CO2CRC Otway Research Facility

Max Watson, CO2CRC

CO2CRC
BUILDING A LOW EMISSIONS FUTURE

2018 Annual Meeting
Carbon Sequestration Leadership Forum
Projects Interaction and Review Team
16 March 2018

CO2CRC Otway Research Facility

One of the most comprehensive CO_2 storage demonstration laboratories in the world

Verification of the fundamental science of CO_2 storage in Australia and further validated the technology globally

Features an investment of over A$110 million to demonstrate real-world injection, storage and monitoring techniques

In-situ access to approximately 400,000 t of CO_2 from the Buttress gas field (79% CO_2 and 19% CH_4), providing the site with a unique storage bank of CO_2 for an array of experiments.

Multiple reservoir-seal pairs within the 1 – 2 km depth range and is ideal for appraising storage and monitoring performance.

Including a state-of-the-art seismic monitoring array (buried receivers and permanent sources) fully validated from past experiments for observing and benchmarking subsurface technologies and processes.

All regulatory approvals for testing and piloting technology and local community support

Availability of high quality, comprehensive, datasets, from previous operations (data obtained from three closely spaced wells).

CO2CRC Otway Research Facility's Projects

Otway Stage 1: 2004 – 2009

- ✓ *Demonstrated safe transport, injection and storage of CO_2 into a depleted gas reservoir*

Otway Stage 2: 2009 – 2019

- ✓ Demonstrate safe injection of CO_2 into a saline formation
- ✓ Stage 2B – Near well residual & solution trapping characterisation
- ✓ Stage 2C – Minimum detection, 4D M&V & Plume stabilisation

Otway Stage 3: 2015 – 2022

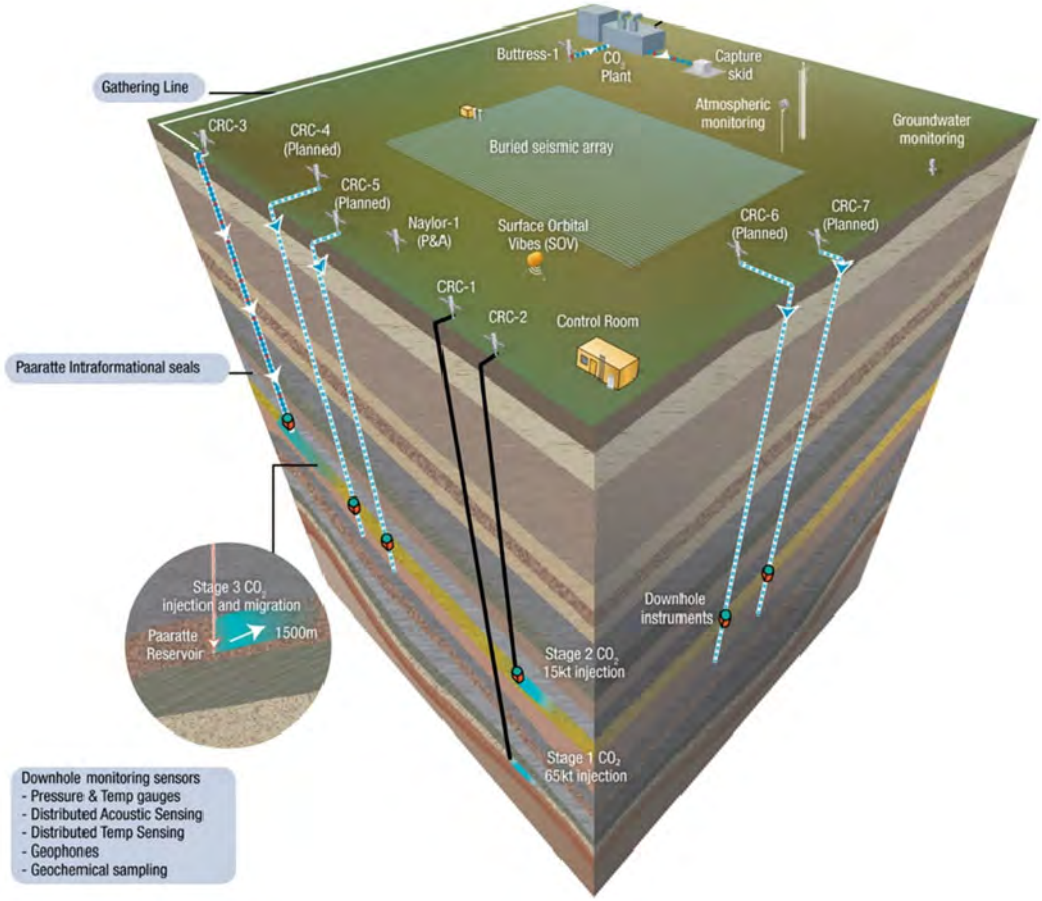
- Demonstrate safe, reliable and cost-effective subsurface monitoring of CO_2

Otway Shallow CO2 Migration: 2016 - 2021

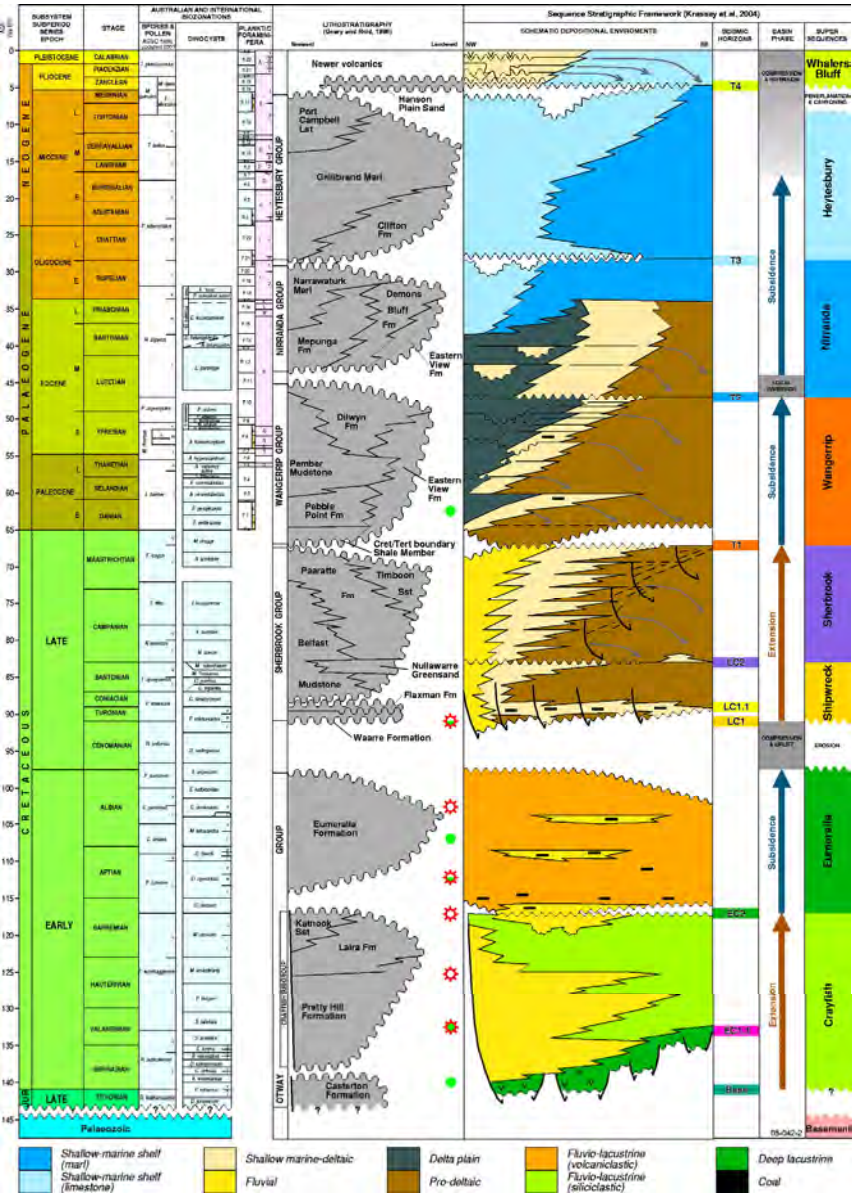
- *Improve capability to predict the role of faults in controlling CO_2 fluid flow in the near surface;*
- *Improve near surface monitoring capabilities*

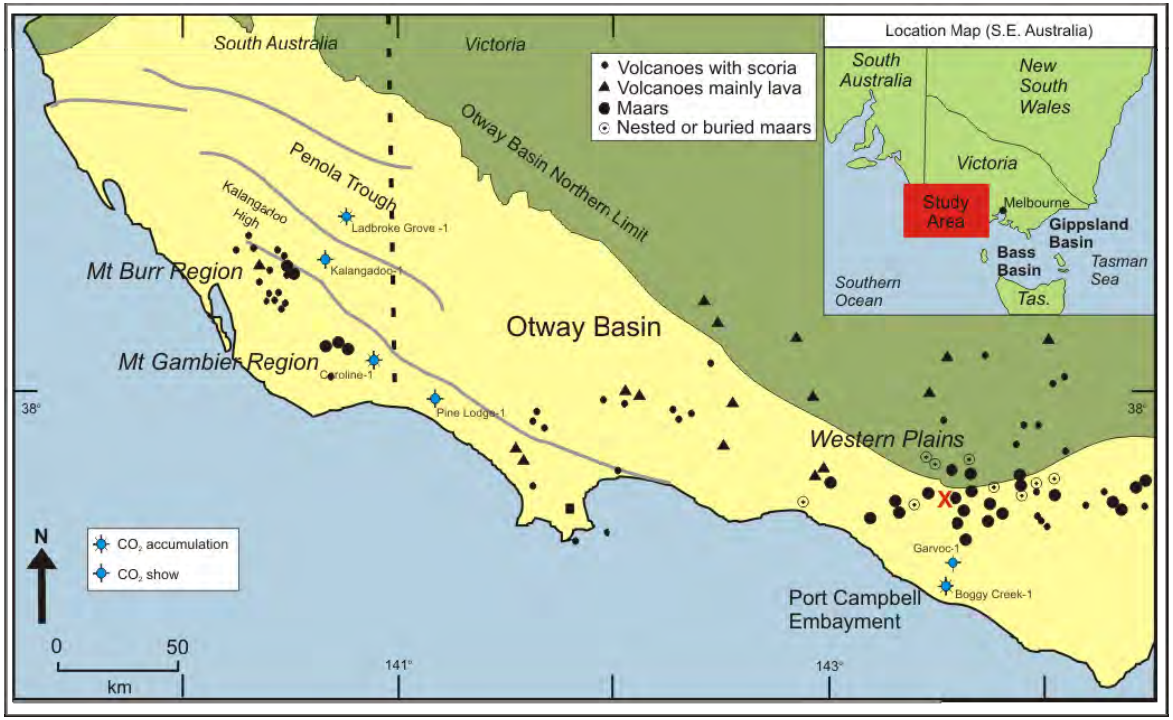
Otway Capture Skid: 2016 – 2019

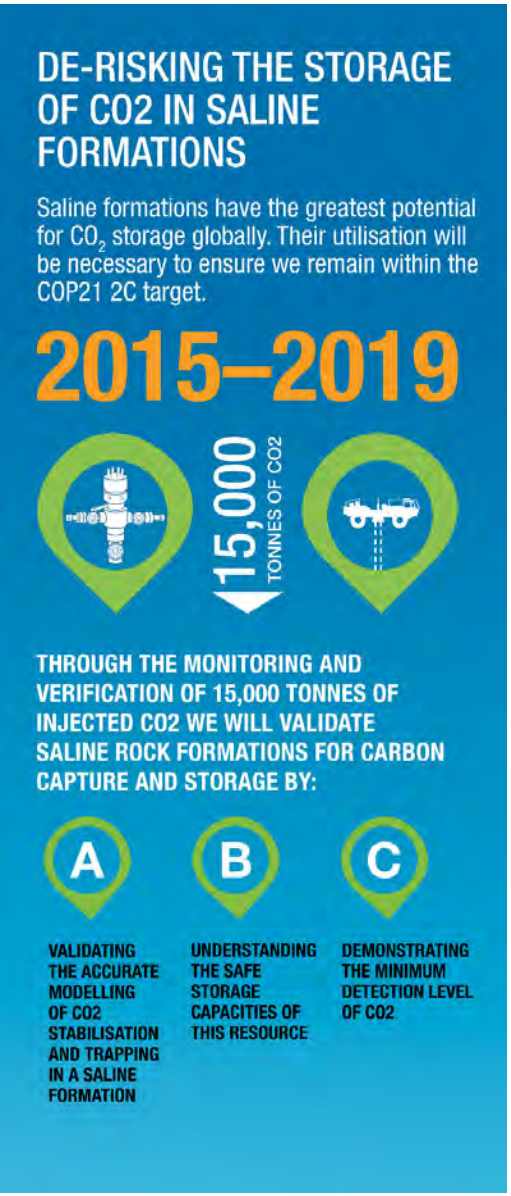
Separating natural gas under high pressure and with high CO_2 content



Otway Basin Region







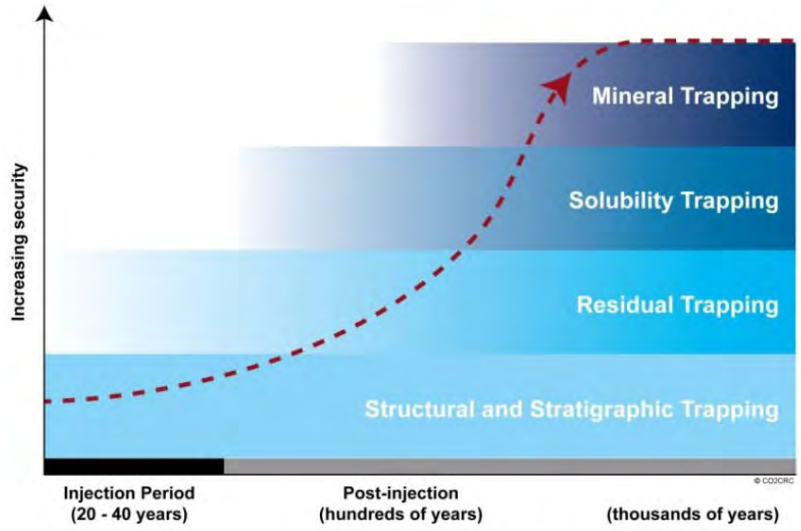
The CO2CRC Otway Project Stage 2

Appraisal

- ✓ 2A :Drill CRC-2
- ✓ 2B: Measure parameters affecting residual and dissolution trapping in a saline formation
- ✓ 2B Extension: interactions with impurities & well test refinement

Operation

- 2C: Spatially track injected CO_2 in a saline formation
  - Minimum detection limit
  - Migration behaviour
  - Stabilisation



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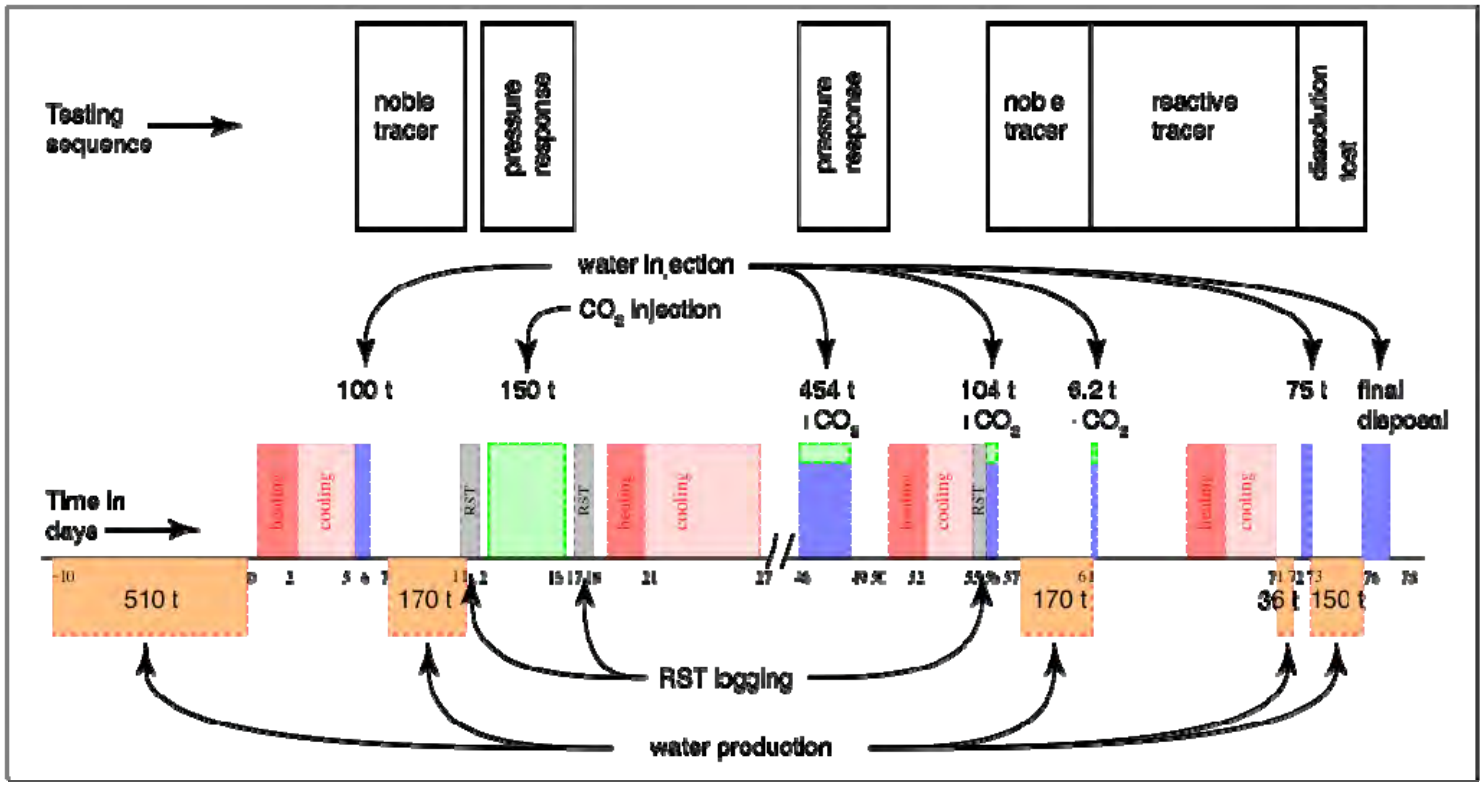
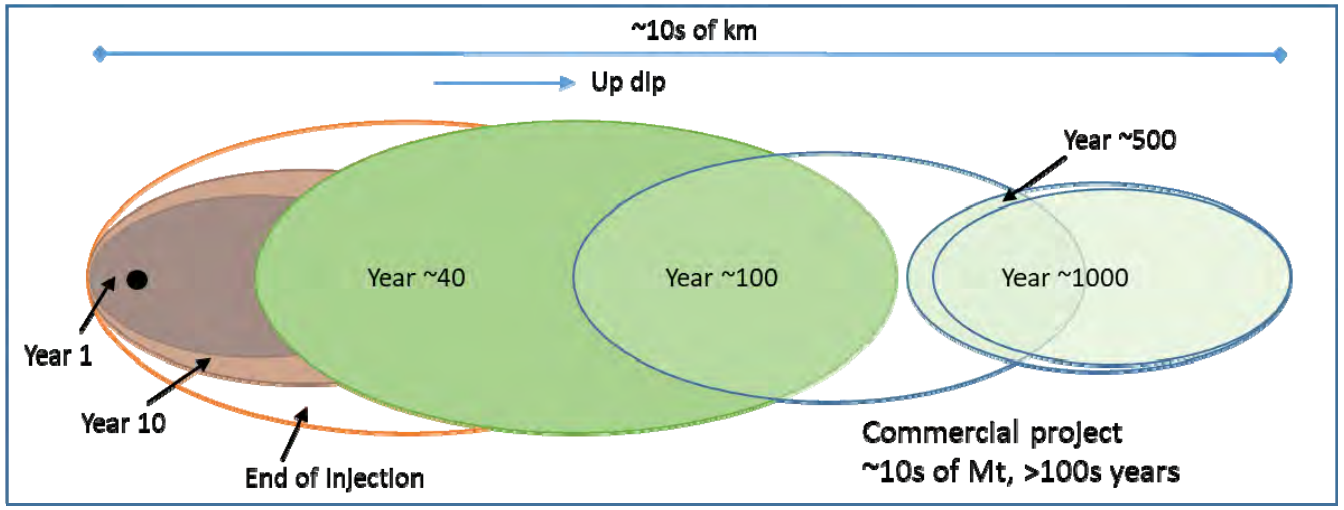
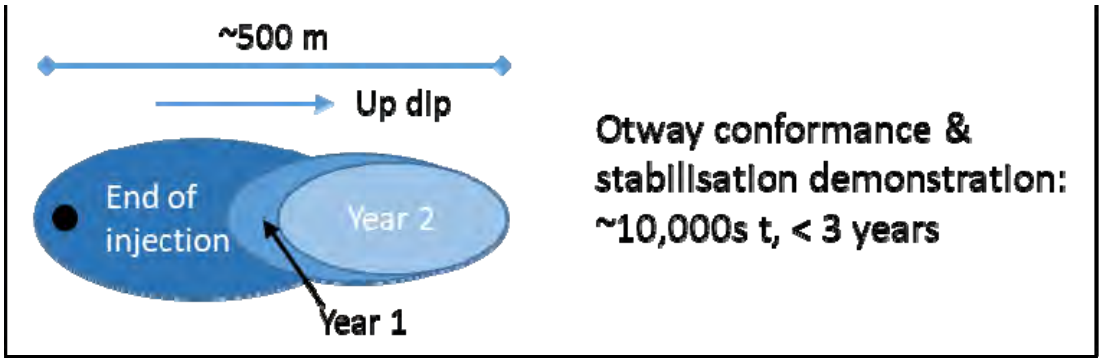
Recognized Project

Otway Stage 2B timeline



Value of the Conformance and Stabilisation Workflow



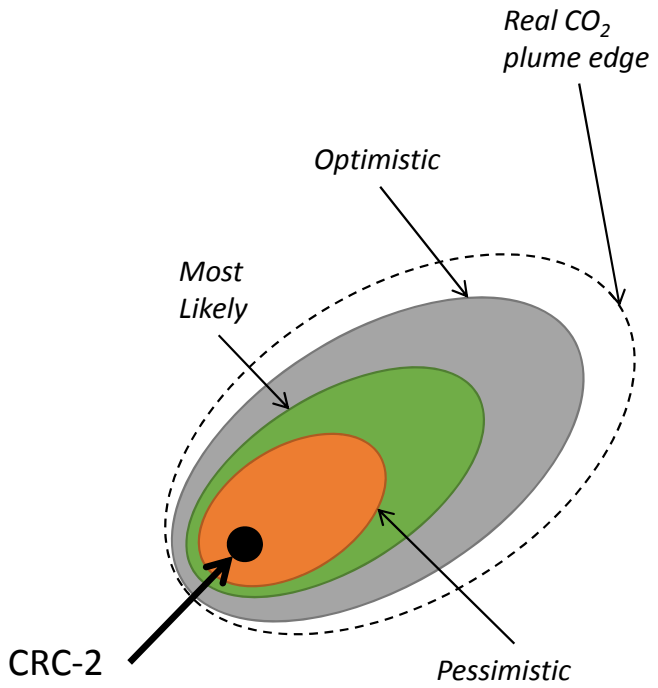


With a small, short-term empirical trial (Otway 2C), a generic and validated workflow for conforming long term plume predictions (including stabilisation) to early monitoring observations will be developed

Otway Stage 2C Challenges

Challenge: Plume's seismic detection

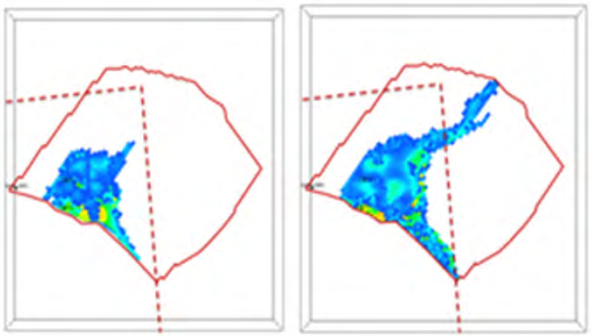
- Very thin plume
- Seismically noisy environment relative to modelled signal
- Poor repeatability
- Best chance to demonstrate achievement of objectives
    - Minimum detection limit
    - Migration behaviour
    - Stabilisation

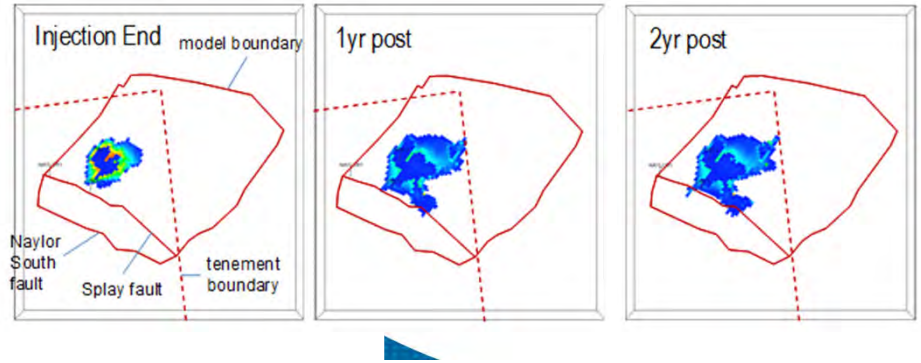


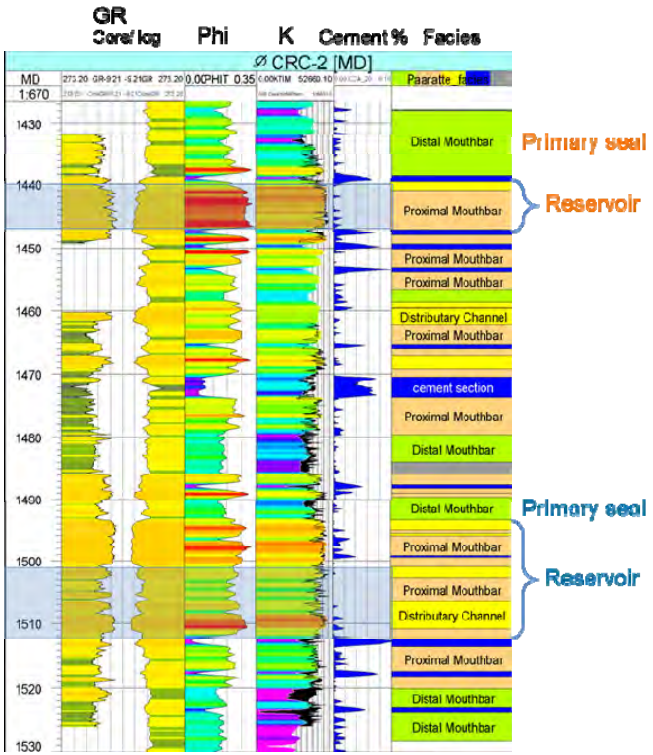
Solution:

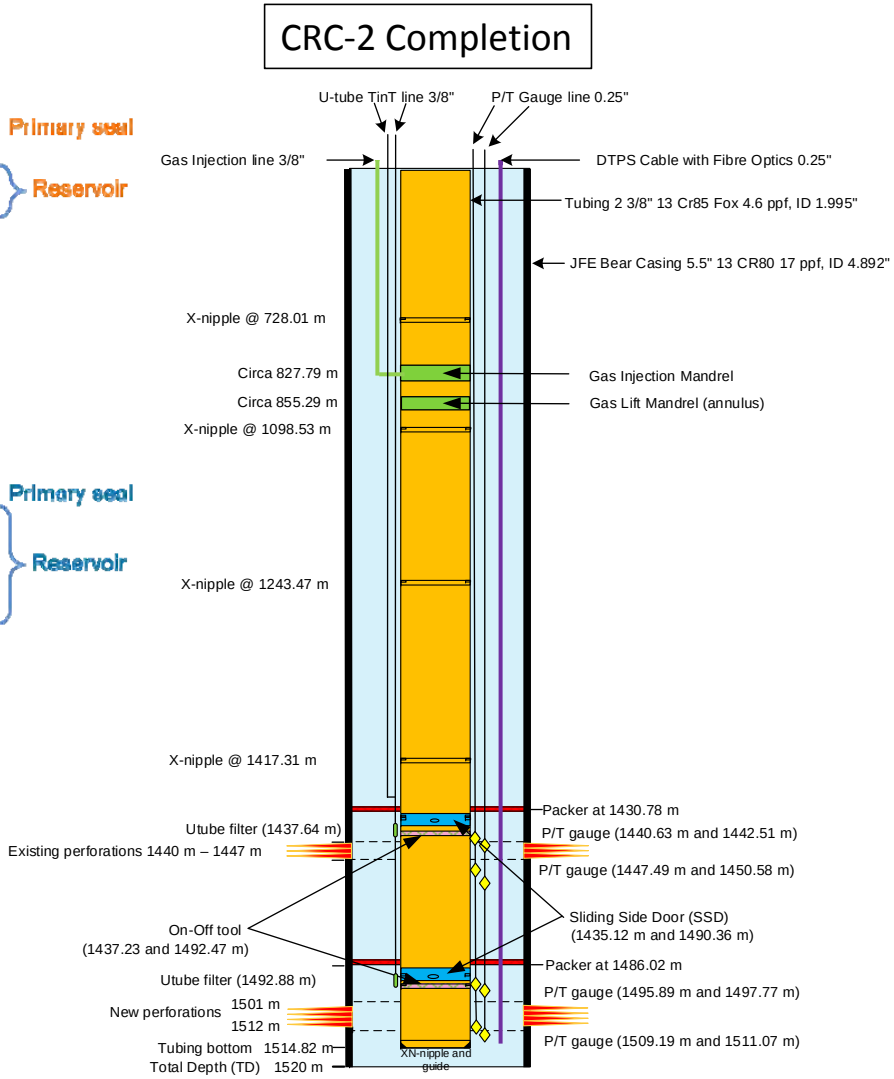
- Buried seismic array
- Re-completion of CRC-2

Recompletion of CRC-2 for Improved Plume Sweep

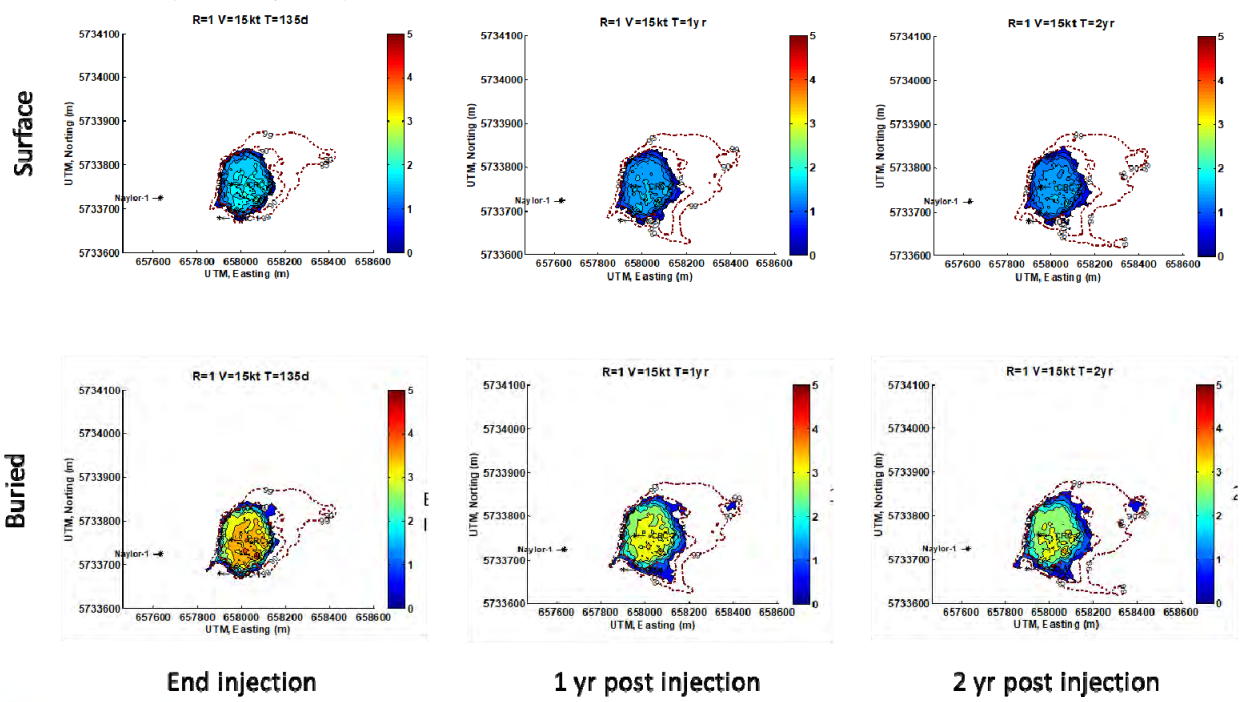


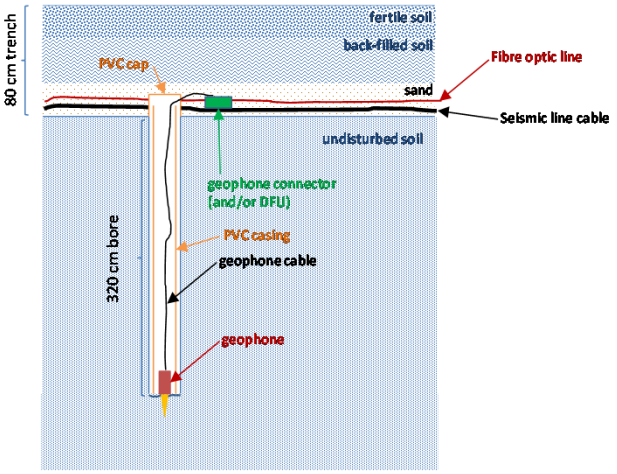


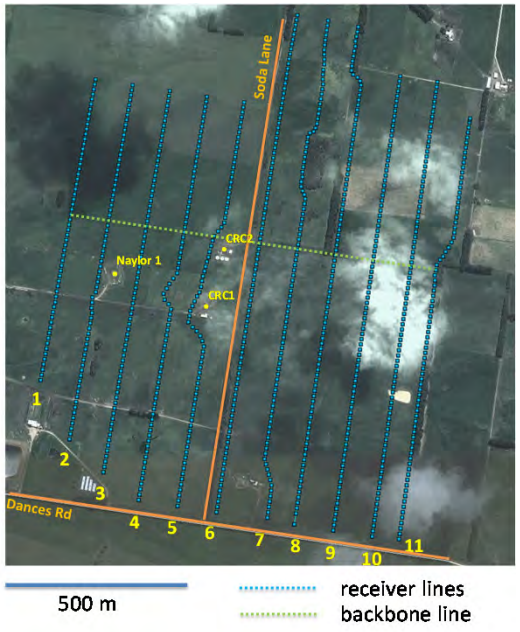




Buried Array for Noise Reduction and Improved Repeatability







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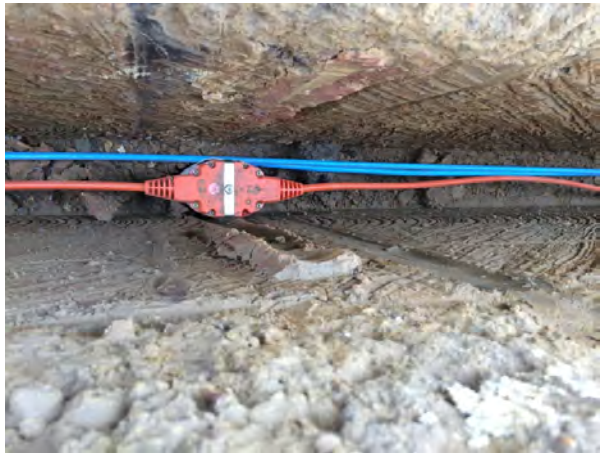

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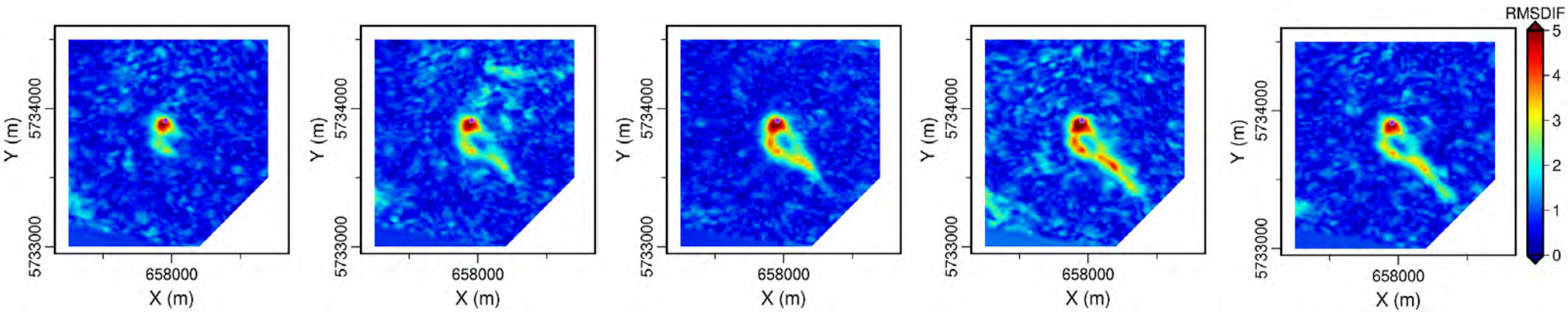
Seismic Time-Lapse Signal

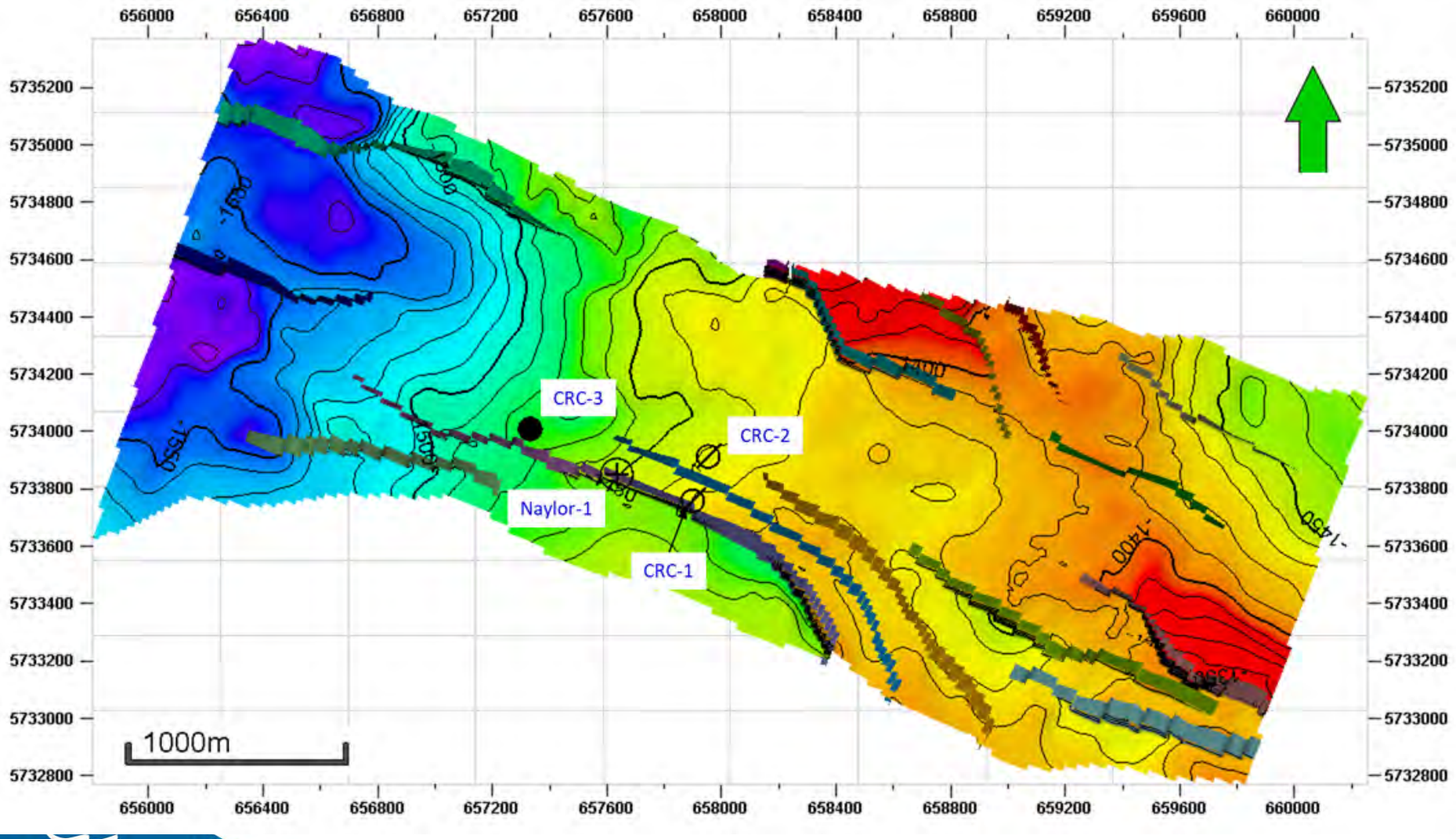
M1 (5kt) M2 (10kt) M3 (15kt) M4 (+ 9 mo) M5 (+ 23 mo)



Objective 1: Detect injected CO_2

Objective 2: Observe CO_2 plume development using TL seismic

Objective 3: Verify stabilisation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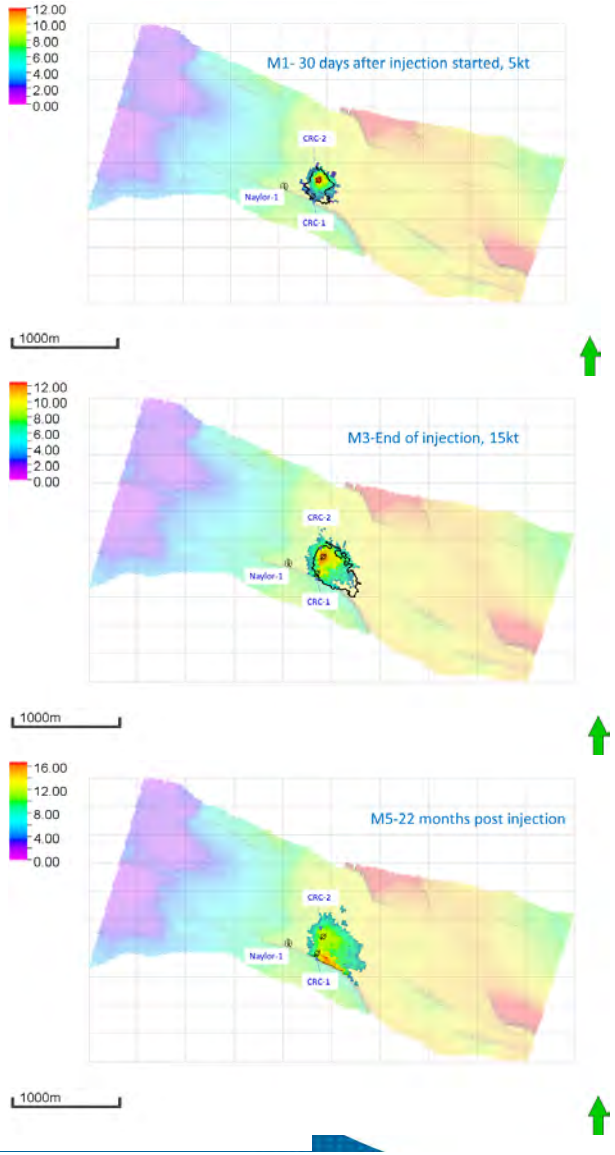
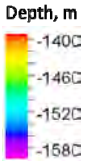
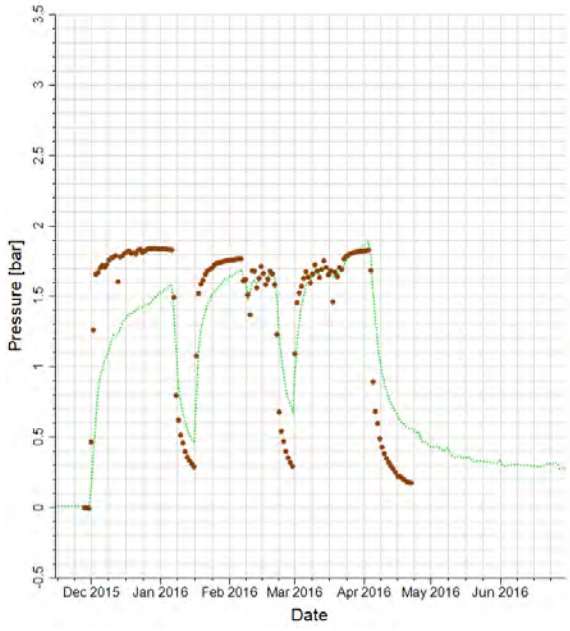
CRC-3
CRC-2
Naylor-1
CRC-1
1000m

Otway Stage 2C History Matching

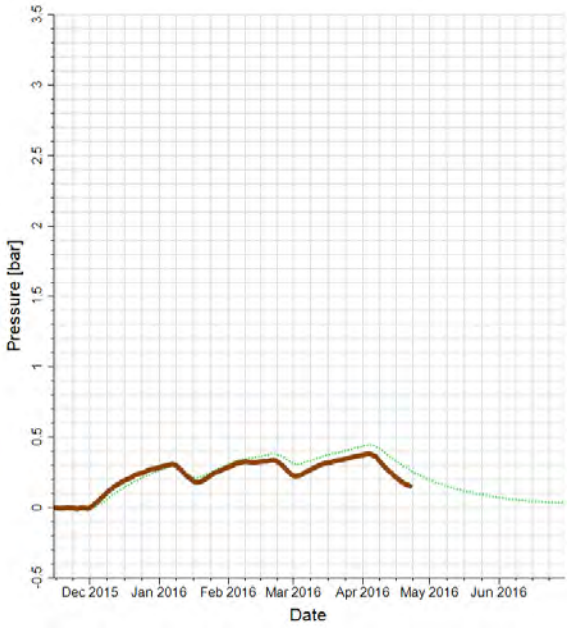




Injection interval



Above Zone Monitoring Interval (AZMI)



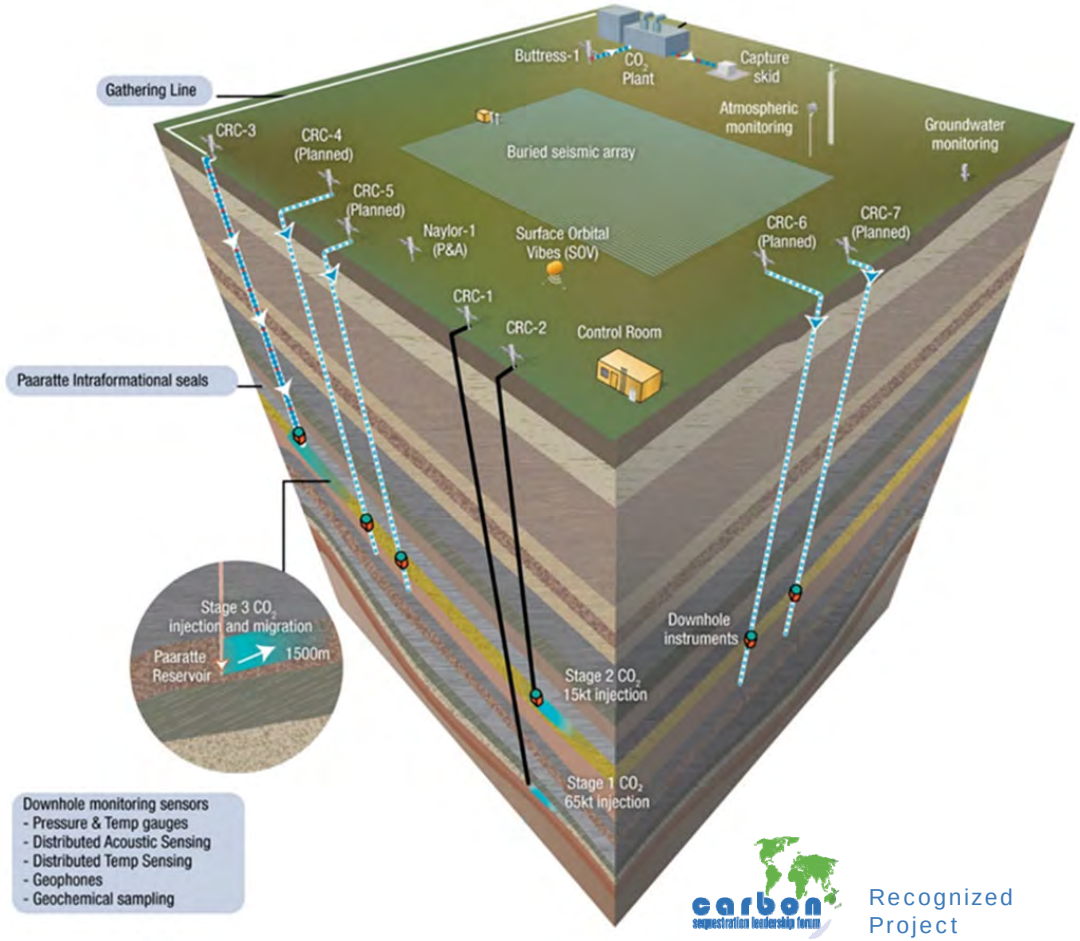
Otway Stage 3
Subsurface Monitoring & Validation

1. We will develop a high-resolution, **real-time monitoring** capability to identify and track CO2 plume movement in the Subsurface

2. We will employ **Non-Invasive monitoring** techniques that will be acceptable for community and regulators.

3. The project will evolve these technologies from benchtop application to in-field validation, **aligned with operator need**.

4. The project will provide a suite of technologies and workflows that can be selected to create bespoke solutions which **optimize effectiveness and costs** in commercial monitoring projects.



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Recognized Project

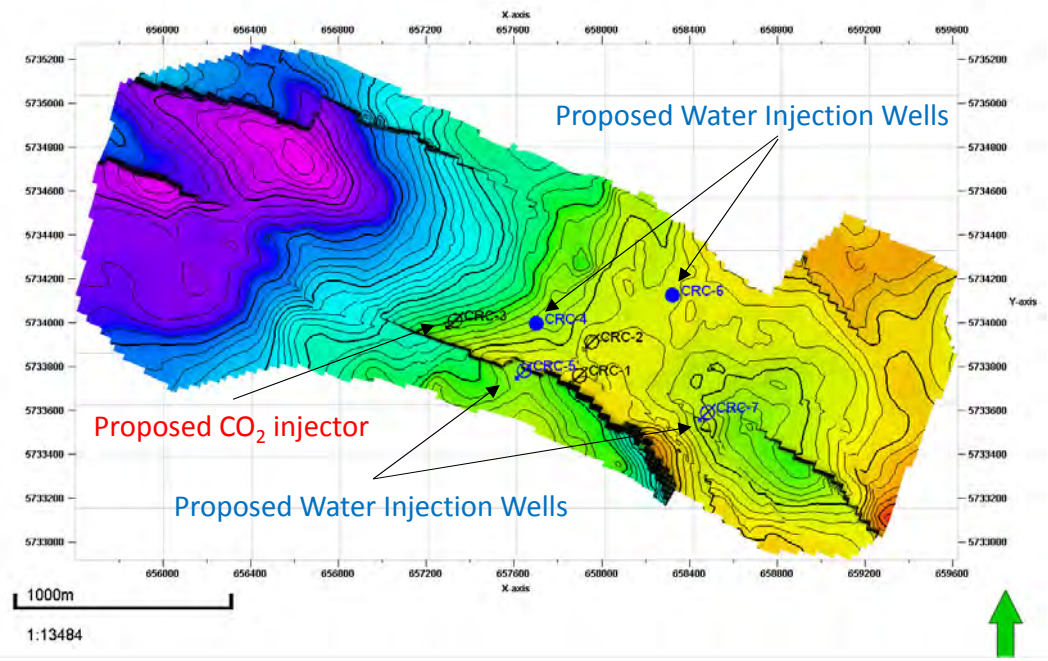
Subsurface Monitoring Concept

Concept:

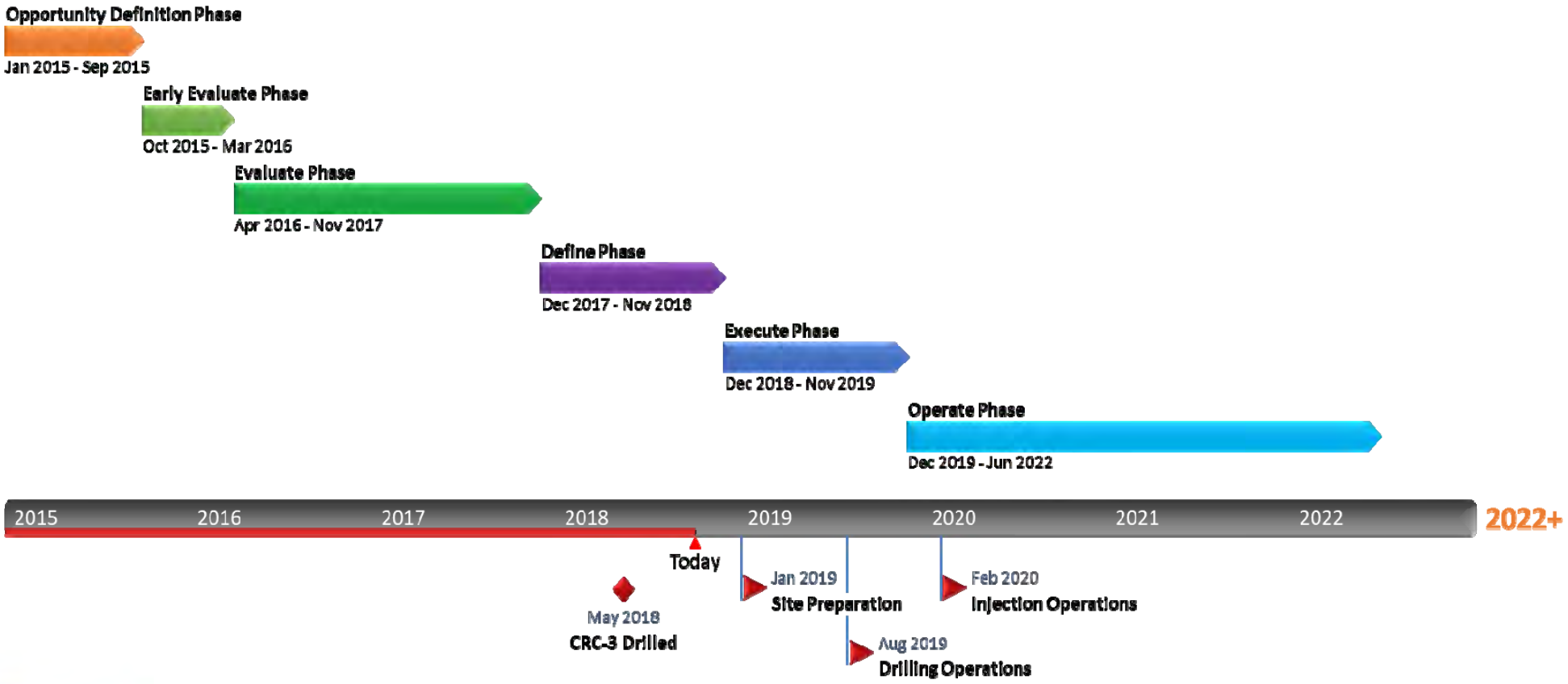
- Monitor from the subsurface
- Monitor relatively small regions of highest risk
- Monitor frequently or continuously
- In operational settings, escalate to planned risk management response if anomalies are detected

Core Monitoring Methods:

- Pressure
  - Pressure Inversion
  - Earth Tide response
  - Pressure Tomography
- Down hole seismic
  - Multi-well 4D VSP with permanent sources & F/O receivers
  - Time-Lapse cross-well seismic
  - Microseismic monitoring



Otway Stage 3 Timeline

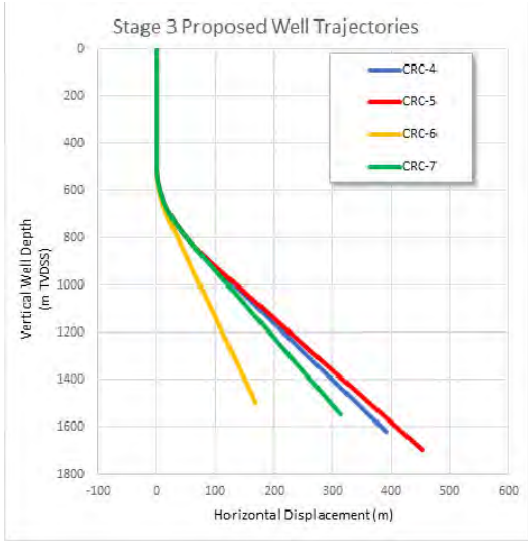


Otway Stage 3 **Execute**

Well Design Summary

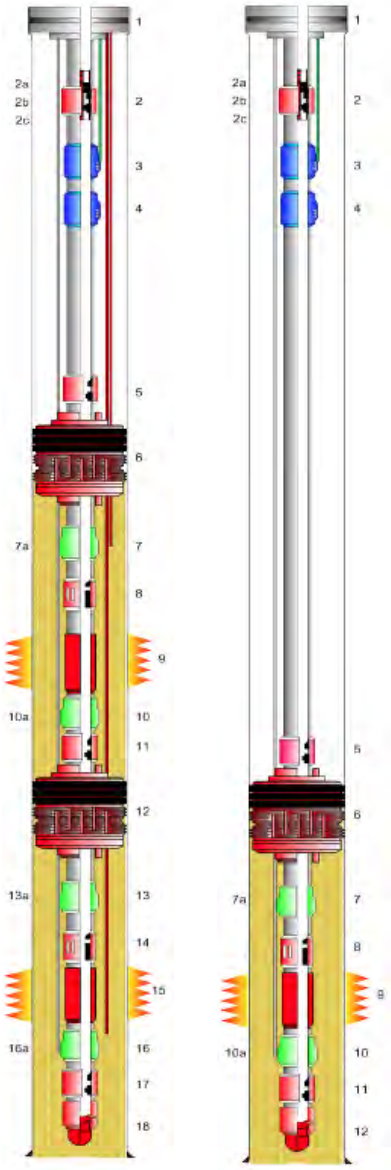
Drilling Four Monitoring Wells

- 12 ¼” hole x 9 ⅝” Casing to ~930m MD
- 8 ½” hole x 5 ½” 13Cr80 Casing to ~1700m MD
- Drilled with water based mud system
- Fibre Optics installed behind 5 ½” Casing
- Single zone perforated completion design
- 2 ⅜” tubing, with multiple control & FO lines



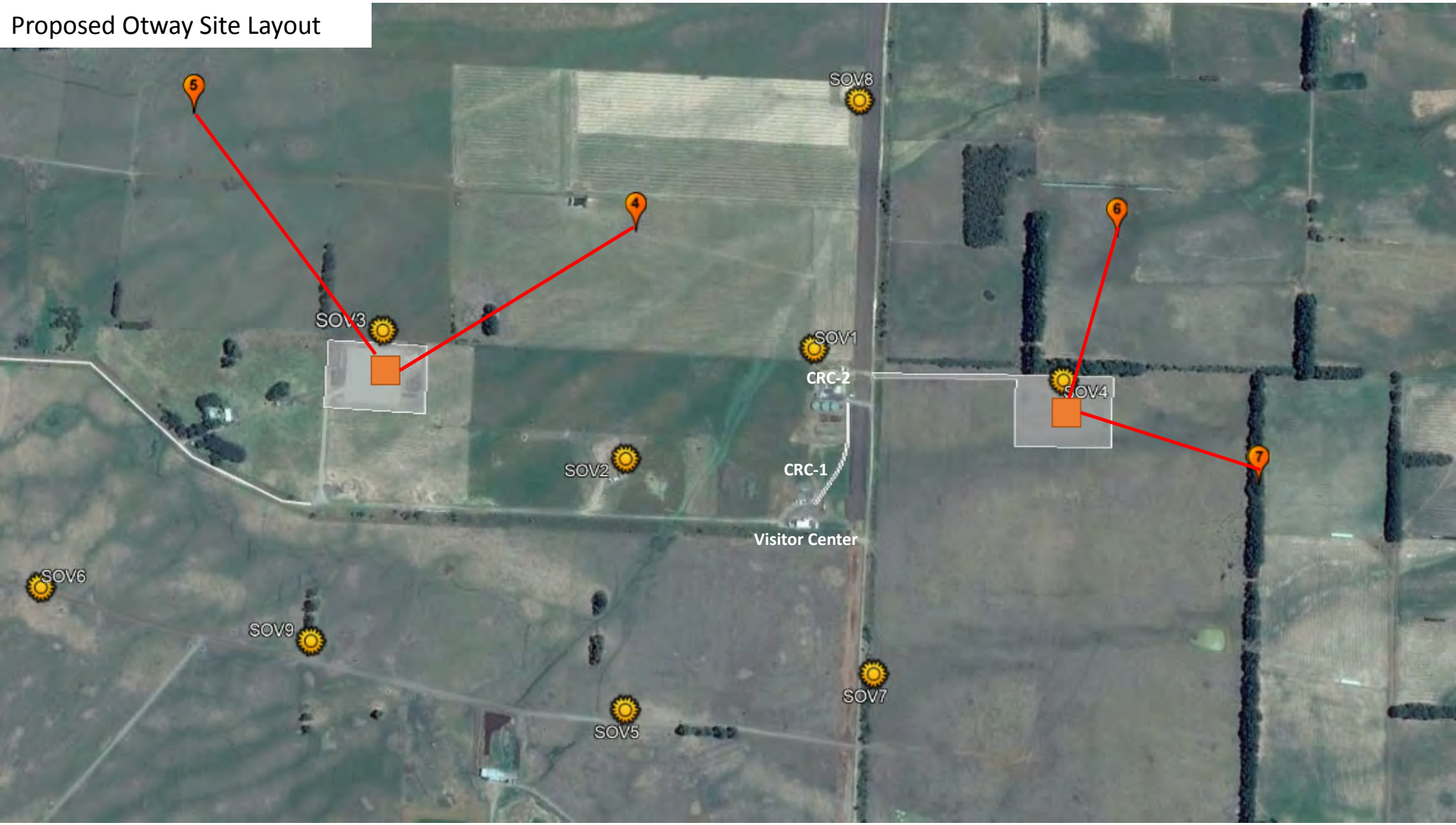
Completion of previously drilled appraisal well

- Appraisal well drilled in 2017
- Single zone completions in 5 ½” casing (currently not perforated)
- 1 x ~10m perforations
- 2 ⅜” tubing, with multiple (8) control & FO lines



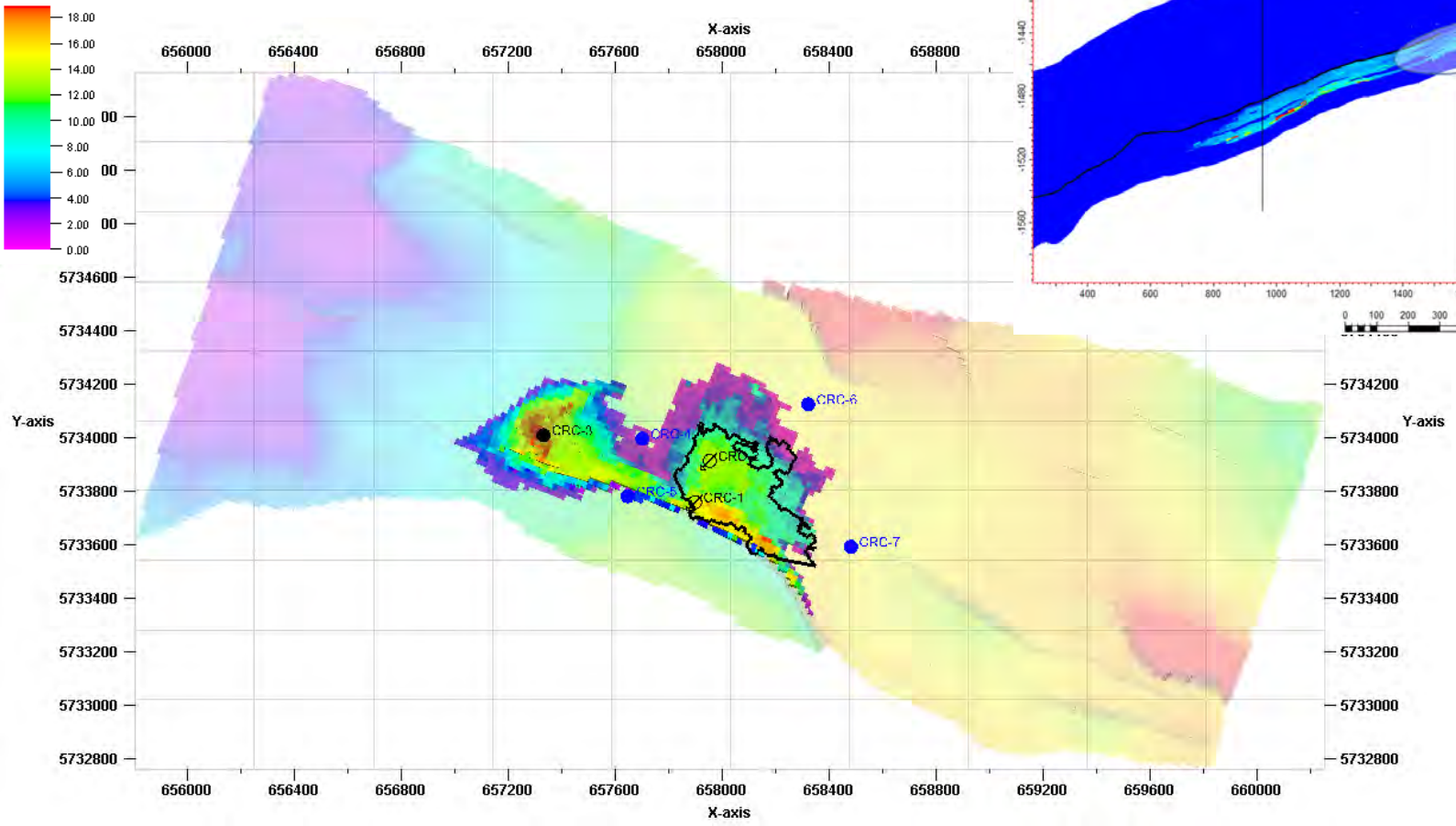
Provisional Well Completion Schematics
- Injector and M&V Designs -

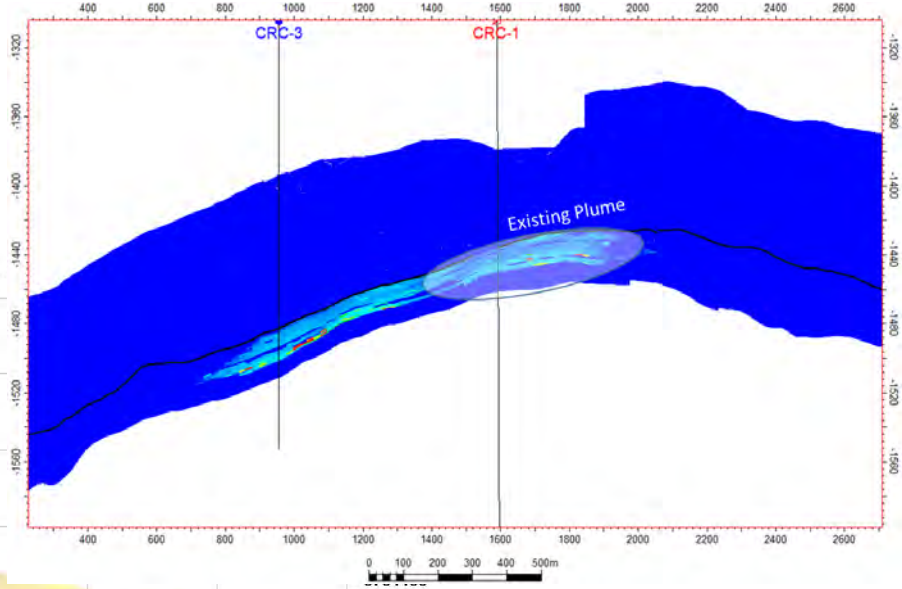
Proposed Otway Site Layout



Injection Scenarios

Injection from CRC-3 into PS1- One year post Injection Plume thickness

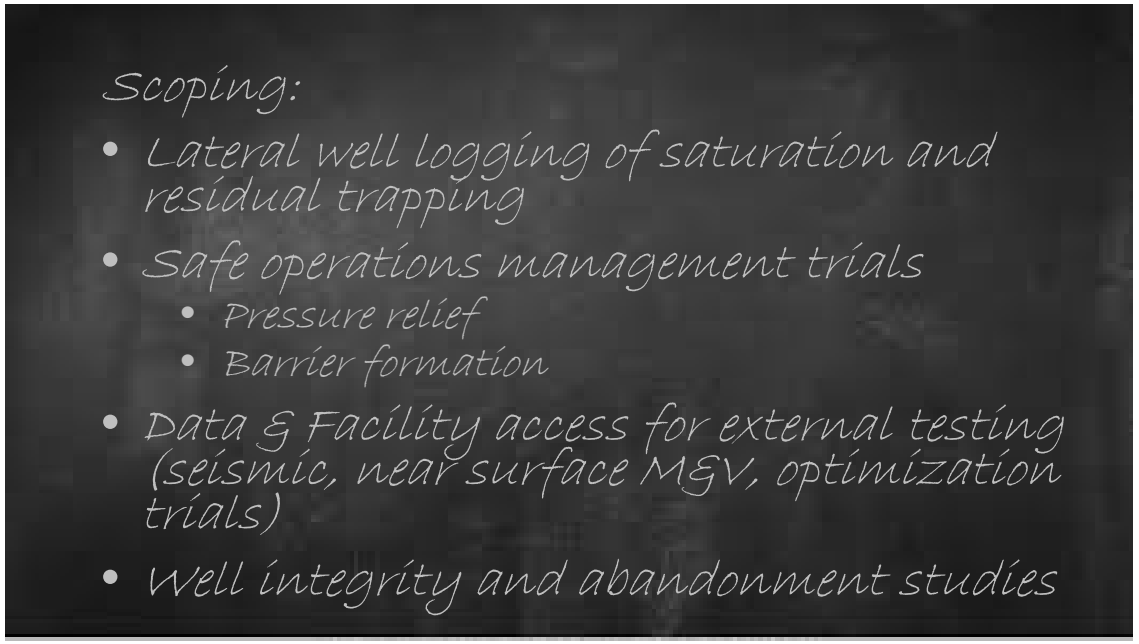




Otway Research Facility - Future

Deliver:

- Otway Stage 3 Project
- Otway Fault Project



- Demonstrate real world CCS for the local community, and the community at large
- Provide an opportunity to overcome real-world engineering challenges under operational conditions
- Enable the decrease technical risk & uncertainty, and tests technical performance, prior to embarking on a large sale project
- Provide impetus to regulators to confront some of the regulatory issues when there is a real project

Government, Industry and Research Partners