

CASE STUDY

Bio-remediation of a former army base, Hereford



Project description

In 2001, George Wimpey Strategic Land commissioned RSK to investigate a 20ha former military site in Hereford. To provide an early indication of areas of concern across the whole site, RSK conducted a preliminary ground investigation and qualitative risk assessment. Additional services performed by RSK during this initial phase of the redevelopment included the preparation of specification and contract documents for the demolition of approximately 50 military buildings on the site. A subsequent series of detailed ground investigations was then targeted on the identified areas of concern to inform quantitative risk assessments.

The risk assessments showed that remediation was required in a hydrocarbon-impacted area, located within the critical initial phase of the housing redevelopment. Contaminated soils were excavated from this area and replaced with clean crushed material arising from demolition works compacted in layers, allowing the housing development to commence without delay. The contaminated soils were moved to a large area of hardstanding located within a later phase of the development, the demolition of which was postponed to allow its use for this purpose. The treatment of the contaminated soils by bioremediation continued as building was progressing in the infilled area, without any impact on the construction programme. Treated soils were subsequently reused to raise levels within a public open space area, as drainage considerations required a general increase in levels across the site.

Preliminary investigation

A desk study indicated that the site had been originally developed as a military camp in the 1930s, comprising wooden huts and a motor transport workshop. The site was redeveloped in the 1960s and 1970s with barracks, administrative and training buildings, motor transport garages, workshops, boat storage, helicopter hangars, an indoor close-quarters battle range and a magazine.

Ground conditions comprised made ground, generally overlying terrace gravels, over highly weathered Raglan Mudstone, generally recovered as a stiff slightly friable reddish brown mottled grey clay of low plasticity. Groundwater was for the most part encountered close to the base of the terrace gravels.



The preliminary trial pit investigation, prior to disconnection of services and demolition of the structures, identified several potential contamination issues requiring more detailed investigation and risk assessment, including:

- Slight hydrocarbon odours detected in trial pits in a grassed area adjacent to the sergeants' mess, which the 1944 plans showed overlying an area where two petrol pumps had formerly been located.
- Strong hydrocarbon odours detected in trial pits in the motor transport area, where three underground fuel storage tanks and a workshop were located.
- An anomalous high arsenic concentration in a sample of made ground from one trial pit.
- The site asbestos register was incomplete, showing very few asbestos-containing materials on site, although asbestos had been observed in numerous locations in the buildings.

Detailed investigations of areas of concern

Subsequent detailed investigations by RSK comprised the installation of groundwater wells to establish the groundwater regime underlying the site; numerous probe holes to 5m depth to delineate contaminated areas; and trial pits both for the additional assessment of arsenic contamination in shallow made ground and to provide additional information to assist in foundation design. An asbestos survey was also completed and incorporated into the demolition specification to ensure that all asbestos materials were removed safely before demolition commenced. The detailed quantitative risk assessment indicated that no action was required in the sergeants' mess area, and this was agreed with the regulators. Similarly, the arsenic concentrations were shown not to be a concern.

However, the presence of a plume of diesel-impacted gravels and mudstone, with total petroleum hydrocarbon concentrations up to 5,000mg/kg and a local plume of free engine oil at the base of the gravels necessitated remediation of the motor transport area. A total volume of 3500m³ of hydrocarbon-contaminated gravels and mudstones was excavated and removed to stockpile on an area of hardstanding.

Remediation

RSK undertook bench-scale pilot trials on bulk samples of contaminated materials to demonstrate that the soils could be treated successfully using ex situ bioremediation. A fixed price lump sum contract was entered into to treat the stockpile of contaminated soils. The soil stockpiles were processed using a grading bucket to remove oversized material and then formed into windrows. A specialised windrow turner machine was used to aerate the material. Treatment continued over a six-month period, with periodic sampling to assess remediation progress.

The final samples for validation analysis were collected when ongoing monitoring by RSK indicated that the bioremediation treatment had reached an asymptotic state. Twenty-seven samples were taken, each consisting of one composite sample (comprising ten sub-samples) per windrow, as proposed in the site-specific working plan. The samples were submitted to a UKAS and mCERTs accredited laboratory for analysis. Initial TPH analyses indicated that the concentrations in all samples were below the initial screening value of 1000ppm. In total, 27 results ranged from <10mg/kg to 920mg/kg, with a mean value of 293mg/kg. The results of the subsequent speciated TPH analyses were compared to site-specific target levels (SSTL) derived for each critical parameter. The concentrations of all parameters for which critical SSTLs were set were below the method detection limit of 0.05ppm. It was concluded that since the concentrations in all samples were below the SSTLs, all the windrows had been successfully remediated.

Conclusions

Based upon the project outcome, the following conclusions can be drawn:

- The phased investigation allowed rapid assessment of potential areas of concern.
- The ex situ remediation strategy allowed the housing development to commence without delay in the area that had been impacted, whilst remediation continued in another part of the site.
- RSK's remedial strategy is applicable to other sites with similar contamination issues.



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