

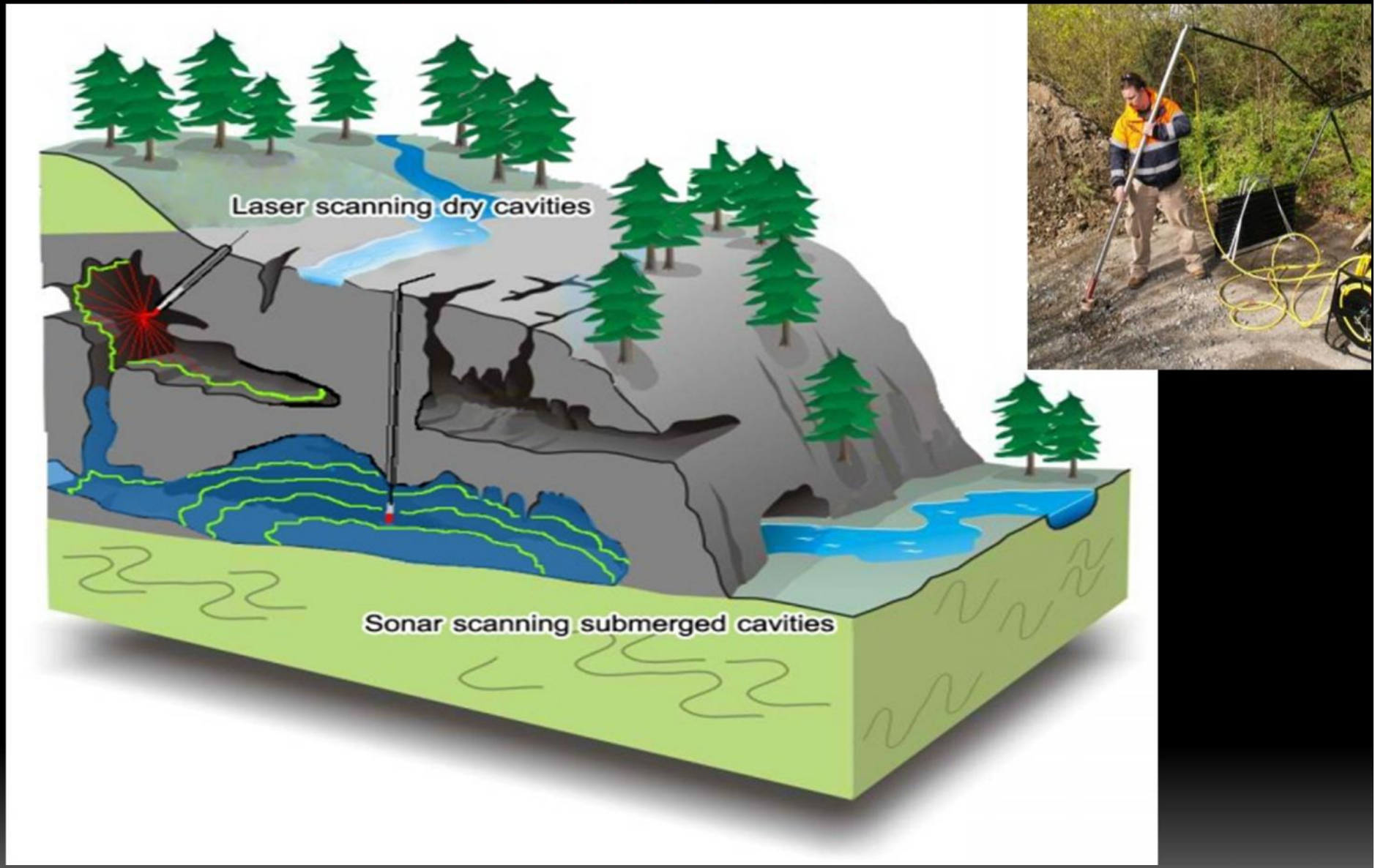
SUBSURFACE LASER SCANNING



- Subsurface laser scanning and multibeam sonar void surveys
- What really does lie beneath and where exactly?
- Mitigating your Risk



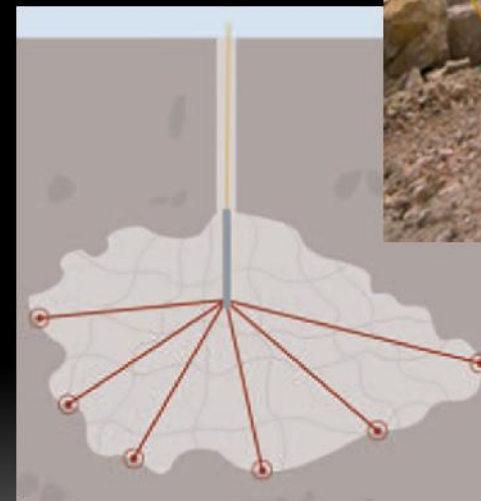
SUBSURFACE LASER SCANNING



SUBSURFACE LASER SCANNING

C-ALS (Cavity Auto Laser Scanner) - **DRY**

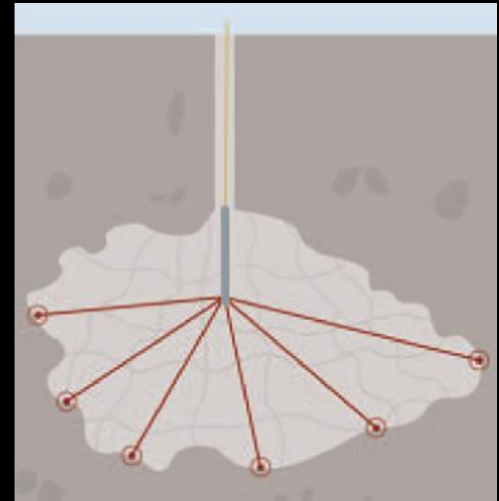
- Deployed through borehole +50mm \varnothing ID
- Infra-red camera (still & video)
- 150m standard radius
- 100m standard & 300m max depth
- Time of flight laser scanner
- Full 360x350 operational range
- 5cm accuracy



SUBSURFACE LASER SCANNING

FARO Focus Laser Scanner - **DRY**

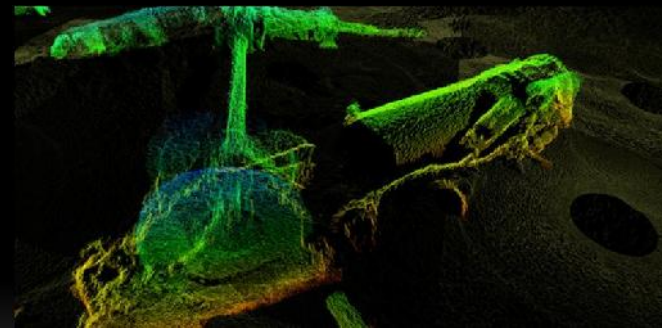
- Deployed through hole 300mm x 180mm
- 90m standard radius & depth
- Time of flight laser scanner
- One million points/second
- Full 360x350 operational range
- 5mm accuracy



SUBSURFACE LASER SCANNING

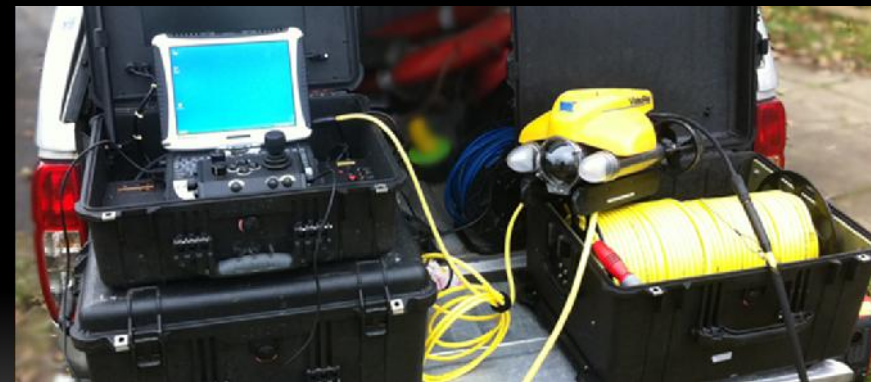
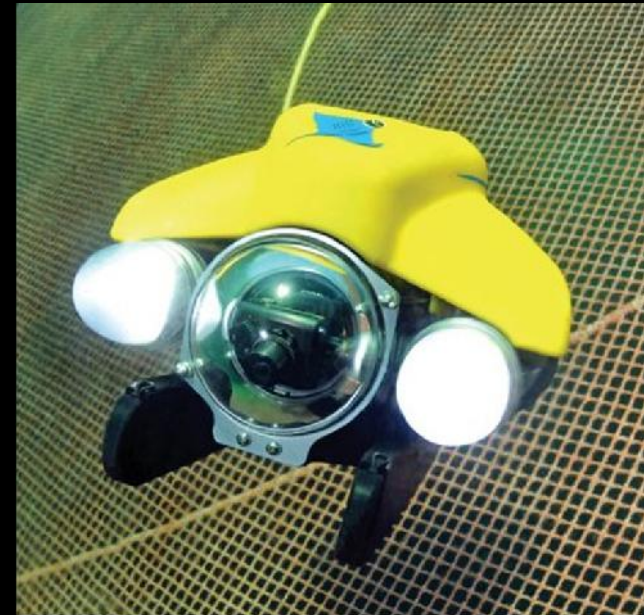
Sonar System - WET

- Use in waterlogged mines, cavities, shafts
- Downhole sonar system in +120mm Ø ID
- Profiling & multibeam sonar systems
- 100m standard radius + 1400m depth
- Heading, Pitch and Roll Sensor
- Geo-referenced Data
- 2cm accuracy



SUBSURFACE LASER SCANNING

- ROV Survey
- VideoRay Pro 4 ROV
- 37.5, 28.9, 22.3 cm
- 6.1 kg
- 4.2 knots
- Dive to 305 m (1,000 ft)
- HD video & photography
- Powerful LED lights

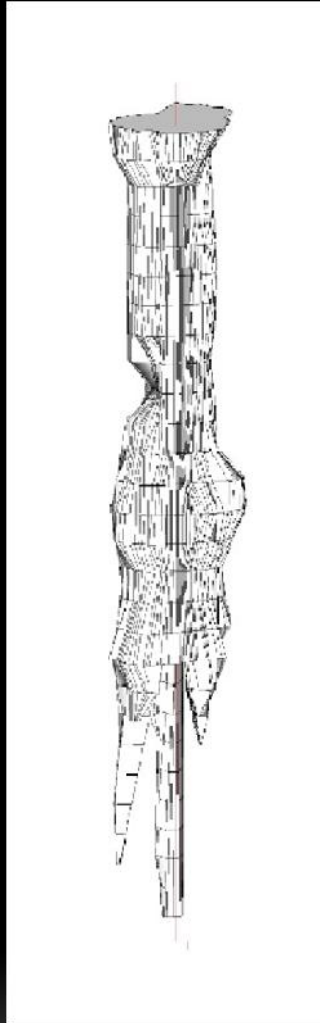
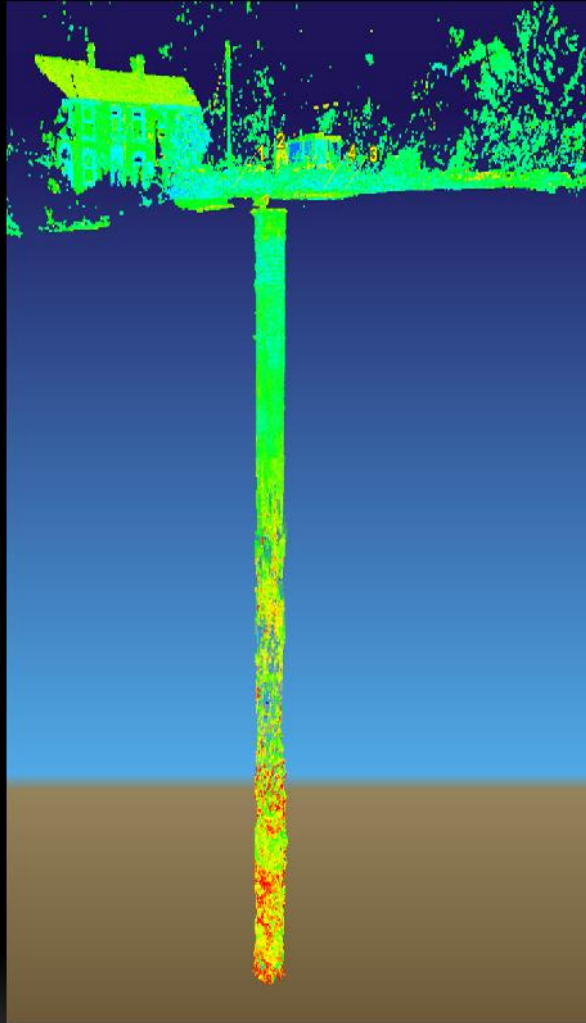


SUBSURFACE LASER SCANNING

- HD Video/Photography
- GE PTZ 6.2 industrial camera
- Watertight to 45m depth
- Remote operation
- Hand held boom or tripod
- Powerful LED lighting
- Zoom control



SUBSURFACE LASER SCANNING



Multibeam Sonar profiling ranges to capture all data

Ability to combine both sonar and laser scan data

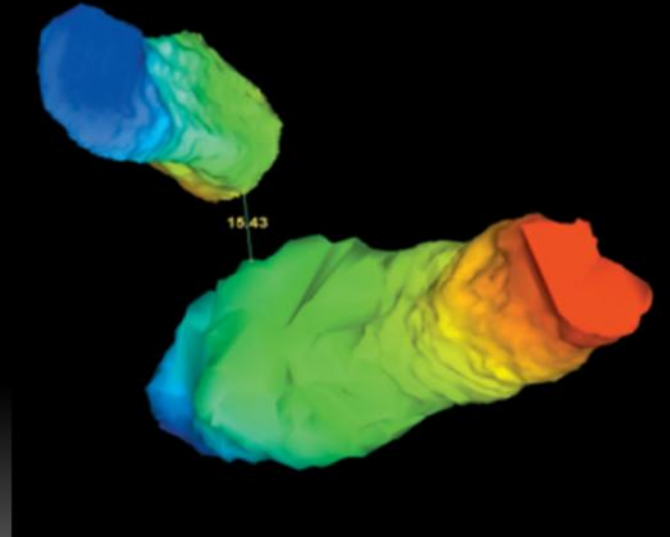
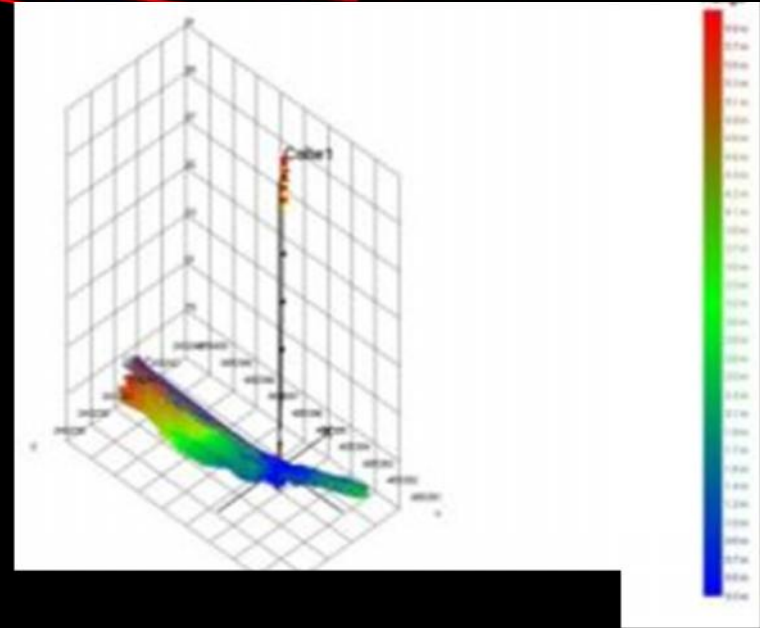
Swansea shaft surveyed down to 300m bgl – 240m submerged



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UNDERGROUND CAVITY SURVEYS

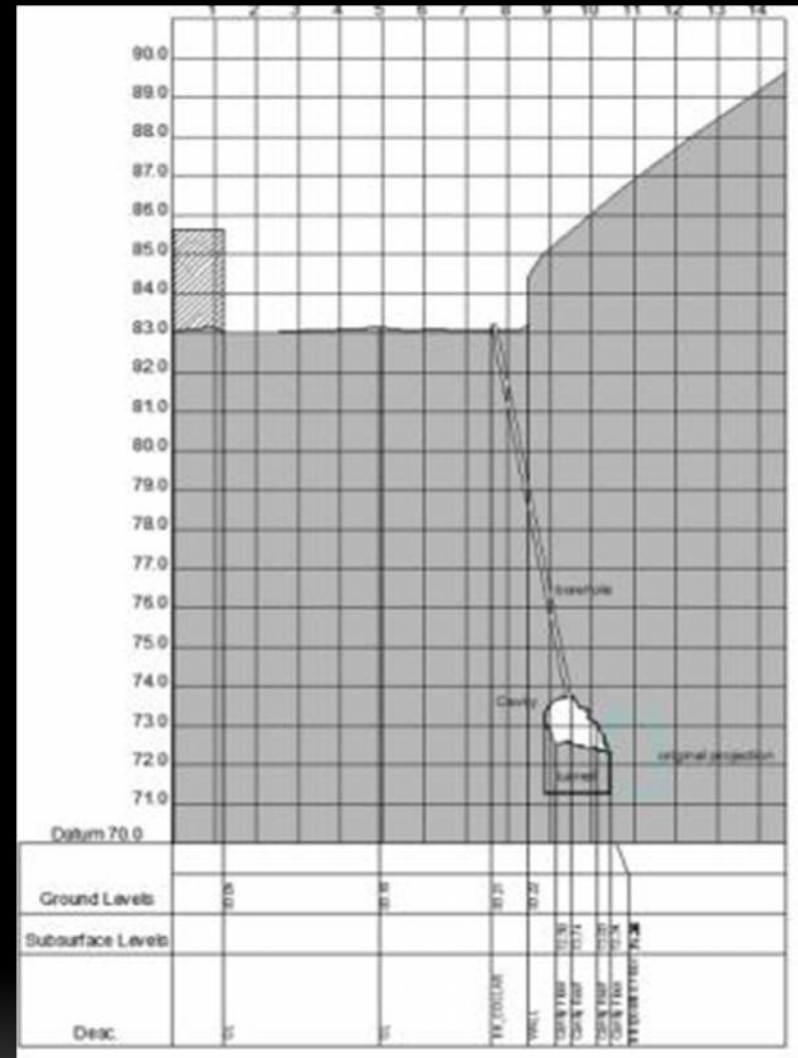
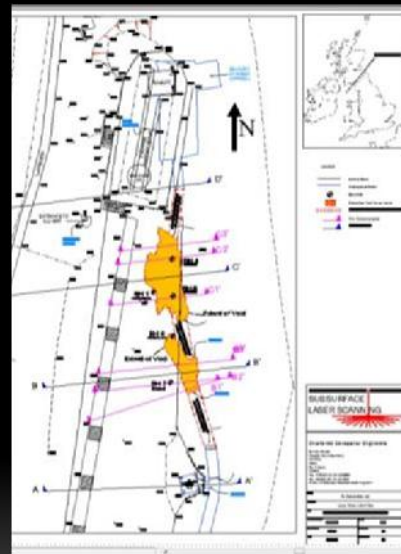
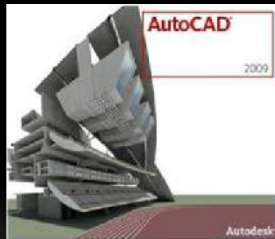
- Accurate 3D sub-surface survey position calculated
- Radius **100m WET** to **150m DRY**
- Results displayed in real time
- Geo-referenced 3D model of void
- Live video feed during works



SUBSURFACE LASER SCANNING

OUTPUT DATA

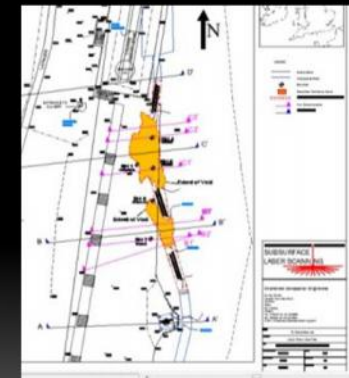
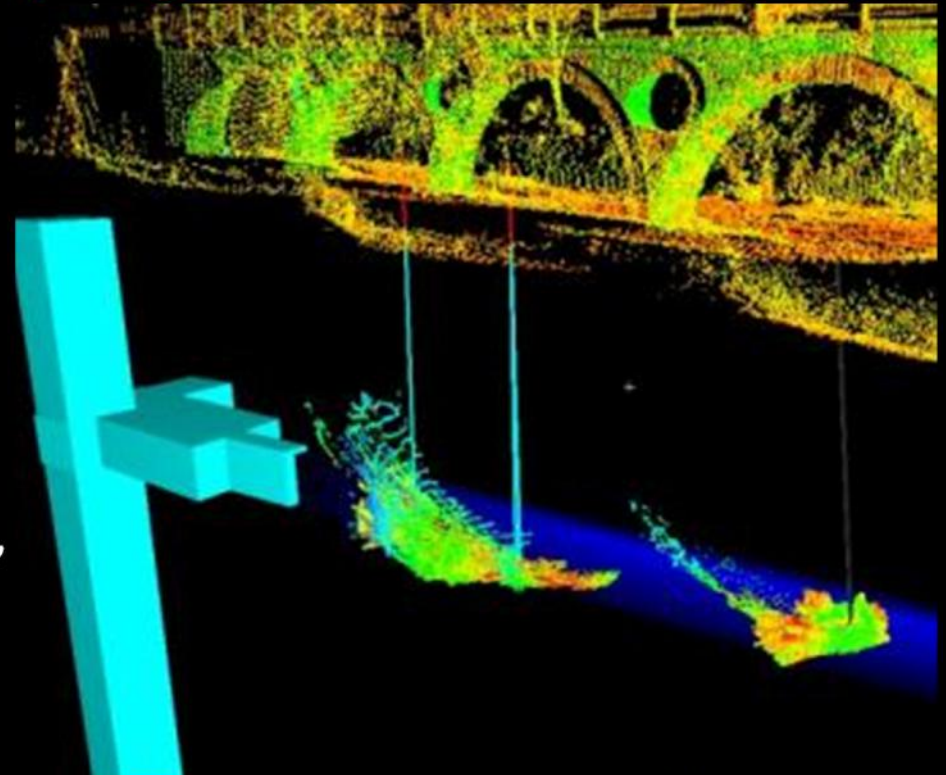
- Full CAD compatibility
- Plans, Sections & 3D models
- Scan to BIM - Revit



SUBSURFACE LASER SCANNING

OUTPUT DATA

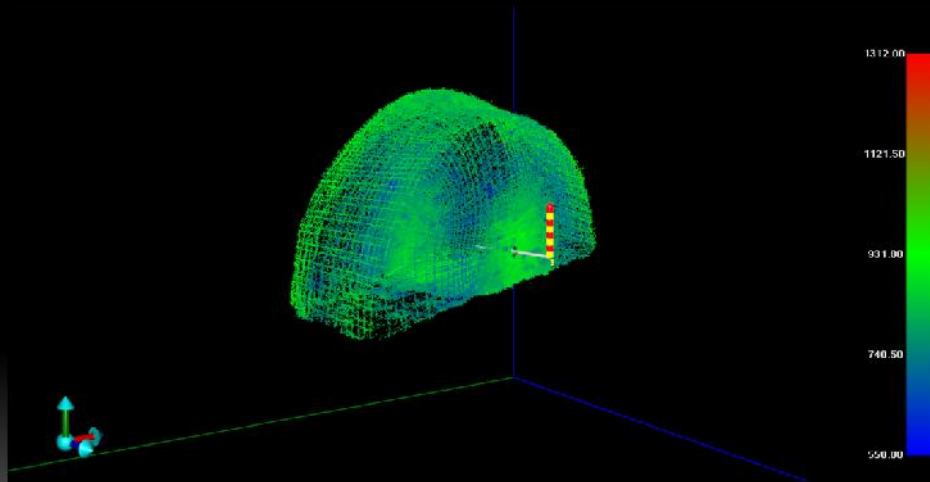
- Full CAD compatibility
- Plans, Sections & 3D models
- Scan data can be output in dxf, ascii or pts
- Fully geo-referenced and locally referenced survey depending on clients needs
- Scan to BIM with level 1 or 2 model intelligence for Revit



SUBSURFACE LASER SCANNING

RUGBY RAIL BRIDGE VOID SURVEYS

- Unknown void size
- Unknown number of voids and geo-referenced orientation
- Surveyed with C-ALS over two nightshifts



SUBSURFACE LASER SCANNING



Case Study

Subsurface Laser Scan survey

Metaliferous mine void

Drump Road, Redruth, Cornwall

SUBSURFACE LASER SCANNING



- Void encountered whilst drilling borehole on land adjacent to Penzance to London main railway line
- CCTV camera used unable to ascertain size, shape or orientation
- Possibility of railway line and adjacent buildings undermining
- Requested to carry out subsurface laser scan survey to produce a 3D geo-referenced model of the surface and underground void

SUBSURFACE LASER SCANNING



Drump Road site and drilling rig in position adjacent to main railway line



SUBSURFACE LASER SCANNING



First borehole drilled into void

CCTV inserted into void to see that it is a large hole. No indication of size, shape or orientation

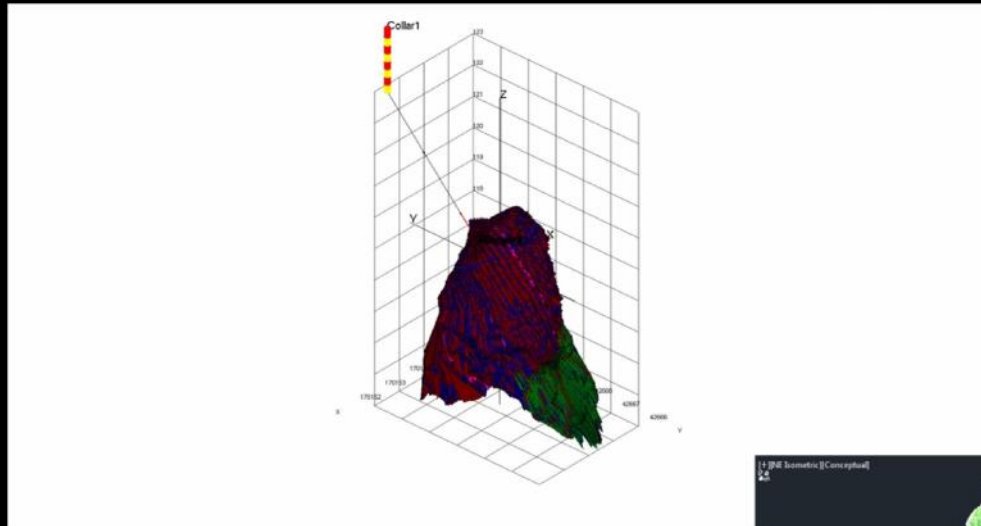


SUBSURFACE LASER SCANNING



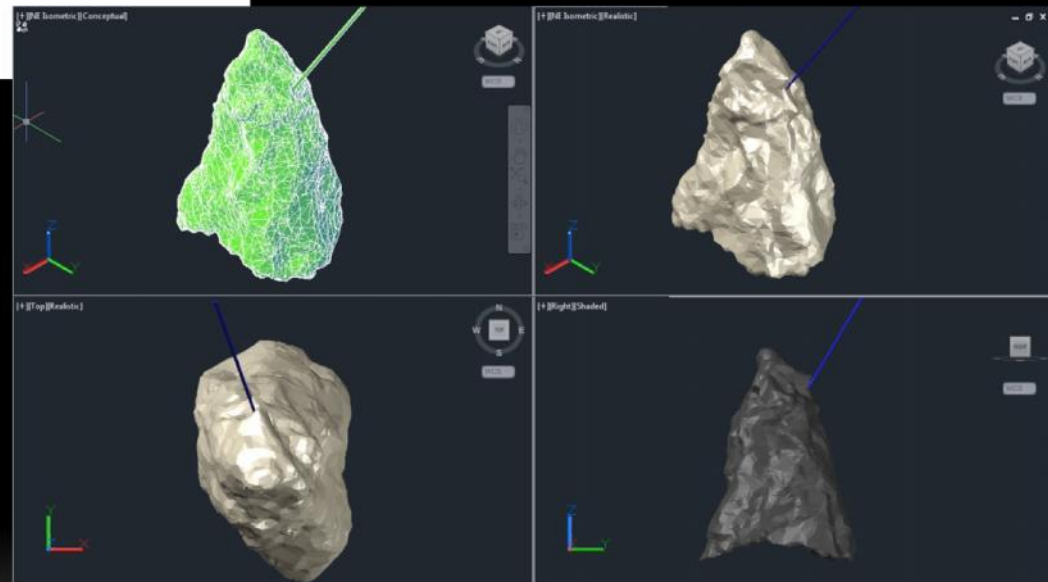
C-ALS inserted into void via borehole

SUBSURFACE LASER SCANNING

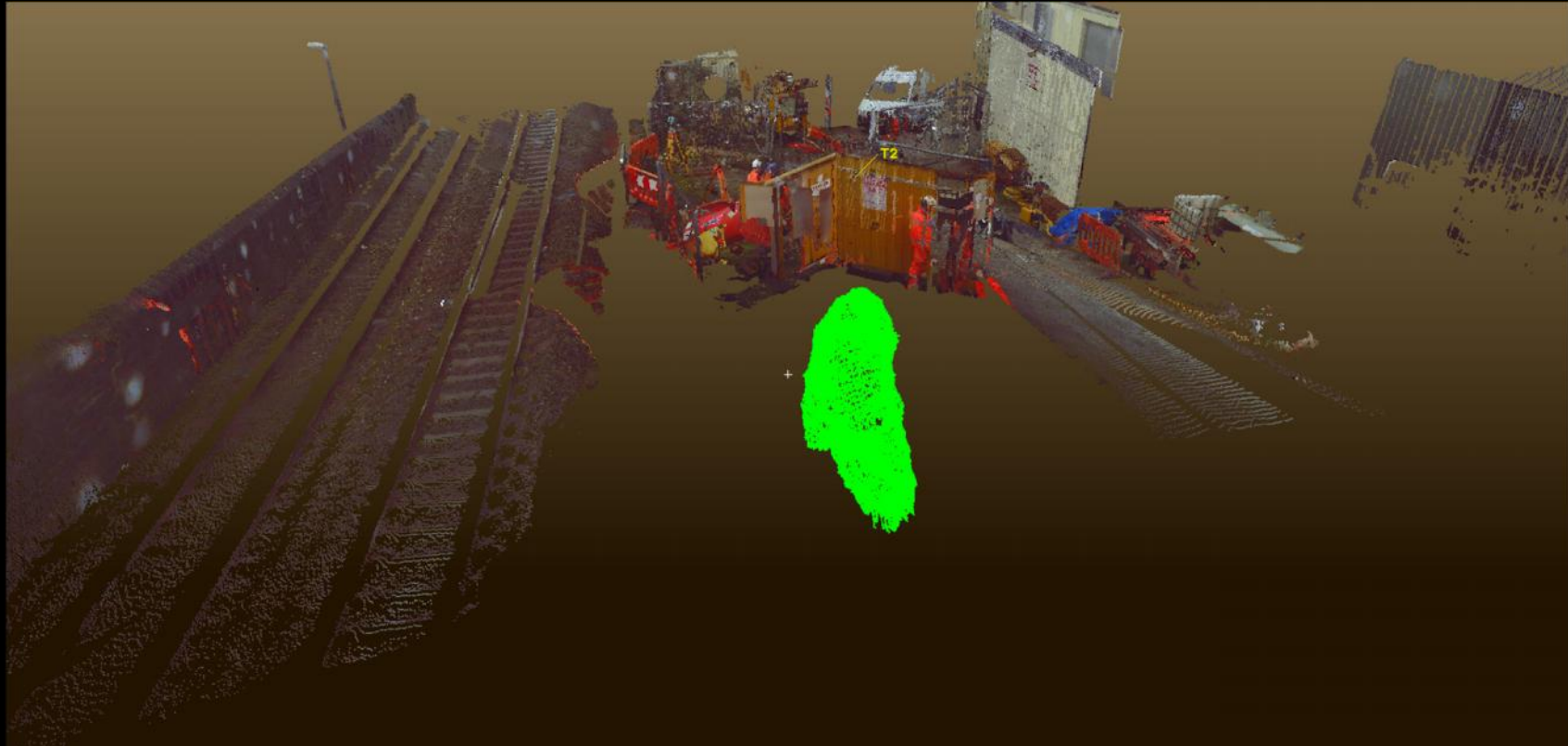


Laser scan raw data relative to borehole location and drill path. Scan data available on site immediately to assist in positioning of further boreholes

Void 3D Modelling relative to borehole location and drill path



SUBSURFACE LASER SCANNING



Surface laser scan combined with subsurface laser scan survey

SUBSURFACE LASER SCANNING



FINAL DELIVERABLES

- Combined 3D geo-referenced void and surface laser scan
- Confirmation that void does not undermine the main railway line or buildings, although large adjacent shaft is known
- Confirmation that there were no attached adits or tunnels
- Accurate volume calculated for backfilling
- Pre-works prior to new track slab install over shaft

SUBSURFACE LASER SCANNING



Continuous void/shaft scanning whilst Keller's jet grouting through track slab

SUBSURFACE LASER SCANNING



Case Study

Subsurface Laser Scan Survey

Collins Green Pit Shaft

Wigan, Lancashire

SUBSURFACE LASER SCANNING

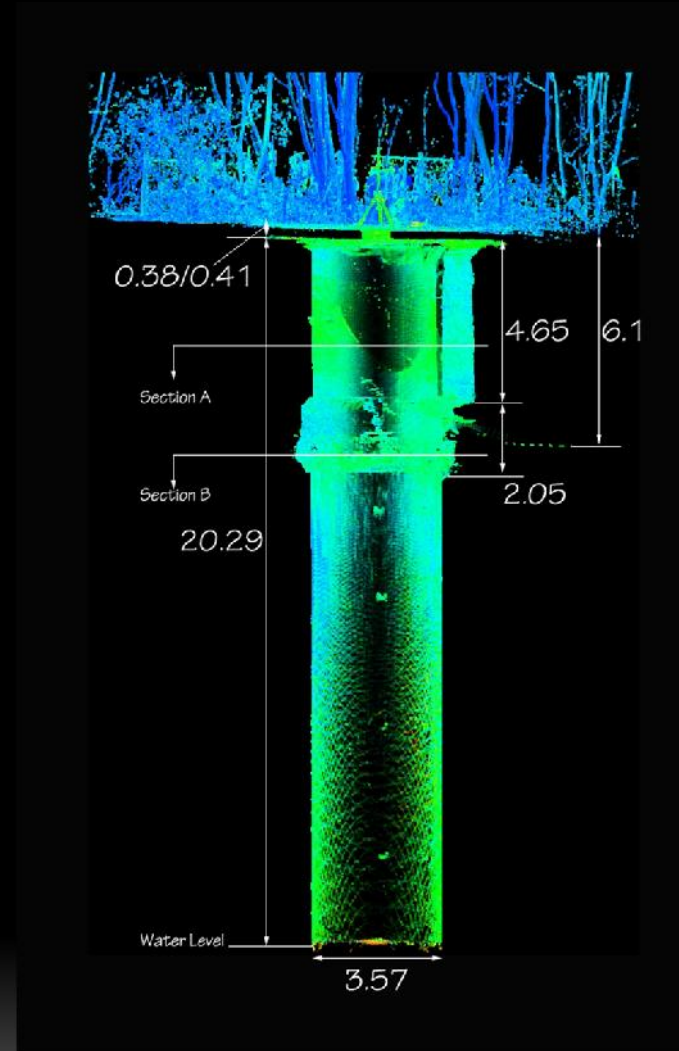
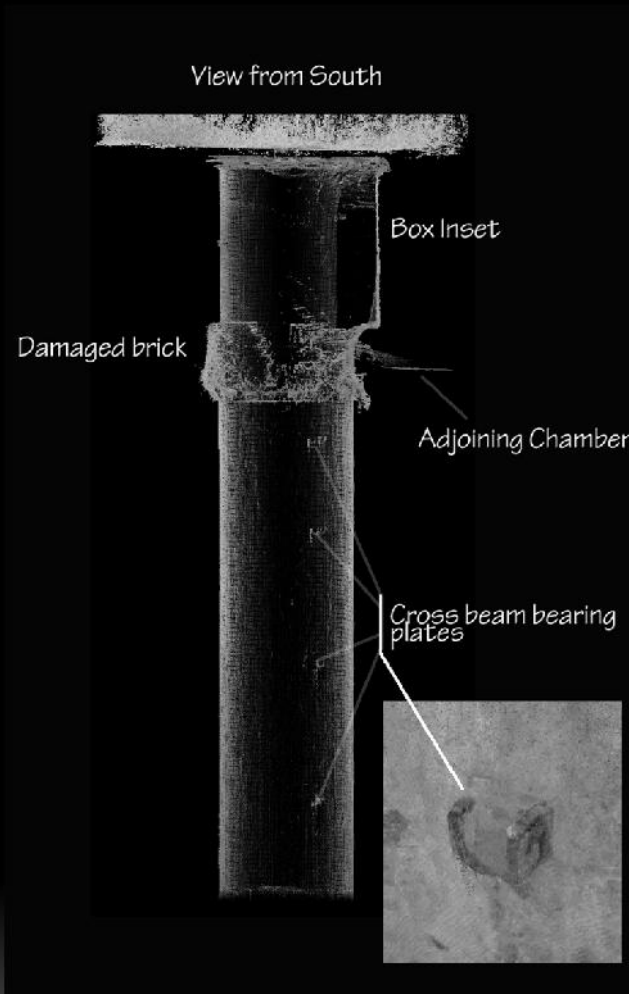


- Geoterra contacted by The Coal Authority in June 2015
- Collins Green old mine shaft
- Capped in 1930's
- Suspected collapsing of shaft lining
- Previously used a CCTV for inspection
- Requested to carry out laser scan survey to produce a full 3D geo-referenced model
- Re-surveyed in June 2016 to determine any lining deformation

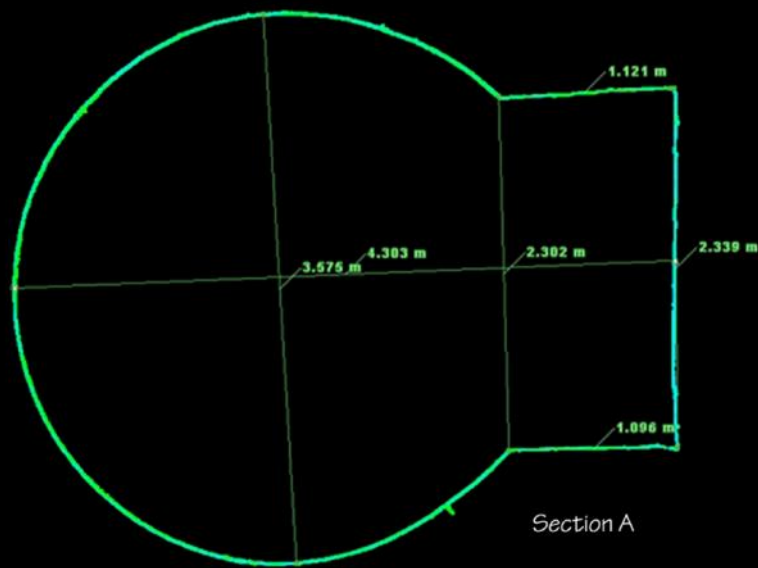
SUBSURFACE LASER SCANNING



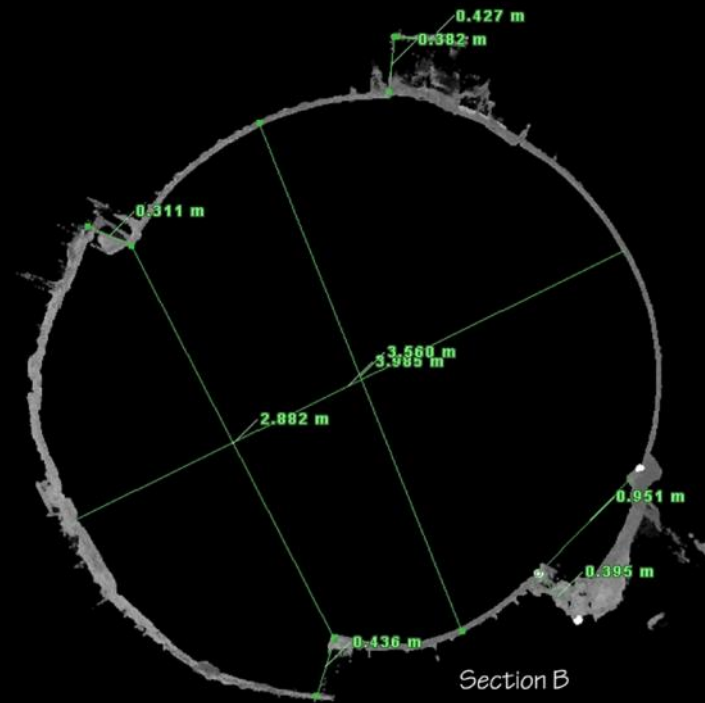
SUBSURFACE LASER SCANNING



SUBSURFACE LASER SCANNING



Section A



Section B

SUBSURFACE
LASER SCANNING



Baxters Pit Shaft
Dimensioned Imagery
The Coal Authority

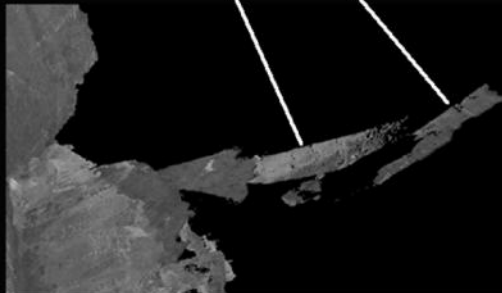
SUBSURFACE LASER SCANNING



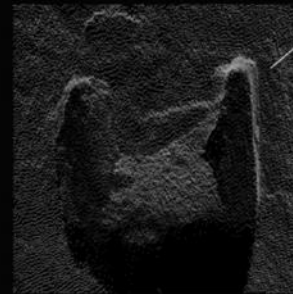
Open to adjoining chamber



Chamber Wall & Floor



Cross beam bearing plates



Baxters Pit
Glead Wood
Winstanley
Lancashire

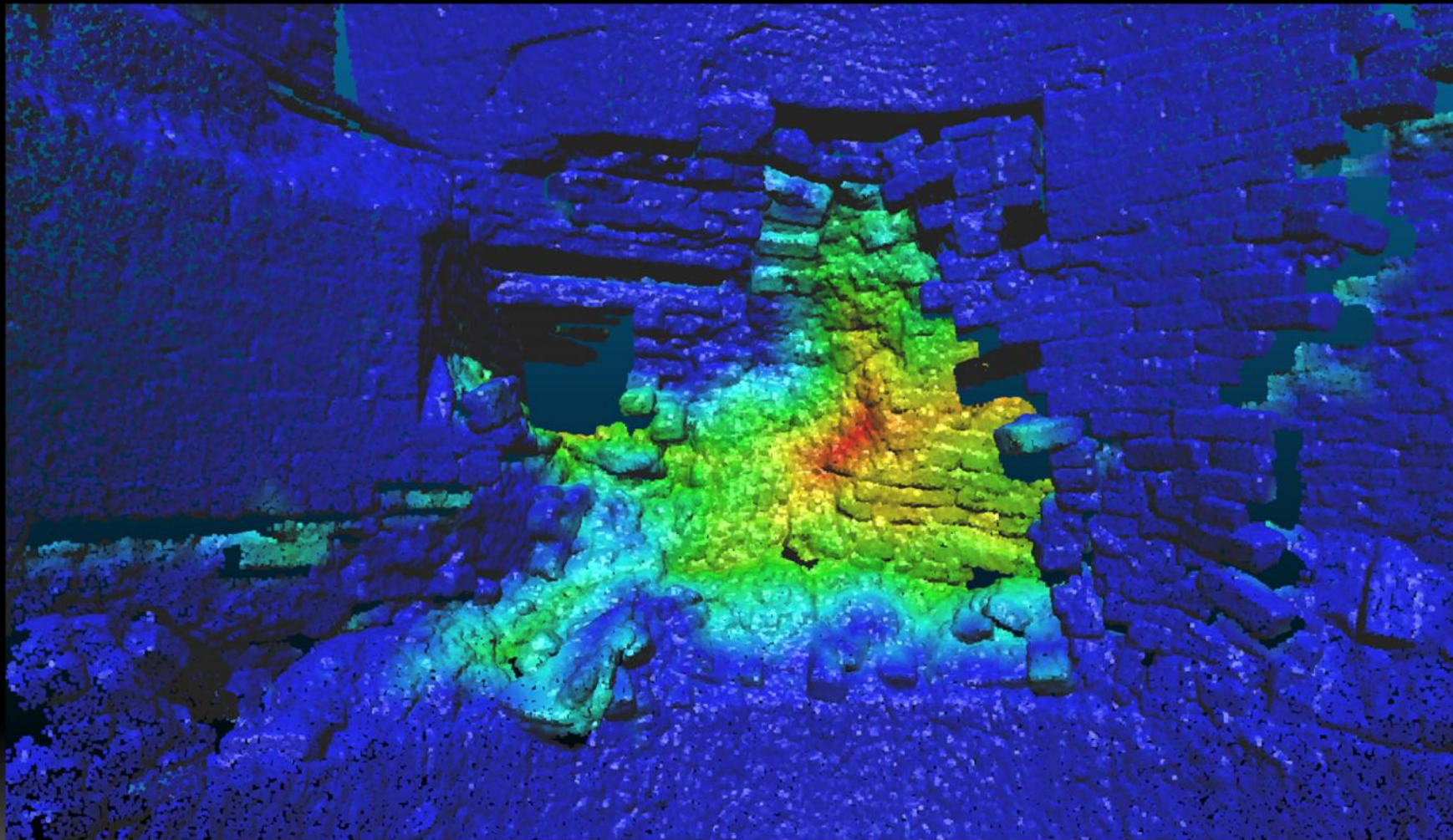
The Coal Authority
SUBSURFACE
LASER SCANNING



Plan View showing
Remaining Timber Beam

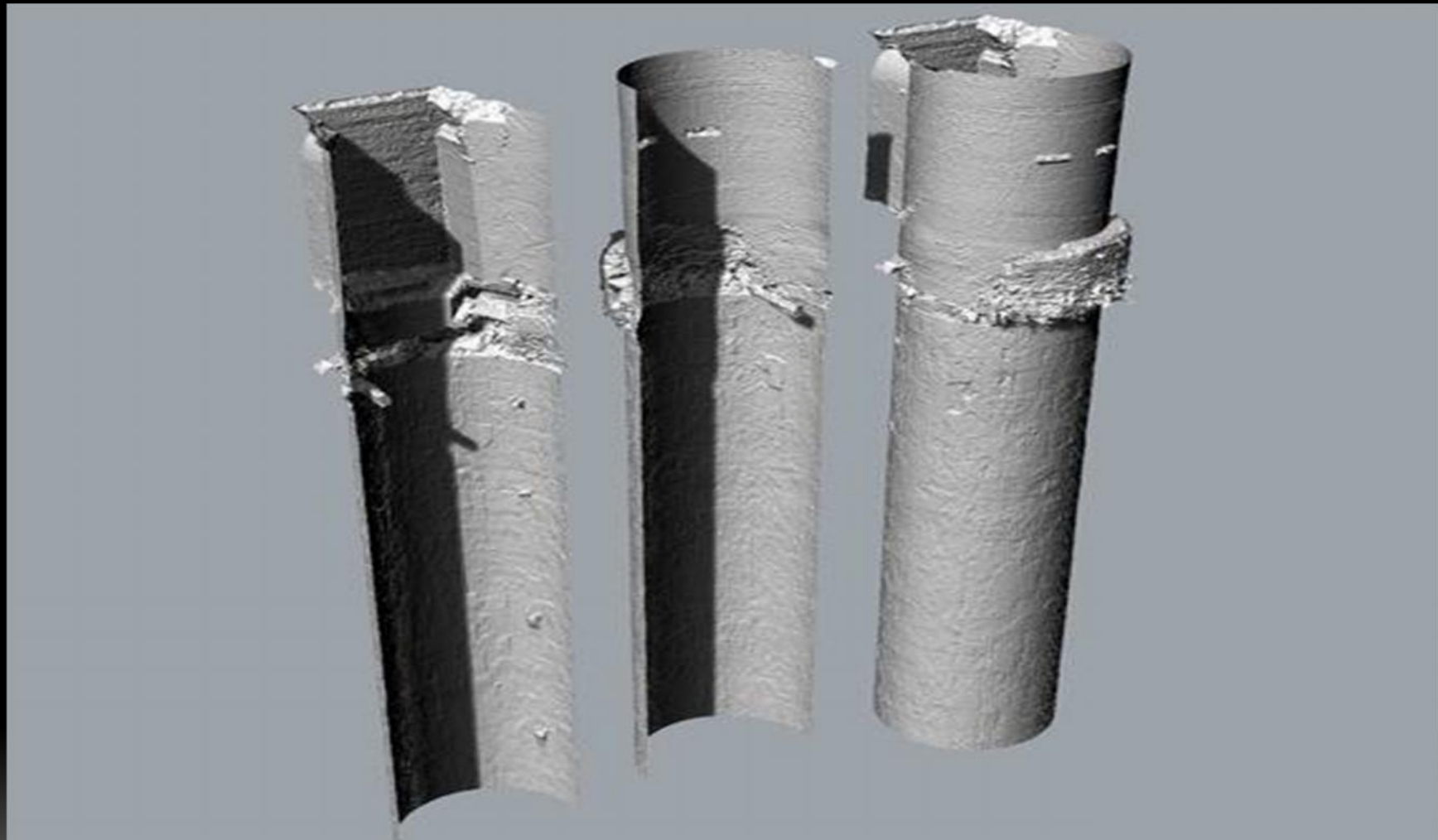
SUBSURFACE LASER SCANNING

Repeated subsurface laser scan surveys – deformation analysis



SUBSURFACE LASER SCANNING

Production of 3D printer resin scaled models for physical assessment



SUBSURFACE LASER SCANNING



LASER SCAN & SONAR SURVEY & DELIVERABLES SUMMATION

- Rapid deployment to site – one day.
- No need for survey personnel to physically enter void or shaft
- Rapid collection of geo-referenced 3D laser scan & sonar survey on both the surface and subsurface via small access hole.
- Rapid turnaround of deliverables.
- 2D cross sections and plan sections.
- 3D measurable Navisworks scan to BIM model ‘rolled out’ shaft walls and adits.
- Client, consultant engineer and contractor provided with accurate subsurface survey data to design remedial measures.
- RISK AVOIDANCE – Ignore the dangers at your peril!!

SUBSURFACE LASER SCANNING



Thank you for listening

Any Questions?



www.geoterra.co.uk