Task 2 Report for the Powder River Basin Coal Review Past and Present and Reasonably Foreseeable Development Activities

Prepared for

Bureau of Land Management
Casper Field Office
and
Wyoming State Office

Submitted by

ENSR Corporation
Fort Collins, Colorado

October 2005
(Revised)

TASK 2 REPORT FOR THE
POWDER RIVER BASIN COAL REVIEW
PAST AND PRESENT AND REASONABLY FORESEEABLE DEVELOPMENT ACTIVITIES

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ACRONYMS AND ABBREVIATIONS

APD	Application for Permit to Drill
API	American Petroleum Institute
AQD	Air Quality Divisions
ARI	Advanced Resources, International
BACT	Best Available Control Technology
bbls	barrels
BCF	Billion cubic feet
BLM	Bureau of Land Management
BNSF	Burlington Northern and Santa Fe Railroad
BOE	barrels of oil equivalent
CANDO	Converse Area New Development Organization
CBNG	coal bed natural gas
CCEDC	Campbell County Economic Development Corporation
CO_2	carbon dioxide
DM&E	Dakota, Minnesota, & Eastern
EA	environmental assessment
EIS	environmental impact statement
EOR	enhanced oil recovery
FERC	Federal Energy Regulatory Commission
FS	U.S. Department of Agriculture, Forest Service
GDP	gross domestic product
GIS	Geographical Information System
I	Interstate
lb/MMBtu	Pounds per million British thermal unit
LBA	Lease by Application
LQD	Land Quality Division
Mcf	thousand cubic feet
MDEQ	Montana Department of Environmental Quality
MMbtus	million British thermal units
MMcf	million cubic feet
MMcfpd	million cubic feet per day
mmtpy	million tons per year
MSHA	Mine Safety and Health Administration
MW	megawatts
MWH	Montgomery Watson Harza
NEPA	National Environmental Policy Act
NO_x	oxides of nitrogen
P&A	plugged and abandoned
P&M	Pittsburg and Midway Coal Mining Company
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PRB	Powder River Basin
PRRCT	Powder River Regional Coal Team
PSO	Public Service Company of Oklahoma
RFD	reasonably foreseeable development
RMG	Reservoir Management Group

RMP	Resource Management Plan
SO_x	sulfur oxides
SR	State Route
STB	U.S. Surface Transportation Board
STIP	State Transportation Improvement Program
TBNG	Thunder Basin National Grasslands
Tcf	trillion cubic feet
TRRC	Tongue River Rail Company
U.S.	United States
UP	Union Pacific
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
USGS	U. S. Geological Survey
WDEQ	Wyoming Department of Environmental Quality
WOGCC	Wyoming Oil and Gas Conservation Commission
WSFC	Wyoming School Facilities Commission
WYDOT	Wyoming Department of Transportation

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1.0 INTRODUCTION

The Powder River Basin (PRB) of Wyoming and Montana is a major energy development area with diverse environmental values. The PRB is the largest coal-producing region in the United States (U.S.); PRB coal is used to generate electricity both within and outside the region. The PRB also has and continues to produce large quantities of oil and natural gas resources. Within the last decade, this region has experienced nationally significant development of natural gas from coal seams.

This PRB Coal Review is a regional technical study to assess cumulative impacts associated with past, present, and reasonably foreseeable development (RFD) in the PRB. For purposes of this study, the Wyoming portion of the PRB study area (**Figure 1-1**) comprises all of Campbell County, all of Sheridan and Johnson counties less the Bighorn National Forest lands to the west of the PRB, and the northern portion of Converse County. It includes all of the area administered by the Bureau of Land Management (BLM) Buffalo Field Office, a portion of the area administered by the BLM Casper Field Office, and a portion of the Thunder Basin National Grasslands (TBNG), which is administered by the U.S. Department of Agriculture, Forest Service (FS) (**Figure 1-2**). The Montana portion of the PRB study area (**Figure 1-1**) comprises the area of relevant coal mines and the air quality study area and includes the lands administered by the BLM Miles City Field Office (**Figure 1-2**). State and privately owned lands also are included in the PRB study area (**Figure 1-3**).

As shown in **Figure 1-3**, the majority of the surface ownership in the PRB study area is private. Conversely, the majority of the mineral ownership in the study area is federal (**Figure 1-4**). Federal mineral ownership may include all minerals in some locations and only specific minerals (e.g., coal or oil and gas) in other locations. As a result, split-estates (where the surface ownership is different than the mineral ownership) exist in a large portion of the PRB.

The Task 2 component of the PRB Coal Review defines the past and present development actions in the study area that have contributed to the current environmental and socioeconomic conditions in the PRB study area. This report also defines the projected RFD scenarios in the Wyoming and Montana PRB for years 2010, 2015, and 2020. For the Wyoming PRB, the past and present development and RFD scenarios include coal mine development as well as coal-related activities (e.g., railroads and coal-fired power plants) and non-coal-related activities (e.g., other minerals, coal bed natural gas [CBNG], and conventional oil and gas). Coal mine development and coal-related activities in the Montana PRB study area are included in this study to facilitate the concurrent development of the Miles City Resource Management Plan (RMP). The past and present activities identified in this report are based on the most recent data available at the end of 2003 and provide the basis for the resource-specific descriptions of current conditions presented in the PRB Coal Review Task 1 reports.

The RFD scenarios presented in this report provide the basis for the analysis of potential cumulative impacts in the Task 3 component of the study. The accuracy of any projected cumulative impact analysis is dependent on the adequacy and accuracy of information regarding potential future development activities in the affected area. While it is impossible to identify all potential future activities over the next 15 years, it is possible and desirable to identify RFDs based on current industry announcements, agency plans, economic trends, and technological advances affecting major industry sectors. Information regarding potential new development is constantly changing;

however, to facilitate development of the information in this study, the RFDs identified in this report reflect information available through the end of 2004.

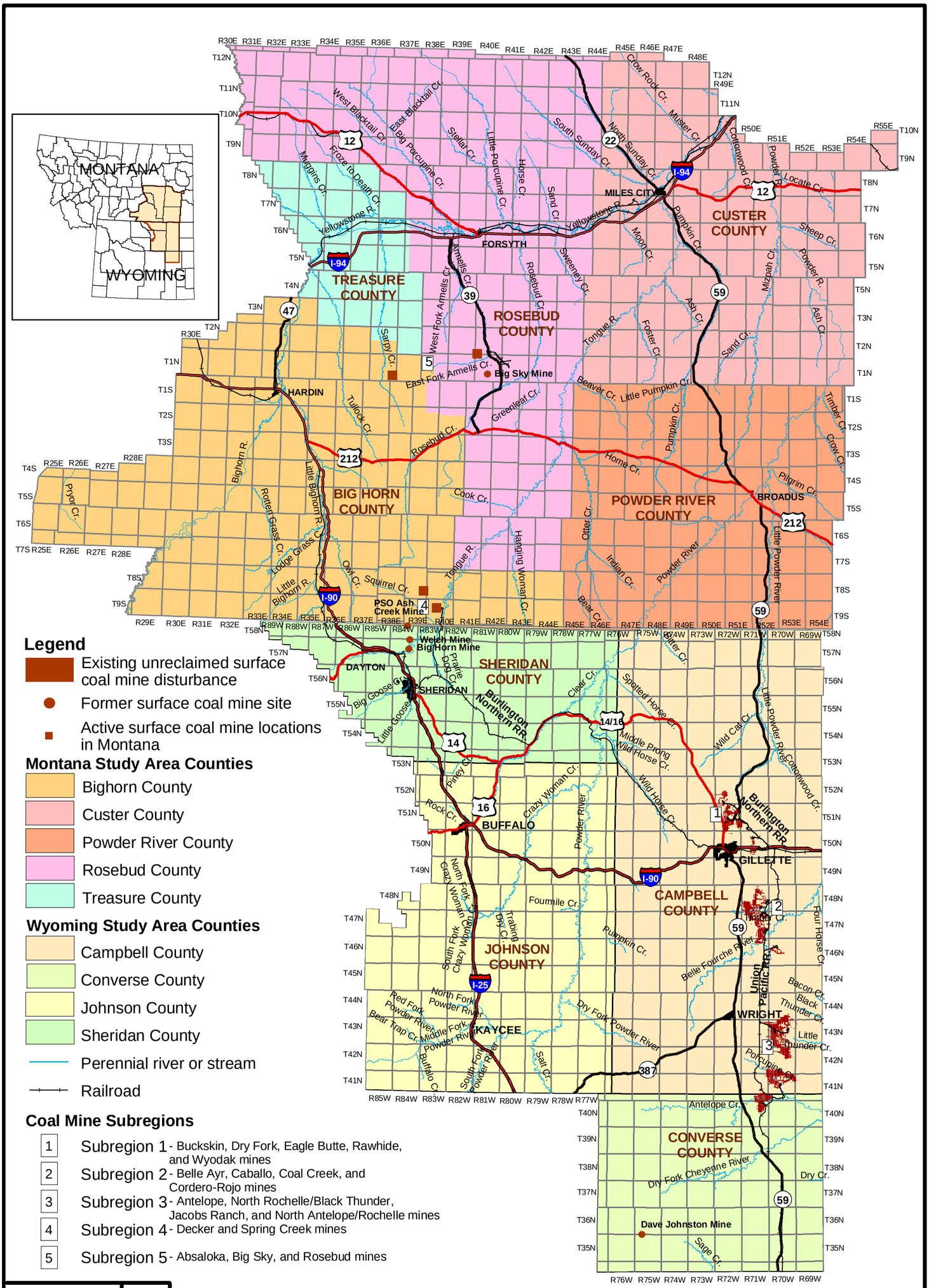
The past and present actions in this report were identified based on information in existing National Environmental Policy Act (NEPA) documents on file with federal and state agencies, and the Coal Development Status Check (BLM 1996). The RFD scenarios in this report were developed based on recent information that identifies proposed and anticipated development in the PRB, including NEPA documents; various other technical reports and studies; federal, state, and local (county) agency management plans; and permit applications. The specific development scenarios and development activities identified in these sources were assessed as to their current status prior to inclusion in the RFD scenarios for the PRB Coal Review. In addition, potential additional projects were identified through interviews with agency and industry representatives, review of published news articles and trade publications, and discussions with community leaders.

The identified RFD activities subsequently were evaluated as to their probability for occurrence. Due to the lack of detailed information for many developments beyond the next few years, the degree of uncertainty associated with the predicted developments and trends increases as the timeframe extends further into the future.

For each of the past and present and RFD projects and activities, project-specific impact-causing parameters (e.g., disturbance acreage, emission levels, employment levels, etc.) have been compiled from the sources identified above. Where specific information was unavailable, assumptions were developed and included based on typical industry-specific standards, permit criteria for similar existing industries, and professional judgment.

In order to account for the variables associated with future coal production, two detailed coal production scenarios (reflecting upper and lower production estimates) were projected for this study to bracket the most likely foreseeable regional coal production level and to provide a basis for quantification of related impact-causing parameters. These future production levels were derived from the analysis of historic production levels and current PRB coal market forecasts, public and private information sources, and input from individual PRB coal operators.

The methodology used to define the past and present and RFD activities is summarized in Chapter 2.0. Information specific to the past and present and RFD activities identified for this study is summarized in Chapter 3.0. The summary of the associated impact-causing parameters is provided in Appendices A through D of this report.



Note: Existing unreclaimed coal mine disturbance footprints were not available for the Montana mine sites.

Source: BLM 2003, 2004; Thunder Basin Coal Company, 2003; http://nris.state.mt.us/gis/gisdatalib.

Powder River Basin Coal Review

Figure 1-1

Montana and Wyoming Study Area

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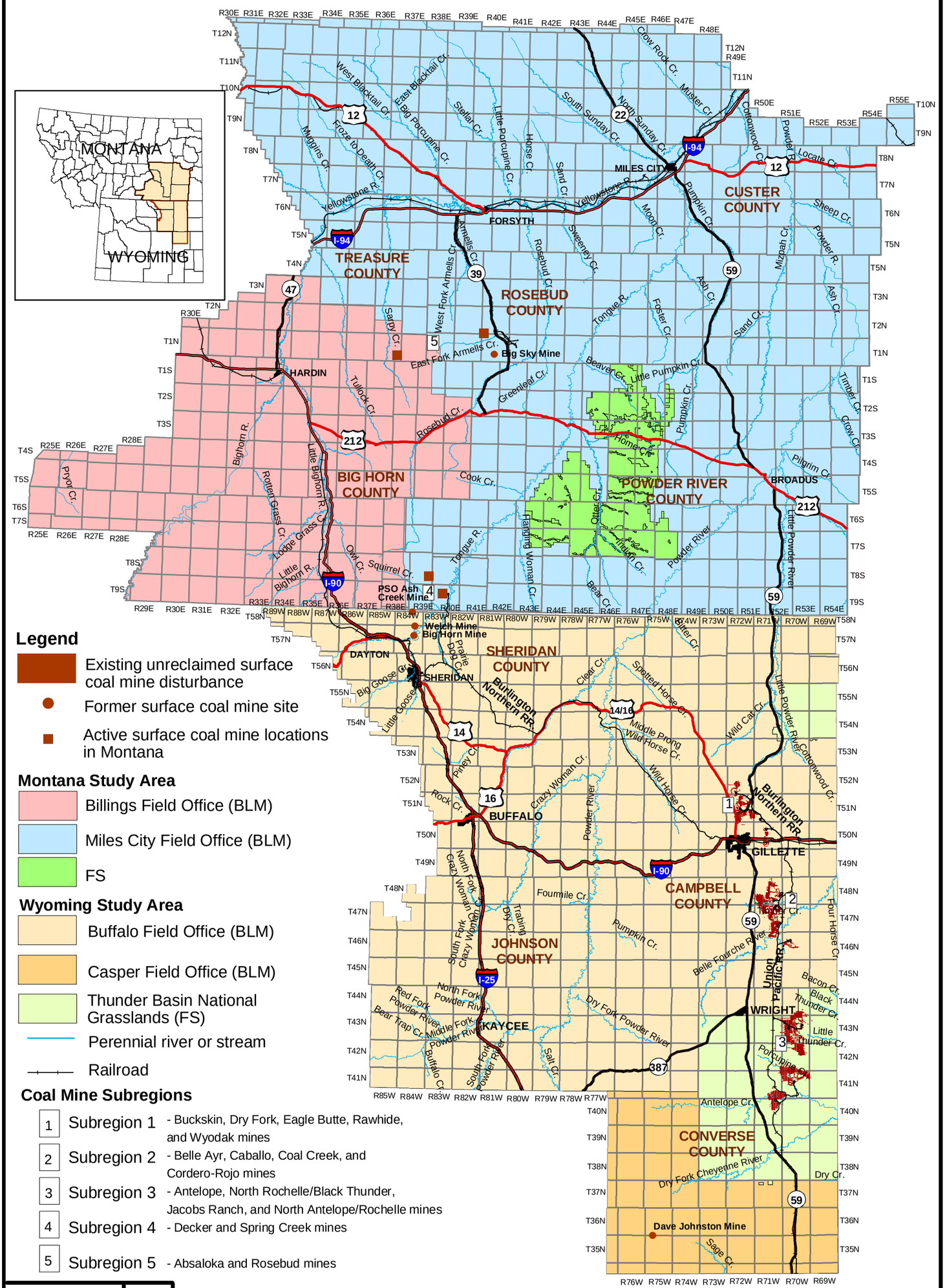

Note: Existing unreclaimed coal mine disturbance footprints were not available for the Montana mine sites.

Source: BLM 2003, 2004; Thunder Basin Coal Company, 2003; http://nris.state.mt.us/gis/gisdatalib.

Powder River Basin Coal Review

Figure 1-2

Federal Land Management

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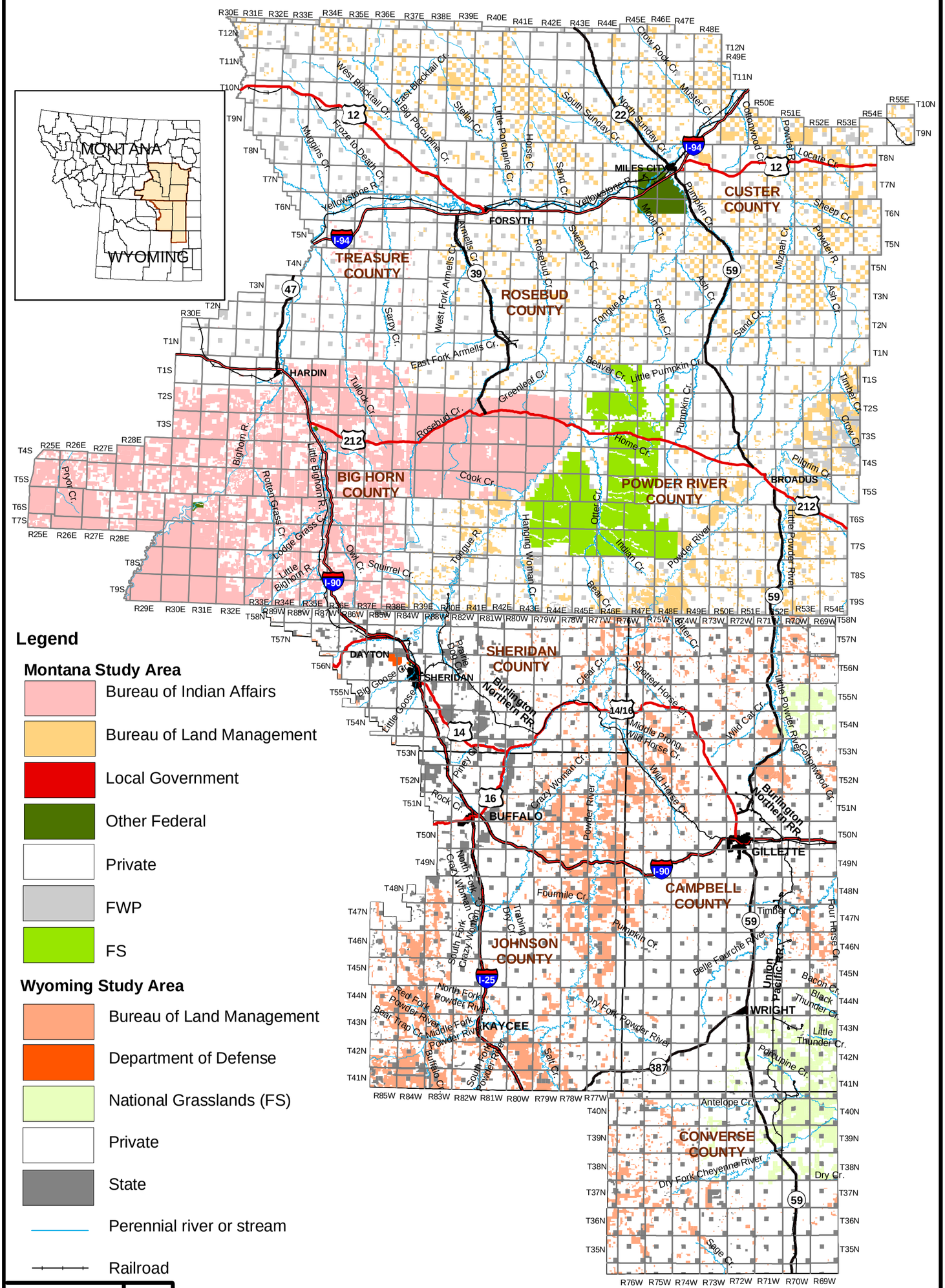

Source: BLM 2003, 2004; Thunder Basin Coal Company, 2003; http://nris.state.mt.us/gis/gisdatalib.

Powder River Basin Coal Review

Figure 1-3

Surface Ownership

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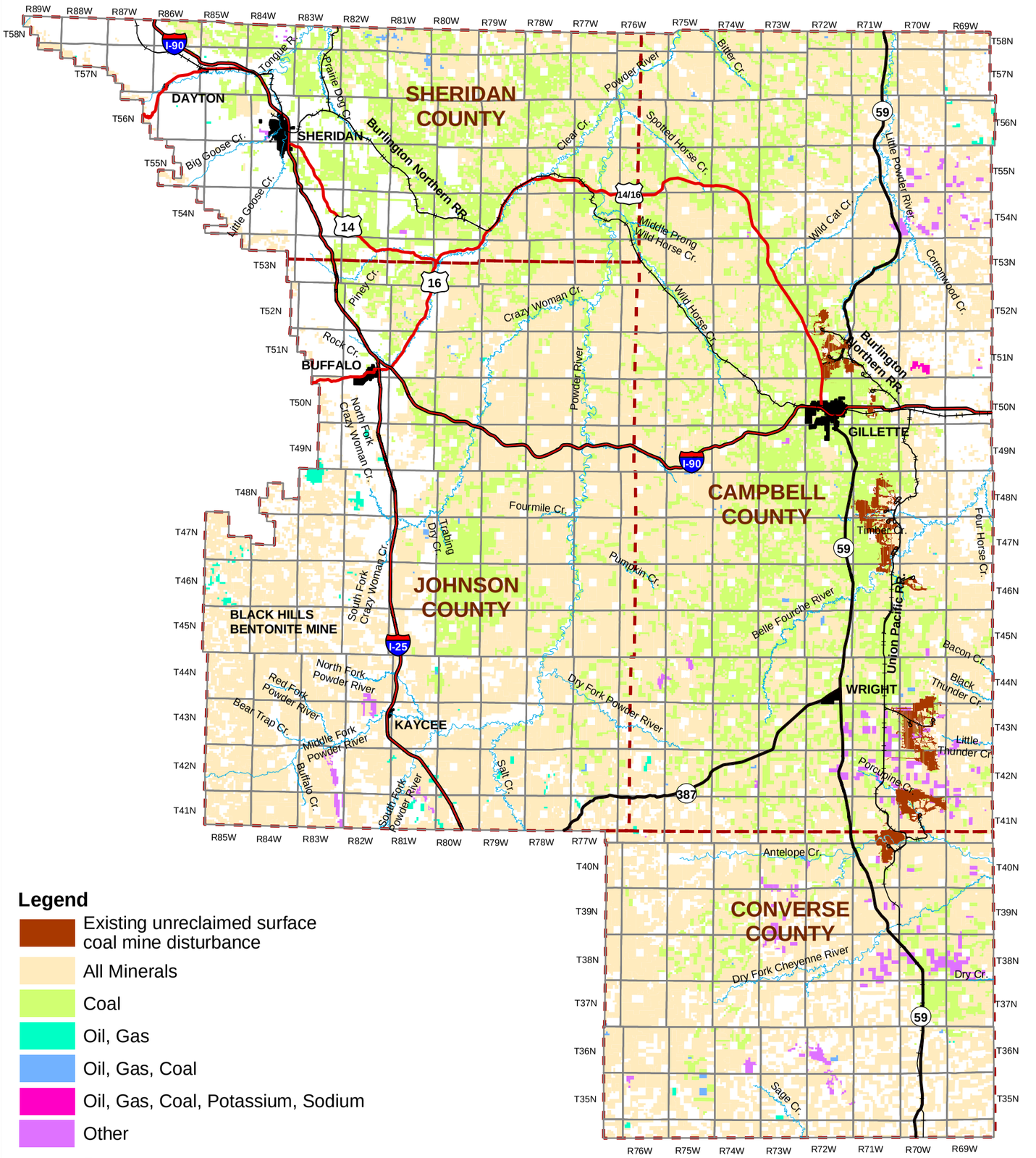
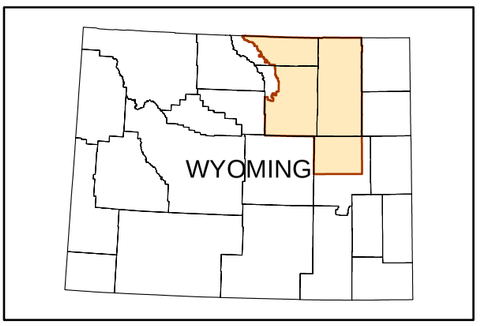


Legend

- Existing unreclaimed surface coal mine disturbance
- All Minerals
- Coal
- Oil, Gas
- Oil, Gas, Coal
- Oil, Gas, Coal, Potassium, Sodium
- Other
- Perennial river or stream
- Railroad



N
W E
S

0 8 16 24 Miles

0 8 16 24 Kilometers

Sources: BLM 2003.

Powder River Basin Coal Review

Figure 1-4
Federal Mineral Ownership

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2.0 METHODOLOGY

To the extent possible, identification parameters (e.g., proponent/project name and/or location) and impact-causing parameters were identified for each of the past and present and RFD actions identified in this report. These parameters include factors that are common to all resources and resource-specific factors, as discussed below. This information was used to describe the past and present actions and RFD scenarios analyzed in this study and is summarized in the tables in Appendices A through D. These summaries have been formatted to facilitate the Task 1 descriptions of current conditions and the Task 3 impact analyses.

The end of year 2003 existing disturbance acreages for this study were based on the database compiled for this Task 2 report (**Tables A-1** through **A-4**, **C-1** through **C-6**, and **D-1** through **D-6** in Appendices A, C, and D, respectively) and, where resource-specific data were required, the associated Geographical Information System (GIS) information (**Tables B-1** and **B-2** in Appendix B). The existing disturbance acreages generated through GIS vary from the disturbance acreages in the Task 2 database due to the following variables. The information in the database was compiled based on information obtained from the data sources and the applied assumptions identified in this Task 2 report. As a result, the database specifies a discrete disturbance acreage for each of the development activities (e.g., coal mines, individual oil and gas wells, etc.) identified for the study. Conversely, the GIS analysis accounted for the spatial relationship of the various development activities, thereby avoiding double counting of disturbance acreages where mapped disturbance areas overlap. In addition, the application of the new-versus-existing well disturbance acreage assumptions varied, as follows. For the database, the number of new wells developed during 2003 versus the number of existing wells at the end of 2003 was quantified, and the appropriate acreage assumptions were applied. The observed ratio in the database between new and existing wells could be determined at the subwatershed level; however, the breakdown could not be applied to the resource-specific information within each subwatershed due to the lack of actual discrete locations for new versus existing wells in the GIS map layers. As a result, for GIS calculation purposes, the existing well acreage was applied to all (existing and new) wells in the GIS layer. Also, slight variations between the GIS study area boundary and GIS resource-specific layers resulted in some under counting of disturbance acreages. Where disturbance acreages are presented in this study, the appropriate source is noted.

Future disturbance and reclamation acreages for the RFD scenarios in this study were based on the database compiled for this report due to the following variables and uncertainties associated with using GIS analysis for defining this information. The methodology and assumptions in Appendix E relative to oil and gas development provide a means of identifying the number of new wells to be developed and the number of existing wells to be plugged and abandoned within each of the subwatersheds for each of the target years for this study (i.e., 2010, 2015, and 2020). However, discrete locations for new and plugged and abandoned well sites for these future time periods are not available. For coal mines, the methodology and assumptions presented in Section 3.1 provide for calculation of future disturbance and reclamation acreages. However, although the general area of potential future coal mine-related disturbance can be identified based on projected reserves, the actual disturbance footprint associated with future mining and the actual locations of future reclaimed areas for the target years are not known. As a result, based on existing information, the spatial relationship between projected future disturbance and reclamation areas and the resource-specific information in the GIS layers for these industries cannot be determined.

Conversely, the database information does provide for quantification of future disturbance and reclamation acreages on a subwatershed basis and, with other information (e.g., projected locations of future coal reserves), a means of qualitatively analyzing future resource-specific impacts for those resources that are site-specific (e.g., vegetation, soils, wildlife habitat). The disturbance acreages for the RFD scenarios (based on the Task 2 database) are presented in the tables in Appendices A, C, and D.

2.1 Factors Common to All Resources

Proponent/Project Name. The proponent or operator and associated project name have been identified for tracking purposes in the database for all past, present, and RFD actions with the exception of oil and natural gas (conventional and CBNG) projects and facilities; the latter typically are geographically dispersed and therefore are more appropriately tracked on a general location basis.

Location. Based on the inclusion of project-specific locations in the database, and the structuring of the database using 4th level sub-basins (referred to as subwatersheds in this study for consistency with the PRB Oil and Gas Environmental Impact Statement [EIS] [BLM 2003]) as a common denominator, the impact-causing parameters within specified areas have been summarized to facilitate cumulative impact evaluations. Mapped locations of the past and present and RFD projects analyzed in this study are presented in Chapter 3.0 in association with the industry-specific discussions.

Timeframe. The database has been structured to link specific, identified levels of development with the target dates for this study. Past and present actions have been summarized based on 2003 (or earlier) data, depending on data availability; parameters for RFD scenarios have been established for 2010, 2015, and 2020 based on information available through the end of 2004.

Land Ownership. Surface ownership in the Wyoming PRB study area is primarily private, with federal and state lands comprising approximately 14 and 8 percent of the area, respectively (see **Figure 1-3**). In the Montana PRB study area, the majority of the land is privately owned, with federal and state lands comprising approximately 25 and 5 percent, respectively. This information has been included in the database to distinguish BLM authorizing actions from other jurisdictional oversight.

Acreage. Mining activity has been projected forward in 5-year increments based on available reserves and high and low projected production levels to facilitate the estimation of future coal mine disturbance and reclamation. The projected mining activity was combined with industry input from the PRB coal producers, and public historical and permitted reclamation activity data, to forecast future disturbance and reclamation acreages.

Future disturbance and reclamation acreages related to coal technology projects and coal railroad transportation infrastructure were estimated from numerous information sources including: the Dakota, Minnesota, & Eastern Railroad (DM&E) Final EIS; Tongue River Railroad U.S. Surface Transportation Board (STB) application; Montgomery Watson Harza (MWH) Coal Planning Report; Burlington Northern and Santa Fe Railroad (BNSF) Guide to Coal Mines report; Wyoming Department of Environmental Quality (WDEQ), Land Quality Division (LQD) annual reports for individual mines; Montana Department of Environmental Quality (MDEQ) mine permit documents;

and related trade magazine articles. Information compiled from these sources was compared against historical production levels. Future disturbance and reclamation acreages were projected to correspond to historical trends for the high and low production forecasts.

Acreages for other past and present and RFD actions were obtained from permit applications, EISs or environmental assessments (EAs), or estimated, where appropriate, based on typical facility sizes (e.g., well pads).

Schedule. The estimated schedule for the construction, operation, and closure/reclamation of proposed coal mines, non-coal mines, coal technology projects, and coal railroad transportation infrastructure, was derived from public information on record with the WDEQ and MDEQ, industry input, and detailed mine-specific reserve sequencing projections. Given the projected high and low production rates, there are adequate economic reserves to sustain all proposed coal mining activity through the year 2020.

Schedules for other past and present and RFD actions have been based on industry input, permitting documents, and assumptions related to trends for interrelated industries (e.g., coal production forecasts in relation to rail capacity).

Production Estimate. Analysis of historic PRB coal production levels, and current reports forecasting future PRB coal market activity from sources including Hill and Associates, Inc., Platts Research and Consulting, Global Insight, and the U.S. Department of Energy (USDOE), were combined with input from the PRB coal mine operators, and regulatory agency input from specialists within the Wyoming and Montana BLM, WDEQ, and MDEQ to project the upper and lower total coal production levels for the PRB. Individual mine production then was allocated based on historic market share performance, current air quality permit limitations, proposed expansion applications on file with the U.S. Environmental Protection Agency (USEPA), WDEQ and MDEQ Air Quality Divisions (AQDs), coal rail loadout capacities, and coal mine operator input.

Capital Investment. Capital investment information relative to RFD actions is presented in the text portion of this report and discussed further in the Task 3C report. Capital investment related to coal mine development was estimated based on requirements for site-specific mine infrastructure (e.g., rail loop and loadout facilities, major mobile equipment purchases, and highway relocations within permitted mine boundaries). Estimated costs are based on historic costs for similar facilities and equipment.

Likelihood. Following identification of the RFDs through year 2020 for the study area, each capital project was assigned a rating for the likelihood of development or occurrence. Both private and public sector activities have been considered. Likelihood ratings were assigned to the identified actions based on the numerical rating system presented below. The numerical rating for each action is identified in the Chapter 3 discussion.

- Certain/highly likely (1) – Inclusive of actions that have been fully funded, permitted, are under construction, or are necessitated to achieve expanded coal output. These actions have an identified proponent/sponsor, project location, and specific details regarding capacity, output, and/or costs.

- Moderately likely (2) – Inclusive of actions for which applications have been submitted to an agency, that are part of a defined capital improvement plan/program, involve an established technology or process, have an identified proponent/sponsor with a demonstrated track record in undertaking/completing similar or related projects, or for which an EIS or EA is in preparation.

- Low likelihood (3) – Inclusive of actions that are undergoing market or feasibility analyses, previously were proposed but failed to proceed and are now under reconsideration, or for which some descriptive information is available but for which no formal regulatory or administrative approval processes have been initiated.

- Currently unknown - Projects for which insufficient information is available for analysis purposes, or to determine the likelihood of the project moving forward, have been assigned a likelihood of currently unknown. These projects have not been included in the RFD database. Alternately, these actions are identified in text with an explanation for their elimination from consideration.

As oil and gas activities differ from individual capital projects due to the dispersed nature of the facilities, the projection of oil and gas activities reflects their likelihood and timeframe.

2.2 Resource-specific Factors

Air Emissions Estimates. Information relative to current conditions has been based on air emissions inventories obtained from WDEQ, MDEQ, and the modeling input files from the Final EIS and Proposed Plan Amendment for the PRB Oil and Gas Project (BLM 2003a), as obtained from Argonne National Laboratories. Air emissions for RFDs have been based on average operations in 2002 and earlier. For each group of sources, an average emissions profile was developed for modeling purposes, based on production and design data.

Water Production/Disposal. Coal mine-related groundwater production data were obtained from individual mine operators and data as reported to the Wyoming State Engineer's Office for permitted wells through 2002. This data and the assumptions presented in Section 3.1.4 of this report were used to determine the future coal mine-related groundwater pumping rates.

Current and future water production and disposal volumes associated with conventional oil and gas and CBNG development have been based on data in the IHS Energy Services™ (IHS) (2004) and Wyoming Oil and Gas Conservation Commission (WOGCC) (2004) databases.

Water Consumption. Dust suppression practices at active coal mines are the single largest factor in water consumption, accounting for an estimated 85 percent of the total water used. Mine operators are required to submit an annual fugitive emissions control report to the WDEQ/AQD that summarizes the annual gallons of water consumed, dust suppression additives, and application techniques used to control dust emissions. For coal mines in the Wyoming PRB, the past several years of reports were reviewed and analyzed, and future water consumption was projected forward based on current practices and forecasted production levels. Water consumption projections for Montana mines were based on the information for Wyoming mines and adjusted for annual production and mining method.

Current and future non-coal mine, coal technology projects, and coal railroad transportation-related water consumption is expected to be minimal and was estimated from existing data on file with the WDEQ and MDEQ, as applicable. Power plant-related water consumption was estimated based on recent analyses at other facilities.

Workforce. Current and future PRB coal mine-related Wyoming employment was estimated by reviewing the past seven annual reports of the Wyoming State Mine Inspector, correlating productivity gains to changes in mine production, and forecasting total employment forward as a function of mine productivity and production. Montana employment information was based on historic levels of personnel from U.S. Mine Safety and Health Administration (MSHA) records.

Current and future non-coal mine, coal technology projects, and coal railroad transportation-related employment is expected to be minimal and was estimated from existing data on file with the WDEQ and MDEQ, as applicable.

Current and future Wyoming workforce requirements for the oil and gas industry are a function of the pace of drilling, number of producing wells, anticipated production life of the wells, and future reclamation activities. Employment assumptions for modeling of social and economic impacts are discussed in the Task 3C report.

Current and future Wyoming workforce requirements for power plants in the PRB are based on information obtained from the operators, project application filings, local economic development organizations, and the Wyoming Department of Employment.

3.0 PAST, PRESENT, AND REASONABLY FORESEEABLE DEVELOPMENT

This section presents a brief description of the industries evaluated in this study. Past and present and RFD coal and coal-related industries (e.g., railroads and power plants) are described below for both the Wyoming and Montana PRB study areas. Non-coal-related industries (e.g., oil and gas, etc.) only are described for the Wyoming PRB study area. Due to the concurrent development of the Miles City Resource Management Plan, only coal mine development and coal-related activities are included in this study for the Montana PRB study area.

A summary of the data sources that were used to define the past and present conditions and RFD scenarios is presented for each industry following the past and present and RFD descriptions. Where information relative to project-specific, impact-causing parameters was unavailable, industry-specific assumptions have been developed to assist in defining existing conditions (Task 1) and to facilitate preparation of the cumulative impact analyses (Task 3) of the PRB Coal Review. These industry-specific assumptions are summarized at the end of each of the following sections.

The impact-causing parameters have been tabulated in the supporting database for the Task 2 report. A summary of the impact-causing parameters associated with each Wyoming coal mine subregion under both the lower and upper production scenarios is presented in **Tables A-1** and **A-2**, respectively, in Appendix A. Impact-causing parameters associated with the Montana coal mine subregions under the lower and upper production scenarios are summarized in **Tables A-3** and **A-4**. **Tables C-1** through **C-6** in Appendix C summarize by subwatershed the impact-causing parameters associated with all past and present and RFD actions (including coal mining activity) in the Wyoming PRB Task 1D study area (**Figure C-1**). **Tables D-1** through **D-6** in Appendix D summarize by subwatershed the impact-causing parameters associated with all past and present and RFD actions (including coal mining activity) in the Wyoming PRB Task 3D study area (**Figure D-1**). As discussed in Section 2.0, GIS data were used to facilitate the resource-specific disturbance acreage estimates for the Task 1D Report for the PRB Coal Review, Current Environmental Conditions (ENSR 2005). **Table B-1** in Appendix B summarizes the GIS-derived coal mine-related disturbance for the Wyoming PRB study area; **Table B-2** summarizes by subwatershed the GIS-derived disturbance acreages associated with all past and present actions.

3.1 Coal

3.1.1 Past and Present Development

3.1.1.1 Wyoming

The first coal mine in the Wyoming PRB was developed near Glenrock, in Converse County, in 1883 (Foulke et al. 2002). During the 1970s and early 1980s, the PRB emerged as a major coal production region. As a result, federal coal leasing became a high profile activity since the PRB's coal is over 90 percent federally owned. In 1982, the BLM temporarily halted further coal leasing; however, the existing mines continued producing coal, which depleted their leased federal coal reserves. As a result, interest in leasing federal coal to extend mining operations at existing mines

in the PRB increased in the late 1980s. There was little to no interest in opening new mines, however, and therefore, there was not enough interest in leasing to justify a regional coal sale. In early 1990, the Powder River Regional Coal Team (PRRCT) decertified the Powder River Federal Coal Region, which allowed BLM to begin processing applications by existing mines to lease maintenance tracts of federal coal using the lease by application (LBA) process.

The 12 currently operating and 1 temporarily inactive coal mines in the Wyoming PRB are grouped by subregion as shown in **Figure 3-1** and as described below. For purposes of this study, the mines in the Sheridan, Wyoming, area have been included in Subregion 4 (Sheridan/Decker), which is discussed in Section 3.1.1.2 of this report.

- Subregion 1 (North Gillette) – Buckskin, Dry Fork (which now includes the old Fort Union), Eagle Butte, Rawhide, and Wyodak mines.

- Subregion 2 (South Gillette) – Belle Ayr, Caballo, Coal Creek, and Cordero-Rojo mines.

- Subregion 3 (Wright) – Antelope, North Rochelle/Black Thunder, Jacobs Ranch, and North Antelope/Rochelle mines.

Of these operations, the Coal Creek Mine currently is inactive.

Other coal mines within the Wyoming PRB study area and their status are described below. Based on their status, these facilities are not analyzed further in this study.

- Clovis Point Mine – part of operating Wyodak and Dry Fork mines

- Izita – permitted dragline walkway from the Coal Creek Mine to the Black Thunder Mine

- KFx – haul road to supply coal from the Wyodak Mine to the adjacent KFx facilities located at the old Fort Union Mine (now part of Dry Fork) area

3.1.1.2 Montana

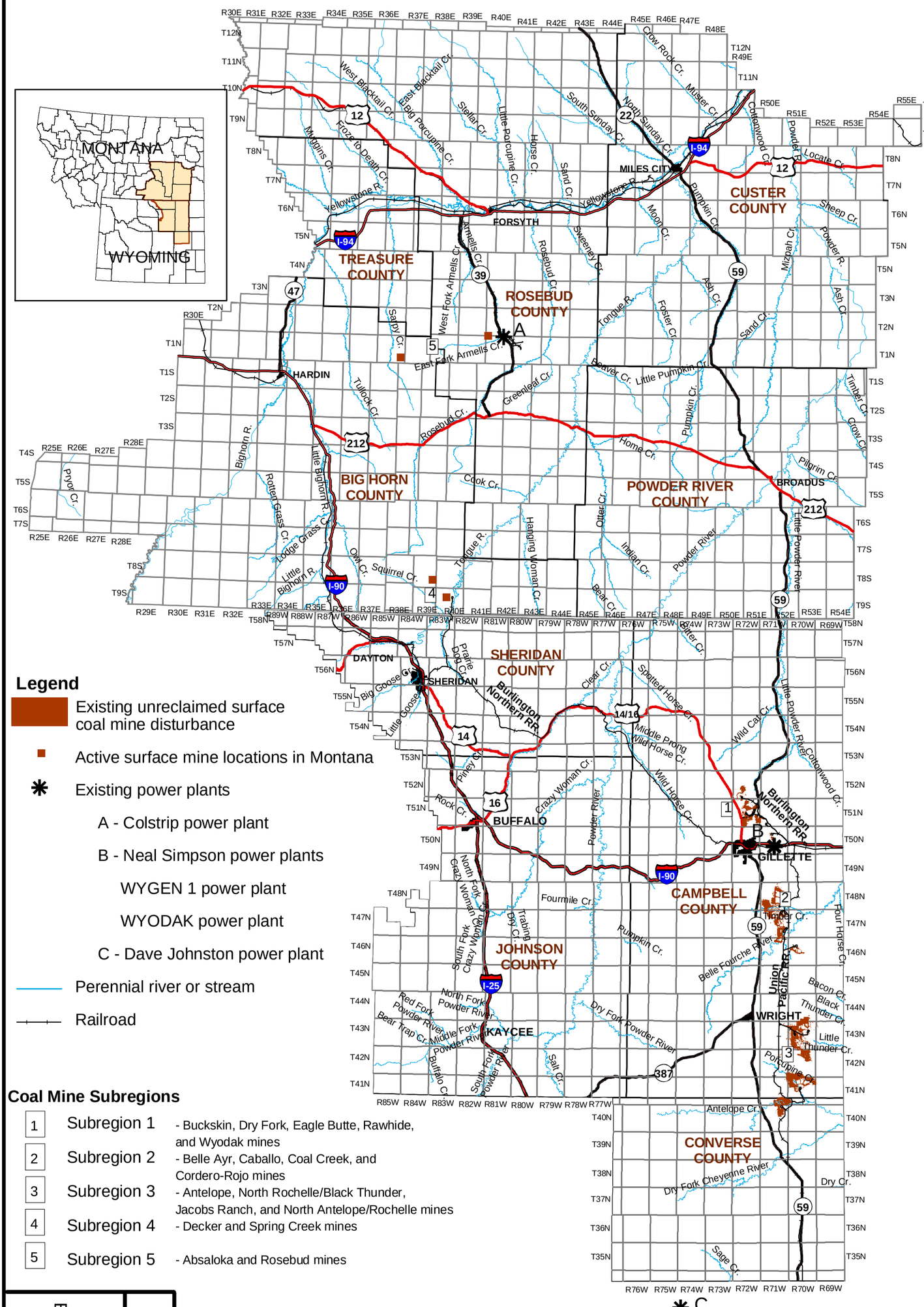
For purposes of this study, Subregion 4 encompasses the coal mining activities in the Sheridan, Wyoming, and Decker, Montana, areas. Subregion 5 encompasses mining activity in the Ashland/Colstrip, Montana, area. The currently active mines in these subregions are shown in **Figure 3-1** and are identified below.

- Subregion 4 (Sheridan/Decker) – Decker (east and west pits) and Spring Creek mines.

- Subregion 5 (Ashland/Colstrip) – Absaloka and Rosebud mines.

Other coal mines in Subregions 4 and 5 and their status are described below. These mines are shown in **Figure 3-1**. Based on their status, these facilities are not analyzed further in this study.

- Big Horn Mine – in final reclamation and awaits final bond release



Powder River Basin Coal Review

Figure 3-1

Existing Coal Mine, Power Plant, and Railroad Development

Note: The Dave Johnston power plant, which is included in this study, is located outside of but adjacent to the study area. Existing unreclaimed coal mine disturbance footprints were not available for the Montana mine sites.

Source: BLM 2003, 2004; Thunder Basin Coal Company, 2003; http://nris.state.mt.us/gis/gisdatalib.

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- Welch Mine – in final reclamation, for final bond release part of an exchange with the Pittsburg & Midway Coal Mining Company (P&M)

- Public Service Company of Oklahoma's (PSO) Ash Creek Mine – has been reclaimed and awaits final bond release

- Big Sky Mine – idle and in final reclamation stages

- Other historic underground mines - Many square miles of historic underground workings exist to the south-southwest of the historic Welch Mine lands. These mines were closed and sealed off in 1953. Subsequent roof collapses over one of these mines (the Acme Mine No. 42) led to the development of underground coal fires in the Monarch and possibly Carney coal beds, which may have spread to other overlying coal beds (i.e., Dietz 2 and Dietz 3). These fires may have been the cause of the 5,207-acre Thunder Child Range Fire in 2001, although the actual cause has not been determined. The WDEQ/Abandoned Mine Land Division has conducted a number of reclamation and emergency rehabilitation projects in recent years in attempts to extinguish the underground coal bed fires; however, based on BLM's 2003 site visit, the fires continue to burn (BLM 2003b). Due to the lack of information relative to the extent of the underground burn area and the uncertainty of the cause of the Thunder Child Range Fire, these historic workings have been eliminated from further analysis in this study.

3.1.2 Reasonably Foreseeable Development

Due to the variables associated with future coal production, two coal production levels (an upper and a lower production level) were projected for the PRB Coal Review to bracket the most likely foreseeable regional coal production level and to provide a basis for quantification of associated impact-causing parameters. **Figures A-1** through **A-6** in Appendix A show projected coal development under the lower and upper development scenarios. **Figures A-6** and **A-7** graphically compare the production levels for Wyoming and Montana, respectively. The basis for the projected production ranges included: 1) an analysis of historic PRB production levels in comparison to the gross domestic product (GDP) and national coal demand; 2) an analysis of current PRB coal market forecasts that model the impact of GDP growth, potential regulatory changes affecting coal-fired power plants, and mining and transportation costs on PRB coal demand; 3) the availability, projected production cost, and quality of future mine-specific coal reserves within the PRB region; and 4) the availability of adequate infrastructure for coal transportation. The projected upper and lower production levels subsequently were allocated to coal mine subregions in the PRB and to individual mines based on past market shares. Individual mine production levels were reviewed relative to potential future production constraints (e.g., loadout capacities), permitted production levels, mining costs, and coal quality.

The methodology used to develop the future coal mine projections for both the lower and upper production scenarios is summarized below.

- The upper end of the range of total PRB mine production was increased from the MWH Coal Planning Estimates Report of March 2003 to bracket higher production forecasted by the Hill and Associates PRB Coal Demand Study of 2003. The Hill and Associates 2003 data were not available at the time of the MWH study.

- The upper end of the production range by mine closely resembles the Hill and Associates 2003 study, with the exception that mine production was not curtailed in the latter years of the study. This adjustment was made to account for a published "glitch" in the Hill and Associates modeling technique ("caused by the fact that we used reserves listed in the state mining permit applications… In many cases, the coal producer simply lists enough reserves to satisfy his 20-year mine plan in the permit application [instead of true geologic reserves] [Hill and Associates 2003].")

- The lower end of the range of total PRB mine production was decreased slightly from the MWH Coal Planning Estimates Report of March 2003 to bracket Platts data and better account for a potential downward market adjustment forecasted in the Hill and Associates 2003 study resulting from possible clean air regulatory changes in 2009.

- Wright area mines were not increased above current WDEQ air quality permit levels due to recent air quality monitoring data exceedences.

- Specific mine loadout capacities were estimated from BNSF railroad reports and mine permit data. Some mines are forecasted to produce above these estimated capacities.

- The South Gillette and Wright subregion mines (Subregions 2 and 3, respectively) are served by Wyoming State Route (SR) 59 and the North Gillette subregion is serviced by U.S. Highway 14/16. Numerous spur roads, tied to these main highways, serve as access roads into the mines in the Wyoming PRB region. The acreages associated with the access roads have been accounted for in the mine-specific acreages for this study.

- The existing road infrastructure provides access to all existing mines and proposed development projects in Subregion 4. It is assumed that only minor upgrades to portions of these routes would be required to address possible increases in traffic and capacity of the routes.

3.1.2.1 Wyoming

Based on the analysis conducted for this study, the forecasted upper production range for the coal mines in the Wyoming PRB study area would mirror the Hill & Associates (2003) forecast, with a strong period of growth through 2007, at which point production is projected to be 490 million tons per year (mmtpy). Coal production subsequently would flatten in response to new environmental regulations scheduled to take effect in 2008 that would further limit electric power plant emissions. The projected growth in coal production would resume in 2010 and continue through 2020, at which point production is projected to be 625 mmtpy. The forecasted lower production level would mirror the more conservative forecasts by Platts (2004) and Global Insight (2004) and the lower production level identified by MWH (2003). Under the projected lower production level, a production of 490 mmtpy would not be realized until 2015, and production in 2020 would be 531 mmtpy. The resulting 2 percent annualized growth rate for the lower production level and 3 percent annualized growth rate for the upper production level through 2020 compare conservatively to the historic 6.8 percent annualized growth rate for the prior 20 years in the Wyoming PRB.

Following the projection of individual mine production levels for the upper and lower production scenarios, likely reserve and mining sequence layouts were developed based on geologic information, 2003 mine pit progressions and projected mine reserve sequence maps on file with the WDEQ/Land Quality Division, and recovery information provided by the PRB operators. The mapped areal extent of mine reserves subsequently were projected in 5-year increments and provided to the PRB coal operators for review and comment. Future coal mining in the Wyoming PRB through 2020 is considered certain/highly likely based on the anticipated production rates in relation to the available economic reserves.

Mine-related capital investment under both the projected lower and upper production scenarios is presented in **Table 3-1**.

Table 3-1
Coal Mine Total Capital Investment by Year
(million dollars)

	Year					
	Lower Production Scenario			Upper Production Scenario		
Mine Subregion	**2010**	**2015**	**2020**	**2010**	**2015**	**2020**
Mobile Equipment						
Subregion 1 – North Gillette	18	56	6	56	89	9
Subregion 2 – South Gillette	35	89	31	68	91	50
Subregion 3 – Wright	110	140	150	150	153	129
Subregion 4 – Sheridan/Decker	32	0	0	34	7	0
Subregion 5 – Ashland/Colstrip	0	0	0	15	39	2
Subtotal	**195**	**276**	**187**	**323**	**379**	**190**
Rail Loadout Facilities[2]						
Subregion 1 – North Gillette	0	0	0	0	5	0
Subregion 2 – South Gillette	0	0	0	0	10	10
Subregion 3 – Wright	5	10	5	20	5	5
Subregion 4 – Sheridan/Decker	20	0	0	20	0	0
Subregion 5 – Ashland/Colstrip	0	0	0	20	20	0
Subtotal	**25**	**10**	**5**	**60**	**40**	**15**
Highway Transportation[3]						
Subregion 1 – North Gillette	0	5	0	0	5	0
Subregion 2 – South Gillette	0	0	5	0	0	5
Subregion 3 – Wright	0	0	0	0	0	0
Subregion 4 – Sheridan/Decker	0	0	0	0	0	0
Subregion 5 – Ashland/Colstrip	0	0	0	0	0	0
Subtotal	**0**	**55**	**5**	**0**	**5**	**5**
Total	**215**	**291**	**197**	**383**	**424**	**210**

[1] Calculate in 2003 dollars at $0.85 per bank cubic yard annual capacity.
[2] Calculate in 2003 dollars at $1.00 per ton annual capacity.
[3] Calculate in 2003 dollars at $5 million per mile relocated excluding land acquisition costs.

Other impact-causing parameters associated with Wyoming coal mine operations are summarized in **Tables A-1** and **A-2** in Appendix A of this report.

3.1.2.2 Montana

The projected upper and lower production trends for the coal mines in the Montana PRB study area would parallel those described in Section 3.1.2.1 for the mines in the Wyoming PRB study area.

Based on the analysis conducted for this study, it is estimated that the current (2003) production of 36.1 mmtpy of coal in the Montana PRB study area would increase to 56.0 mmtpy under the lower production scenario and to 83.0 mmtpy under the upper production scenario by 2020. Production at currently operating mines is projected to continue throughout the study period. In addition, three potential new developments (i.e., P&M Ash Creek Mine, Otter Creek Mine, and Kinsey Mine) have been identified in the Montana PRB study area. Under the lower production scenario, it is projected that production at the P&M Ash Creek Mine would be initiated by 2010; the Otter Creek and Kinsey mines would not be developed. Under the upper production scenario, it is projected that production would be initiated by 2010 at both the Otter Creek and P&M Ash Creek mines and by 2015 at the Kinsey Mine. Development of these mines would be dependent on markets for the coal and may be tied to development of infrastructure including the Tongue River Railroad and/or power plants. It is assumed that development of the Otter Creek Mine would require construction of Tongue River Rail Company's (TRRC's) proposed Tongue River Railroad and a power plant near Miles City, Montana. However, at this time, no application has been filed for a new power plant at this location. It is assumed that the Kinsey Mine would be developed in response to construction of a mine-mouth power plant; however, an application for a new power plant at this location has not been filed at this time.

Following the development of individual mine production levels for the two scenarios, individual mine reserves and mining sequence layouts were developed based on geologic information and 2003 mine pit progressions on file with the MDEQ. Reserves beyond the current mine permit boundaries and existing mine lease boundaries (e.g., potential developments including P&M Ash Creek, Otter Creek, and Kinsey mines) were sequenced based on strip ratio and proximity to past mining. The mapped areal extent of mine reserves subsequently were projected in 5-year increments (**Figures A-3** and **A-4** in Appendix A). Future coal mining in the Montana PRB study area is considered certain/highly likely based on the anticipated production rates in relation to the available economic reserves. However, the likelihood for both the Otter Creek and Kinsey mines is considered low under the upper production scenario due to their inter-dependency on other developments. These two mines would not be developed under the lower production scenario.

Three additional properties (CX Ranch, Young's Creek, and North Ashland) were identified by Hill and Associates (2003) as potential coal mine sites. However, based on the lack of information for these potential mine sites, their likelihood for development is currently unknown. As a result, they have been eliminated from further analysis in this study.

Mine-related capital investment under both the projected lower and upper production scenarios is presented in **Table 3-1**.

3.1.3 Data Sources

Public information in the form of permit documents, annual reports, permit applications, LBAs, EISs, correspondence, and articles was obtained from the WDEQ (Land Quality and Air Quality divisions), MDEQ, BLM Casper Field Office and Wyoming State Office, BLM Montana State Office and Miles City Field Offices, Wyoming State Mine Inspector's Office, USDOE, STB, Federal Energy Regulatory Commission (FERC), and numerous trade and industry publications.

Proprietary economic reports forecasting regional coal market activity from Hill and Associates Inc., Platts, Global Insight, and proprietary industry input from the individual coal mine operators in the Wyoming and Montana PRB study area, also were used in the preparation of the coal resources sections of this report.

3.1.4 Assumptions

In addition to the information obtained from the identified data sources, the following assumptions were used to define specific impact-causing parameters for coal mines:

Past and Present Development:

- Existing operations are not part of the abandoned mine lands programs.

RFD:

- It is assumed that Ash Creek and the other Decker area mines would obtain new WDEQ- and MDEQ-approved air quality permits, as applicable, consistent with their forecasted production levels.

- Consistent with historical trends, it is assumed that currently idle mines would be brought back into production during periods of high growth in the projected upper end of the production range.

- Under the lower production scenario, it is assumed that the P&M Ash Creek Mine would initiate production by 2010; the Otter Creek and Kinsey mines would not be developed. Under the upper production scenario, it is assumed that production would be initiated by 2010 at both the Otter Creek and P&M Ash Creek mines and by 2015 at the Kinsey Mine. However, development of the TRRC's proposed rail line and construction of a power plant near Miles City would be required for the Otter Creek Mine to become operational. Development of the Kinsey Mine would be dependent on construction of a mine-mouth power plant. No permits have been submitted at this time for power plants in either of these locations.

- It is assumed that production from the P&M Ash Creek Mine in Wyoming would be serviced by existing capacity in the BNSF rail line operating in Sheridan, Wyoming.

- It is anticipated that TRRC's construction of 130 miles of new rail line between Miles City and Decker, Montana, would be completed and operational by 2010; however, construction of the rail line would be dependent on the development of the Otter Creek Mine, which only would be

developed under the upper production scenario. The new rail line would have a capacity of approximately 100 mmtpy.

- No major state or interstate highways would be impacted by future mining activities in Montana.

- Construction of the proposed DM&E rail line is estimated to be completed between 2010 and 2014 (or when production in the Wyoming PRB approaches 450 mmtyp); operation is assumed starting with the 2015 time period. The rail line would add approximately 100 mmtpy of rail transportation capacity for the Wright and South Gillette subregion mines.

- Projections for groundwater production beyond 2002 assume that groundwater production rates under both the low and high production scenarios would remain the same as during the period between 2000 and 2002.

- Based on information provided by the coal mines, it is assumed that the majority of groundwater pumpage would come from the Wasatch Formation.

3.2 Power Plants

3.2.1 Past and Present Development

3.2.1.1 Wyoming

Currently, there are four coal-fired power plants in the PRB study area (see **Figure 3-1**). Black Hills Power Corporation owns and operates the Neal Simpson Units 1 and 2 (21.7-megawatts [MW] and 80-MW, respectively), WYGEN 1 (80-MW), and Wyodack (330-MW) power plants, all of which are located approximately 5 miles east of Gillette, Wyoming. Pacific Power and Light's Dave Johnston Power Plant is located near Glenrock, Wyoming, outside of, but adjacent to, the study area.

Hartzog, Arvada, and Barber Creek are three separate interconnected gas-fired power plants located near Gillette, Wyoming. Each contains three separate 5-MW rated turbines to provide electric power to Basin Electric and its customers. In winter, the maximum capacity can reach 22.6 MW from each site. All units are in operating condition, although they do not operate at maximum capacity.

3.2.1.2 Montana

The major existing coal-fired power plant in the Montana PRB study area is the Colstrip Power Plant, which is located near Colstrip, Montana, in Rosebud County (**Figure 3-1**). The facility consists of four separate coal-fired units on the same plant site. Units 1 and 2 are estimated at 450 MWs of power generation capacity each, and units 3 and 4 each are 778-MW design capacity. Recently, the facility received a permit to burn up to 28 percent petroleum coke in its Units 1 and 2 boilers, replacing coal as a fuel source.

A second smaller coal-fired power plant, the Colstrip Energy Limited facility, is in operation at a site approximately 1.5 miles north of Colstrip (**Figure 3-1**). The facility generally burns waste coal and

has operated below maximum capacity in recent years. Permitting officials indicate that it has approximately 120 MW of electric generation capacity.

3.2.2 Reasonably Foreseeable Development

Coal-fired power plants have been, and likely would continue to be, constructed in the PRB to avoid high shipping costs for coal. Currently, adequate transmission line capacity exists to deliver the existing generating capacity to market; however, that capacity would need to be increased in order to provide adequate markets for new power plants.

Construction of new coal-fired power plants may involve some of the largest capital investments undertaken by industry, and substantial time would be required for obtaining permits and constructing such facilities. Recent estimates for a major coal-fired power plant are that a project would require 2 to 4 years to obtain the required permits, with an additional 4 to 6 years for construction. An estimated development cost of over $1 billion would apply to most major coal-fired power plants (based on an estimated $1,500 per installed kilowatt [$1.5 million per installed MW] generating capacity). A workforce of up to 1,500 personnel would be required at peak construction, with a likely operating workforce of 100 to 150 for each operating plant, based on estimates from current operating facilities.

Air emissions from coal-fired power plants are undergoing intense scrutiny by regulatory agencies, environmental groups, and the general public. Recent proposed legislation in the U.S. Congress and proposed regulations by the USEPA may influence air emissions, including limits on carbon dioxide, which is not currently regulated; as of March 2005, mercury emissions are now regulated (USEPA 2005). Even a well-regulated facility would have major emissions of criteria air pollutants. For example, for a 1,000-MW plant using the Best Available Control Technology (BACT) for this industry, the estimate of sulfur dioxide and nitrogen oxides emissions would be approximately 2,500 tons per year for each pollutant. Particulate matter emissions likely would be 600 to 700 tons per year from the power plant stack, with additional fugitive and handling emissions for coal and waste. The air permit for each facility would need to demonstrate BACT for each of the major criteria air pollutants, including lead.

Water requirements for each coal-fired power plant would involve both a determination of the control technologies (wet scrubber versus dry scrubber for sulfur dioxide [SO_2]) and the facility cooling operations (wet or dry cooling towers, or a potential hybrid). An approximate estimate of the maximum water supply requirements for a wet scrubber and a wet cooling tower is 10,000 to 12,000 acre-feet per year for a typical 1,000-MW coal-fired power plant, based on recent analyses at other facilities.

3.2.2.1 Wyoming

Any proposed coal-fired power plant that plans to initiate operation by 2010 currently would have to be undergoing air permit review in order to obtain the required construction permits and complete construction by 2010. The following three identified projects currently are considered likely for 2010 development (**Figure 3-2**).

- Black Hills Power and Light's WYGEN 2 coal-fired unit located east of Gillette currently is under construction, with an estimated start date of 2008. As originally permitted, this unit has a planned production capacity of 500 MW and would consume approximately 2.8 million tons of coal per year. The facility would cover 60 acres within the existing 200-acre Black Hills Power and Light power plant area. Operation of this facility by 2010 is considered highly likely.

- North American Power Group has permitted a 250-MW coal-fired power plant (Two-Elk Unit 1) at a 40-acre site located approximately 15 miles southeast of Reno Junction (near Wright), Wyoming. As originally permitted, the project also would include installation of a 45-MW gas-fired turbine. The air permit originally was issued in August 2002; however, construction was suspended and the permit renewed, with actual startup expected in 2008. This unit would be dry-cooled, requiring very little water. Campbell County recently approved more than $123 million in industrial revenue bonds for application to the Two-Elk financing. Operation of this facility by 2010 is considered moderately likely.

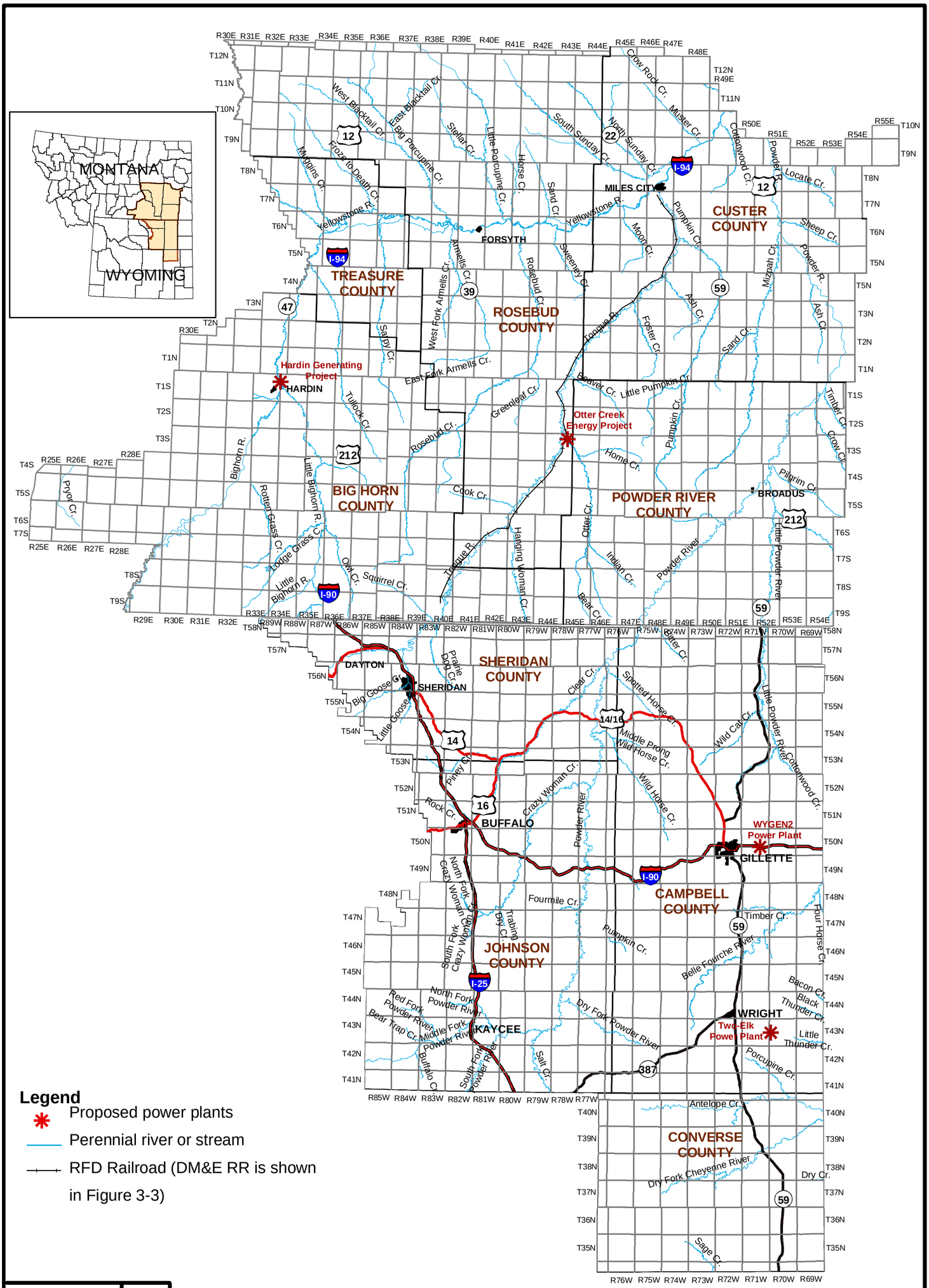
- Basin Electric Power Cooperative is in the process of obtaining permits for a 250-MW coal-fired power plant near Gillette, Wyoming, but no specific site has been selected. The estimated startup date is 2010-2011. No design data are available at this time; however, based on current expected performance, it is estimated that 1.2 million tons of coal per year would be required to fuel the facility. The cooling technology also has not been finalized, but likely would involve a dry scrubber, since that type of operation commonly is installed for PRB coal-fired units. Operation of this facility by 2010 is considered moderately likely.

For 2015 and 2020, it is estimated that under the upper production scenario a maximum of one additional 700-MW coal-fired power plant would be constructed through 2020. It is assumed the additional unit, if developed, would be constructed in the Gillette area or near operating coal mines. The main restriction appears to be the lack of electric power transmission capacity from the area to customers outside the state. All existing power plants in the PRB region are assumed to remain operational through 2020.

3.2.2.2 Montana

Two separate potential power plant developments currently have been approved or are under consideration by the MDEQ for sites in the Montana study area (**Figure 3-2**). All new power plant projects would be required, under air permitting rules, to install BACT on their air emissions. These current factors would be used to estimate emissions from any proposed new project. (For example 0.06 pounds per million British thermal unit [lb/MMBtu] for oxides of nitrogen [NO_x] and sulfur oxides [SO_x], and 0.025 lb/MMBtu for particulate matter with an aerodynamic diameter of 10 microns or less [PM_{10}] emissions controls.)

- A construction permit was issued for the Hardin Generation Project, at a site approximately 1.2 miles northeast of Hardin, Montana. This is a coal-fired boiler unit, with a capacity of 113 MWs of electric power. The facility currently is under construction; however, the permit is under appeal (Skibisky 2004). There currently is no enforcement action to cease construction while the appeal is resolved. Permitting issues may be resolved in time to allow production prior to 2010. For purposes of this study, this facility's operation in 2010 and future years is considered to be highly likely.



Note: Final site selection for the Otter Creek Energy Project is pending.

Source: BLM 2003; STB 2004.

Powder River Basin Coal Review

Figure 3-2

RFD Power Plants and Railroad Development

10/20/05

- The Otter Creek Energy Project is reviewing opportunities to install up to 3,000 MW of coal-fired power plant electric power generating capacity. Potential sites are near rail lines and coal properties near Ashland, Montana. An exact site and project size will be selected for modeling purposes; however, it is likely that over the time frame of this study, the installed capacity would not reach the 3,000-MW generating capacity. It is expected that by 2010, there would be no new units installed at this site, and the lower projection scenario would involve only one 750-MW unit by 2015. The maximum expected capacity under the high projection scenario would be 1,500 MW (two 750-MW units) by 2020. No formal application has been submitted, and the project is considered a low likelihood for both 2015 and 2020.

One significant modification for coal use may occur at the Colstrip Power Plant. The facility has received an air permit to increase the capacity to burn petroleum coke in lieu of coal in its units 1 and 2 boilers. Up to 28 percent of the firing capacity can be fueled with petroleum coke, based on the recent permit application.

By 2015, under the lower development scenario, it is assumed that only the Hardin Generation Project and one 750-MW unit at the Otter Creek Energy Project would be constructed and operating. For the upper development scenario, in addition to the Hardin Generation Project, it is assumed that two 750-MW units would be developed at or near the Otter Creek Project by 2020.

As discussed in Section 3.1.2.2, construction of a new power plant near Miles City, Montana, would be required for development of the Otter Creek Mine, and construction of a mine-mouth power plant would be required for development of the Kinsey Mine. However, due to the lack of permit applications or project-specific information, the likelihood for their development currently is unknown. As a result, they have been eliminated from further analysis in this study.

Bull Mountain Development Company has permitted the Roundup Power Project, a coal-fired power plant that would operate two 390-MW pulverized coal-fired boilers. This mine-mouth power plant would be located adjacent to the Bull Mountains Mine, approximately 12 miles south-southeast of Roundup, Montana, and just east of U.S. Highway 87 in Musselshell County. As this power plant would be located greater than 30 miles west of the Montana PRB study area, the facility has been eliminated from further analysis.

3.2.3 Data Sources

Information relative to existing power plants in the Wyoming PRB study area was obtained from construction and operating permits on file with the WDEQ and direct contact with power plant operators. Data for existing power plants in the Montana PRB study area were obtained from the facility permits available through the MDEQ web site and from discussions with MDEQ staff.

Information relative to reasonably foreseeable power plants through 2010 was obtained from existing permit applications either under review or extended for a start of construction and news releases. Data also were obtained from each identified proponent (Black Hills Power and Light and North American Power Group). Data for the Hardin Generation Project were obtained from the facility permits available through the MDEQ web site and from discussions with MDEQ staff. Data for the Otter Creek Energy Project were obtained from a fact sheet provided by the potential developer.

3.2.4 Assumptions

In addition to the information obtained from the identified data sources, the following assumptions were used to define specific impact-causing parameters for power plants:

Past and Present Development:

- Surface disturbance associated with a typical power plant facility would be 60 to 200 acres, based on available acreage data from other power plants.

- Annual emissions for the Colstrip Power Plant would be 16,000 tons per year of SO_2, 32,000 ton per year of NO_x, and approximately 500 tons per year of PM_{10} from the main stacks.

RFD (2010):

- New power plants would comply with BACT for maximum controls.

- Existing power plants would be required to apply additional controls for NO_x, SO_2, PM_{10}, and particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$) in response to the regional haze rule.

- As originally permitted, annual emissions for the WYGEN 2 power plant would be 2,028 ton/year of NO_x, 3,381 ton/year of SO_2, and 421 ton/year of PM_{10}. Construction of the WYGEN 2 power plant would require a workforce of 750 to 1,000 construction workers, employed over a 4- to 5-year period, and an additional 75 to 100 employees for operations.

- As originally permitted, annual emissions for the Two-Elk Unit 1 power plant would be 1,756 ton/year of NO_x, 1,991 ton/year of SO_2, and 234 ton/year of PM_{10}. Project construction would occur over a 2-year period, with a temporary peak workforce of 750 workers. The estimated operating workforce would include 50 full-time equivalent staff. Total expected capital investment would be about $450 million.

- As currently being permitted, Basin Electric Power Cooperative's 250-MW power plant would be constructed near Gillette, Wyoming.

- It is assumed that permitting issues for the Hardin Generation Project near Hardin, Montana, will be resolved in time to allow production by 2010.

- Assume minimal added rail shipping and associated emissions.

RFD (2015 and 2020):

- Under the upper production scenario, one additional 700-MW power plant also could be constructed in the Wyoming PRB by 2020.

- Under the lower coal production scenario, it is assumed that one 750-MW (Otter Creek) coal-fired power plant would be constructed in the Montana PRB study area by 2015. Under the upper production scenario, it is assumed that an additional 750-MW unit would be constructed at Otter Creek by 2020, bringing the total capacity to 1,500 MW. The Otter Creek Energy Project size could reach 2,000 acres, depending on design issues such as disposal of coal combustion wastes and local terrain limitations.

- Construction of each power plant would require a workforce of 750 to 1,000 construction workers employed over a 4-year period. Each plant would require an estimated operating workforce of 75 to 100.

- New power plants would comply with BACT for maximum controls.

- For the proposed power plants, the modeling assumes representative stack parameters, such as a stack height of 500 feet, diameter of 30 feet, and temperature and flow rate similar to other coal-fired power plants with wet scrubbers.

3.3 Transportation

Information relative to past and present and RFD railroad activities is presented below. Information relative to highways is presented in Section 3.12.

3.3.1 Past and Present Development

3.3.1.1 Wyoming

The Wright and South Gillette subregion coal mines located south of Interstate (I) 90 are serviced by a joint Union Pacific (UP)/BNSF rail line (see **Figure 3-1**). The existing capacity of the line is estimated at approximately 350 mmtpy. The 2003 coal production from the same mines totaled 308 mmtpy, equating to an 88 percent utilization of the existing rail capacity. The existing capacity of the BNSF line servicing the North Gillette subregion mines north of I-90 (see **Figure 3-1**) is estimated at 250 mmtpy. The 2003 coal production from the North Gillette subregion totaled 55 mmtpy, equating to a 22 percent utilization of the existing rail capacity. An unknown amount of coal leaving the North Gillette subregion mines on the BNSF line is transported farther south along the joint UP/BNSF line. This unknown amount was not included in the estimated utilization of the joint UP/BSNF line, and therefore, current actual utilization of the joint line could be higher.

3.3.1.2 Montana

Existing BNSF rail lines are in place with adequate capacity for all existing mines. The existing BNSF rail line extends from the mainline to both the Decker and Spring Creek mines. It is assumed that the existing railroad infrastructure has capacity for approximately 100 mmtpy from the region.

3.3.2 Reasonably Foreseeable Development

3.3.2.1 Wyoming

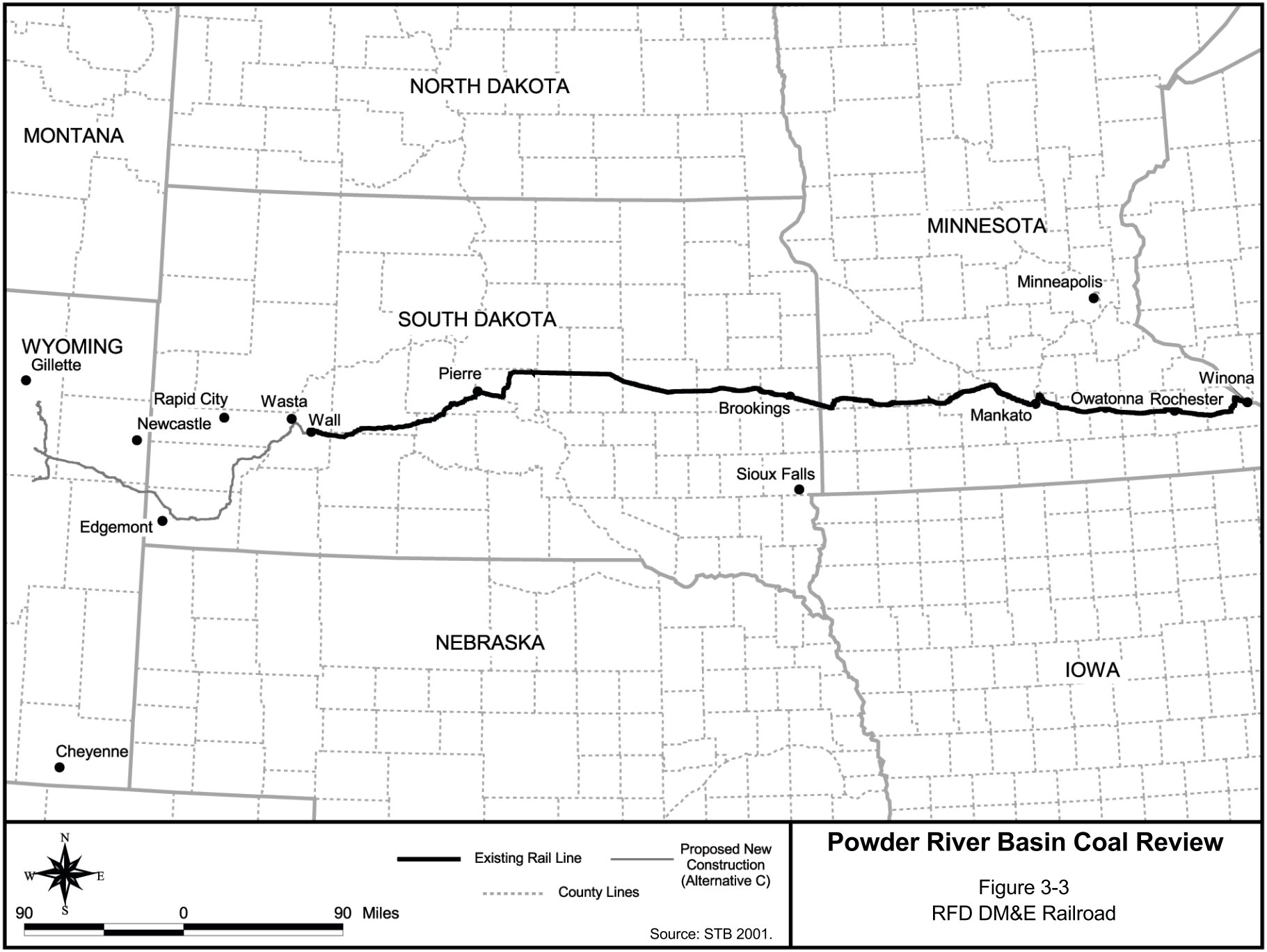
UP/BNSF Expansion. The single largest capital and infrastructure cost related to the projected future coal mining rates is rail expansion for the mines south of Gillette. Plans have been developed to improve sections of the existing joint UP/BNSF rail line and to increase capacity from 350 to 400 mmtpy as early as 2006. This would accommodate the projected upper and lower production rates at the southern mines, which are projected to produce 400 mmtpy by 2010 and 2016, respectively. This expansion has a likelihood rating of highly likely.

DM&E Rail Line. The proposed DM&E rail line, which would include new rail construction in South Dakota and Wyoming (approximately 15 and 265 miles, respectively) and 600 miles of rail line rehabilitation in South Dakota and Minnesota, would provide additional rail capacity for the coal mines in the Wyoming PRB (**Figure 3-3**). Approximately 78 miles of the new rail construction would occur in the PRB study area. On January 28, 2002, the STB issued a final written decision granting DM&E authority to construct and operate the line subject to 147 environmental conditions, including an environmental oversight period that would continue through the first 2 years of operation. The Record of Decision was successfully appealed, and additional environmental analysis has been required as a result. Pending completion of the required additional analysis, the $1.4 billion project would provide 100 mmtpy of new rail capacity for the southern PRB mines and open new markets for this coal. The project also would provide new rail spur services to the Jacobs Ranch, Black Thunder, Caballo-Rojo, Coal Creek, Cordero, and Belle Ayr mines. It is projected that when the total rail haulage requirement from the eastern Wyoming PRB reaches between 450 and 500 million tons per year, the DM&E line would be constructed. Although the timing would depend on actual production and near-term forecasts from the southern portion of the PRB, it is assumed for this study that the new rail line would be operational by 2015. The construction of this rail line has a likelihood rating of moderately likely.

3.3.2.2 Montana

It is anticipated that future production rates from the currently operating mines in Subregion 4 would not exceed the capacity of the existing BNSF rail line (100 mmtpy) through 2020. It also is anticipated that the existing capacity (100 mmtpy) of the currently operating BNSF rail line would be sufficient to accommodate additional production from the P&M Ash Creek Mine in the Wyoming portion of Subregion 4. Any upgrades would be minor and limited to spur track connections.

It is anticipated that reasonably foreseeable railroad development within the Montana PRB study area would be limited to the construction of TRRC's proposed rail line between Miles City and Decker, Montana (**Figure 3-2**). The rail line would provide for transportation of coal from existing and future mines to markets in the midwest and northeastern states. It also would be required to facilitate development of the proposed Otter Creek Mine. This railroad also would supplement existing transportation choices available to the existing Decker and Spring Creek mines and may result in changes to the existing coal transport patterns from these operations. However, it is projected that construction of the railroad would not occur unless the Otter Creek Mine is developed. There may be some phased development of the railroad.



Powder River Basin Coal Review

Figure 3-3
RFD DM&E Railroad

The proposed route for TRCC's rail line generally follows the Tongue River from near the Spring Creek Mine to Miles City, Montana. The project has been reviewed by the STB for possible development. The $109 million project would provide 100 mmtpy of new rail capacity. Based on the inter-dependency of this rail line with the development of the Otter Creek Mine, it is assumed for this study that development of the rail line would not occur under the lower development scenario. Under the upper development scenario, it is assumed that the rail line would be operational by 2010, a low likelihood has been assigned to this action.

Rail access to the North Kinsey mine would not be required, as it is assumed that this mine would support a mine-mouth power plant. The preliminary nature of this mine is such that there are no known proposed routes to the project area.

3.3.3 Data Sources

Information from the BNSF Railway Coal Business Unit, DM&E Railroad Corporation Final EIS, Tongue River Railroad STB Application, Surface Transportation Board web site, BNSF Railway Coal Business Unit, and MWH Coal Planning Estimates Report was used in the preparation of the coal railroad transportation sections of this report.

3.3.4 Assumptions

In addition to the information obtained from the identified data sources, the following assumptions were used to define specific impact-causing parameters for transportation:

Past and Present Development:

- Existing railroad disturbance rights-of-way are assumed to be 100 feet in width.

RFD:

- It is assumed that the UP/BNSF rail capacity for the southern portion of the PRB would increase from 350 to 400 mmtpy in 2006; associated construction would include the addition of sidings and trackage parallel to existing facilities within the existing right-of-way.

- The construction right-of-way for the portion of the DM&E rail line in the Wyoming PRB study area would be approximately 78 miles long and 100 feet wide. Although the timing would depend on completion of additional environmental permitting and actual production and near-term forecasts from the southern portion of the PRB, it is assumed for this study that the new rail line would be operational by 2015.

- The construction right-of-way for TRRC's new rail line in the Montana PRB study area would be 130 miles long and 100 feet wide. It is assumed this new rail line would be operational by 2010. However, project financing and construction would be dependent on the development of the Otter Creek Mine which only would be developed under the upper production scenario. Under the lower production scenario, it is assumed that the rail line would not be constructed.

- It is assumed that the initial use of the rail line would be for the transport of coal from the Otter Creek Mine to a yet to be proposed power plant near Miles City, Montana.

3.4 Coal Technology

3.4.1 Past and Present Development

3.4.1.1 Wyoming

There are no existing coal technology projects in the Wyoming PRB study area. Although test facilities have been constructed by KFx at the Fort Union Mine (now part of the Dry Creek Mine), AMAX (predecessor to Foundation Coal West, Inc.) at the Belle Ayr Mine, and ENCOAL at the Buckskin Mine, no commercial production has occurred. These facilities either have been dismantled or are no longer in use.

3.4.1.2 Montana

Within the past 10 years, a coal processing facility used to reduce moisture content and remove sulfur was associated with the Rosebud Mine. However, this facility has been dismantled and removed from the mine site. Therefore, it is not considered further in this analysis.

3.4.2 Reasonably Foreseeable Development

3.4.2.1 Wyoming

KFx Coal Beneficiation Project. Components are being fabricated for the proposed KFx coal beneficiation project in anticipation of permit approval and projected construction in 2005 near the old Fort Union Mine (now part of the Dry Fork Mine). It is expected that the plant would process approximately 750,000 tons of coal per year. This operation has a high likelihood of proceeding with production given the technology being used and the forecast market conditions in the PRB. If the process and market prove competitive, the company has suggested that up to five additional units could be built in the PRB. However, pending the completion, testing, and successful marketing of the initial development, the likelihood for development of additional units is currently unknown. As a result, the potential development of additional units has been eliminated from further analysis in this study.

Rentech Inc. Coal Liquefaction Project. A study has been funded by the Wyoming Business Council to assess the feasibility of a liquefaction facility to produce low-sulfur diesel fuel from sub-bituminous coal. A presentation on this feasibility study was presented to the State of Wyoming Governor's Office and Business Council in April 2004. The location and schedule for construction of the conceptual facility has not been proposed. Published information indicates that production of 10,000 barrels per day of diesel fuel using 3 million tons of coal per year may be possible. The proposed process would use the historic Fishcher-Tropsch process that has been utilized to convert coal into liquids. Limited information is available on this proposed project. As a result, its likelihood for development is currently unknown, and it has been eliminated from further analysis in this study.

Arch Coal, Inc. and KFx Joint Venture. Arch and KFx are evaluating the possibility of jointly developing an 8 mmtpy coal beneficiation project at the Coal Creek Mine. The likelihood for this project is currently unknown, and it has been eliminated from consideration in this study.

Long-term Prospects. The Wyoming Business Council, Campbell County Economic Development Corporation (CCEDC), and Converse Area New Development Organization (CANDO) all are actively pursuing coal gasification development. While there appears to be substantial interest in these opportunities, it is unknown whether large-scale operations would be developed within the 2010 to 2020 timeframe, given permitting, engineering, and construction time requirements. CANDO specifically is pursuing the development of hydrogen-fueled power generation and coal gasification leading to production of pure hydrogen with CO_2 as a by-product. Although long-term prospects are uncertain, a recently completed feasibility study assessed the capacity of Converse County to meet the critical requirements for coal-based industrial development. CANDO is actively pursuing development in these areas. However, due to the lack of an identified project proponent with adequate financing to pursue such development, the likelihood for such development is currently unknown. As a result, coal gasification development is not considered further in this study.

3.4.2.2 Montana

There are no known proposed coal technology projects within the Montana PRB study area.

3.4.3 Data Sources

Information on KFx-proposed projects was based on KFx corporate information provided on the company's web site. The information for Rentech Inc. was based on a published news article and information available on their web site. Information regarding the long-term prospects for coal technology development was derived from a 2004 feasibility study and conversations with local economic development officials (City of Douglas 2004; Spencer 2004; Werner 2004).

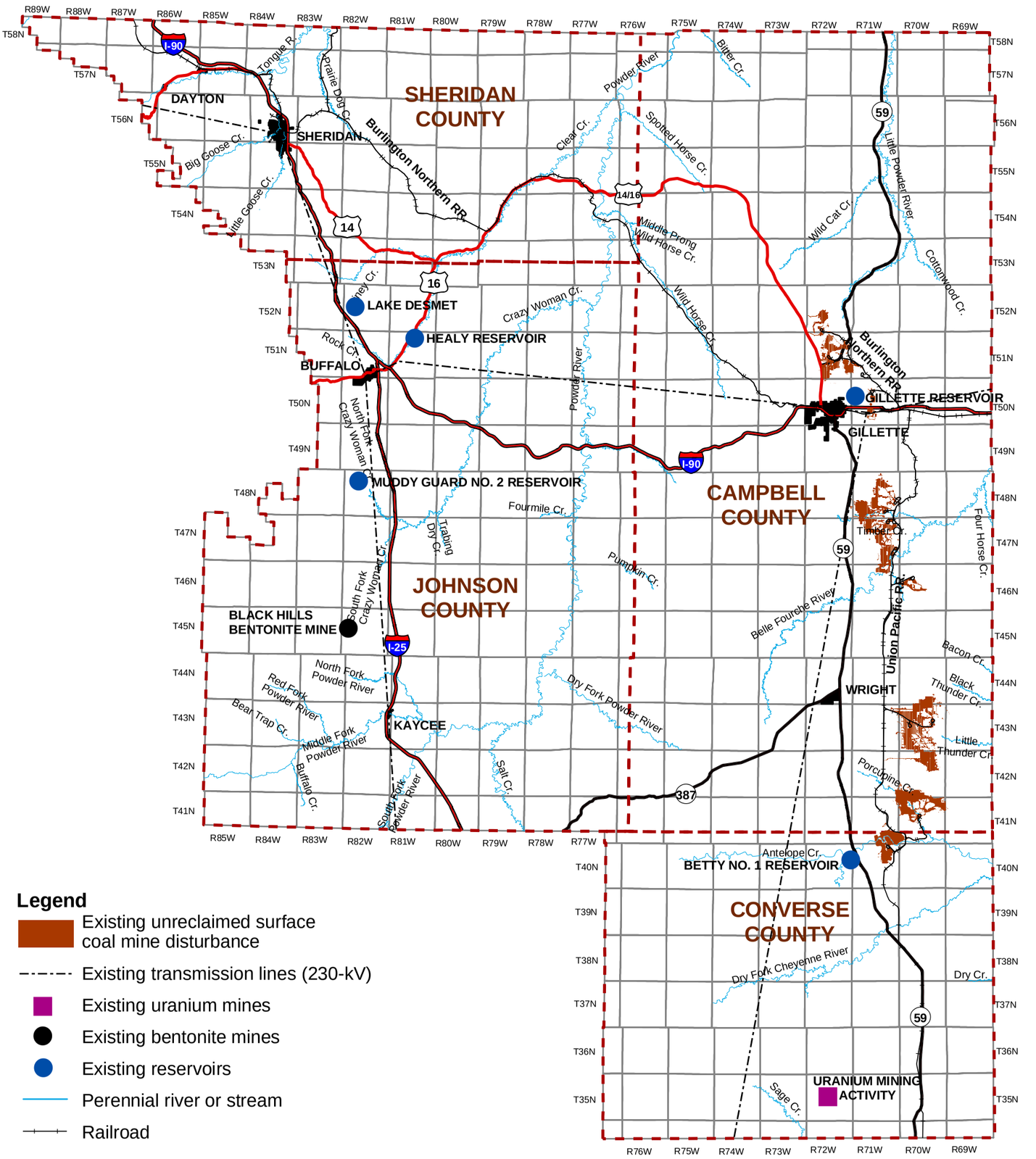
3.4.4 Assumptions

- The KFx coal beneficiation project would be constructed in 2005 and would operate throughout the period of this study. The initial phase of the project would provide 25 permanent jobs.

3.5 Transmission Lines

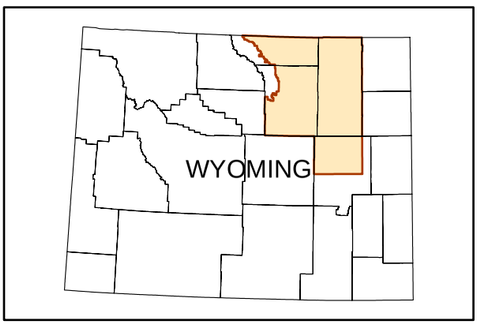
3.5.1 Past and Present Development

Major transmission lines in the Wyoming PRB study area that support the regional distribution system are associated with the Dave Johnston power plant located near Glenrock, Wyoming, and the power plants operated by Black Hills Power and Light, which are located east of Gillette (**Figure 3-4**). These 230-kV transmission lines have been in place for several years, and their associated permanent disturbance is minimal. Distribution power lines associated with conventional oil and gas and CBNG development also occur within the study area. For purposes of this study, these power lines have been factored in proportionally on a per well basis as discussed in Appendix E.



Legend

- Existing unreclaimed surface coal mine disturbance
- Existing transmission lines (230-kV)
- Existing uranium mines
- Existing bentonite mines
- Existing reservoirs
- Perennial river or stream
- Railroad



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0 8 16 24 Kilometers

Note: Transmission line corridors are approximate.

Sources: HKM et al. 2002 a, b; Western Electric Coordinating Council 2004; WDEQ 2004.

Powder River Basin Coal Review

Figure 3-4
Existing Transmission Lines, Other Mines, and Reservoirs

07/18/05

3.5.2 Reasonably Foreseeable Development

It is estimated that during the time frame of this study one transmission line would be constructed running south to Colorado markets and one would be constructed eastward to mid-west markets. Markets will dictate the size and location of such facilities, and these are not known as of this time. Also, transmission lines are a necessary supporting infrastructure for power generating facilities to provide connection to the grid. As a result, it is assumed they would be required as part of the overall system development for the RFD power plants identified in Section 3.2.2.1. However, no specific proposals for these transmission lines have been identified. Based on the lack of information relative to location or length of specific RFD transmission lines and the minimal associated disturbance, they are not analyzed further in this study.

3.5.3 Data Sources

Information relative to RFD transmission line projects was based on new power plant project information contained in trade journals and newspaper publications. This information was not explicit relative to supporting infrastructure; however, since power plant and transmission line projects are interrelated, it provided a reasonable basis for the conclusions on RFDs in this section.

3.5.4 Assumptions

Past and Present Development: No assumptions relative to past and present transmission lines have been identified.

RFD:

- It is assumed that disturbance associated with future construction of transmission lines to tie the RFD power plants to the grid would be minimal.

3.6 Other Mines

3.6.1 Past and Present Development

Past and present uranium, sand, gravel, bentonite, clinker, and scoria mines exist in the Wyoming PRB study area. There are three defined uranium districts in the PRB, including Pumpkin Buttes, Southern Powder River, and Kaycee (BLM 2003a). Numerous uranium mining sites occurred in these districts; however, they were mined out or uneconomic. Uranium currently is produced via the in situ leach method in the Southern Powder River district at Smith Ranch and Highland/Morton Ranch (Harris 2003) (**Figure 3-4**).

There are several bentonite localities in the PRB study area, and bentonite is mined at Kaycee (Wyoming Mining Association 2004) (**Figure 3-4**).

The more important aggregate mining localities are in Johnson and Sheridan counties (U.S. Geological Survey [USGS] 2003). The largest identified aggregate operation is located in the

Lighting Creek subwatershed. It has an associated total disturbance area of approximately 67 acres, of which 4 acres have been reclaimed. The remainder of the identified operations are relatively small (less than 5 acres each) and are scattered throughout Campbell and Converse counties.

Scoria or clinker (which is formed when coal beds burn and the adjacent rocks become baked) is used as aggregate where alluvial gravel or in-place granite/igneous rock is not available. Scoria generally is mined in the Converse and Campbell counties portion of the Wyoming PRB study area.

For purposes of this study, the smaller operations are not considered further in this study due to the lack of information relative to their specific locations and the low overall associated acreage (approximately 100 acres), which per subwatershed would be minimal.

3.6.2 Reasonably Foreseeable Development

Increased sand, gravel, and scoria production and associated surface disturbance are anticipated in the Wyoming PRB study area in the future. The likelihood of increased production of these materials is high, as aggregate would be required for road maintenance and new construction activities. As other primary resources (e.g., coal and oil and gas) are developed, aggregate would need to be produced to support these ongoing activities. New quarries and increased production from existing operations are expected. It is anticipated that these operations would vary in size based on the immediate need from the primary industries. However, based on the lack of specific information relative to related impact-causing parameters, these activities are not analyzed further in this analysis.

There has been a recent increase in interest in uranium for power plants here and abroad. However, based on current commodity forecasts as of June 2004, no specific uranium mine development is anticipated in the Wyoming PRB study area. Although some claims have been staked since that time, they are primarily land position plays with no specifically defined projects. As a result, RFD uranium mining has been eliminated from further consideration in this study.

It is assumed that bentonite mining would continue throughout the study period. It is anticipated that production would continue from existing active mines, with no new mines developed through 2020.

3.6.3 Data Sources

The information for past, present, and RFD sand, gravel, scoria, and uranium operations was obtained from public information available through WDEQ. Where operations are large enough to file annual reports, acreages of disturbance and reclamation were tabulated. Information relative to bentonite mines was based on WDEQ/LQD permit information and annual reports.

3.6.4 Assumptions

In addition to the information obtained from the identified data sources, the following assumptions were used to define specific impact-causing parameters for sand, gravel, scoria, and uranium mines:

Past and Present Development: No assumptions relative to past and present sand, gravel, scoria, or uranium mines have been identified.

RFD:

- It is assumed that growth in demand for aggregates for use as construction materials would occur, while growth in demand for uranium may not occur.

3.7 Oil and Gas

3.7.1 Past and Present Development

3.7.1.1 Conventional Oil and Gas

Early oil exploration in the PRB was based on direct evidence of surface seeps or drilling anticlinal structures that were exposed on the surface. Oil was first produced from the PRB in 1887 from the Newcastle Formation on the east side of the basin near Moorcroft, Wyoming (MacGregor 1972). In 1889, oil seeps led to the discovery of oil production at Shannon Field on the north end of the Salt Creek anticline. In 1908, the crest of the anticline was drilled resulting in the discovery of the Salt Creek Oil Field. Salt Creek had produced over 669 million barrels (bbls) of oil to the end of 2002 and is still in production. The discovery of Salt Creek led to the drilling of other large anticlines located on the southern periphery of the basin. Big Muddy was discovered in 1916, and Lance Creek was discovered in 1918 (WOGCC 2004).

During the 1930s, low prices depressed exploration in the basin. After World War II, a new round of exploration began with extensive use of seismic surveys to look for structural traps that could not be readily verified from surface mapping (McGregor 1972). Also in the early 1950s, stratigraphic trapping of oil was discovered in the Newcastle Sandstone on the east side of the basin. A number of other Cretaceous reservoirs formed by stratigraphic trapping were discovered in the 1950s; however, with a few exceptions, drilling generally was confined to relatively shallow targets. In the late 1950s, oil production was found in sandstones of the Minnelusa Formation. Minnelusa production has been prolific over the years with the main production fairway being in the northeast portion of the basin. However, the Minnelusa equivalents (“Leo” Sands) also produce on the southeast side of the basin. Pennsylvanian rocks also produce along the basin axis in the western part of the basin.

In the 1960s and 1970s, drilling moved into deeper parts of the basin that resulted in the discovery of some prolific oil fields in stratigraphic traps in upper and lower Cretaceous rocks (McGregor 1972). The discovery of giant Bell Creek in 1967 (reserves greater than 150 million barrels of oil from the Muddy Sandstone) on the Montana side of the basin set off a wave of exploration that resulted in a number of discoveries in Wyoming in the Muddy Sandstone (Drew 1990). Such Muddy fields included Recluse, Kitty, and Highlight. Drilling continued for deeper targets and resulted in the discovery of upper Cretaceous fields such as House Creek, Hartzog Draw, Holler Draw, and Jepson Draw, all characterized by long narrow reservoirs that were deposited as marine bars. Stratigraphic traps in upper Cretaceous rocks remained as prime targets for drillers in the late 1970s into the early 1980s with discoveries such as Well Draw and Scott Field, located in southern

Converse County. The Minnelusa also provided a mainstay for wildcat drillers during that time period.

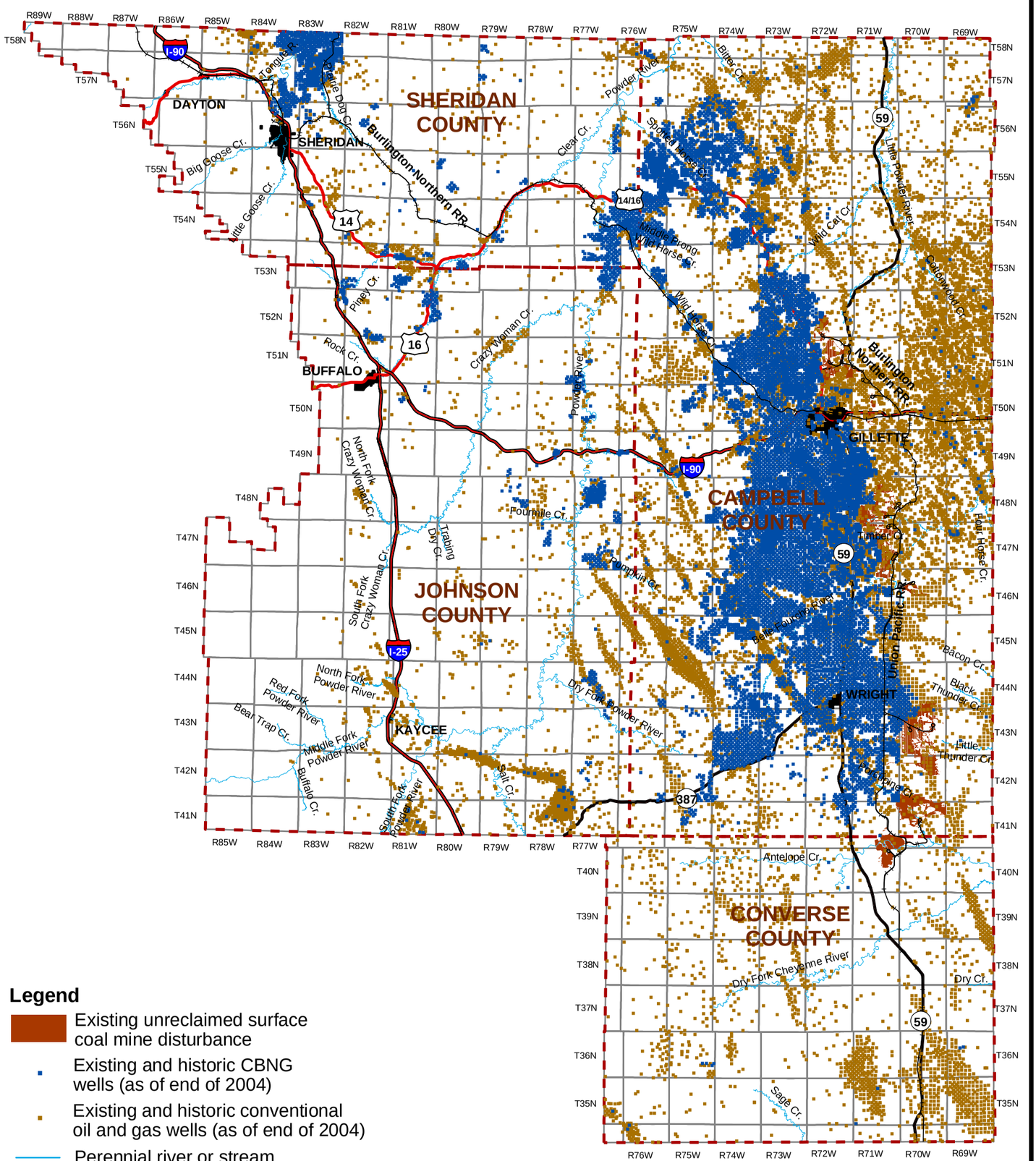
Very little conventional oil and gas activity has occurred in the last 15 years in the study area, and only approximately 1,500 wells were drilled from 1990 to 2003. The 1,500 wells include producing, injection, and wildcat (exploration) wells. The only significant discovery has been the African Swallow Field, discovered in 2000, which produced over a million barrels of oil and 14 billion cubic feet (BCF) of gas from two wells by the end of 2003 (WOGCC 2004).

As of the end of 2003, there were approximately 3,500 productive conventional oil and gas wells in the Wyoming PRB study area plus 1,386 seasonally active wells (IHS 2004). **Figure 3-5** shows the location of all wells (producing, non-producing, and plugged and abandoned). Approximately 13 million barrels of oil and 41 BCF of conventional gas (20.24 million barrels of oil equivalent [BOE]) were produced from these wells in 2003 based on WOGCC (2004) data; IHS (2004) data report approximately 13 million barrels of oil and approximately 40 BCF of conventional gas. The USGS (2002) estimated that the mean undiscovered non-coal bed hydrocarbon resource in the PRB (including Montana) is 1.8 BOE.

3.7.1.2 CBNG

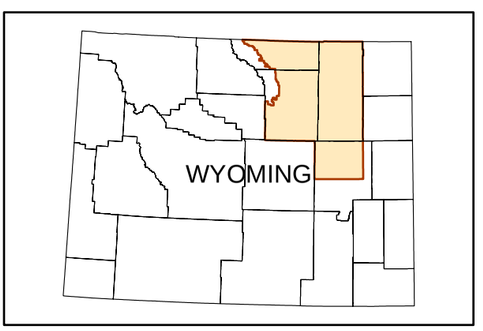
CBNG activity began in the 1980s, however it took a number of years before commercially viable production was established. A total of three Applications for Permit to Drill (APDs) were issued in 1986 for CBNG wells in Campbell County (WOGCC 2004). The first commercial gas production directly from coal seams occurred in 1989 at Rawhide Butte north of Gillette (Debruin and Jones 1989). Annual submission of APDs did not exceed 100 until 1992 when 110 APDs were filed. By the late 1990s, after commercially viable production was proven, the number of APDs submitted began to soar: 561 in 1996, 808 in 1997, 1,494 in 1998, and 5,101 in 1999 (WOGCC 2004). In the 1-year period from June 2003 to May 2004, over 6,700 APDs were received statewide by the WOGCC.

The initial coal bed development in the early 1990s was concentrated in the area between Gillette and Wright, Wyoming, and State Routes (SRs) 59 and 50 in the Marquiss and Lighthouse project areas (Flores et al. 2001). The development soon moved out of that area and spread to the west and northwest. At the end of 2003, there were 14,758 producing CBNG wells in the study area (IHS 2004), and total production for 2003 was 346 BCF, or 88 percent of the total gas production from the basin (WOGCC 2004). From 1987 to 2003, the total cumulative gas production from PRB coals was over 1.2 trillion cubic feet. The total water production for the same time period was approximately 2.3 billion barrels. Annual methane production has increased rapidly since 1999 and appears to have started to level off or even decrease. Water production has decreased slightly; however, it still was more than 500 million barrels during 2003. In 2003, the average CBNG production was 900 million cubic feet per day (MMcfpd) (Holcomb 2003). CBNG production appears to have peaked from a high of 977 MMcfpd in October 2003 to 899 MMcfpd in March 2004 (Oil and Gas Journal 2004). CBNG wells in the Wyoming PRB study area as of the end of 2003 are shown in **Figure 3-5**.



Legend

- Existing unreclaimed surface coal mine disturbance
- Existing and historic CBNG wells (as of end of 2004)
- Existing and historic conventional oil and gas wells (as of end of 2004)
- Perennial river or stream
- Railroad



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Source: BLM 2003; IHS 2005; WOGCC 2005.

Powder River Basin Coal Review

Figure 3-5

Existing and Historic Oil and Gas Wells

07/19/05

3.7.2 Reasonably Foreseeable Development

Conventional oil and gas and CBNG development does not fit in the capital project likelihood of occurrence classifications as discussed in Section 2.1. Oil and gas exploration and development have inherent characteristics that set it apart from other capital projects. These characteristics include the following:

- The activities are conducted by multiple companies or entities;
- The activities cover broad geographic areas;
- Generally, permitting can take place in a relatively short time frame compared to other capital projects;
- The activities are extremely price sensitive and, therefore, hard to predict over long periods of time; and
- Technological advancements can be rapidly implemented resulting in sudden increases of activity in a relatively short period of time.

The probability for new oil and gas activities (including CO_2 enhanced oil recovery [EOR] and associated pipelines) to occur in the future is a certainty; however, the level of activity is uncertain. The following discussions of reasonably foreseeable activity for conventional oil and gas and CBNG are estimates of the level of activity that could be expected to occur, based on recent trends analyzed for this study and the methodology and assumptions presented in Appendix E.

3.7.2.1 Conventional Oil and Gas

Table 3-2 summarizes the projected production, number of wells, and long-term disturbance associated with conventional oil and gas development through 2020. From 1990 to 2004, a total of approximately 1,500 wells were drilled in the study area (IHS 2004). Of those, 60 percent were development wells drilled in established producing areas. The other 40 percent of wells were classified as wildcat wells or wells drilled outside of producing areas or wells drilled to test non-producing prospective zones in producing areas. Of the wildcat wells, approximately 75 percent were plugged and abandoned. From 1990 through 2003, new field wildcat wells resulted in the discovery of 61 new fields that provided 719,000 barrels of oil and 1.45 BCF of non-CBNG in 2003 (WOGCC 2004).

In a departure from the trend of the last 15 years, it is expected that the recent increase in oil prices would reverse the decline in oil production, with production increasing and peaking around 2010 at approximately 18.5 million barrels (BLM RMG 2005) (**Table 3-2**). (Refer to Appendix E for assumptions used in well number, production, and disturbance projections.)

The active wells identified in **Table 3-2** include wells that produce year-round, seasonally producing wells, and service wells (mainly injection wells). It is estimated that there are approximately 2,000 idle conventional oil and gas wells in the PRB study area (WOGCC 2005a); however, these wells gradually would be reduced in the future through aggressive plugging programs, and the idle

well locations (once the wells are abandoned) would be reclaimed and no longer represent a disturbance.

Table 3-2
Projection of Conventional Oil and Gas Activity

Wells and Production	Existing	Projected		
	2003	2010	2015	2020
Annual Gas Production (BCF)	39.9	42.7	39.0	35.1
Annual Oil Production (million barrels)	12.9	15.7	14.3	12.9
Active Wells	5,067	5,603	5,115	4,625
Inactive Wells	1,994	954	563	332

A typical drilling location, including access road, is assumed to disturb approximately 2.75 acres. Long-term disturbance at existing well sites is assumed to be 2.0 acres following partial reclamation (BLM 2003a). If a well is abandoned, the entire disturbance area is reclaimed. If a well is productive, a portion of the disturbance area is reclaimed initially, with final reclamation occurring at the end of production. Based on these assumptions, **Table 3-2** shows the long-term disturbance at each of the benchmark years.

It is certain that conventional oil and gas exploration and development would continue, but at a rate far below previous levels in the basin's history. If the trends of the last 10 to 15 years are indicative of future activity, conventional oil and gas would continue to be produced but at ever decreasing rates.

The USGS (2002) estimated that the mean undiscovered non-coal bed hydrocarbon resource in the PRB (including Montana) is 1.8 billion BOE. This number indicates that the PRB, as well as the study area, has a potentially important non-coal bed hydrocarbon resource base. Whether that resource is exploited is dependent upon a number of factors. At present, the economics favor the shallow and easier exploitable CBNG resource. The low oil prices and preferential investment in CBNG resources probably has resulted in the investment into other plays in the basin, with an associated decline of oil and non-CBNG activity over the past 15 years. If the non-coal bed resource is to be exploited to any great degree in the future, industry would have to invest in those plays. As the CBNG play moves into maturity, and if oil prices stabilize over $45 per barrel, then oil and non-CBNG resources potentially could become attractive exploration targets. However, it is not likely that the PRB ever would reach a producing rate of 30 million barrels of oil per year again (BLM 2001).

As of the end of 2004, there were no readily available data concerning incremental production data from CO_2 flooding (WOGCC 2004). There is a potential for additional EOR activity in the study area, but so far the projects that have been conducted are pilot scale and involve the "huff and puff" process whereby the gas is brought to individual injection wells by tanker truck. Possible EOR candidates in the PRB include Harzog Draw, House Creek, Hilight, Raven Creek, Rozet, Kitty, Gas Draw, and Recluse Fields (DeBruin 2001). These fields could qualify for EOR because they had 50 million barrels or more of original oil in place; however, many smaller fields also could qualify. The potential for additional EOR activity would be dependent upon the availability of a CO_2 source. Wyoming has a large resource of CO_2 produced from the La Barge Anticline in the Green River

Basin. There also are abundant CO_2 resources at the Madden Unit in the Wind River Basin. In total, Wyoming has a CO_2 production capacity in excess of 500 MMcfpd (DeBruin 2001). Pipelines would need to be constructed to transport this available CO_2 into the PRB (see Section 3.8, Pipelines). The State of Wyoming has a severance tax break of 2 percent on oil produced from WOGCC-approved CO_2 EOR projects to encourage producers to take advantage of the CO_2 resource and to encourage oil production. However, there are no proposals to extend the CO_2 pipeline that ends at Salt Creek and Sussex Fields in the near term (the next 5 years). The likelihood rating of any such CO_2 EOR project would be low, since the CO_2 pipeline at Salt Creek originally was proposed to end at Hartzog draw (DeBruin 2002).

3.7.2.2 CBNG

The future of CBNG development is highly sensitive to the price of gas. For a number of years, Wyoming natural gas production has been affected by the so-called price differential. The price differential is the difference in the gas price at the Opal and Cheyenne hubs in Wyoming and the national benchmark price recorded at the Henry Hub in Louisiana. The differential results when there is inadequate pipeline capacity to move Rocky Mountain region gas to markets outside of the area. Historically, the differential has been as high as $2.40 per million British thermal units (MMbtus) (Holcomb 2003) (1 Mcf is roughly equivalent to 1 MMBtus). This disparity in price has resulted in an estimated loss of more than $2 billion dollars to producers and attendant fiscal impacts for state and federal governments (Holcomb 2004). The lack of interstate pipeline transmission capacity in Wyoming is cited as the major reason for the price differential. The differential was somewhat eased in 2003 with the opening of the Kern River Pipeline expansion that moves gas from southwestern Wyoming, northwestern Colorado, and northeastern Utah. At that time, the differential went from $1.86 per MMbtus to $0.60 per MMbtus (Holcomb 2004). However, the addition of the Kern River system capacity did not completely solve the differential problem.

The consequences of the price differential were researched by Advanced Resources, International (ARI) (2002). ARI evaluated the impacts to the CBNG resource associated with various water disposal methods. ARI (2002) also evaluated the effects of three price scenarios on the CBNG resource as follow:

- Under a status quo price scenario (basin price differential of $1.80 per Mcf), the economically recoverable CBNG resource only would be 1.5 trillion cubic feet (Tcf), with the primary water disposal option being surface discharge. No other disposal options were economical under this price scenario. ARI (2002) states that much of this development already has occurred, and if the differential doesn't change, not much increase in development would be expected.

- In a transitional price scenario, where the basin differential narrows to $0.80 per Mcf after a number of years and beyond, variable amounts of the resource would be economical for a number of disposal options. Under this scenario, the economically recoverable resource ranges were projected to be 22.4 Tcf with surface discharge, 20.0 Tcf with impoundment infiltration, 18.8 Tcf with shallow re-injection, and 7.1 to 10.2 Tcf with active treatment.

- In the third scenario, the basin differential immediately would go to $0.80 per Mcf. Under this scenario, the economically recoverable resource ranges would be 29.1 Tcf with surface discharge, 27.8 Tcf with impoundment infiltration, 27.1 Tcf with shallow re-injection, and 17.8 to 2.6 Tcf with active treatment.

In the Final EIS and Proposed Plan Amendment for the PRB Oil and Gas Project (BLM 2003a), the preferred alternative favored the disposal of produced CBNG water in infiltration impoundments to be accompanied by groundwater and surface water monitoring, except in the Belle Fourche and Cheyenne River drainages where direct discharge to ephemeral streams was allowed. The disposal of produced coal bed water in infiltration impoundments would fit with the second or third ARI scenarios described above. The recoverable CBNG resource would be in the range of 20 to 29 Tcf if the price differential remains at $0.80 per Mcf or less, and gas prices in general remain at reasonable long-term levels ($3.56 per Mcf or equivalent to crude oil at $25 per barrel). In spite of recent record highs for crude oil, the long-term forecast (10 years or more) for crude oil prices is expected to be around $25 per barrel (Winnecke 2003). The size of the differential would be dependent upon the magnitude of production capacity in the Wyoming PRB and available pipeline capacity to deliver the gas to external markets. As a comparison to the ARI estimate, the USGS (2002) estimated that the undiscovered CBNG resource in the PRB is 14.3 Tcf.

The amount of CBNG activity appears to be at a lower rate than was forecast by earlier projections in the Final EIS and Proposed Plan Amendment for the PRB Oil and Gas Project (BLM 2003a). New CBNG well numbers fell from a high of slightly more than 4,600 in 2001 to approximately 2,000 in 2004. It is anticipated that the number of new wells would increase so that between 2005 and 2020 the number of new wells drilled per year would range between 2,700 to 2,800. The projected number of cumulative CBNG wells and active CBNG wells are shown in **Figure C-2** in Appendix C. (Refer to Appendix E for assumptions used in the analysis of CBNG activity.) As shown in **Table 3-3**, there would be 30,528 CBNG wells by 2010, much lower than the over 40,000 wells predicted for the same time period in the Final EIS and Proposed Plan Amendment for the PRB Oil and Gas Project (BLM 2003a). It is anticipated that production would increase from the 338 BCF per year observed in 2003 to approximately 640 BCF per year in 2010.

Table 3-3
Projection of CBNG Activity

Wells and Production	Existing	Projections		
	2003	2010	2015	2020
Annual Production (BCF)	338	640	694	631
Active Wells	14,758	30,528	33,890	31,311

3.7.3 Data Sources

The data and information for conventional oil and gas and CBNG resource development projections were derived from several sources including: WOGCC on-line well files, BLM public documents, IHS well data, Wyoming Geological Survey publications, and the BLM Wyoming State Office Reservoir Management Group (RMG).

3.7.4 Assumptions

Assumptions relative to past and present and reasonably foreseeable oil and gas activity are presented in Appendix E.

3.8 Pipelines

3.8.1 Past and Present Development

Major transportation pipelines for the transport of product to outside markets are a key factor in the development of CBNG and conventional oil and gas resources in the Wyoming PRB study area. Major transportation pipelines also provide for transport of CO_2 to crude oil well fields, which depend somewhat on the availability of CO_2 for EOR. Currently, there are 13 major transportation pipeline systems in the PRB that transport gas resources to markets outside of the basin (Flores et al. 2001). The current capacity of these pipeline systems is 1.9 BCF per year. Currently, the combined natural gas production (CBNG and conventional gas) in the Wyoming PRB study area is approximately 1.06 BCF. As shown in **Figure 3-6**, there also are numerous oil, gas, and products pipelines in the study area. Gathering lines associated with conventional oil and gas and CBNG development also occur within the study area. For purposes of this study, these gathering lines have been factored in proportionally on a per well basis as discussed in Appendix E.

3.8.2 Reasonably Foreseeable Development

The availability of major transportation pipeline capacity is a key factor in the future development of CBNG and conventional gas resources in the Wyoming PRB study area. Increased recovery of crude oil also may depend somewhat on the availability of CO_2 for EOR projects.

Additional capacity for transport of natural gas out of the Wyoming PRB is expected to be available by mid-year 2005 as a result of the recently completed Grasslands Pipeline Project, which will move gas from the northeastern PRB to North Dakota where it ties in to the Northern Border Pipeline system. This pipeline was constructed within an existing right-of-way. The only other proposed pipeline to move gas directly out of the Wyoming PRB is the Bison Pipeline Project. The 315-mile-long Bison project (approximately 53 miles of which would occur in the Wyoming study area) would have a capacity of 240 MMcfpd capacity, if constructed (**Figure 3-7**). As with the Grasslands project, the Bison project would move gas northward directly out of the PRB and into the Northern Border Pipeline system (FERC 2004). FERC had expected the Bison project proposal to be filed in December 2003, but no filing was submitted (FERC 2004). As a result, the Bison Pipeline project is assumed to have a low likelihood rating for operation by 2010.

Other proposed pipeline projects designed to move gas out of the Rocky Mountain area include the Cheyenne Plains Expansion, Trailblazer Expansion, Advantage Southern Project, Piceance to Cheyenne, Wheatland Expansion Project, Piceance Basin Expansion, and the Western Frontier Project (FERC 2004). Construction of these projects would help alleviate the overall price differential, but they would not be located in the Wyoming PRB. As a result, they are not considered further in this study.

Estimates of the growth of Wyoming PRB CBNG production range from a 2003 level of 900 MMcfpd to 3 to 4 BCF per day around 2007, and it is anticipated that they would remain at or above those levels until 2015 (Holcomb 2003). At that level, several Grasslands-sized projects could be built and still not cover the expected production capacity of the Wyoming PRB CBNG development. The current capacity is 1.9 BCF per day. With all natural gas production at approximately 1.06 BCF per day, there would be excess capacity at least in the near future.

However, the amount of pipeline capacity is a serious concern that could limit the amount of future CBNG development. Without adequate pipeline capacity, producers would have to defer the drilling of more wells. The pipeline capacity appears to control the total level of production and development that would be expected to occur from the Wyoming PRB coal beds. If production levels were to reach 3 to 4 BCF per day, it is reasonable to assume that four to five (up to 1.0 BCF per day total capacity) Grasslands-sized projects could be built in the near future, but no formal proposals have been made to date. However, based on the assumptions in Appendix E, the current (2003) CBNG production rate of 927 MMcfpd is projected to increase to approximately 1.7 BCF per day in 2020. As a result, the likelihood for additional new pipeline construction is currently unknown.

The CO_2 pipeline from Bairoil, Wyoming, to Salt Creek, Wyoming, may be extended into the study area to the Sussex Field to support EOR activity; however, no formal application had been made as of June 2004. Although it took many years for a CO_2 source to reach the Wyoming PRB, it is very likely that several pipelines could be built in the study area in the near future to provide additional gas for EOR projects. However, since no CO_2 EOR projects have been identified beyond Salt Creek, the likelihood for construction of additional CO_2 pipelines is currently unknown. As a result, they are not considered further in this analysis.

EOR projects using CO_2 not only would require additional transportation pipelines, but also additional field infrastructure including CO_2 delivery pipelines, collection pipelines, and compressors. In order to provide CO_2, just a few of the potential fields would require 100 to 200 hundred miles of new pipeline just by looking at the distances of candidate fields from the CO_2 pipeline terminus at Salt Creek. It is assumed that disturbance from added infrastructure would be minimal since pipelines and compressors most likely would be placed in previously disturbed areas (roads and central processing facilities) (BLM 2001).

3.8.3 Data Sources

Information on major natural gas transportation pipelines was derived from FERC web site data, BLM documents, and published sources.

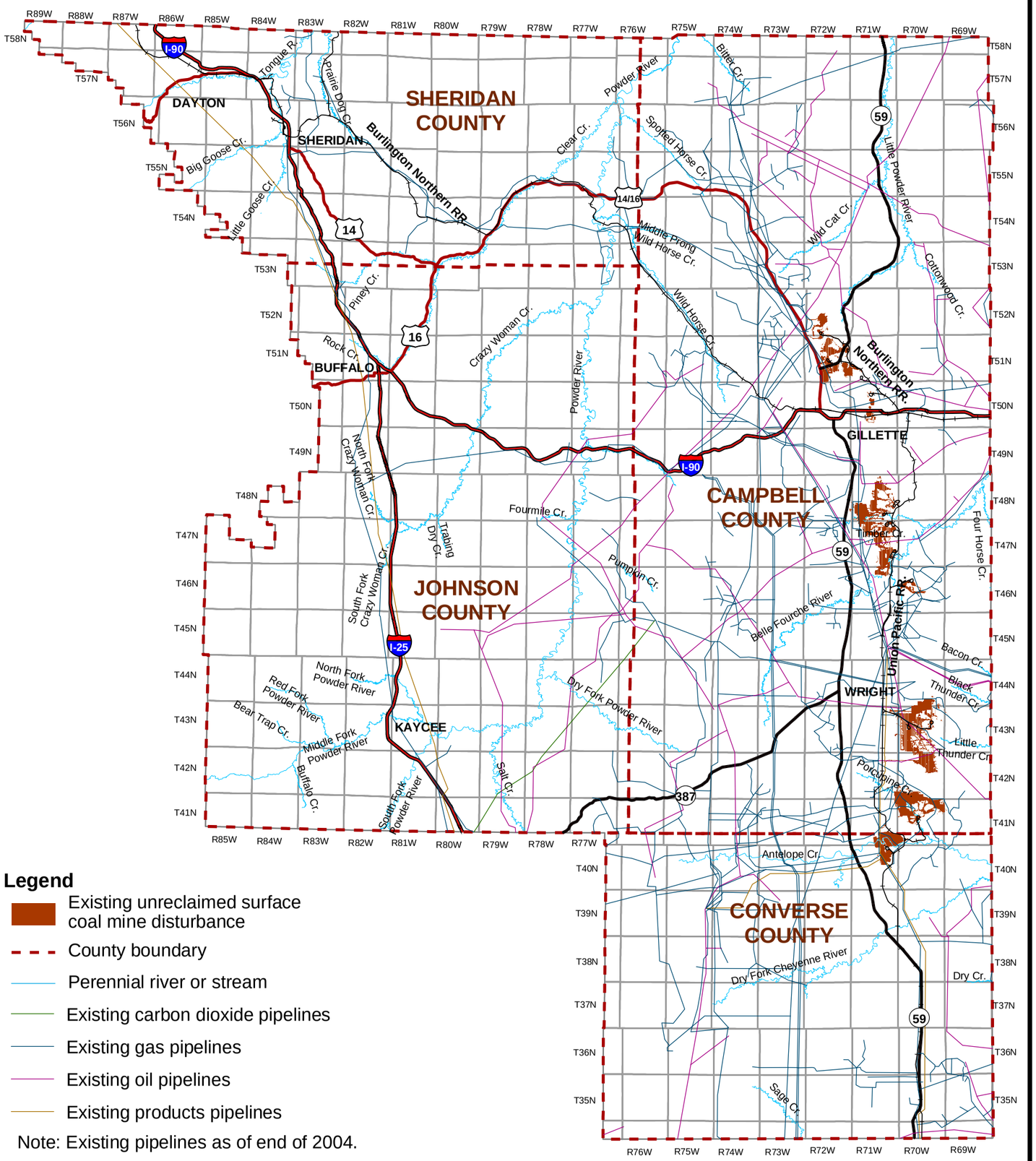
3.8.4 Assumptions

In addition to the information obtained in the identified data sources, the following assumptions were used to define specific impact-causing parameters for pipelines:

Past and Present Development:

- Present pipeline capacity out of the PRB is 1.9 BCF per day, and daily production is up to 1 BCF.

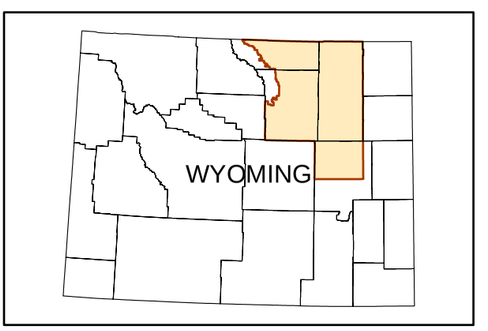
- It is assumed that existing pipeline rights-of-way have a disturbance width of 50 feet, which conservatively accounts for access roads, ground-disturbing maintenance activities, and permanent facilities (e.g., compressor stations, valves, etc.) located at intervals along the rights-of-way.

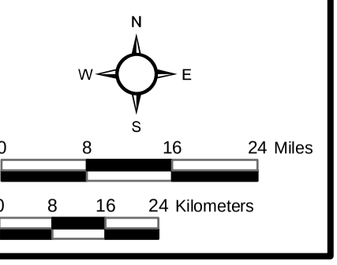


Legend

- Existing unreclaimed surface coal mine disturbance
- County boundary
- Perennial river or stream
- Existing carbon dioxide pipelines
- Existing gas pipelines
- Existing oil pipelines
- Existing products pipelines

Note: Existing pipelines as of end of 2004.





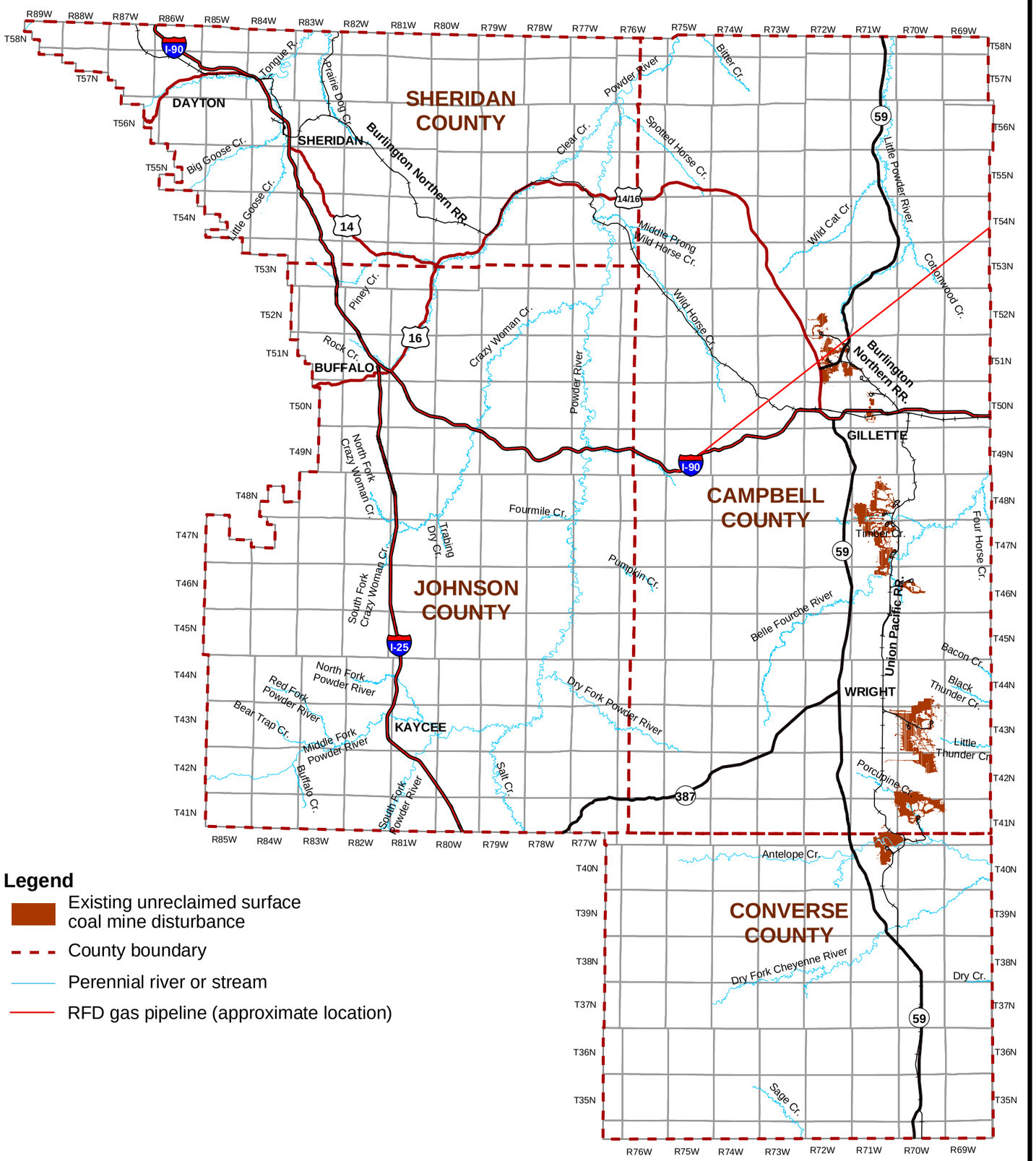
Source: Debruin 2002.

Powder River Basin Coal Review

Figure 3-6

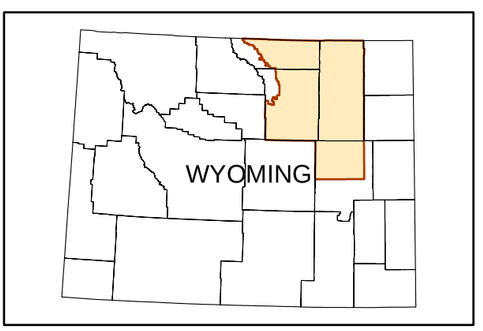
Existing Pipelines

07/20/05



Legend

- Existing unreclaimed surface coal mine disturbance
- County boundary
- Perennial river or stream
- RFD gas pipeline (approximate location)



N
W E
S

0 8 16 24 Miles

0 8 16 24 Kilometers

Source: Debruin 2002; FERC 2004.

Powder River Basin Coal Review

Figure 3-7
RFD Major Pipelines

07/21/05

- In the study area, there are 2,622 miles of natural gas transportation pipelines, 906 miles of crude oil pipelines, 210 miles of petroleum product pipelines, and 37 miles of CO_2 pipeline.

RFD:

- Any new major transportation pipelines would incur a disturbance area based on an average construction right-of-way width of 100 feet during the year of construction. It is assumed that in subsequent years there would be a potential right-of-way disturbance width of 50 feet, which conservatively accounts for access roads, ground-disturbing maintenance activities, and permanent facilities (e.g., compressor stations, valves, etc.) located at intervals along the rights-of-way.

3.9 Refineries

3.9.1 Past and Present Development

There are no existing petroleum refineries in the Wyoming PRB study area.

3.9.2 Reasonably Foreseeable Development

No plans for the construction and operation of any petroleum refineries in the Wyoming portion of the PRB have been identified.

3.9.3 Data Sources

Data sources that were reviewed for potential information relative to refineries in the Wyoming PRB study area included databases maintained by the USDOE, Energy Information Administration and input from the CCEDC and Wyoming Business Council.

3.9.4 Assumptions

There are no assumptions relative to refineries.

3.10 Reservoirs and Other Water Developments

Reservoirs in the PRB study area were identified based on the Powder/Tongue River Basin Water Plan (HKM et al. 2002a) and Northeast Wyoming River Basins Water Plan (HKM et al. 2002b). These plans, which encompass the PRB study area, were prepared for the Wyoming Water Development Commission for their Basin Planning Program. The plans identified the key water supply reservoirs (generally 1,000 acre-feet or greater) in these basins; industrial ponds and impoundments were not addressed in the plans.

Industrial ponds or impoundments associated with mining and CBNG development occur within the study area. For purposes of this study, impoundments associated with coal mining activity have been accounted for in the mine-related disturbance areas. The disturbance area associated with

CBNG-related impoundments has been factored in on a per well basis as discussed in Appendix E. As of 2000, there were a total of 1,976 stock water ponds in the study area (BLM 2003a); however, based on the assumed low overall associated acreage per subwatershed, they have been eliminated from further analysis.

3.10.1 Past and Present Development

Currently, there are 14 key water storage reservoirs in the Powder/Tongue River Basin and 5 key water storage reservoirs in the Northeast Wyoming River Basins (HKM Engineering et al. 2003a,b). Three of the key water storage reservoirs located in the Powder/Tongue River Basin planning area (Healy, Lake Desmet, and Muddy Guard No. 2) and two of the key water storage reservoirs in the Northeast Wyoming River Basins planning area (Gillette and Betty No. 1) occur in the Wyoming PRB study area (**Figure 3-4)**. These reservoirs provide for irrigation water and recreational activities.

3.10.2 Reasonably Foreseeable Development

Based on the Powder/Tongue River Basin Water Plan (HKM Engineering et al. 2002a) and the Northeast Wyoming River Basins Water Plan (HKM Engineering et al. 2002b) that were prepared for the Wyoming Water Development Commission for its Basin Planning Program, there are long-range projections for development of additional reservoirs in the Wyoming PRB study area. However, none of these reservoirs have reached the planning stage; therefore, their likelihood is currently unknown. As a result, they have been eliminated from further analysis.

3.10.3 Data Sources

Information presented in the Powder/Tongue River Basin Water Plan (HKM Engineering et al. 2002a) and the Northeast Wyoming River Basins Water Plan (HKM Engineering et al. 2002b) was used to develop the reservoirs and other water developments section of this report. These plans were developed for the Wyoming Water Development Commission for their Basin Planning Program.

3.10.4 Assumptions

No assumptions were required for this study to define specific impact-causing parameters for reservoirs and water developments.

3.11 Other Industrial Manufacturing

3.11.1 Past and Present Development

There are a number of existing industrial manufacturing establishments located in the Wyoming PRB study area. Most are relatively small with fewer than 25 employees and predominately serve local and regional markets, the majority of which are directly or indirectly related to energy resource development and production. For example, L&H Welding and Machine based in Gillette and the

largest industrial manufacturing firm in the region specializes in repairs, rebuilding, and manufacturing for the mining industry. Other industrial manufacturing establishments in the region provide metal fabrication, metal plating, custom and precast concrete products, and specialized chemical products and services (Dun & Bradstreet 2003). Over the years, some of these firms have expanded such that they now support activities and serve markets outside the PRB region. However, they remain dependent upon the local and regional markets to sustain their existing operations.

3.11.2 Reasonably Foreseeable Development

It is anticipated that chemical feed stock plants supplying the mining industry with materials such as ammonium nitrate fuel oil would be expanded. It is assumed that increased coal production would result in an increased demand for fuels and explosives. This increased demand could result in the need for the development of new off site chemical feed stock plants in the study area. Although CANDO reports that a company is considering this prospect (Werner 2004), project-specific information is not available. As a result, the potential development of new chemical feed stock plants is not considered further in this analysis.

Local economic development organizations, including CCEDC and CANDO are continually engaged in efforts to recruit or assist new business formation in the PRB study area. For example, CANDO is pursuing development of an ammonium nitrate plant (using methane as a feedstock) in the Bill, Wyoming, area, as well as location of an aluminum mill in the same general location. These and similar prospects are long-term potential whose outcomes are uncertain and for which little information and detail are available. As a result, they have been eliminated from analysis in this study.

3.11.3 Data Sources

Information relative to potential major industrial development was obtained from state and local business and economic development organizations.

3.11.4 Assumptions

There are no assumptions relative to other industrial manufacturing.

3.12 Other Development

3.12.1 Past and Present Development

In addition to the specific projects and developments described above, the PRB hosts a vast network of additional public and private physical infrastructure, private businesses, and public activities that has developed over time. Examples of infrastructure include the highway and road networks, airports, government offices, hospitals, public schools, municipal water systems, and extensive residential and commercial real estate development. Private enterprises include local retail and service establishments, newspaper publishing, and transportation and distribution firms.

The construction, maintenance, and continuing operations associated with this network of development represent an extensive series of public and private investments, as well as changes in land use, surface disturbances, water consumption, and the factors that characterize local air quality. Those investments and changes have occurred over a period of time and in response to many different influences.

3.12.2 Reasonably Foreseeable Development

There are numerous current and anticipated plans for future investment in public and private infrastructure in the PRB. Such investments would include state and local investment in transportation, administrative, and educational facilities. A number of planned investments are summarized below. Given the timing, scale, year-to-year variability, relatively short construction timetables associated with such public investments, the existence of a relatively large and diversified construction industry in the region and nearby areas, and the limited potential for these projects to alter long-term conditions in the PRB, they are not included in the RFD database. However, one or more of these and similar projects could warrant consideration in a cumulative analysis for a site-specific project due to proximity or coincidental project schedules and timetables.

Highways and Airports

Public highways and airports are important components of the public infrastructure in the PRB. The Wyoming Department of Transportation (WYDOT) prepares an annual State Transportation Improvement Program (STIP) based on an ongoing process of needs assessment, priority rating, fiscal analysis, and manpower analysis. The 2004 STIP includes planned construction for the 2004 fiscal year and preliminary engineering estimates for projects with anticipated construction dates through 2009. In general, Wyoming transportation projects scheduled over the next 5 years include maintenance, reconstruction, and improvement projects. Airport improvement plans consist primarily of pavement rehabilitation and overlays, with some minor expansion of taxiways, aprons, and parking. No construction of new highways is scheduled, and no new airports are proposed.

The estimated 2005 through 2009 anticipated construction costs for highway and airport maintenance, reconstruction, and improvement projects in the study area total approximately $215.4 million. The level of construction and location of the projects included in these estimates would vary from year to year.

Other Public Facilities

Campbell County

A $10.7 million expansion and renovation of the Campbell County courthouse is scheduled for completion in 2005 (Gillette News-Record 2004b). In addition, a capital facilities tax ballot question in Campbell County in the 2004 election asked voters to approve the imposition of a $0.01 sales and use tax dedicated to the following capital facilities.

- A $14.4 million Gillette Campus of the Northern Wyoming Community College to house updated and expanded diesel mechanic and welding programs.

- Two community development projects in Wright.

Voters also were asked to approve an increase in the lodging tax from 2 percent to 3 percent to help fund operation of a visitor center. Both tax measures were defeated. Renewed attempts to gain voter approval to proceed with one or more of these projects could be anticipated during the RFD scenario. However, the timing and outcomes of such attempts are unknown.

A special election seeking approval of a $19.5 million expansion of the CAM-Plex conference and multi-event center facility in Gillette was held in May 2005; the expansion was approved.

City of Gillette

The Fiscal Year 2004 – 2005 City of Gillette budget contains over $14 million for capital projects including $5.3 million for pavement management and street improvement projects, $900,000 for drainage projects, $250,000 for parks projects, $2.8 million of water projects, and $4.05 million for sewer projects. In addition, the city plans to spend $2.3 million for waste water treatment plant renovation and expansion, a multi-year project anticipated to cost $10.9 million in total (City of Gillette 2004a).

School Districts

The Wyoming School Facilities Commission (WSFC) oversees all aspects of construction and maintenance of school facilities and physical plant. School districts must submit a 5-year plan for facilities spending under the categories of minor capital construction, capital construction, and major maintenance. The currently approved master plans include a total of $72.3 million in new capital construction for the 7 school districts that are completely or partially in the Wyoming PRB study area (WSFC 2005). Of the 5-year total, approximately $60 million is projected to occur by 2008. Minor capital construction and major maintenance estimates have been excluded, as they represent ongoing facility costs.

General Industrial and Commercial Development

Additional private sector development may occur within the context of normal community and economic development. For example, the CCEDC concluded a business retention survey of 98 major employers, representing 47 percent of the total employment in Gillette. Of the 98 entities, 57 had current job openings totaling 351 positions, most in the skilled trades and crafts. Additionally, these companies anticipate 2 to 3 percent employment growth in the next several years and anticipate a combined capital investment in excess of $30 million through 2006 (Bigelow 2004). While these economic stimuli are collectively noteworthy in the context of local economic development, there is no single employer or event warranting inclusion in the RFD.

Commercial development potentials include an announcement by Home Depot to construct a 102,000 square-foot store in Gillette and unconfirmed reports that Wal-Mart will expand its existing Gillette store into a Super Wal-Mart on the same site.

While these economic stimuli are collectively noteworthy in the context of local economic development, there is no single employer or event warranting inclusion in the RFD.

3.12.3 Data Sources

Information regarding public sector infrastructure plans was compiled from published state and local documents and discussions with local officials.

3.12.4 Assumptions

- Portions of U.S. Highway 14/16 and SR 59 may have to be relocated to accommodate coal mining activities. Under both the upper and lower coal production scenarios, the Eagle Butte Mine is expected to begin mining coal from their currently proposed LBA tract in 2015, which would affect approximately 1.5 miles of U.S. Highway 14/16. Under the upper production scenario, the Belle Ayr Mine is expected to forgo mining of currently leased reserves under SR 59 to pursue reserves to the north. However, if an LBA is not submitted for these reserves, or if the mine is unsuccessful in obtaining the new reserves, it is likely that approximately 1.5 miles of SR 59 would be affected by mining between 2015 and 2020.

- Any new surface disturbance associated with highway and airport maintenance projects (e.g., resurfacing) would be minimal or would involve lands that previously were disturbed, but which have since been revegetated.

- New surface disturbance associated with future public infrastructure and private commercial and industrial development would be limited and occur primarily within or adjacent to the presently urbanized areas.

3.13 Relationship Among Projects

Many of the energy-related and industrial projects in the PRB study area are interdependent. In addition, many of the RFD activities in the PRB are interrelated or dependent upon other types of industries to provide the necessary infrastructure to support their development and operation. For example, coal mines are dependent on rail lines with sufficient capacity to transport coal to power plants outside of the PRB, or on the presence of mine-mouth coal-fired power plants. Power plants in turn are dependent on the availability of sufficient transmission line capacity for the transport of electricity to markets. The oil and gas industry is dependent upon the availability of sufficient transportation pipeline capacity for the transport of product to markets outside of the basin. Alternately, some of the identified projects are related from the standpoint of resource impacts, such as the potential cumulative effects of groundwater drawdown associated with the coal mine and CBNG industries. As a result, the PRB Coal Review has included the array of projects identified above to define the development limitations that exist as a result of their interdependency (a factor in determining the likelihood for development of the RFDs) and to fully analyze the potential impacts in the study area.

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5.0 REFERENCES

5.1 References Cited in Text

Advanced Resources International (ARI). 2002. Powder River Basin Coal Bed Methane Development and Produced Water Management Study. Internet web site: http://www.netl.doe.gov/scng/policy/ refshelf/PowderRiverBasin.pdf. November 2002.

Beels, P. 2005. BLM Buffalo Field Office. Personal communication with W. Berg, ENSR. May 12, 2005.

Bigelow, S. 2004. Executive Director, Campbell County Economic Development Corporation. Personal communication with G. Blankenship, Blankenship Consulting LLC. July 9, 2004.

Bureau of Land Management (BLM). 2003a. Final Environmental Impact Statement and Proposed Plan Amendment for the Powder River Basin Oil and Gas Project. Wyoming State Office and Buffalo Field Office Cheyenne and Buffalo, Wyoming. January 2003.

_____. 2003b. Final Environmental Impact Statement for the Pittsburg and Midway Coal Mining Company Coal Exchange Proposal. Wyoming State Office and Casper Field Office, Cheyenne and Casper, Wyoming. July 2003.

_____. 1996. Coal Development Status Check Powder River Federal Coal Region Montana & Wyoming Data Tables. Data Compiled by: Wyoming Bureau of Land Management Buffalo Resource Area, Casper District, & State Offices, and Montana Bureau of Land Management Powder River Resource Area, Miles City District & State Offices.

Bureau of Land Management (BLM) Reservoir Management Group (RMG) 2005. Wyoming State Office. Personal communications with W. Berg and D. Dufresne, ENSR. March and April 2005.

Burlington Northern and Santa Fe (BNSF) Railway, Coal Business Unit. 2001. Guide to Coal Mines 2001. Internet web site: http://www.bnsf.com.

City of Douglas. 2004. A Feasibility Study of Coal-based Industrial Development in Douglas, Wyoming and the Surrounding Area. Prepared by the Spearman Group for the City of Douglas.

DeBruin, R. 2002. Oil and Gas Fields Map of the Powder River Basin, Wyoming. Map Series 51. Wyoming State Geological Survey. Laramie, Wyoming.

DeBruin, R. H. 2001. Carbon Dioxide in Wyoming. Wyoming State Geological Survey, Laramie, Wyoming. Information Pamphlet No. 8.

Drew, L. J. 1990. Oil and Gas Forecasting: Reflections of a Petroleum Geologist. Oxford University Press, New York, New York; 252p.

Dun & Bradstreet. 2003. MarketPlace Database, Oct. – Dec. 2003, Business listings for Wyoming.

5.0 References

Eggerman, C. 2005. Environmental Engineer, Wyoming Oil and Gas Conservation Commission, Casper, Wyoming. Personal communication with W. Berg, ENSR. April 13, 2005.

ENSR. 2005. Task 1D Report for the Powder River Basin Coal Review, Current Environmental Conditions. Prepared for the Bureau of Land Management Casper Field Office and Wyoming State Office. June 2005.

Federal Energy Regulatory Commission (FERC). 2004. Major Pipeline Projects on the Horizon as of February 2004. Internet web site: http://www.ferc.gov/for-citizens/projectsearch/SearchProjects.aspx. Accessed July 2, 2004.

Flores, R. M., G. D., Stricker, J. F. Meyer, T. E. Doll, P. H. Norton, Jr., R. J. Livingston, and M. C. Jennings. 2001. A Field Conference on Impacts of Coalbed Methane Development in the Powder River Basin. U.S. Geological Survey Open-file Report 01-126.

Foulke, T., R. Coupal, D. Taylor. 2002. Economic Trends in Wyoming's Mineral Sector: Coal. University of Wyoming Cooperative Extension Service. January 2002.

Gillette News Record. 2004. Council Will Back Three Projects. June 9, 2004.

Global Insight. 2004. 2002 Coal Outlook Report. Internet web site: http://www.globalinsight.com. Accessed June 2004.

HKM Engineering, Inc., Lord Consulting, and Watts and Associates. 2002a. Powder/Tongue River Basin Plan. Prepared for Wyoming Water Development Commission Basin Planning Program. February 2002.

_____. 2002b. Northeast Wyoming River Basins Plan. Prepared for Wyoming Water Development Commission Basin Planning Program. February 2002.

Hill & Associates, Inc. 2003. Western U.S. Coal Supply Series, Powder River Basin Coal Supply, Demand, and Prices, 2002-2013.

_____. 2003. Western U.S. Coal Supplies Series, Powder River Basin Coal Supply, Demand, and Prices, 2002-2013.

_____. 2003. Outlook for U.S. Steam Coal, Long-Term Forecast to 2022.

_____. 2002. Western U.S. Coal Supplies Series, Powder River Basin Coal Supply, Demand, and Prices, 2002-2013.

Holcomb, J. 2003. Rocky Mountain Pipeline Assessment. Prepared for Pace Global Energy Services. February 7, 2003. Presented at the Rocky Mountain Association of Geologists and Petroleum Technology Transfer Council Coalbed Methane Symposium. Denver, Colorado. June 10, 2003.

IHS Energy Services™ (IHS). 2004. Oil and Gas Production and Well History Database.

McGregor, A. A. 1972. The Powder River Basin. In: Mallory, W.W., ed., Geologic Atlas of the Rocky Mountain Region: Denver, Colorado. Rocky Mountain Association of Geologists. pp. 269-270.

Montana Department of Environmental Quality (MDEQ). 2003. Annual Reports for the following Mines: Decker, Spring Creek, Absaloka, Rosebud, and Big Sky.

Montgomery Watson Harza (MWH). 2003. BLM Coal Planning Estimates Report. March 20, 2003.

Oil and Gas Journal. 2004. Wyoming (regional summary). Oil and Gas Journal. pp. 44. July 5, 2004.

Platts Research and Consulting, Platts Coal Market Research Services. 2004. 20-year Long Term Price and Volume Forecasts. Internet web site: http://www.platts.com.

Randall, A. G. 1989. Shallow Tertiary Gas Production, Powder River Basin, Wyoming. In: Eisert, J. I. (ed). Gas Resources of Wyoming, Wyoming Geological Association Fortieth Annual Field Conference Guidebook, Casper, Wyoming. pp. 83-96. September 10-14, 1989.

RENTECH Inc. 2004. Economic Conversion of Wyoming Coal to Clean FT Fuels, Presented to State of Wyoming Governor's Office and Business Council. Internet website: http://www.rentechinc.com. Accessed July 2005.

Skibisky, D. 2004. Montana Department of Environmental Quality. Personal communication with B. MacDonald, ENSR. March 14, 2005.

Spencer, D. R. 2004. North East Region Director, Wyoming Business Council. Personal communication with G. Blankenship, HSGA. April 4 and July 9, 2004.

Thunder Basin Coal Company. 2003. 2002-2003 Coal Creek Mine Annual Report. Permit No. 483-T4. February 2003.

U.S. Environmental Protection Agency (USEPA). 2005. Utility Mercury Reductions Rule. Internet web site: http://www.epa.gov/air/mercuryrule/.

U.S. Geological Survey (USGS). 2002. Assessment of Undiscovered Oil and Gas Resources of the Powder River Basin Province of Wyoming and Montana, 2002. USGS National Oil and Gas Assessment Fact Sheet FS-146-02.

Werner, E. 2004. Business Development Director, Converse Area New Development Organization. Personal communication with E. Strid, Mine Engineers, Inc., relative to chemical feed stock plants. April 2004.

Winnecke, G. J. 2003. Future Oil Prices Likely Higher Than Historic $18-22/bbl Consensus. Oil and Gas Journal. pp. 30-37. September 29, 2003.

Wyoming Oil and Gas Conservation Commission (WOGCC). 2005a. Wyoming Oil and Gas Supervisor, Wyoming Oil and Gas Conservation Commission. Personal communication with W. Berg, ENSR, regarding Application Permit to Drill approvals. April 13, 2005.

_____. 2005b. CBM Well Database. Internet web site: http://www.wogcc.state.wy.us/urecordsMenu.cfm.

_____. 2004. Wyoming Statistics. Internet web site: http://wogcc.state.wy.us/cfdocs/2002stats.htm.

Wyoming School Facilities Commission (WSFC). 2005. 2004 Approved Five Year Master Plans. Internet web site: http://sfc.state.wy.us/index.aspx.

5.2 Supporting Documentation used in Report Preparation

Antelope Coal Co. 2003. Wyoming Department of Environmental Quality-Land Quality Division Annual Report. Antelope Mine Permit #525-T7. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. October 1, 2002 – September 30, 2003.

Antelope Coal Co. Antelope Mine 2002 and 2003 Annual Dust Control Report, 2003 Permit Modification Application. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

Black Hills Bentonite, LLC. 2003-2004. Annual Mining Report. May 12, 2004.

Bureau of Land Management (BLM). 2004. Compilation of disturbed and reclaimed acreages provided to the BLM by coal mine operators. Casper Field Office. September 2004.

_____. 2003. West Hay Creek Coal Draft Environmental Impact Statement. Wyoming State Office and Casper Field Office, Cheyenne and Casper, Wyoming. March 2003.

_____. 2003. Pittsburgh and Midway Land Exchange Final Environmental Impact Statement. Wyoming State Office and Rock Springs Field Office, Cheyenne and Rock Springs, Wyoming. July 2003.

_____. 2003. South Powder River Basin Coal Final Environmental Impact Statement. Wyoming State Office and Casper Field Office, Cheyenne and Casper, Wyoming. December 2003.

_____. 2001. Reasonable Foreseeable Development Scenario for Oil and Gas Development in the Buffalo Field Office Area, Campbell, Johnson, and Sheridan Counties, Wyoming. Prepared by the BLM Wyoming State Office Reservoir Management Group, Casper, Wyoming. February 2001.

Burlington Northern and Santa Fe Railway, Coal Business Unit. No date. Guide to Coal Mines Severed by Burlington Northern and Santa Fe Railway. Internet web site: http:/www.bnsf.com. Accessed June 2004.

Caballo Coal Co. 2003. 2003 Annual Mining and Reclamation Report. Rawhide Mine Permit #240-T4. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. October 8, 2002 – October 7, 2003.

Caballo Coal Co. 2003. 2002 – 2003 Annual Mining and Reclamation Report. Caballo Mine Permit #433-T5. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. April 1 2002 – March 31, 2003.

Caballo Coal Co. Rawhide Mine. 2001 and 2002 Annual Dust Control Report. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

Caballo Rojo, Inc. 2003. Land Quality Division Annual Report. Caballo Rojo Mine Permit #511-T6. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. July 1, 2002 – June 30, 2003.

Caballo Rojo, Inc. Caballo Rojo Mine. 2000, 2001, and 2003 Annual Dust Control Report. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

Campbell County, Elections Clerk. Results of the 2004 Election Office. Personal communication with R. Dutton, Sammons/Dutton LLC. March 14, 2005.

City of Gillette. 2004. City of Gillette Budget 2004 – 2005. Internet web site: http://www.ci.gillette.wy.us/budget/BudgetLetter0504.pdf. Accessed July 9, 2004.

Cordero Mining Co. 2003. Cordero Mine Annual Report. Cordero Mine Permit #237-T6. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. August 1, 2002 – July 31, 2003.

DeBruin, R. H. and R. W. Jones, 1989. Coalbed Methane in Wyoming. In: Eisert, J.L. ed., Gas Resources of Wyoming; Wyoming Geological Association of Geologists 40th Field Conference Guidebook, Casper, Wyoming. pp. 97-103. September 10-14, 1989.

Federal Energy Regulatory Commission (FERC). 2004. 2001, 2002, and 2003 Coal Data Base. Internet web site: http://www.ferc.gov. Accessed June 2004.

Gillette News Record. 2004. Construction Will Make Parking Tight. April 2, 2004.

HKM Engineering, Inc. 2003. Wyoming State Water Plan, Northeast Wyoming River Basins Water Plan Technical Memoranda, Appendix G, Industrial Water Use. March 2003.

Hill & Associates, Inc. 2002. Outlook for U.S. Steam Coal, Long-Term Forecast to 2022.

_____. 2001. Western U.S. Coal Supplies Series, Powder River Basin Coal Supply, Demand, and Prices, 2001-2011.

Holcomb, J. 2004. Rocky Mountain Pipeline Infrastructure: The Need for More Capacity. Rocky Mountain Gas Symposium, Denver, Colorado. February 11, 2004.

Ihle, J. 2001. Coal Forecasting: Modeling the 'Commodity'.

5.0 References

Jacobs Ranch Coal Co., (Jacobs Ranch Mine) 2001 and 2002 Annual Dust Control Report, 2003 Permit Modification Application. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

Jacobs Ranch Coal Co. 2003. Annual Report. Jacobs Ranch Mine Permit #271-T4. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. January 1, 2003 – December 31, 2003.

KFx Wyoming, Inc. 2003. Annual Report. KFx Mine Permit #186-T4. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. January 23, 2002 – December 31, 2003.

Powder River Coal Co. 2003. North Antelope Rochelle Mine 2003 Annual Report. North Antelope Rochelle Mine Permit #569-T5. Submitted to the Wyoming Department of Environmental Quality-Land Quality Division. December 2003.

Powder River Coal Co. North Antelope Rochelle Mine 2001 and 2002 Annual Dust Control Report, 2003 Permit Modification Application. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

Powder River Coal Co. Caballo Mine 2000, 2001, and 2002 Annual Dust Control Report, 2003 Permit Modification Application. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

RAG Coal West, Inc. 2003. 2003 Annual Report. Belle Ayr Mine Permit #214-T6. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. January 2003.

RAG Coal West, Inc. Belle Ayr Mine 2001 and 2002 Annual Dust Control Report, 2003 Permit Modification Application. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

RAG Coal West Inc. Eagle Butte Mine. 2001 Annual Dust Control Report. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

RAG Coal West Inc. 2003. 2003 Annual Report. Eagle Butte Mine Permit #428-T4. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. December 2003.

Spencer, D.R. 2004. Northeast Region Director, Wyoming Business Council. Personal communication with G. Blankenship, Blankenship Consulting LLC. April and July 2004.

Thunder Basin Coal Co., LLC. 2003. 2002 – 2003 Coal Creek Mine Annual Report. Coal Creek Mine Permit #483-T4. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. February 2003.

Thunder Basin Coal Co., LLC. 2003. 2003 Black Thunder Mine Annual Report. Black Thunder Mine Permit #233-T6. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. December 2003.

Thunder Basin Coal Co., LLC, (Black Thunder Mine), 2001 and 2002 Annual Dust Control Report, 1999 Section 21 – Construction Permit Application, 2003 Permit Modification Application. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

Thunder Basin Coal Co., LLC. Coal Creek Mine 2003 Permit Modification Application. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

Triton Coal Co., LLC. 2003. 2002 Annual Report. Buckskin Mine Permit #500-T6. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. January 1, 2003 – December 31, 2003.

Triton Coal Co., LLC. 2003. 2003 Wyoming D.E.Q Annual Report. North Rochelle Mine Permit #550-T5. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division.

Triton Coal Co., LLC. North Rochelle Mine 2002 and 2003 Annual Dust Control Report. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

Triton Coal Co., LLC. Buckskin Mine. 2002 Annual Dust Control Report, 2003 Permit Modification Application. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

U.S. Department of Energy (USDOE), Energy Information Administration (EIA). 2004. Refining Capacity Data for U.S. Refinery Operations. Database web site: http://www.eia.doc.gov/oil_gas/petrolium/.

_____. 2003. U.S. Refineries Operable Atmospheric Crude Oil Distillation Capacity (Barrels per Calendar Day) as of January 1, 2003. Internet web site: http://www.eia.doe.gov/neic/rankings/refineries.htm. Accessed July 7, 2004.

_____. No date. Annual Energy Outlook 2004 with Projections to 2025.

U.S Department of Energy (USDOE). No date. U.S. Coal Supply and Demand: 2003 Review.

_____. No date. Annual Coal Report 2002.

U.S. Department of Transportation, Surface Transportation Board (STB). 2001. Dakota, Minnesota & Eastern Railroad Corporation Final Environmental Impact Statement. November 2001. Internet web site: http://www.stb.dot.gov. Accessed June 2004.

_____. 2004. Tongue River Railroad Company, Inc. – Construction and Operation – Western Alignment, Tongue River III Application. December 6, 2004. Internet web site: http://www.stb.dot.gov.

Werner, E. 2004. Business Development Director, Converse Area New Development Organization. Personal communication with G. Blankenship, Blankenship Consulting LLC. June 2004.

Western Fuels – Wyoming, LLC. Dry Fork Mine. 2000 and 2002 Annual Dust Control Report. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

5.0 References

Western Fuels – Wyoming, LLC. 2003. Annual Report. Dry Fork Mine Permit #599-T3. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. February 1, 2002 – January 31, 2003.

Wyodak Resources Dev. Corp. 2003. Annual Report. Wyodak Mine Permit #232-T5. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. November 1, 2002 – October 31, 2003.

Wyodak Resources Dev. Corp. Wyodak Mine. 2002 and 2003 Annual Dust Control Report. Submitted to Wyoming Department of Environmental Quality-Air Quality Division.

Wyoming Coal Resources Co. 2003. Annual Report. Fort Union Mine Permit #659-T2. Submitted to the Wyoming Department of Environmental Quality–Land Quality Division. March 1, 2002 – February 28, 2003.

Wyoming Department of Employment, Office of Mine Inspector. 1997, 1998, 1999, 2000, 2001, 2002, and 2003, Annual Reports.

Wyoming Department of Environmental Quality (WDEQ). 2004. Annual reports as filed for other mines (non-coal mines).

Wyoming Department of Transportation (WYDOT). 2003. 2004 State Transportation Improvement Program.

Wyoming Mining Association, Wyoming Coal Information Committee. A Concise Guide to Wyoming Coal. 2002 Report.

_____. A Concise Guide to Wyoming Coal. 2003 Report.

Wyoming State Engineers Office (WSEO). 2005. Documentation relative to coal mine water production provided to ENSR. January 2005.

Wyoming State Geological Survey. 2003. Wyoming Geo-notes. Number 78. Laramie, Wyoming. November 2003.

APPENDIX A

SUPPORTING TABLES AND FIGURES – COAL MINE SUBREGIONS

Table A-1
Wyoming PRB Coal Development by Subregion
Impact-causing Parameters under the Lower Production Scenario[1]
(based on database)

Subregion	Annual Production for Most Recent Report Year (million tons)	Cumulative Disturbed Area for Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas Available for Reclamation through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas Unavailable for Reclamation through Most Recent Report Year (acres)	Total Employment for Report Year	Annual Water Consumption (mmgpy)	Annual Water Production (acre-feet)
Past and Present (2003)								
Subregion 1	55	12,047	3,054	3,360	5,633	746	387	586
Subregion 2	77	21,249	6,783	6,107	8,359	861	544	1,373
Subregion 3	231	35,498	11,401	13,992	10,105	3,090	1,709	2,295
Total for Past and Present	**363**	**68,794**	**21,238**	**23,459**	**24,097**	**4,697**	**2,640**	**4,254**
Reasonably Foreseeable Development (2010)								
Subregion 1	62	15,231	5,004	3,968	6,260	787	441	505
Subregion 2	95	28,021	12,183	6,830	9,008	1,323	656	2,072
Subregion 3	254	55,410	27,751	16,588	11,070	3,153	1,874	4,354
Total for 2010	**411**	**98,662**	**44,938**	**27,386**	**26,338**	**5,263**	**2,971**	**6,931**
Reasonably Foreseeable Development (2015)								
Subregion 1	74	17,457	6,654	4,202	6,601	830	543	505
Subregion 2	112	32,356	15,683	7,314	9,359	1,369	764	2,072
Subregion 3	281	67,423	38,851	16,983	11,589	3,186	2,077	4,354
Total for 2015	**467**	**117,236**	**61,188**	**28,499**	**27,549**	**5,405**	**3,384**	**6,931**
Reasonably Foreseeable Development (2020)								
Subregion 1	78	19,729	8,429	4,350	6,950	840	569	505
Subregion 2	126	36,994	19,683	7,589	9,723	1,476	845	2,072
Subregion 3	291	80,720	51,351	17,243	12,124	3,215	2,157	4,354
Total for 2020	**495**	**137,443**	**79,463**	**29,182**	**28,797**	**5,531**	**3,571**	**6,931**

[1]Applies to both the Task 1D and Task 3D study areas (**Figures C-1** and **D-1**, respectively).

Table A-2
Wyoming PRB Coal Development by Subregion
Impact-causing Parameters under the Upper Production Scenario[1]
(based on database)

Subregion	Annual Production for Most Recent Report Year (million tons)	Cumulative Disturbed Area for Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year(acres)	Cumulative Unreclaimed Areas Available for Reclamation through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas Unavailable for Reclamation through Most Recent Report Year (acres)	Total Employment for Report Year	Annual Water Consumption (mmgpy)	Annual Water Production (acre-feet)
Past and Present (2003)								
Subregion 1	55	12,047	3,054	3,360	5,633	746	387	586
Subregion 2	77	21,249	6,783	6,107	8,359	861	544	1,373
Subregion 3	232	35,498	11,401	13,992	10,105	3,090	1,709	2,295
Total for Past and Present	**364**	**68,794**	**21,238**	**23,459**	**24,097**	**4,697**	**2,640**	**4,254**
Reasonably Foreseeable Development (2010)								
Subregion 1	78	15,911	5,404	4,217	6,290	811	570	505
Subregion 2	117	29,279	13,416	7,536	8,328	1,375	807	2,072
Subregion 3	284	57,258	27,951	18,236	11,070	3,153	2,101	4,354
Total for 2010	**479**	**102,448**	**46,771**	**29,989**	**25,688**	**5,339**	**3,478**	**6,931**
Reasonably Foreseeable Development (2015)								
Subregion 1	104	18,490	7,329	4,500	6,660	905	785	505
Subregion 2	138	35,624	18,616	8,248	8,760	1,431	952	2,072
Subregion 3	301	70,431	39,451	19,391	11,589	3,186	1,834	4,354
Total for 2015	**543**	**124,545**	**65,396**	**32,139**	**27,009**	**5,522**	**3,571**	**6,931**
Reasonably Foreseeable Development (2020)								
Subregion 1	121	21,311	9,529	4,766	7,013	1,019	935	505
Subregion 2	148	42,981	25,016	8,758	9,206	1,444	1,018	2,072
Subregion 3	307	84,797	51,651	21,021	12,124	3,215	2,279	4,354
Total for 2020	**576**	**149,089**	**86,196**	**34,545**	**28,345**	**5,678**	**4,232**	**6,931**

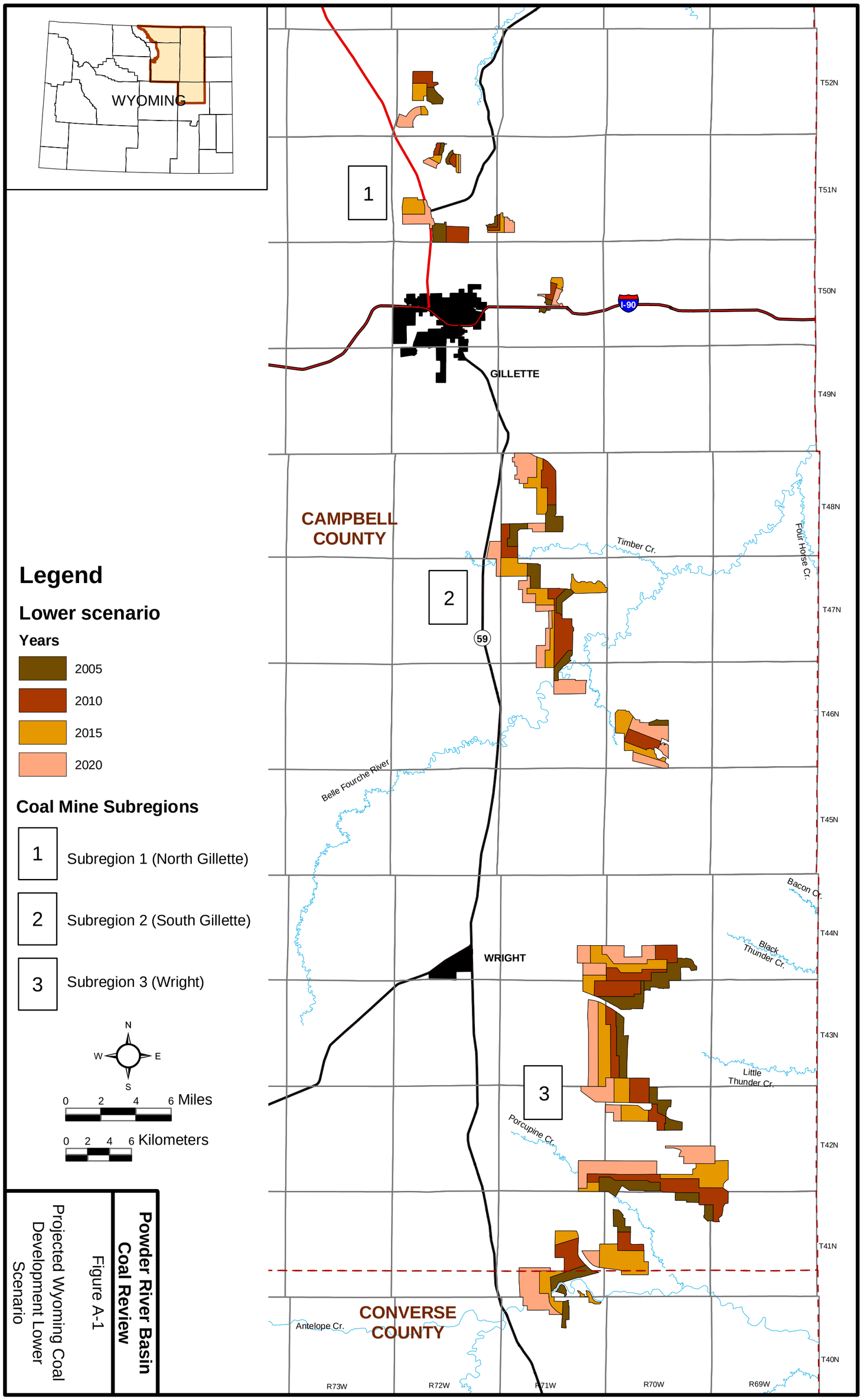
[1] Applies to both the Task 1D and Task 3D study areas (**Figures C-1** and **D-1**, respectively).

Table A-3
Montana PRB Coal Development by Subregion
Impact-causing Parameters under the Lower Production Scenario
(based on database)

Subregion	Annual Production for Most Recent Report Year (million tons)	Cumulative Disturbed Area for Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas Available for Reclamation through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas Unavailable for Reclamation through Most Recent Report Year (acres)	Total Employment for Report Year	Annual Water Consumption (mmgpy)	Annual Water Production (acre-feet)
Past and Present (2003)								
Subregion 4	17	9,581	2,474	3,677	3,430	277	122	0
Subregion 5	19.1	22,037	11,318	7,831	2,888	456	141	0
Total for Past and Present	**36.1**	**31,618**	**13,792**	**11,508**	**6,318**	**733**	**263**	**0**
Reasonably Foreseeable Development (2010)								
Subregion 4	21	29,310	3,614	15,226	10,470	316	151	0
Subregion 5	20	64,393	15,718	39,981	8,694	432	144	0
Total for 2010	**41**	**93,703**	**19,332**	**55,207**	**19,164**	**748**	**295**	**0**
Reasonably Foreseeable Development (2015)								
Subregion 4	28	39,815	4,764	20,821	14,230	400	202	0
Subregion 5	20	84,252	18,924	53,716	11,612	411	144	0
Total for 2015	**48**	**124,067**	**23,688**	**74,537**	**25,842**	**811**	**346**	**0**
Reasonably Foreseeable Development (2020)								
Subregion 4	36	50,928	6,089	26,389	18,450	492	260	0
Subregion 5	20	103,309	22,303	67,067	13,939	391	144	0
Total for 2020	**56**	**154,237**	**28,392**	**93,456**	**32,389**	**883**	**404**	**0**

Table A-4
Montana PRB Coal Development by Subregion
Impact-causing Parameters under the Upper Production Scenario
(based on database)

Subregion	Annual Production for Most Recent Report Year (million tons)	Cumulative Disturbed Area for Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas Available for Reclamation through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas Unavailable for Reclamation through Most Recent Report Year (acres)	Total Employment for Report Year	Annual Water Consumption (mmgpy)	Annual Water Production (acre-feet)
Past and Present (2003)								
Subregion 4	17	9,581	2,474	3,677	3,430	277	122	0
Subregion 5	19.1	22,037	11,318	7,831	2,888	456	141	0
Total for Past and Present	**36.1**	**31,618**	**13,792**	**11,508**	**6,318**	**733**	**263**	**0**
Reasonably Foreseeable Development (2010)								
Subregion 4	27	29,686	3,614	15,602	10,470	372	195	0
Subregion 5	24	64,713	15,718	40,151	8,844	476	174	0
Total for 2010	**51**	**94,399**	**19,332**	**55,753**	**19,314**	**848**	**369**	**0**
Reasonably Foreseeable Development (2015)								
Subregion 4	35	40,737	4,764	21,743	14,230	444	252	0
Subregion 5	39	85,823	18,880	54,831	12,112	707	282	0
Total for 2015	**74**	**126,560**	**23,644**	**76,574**	**26,342**	**1151**	**534**	**0**
Reasonably Foreseeable Development (2020)								
Subregion 4	42	52,541	6,089	28,002	18,450	491	302	0
Subregion 5	41	108,343	22,302	70,852	15,189	676	296	0
Total for 2020	**83**	**160,884**	**28,391**	**98,854**	**33,639**	**1167**	**598**	**0**

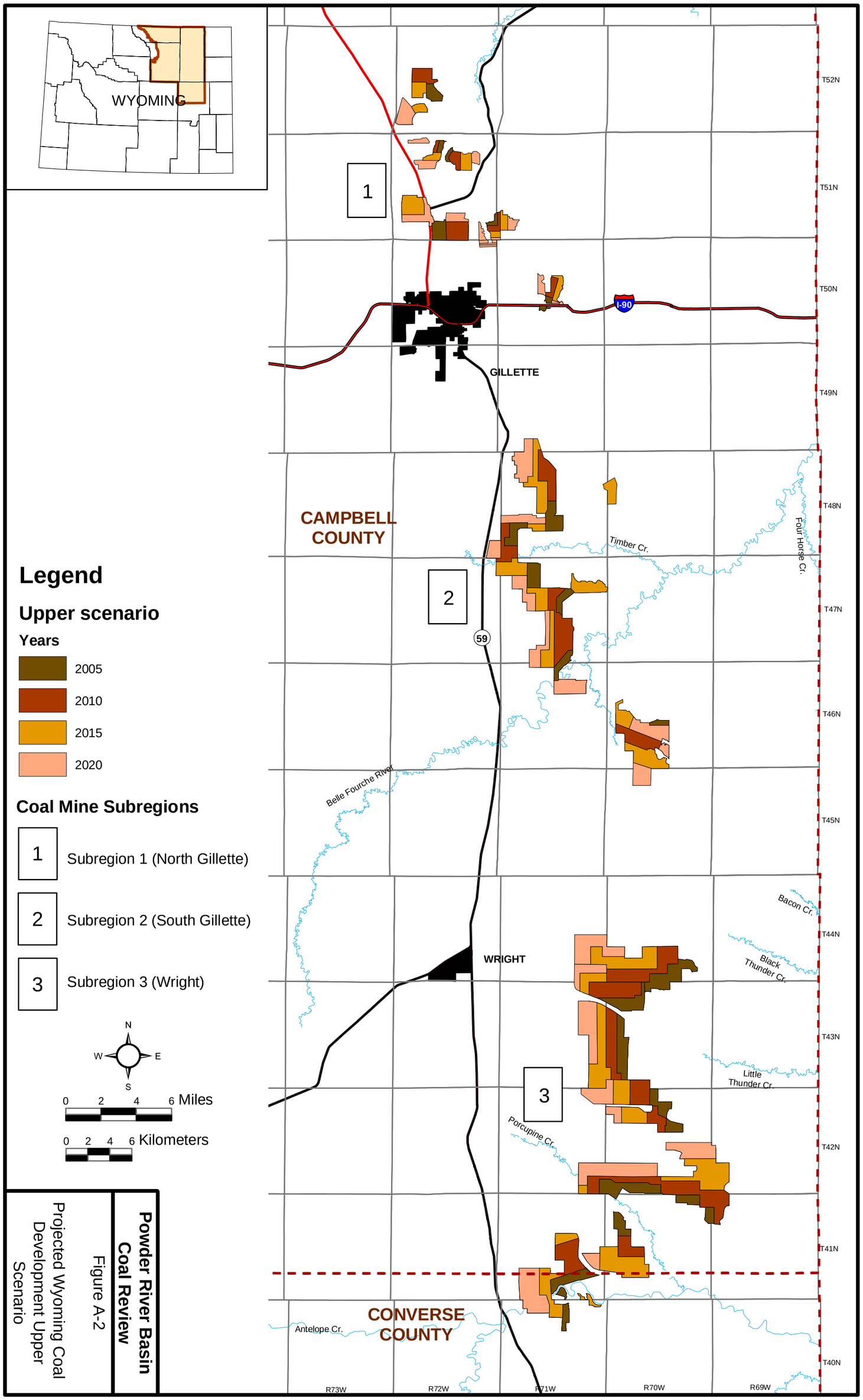


Powder River Basin Coal Review

Figure A-1

Projected Wyoming Coal Development Lower Scenario

07/20/05

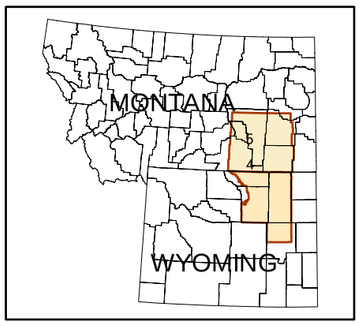


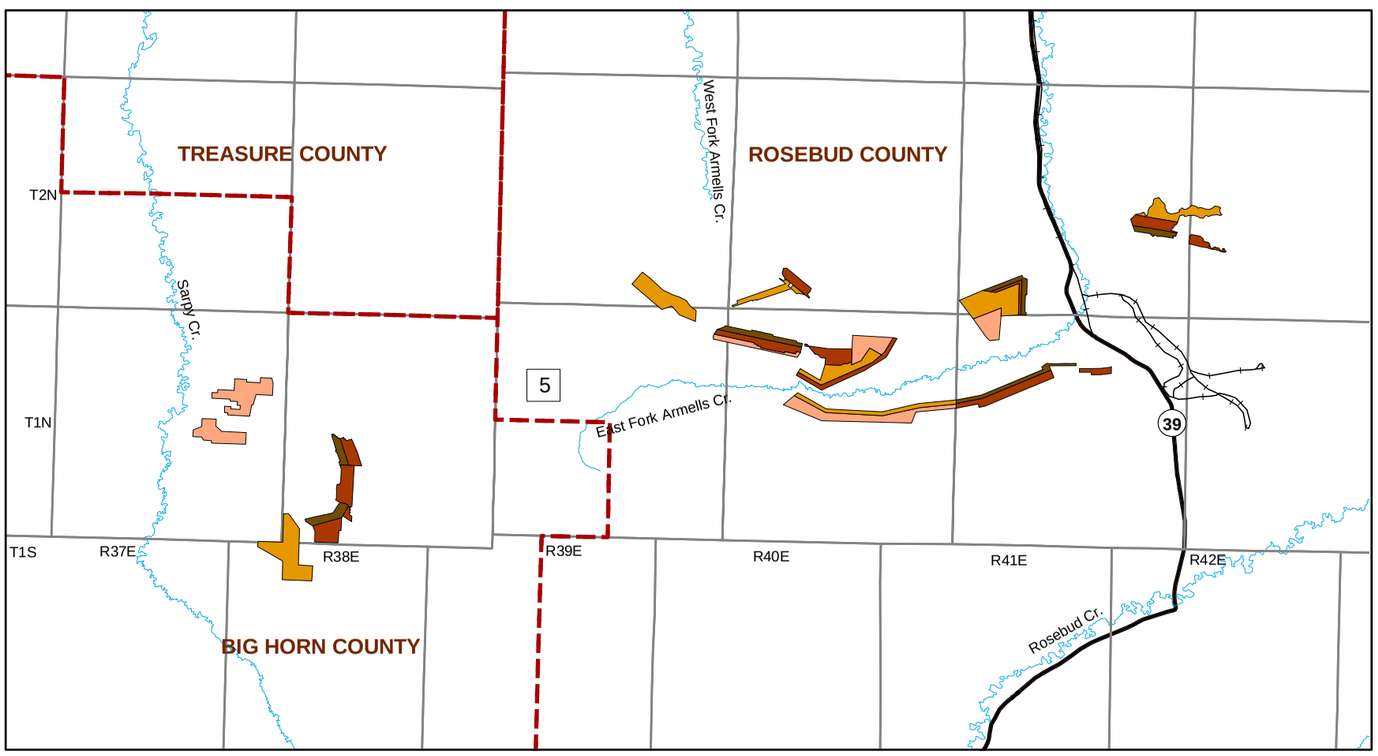
Powder River Basin Coal Review

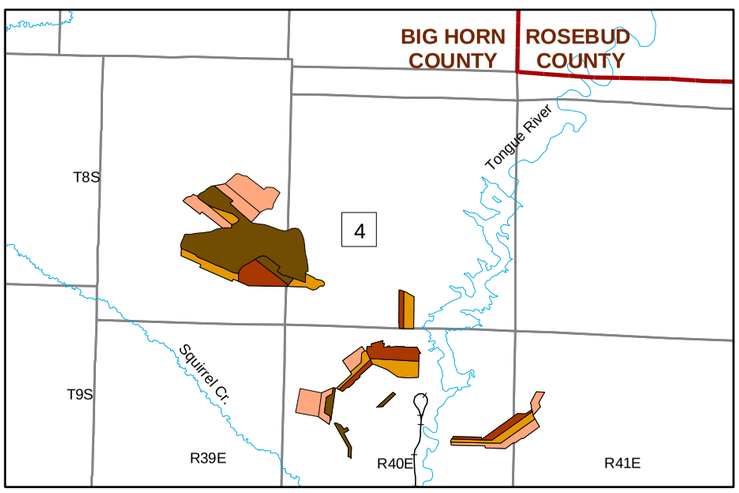
Figure A-2

Projected Wyoming Coal Development Upper Scenario

07/20/05







Legend

Lower Scenario

Years

- 2005
- 2010
- 2015
- 2020

Coal Mine Subregions

- 4 Subregion 4 (Sheridan/Decker)
- 5 Subregion 5 (Ashland/Colstrip)

N
W E
S

0 2 4 6 Miles

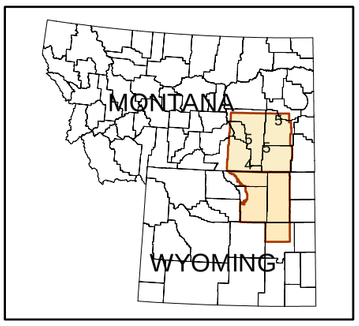
0 2 4 6 Kilometers

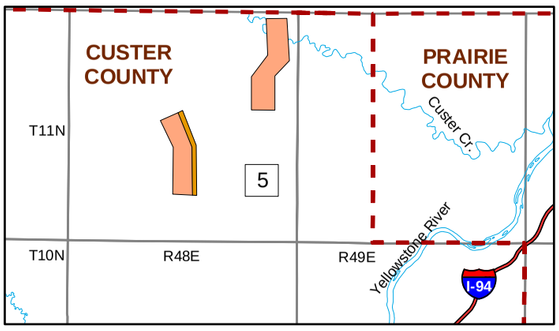
Powder River Basin Coal Review

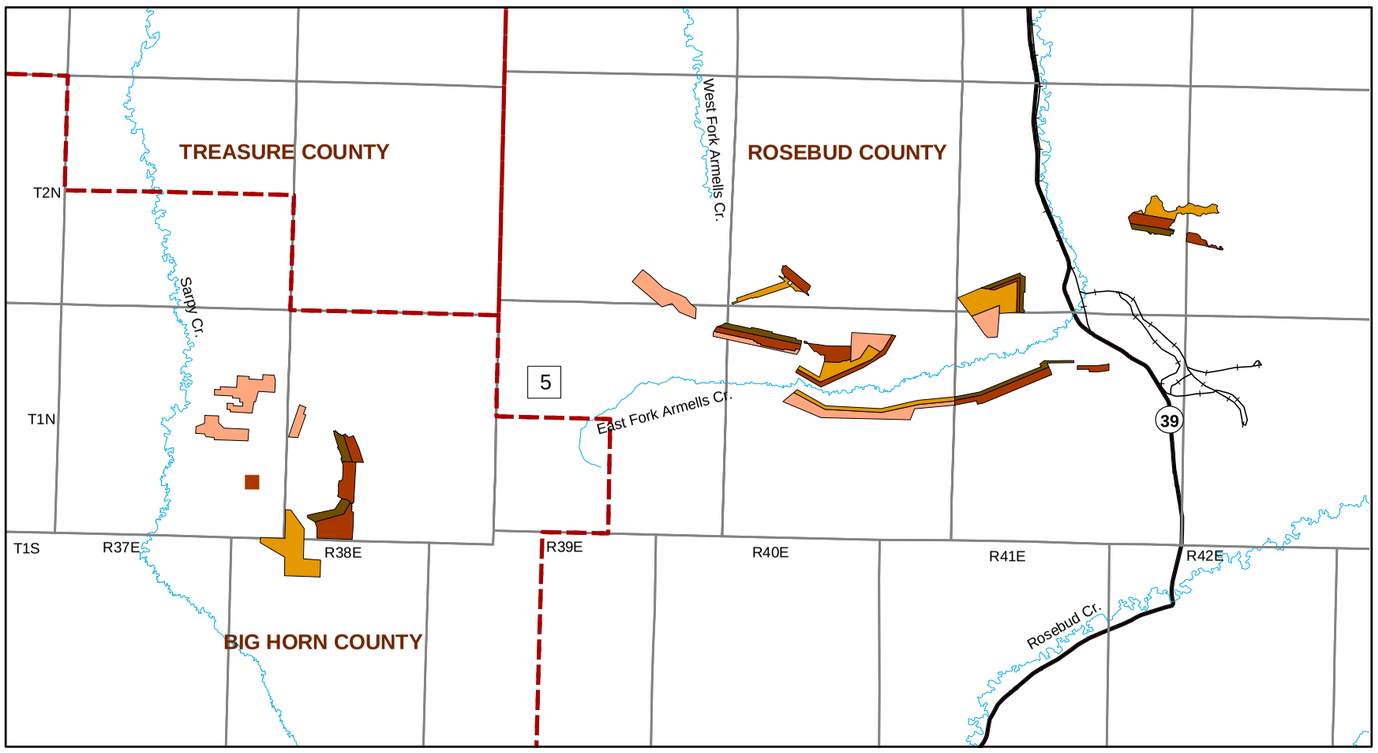
Figure A-3

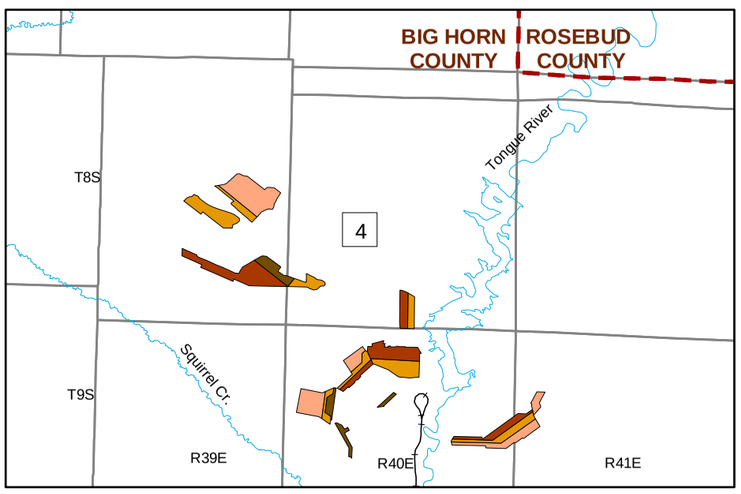
Projected Montana Coal Development Lower Scenario

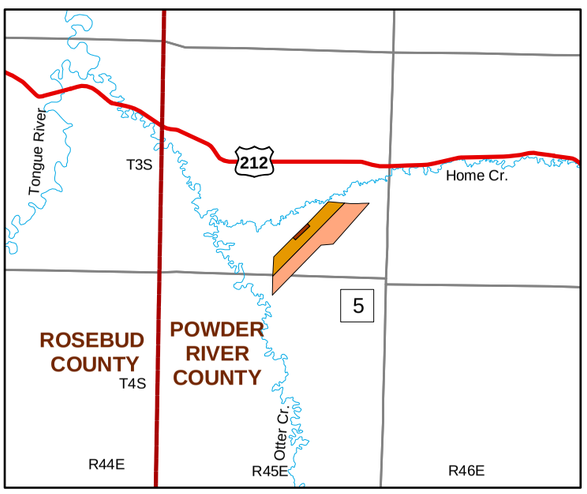
07/20/05











Legend

Upper Scenario

Years

- 2005
- 2010
- 2015
- 2020

Coal Mine Subregions

- 4 Subregion 4 (Sheridan/Decker)
- 5 Subregion 5 (Ashland/Colstrip)

N
W E
S

0 2 4 6 Miles

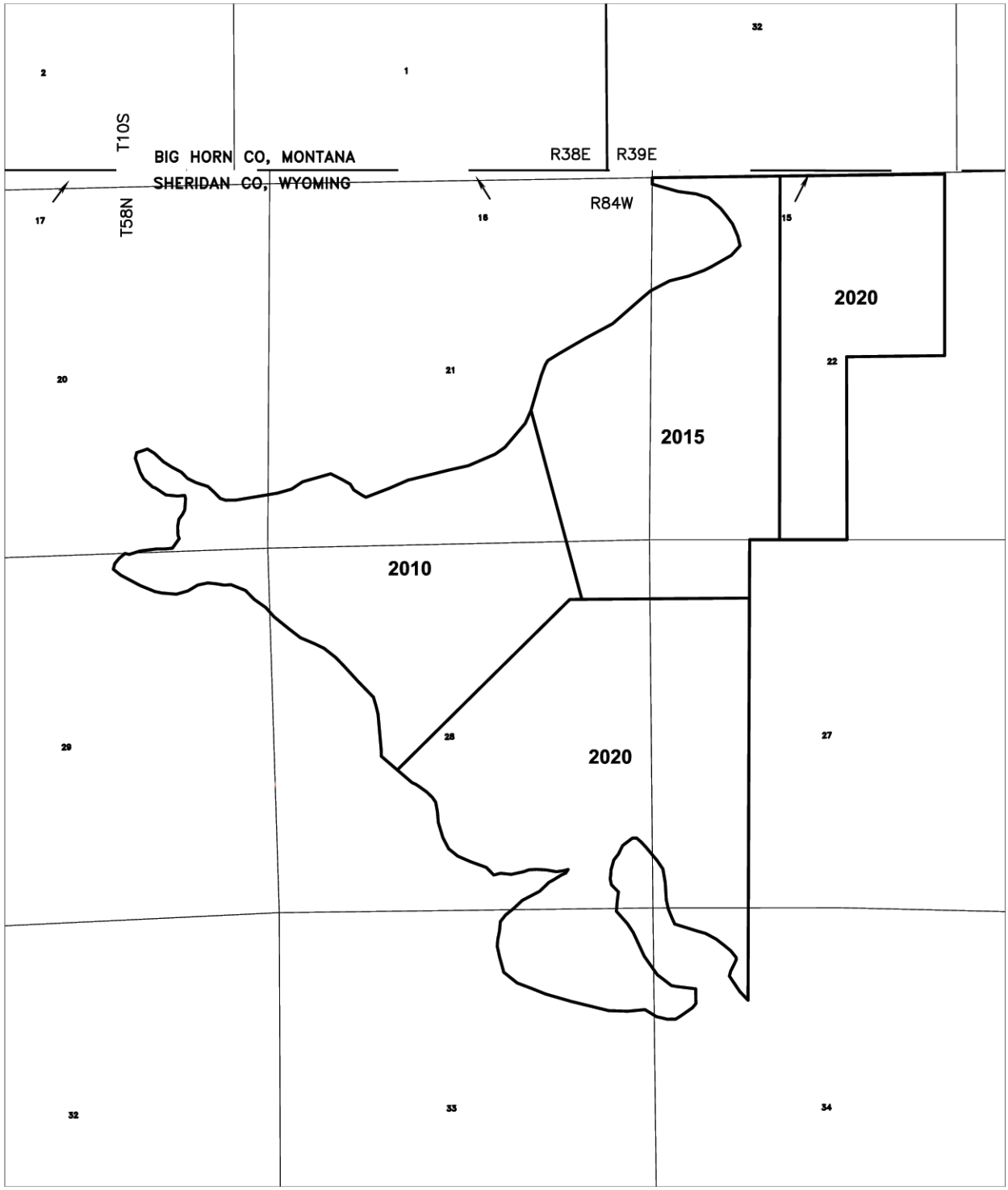
0 2 4 6 Kilometers

Powder River Basin Coal Review

Figure A-4

Projected Montana Coal Development Upper Scenario

07/20/05



LEGEND:

RESERVE DEVELOPMENT

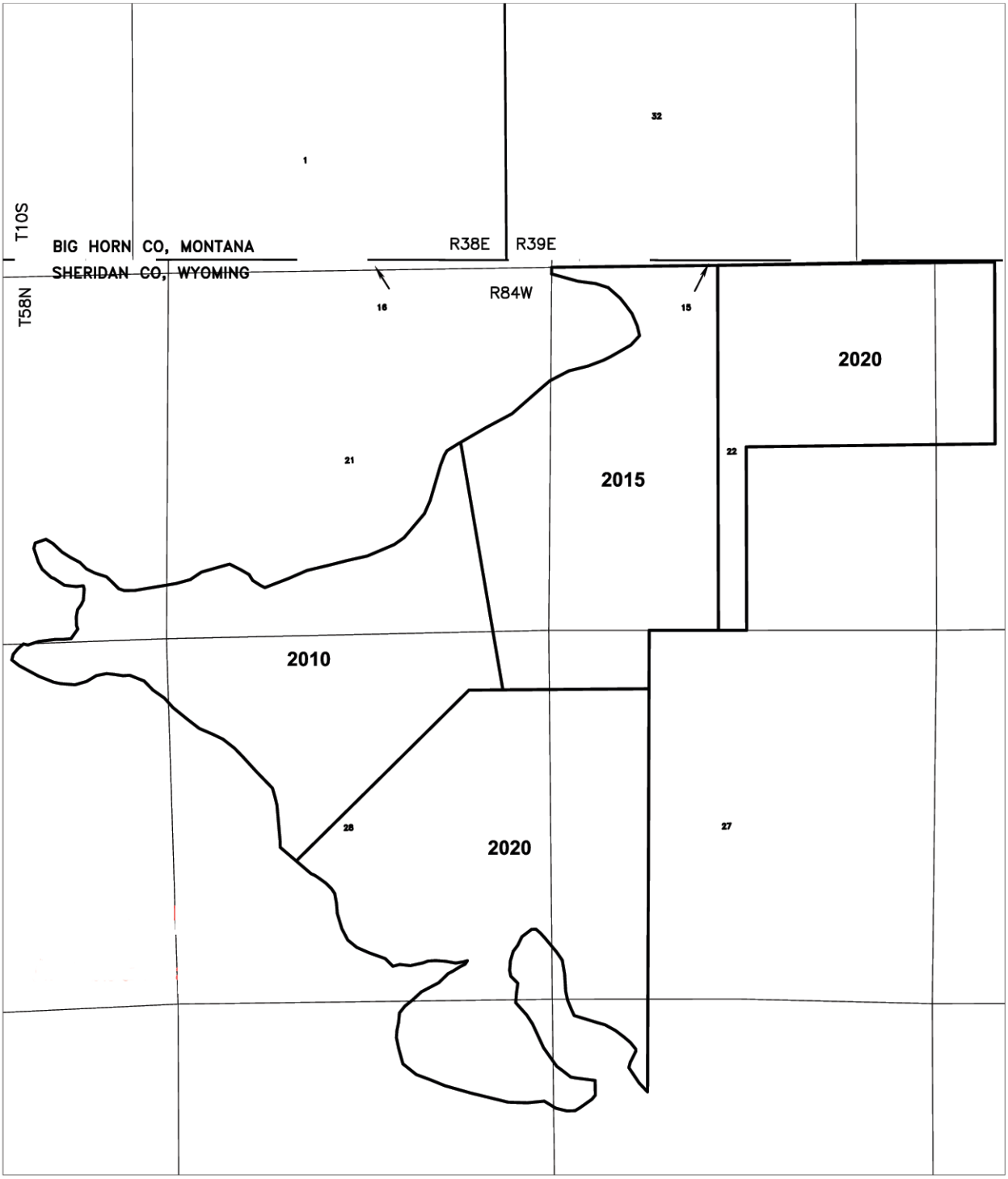
SCALE IN FEET

1,000 0 1,000 2,000

Powder River Coal Review

Figure A-5

Wyoming Portion of Subregion 4
Lower Scenario



LEGEND:

RESERVE DEVELOPMENT

N

SCALE IN FEET

1,000 0 1,000 2,000

Powder River Coal Review

Figure A-6

Wyoming Portion of Subregion 4
Upper Scenario

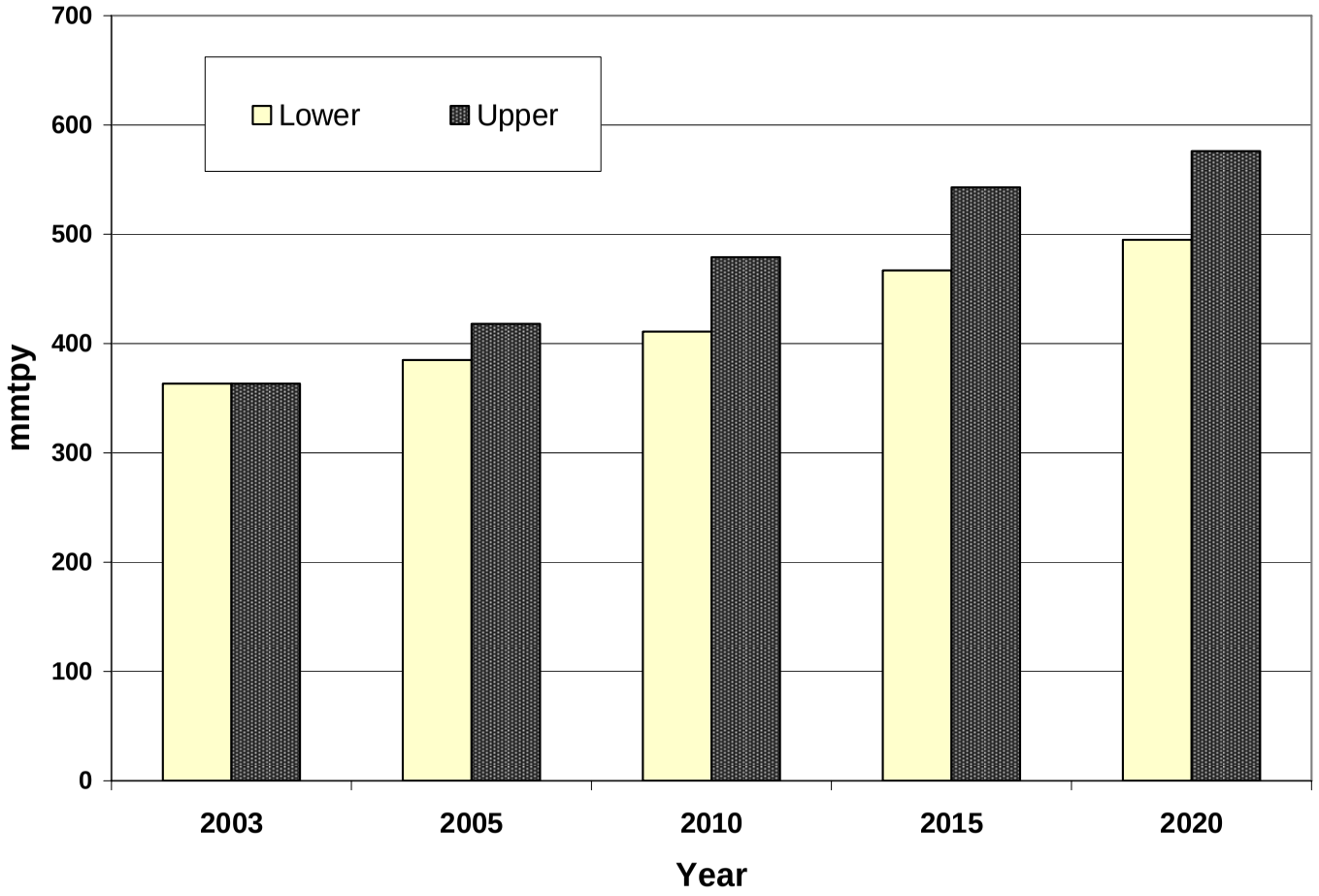


Figure A-7. Total Coal Production for Mines in Subregions 1, 2, and 3 – Lower and Upper Production Scenarios

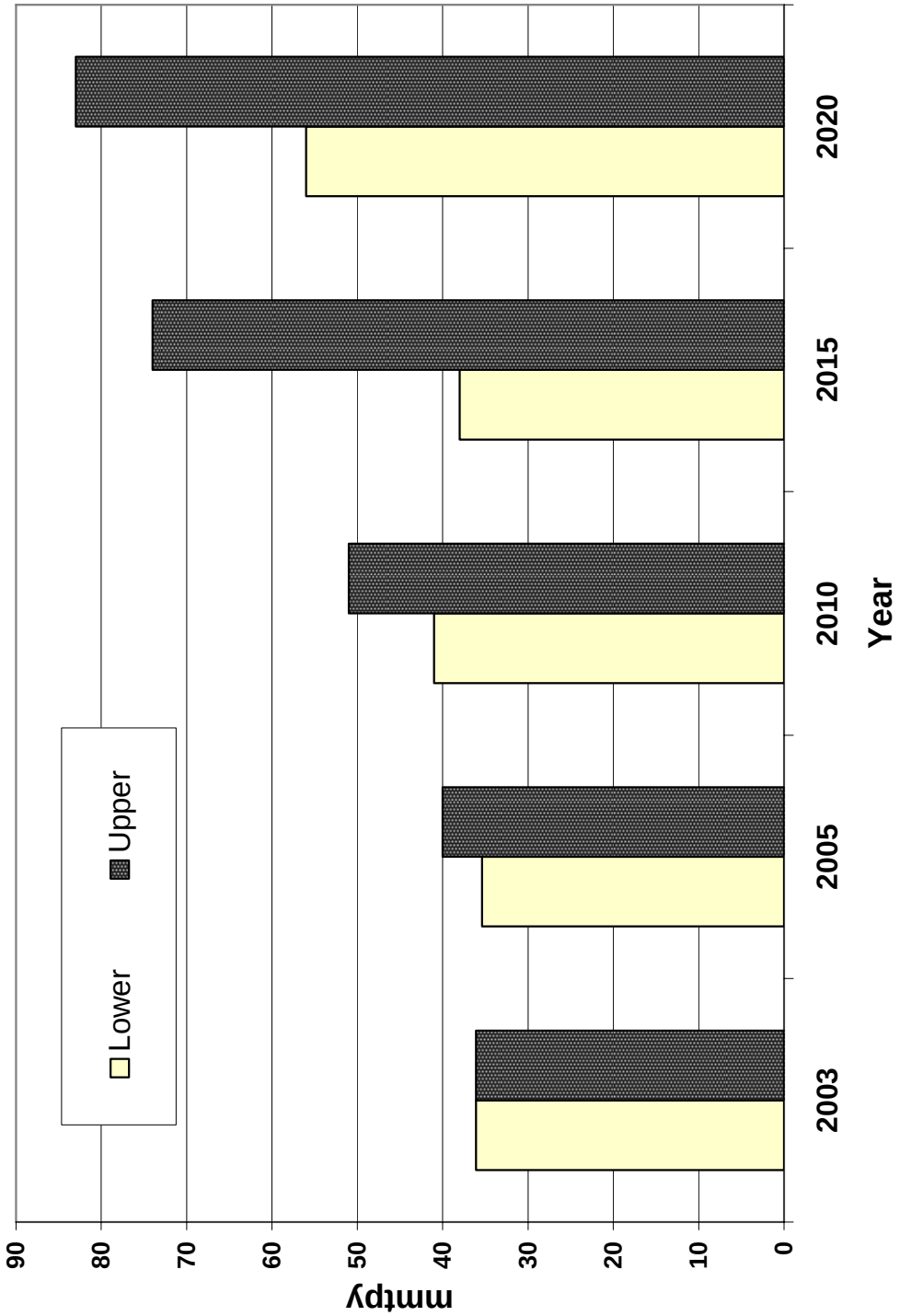


Figure A-8. Total Coal Production for Mines in Subregions 4 and 5 – Lower and Upper Production Scenarios

APPENDIX B

EXISTING (2003) DISTURBANCE

Table B-1
Coal Mine-related Disturbance in the Wyoming PRB Study Area
(based on GIS)

Area	Disturbance (acreage as of end 2003)
Disturbance by Subregion	
Subregion 1	8,968
Subregion 2	14,628
Subregion 3	27,511
Total	**51,107**
Disturbance by Subwatershed	
Little Powder River	8,018
Antelope Creek	13,785
Upper Cheyenne River	13,726
Upper Belle Fourche River	15,578
Total	**51,107**

Table B-2
Total Past and Present Development-related Disturbance in the Wyoming PRB Study Area by Subwatershed
(based on GIS)

Subwatershed	Total Disturbance (acres)
Little Bighorn River	64
Upper Tongue River	3,574
Middle Fork Powder River	259
North Fork Powder River	0
Upper Powder River	12,444
South Fork Powder River	313
Salt Creek	1,225
Crazy Woman Creek	494
Clear Creek	4,405
Middle Powder River	2,297
Little Powder River	17,896
Little Missouri River	163
Antelope Creek	19,807
Dry Fork Cheyenne River	1,684
Upper Cheyenne River	16,656
Lightning Creek	2,900
Upper Belle Fourche River	37,148
Middle North Platte River	561
Total Disturbance Acreage	**121,890**

APPENDIX C

SUPPORTING TABLES AND FIGURES– TASK 1D STUDY AREA

Table C-1
Wyoming PRB Coal-related Development Disturbance Acreages in the Task 1D Study Area[1]
(based on database)

Subwatershed	Lower and Upper Production Scenarios		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Past and Present (2003)			
Antelope Creek	375	0	375
Clear Creek	369	0	369
Crazy Woman Creek	0	0	0
Dry Fork Cheyenne River	141	0	141
Lightning Creek	401	0	401
Little Bighorn River	41	0	41
Little Missouri River	0	0	0
Little Powder River	340	0	340
Middle North Platte River	0	0	0
Middle Powder River	0	0	0
Middle Fork Powder River	0	0	0
North Fork Powder River	0	0	0
Salt Creek	0	0	0
South Fork Powder River	0	0	0
Upper Belle Fourche River	1,320	0	1,320
Upper Cheyenne River	285	0	285
Upper Powder River	515	0	515
Upper Tongue River	1,103	0	1,103
Total for Past and Present	**4,891**	**0**	**4,891**
Reasonably Foreseeable Development (2010)			
Antelope Creek	375	0	375
Clear Creek	369	0	369
Crazy Woman Creek	0	0	0
Dry Fork Cheyenne River	141	0	141
Lightning Creek	401	0	401
Little Bighorn River	41	0	41
Little Missouri River	0	0	0
Little Powder River	340	0	340
Middle North Platte River	0	0	0
Middle Powder River	0	0	0
Middle Fork Powder River	0	0	0
North Fork Powder River	0	0	0
Salt Creek	0	0	0
South Fork Powder River	0	0	0
Upper Belle Fourche River	1,355	0	1,355
Upper Cheyenne River	325	0	325
Upper Powder River	515	0	515
Upper Tongue River	1,103	0	1,103
Total for 2010	**4,966**	**0**	**4,966**

Table C-1 (continued)

Subwatershed	Lower and Upper Production Scenarios		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Reasonably Foreseeable Development (2015)			
Antelope Creek	593	0	593
Clear Creek	369	0	369
Crazy Woman Creek	0	0	0
Dry Fork Cheyenne River	141	0	141
Lightning Creek	401	0	401
Little Bighorn River	41	0	41
Little Missouri River	0	0	0
Little Powder River	340	0	340
Middle North Platte River	0	0	0
Middle Powder River	0	0	0
Middle Fork Powder River	0	0	0
North Fork Powder River	0	0	0
Salt Creek	0	0	0
South Fork Powder River	0	0	0
Upper Belle Fourche River	1,609	0	1,609
Upper Cheyenne River	798	0	798
Upper Powder River	515	0	515
Upper Tongue River	1,103	0	1,103
Total for 2015	**5,911**	**0**	**5,911**
Reasonably Foreseeable Development (2020)			
Antelope Creek	593	0	593
Clear Creek	369	0	369
Crazy Woman Creek	0	0	0
Dry Fork Cheyenne River	141	0	141
Lightning Creek	401	0	401
Little Bighorn River	41	0	41
Little Missouri River	0	0	0
Little Powder River	340	0	340
Middle North Platte River	0	0	0
Middle Powder River	0	0	0
Middle Fork Powder River	0	0	0
North Fork Powder River	0	0	0
Salt Creek	0	0	0
South Fork Powder River	0	0	0
Upper Belle Fourche River	1,609	0	1,609
Upper Cheyenne River	798	0	798
Upper Powder River	515	0	515
Upper Tongue River	1,103	0	1,103
Total for 2020	**5,911**	**0**	**5,911**

[1]Coal-related activities as defined for this study include coal-fired power plants, railroads, major (230-kV) transmission lines, and coal technology projects. However, as discussed in Section 3.5, disturbance associated with major (230-kV) transmission lines is not analyzed in this study as the disturbance related to existing lines is minimal and information in relation to RFD transmission lines is lacking. The Task 1D study area is presented in **Figure C-1**.

Table C-2
Wyoming PRB Oil and Gas and Related Development Disturbance Acreages in the Task 1D Study Area[1]
(based on database)

Subwatershed	Lower and Upper Production Scenarios		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Past and Present (2003)			
Antelope Creek	12,961	6,964	5,997
Clear Creek	4,572	3,281	1,291
Crazy Woman Creek	1,868	1,416	453
Dry Fork Cheyenne River	3,282	1,681	1,601
Lightning Creek	4,949	2,237	2,712
Little Bighorn River	48	24	24
Little Missouri River	630	465	164
Little Powder River	32,573	20,953	11,621
Middle North Platte River	1,876	1,611	265
Middle Powder River	703	383	319
Middle Fork Powder River	7,509	4,472	3,037
North Fork Powder River	88	88	0
Salt Creek	3,396	1,963	1,432
South Fork Powder River	1,029	696	333
Upper Belle Fourche River	58,538	36,320	22,218
Upper Cheyenne River	6,924	3,856	3,067
Upper Powder River	34,324	20,774	13,550
Upper Tongue River	12,010	7,497	4,512
Total for Past and Present (as of 2003)	187,278	114,684	72,594
Reasonably Foreseeable Development (2010)			
Antelope Creek	22,204	14,409	7,795
Clear Creek	19,252	12,170	7,082
Crazy Woman Creek	12,336	7,596	4,741
Dry Fork Cheyenne River	5,200	3,610	1,590
Lightning Creek	6,871	4,827	2,043
Little Bighorn River	48	24	24
Little Missouri River	1,163	905	258
Little Powder River	44,491	30,603	13,889
Middle North Platte River	2,148	1,832	316
Middle Powder River	2,640	2,037	603
Middle Fork Powder River	12,965	8,194	4,771
North Fork Powder River	245	131	114
Salt Creek	3,066	2,059	1,007
South Fork Powder River	729	468	261
Upper Belle Fourche River	72,954	51,881	21,074
Upper Cheyenne River	7,290	4,502	2,788
Upper Powder River	85,742	55,170	30,572
Upper Tongue River	26,377	17,093	9,284
Total for 2010	325,722	217,512	108,210

Table C-2 (continued)

Subwatershed	Lower and Upper Production Scenarios		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Reasonably Foreseeable Development (2015)			
Antelope Creek	30,740	22,298	8,443
Clear Creek	30,745	21,378	9,367
Crazy Woman Creek	20,163	13,765	6,397
Dry Fork Cheyenne River	7,661	6,032	1,629
Lightning Creek	10,124	8,023	2,101
Little Bighorn River	48	24	24
Little Missouri River	1,284	1,042	242
Little Powder River	53,705	40,302	13,403
Middle North Platte River	2,306	1,987	319
Middle Powder River	4,276	3,642	634
Middle Fork Powder River	17,359	12,300	5,059
North Fork Powder River	182	114	68
Salt Creek	3,351	2,363	989
South Fork Powder River	765	513	252
Upper Belle Fourche River	82,582	64,974	17,608
Upper Cheyenne River	8,414	5,828	2,585
Upper Powder River	121,431	85,991	35,440
Upper Tongue River	37,333	26,695	10,638
Total for 2015	432,469	317,272	115,197
Reasonably Foreseeable Development (2020)			
Antelope Creek	39,375	31,135	8,240
Clear Creek	40,061	30,449	9,613
Crazy Woman Creek	26,117	19,660	6,457
Dry Fork Cheyenne River	10,754	9,140	1,613
Lightning Creek	14,242	12,118	2,123
Little Bighorn River	48	24	24
Little Missouri River	1,383	1,153	230
Little Powder River	61,682	49,439	12,243
Middle North Platte River	2,396	2,087	309
Middle Powder River	6,277	5,670	608
Middle Fork Powder River	20,853	16,199	4,654
North Fork Powder River	88	88	0
Salt Creek	3,698	2,658	1,040
South Fork Powder River	812	556	256
Upper Belle Fourche River	92,161	77,325	14,835
Upper Cheyenne River	9,488	7,136	2,352
Upper Powder River	147,871	114,360	33,511
Upper Tongue River	46,478	36,032	10,445
Total for 2020	523,784	415,230	108,554

[1] Inclusive of conventional oil and gas and CBNG activities and major transportation pipelines. Disturbance associated with ancillary facilities (including gather lines and distribution power lines) has been factored in on a per well basis as discussed in Appendix B of this report. The Task 1D study area is presented in **Figure C-1**.

Table C-3
Wyoming PRB Total Development-related Disturbance Acreages In the Task 1D Study Area[1] (based on database)

Subwatershed	Lower Production Scenario			Upper Production Scenario		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Past and Present (2003)						
Antelope Creek	28,610	10,412	18,198	28,610	10,412	18,198
Clear Creek	7,840	3,281	4,559	7,840	3,281	4,559
Crazy Woman Creek	1,916	1,416	501	1,916	1,416	501
Dry Fork Cheyenne River	3,423	1,681	1,742	3,423	1,681	1,742
Lightning Creek	5,350	2,237	3,113	5,350	2,237	3,113
Little Bighorn River	88	24	65	88	24	65
Little Missouri River	630	465	164	630	465	164
Little Powder River	43,178	23,596	19,582	43,178	23,596	19,582
Middle North Platte River	1,876	1,611	265	1,876	1,611	265
Middle Powder River	703	383	319	703	383	319
Middle Fork Powder River	7,509	4,472	3,037	7,509	4,472	3,037
North Fork Powder River	88	88	0	88	88	0
Salt Creek	3,396	1,963	1,432	3,396	1,963	1,432
South Fork Powder River	1,029	696	333	1,029	696	333
Upper Belle Fourche River	83,034	43,514	39,520	83,034	43,514	39,520
Upper Cheyenne River	27,604	11,809	15,794	27,604	11,809	15,794
Upper Powder River	34,839	20,774	14,065	34,839	20,774	14,065
Upper Tongue River	13,113	7,497	5,616	13,113	7,497	5,616
Total for Past and Present	**264,226**	**135,922**	**128,304**	**264,226**	**135,922**	**128,304**

Table C-3 (Continued)

Subwatershed	Lower Production Scenario			Upper Production Scenario		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Reasonably Foreseeable Development (2010)						
Antelope Creek	47,173	25,457	21,716	48,132	25,457	22,675
Clear Creek	22,521	12,170	10,350	22,521	12,170	10,350
Crazy Woman Creek	12,384	7,596	4,789	12,384	7,596	4,789
Dry Fork Cheyenne River	5,341	3,610	1,731	5,341	3,610	1,731
Lightning Creek	7,272	4,827	2,444	7,272	4,827	2,444
Little Bighorn River	88	24	65	88	24	65
Little Missouri River	1,163	905	258	1,163	905	258
Little Powder River	57,733	35,046	22,688	58,348	35,446	22,902
Middle North Platte River	2,148	1,832	316	2,148	1,832	316
Middle Powder River	2,640	2,037	603	2,640	2,037	603
Middle Fork Powder River	12,965	8,194	4,771	12,965	8,194	4,771
North Fork Powder River	245	131	114	245	131	114
Salt Creek	3,066	2,059	1,007	3,066	2,059	1,007
South Fork Powder River	729	468	261	729	468	261
Upper Belle Fourche River	104,804	64,625	40,180	106,127	65,858	40,271
Upper Cheyenne River	38,603	21,205	17,397	39,492	21,405	18,086
Upper Powder River	86,258	55,170	31,087	86,258	55,170	31,087
Upper Tongue River	27,480	17,093	10,387	27,480	17,093	10,387
Total for 2010	**432,613**	**262,450**	**170,164**	**436,399**	**264,283**	**172,117**
Reasonably Foreseeable Development (2015)						
Antelope Creek	61,991	38,946	23,047	63,512	38,946	24,567
Clear Creek	34,013	21,378	12,636	34,013	21,378	12,636
Crazy Woman Creek	20,211	13,765	6,445	20,211	13,765	6,445
Dry Fork Cheyenne River	7,803	6,032	1,770	7,803	6,032	1,770
Lightning Creek	10,525	8,023	2,502	10,525	8,023	2,502
Little Bighorn River	88	24	65	88	24	65
Little Missouri River	1,284	1,042	242	1,284	1,042	242

Table C-3 (Continued)

Subwatershed	Lower Production Scenario			Upper Production Scenario		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Little Powder River	68,912	46,245	22,667	69,827	46,920	22,906
Middle North Platte River	2,306	1,987	319	2,306	1,987	319
Middle Powder River	4,276	3,642	634	4,276	3,642	634
Middle Fork Powder River	17,359	12,300	5,059	17,359	12,300	5,059
North Fork Powder River	182	114	68	182	114	68
Salt Creek	3,351	2,363	989	3,351	2,363	989
South Fork Powder River	765	513	252	765	513	252
Upper Belle Fourche River	119,283	81,368	37,915	122,669	84,301	38,368
Upper Cheyenne River	46,149	28,031	18,117	47,635	28,631	19,003
Upper Powder River	121,947	85,991	35,955	121,947	85,991	35,955
Upper Tongue River	38,436	26,695	11,741	38,436	26,695	11,741
Total for 2015	**558,881**	**378,460**	**180,422**	**566,189**	**382,668**	**183,520**
Reasonably Foreseeable Development (2020)						
Antelope Creek	77,854	54,583	23,270	80,466	54,083	26,383
Clear Creek	43,330	30,449	12,881	43,330	30,449	12,881
Crazy Woman Creek	26,165	19,660	6,505	26,165	19,660	6,505
Dry Fork Cheyenne River	10,895	9,140	1,754	10,895	9,140	1,754
Lightning Creek	14,643	12,118	2,524	14,643	12,118	2,524
Little Bighorn River	88	24	65	88	24	65
Little Missouri River	1,383	1,153	230	1,383	1,153	230
Little Powder River	78,912	57,007	21,904	80,237	58,057	22,180
Middle North Platte River	2,396	2,087	309	2,396	2,087	309
Middle Powder River	6,277	5,670	608	6,277	5,670	608
Middle Fork Powder River	20,853	16,199	4,654	20,853	16,199	4,654
North Fork Powder River	88	88	0	88	88	0
Salt Creek	3,698	2,658	1,040	3,698	2,658	1,040
South Fork Powder River	812	556	256	812	556	256

Table C-3 (Continued)

Subwatershed	Lower Production Scenario			Upper Production Scenario		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Upper Belle Fourche River	133,747	97,869	35,880	139,992	103,252	36,738
Upper Cheyenne River	53,291	35,039	18,251	54,756	35,839	18,917
Upper Powder River	148,387	114,360	34,026	148,387	114,360	34,026
Upper Tongue River	47,581	36,032	11,549	47,581	36,032	11,549
Total for 2020	**670,400**	**494,693**	**175,706**	**682,047**	**501,426**	**180,619**

[1] Inclusive of disturbance associated with coal mining, coal-related activities, oil and gas and related development, and other development activities identified for this study. Other quantifiable activities include approximately 171, 2,899, 48, and 145 acres of disturbance associated with major water storage reservoirs in the Antelope Creek, Clear Creek, Crazy Woman Creek, and Little Powder River subwatersheds (2003 through 2020), respectively. The Task 1D study area is presented in **Figure C-1**.

Note: Minor discrepancies in total acreages are the result of rounding.

Table C-4
Wyoming PRB Coal Mine-related Production, Employment, and Water-related Information Under the Lower Production Scenario for the Task 1D Study Area[1] (based on database)

Subwatershed	Lower Production Scenario				Upper Production Scenario			
	Annual Coal Production for Report Year (million tons)	Total Employment for Report Year[2]	Annual Water Consumption (mmgpy)	Annual Water Production[3] (mmgpy)	Annual Coal Production for Report Year (million tons)	Total Employment for Report Year[2]	Annual Water Consumption (mmgpy)	Annual Water Production[3] (mmgpy)
Past and Present (2003)								
Antelope Creek	110	1,386	763	472	110	1,386	763	472
Clear Creek	0	0	0	0	0	0	0	0
Crazy Woman Creek	0	0	0	0	0	0	0	0
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0
Lightning Creek	0	0	0	0	0	0	0	0
Little Bighorn River	0	0	0	0	0	0	0	0
Little Missouri River	0	0	0	0	0	0	0	0
Little Powder River	50	676	359	191	50	676	359	191
Middle North Platte River	0	0	0	0	0	0	0	0
Middle Powder River	0	0	0	0	0	0	0	0
Middle Fork Powder River	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0
Salt Creek	0	0	0	0	0	0	0	0
South Fork Powder River	0	0	0	0	0	0	0	0
Upper Belle Fourche River	81	1,001	660	447	81	1,001	660	447
Upper Cheyenne River	122	1,704	946	276	122	1,704	946	276
Upper Powder River	0	0	0	0	0	0	0	0
Upper Tongue River	0	0	0	0	0	0	0	0
Total for Past and Present	**363**	**4,767**	**2,728**	**1,386**	**363**	**4,767**	**2,728**	**1,386**

Table C-4 (Continued)

Subwatershed	Lower Production Scenario: Annual Coal Production for Report Year (million tons)	Lower Production Scenario: Total Employment for Report Year[2]	Lower Production Scenario: Annual Water Consumption (mmgpy)	Lower Production Scenario: Annual Water Production[3] (mmgpy)	Upper Production Scenario: Annual Coal Production for Report Year (million tons)	Upper Production Scenario: Total Employment for Report Year[2]	Upper Production Scenario: Annual Water Consumption (mmgpy)	Upper Production Scenario: Annual Water Production[3] (mmgpy)
Reasonably Foreseeable Development (2010)								
Antelope Creek	121	1,399	842	899	127	1,399	884	899
Clear Creek	0	0	0	0	0	0	0	0
Crazy Woman Creek	0	0	0	0	0	0	0	0
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0
Lightning Creek	0	0	0	0	0	0	0	0
Little Bighorn River	0	0	0	0	0	0	0	0
Little Missouri River	0	0	0	0	0	0	0	0
Little Powder River	57	709	412	165	70	732	520	165
Middle North Platte River	0	0	0	0	0	0	0	0
Middle Powder River	0	0	0	0	0	0	0	0
Middle Fork Powder River	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0
Salt Creek	0	0	0	0	0	0	0	0
South Fork Powder River	0	0	0	0	0	0	0	0
Upper Belle Fourche River	100	1,450	773	675	125	1,450	945	675
Upper Cheyenne River	133	1,721	1,032	520	157	1,721	1,217	520
Upper Powder River	0	0	0	0	0	0	0	0
Upper Tongue River	0	0	0	0	0	0	0	0
Total for 2010	**411**	**5,279**	**3,059**	**2,258**	**479**	**5,302**	**3,566**	**2,258**
Reasonably Foreseeable Development (2015)								
Antelope Creek	133	1,399	925	899	133	1,399	925	899
Clear Creek	0	0	0	0	0	0	0	0
Crazy Woman Creek	0	0	0	0	0	0	0	0
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0
Lightning Creek	0	0	0	0	0	0	0	0
Little Bighorn River	0	0	0	0	0	0	0	0
Little Missouri River	0	0	0	0	0	0	0	0

Table C-4 (Continued)

Subwatershed	Lower Production Scenario				Upper Production Scenario			
	Annual Coal Production for Report Year (million tons)	Total Employment for Report Year[2]	Annual Water Consumption (mmgpy)	Annual Water Production[3] (mmgpy)	Annual Coal Production for Report Year (million tons)	Total Employment for Report Year[2]	Annual Water Consumption (mmgpy)	Annual Water Production[3] (mmgpy)
Little Powder River	69	709	514	165	88	732	681	165
Middle North Platte River	0	0	0	0	0	0	0	0
Middle Powder River	0	0	0	0	0	0	0	0
Middle Fork Powder River	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0
Salt Creek	0	0	0	0	0	0	0	0
South Fork Powder River	0	0	0	0	0	0	0	0
Upper Belle Fourche River	117	1,450	881	675	154	1,450	1,144	675
Upper Cheyenne River	148	1,721	1,152	520	168	1,721	909	520
Upper Powder River	0	0	0	0	0	0	0	0
Upper Tongue River	0	0	0	0	0	0	0	0
Total for 2015	**467**	**5,279**	**3,472**	**2,258**	**543**	**5,302**	**3,659**	**2,258**
Reasonably Foreseeable Development (2020)								
Antelope Creek	137	1,399	953	899	137	1,399	953	899
Clear Creek	0	0	0	0	0	0	0	0
Crazy Woman Creek	0	0	0	0	0	0	0	0
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0
Lightning Creek	0	0	0	0	0	0	0	0
Little Bighorn River	0	0	0	0	0	0	0	0
Little Missouri River	0	0	0	0	0	0	0	0
Little Powder River	71	709	529	165	103	732	816	165
Middle North Platte River	0	0	0	0	0	0	0	0
Middle Powder River	0	0	0	0	0	0	0	0
Middle Fork Powder River	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0
Salt Creek	0	0	0	0	0	0	0	0
South Fork Powder River	0	0	0	0	0	0	0	0

Table C-4 (Continued)

Subwatershed	Lower Production Scenario				Upper Production Scenario			
	Annual Coal Production for Report Year (million tons)	Total Employment for Report Year[2]	Annual Water Consumption (mmgpy)	Annual Water Production[3] (mmgpy)	Annual Coal Production for Report Year (million tons)	Total Employment for Report Year[2]	Annual Water Consumption (mmgpy)	Annual Water Production[3] (mmgpy)
Upper Belle Fourche River	133	1,450	973	675	166	1,450	1,225	675
Upper Cheyenne River	154	1,721	1,204	520	170	1,721	1,326	520
Upper Powder River	0	0	0	0	0	0	0	0
Upper Tongue River	0	0	0	0	0	0	0	0
Total for 2020	**495**	**5,279**	**3,659**	**2,258**	**576**	**5,302**	**4,320**	**2,258**

[1] The Task 1D study area is shown in **Figure C-1**.
[2] Based on coal mine information, with the exception of 70 power plant-related employees identified in the Upper Belle Fourche River subwatershed numbers.
[3] For purposes of this study, the annual coal mine-related water production is assumed to be the same under both the lower and upper production scenarios.

Table C-5
Wyoming PRB Oil and Gas Production and Conventional Oil and Gas Water-related Information for the Task 1D Study Area[1] (based on database)

Subwatershed	Annual Oil Production for Report Year (barrels)	Annual Gas Production for Report Year[2] (mmcf)	Annual Conventional Oil- and Gas-related Water Production (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume Direct) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Passive Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Active Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Infiltration Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Containment Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Land Application) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Injection) (mmgpy)
Past and Present (2003)										
Antelope Creek	831,582	31,887	5	3	0	0	2	0	0	0
Clear Creek	17,042	5	7	2	0	1	2	0	1	1
Crazy Woman Creek	0	0	0	0	0	0	0	0	0	0
Dry Fork Cheyenne River	398,311	10,277	1	0	0	0	0	0	0	0
Lightning Creek	508,091	983	16	4	0	2	6	1	2	2
Little Bighorn River	108,053	0	212	53	0	21	74	11	32	21
Little Missouri River	0	0	0	0	0	0	0	0	0	0
Little Powder River	2,961,036	39,619	1,777	800	0	0	533	178	178	89
Middle North Platte River	160,366	0	314	78	0	31	110	16	47	31
Middle Powder River	0	0	56	14	0	6	20	3	8	6
Middle Fork Powder River	428,817	18,756	26	9	1	1	8	3	3	1
North Fork Powder River	0	0	0	0	0	0	0	0	0	0
Salt Creek	171,352	28	231	58	0	23	81	12	35	23
South Fork Powder River	85,143	1	99	25	0	10	35	5	15	10
Upper Belle Fourche River	4,728,251	146,805	1,350	607	0	0	540	67	0	135
Upper Cheyenne River	153,924	26,899	13	7	0	0	5	1	0	1
Upper Powder River	2,305,549	65,143	133	47	0	13	53	7	7	7
Upper Tongue River	18,076	35,389	37	0	9	2	17	4	2	4
Total for Past and Present	**12,875,593**	**375,792**	**4,278**	**1,707**	**11**	**110**	**1,485**	**306**	**329**	**330**

Table C-5 (Continued)

Subwatershed	Annual Oil Production for Report Year (barrels)	Annual Gas Production for Report Year[2] (mmcf)	Annual Conventional Oil- and Gas-related Water Production (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume Direct) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Passive Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Active Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Infiltration Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Containment Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Land Application) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Injection) (mmgpy)
Reasonably Foreseeable Development (2010)										
Antelope Creek	699,364	71,491	5	3	0	0	2	0	0	0
Clear Creek	34,084	175	14	4	0	1	5	1	2	1
Crazy Woman Creek	12,808	41,235	4	1	0	0	1	0	1	0
Dry Fork Cheyenne River	381,362	11,215	49	12	0	5	17	2	7	5
Lightning Creek	298,985	2,275	10	2	0	1	3	0	1	1
Little Bighorn River	0	0	0	0	0	0	0	0	0	0
Little Missouri River	179,312	552	59	15	0	6	21	3	9	6
Little Powder River	4,178,501	54,910	2,508	1,129	0	0	752	251	251	125
Middle North Platte River	276,996	206	542	135	0	54	190	27	81	54
Middle Powder River	250,826	6,956	135	34	0	14	47	7	20	14
Middle Fork Powder River	531,616	36,948	32	11	2	2	10	3	3	2
North Fork Powder River	0	0	0	0	0	0	0	0	0	0
Salt Creek	186,403	398	251	63	0	25	88	13	38	25
South Fork Powder River	72,529	364	85	21	0	8	30	4	13	8
Upper Belle Fourche River	6,612,754	134,930	1,888	849	0	0	755	94	0	189
Upper Cheyenne River	54,368	28,561	5	3	0	0	2	0	0	0
Upper Powder River	1,894,972	213,086	110	38	0	11	44	5	5	5
Upper Tongue River	71,701	79,823	148	0	37	7	67	15	7	15
Total for 2010	**15,736,580**	**683,125**	**5,843**	**2,320**	**39**	**135**	**2,032**	**427**	**439**	**451**
Reasonably Foreseeable Development (2015)										
Antelope Creek	640,214	84,129	4	2	0	0	1	0	0	0
Clear Creek	29,824	177	12	3	0	1	4	1	2	1
Crazy Woman Creek	10,246	57,069	3	1	0	0	1	0	1	0
Dry Fork Cheyenne River	349,581	11,152	52	13	0	5	18	3	8	5
Lightning Creek	277,891	3,243	9	2	0	1	3	0	1	1

Table C-5 (Continued)

Subwatershed	Annual Oil Production for Report Year (barrels)	Annual Gas Production for Report Year[2] (mmcf)	Annual Conventional Oil- and Gas-related Water Production (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume Direct) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Passive Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Active Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Infiltration Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Containment Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Land Application) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Injection) (mmgpy)
Little Bighorn River	0	0	0	0	0	0	0	0	0	0
Little Missouri River	158,820	489	52	13	0	5	18	3	8	5
Little Powder River	3,807,528	52,974	2,285	1,028	0	0	686	229	229	114
Middle North Platte River	247,838	367	485	121	0	48	170	24	73	48
Middle Powder River	224,142	6,804	121	30	0	12	42	6	18	12
Middle Fork Powder River	496,370	39,968	30	11	2	2	9	3	3	2
North Fork Powder River	0	0	0	0	0	0	0	0	0	0
Salt Creek	177,720	511	239	60	0	24	84	12	36	24
South Fork Powder River	67,799	340	79	20	0	8	28	4	12	8
Upper Belle Fourche River	5,963,186	102,772	1,702	766	0	0	681	85	0	170
Upper Cheyenne River	52,249	24,662	4	2	0	0	2	0	0	0
Upper Powder River	1,723,898	254,956	100	35	0	10	40	5	5	5
Upper Tongue River	64,471	92,910	133	0	33	7	60	13	7	13
Total for 2015	**14,291,777**	**732,522**	**5,312**	**2,108**	**35**	**123**	**1,847**	**388**	**401**	**410**
Reasonably Foreseeable Development (2020)										
Antelope Creek	581,064	79,685	4	2	0	0	1	0	0	0
Clear Creek	25,563	163	11	3	0	1	4	1	2	1
Crazy Woman Creek	10,246	57,642	3	1	0	0	1	0	1	0
Dry Fork Cheyenne River	317,801	10,332	42	10	0	4	15	2	6	4
Lightning Creek	257,714	3227	8	2	0	1	3	0	1	1
Little Bighorn River	0	0	0	0	0	0	0	0	0	0
Little Missouri River	140,888	434	46	12	0	5	16	2	7	5
Little Powder River	3,436,555	45,459	2,063	928	0	0	619	206	206	103
Middle North Platte River	218,681	367	428	107	0	43	150	21	64	43
Middle Powder River	197,459	6,057	106	27	0	11	37	5	16	11

Table C-5 (Continued)

Subwatershed	Annual Oil Production for Report Year (barrels)	Annual Gas Production for Report Year[2] (mmcf)	Annual Conventional Oil- and Gas-related Water Production (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume Direct) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Passive Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Active Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Infiltration Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Containment Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Land Application) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Injection) (mmgpy)
Middle Fork Powder River	461,125	35,924	28	10	1	1	8	3	3	1
North Fork Powder River	0	0	0	0	0	0	0	0	0	0
Salt Creek	168,458	486	227	57	0	23	79	11	34	23
South Fork Powder River	63,069	316	74	18	0	7	26	4	11	7
Upper Belle Fourche River	5,313,618	76,263	1,517	683	0	0	607	76	0	152
Upper Cheyenne River	50,131	19,768	4	2	0	0	1	0	0	0
Upper Powder River	1,555,456	239,089	90	32	0	9	36	5	5	5
Upper Tongue River	56,638	91,180	117	0	29	6	53	12	6	12
Total for 2020	**12,854,466**	**666,391**	**4,767**	**1,893**	**31**	**111**	**1,656**	**349**	**361**	**367**

[1] The Task 1D study area is shown in **Figure C-1**.
[2] Natural gas produced by conventional gas and CBNG wells.

Table C-6
Wyoming PRB CBNG Water-related Information for the Task 1D Study Area[1] (based on database)

Subwatershed	Annual CBNG-related Water Production (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume Direct) (mmgpy)	Annual CBNG-related Water Disposal (Passive Treatment) (mmgpy)	Annual CBNG-related Water Disposal (Active Treatment) (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume to Infiltration Impoundments) (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume to Containment Impoundments) (mmgpy)	Annual CBNG-related Water Disposal (Land Application) (mmgpy)	Annual CBNG-related Water Disposal (Injection) (mmgpy)
Past and Present (2003)								
Antelope Creek	1,290	710	0	0	452	65	0	65
Clear Creek	367	92	0	37	128	18	55	37
Crazy Woman Creek	0	0	0	0	0	0	0	0
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0
Lightning Creek	0	0	0	0	0	0	0	0
Little Bighorn River	0	0	0	0	0	0	0	0
Little Missouri River	0	0	0	0	0	0	0	0
Little Powder River	2,753	1,239	0	0	826	275	275	138
Middle North Platte River	0	0	0	0	0	0	0	0
Middle Powder River	0	0	0	0	0	0	0	0
Middle Fork Powder River	1,147	402	57	57	344	115	115	57
North Fork Powder River	0	0	0	0	0	0	0	0
Salt Creek	0	0	0	0	0	0	0	0
South Fork Powder River	0	0	0	0	0	0	0	0
Upper Belle Fourche River	7,566	3,405	0	0	3,026	378	0	757
Upper Cheyenne River	1,078	593	0	0	377	54	0	54
Upper Powder River	5,237	1,833	0	524	2,095	262	262	262
Upper Tongue River	2,689	0	672	134	1,210	269	134	269
Total for Past and Present	**22,127**	**8,272**	**730**	**752**	**8,458**	**1,436**	**841**	**1,637**
Reasonably Foreseeable Development (2010)								
Antelope Creek	4,682	2,575	0	0	1,639	234	0	234
Clear Creek	3,494	874	0	349	1,223	175	524	349
Crazy Woman Creek	29	10	0	3	9	1	4	1

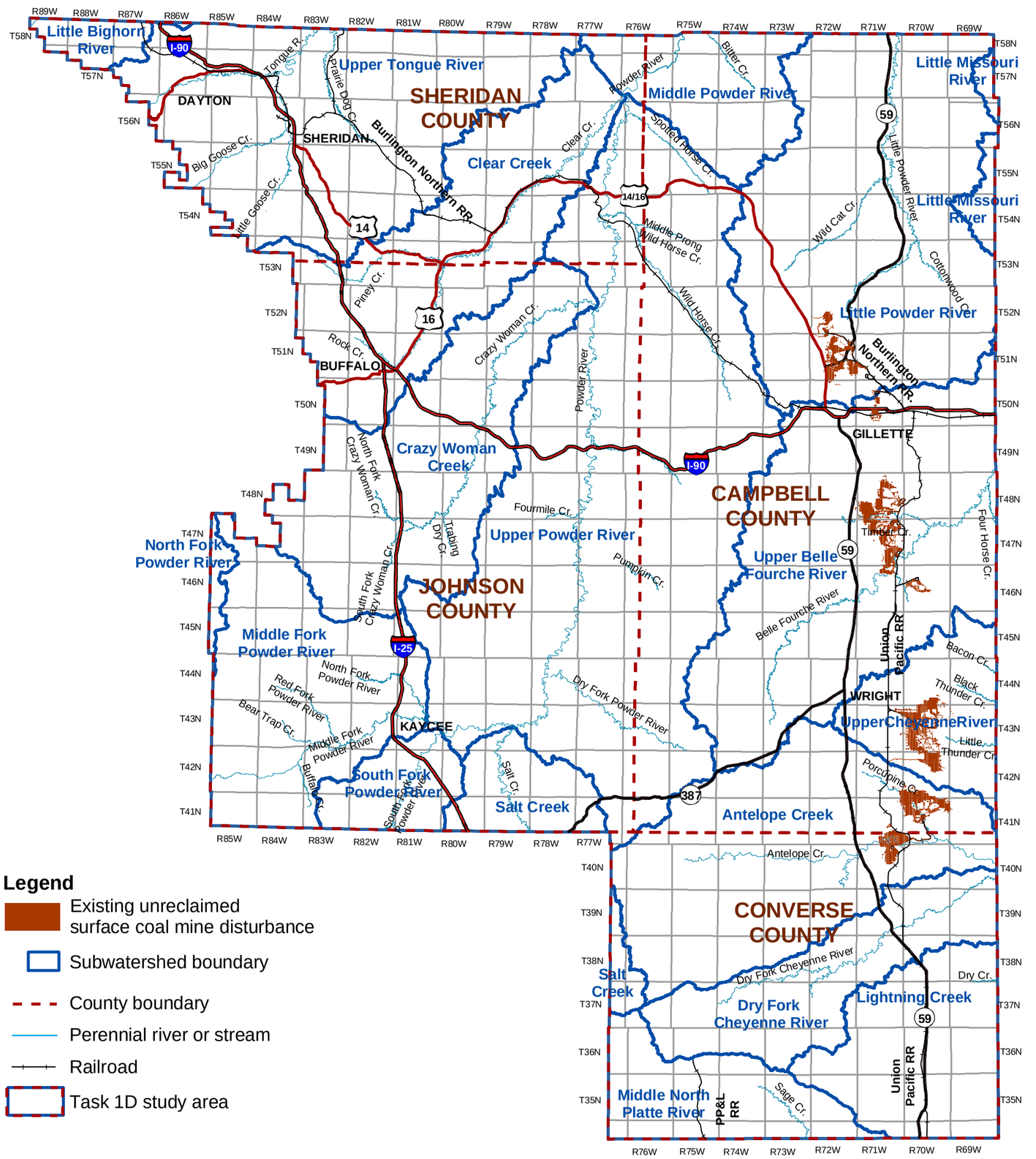
Table C-6 (Continued)

Subwatershed	Annual CBNG-related Water Production (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume Direct) (mmgpy)	Annual CBNG-related Water Disposal (Passive Treatment) (mmgpy)	Annual CBNG-related Water Disposal (Active Treatment) (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume to Infiltration Impoundments) (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume to Containment Impoundments) (mmgpy)	Annual CBNG-related Water Disposal (Land Application) (mmgpy)	Annual CBNG-related Water Disposal (Injection) (mmgpy)
Dry Fork Cheyenne River	90	22	0	9	31	4	13	9
Lightning Creek	111	28	0	11	39	6	17	11
Little Bighorn River	0	0	0	0	0	0	0	0
Little Missouri River	0	0	0	0	0	0	0	0
Little Powder River	3,814	1,716	0	0	1,144	381	381	191
Middle North Platte River	13	3	0	1	5	1	2	1
Middle Powder River	66	16	0	7	23	3	10	7
Middle Fork Powder River	2,271	795	114	114	681	227	227	114
North Fork Powder River	0	0	0	0	0	0	0	0
Salt Creek	24	6	0	2	8	1	4	2
South Fork Powder River	4	1	0	0	2	0	1	0
Upper Belle Fourche River	6,856	3,085	0	0	2,742	343	0	686
Upper Cheyenne River	1,181	650	0	0	413	59	0	59
Upper Powder River	17,922	6,273	0	1,792	7,169	896	896	896
Upper Tongue River	5,160	0	1,290	258	2,322	516	258	516
Total for 2010	**45,719**	**16,055**	**1,404**	**2,547**	**17,451**	**2,848**	**2,337**	**3,077**
Reasonably Foreseeable Development (2015)								
Antelope Creek	5,791	3,185	0	0	2,027	290	0	290
Clear Creek	4,744	1,186	0	474	1,660	237	712	474
Crazy Woman Creek	40	14	0	4	12	2	6	2
Dry Fork Cheyenne River	139	35	0	14	49	7	21	14
Lightning Creek	177	44	0	18	62	9	27	18
Little Bighorn River	0	0	0	0	0	0	0	0
Little Missouri River	0	0	0	0	0	0	0	0
Little Powder River	3,686	1,659	0	0	1,106	369	369	184
Middle North Platte River	24	6	0	2	8	1	4	2
Middle Powder River	97	24	0	10	34	5	15	10
Middle Fork Powder River	2,460	861	123	123	738	246	246	123
North Fork Powder River	0	0	0	0	0	0	0	0
Salt Creek	31	8	0	3	11	2	5	3

Table C-6 (Continued)

Subwatershed	Annual CBNG-related Water Production (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume Direct) (mmgpy)	Annual CBNG-related Water Disposal (Passive Treatment) (mmgpy)	Annual CBNG-related Water Disposal (Active Treatment) (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume to Infiltration Impoundments) (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume to Containment Impoundments) (mmgpy)	Annual CBNG-related Water Disposal (Land Application) (mmgpy)	Annual CBNG-related Water Disposal (Injection) (mmgpy)
South Fork Powder River	3	1	0	0	1	0	0	0
Upper Belle Fourche River	5,182	2,332	0	0	2,073	259	0	518
Upper Cheyenne River	1,018	560	0	0	356	51	0	51
Upper Powder River	21,520	7,532	0	2,152	8,608	1,076	1,076	1,076
Upper Tongue River	6,022	0	1,506	301	2,710	602	301	602
Total for 2015	**50,935**	**17,446**	**1,629**	**3,102**	**19,455**	**3,155**	**2,780**	**3,368**
Reasonably Foreseeable Development (2020)								
Antelope Creek	5,524	3,038	0	0	1,933	276	0	276
Clear Creek	4,886	1,222	0	489	1,710	244	733	489
Crazy Woman Creek	40	14	0	4	12	2	6	2
Dry Fork Cheyenne River	139	35	0	14	49	7	21	14
Lightning Creek	178	45	0	18	62	9	27	18
Little Bighorn River	0	0	0	0	0	0	0	0
Little Missouri River	0	0	0	0	0	0	0	0
Little Powder River	3,158	1,421	0	0	947	316	316	158
Middle North Platte River	24	6	0	2	8	1	4	2
Middle Powder River	90	22	0	9	31	4	13	9
Middle Fork Powder River	2,210	774	111	111	663	221	221	111
North Fork Powder River	0	0	0	0	0	0	0	0
Salt Creek	30	7	0	3	10	1	4	3
South Fork Powder River	3	1	0	0	1	0	0	0
Upper Belle Fourche River	3,807	1,713	0	0	1,523	190	0	381
Upper Cheyenne River	813	447	0	0	285	41	0	41
Upper Powder River	20,189	7,066	0	2,019	8,076	1,009	1,009	1,009
Upper Tongue River	5,916	0	1,479	296	2,662	592	296	592
Total for 2020	**47,009**	**15,811**	**1,589**	**2,964**	**17,974**	**2,915**	**2,651**	**3,104**

[1] The Task 1D study area is shown in **Figure C-1**.



Source: BLM 2003a, 2004; Thunder Basin Coal Company 2003.

Powder River Basin Coal Review

Figure C-1

Task 1D Study Area and Subwatersheds

10/19/05

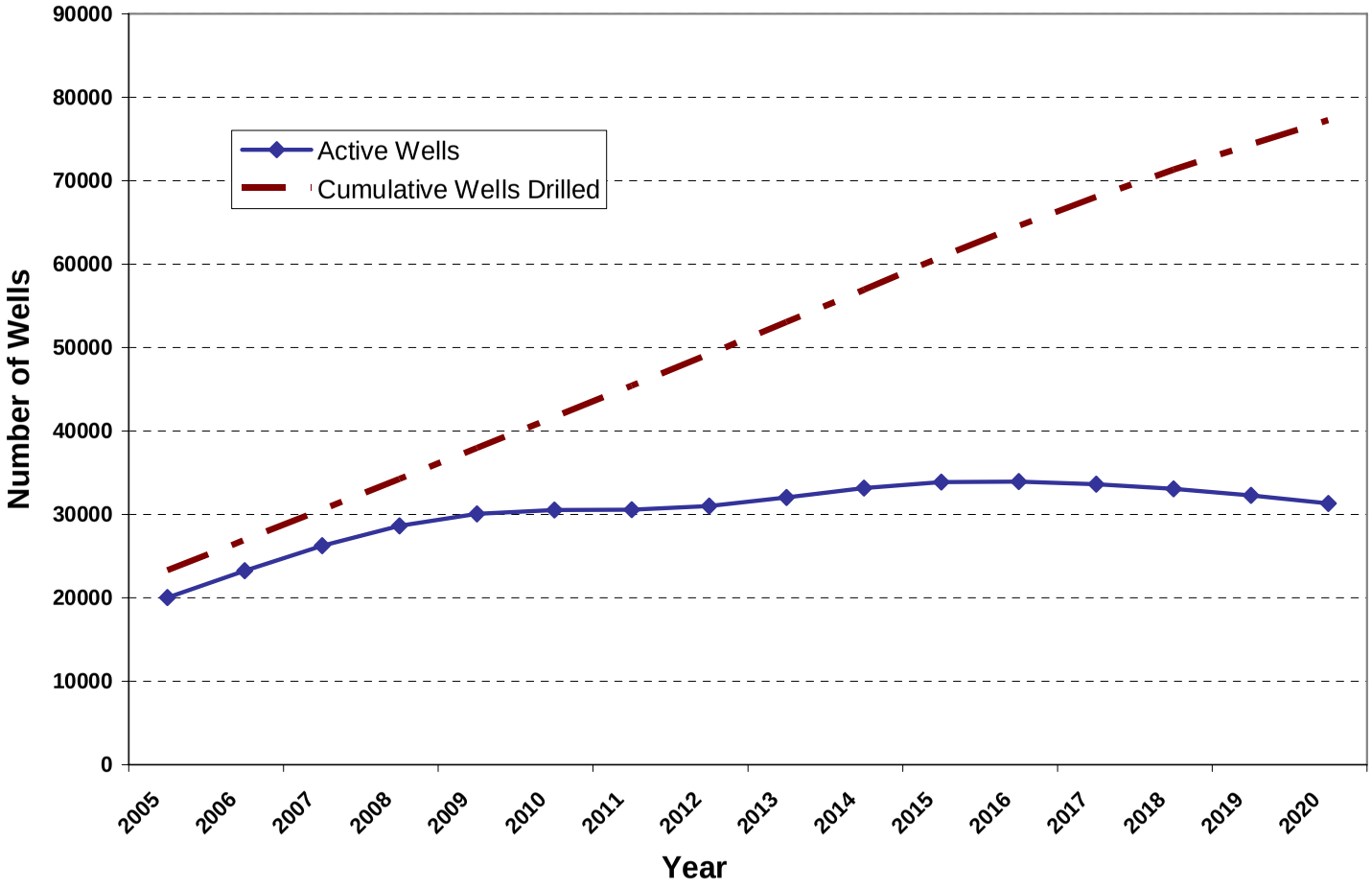


Figure C-2. Projected Numbers of Active CBNG Wells and Cumulative CBNG Wells Drilled in the Wyoming PRB

Note: See Appendix E for assumptions and methodology used in developing CBNG projections.

APPENDIX D

SUPPORTING TABLES AND FIGURES– TASK 3D STUDY AREA

Table D-1
Wyoming PRB Coal-related Development Disturbance Acreages in the Task 3D Study Area[1] (based on database)

Subwatershed	Lower and Upper Production Scenarios		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Past and Present (2003)			
Antelope Creek	375	0	375
Dry Fork Cheyenne River	141	0	141
Little Powder River	340	0	340
Upper Belle Fourche River	1,320	0	1,320
Upper Cheyenne River	285	0	285
Upper Powder River	515	0	515
Total for Past and Present (as of 2003)	**2,976**	**0**	**2,976**
Reasonably Foreseeable Development (2010)			
Antelope Creek	375	0	375
Dry Fork Cheyenne River	141	0	141
Little Powder River	340	0	340
Upper Belle Fourche River	1,355	0	1,355
Upper Cheyenne River	325	0	325
Upper Powder River	515	0	515
Total for 2010	**3,051**	**0**	**3,051**
Reasonably Foreseeable Development (2015)			
Antelope Creek	593	0	593
Dry Fork Cheyenne River	141	0	141
Little Powder River	340	0	340
Upper Belle Fourche River	1,609	0	1,609
Upper Cheyenne River	798	0	798
Upper Powder River	515	0	515
Total for 2015	**3,997**	**0**	**3,997**
Reasonably Foreseeable Development (2020)			
Antelope Creek	593	0	593
Dry Fork Cheyenne River	141	0	141
Little Powder River	340	0	340
Upper Belle Fourche River	1,609	0	1,609
Upper Cheyenne River	798	0	798
Upper Powder River	515	0	515
Total for 2020	**3,997**	**0**	**3,997**

[1] Coal-related activities as defined for this study include coal-fired power plants, railroads, major (230-kV) transmission lines, and coal technology projects. However, as discussed in Section 3.5, disturbance associated with major (230-kV) transmission lines is not analyzed in this study as the disturbance related to existing lines is minimal and information in relation to RFD transmission lines is lacking. The Task 3D study area is presented in **Figure D-1**.

Table D-2
Wyoming PRB Oil and Gas and Related Development Disturbance Acreages in the Task 3D Study Area[1]
(based on database)

Subwatershed	Lower and Upper Production Scenarios		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Past and Present (2003)			
Antelope Creek	12,961	6,964	5,997
Dry Fork Cheyenne River	3,282	1,681	1,601
Little Powder River	32,573	20,953	11,621
Upper Belle Fourche River	58,538	36,320	22,218
Upper Cheyenne River	6,924	3,856	3,067
Upper Powder River	34,324	20,774	13,550
Total for Past and Present (as of 2003)	**148,602**	**90,548**	**58,053**
Reasonably Foreseeable Development (2010)			
Antelope Creek	22,204	14,409	7,795
Dry Fork Cheyenne River	5,200	3,610	1,590
Little Powder River	44,491	30,603	13,889
Upper Belle Fourche River	72,954	51,881	21,074
Upper Cheyenne River	7,290	4,502	2,788
Upper Powder River	85,742	55,170	30,572
Total for 2010	**237,883**	**160,175**	**77,707**
Reasonably Foreseeable Development (2015)			
Antelope Creek	30,740	22,298	8,443
Dry Fork Cheyenne River	7,661	6,032	1,629
Little Powder River	53,705	40,302	13,403
Upper Belle Fourche River	82,582	64,974	17,608
Upper Cheyenne River	8,414	5,828	2,585
Upper Powder River	121,431	85,991	35,440
Total for 2015	**304,534**	**225,426**	**79,108**
Reasonably Foreseeable Development (2020)			
Antelope Creek	39,375	31,135	8,240
Dry Fork Cheyenne River	10,754	9,140	1,613
Little Powder River	61,682	49,439	12,243
Upper Belle Fourche River	92,161	77,325	14,835
Upper Cheyenne River	9,488	7,136	2,352
Upper Powder River	147,871	114,360	33,511
Total for 2020	**361,331**	**288,536**	**72,794**

[1] Inclusive of conventional oil and gas and CBNG activities and major transportation pipelines. Disturbance associated with ancillary facilities (including gather lines and distribution power lines) has been factored in on a per well basis as discussed in Appendix B of this report. The Task 3D study area is presented in **Figure D-1**.

Table D-3
Wyoming PRB Total Development-related Disturbance Acreages
In the Task 3D Study Area[1]
(based on database)

Subwatershed	Lower Production Scenario			Upper Production Scenario		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Past and Present (2003)						
Antelope Creek	28,610	10,412	18,198	28,610	10,412	18,198
Dry Fork Cheyenne River	3,423	1,681	1,742	3,423	1,681	1,742
Little Powder River	43,178	23,596	19,582	43,178	23,596	19,582
Upper Belle Fourche River	83,034	43,514	39,520	83,034	43,514	39,520
Upper Cheyenne River	27,604	11,809	15,794	27,604	11,809	15,794
Upper Powder River	34,839	20,774	14,065	34,839	20,774	14,065
Total for Past and Present	**220,688**	**111,786**	**108,901**	**220,688**	**111,786**	**108,901**
Reasonably Foreseeable Development (2010)						
Antelope Creek	47,173	25,457	21,716	48,132	25,457	22,675
Dry Fork Cheyenne River	5,341	3,610	1,731	5,341	3,610	1,731
Little Powder River	57,733	35,046	22,688	58,348	35,446	22,902
Upper Belle Fourche River	104,804	64,625	40,180	106,127	65,858	40,271
Upper Cheyenne River	38,603	21,205	17,397	39,492	21,405	18,086
Upper Powder River	86,258	55,170	31,087	86,258	55,170	31,087
Total for 2010	**339,912**	**205,113**	**134,799**	**343,698**	**206,946**	**136,752**
Reasonably Foreseeable Development (2015)						
Antelope Creek	61,991	38,946	23,047	63,512	38,946	24,567
Dry Fork Cheyenne River	7,803	6,032	1,770	7,803	6,032	1,770
Little Powder River	68,912	46,245	22,667	69,827	46,920	22,906
Upper Belle Fourche River	119,283	81,368	37,915	122,669	84,301	38,368
Upper Cheyenne River	46,149	28,031	18,117	47,635	28,631	19,003

Table D-3 (Continued)

Subwatershed	Lower Production Scenario			Upper Production Scenario		
	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)	Cumulative Disturbance Through Most Recent Year (acres)	Cumulative Permanently Reclaimed Areas through Most Recent Report Year (acres)	Cumulative Unreclaimed Areas through Most Recent Report Year (acres)
Upper Powder River	121,947	85,991	35,955	121,947	85,991	35,955
Total for 2015	**426,084**	**286,614**	**139,472**	**433,392**	**290,822**	**142,570**
Reasonably Foreseeable Development (2020)						
Antelope Creek	77,854	54,583	23,270	80,466	54,083	26,383
Dry Fork Cheyenne River	10,895	9,140	1,754	10,895	9,140	1,754
Little Powder River	78,912	57,007	21,904	80,237	58,057	22,180
Upper Belle Fourche River	133,747	97,869	35,880	139,992	103,252	36,738
Upper Cheyenne River	53,291	35,039	18,251	54,756	35,839	18,917
Upper Powder River	148,387	114,360	34,026	148,387	114,360	34,026
Total for 2020	**503,085**	**367,999**	**135,085**	**514,732**	**374,732**	**139,998**

[1] Inclusive of disturbance associated with coal mining, coal-related activities, oil and gas and related development, and other development activities identified for this study. Other quantifiable activities include approximately 171 and 145 acres of disturbance associated with major water storage reservoirs in the Antelope Creek and Little Powder River subwatersheds (2003 through 2020), respectively. The Task 3D study area is presented in **Figure D-1**.

Note: Minor discrepancies in total acreages are the result of rounding.
Based on GIS, the total land area in the Task 3D study area encompasses 4,490,205 acres.

Table D-4
Wyoming PRB Coal Mine-related Production, Employment, and Water-related Information for the Task 3D Study Area[1] (based on database)

Subwatershed	Lower Production Scenario				Upper Production Scenario			
	Annual Coal Production for Report Year (million tons)	Total Employment for Report Year[2]	Annual Water Consumption (mmgpy)	Annual Water Production[3] (mmgpy)	Annual Coal Production for Report Year (million tons)	Total Employment for Report Year	Annual Water Consumption (mmgpy)	Annual Water Production[3] (mmgpy)
Past and Present (2003)								
Antelope Creek	110	1,386	763	472	110	1,386	763	472
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0
Little Powder River	50	676	359	191	50	676	359	191
Upper Belle Fourche River	81	1,001	660	447	81	1,001	660	447
Upper Cheyenne River	122	1,704	946	276	122	1,704	946	276
Upper Powder River	0	0	0	0	0	0	0	0
Total for Past and Present	**363**	**4,767**	**2,728**	**1,386**	**363**	**4,767**	**2,728**	**1,386**
Reasonably Foreseeable Development (2010)								
Antelope Creek	121	1,399	842	899	127	1,399	884	899
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0
Little Powder River	57	709	412	165	70	732	520	165
Upper Belle Fourche River	100	1,450	773	675	125	1,450	945	675
Upper Cheyenne River	133	1,721	1,032	520	157	1,721	1,217	520
Upper Powder River	0	0	0	0	0	0	0	0
Total for 2010	**411**	**5,279**	**3,059**	**2,258**	**479**	**5,302**	**3,566**	**2,258**
Reasonably Foreseeable Development (2015)								
Antelope Creek	133	1,399	925	899	133	1,399	925	899
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0
Little Powder River	69	709	514	165	88	732	681	165

Table D-4 (Continued)

Subwatershed	Lower Production Scenario				Upper Production Scenario			
	Annual Coal Production for Report Year (million tons)	Total Employment for Report Year[2]	Annual Water Consumption (mmgpy)	Annual Water Production[3] (mmgpy)	Annual Coal Production for Report Year (million tons)	Total Employment for Report Year	Annual Water Consumption (mmgpy)	Annual Water Production[3] (mmgpy)
Upper Belle Fourche River	117	1,450	881	675	154	1,450	1,144	675
Upper Cheyenne River	148	1,721	1,152	520	168	1,721	909	520
Upper Powder River	0	0	0	0	0	0	0	0
Total for 2015	**467**	**5,279**	**3,472**	**2,258**	**543**	**5,302**	**3,659**	**2,258**
Reasonably Foreseeable Development (2020)								
Antelope Creek	137	1,399	953	899	137	1,399	953	899
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0
Little Powder River	71	709	529	165	103	732	816	165
Upper Belle Fourche River	133	1,450	973	675	166	1,450	1,225	675
Upper Cheyenne River	154	1,721	1,204	520	170	1,721	1,326	520
Upper Powder River	0	0	0	0	0	0	0	0
Total for 2020	**495**	**5,279**	**3,659**	**2,258**	**576**	**5,302**	**4,320**	**2,258**

[1] The Task 3D study area is shown in **Figure D-1**.
[2] Based on coal mine information, with the exception of 70 power plant-related employees identified in the Upper Belle Fourche River subwatershed numbers.
[3] For purposes of this study, the annual coal mine-related water production is assumed to be the same under both the lower and upper production scenarios.

Table D-5
Wyoming PRB Oil and Gas Production and Conventional Oil and Gas Water-related Information for the Task 3D Study Area[1]
(based on database)

Subwatershed	Annual Oil Production for Report Year (barrels)	Annual Gas Production for Report Year[2] (mmcf)	Annual Conventional Oil- and Gas-related Water Production (mmtpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume Direct) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Passive Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Active Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Infiltration Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Containment Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Land Application) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Injection) (mmgpy)
Past and Present (2003)										
Antelope Creek	831,582	31,887	5	3	0	0	2	0	0	0
Dry Fork Cheyenne River	398,311	10,277	1	0	0	0	0	0	0	0
Little Powder River	2,961,036	39,619	1,777	800	0	0	533	178	178	89
Upper Belle Fourche River	4,728,251	146,805	1,350	607	0	0	540	67	0	135
Upper Cheyenne River	153,924	26,899	13	7	0	0	5	1	0	1
Upper Powder River	2,305,549	65,143	133	47	0	13	53	7	7	7
Total for Past and Present	**11,378,653**	**320,629**	**3,280**	**1,464**	**0**	**13**	**1,133**	**253**	**185**	**232**
Reasonably Foreseeable Development (2010)										
Antelope Creek	699,364	71,491	5	3	0	0	2	0	0	0
Dry Fork Cheyenne River	381,362	11,215	49	12	0	5	17	2	7	5
Little Powder River	4,178,501	54,910	2,508	1,129	0	0	752	251	251	125
Upper Belle Fourche River	6,612,754	134,930	1,888	849	0	0	755	94	0	189
Upper Cheyenne River	54,368	28,561	5	3	0	0	2	0	0	0
Upper Powder River	1,894,972	213,086	110	38	0	11	44	5	5	5
Total for 2010	**13,821,319**	**514,193**	**4,563**	**2,034**	**0**	**16**	**1,572**	**354**	**264**	**325**
Reasonably Foreseeable Development (2015)										

Table D-5 (Continued)

Subwatershed	Annual Oil Production for Report Year (barrels)	Annual Gas Production for Report Year[2] (mmcf)	Annual Conventional Oil- and Gas-related Water Production (mmtpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume Direct) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Passive Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Active Treatment) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Infiltration Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Discharge Volume to Containment Impoundments) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Land Application) (mmgpy)	Annual Conventional Oil- and Gas-related Water Disposal (Injection) (mmgpy)
Antelope Creek	640,214	84,129	4	2	0	0	1	0	0	0
Dry Fork Cheyenne River	349,581	11,152	52	13	0	5	18	3	8	5
Little Powder River	3,807,528	52,974	2,285	1,028	0	0	686	229	229	114
Upper Belle Fourche River	5,963,186	102,772	1,702	766	0	0	681	85	0	170
Upper Cheyenne River	52,249	24,662	4	2	0	0	2	0	0	0
Upper Powder River	1,723,898	254,956	100	35	0	10	40	5	5	5
Total for 2015	**12,536,656**	**530,644**	**4,148**	**1,847**	**0**	**15**	**1,428**	**322**	**241**	**295**
Reasonably Foreseeable Development (2020)										
Antelope Creek	581,064	79,685	4	2	0	0	1	0	0	0
Dry Fork Cheyenne River	317,801	10,332	42	10	0	4	15	2	6	4
Little Powder River	3,436,555	45,459	2,063	928	0	0	619	206	206	103
Upper Belle Fourche River	5,313,618	76,263	1,517	683	0	0	607	76	0	152
Upper Cheyenne River	50,131	19,768	4	2	0	0	1	0	0	0
Upper Powder River	1,555,456	239,089	90	32	0	9	36	5	5	5
Total for 2020	**11,254,625**	**470,596**	**3,719**	**1,657**	**0**	**13**	**1,279**	**289**	**217**	**264**

[1] The Task 3D study area is shown in **Figure D-1**.
[2] Natural gas produced by conventional gas and CBNG wells.

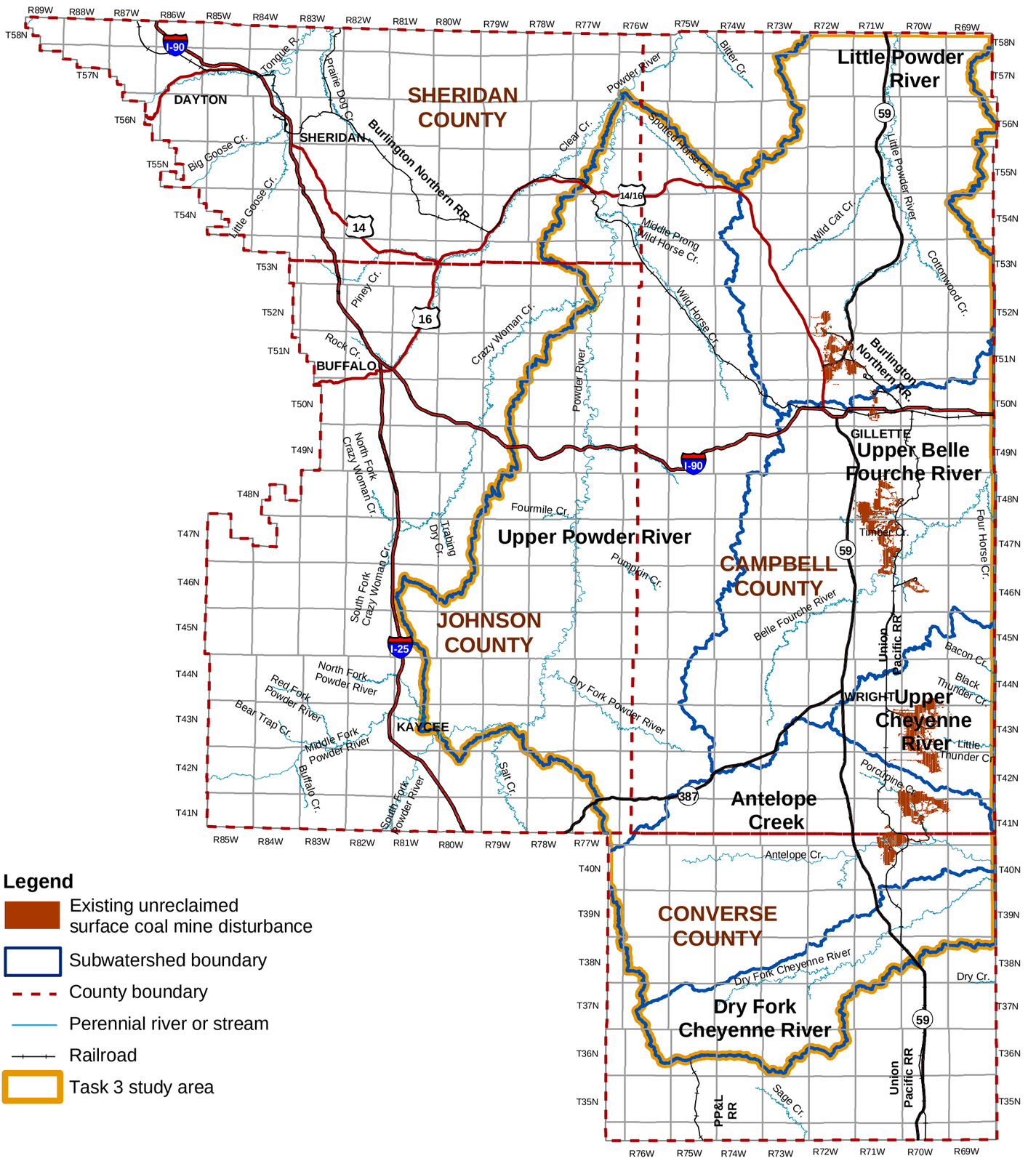
Table D-6
Wyoming PRB CBNG Water-related Information for the Task 3D Study Area[1]
(based on database)

Subwatershed	Annual CBNG-related Water Production (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume Direct) (mmgpy)	Annual CBNG-related Water Disposal (Passive Treatment) (mmgpy)	Annual CBNG-related Water Disposal (Active Treatment) (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume to Infiltration Impoundments) (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume to Containment Impoundments) (mmgpy)	Annual CBNG-related Water Disposal (Land Application) (mmgpy)	Annual CBNG-related Water Disposal (Injection) (mmgpy)
Past and Present (2003)								
Antelope Creek	1,290	710	0	0	452	65	0	65
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0
Little Powder River	2,753	1,239	0	0	826	275	275	138
Upper Belle Fourche River	7,566	3,405	0	0	3,026	378	0	757
Upper Cheyenne River	1,078	593	0	0	377	54	0	54
Upper Powder River	5,237	1,833	0	524	2,095	262	262	262
Total for Past and Present	**17,924**	**7,779**	**0**	**524**	**6,776**	**1,034**	**537**	**1,274**
Reasonably Foreseeable Development (2010)								
Antelope Creek	4,682	2,575	0	0	1,639	234	0	234
Dry Fork Cheyenne River	90	22	0	9	31	4	13	9
Little Powder River	3,814	1,716	0	0	1,144	381	381	191
Upper Belle Fourche River	6,856	3,085	0	0	2,742	343	0	686
Upper Cheyenne River	1,181	650	0	0	413	59	0	59
Upper Powder River	17,922	6,273	0	1,792	7,169	896	896	896
Total for 2010	**34,545**	**14,321**	**0**	**1,801**	**13,139**	**1,918**	**1,291**	**2,075**

Table D-6 (Continued)

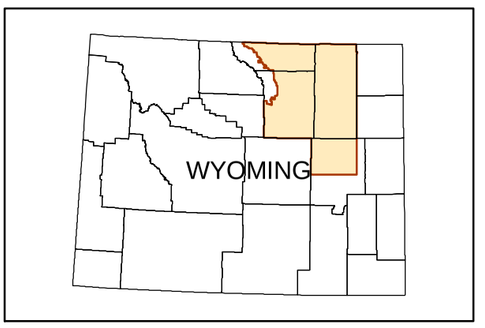
Subwatershed	Annual CBNG-related Water Production (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume Direct) (mmgpy)	Annual CBNG-related Water Disposal (Passive Treatment) (mmgpy)	Annual CBNG-related Water Disposal (Active Treatment) (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume to Infiltration Impoundments) (mmgpy)	Annual CBNG-related Water Disposal (Discharge Volume to Containment Impoundments) (mmgpy)	Annual CBNG-related Water Disposal (Land Application) (mmgpy)	Annual CBNG-related Water Disposal (Injection) (mmgpy)
Reasonably Foreseeable Development (2015)								
Antelope Creek	5,791	3,185	0	0	2,027	290	0	290
Dry Fork Cheyenne River	139	35	0	14	49	7	21	14
Little Powder River	3,686	1,659	0	0	1,106	369	369	184
Upper Belle Fourche River	5,182	2,332	0	0	2,073	259	0	518
Upper Cheyenne River	1,018	560	0	0	356	51	0	51
Upper Powder River	21,520	7,532	0	2,152	8,608	1,076	1,076	1,076
Total for 2015	**37,336**	**15,302**	**0**	**2,166**	**14,218**	**2,051**	**1,466**	**2,133**
Reasonably Foreseeable Development (2020)								
Antelope Creek	5,524	3,038	0	0	1,933	276	0	276
Dry Fork Cheyenne River	139	35	0	14	49	7	21	14
Little Powder River	3,158	1,421	0	0	947	316	316	158
Upper Belle Fourche River	3,807	1,713	0	0	1,523	190	0	381
Upper Cheyenne River	813	447	0	0	285	41	0	41
Upper Powder River	20,189	7,066	0	2,019	8,076	1,009	1,009	1,009
Total for 2020	**33,631**	**13,721**	**0**	**2,033**	**12,813**	**1,839**	**1,346**	**1,879**

[1] The Task 3D study area is shown in **Figure D-1**.



Legend

- Existing unreclaimed surface coal mine disturbance
- Subwatershed boundary
- County boundary
- Perennial river or stream
- Railroad
- Task 3 study area



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0 8 16 24 Miles

0 8 16 24 Kilometers

Source: BLM 2003a, 2004; Thunder Basin Coal Company 2003.

Powder River Basin Coal Review

Figure D-1

Task 3D Study Area and Subwatersheds

10/19/05

APPENDIX E

METHODOLOGY AND ASSUMPTIONS FOR OIL AND GAS RFD PROJECTIONS

1.0 GENERAL INFORMATION

Primary Data Source: IHS (2004) data files were sorted by the BLM for use in this study. Two IHS data files were used to establish the existing level of oil and gas development in the Wyoming PRB: one for production and one for all wells. Both files covered all of Campbell, Johnson, and Sheridan counties. All of Converse County also was provided, but only wells identified as part of the PRB study area were considered in the analysis. Production data provided information on producing wells in the study area for the period of December 1, 2003, to December 1, 2004, according to permit number. The earliest information provided in the production file was from 1974. The other file ('*all well*') provided information on location (latitude/longitude), completion depth, and initial target product for all wells within the study area. In order to eliminate duplication between the two data files, location information (latitude/longitude) from the *all well* data was applied to wells in the production file, identical wells were identified by comparing American Petroleum Institute (API) numbers, and all wells were mapped and 4th level sub-basins (referred to as subwatersheds for consistency with the PRB Oil and Gas EIS [BLM 2003]) assigned through the GIS.

Secondary Information Source: The WOGCC (2005b) web site provided a current searchable CBNG database, which was used during this analysis for production comparisons. It also provided mineral rights ownership on a well-by-well basis, which was spot-checked against mapped mineral ownership information.

Tertiary Information Source: BLM and WOGCC. BLM information concerning projected federal APDs for CBNG, the rate of APDs that actually become wells, information on CBNG production lives, and mineral rights ownership was used in this study. The WOGCC provided information concerning potential numbers of inactive conventional wells that may be present in the study area.

The following sections describe the methodology and key assumptions used in developing the database of past, present, and reasonably foreseeable oil and gas development in the Wyoming PRB.

2.0 2003 PRODUCTION DATA DETERMINATION

The production file (IHS 2004) included well locations, well types, and initial production date as well as production data from 1990 to 2004. In order to normalize the data for 2003, allowing consistency with the timeline for the remainder of the PRB Coal Review Task 2 past and present data, only wells listed as first producing prior to 2004 were considered in the analyses. Wells were plotted and assigned subwatershed locations using GIS, then identified as conventional wells or CBNG wells based on well types and production information (only gas wells not producing oil within the IHS file time frame were considered to be CBNG; injection wells not producing any oil or gas were not included with either grouping). The number of active versus inactive wells was determined for each production type and subwatershed. Conventional wells designated as inactive were determined to be either shut-in (destined for plugging and abandonment) or seasonally active. Seasonally active wells were categorized separately (see Section 5.0 for further discussion). CBNG wells designated as inactive were determined to be drilled and ready to produce (Eggerman 2005), and were therefore lumped with active wells for current and future calculations.

Production (baseline and cumulative) information was developed for wells grouped by subwatershed and well type. Because information in the IHS data was limited to 1990 through 2004, wells within these groupings were then analyzed by BLM for cumulative and yearly production since 1974. Cumulative data included all production through 2003.

Assumptions;

1) Wells not showing a history of oil production in the IHS file and did not produce oil in the past, are CBNG wells, with the following exception. There are a small number of conventional gas wells that produce from sandstones in the Fort Union Formation (Randall 1989). The number of these wells reported by Randall (1989) was 37, and the source of the gas was reportedly from coal seams. These wells were deemed insignificant when compared with the total number of CBNG wells in the study area.
2) Historic wells included in the IHS *all wells* file, but not included in the IHS production file, were assumed to be conventional wells.

3.0 ESTIMATE OF CONVENTIONAL OIL AND GAS WELLS DRILLED PER YEAR

Numbers of conventional wells drilled since 1990 were determined using the IHS *all wells* file. Only wells with a completion date between December 31, 1989, and the present (2003) were used in this analysis. Also, only wells that were located in T34N through T58N were used. Only wells deeper than 2,000 feet were considered to be conventional oil and gas wells. A breakdown according to the well classification provided in the IHS data file (e.g., plugged and abandoned [P&A], wildcat, injection, etc.) subsequently was performed. The final result was an estimate of 100 conventional oil and gas wells drilled in the PRB per year from 1990 through 2004.

Because estimating future activity in the region based on past activity did not account for recent increases in oil prices (which may cause an increased interest in oil in the region), or the potential for reactivating dormant wells, the future estimate was based on the predicted number of operating conventional wells in the region. Numbers of predicted operating wells were based on the expected numbers of operating wells per year taken from a graph provided by the BLM Reservoir Management Group (RMG) (2005), which accounts for the potential increase in oil and gas production in the region based on increasing oil price estimates (based on changing percent increases or decreases in wells) (see **Table E-1**). Unanticipated future price fluctuations could affect (increase or decrease) future well projection numbers. The previous year estimate of active wells was multiplied by the indicated factor to estimate the current year number of active wells. The numbers of historic wells used by the BLM RMG closely tracked with the number of wells from the IHS database designated as crude oil, but production information and well counts produced for this study also included the wells designated as gas, oil, or injection that had produced oil. The year the additional wells came on line was determined, and they were added to the historic numbers from the BLM RMG (2005) based on these dates. Therefore, the historic active well numbers were adjusted upward based on the number of those wells that came on line each year. All wells operating prior to 1974 were added to 1974. Future well numbers then were projected.

Table E-1
Changes In Projected Number of Operating Conventional Wells

Years	Increase or Decrease	Percent
2005	Decrease	1
2006-2009	Increase	5
2010-2012	Decrease	2
2013-2020	Decrease	3

The number of projected new wells each year was estimated based on the assumptions that the P&A rate of operating conventional wells is 10 percent, and the percent of new wells drilled that are unsuccessful (therefore P&A) is 40 percent (IHS 2004). Wells that are not P&A were assumed to be producing. This equation follows:

New active wells = 0.6 x current year new wells – 0.9 x previous year active wells

Assumptions:

1) Wells located in T34N through T58N are within the PRB study area.
2) All shallow wells (completion depth of less than 2,000 feet) are CBNG wells.
3) The PRB will see a short-term increase in the number of operating wells in the region, followed by a slow decline.
4) Forty percent of wells drilled will be nonproductive and P&A within that year, and an additional 10 percent of active wells will be P&A each year.

4.0 ESTIMATE OF FUTURE P&A CONVENTIONAL OIL AND GAS WELLS RELATIVE TO THE TOTAL NUMBER OF WELLS

For the last 15 years, the percent of new wells that have been drilled and P&A in the study area has been 40 percent (IHS 2004). This includes all classifications of wells: wildcats, development wells, and injection wells. The number of wells P&A in each subwatershed was determined by year from 1990 to 2004 using the IHS *all wells* file. Historically, the mean percent of P&A wells relative to the number of active wells was 1.6 percent (IHS 2004). This ratio was applied to yearly totals of conventional wells to estimate the number of P&A wells for the years 2004 to 2009. Because the predicted decline of active wells between 2010 and 2020 (BLM RMG 2005) required an increase in the number of P&A wells, the P&A rate was adjusted to equal the decline rate of those years plus 0.5 percent. The sum of the new P&A wells and the operating P&A wells was the total for each year.

Assumptions:

1) Forty percent of new wells are unproductive and P&A within the first year after drilling.
2) Decline rates were based on data provided by BLM RMG (2005).
3) The wells to be abandoned will not depend on geographic location.

5.0 ESTIMATE OF THE NUMBER OF FUTURE ACTIVE, INACTIVE, P&A, AND TOTAL CONVENTIONAL OIL AND GAS WELLS

The estimated number of P&A wells was based on the number of new wells multiplied by a factor of 0.4 (which is the approximate rate of new wells closed within the first year of operation based on oil field data within the area), plus the previous year's cumulative total wells and the current number of inactive wells multiplied by a factor of 0.1. The following equation was used:

P&A wells = (previous years cumulative wells x 0.100) + (new wells for year x 0.4) + (0.1 x inactive wells)

The number of cumulative wells was determined based on the sum of the previous year's cumulative wells plus the new wells. The following equation was used:

Cumulative wells = (previous year's cumulative wells) x (1-0.100) + new wells for year

The number of inactive wells (over 3,000) for the baseline year was determined using the IHS production file. According to WOGCC (2005b), it is possible and reasonable that the number of shut-in wells in the region could be estimated at 2,000. The remaining wells could be considered to be seasonally active, but may not have been listed as active in the IHS production database, because the information was downloaded during winter months while these wells were inactive. Because locating individual shut-in or seasonally active wells was not realistic; wells reclassified as seasonally active (about 1,000 wells) were removed from the inactive category and distributed throughout subwatersheds proportionally to the number of active wells. Future rates of seasonally active wells were estimated to remain constant, while a yearly P&A rate of 10 percent was applied to the remaining inactive (shut-in) wells.

Assumptions:

1) Approximately 2,000 truly inactive (shut-in) wells exist within the PRB study area. Remaining wells designated as inactive in the IHS database are actually seasonally active. These wells were distributed proportionally to the active wells in the region.

6.0 ALLOCATION OF FUTURE CONVENTIONAL OIL AND GAS WELLS BY SUBWATERSHED

The number of wells drilled per subwatershed was determined by year from 1990 to 2004, using the IHS *all wells* file and GIS. The mean ratio of wells drilled per subwatershed relative to the basin-wide total number of wells was determined for this period, and the mean ratio was applied to the estimated future total number of wells to distribute them throughout the subwatersheds.

Assumptions:

1) The future distribution pattern of wells by subwatershed will be similar to past and present distribution patterns.

7.0 ESTIMATE OF THE RATE OF P&A CBNG WELLS PER SUBWATERSHED PER YEAR

Because CBNG in the PRB is a relatively new play, past P&A rates of CBNG wells in the region is not an accurate predictor for future rates. Also, due to changes in technology and drilling depths, previous estimates of well life at 7 years may be too low. Current rates of unsuccessful wells drilled in the region are 4.1 percent (BLM RMG 2005). Estimated rates for plugging and abandoning successful wells were based on well age, with the majority of wells ending their productive lives at 10 years (**Table E-2**).

Table E-2
Expected Lifespan of CBNG Wells

Age of Well (year)	Percent of Active Wells for Year Expected to be P&A
8	10
9	20
10	30
11	30
12	10
Total	**100**

P&A wells were distributed among the subwatersheds based on the proportion of active wells in the subwatershed. Wells were further subdivided by oil and gas mineral ownership proportionally to the ownership distribution of the previous years active wells.

Assumptions:

1) It is assumed that abandonment rates of new wells will be 4.1 percent (BLM RMG 2005).
2) Wells will be P&A between 8 and 12 years after they start producing, with the majority of wells abandoned after 10 years of operation (BLM RMG 2005).
3) The distribution pattern of abandoned wells between subwatersheds will be proportional to the numbers of active wells in the subwatersheds.

8.0 ESTIMATE OF THE FUTURE RATE OF CBNG WELLS DRILLED PER SUBWATERSHED PER YEAR

The number of CBNG wells drilled per subwatershed between 1990 and 2004 was determined from the IHS *all wells* file, based on the dates the wells went on line and the dates the wells were completed (the numbers were within 0.1 percent of each other). The total number of wells drilled from 2002 to 2004 was compared to future estimates presented in Table 2-1 in the PRB Oil and Gas Final EIS (BLM 2003). The (then) future estimates from the Final EIS were higher than the actual data from the IHS file. Because mineral rights in the region are primarily federal, future wells drilled would be largely dependent on the projected number of APDs to be issued by the BLM Field Offices in the region.

The BLM Casper Field Office expects to issue 35 federal APDs each year between 2005 and 2020. The BLM Buffalo Field Office expects to issue 2,500 APDs per year from 2005 to 2015, which would decline by 200 wells per year from 2016 to 2020. The number of wells drilled in 2003 and 2004 were obtained from the IHS production database. Approximately 89.8 percent of federally issued APDs would result in drilled wells (BLM RMG 2005).

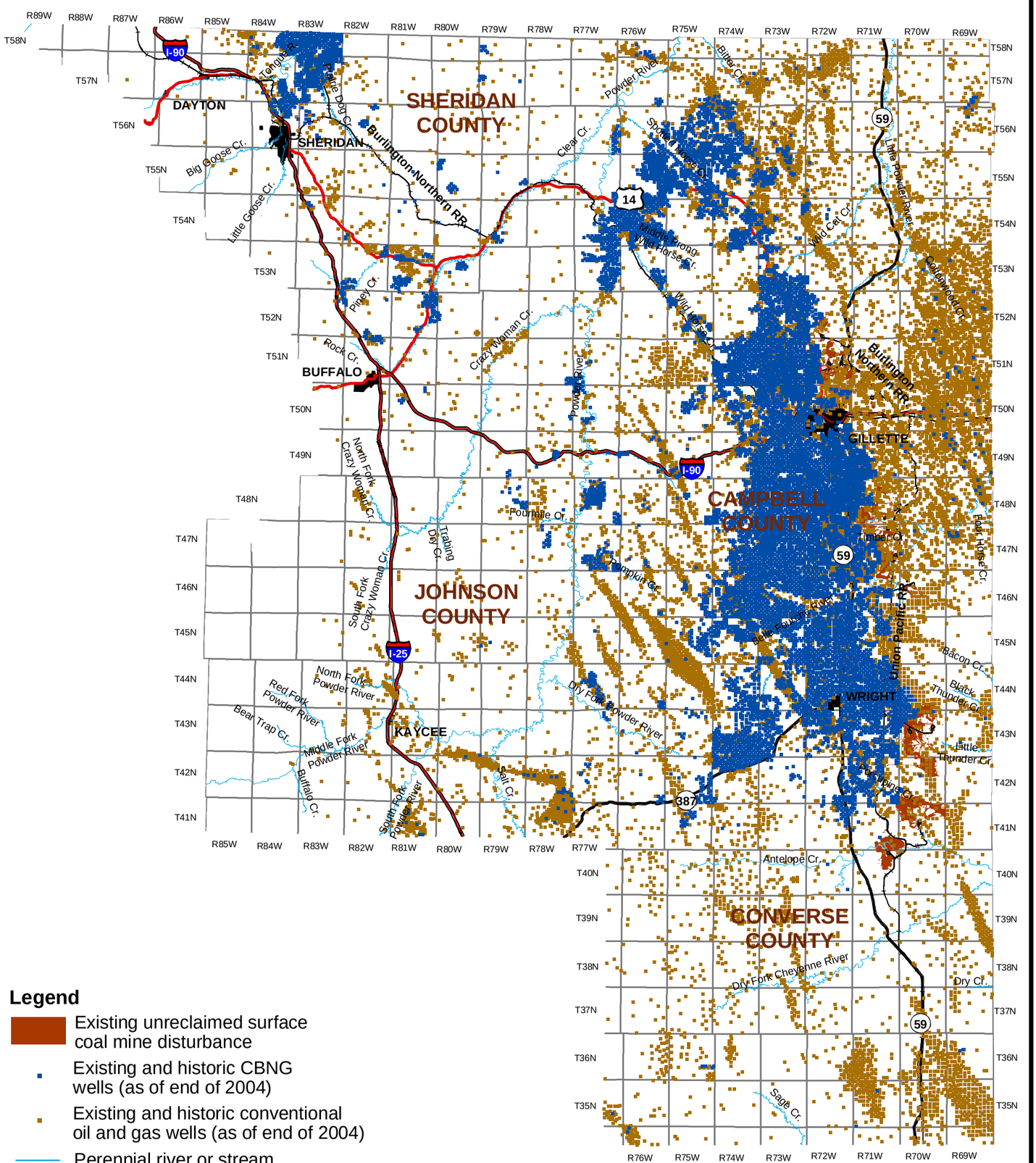
The number of state/fee permits anticipated per year in the PRB study area was calculated in several steps. Estimates of available pads were determined using GIS, as follows. 1) The area of consideration in each subwatershed was defined as that area overlying the major coal-bearing strata of the Fort Union Formation. 2) Currently active conventional wells and all CBNG wells were plotted (see **Figure E-1**), and an 80-acre buffer around each existing well was removed from consideration for future development. 3) The areas remaining were quantified in acres according to oil and gas mineral ownership. Although areas that contain thin multiple coal seams or low gas content could not be economically drilled, they have not been defined for or excluded from this study which looked at the averages. 4) Available acreages were divided into 80-acre parcels to estimate the number of available well pads. Each year, the number of available pads was reduced by the estimated number of APDs issued for each ownership divided by 1.45, which is the overall number of CBNG wells per pad (BLM 2003). First, the ratio of available state/fee 80-acre pads available for development relative to federal mineral ownership lands was estimated. This proportion was applied to the number of federal APDs issued to calculate the anticipated number of state/fee APDs issued. An estimated 72.4 percent of state/fee APDs are drilled (BLM RMG 2005). The estimated number of wells drilled was calculated by the following equation:

BLM Casper Field Office APDs for 2005 – 2020 = 35/year

BLM Buffalo Field Office APDs for 2005 – 2020 = X/year

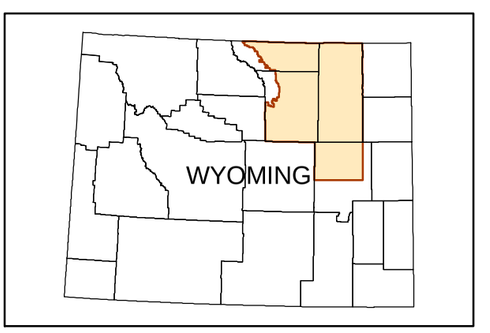
where

X = 2,500 for years 2005 through 2015, 2,300 in 2016, 2,100 in 2017, 1,900 in 2019, and 1,500 in 2020



Legend

- Existing unreclaimed surface coal mine disturbance
- Existing and historic CBNG wells (as of end of 2004)
- Existing and historic conventional oil and gas wells (as of end of 2004)
- Perennial river or stream
- Railroad



N
W E
S

0 8 16 24 Miles

0 8 16 24 Kilometers

Source: BLM 2003; IHS 2005; WOGCC 2005.

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Figure E-1

Producing Oil and Gas Wells and Completed Wells Ready to Produce

10/19/05

Federal APDs = BLM Buffalo Field Office APDs or BLM Casper Field Office APDs

Federal wells drilled = Federal APDs x 0.898

and

$$\textit{State/Fee APDs} = \frac{\textit{State/Fee Available Pads}}{\textit{Federal Available Pads}} \times \textit{Federal APDs}$$

State/Fee wells drilled = State/Fee APDs x 0.724

and

Current year Federal pads = Previous year Federal Pads – Previous year Federal APDs/1.45

Current year State/Fee pads = Previous year State/Fee Pads – Previous year State/Fee APDs/1.45

and

Wells drilled for year = Federal Wells Drilled + State/Fee Wells Drilled

Distribution of new wells into subwatersheds was based on the proportion of available pads.

Assumptions:

1) The BLM Buffalo Field Office will issue 2,500 APDs/year from 2005 to 2015. Starting in 2016, the number of federal permits issued per year is declined at a rate of 200 per year until 2020 to account for a tapering off of activity that would be expected to occur after 25 years of activity in the play. The BLM Casper Field Office will issue 35 APDs per year between 2005 and 2020. Of all federal APDs issued, 89.8 percent will be drilled (BLM RMG 2005).
2) The number of state/fee APDs that the WOGCC will issue will be proportional to the number of federal APDs issued by each BLM Field Office, as well as to the amount of remaining available spacing for state/fee pads within the BLM Field Office boundaries. Of the state APDs issued, 72.4 percent will be drilled.
3) An average of 1.45 wells will be drilled per pad (BLM 2003a).
4) Distribution of new wells in the PRB subwatersheds will be proportional to remaining available pads within the jurisdiction of each BLM Field Office.
5) No significant CBNG development will occur outside of the Wasatch/Fort Union coal outcrop.
6) Technology used to extract CBNG will not change significantly during the time frame of this study.
7) Future wells will be drilled based on 80-acre pad spacing.

9.0 DETERMINATION OF FUTURE YEARLY TOTAL PRODUCTION OF NATURAL GAS AND WATER FROM CBNG WELLS AND OIL, GAS, AND WATER FROM CONVENTIONAL WELLS

The mean current (2003) well production (oil, natural gas, and water) was determined by subwatershed on a per operating well basis for 2003. The mean current production was estimated on a per operating well basis. The mean production rate was applied on a per well basis for future estimates. Where no historical production information was available to develop future subwatershed-based estimates, basin-wide mean per-well production was used. Because production levels varied greatly between and within subwatershed data, and because current means were not available for some subwatersheds (i.e., no wells were producing within the subwatershed), means of the production of each product or water across all subwatersheds for each production type (conventional oil and gas and CBNG) were used. These means were multiplied by the estimated number of producing wells in each future time period analyzed for this study. It should be noted that estimates of future production rates could be affected by unanticipated oil and gas price fluctuations, potential lower production rate per well, or the tapping of thinner coal seams that proportionally would produce less gas.

Assumption:

1) While production from individual wells can vary greatly, because the number of wells is fairly large, the overall mean is representative of regional production.
2) The average rate of production per well will not change greatly over the period of this study.
3) Average annual production is 30,000 MCF/year based on the average number of wells for 2002, 2003, and 2004 divided into the total production each year, then averaged over the 3-year period.

10.0 DETERMINATION OF FUTURE CUMULATIVE VALUES FOR PRODUCTION OF OIL, NATURAL GAS, AND WATER

Future cumulative production values were identified by determining the estimated yearly production (products and water) for the yearly estimated number of wells and adding these to the previous dataset's cumulative estimate. The equation for this is:

Estimated cumulative production for given year = previous year estimated cumulative + current year estimated production

11.0 DETERMINATION OF WATER PRODUCTION, CONSUMPTION, INJECTION, AND DISCHARGE AMOUNTS

The number of injection wells and volumes of injection water for 2003 were determined from the IHS production file for wells identified as injection. The number of injection wells in relation to the overall number of wells in the basin was negligible.

Assumptions:

1) Water reported in the IHS database for wells identified as injection was assumed to be the volume of water injected.
2) Water produced within a subwatershed either would be injected or discharged within the same subwatershed.

12.0 ESTIMATE OF DISTURBED AND RECLAIMED ACREAGE RELATED TO CONVENTIONAL OIL AND GAS AND CBNG ACTIVITIES

The overall rates of disturbance due to CBNG well development were estimated in the PRB Oil and Gas Final EIS (BLM 2003a); the following information was developed from **Tables 2-1**, **2-23**, and **2-24**, which summarized alternative 2A. Total short- and long-term per-well disturbance was estimated by dividing the estimated total acreages disturbed (inclusive of pads, roads, pipelines, etc.) (**Tables 2-23** and **2-24**) by the estimated number of new wells drilled during the period (**Table 2-1**). Estimated disturbance was 5.2 acres per well for short-term disturbance, and 2.4 acres per well for long-term disturbance. As a result, each per pad disturbance acreage also accounts for a portion of the well field-related road, pipeline, water handling facilities, and other associated facilities disturbance. Drilling multiple wells per pad was factored in the EIS calculations. The short-term disturbance area was calculated based on the number of new wells during the year. Long-term disturbance was calculated based on the cumulative number of wells excluding new wells for the year. Reclamation each year was based on the addition of the number of new P&A wells multiplied by the long-term disturbance (5.2 acres), old P&A wells multiplied by short-term disturbance (2.4 acres), and the partial reclamation of new well pads for operating wells for the year (2.8 acres).

The rates of disturbance due to conventional oil and gas wells were estimated in the PRB Oil and Gas Final EIS (BLM 2003) at 2.75 acres for wells during construction, and as 2.0 acres during production. The per-well disturbance of 2.75 acres was applied to wells developed within the last year, and the per-well disturbance of 2.0 acres was applied to all other active and inactive wells for the period. Each per pad disturbance acreage also accounts for a portion of the associated ancillary facilities. Reclamation each year was based on the addition of the number of new P&A wells multiplied by the short-term disturbance (2.75 acres), old P&A wells multiplied by long-term disturbance (2.0 acres), and the partial reclamation of new operating wells for the year (0.75 acres).

Assumptions:

1) The estimated per-well disturbance acreages will not change during the study (initial disturbance of 2.75 acres for conventional oil and gas wells and 5.2 acres for CBNG wells).
2) Overall disturbance will be distributed evenly among wells.
3) A portion of the short-term disturbance will be reclaimed within the year after the well is drilled (0.75 acre for each conventional oil and gas well and 2.8 acres for each CBNG well).
4) Long-term disturbance due to conventional oil and gas and CBNG wells will be reclaimed within the year wells are listed as abandoned (2.0 acres for each conventional oil and gas wells and 2.4 acres for each CBNG well). This accounts for reclamation of associated roads, pipelines, water handling facilities, etc., as proportionally included in the disturbance acreage for each pad.

13.0 ESTIMATE OF THE VOLUME OF WATER DISPOSED OF BY VARIOUS DISPOSAL METHODS

It is assumed that the volume of water to be disposed of through each disposal method would vary between subwatersheds, according to the following table from the PRB Oil and Gas Final EIS (BLM 2003a).

Percent of Total Water Production per Discharge Method

Subwatershed	Untreated Discharge	Passive Treatment	Active Treatment	Infiltration Impoundment	Containment Impoundment	LAD	Injection
Upper Tongue River	0	25	5	45	10	5	10
Upper Powder River	35	0	10	40	5	5	5
Salt Creek	55	0	0	35	5	0	5
Crazy Woman Creek	35	0	10	30	5	15	5
Clear Creek	25	10	10	35	5	15	10
Middle Powder River	35	5	5	30	10	10	5
Little Powder River	45	0	0	30	10	10	5
Antelope Creek	55	0	0	35	5	0	5
Upper Cheyenne River	55	0	0	35	5	0	5
Upper Belle Fouche River	45	0	0	40	5	0	10

Sources: Beels 2005; BLM 2003b.

Where possible, estimated produced water volumes within subwatersheds were allocated among disposal methods according to this table. Water disposal in subwatersheds without an indicated preferred allocation for disposal methods (Dry Fork Cheyenne River, Lightning Creek, Little Bighorn River, Little Missouri River, Middle Fork Powder River, Middle North Platte River, North Fork Powder River, Salt Creek, and South Fork Powder River) was assumed to be allocated in the same way as Clear Creek, since Clear Creek offered the most widely distributed disposal methods.

Assumptions:

1) It is assumed that the percent of total produced water discharged to impoundments, outfalls, or through injection in each subwatershed will be allocated per the PRB Oil and Gas Final EIS (BLM 2003) estimates.
2) It is assumed that water disposal in subwatersheds without an indicated allocation in the PRB Oil and Gas Final EIS (BLM 2003) will be the same as identified in that document for the Clear Creek subwatershed.