

# BigRAID

A large version of the BAS RAID – Plans for drilling RNO-G and SLCECs

*Julius Rix (BAS), Chris Kerr(BAS), Keith Makinson(BAS), Robert Mulvaney(BAS), Andy Smith(BAS), Ian McNulty (Extreme Instrumentation), Albrecht Karle (University of Wisconsin - Madison), Abigail Vieregg (University of Chicago),*



# BAS RAID drilled to 461m in 104 hours



Video 2x speed



British  
Antarctic Survey  
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE  
FOR PLANET EARTH

# BAS RAID

BigRAID is a large diameter version of the British Antarctic Survey (BAS) Rapid Access Isotope Drill (RAID)

- 3" barrel diameter
- 400W motor
- Drill goes up and down hole removing small lengths (~1.5m) of ice at a time, similarly to an ice core drill.
- Chippings rather than core take so a small lightweight winch can be designed for speed rather than core breaking.
- Chippings quickly discharged at the surface by reversing the drill motor.
- Semi-autonomous drilling
  - Automatic drill and winch controls allow driller to be freed up to help sampling the ice chippings.
  - Could be made more autonomous if chippings were not needed to be collected.
- Successfully drilled to 461m at Little Dome C.



British  
Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE  
FOR PLANET EARTH

# BAS RAID

- Most recently drilled to 350m at Sherman Island.
- Rate of penetration  $>0.6\text{m/min}$
- Large chippings



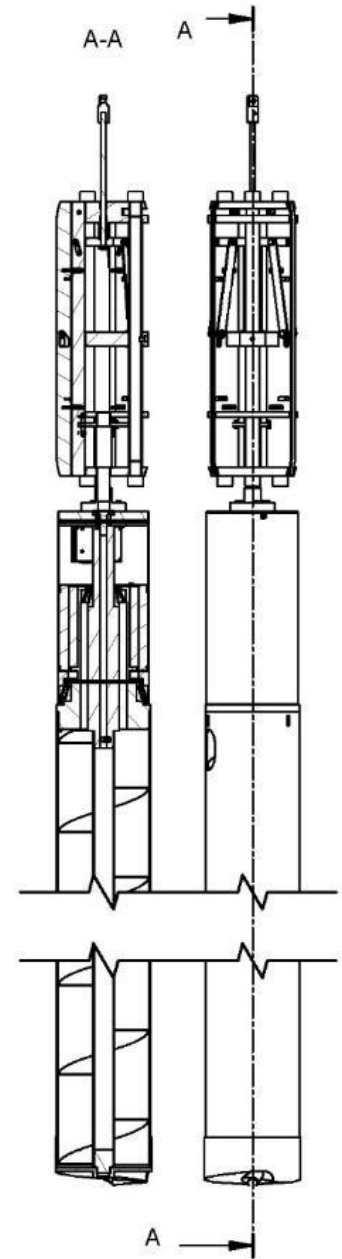
British  
Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE  
FOR PLANET EARTH

# BigRAID

- Large diameter version of BAS RAID
- Prototype being built for joint UK Chile project Subglacial Lake CECs (SLCECs) project originally for testing this Antarctic Season
  - New Direct drive frameless motor.
    - 10.2" OD, Operating power 2.2kW (capable of 3.3kW)
    - No gearbox and fully integrated design.
  - Motor size means borehole is ~285mm (11.2") OD.
  - Extra diameter of drill may help with borehole closure.
  - Auger transportation experiments suggest we should be able to drill ~1.5m per drop.



British  
Antarctic Survey

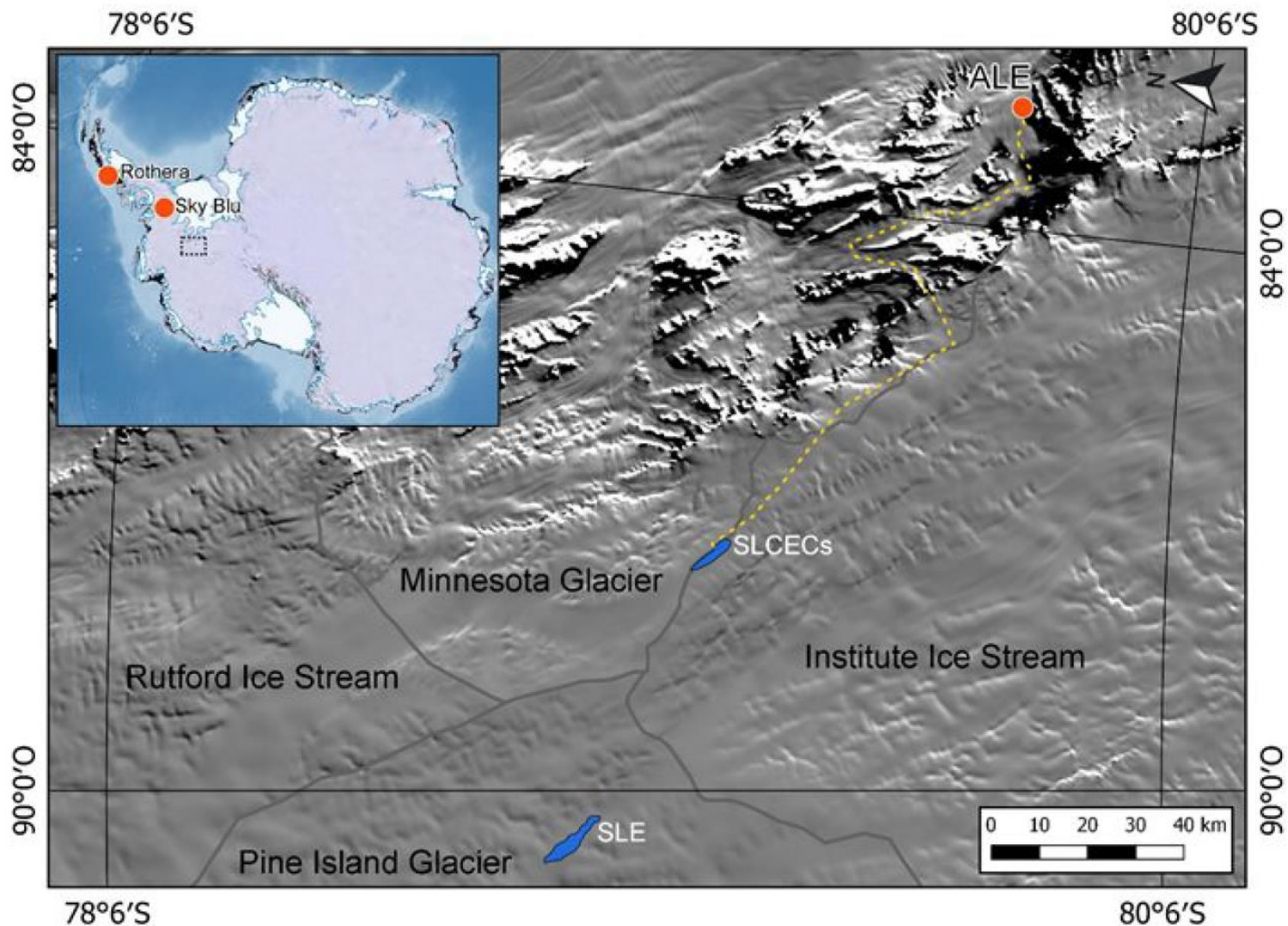
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE  
FOR PLANET EARTH

# BigRAID SLCECs plan

- Subglacial lake CECs

CECs  
CENTRO  
DE ESTUDIOS  
CIENTÍFICOS



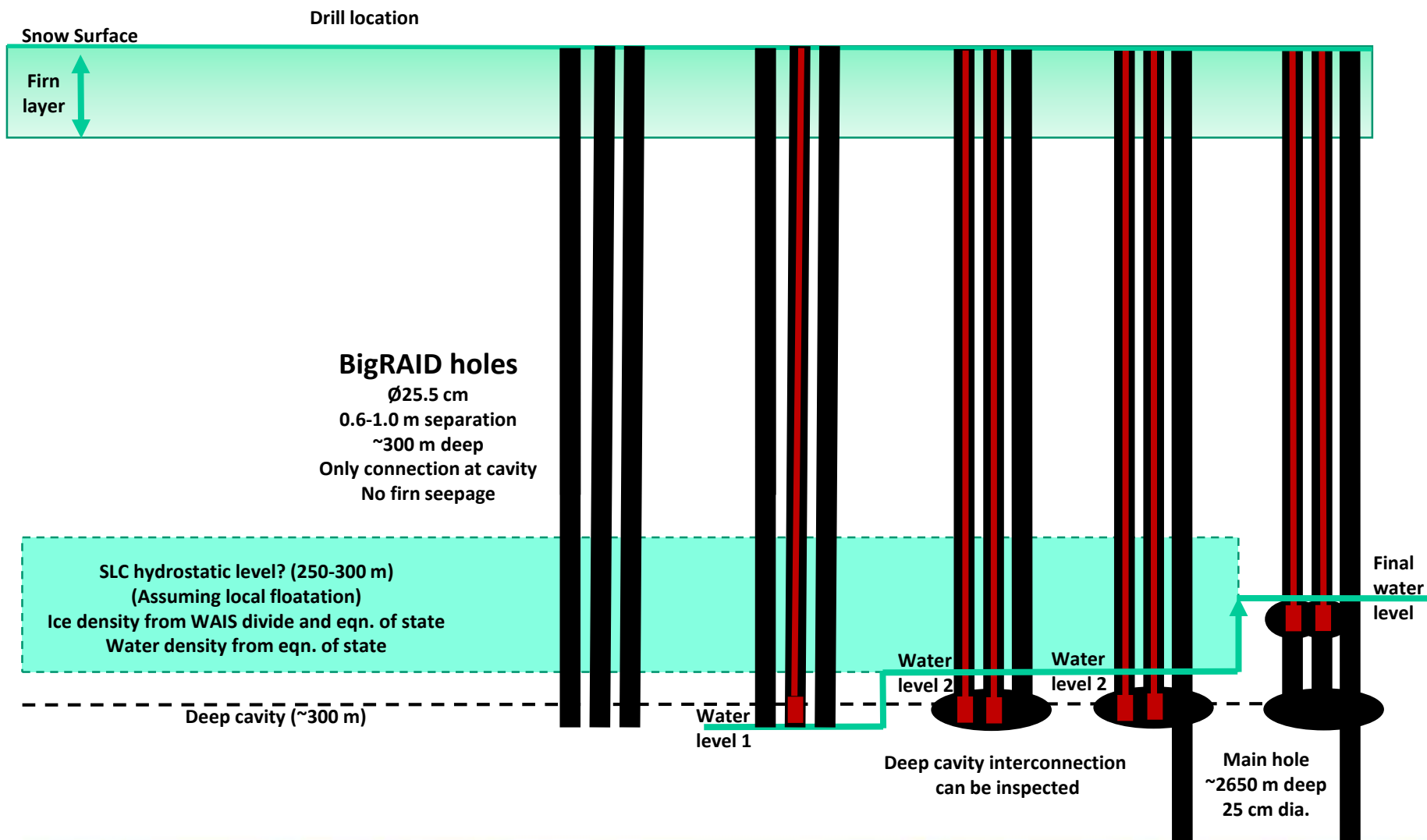
British  
Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE  
FOR PLANET EARTH

# BigRAID SLCECs plan

- SLCECs – Pilot holes



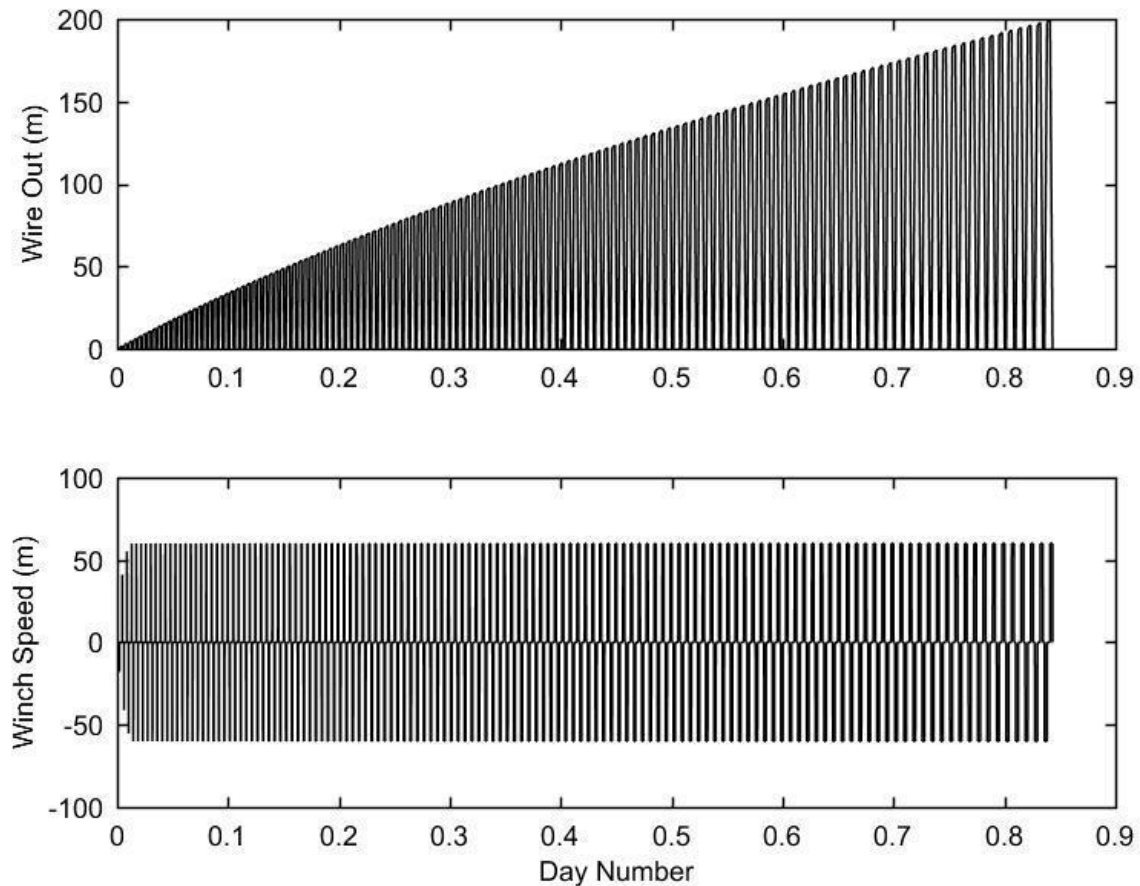
British  
Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE  
FOR PLANET EARTH

# BigRAID drilling to 200m

- Assuming 1.5 m per drop, Rate of penetration 0.4 m/min, 2 minute surface time.  $\sim 0.85$  days to reach 200 m or  $\sim 0.38$  days to reach 100 m.



British  
Antarctic Survey

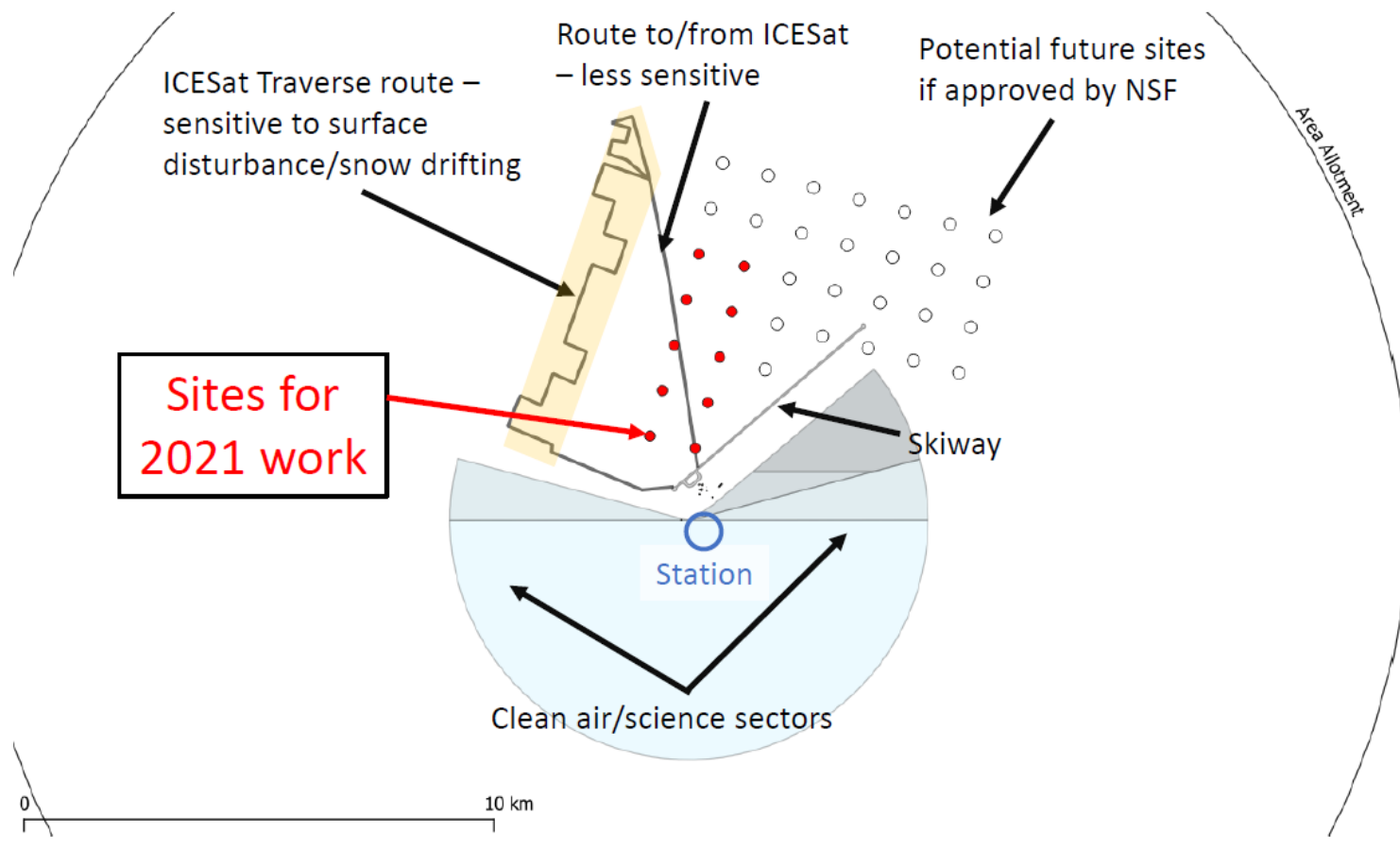
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE  
FOR PLANET EARTH



# BigRAID RNO-G plan

## SITE LAYOUT FOR 2021 WORK



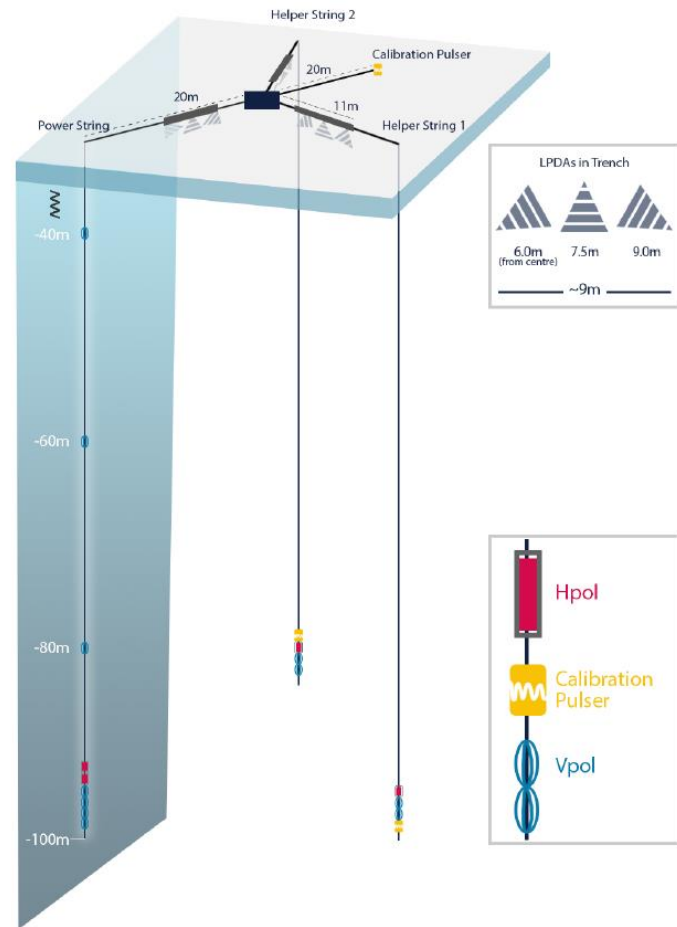
British  
Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE  
FOR PLANET EARTH

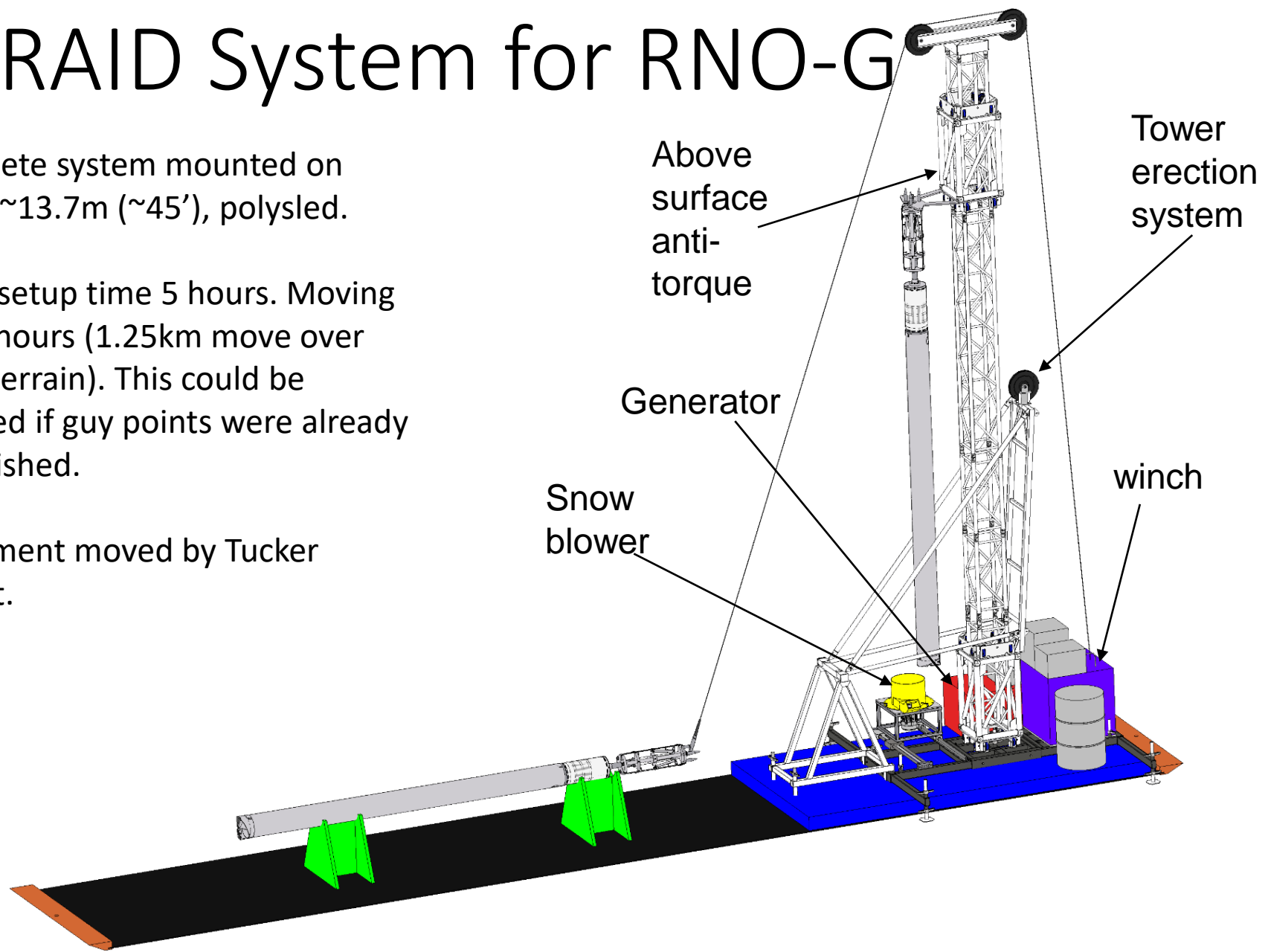
# BigRAID RNO-G plan

- 10 Stations
  - three 100m deep boreholes
- Total of 30 boreholes to drill for the array
  - 2-3 to 200m depth
- Arrival 22<sup>nd</sup> May until 15<sup>th</sup> July
- 54 days on station for drilling however:
  - New system - optimisation
  - North Wind days
- Design to automate and speed up the complete process as much as possible.
- Carry out as much testing as possible.



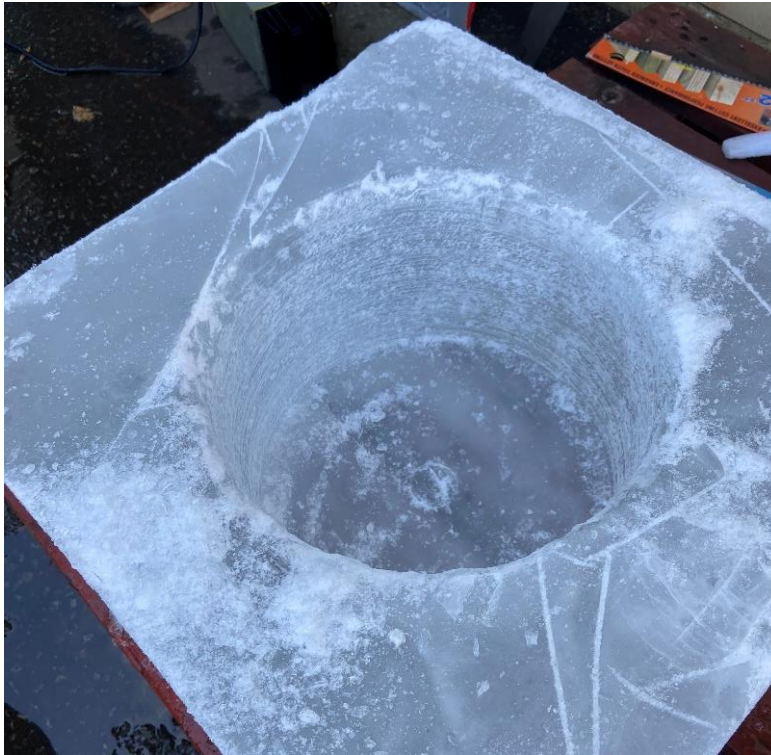
# BigRAID System for RNO-G

- Complete system mounted on single ~13.7m (~45'), polysled.
- Initial setup time 5 hours. Moving site 2 hours (1.25km move over good terrain). This could be reduced if guy points were already established.
- Equipment moved by Tucker Snocat.



# BigRAID testing

- UK Testing
  - Short barrel test Nov 2020 (BAS freezer)
  - Penetration rate of 0.4m/min achieved



British  
Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE  
FOR PLANET EARTH

# BigRAID testing

- UK Testing
  - Tower erection (Dec 2020). Video 2x speed



# BigRAID testing

- UK Testing
  - Full size test next week (Commercial Freezer) .
    - Drill through 2m of ice
    - Check chip transportation and discharge
    - Check anti-torque
- Integration and procurement of full system.
  - Winch
  - Modifications
  - Polysled
  - Above surface anti-torque.
  - Snow Blower – Chipping removal
  - Automation

Video 2x speed  
8x during winching



British  
Antarctic Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE  
FOR PLANET EARTH

*Thanks*

