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| <b>CLIENT:</b>     | North Yorkshire<br>County Council |
| <b>DURATION:</b>   | 10 Day                            |
| <b>SHIFT TYPE:</b> | Days                              |
| <b>YEAR:</b>       | 2016                              |
| <b>LOCATION:</b>   | North Yorkshire, UK               |
| <b>AREA:</b>       | 1200m <sup>3</sup>                |
| <b>SOLUTION:</b>   | Bacel Hardfoam                    |

### PROJECT GOAL:

North Yorkshire County Council had an abandoned shaft which had been used as a landfill site had opened up and was progressively collapsing into the hole presenting a danger to walkers and animals.

Jacobs Engineers were appointed to find a solution for filling or closing up the collapsed vertical air shaft 20 metres deep x 8 metres diameter at this old landfill site at Great Ayton.

Access was the main problem facing a filling solution. The shaft was 3 km from the nearest road and at the top of a large hill over soft compressible soil topped landfill material mostly surrounded by fully cultivated fields with no access road capable of taking tipper trucks.

Foaming and pumping equipment was able to be demounted from the truck and still be used at the remote location without need for external power or water. The pumping equipment and materials were transported to the remote location by rough terrain multifunction telehandler.

The pumping equipment requires compressed air as the only means of power and so the compressor was taken up the hill also and located a short hose length from the shaft.

Works were completed in 3 phases.

### PROJECT DESCRIPTION:

**Phase 1** Filling the lower portion of the shaft (-20m up to -12m) EPS (lightweight polystyrene) blocks were dropped into the base of the shaft to sit on the water present at the bottom. Then a 63mm filling pipe was lowered 20 metres down into the shaft and the foam was pumped directly on top of the EPS. The foam was allowed to spread and fill all voids within the surrounding landfill materials bonding

them together in 1.5 meter high lifts which allowed 3 metres vertical fill per day.

This filling continued over 4 days by which time 290m<sup>3</sup> had brought the top of the BACEL foam level with a rock layer which would be the foundation for a concrete cap, Steel wire mesh fencing panels were placed across the foam between lifts and also wrapped in geotextile at the entrances to 2 horizontal shafts running left and right into the rock layers. This was to block off the horizontal shafts to minimize the m<sup>3</sup> of foam pumped whilst bring up the top of the foam level with the rock head.

**Phase 2** Placing a concrete cap at rock head level at -12m After one week of cure time, it was possible for rescue men to be lowered into the shaft and stand on the BACEL foam, but there was still high danger of further sidewall collapses so this was avoided as a work method. Therefore the concrete cap at rock head level was placed by using a local concrete pumping company to pump up the steep side of the hill that had the close truck access. This way a 400 mm thick lightweight slab was pumped from the mouth of the shaft top directly down onto and over some geotextile which had been spread out over the top of the BACEL foam.

**Phase 3** Filling from -11.5m to - Grd level. Again the BACEL foam was pumped from above down into the shaft via 63mm filling hoses to avoid man access down the shaft. This time the BACEL was pumped onto the concrete slab in daily lifts of up to 2-3 metres until the required height was achieved. Then a 500mm layer of heavy density BACEL was foamed as a cap, and this was covered with geotextile. After a 3 week cure time, 500mm of local soil (scraped from the surrounding area) will be placed onto the geotextile to finish the filling process. This phase had a total of 750m<sup>3</sup> of foam pumped in 6 days.