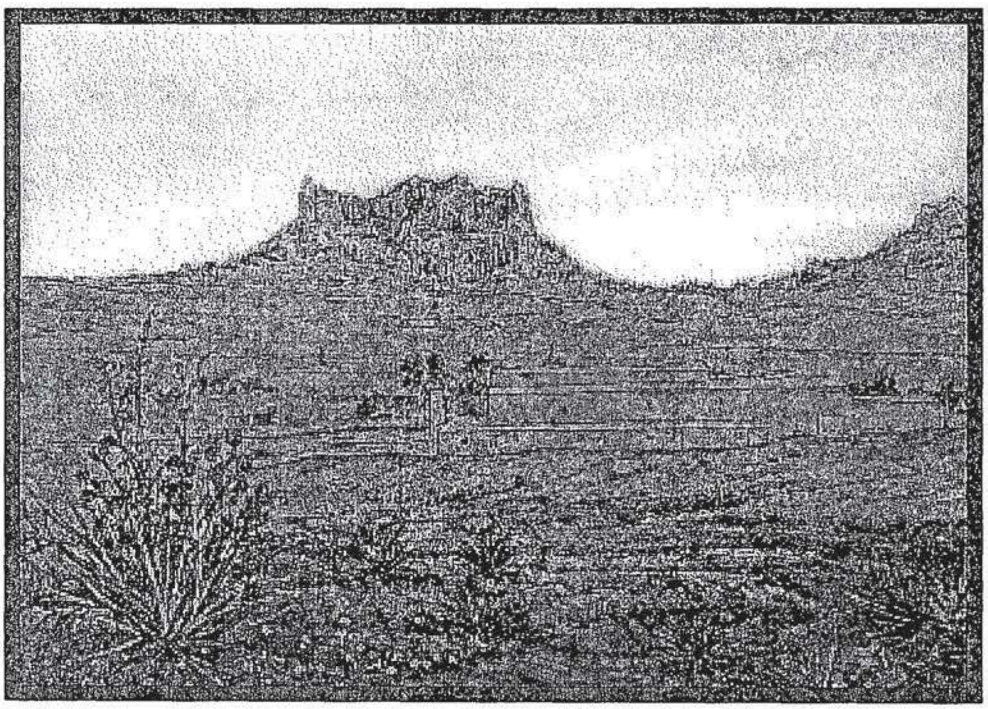
Crow Butte Resources, Inc.

Responses to NRC Request for Additional Information

Technical Review

License Renewal Amendment Request

Source Material License SUA-1534



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May, 2009

Should additional construction take place, there is a possibility that sediment load may increase in Squaw Creek. If rain, producing runoff, occurs during construction a small amount of the fill may be carried into the creek. In addition, site reclamation with backfilling of the ponds, grading the plant site, and replacing topsoil will also expose unsecured soil for suspension in runoff waters. The increased sediment load as a result of precipitation during construction or reclamation should not significantly affect the quality of Squaw Creek since the more sensitive areas of the stream are located upstream from the point of entry of the tributary.

7.12.1.3 Water Levels

The effects of the production and restoration phases of the project on water levels in the Chadron aquifers has been evaluated, both at current production levels as well as the proposed 9,000 gpm production level. The potential impact of the mining operations on water users of the Chadron Aquifer near the project site relates only to a decrease in formation pressure (drawdown) of the aquifer. The in-situ leach operations will not impact the quality of the groundwater available to the well user. It should be noted that private wells completed in the Chadron Aquifer are relatively rare and only a few are regularly used for domestic purposes. To assess the pressure decrease associated with the Crow Butte project, it is necessary to establish the total consumptive water use of the mining operations from the primary leaching to the groundwater restoration phase. The method of calculation will then incorporate individual flow rates, along with the timing and spatial position of those flow rates.

Since groundwater is injected as well as extracted in the ISL process, the flow rates of interest in gauging the impact are the net flows, or extraction minus injection. These net withdrawals and their timing were estimated from the generalized production schedule shown in **Table 7.12-1**. The net groundwater loss from the Chadron Aquifer will be around 105 gpm by year three. However, this overall net loss is small and is comparable to an industrial well or irrigation well pumping at this same rate.

Three years was used as a representative length of time for production, and then restoration, of a typical wellfield unit. Since distance weakens the effects of pressure transients (caused by water production) dramatically, it is important to allocate withdrawal points, for calculation purposes, throughout the expected production area, especially as the area increases in size. As a result, withdrawal points were considered centered in multiple wellfield units across the Crow Butte License Area (**Figure 7.12-1**). The base of this figure has been updated to reflect the withdrawal points discussed above and the water wells completed in the Chadron Aquifer nearest to the Crow Butte ISL project. Withdrawal points are noted with letters (A, B, C, etc.) and correlate to the same letters shown in **Table 7.12-1**. Since the density of the Chadron Aquifer wells increase northwest from the Crow Butte project area toward Crawford, the tentative wellfield production schedule shown in **Table 7.12-1** provides an early and separate progression of the wellfield production away from the Crow Butte Central Plant area toward the Crawford area. This will maximize the effect of withdrawals on the Crawford area wells and provide a more conservative estimate of impact.

Table 7.12-1: Production Restoration Schedule Flow Projections

Year	Production			Restoration			Total Net Withdrawal
	Flow	Withdrawal Point	Net Withdrawal	Flow	Withdrawal Point	Net Withdrawal	
1	4000	B	20.0	450	A	36	56.0
2	4500	B	22.5	500	A	40	62.5
3	5000	B	25.0	1000	A	80	105.0
4	5000	C,D	25.0	1000	A	80	105.0
5	5000	C,D	25.0	1000	B	80	105.0
6	5000	C,D	25.0	1000	B	80	105.0
7	5000	D,E	25.0	1000	B	80	105.0
8	5000	E,F	25.0	1000	C,D	80	105.0
9	5000	E,F	25.0	1000	C,D	80	105.0
10	5000	F,G	25.0	1000	C,D	80	105.0
11-20+	5000		25.0	1000		80	105.0
+1	0	0	0	1000		80	80.0
+2	0	0	0	1000		80	80.0
+3	0	0	0	1000		80	80.0
+4	0	0	0	1000		80	80.0

Note:

A, B, etc. refer to wellfield withdrawal points, see **Figure 7.12-1** (Revised). All flow rates are in gpm.

The pressure drawdown calculations were made using the unsteady state solution to the exponential integral describing radial flow in a confined aquifer. The Principal of Superposition was used in the calculations to allow flow rates to a particular location to vary, as they normally would during production and restoration (start, stop, restart, etc.). The formation flow parameters employed in the computer model were 2725 gpd/ft for transmissivity and 1.04×10^{-4} for storage coefficient and are considered representative of the pumping tests conducted at the Crow Butte License Area.

Figures 7.12-2 through **Figure 7.12-5** show the estimated drawdowns over time for each of the Chadron Aquifer water wells (ww) outside of the Crow Butte License Area shown on **Figure 7.12-1**. As shown, the changes in formation pressures vary according to timing and location of water well withdrawals, with maximum drawdowns in this case of 26-27 feet reached at different times depending upon the location of the water well. After this, the formation water pressures will rise again as consumptive water use is decreased, then altogether stopped. Recharge of the Chadron Aquifer was ignored in these calculations, which resulted in larger, more conservative drawdowns. However, it can be expected that sometime during the mining operation, the cone of influence resulting from the net withdrawals will reach equilibrium as a result of recharge of the surrounding aquifer.

Table 7.12-2 shows the maximum projected drawdowns, without formation recharge, caused by Crow Butte mining operations to the surrounding Chadron water wells. It also includes an estimated maximum drawdown available in those water wells, assuming the wells were drilled to the bottom of the Chadron Aquifer, a sand thickness of 60 feet, and drawdown to the top of the Chadron. The ratio of maximum drawdown to available drawdown is then shown as a percentage. That ratio varies from 4.4 percent to 16.7 percent with an average of 9.0 percent. Generally, the relative impact of the Crow Butte project on the Chadron water well users is small. Chadron water has limited use as a groundwater supply because of its generally poor quality and high radionuclide content. If a user has his pump set just below the level, he may have to lower the pump by up to 25 feet to accommodate the drawdown.

In the Crawford area, several Chadron Aquifer water wells flow at the surface as a result of the elevation represented by the formation water pressure being higher than the ground-surface elevation. These wells are noted as having a positive Static Water Level in **Table 7.12-2**. Comparing the predicted drawdowns in the Crawford area to the static levels of **Table 7.12-2** indicates that some of the wells may no longer be flowing after some time. However, the water level will remain near the ground surface and submersible pumps can be installed to accommodate the well user. Later, as consumptive water use from mining operations is stopped, the formation pressures should recover so that these wells will again be flowing.

Figure 7.12-1: Location of Wellfield Withdrawal Points – Dawes County, Nebraska

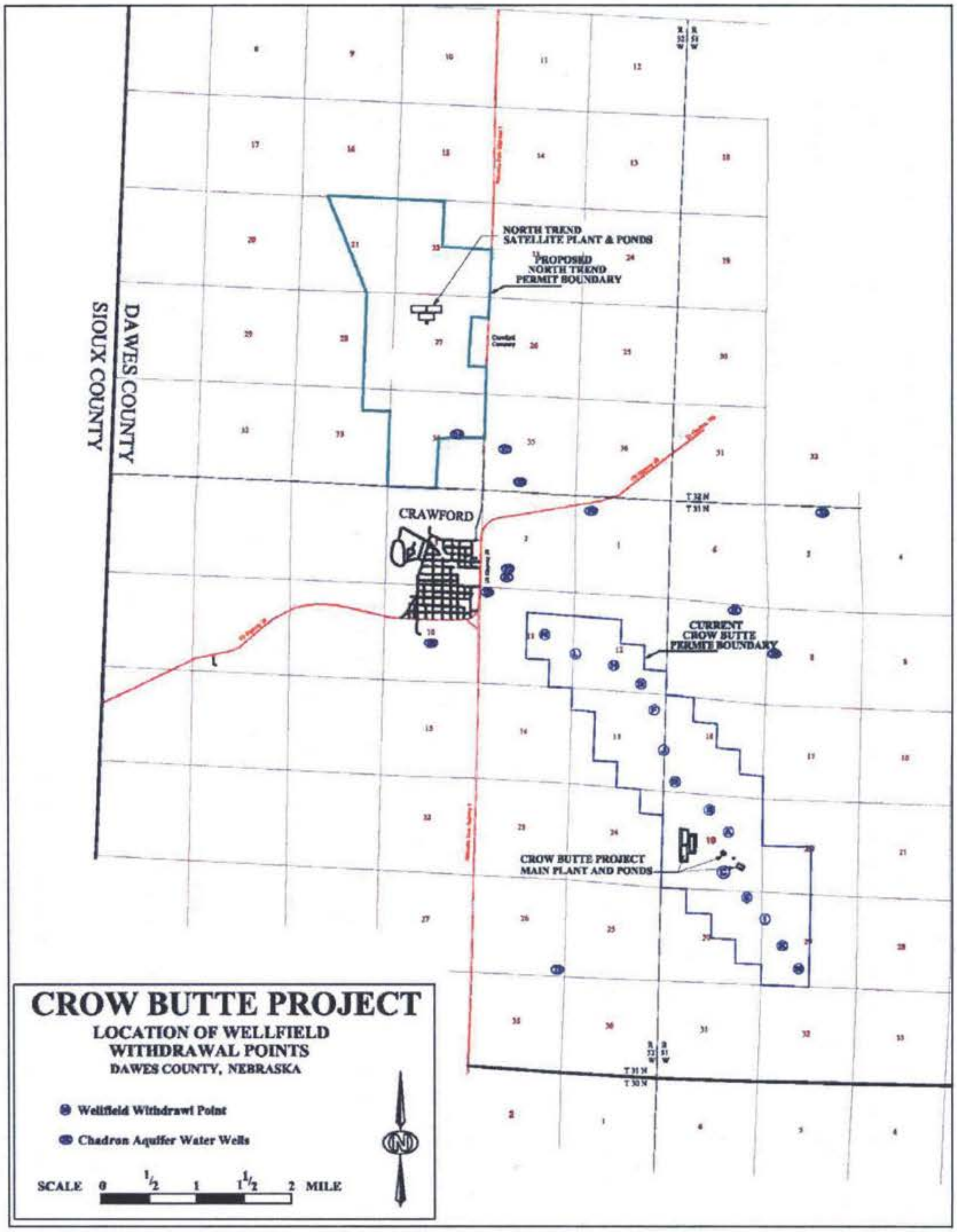

Figure 7.12-2: Crow Butte Project Impact of Water Withdrawals

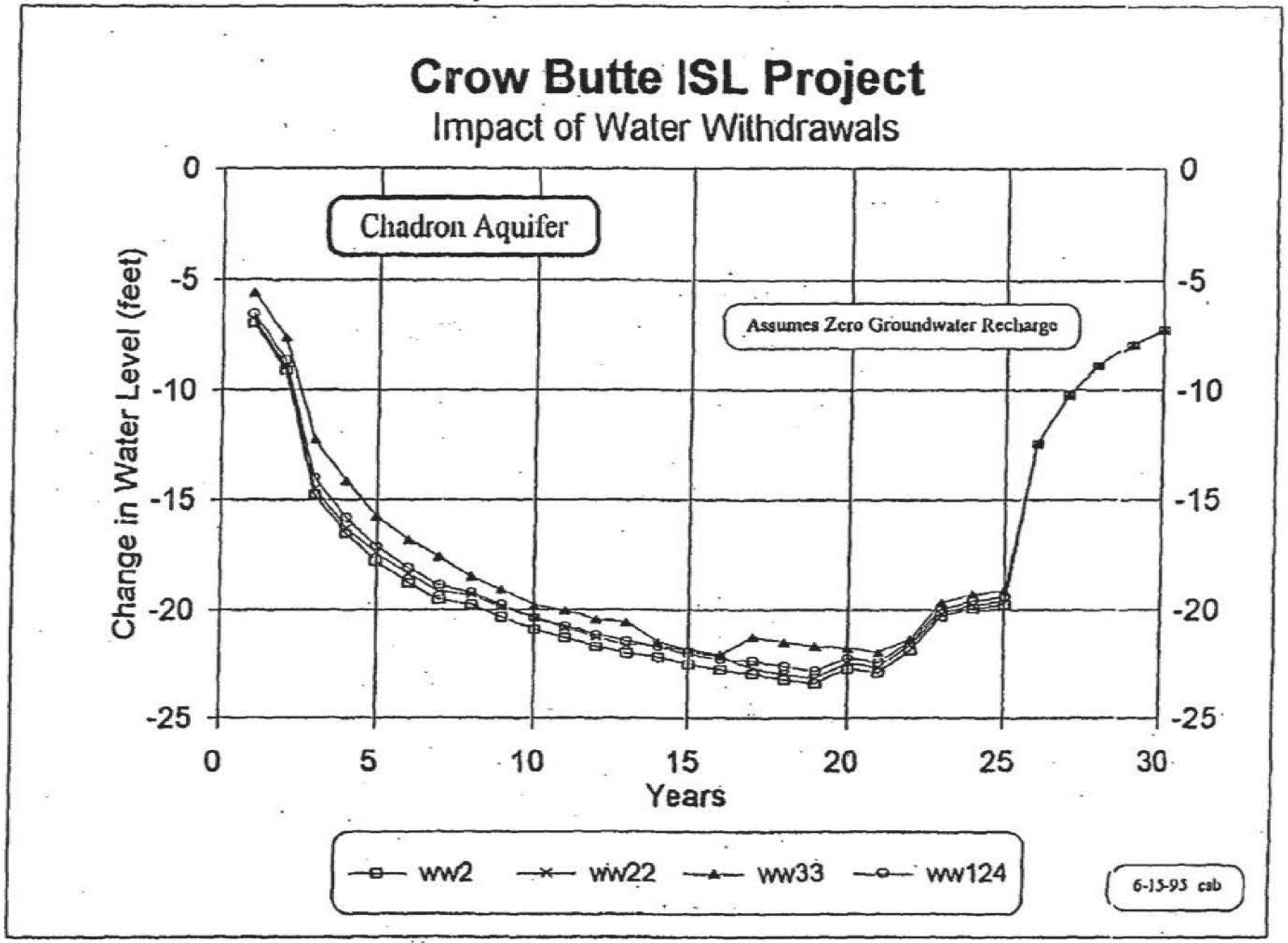

Figure 7.12-3: Crow Butte Project Impact of Water Withdrawals

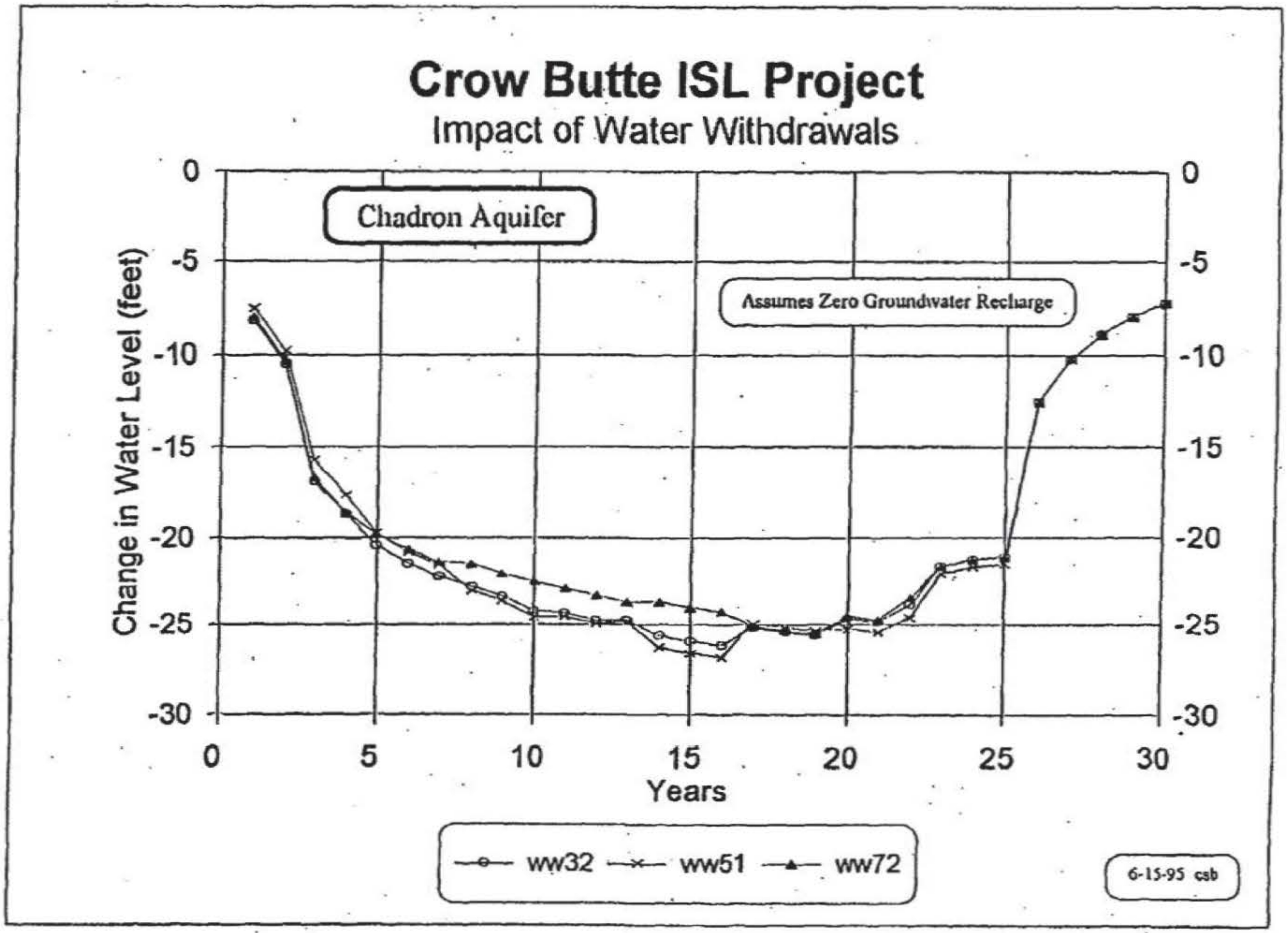

Figure 7.12-4: Crow Butte Project Impact of Water Withdrawals

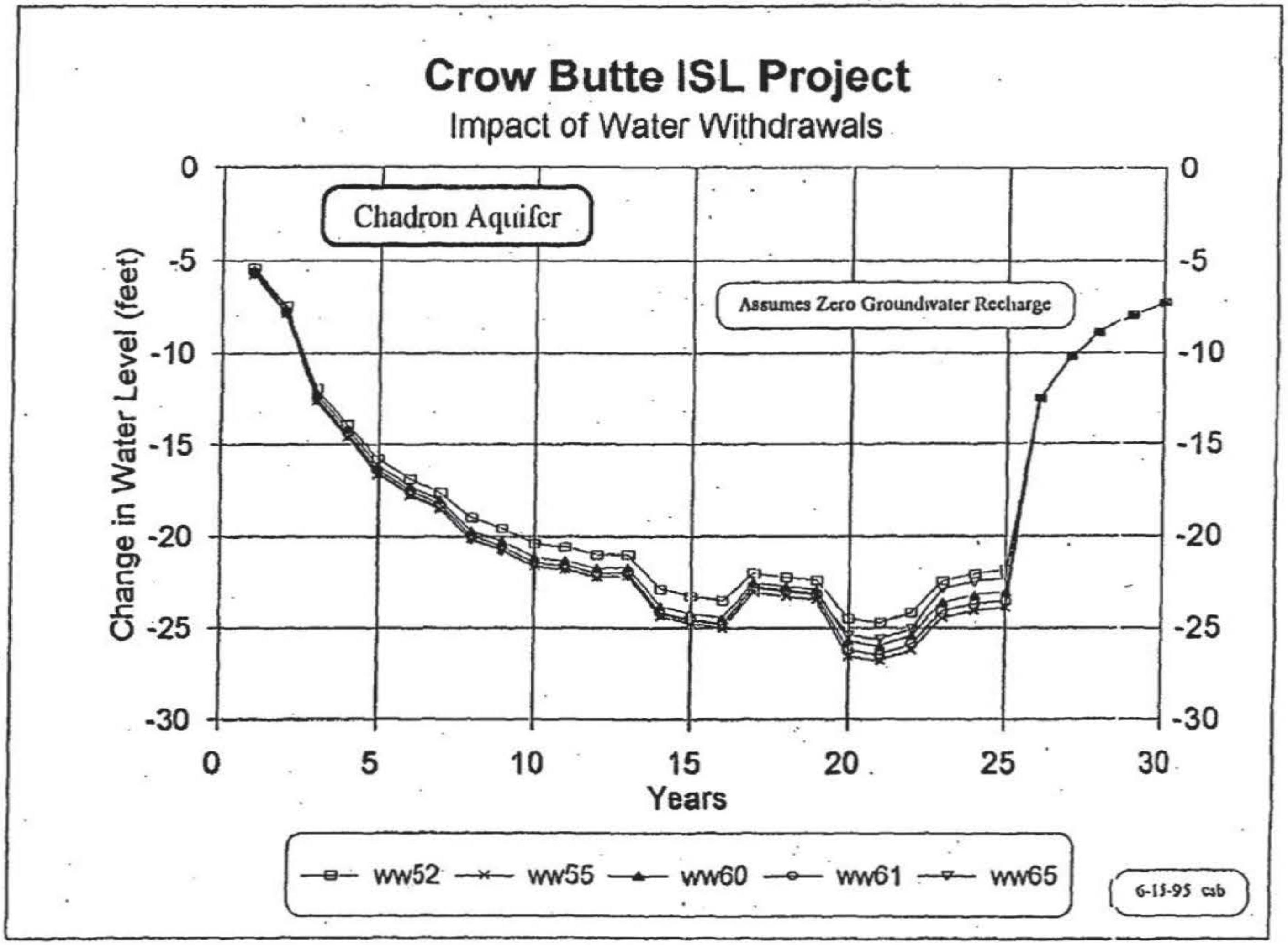

Figure 7.12-5: Crow Butte Project Impact of Water Withdrawals

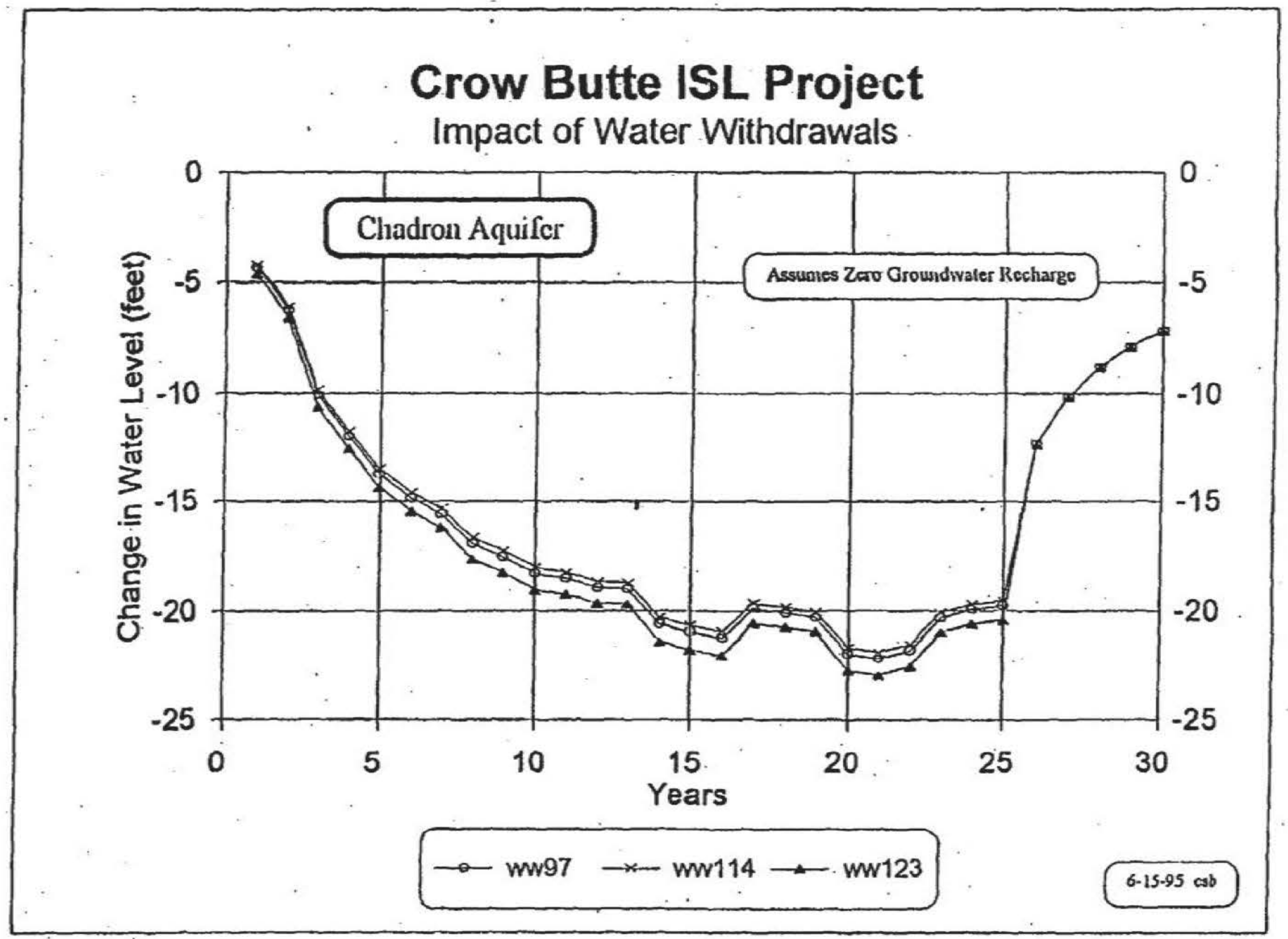

Table 7.12-2: Estimated Percent Reduction in Available Drawdown in Chadron Aquifer Water Wells as a Result of the Crow Butte ISL Operations

Water Well Number	Static Water Level (feet)[1]	Total Depth of Well (feet)	Figure Number: Drawdown vs. Time	Projected Maximum Drawdown (feet)	Maximum Available Drawdown (feet)[2]	Reduction of Available Drawdown (percent)
2	-60 est.	650	4.12-2	-23.4	530	-4.4
22	-70 est.	400	4.12-2	-23.2	270	-8.6
33	-20 est.	212	4.12-2	-22.1	132	-16.7
124	-50 est.	520	4.12-2	-22.8	410	-5.6
32	-39.8	400	4.12-3	-26.2	300	-8.7
51	-30 est.	300	4.12-3	-26.8	210	-12.8
72	-82.2	450	4.12-3	.25.5	308	-8.3
52	4.62[3]	420	4.12-4	-24.7	365	-6.8
55	-6.25[3]	320	4.12-4	-26.8	254	-10.5
60	20 est.	312	4.12-4	-25.9	272	-9.5
61	19.64[3]	280	4.12-4	-26.4	240	-11.0
65	22.52[3]	260	4.12-4	-25.6	223	-11.5
97	57.75[3]	380	4.12-5	-22.2	378	-5.9
114	60 est.	470	4.12-5	-21.9	470	-4.7
123	21.37[3]	280	4.12-5	-23.0	241	-9.5
					Average =	-9.0

1 + = Above Ground Level; - = Below Ground Level

2 To the Top of the Chadron Sandstone; assumes 60 feet sand thickness

3 Measured 11/83

travel time for the Red Clay unit was also incorrect and has been updated.

The text in section 2.7.2.3 has been revised to reflect the correct data.

5. Include groundwater-level distributions (in addition to water level measurements in 1982, 1983 and 1993) for the Brule and Chadron Formations to show both seasonal and historical variations in groundwater levels, flow direction, and gradient.

CBR RESPONSE:

The following information has been incorporated into Section 2.7.2.1:

*Water levels collected from the Basal Chadron Sandstone in 1982-1983 indicate groundwater flow to the south and southwest north of the town of Crawford and flow to the north and northwest within the Class III Permit Area. More recent water levels collected in March-April 2008, October 2008 and February-March 2009 all indicate groundwater flow is directed to the southeast in the southern portion of Mine Unit 10 and shifts to predominantly north and northeast-directed flow south of Mine Unit 8 (**Figures 2.7-4b**, **2.7-4c** and **2.7-4d**). Hydraulic gradients are locally highly variable within the permit area as a result of production activities and ranged from 0.004 to 0.064 ft/ft during the 2008 to 2009 time period. Water levels in the Basal Chadron Sandstone have decreased from approximately 40 to 60 feet across the permit area between the 1982-1983 and 2008-2009 time period. There were no significant seasonal changes to water levels, flow directions or range of hydraulic gradients observed in the Basal Chadron Sandstone between spring (March-April 2008) and fall (October 2008) conditions.*

*Water levels collected from the Brule Formation within the Class III Permit Area in 1982-1983 indicate groundwater flow to the northwest with an average hydraulic gradient of 0.012 ft/ft (**Figure 2.7-3a**). Water levels collected from the Brule Formation in March-April 2008, October 2008 and February-March 2009 similarly all indicate groundwater flow to the northwest with slightly higher average hydraulic gradients of 0.025, 0.041 and 0.043 ft/ft, respectively (**Figures 2.7-3b**, **2.7-3c** and **2.7-3d**). Based on these 2008 and 2009 water levels, steeper gradients generally occur south of Mine Unit 8 compared to the 1982-1983 time period. Water levels in the Brule Formation have not significantly changed within the southern and central portions of the Class III Permit Area between the 1982/1983 to 2009 time period. However, higher water levels (approximately 15 feet) were observed in Mine Unit 10 during the 2008 to 2009 time period than during the 1982 to 1983 time period. There were no significant seasonal changes to water levels, flow directions or range of hydraulic gradients observed in the Brule Formation between spring (March-April 2008) and fall (October 2008) conditions.*

6. Referring to Table 7.12-2 in the application, please use current operational data to assess any changes to the maximum available drawdown.

CBR RESPONSE:

*Predicted maximum drawdowns for water wells averaged approximately -25 ft as shown on **Table 7.12-2** of the application. These values were estimated assuming total net withdrawal rates of approximately 105 gpm. Actual net withdrawal rates were approximately double those used for the drawdown*

*estimates; therefore, these pumping rates would be assumed to result in actual average predicted drawdowns of approximately 50 ft. **Table 2A,** which is included as an attachment to this response document, presents a comparison of current projected drawdown estimates (2008 and 2009) to initial predicted drawdown estimates (1983) for wells 32, 72, 55, 97, and 123, where water level measurements are compared. Measured drawdowns range between 2.6 ft. for well 72 and -42.8 ft for well 32. These measured drawdowns are less than the predicted average drawdown of -50 ft referenced above, which would validate drawdown predictions.*

7. ~~**Include baseline concentrations to other water quality measures (in addition to uranium and radium) for surface waters (see the application, p. 5-118 of for a list of baseline water quality parameters). If only uranium and radium were deemed to be sufficient for setting baseline concentrations, please provide the justification.**~~

~~**CBR RESPONSE:**~~

~~*The non-radiological and radiological baseline water quality parameters listed on page 5-118 are actually for groundwater. Section 5.8 primarily addresses radiological monitoring, whereas, nonradiological baseline monitoring is addressed in Section 2.9. In order to avoid further confusion with this section, the referenced water quality data on page 5-118 have been deleted. A new table (**Table 2.9-2**) showing these nonradiological groundwater monitoring parameters, and a table showing the surface water nonradiological monitoring parameters (**Table 2.9-9**), have been added to Sections 2.9-1 and 2.9-4, respectively. In addition, additional discussions concerning the preoperational monitoring were added to Section 2.9.*~~

~~*The initial baseline water quality measurements were completed prior to the construction and operations of the current CBR licensed facility (CBR facility). Samples were collected from Squaw Creek, English Creek, White Clay Creek, White River and all surface bodies (e.g., impoundments) within the commercial permit area. Water sampling began in 1982 and, in some cases, continued into 1987. Water quality measurements included the baseline water quality indicators listed in Section 5.8.8.2 of the application. Sediment samples were collected and analyzed for natural uranium, radium-226 (Ra-226), thorium-230 (Th-230) and lead-210 (Pb-210). This sediment sampling program is discussed in Section 5.8.7.8 of the application. These preoperational baseline sampling locations and flow and analytical measurements were previously submitted to the NRC for the current CBR facility (FEN 1987); therefore, these data were not included in the application. Uranium and radium were not deemed to be sufficient for setting baseline concentrations (see discussion below). Language clarifying the previous submittal of preoperational surface water baseline monitoring data was added to Section 2.9.4 of this application. The FEN 1987 reference was added to Section 2.9.7(References).*~~

~~*The purpose of the uranium and radium sampling referenced in this NRC comment was, and continues to be, to monitor potential impacts on streams or water bodies during operational activities, as per license conditions. As part of the operational monitoring program, water samples are collected from each stream flowing through a wellfield area (one upstream and one downstream) and from any water impoundment in the wellfield area. CBR is only required to collect water samples to be analyzed for natural uranium and Ra-226 as per the operational monitoring program shown in **Table 5.8-5** of the application. In addition, sediment samples where each surface water sampling is performed, are also collected and analyzed for natural uranium, Ra-226 and Pb-210.*~~

Response to Section 2.7 Hydrology NRC Comment #6

Table 2A Measured Drawdowns

Water Well Number	Static Water Level (1983)	Total Depth of Well	Projected Maximum Drawdown	Maximum Available Drawdown	Static Water Level April, 2008	Static Water Level April, 2009	Actual Drawdown
	feet						
32	-39.8	400.0	-26.2	300.0	--	-82.6	-42.8
72	-82.2	450.0	-25.5	308.0	--	-79.6	2.6
55	-6.3	320.0	-26.8	254.0	--	-46.0	-39.7
97	57.8	380.0	-22.2	378.0	32.3	--	-25.4
123	21.4	280.0	-23.0	241.0	11.6	--	-9.8

Note: Measured values are one-time water level measurements.