

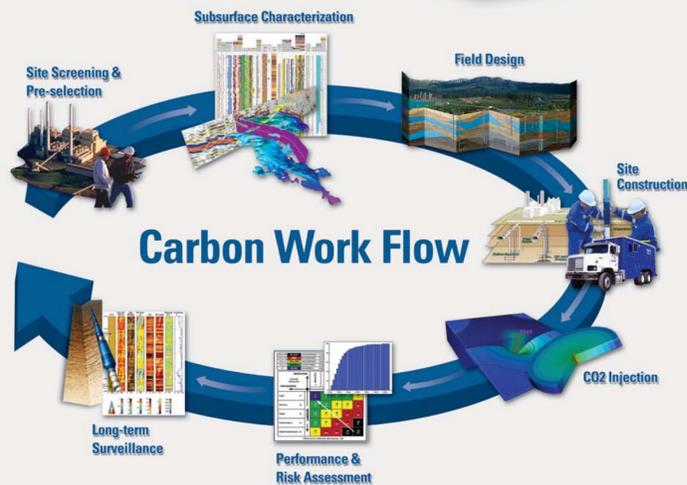
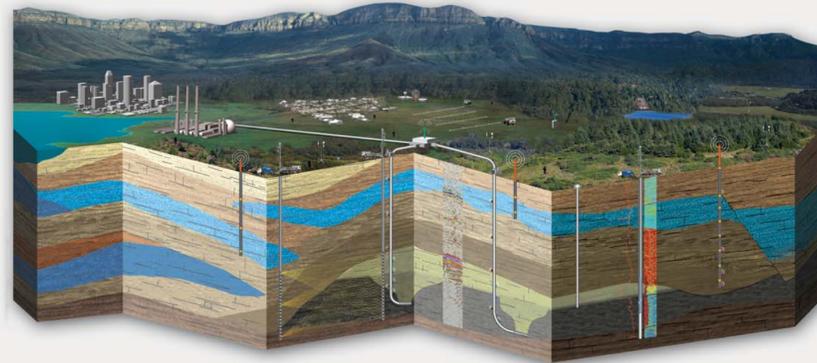
The need for multi-formation monitoring schemes for geologic CO2 sequestration: multilevel vs. conventional monitoring wells.



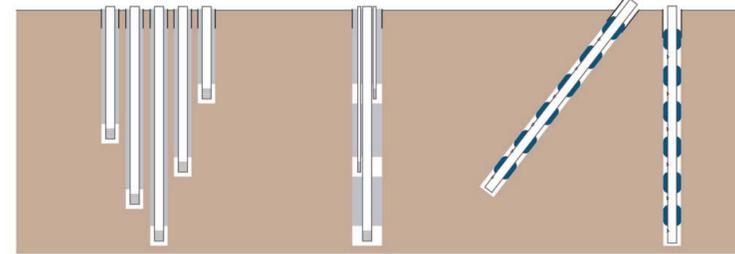
W.H. Black¹, D.G. Mercer¹, A. Duguid²

1. Schlumberger Water Services, Vancouver, BC | 2. Schlumberger Carbon Services, Pittsburgh, PA

Monitoring, measurement and verification (MMV) of CO2 in the subsurface will be an important factor for the success of any CO2 sequestration project and long-term groundwater monitoring should be a major component of any CO2-storage MMV program. Reliable groundwater monitoring technologies will be paramount in gaining public and regulatory approval of sequestration sites and for accurate site modeling and simulation.



Conventional Monitoring Wells vs. Westbay Completions



Individual devices in individual boreholes

- Limited data
- Atmospheric exposure
- Cost prohibitive

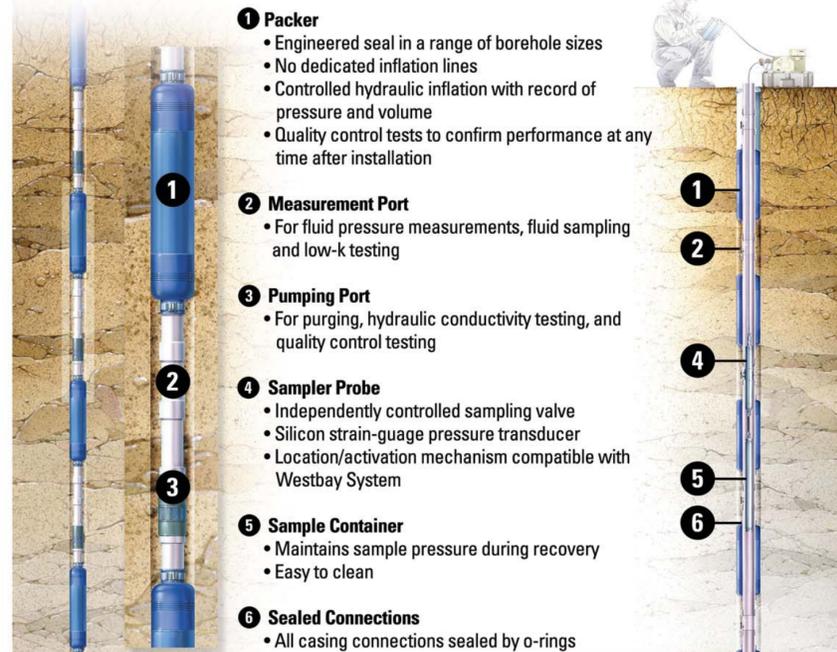
Multiple devices in one borehole

- Limited data
- Complex construction
- Limited operations

Multilevel completion in one borehole

- Increased data
- Increased versatility
- Improved data quality

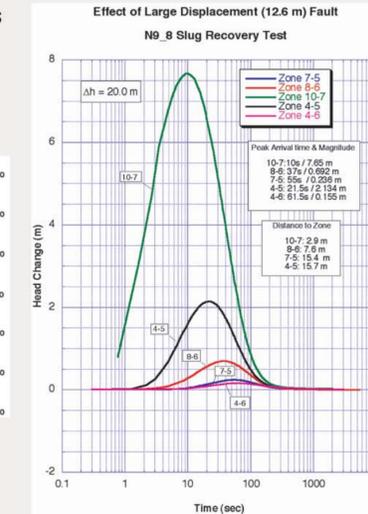
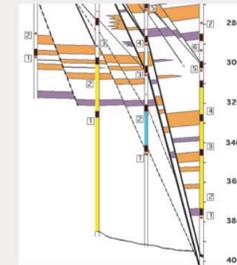
Multilevel completions are the only means of obtaining the number of monitoring points and thus the amount of data required to clearly understand subsurface fluid conditions.



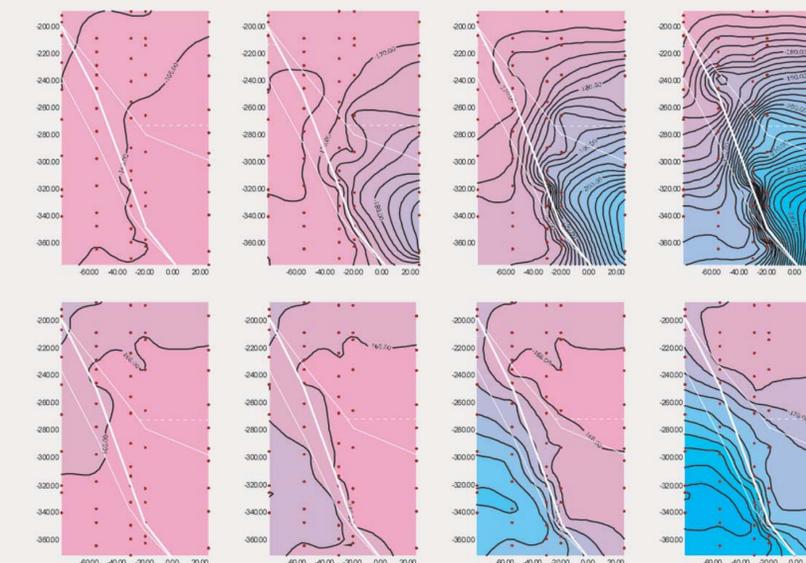
Detailed Data

A detailed array of discrete monitoring intervals provides a much clearer understanding of actual hydrogeologic conditions.

Cross-well slug-interference test results (right)



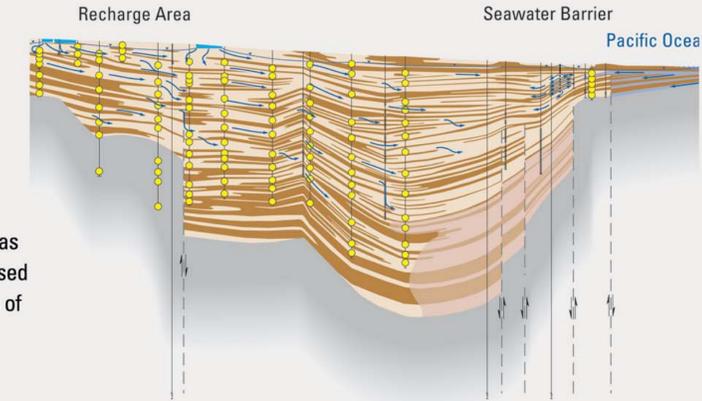
Pumping test results (below)



Ref: B. Johnson et al., Texas A&M University

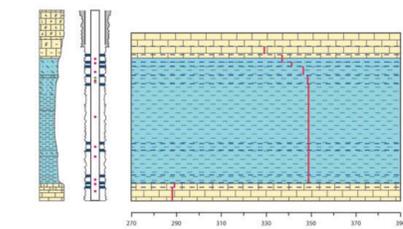
Detailed monitoring is being applied on a larger scale, such as for the groundwater basin of the Orange County Water District in California

The increased amount of data has reduced uncertainty and increased confidence in predictive models of basin performance.

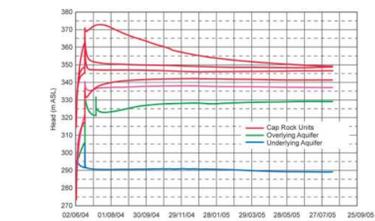


After Orange County Water District

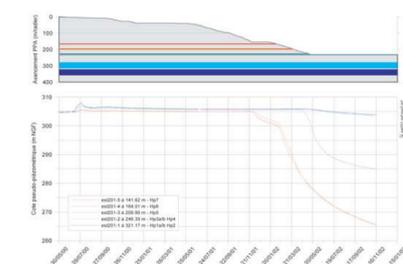
Higher quality data means reduced risk and increased safety



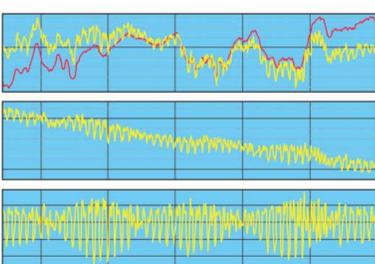
Profile of head vs. depth reveals vertical permeability



Long-term monitoring of pressure through the geologic profile



Long-term monitoring of pressure in aquifers overlying the cap rock



Data filtering for analysis of barometric effects, earth tide effects, etc.

After ANDRA