

## **BELL CREEK TEST SITE GEOLOGICAL MODEL DEVELOPMENT INITIATED**

Plains CO<sub>2</sub> Reduction (PCOR) Partnership Phase III  
Task 4 – Milestone M9

*Prepared for:*

Andrea T. McNemar

U.S. Department of Energy  
National Energy Technology Laboratory  
3610 Collins Ferry Road  
PO Box 880  
Morgantown, WV 26507-0880

*Prepared by:*

James A. Sorensen  
Edward N. Steadman  
John A. Harju

Energy & Environmental Research Center  
University of North Dakota  
15 North 23rd Street, Stop 9018  
Grand Forks, ND 58202-9018

David J. Moffatt

Spectra Energy Transmission  
Suite 2600, 425 1st Street SW  
Fifth Avenue Place, East Tower  
Calgary, AB T2P 3L8  
CANADA

## **DOE DISCLAIMER**

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government, nor any agency thereof, nor any of their employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report is available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161; phone orders accepted at (703) 487-4650.

## **EERC DISCLAIMER**

**LEGAL NOTICE** This research report was prepared by the Energy & Environmental Research Center (EERC), an agency of the University of North Dakota, as an account of work sponsored by the U.S. Department of Energy National Energy Technology Laboratory, the North Dakota Industrial Commission, and numerous other partners. Because of the research nature of the work performed, neither the EERC nor any of its employees makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement or recommendation by the EERC.

## TABLE OF CONTENTS

|  |   |
|--|---|
| LIST OF FIGURES .....                        | i |
| BACKGROUND .....                             | 1 |
| Geological Model Development Initiated ..... | 2 |

## LIST OF FIGURES

|   |   |   |
|---|---|---|
| 1 | Alternating cycles of water and CO <sub>2</sub> injection for EOR ..... | 2 |
|---|---|---|



## **BELL CREEK TEST SITE GEOLOGICAL MODEL DEVELOPMENT INITIATED**

### **BACKGROUND**

The Plains CO<sub>2</sub> Reduction (PCOR) Partnership is initiating discussions with Denbury Resources Inc. (Denbury) to determine the efficacy of developing a robust and practical monitoring, verification, and accounting (MVA), risk management, and simulation project associated with a commercial-scale injection of carbon dioxide (CO<sub>2</sub>) for the purpose of simultaneous enhanced oil recovery (EOR) and storage of CO<sub>2</sub>. A technical team that includes Denbury, the Energy & Environmental Research Center (EERC), and others will conduct a variety of activities to determine the baseline geological characteristics of the injection site and surrounding areas. Denbury will carry out the injection process while the EERC will conduct CO<sub>2</sub> MVA activities at the site. The project, which will be conducted in the Bell Creek oil field, Powder River County, southeastern Montana, will provide insight regarding the impact of miscible CO<sub>2</sub> flood tertiary recovery on oil production and successful CO<sub>2</sub> storage within a sandstone reservoir in the Cretaceous Muddy Formation. The Bell Creek project will be a unique opportunity to develop a set of cost-effective MVA protocols for large-scale CO<sub>2</sub> storage associated with an EOR operation.

The Bell Creek oil field is an ideal candidate for a CO<sub>2</sub> tertiary recovery project for a number of reasons. The primary reason is its depth of 4500 feet, which results in temperature and pressure conditions that will maintain the injected CO<sub>2</sub> in a supercritical state and allow for miscibility of the CO<sub>2</sub> in the oil. The secondary reason is that Bell Creek's permeability is 900 millidarcies and its porosity averages 24%, allowing for high CO<sub>2</sub> injection rates and a fairly rapid production response. Figure 1 is a representation of a typical CO<sub>2</sub>-based injection scheme for tertiary EOR operations.

The Lost Cabin Gas Plant, located in Fremont County, Wyoming, is owned and operated by ConocoPhillips and currently generates approximately 50 million cubic feet per day of CO<sub>2</sub>. Denbury and ConocoPhillips have entered into a 15-year CO<sub>2</sub> purchase and sale agreement. Denbury plans to build compression facilities adjacent to the Lost Cabin Gas Plant to take the feed from 50 to 2200 psi, allowing for delivery to the project site at injection-ready pressure. Along with construction of a 226-mile pipeline to transport the compressed CO<sub>2</sub> to its Bell Creek Field in southeastern Montana, Denbury will upgrade its current waterflood secondary recovery project into a miscible CO<sub>2</sub> flood tertiary recovery project. It is estimated that the site will be ready for CO<sub>2</sub> injection in September 2011.

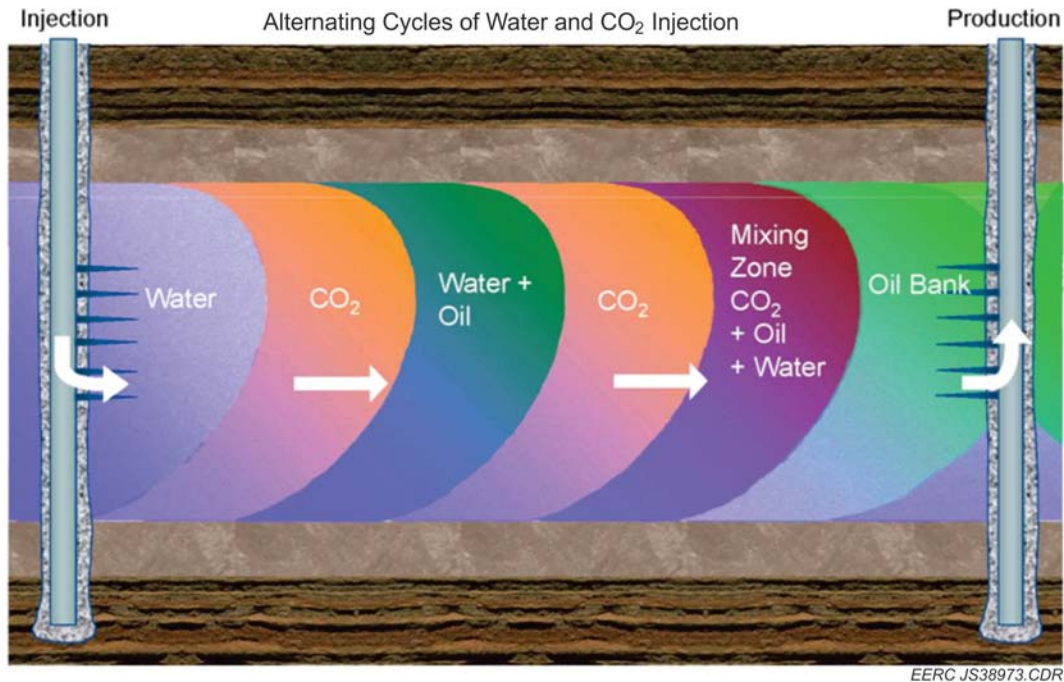


Figure 1. Alternating cycles of water and CO<sub>2</sub> injection for EOR.

### Geological Model Development Initiated

A variety of activities focused on developing a geological model of the Bell Creek oil field were initiated in the third quarter of Phase III – Year 3. These activities include the following:

- Publicly available well log data were obtained from the Montana Board of Oil and Gas Conservation.
- Well log data were used to identify the tops of key formations within the Bell Creek oil field and its surrounding area. Specifically, the tops for the Cretaceous Muddy Formation which serves as the reservoir rock for the Bell Creek oil field were identified. Potential seal formations were also identified.
- The well log data were used to create thickness isopach maps and identify major structural elements of the Bell Creek oil field.
- Further development of the geological model is ongoing and will continue as new, further detailed data become available.