMITH #29	STK	5421	55	5365.7	5270.7	5240.7	125
SMITH SHEEP COMPANY	354774	864257	HAY MEADOW #1	STK	5388	21	5366.9	5287.9	5257.9	109
MARY L MANES	315449	833463	MARY #1	DOM_GW	5446	77	5369.2	5046.2	5023.2	346
WILLIAM R. VOLLMAN	383666	875533	VOLLMAN #6	DOM_GW	5535	165	5369.8	5114.8	5084.8	285
J & J DEVELOPMENT COMPANY INC.	312845	836127	J & J #1-A 15	DOM_GW	5482	110	5372.1	5372.1	5252.1	120
WILLIAM H. MASON	350652	898114	MASON #2	STK	5493	120	5373.5	5293.5	5238.5	135
SMITH LAND COMPANY	349547	857053	SMITH #28	STK	5412	35	5376.9	5241.9	5211.9	165
DUCK CREEK RANCHES INC.	370514	884779	DUCK CREEK #17-2	STK	5483	106	5377.1	5338.1	5300.1	77
Hornbuckle Ranch	318063	895538	HORNBUCKLE WELL #26	STK	5519	140	5379.4	5119.4	5044.4	335
DUCK CREEK RANCHES INC.	363877	902057	DUCK CREEK #31	STK	5507	125	5382.0	5369.0	5347.0	35
VOLLMAN WILLIAM R.	378444	876858	VOLLMAN #4	STK	5510	127	5383.4	5360.4	5310.4	73
TILLARD 55 L. T. D.	319464	850590	HERMA # 3	STK	5459	75	5384.1	5304.1	5284.1	100
DUCK CREEK RANCHES INC.	373171	884771	DUCK CREEK #17	STK	5488	102	5385.5	5324.5	5262.5	123
DE PATTERSON RANCH CORPORATIC	321701	919146	WEST 11	STK	5426	40	5386.1	5106.1	5076.1	310
WILLIAM H. MASON	354625	899422	MASON #3	DOM_GW; STK	5572	180	5391.6	5281.6	5261.6	130
J & J DEVELOPMENT COMPANY INC.	311525	834823	J & J #1 A 20	DOM_GW	5526	130	5395.6	5395.6	5285.6	110
TILLARDS 55 LTD.	323403	848062	TILLARDS 55 #3	STK	5548	150	5397.8	5237.8	5197.8	200
TILLARD'S 55 RANCH	315593	888983	ENL L O #1	STK	5534	135	5398.7	5108.7	5088.7	310
SMITH SHEEP CO.	352140	864970	SMITH #31	STK	5435	36	5398.8	5314.8	5284.8	114
SMITH SHEEP COMPANY	381068	864908	TAYLOR # 3	STK	5491	87	5403.7	5255.7	5235.7	168
WILLIAM M. HENRY	317684	911272	HENRY #6	STK	5469	65	5404.3	5269.3	5238.3	166
J & J DEVELOPMENT COMPANY INC.	312743	832210	J & J 1 - 57	DOM_GW	5516	110	5406.1	5406.1	5216.1	190
VOLLMAN RANCHES INC.	383667	871546	VOLLMAN #1	STK	5550	142.3	5407.3	5389.6	5377.6	30
DUCK CREEK RANCHES INC.	362561	900742	REYNOLDS #36 (DEEPENED)	STK	5468	58	5409.9	5327.9	5297.9	112
BURTON O. BARBER	340343	849754	BOWMAN #1	STK	5586	175	5411.0	5426.0	5408.0	3
WILLIAM R. & ALICE L. VOLLMAN	367849	880810	ADAMS #1	STK	5515	100	5415.1	5305.1	5265.1	150
SMITH SHEEP CO.	344280	839890	SMITH #42	STK	5482	60	5422.2	5392.2	5379.2	43
SMITH LAND COMPANY	387632	862268	SMITH #16	STK	5484	60	5423.5	5373.5	5343.5	80
SMITH SHEEP CO.	387632	862268	SMITH 16	STK	5484	60	5423.5	5293.5	5363.5	60
JOE PATTERSON RANCH CORP.	325794	940181	KENNY	STK	5554	130	5424.1	5094.1	5064.1	360
DUCK CREEK RANCHES INC.	363869	898114	DUCK CREEK #1	STK	5466	40	5426.4	5346.4	5316.4	110
VAN IRVINE	316888	890296	LO #1 (DEEPENED)	STK	5572	135	5437.1	5382.1	5232.1	205
DE PATTERSON RANCH CORPORATIC	331045	934884	SCOTTIE	STK	5500	60	5440.3	5140.3	5110.3	330
PEABODY DEVELOPMENT COMPANY	313813	923179	QUICK DRAW #1	MS; STK	5616	175	5441.0	4856.0	4826.0	615
HORNBUCKLE RANCH, INC.	338765	900752	LOWER BROWN SPRINGS #1	STK	5527	86	5441.2	5414.2	5381.2	60
WM. VALENTINE & SONS INC.	307611	845422	BAKER #14	STK	5522	80	5441.6	5261.6	5231.6	210

Table 3-2 (Cont'd). Stock and Domestic Well User Information

Applicant	Easting (ft)	Northing (ft)	Owner	Uses	Surface Elevation (ft-MSL)	Static Water Level (ft)	Groundwater Elevation (ft-MSL)	Top Screen (ft-MSL)	Bot Screen (ft-MSL)	Water Column (ft)
SMITH SHEEP CO.	363956	863616	SMITH #35	STK	5484	40	5444.5	5414.5	5384.5	60
SMITH SHEEP CO.	350840	872924	SMITH #32	STK	5569	115	5453.8	5453.8	5403.8	50
WILLIAM H. MASON	355951	898112	MASON #1	DOM_GW	5533	75	5458.4	5426.4	5415.4	43
FLORENCE P. COATES	335051	833297	BUD HALL #1	STK	5578	120	5458.4	5338.4	5198.4	260
SMITH SHEEP COMPANY	363956	863616	HAY MEADOW #1	STK	5484	21	5463.5	5439.5	5399.5	64
DUCK CREEK RANCHES INC.	371132	880821	REYNOLDS #20	STK	5500	26	5473.5	5473.5	5454.5	19
Hornbuckle Ranch	345649	894172	HORNBUCKLE #20	DOM_GW; STK	5487	13	5473.8	5396.8	5368.8	105
SMITH LAND COMPANY	341646	855810	SMITH #27	STK	5511	36	5475.0	5211.0	5181.0	294
DUCK CREEK RANCHES INC.	360036	886168	REYNOLDS #13	STK	5625	150	5475.3	5500.3	5437.3	38
Cole Creek Sheep Co.	301174	865240	CHEYENNE RIVER #1	STK	5611	130	5480.7	5395.7	5300.7	180
FRED AND NANCY LINDIG	312743	832210	LINDIG #1	DOM_GW	5516	30	5486.1	5246.1	5216.1	270
HORNBUCKLE RANCH, INC.	344334	888878	UPPER BROWN SPRING #1	STK	5517	29	5488.4	5407.4	5365.4	123
55 Ranch - Werner, Inc.	323333	895467	PEN #55 1	STK	5567	75	5491.7	5266.7	5236.7	255
SMITH SHEEP CO.	361365	878178	SMITH #34	STK	5602	110	5492.0	5442.0	5412.0	80
WILLIAM R. VOLLMAN	369218	874195	VOLLMAN #2	STK	5581	85	5496.2	5461.2	5431.2	65
Hornbuckle Ranch	327342	890140	HORNBUCKLE #19	STK	5669	162	5507.5	5489.5	5404.5	103
Cole Creek Sheep Co.	295991	892955	LO #1000W	STK	5751	240	5510.7	5400.7	5340.7	170
SMITH LAND COMPANY	345622	845187	SMITH #26	STK	5565	38	5526.8	5514.8	5508.8	18
WM. VALENTINE & SONS INC.	304978	845470	BECK-IN-SMITHS #17	STK	5621	90	5531.5	5311.5	5281.5	250
RALPH J. & MARY-LEIGH WILLIAMS	315461	865162	WILLIAMS #1	DOM_GW; STK	5644	110	5534.4	5284.4	5269.4	265
SMITH SHEEP COMPANY	357416	876202	WW109 A	STK	5629	90	5538.8	5568.8	5458.8	80
SMITH SHEEP CO.	343004	886230	SMITH #51	STK	5637	78	5559.0	5517.0	5487.0	72
SMITH SHEEP CO.	356087	876874	SMITH #33	STK	5632	60	5571.6	5501.6	5471.6	100
GEORGE C. KINDT	314214	857241	JOAN #2	DOM_GW; STK	5693	60	5632.6	5442.6	5412.6	220
SMITH SHEEP CO.	327302	876924	SMITH 61	STK	5763	125	5638.0	5623.0	5593.0	45
SMITH SHEEP CO.	342975	878252	SMITH #41	STK	5744	60	5684.3	5674.3	5659.3	25
SMITH SHEEP CO.	327315	883514	SMITH #49	STK	5837	140	5697.0	5627.0	5597.0	100
SMITH SHEEP CO.	327277	871650	SMITH #50	STK	5766	50	5715.8	5715.8	5700.8	15
LUCETTA LENZEN	336378	876867	LENZEN #1	STK	5824	102	5721.6	5678.6	5658.6	63
LUCETTA M. LENZEN	335078	883499	NORTH	DOM_GW; STK	5765	30	5734.6	5574.6	5544.6	190
LENZEN RANCH CO.	335066	880846	LENZEN RANCH CO #3	STK	5881	60	5820.6	5660.6	5640.6	180



AQUI-VER, INC. *Hydrogeology, Water Resources & Data Services*	0 2 4 8 Miles STATE PLANE ZONE EAST NAD27	PROJECT # 40100545 DATE: 9/12/11 DRAWN BY: CLIN REVIEWED BY: BSMITH DOCUMENT NAME AND PATH	Cameco	**MODFLOW MODEL DOMAIN** SMITH RANCH-HIGHLAND/REYNOLDS RANCH FACILITIES CONVERSE COUNTY - WYOMING	**FIGURE:** 3-1



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0 2 4 8
Miles

STATE PLANE ZONE EAST NAD27

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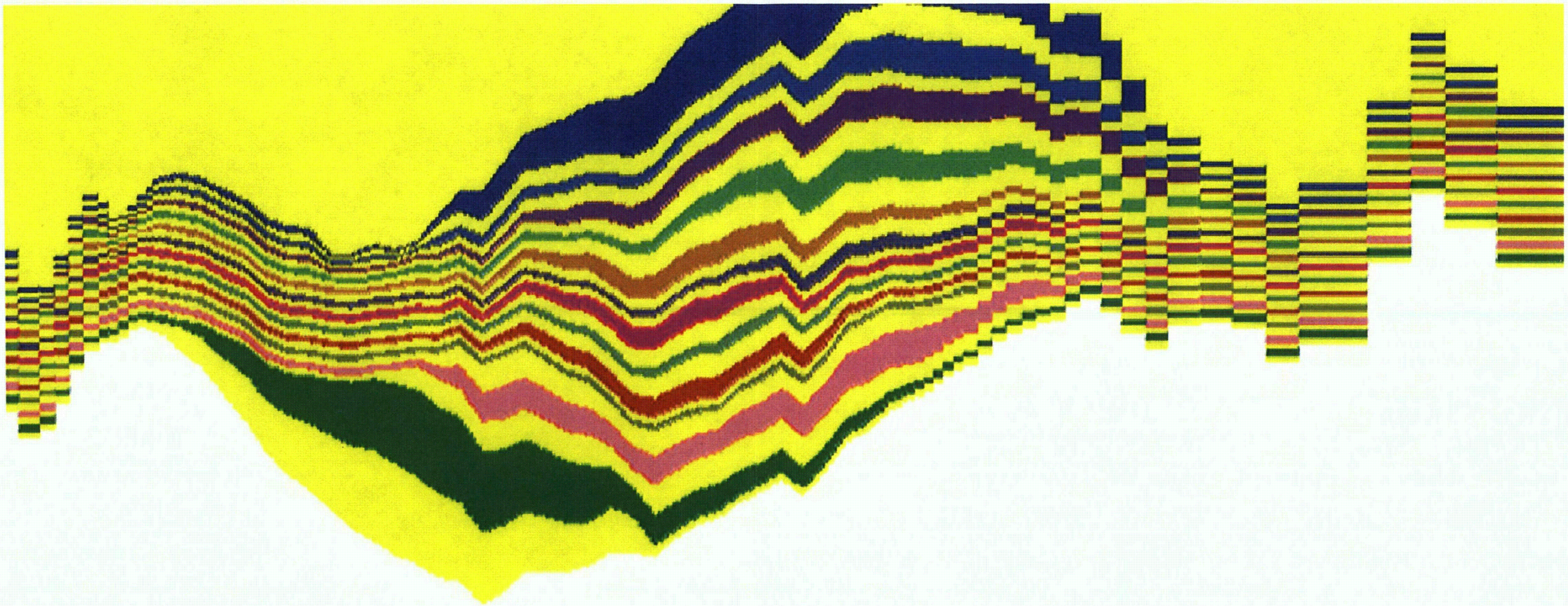
MODEL CROSS-SECTION LOCATION MAP

SMITH RANCH-HIGHLAND/REYNOLDS RANCH FACILITIES
CONVERSE COUNTY - WYOMING

FIGURE:
3-2

A

A'



NOTES:
Vertical exaggeration = 100x.
Data interpretation by AQUI-VER, INC.

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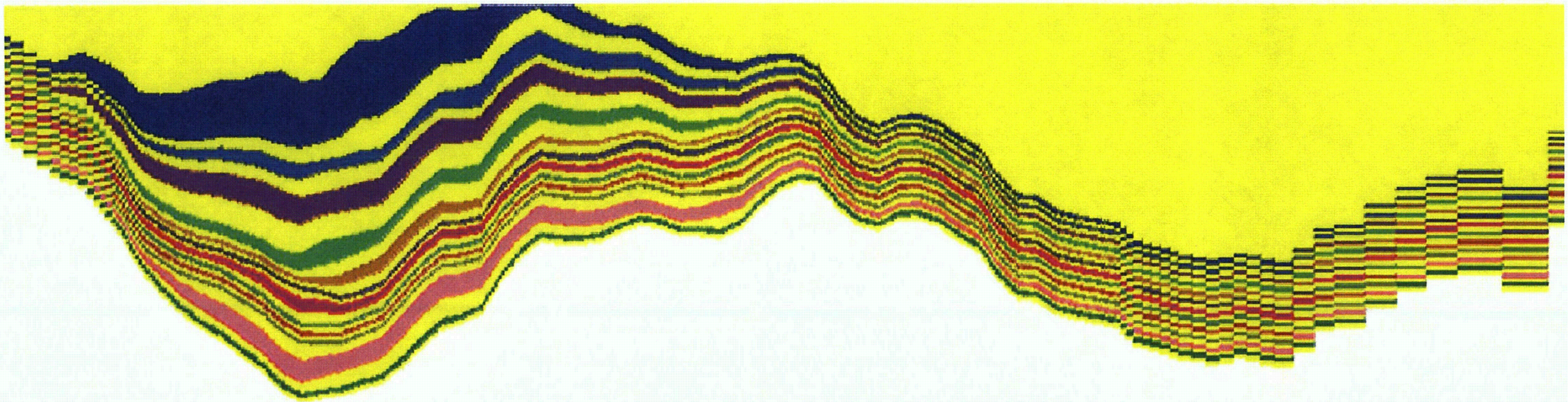
MODEL CROSS-SECTION A-A'

SMITH RANCH-HIGHLAND/REYNOLDS RANCH FACILITIES
CONVERSE COUNTY - WYOMING

FIGURE:
3-3

B

B'



NOTES:
Vertical exaggeration = 100x.
Data interpretation by AQUI-VER, INC.

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0 1.5 3 6
Miles

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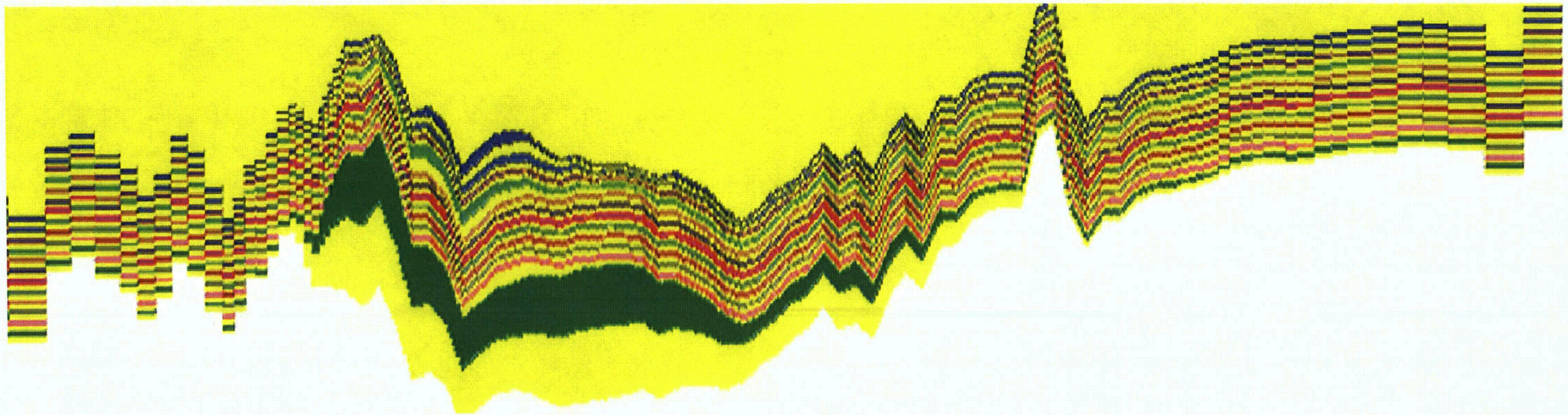
MODEL CROSS-SECTION B-B'

SMITH RANCH-HIGHLAND/REYNOLDS RANCH FACILITIES
CONVERSE COUNTY - WYOMING

FIGURE:
3-4

C

C'



NOTES:
Vertical exaggeration = 100x.
Data interpretation by AQUI-VER, INC.

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0 1.5 3 6
Miles

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MODEL CROSS-SECTION C-C'

SMITH RANCH-HIGHLAND/REYNOLDS RANCH FACILITIES
CONVERSE COUNTY - WYOMING

FIGURE:
3-5

Legend

- Water Well User Location - Drawdown Target
- Smith Ranch - Highland Proposed Boundary
- Reynolds Proposed Boundary
- 10 Mi. Buffer
- Interstate
- Highway
- Intermittent Stream
- Perennial Stream

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco.

Natrona Co
Converse Co
Bill
Evansville
Glenrock
Dry Fork Cheyenne River
Box Creek
North Fork
Lightning Creek
Sage Creek
Stud Creek
North Platte River
59
256
20
95
258
25

AQUI-VER, INC. *Hydrogeology, Water Resources & Data Services*	0 2 4 8 Miles STATE PLANE ZONE EAST NAD27	PROJECT # 40100545 DATE: 9/12/11 DRAWN BY: CLIN REVIEWED BY: BSMITH DOCUMENT NAME AND PATH	Cameco	**WATER-TABLE ELEVATION** SMITH RANCH-HIGHLAND/REYNOLDS RANCH FACILITIES CONVERSE COUNTY - WYOMING	**FIGURE:** 3-6

N

Legend

- Water Supply Well
- Smith Ranch - Highland Proposed Boundary
- Reynolds Proposed Boundary
- 10 Mi. Buffer
- Interstate
- Highway
- Intermittent Stream
- Perennial Stream

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco.

MANNING 7 B C
MANNING 1 B C
MANNING B C 17
MANNING #12 B C
CONOCO 36-4-38-74
MANNING 8 B C
TIN CAKE HOUSE
BROOK # 1
ELEC.WELL-RICK
Solar Well #1
PATTERSON #9
RED WINDMILL-JANE
KENNY
OLD BRANDING CORRALE
SCHOOL PATTERSON 36-3
FEDERAL 12 T
BEAR CREEK
JUDSON
QUICK DRAW #3
WEST 11
DON #55 1
HENRY #5
HORNBUCKLE #18
BUCK PASTURE #1
RESERVOIR PASTURE #1
PEN #55 1
HORNBUCKLE #24
HORNBUCKLE WELL #25
LO #1000W
SAGE CREEK GAS PLANT WATERWELL #1
LO #1 (DEEPENED)
ENL L O #1
BAKER #12
HARDY #13
MANNING #11 B C
MANNING #7 B 138
MANNING B C 18
ORPHA TRAIL WELL #1
CARSON (PHILLIPS) #1
HARDY #T B 139
HARDY #T.B. 267
SKY #1
MAIL BOX
HORNBUCKLE WELL #11
HORNBUCKLE #23
MANNING 5 B C
STRANGE FED #1-27
SPEAR-K RANCH #1
MANNING 4 B C
MANNING #15 B C
SCOTTIE
MANNING 6 B C
MANNING #13 B C
HENRY #9
WES DIPPING VAT
SOUTH PAST. SOLAR
HORNBUCKLE WELL #8
HORNBUCKLE WELL #10
WIND #55 1
HENRY #3
HORNBUCKLE WELL #7
HOOPER HOUSE WELL
HORNBUCKLE WELL #4
HORNBUCKLE #21
REYNOLDS #36 (DEEPENED)
MASON #3
MASON #2
LOWER BROWN SPRINGS #1
HORNBUCKLE #20
HORNBUCKLE #19
NORTH
SMITH #49
LENZEN RANCH CO #3
SMITH 61
LENZEN #1
SMITH #50
CHEYENNE RIVER #1
TILLARD 55 #3
SEIDEL #1
POPSKULL 26-2
BAKER #14
BECK-IN-SMITHS #17
WILLIAMS #1
JOAN #2
VAN BUSKIRK #1
Hoyer #1
EMVY #1
HOYER #1
LEYRER #1
SCHOLTZ #1 / SCHOLTZ #2
MOOREN # 1, ROY #1, J&J #1-A 15, J&J #1 A 20, J&J 1-57, J&J 1-69, LINDIG #1, HOWE #1, MARY #1, GURWELL #1, SHIDELER #1, SPENCER PASTURE #16
DAVIS #1
RUNNION #1
TILLARD RANCH 16
NEGLEY #3
TILLARD NO 11
NEGLEY #4
NEGLEY #5
TILLARD RANCH 15
HENRY KEENAN #5
NORTH DONA #1
SMITH #6
EVANOFF #3
BERNARD #1
E EVANOFF #1
HENRY #2
HENRY KEENAN #1
HENRY KEENAN #3
MADSEN #1
SCOTT MEEKER
MADSEN #3
MANNING #7
MANNING #8
#3 G MANNING DOMESTIC WELL
MANNING #10
MANNING #6
#1 G MANNING SOUTHWEST WINDMILL
MANNING #9
NUMRICH #3
FOWLER #1
COWGER 1
LUND #2
NORTH BOX #130
BOLAND #1
ENL HIGHLAND #23
NORTH BOX #2
ENL HIGHLAND #22
BULL PASTURE
BOX CREEK #3
MONUMENT #68
SOUTH BOX #1
EAST JENKINS #13
LIGHTNING CREEK
MORTON #T B 113
BALLARD #7 #37-7
MADSEN #6
BALLARD #9, #37-9
BALLARD #8 #37-8
BALLARD #4, #37-4
BALLARD HOUSE #37-1
SOUTHEAST BALLARD, #37-5
BALLARD #5, #37-5
JAKE JOHNSON #7
BALLARD #6, #37-6
JAKE JOHNSON #4
JAKE JOHNSON #5
JAKE JOHNSON #6
PAXTON #1 NW
ANDERSON #1
MACHINE PASTURE #122
READ WELL #1
READ WELL #2
BAKER #1
BAKER 10 A
HORNBUCKLE WELL #4
DCR # 27 (37-73)
DUCK CREEK #31
DUCK CREEK #28
DUCK CREEK #32
REYNOLDS #32
DUCK CREEK #1
REYNOLDS NO. 3
MASON #1
UPPER BROWN SPRING #1
DUCK CREEK #1-2
REYNOLDS #13
DUCK CREEK #17
SMITH #51
REYNOLDS #20
TERRELL NO. 1
SMITH #34
ADAMS #1
VOLLMAN #4
SMITH #33
REYNOLDS #21-3
VOLLMAN #6
WW 109 A
VOLLMAN #2
VOLLMAN #5
VOLLMAN #1
VOLLMAN #3
SMITH #41
SMITH #32
SMITH #31
SMITH #35
TAYLOR # 3
HAY MEADOW #1
HAY MEADOW #1
SMITH 46
HERMA # 3
SMITH #28
SOLAR PANEL 2
SMITH #18
SMITH #16
SMITH #27
POTTS #1
SMITH #47
SMITH #29
SMITH #17
STROCK #2
#15 SMITH
EAST SHEARING PENS #1
TILLARDS 55 #3
BOWMAN #1
SMITH #36
SHORTY SPEAR #1
SMITH #26
SMITH #24
SMITH #30
STROCK #1
URSEY #1
SMITH #25
SMITH #48
SPENCER #2
MARY WHITE #1
SMITH #42
ONIEL #3
SOUTH
SMITH #14
WEST DOWNS #1
SMITH #22
SMITH #20
TOMMY #1
DUGAN #3
SPENCER #15
WINSINGER #1
EDWARDS #97
HENRY KEENAN #4
SMITH #21
LAYTON #2
SMITH #13
KEENAN #36
LAYTON #5
WILLIAMS SPRINGS #102
BUD HALL #1
LAYTON #1
SMITH #38
DEIL #1
SMITH #37
SMITH #10
STROCK #1
HILL TOP #1
FLEMING #1
SMITH #9
SMITH #44
LAYTON #4
LYNCH #1
DUGAN #2
LAKE PASTURE #1
SMITH #3
Strock #2
SMITH #52
CLARK DUGAN #1
ED MOORE, SPRING PASTURE WELL #1
SMITH #4
LAYTON #1
SMITH #45 (DEEPENED)
PACIFIC POWER & LIGHT #4
LAYTON #3, ANDERSON #1, HICKERSON #1, BOURQUIN #1, BOURQUIN #2, NEGLEY #1, NEGLEY #2, NEGLEY #6, LUCKY FIVE #1, LUCKY FIVE #2, ELRU #1, KT #1, HIGHWAY CORNER #1, HIGHWAY CORNER #2, RUXTABLE #1
PNS L114
HILDEBRAND #1
KEENAN #4
HILDEBRAND #2

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STATE PLANE ZONE EAST NAD27

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DOMESTIC AND STOCK WELL LOCATIONS

SMITH RANCH-HIGHLAND/REYNOLDS RANCH FACILITIES
CONVERSE COUNTY - WYOMING

FIGURE: 3-7

N

Legend

- Water Supply Well
- Permitted Niobrara Oil Well
- Existing Niobrara Oil Well
- Smith Ranch - Highland Proposed Boundary
- Reynolds Proposed Boundary
- 10 Mi. Buffer
- Interstate
- Highway
- Intermittent Stream
- Perennial Stream

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco.

Natrona Co

Converse Co

Bill

Dry Fork Cheyenne River

Box Creek

North Fork

Sand Creek

Sage Creek

Lightning Creek

North Platte River

Evansville

Glenrock

59

256

20

95

25

258

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STATE PLANE ZONE EAST NAD27

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NIOBRARA SHALE OIL PRODUCTION AND WATER SUPPLY LOCATIONS

SMITH RANCH-HIGHLAND/REYNOLDS RANCH FACILITIES
CONVERSE COUNTY - WYOMING

FIGURE: 3-8

4. HYDROLOGIC IMPACT SIMULATIONS

Independent hydrologic impact simulations were completed using for the SRH-RR ISR development and for Niobrara Shale oil well drilling and fracking operations. The cumulative hydrologic impact was then simulated by combining impacts of both operations into a single model simulation.

Hydrologic impacts were simulated over a 33-year future ISR development period, beginning in the first quarter of 2011 (Development Year 1). Niobrara Shale oil well drilling and fracking operations were assumed to begin simultaneously in Development Year 1 and continue through Development Year 2.

4.1 SRH-RR ISR IMPACT ASSESSMENT

Hydrologic impacts due to the operation of the SRH-RR ISR facility were simulated over an estimated 33-year development and restoration period beginning in the 1st quarter of 2011 and continuing through the last quarter of 2053. The SRH-RR impact simulation includes 24 existing and planned future mine units, as shown on **Figure 4-1**.

4.1.1 SRH-RR Operations

Groundwater withdrawals for the SRH-RR impact simulations were developed from wellfield production and restoration bleed rates (net pumping rates) presented in water balance information provided by Cameco Resources for existing and future mine units (**Attachment C**).

Groundwater withdrawals due to ISR production are assumed to be one percent of total wellfield production (one percent bleed). The ISR production bleed is expected to vary from 60 to 140 gallons per minute (gpm) over the life of the mine, with maximum production occurring in Development Year 3.

Groundwater withdrawals due to ISR restoration are assumed to be 25 percent of total restoration flow (25 percent bleed), equivalent to a 75 percent Reverse Osmosis treatment efficiency with 25 percent brine reject (for disposal). The ISR restoration bleed is expected to vary from 163 to 856 gpm over the life of the mine, with maximum restoration withdrawals occurring in Development Year 7. Total groundwater withdrawals due to ISR production and restoration vary from 163 gpm at the end of the mine life, to a maximum of 963 gpm in Development Year 7.

Groundwater withdrawals were simulated in the groundwater flow model as a series of one to three pumping centers spread uniformly across each mine unit, which should provide an adequate spatial distribution given the scale of this study. The location of MODFLOW pumping wells is illustrated in **Figure 4-2.** The simulated pumping rate and duration for each model production well is tabulated and summarized in **Attachment A, Table A-1**.

4.1.2 SRH-RR Impact Assessment Results

Projected hydrologic impacts (drawdown) associated with the SRH-RR ISR operation are summarized in **Table 4-1**. **Figures 4-3 through 4-15** illustrate the model drawdown distribution in the water-table aquifer and ISR production sands at the time of the maximum projected drawdown. The majority of stock and

domestic wells in this study are completed in multiple sand units (model layers). Drawdown values shown in **Table 4-1** for wells completed in multiple sand intervals represents the flow-weighted average of the drawdown observed in each individual sand unit.

Drawdown in the shallow water-table aquifer due to ISR operations is predicted to be less than 10 feet at stock and domestic well locations over the life of the mine. ISR impacts greater than 10 feet are predicted in one stock watering and domestic supply well completed in the deeper production sand aquifer located nearest to the SRH-RR facilities. A maximum impact of 21.85 feet was computed in stock watering and domestic supply well Mason #3 in Development Year 18, located adjacent to the Reynolds Ranch satellite ISR facilities and completed in the deeper production sand interval. In general, maximum impacts occur toward the end of the mine life, but the timing of maximum impacts at individual stock and domestic wells varies significantly based on their relative proximity to the SRH-RR property and the well completion interval (depth). The predicted drawdown due to ISR development should not have an adverse impact on water resources in the area.

4.2 LUDEMAN ISR PROJECT AND DEEP DISPOSAL WELL IMPACT ASSESSMENT

The United States Nuclear Regulatory Commission (NRC) requested that Cameco evaluate the hydrologic impacts of Uranium One's Ludeman ISR Project located approximately four miles south of SRH-RR, including the cumulative impacts of Deep Disposal Wells (DDW's). The NRC requested this analysis as part of their in their review of the SRH-RR Environmental Report (ER), Request for Additional Information (RAI) CI-2. Specifically, RAI CI-2 states:

> ***"Please provide an assessment of the impacts of the proposed Ludeman Project by Uranium One in the cumulative impacts analysis for the Smith Ranch site.***
>
> *In Table 2-1 of the ER, the Ludeman Project, an RFFA, is proposed to be developed within the same geographic area modeled for Smith Ranch site cumulative impacts; however, it is not clear how or if the Ludeman Project was addressed in Cameco's cumulative impact analysis. For example, the model of cumulative hydrologic impacts for the Smith Ranch site is presented in Appendix E of the ER, but the impacts of the Ludeman Project's operations are not evaluated in the ER's Appendix E's model. Additionally, the anticipated volumes of liquid process wastes at the Ludeman Project to be disposed via deep well injection should be included in Cameco's assessment of cumulative impacts to deep aquifers from deep well injection.*
>
> *Cameco's cumulative impact assessment should include impacts from the proposed Ludeman Project."*

The Ludeman Project and DDW hydrologic impact assessment is included in **Attachment D**.

4.2.1 LUDEMAN Project and DDW Impact Assessment Results

Results of the Ludeman and SRH-RR ISR impact assessment indicates a small incremental increase in drawdown of less than 1-foot is predicted as a result of Ludeman and SRH-RR impacts on one another (see

Figures 2 through 7, Attachment D). Given these results, cumulative hydrologic impacts resulting from the combined Ludeman Project and SRH-RR operations are very similar to individual facility impacts, and should not adversely impact ISR operations or water resources at either facility. Likewise, results of the DDW impact assessment indicates the operation of DDW's at the Ludeman Project and SRH-RR should not hydraulically influence or otherwise adversely impact one another.

4.3 SMITH #1 IRRIGATION WELL IMPACT ASSESSMENT

The U.S. NRC requested that Cameco evaluate the hydrologic impacts of the Smith #1 irrigation well located in Section 12, T35N, R74W. The well is located approximately 3,200 feet east of the closest injection and production wells in Mine Unit 15A (See **Figure 1, Attachment E**). This assessment was requested by the United States Nuclear Regulatory Commission (NRC) in their review of the Technical Report (TR) portion of the license renewal application for Source Materials License SUA-1584 as a Request for Additional Information (RAI) 8. Specifically, RAI 8 states:

> *"Cameco stated two irrigation wells were completed in Section 12 of T35N, R74 W on page D6-12 of the Wyoming Department of Environmental Quality (WDEQ) Smith Ranch permit. Staff was not able to find the Wyoming State Engineer's Office (WSEO) permit numbers for these wells to determine their completion interval or ground water rates to assess if they may affect the safety of operations.*
>
> *Please provide the WSEO permit names for the two irrigation wells installed in Section 12 of T35NR74 W. Please identify the aquifers in which these wells are completed. Please provide the current status of these wells. Please assess if the ground water use at these wells could affect hydraulic control of nearby mine units within the Smith Ranch license area".*

The Smith #1 irrigation well impact assessment is included in **Attachment E.**

4.3.1 Smith #1 Irrigation Well Impact Assessment Results

The maximum drawdown and radius of influence produced by irrigation well Smith #1 after 5 months of irrigation is shown on **Figure 1 of Attachment E**. These results demonstrate irrigation pumping from Smith #1 should not adversely affect hydraulic control of mining solutions in neighboring mine units, as the drawdown and resulting radius of influence produced by irrigation pumping is insufficient to overcome the inward hydraulic gradient produced by the production bleed in MU-15A.

4.4 NIOBRARA SHALE DEVELOPMENT IMPACT ASSESSMENT

Hydrologic impacts due to recent Niobrara Shale well drilling and fracking operations were simulated over a limited two-year development period. The simulation accounts for the development of a shallow groundwater supply needed to support existing and permitted Niobrara Shale horizontal well drilling and fracking operations within a 10-mile radius of the facility. It is recognized that Niobrara Shale well development may be significantly larger and of greater longevity than simulated in this study. However, the Niobrara Shale oil play is in an early stage of exploration and development, and there are no definitive data

to suggest what the actual level of development activity will be in the long term. Therefore, this assessment is limited only to existing and permitted wells in the WYOGC database.

As described in Section 3.4, it is estimated that 4-5 million gallons of water will be needed to drill and frack a single horizontal shale oil well. There are currently eight existing or permitted Niobrara Shale horizontal wells within a 10-mile radius of the SRH-RR facility **(Figure 3-8).** Therefore, it is conservatively estimated 40 million gallons of groundwater will be needed to support the drilling and fracking operations over an estimated two-year development period. The impact assessment assumes that water for the drilling and fracking operations will be supplied by eight water supply wells permitted by the oil field operator (Chesapeake Operating, Inc.), as shown in **Figure 3-8**. Each well is assumed to pump at a constant rate of 4.76 gpm for a period of two years (equivalent to a total volume of 40 million gallons).

The U.S. NRC requested an evaluation of additional fracking water supply wells after submittal of the original Cumulative Hydrologic Impact Assessment for SRH-RR dated January 26, 2012. The U.S. NRC requested this analysis as part of their review of the Technical Report (TR) portion of the license renewal application for Source Materials License SUA-1584, Request for Additional Information (RAI) 9. Specifically, RAI 9 states:

> *"Cameco identified three new wells, P193308.0W, P189481.0W, and P193341.0W, which were installed in either 2009 or 2010 near Smith Ranch. These wells have permitted water use rates of 150, 25, and 150 gpm. The permits state the wells are associated with oil and gas drilling operations. Staff could not determine if the wells have been installed or could affect operations.*
>
> *Cameco approved in either 2009 or 2010. Please provide the current status of these wells. Please identify the aquifers in which these wells are completed. Please evaluate if the use of these wells could affect the hydraulic control of nearby mine units in the Smith Ranch license area."*

The additional fracking water supply well impact assessment is included in **Attachment F.**

4.4.1 Niobrara Shale Development Results

Projected hydrologic impacts (drawdown) associated with Niobrara Shale well drilling and fracking operations are summarized in **Table 4-1 and Attachment F**. Maximum hydrologic impacts occur in wells closest to water supply wells and those that are completed in the water-table aquifer (Layer 1). Drawdown in the shallow water-table aquifer due to limited Niobrara Shale development is very limited and less 1-foot at all stock and domestic well locations over the two-year development period. A maximum drawdown of 0.09 foot was computed at stock watering well Smith #17 at the end of impact simulation (Development Year 2).

4.5 CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT RESULTS

The cumulative hydrologic impact (drawdown) associated with SRH-RR and limited Niobrara Shale development was computed by simulating the simultaneous development of ISR and Niobrara Shale impacts. For this assessment, it was assumed that ISR and Niobrara Shale development activities begin simultaneously at the beginning of Development Year 1.