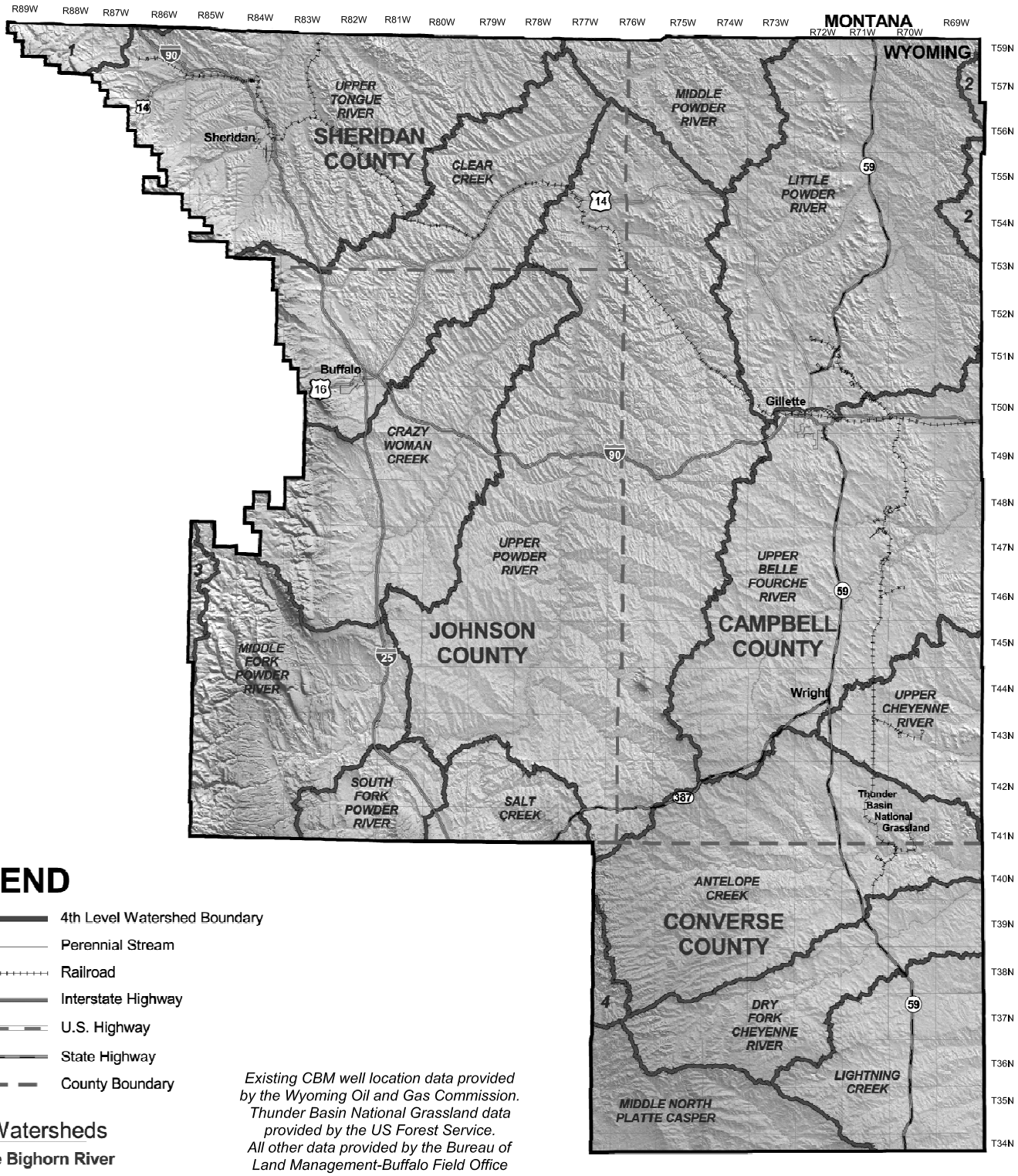
1.0 INTRODUCTION

This groundwater modeling report is a technical support document for the Powder River Basin Oil and Gas Environmental Impact Statement (PRB O&G EIS). The Project Area covers the Wyoming part of the Powder River Basin (PRB), as shown in Figure 1-1. The intent of the EIS is to provide an overall projection of impacts associated with development of coal bed methane (CBM) and non-CBM oil and gas and to address the specific issues that were raised in public meetings held to discuss the proposal to develop CBM on federal lands in the PRB. This technical document describes the groundwater flow modeling that was used to evaluate the impacts associated with CBM development. The modeling did not include development of non-CBM oil and gas but included the impacts associated with coal mining operations.

The majority of the methane gas contained in the PRB coals is adsorbed in coal pores under hydrostatic pressure. The hydraulic pressure is reduced by pumping groundwater from production wells completed in the target coal to develop the methane gas resource. This reduction in hydraulic pressure allows the methane gas to desorb from pores in the coal and migrate to cleats and fractures in the coal by diffusion. The methane is transported to production wells by fractures under the prevailing pressure gradients. The gas and the water typically separate within the production well casing so that the gas can be piped directly from the wellhead. Pumped water would be managed in several ways, including discharge to local surface drainages (with or without prior treatment), infiltration via shallow impoundments, storage in reservoirs (containment), injection into deeper geologic units via wells, and land application.

A major potential impact associated with CBM development involves groundwater resources. Specifically, concern arises from the potential of CBM development to lower groundwater levels significantly. Numerical groundwater flow modeling was used to predict the impacts to groundwater from CBM development in the PRB. The model also included the superimposed influences of surface coal mining operations. Modeling was necessary because of the large extent and variability of the cumulative stresses imposed by mining and CBM development on the aquifer units of the PRB. This work was supplemented with existing trends in data to support conclusions. Produced water is managed in various ways that allow a certain proportion of the produced water to infiltrate into the subsurface and recharge aquifers. The model was used to evaluate the impacts of various water management strategies on recharge to the groundwater system.

Alternative 1 (Proposed Action) would add 39,367 new wells over a 10-year development period from 2002 to 2011, and involves three alternatives for water management. Alternative 1 assumes a mix of surface discharge, infiltration impoundments, containment impoundments, injection, and land application, but emphasizes surface discharge. Alternative 2A emphasizes infiltration and Alternative 2B includes treatment of pumped groundwater for beneficial use. Alternative 3 (No Action) assumes that new production wells would be developed only on non-federal mineral ownership lands over the development period. These development and water management scenarios are described in more detail in Chapter 2 of the final EIS (FEIS).



LEGEND

- 4th Level Watershed Boundary
- Perennial Stream
- Railroad
- Interstate Highway
- U.S. Highway
- State Highway
- County Boundary

Sub-Watersheds

1--Little Bighorn River
2--Little Missouri River
3--North Fork Powder River
4--Salt Creek

Existing CBM well location data provided by the Wyoming Oil and Gas Commission. Thunder Basin National Grassland data provided by the US Forest Service. All other data provided by the Bureau of Land Management-Buffalo Field Office and Casper Field Office.

Transverse Mercator Projection
1927 North American Datum
Zone 13

N

10 0 10 20 30 Miles

POWDER RIVER BASIN OIL & GAS PROJECT FEIS

TECHNICAL REPORT GROUNDWATER MODELING

FIGURE 1-1
PROJECT LOCATION MAP

ANALYSIS AREA: CAMPBELL, CONVERSE, JOHNSON & SHERIDAN COUNTIES, WYOMING

Date: 09/04/02	Drawing File: Figure 1-1.dwg
Scale: As Noted	Drawn By: ETC

In developing a CBM project, a portion of the water contained in the coal aquifer is removed at specific locations, releasing methane gas for collection. The primary impact to groundwater associated with development of CBM in the PRB involves removal of groundwater stored within the target coal seams. This removal results in loss of available hydraulic head in the coal seams of the upper portion of the Fort Union Formation. This loss in head (drawdown) could affect water wells completed in the coal seams in the form of reduced well yields and potential emissions of methane.

Reduction in head within the coal aquifer can induce leakage from overlying and underlying zones, leading to reduced hydraulic head in these aquifers as well. The extent of leakage (and reduction in head) is largely a function of the vertical permeability of the geologic units that separate these aquifer units from the coal. Natural discharge of springs may be affected by this reduction in hydraulic head in the source aquifer unit. Infiltration of CBM-produced water may cause new springs or seeps to develop.

Surface discharge of extracted groundwater from CBM operations into surface drainages and constructed impoundments will enhance recharge of shallow aquifers below creeks and ponds. Similarly, injection of produced CBM water will recharge the aquifer units within the injection zones where the injection wells are completed. The influence of various water handling options was addressed by the modeling in terms of recharge to the groundwater system.