

PART 11 : GEOLOGY AND CONTAMINATION

11.1 Methodology

- 11.1.1 This section assesses the potential effects on the geology within the study area resulting from the implementation of the proposals. The nature and alignment of the underlying soils has a major influence on the environmental nature of the area of the scheme and hence determines many of the environmental impacts of the scheme. The report also includes assessment of contaminated land issues.
- 11.1.2 This assessment has been carried out in accordance with the guidance of the Highways Agency given in DMRB Volume 11, Section 3, Part 11, June 1993/August 1994. An assessment of impacts on agricultural soil quality, required under Part 11 of DMRB Volume 11, Section 3, has been undertaken separately and is summarised in Part 12 of this ES.
- 11.1.3 This assessment has used information obtained from literature studies and ground investigations carried out between 1973 and 2007.
- 11.1.4 Environmental impact is assessed in accordance with DMRB IAN 81/06 as described in Section 1 Part 3 of this ES (paragraphs 3.1.22 – 3.1.31).

11.2 Key Guidance and Legislation

- 11.2.1 Development in relation to geology, including the extraction of minerals is covered through Waste and Minerals Local Plans required under the Planning and Compensation Act 1991. The role of these plans is to help local authorities plan for future waste development and the supply of minerals by setting out land-use policies and decision making criteria relevant to these issues. They are drawn up by County Councils.
- 11.2.2 Protection of existing geological features is covered through national designation i.e. Sites of Special Scientific Interest (SSSI) and on a regional basis via Regionally Important Geological Sites (RIGS). These designations are taken into account in scheme approval by local or national planning authorities.
- 11.2.3 Legislation with regard to contaminated land is aimed at the identification and control of risks created by substances in the ground, in particular to human health and controlled waters. Control is implemented by Regulations under the Environmental Protection Act (EPA) 1990 and under the planning regime.
- 11.2.4 Waste legislation relating to the proposals is set out in a series of regulations made under the EPA 1990. The Waste Management Licensing Regulations 1996 require that waste materials are disposed of only at appropriately licensed sites, unless specified exemptions apply and are approved by the Environment Agency.

Regulatory requirements extend to all those who produce, keep, treat or dispose of wastes.

11.2.5 Contaminated land legislation is also covered by the EPA together with the Environment Act 1995. Contaminated land is defined for the purposes of the Acts as land where due to the presence of substances it appears to the Local Authority that Significant Harm (or a significant possibility of such harm) is being caused or pollution of controlled waters is being or is likely to be caused.

11.3 Consultations

11.3.1 Information on geological features of the study area has been obtained from the following sources:-

- EA information on landfill sites, designated contaminated land and pollution incidents.
- The Coal Authority on the presence of underground coal mineworkings.
- British Gypsum on the presence of underground gypsum workings.
- The British Geological Survey with regards to the presence of recorded gypsum adits.

11.3.2 The Coal Authority report that that nearest underground coal workings associated with Clifton Colliery are at a significant depth and will not affect the route.

11.3.3 British Gypsum indicate that there are some shallow recorded gypsum workings that may affect the route and an adit (an adit is a type of entrance to an underground mine which is horizontal or nearly horizontal. Adits are usually built into the side of a hill or mountain, and often occur when a measure of coal or an ore body is located inside the mountain but above the adjacent valley floor or coastal plain) was recorded by the British Geological survey adjacent to the route associated with these workings. This adit is noted on the aerial photographs. Although the BGS note the presence of the adit on their plans, no further information was available regarding this feature after consultation with their records department.

11.3.4 There are no SSSIs or RIGSs relating to geological features in the vicinity of the scheme.

11.3.5 No consultations with the regulatory authorities have been undertaken with regard to contaminated land, though pertinent information has been obtained from databases maintained by the Environment Agency and the Local Authority with regard to designated contaminated land sites; licensed and other waste disposal sites and historical pollution incidents.

11.4 The Study Area

- 11.4.1 The study area is as described in the ES Section 1 Part 1, and as illustrated in the ES Volume 2 Figure 2.11.1 Geological Plans.
- 11.4.2 Potential sources of contamination within the corridor of influence include the power station, a petrol filling station in Clifton, possible imported materials associated with urban development in Clifton and a number of small waste disposal sites (see ES Volume 2 Figure 1.2.2 Environmental Constraints).
- 11.4.3 Potential 'receptors' which may be harmed by contamination include residential occupiers adjacent to the route, contractors undertaking works, surface water courses (including the River Soar and Fairham Brook), groundwater and building materials.

11.5 Baseline Conditions

- 11.5.1 Information on the geology of the scheme area has been obtained from British Geological Survey Maps and Memoirs and from a series of ground investigations undertaken between 1973 and 2007. These show that the area is underlain by unproven thicknesses of the Mercia Mudstone Group of the Triassic period.
- 11.5.2 Ground investigation works have indicated that the solid geology of the entire route is dominated by mudstones of varying weathering grades. Sandstone skerries have also been encountered along the entire route, whilst gypsum bands were encountered along the route in the areas of Thrumpton and Ratcliffe power station.
- 11.5.3 Overlying the solid geology are the superficial deposits, made-ground and fill. These consist of:
- Cohesive and granular made-ground associated with embankments, structures and an ash pit opposite the power station.
 - Deposits across the River Soar floodplain comprising Alluvium over River Terrace Deposits consisting of Wanlip and Syston sands and gravels. These deposits have been proved to a maximum depth of 11.30m below ground level.
 - Additional River Terrace deposits of the Holme Pierrepont Sand and Gravel, located around the Thrumpton Accommodation overbridge to the edge of the urban area of Clifton.
 - Glacial Head Deposits which are widespread within the central part of the route, east of the River Soar up to the edge of the urban section southwest of Clifton. Head material recovered from the boreholes is generally described as firm red brown mottled blue grey slightly sandy gravelly Silt or Clay.
 - Glacial Till was proved up to 6.5m thick, with material generally described as firm to stiff brown slightly sandy slightly gravelly Clay.

- Made-ground associated with highway cuttings and embankment structures.

11.6 Potential Impacts

11.6.1 Testing of soils encountered during the ground investigation carried out by WYGE was undertaken to assess:

- Risks to earthmoving contractors and others who may be exposed to soils by direct contact or inhalation of airborne dusts during or after works.
- Risks to controlled waters (surface waters and groundwater) by leaching or by runoff of solids in drainage water.
- Risks of adverse effects on plant growth in subsequent landscaping.
- Risks to construction materials.
- Potential waste classification should soils require off-site disposal.

11.6.2 In accordance with Highways Agency guidance and current UK best practice, the assessment of contamination follows a risk assessment approach. This considers the contamination hazards and potential targets (receptors) identified, and the feasible pathways between the two. Risk is defined as the combination of:

- (i) the probability, or frequency, of occurrence of a defined hazard (for example, exposure of a receptor to a substance with the potential to cause harm); and
- (ii) the magnitude (including the seriousness) of the consequences.

11.6.3 For a risk of pollution or environmental harm to occur as a result of ground contamination, all of the following elements must be present:

- (i) a source, i.e. a substance that is capable of causing pollution or harm;
- (ii) a receptor (or target), i.e. something which could be adversely affected by the contaminant; and
- (iii) a pathway, i.e. a route by which the contaminant can reach the receptor.

11.6.4 If any one of these elements is missing there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

11.6.5 Ground investigations for contamination have been undertaken during impact assessment of this scheme only where potential sources have been identified, based on historical or current features and activities. Whilst there may be a risk of contaminants being present elsewhere, this risk is considered low, and will be addressed by ongoing inspection and awareness during the works. Most

excavations associated with the works will be in natural ground materials in which contamination is not anticipated.

11.6.6 Where ground investigation has been carried out, samples have been obtained for laboratory analysis. Soils have been tested for a screening suite of commonly encountered contaminants, including those which would be anticipated based on the historical or current uses of the investigated area. Leachability testing has also been carried out to assess the risks of pollution of controlled waters (surface water courses and groundwater). Test results were compared with criteria devised to be protective of human health (based on conservative assumptions of exposure to contamination) and of the water environment.

11.6.7 Some contaminants were identified in localised areas at concentrations in excess of those typically encountered in clean natural soils. These are summarised in Table 2.11.1 below.

Table 2.11.1 : Summary of Identified Contamination

Location	Material	Contaminant
Embankment close to M1 Junction 24	Ash (Pulverised Fuel Ash – PFA)	Arsenic
Adjacent to Midland Mainline railway underpass	‘Made-ground’ including clinker and brick with slight hydrocarbon odour.	Mineral oil, Zinc, Sulphates.
In the vicinity of Ratcliffe Power Station	Ash, clinker, natural sandy gravel	Arsenic (including leachable), hydrocarbons, Benzo(a)pyrene
Adjacent to petrol filling station, Clifton	Hydrocarbons odour	(test results below criteria, but possibly indicative of materials in the vicinity requiring suitable handling)

11.6.8 Concentrations of contaminants are considered to be typical of the types of materials with which they are associated. The contamination is considered to be of marginal significance with regard to human health, requiring only the maintenance of good site hygiene practice to control risk to the most exposed receptor group i.e. site works contractors. No significant risk is indicated to other humans including adjacent occupiers, and no special precautions are required during the works. Where hydrocarbons were identified, it is possible that any excavated materials may require off-site disposal, possibly as Hazardous Waste pending further testing. Hydrocarbons were however very localised and do not represent any significant volumes of materials which would be unsuitable for use as fill elsewhere within the works. Hydrocarbons, and sporadically identified leachable Arsenic typically associated with ash deposits, may represent potential risks to controlled waters and

appropriate measures will be undertaken to ensure that no risks of water pollution are created (further details are provided in Section 2 Part 10 of this ES).

11.6.9 Although slightly elevated concentrations of metals and sulphates were sporadically encountered in groundwater, no evidence considered likely to reflect significant contamination was identified. Some further assessment of controlled waters risk may be appropriate if excavation of areas of ash deposition is required.

11.7 Design and Mitigation Measures

11.7.1 In general, geological mitigation measures would focus upon ensuring that:

- (i) excavations of materials maximise the potential for their re-use and minimise the requirement for off site disposal;
- (ii) embankments and cuttings are stabilised; and
- (iii) any potential sources of contamination are identified through ground investigation, and pollution prevented by the removal or treatment of such materials as appropriate.

11.7.2 Environmental impacts with relation to geology will cover the following features of the scheme:

- (i) impact on above ground important geological features;
- (ii) impact on below ground important geological deposits;
- (iii) impact due to the release and spread of contaminants within rocks or soils;
- (iv) impact on underlying soil or rock strata relating to previous mining activities and planned construction activities.

Above Ground Important Geological Features

11.7.3 There are no recorded important above ground geological features, in the form of geological SSSIs or RIGSs in the vicinity of the site. Mitigation to protect above ground important geological features is, therefore, not required.

Below Ground Important Geological Deposits

11.7.4 The scheme area does contain below ground important geological mineral deposits which could in the future be used as fill in construction activities, particularly the terrace gravels present within the flood plains of the River Trent and Soar and the excavated Mercia Mudstone. Where possible soils and rock excavated on the site would be reused in new earthworks on the scheme so as to minimise requirements for importation of fill materials and excavation from local borrow pits. Prior to excavation of soils these would be classified in terms of reusability and

contamination. Excavation would be undertaken with regard to maximising reuse and minimising off site disposal through, as necessary, separation and protection of soils during excavation and zoning of fill during placement.

Release and Spread of Contamination

- 11.7.5 With regard to impacts due to the release and spread of contaminants within rocks or soils, current information indicates that contamination along the route of the A453 would be limited to excavation into the backfilled ash pits associated with the former power station and localised hydrocarbon contamination. If additional small areas of contamination are encountered, during further investigation or during construction, source-pathway-receptor risk assessment would be made of the potential impact of the contamination. Mitigation would then be defined involving, as necessary, removal or treatment of the contamination to prevent pathways to sensitive receptors.
- 11.7.6 Detailed design measures to control environmental impacts due to contaminated ground have not been specified. However, the following general practices would be adopted:
- removal of any excavated materials significantly contaminated by hydrocarbons;
 - avoidance of exposure of ash at or close to the surface, increasing the risk of runoff of solids and of leaching;
 - minimising the excavation of potentially contaminated materials, notably ash.

Previous Mining Activities and Planned Construction

- 11.7.7 Stability analyses would be undertaken for all earth placement to define stable slopes prior to placement with particular regard to areas of previous instability. Where practical earthworks would be designed so as to minimise land take and earthwork soil requirements.
- 11.7.8 Detail design will be undertaken of embankment and cutting slopes to define safe angles and any necessary drainage. Groundwater monitoring carried out to date has indicated that significant dewatering is not likely to be required during construction and dewatering is not likely to have any significant effect on surrounding water tables. During and after construction operations groundwater would be monitored and design of any dewatering operations would be undertaken with reference to the EA and local landowners.
- 11.7.9 Detailed design would be undertaken of any new drainage ponds and flood compensation areas to define safe slopes and impact on groundwater and geology. These are likely to be shallow features resulting in little direct impact. During and after construction operations groundwater would be monitored and design of any

dewatering operations would be undertaken with reference to the EA and local landowners.

11.8 Magnitude of Impacts and Significance of Effects

11.8.1 Magnitude of impacts and the significance of effects of the scheme with respect to geology are summarised in Table 2.11.2 below. Sensitivity, magnitude of impact and significance of effects are derived from Tables 1.3.1, 1.3.2 and 1.3.4 in Section 1 Part 3 of this ES, respectively.

Table 2.11.2 : Geological Environmental Impacts

Feature	Sensitivity	Impact	Mitigation	Significance
Above ground environmental features – no designated features.	Negligible	No change	None	Neutral
Below ground geological deposits – use of mainly clays with disturbance to river terrace deposits.	Low	Minor Negative	Design to maximise reuse of materials in scheme and minimise excavation and land take requirements.	Slight Adverse
Release and spread of contamination - excavation of ash pits during construction works.	Low	Minor Negative	Design of earthworks to avoid excavation and disturbance of any contaminated ground; minimise potential for runoff of suspended solids. Possible localised disposal of impacted soils off site if unsuitable materials are excavated.	Neutral
Release and spread of contamination - possible disturbance of additional unknown local contamination during construction works.	Low	Minor Negative	Where contamination encountered during construction, risk assessment undertaken to identify any remediation required. Appropriate remedial strategy to be adopted.	Neutral
Mining activities – Gypsum workings.	Low	Minor Negative	Ground investigation carried out in any identified areas, remediation	Slight Adverse

Feature	Sensitivity	Impact	Mitigation	Significance
			based on risk assessment.	
Construction activities – disturbance of geology due to construction of cuttings.	Low	Minor Negative	Detailed design following consultation with the Environment Agency. Continued monitoring of groundwater.	Slight Adverse
Construction activities - disturbance of geology due to drainage ponds and flood compensation areas.	Low	Minor Negative	Detailed design following consultation with the Environment Agency. Continued monitoring of groundwater.	Slight Adverse
Construction activities - disturbance of geology due to foundation construction.	Low	Negligible	None	Neutral

11.8.2 Impacts associated with contamination during the construction period are assessed as *Minor Negative*, based on the potential for disturbance of known (or unknown) contaminated ground, particularly associated with ash disposal areas at the power station and localised hydrocarbons and other contamination. Impacts may be to human health (principally construction workers) and to controlled waters by leaching from contaminated soils.

11.8.3 Ongoing environmental impacts during use of the improved road following construction are considered neutral.

11.8.4 Mitigation of the impacts is required in relation to disturbance of geology due to construction activities. The sensitivity associated with the resource is assessed as low and the overall significance of the impact is assessed as *Slight Adverse*.

11.8.5 Appropriate measures are included to avoid exposure of contaminated materials (for example, ash waste) and to manage any hydrocarbons-contaminated soils, and accordingly the road widening proposal is assessed as having a neutral impact relating to contamination.

11.8.6 Overall the significance of geological / contaminated land impacts has been assessed as *NEUTRAL* to *SLIGHT ADVERSE*.

11.9 Summary

11.9.1 Assessment of the potential effects on the geology within the study area resulting from the implementation of the proposals has been undertaken as set out in the

above sections, and an assessment of impacts associated with contaminated ground undertaken.

- 11.9.2 Assessment indicates that a potential *Minor Negative* impact is associated with disturbance of ash associated with the Ratcliffe on Soar Power Station which underlie the scheme with possible other minor contamination and with disturbance of local geology in order to win materials for the scheme. *Minor Negative* impacts are also potentially associated with disturbance of geology due to construction activities.
- 11.9.3 Mitigation of *Minor Negative* impacts is required for the excavation of ash materials or other minor and sporadic contaminated ground. Mitigation would involve avoidance of disturbance of the fill material as part of the construction works where possible. Taking into account mitigation, the overall environmental impact significance associated with contamination both during construction and during the operational phase is assessed as *Neutral*.
- 11.9.4 Mitigation of *Minor Negative* impacts is required in relation to disturbance of geology due to construction activities. The sensitivity associated with the resource is assessed as *Low* and the overall significance of the impact is assessed as *Slight Adverse*. Mitigation would involve monitoring of groundwater and ground and, as necessary, liaison with the Environment Agency over potential impact and design of works to minimise impact.
- 11.9.5 Other impacts relating to above ground geological features and historical mining activities are assessed as *Neutral*.
- 11.9.6 The overall significance of effects upon geological issues is considered to be *Neutral to Slight Adverse*.