

Subject: **Powder/Tongue River Basin Plan  
Industrial Water Use  
Task 2C**

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## **INTRODUCTION**

This technical memorandum provides information on existing water use for the major industrial water users in the Powder/Tongue River Basin.

The industries examined include:

Electric Power Generation  
Lake DeSmet Energy Co.

Coalbed Methane Production  
Yates Petroleum Corp.  
Barrett Resources  
Pennaco Energy, Inc.  
Phillips Petroleum  
Fidelity Exploration Co.  
Pioneer Oil Co.  
J.M. Huber Co.  
CMS Energy  
Citation Oil Co.

Oil & Gas Production  
Howell Petroleum Corp.  
Exxon/Mobil Corp.  
Ensign EOG Operating Co.

Coal Mining  
Kennecott Energy Company

Industrial water use data summaries have been prepared for two of the contacts, Lake DeSmet Energy Company and Kennecott Energy Company, and are provided at the back of this memorandum. The summaries include a description of the operation, water source, water supply system, discharge system, and an estimate of annual water usage. The remainder of the industrial uses are generally described in the following sections.

Of the users listed above, only Lake DeSmet Energy Co. depends upon surface water for its water supply – and its supplies have yet to be utilized.

## **METHODOLOGY**

Most of the information reported here was collected directly through telephone or personal interviews with individual water users, as well as interviews with the Coalbed Methane Coordination Coalition, the Wyoming Oil & Gas Conservation Commission (OGCC), and the U.S. Bureau of Land Management. In

the case of electric power generation and coalbed methane production, additional data interpretation is required.

Because Lake DeSmet Energy Co.'s rights are a matter of public record, those rights and previous interviews with State Engineer's Office water commissioners provide the basis for that summary. The company's current consumptive water use consists of evaporation, primarily from Lake DeSmet Reservoir. The evaporative loss from Lake DeSmet is included in the Storage Operation and Description Memorandum for this project.

All coalbed methane extraction is dependent on lowering the pressure over the coal seam through reducing the column of water in the coal aquifer. The water produced from these wells is not used consumptively – at least initially. The water is simply transferred from ground water to surface water status. The water can be stored in reservoirs where it can evaporate or percolate into shallow aquifers; or discharge into nearby drainages. Stock, wildlife, and vegetation consume some of the water along the watercourses. If the water is discharged into a drainage directly, a significant portion of the discharge water also percolates into the ground or evaporates along the watercourse. Because none of the well discharge monitoring as reported in the Oil and Gas Conservation Commission's (OGCC) databases extends downstream, potential consumptive uses cannot be effectively quantified. Nevertheless, the OGCC database contains the most complete information available on discharges from CBM wells.

HKM downloaded the CBM water discharge database from the OGCC Internet site as two Microsoft Excel spreadsheets (dated 1/28/2002, downloaded 2/15/2002), then used a combination of relational database, spreadsheet, and GIS software tools to estimate the cumulative discharge from all wells in the Northeast Wyoming River Basin and each of the subbasins within it.

The OGCC data set is striking for being the best source of data on CBM produced water available, but it isn't perfect. The OGCC data set includes production figures for 10,995 fewer wells in Wyoming than it has individual identity codes for. According to OGCC staff, this is due to several factors: expired wells, temporarily abandoned ones, wells awaiting approval, shut-in wells, and wells for which operators refuse to submit data. Unfortunately, the OGCC has no way of gauging the magnitude of the last factor.

The numbers reported here are generated from the OGCC's month-by-month reckoning. In the case of the year 2001 totals, all months for the year 2001 are totaled for each production point. (Some wells have multiple production points, being developed in multiple coal seams or aquifers.) To generate the cumulative sum for all wells in the basin for their entire production period, all production associated with each unique identifier was totaled. The well locations associated with these totals are used to create a theme in a GIS. The resulting GIS allows users to query each subbasin by Hydrologic Unit Code (HUC) to understand how many barrels of water are being produced by how many wells within the subbasin during the year 2001 and during the history of CBM development in the basin.

## **CONCLUSIONS**

### **Industrial Surface Water Use**

Industrial use of surface water is very limited in the Powder/Tongue River Basin. Table 1 below lists the 10 major industrial surface water rights, their source of supply, and point of diversion. All of these stem from the industrial rights held in Lake DeSmet. Because these rights have yet to be developed, their usage or consumption is a function of reservoir evaporation as reported in the Storage Operation and Description Memorandum. The only other industrial uses from surface water sources in the Powder/Tongue River Basin come from temporary applications like road construction, according to Water Division II superintendent Mike Whitaker.

**Table 1: Ten largest industrial surface water rights, Powder/Tongue River Basin**

<b>Reservoir</b>	<b>Use</b>	<b>Permit No.</b>	<b>Volume (a-f)</b>	<b>Headgate Location (S-T-R)</b>	<b>Priority</b>	<b>Water Right Holder</b>
Healy Res.	D,I,Ind	7289R	41,974	9-51-081	04-15-1957	Texaco, Inc.
Second Enl. Lake DeSmet Res	Ind	6225R	38,960	31-53-082	02-02-1955	Texaco, Inc.
Reynolds High Dam	I,Ind	7291R	37,340	31-53-082	11-13-1963	Texaco, Inc.
Enl. Lake DeSmet Res.	D,I,Ind,S	5829R	30,129	6-52-082	04-03-1950	Reynolds Mining Corporation
Third Enl. Lake DeSmet Res.	I,Ind	7009R	17,738	31-53-082	02-25-1955	Texaco, Inc.
First Enl. Healy Res.	D,I,Ind	7290R	13,725	31-53-083	10-14-1957	Texaco, Inc.
Lower Clear Creek Res	I,Ind	7292R	11,800	31-53-082	02-21-1968	Lower Clear Creek
Reynolds Box Elder Res.	I,Ind,S	6226R	8,902	31-53-082	02-04-1955	Texaco, Inc.
Reynolds Shell Creek Res.	I,Ind	6227R	1,304	31-53-082	03-08-1955	Texaco, Inc.
Enl. Reynolds Shell Creek Res	I,Ind,S	7532R	740	31-53-082	04-16-1957	Texaco, Inc.

### **Industrial Ground water Use**

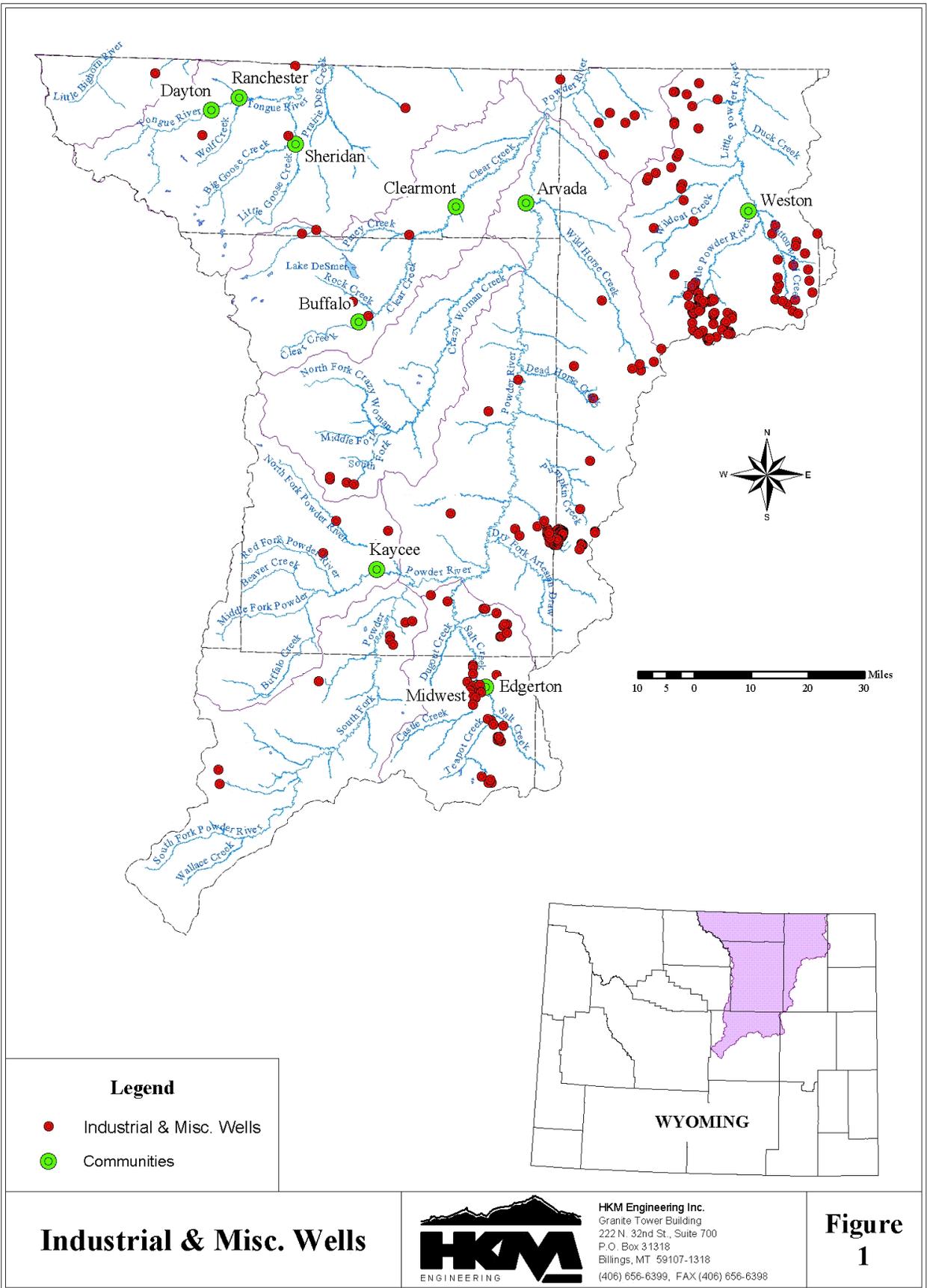
The majority of industrial water use in the basin is attributed to ground water sources. The oil and gas (O&G) production and coal bed methane (CBM) industries are the major ground water producers in the basin, but tend to consumptively use large amounts of water through “water-flood” or injection practices because water is transferred from a water aquifer into an oil or gas aquifer, degrading the water quality. Only one mine coal mine was identified in this basin, Spring Creek Mine, a “dry mine” with no documented water use and no discharge permits. An inventory of the permitted industrial and miscellaneous use wells is provided in the Industrial Ground Water Wells data theme developed for this study and generally shown on Figure 1.

### **Conventional Oil & Gas Production**

To illustrate the demand for water from conventional oil and gas production in the Powder/Tongue Basin, the Wyoming Oil & Gas Commission provided data on injection wells (wells used to inject water into oil or gas aquifers to displace oil and gas) and produced water (see Tables 2 and 3).

These data indicate that 1,593 wells inject just less than 38,000 acre-feet of water into aquifers in the basin in the year 2000. And 2,343 wells produced just less than 44,000 acre-feet of water in the basin in the year 2000.

Unfortunately, this provides only the “input” side of the equation; produced water and water pumped specifically for the purpose are used for injection, while only the Department of Environmental Quality maintains records of how much water is permitted for discharge from each well. No individual or agency has attempted to quantify the discharges permitted for oil and gas producers on a basis that could be used here. As a result, the amount of water used in conventional oil and gas operations in the basin cannot be identified at this time.



**Table 2. Conventional O&G injected water, year 2000, Powder/Tongue River Basin**

<b>Subbasin (by HUC)</b>	<b>Volume for year (bbl)</b>	<b>Number of wells</b>
10080016	1,046,450	5
10090101	944,551	6
10090201	939,558	15
10090202	10,367,773	273
10090203	3,461,270	21
10090204	248,520,306	972
10090205	346,856	9
10090206	0	0
10090207	811,853	29
10090208	27,271,762	263
<b>TOTAL</b>	<b>293,710,379</b>	<b>1,593</b>

**Table 3. Conventional O&G produced water, year 2000, Powder/Tongue River Basin**

<b>Subbasin (by HUC)</b>	<b>Volume for year (bbl)</b>	<b>Number of wells</b>
10080016	0	0
10090101	20,011	3
10090201	7,939,904	33
10090202	4,563,499	414
10090203	2,293,684	28
10090204	284,966,110	1,456
10090205	12,122	4
10090206	22,909	5
10090207	318,287	25
10090208	39,326,636	375
<b>TOTAL</b>	<b>339,463,162</b>	<b>2,343</b>

### ***Coalbed Methane***

There is little direct consumptive use in the CBM industry. The majority of water is produced water from the coal seam dewatering process. Nevertheless, a significant portion of the discharged water is estimated to be lost in conveyance along existing drainages. Based on information from the Coalbed Methane Coordination Coalition, as a general rule, there are approximately 105 gallons of water produced per 1000 CF of methane gas. This value varies from well to well as a function of the coal seam and the age of the well, with water production generally decreasing with the age of the well.

Wyoming Oil & Gas Conservation Commission (OGCC) records (updated Jan. 28, 2002) show 6,184 CBM wells in the Powder/Tongue River Basin, with a total water discharge of 188.7 million barrels of water during the year 2001 (more than 24,300 acre-feet in that year). Because OGCC's data collection activities go back to the 1970s, their records of cumulative CBM activity essentially cover the history of the industry's activity in the basin. Cumulatively, the Powder/Tongue River Basin has produced 391.8 million barrels of water from CBM activity (or just less than 50,500 acre-feet of water).

The following tables summarize the year 2001 and cumulative CBM produced water discharges in the Northeast Wyoming Rivers Basin by subbasin (designated by Hydrologic Unit Code, or HUC, found on Figure 2).

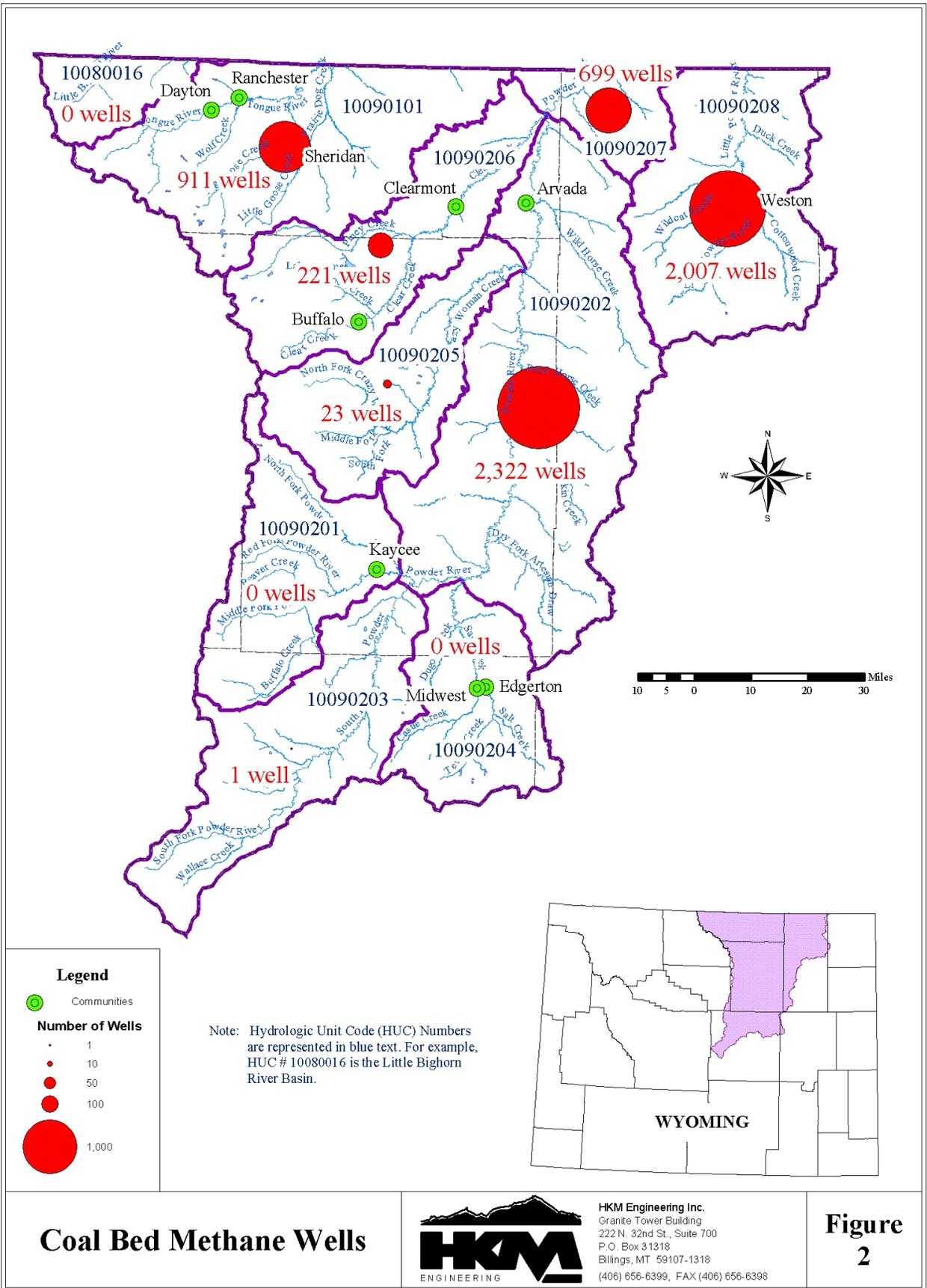


Table 4: Year 2001 CBM Produced Water, Powder/Tongue River Basin

HUC	prod'n pts	2001 Total	
		BBL.	a-f
10080016	0	0	0.00
10090101	925	22,107,183	2,849.48
10090201	0	0	0.00
10090202	2,331	80,773,926	10,411.26
10090203	1	12,588	1.62
10090204	0	0	0.00
10090205	23	9,772	1.26
10090206	223	185,970	23.97
10090207	700	17,130,073	2,207.96
10090208	2,010	68,532,911	8,833.47
<b>Total</b>	<b>6,213</b>	<b>188,752,423</b>	<b>24,329.02</b>

Table 5: Cumulative CBM Produced Water, Powder/Tongue River Basin

HUC	# wells	Cumulative Total	
		BBL.	a-f
10080016	0	0	0.00
10090101	911	31,346,103	4,040.32
10090201	0	0	0.00
10090202	2,322	132,560,758	17,086.26
10090203	1	27,115	3.49
10090204	0	0	0.00
10090205	23	9,772	1.26
10090206	221	255,626	32.95
10090207	699	27,158,062	3,500.51
10090208	2,007	200,421,927	25,833.14
<b>Total</b>	<b>6,184</b>	<b>391,779,363</b>	<b>50,497.93</b>

Note: One well may have multiple production points, having been developed in several coal seams or aquifers. This is how the number of production points in Table 4 exceeds the number of wells in Table 5.

The numbers summarized in these tables do not indicate what happens to the water once it is transferred from ground water to surface water by CBM wells. No agency monitors the fate of CBM water once it leaves a wellhead. Information received through various interviews indicates that the majority of the discharge water is allowed to flow into existing drainages, though some is stored in small reservoirs and disposed of through infiltration or evaporation. A small amount may also be disposed of through land application (irrigation); but as noted previously there is little information with respect to disposal. A significant portion of discharged CBM water is likely lost in conveyance. Coalbed Methane Coordination Coalition coordinator Mickey Steward maintains that the information available from monitoring wells maintained by the various coal mines around Gillette provide an opportunity to understand how much CBM discharge water enters shallow, alluvial aquifers. This research has yet to be undertaken.

Other information on CBM wells, like locations and densities, can be found in the GIS data theme developed for this study and as generally shown on Figure 2.

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## Industrial Summary

**Entity:** Lake DeSmet Energy Company

**Industry:** Power Generation

**Operation:** The company owns the largest coal reserves in America and 62,000 acre-feet in Lake DeSmet, 5,140 acre-feet in Healy Reservoir (an intake structure for a pump and piping system that charges DeSmet), 2,200 acre-feet in Cloud Peak Reservoir, and 900 acre-feet in Willow Park. Though the company is currently marketing its coal, it has not yet been developed, and the water resources reserved for that development effort have also yet to be used.

**Water Source:** Surface water: Clear and Piney creeks

**Water Supply:** 5,140 acre-feet of the company's rights are in Healy and can be pumped to DeSmet for use to the south when demanded. The remainder of the industrial water right is in DeSmet.

**Discharge System:** From Healy Reservoir, pump and pipe to DeSmet; from DeSmet, outlets to the south and north.

**Estimated Annual Water Usage:** None

## **Industrial Summary**

**Entity:** Kennecott Energy /Spring Creek Mine

**Industry:** Coal Mining

**Operation:** The Spring Creek Mine, located north of Sheridan, produces approximately 11.3 million tons of coal annually. The Spring Creek Mine was described as a “dry mine” with no water use or discharge.

**Water Source:** NA

**Water Supply:** NA

**Discharge System:** This is a no discharge facility, and there are no discharge permits.

**Estimated Annual Water Use:** NA