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Multi-Level System Installation on an Active Site (Sellafield)

Challenges, Learning, and Benefits

John Heneghan – Sellafield Ltd

14 November 2025

The Sellafield site

- Located in NW England
- UK's largest nuclear site
- TNT production facility during WW2
- First nuclear development started in 1947 – Windscale reactors (Pile 1 went critical – October 1950)
- Ongoing site development ever since
- Significant legacy of soil and groundwater contamination
  - Historic and ongoing events
  - Multiple release points
  - Complex geology & hydrogeology
- Sellafield Ltd environmental and safety reports - GOV.UK

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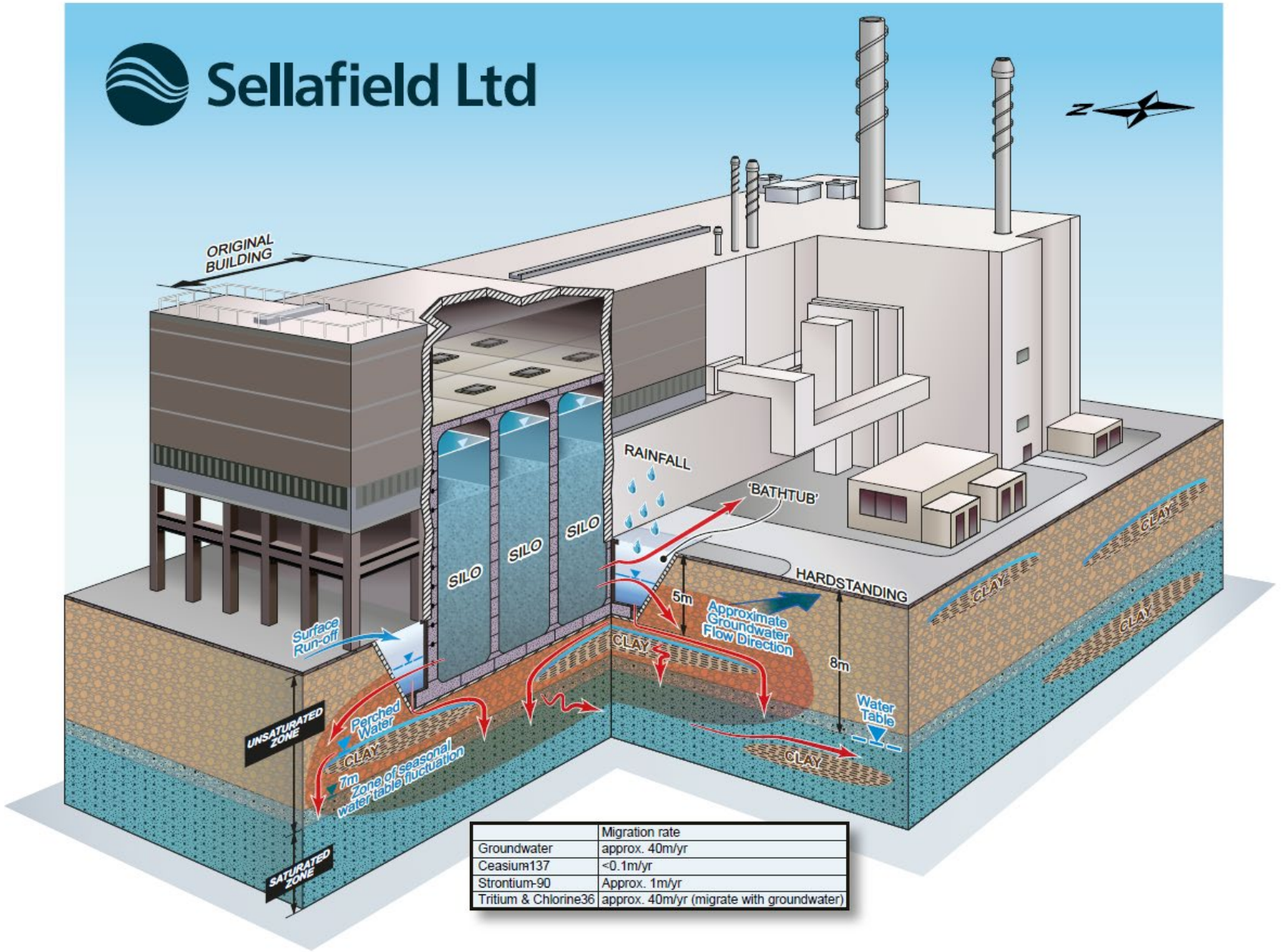
The MSSS problem

- The Magnox Swarf Storage Silos are the main contamination source term on site
  - Underwater storage of Magnox fuel cladding swarf
  - 22 storage compartments
  - Below ground leakage from the original six compartments
- Historic and ongoing (since 2019) leakage
  - Current leak rate ca.2.1 m^3/day
- Resumption of leakage prompted a review of existing groundwater monitoring arrangements
  - DQO review of existing groundwater monitoring arrangements



	Migration rate
Groundwater	approx. 40m/yr
Ceasium137	<0.1m/yr
Strontium-90	Approx. 1m/yr
Tritium & Chlorine36	approx. 40m/yr (migrate with groundwater)

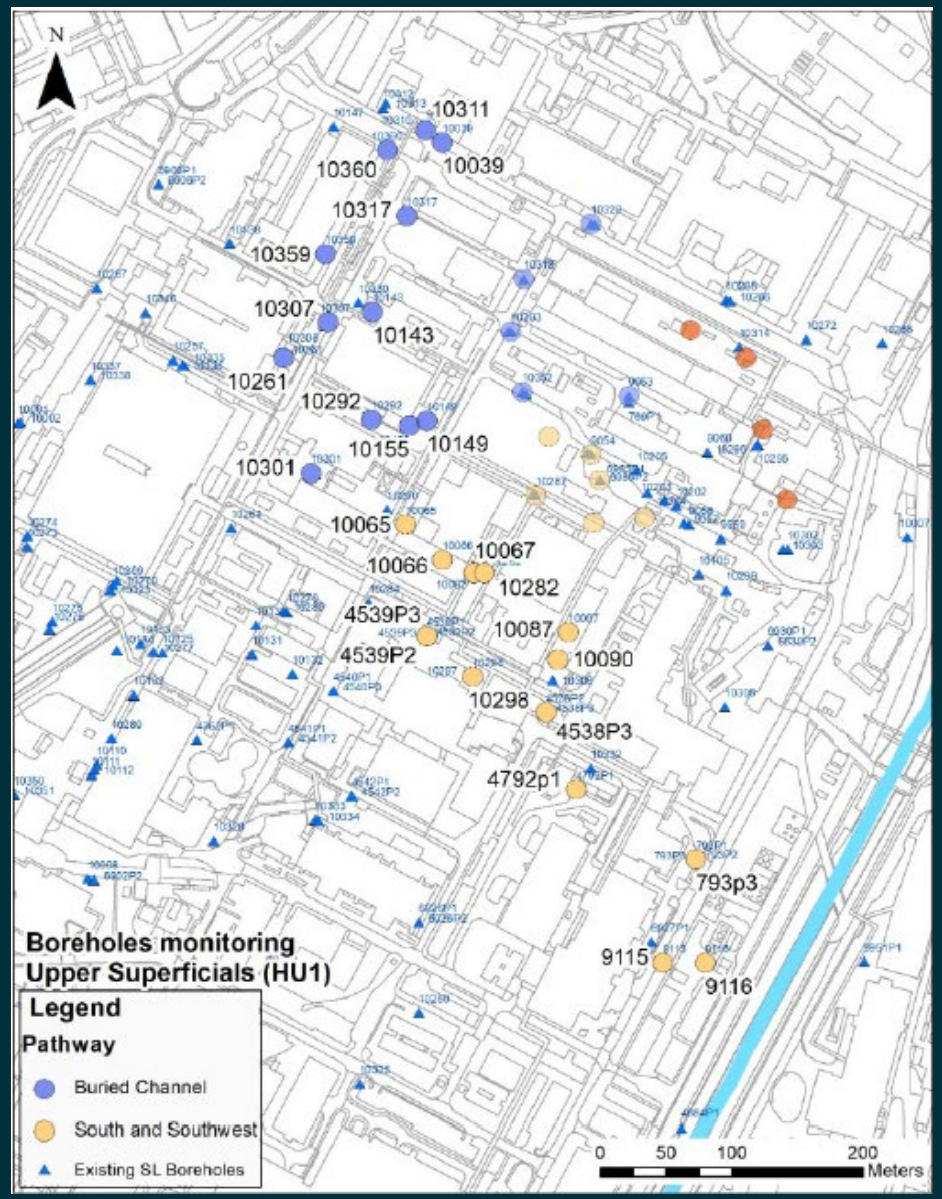
DQO summary

- Concluded April 2021

- Review of:
  - ‘Inner’ groundwater monitoring arrays
  - ‘Outer’ groundwater monitoring arrays

- Monitoring gaps identified
  - Lateral coverage generally okay – some gaps
  - Vertical coverage – multiple gaps identified

- 25 new boreholes proposed



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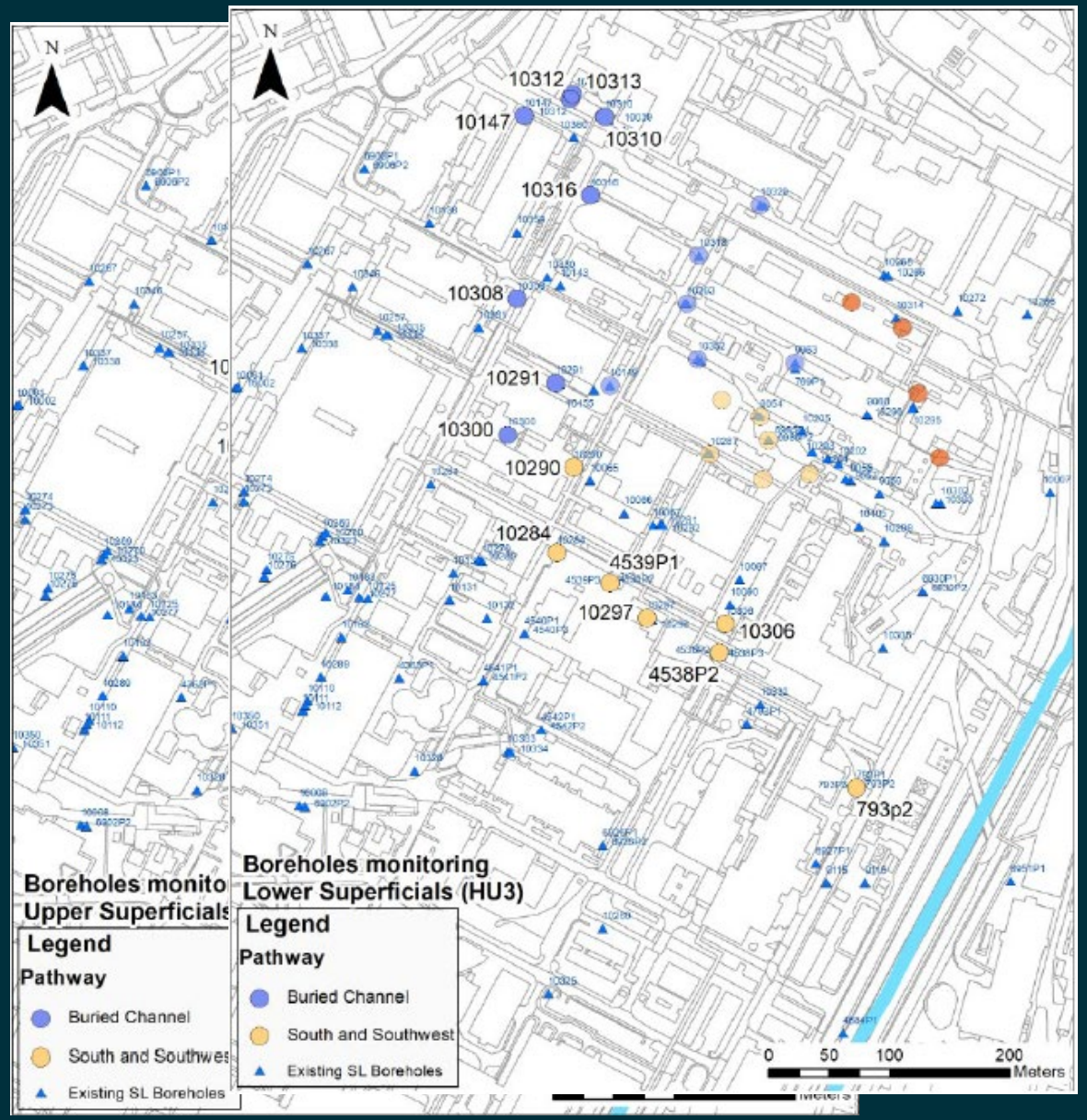

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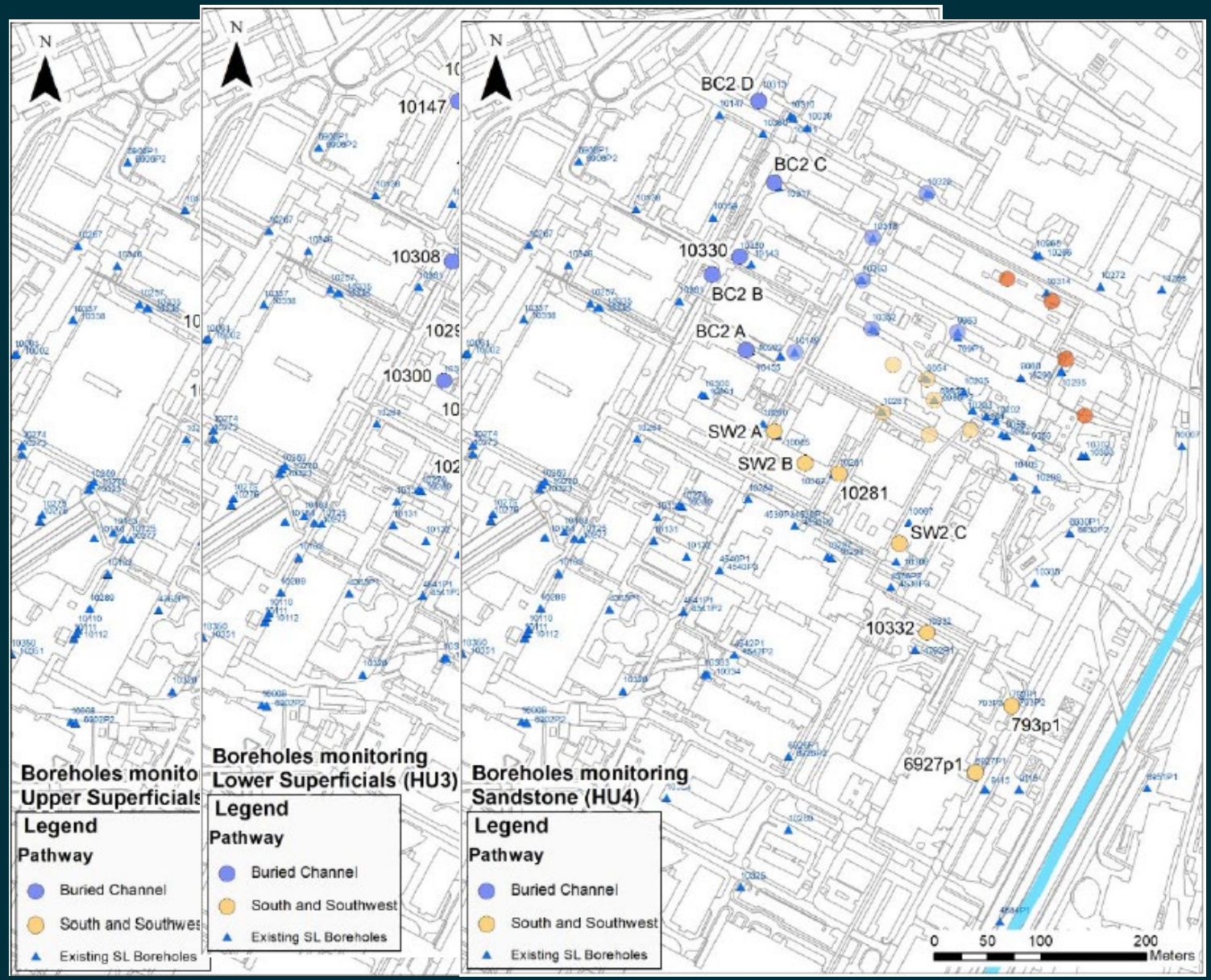

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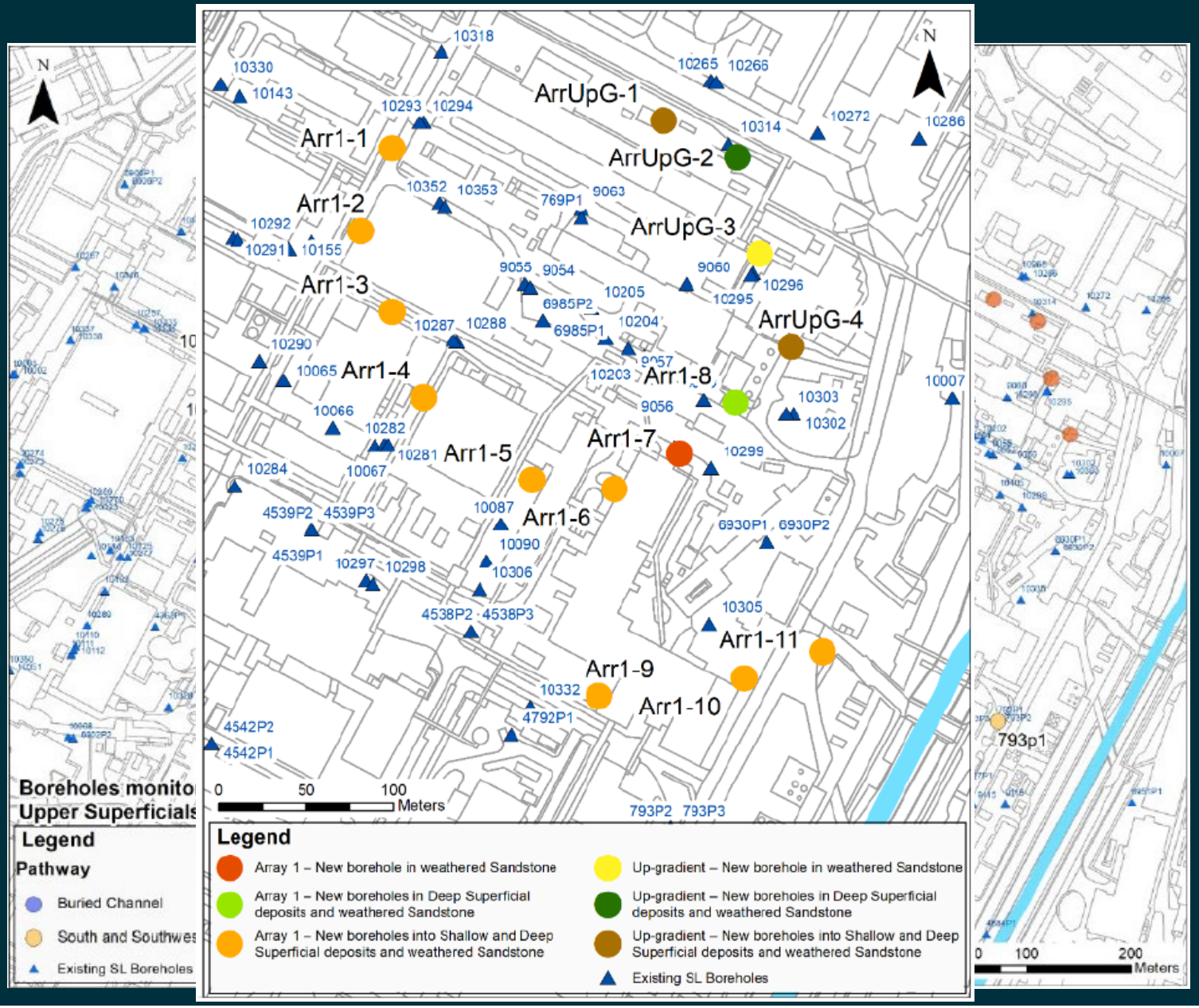

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25 new boreholes?

- Significant logistical challenges
  - Complex operational environment
    - Above ground and buried infrastructure
    - Multiple operational plants
    - Limited space
  - Radiological / dose constraints
- Undertook a contractor led review of the market of available multi-level well systems
  - Solinst CMT system favoured……however, issues identified
- 11 provisional installation locations identified
- Seven in first phase

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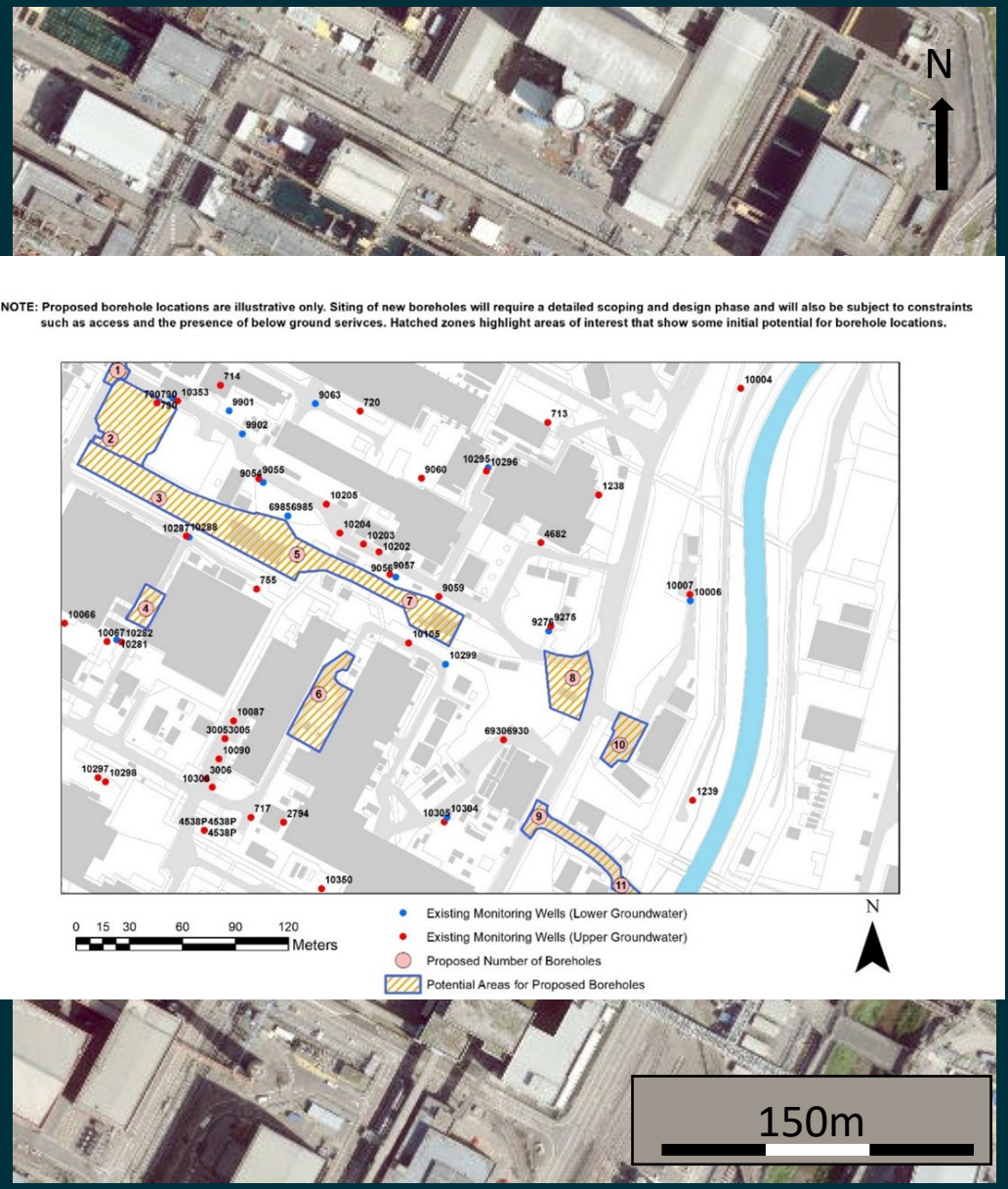

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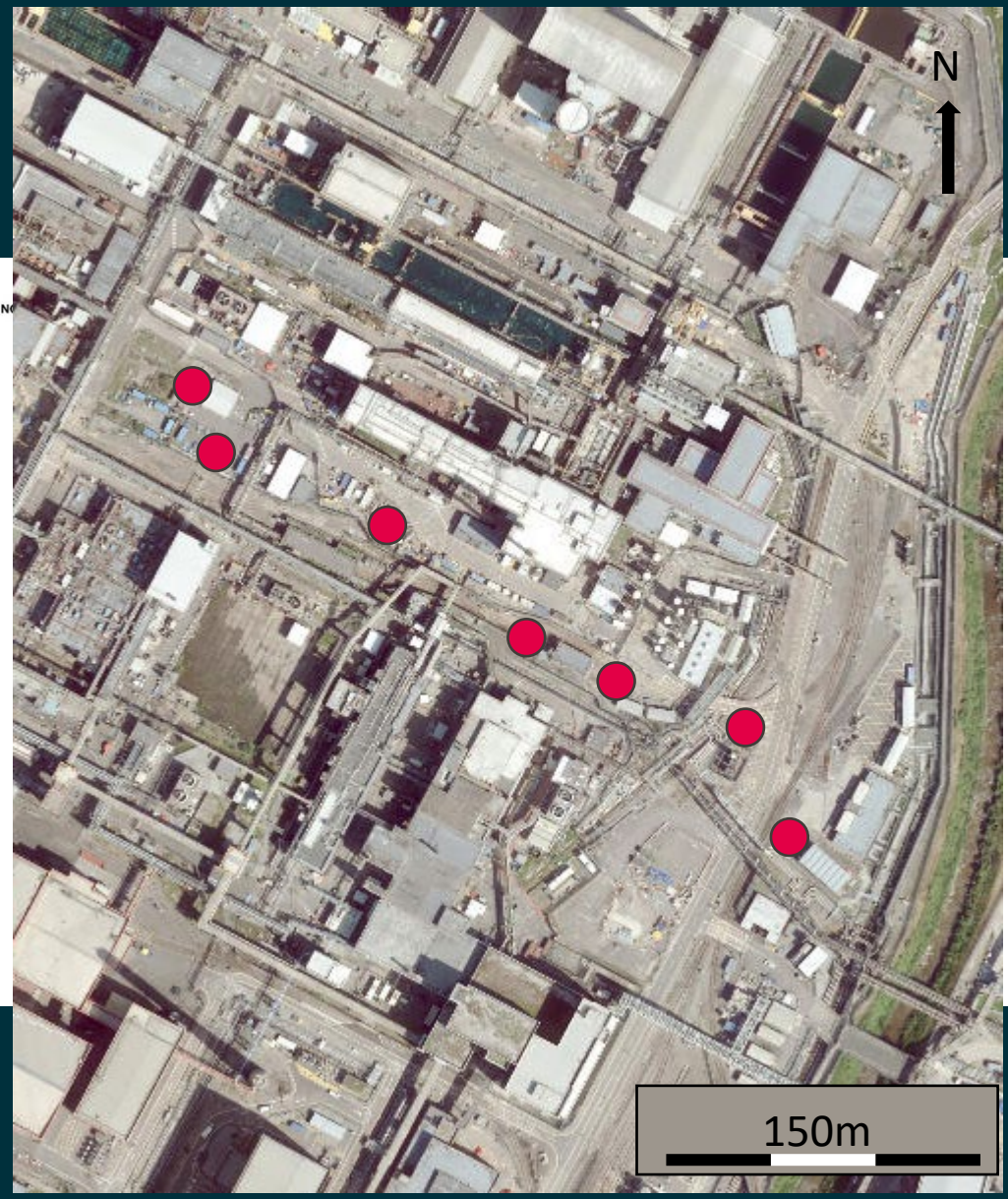

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Multi-level systems – pro and cons

CMT system:

- CMT has a fixed number of channels (3 or 7)
  - Narrow port diameters
- Required sample volumes can be up to 12L
- Long-term high-resolution head data identified as a key monitoring objective
  - No option for level logger deployment
- Groundwater is ca. 8 – 9m BGL, limiting pumping options

Morwick G360 system:

- Morwick system identified as an alternative
- Configurable port numbers and diameters
  - More options for data collection
  - Better sampling options
- But, new to market and no UK experience
- No off-the-shelf procurement route

Morwick G360 system

- Trial installation undertaken by our preferred drilling contractor
- On-site support from Morwick G360 team
- Invaluable learning ahead of main phase of works
- Successful trial confirmed selection of Morwick G360 MLS for site installation
  - Six five port systems
  - One six port system

Installation challenges

- Lots of buried infrastructure – the first metre was the hardest!
- Tight working environment – installation challenges
- High radiation background (challenge optimising port depth selection)
- Difficult geology – highly heterogenous – precise installation required
- Drilling challenges e.g. significant sediment ingress in open hole bedrock
- Installations
  - Measure, measure, measure!
  - Check, check, check!



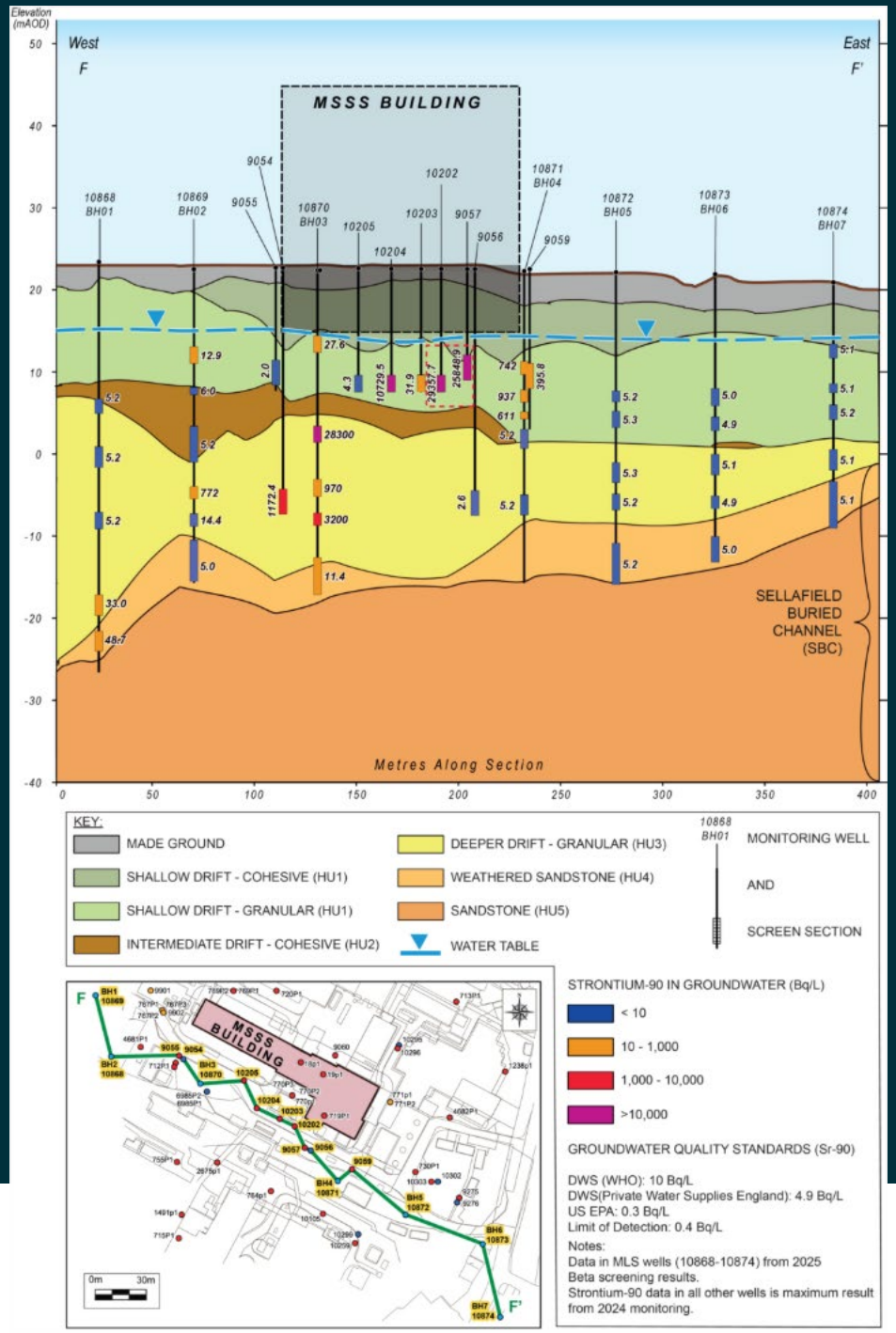

Operational challenges

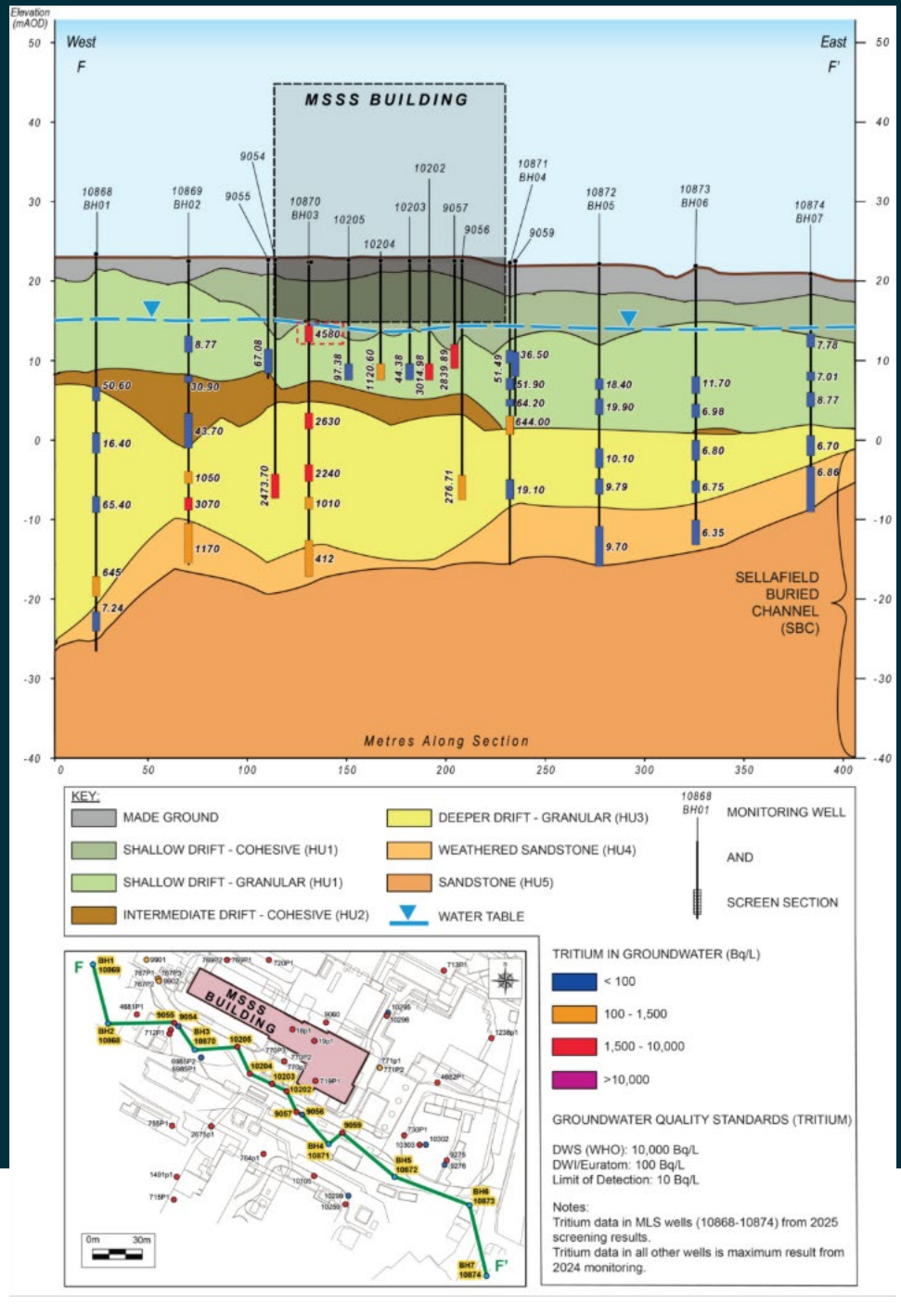
- Getting sampling underway took longer than anticipated
  - 35 sample points going live at once
  - Needed to build operator familiarity on new systems
  - Some port development required – not helped by the delay in starting sampling
    - Two ports considered to be non-functional
  - Sampling takes longer than for standard wells

- But……
  - Much better vertical resolution of contaminant distribution
  - Better insights into vertical head profiles

Data insights

- Notable differences in H-3 & Sr-90 distribution
- Evidence of discrete plumes





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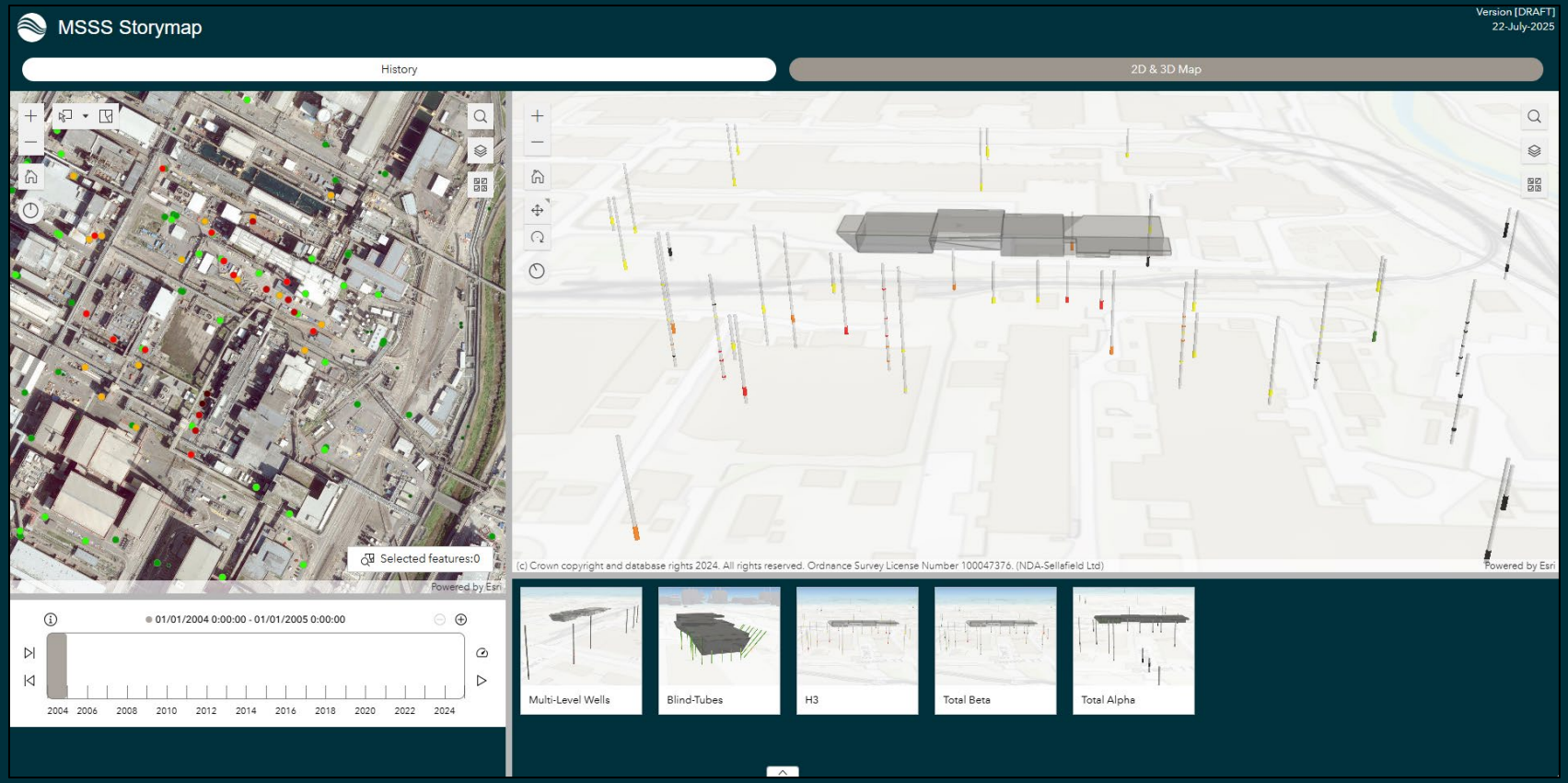
Data presentation

- We are actively looking at ways to improve the presentation of 3D data, e.g. 3D GIS embedded in StoryMaps



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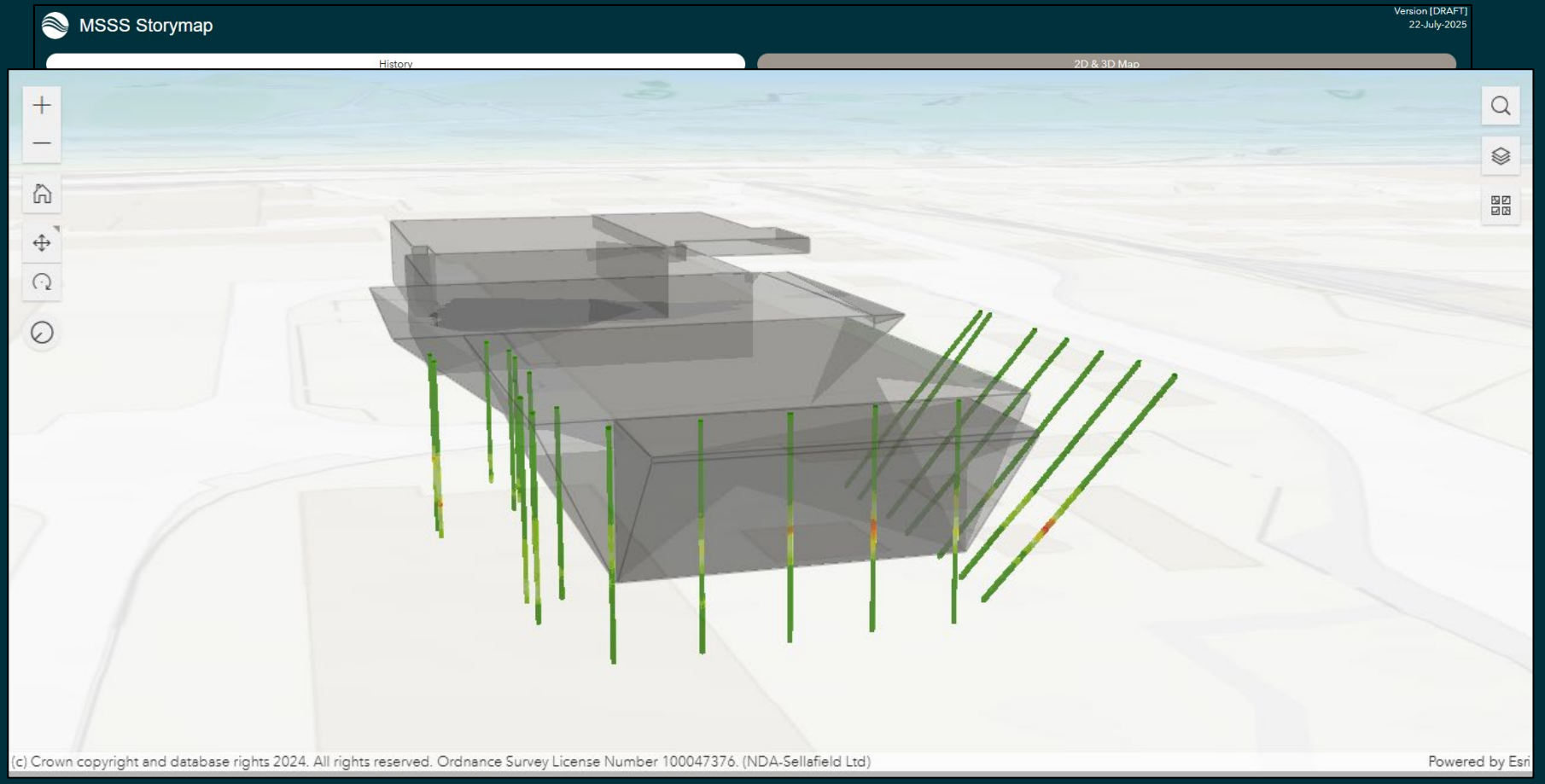

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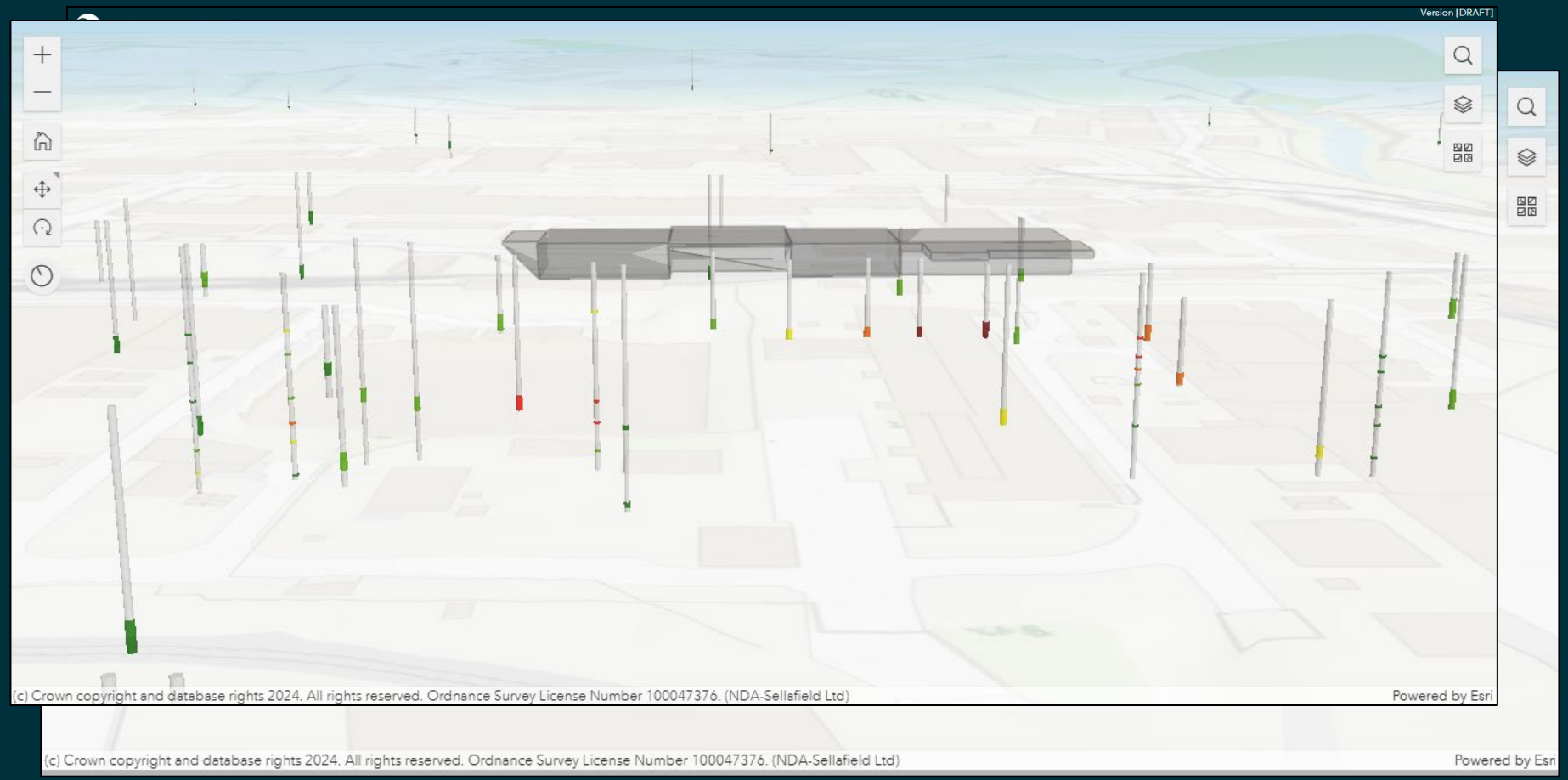

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Summary

- On complex sites discrete vertical characterisation is important
- It can be hard, particularly when significant operational constraints are present
- Multi-level well systems offer many potential benefits
  - But, they do have their own challenges
- Choices around improved vertical characterisation should be based on sound decision making
- The benefits of improved vertical characterisation can be significant
- But, you might end up with more questions than answers…….

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