

# Bervie Braes Slope Stabilisation, Stonehaven, Aberdeenshire

## Project Profile

**Client:** Aberdeenshire Council

**Designers:** Jacobs

**Value:** £2.4m



Bervie Braes is a coastal slope lying immediately to the west of Stonehaven Harbour. The Braes form part of the Stonehaven Conservation Area and extend for approximately 850m and reach a maximum height difference of 55m. Sections of the slope were unstable and had been moving and failure scars were visible along the slopes. The slope profile was made up of a series of hollows, mounds and bulges which represented washouts from old springs, failed material and areas of creep. Overlapping of old apparently inactive and active areas of slope instability provided the slope with a hummocky appearance. Bervie Braes Road - the Dunnottar Mains to Stonehaven coast road—runs across the slope but was closed to traffic due to subsidence in the carriageway and following stabilisation works it was intended that the road was reopened with reduced width as a pedestrian/cycling track.

The Stabilisation Work comprised installation of landslip prevention measures on a 500m long, up to 33m high, section of the slope between the closed Bervie Braes Road and the 60 residential properties at the toe of the slope.

Ground investigations had shown that loose sands overlie glacial sands/gravels and/or glacial till in the slope area to be stabilised. The groundwater regime within the Braes comprised a shallow perched groundwater within the Raised Beach deposits which was variable in level with circular hollows on the upper and lower slopes being evidence of previous springs which have in time collapsed. A seepage line existed within the middle of the lower slope at the point at which the Raised Beach deposits outcrop on the face.

Stabilisation work included the following;

- Installation of 1,425 soil nails and reinforced concrete surface nail head pads on a 2.5m grid
- Dividag 32mm hollow bar grouted soil nails were used, drilled-in with a grout flush
- The soil nails were up to 24m long to ensure anchoring in competent strata
- 35 test nails were installed and tested in order to verify the design
- Construction of a new slope drainage system comprising 2 rows of 10m long drilled raking drains at the base of the slope, outfall channels and a concrete contour drainage channel
- Replacement of existing blocked/damaged slope drainage filter/carrier drains
- Construction of new filter drains, channel drains, associated catch-pits and kerbing on Bervie Braes Road
- Installation of new or upgraded road drainage system and associated inlet / outfalls
- Reinstatement of the failed road surface over a 50m section
- Placement of 5,225m<sup>2</sup> mesh and erosion control matting
- Re-vegetation and landscaping of the slope on completion.



# Bervie Braes Slope Stabilisation, Stonehaven, Aberdeenshire (Cont'd)

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The length and steepness of the slope, the restricted access to the base of the slope together with the large number and length of soil nails meant that conventional soil nailing equipment including excavator mounted feed beams or rope access equipment was not suitable for this location and we established an innovative system of tracked, air powered rotary percussive drilling rigs secured and hauled by winches which were set up on the closed Bervie Braes road.

Each rig operated with its own winch which was permanently secured to the rig. The 10 tonne winches sat on frames and were supplied with kentledge loading thus enabling them to be quickly moved by telehandler to subsequent rows of holes. Grout mixing and pumping plant was also set up on the carriageway above the work.

Following installation and proof testing of soil nails, installation of the specially designed in-situ reinforced concrete soil nail head pads was carried out. These were recessed into the slope to ensure the soil nails were not exposed on completion of the slope netting and reinstatement work. Concrete for the nail head pads was pumped to each position using a 30m boom concrete pump requiring up to 50 heads to be prepared in advance for each pump visit.

Along the full length of the base of the slope, 2 rows of drilled drain holes with perforated pipes were installed at a 10° angle to intercept the groundwater table. These drains discharge into a pre-cast concrete collector channel that was installed along the edge of the footpaths which extend along the full length of the slope base and which were connected at 2 positions to newly constructed surface water sewers which outfall in the river and harbour.

