

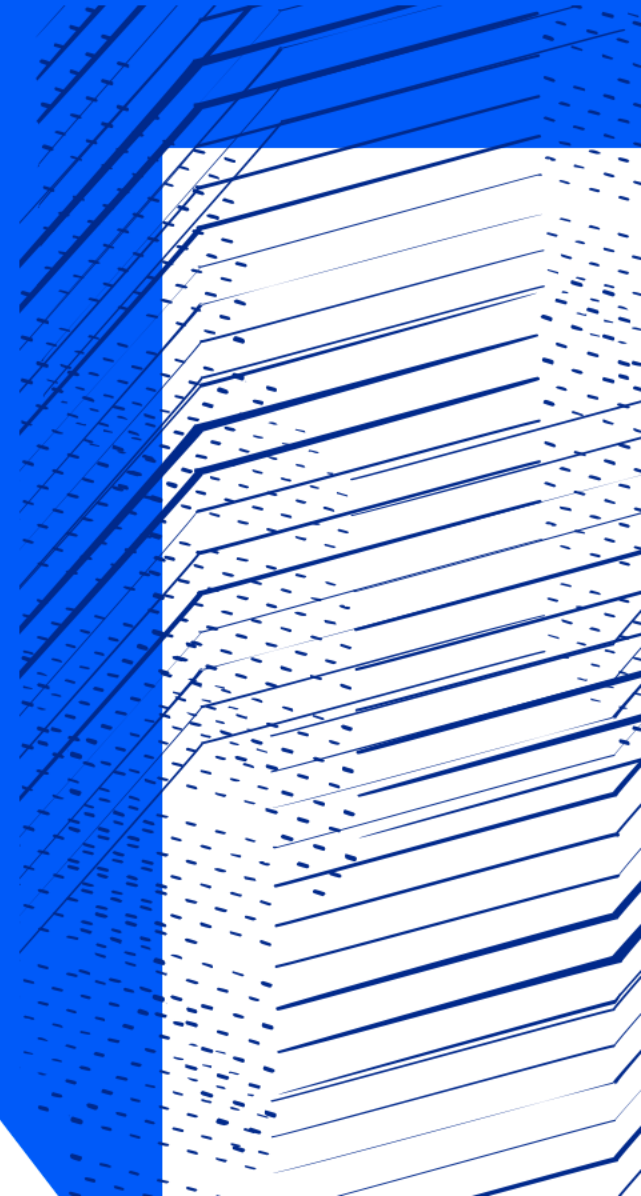


Science and
Technology
Facilities Council

Boulby Underground
Laboratory

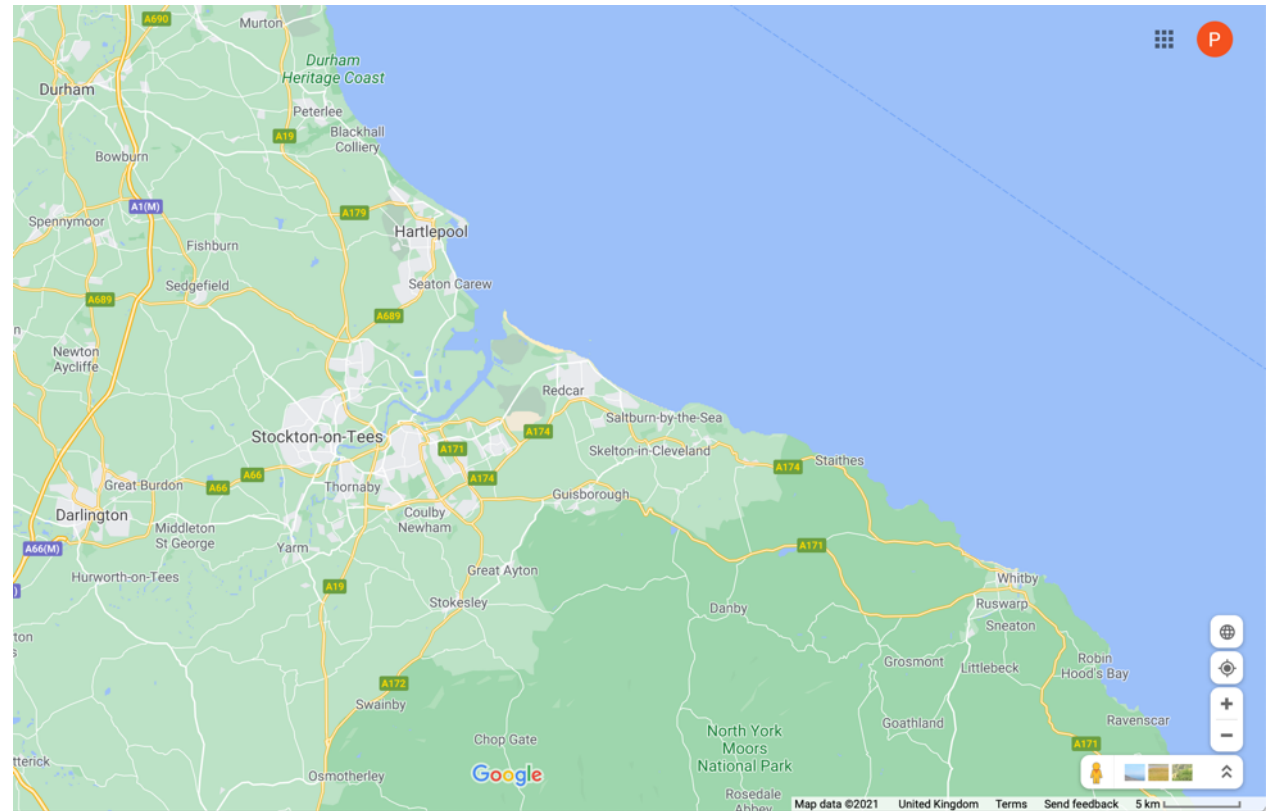
Boulby Underground Laboratory

Paul Scovell – 20/03/2024



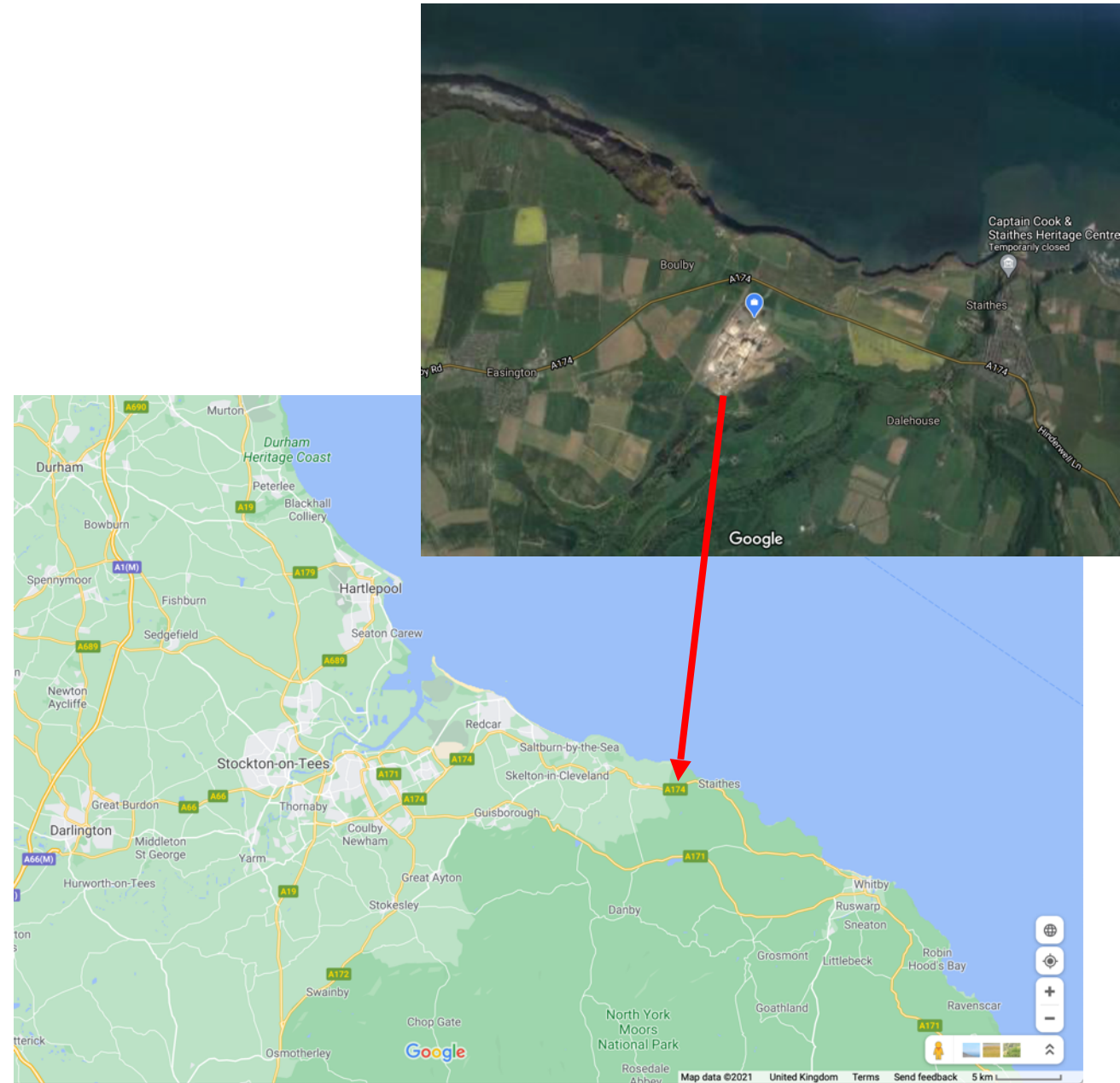
Boulby Mine

- Boulby Mine is located in the north-east of England
- About 25 minutes north-west of Whitby



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Boulby Underground Laboratory

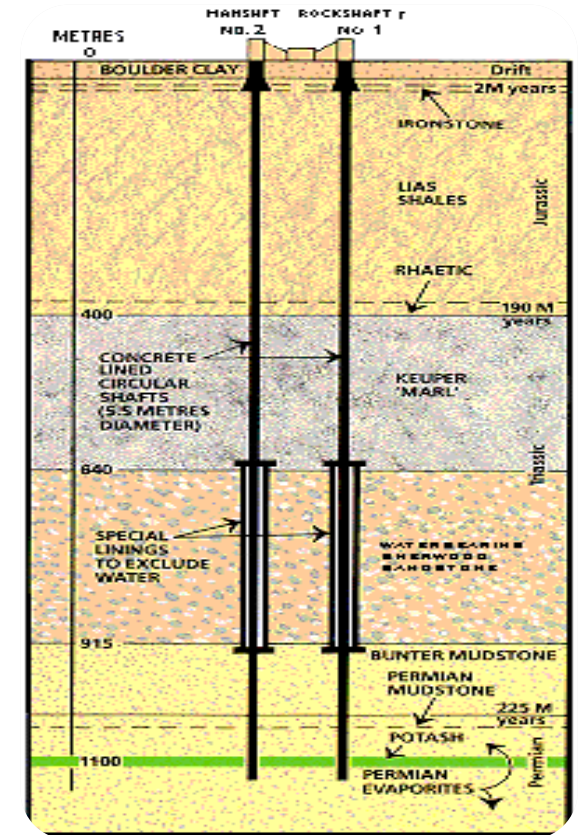
Credit: Qualter Hall



Credit: Google Maps

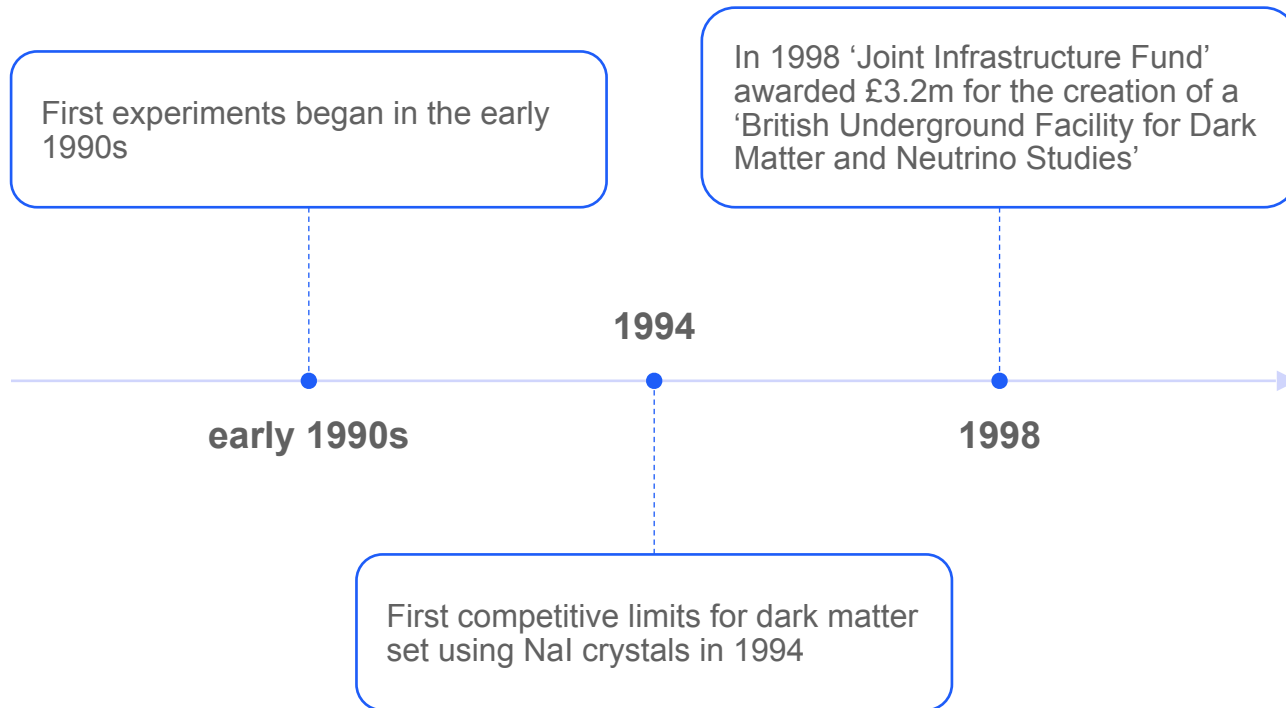
Boulby Mine

- Commercial Polyhalite and Salt mine
- Shafts sunk in 1968 with full production from 1976
- Main tunnels mined through salt – remains of Zechstein sea
 - Potash (previously mined) sits above
 - Polyhalite sits below



The Boulby Underground Laboratory

First Physics



The current facility



The current facility

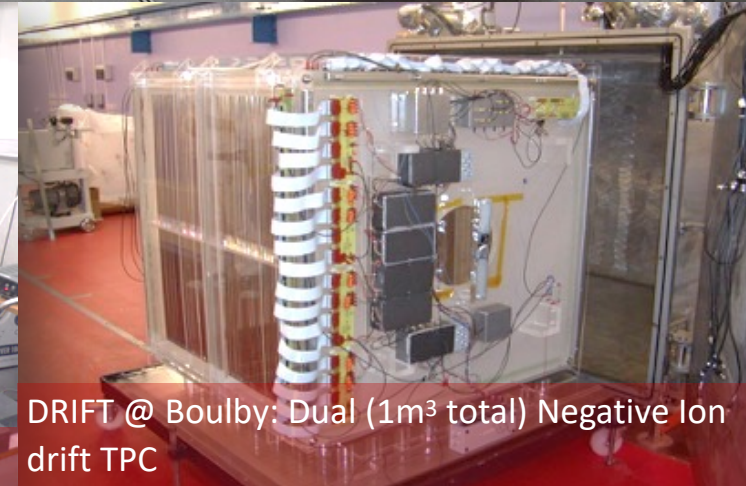
- Boulby has hosted studies in the Dark Matter search for over two decades including NAIAD, DRIFT & ZEPLIN experiments
- Boulby currently hosts CYGNUS directional DM programme, NEWS-G/ Dark-Sphere R&D experiments
- The BUGS lab provides ultra low background material screening for worldwide experiments e.g. LUX-ZEPLIN



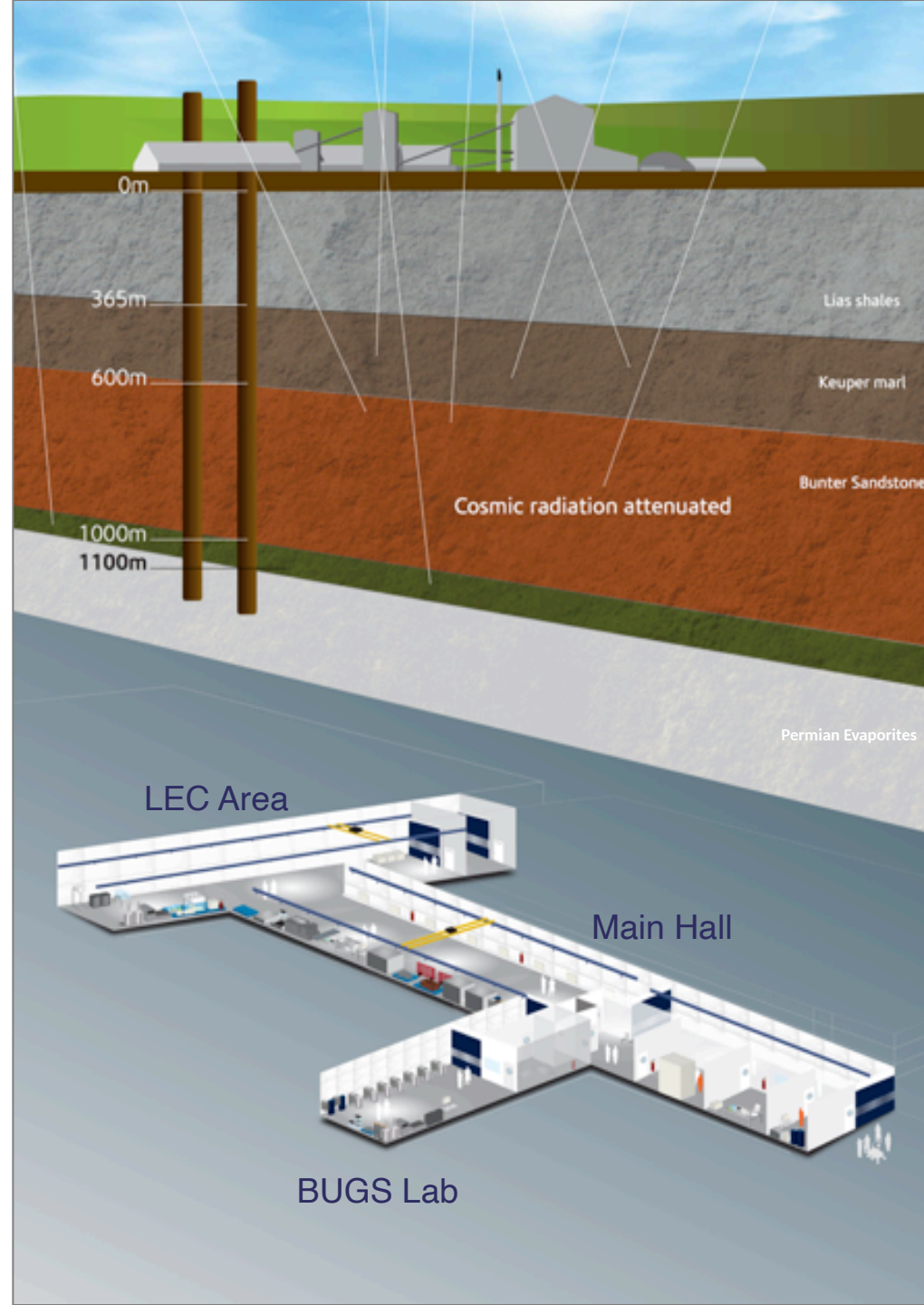
Boulby Underground
Laboratory



NEWS-G: Spherical TPC R&D



DRIFT @ Boulby: Dual (1m³ total) Negative Ion drift TPC



Looking to the future

Continued Expansion

- STFC committed to the future expansion of the Boulby Underground Laboratory
- Singled out in STFC delivery plan as a key strategic long-term ambition



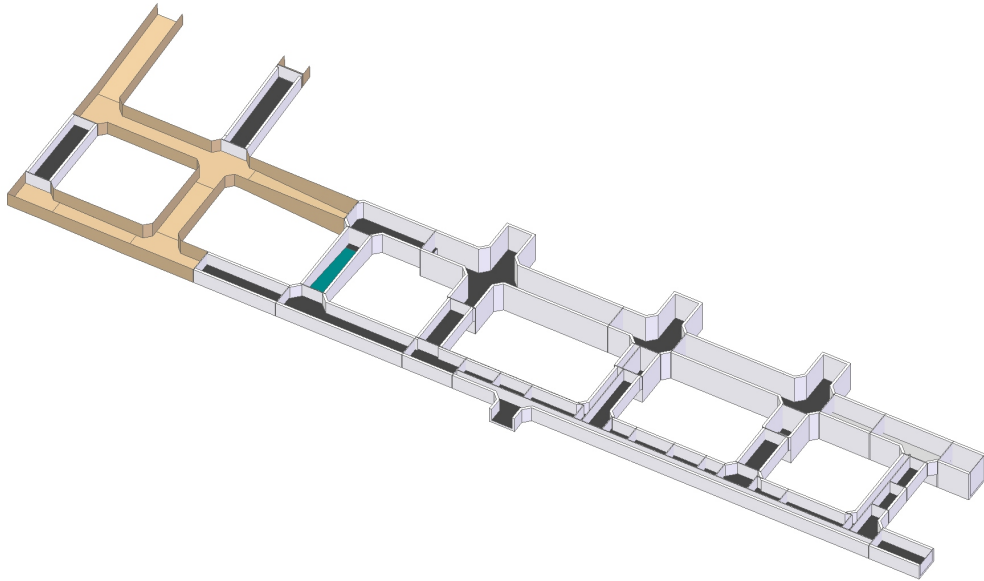
- Complete the design study for a greatly expanded underground science facility in the North East, with the potential to host a major international science infrastructure, such as a next generation dark matter experiment (with £2.8 million from the Infrastructure Fund).

Continued expansion

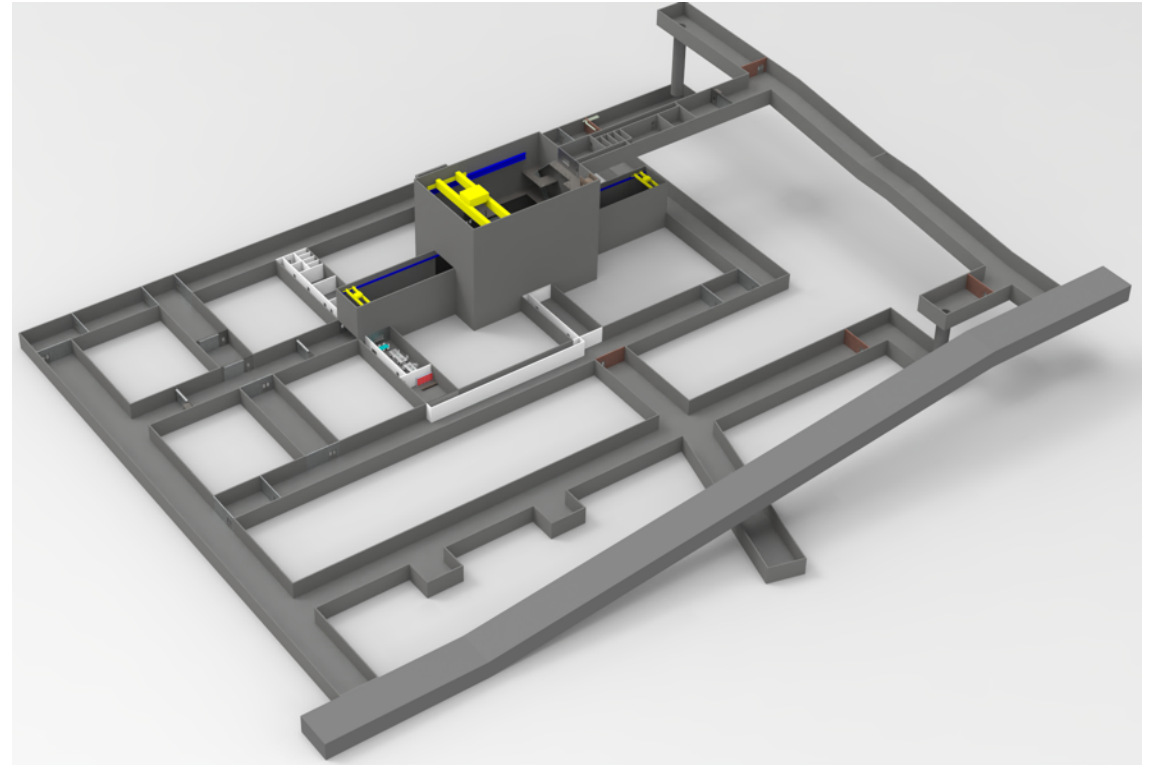
- Staged approach
- Stage 1 will be in current salt strata
 - Excavation beginning early
 - Designed for construction of experiment for stage 2 and for long term multi-disciplinary laboratory
- Stage 2 will be deeper in polyhalite
 - Excavation beginning later
 - Large experimental excavation targeting next gen low-background particle physics

Conceptual Design

Stage 1



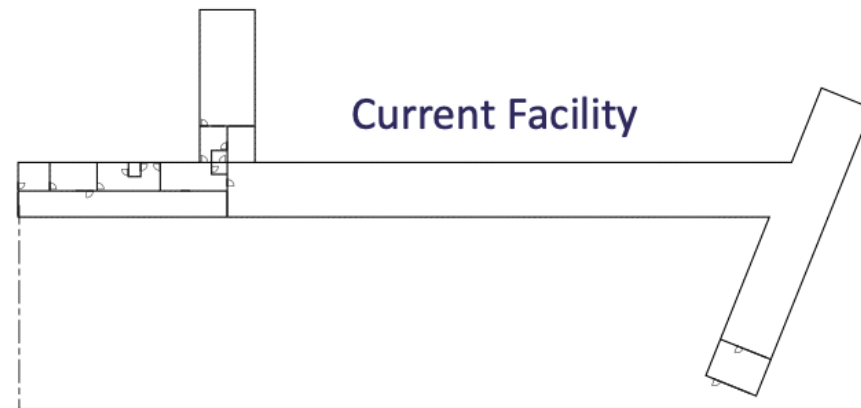
Stage 2



Final design of both will differ

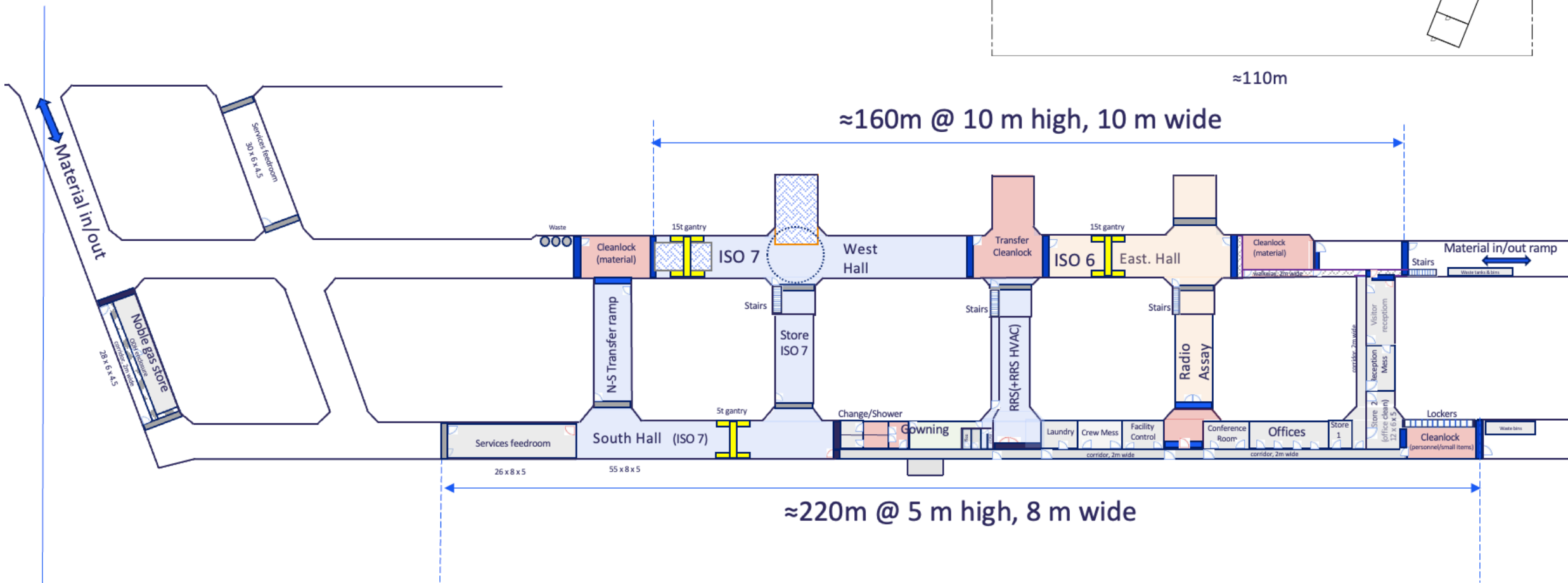
Stage 1 detail

Subject to change!



≈110m

≈160m @ 10 m high, 10 m wide



≈220m @ 5 m high, 8 m wide

0

100

200

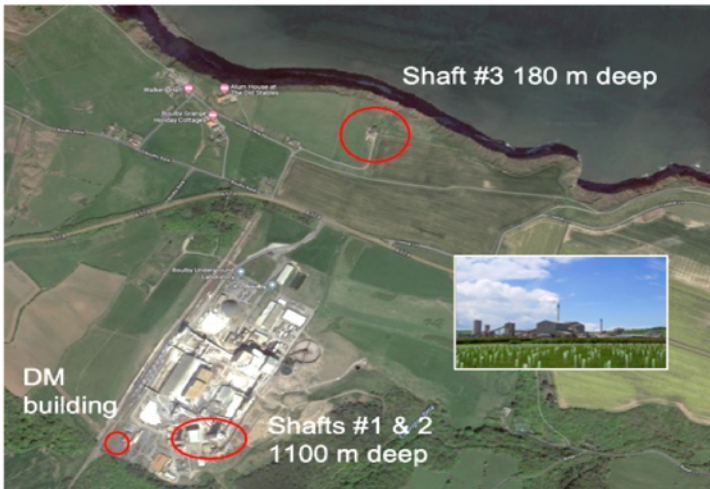
300

Laboratory

Shaft 3

Tailings (no. 3) shaft specs:

- 180m vertical shaft
- ~50m from coastal cliffs.
- 5m diameter shaft with 3T capacity crane.
- Personnel Cage (used few times/day), water & ventilation pipes, access stairs/ladders



Future Quantum Work

- Several measurements to support future quantum studies are underway:
- Electric field measurements
 - Some initial studies performed with BGS & RAL, more to come
- Seismic measurements
 - Studies to be performed in underground area, shaft 3 and on the surface
 - Will give a full picture of the seismic profile at Boulby
 - Using a number of sensors from Guralp

Conclusion

- There has been a rich history of scientific research at the Boulby Underground Laboratory
- This continues across many disciplines
- STFC committed to the future development of Boulby
- The future is bright – please join us!
 - Unless you have already in which case, keep it up!



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Thank you

boulby.stfc.ac.uk

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