

Mining Ground Investigations

What is the situation?

The UK has a wide range of mineral deposits which have been, and in some cases continue to be, exploited by a variety of mining methods determined either by the type and configuration of the mineral deposit or the technology available at the time of mining. The legacy of this mining activity is that there are numerous caverns, voids, broken ground, tunnels, shafts and adits in the vicinity of the railway. Underground workings, particularly where shallow, may collapse and cause surface settlement, and if this occurs in close proximity to the railway corridor it can have a significant impact on both the safety and performance of the railway.

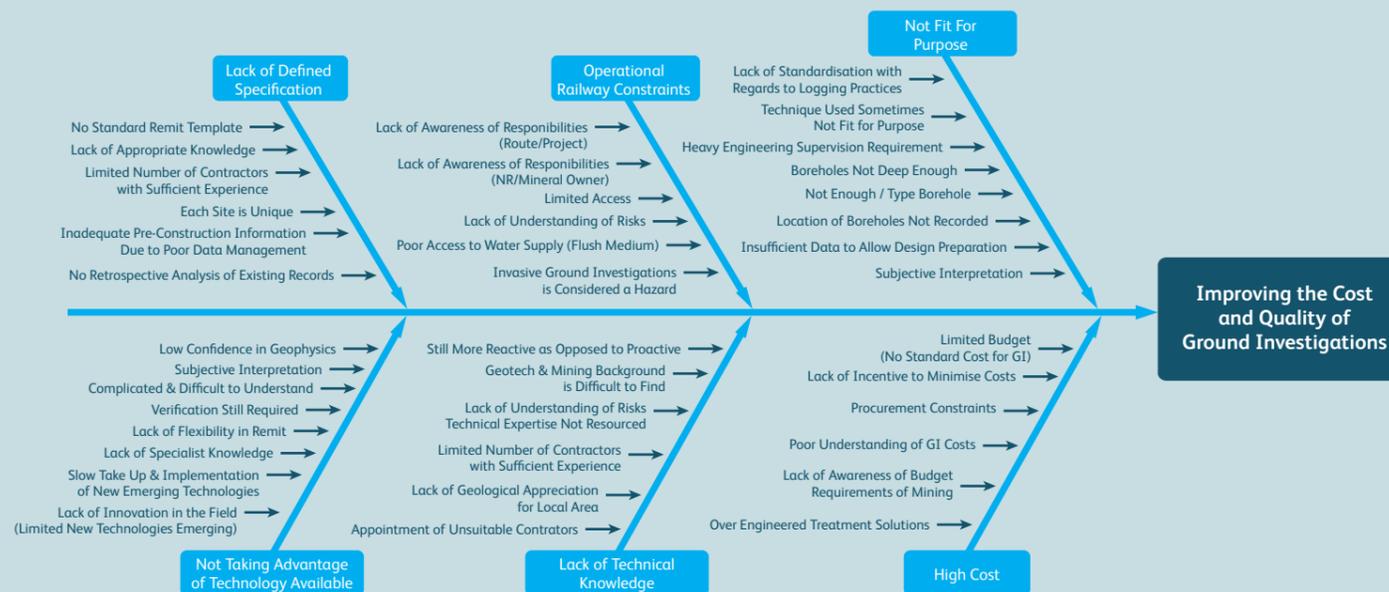
Existing Network Rail records indicate that there are in excess of 5000 known shallow mining hazards near the railway, which includes both mine workings and mine entries. Network Rail are in the process of risk ranking all of the known shallow mining hazards in order to prioritise pro-active investigation and treatment. There is an obligation to provide adequate permanent and sustainable mitigation for at least the 20% of the high risk sites by the end of CP6 and provide suitable interim risk mitigation to all other high risk sites during CP6.

Each of the high risk sites will require a desk study, which in many cases will recommend that ground investigation be carried out. The three primary objectives of the ground investigations are (1) to establish the nature, condition and extent of the mining hazard (2) establish the condition of the surrounding strata and any effects on existing railway infrastructure (3) to provide adequate data for the design of any mitigation measures that may be required.

Undertaking conventional mining ground investigations in the vicinity of an operational railway can be very challenging, this is primarily due to access restrictions and limited possession times. This often results in higher than expected costs and concessions being made with respect to the techniques selected and the quality of data obtained.

In order to meet our obligations within the available budget and timescale, significant improvements need to be made to our ground investigation practices. To meet this challenge we must develop innovative ground investigation strategy that draws on both new and existing technologies.

Analysis of causes



Priority problems

Specific priority problems

- Mining ground investigation on the railway is expensive.
- Often not fit for purpose, inappropriate techniques used.
- Failure to embrace new technologies and lack of innovation in the field.

Related goal

- There is an obligation for all routes to provide adequate permanent and sustainable mitigation for at least the 20% of the High Risk sites in their route area by the end of CP6.

Benefit

- Network Rail will be able to meet its obligations within budget and timescale.
- Improvements in the quality of ground investigation data feeding into the design of mitigation measures.

Specific research needs

In order to address the challenge, it is anticipated that a study will be completed and a report prepared that includes but is not limited to:

- An overview of the types of hazards associated with historic shallow mining that require investigation.
- Overview of key legislation, guidance documents and Network Rail standards and specifications applicable to mining ground investigations in the vicinity of the railway.
- Overview of health and safety legislation and best practice relating to ground investigations.
- Identification of the data outcomes required from ground investigation to inform the design of mitigation solutions.
- A review of current ground investigation practices employed by Network Rail to evaluate mining hazards ideally based on recent case studies relating to both coal and metalliferous mining.
- Identification of ground investigation solutions for shallow mining and mine entry hazards drawing on both new and existing technologies. In developing these solutions consideration must be given to the constraints associated with carrying out a ground investigation in a railway environment. Ideally the ground investigation solutions identified should fall within the following categories:
 1. Direct methods of ground investigation (Example research areas might include: rotary open hole techniques, cored boreholes, sonic drilling).
 2. Geophysical methods (Example research areas might include: Micro gravity, electromagnetic, magnetic, resistivity, ground penetrating radar, seismic, borehole geophysics etc).
 3. Other means of investigation (Example research areas might include: Underground surveys, subsurface laser scanning, aerial and satellite data).
- A set of recommendations for a ground investigation strategy.
- A cost/benefit exercise comparing existing practices with the recommended.