ATTACHMENT B

OIL AND GAS WELL INFORMATION

Permitted and Producting Niobrara Shale Oil Wells

Api_Number	Company	Well_NO	Unit_Lease	Qtr1	Qtr2	Section_	Township	Range	Elevation	Foot1	Foot2	Lease_No	Field	County	Status	TD	Bot_Form	Comments
49-009-28435	SAMSON RESOURCES COMPANY	24-30 38-73H	BUFFUM FEDERAL	SE	SW	30	38N	73W	5193	135 FSL	1881 FWL	WYW118536	HORNBUCKLE	Converse	AP	10172	NIOBRARA	Permitted
49-009-28271	CHESAPEAKE OPERATING INC	35-73 16-2H	SPILLMAN DRAW UNIT	SE	SE	16	35N	73W	5297	330 FSL	495 FEL	ST 08-000215	PURPLE SAGE	Converse	AP	12495	NIOBRARA	Permitted
49-009-28262	CHESAPEAKE OPERATING INC	35-73 20-1H	SPILLMAN DRAW UNIT	NW	NW	20	35N	73W	5259	210 FNL	1046 FWL	WYW175919	WC	Converse	AP	12713	NIOBRARA	Permitted
49-009-28400	EOG RESOURCES INC	30-23H	SAGE CREEK	NE	NW	23	35N	74W	5451	280 FNL	1585 WL	WYW4160410	WC	Converse	AP	12904	NIOBRARA	Permitted
49-009-28409	CHESAPEAKE OPERATING INC	36-73 36-1H	SPILLMAN DRAW UNIT	SW	NW	36	36N	73W	5398	1480 FNL	610 FWL	ST 05-00255	WC	Converse	DP	12356	NIOBRARA	Permitted
49-009-28411	CHESAPEAKE OPERATING INC	35-73 10-1H	SPILLMAN DRAW UNIT	SE	SE	10	35N	73W	5393	384 FSL	1253 FEL		WC	Converse	DP	12538	NIOBRARA	Permitted
49-009-28428	CHESAPEAKE OPERATING INC	35-73 10-2H	SPILLMAN DRAW UNIT	SE	SE	10	35N	73W	5392	353 FSL	1254 FEL	WYW175918	WC	Converse	AP	12509	NIOBRARA	Permitted
928248	CHESAPEAKE OPERATING INC	No. 35-73 15-1H	SPILLMAN DRAW UNIT	SE	SE	15	35N	73W	5309	1422 FSL	1428 FWL	WYW149955	PURPLE SAGE	Converse	PO	12485	NIOBRARA	Producing Oil

PRODUCING OIL AND GAS WELLS WITHIN 10 MILE RADIUS OF SRH-RR FACILITY

Api_Number	Township	T_Dir	Range	R_Dir	County	Permit_No	WellNumber	UnitLease	Qtr1	Qtr2	Section	Company	LeaseNum	FieldName	ElevationK	StatYear	TotalDepth	BotForm	Frm2StatYr	OilBBLS	GasMCF	WaterBBLS
906285	33	N	75	W	9	6285	No. 2	REFINERY PATENTED	NE	NW	5	LINC ENERGY PETROLEUM WYO INC		GLENROCK	5021 KB	1978	7258	LAKOTA	2011	262,958	8,963	509,546
921434	35	N	70	W	9	21434	No. 1	GOODRICH	SE	NW	6	BLACK BEAR OIL CORPORATION		MIKES DRAW	4960 KB	1978	7804	TEAPOT	2011	56,007	70,852	26,300
921465	35	N	70	W	9	21465	No. 1	HOLMES FEE	NE	NE	6	BLACK BEAR OIL CORPORATION		MIKES DRAW	4932 KB	1979	7720	TEAPOT	2011	149,627	258,337	23,852
921546	35	N	71	W	9	21546	No. 21-4	GRABLE	NE	NW	4	BLACK BEAR OIL CORPORATION	WYW63034	SCOTT	5141	1979	8742	PARKMAN	2011	92,974	319,143	13,399
921561	35	N	71	W	9	21561	No. 23-5	CAMPBELL	NE	SW	5	BLACK BEAR OIL CORPORATION	WYW44175	SCOTT	5111	1979	8811	PARKMAN	2011	116,072	340,505	23,979
921516	35	N	71	W	9	21516	No. 21-5	CAMPBELL	NE	NW	5	BLACK BEAR OIL CORPORATION	WYW44175	SCOTT	5144	1979	8815	PARKMAN	2011	129,718	304,858	23,307
921558	35	N	71	W	9	21558	No. 21-8	CAMPBELL	NE	NW	8	BLACK BEAR OIL CORPORATION	WYW44175	SCOTT	5120	1979	8830	PARKMAN	2011	105,224	205,649	23,489
921507	35	N	71	W	9	21507	No. 2-6	LITTLE CEASAR	NE	NW	6	HYPERION OIL & GAS LLC	ST 77-451	SCOTT	5064 KB	1979	8878	PARKMAN	2011	142,287	241,182	39,590
921519	35	N	71	W	9	21519	No. 3-6	HARRIET	NE	SE	6	MATRIX PRODUCTION COMPANY	FEE	SCOTT	5118 KB	1979	8881	PARKMAN	2011	108,509	133,724	27,951
921646	35	N	71	W	9	21646	No. 4-6	WAGNER	NE	SW	6	HYPERION OIL & GAS LLC	WYW60401A	SCOTT	5166 KB	1979	8900	PARKMAN	2011	143,214	254,665	37,459
921596	35	N	71	W	9	21596	No. 1	MORTON SCOTT FEE	NE	SE	7	CHACO ENERGY COMPANY		SCOTT	5167	1979	8900	PARKMAN	2011	58,674	140,917	26,202
921559	35	N	71	W	9	21559	No. 23-8	CAMPBELL	NE	SW	8	BLACK BEAR OIL CORPORATION	WYW44175	SCOTT	5241	1979	8951	PARKMAN	2011	87,767	261,040	21,260
921687	35	N	71	W	9	21687	No. 2	MEASOR FED W-60401	NE	NW	12	BLACK BEAR OIL CORPORATION	WYW60401	MIKES DRAW	4969 KB	1980	8400	PARKMAN	2011	153,017	136,481	31,373
921792	35	N	71	W	9	21792	No. 21-27	KEELY	NE	NW	27	HYPERION OIL & GAS LLC	FEE	SCOTT	5173 KB	1980	8729	PARKMAN	2011	116,958	54,335	38,753
921794	35	N	71	W	9	21794	No. 2	BECKY	NE	SW	15	PRIMA EXPLORATION INC	WYW50677	SCOTT	5133	1980	8748	PARKMAN	2011	76,518	59,471	2,449
921590	35	N	71	W	9	21590	No. 11-4	FEDERAL W-60402	NE	SW	4	HYPERION OIL & GAS LLC	WYW60402	SCOTT	5199 KB	1980	8756	PARKMAN	2011	95,805	263,283	27,819
921738	35	N	71	W	9	21738	No. 3	GATES FEDERAL	NE	NW	21	HYPERION OIL & GAS LLC	WYW62625	SCOTT	5135 KB	1980	8800	PARKMAN	2011	100,675	188,879	40,367
921712	35	N	71	W	9	21712	No. 21-28	IRWIN	NE	NW	28	HYPERION OIL & GAS LLC	FEE	SCOTT	5119 KB	1980	8807	PARKMAN	2011	123,344	65,370	32,385
921647	35	N	72	W	9	21647	No. 1-1	SCOTT STATE 76-0380	NE	NE	1	HYPERION OIL & GAS LLC	76-0380	SCOTT	5094 KB	1980	8822	PARKMAN	2011	145,105	256,904	86,007
921665	35	N	71	W	9	21665	No. 1-3	FEDERAL 952	SW	NE	3	HYPERION OIL & GAS LLC	WYW59952	SCOTT	5195 KB	1981	8550	PARKMAN	2011	89,530	88,712	58,670
921795	35	N	71	W	9	21795	No. 3	BECKY	NE	NE	15	PRIMA EXPLORATION INC	WYW50677	SCOTT	5079	1981	8633	PARKMAN	2011	62,218	47,945	23,678
921843	35	N	71	W	9	21843	No. 43-28	BLAKE FEDERAL	NE	SE	28	HYPERION OIL & GAS LLC	WYW56933B	SCOTT	5227 KB	1981	8800	PARKMAN	2011	97,885	62,779	19,510
921946	35	N	71	W	9	21946	No. 32-6	WENDY	SW	NE	6	HYPERION OIL & GAS LLC	FEE	SCOTT	5088 KB	1981	8804	PARKMAN	2011	151,764	310,786	19,596
921802	35	N	72	W	9	21802	No. 1	HAWTHORN FEDERAL	NE	SE	1	HYPERION OIL & GAS LLC	WYW51172	SCOTT	5089 KB	1981	8879	PARKMAN	2011	104,661	208,221	89,837
921966	35	N	72	W	9	21966	No. 1-11	FEDERAL W-55819	NE	SW	1	BLACK BEAR OIL CORPORATION	WYW106213	SCOTT	5145 KB	1981	8950	PARKMAN	2011	98,930	185,201	92,034
921789	35	N	72	W	9	21789	No. 1-3	FEDERAL W-62625	NE	NW	1	BLACK BEAR OIL CORPORATION	WYW62625	SCOTT	5205 KB	1981	8987	PARKMAN	2011	60,280	180,997	114,834
922032	35	N	71	W	9	22032	No. 23-27	DUNCO FEDERAL	NE	SW	27	HYPERION OIL & GAS LLC	WYW33781	SCOTT	0	1982	8867	PARKMAN	2011	76,262	40,303	17,672
922195	35	N	71	W	9	22195	No. 12-5	CAMPBELL	SW	NW	5	BLACK BEAR OIL CORPORATION	WYW44175	SCOTT	5074	1983	9735	PARKMAN	2011	78,680	202,472	18,827
922043	35	N	71	W	9	22043	No. 13-4	FEDERAL W-60402	SW	SW	4	HYPERION OIL & GAS LLC	WYW60402	SCOTT	5224 KB	1983	10050	SUSSEX	2011	260,386	420,895	103,550
922358	35	N	71	W	9	22358	No. 14-5	CAMPBELL	SW	SW	5	BLACK BEAR OIL CORPORATION	WYW44175	SCOTT	5125	1984	8850	PARKMAN	2011	71,349	287,438	42,783
922359	35	N	71	W	9	22359	No. 12-8	CAMPBELL	SW	NW	8	BLACK BEAR OIL CORPORATION	WYW44175	SCOTT	0	1984	8922	PARKMAN	2011	55,324	178,524	40,196
922357	35	N	71	W	9	22357	No. 12-4	GRABLE	SW	NW	4	BLACK BEAR OIL CORPORATION	WYW63034	SCOTT	0	1984	9971	PARKMAN	2011	74,806	249,686	10,239
921544	35	N	71	W	9	21544	No. 2-4	DONNELL	NE	NE	4	HYPERION OIL & GAS LLC	FEE	SCOTT	5075 KB	1985	8593	PARKMAN	2011	107,325	163,017	48,406
921815	35	N	71	W	9	21815	No. 23-22	MORTON	NE	SW	22	HYPERION OIL & GAS LLC	FEE	SCOTT	5079 KB	1985	8658	PARKMAN	2011	112,168	52,256	51,148
922128	35	N	72	W	9	22128	No. 3-2	ADCOCK	NE	SE	2	BLACK BEAR OIL CORPORATION		SCOTT	0	1985	9038	PARKMAN	2011	94,737	73,291	183,518
922197	35	N	71	W	9	22197	No. 32-5	CAMPBELL	SW	NE	5	BLACK BEAR OIL CORPORATION	WYW44175	SCOTT	5137	1985	9999	SUSSEX	2011	154,766	317,561	30,045
921639	35	N	71	W	9	21639	No. 1-10	FEDERAL SHELDON DRAW	NE	NW	10	HYPERION OIL & GAS LLC	WYW59952	SCOTT	5109 KB	1986	8605	PARKMAN	2011	101,956	89,469	65,767
921638	35	N	71	W	9	21638	No. 2-10	FEDERAL 952 (SHLEDON	NE	SW	10	HYPERION OIL & GAS LLC	WYW59952	SCOTT	5154 KB	1986	8717	PARKMAN	2011	103,899	83,586	61,735
921623	35	N	71	W	9	21623	No. 41-20	CAMPBELL	NE	NE	20	BLACK BEAR OIL CORPORATION	WYW44175	SCOTT	5202	1987	8916	PARKMAN	2011	55,067	104,990	72,012
922706	35	N	75	W	9	22706	No. 28-1	POPSKULL FEE	SE	NW	28	MONCRIEF W A JR		POPSKULL	0	1989	12342	MORRISON	2011	179,536	80,878	39
922747	35	N	75	W	9	22747	No. 28-2	POPSKULL	NW	NE	28	MONCRIEF W A JR	FEE	POPSKULL	5412 KB	1991	12500	MORRISON	2011	134,816	55,258	5
921640	35	N	71	W	9	21640	No. 1-7	DONNELLY	NE	NE	7	HYPERION OIL & GAS LLC	FEE	SCOTT	5197 KB	1994	8891	PARKMAN	2011	98,270	140,137	96,728
922810	35	N	71	W	9	22810	No. 34-9	MORTON	SW	SE	9	HYPERION OIL & GAS LLC	FEE	SCOTT	5184	1994	9966	SUSSEX	2011	114,902	100,369	9,462
921951	35	N	71	W	9	21951	No. 21-22	SHARYN	NE	NW	22	HYPERION OIL & GAS LLC	ST 79-284	SCOTT	5049 KB	1997	8633	PARKMAN	2011	100,944	50,480	24,311
921571	35	N	71	W	9	21571	No. 3-4	LITTLE NICK	NE	SE	4	HYPERION OIL & GAS LLC	FEE	SCOTT	5180 KB	1997	8749	PARKMAN	2011	104,773	139,731	85,655
922290	35	N	71	W	9	22290	No. 34-4	LOGAN B	SW	SE	4	HYPERION OIL & GAS LLC	FEE	SCOTT	5172 KB	1997	8778	PARKMAN	2011	74,944	148,668	41,357
922116	35	N	71	W	9	22116	No. 43-27	KEITH FEDERAL	NE	SE	27	HYPERION OIL & GAS LLC	WYW33781	SCOTT	5243 KB	1997	8839	PARKMAN	2011	66,806	39,786	50,609
922330	35	N	71	W	9	22330	No. 12-9	GULFSHORE	SW	NW	9	HYPERION OIL & GAS LLC	WYW56933C	SCOTT	5173	1997	10024	PARKMAN	2011	115,915	200,025	12,763
921591	35	N	71	W	9	21591	No. 23-9	MORTON	NE	SW	9	HYPERION OIL & GAS LLC	FEE	SCOTT	5228 KB	1997	10050	PARKMAN	2011	133,517	173,665	21,362
922944	35	N	71	W	9	22944	No. 32-16	BOWMAN DRAW	SW	NE	16	HYPERION OIL & GAS LLC	ST 70-3986	SCOTT	5143	1997	10050	SUSSEX	2011	124,503	211,952	12,024
922372	35	N	71	W	9	22372	No. 12-22	BRYAN	SW	NW	22	HYPERION OIL & GAS LLC	FEE	SCOTT	5101	1997	10050	PARKMAN	2011	164,332	123,936	46,223
921804	35	N	71	W	9	21804	No. 4	GATES FEDERAL	NE	SW	21	HYPERION OIL & GAS LLC	WYW62625	SCOTT	5092 KB	1998	8696	PARKMAN	2011	180,221	127,956	110,013
922940	35	N	71	W	9	22940	No. 12-27	KEELEY	SW	NW	27	HYPERION OIL & GAS LLC	FEE	SCOTT	0	1998	10026	SUSSEX	2011	93,406	75,266	6,535
921947	35	N	76	W	9	21947	No. 1	WILLIAM VALENTINE	NW	SE	27	CHESAPEAKE OPERATING INC		V-TWO DRAW	5495	1998	12485	TENSLEEP	2011	116,679	0	295
921497	35	N	71	W	9	21497	No. 1-6	JACK MORTON	NE	NE	6	HYPERION OIL & GAS LLC	FEE	SCOTT	5061 KB	1999	8590	PARKMAN	2011	130,259	289,258	30,823
922341	35	N	71	W	9	22341	No. 2-3	SHELDON DRAW FEDERAL	NE	NE	3	HYPERION OIL & GAS LLC	WYW59952	SCOTT	5127 KB	1999	8630	PARKMAN	2011	48,344	72,335	27,984
922014	35	N	71	W	9	22014	No. 21-3	SHEILA FEDERAL	NE	NW	3	HYPERION OIL & GAS LLC	WYW33310	SCOTT	5091 KB	1999	8638	PARKMAN	2011	84,576	100,626	11,512
921996	35	N	71	W	9	21996	No. 43-21	CTT	NE	SE	21	HYPERION OIL & GAS LLC	FEE	SCOTT	5101 KB	1999	8728	PARKMAN	2011	129,073	85,968	64,995
921844	35	N	71	W	9	21844	No. 41-28	TROY FEDERAL	NE	NE	28	HYPERION OIL & GAS LLC	WYW56933B	SCOTT	5167 KB	1999	8756	PARKMAN	2011	78,645	26,736	103,448
922331	35	N	71	W	9	22331	No. 14-6	CANNON	SW	SW	6	HYPERION OIL & GAS LLC	WYW60401A	SCOTT	5110 KB	1999	8860	PARKMAN	2011	67,060	99,262	85,483
921825	35	N	71	W	9	21825	No. 32-27	JILL	SW	NE	27	HYPERION OIL & GAS LLC	FEE	SCOTT	5212 KB	1999	10020	PARKMAN	2011	91,446	42,561	31,660

920410	35 N	71 W	9	20410	No. 1	BOWMAN DRAW STATE	NE	NE	16	HYPERION OIL & GAS LLC	ST 70-3986	SCOTT	5151	2000	9953	PARKMAN	2011	89,176	143,479	34,255
921735	35 N	71 W	9	21735	No. 2	BOWMAN DRAW STATE	NE	SW	16	HYPERION OIL & GAS LLC	ST 70-3986	SCOTT	5115	2000	9975	PARKMAN,SS	2011	140,039	338,013	35,532
921593	35 N	71 W	9	21593	No. 2	M. E.	NE	SE	8	HYPERION OIL & GAS LLC	FEE	SCOTT	5214 KB	2000	10075	PARKMAN	2011	180,767	301,112	121,262
921594	35 N	71 W	9	21594	No. 1	M. E.	NE	NE	8	HYPERION OIL & GAS LLC	FEE	SCOTT	4851 KB	2000	10077	SUSSEX COAL	2011	105,836	210,054	100,269
921692	35 N	71 W	9	21692	No. 21-9	ANNE D OWEN	NE	NW	9	HYPERION OIL & GAS LLC	WYW56933C	SCOTT	5270 KB	2000	10106	PARKMAN	2011	109,718	167,934	21,834
921573	35 N	71 W	9	21573	No. 41-5	CAMPBELL	NE	NE	5	BLACK BEAR OIL CORPORATION	WYW44175	SCOTT	5094	2001	8738	PARKMAN	2011	132,211	339,293	25,217
922438	35 N	71 W	9	22438	No. 14-22	RED FOX	SW	SW	22	HYPERION OIL & GAS LLC	FEE	SCOTT	5152	2001	9947	PARKMAN	2011	186,037	160,110	40,144
921560	35 N	71 W	9	21560	No. 43-5	CAMPBELL	NE	SE	5	BLACK BEAR OIL CORPORATION	WYW44175	SCOTT	5189	2002	10080	SUSSEX	2011	140,753	324,555	23,754
928001	35 N	71 W	9	28001	No. 12-6	LITTLE CAESAR	SW	NW	6	HYPERION OIL & GAS LLC	ST 77-0451	SCOTT	0	2005	8900	PARKMAN	2011	17,719	24,195	23,996
921685	35 N	71 W	9	21685	No. 41-9	NNG FEDERAL	NE	NE	9	HYPERION OIL & GAS LLC	WYW59952	SCOTT	5170 KB	2007	8717	PARKMAN	2011	98,092	115,350	36,730
922922	35 N	76 W	9	22922	No. 12-26	FEDERAL	NW	SW	26	WINDSOR ENERGY GROUP LLC	WYW126318	V-TWO DRAW	0	2009	10600	DAKOTA	2011	91,078	2,379	2,215
922462	35 N	71 W	9	22462	No. 34-21	PEGGY FEDERAL	SW	SE	21	HYPERION OIL & GAS LLC	WYW56933	SCOTT	5169 KB	2010	8846	PARKMAN	2011	60,459	72,063	40,855
922927	35 N	71 W	9	22927	No. 32-28	TROY FEDERAL	SW	NE	28	HYPERION OIL & GAS LLC	WYW56933B	SCOTT	5167	2010	10027	SUSSEX	2011	28,230	36,605	20,400
922954	35 N	71 W	9	22954	No. 34-27	CLAUSEN RANCH	SW	SE	27	HYPERION OIL & GAS LLC	WYW33781	SCOTT	5317	2010	10200	SUSSEX	2011	46,038	63,721	8,292
928224	35 N	73 W	9	28224	No. 16-1H	SDDU STATE	SE	SW	16	CHESAPEAKE OPERATING INC	ST 04-00085	WC	0	2010	17150	FRONTIER	2011	83,974	71,012	34,969
928248	35 N	73 W	9	28248	No. 35-73 15-1H	SPILLMAN DRAW UNIT	NE	SW	15	CHESAPEAKE OPERATING INC	WYW149955	PURPLE SAGE	0	2011	12485	NIOBRARA	2011	15,986	14,454	17,846
921731	36 N	71 W	9	21731	No. 1	DAUGAARD	NE	SE	28	HYPERION OIL & GAS LLC	WYW50674	SCOTT	4978 KB	0	8565	PARKMAN	2011	127,005	100,557	15,234
921486	36 N	71 W	9	21486	No. 1-32	MORTON	NE	SW	32	HYPERION OIL & GAS LLC	FEE	SCOTT	5033	1978	8686	PARKMAN	2011	147,494	284,179	15,628
921504	36 N	70 W	9	21504	No. 1	THELMA FEE	NE	SE	31	BLACK BEAR OIL CORPORATION		MIKES DRAW	0	1979	7775	TEAPOT	2011	125,955	189,163	23,592
921515	36 N	71 W	9	21515	No. 1-32	FEDERAL W-60402	NE	NE	32	HYPERION OIL & GAS LLC	WYW60402	SCOTT	4997 KB	1979	8577	PARKMAN	2011	140,151	222,710	39,151
921520	36 N	71 W	9	21520	No. 2-32	MARDEL	NE	SE	32	HYPERION OIL & GAS LLC	FEE	SCOTT	5057 KB	1979	8594	PARKMAN	2011	120,682	209,433	12,525
921508	36 N	71 W	9	21508	No. 1-28	EARL	NE	SW	28	HYPERION OIL & GAS LLC	FEE	SCOTT	4982 KB	1979	8595	PARKMAN	2011	89,351	72,724	9,863
921576	36 N	71 W	9	21576	No. 23-29	MERLE	NE	SW	29	BLACK BEAR OIL CORPORATION	WYW60403	SCOTT	4992	1979	8651	PARKMAN	2011	115,993	332,763	33,735
921562	36 N	71 W	9	21562	No. 2-31	R D V	NE	NE	31	HYPERION OIL & GAS LLC	WYW67675	SCOTT	0	1979	8747	PARKMAN	2011	161,464	175,703	25,866
921589	36 N	71 W	9	21589	No. 1-30	MORTON	NE	NW	30	HYPERION OIL & GAS LLC	FEE	SCOTT	4988 KB	1979	8749	PARKMAN	2011	217,226	366,839	45,601
921531	36 N	71 W	9	21531	No. 1-31	BUTCH	NE	SE	31	HYPERION OIL & GAS LLC	FEE	SCOTT	5021 KB	1979	8785	PARKMAN	2011	168,657	237,300	14,631
921588	36 N	71 W	9	21588	No. 2-29	JET	NE	NE	29	HYPERION OIL & GAS LLC	WYW20264	SCOTT	4951	1980	8511	PARKMAN	2011	127,622	119,819	26,391
921587	36 N	71 W	9	21587	No. 3-33	FEDERAL	NE	NW	33	HYPERION OIL & GAS LLC	WYW60402	SCOTT	4996	1980	8540	PARKMAN	2011	197,679	146,127	20,838
921577	36 N	71 W	9	21577	No. 2-33	FEDERAL	NE	NE	33	ANDERSON MANAGEMENT COMPANY	WYW31318	SCOTT	5022	1980	8569	PARKMAN	2011	117,339	104,449	31,532
921637	36 N	71 W	9	21637	No. 1-34	MORTON FEE	NE	SE	34	HYPERION OIL & GAS LLC		SCOTT	5095 KB	1980	8570	PARKMAN	2011	54,909	36,311	13,765
921578	36 N	71 W	9	21578	No. 1-33	FEDERAL	NE	SE	33	ANDERSON MANAGEMENT COMPANY	WYW31318	SCOTT	5031	1980	8620	PARKMAN	2011	135,717	115,475	31,360
921614	36 N	71 W	9	21614	No. 1-19	MORTON FEE	NE	SE	19	HYPERION OIL & GAS LLC		SCOTT	4992 KB	1980	8626	PARKMAN	2011	104,301	85,282	13,359
921768	36 N	71 W	9	21768	No. 41-30	FM-FEDERAL	NE	NE	30	HYPERION OIL & GAS LLC	WYW20264	SCOTT	4988 KB	1980	8674	PARKMAN	2011	146,691	163,951	37,006
920121	36 N	71 W	9	20121	No. 9-30	FEDERAL W-56242	NE	SE	30	HYPERION OIL & GAS LLC	WYW56242	SCOTT	4995 KB	1980	8690	PARKMAN	2011	175,380	269,160	39,409
921648	36 N	71 W	9	21648	No. 23-19	MAGGIE W-67031	NE	SW	19	CHACO ENERGY COMPANY	WYW67031	SCOTT	5031 KB	1980	8739	PARKMAN	2011	180,261	264,313	48,606
921669	36 N	71 W	9	21669	No. 23-30	MORTON	NE	SW	30	HYPERION OIL & GAS LLC	FEE	SCOTT	5015 KB	1980	8767	PARKMAN	2011	214,080	300,888	110,508
921797	36 N	72 W	9	21797	No. 41-25	CSC FEDERAL	NE	NE	25	HYPERION OIL & GAS LLC	WYW108281	SCOTT	5018 KB	1980	8800		2011	166,256	253,116	83,352
921782	36 N	72 W	9	21782	No. 43-24	LITTLE JIMMY G	NE	SE	24	HYPERION OIL & GAS LLC	FEE	SCOTT	5069	1980	8811	PARKMAN	2011	161,944	193,560	54,527
921776	36 N	72 W	9	21776	No. 41-36	STATE 73-44632	NE	NE	36	HYPERION OIL & GAS LLC	73-44632	SCOTT	5091 KB	1980	8870	PARKMAN	2011	166,905	229,256	73,440
921909	36 N	71 W	9	21909	No. 3-16	STATE 25	NE	NE	16	HYPERION OIL & GAS LLC	ST 78-0025	SCOTT	0	1981	8470	PARKMAN	2011	75,494	52,734	12,905
921702	36 N	71 W	9	21702	No. 1-28	MORTON	NE	NW	28	HYPERION OIL & GAS LLC	FEE	SCOTT	4967 KB	1981	8488	PARKMAN	2011	121,508	95,404	10,827
921901	36 N	71 W	9	21901	No. 41-8	JIMBO	NE	NE	8	HYPERION OIL & GAS LLC	FEE	SCOTT	5044 KB	1981	8605	PARKMAN	2011	91,443	38,670	13,120
921821	36 N	71 W	9	21821	No. 3	FEDERAL W-60403	NE	SW	8	BLACK BEAR OIL CORPORATION	WYW33783	SCOTT	5064 KB	1981	8670	PARKMAN	2011	106,658	169,308	32,573
921906	36 N	71 W	9	21906	No. 2	MORTON'S INC 41-19	NE	NE	19	BERENERGY CORPORATION		SCOTT	5024 KB	1981	8670	PARKMAN	2011	102,916	174,307	61,012
921892	36 N	71 W	9	21892	No. 21-19	MORTONS INC	NE	NW	19	BERENERGY CORPORATION		SCOTT	5059 KB	1981	8700	PARKMAN	2011	140,949	208,088	71,878
921956	36 N	71 W	9	21956	No. 3	MORTONS INC 41-18	NE	NE	18	BERENERGY CORPORATION		SCOTT	5062 KB	1981	8706	PARKMAN	2011	114,139	174,787	44,236
921987	36 N	71 W	9	21987	No. 4	MORTONS INC 43-7	NE	SE	7	BERENERGY CORPORATION		SCOTT	5138 KB	1981	8740	PARKMAN	2011	84,462	132,187	37,183
921822	36 N	71 W	9	21822	No. 4	FEDERAL W-33783	NE	NE	7	BLACK BEAR OIL CORPORATION	WYW33783	SCOTT	5202 KB	1981	8804	PARKMAN	2011	88,857	110,193	55,264
921769	36 N	71 W	9	21769	No. 2	FED MORTON 18 W33783	NE	NW	18	BLACK BEAR OIL CORPORATION	WYW33783	SCOTT	5168 KB	1981	8820	PARKMAN	2011	101,552	117,028	79,037
921897	36 N	72 W	9	21897	No. 2-25	FEDERAL W-31766	NE	NW	25	GREAT WESTERN DRILLING COMPANY	WYW31766	SCOTT	5056 KB	1981	8832	PARKMAN	2011	85,050	163,560	154,706
921896	36 N	72 W	9	21896	No. 1-25	FEDERAL W-86186	NE	SE	25	GREAT WESTERN DRILLING COMPANY	WYW36186	SCOTT	0	1981	8846	PARKMAN	2011	139,503	262,226	136,314
921853	36 N	71 W	9	21853	No. 1-16	STATE 25	NE	SW	16	HYPERION OIL & GAS LLC	ST 78-0025	SCOTT	4965 KB	1981	9506	PARKMAN	2011	86,206	65,153	15,703
921144	36 N	74 W	9	21144	No. 11-9	WERNER	NW	NW	9	MERRION OIL & GAS CORPORATION	FEE	MARTIN SPRINGS	5512	1981	9516	PARKMAN	2011	378,729	131,977	527,009
921849	36 N	71 W	9	21849	No. 2-16	STATE 25	NE	NW	16	HYPERION OIL & GAS LLC	ST 78-0025	SCOTT	5022 KB	1981	13058	DAKOTA	2011	93,003	58,189	36,662
922074	36 N	71 W	9	22074	No. 21-1	MOHR	SW	SW	21	HYPERION OIL & GAS LLC	FEE	SCOTT	4935 KB	1982	8500	PARKMAN	2011	107,195	204,707	12,367
922069	36 N	71 W	9	22069	No. 20-1	BARNBURNER FEDERAL	NE	NE	20	HYPERION OIL & GAS LLC	WYW67675	SCOTT	4983	1982	8600	PARKMAN	2011	121,544	194,422	17,631
922095	36 N	71 W	9	22095	No. 32-30	RAY	SW	NE	30	HYPERION OIL & GAS LLC	FEE	SCOTT	4999 KB	1982	8757	PARKMAN	2011	163,203	206,951	37,264
922096	36 N	71 W	9	22096	No. 12-30	ROY	SW	NW	30	HYPERION OIL & GAS LLC	FEE	SCOTT	4999 KB	1982	8762	PARKMAN	2011	199,324	366,746	46,627
922200	36 N	71 W	9	22200	No. 14-19	CHIPPEWA FEE	SW	SW	19	CHACO ENERGY COMPANY	FEE	SCOTT	5049 KB	1982	8772	PARKMAN	2011	155,280	272,990	60,131
922173	36 N	71 W	9	22173	No. 31-3	FEDERAL W-20264	SW	NW	31	HYPERION OIL & GAS LLC	WYW20264	SCOTT	5153 KB	1982	8876	PARKMAN	2011	186,346	365,619	44,577
922071	36 N	72 W	9	22071	No. 1-26	FEDERAL W-5932	NE	NE	26	GREAT WESTERN DRILLING COMPANY	WYW5932	SCOTT	5098 KB	1982	8936	PARKMAN	2011	86,810	108,605	184,565
921941	36 N	71 W	9	21941	No. 15-30	FEDERAL W-56242	SW	SE	30	HYPERION OIL & GAS LLC	WYW56242	SCOTT	5079 KB	1982	9937	SUSSEX	2011	193,045	376,510	35,008
922148	36 N	71 W	9	22148	No. 3-32	LMR JERICHO	SW	SW	32	HYPERION OIL & GAS LLC	FEE	SCOTT	5134 KB	1982	10065	PARKMAN	2011	96,933	273,770	18,114
922311	36 N	71 W	9	22311	No. 2-20	MORTON	SW	SW	20	HYPERION OIL & GAS LLC		SCOTT	4976 KB	1983	8620	PARKMAN	2011	106,760	166,617	12,897

922328	36 N	71 W	9	22328	No. 5	MORTON'S 12-19	SW	NW	19	BERENERGY CORPORATION		SCOTT	5043 KB	1983	8700	PARKMAN	2011	113,304	223,180	71,984
922251	36 N	71 W	9	22251	No. 32-31	MAUPIN-FEDERAL	SW	NE	31	HYPERION OIL & GAS LLC	WYW20264	SCOTT	5141 KB	1983	8856	PARKMAN	2011	192,963	335,916	37,693
921971	36 N	71 W	9	21971	No. 7-32	FEDERAL W-60402	SW	NE	32	HYPERION OIL & GAS LLC	WYW60402	SCOTT	5021 KB	1983	9847	SUSSEX	2011	132,539	303,975	40,237
921959	36 N	71 W	9	21959	No. 5-33	FEDERAL	SW	NW	33	HYPERION OIL & GAS LLC	WYW60402	SCOTT	5050	1983	9860	SUSSEX	2011	126,272	276,475	33,099
922365	36 N	71 W	9	22365	No. 5-16	SHELDON DRAW STATE	SW	NW	16	HYPERION OIL & GAS LLC	ST 78-0025	SCOTT	0	1984	8650	PARKMAN	2011	100,322	70,117	35,391
922327	36 N	71 W	9	22327	No. 12-20	BOLAND	SW	NW	20	BLACK BEAR OIL CORPORATION		SCOTT	4987 KB	1984	8651	PARKMAN	2011	78,838	267,764	23,767
922334	36 N	71 W	9	22334	No. 14-17	BOLAND	SW	SW	17	BLACK BEAR OIL CORPORATION	FEE	SCOTT	5032	1984	8653	PARKMAN	2011	62,325	205,957	24,380
922329	36 N	71 W	9	22329	No. 6	MORTON'S 32-19	SW	NE	19	BERENERGY CORPORATION		SCOTT	5021 KB	1984	8700	PARKMAN	2011	121,475	254,762	53,128
922335	36 N	71 W	9	22335	No. 3	USA MORTON	SW	SE	18	BLACK BEAR OIL CORPORATION	WYW66006	SCOTT	0	1984	8765	PARKMAN	2011	94,349	218,479	14,154
922503	36 N	72 W	9	22503	No. 3-25	FEDERAL W-36186	SW	SE	25	GREAT WESTERN DRILLING COMPANY	WYW36186	SCOTT	5055 KB	1984	8808	PARKMAN	2011	79,082	218,723	105,186
922504	36 N	72 W	9	22504	No. 4-25	FEDERAL W-50382	SW	NW	25	GREAT WESTERN DRILLING COMPANY	WYW63530	SCOTT	5109 KB	1984	8854	PARKMAN	2011	57,340	136,017	138,378
922380	36 N	72 W	9	22380	No. 32-36	STATE	SW	NE	36	HYPERION OIL & GAS LLC	73-44632	SCOTT	5143	1984	8962	PARKMAN	2011	99,085	175,240	86,930
922497	36 N	71 W	9	22497	No. 1-36	STATE 84-00520	NE	SE	36	MATRIX PRODUCTION COMPANY	84-00520	MIKES DRAW	5025 KB	1985	7830	TEAPOT	2011	49,274	23,953	52,116
922588	36 N	71 W	9	22588	No. 3-36	STATE 84-00520	NE	NE	36	MATRIX PRODUCTION COMPANY	84-00520	MIKES DRAW	5039 KB	1985	7849	TEAPOT	2011	25,238	20,586	15,722
921502	36 N	71 W	9	21502	No. 1-29	LET	NE	SE	29	HYPERION OIL & GAS LLC	FEE	SCOTT	4969	1985	8436	PARKMAN	2011	108,028	96,724	7,041
922482	36 N	71 W	9	22482	No. 32-18	MORTONS FEE	SW	NE	18	BERENERGY CORPORATION		SCOTT	5118 KB	1985	8845		2011	80,339	141,446	37,330
922474	36 N	75 W	9	22474	No. 3-5	UNIT W-46448	NW	NE	5	DUGAN PRODUCTION CORP	WYW46448	COLE NORTHEAST	5643	1985	12040	FRONTIER 1	2011	178,229	306,124	8,451
922486	36 N	76 W	9	22486	No. 32-1	SAND DUNES W-56951A	SW	NE	1	MERIT ENERGY COMPANY	WYW56951A	SAND DUNES	5713 KB	1985	12840	MORRISON	2011	1,022,891	5,261,813	8,612
922198	36 N	71 W	9	22198	No. 14-29	MERLE	SW	SW	29	BLACK BEAR OIL CORPORATION	WYW60403	SCOTT	5023	1986	9909	SUSSEX	2011	149,830	325,546	36,778
922633	36 N	76 W	9	22633	No. 44-12	SAND DUNES	C	SE	12	MERIT ENERGY COMPANY	WYW65560	SAND DUNES	5760	1987	12955	LAKOTA	2011	1,761,322	6,047,161	8,274
922190	36 N	75 W	9	22190	No. 1-4	NE COLE UNIT W-44188	SW	NW	4	DUGAN PRODUCTION CORP	WYW44188	COLE NORTHEAST	0	1987	13043	MORRISON	2011	127,382	353,904	7,341
921062	36 N	72 W	9	21062	No. 1-23	FEDERAL W-5932	NE	SE	23	BLACK BEAR OIL CORPORATION	WYW5932	SCOTT	5191 KB	1988	8982	STEELE	2011	49,588	0	167,632
922643	36 N	75 W	9	22643	No. 1	SOUTH SAND DUNES F	NW	SW	16	PRIMA EXPLORATION INC		SAND DUNES	5687	1988	13294	MORRISON	2011	139,162	92,935	1,859
922648	36 N	75 W	9	22648	No. 1	SO SAND DUNES E	SW	SE	9	PRIMA EXPLORATION INC	FEE	SAND DUNES	5561	1988	13375	MORRISON	2011	152,661	177,817	57,300
922644	36 N	75 W	9	22644	No. 1	SOUTH SAND DUNES G	SE	NW	21	PRIMA EXPLORATION INC	WYW66022	SAND DUNES	5751	1988	13440	MORRISON	2011	176,460	118,814	2,514
922700	36 N	75 W	9	22700	No. 22-19	SAND DUNES W113166	SE	NW	19	MERIT ENERGY COMPANY	WYW113166	SAND DUNES	0	1990	12895	DAKOTA	2011	3,507,492	15,361,360	9,515
922664	36 N	75 W	9	22664	No. 1	S SAND DUNES D 82743	NW	SE	8	PRIMA EXPLORATION INC	WYW82743	SAND DUNES	0	1990	12990		2011	84,560	117,519	1,046
921898	36 N	72 W	9	21898	No. 1-25	STATE 72-28417	NE	SW	25	GREAT WESTERN DRILLING COMPANY	72-28417	SCOTT	5053 KB	1992	8833	PARKMAN	2011	146,297	298,057	121,066
922732	36 N	76 W	9	22732	No. 33-35	DERRICK DRAW	NW	SE	35	MERIT ENERGY COMPANY	WYW98055	DERRICK DRAW	5797 KB	1992	12321	LAKOTA	2011	346,944	272,826	5,333
922703	36 N	76 W	9	22703	No. 32-25A	SAND DUNES W-92361	SW	NE	25	MERIT ENERGY COMPANY	WYW92361	DERRICK DRAW	6056 KB	1992	12926	MORRISON	2011	3,119,966	14,055,896	7,316
922695	36 N	75 W	9	22695	No. 23-7	SAND DUNES W-65558	C	SW	7	MERIT ENERGY COMPANY	WYW65558	SAND DUNES	5744 KB	1992	12950	LAKOTA	2011	1,226,054	6,471,464	9,517
922111	36 N	71 W	9	22111	No. 1	BISTORT-A W-33782	NE	SW	9	BLACK BEAR OIL CORPORATION	WYW33782	SCOTT	5048 KB	1993	8636	PARKMAN	2011	81,555	99,560	19,012
921939	36 N	71 W	9	21939	No. 8	FEDERAL W-67675	NE	SE	6	BLACK BEAR OIL CORPORATION	WYW67675	SCOTT	5210 KB	1993	8855	CODY	2011	73,882	93,728	37,351
921823	36 N	71 W	9	21823	No. 7-5	FEDERAL W-33783	NE	NW	7	BLACK BEAR OIL CORPORATION	WYW33783	SCOTT	5230 KB	1993	8945	PARKMAN	2011	72,135	88,417	44,773
922763	36 N	76 W	9	22763	No. 13-24	SAND DUNES UNIT	NW	SW	24	MERIT ENERGY COMPANY	WYW123238	SAND DUNES	5923	1993	12690	SKULL CREE	2011	2,314,511	12,968,157	8,169
922806	36 N	76 W	9	22806	No. 44-1	SAND DUNES	SE	SE	1	MERIT ENERGY COMPANY	WYW56951A	SAND DUNES	5862	1993	12740		2011	539,818	3,401,302	7,370
922613	36 N	75 W	9	22613	No. 23-4	BLIZZARD	NW	NW	23	EARTHSTONE ENERGY INC	WYW55434	BLIZZARD	5962	1993	14580	MUDDY	2011	221,520	284,405	13,922
922808	36 N	71 W	9	22808	No. 2	BARNBURNER	SW	NE	20	HYPERION OIL & GAS LLC	WYW20264	SCOTT	0	1994	8490	PARKMAN	2011	42,755	77,941	18,379
922174	36 N	71 W	9	22174	No. 31-4	FEDERAL W-20264	SW	SW	31	HYPERION OIL & GAS LLC	WYW67675	SCOTT	5082 KB	1994	8817	PARKMAN	2011	162,961	309,302	57,746
922811	36 N	71 W	9	22811	No. 4-32	MARDEL	SW	SE	32	HYPERION OIL & GAS LLC	FEE	SCOTT	0	1994	9925	SUSSEX	2011	71,625	153,149	10,061
922873	36 N	71 W	9	22873	No. 12-21	FEDERAL JOHNSON	SW	NW	21	HYPERION OIL & GAS LLC	WYW67031	SCOTT	0	1995	8570	PARKMAN	2011	71,947	108,501	18,724
922874	36 N	71 W	9	22874	No. 14-18	FEDERAL BONER	SW	SW	18	HYPERION OIL & GAS LLC	WYW66006	SCOTT	0	1995	9945	SUSSEX	2011	40,159	47,537	58,909
921835	36 N	72 W	9	21835	No. 23-36	STATE 73-44632	NE	SW	36	HYPERION OIL & GAS LLC	73-44632	SCOTT	5166 KB	1997	8962	PARKMAN	2011	79,396	127,510	101,384
922308	36 N	71 W	9	22308	No. 2-32	WEBER	SW	NW	32	HYPERION OIL & GAS LLC	WYW57333	SCOTT	5013	1997	9830	SUSSEX	2011	85,559	127,548	18,931
922886	36 N	71 W	9	22886	No. 12-17	BOLAND	SW	NW	17	HYPERION OIL & GAS LLC	FEE	SCOTT	0	1997	9853	SUSSEX	2011	38,452	49,104	22,987
921678	36 N	71 W	9	21678	No. 21-20	BOLAND 1	NE	NW	20	HYPERION OIL & GAS LLC	FEE	SCOTT	4974	1999	8604	PARKMAN	2011	109,204	100,715	34,109
921779	36 N	71 W	9	21779	No. 21-17	BOLAND 3	NE	NW	17	HYPERION OIL & GAS LLC	FEE	SCOTT	5030 KB	1999	8658	PARKMAN	2011	82,306	32,654	17,796
921540	36 N	71 W	9	21540	No. 1-32	WEBER FEDERAL	NE	NW	32	HYPERION OIL & GAS LLC	WYW57333	SCOTT	5007 KB	1999	8672	PARKMAN	2011	102,049	117,036	26,046
921666	36 N	71 W	9	21666	No. 43-18	MORTON RANCH	NE	SE	18	HYPERION OIL & GAS LLC	WYW66006	SCOTT	5096 KB	1999	8716	PARKMAN	2011	123,693	88,460	35,703
921667	36 N	71 W	9	21667	No. 23-18	MORTON RANCH	NE	SW	18	HYPERION OIL & GAS LLC	WYW66006	SCOTT	5094	1999	8750	PARKMAN	2011	115,965	96,035	80,468
922306	36 N	71 W	9	22306	No. 14-30	RED ROCK	SW	SW	30	HYPERION OIL & GAS LLC	WYW20264	SCOTT	5081 KB	1999	8844	PARKMAN	2011	103,382	175,775	50,859
921834	36 N	72 W	9	21834	No. 21-36	STATE 73-44632	NE	NW	36	HYPERION OIL & GAS LLC	73-44632	SCOTT	5084 KB	1999	8884	PARKMAN	2011	95,972	140,048	95,139
922442	36 N	72 W	9	22442	No. 34-36	STATE 73-44632	SW	SE	36	HYPERION OIL & GAS LLC	73-44632	SCOTT	5162 KB	1999	10160	SUSSEX	2011	86,208	138,373	64,203
921777	36 N	72 W	9	21777	No. 43-36		NE	SE	36	HYPERION OIL & GAS LLC	73-44632	SCOTT	5158	2000	8960		2011	149,249	161,538	43,254
922729	36 N	76 W	9	22729	No. 11-36	SAND DUNES UNIT	NW	NW	36	MERIT ENERGY COMPANY	ST 79-233	DERRICK DRAW	5795	2000	12500	SKULL CREEK	2011	2,973,437	18,391,438	20,951
922713	36 N	76 W	9	22713	No. 33-24	SAND DUNES UNIT	NW	SE	24	MERIT ENERGY COMPANY	WYW75847	SAND DUNES	5875	2000	12816	LAKOTA	2011	3,406,567	13,699,884	12,159
923031	36 N	71 W	9	23031	No. 34-5	BONER	SW	SE	5	HYPERION OIL & GAS LLC		SCOTT	0	2001	8875	PARKMAN	2011	33,445	53,975	7,866
922765	36 N	76 W	9	22765	No. 21-13	SAND DUNES FEE	NE	NW	13	MERIT ENERGY COMPANY	FEE	SAND DUNES	5820 KB	2001	12870	SKULL CRK	2011	251,881	2,019,367	8,308
927950	36 N	71 W	9	27950	No. 21-21	FEDERAL JOHNSON	NE	NW	21	HYPERION OIL & GAS LLC	WYW067031	SCOTT	4926.5	2003	8576	PARKMAN	2011	30,352	20,502	7,252
922741	36 N	76 W	9	22741	No. 42-15	SAND TRAP	SE	NE	15	MERIT ENERGY COMPANY	FEE	SAND DUNES	6041 KB	2004	12865	LAKOTA	2011	2,690,305	7,266,993	3,581
922764	36 N	76 W	9	22764	No. 21-12	SAND DUNES	NE	NW	12	MERIT ENERGY COMPANY	WYW65560	SAND DUNES	5859	2007	13030	FRONTIER	2011	42,743	1,376	0
922908	36 N	76 W	9	22908	No. 11-12	SAND DUNES MUDDY UN	NW	NW	12	MERIT ENERGY COMPANY	WYW65560	SAND DUNES	0	2007	13240	SKULL CRK	2011	145,555	383,707	916
922720	36 N	76 W	9	22720	No. 33-11	SAND DUNES	NW	SE	11	MERIT ENERGY COMPANY	WYW61265	SAND DUNES	5874	2007	13538	MORRISON	2011	6,603	216,057	6
922914	36 N	76 W	9	22914	No. 21-14	SAND DUNES MUDDY UN	NE	NW	14	MERIT ENERGY COMPANY	FEE	SAND DUNES	0	2008	13095	MUDDY	2011	10,927	211,362	81

922323	36 N	71 W	9	22323	No. 2-19	MORTON	SW	SE	19	HYPERION OIL & GAS LLC		SCOTT	0	2009	8714	PARKMAN	2011	114,280	241,699	21,398
922243	36 N	72 W	9	22243	No. 32-25	DORCAS	SW	NE	25	HYPERION OIL & GAS LLC	FEE	SCOTT	5019 KB	2010	8777	PARKMAN	2011	111,349	238,123	71,815
922257	36 N	72 W	9	22257	No. 34-24	AUTUMN	SW	SE	24	HYPERION OIL & GAS LLC	WYW108281	SCOTT	5072	2010	8822	PARKMAN	2011	46,380	53,942	81,366
922079	36 N	72 W	9	22079	No. 2-35	GALLIVAN USA	NE	SW	35	HYPERION OIL & GAS LLC	WYW32822	SCOTT	5190 KB	2010	9047	PARKMAN	2011	92,139	80,503	108,304
922892	36 N	71 W	9	22892	No. 12-29	BONER	SW	NW	29	HYPERION OIL & GAS LLC	FEE	SCOTT	0	2010	9800	SUSSEX	2011	96,685	206,522	29,295
928278	36 N	71 W	9	28278	No. 14-8	FEDERAL	SW	SW	8	BLACK BEAR OIL CORPORATION	WYW 33783	SCOTT	0	2011	8710	PARKMAN	2011	4,513	3,885	4,308
922241	36 N	71 W	9	22241	No. 34-31	WILLIE	SW	SE	31	HYPERION OIL & GAS LLC	FEE	SCOTT	5043 KB	2011	8787	PARKMAN	2011	139,936	292,574	27,715
928279	36 N	71 W	9	28279	No. 32-7	FEDERAL	SW	NE	7	BLACK BEAR OIL CORPORATION	WYW 33783	SCOTT	0	2011	8830	PARKMAN	2011	3,710	745	4,867
920513	37 N	74 W	9	20513	No. 12-7	FEDERAL	NW	SW	7	NORTH FINN LLC	WYW0272373	SPEARHEAD RANCH	5431	1974	13262	FRONTIER	2011	40,407	10,539	102
921784	37 N	74 W	9	21784	No. 41-16	ACKERMAN	NE	NE	16	SM ENERGY COMPANY	72-33103	PHILLIPS CREEK	5317	1980	13230	FRONTIER	2011	133,919	495,541	2,790
921841	37 N	74 W	9	21841	No. 31-21	WATERS	NW	NE	21	SM ENERGY COMPANY	FEE	PHILLIPS CREEK	5379	1981	13290	FRONTIER	2011	343,214	375,392	5,772
921988	37 N	74 W	9	21988	No. 23-4	FORD	NE	SW	4	SM ENERGY COMPANY	WYW39549	PHILLIPS CREEK	5230	1982	13069	FRONTIER-2	2011	228,418	2,059,562	6,339
922484	37 N	73 W	9	22484	No. 34-14	REYNOLDS FEE	SW	SE	14	MERIT ENERGY COMPANY		HORNBUCKLE	5081 KB	1985	10085	SUSSEX	2011	134,892	37,181	1,133
922493	37 N	73 W	9	22493	No. 11-7	BAKER	SW	NE	11	MERIT ENERGY COMPANY	WYW63529	HORNBUCKLE	5151	1985	10108	SUSSEX	2011	80,776	0	559
922536	37 N	73 W	9	22536	No. 41-23	STATE 81-0056	NE	NE	23	ENERGY SEARCH COMPANY INC	81-0056	HORNBUCKLE	5148	1985	10160	SUSSEX	2011	73,232	17,058	47
922499	37 N	73 W	9	22499	No. 42-15	UKELE	SE	NE	15	SM ENERGY COMPANY	75-9151	HORNBUCKLE	5163	1985	10220	SUSSEX	2011	127,946	172,016	2,621
922472	37 N	75 W	9	22472	No. 2-33	UNIT FEDERAL W-36195	SE	SW	33	DUGAN PRODUCTION CORP	WYW36195	COLE NORTHEAST	5590 KB	1985	11920	FRONTIER	2011	84,510	303,327	15,872
922527	37 N	72 W	9	22527	No. 1-6	REYNOLDS WY-69-P56	NE	NW	6	CITATION OIL & GAS CORPORATION	FEE	BRUSH CREEK	4946 KB	1986	13022	MORRISON	2011	404,023	624,295	8,837
922689	37 N	73 W	9	22689	No. 14-2	HIGHLAND FLATS	SW	SW	2	MERIT ENERGY COMPANY	FEE	HORNBUCKLE	5158	1988	10107	SUSSEX	2011	140,061	110,543	2,253
922690	37 N	73 W	9	22690	No. 34-11	HIGHLAND FLATS	SW	SE	11	MERIT ENERGY COMPANY	WYW73473	HORNBUCKLE	5206	1988	10175	SUSSEX	2011	84,097	33,064	2,139
922419	37 N	73 W	9	22419	No. 13-11	HIGHLAND	NW	SW	11	MERIT ENERGY COMPANY	WYW42587	HORNBUCKLE	5254	1988	10181	SUSSEX	2011	179,135	86,619	2,920
922369	37 N	73 W	9	22369	No. 11-11	BB & B	NW	NW	11	MERIT ENERGY COMPANY	WYW42587	HORNBUCKLE	0	1988	13450	MORRISON	2011	147,590	48,820	3,514
922668	37 N	75 W	9	22668	No. 1-27	WERNER FEE	SW	NE	27	JETTA OPERATING COMPANY INC	FEE	SPEARHEAD RANCH	5479	1988	13716	MORRISON	2011	55,421	130,917	797
922702	37 N	73 W	9	22702	No. 11-14	STATE 78-950	C	NW	14	MERIT ENERGY COMPANY	78-950	HORNBUCKLE	5188 KB	1989	10150	SUSSEX	2011	141,463	92,156	2,598
922736	37 N	73 W	9	22736	No. B-26	STATE	NE	SE	26	SAMSON RESOURCES COMPANY	ST 89-00282	HORNBUCKLE	0	1992	10257	PARKMAN	2011	93,033	11,562	769
922788	37 N	74 W	9	22788	No. 23-22	HENRY	NE	SW	22	SM ENERGY COMPANY	FEE	PHILLIPS CREEK	0	1993	12995	FRONTIER-2	2011	62,687	111,536	520
922793	37 N	73 W	9	22793	No. 22-3	HIGHLAND FLATS	SE	NW	3	MERIT ENERGY COMPANY	WYW78824	HORNBUCKLE	5168	1994	10150	SUSSEX	2011	120,926	57,358	1,802
922791	37 N	73 W	9	22791	No. 23-14	HIGHLAND FLATS	NE	SW	14	MERIT ENERGY COMPANY	78-950	HORNBUCKLE	5077	1995	10081	SUSSEX	2011	166,236	67,189	1,569
922794	37 N	73 W	9	22794	No. 12-2	HIGHLAND FLATS	SW	NW	2	MERIT ENERGY COMPANY	WYW73473	HORNBUCKLE	0	1995	10100	SUSSEX	2011	66,463	28,450	890
922277	37 N	73 W	9	22277	No. 32-2	FEDERAL	SW	NE	2	MERIT ENERGY COMPANY	WYW39967	HORNBUCKLE	5088	1995	13350	LAKOTA	2011	106,724	9,615	1,664
922728	37 N	73 W	9	22728	No. 33-23	STATE	NW	SE	23	SAMSON RESOURCES COMPANY	ST 81-0056	HORNBUCKLE	0	1997	10200	PARKMAN	2011	71,878	17,191	816
921306	37 N	75 W	9	21306	No. 1-11	JUDSON FEE	SE	SE	11	NORTH FINN LLC	FEE	SPEARHEAD RANCH	0	1997	12780	CARLILE	2011	331,017	2,612,317	20
920201	37 N	73 W	9	20201	No. 11-24	FEDERAL-P	NW	NW	24	SAMSON RESOURCES COMPANY	WYW102949	HORNBUCKLE	5170 KB	1998	8921	PARKMAN	2011	97,691	20,181	800
922777	37 N	73 W	9	22777	No. 21-23	REYNOLDS FEE	NE	NW	23	SAMSON RESOURCES COMPANY		HORNBUCKLE	0	1998	10080	SUSSEX	2011	128,898	28,707	818
922727	37 N	73 W	9	22727	No. 21-26	REYNOLDS	NE	NW	26	SAMSON RESOURCES COMPANY	WYW102950	HORNBUCKLE	0	1998	10200		2011	89,539	16,996	648
922699	37 N	73 W	9	22699	No. 1	BAKER	SE	SE	10	SAMSON RESOURCES COMPANY	WYW112575	HORNBUCKLE	0	1998	10249	SUSSEX	2011	187,729	67,145	929
922910	37 N	73 W	9	22910	No. 13-24	DUCK FEDERAL	NW	SW	24	SAMSON RESOURCES COMPANY	WYW39967	HORNBUCKLE	0	1998	10250	SUSSEX	2011	115,522	4,779	997
922737	37 N	73 W	9	22737	No. A-25	STATE	SE	SW	25	SAMSON RESOURCES COMPANY	ST 80-291	HORNBUCKLE	0	1998	10297	TEAPOT	2011	53,189	4,582	1,048
922742	37 N	73 W	9	22742	No. B-23	REYNOLDS 81-0056	C	SW	23	SAMSON RESOURCES COMPANY		HORNBUCKLE	5280 KB	1998	10326	SUSSEX	2011	95,192	27,052	823
922467	37 N	73 W	9	22467	No. 31-14	STATE	NW	NE	14	MERIT ENERGY COMPANY		HORNBUCKLE	4166 KB	2003	10150	SUSSEX	2011	125,885	38,933	1,372
922004	37 N	76 W	9	22004	No. 44-36	SAND DUNES 73-27141	SE	SE	36	MERIT ENERGY COMPANY	STATE	SAND DUNES	5704 KB	2003	12960	MORRISON	2011	240,837	529,855	42
922958	37 N	73 W	9	22958	No. 44-18X	BLACK ISLAND FEDERAL	C	SE	18	SAMSON RESOURCES COMPANY	WYW138424	WC	0	2006	13974	DAKOTA	2011	3,275	0	217
922551	37 N	73 W	9	22551	No. 31-3	HIGHLAND W-78824	NW	NE	3	MERIT ENERGY COMPANY	WYW78824	HORNBUCKLE	5171 KB	2007	10113	SUSSEX	2011	132,015	62,982	167
922893	37 N	73 W	9	22893	No. 31-10	BB & B	NW	NE	10	MERIT ENERGY COMPANY	FEE	HORNBUCKLE	0	2007	10150	SUSSEX	2011	66,821	30,018	963
928131	37 N	75 W	9	28131	No. 32-34	SOUTH FORK FEDERAL	SW	NE	34	KERR-MCGEE OIL & GAS ONSHORE LP	WYW91194	WC	0	2007	13615		2011	21,649	32,203	1,443
928147	37 N	73 W	9	28147	No. 13-13	HIGHLAND FLATS	NW	SW	13	MERIT ENERGY COMPANY		HORNBUCKLE	0	2008	10200	SUSSEX	2011	13,249	2,026	100
928215	37 N	74 W	9	28215	No. 1-2H	THUNDERBOLT	SE	SE	2	SLAWSON EXPLORATION COMPANY INC		POWELL SOUTH	0	2008	15793	FRONTIER	2011	49,063	10,692	6,972
928240	37 N	74 W	9	28240	No. 41-15H F	HENRY FEDERAL	NE	NE	15	HELIS OIL & GAS COMPANY LLC ESTATE	WYW17956	PHILLIPS CREEK	0	2009	18400		2011	97,575	155,803	59,811
928256	37 N	73 W	9	28256	No. 34-22H	DCR STATE	SW	SE	22	SAMSON RESOURCES COMPANY	ST 81-00056	HORNBUCKLE	0	2010	10115	SSUSEX	2011	80,171	11,229	6,641
928233	37 N	73 W	9	28233	No. 44-25H	DCR FEE	SE	SE	25	SAMSON RESOURCES COMPANY		HORNBUCKLE	0	2010	10142	SUSSEX	2011	76,819	8,749	7,612
922400	37 N	73 W	9	22400	No. 43-3	HIGHLAND W-47304	NE	SE	3	MERIT ENERGY COMPANY	WYW47304	HORNBUCKLE	5169 KB	2010	10150	SUSSEX	2011	262,013	122,947	7,530
928247	37 N	73 W	9	28247	No. 11-15H	DCR STATE	NW	NW	15	SAMSON RESOURCES COMPANY	ST 75-09151	HORNBUCKLE	0	2010	10182		2011	97,536	9,284	9,390
928310	37 N	73 W	9	28310	No. 21-21H	DCR STATE	NE	NW	21	SAMSON RESOURCES COMPANY	ST 07-00049	HORNBUCKLE	0	2011	14818	SUSSEX	2011	16,715	0	458
921303	38 N	73 W	9	21303	No. 1	FED 43-11 W-0311380	NE	SE	11	SAMSON RESOURCES COMPANY	WYW0311380	DRY FORK	0	1977	8661	PARKMAN	2011	224,716	170,492	241,595
921302	38 N	73 W	9	21302	No. 2	FED 41-14 W-0310897A	NE	NE	14	SAMSON RESOURCES COMPANY	WYW0310897A	DRY FORK	5290 KB	1984	8758	PARKMAN	2011	197,657	125,043	301,491
922487	38 N	74 W	9	22487	No. 1-2	BOZEMAN W-87888	NW	SE	2	JETTA OPERATING COMPANY INC	WYW87888	POWELL	5383 KB	1985	12650	FRONTIER 1	2011	94,868	1,599,247	0
922518	38 N	74 W	9	22518	No. 1-24	FEDERAL W-40793	SW	NE	24	JETTA OPERATING COMPANY INC	WYW40793	POWELL	5252 KB	1985	13689	MORRISON	2011	19,295	220,458	15
922557	38 N	74 W	9	22557	No. 1-26	SOUTH POWELL FEDERAL	SW	NE	26	JETTA OPERATING COMPANY INC	WYW103881	POWELL	5371	1987	13868	LAKOTA	2011	122,174	311,458	20
922675	38 N	73 W	9	22675	No. 23-34	HIGHLAND FLATS FEE	NE	SW	34	MERIT ENERGY COMPANY		HORNBUCKLE	5090 KB	1988	10054	SUSSEX	2011	147,383	110,047	1,750
922687	38 N	73 N	9	22687	No. 34-34	HIGHLAND FLATS 31775	SW	SE	34	MERIT ENERGY COMPANY	WYW31775	HORNBUCKLE	5153 KB	1988	10110	SUSSEX	2011	127,343	60,694	1,766
922673	38 N	74 W	9	22673	No. 1-35	SOUTH POWELL FEDERAL	SW	NE	35	JETTA OPERATING COMPANY INC	WYW40793	POWELL	5242	1988	13800	FRONTIER	2011	88,451	213,732	34
920084	38 N	73 W	9	20084	No. 1	HARTLEY 32-11 GOVT	SW	NW	11	SAMSON RESOURCES COMPANY	WYW0225803	DRY FORK	5168 KB	1993	14811	MINNELUSA	2011	23,269	23,369	102,761
922301	38 N	74 W	9	22301	No. 1-13	S. POWELL	NE	SW	13	JETTA OPERATING COMPANY INC	WYW40793	POWELL	0	1995	13611	LAKOTA	2011	351,574	1,156,339	0
922768	38 N	73 W	9	22768	No. 24-27	BUCKLE 24-27 W124838	SE	SW	27	SAMSON RESOURCES COMPANY	WYW124838	HORNBUCKLE	0	1998	9788	SUSSEX	2011	88,655	36,081	679

922767	38 N	73 W	9	22767	No. 42-33	BAKER FEE	SE	NE	33	SAMSON RESOURCES COMPANY	FEE	HORNBUCKLE	0	1998	9960	SUSSEX	2011	78,785	15,289	786
922762	38 N	73 W	9	22762	No. 44-28	BUCKLE	SE	SE	28	SAMSON RESOURCES COMPANY	WYW76347	HORNBUCKLE	5114 KB	1998	10030	SUSSEX	2011	89,901	21,058	620
922355	38 N	73 W	9	22355	No. 28-1	HORNBUCKLE	NE	SW	28	SAMSON RESOURCES COMPANY		HORNBUCKLE	5194 KB	1998	10191	SUSSEX	2011	79,019	13,336	1,455
921872	38 N	73 W	9	21872	No. 24-1	FEDERAL W-57343	NW	NW	24	BLACKJACK OIL INC	WYW57343	BRUSH CREEK	5035 KB	2002	8800	PARKMAN	2011	159,039	18,986	36,532
921889	38 N	73 W	9	21889	No. 13-1	FEDERAL	SW	SW	13	BLACKJACK OIL INC	WYW158928	DRY FORK	5088	2003	8828	PARKMAN	2011	346,617	29,885	168,160
921890	38 N	73 W	9	21890	No. 13-2	FEDERAL	SW	NW	13	BLACKJACK OIL INC	WYW079854A	DRY FORK	5211	2003	8887	PARKMAN	2011	128,208	24,696	128,281
927938	38 N	72 W	9	27938	No. 1	GOEMMER	NW	SE	31	YATES PETROLEUM CORPORATION		WC	4925.4	2004	13016	FRONTIER	2011	27,046	0	757
922620	38 N	74 W	9	22620	No. 2-1	FEDERAL W-67981	NW	SW	1	JETTA OPERATING COMPANY INC	WYW67981	POWELL	5293 KB	2005	12572	FRONTIER	2011	167,836	1,090,257	0
920436	38 N	74 W	9	20436	No. 1	PATTERSON	NW	NW	17	TRIPOWER RESOURCES LLC		SPEARHEAD RANCH	5422	2005	14198	FRONTIER 1	2011	138,551	4,252,284	21,748
928158	38 N	73 W	9	28158	No. 42-34V	HB BLAYLOCK FEE	SE	NE	34	SAMSON RESOURCES COMPANY		HORNBUCKLE	0	2007	10100	SUSSEX	2011	13,438	5,524	839
928196	38 N	73 W	9	28196	No. 14-34	HIGHLAND FLATS	SW	SW	34	MERIT ENERGY COMPANY		HORNBUCKLE	0	2008	10200	SUSSEX	2011	11,720	3,520	0
928195	38 N	73 W	9	28195	No. 21-33H	HR FEE	NE	NW	33	SAMSON RESOURCES COMPANY		HORNBUCKLE	0	2008	14390	SUSSEX	2011	115,110	43,358	7,734
928244	38 N	73 W	9	28244	No. 44-21H	GH FEDERAL	SE	SE	21	SAMSON RESOURCES COMPANY	WYW118536	HORNBUCKLE	0	2010	9937	SUSSEX	2011	108,303	32,430	8,943
928220	38 N	73 W	9	28220	No. 24-22H	GH FEDERAL	SE	SW	22	SAMSON RESOURCES COMPANY	WYW140227	HORNBUCKLE	0	2010	14366		2011	66,059	33,945	12,268
928321	38 N	73 W	9	28321	No. 21-19H	RUSSELL FEE	NE	NW	19	SAMSON RESOURCES COMPANY		HORNBUCKLE	0	2011	14716	SUSSEX	2011	12,529	616	302
928225	38 N	73 W	9	28225	No. 11-28H	HR FEDERAL	NW	NW	28	SAMSON RESOURCES COMPANY		HORNBUCKLE	0	2011	14965	SUSSEX	2011	13,424	1,010	3,186

ATTACHMENT C

SMITH RANCH-HUP/REYNOLDS RANCH

PRODUCTION, RESTORATION, AND GROUNDWATER WITHDRAWAL RATE SCHEDULE

PRODUCTION - SMITH RANCH

Development Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
MU1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU3	15	15	15	15	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU4/4A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU15	12	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU15A	12	9	9	9	11	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU7	0	7	7	7	11	11	11	21	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU9	24	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU10	0	12	12	12	12	12	12	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU11	0	0	0	12	12	12	12	12	24	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUK	15	15	15	15	15	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUE	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUH	8	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUF	2	12	8	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUI	8	2	2	3	3	5	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUJ	8	2	2	3	3	5	5	5	5	5	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0
Total Production Bleed (gpm)	109	99	95	94	79	67	62	54	54	33	9	9	9	0	0	0	0	0	0	0	0	0	0	0	0

PRODUCTION - REYNOLDS RANCH

Development Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
MU27	0	0	45	45	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU21	0	0	0	0	0.0	45	45	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU22	0	0	0	0	0	0	0	45	45	45	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU23	0	0	0	0	0	0	0	0	0	0	0	60	60	60	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	60	60	0	0	0	0	0	0	0	0	0	0	0
MU26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	60	60	0	0	0	0	0	0	0
MU28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	60	60	60	0	0
Total Production Bleed (gpm)	0	0	45	45	45	45	45	45	45	45	45	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	0	0

TOTAL PRODUCTION

Total Production Bleed, ALL	109	99	140	139	124	112	107	99	99	78	54	69	69	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	0	0

RESTORATION - SMITH RANCH

Development Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
MU1	83	112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU2	0	0	119	119	113	113	113	79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU3	0	0	0	0	0	83	125	162	152	102	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU4_4A	50	112	112	112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU15	0	0	0	27	152	152	152	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU15A	0	0	0	0	0	0	0	103	88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU7	0	0	0	0	0	0	0	0	0	114	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU9	0	0	169	151	101	102	101	101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU10	0	0	0	0	0	0	0	0	147	89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU11	0	0	0	0	0	0	0	0	0	83	213	152	152	152	63	0	0	0	0	0	0	0	0	0	0
MUC	7	175	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUD	0	74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUD_Ext	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUE	1	15	127	152	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUH	0	0	0	0	0	53	203	203	203	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUF	0	0	0	137	203	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MUI	0	0	0	0	0	0	0	0	0	0	52	203	169	0	0	0	0	0	0	0	0	0	0	0	0
MUK	0	0	0	0	0	0	0	0	0	83	190	152	25	0	0	0	0	0	0	0	0	0	0	0	0
MUJ	0	0	0	0	0	0	0	0	0	0	0	0	0	153	169	0	0	0	0	0	0	0	0	0	0
Total Restoration Bleed (gpm)	212	489	527	698	581	520	693	647	590	590	530	506	345	305	231	0	0	0	0	0	0	0	0	0	0

RESTORATION - REYNOLDS RANCH

Development Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
MU27	0	0	0	0	0	163	163	163	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU21	0	0	0	0	0	0	0	0	163	163	163	163	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU22	0	0	0	0	0	0	0	0	0	0	0	0	163	163	163	163	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	163	163	163	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MU24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	163	163	163	0	0	0	0	0	0	0	0	0	0	0
MU25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	163	163	163	163	163	0	0	0	0	0	0
MU26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	163	163	163	163	0	0
MU28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	163	163
Total Restoration Bleed (gpm)	0	0	0	0	0	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163

TOTAL RESTORATION

	212	489	527	698	581	683	856	810	752	752	692	669	508	468	394	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163	163

TOTAL RESTORATION + PRODUCTION

	320	587	667	837	705	794	963	909	851	830	746	738	577	528	454	223	223	223	223	223	223	223	223	223	223	223	223	223	223	223	223	163	163

Notes:
1) Units in gpm
2) RO Reject (Bleed) = 25% of RO Feed
3) All rates rounded to nearest gpm

AQUI-VER, INC.

Cameco

Cumulative Hydrologic Impact Assessment

Cameco Resources
North Butte Facility
Campbell County, Wyoming

December 7, 2011

Prepared By:

AQUI-VER, INC.

4800 Wadsworth Boulevard

Suite 400

Wheat Ridge, CO 80033 USA

Disclaimer and Statement of Confidentiality

This study has been prepared on behalf of and for the exclusive use of Cameco Resources and is subject to and issued in accordance with the agreement between Cameco Resources and Aqui-Ver, Inc. This report and information used in preparation is strictly confidential and is intended for use solely by Cameco Resources and their designated representatives. Copying or distribution of this document without the permission of Cameco Resources is not permitted. Aqui-Ver, Inc. accepts no liability or responsibility whatsoever for use of or reliance upon this study by any third party.

Signatures and Certifications:

Signature 1 : Robert L. Lewis

Name (Please Print) : Robert L. Lewis

PROFESSIONAL GEOLOGIST
ROBERT L. LEWIS
PG-522
WYOMING

TABLE OF CONTENTS

1.	EXECUTIVE SUMMARY	1
2.	INTRODUCTION	2
3.	GROUNDWATER FLOW MODEL DEVELOPMENT	3
3.1	Model Grid, Layering, and Boundary Conditions	3
3.2	Model Aquifer Characteristics	4
3.2.1	Hydraulic Conductivity	4
3.2.1	Storage Parameters	5
3.2.2	Model Layer Elevation (Depth)	6
3.3	Stock and Domestic Wells	6
3.4	CBM Wells	6
4.	MODEL CALIBRATION	9
4.1	CBM Development Calibration	9
4.1.1	CBM Calibration Results	9
4.2	North Butte Aquifer Test SS2M Calibration	10
4.3	Nichols Ranch MN-1 Aquifer Test Calibration	10
4.4	Hank Unit URZHF-5 Aquifer Test Simulation	11
5.	HYDROLOGIC IMPACT SIMULATIONS	13
5.1	NORTH BUTTE ISR IMPACT ASSESSMENT	13
5.1.1	North Butte ISR Operations	13
5.1.2	North Butte Impact Assessment Results	14
5.2	NICHOLS RANCH ISR IMPACT ASSESSMENT	14
5.2.1	Nichols Ranch ISR Operations	14
5.2.2	Nichols Ranch Impact Assessment Results	15
5.3	HANK UNIT ISR IMPACT ASSESSMENT	15
5.3.1	Hank Unit ISR Operations	15
5.3.2	Hank Unit Impact Assessment Results	16
5.4	WILLOW CREEK ISR IMPACT ASSESSMENT	16
5.4.1	Willow Creek ISR Operations	16
5.4.2	Willow Creek Impact Assessment Results	17

5.5 CBM IMPACT ASSESSMENT 17

5.5.1 CBM Impact Assessment Results 18

5.6 CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT RESULTS 18

5.7 SUMMARY AND CONCLUSIONS 18

6. REFERENCES 22

LIST OF FIGURES, TABLES, & ATTACHMENTS

Figure	Title
2-1	Regional Site Overview
3-1	Layer 1 Boundary Conditions
3-2	Layer 2 Boundary Conditions
3-3	Layer 3 Boundary Conditions
3-4	Layer 4 Boundary Conditions
3-5	Layer 5 Boundary Conditions
3-6	Layer 6 Boundary Conditions
3-7	Layer 7 Boundary Conditions
3-8	Top of the F-Sand Aquifer
3-9	Bottom of the A-Sand Aquifer
3-10	Top of the Big George CBM Aquifer
3-11	Water-Table Elevation
3-12	Domestic and Stock Wells
3-13	CBM Well Locations
3-14	Model Domain CBM Well Production
4-1	Calibrated CBM Drawdown, Big George Coal Bed
4-2	Modeled vs. Observed Drawdown, North Butte SS2M Aquifer Test Calibration
4-3	Modeled vs. Observed Drawdown, Nichols Ranch MN-1 Aquifer Test Calibration
5-1	North Butte ISR Facility
5-2	North Butte Drawdown Impact, A-Sand
5-3	North Butte Drawdown Impact, B-Sand
5-4	North Butte Drawdown Impact, C Sand
5-5	North Butte Drawdown Impact, F Sand
5-6	North Butte Drawdown Impact, G/H-Sand
5-7	Nichols Ranch ISR Facility
5-8	Nichols Ranch Drawdown Impact, A-Sand
5-9	Nichols Ranch Drawdown Impact, B-Sand
5-10	Nichols Ranch Drawdown Impact, C-Sand
5-11	Nichols Ranch Drawdown Impact, F-Sand
5-12	Nichols Ranch Drawdown Impact, G/H-Sand
5-13	Hank Unit ISR Facility
5-14	Hank Unit Drawdown Impact, A-Sand
5-15	Hank Unit Drawdown Impact, B-Sand
5-16	Hank Unit Drawdown Impact, C-Sand
5-17	Hank Unit Drawdown Impact, F-Sand
5-18	Hank Unit Drawdown Impact, G/H-Sand
5-19	Willow Creek ISR Facility
5-20	Willow Creek Drawdown Impact, A-Sand

Figure	Title
5-21	Willow Creek Drawdown Impact, B-Sand
5-22	Willow Creek Drawdown Impact, C-Sand
5-23	Willow Creek Drawdown Impact, F-Sand
5-24	Willow Creek Drawdown Impact, G/H-Sand
5-25	CBM Impact Drawdown, Big George Coal Bed
5-26	CBM Impact Drawdown, Lower Wasatch Aquitard
5-27	CBM Impact Drawdown, A-Sand
5-28	CBM Impact Drawdown, B-Sand
5-29	CBM Impact Drawdown, C-Sand
5-30	CBM Impact Drawdown, F-Sand
5-31	Cumulative Drawdown Impact, A-Sand, Development Year 5
5-32	Cumulative Drawdown Impact, B-Sand, Development Year 5
5-33	Cumulative Drawdown Impact, C-Sand, Development Year 5
5-34	Cumulative Drawdown Impact, F-Sand, Development Year 5
5-35	Cumulative Drawdown Impact, G/H-Sand, Development Year 5
5-36	Cumulative Drawdown Impact, A-Sand, Development Year 8
5-37	Cumulative Drawdown Impact, B-Sand, Development Year 8
5-38	Cumulative Drawdown Impact, C-Sand, Development Year 8
5-39	Cumulative Drawdown Impact, F-Sand, Development Year 8
5-40	Cumulative Drawdown Impact, G/H-Sand, Development Year 8

Table	Title
3-1	Model Hydrostratigraphic Summary
3-2	Model Hydraulic Conductivity Parameters
3-3	Model Storage Parameters
3-4	Water Well Information
4-1	Model Calibration Results, North Butte Pump Test SS2M Simulation
4-2	Model Calibration Results, Nichols Ranch Pump Test MN-1 Simulation
5-1	Hydrologic Impact Assessment Summary

Attachments	Title
A	CBM Monitoring Well Water Level Data
B	North Butte ISR Wellfield Development Plan and Water Balance
C	Willow Creek ISR Mining and Restoration Schedule

1. EXECUTIVE SUMMARY

Cameco Resources has conducted an assessment of the hydrologic impacts resulting from In-Situ Recovery (ISR) and Coal Bed Methane (CBM) operations in the vicinity of the North Butte ISR property in Campbell County, Wyoming. Hydrologic impacts (drawdown) resulting from the planned development of the North Butte, Nichols Ranch, Willow Creek, and Hank Unit ISR properties were included in this assessment. The hydrologic impact of existing and future Coal Bed Methane (CBM) development was also considered. Finally, the combined or cumulative hydrologic impact resulting from ISR and CBM development was calculated.

Hydrologic impacts due to ISR and CBM development were simulated using a three-dimensional groundwater flow model over an estimated 16 year ISR development and restoration period. The drawdown computed by the groundwater flow model was evaluated at 81 stock and domestic well locations located within a three-mile radius of the ISR facilities.

In general, maximum hydrologic impacts occur in wells closest to ISR facilities and completed within ISR production sands (A- through F-Sands). Cumulative drawdown impacts greater than 20 feet are predicted in two wells (Pfister Ranch and Brown #5) located near the North Butte and Hank Unit ISR facilities. Cumulative drawdown greater than 10 feet is predicted in 23 of 81 wells included in this study. Drawdown in shallow water-table wells (G/H-Sand) is predicted to be negligible (less than 0.2 feet) over the life of ISR and CBM operations.

As a practical matter, predicted hydrologic impacts associated with ISR and CBM development are not significant. Predicted drawdown due to ISR and CBM development is less than 10 percent of the available water column in wells having greater than 10 feet of predicted drawdown. 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 would normally be overcome simply by lowering the pump, or in the worse case, by installing an additional supply well (and pump) to make up for needed production.

Individual ISR facilities are predicted to cause between 0.5 and 4 feet of drawdown at neighboring ISR facilities. The cumulative maximum impact of neighboring ISR facilities on one another is predicted to be between 5 and 8 feet over the 16 year development period. Drawdown impacts due to the simultaneous operation of ISR facilities should not impact the ability of individual ISR facilities to operate as planned, and will allow effective hydraulic containment of mining solutions.

2. INTRODUCTION

Cameco Resources (Cameco) has conducted an assessment of the hydrologic impacts resulting from In-Situ Recovery (ISR) and Coal Bed Methane (CBM) operations in the vicinity of the North Butte ISR property in Campbell County, Wyoming (**Figure 2-1**). This study was undertaken at the request of the U.S. Nuclear Regulatory Commission (NRC) in a meeting between Cameco Resources and NRC staff on November 3, 2010. The projected future groundwater impact or drawdown in local stock and domestic wells (including the Pfister Ranch/BRT well) resulting from ISR and CBM operations is the primary objective of this work.

The following specific tasks were accomplished as part of this work:

- Assessment of the hydrologic impact to local stock and domestic wells resulting from the operation of Cameco's future North Butte ISR project,
- Assessment of the hydrologic impact to local stock and domestic wells resulting from the operation of Uranerz Energy Corporation (Uranerz) future Nichols Ranch ISR project,
- Assessment of the hydrologic impact to local stock and domestic wells resulting from the operation of Uranerz future Hank Satellite ISR project,
- Assessment of the hydrologic impact to local stock and domestic wells resulting from the operation of Uranium One Willow Creek ISR project,
- Assessment of the hydrologic impact to local stock and domestic wells resulting from CBM dewatering operations in the region,
- Assessment of the combined or cumulative hydrologic impacts of the aforementioned individual ISR and CBM operations,
- Assessment of the individual and combined drawdown impacts of neighboring ISR facilities on one another.

3. GROUNDWATER FLOW MODEL DEVELOPMENT

Potential hydrologic impacts resulting from ISR and CBM operations 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 CBM dewatering 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 CBM 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

Figures 3-1 through 3-7 illustrate the groundwater flow model grid and boundary conditions. The model domain consists of 7 layers, 278 rows, and 261 columns. The model domain is approximately 45 miles east to west and 23 miles north to south, and includes a significant portion of southwestern portion of the Powder River Basin. The model domain extends to natural aquifer outcrop locations on the western boundary, 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, eastern, and southern model boundaries to allow groundwater flow into and out of the model domain as regional and local flow conditions change over time.

Table 3-1 summarizes the model layering and associated hydrostratigraphy. ISR production sands of interest to this study include a series of stacked sands separated by lower permeability claystone and siltstone of the Wasatch Formation (Layers 1 through 5). The aquifers are labeled in reverse alphabetical order, from shallowest to deepest, beginning with the G/H-Sand (shallow water-table aquifer), the F-Sand (Layer 2 and ISR production unit), the C-Sand (Layer 3 and ISR production unit), the B-Sand (Layer 4 and ISR production unit), and the A-Sand (Layer 5 and ISR production unit). In the vicinity of the North Butte property, ISR production sands (A- through F-Sands) vary from 40 to more than 80 feet thick and extend to more than 600 feet below the ground surface. Lower permeability aquitards separating the individual aquifers are modeled implicitly.

Underlying the ISR production sand interval, model Layer 6 represents a thick sequence of primarily low permeability claystone, siltstone and shale of the Lower Wasatch and Upper Fort Union Formations. This regional aquitard separates the overlying ISR production sand interval from the underlying Big George/Anderson-Wyodak coal bed (Layer 7), which has been undergoing regional dewatering in support of CBM operations in the region since 1999.

Table 3-1. Model Hydrostratigraphic Summary

Layer	Description	Geologic Formation	Average Depth (feet BGS)[1]	Production Interval	Avg. Thickness (feet)[1]
1	G/H-Sand Aquifer	Wasatch	40	No	160
	Aquitard	Wasatch	200	No	100
2	F-Sand Aquifer	Wasatch	300	Hank Unit ISR	40
	Aquitard	Wasatch	340	No	120
3	C-Sand Aquifer	Wasatch	460	North Butte ISR	50
	Aquitard	Wasatch	510	No	15
4	B-Sand Aquifer	Wasatch	525	North Butte ISR Willow Creek ISR	80
	Aquitard	Wasatch	605	No	15
5	A-Sand Aquifer	Wasatch	620	Nichols Ranch ISR North Butte ISR Willow Creek ISR	75
6	Aquitard	Lower Wasatch Fort Union	695	No	765
7	Coal Bed Aquifer	Fort Union	1,460	CBM Dewatering	110

1 - Average depth and thickness of unit at North Butte ISR Facility. Depth and thickness vary significantly across the model domain.

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).

3.2.1 Hydraulic Conductivity

Table 3-2 summarizes the model horizontal and vertical hydraulic conductivity parameters for each model layer. Hydraulic conductivity parameters for the ISR production sands (A- through F-Sands) were established from site-specific aquifer testing and groundwater modeling performed as part of the mine permitting process (Uranerz, 1989; Uranerz, 2007; Uranerz, 2010a; Uranerz, 2010b, U.S. NRC, 1988). Hydraulic conductivity parameters for the shallow water-table aquifer (Layer 1), CBM aquitard (Layer 6), and the Big George/Anderson-Wyodak coal bed (Layer 7) were established from regional modeling and geologic studies (Brenneis, 1997; AHA, 2002). A vertical hydraulic conductivity of 0.0001 ft/day was assigned to model Layers 2 through 5 (ISR production interval), and represents the average vertical conductivity of implicit aquitards measured during multi-well pump tests at North Butte, Nichols Ranch, and Hank Unit ISR properties.

Table 3-2. Model Hydraulic Conductivity Parameters

Layer	Kx,y (ft/day)[1]	Kz (ft/day)	Source
1 (G/H-Sand)	0.200	1e-04	Uranerz (2007); AHA (2002)
2 (F-Sand)	0.3 - 6.5 (1.9)	1e-04	Uranerz (1989); Uranerz (2007); Uranerz (2010b)
3 (C-Sand)	0.5 - 2.6 (0.95)	1e-04	Uranerz (1989); Uranerz (2007)
4 (B-Sand)	0.5 - 2.6 (0.95)	1e-04	Uranerz (1989); Uranerz (2007); U.S. NRC (1988)
5 (A-Sand)	0.3 - 1.0 (0.5)	1e-04	Uranerz (1989); Uranerz (2007); Uranerz (2010a); U.S. NRC (1988)
6 (Aquitard)	0.35	5.2E-06	AHA (2002)
7 (CBM Aquifer)	2.4	1.0	Brenneis (1997); AHA (2002)

1 - Geometric mean of hydraulic conductivity measurements in parentheses

3.2.1 Storage Parameters

Table 3-3 summarizes model storage parameters for each model layer. The specific storage of model layers was calculated from results of site-specific aquifer testing at each ISR facility, and from published regional studies. The confined storage coefficient is then computed by the groundwater flow model by multiplying the specific storage and the thickness of the model layer for confined aquifers. A specific yield of 0.15 was assigned to model layers 1 and 2 (unconfined or convertible layers).

Table 3-3. Model Storage Parameters

Layer	**Specific Storage[1]**	**Specific Yield[2]**	Source
1 (G/H-Sand)	3e-05	0.15	AHA (2002)
2 (F-Sand)	3e-06	0.15	Uranerz (1989); Uranerz (2007); Uranerz (2010b)
3 (C-Sand)	3e-06	NA	Uranerz (1989); Uranerz (2007)
4 (B-Sand)	3e-06	NA	Uranerz (1989); Uranerz (2007)
5 (A-Sand)	3e-06	NA	Uranerz (1989); Uranerz (2007); Uranerz (2010a)
6 (Aquitard)	1.5e-06	NA	AHA (2002)
7 (CBM Aquifer)	5e-07	NA	Brenneis (1997); AHA (2002)

1 - Specific Storage = Storage Coefficient/Thickness

2 – Specific yield applicable only to unconfined or convertible layers

3.2.2 Model Layer Elevation (Depth)

The depth and elevation of model Layers 1 through 5 (water-table aquifer and ISR production sands) were developed from borehole and well log information provided in mine permitting documents and electronic databases for each ISR facility (Uranerz, 1989; Uranerz, 2007; Uranerz, 2010a; Uranerz, 2010b; Cameco Resources, 2010; Uranerz, 2010c). The depth and elevation of model Layers 6 and 7 (Lower Wasatch aquitard and Big George/Anderson-Wyodak coal bed) were obtained from the CBM well database maintained by the Wyoming Oil and Gas Commission (WYOGC, 2010). The elevation of the top of the ISR production interval (Layer 2, F-Sand) is illustrated in **Figure 3-8**. The elevation of the bottom of the ISR production interval (Layer 5, A-Sand) is illustrated in **Figure 3-9**. The top of the Big George CBM aquifer (Layer 7) is illustrated in **Figure 3-10**.

The water-table elevation (Top of Layer 1, G/H-Sand) was utilized as the reference elevation (zero datum) for the impact modeling. The estimated elevation of the water-table derived from ISR facility well data and regional publications is illustrated in **Figure 3-11**. 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 CBM development was evaluated at 81 stock and domestic well locations located within a 3-mile radius of the North Butte, Nichols Ranch, Hank, and Willow Creek, ISR facilities (**Figure 3-12**). Stock and domestic well information was compiled from mine permitting and electronic database information obtained for each ISR facility (Uranerz, 2007; Cameco, 2010; U.S. NRC, 2011). Stock and domestic well information relevant to this study is summarized in **Table 3-4**.

3.4 CBM Wells

CBM well completion and production data were obtained from the Wyoming Oil and Gas Commission electronic database (WYOGC, 2010). The groundwater flow model includes 3898 CBM wells in production over the period January 1999 through December 2010. The location of CBM production wells included in this study is provided in **Figure 3-13**.

Significant CBM dewatering activities began within the model area in 1999. **Figure 3-14** provides a summary of CBM water production for wells within the model domain from January 1999 through December of 2010. CBM water production in the region peaked in 2009 at approximately 6,050 gallons per minute (gpm) (1854 wells in production). Regional CBM production is expected to decline slowly in the future, with CBM dewatering expected to terminate in approximately 2018 (AHA, 2002).

Table 3-4. Water Well Information

Well ID	Easting	Northing	Permitted Use	Model Layer (Top)	Model Layer (Bottom)	Sand Completion Interval
Brown #4	287527	1099210	Stock	1	2	F/G/H
Brown #5	302582	1128702	Stock	3	4	B/C
BROWN (WS)	299771	1124707	Stock	3	3	C
C#1	305024	1100324	Stock	1	2	F/G/H
Calving #1	288889	1100539	Stock	3	4	B/C
Calving Shed #18	283973	1130471	Stock	1	1	G/H
CCI #2	308053	1137996	Stock	2	3	C/F
Connie #2	307811	1116422	Stock	3	3	C
Dobie Hill Well #1	307948	1126022	Stock	3	4	B/C
Doughstick #4	288850	1099194	Stock	1	2	F/G/H
Doughstick #5	286218	1100557	Stock	1	1	G/H
Dry Pasture #2	287802	1124867	Stock	1	1	G/H
East Pfister #1	314927	1132622	Stock	1	1	G/H
Franklin Brown #1	289257	1108478	Stock	3	4	B/C
Garden Well	287540	1100555	Domestic	4	5	A/B
Means #1	302320	1108491	Stock	2	4	B/F
North Pfister	308190	1144538	Stock	1	1	G/H
Old Maids #1	292997	1115336	Stock	2	2	F
Pfister Ranch	301242	1131160	Stock/Misc*	3	4	B/C
Red Barrel #1	294657	1128822	Stock	2	3	C/F
Simpson #1	313250	1109478	Stock	3	5	A/B/C
West Old Maid #1	286415	1118082	Stock	2	2	F
West Old Maid #2	286283	1109976	Stock	2	4	B/C/F
Beecher NE #25	278540	1126114	Stock	1	2	F/G/H
Doughstick #2	283519	1097861	Stock	6	6	Lower Wasatch
Dry Flowing Fork #3	272936	1100395	Stock	2	2	F
Dry Flowing Fork #5	266308	1096612	Stock	2	2	F
Dry Fork #1	268927	1096540	Stock	2	2	F
Dry Fork Flowing #1	261162	1109954	Stock	2	3	C/F
Dry Fork Flowing #2	263722	1104652	Stock	2	3	C/F
Dry Fork Flowing #4	266339	1101977	Stock	2	3	C/F
Fetty Well #1	278214	1099124	Stock	1	3	C/F/G/H
Kerr-McGee #1	261062	1103292	Stock	2	3	C/F
Pat's Well #1	279631	1103218	Stock	3	4	B/C
Pug #1	275622	1101793	Stock	3	3	C
Red Spring Artesian #1	271715	1112711	Stock	6	6	Lower Wasatch
A E C Well #19	274437	1142573	Domestic/Stock	5	5	A
Back Drew #8	253306	1158049	Stock	3	3	C
Back Lower Drew #24	257324	1165857	Stock	3	3	C
Barn #30	278508	1133460	Misc	6	6	Lower Wasatch
Bercher NE #29	271657	1131801	Stock	2	2	F
Bons #1	297213	1164758	Misc	1	1	G/H
Bons #1-24NW	294798	1165702	Misc	1	1	G/H
Bons #1-24SW	294898	1162507	Misc	1	1	G/H
Bons #1-25	294471	1158431	Misc	1	1	G/H
Brewer #1	233523	1168387	Domestic/Stock	1	1	G/H
Bridge #1	275691	1170304	Stock	1	1	G/H
Butte Pasture Well #9	280336	1133237	Stock	1	1	G/H

Table 3-4 (Con't). Water Well Information

Well ID	Easting	Northing	Permitted Use	Model Layer (Top)	Model Layer (Bottom)	Sand Completion Interval
Deforest #16	275756	1153787	Stock	1	1	G/H
Del Gulch #35	278731	1130166	Stock	2	2	F
Dells Gulch Upper #14	274468	1128235	Stock	1	1	G/H
Drew Well #7	260959	1160770	Stock	2	2	F
Ellendale #4	277224	1138394	Domestic/Stock	3	3	C
Ellen #1	281964	1158318	Stock	1	1	G/H
ENL Willow Corral #32	274292	1142398	Misc	6	6	Lower Wasatch
ENL Dry Pasture #2	286822	1124613	Stock	5	5	A
Hartsog #1	319409	1169880	Stock	1	1	G/H
Helot #1	271221	1159566	Stock	3	4	B/C
Helot Draw #34	275620	1159433	Stock	4	4	B
Helot #4	281062	1142544	Domestic/Stock	4	4	B
House Well #3	280175	1133471	Domestic	3	3	C
Jay #1	293072	1160673	Stock	1	1	G/H
Jepson #1	234739	1168389	Stock	3	3	C
Jepson #2	234554	1174383	Stock	1	1	G/H
Levan #1	286420	1162489	Stock	3	3	C
Middle Well #5	266615	1150271	Stock	2	3	C/F
North Prong Deep	289293	1157187	Stock	2	2	F
SP#1-24	297258	1162534	Stock	1	1	G/H
SP#1-25	295751	1159385	Stock	1	1	G/H
SP#1-26	291684	1159348	Stock	2	2	F
SS Pump #1	263783	1155215	Domestic/Stock	3	3	C
SW Willow #1	263731	1137225	Stock	4	4	B
Willow #2	242808	1177956	Stock	1	1	G/H
Willow #3	237627	1180588	Stock	1	1	G/H
Willow Corral #32	274463	1142398	Domestic/Stock	5	6	A/Lower Wasatch
Willow Ridge Well #20	263223	1129955	Stock	6	6	Lower Wasatch
Willow SE Well #26	266633	1135673	Stock	1	1	G/H
Willow Dug Well #15	270849	1135529	Stock	1	1	G/H
Young #1	269319	1170003	Stock	3	3	C
Young #2	237643	1169180	Stock	3	3	C

* Includes non-potable domestic uses including laundry and bathing (not a drinking water source)

4. MODEL CALIBRATION

In order to increase the reliability of hydrologic impact predictions, the groundwater flow model was calibrated to historical ISR aquifer testing and CBM development activities. Four individual transient model calibrations/simulations were undertaken as part of this work: 1) historical CBM development, 2) North Butte ISR multi-well aquifer test, 3) Nichols Ranch ISR multi-well pumping test, and 4) Hank Unit ISR multi-well aquifer test.

4.1 CBM Development Calibration

Historical CBM dewatering activities were simulated over the period January 2009 through December 2010 as part of the model calibration process. Annual CBM water production for each CBM well were input into the model for each model year, as summarized in the cumulative annual production curve in **Figure 3-14**.

Because CBM development extends beyond model boundaries to the north, south, and east, General Head Boundaries were modified to simulate the projected regional drawdown from CBM development over the period 1999 through 2010 in the Powder River Basin, based on regional drawdown simulations presented in AHA (2002).

4.1.1 CBM Calibration Results

The drawdown resulting from historical CBM development in October of 2010 was simulated and compared to drawdowns observed in regional CBM monitoring wells maintained by the Bureau of Land Management (BLM, 2010).

Within the model domain, there are three CBM monitoring well networks that were installed prior to significant CBM development that could be used for purposes of model calibration. These monitoring well locations generally include wells installed in the CBM aquifer (Model Layer 7), and one or more wells installed within the overlying Lower Wasatch/Fort Union aquitard sands (Model Layer 6). CBM monitoring wells used for model calibration include 1) the Pistol well network located approximately 3.5 miles north of the North Butte ISR permit boundary, 2) the Bullwacker well network located approximately 6.5 miles southwest of the Nichols Ranch ISR permit boundary, and 3) the West Pine Tree well network located approximately 7.5 miles south of the Nichols Ranch ISR permit boundary. Historical water level data for CBM monitoring wells used in the model calibration are provided in **Attachment A**.

Results of the CBM development calibration are shown on **Figure 4-1**. Simulated drawdown in October of 2010 in the CBM coal bed (model Layer 7) in the vicinity of the ISR facilities is greater than 800 feet. Model simulated drawdown is within 3 percent of observed drawdown, well within excepted standards for adequate model calibration.

Although much less significant, measurable drawdown is observed in the overlying Lower Wasatch/Fort Union aquitard sands (Layer 6). Model simulated drawdown in October of 2010 in model Layer 6 is approximately 4 to 6 feet. This result compares reasonably well to drawdown observed in Lower Wasatch/Fort Union sand wells, which generally show less than 6 feet of drawdown, except where overlying monitor wells are separated from the CBM aquifer vertically by less than 100 feet, or near basin margins where the aquitard is thin or missing due to erosion in outcrop areas (e.g. Bullwacker Wasatch sand well).

4.2 North Butte Aquifer Test SS2M Calibration

The drawdown resulting from the SS2M multi-well pumping test (Uranerz, 1989) was simulated in order to validate estimates of hydraulic conductivity and storage parameters in the vicinity of the North Butte ISR property. Observed drawdown at the end of the 3.9 day pumping period was compared to the simulated drawdown at three observation well locations: SS2BC1, SS2BC2, and SS2MP. The pumping well (SS2M) and all observation wells were completed within the B- and C- Sand production zone (Layers 3 and 4).

Results of the SS2M aquifer test simulation are shown in **Table 4-1** and **Figure 4-2**. Model simulated drawdown is within 6 percent of observed drawdown, and other statistical measures of calibration adequacy are within excepted standards for model calibration. No discernable drawdown was observed in monitoring wells installed in overlying (F-Sand) and underlying (A-Sand) aquifers, consistent with model simulated results showing no significant drawdown in overlying or underlying model layers.

Table 4-1 . Model Calibration Results, North Butte Pump Test SS2M Simulation

Well ID	Time (days)	X	Y	Layer	Observed	Computed	Weight	Group	Residual
SS2BC1	3.94	296985.74	1134202	4	11.05	11.24885	0	1	-0.19885
SSBC2	3.94	297061.31	1134112	3	14.6	14.15355	0	1	0.446449
SSBC2	3.94	297061.31	1134120	4	14.6	14.0015	0	1	0.598505
SS2BC1	3.94	296981.98	1134202	3	11.05	11.44013	0	1	-0.39013
SS2MP	3.94	297182.55	1134223	3	8	8.496127	0	1	-0.49613
SS2MP	3.94	297188.19	1134221	4	8	8.038741	0	1	-0.03874
Residual Mean	-0.01315								
Abs. Res. Mean	0.361468								
Res. Std. Dev.	0.407405								
Sum of Squares	0.996911								
RMS Error	0.407617								
Min. Residual	-0.496127								
Max. Residual	0.598505								
Number of Observations	6								
Range in Observations	6.6								
Scaled Std. Dev.	0.061728								
Scaled Abs. Mean	0.054768								
Scaled RMS	0.06176								

4.3 Nichols Ranch MN-1 Aquifer Test Calibration

The drawdown resulting from the MN-1 multi-well pumping test (Uranerz, 2007) was simulated in order to validate estimates of hydraulic conductivity and storage parameters in the vicinity of the Nichols Ranch ISR property. Observed drawdown at the end of the 3.2 day pumping period was compared to the simulated drawdown at three observation well locations: Nichols-1 OBS, MN-2 OBS, and MN-3 OBS. The pumping well (MN-1) and all observation wells were completed within the A-Sand production zone (Layers 5).

Results of the MN-1 aquifer test simulation are shown in **Table 4-2** and **Figure 4-3**. Model simulated drawdown is within 6 percent of observed drawdown except at observation well MN-2 OBS, where observed

and simulated drawdown vary by a factor of approximately two (0.15 feet observed drawdown versus 0.30 feet of simulated drawdown). No discernable drawdown was observed in monitoring wells installed in overlying (B-Sand) and underlying (1-Sand) aquifers, consistent with model simulated results showing no significant drawdown in overlying or underlying model layers.

Given the relatively small amount of drawdown observed at MN-2 during the test, and the relative adequacy of other statistical measures of calibration, the MN-1 aquifer test simulation results are considered adequate for purposes of hydrologic impact modeling.

Table 4-2. Model Calibration Results, Nichols Ranch Pump Test MN-1 Simulation

Well ID	Time (days)	X	Y	Layer	Observed	Computed	Weight	Group	Residual
Nichols-1_OBS	3.16	272265	1107430	5	0.99	0.962485	0	1	0.027515
MN-2_OBS	3.16	273844	1108147	5	0.15	0.308757	0	1	-0.15876
MN-3_OBS	3.16	275167	1106960	5	0.7	0.654625	0	1	0.045375
Residual Mean	-0.028622								
Abs. Res. Mean	0.077216								
Res. Std. Dev.	0.092307								
Sum of Squares	0.02802								
RMS Error	0.096643								
Min. Residual	-0.158757								
Max. Residual	0.045375								
Number of Observations	3								
Range in Observations	0.84								
Scaled Std. Dev.	0.10989								
Scaled Abs. Mean	0.091923								
Scaled RMS	0.115051								

4.4 Hank Unit URZHF-5 Aquifer Test Simulation

The drawdown resulting from the URZHF-5 multi-well pumping test (Uranerz, 2007) was simulated in order to validate estimates of hydraulic conductivity and storage parameters in the vicinity of the Hank Unit ISR property. The pumping well (URZHF-5) and production zone observation wells were completed within the F-Sand aquifer (Layer 2).

The quality of the URZHF-5 aquifer test data was poor. No observation wells were installed within 1500 feet of the pumping well in the production interval (F-Sand), resulting in less than 0.3 feet of drawdown in observation wells. Drawdown also showed considerable variation during the test (equal to the total drawdown observed in observation wells), and results cannot therefore be deemed adequate for purposes of a quantitative measure for model calibration purposes.

Observed drawdown at the end of the 1.8 day pumping period was compared to the simulated drawdown at two observation well locations: Hank-1 OBS and BRG-OBS. Model simulated drawdown of approximately 0.1 foot was simulated at observation well locations, which is within the expected range of accuracy of the

drawdown observed during the test (0.21 and 0.26 feet maximum drawdown, respectively). No discernable drawdown was observed in monitoring wells installed in overlying (G-Sand) and underlying (C-Sand) aquifers, consistent with model simulated results showing no significant drawdown in overlying or underlying model layers.

5. HYDROLOGIC IMPACT SIMULATIONS

Hydrologic impact simulations were performed using the groundwater flow model for each ISR facility and for CBM dewatering activities in order to assess future impacts due to individual facilities/operations. The cumulative hydrologic impact was then computed by adding individual ISR facility and CBM dewatering impacts together as allowed by the principal of superposition.

Hydrologic impacts were simulated over a 16 year development period, beginning in approximately the 4th quarter of 2013 (Development Year 1) and extending through 2029 (Development Year 16). North Butte and Nichols Ranch ISR operations were assumed to begin simultaneously in Development Year 1. Hank Unit ISR operations were assumed to begin two years after start-up of the North Butte and Nichols Ranch ISR operations (beginning of Development Year 3). The Willow Creek ISR facility is currently in operation, and impact simulations therefore included a three year pre-development period (2011 through 2013), with operations extending through Development Year 11 (2023). CBM dewatering operations were assumed to be continuous over the period 1999 through 2018 (pre- development period through Development Year 5).

5.1 NORTH BUTTE ISR IMPACT ASSESSMENT

Hydrologic impacts due to the operation of the North Butte ISR facility were simulated over an estimated 16 year development and restoration period beginning in the 4th quarter of 2013 and continuing through 2029. The North Butte ISR facility will include development of five Mine Units (MU-1 through MU-5) as shown on **Figure 5-1**.

5.1.1 North Butte ISR Operations

The mining and restoration schedule and water balance assumptions for the North Butte hydrologic impact simulations are provided in **Attachment B**. Mining is planned to proceed sequentially in numerical order, beginning with Mine Unit 1 and ending with the development of Mine Unit 5. Restoration is assumed to proceed immediately after completion of each phase of mining.

Economically recoverable uranium is present primarily within the B- and C-Sands at the North Butte property, with the majority of development expected to take place within the B-Sand interval. For purposes of this modeling, it is assumed that groundwater withdrawals are taken from the B-Sand (model Layer 4).

Groundwater withdrawals due to ISR production are assumed to be 1 percent of total wellfield production (1% bleed). The ISR production bleed is expected to vary from a minimum of 22 gpm at the start of mining and increase as wellfield development progresses to a maximum of 60 gpm over the period 2018 through 2021 (Development year 5 through 9).

Groundwater withdrawals due to ISR restoration are assumed to be 5 percent of total restoration flow (5% bleed), with total restoration flow assumed to be equivalent to the Reverse Osmosis (RO) treatment capacity. RO treatment capacity is assumed to vary from 600 gpm at the beginning of restoration (Development Year 5) to a maximum of 900 gpm over the period 2023 through 2028 (Development Year 10 through 15). The resulting ISR restoration bleed will vary from 30 to 45 gallons per minute over the life of the mine. Total groundwater withdrawals from the production sands due to ISR production and restoration is therefore assumed to vary from 22 gpm in Development Year 1 to a maximum of 90 gpm in Development Year 5 through 8.

Groundwater withdrawals were simulated in the groundwater flow model as a series of 7 to 10 pumping centers per Mine Unit, with the withdrawal rate of each pumping center corresponding roughly to the bleed associated with an individual wellhouse (each wellhouse would typically receive flow from approximately 20 individual 5-spot well patterns).

Given an RO efficiency of approximately 85 percent (15% reject to disposal), it will be necessary to develop a source of make-up water equivalent to the difference between the facility bleed and the RO reject volume. Given that ISR restoration is planned to begin at approximately the same time that CBM dewatering is expected to terminate (Development Year 5), it is assumed that make-up water will be provided by three existing CBM production wells located within the North Butte permit boundary (model Layer 7). Hydrologic impacts due to make-up production are included in the North Butte impact assessment and not as part of the CBM impact assessment.

5.1.2 North Butte Impact Assessment Results

Projected hydrologic impacts (drawdown) associated with the North Butte ISR operation are summarized in **Table 5-1** and **Figures 5-2** through **5-6**. In general, maximum impacts due to North Butte ISR development occur around Development Year 8, but the timing of maximum impacts at individual stock and domestic wells may vary somewhat based on their relative proximity to the North Butte property and the well completion interval.

The majority of stock and domestic wells in this study are completed in multiple sand units (e.g. B/C, F/G/H). The drawdown observed in wells completed in multiple sand units (model layers) will represent the flow-weighted average of the drawdown observed in each individual sand unit (model layer). Drawdown values shown in **Table 5-1** for wells completed in multiple sand intervals represent the arithmetic average of the drawdown observed in each model layer (a reasonable assumption given that production sands typically have similar transmissivity).

Stock and domestic wells completed within the production interval (B-Sand) show the greatest impact, with a maximum drawdown of approximately 21 feet predicted at the Pfister Ranch (BRT) well located southeast of the North Butte facility. Impacts to wells completed in overlying and underlying sands (C-Sand, A-Sand) also show measurable impacts of up to 10 feet of drawdown near the North Butte property. Impacts to the shallow water-table aquifer (G/H-Sand) are expected to be negligible.

5.2 NICHOLS RANCH ISR IMPACT ASSESSMENT

Hydrologic impacts due to the operation of the Nichols Ranch ISR facility were simulated over an estimated six year development and restoration period, beginning in the 4th quarter of 2013 and continuing through 2019. The Nichols Ranch ISR facility will include the development of two Mine Units (MU-1 and MU-2) as shown on **Figure 5-7**.

5.2.1 Nichols Ranch ISR Operations

Mining at the Nichols Ranch property is assumed to proceed sequentially, beginning with Mine Unit 1 and ending with the development of Mine Unit 2. Economically recoverable uranium is present primarily within the A-Sand at the Nichols Ranch property. For purposes of this modeling, it is assumed that groundwater withdrawals are taken solely from the A-Sand (model Layer 5).

It is assumed each mine unit will require 1.5 years to mine, resulting in a three-year mine production period. Restoration is assumed to begin in Development Year 1.5 after the completion of mining in MU-1, and continue through Development Year 6 with the restoration of MU-2.

Groundwater withdrawls due to ISR production are assumed to be 1 percent of total wellfield production (1% bleed) (Uranerz, 2007, Uranerz, 2010a). The ISR production bleed is assumed to be 35 gpm for the duration of the production period (1 percent of 3500 gpm estimated total production flow rate).

Groundwater withdrawals due to ISR restoration are assumed to be limited by a deep disposal well capacity of approximately 100 gpm. Given an assumed production bleed of 35 gpm, the maximum restoration bleed is assumed to be a maximum of 65 gpm during the mining period (Development Year 1.5 through Development Year 3), and 100 gpm for the post-mining period (Development Years 4 through 6).

Groundwater withdrawls were simulated in the groundwater flow model as a series of 12 pumping centers per Mine Unit, with the withdrawl rate of each pumping center corresponding roughly to the bleed associated with an individual wellhouse.

5.2.2 Nichols Ranch Impact Assessment Results

Projected hydrologic impacts (drawdown) associated with the Nichols Ranch ISR operation are summarized in **Table 5-1** and **Figures 5-8** through **5-12**. In general, maximum impacts due to Nichols Ranch ISR development occur around Development Year 5, but the timing of maximum impacts at individual stock and domestic wells may vary somewhat based on their relative proximity to the Nichols Ranch property and the well completion interval.

Stock and domestic wells located nearest to the Nichols Ranch property and located in or adjacent to the A-Sand production unit (Layer 5) show the greatest impact, with maximum drawdowns of 10 to 15 feet observed in wells located closest to the Nichols Ranch facility. Impacts to the shallow water-table aquifer (G/H-Sand) are expected to be negligible.

5.3 HANK UNIT ISR IMPACT ASSESSMENT

Hydrologic impacts due to the operation of the Hank Unit ISR facility were simulated over an estimated six year development and restoration period beginning in 2016 (Development Year 3) and continuing through 2021 (Development Year 8). The Hank Unit ISR facility will include the development of two Mine Units (MU-1 and MU-2) as shown on **Figure 5-13.**

5.3.1 Hank Unit ISR Operations

Mining at the Hank Unit ISR property is assumed to proceed sequentially, beginning with Mine Unit 1 and ending with the development of Mine Unit 2. Economically recoverable uranium is present primarily within the F-Sand at the Hank Unit property. For purposes of this modeling, it is assumed that groundwater withdrawls are taken solely from the F-Sand (model Layer 2).

It is assumed each mine unit will require 1.5 years to mine, resulting in a three-year mine production period (Development Years 3 through 5). Restoration is assumed to begin in Development Year 4.5 after the completion of mining in MU-1, and continue through Development Year 8 with the restoration of MU-2.

Groundwater withdrawls due to ISR production are assumed to be 3 percent of total wellfield production (3% bleed) (Uranerz, 2007, Uranerz, 2010b). The ISR production bleed is assumed to be 75 gpm for the duration of the production period (3 percent of 2500 gpm estimated total production flow rate).

Groundwater withdrawls due to ISR restoration are assumed to be limited by a total deep disposal well capacity of approximately 100 gpm. Given an assumed production bleed of 75 gpm, the maximum restoration bleed is assumed to be a maximum of 25 gpm during the mining period and 100 gpm for the post-mining period.

Groundwater withdrawls were simulated in the groundwater flow model as a series of 12 pumping centers per Mine Unit, with the withdrawl rate of each pumping center corresponding roughly to the bleed associated with an individual wellhouse.

5.3.2 Hank Unit Impact Assessment Results

Projected hydrologic impacts (drawdown) associated with the Hank Unit ISR operation are summarized in **Table 5-1** and **Figures 5-14** through **5-18**. In general, maximum impacts due to Hank Unit ISR development occur around Development Year 8, but the timing of maximum impacts at individual stock and domestic wells may vary somewhat based on their relative proximity to the Hank Unit ISR property and the well completion interval.

Stock and domestic wells located nearest to the Hank property and located in or adjacent to the F-Sand production unit (Layer 2) show the greatest impact, with maximum drawdowns of approximately 4 to 6 feet observed in wells located closest to the Hank Unit ISR facility. Impacts to the overlying shallow water-table aquifer (G/H-Sand) are expected to be negligible.

5.4 WILLOW CREEK ISR IMPACT ASSESSMENT

The Willow Creek ISR facility is composed of two distinct sites operated by Uranium One USA, Inc. The Christensen Ranch satellite facility contains an ion exchange (IX) plant and existing and future wellfields (**Figure 5-19**). The Irigaray satellite contains the central processing plant (CPP) and potential future wellfields, and is located northwest of the Christensen Ranch satellite. Hydrologic impacts due to the operation of the existing and future Christensen Ranch ISR wellfields were simulated over an estimated 13-year development and restoration period beginning in 2011 (three year predevelopment period) and continuing through 2023 (Development Year 10), according to the schedule shown in **Attachment C**. The impact assessment includes the development and restoration of six Mine Units (MU-7 though MU-12) within the Christensen Ranch site illustrated on **Figure 5-19**. Potential future operation of ISR wellfields at the Irigaray satellite were not included in this assessment given the uncertain nature of this future development.

5.4.1 Willow Creek ISR Operations

Operations at the Willow Creek ISR property are assumed to proceed sequentially, beginning with MU-7 and ending with the development and restoration of MU-12. Restoration of MU1 through MU-6 has been completed. Economically recoverable uranium is present primarily within the K-Sands at the Willow Creek property (equivalent to the A- and B-Sands at other ISR facilities). For purposes of this assessment, it is assumed that groundwater withdrawals are taken solely from the A- and B-Sands (model Layers 4 and 5).

Restoration is assumed to begin in immediately after the completion of mining in MU-7 and continue through the completion of restoration of MU-12.

Groundwater withdrawals due to ISR production are assumed to be 1 percent of the total wellfield production flow (1% bleed) (U.S. NRC, 2011). The ISR production bleed is assumed to be 40 gpm for the duration of the mine life based on a total facility production capacity of 4,000 gpm. The production bleed was divided among all mine units actively in production at any particular time. Groundwater withdrawals due to ISR restoration are assumed to be limited to 37.5 gpm by the current 150 gpm RO treatment capacity (25 percent brine reject) and a total water disposal capacity of approximately 150 gpm. Groundwater withdrawals were simulated in the groundwater flow model as a series of two or three pumping centers per mine unit.

5.4.2 Willow Creek Impact Assessment Results

Projected hydrologic impacts (drawdown) associated with the Willow Creek ISR operation are summarized in Table 5-1 and **Figures 5-20 through 5-24**. In general, maximum impacts due to Willow Creek ISR development generally occur between Development Years 2 and 5, but the timing of maximum impacts at individual stock and domestic wells may vary somewhat based on their relative proximity to the Willow Creek property and the well completion interval. Stock and domestic wells located nearest to the Willow Creek property and located in or adjacent to the A and B production sands (Layers 4 and 5) show the greatest impact, with a maximum drawdown of approximately 14 feet observed in well Helot #4 located within the permit boundary adjacent to Mine Unit 7. Impacts to the overlying shallow water-table aquifer (G/H-Sand) are expected to be negligible.

5.5 CBM IMPACT ASSESSMENT

Hydrologic impacts due to CBM dewatering were simulated over a 31 year development and recovery period. CBM development is assumed to have begun in 1999 with peak water production occurring in 2009. CBM water production is assumed to decrease gradually beginning in 2010 (pre-ISR development period) with CBM dewatering operations terminating in 2018 (Development Year 5), as shown in **Figure 3-14**.

There were approximately 1570 CBM wells in production within the model domain as of November 2010 (WYOGC, 2010). For purposes of the impact modeling, it is assumed these wells continue to remain in production through 2018, but at gradually declining production rates based on the production curve in **Figure 3-14**. The total future annual water production is assumed to be divided equally among the 1570 CBM wells in the model domain over the period 2011 through 2018.

Because the overlying ISR production sands (A-Sand through F-Sand) experience the maximum drawdown from CBM dewatering 4 to 6 years *after* the termination of CBM dewatering activities in 2018, the CBM impact simulation was allowed to continue for an extended recovery period equivalent to the duration of the ISR development and restoration period (through Development Year 16 in 2029).

Because CBM development extends beyond model boundaries to the north, south, and east, General Head Boundaries were modified to simulate the projected regional drawdown (and recovery) from CBM development over the period 1999 through 2030 in the Powder River Basin, based on regional drawdown simulations presented in AHA (2002).

5.5.1 CBM Impact Assessment Results

Projected hydrologic impacts (drawdown) associated with CBM dewatering activities are summarized in **Table 5-1** and **Figures 5-25** through **5-30**. In general, maximum impacts due to CBM development occur around Development Year 9 (about four years after the termination of CBM dewatering), but the timing of maximum impacts at individual stock and domestic wells may vary somewhat based on their relative proximity to CBM production wells and the well completion interval (depth).

Drawdown impacts are projected to be the greatest in the deepest wells (e.g. those wells having the least vertical separation from the CBM production interval). Maximum drawdowns of less than 13 feet are predicted in stock wells completed below the ISR production sands in the Lower Wasatch aquitard sands (Layer 6). Drawdown in wells completed in the ISR production interval (A-Sand through F-Sand) are predicted to be considerably less, with maximum drawdowns predicted to be less than 1-foot.

5.6 CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT RESULTS

The cumulative hydrologic impact (drawdown) associated with ISR and CBM development was calculated by adding the impacts of individual ISR and CBM developments as allowed by the principal of superposition. The timing of the maximum cumulative drawdown varies depending on the well location and completion interval, but the largest cumulative drawdown impacts are generally observed to occur between Development Years 2 and 8.

A summary of cumulative drawdown impacts is provided in **Table 5-1**. Cumulative drawdown impacts for Development Year 5 are shown in **Figures 5-31** through **5-35**. Cumulative drawdown impacts for Development Year 8 are shown in **Figures 5-36** through **5-40**.

In general, maximum cumulative drawdown occurs in wells closest to ISR facilities and completed within ISR production sands. Cumulative drawdown impacts greater than 20 feet are predicted in two wells (Pfister Ranch and Brown #5) located near the North Butte and Hank Unit ISR facilities. Cumulative drawdown greater than 10 feet is predicted in 23 of 81 wells included in this study.

5.7 SUMMARY AND CONCLUSIONS

As a practical matter, predicted hydrologic impacts associated with ISR and CBM development are not significant. Stock and domestic wells in this study are typically 250 to more than 600 feet deep and possess an available water column of 150 to more than 400 feet. In fact, predicted drawdown due to ISR and CBM development is less than 10 percent of the available water column in wells having greater than 10 feet of predicted drawdown. 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 worst case, by installing an additional supply well (and pump) to make up for lost production.

Individual ISR facilities are predicted to cause between 0.5 and 4 feet of drawdown at neighboring ISR facilities (**Table 5-1**). The cumulative maximum impact of neighboring ISR facilities on one another is predicted to be between 5 and 8 feet over the 16 year development period. Drawdown impacts due to the

simultaneous operation of ISR facilities should not impact the ability of individual ISR facilities to operate as planned, and will allow effective hydraulic containment of mining solutions.

Table 5-1. Hydrologic Impact Assessment Summary

Well/Facility ID	Easting	Northing	Type	Model Layer (Top)	Model Layer (Bot)	Sand Interval	Maximum Simulated Drawdown (ft) North Butte ISR Operation	Nichols Ranch ISR Operation	Hank ISR Operation	Willow Creek ISR Operation	CBM Operations	Maximum Cumulative Drawdown	Max Cumulative Drawdown Year
Pfister Ranch	301242	1131160	Stock/Misc*	3	4	B/C	21.10	1.90	3.94	1.71	0.38	25.9	8
Brown #5	302582	1128702	Stock	3	4	B/C	15.20	1.92	4.25	1.42	0.39	21.11	8
ENL Dry Pasture #2	286822	1124613	Stock	5	5	A	12.58	6.02	2.16	2.26	0.51	19.13	8
BROWN (WS)	299771	1124707	Stock	3	3	C	10.03	2.18	6.20	1.21	0.33	17.73	8
Helot #4	281062	1142544	Domestic/Stock	4	4	B	8.73	1.82	1.19	13.81	0.34	17.03	2
A E C Well #19	274437	1142573	Domestic/Stock	5	5	A	5.58	1.99	0.92	9.52	0.42	16.12	2
Pat's Well #1	279631	1103218	Stock	3	4	B/C	2.16	14.75	1.09	0.54	0.15	15.79	5
Helot #1	271221	1159566	Stock	3	4	B/C	2.09	0.52	0.38	13.64	0.26	14.78	3
Red Barrel #1	294657	1128822	Stock	2	3	C/F	9.15	1.80	5.10	1.41	0.22	13.13	8
Doughstick #2	283519	1097861	Stock	6	6	Lower Wasatch	0.44	0.19	<0.03	0.03	12.80	13.1	8
Helot Draw #34	275620	1159433	Stock	4	4	B	2.85	0.61	0.47	12.28	0.32	13.02	5
Barn #30	278508	1133460	Misc	6	6	Lower Wasatch	0.49	0.08	0.03	0.11	12.37	12.98	9
Willow Corral #32	274463	1142398	Domestic/Stock	5	6	A/Lower Wasatch	2.92	1.03	0.47	4.73	6.21	12.96	12
Dobie Hill Well #1	307948	1126022	Stock	3	4	B/C	8.30	1.48	4.15	0.66	0.43	12.95	8
Garden Well	287540	1100555	Domestic	4	5	A/B	2.60	10.32	1.27	0.50	0.52	12.87	5
SW Willow #1	263731	1137225	Stock	4	4	B	2.83	2.11	0.60	8.41	0.28	12.81	7
ENL Willow Corral #32	274292	1142398	Misc	6	6	Lower Wasatch	0.44	0.06	0.02	0.15	11.99	12.48	12
House Well #3	280175	1133471	Domestic	3	3	C	6.27	2.46	1.76	3.13	0.24	12.45	9
Willow Ridge Well #20	263223	1129955	Stock	6	6	Lower Wasatch	0.37	0.07	0.02	0.11	12.14	12.43	12
Red Spring Artesian #1	271715	1112711	Stock	6	6	Lower Wasatch	0.41	0.16	<0.02	0.06	12.20	12.33	8
SS Pump #1	263783	1155215	Domestic/Stock	3	3	C	1.48	0.48	0.30	10.41	0.20	11.92	4
Franklin Brown #1	289257	1108478	Stock	3	4	B/C	3.89	7.20	2.08	0.67	0.40	11.52	5
Pug #1	275622	1101793	Stock	3	3	C	1.54	10.71	0.80	0.44	0.13	11.2	5
Ellendale #4	277224	1138394	Domestic/Stock	3	3	C	5.01	1.81	1.28	4.24	0.23	9.41	9
Old Maids #1	292997	1115336	Stock	2	2	F	2.79	1.88	5.30	0.58	0.18	9.25	8
Back Drew #8	253306	1158049	Stock	3	3	C	0.74	0.27	0.15	8.22	0.19	9.17	8
Connie #2	307811	1116422	Stock	3	3	C	4.39	1.60	4.49	0.54	0.42	9.14	8
West Old Maid #2	286283	1109976	Stock	2	4	B/C/F	3.39	6.73	2.13	0.66	0.30	8.93	5
Calving #1	288889	1100539	Stock	3	4	B/C	2.28	6.74	1.32	0.44	0.42	8.69	6
Middle Well #5	266615	1150271	Stock	2	3	C/F	1.81	0.57	0.39	7.05	0.16	8.68	6
CCI #2	308053	1137996	Stock	2	3	C/F	6.57	0.72	2.62	0.97	0.26	8.64	8
West Old Maid #1	286415	1118082	Stock	2	2	F	2.71	2.09	3.39	0.68	0.16	7.74	8
Back Lower Drew #24	257324	1165857	Stock	3	3	C	0.77	0.23	0.15	5.97	0.21	6.99	8
Means #1	302320	1108491	Stock	2	4	B/F	3.00	2.30	2.79	0.43	0.41	6.71	8
Del Gulch #35	278731	1130166	Stock	2	2	F	2.93	1.49	2.12	1.18	0.13	6.65	8
Simpson #1	313250	1109478	Stock	3	5	A/B/C	2.75	1.36	1.91	0.35	0.71	5.85	8
Young #1	269319	1170003	Stock	3	3	C	1.10	0.25	0.20	5.16	0.21	5.85	4
Dry Fork Flowing #4	266339	1101977	Stock	2	3	C/F	0.68	4.95	0.40	0.25	0.15	5.39	5
Levan #1	286420	1162489	Stock	3	3	C	1.96	0.33	0.38	2.80	0.17	5.25	3
Drew Well #7	260959	1160770	Stock	2	2	F	0.76	0.23	0.17	3.99	0.12	5.01	8
Bercher NE #29	271657	1131801	Stock	2	2	F	1.92	1.17	1.10	1.34	0.11	4.71	9
Dry Fork Flowing #2	263722	1104652	Stock	2	3	C/F	0.58	4.15	0.29	0.27	0.12	4.42	5
SP#1-26	291684	1159348	Stock	2	2	F	2.00	0.32	0.45	2.00	0.14	4.31	8

Table 5-1 (Cont'd). Hydrologic Impact Assessment Summary

Well/Facility ID	Easting	Northing	Type	Model Layer (Top)	Model Layer (Bot)	Sand Interval	Maximum Simulated Drawdown (ft) North Butte ISR Operation	Nichols Ranch ISR Operation	Hank ISR Operation	Willow Creek ISR Operation	CBM Operations	Maximum Cumulative Drawdown	Max Cumulative Drawdown Year
Fetty Well #1	278214	1099124	Stock	1	3	C/F/G/H	0.78	3.77	0.83	0.21	0.15	4.25	5
North Prong Deep	289293	1157187	Stock	2	2	F	2.22	0.38	0.53	2.30	0.14	3.65	2
Dry Flowing Fork #3	272936	1100395	Stock	2	2	F	0.70	2.46	0.60	0.21	0.06	3.31	5
Dry Fork Flowing #1	261162	1109954	Stock	2	3	C/F	0.50	2.92	0.21	0.07	0.09	3.14	5
Kerr-McGee #1	261062	1103292	Stock	2	3	C/F	0.36	2.87	0.17	0.18	0.02	3.01	5
Craney #1	275852	1175706	Stock	2	2	F	0.79	0.16	0.15	2.42	0.13	3.01	5
Beecher NE #25	278540	1126114	Stock	1	2	F/G/H	1.34	0.84	1.05	0.49	0.07	2.56	8
Young #2	237643	1169180	Stock	3	3	C	0.25	0.09	0.05	2.30	0.21	2.53	9
Dry Fork #1	268927	1096540	Stock	2	2	F	0.47	1.91	0.29	0.15	0.06	2.39	5
Jepson #1	234739	1168389	Stock	3	3	C	0.20	0.07	0.04	1.81	0.21	2.06	9
Doughstick #4	288850	1099194	Stock	1	2	F/G/H	0.58	1.05	0.65	0.13	0.10	2.05	5
Dry Flowing Fork #5	266308	1096612	Stock	2	2	F	0.38	1.57	0.30	0.12	0.05	1.94	5
Brown #4	287527	1099210	Stock	1	2	F/G/H	0.57	1.09	0.65	0.13	0.08	1.89	5
C#1	305024	1100324	Stock	1	2	F/G/H	0.59	0.59	0.80	0.10	0.14	1.83	9
Dells Gulch Upper #14	274468	1128235	Stock	1	1	G/H	0.06	0.02	0.03	0.03	<.01	0.12	16
Dry Pasture #2	287802	1124867	Stock	1	1	G/H	0.07	0.02	0.06	0.02	<0.01	0.11	12
North Pfister	308190	1144538	Stock	1	1	G/H	0.10	<0.01	0.03	0.01	<0.01	0.11	12
Butte Pasture Well #9	280336	1133237	Stock	1	1	G/H	0.06	0.02	0.04	0.03	<.01	0.11	16
East Pfister #1	314927	1132622	Stock	1	1	G/H	0.07	<0.01	0.04	0.01	<0.01	0.09	12
Deforest #16	275756	1153787	Stock	1	1	G/H	0.04	<.01	<.01	0.06	<.01	0.09	10
Willow Dug Well #15	270849	1135529	Stock	1	1	G/H	0.05	0.02	0.02	0.04	<.01	0.09	16
Ellen #1	281964	1158318	Stock	1	1	G/H	0.04	<.01	<.01	0.05	<.01	0.08	10
Jay #1	293072	1160673	Stock	1	1	G/H	0.05	<.01	<.01	0.04	<.01	0.08	16
SP#1-25	295751	1159385	Stock	1	1	G/H	0.05	<.01	0.01	0.04	<.01	0.08	16
Willow SE Well #26	266633	1135673	Stock	1	1	G/H	0.04	0.02	0.02	0.05	<.01	0.08	10
Bons #1-25	294471	1158431	Misc	1	1	G/H	0.06	<.01	0.01	0.04	<.01	0.07	16
Calving Shed #18	283973	1130471	Stock	1	1	G/H	0.03	0.02	0.04	0.02	<0.01	0.06	12
Bons #1-24SW	294898	1162507	Misc	1	1	G/H	0.04	<.01	<.01	0.04	<.01	0.06	16
SP#1-24	297258	1162534	Stock	1	1	G/H	0.04	<.01	<.01	0.03	<.01	0.06	16
Doughstick #5	286218	1100557	Stock	1	1	G/H	0.03	0.02	0.02	0.01	<0.01	0.05	13
Bons #1	297213	1164758	Misc	1	1	G/H	0.04	<.01	<.01	0.03	<.01	0.05	16
Bons #1-24NW	294798	1165702	Misc	1	1	G/H	0.03	<.01	<.01	0.03	<.01	0.05	16
Bridge #1	275691	1170304	Stock	1	1	G/H	0.02	<.01	<.01	0.04	<.01	0.05	10
Jepson #2	234554	1174383	Stock	1	1	G/H	<.01	<.01	<.01	0.04	<.01	0.04	10
Brewer #1	233523	1168387	Domestic/Stock	1	1	G/H	<.01	<.01	<.01	0.02	<.01	0.03	10
Willow #2	242808	1177956	Stock	1	1	G/H	<.01	<.01	<.01	0.02	<.01	0.02	10
Hartsog #1	319409	1169880	Stock	1	1	G/H	0.01	<.01	<.01	<.01	<.01	0.01	16
Willow #3	237627	1180588	Stock	1	1	G/H	<.01	<.01	<.01	0.01	<.01	0.01	10
North Butte ISR Facility	296439	1134872	Facility	3	4	B/C	----	1.90	2.87	3.12	<0.3	----	----
Willow Creek ISR Facility	271969	1148300	Facility	4	5	A/B	3.91	1.21	0.67	----	<0.4	----	----
Nichols Ranch ISR Facility	274030	1107343	Facility	5	5	A	2.62	----	0.98	0.82	<0.5	----	----
Hank Satellite ISR Facility	302392	1119930	Facility	2	2	F	3.69	1.38	----	0.62	<0.2	----	----

* Includes non-potable domestic uses including laundry and bathing (not a drinking water source)

6. REFERENCES

Applied Hydrology Associates, Inc. and Greystone Environmental Consultants (2002). Technical Report, Powder River Basin Oil and Gas Environmental Impact Statement, Groundwater Modeling of Impacts Associated with Mining and Coal Bed Methane Development In the Powder River Basin. Prepared for the Bureau of Land Management, Buffalo, Wyoming Field Office, December 2002.

Brenneis, M.P. (1997). Aquifer Parameter Investigation of the Wasatch and Fort Union Formations in the Powder River Basin, Wyoming.

Bureau of Land Management (2010). Electronic database of regional CBM monitoring well network, December 2010.

Cameco Resources (2010). Electronic well and geological database for the North Butte Facility.

Harbaugh, A.W., Banta, E.R., Hill, M.C., and McDonald, M.G. (2000). MODFLOW 2000 - The U.S. Geological Survey Modular Ground-Water Model – User Guide to Modularization Concepts and the Ground-Water Flow Process, Open File Report 00-92.

Reilly, T.E., and Harbaugh, A.W. 2004. Guidelines for evaluating ground-water flow models: U.S. Geological Survey Scientific Investigations Report 2004-5038.

Uranerz USA, Inc. (1989). Wyoming DEQ Permit to Mine Application and USNRC Source Material License Application, North Butte ISL Project, Campbell County, Wyoming. March 1989, Appendix D6

Uranerz Energy Corporation (2007). Nichols Ranch ISR Project, U.S.N.R.C. Source Material License Application, Volume VI Appendix D6, November 2007.

Uranerz Energy Corporation (2010a). Nichols Ranch ISR Project, U.S.N.R.C. Source Material License Application, Volume II, Addendum 3B (Nichols Ranch Groundwater Modeling), July 2010.

Uranerz Energy Corporation (2010b). Nichols Ranch ISR Project, U.S.N.R.C. Source Material License Application, Volume II, Addendum 3C (Hank Unit Groundwater Modeling), July 2010.

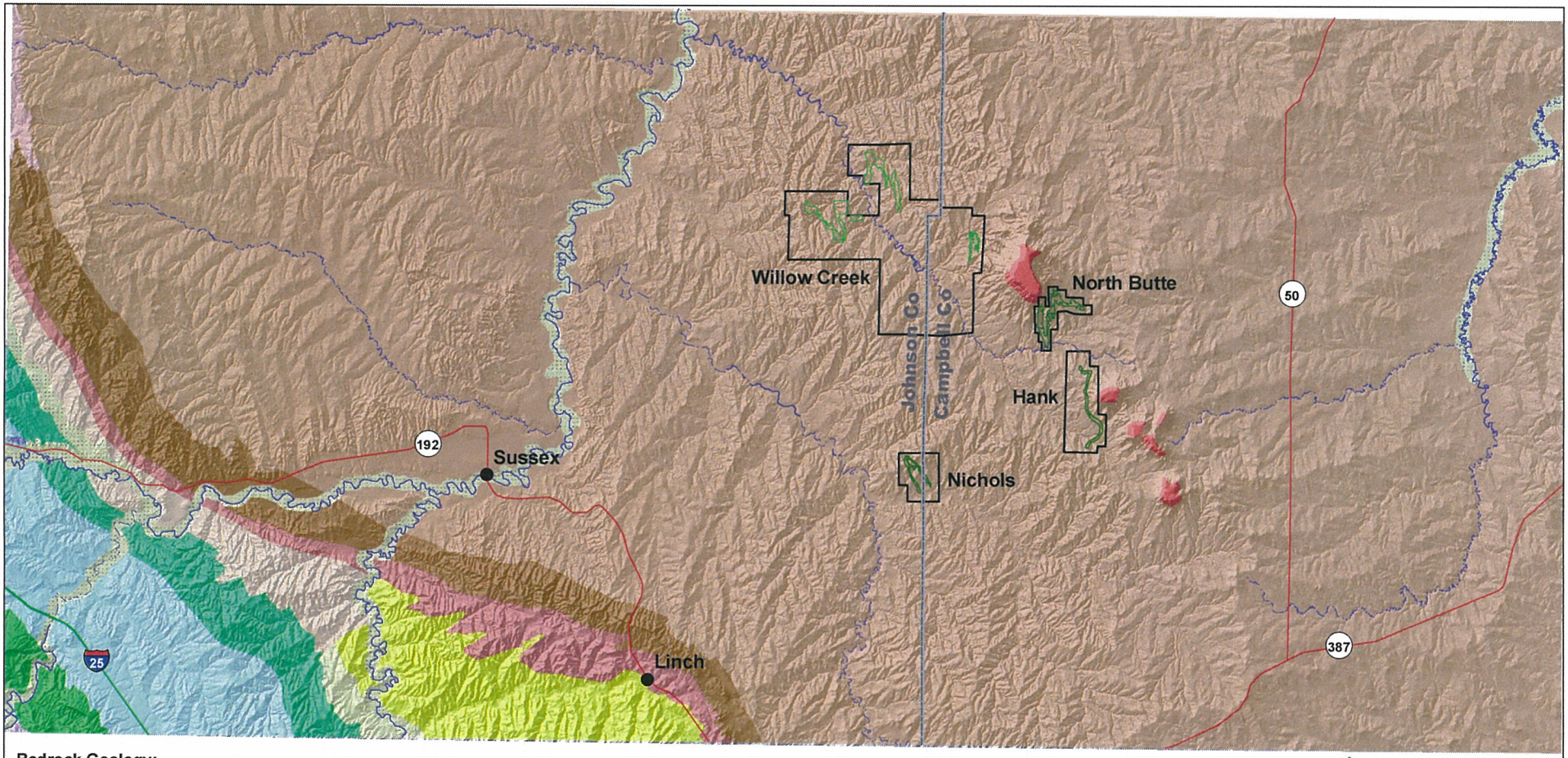
Uranerz Energy Corporation (2010c). Electronic files containing ISR operations information and sand elevation data for the Nichols Ranch and Hank Unit ISR facilities.

U.S. Nuclear Regulatory Commission (1988). Environmental Assessment by the Uranium Recovery Field Office in Consideration of a Major Amendment to Source Material License SUA-1341 for Malapai Resources Company, Christensen Ranch In Situ Leach Satellite Operation, Campbell and Johnson Counties, Wyoming. Docket No. 40-8502.

U.S. Nuclear Regulatory Commission (2011). Final Environmental Assessment for the Renewal of U.S. Nuclear Regulatory Commission License No. SUA-1341 for Uranium One USA, Inc., Irigaray and Christensen Ranch Projects (Willow Creek Project), Wyoming. Docket No. 40-8502.

Wyoming Oil and Gas Commission (2010). Coal Bed Methane well completion and production data, electronic database, December 2010.

FIGURES



Bedrock Geology:

- Alluvium and colluvium
- Cody shale
- Fort Union formation
- Fort Union formation: Lebo member
- Fort Union formation: Tullock member
- Fox Hills sandstone and Lewis shale
- Frontier formation
- Gravel, pediment, and fan deposits
- Lance formation
- Lance formation, Fox Hills sandstone, Meteetse formation, and Bearpaw and Lewis shales
- Mesaverde group
- Mowry and Thermoplis shales
- Wasatch formation, main body
- White River formation

N

- Permit Boundary
- Mine Unit Boundary
- Insterstate
- 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.

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

0 1.5 3 6
Miles
State Plane NAD27

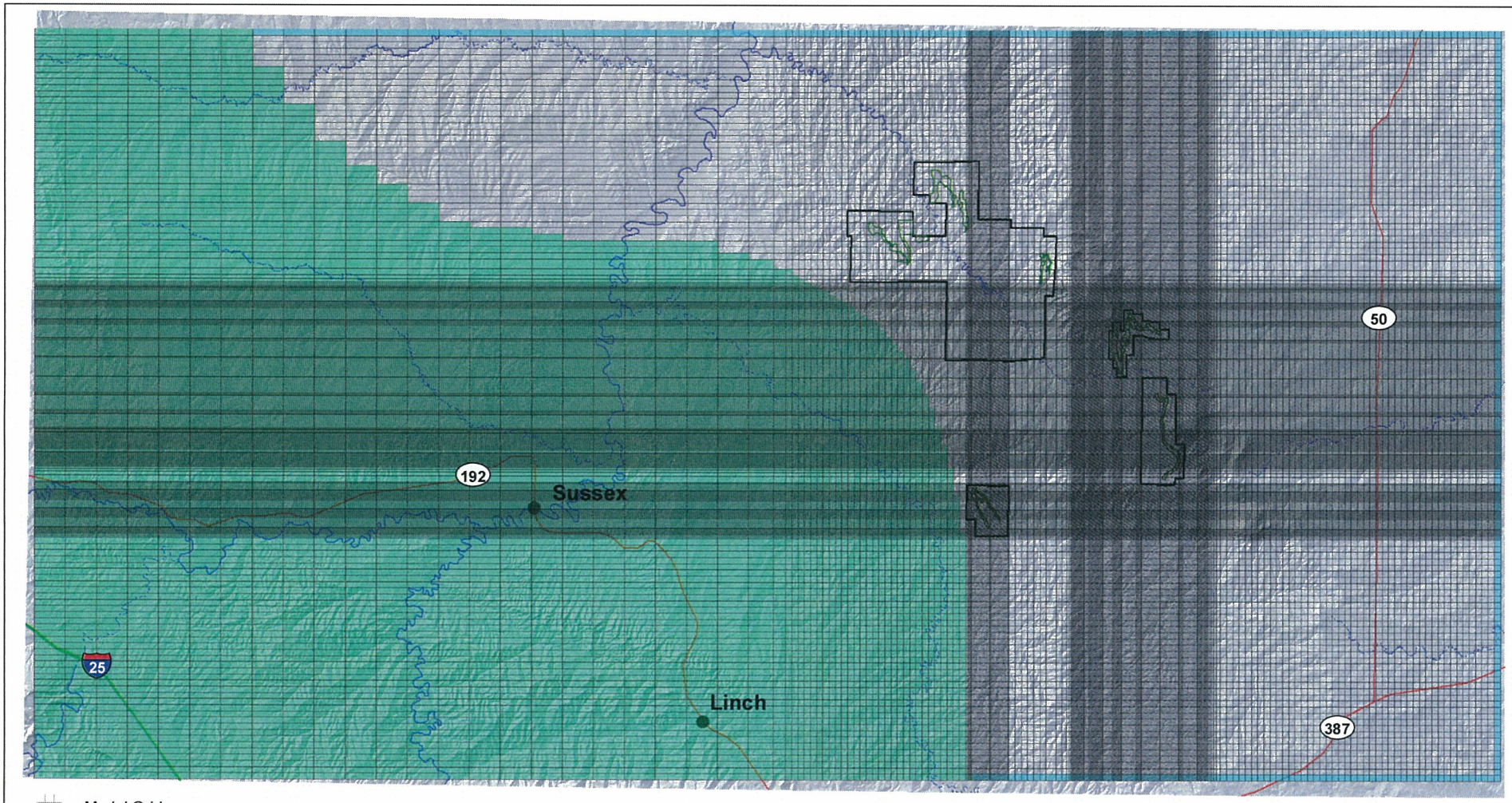
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\2-1-REGIONAL_SITE_OVERVIEW.mxd

Cameco

REGIONAL SITE OVERVIEW

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
2-1



Model Grid
General Head Boundary
No Flow Boundary
Permit Boundary
Mine Unit Boundary
Insterstate
Highway
Intermittent Stream
Perennial Stream
N

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 1.5 3 6
Miles
State Plane NAD27

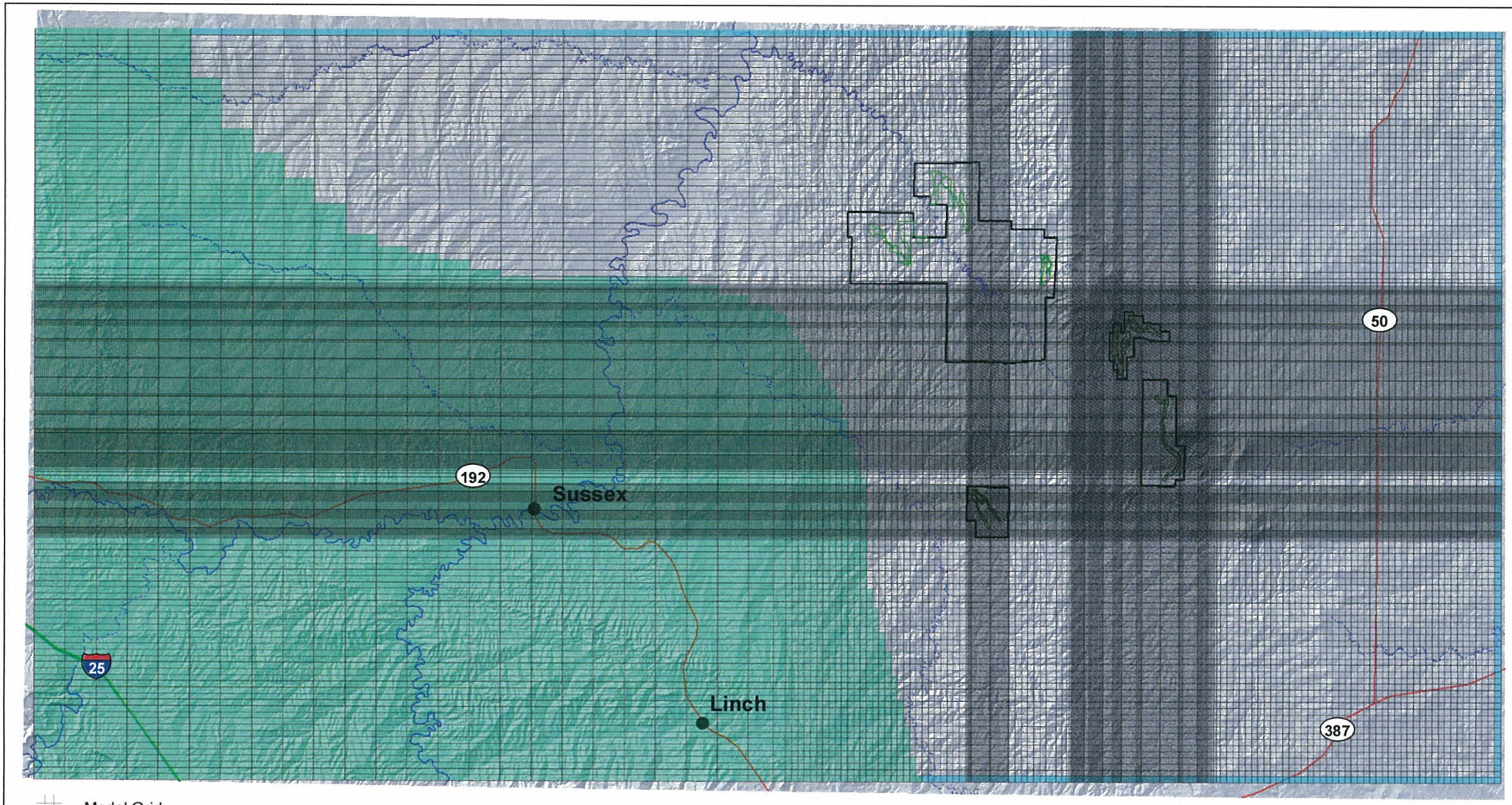
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-1-LAYER1_BOUNDARY_CONDITIONS.mxd

Cameco

LAYER 1 BOUNDARY CONDITIONS

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-1



Model Grid
General Head Boundary
No Flow Boundary
Permit Boundary
Mine Unit Boundary
Insterstate
Highway
Intermittent Stream
Perennial Stream
N

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 1.5 3 6
Miles
State Plane NAD27

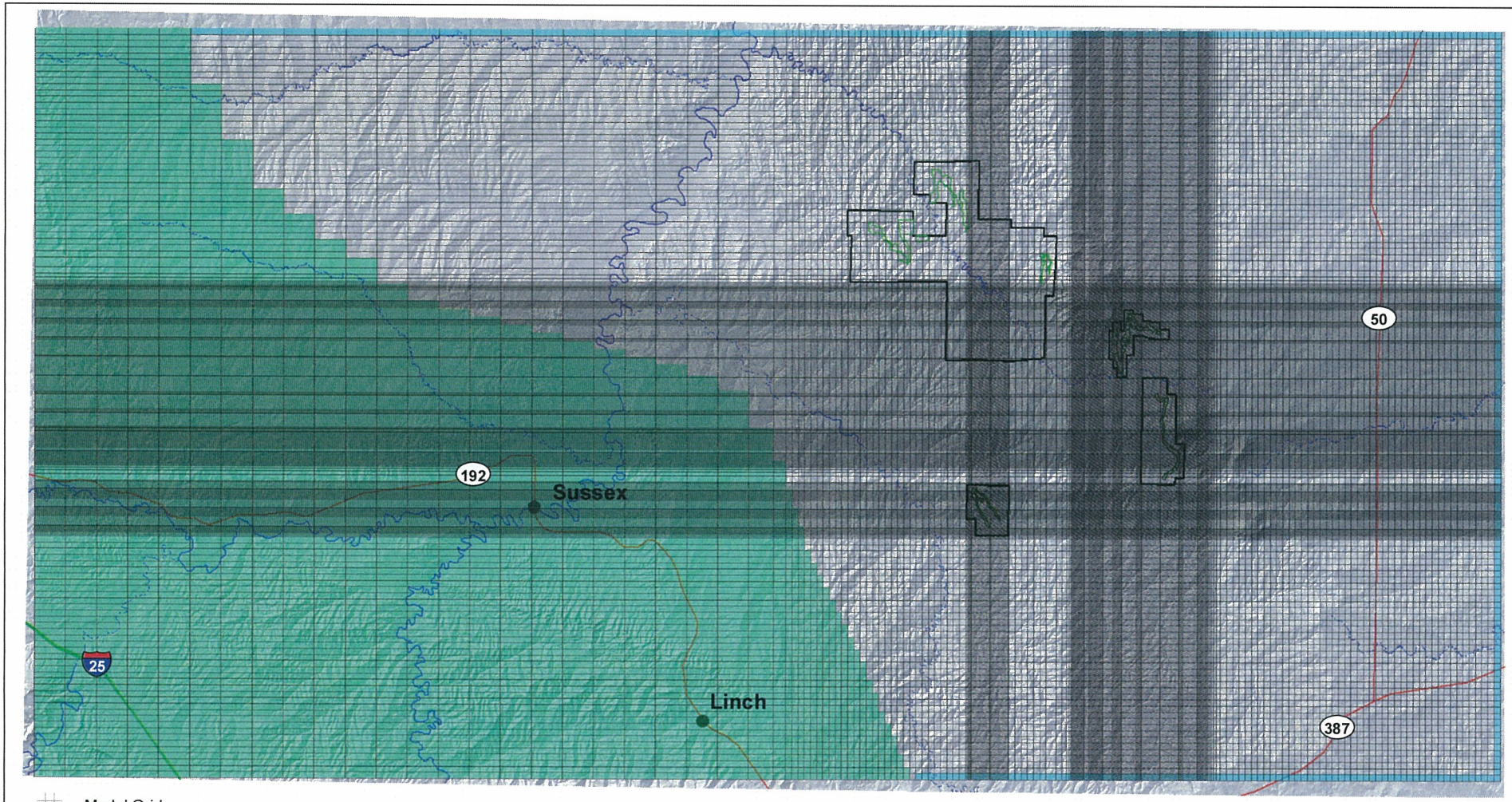
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-2-LAYER2_BOUNDARY_CONDITIONS.mxd

Cameco

LAYER 2 BOUNDARY CONDITIONS

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-2



Model Grid
General Head Boundary
No Flow Boundary
Permit Boundary
Mine Unit Boundary
Insterstate
Highway
Intermittent Stream
Perennial Stream
N

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

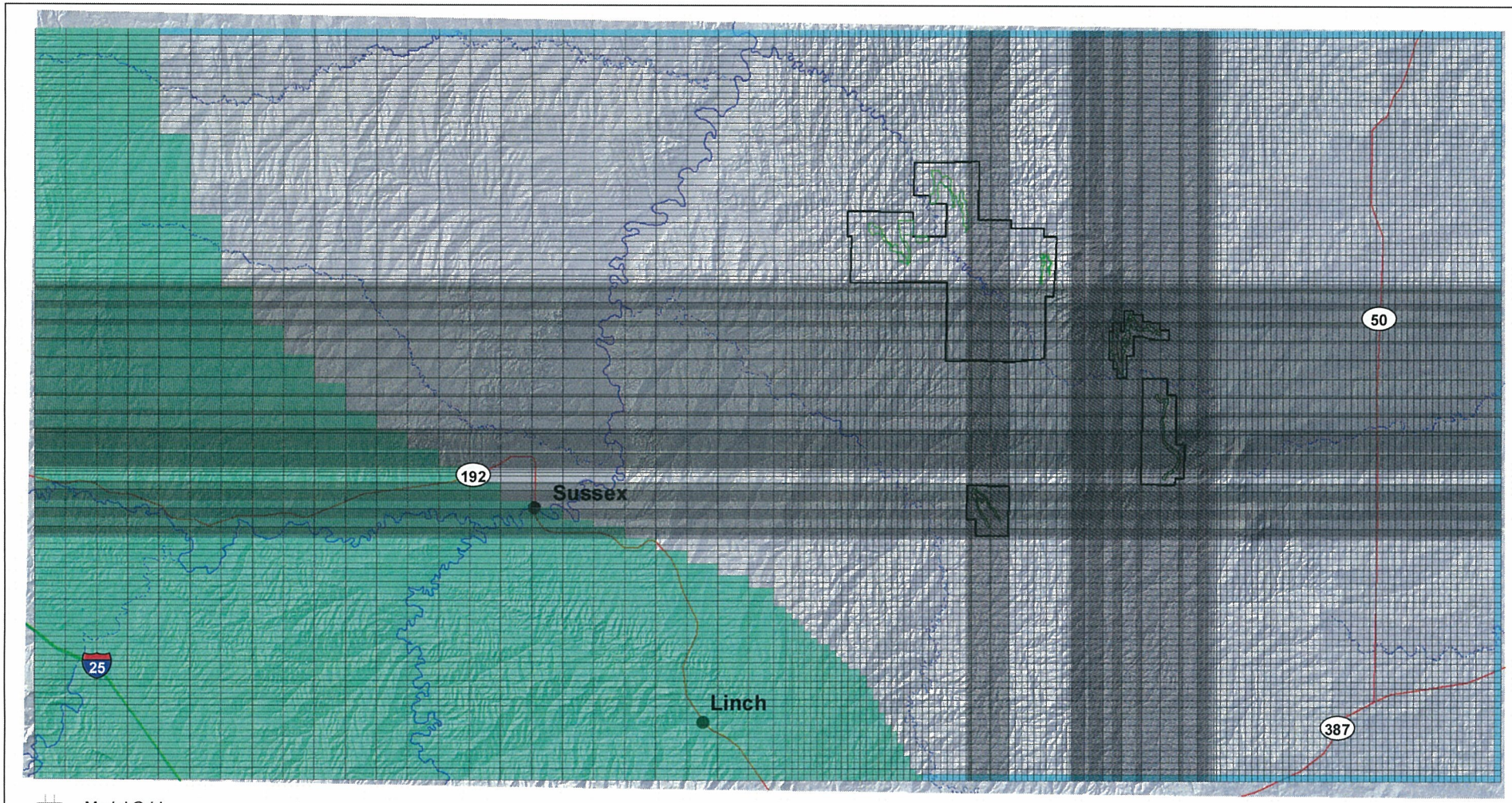
0 1.5 3 6
Miles
State Plane NAD27

PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-3-LAYER3_BOUNDARY_CONDITIONS.mxd

Cameco

LAYER 3 BOUNDARY CONDITIONS
CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-3



Model Grid
General Head Boundary
No Flow Boundary
Permit Boundary
Mine Unit Boundary
Insterstate
Highway
Intermittent Stream
Perennial Stream
N

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 1.5 3 6
Miles
State Plane NAD27

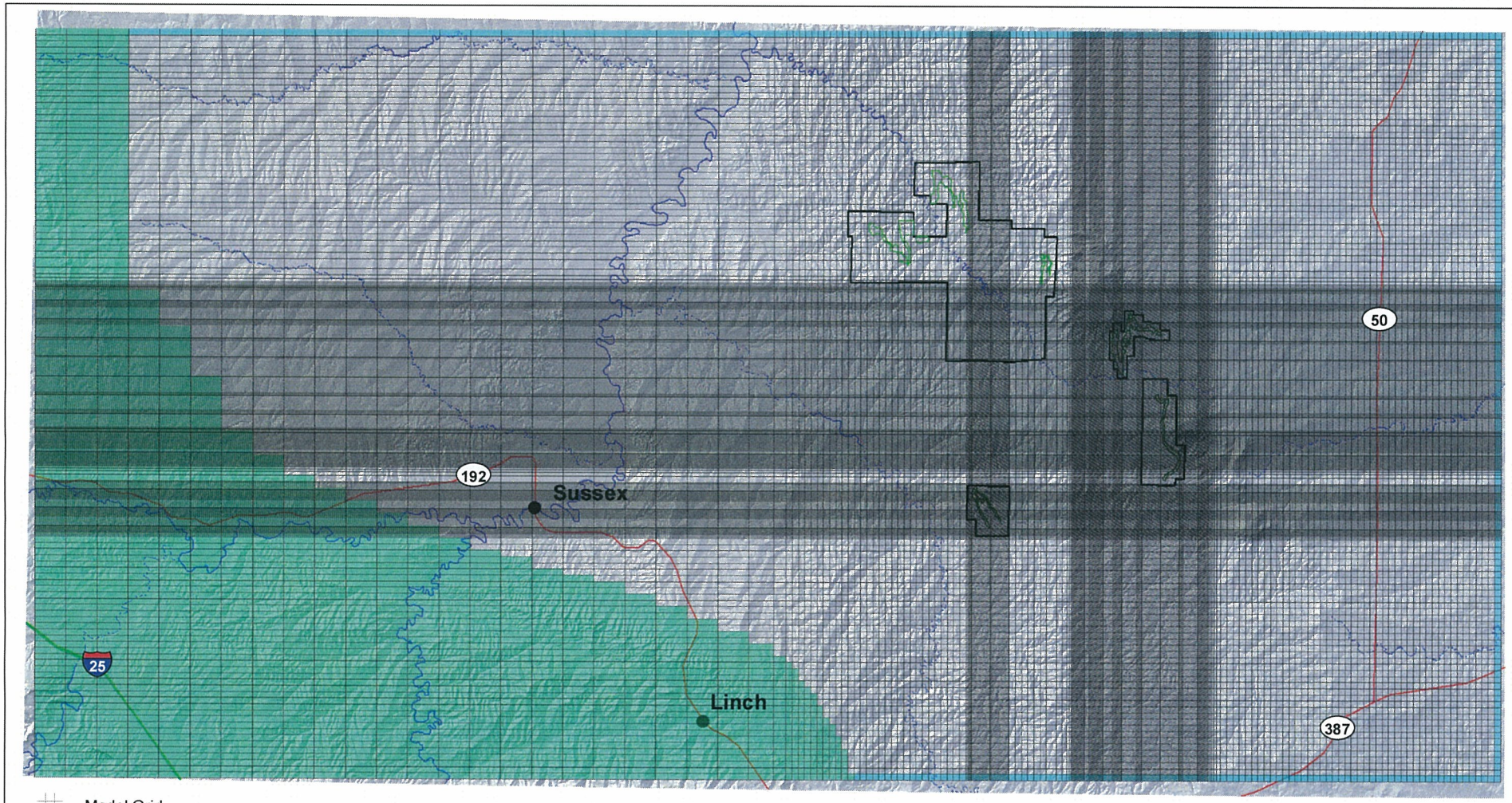
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-4-LAYER4_BOUNDARY_CONDITIONS.mxd

Cameco

LAYER 4 BOUNDARY CONDITIONS

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-4



Model Grid
General Head Boundary
No Flow Boundary
Permit Boundary
Mine Unit Boundary
Insterstate
Highway
Intermittent Stream
Perennial Stream
N

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 1.5 3 6
Miles
State Plane NAD27

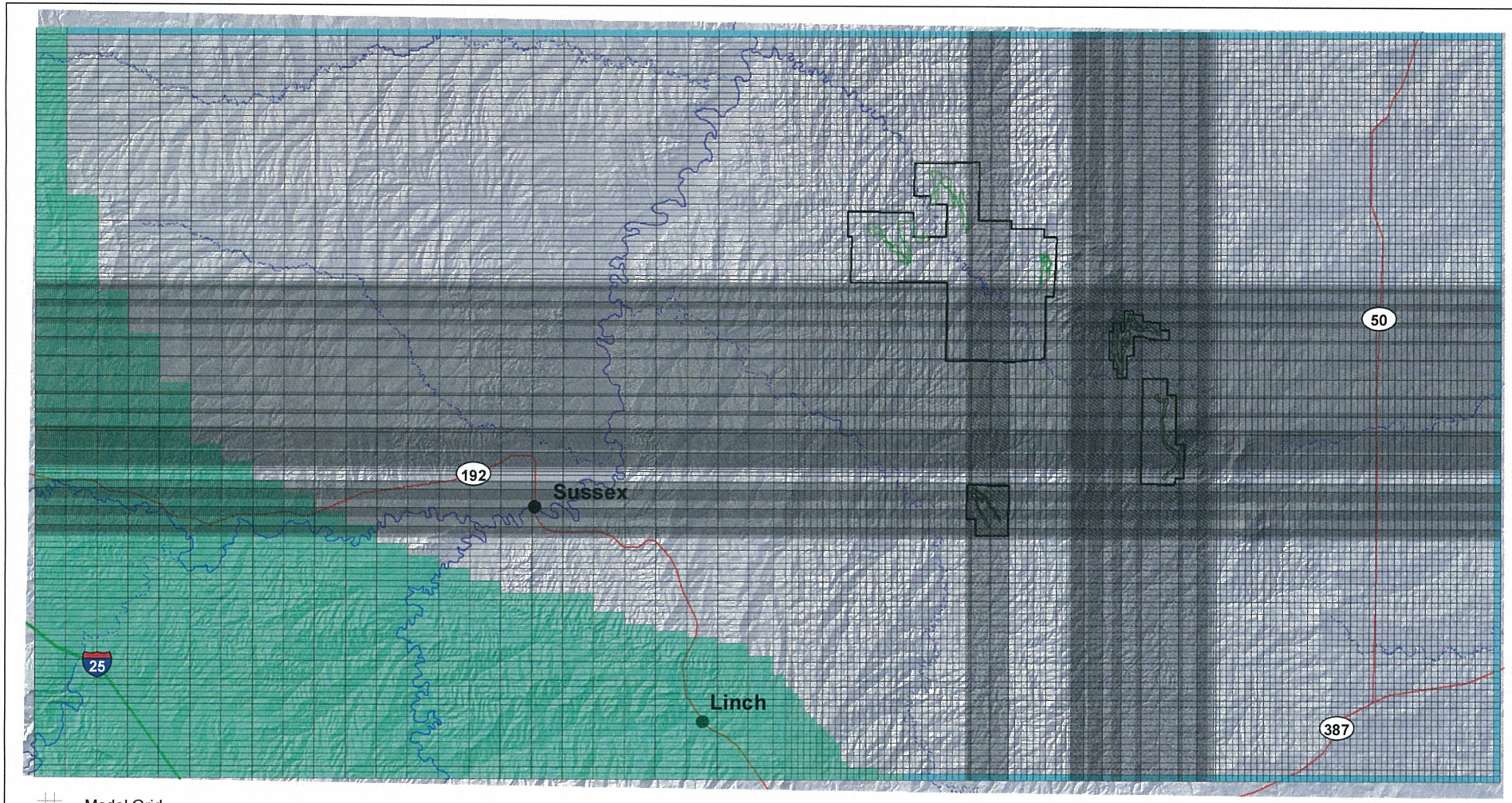
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-5-LAYER5_BOUNDARY_CONDITIONS.mxd

Cameco

LAYER 5 BOUNDARY CONDITIONS

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-5



Model Grid
General Head Boundary
No Flow Boundary
Permit Boundary
Mine Unit Boundary
Insterstate
Highway
Intermittent Stream
Perennial Stream
N

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 1.5 3 6
Miles
State Plane NAD27

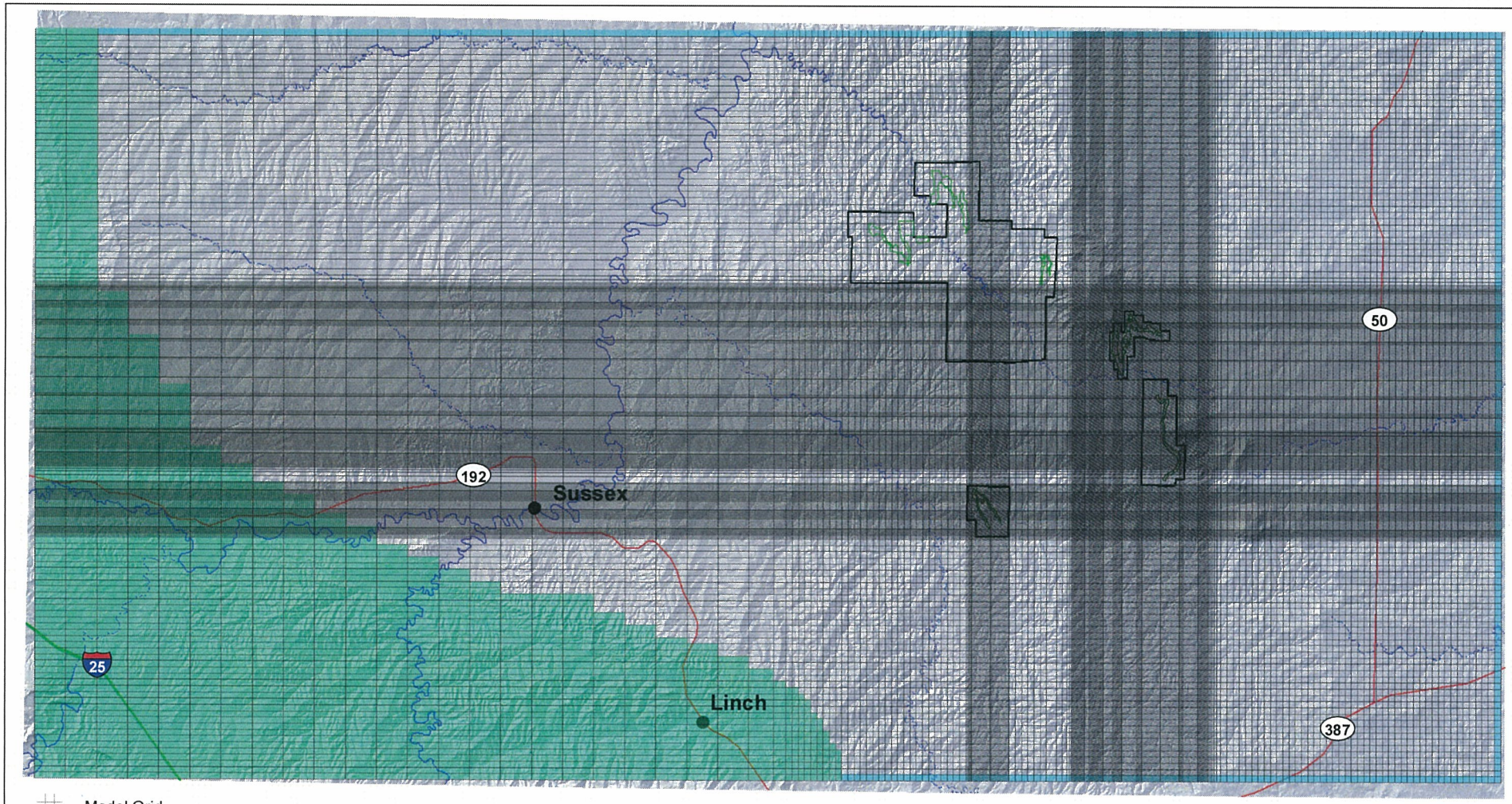
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-6-LAYER6_BOUNDARY_CONDITIONS.mxd

Cameco

LAYER 6 BOUNDARY CONDITIONS

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-6



Model Grid
General Head Boundary
No Flow Boundary
Permit Boundary
Mine Unit Boundary
Insterstate
Highway
Intermittent Stream
Perennial Stream
N

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 1.5 3 6
Miles
State Plane NAD27

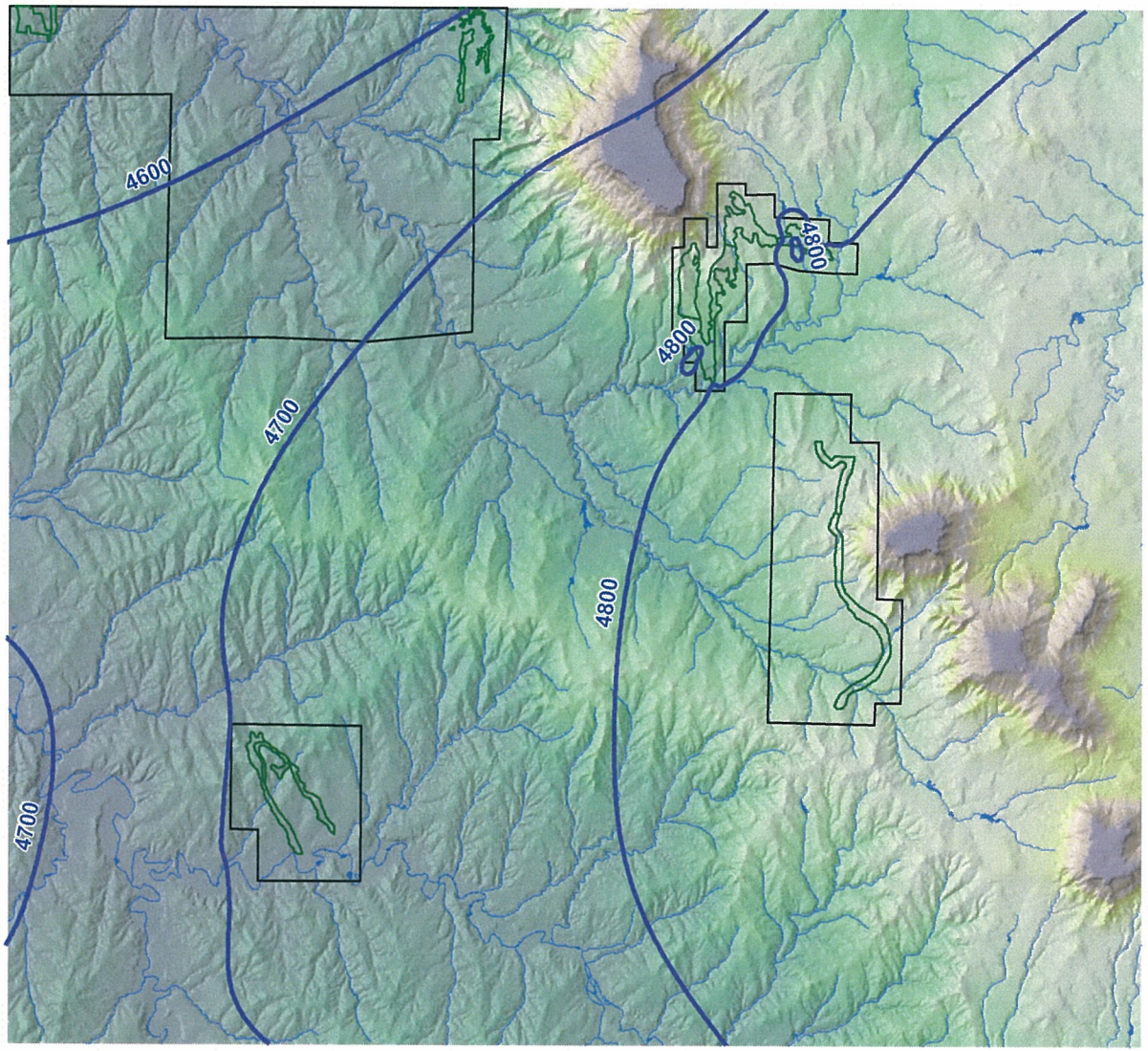
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-7-LAYER7_BOUNDARY_CONDITIONS.mxd

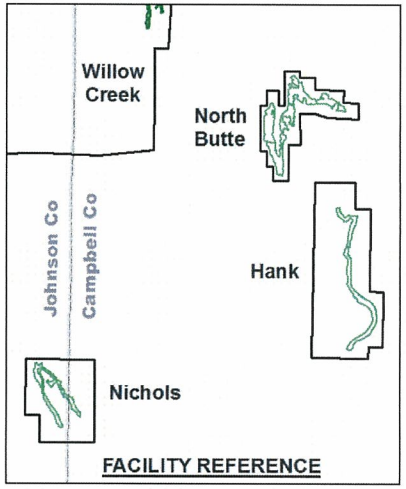
Cameco

LAYER 7 BOUNDARY CONDITIONS

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-7





N

Legend

- Aquifer Elevation (Ft. MSL)
- Permit Boundary
- Mine Unit Boundary
- Drainage

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 3,000 6,000 12,000
Feet
State Plane NAD27

PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-8-MODEL_ELEVATION_F-SAND_TOP.mxd

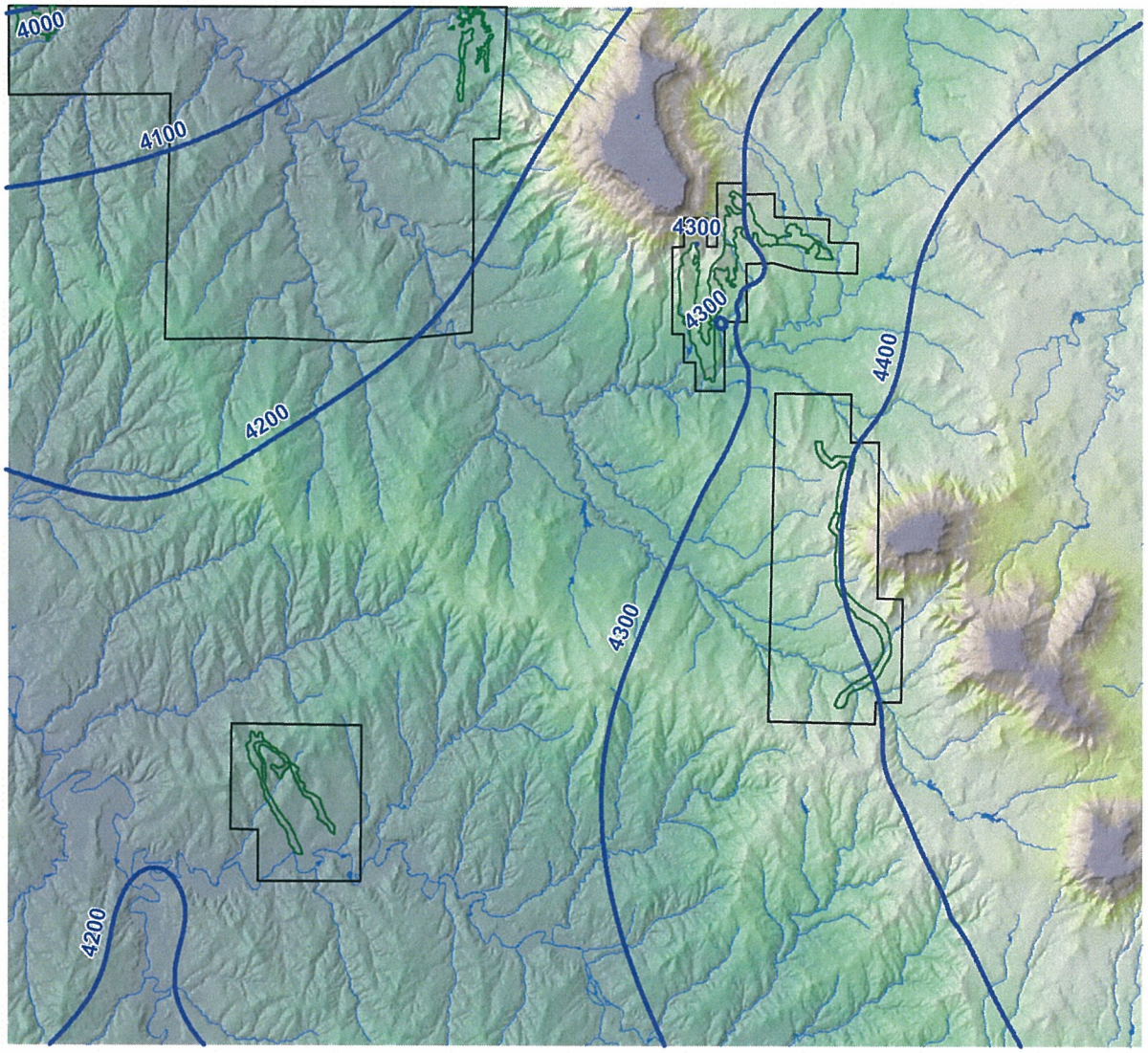
Cameco

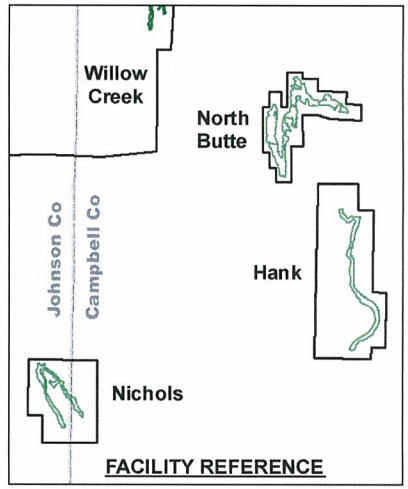
TOP OF THE F-SAND AQUIFER

CAMECO RESOURCES NORTH BUTTE FACILITY

CAMPBELL COUNTY - WYOMING

FIGURE:
3-8





N

Legend

- Aquifer Elevation (Ft. MSL)
- Permit Boundary
- Mine Unit Boundary
- Drainage

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 3,000 6,000 12,000
Feet
State Plane NAD27

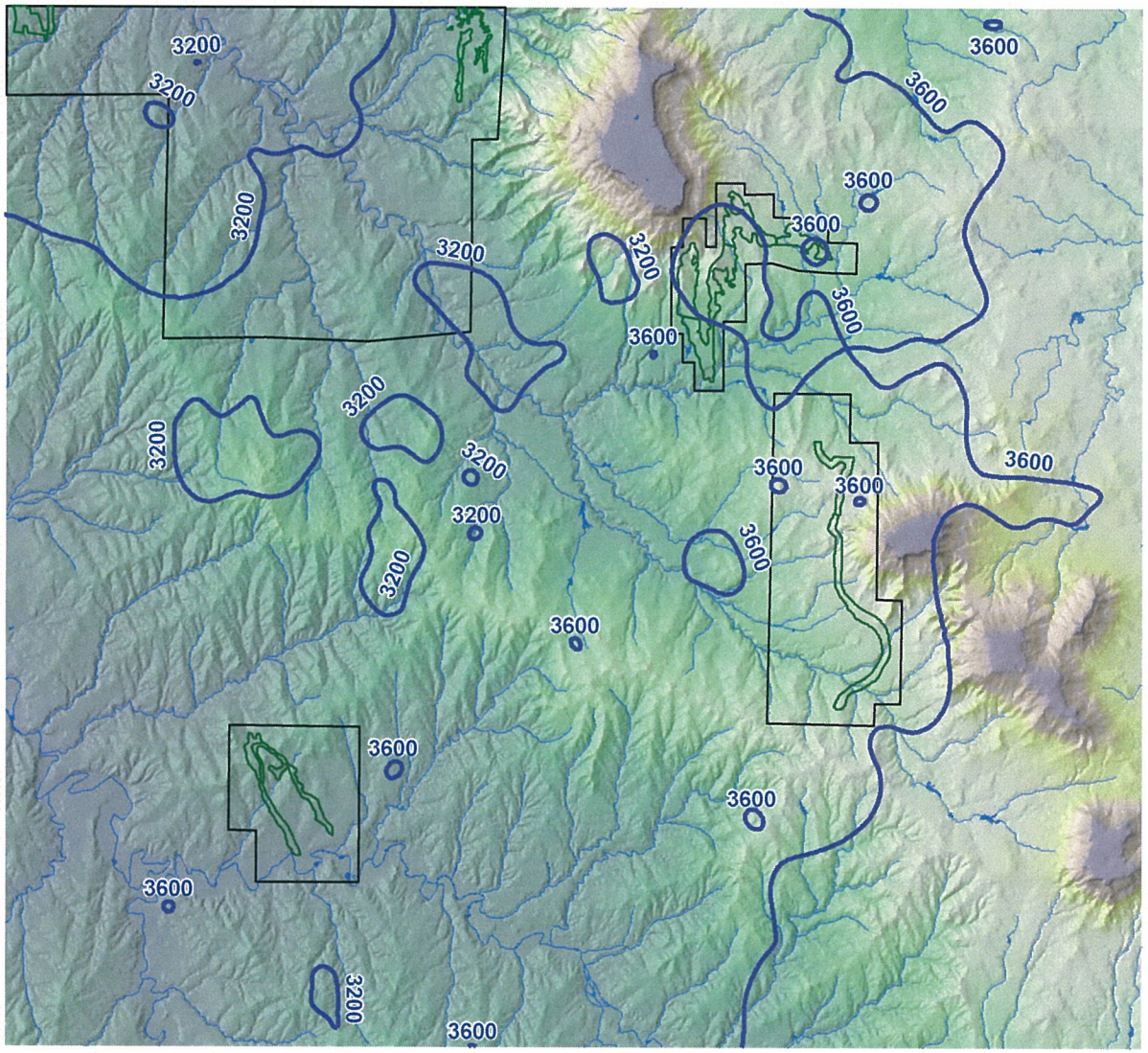
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-9-MODEL_ELEVATION_A-SAND_BOTTOM.mxd

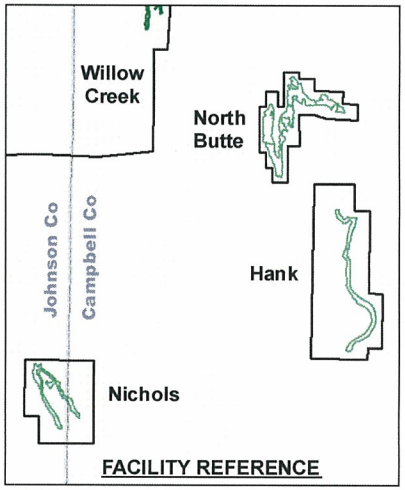
Cameco

BOTTOM OF THE A-SAND AQUIFER

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-9





N

Legend

- Aquifer Elevation (Ft. MSL)
- Permit Boundary
- Mine Unit Boundary
- Drainage

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 3,000 6,000 12,000
Feet
State Plane NAD27

PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-10-MODEL_ELEVATION_CBM-COAL-BED_TOP.mxd

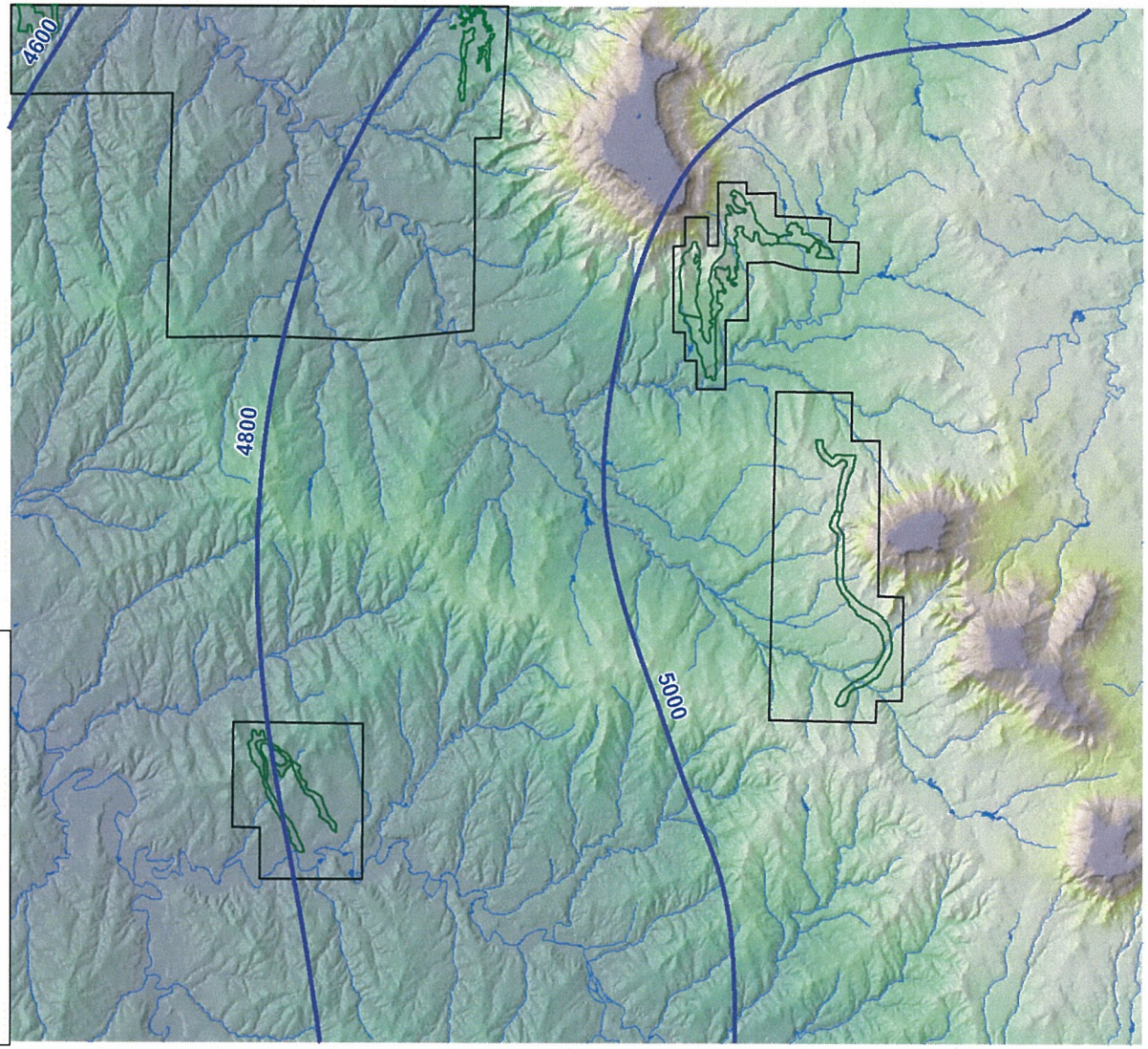
Cameco

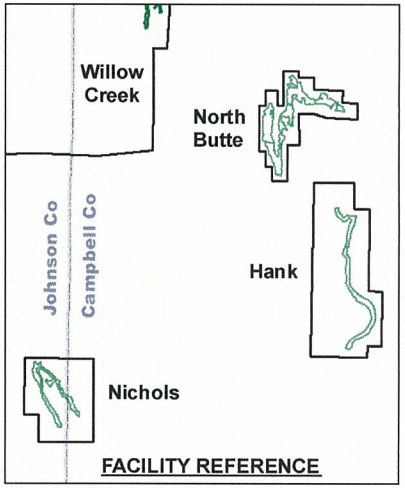
TOP OF THE BIG GEORGE CBM AQUIFER

CAMECO RESOURCES NORTH BUTTE FACILITY

CAMPBELL COUNTY - WYOMING

FIGURE: 3-10





N

Legend

- Water Table Elevation (Ft. MSL)
- Permit Boundary
- Mine Unit Boundary
- Drainage

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 3,000 6,000 12,000
Feet
State Plane NAD27

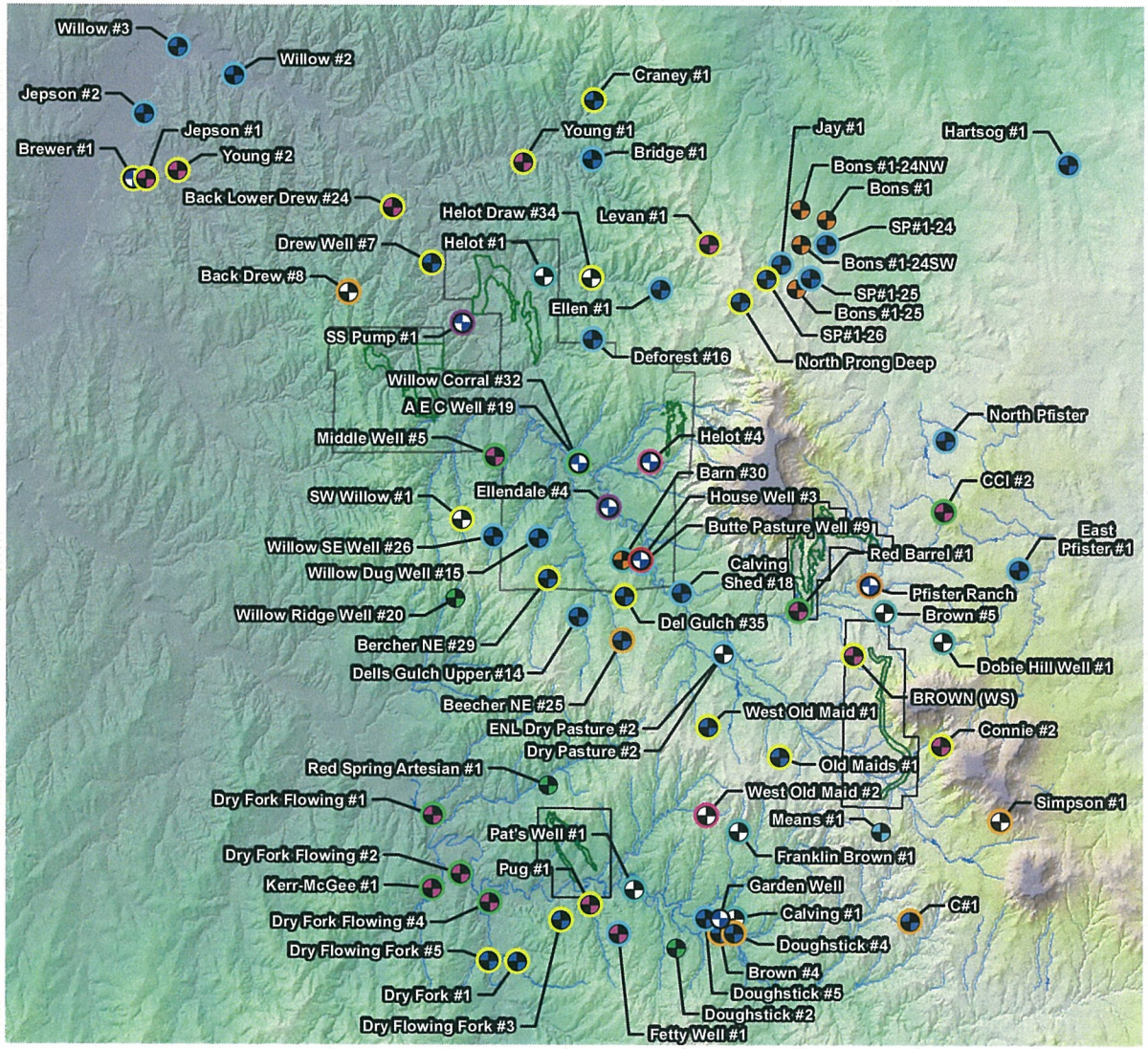
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-11-MODEL_ELEVATION_WATER-TABLE.mxd

Cameco

WATER-TABLE ELEVATION

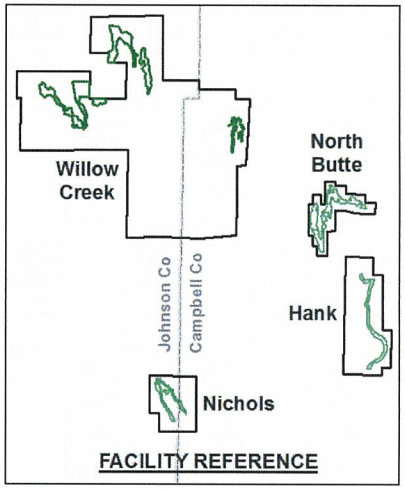
CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-11



Legend

- Domestic A/B
- Domestic B/C
- Domestic C
- Domestic/Stock A
- Domestic/Stock A /Lower Wasatch
- Domestic/Stock B
- Domestic/Stock C
- Domestic/Stock G/H
- Stock A
- Stock A/B/C
- Stock B
- Stock B/C
- Stock B/C/F
- Stock B/F
- Stock C
- Stock C/F
- Stock C/F/G/H
- Stock F
- Stock F/G/H
- Stock G/H
- Stock Lower Wasatch
- Permit Boundary
- Mine Unit Boundary
- Drainage



NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 4,000 8,000 16,000
Feet
State Plane NAD27

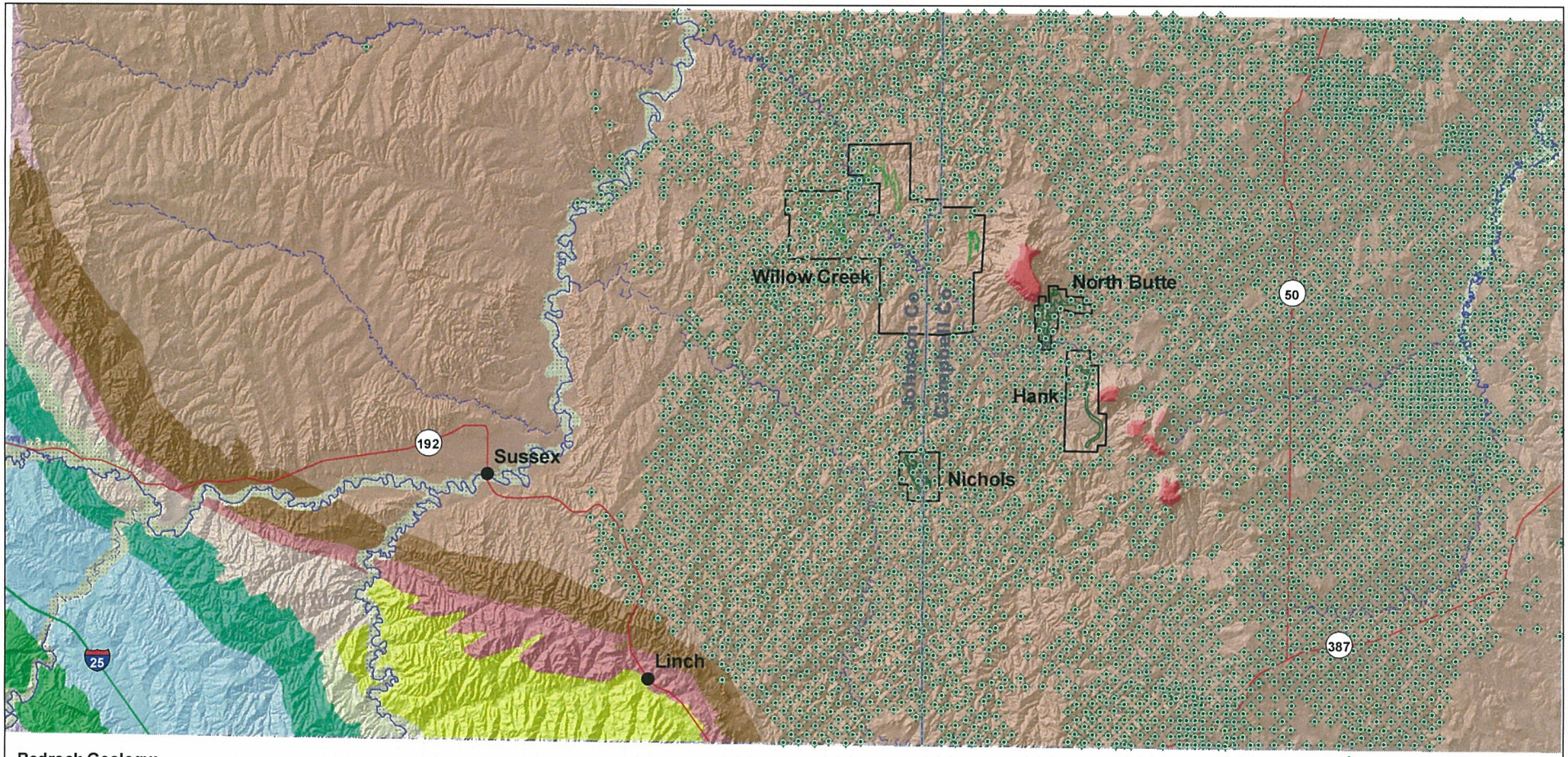
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-12-DOMESTIC-STOCK_WELLS.mxd

Cameco

DOMESTIC AND STOCK WELLS

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-12



Bedrock Geology:

- Alluvium and colluvium
- Cody shale
- Fort Union formation
- Fort Union formation: Lebo member
- Fort Union formation: Tullock member
- Fox Hills sandstone and Lewis shale
- Frontier formation
- Gravel, pediment, and fan deposits
- Lance formation
- Lance formation, Fox Hills sandstone, Meteetse formation, and Bearpaw and Lewis shales
- Mesaverde group
- Mowry and Thermoplis shales
- Wasatch formation, main body
- White River formation
- CBM Well
- Permit Boundary
- Mine Unit Boundary
- Insterstate
- Highway
- Intermittent Stream
- Perennial Stream

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center, USGS, and Wyoming Oil & Gas Commission. Site data provided by Cameco.

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

0 1.5 3 6
Miles
State Plane NAD27

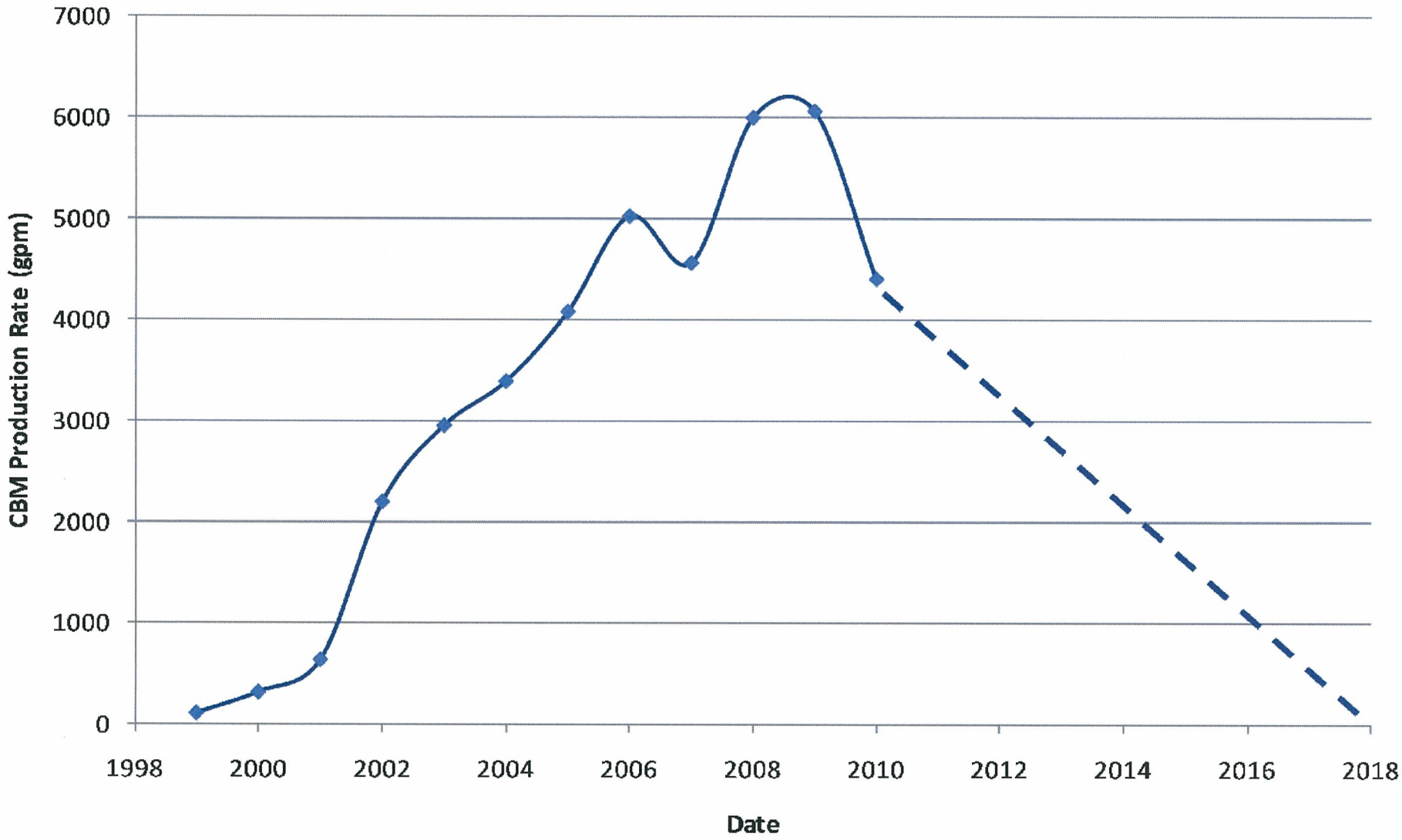
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-13-REGIONAL_SITE_OVERVIEW.mxd

Cameco

CBM WELL LOCATIONS

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-13

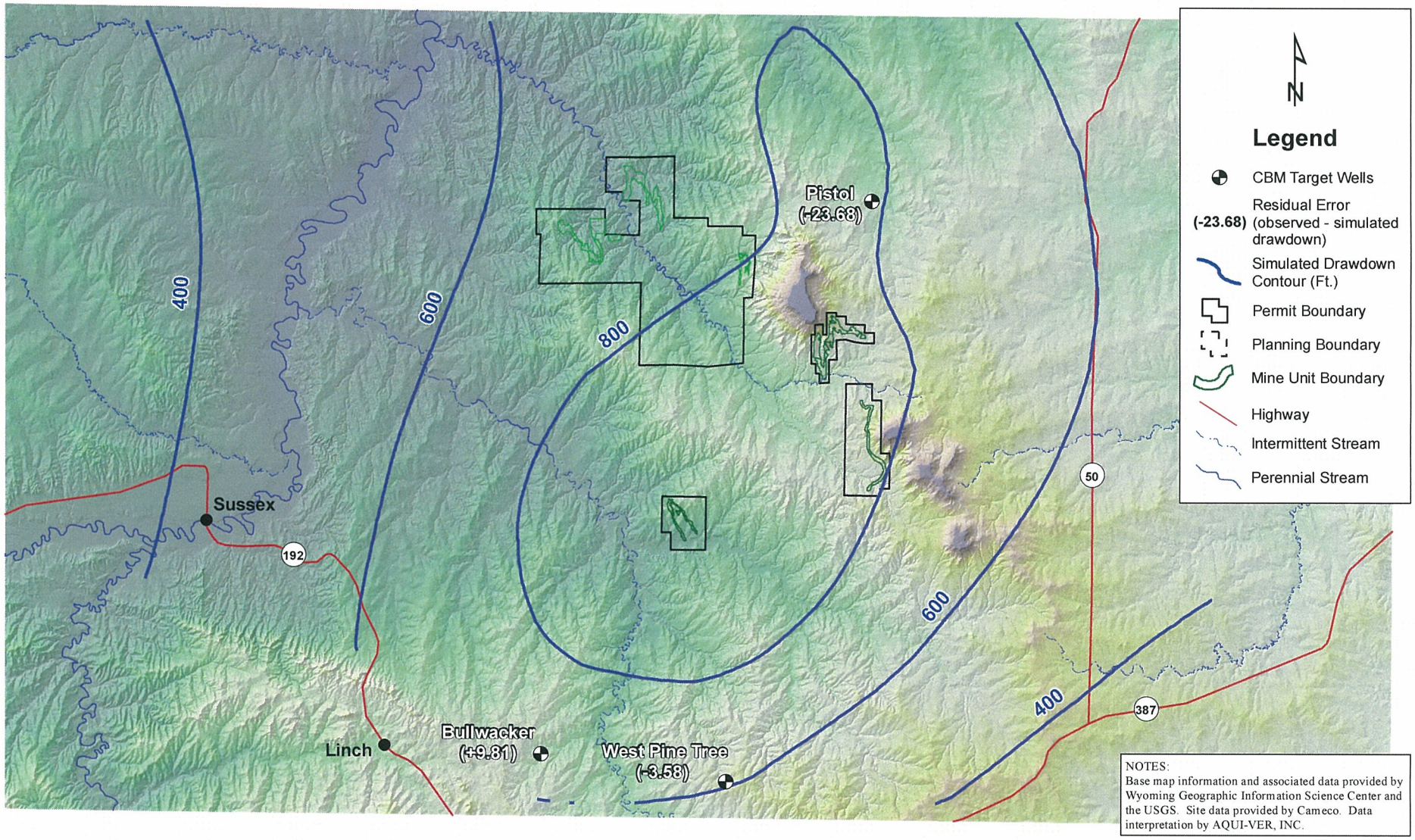


AQUI-VER, INC.
Hydrogeology, Water Resources & Data Services

PROJECT 40100542
DATE: 3/18/11
DRAWN BY: CLIN
REVIEWED BY: BLEWIS
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\3-14-MODEL_DOMAIN_CBM_GRAPH.mxd

MODEL DOMAIN CBM WELL PRODUCTION
CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
3-14



NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

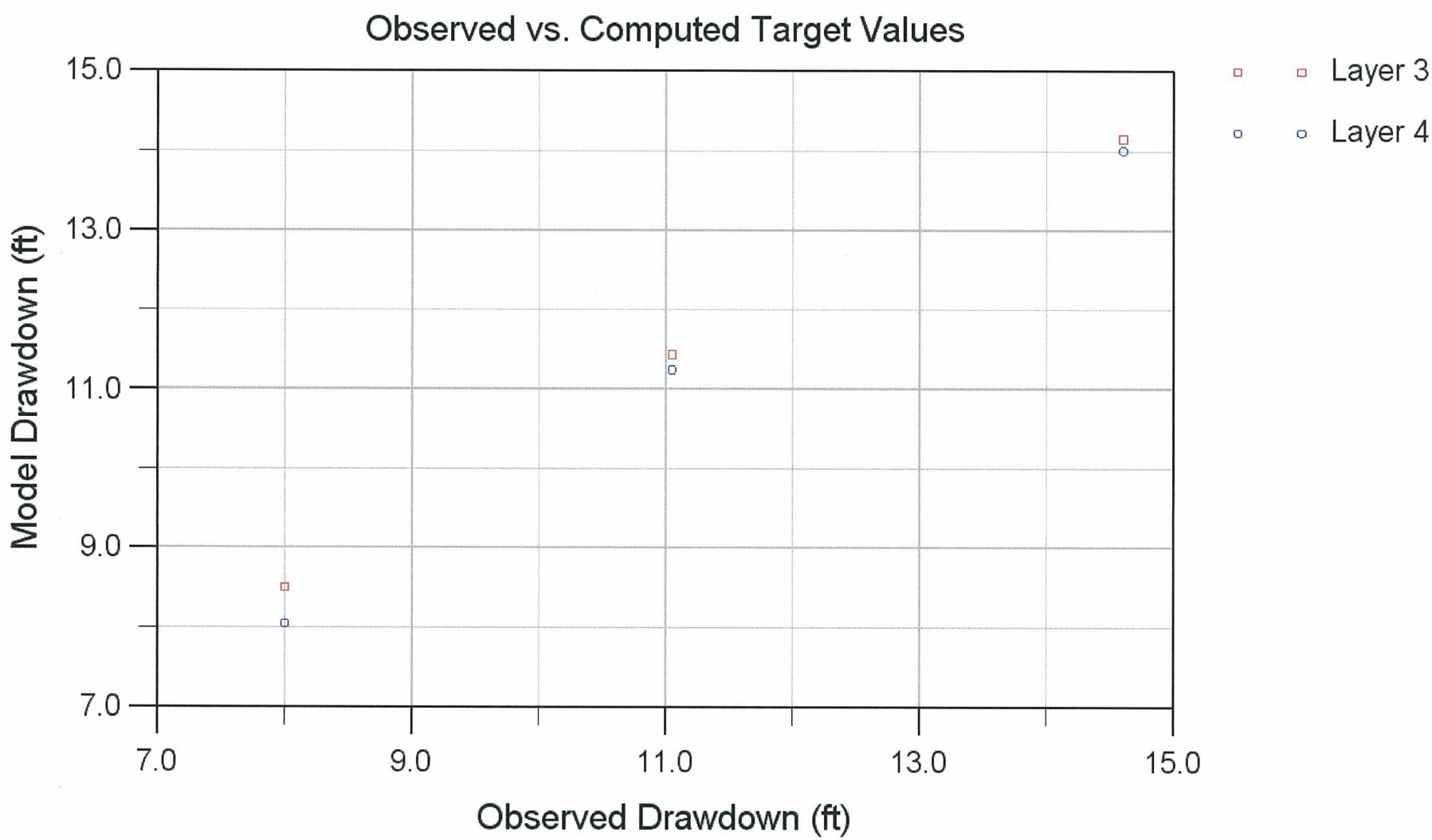
0 1.3 2.6
Miles
State Plane NAD27

PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\4-1-CALIBRATED_CBM_DRAWDOWN.mxd

Cameco

CALIBRATED CBM DRAWDOWN
(LAYER 7 - BIG GEORGE COAL)
CAMECO RESOURCES NORTH BUTTE FACILITY, CAMPBELL COUNTY - WYOMING

FIGURE:
4-1

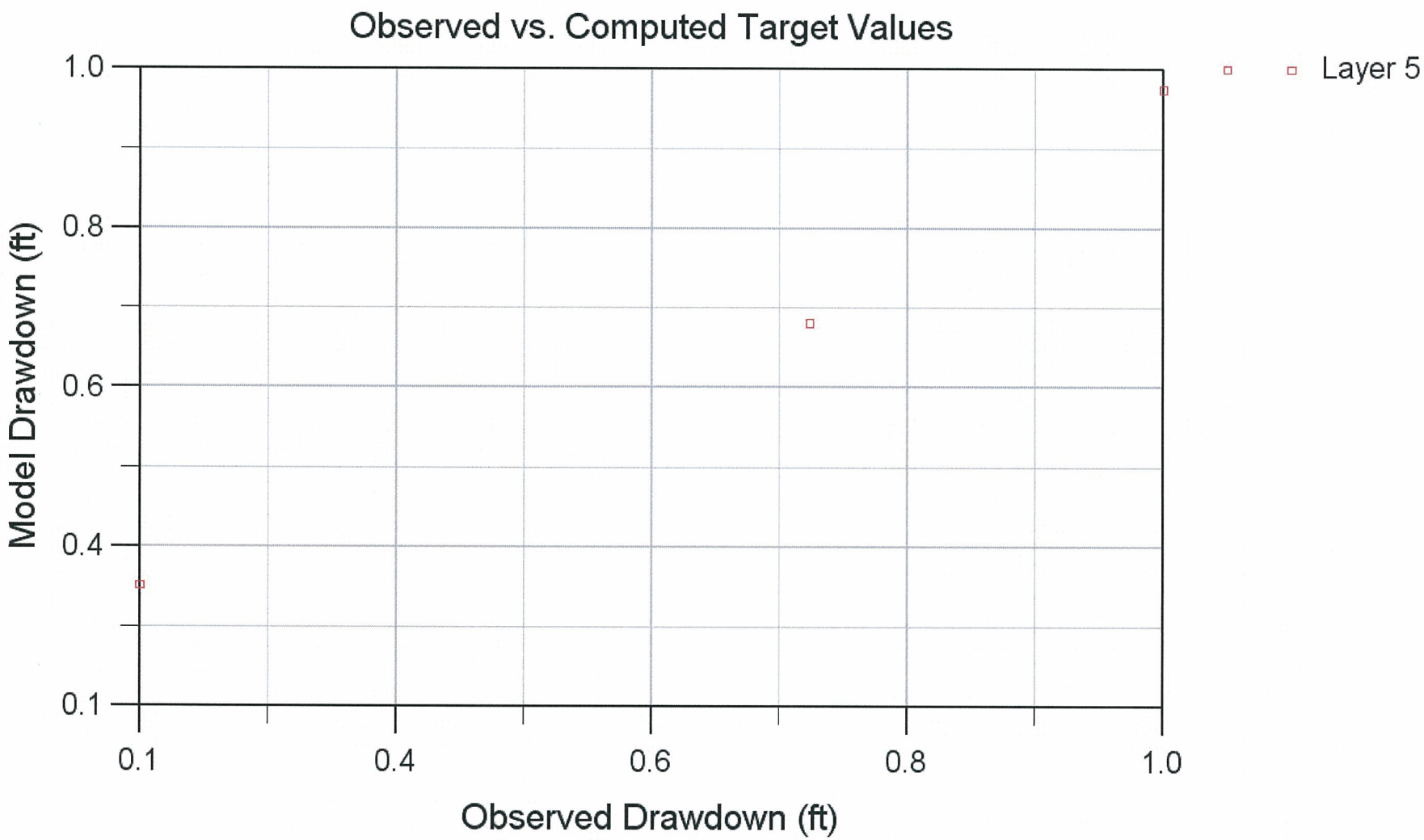


AQUI-VER, INC.
Hydrogeology, Water Resources & Data Services

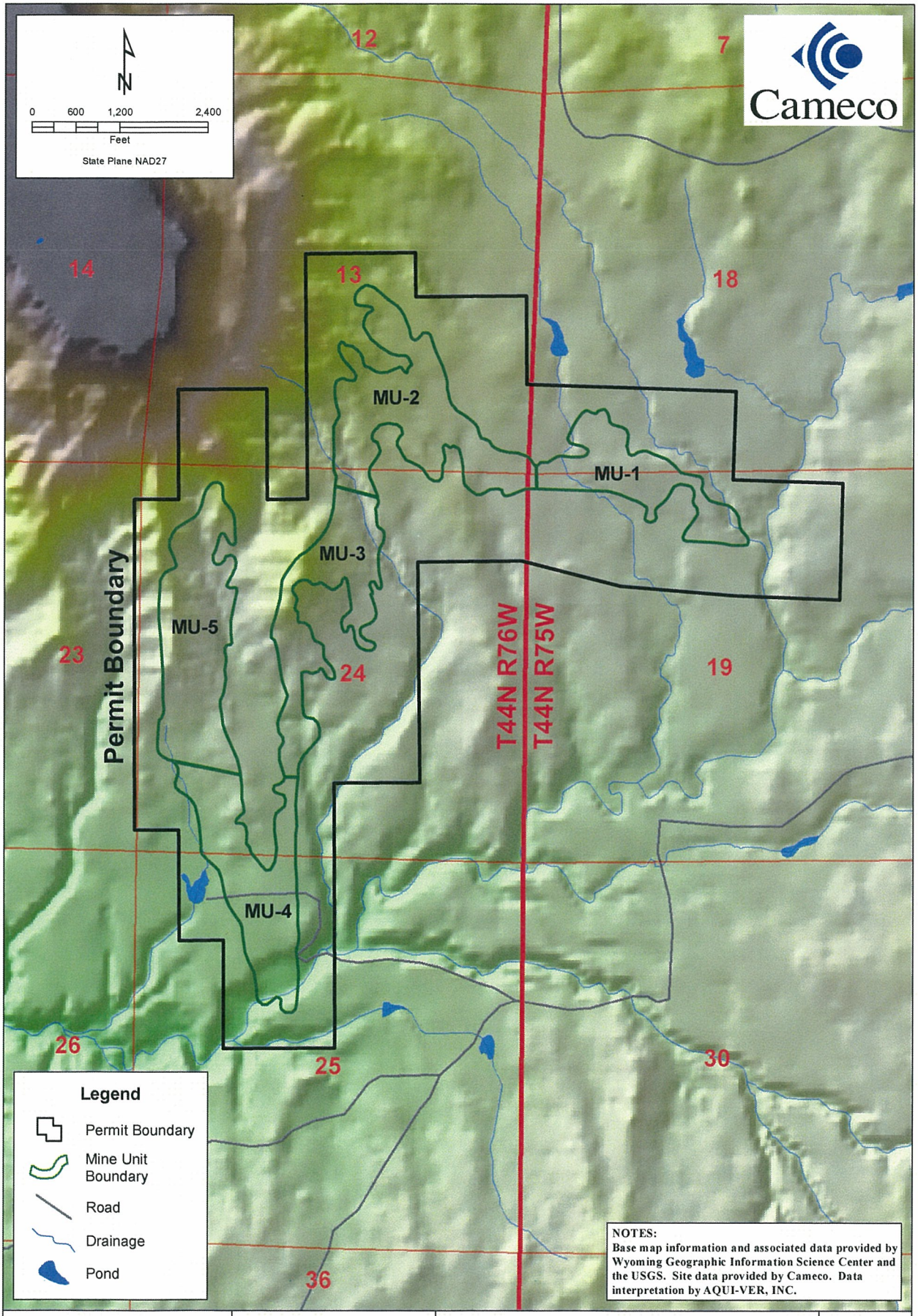
PROJECT 40100542
DATE: 3/18/11
DRAWN BY: CLIN
REVIEWED BY: BLEWIS
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\4-2-MOD-V-OBSV_DRWDN_NORTH-BUTTE.mxd

MODELED vs OBSERVED DRAWDOWN
NORTH BUTTE SS2M AQUIVER TEST CALIBRATION
CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
4-2



AQUI-VER, INC. *Hydrogeology, Water Resources & Data Services*	PROJECT 40100542 DATE: 3/18/11 DRAWN BY: CLIN REVIEWED BY: BLEWIS Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\4-3-MOD-V-OBSV_DRWDN_NICHOLS.mxd	**MODELED vs OBSERVED DRAWDOWN** **NICHOLS RANCH MW-1 AQUIFER TEST CALIBRATION** CAMECO RESOURCES NORTH BUTTE FACILITY CAMPBELL COUNTY - WYOMING	**FIGURE:** 4-3

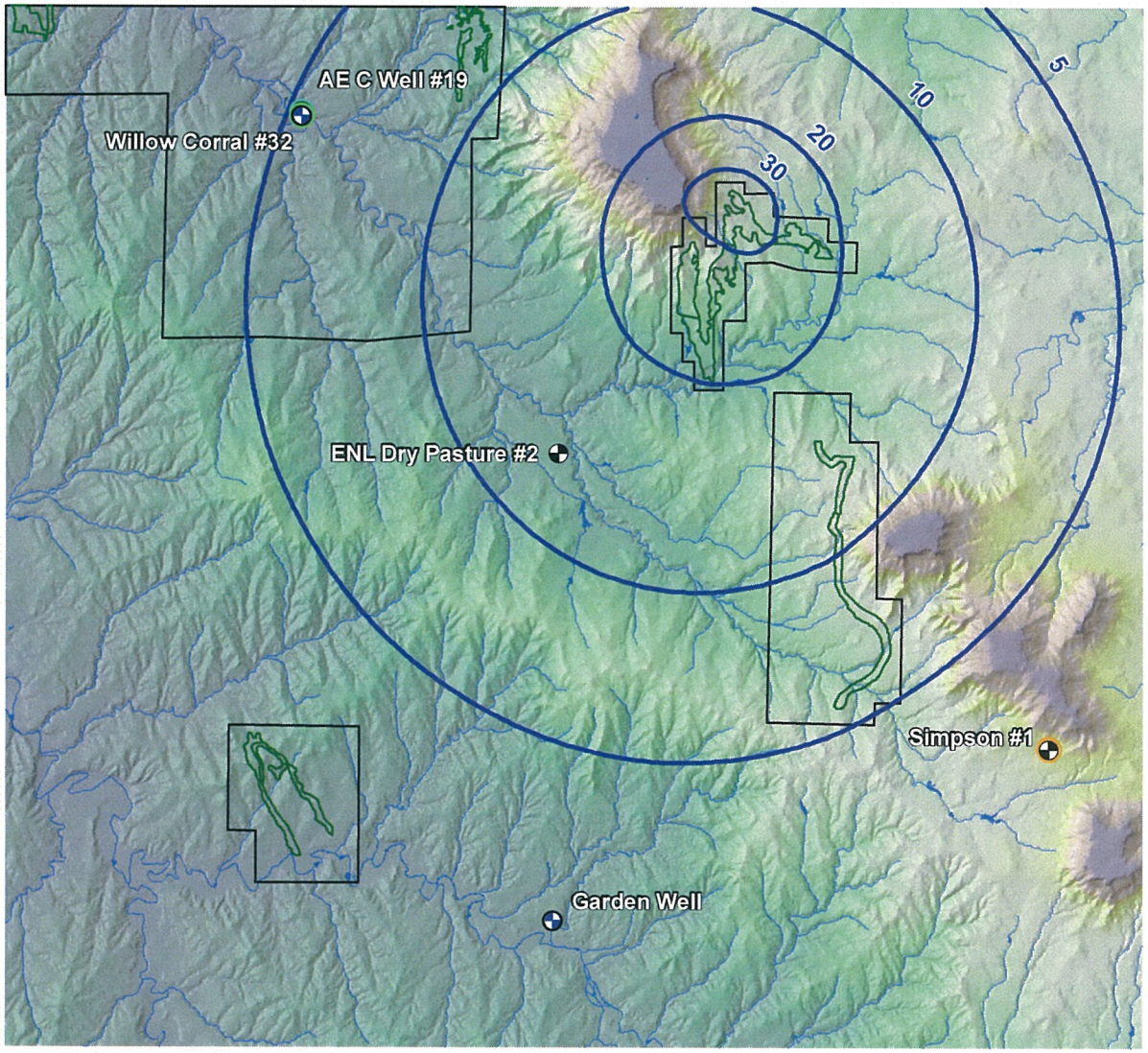


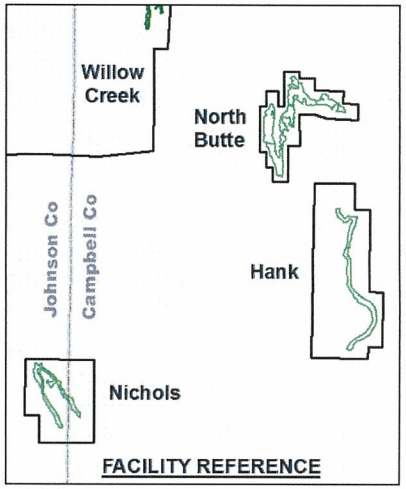
AQUI-VER, INC.
Hydrogeology, Water Resources & Data Services

PROJECT 40100542
DATE: 3/18/11
DRAWN BY: CLIN
REVIEWED BY: BL
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD\5-1-NORTH_BUTTE_FACILITY.mxd

NORTH BUTTE FACILITY
CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
5-1





N

Legend

- Drawdown Contour (Ft.)

Domestic / Stock Wells: Sand Interval

- Domestic A/B
- Domestic/Stock A
- Domestic/Stock A /Lower Wasatch
- Stock A
- Stock A/B/C
- Permit Boundary
- Mine Unit Boundary
- Drainage

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 3,000 6,000 12,000
Feet
State Plane NAD27

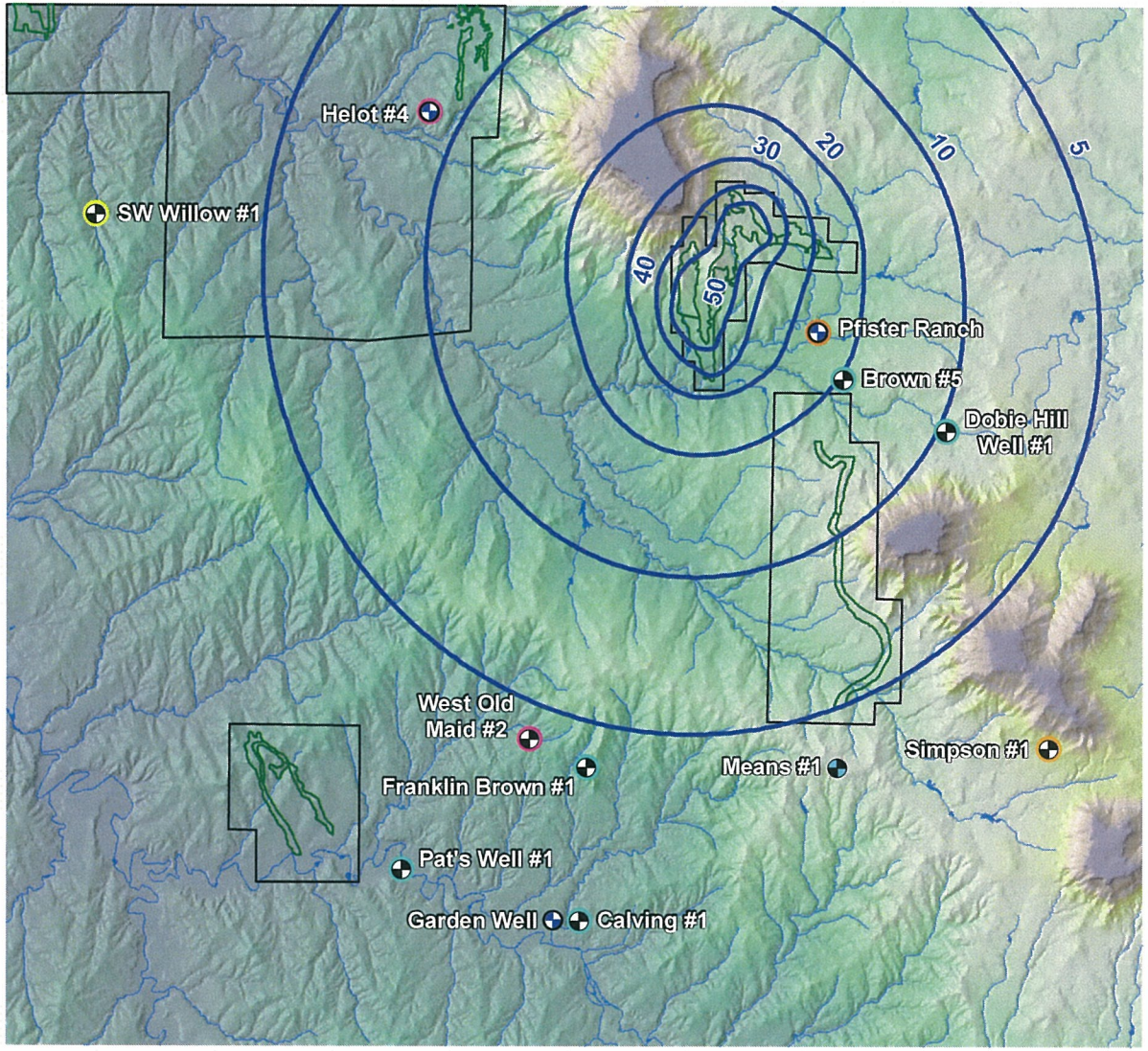
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\5-2-NORTHBUTTE_DRAWDOWN_A-SAND.mxd

Cameco

NORTH BUTTE DRAWDOWN IMPACT - A-SAND
DEVELOPMENT YEAR 8

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
5-2

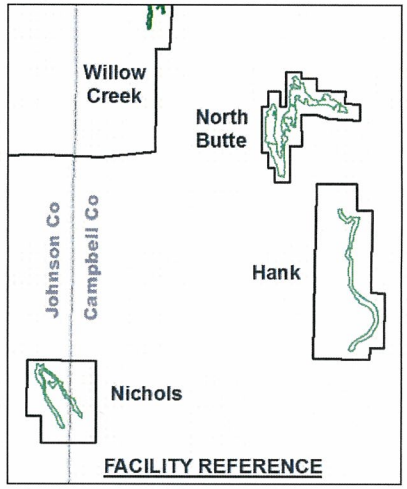


Legend

- Drawdown Contour (Ft.)

Domestic / Stock Wells: Sand Interval

- Domestic A/B
- Domestic B/C
- Domestic/Stock B
- Stock A/B/C
- Stock B
- Stock B/C
- Stock B/C/F
- Stock B/F
- Permit Boundary
- Mine Unit Boundary
- Drainage



NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 3,000 6,000 12,000
Feet
State Plane NAD27

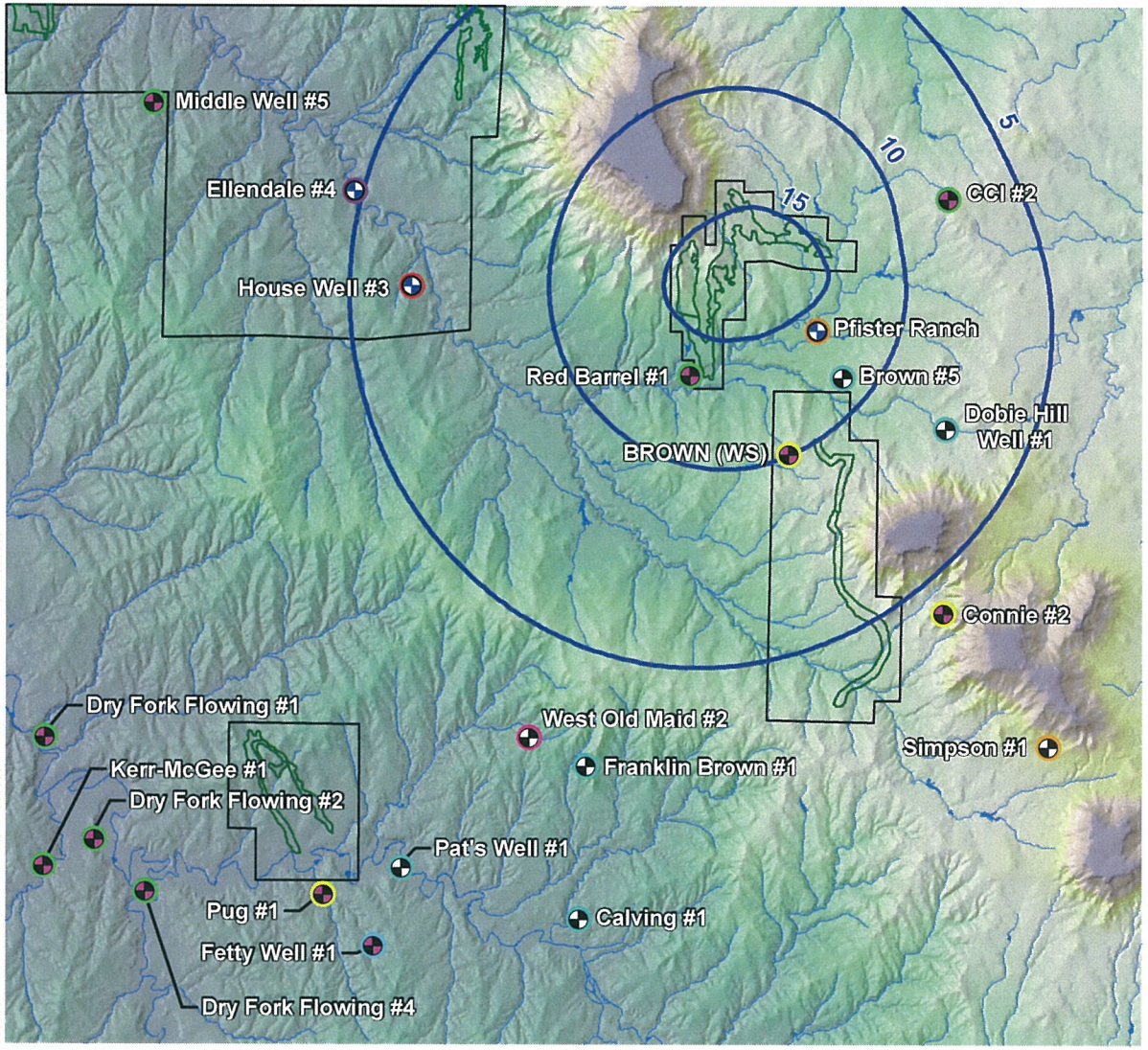
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\5-3-NORTHBUTTE_DRAWDOWN_B-SAND.mxd

Cameco

NORTH BUTTE DRAWDOWN IMPACT - B-SAND
DEVELOPMENT YEAR 8

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
5-3



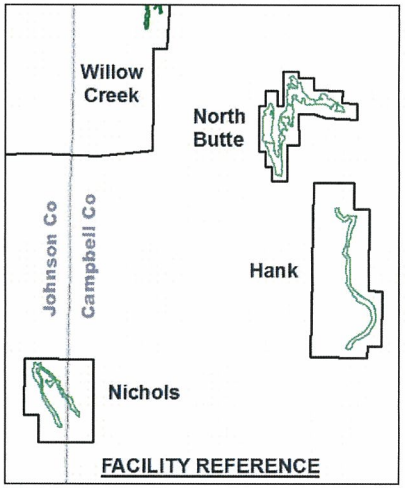
N

Legend

- Drawdown Contour (Ft.)

Domestic / Stock Wells: Sand Interval

- Domestic B/C
- Domestic C
- Domestic/Stock C
- Stock A/B/C
- Stock B/C
- Stock B/C/F
- Stock C
- Stock C/F
- Stock C/F/G/H
- Permit Boundary
- Mine Unit Boundary
- Drainage



NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 3,000 6,000 12,000
Feet
State Plane NAD27

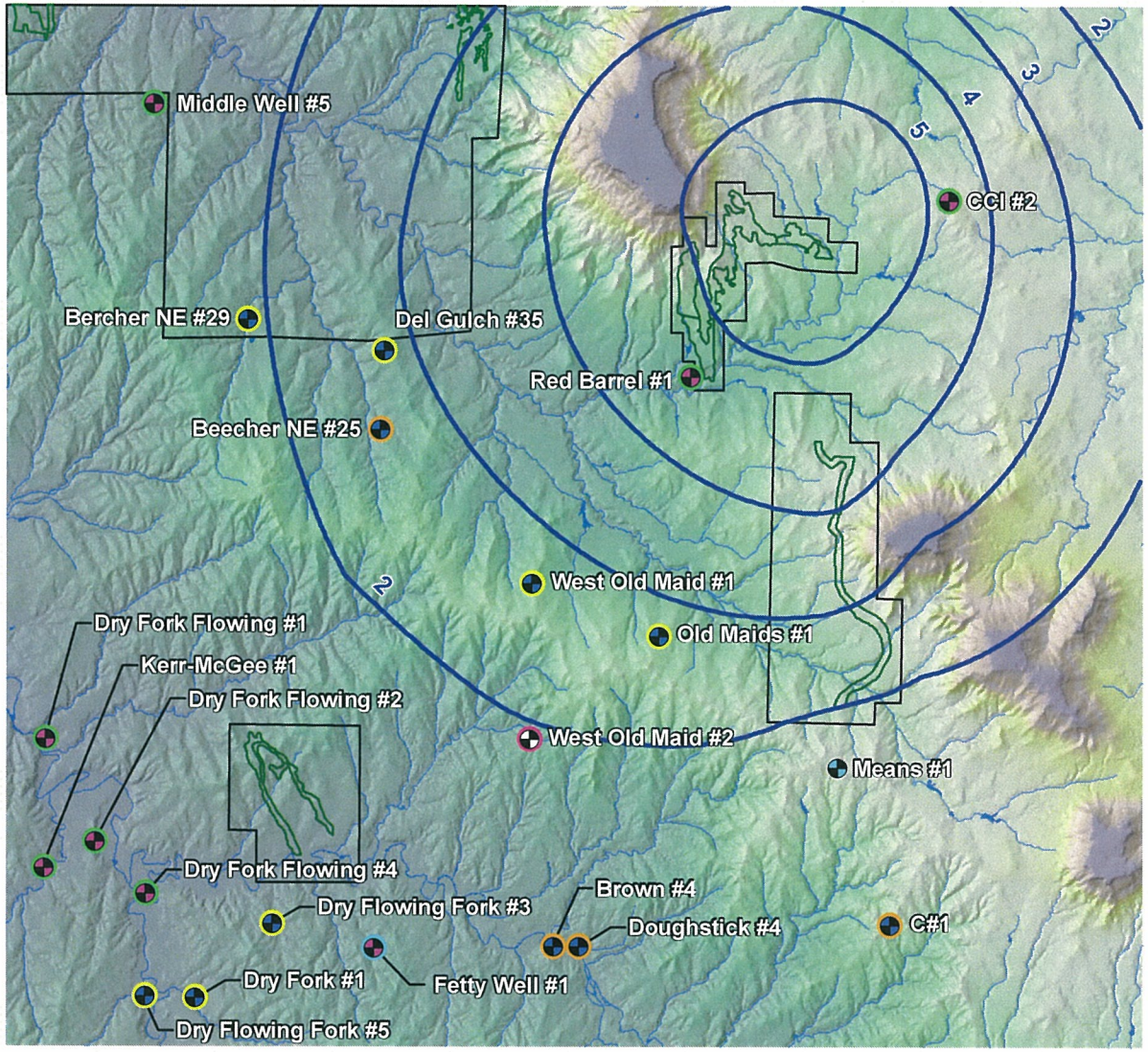
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\5-4-NORTHBUTTE_DRAWDOWN_C-SAND.mxd

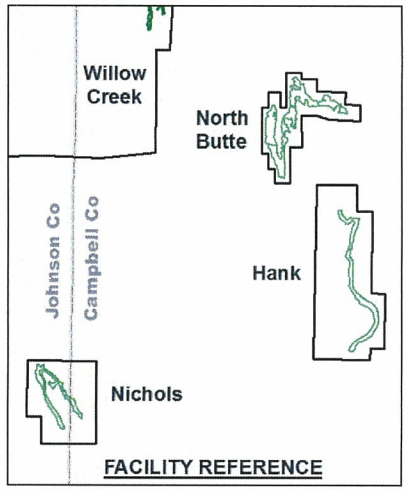
Cameco

NORTH BUTTE DRAWDOWN IMPACT - C-SAND
DEVELOPMENT YEAR 8

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
5-4





Legend

N

Drawdown Contour (Ft.)

Domestic / Stock Wells: Sand Interval

- Stock B/C/F
- Stock B/F
- Stock C/F
- Stock C/F/G/H
- Stock F
- Stock F/G/H
- Permit Boundary
- Mine Unit Boundary
- Drainage

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 3,000 6,000 12,000
Feet
State Plane NAD27

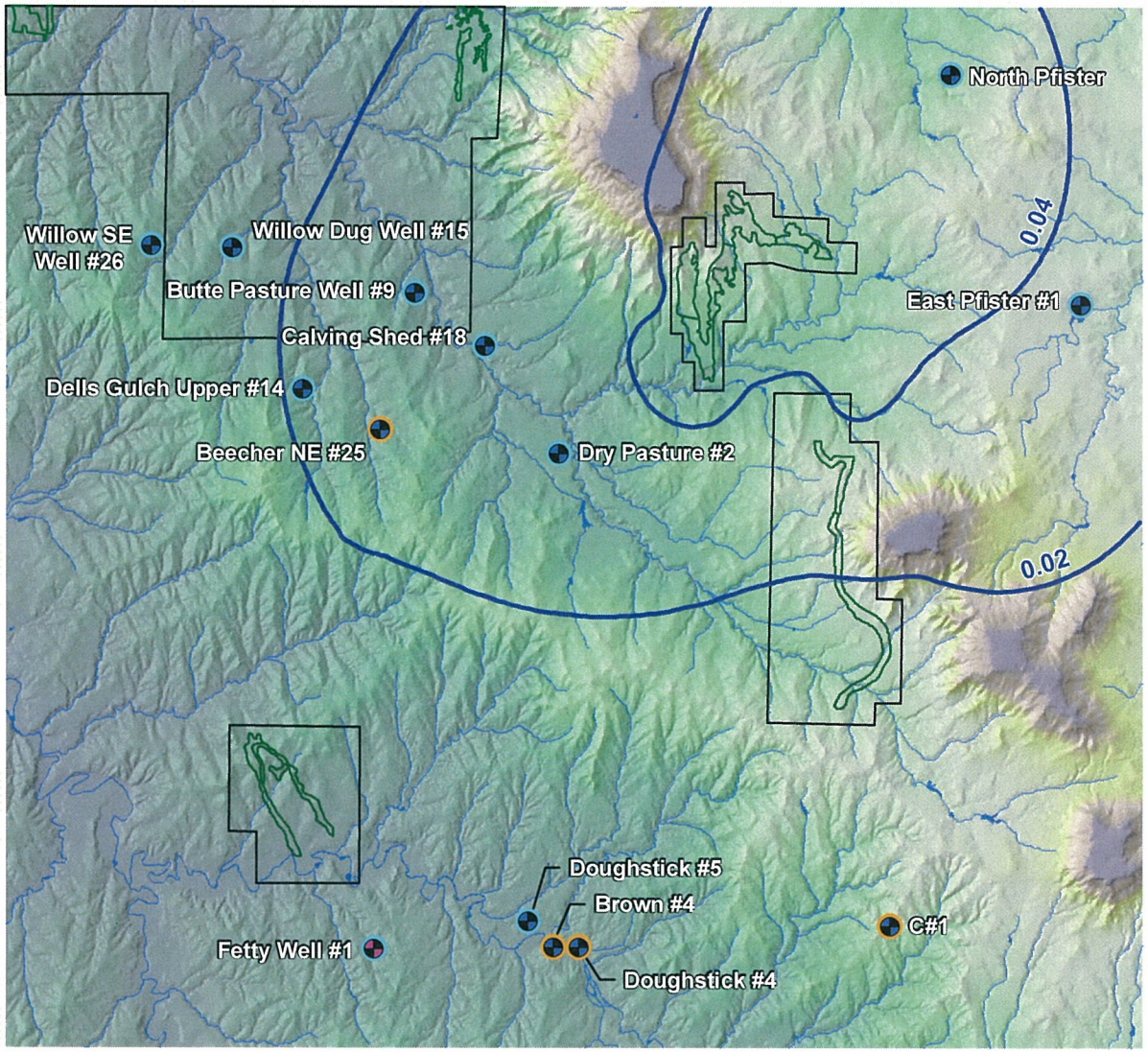
PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\5-5-NORTHBUTTE_DRAWDOWN_F-SAND.mxd

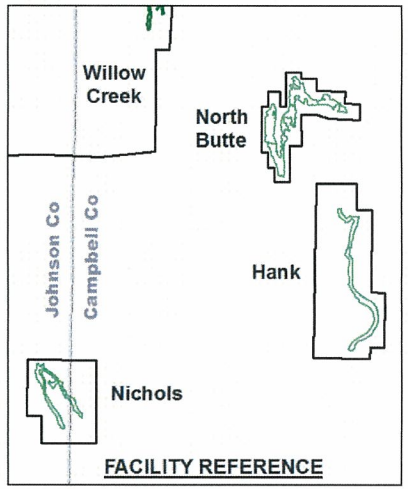
Cameco

NORTH BUTTE DRAWDOWN IMPACT - F-SAND
DEVELOPMENT YEAR 8

CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
5-5





Legend

- Drawdown Contour (Ft.)

Domestic / Stock Wells: Sand Interval

- Domestic/Stock G/H
- Stock C/F/G/H
- Stock F/G/H
- Stock G/H
- Misc G/H
- Permit Boundary
- Mine Unit Boundary
- Drainage

NOTES:
Base map information and associated data provided by Wyoming Geographic Information Science Center and the USGS. Site data provided by Cameco. Data interpretation by AQUI-VER, INC.

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

0 3,000 6,000 12,000
Feet
State Plane NAD27

PROJECT 40100542
DATE: 3/15/11
DRAWN BY: CLIN
REVIEWED BY:
Y:\Clients\indep\40100542\GRAPHICS\GIS\MXD_figures\5-6-NORTHBUTTE_DRAWDOWN_GH-SAND.mxd

Cameco

NORTH BUTTE DRAWDOWN IMPACT - G/H-SAND
DEVELOPMENT YEAR 8
CAMECO RESOURCES NORTH BUTTE FACILITY
CAMPBELL COUNTY - WYOMING

FIGURE:
5-6