Chapter 13 Ground conditions and contamination

Introduction

13.1 WSP was commissioned by Countryside Properties to carry out the ground conditions assessment for the EIA.

13.2 The key issue to be examined is the potential for contamination to be uncovered at the site either from the past uses or adjacent land uses, such as the petrol garage on the north-east boundary of the site. There is also the potential for contamination to be generated during construction from spillages of fuel or oil. The nature of the proposed development means that contamination is unlikely to occur after the construction phase, except for pollutants carried in run-off from the new roads.

13.3 The receptors sensitive to any release of contamination include the construction workers, future residents, nearby surface water bodies (Pingle Brook and Gagle Brook) and the groundwater. Ground conditions was scoped as an issue of secondary significance for examination.

Legislation and policy

13.4 Land contamination is regulated under several regimes, including environmental protection, pollution prevention and control, waste management, planning and development control, and health and safety legislation. The specific UK legislation on contaminated land is principally contained in Part IIA of the Environmental Protection Act (EPA), 1990.

Environmental Protection Act (EPA) 1990

13.5 This legislation endorses the principle of a 'suitable for use' approach to contaminated land, where remedial action is only required if there are unacceptable risks to health or the environment, taking into account the use of the land and its environmental setting.

13.6 The statutory guidance (Department of Environment, Transport and the Regions Circular 02/2000), which brought into effect the EPA 1990 legislation on April 1 2000, describes a risk assessment methodology in terms of 'significant pollutants' and ‘significant pollutant linkages’ within a source-pathway-receptor model. The model comprises:

- the principal pollutant hazards associated with a site (the sources)
- the principal receptor at risk from the identified hazards
- the existence of plausible pathways that may exist between the identified hazards and receptor.

13.7 For land to be determined as 'contaminated' in a regulatory sense, and thereby require remediation (or a change to less sensitive use), all three elements (source-pathway-receptor) of a significant pollutant linkage must be present.

Planning Policy Statement (PPS 23) - Planning and Pollution Control

13.8 The contaminated land regime set out in the EPA 1990 and its accompanying regulations deals with the existing condition of land. At the time of a proposed development, the local authority may require remediation works as part of the development of the site. These works usually encompass site investigation, consultation and remediation works/risk management.

13.9 Whilst the planning and pollution control systems are separate, they are complementary in that both are designed to protect the environment from potential harm caused by development and site operations, albeit with different objectives. Historic land contamination is a material planning consideration, which must be taken into account at various stages in the planning process, including proposals for the future use and redevelopment of a site.

13.10 A planning authority may require remediation works additional to those that would be required under Part IIA of the EPA 1990, to ensure the land is fit for purpose, for example, in situations where the new land use is more ‘sensitive’ in health and safety terms than the existing land use, or where the process of ground disturbance due to redevelopment leads to increased environmental risks.

Local plan policy

13.11 The Cherwell Local Plan 2011 Revised Deposit Draft (July 2004) includes a policy on contaminated land. Policy EN17 states that:

> *‘Development on land which is known or suspected to be contaminated will only be permitted if:*
>
> *i)* *adequate measures can be taken to remove any threat of contamination to future occupiers of the site*
>
> ii) *the development is not likely to result in contamination of surface or underground water resources’*.

Methodology

Baseline

13.12 WSP's ground conditions assessment is based on enquiries and investigations carried out in April 2005. The assessment is based on a wider study area than the application boundary. The study area covers the land between the A41 and A4095 to Chesterton and from Middleton Stoney Road to Gagle Brook.

13.13 For details on geology, information has been obtained from the British Geological Survey 1999 (1:10000 series sheet SP25SE – Solid and Drift Edition).

13.14 The ground conditions assessment has reviewed the findings of the original desk study report produced by Pell Frischmann in April 2001 and the ground investigation factual and interpretative report, also by Pell Frischmann, dated October 2001. The data sources and references that have been examined in preparation of this report are shown in figure 13.1.

WSP, South West Bicester, Environmental Impact Assessment, Ground Conditions, June 2005
Pell Frischmann, Desk Study Report, April 2001
Pell Frischmann, Ground Investigation Factual and Interpretative Report, October 2001
Geological Survey of Great Britain 1:10000 Scale Geological Map Sheet No. SP52SE (Solid and Drift Edition).
Building Research Establishment 1996 Digest 363 – Sulphate and Acid Resistance of Concrete in the Ground.
BS 5930:1999 Code of Practice for Site Investigation
BS 1377:1990 Soils for Engineering Purposes
Design Manual for Roads and Bridges HD25/94
Specification for Highway Works Series 600

Figure 13.1 Data sources and references

13.15 Existing ground conditions have been established from drilling cable percussion boreholes and excavating trial pits during a site investigation survey. A total of 11 boreholes and 110 trial pits were used in the investigation.

13.16 To identify the level of contamination at the site, geotechnical and chemical laboratory testing was carried out on a range of samples taken from the boreholes and trial pits. The samples were also tested for engineering conditions. All boreholes and trial pits were backfilled using the arisings.

13.17 Laboratory testing for engineering conditions was carried out by Thyssen Geotechnical and chemical testing by ECOS Ltd. Chemical tests were carried out on soil samples to detect the presence and concentration of the following:

- arsenic
- boron
- cadmium
- chromium
- copper
- sulphate
- PAH
- lead
- mercury
- nickel
- DRO
- pH
- sulphide
- Pesticide suite
- cyanide
- thiocyanate
- selenium
- zinc
- phenol
- sulphur
- leachate.

13.18 Chemical tests were also carried out on groundwater samples to detect the presence and concentration of the following:

- arsenic
- boron
- cadmium
- chromium
- copper
- sulphate
- PAH
- ammoniacal nitrogen
- lead
- mercury
- nickel
- DRO
- pH
- sulphide
- Chloride
- total organic carbon.
- cyanide
- thiocyanate
- selenium
- zinc
- phenol
- sulphur
- PCB

13.19 Leaching tests were carried out on some of the soil samples and the samples were then analysed for ammonia, arsenic, boron, cadmium, chromium, copper, lead, manganese, mercury, nickel, pH, total phenols, selenium and zinc.

13.20 These tests were used to identify the potential for contamination to be present at the site. The results were considered in relation to the appropriate threshold levels.

Impact assessment

13.21 The proposals and master plan have been examined in the context of the baseline environment to identify the ground conditions and contamination potential effects. Where adverse effects have been predicted, consideration has been given to potential mitigation measures. The residual effects following mitigation have subsequently been determined.

Assessment of significance

13.22 There are no known published standard criteria for assessing the significance of the potential effects that may arise from ground conditions and contamination. However, where appropriate, statutory or best practice guidance has been applied through the assessment and determination of soil and contamination-related issues. Measures of the magnitude or scale of effect and the importance or sensitivity of the resource affected have been used.

13.23 The significance of effect (where a contamination risk has been identified) has been determined from criteria developed from best practice techniques and expert knowledge.

13.24 The criteria used to determine the sensitivity of potential contamination receptors and magnitude of possible contamination effects arising from the proposed development are shown in figures 13.2 and 13.3. The significance of an effect on a receptor is then determined by considering these two measures, together with the determination of significance matrix shown in figure 13.4. The generic definitions of significance of effects relating to land contamination and ground conditions are also listed in figure 13.4.

Baseline

Topography

13.25 The site slopes gently in an easterly direction. The highest point is in the north-west corner at approximately 82.7 m AOD. The lowest point is the southern boundary at approximately 66.0 AOD.

Geology

13.26 The site is underlain by rocks of the Jurassic Period with overlying superficial deposits of alluvium along the routes of local streams. Generally the strata covering this site consist of alluvial deposits (peat, sand and soft clay), gravel with limestone cobbles, stiff clay (becoming mudstone with depth) or a clay overlying limestone Cornbrash. A strong limestone layer was encountered over much of the site at depths varying between 0.7m and 1.7m and at 2.6m in one isolated area.

13.27 Generally the centre, south and south-west of the study area is undisturbed ground consisting of stiff 'Kellaways Clay' underlain by a weak mudstone or Cornbrash. The Cornbrash was encountered in this area at varying depths, from 0.6m to 2.5m. Cornbrash is described as a 'predominantly coarse granular material (highly to completely weathered limestone)', being gravel with a high clay or silt content.

13.28 The northern and western areas of the study area are generally a sandy, clayey gravel with limestone cobbles, overlying a strong limestone layer at around 1.0m depth. Loose sand was encountered towards the central southern boundary of the study area in layers up to 0.7m thick between depths of 0.3m and 1.5m.

Made ground

13.29 There are three areas of localised fill within the study area, in the north-west corner, the north-east corner and in the central eastern area. These areas are within the application site. Figure 13.5 shows the location of the areas of made ground, peat and soft organic clay and localised contaminated areas.

13.30 In the north-west area, this made ground forms the infill to a historic quarry. This consists almost entirely of ash and clinker fill, with glass, metal and pottery fragments to a depth of approximately 2.5m, under which is gravel or soft clay, becoming stiff clay and mudstone.

Adjacent to this localised fill, gravel with limestone cobbles were encountered below the topsoil, with strong limestone encountered from 0.6m to 1.0m depth.

13.31 Trial pits to the north-east indicated another quarried area. This area has been infilled with a layer of peat overlying soft clay with organic deposits to around 0.6m depth and fine sand with some limestone gravel below this. The topsoil in this area also contains organic material and one of the trial pits revealed the presence of plant remains to a depth of 1.3m. There is some evidence to suggest that lime burning has taken place in this area.

13.32 The third area of localised fill occurs centrally along the eastern border of the study area. Here the made ground typically consists of stiff clay with some gravel and cobbles. It is possible that this location has also been used as a limestone quarry. Water was encountered seeping into the trial pits in this area at 2.1m depth.

13.33 In another localised area south of Pingle Brook, a layer of fine, clayey sand up to 0.4m thick was encountered overlying the gravel, cobbles and limestone.

Groundwater

13.34 The survey identified that the occurrence of groundwater was intermittent across the study area, seeping from within the Cornbrash, or at the upper levels of the mudstone wherever this was encountered. In addition, groundwater was encountered seeping into the central eastern quarry area.

13.35 In the north-east corner, the occurrence of ground water was considered to be a result of the proximity of Pingle Brook. All groundwater levels may be seasonal and historically high groundwater levels have occurred during the winter months on this site.

Contamination potential

13.36 The majority of the study area has been used for agriculture. There is no history of contaminative use on or adjacent to the site except for the existence of the ash-filled quarry in the north-west corner, the proximity of a petrol station along the eastern boundary and Whitelands Farm complex. The petrol station does not appear to have caused any contamination in the region of TP90 (see figure 13.5).

13.37 Whitelands Farm has been used historically as a mixed arable and dairy farm. Materials in the areas around any silage and animal waste storage and around the farm's fuel storage tanks may potentially be contaminated. The farm is outside of the application area and will continue to operate as a farm in the future. It is considered unlikely that these operations will affect the development proposals.

13.38 There is no record of any landfill sites within 250m of the study area and no other sources of potential contamination have been identified. The Environment Agency has confirmed that they have no records of any significant pollution incidents (category 1 or 2) on or within 500m of the site.

Result of chemical testing of soil samples

13.39 The results of the chemical testing of the soil samples show high arsenic and lead concentrations in the made ground in the north-west corner of the study area, generally within the ash fill. In the samples taken, arsenic levels exceeded 69mg/kg and lead exceeded 701mg/kg, both of which are in excess of the contamination land exposure assessment (CLEA) threshold levels of 20mg/kg and 450mg/kg respectively for residential gardens.

13.40 Contamination by phytotoxic metals nickel (>50mg/kg) and zinc (>1200mg/kg) was also high in this filled area in the north-west. These values are based on the CLEA guidelines. The levels should be taken into consideration if the materials are to be used in landscaping fill.

13.41 High arsenic levels (up to 231mg/kg) were also encountered in a localised area centrally along the eastern boundary. This area is considered to consist of made ground that contains some clinker-like material. It appears to represent a 'hot spot' also containing a high level of nickel (162mg/kg > 50mg/kg) and an unusually high sulphate result (14,027mg/kg, which exceeds the Inter-Departmental Committee on the Redevelopment of Contaminated Land (ICRCL) Action limit of 10,000mg/kg).

13.42 Sulphate levels over the ICRCL threshold limit of 2,000mg/kg were also found in the north-east corner of the study area.

13.43 Generally in the topsoil across the centre of the study area and in the northern area there are slightly elevated levels of arsenic (>10mg/kg) and nickel (>70mg/kg), which are considered to be generally within the acceptable limit for use in domestic gardens.

13.44 Leaching tests were carried out on some of the soil samples. No significant concentrations of the contaminants were found in the samples.

13.45 Further details of the contamination results are included in the Ground Conditions and Contamination Technical Appendix 6.

Results of chemical testing of groundwater samples

13.46 There was no significant level of contamination in any of the groundwater samples taken. This indicates that it is unlikely that any mobile contaminants are being transferred to an off-site and similarly that there is a low risk of contaminants migrating onto the site.

13.47 There is a possibility that the groundwater at the site is affected by potential contamination at Whitelands Farm complex.

Japanese knotweed

13.48 A small area of Japanese knotweed is present to the south of the study area. This is outside of the application boundary.

Other potential areas of contamination

Radon gas

13.49 The Building Research Establishment identifies the limestone within north Oxfordshire to be a potential source of radon gas.

Future baseline

13.50 In the absence of the proposals, it has been assumed that the site will remain as agricultural land and the farm's operations will continue as at present. If there is contamination at Whitelands Farm, this could potentially influence the ground conditions and contamination environment in the future. However, this is considered to be a low risk and it is unlikely that this continued use of the site would significantly change the baseline environment of the site in the future.

Assessment of sensitivity

13.51 The receptors sensitive to changes to the ground conditions and contamination at the site include future residents and occupiers of the site and the surface water and groundwater. Future residents, visitors and occupiers of the site are all considered to be of high sensitivity with respect to the release of contamination. The adjacent land uses including agricultural land and residential areas are also considered to be of high sensitivity.

13.52 The surface water bodies at the site include Pingle Brook and an unnamed watercourse. Gagle Brook flows to the south of the site. The groundwater at the site and the groundwater abstraction points are also sensitive with respect to changes to ground conditions and contamination. These receptors are all considered to be of medium sensitivity. Further details are including in chapter 6, hydrology and water quality.

Potential effects

During construction

13.53 There is the potential for the existing contamination at the site to be released by the excavation works and general construction activities. This could potentially affect construction workers on site and mobilise contaminants into the ground and surface water. The construction workers are of high sensitivity. There is the potential for a small change if appropriate controls are not adopted. This will result in an adverse effect of moderate significance.

13.54 The mobilisation of contaminants during construction could potentially affect the ground and surface water. These receptors are of medium sensitivity and the magnitude of change is considered to be small. If no mitigation is proposed, there will be an adverse effect of moderate significance.

13.55 There is a very small risk that contaminants could be mobilised off site via the soils and groundwater. The adjacent land uses are considered to be of high sensitivity. However, the magnitude of change is negligible and no significant effects have been predicted.

13.56 There is also the potential for contamination to be generated during construction as a result of oil spillages and leaks from equipment and vehicles. This could potentially affect construction workers and future residents through direct contact. These receptors are considered to be of high sensitivity and the magnitude of change is small. Without mitigation, the construction work potentially results in an adverse effect of moderate significance.

Post-construction

13.57 Without appropriate remediation, the existing contamination could affect the future use of the site. Future residents will be sensitive due to the creation of residential gardens. These receptors are of high sensitivity and the magnitude of change is small. This results in an adverse effect of moderate significance.

13.58 The pupils and teachers attending the new schools on site are sensitive with respect to the school playing fields and areas of open space. These receptors are of high sensitivity and the magnitude of change is small. This results in an adverse effect of moderate significance.

13.59 Residents, occupiers and site users would be at risk from the open spaces, parks and formal sports provision proposed at the site. These receptors are considered to be of high sensitivity. The magnitude of change is small and this potential adverse effect is of moderate significance.

13.60 Contamination could be generated post-construction as a result of the surface water run-off from the new development. This could affect surface and groundwater, and potentially the new residents. The magnitude of change is small and this adverse effect is considered to be of moderate significance.

13.61 It is possible that the existing area of Japanese knotweed could spread through natural growth if not appropriately treated, possibly affecting adjacent land uses and domestic gardens. This area is outside of the boundary of the development and will not be affected by the development proposals. It is understood that steps are being taken to eradicate the existing area of knotweed. As this infestation will not be affected by the proposal, no significant effects have been predicted.

Mitigation

Remediation of existing contamination

13.62 A detailed remediation scheme will be developed for the site. This will involve further soil testing with respect to certain areas.

13.63 The areas for detailed testing include:

- the potential contamination areas as shown on figure 13.5. This will determine the extent of the contamination and inform the remediation strategy
- the topsoil across the centre of the site and in the northern area where there are slightly elevated levels of arsenic (>10mg/kg) and nickel (>70mg/kg). These are generally considered to be within the acceptable limit for use in domestic gardens. However, more detailed testing using the Physiologically Based Extraction Test (PBET) to determine the bioavailability of arsenic will be undertaken
- the areas of the site that will be covered by buildings. The Building Research Establishment identifies the limestone within north Oxfordshire to be a potential source of radon gas. Further testing will be undertaken to inform the engineering design and address any significant radon levels.

13.64 Remediation options will be identified following analysis of the soil testing results. This will involve an assessment of the proposed end use of each area of the site. This has a bearing on the type of mitigation measures used in respect of contaminated soils. Soft landscaped areas and domestic gardens may require excavation of the contaminated material up to 1.0m depth and replacement with clean cover from an approved source. Contaminated materials in areas that are to be hard landscaped or covered with road pavement construction may possibly be left in place. Consideration will be given to the suitability of on-site remediation measures, as well as the requirement for disposing of contaminated soils off-site.

13.65 With respect to the potential extent of contamination in the north-western area of the site, some contamination may be left *in situ* if it is covered by the proposed perimeter road and access junction. An alternative strategy will be developed for any areas of landscape planting.

13.66 The remediation strategy will consider relevant guidance. For example, according to the 'Guidance on the Disposal of Contaminated Soils', published by the EA, topsoil contaminated by arsenic will have to be transported to a suitably licensed site.

Engineering considerations

13.67 In terms of engineering design, the materials noted as unsuitable for foundation loading will be removed and replaced with suitable granular material, or the foundations will be taken through the unsuitable soils to a layer with a suitable bearing capacity.

Best practice measures

13.68 All the developers will use best practice techniques during the construction phase. This will include provision of emergency equipment for use in the event of accidental spillage. Any ground contaminated by spillage of fuel oils or hydraulic oils during construction will be excavated and removed to an appropriately licensed waste disposal site. Personal protective equipment (PPE) will be provided for construction workers where necessary.

13.69 Surface water drainage measures will be designed with appropriate pollution prevention measures through the incorporation of sustainable drainage systems (SUDS) in accordance with best practice. This will ensure that the runoff from the development will not affect the surface water bodies or groundwater post-construction. Maintenance of the trapped gullies, swales, highway drainage systems, interception facilities and infiltration basins, including the pollution prevention equipment, will ultimately be the responsibility of Cherwell District Council and Oxfordshire County Council. Until adoption, however, the developers will carry out the necessary maintenance of these systems and facilities. Waste water and materials removed during routine maintenance will be disposed of to an appropriately licensed waste disposal site.

Residual effects

13.70 A remediation strategy will be developed to address the areas of potential contamination present on site. This strategy will ensure that site will be properly remediated during the site preparation work, preventing any impacts on future site users. During the remediation work, measures will be taken to ensure no contamination is released to sensitive receptors. These measures will reduce the magnitude of change for all these potential impacts to negligible and no residual effects have been predicted.

13.71 The proposed mitigation measures during construction will ensure that no contamination will be generated during this phase and no significant residual effects will result. The design of the surface water drainage scheme will ensure that no residual effects will arise post-construction.

Large **Medium** **Small** **Negligible**

Typical description of the receptor

Large area of the site contains contamination levels that significantly exceed the intervention levels or Soil Guideline Values. Remediation to a state 'suitable for use' required prior to site development

Contaminants identified that are hazardous even in small quantities, eg asbestos, methane. Removal required prior to site development

Professional judgement can be used to moderate the magnitude category if the susceptibility of the receptor to the particular type of change proposed, or its capacity to absorb it, so warrants. For example, not all contaminants are considered harmful to all receptor types (eg phytotoxic contaminants are only considered harmful to flora and fauna) and therefore the sensitivity to contamination will depend on the contaminants identified. In terms of the potential for contamination to occur as a result of the proposals, existing background contamination levels within the soil may affect the capacity of the environment to accommodate pollution incidents, should they occur. The assessment will highlight how and why any moderation was used.

Proposals cause the release or mobilisation of contaminants through the creation of a pathway to expose receptors to high levels of contamination. Eg ecosystems may be exposed to a level of contamination with the potential to cause a major or long term change through phytotoxicity, disruption of reproduction or zootoxicity, and humans may be exposed to levels considered harmful to health

Small area of the site contains contamination levels that exceed the intervention levels or Soil Guideline Values, or several contaminants identified that marginally exceed these. Remediation to a state 'suitable for use' required prior to site development

Proposals cause the release or mobilisation of contaminants through the creation of a pathway to expose receptors to contamination. Eg ecosystems may be exposed to a level of contamination with the potential to cause a minor or short term change through phytotoxicity, disruption of reproduction or zootoxicity, and humans may be exposed to levels approaching those considered harmful to health

Contaminants identified on site are approaching the Soil Guideline Values, or are between the target and intervention levels. Remediation may be required prior to development

Proposals cause the release or mobilisation of contaminants through the creation of a pathway to expose receptors to low levels of contamination, although these levels are not considered to present a risk to receptors

Existing contaminants identified are found in relatively low concentrations that pose no significant risk to receptors, and therefore no remedial action is taken

Figure 13.2 Ground conditions and contamination: magnitude of change

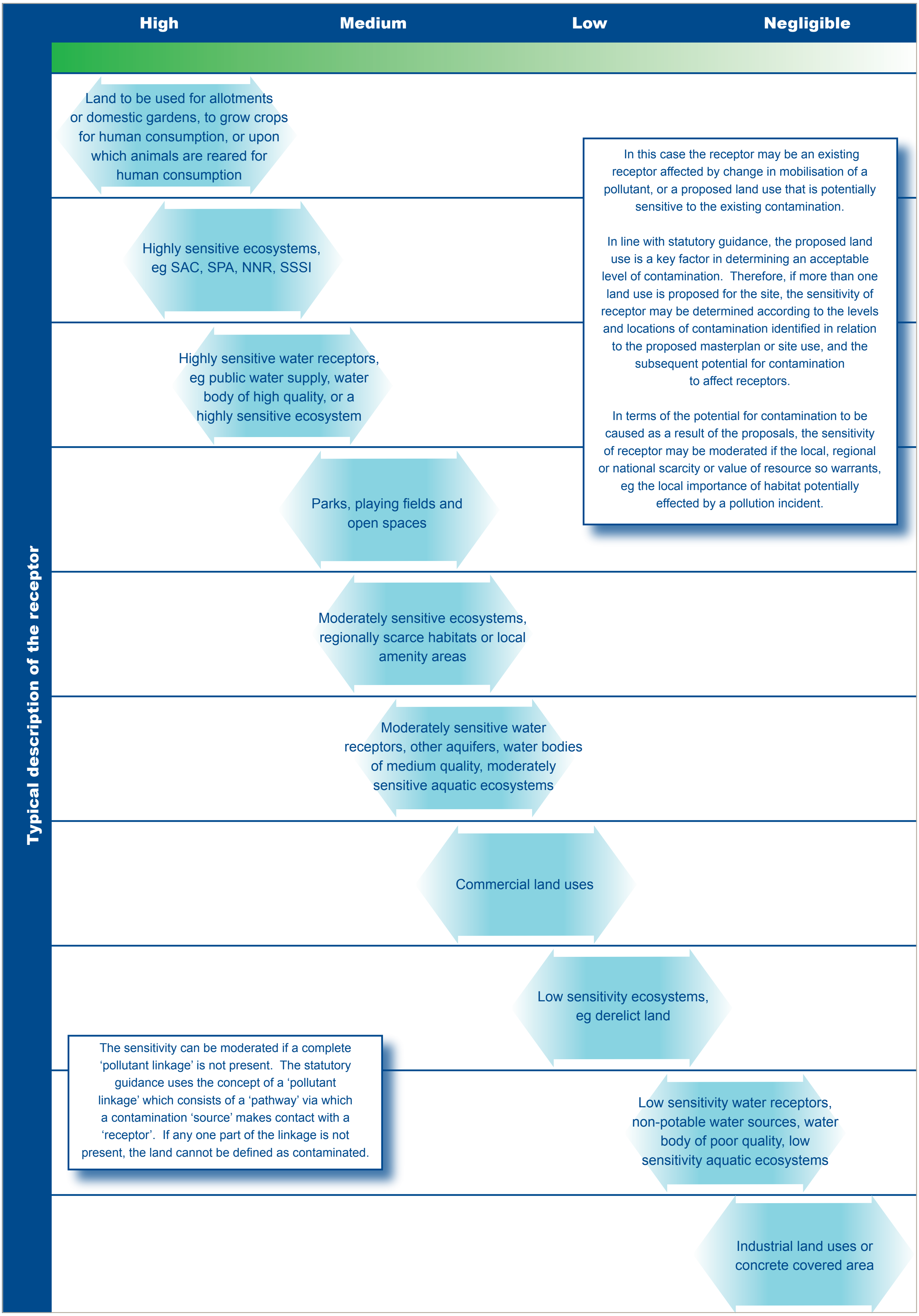
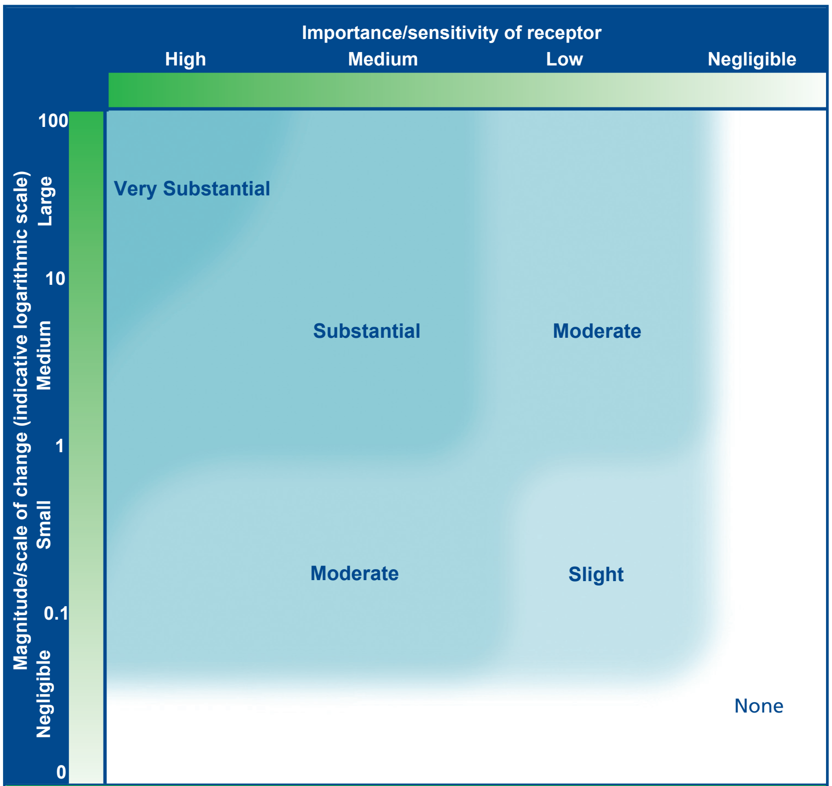


Figure 13.3 Ground conditions and contamination: sensitivity or importance of receptor



Very substantial:
Highly sensitive land uses, highly sensitive ecosystems and water receptors and also land uses resulting in human exposure to hazard experience concentrations of contaminant greater than their intervention level, or between intervention and target level. Pathway to release/mobilisation/exposure to contaminant is generated to humans and/or ecosystem. Potential for moderate and major changes to very sensitive ecosystems.

Substantial:
Moderately sensitive land uses, ecosystems and water receptors are exposed to contaminant concentrations greater than their intervention level, or between intervention and target level. Potential for moderate and major changes to very sensitive or sensitive ecosystems.

Moderate:
Low sensitivity land uses, water receptors and ecosystems exposed to contaminant concentrations greater than their intervention level, or between intervention and target level. Also highly sensitive receptors exposed to contaminants approaching target level. Potential for minor changes to ecosystems.

Slight:
Low sensitivity land uses, water receptors and ecosystems exposed to contaminant concentrations approaching target level. Potential for minor changes to ecosystem. High/moderately sensitive receptors are exposed to contaminants found in relatively low concentrations that pose no significant risk to humans animals or plants.

Not significant:
Non-sensitive land use, water course or ecosystem exposed to contaminants found in relatively low concentrations that pose no significant risk to humans animals or plants.

Figure 13.4 Ground conditions and contamination significance matrix

Areas consisting of “made ground”*

Areas consisting of peat and soft organic clay*

Potential extent of localised contaminated areas*

Contamination by arsenic >20mg/kg

NOTE
*Information taken from WSP drawings:
1546/UD/002RevP1 (Site Constraints) July 2005
1546/SI/001RevP1 (Borehole and Trial Pit Locations) August 2005
1546/D/001RevP1 (Proposed Storage Pond Layout) August 2005

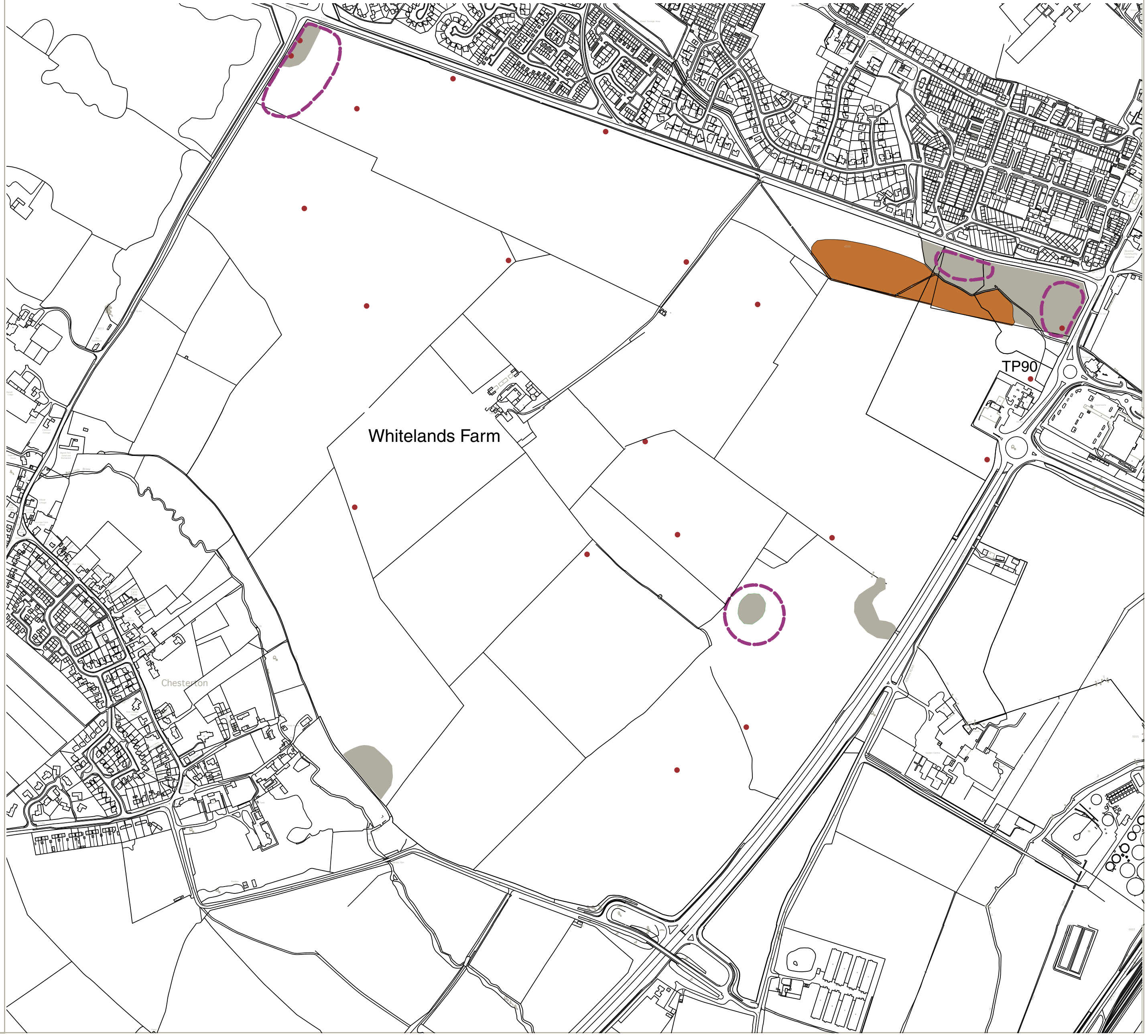


Figure 13.5 Areas of made ground and contamination ‘hot spots’ at the site

0 250m