Workshop on Development of Best Practices Manual and Public Policy Tools

Dr. Carolyn K. Preston, P.Eng.
Project Integrator

Natural Resources Canada

5th Annual Conference on Carbon Capture and Sequestration

Alexandria, Virginia, USA

May 10, 2006

IEA GHG
WEYBURN-MIDALE
CO_2 MONITORING
AND STORAGE PROJECT

Purpose of this Workshop

- **Develop a work plan of actionable items for the Technical and Policy Components of the Project**
- **To achieve this, we will be dividing up into four breakout groups to seek your thoughts and opinions:**
  - Well-bore integrity, site selection, long-term monitoring (Technical)
  - Risk assessment and risk management (Technical)
  - Public communications and outreach (Policy)
  - Regulatory issues for long-term CCS (Policy)

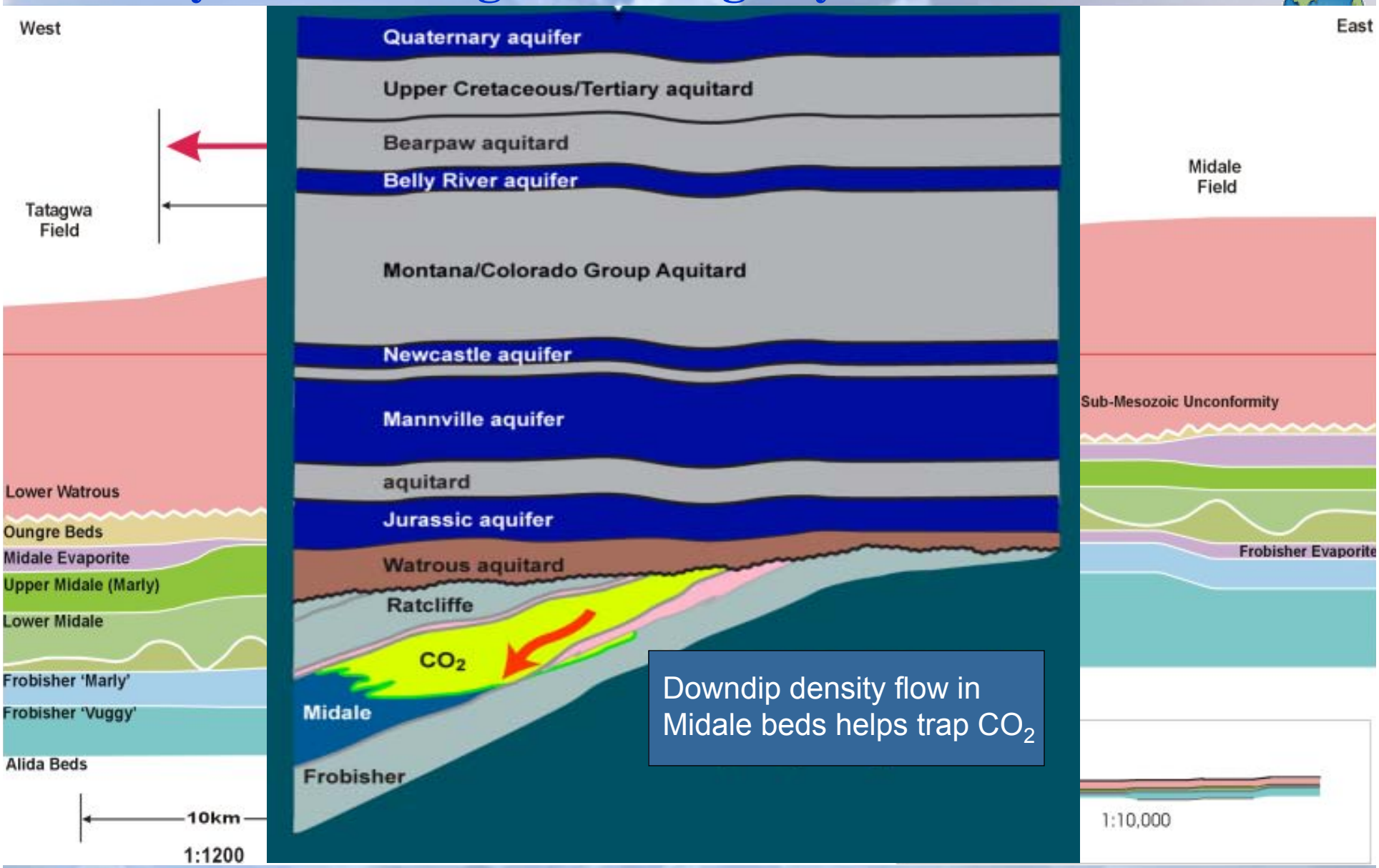
But first, a brief summary of where we are to date…

A comprehensive, internationally peer-reviewed data set

- Baseline monitoring survey (geophysical, geochemical, surface) in July 2000 (pre-injection)
- CO_2 injection began in September 2000 in 19 of 75 planned patterns
- R&D program focused on the first 19 patterns (Phase 1a)
- Regular monitoring surveys completed (quarterly, annually)
- Expert review led by IEA GHG in mid-2003 to make course adjustments and plan for Final Phase
- Expert review of Final Phase Technical Program led by IEA GHG in early 2006

Facility where main CO_2 pipeline enters Weyburn field from Beulah, ND

Weyburn Geological Storage System – Phase 1



Saskatchewan Geological Survey; University of Alberta

Summary of Phase 1 Results

- **Geological "container" at Weyburn is effective:**
  - Primary carbonate and secondary shale seals are highly competent
  - Sluggish hydrogeological flow in Midale beds
  - Hydraulic separation between adjacent aquifers
  - No fluid flow connecting all aquifers (including flow along fractures, discontinuities)

- **Migration of CO_2 outside the EOR area at 5000 years post-injection:**
  - 26.8% (7 million tonnes) moves outside the EOR area but remains within the geological region or "system under study":
    - **18.2% migrates to geosphere below reservoir via water phase but is confined within EOR perimeter**
    - **8.6% migrates laterally within reservoir but outside 75 EOR patterns (moving updip or northeast)**
    - **0.02% goes above reservoir but confined within EOR perimeter**
    - **0.14% leaks via aging, abandoned wells**
    - **0.0% enters potable aquifers near the surface**

Why pursue a Final Phase (2005-2008) project?

"Encourage the widespread use of technologies required for the design, implementation, monitoring and verification of a significant number of CO_2 geological storage projects in Canada and the USA"

- Build a Best Practices Manual (BPM) as a practical, technical guide for design and implementation for CO_2 storage associated with EOR
- Influence the development of clear, workable regulations for CO_2 storage, building upon existing, effective regulatory framework
- Influence the development of an effective public consultation process
- Influence the development of effective public policy to seed the development of a large, economic CO_2 supply and infrastructure, and a mechanism for monetizing credits for CO_2 storage

IEA GHG Weyburn-Midale CO_2 Monitoring and Storage Project

Best Practices Manual – Final Phase

Protocols for:

- ***Storage site selection***
- ***Monitoring and verification of stored CO_2***
- ***Well-bore integrity monitoring and remediation***
- ***Long-term risk assessment and risk management***
- ***Maximizing economic CO_2 storage capacity***

ptrc
Petroleum Technology Research Centre

Technical Priorities – Final Phase

1. Geological Integrity (Site Selection)

- develop firm protocols for site selection
- minimum data set required for successful site selection and full RA
- integrate hydrogeological, geophysical, geological data sets vis à vis seal integrity
- impact of CO_2 on geochemical and geomechanical processes and regional seals/geology

2. Well-bore Integrity

- essential parameters to define well-bore integrity
- impact of current well abandonment practices on long-term CO_2 storage and proposed future abandonment/remediation requirements
- conduct cased-hole dynamic testing (pressures and mobile fluids that signal CO_2 migration out of zone)
- document safe practices and impact on well-bore integrity and geomechanics

Technical Priorities – Final Phase

3. **Storage Monitoring Methods (Geophysics, Geochemistry)**
   - are multi-year 4D seismic programs an appropriate monitoring and verification requirement?
   - quantitative prediction of CO_2 location and volume
   - determine CO_2 distribution through in-situ, time-lapse well logging; spinner surveys; selective drilling, coring and logging of slim holes
   - continue to explore passive seismic monitoring
4. **Risk Assessment; Storage and Trapping Mechanisms; Remediation Measures; Environment, Health and Safety**
   - complete full-field risk assessment from Phase 1
   - determine risk levels for various storage optimization scenarios
   - study natural analogues vis à vis well-bore and storage integrity
   - ultimate fate of CO_2 , relative volumes in each trapping mechanism, time lapse to trapping, and factors affecting these
   - determine methods for stimulating/accelerating CO_2 mineral fixation at reservoir conditions

Overarching Principles: Address gaps in IPCC CCS Report and facilitate good public policy development to ensure widespread deployment of long-term CCS

Public Communications and Outreach (Policy) – Final Phase

- With stakeholders, develop a Communication Plan based on the Weyburn experience and other major international CO_2 geological storage projects:
  - *Identify and focus on issues (and metrics) of key interest to policy makers, regulators, investors and (national and local) public*
  - *Appropriately communicate the Best Practices Manual and other relevant technical information to these essentially non-technical audiences*
  - *Launch the public communication process early*
- Based on issues/feedback from these stakeholders, revisit and accordingly revise the Best Practices Manual

Key PEO Messages from April Consultation Workshop

- Develop a long-term communications framework for CCS that is focused on large-scale deployment but draws on the Weyburn-Midale experience

- Plan to deliver on part of that framework within the 3-4 year window of our Project

- Key elements of communications plan:

  - level and nature of information dependent upon audience (local vs. national and non-technical vs. technical)
  - make use of existing opportunities to share information
  - provide general, unbiased, non-technical educational materials on CCS
  - commit to ongoing communication and feedback
  - stress importance of long-term nature of CO_2 geological storage
  - use communications experts to introduce CCS technologies
  - be pre-emptive and proactive rather than reactive

Key PEO Messages from April Consultation Workshop

- Specific messages:
  - the leadership role of the Project in the development of CCS technology
  - the economic and environmental benefits (a "win-win" situation)
  - CCS is one approach to GHG management within a portfolio of options
  - the consequences of doing nothing
  - safety and reliability of geological storage
  - scale of CCS projects
  - we have demonstrated that large amounts of CO_2 can be stored and we can monitor where it is underground
  - risk information should be presented in a balanced manner
  - consistent, common messaging
- Communication tools:
  - multi-layered website of information and feedback surveys
  - mailouts to local residents
  - media articles with well-known and trusted reporters
  - distribute what is readily and publicly available (e.g. PCO_2R, CCP, etc.)

Regulatory Policy Research – Final Phase

- Use existing national and provincial regulations as a basis for developing a generic "Straw Dog" regulatory application suitable for use in many different jurisdictions, addressing long-term storage issues and gas-credit accounting

- Work with regulatory bodies to develop fit-for-purpose, science-based, multi-jurisdictional regulations and outline an effective two-way public communication process

- Based on the foregoing, and feedback from stakeholders, revisit and accordingly revise the Best Practices Manual to make it universally applicable

Key Regulatory Messages from April Consultation Workshop

- Canadian provinces have existing regulatory systems in place to support EOR and all other oil and gas activities (such as AGR)
- Jurisdictional regulators have mechanisms to engage stakeholders
- However, the focus is presently on short-term storage
- We need to consider the impact of the long-term fate of CO_2 (i.e. post-abandonment for XXX years) and offset/credit opportunities associated with EOR activities
  - influence the development of effective public policies, including quantification and verification protocols
  - enhance existing regulatory systems to include monitoring and reporting expectations, liability, etc.

Breakout Group Questions

- **Technical: Well-bore integrity, site selection, long-term monitoring**
  (Ray Knudsen)
  - What do you foresee are the minimum requirements for site selection?
  - What would likely be the minimum monitoring standards over the long term?
  - In view of the gaps identified in the IPCC Special Report on CCS, where could we make some big hits in filling those gaps?
  - Any thoughts from policy makers?

- **Technical: Risk assessment and risk management**
  (Dubravka Bulut)
  - What experiences from other industries could help us in developing a credible risk assessment framework and risk management strategy?
  - In view of the gaps identified in the IPCC Special Report on CCS, where could we make some big hits in filling those gaps?
  - Any thoughts from policy makers?

.../2

Breakout Group Questions (cont'd)

- **Policy: Public communications and outreach**
  (Anne-Marie Thompson)
  - What are the key messages that need to be relayed to the technical and non-technical public and government audiences?
  - What tools or approaches should we use to engage and educate stakeholders and public / government audiences?
  - Are there any lessons you have learned that would help us understand what we should and should not do when communicating with the public?

- **Policy: Potential regulatory issues for long-term CO_2 geological storage**
  (Ken Brown)
  - What should we focus on in strengthening our existing regulatory frameworks?
  - What knowledge gaps need to be addressed in methodology development for emissions inventories and accounting?
  - What would be essential elements of a practical framework to deal with liability issues?