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

Laser scanning dry cavities

Sonar scanning submerged cavities
C-ALS (Cavity Auto Laser Scanner) - DRY

- Deployed through borehole +50mm Ø 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
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
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
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
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
OUTPUT DATA

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

Subsurface Laser Scan survey

Metaliferous mine void
Drump Road, Redruth, Cornwall
• 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
Drump Road site and drilling rig in position adjacent to main railway line
First borehole drilled into void

CCTV inserted into void to see that it is a large hole. No indication of size, shape or orientation
C-ALS inserted into void via borehole
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.
Surface laser scan combined with subsurface laser scan survey
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
Continuous void/shaft scanning whilst Keller’s jet grouting through track slab
Case Study

Subsurface Laser Scan Survey

Collins Green Pit Shaft
Wigan, Lancashire
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

Section A

Section B

Baxters Pit Shaft
Dimensioned Imagery
The Coal Authority
Repeated subsurface laser scan surveys – deformation analysis
SUBSURFACE LASER SCANNING

Production of 3D printer resin scaled models for physical assessment
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!!
Thank you for listening

Any Questions?