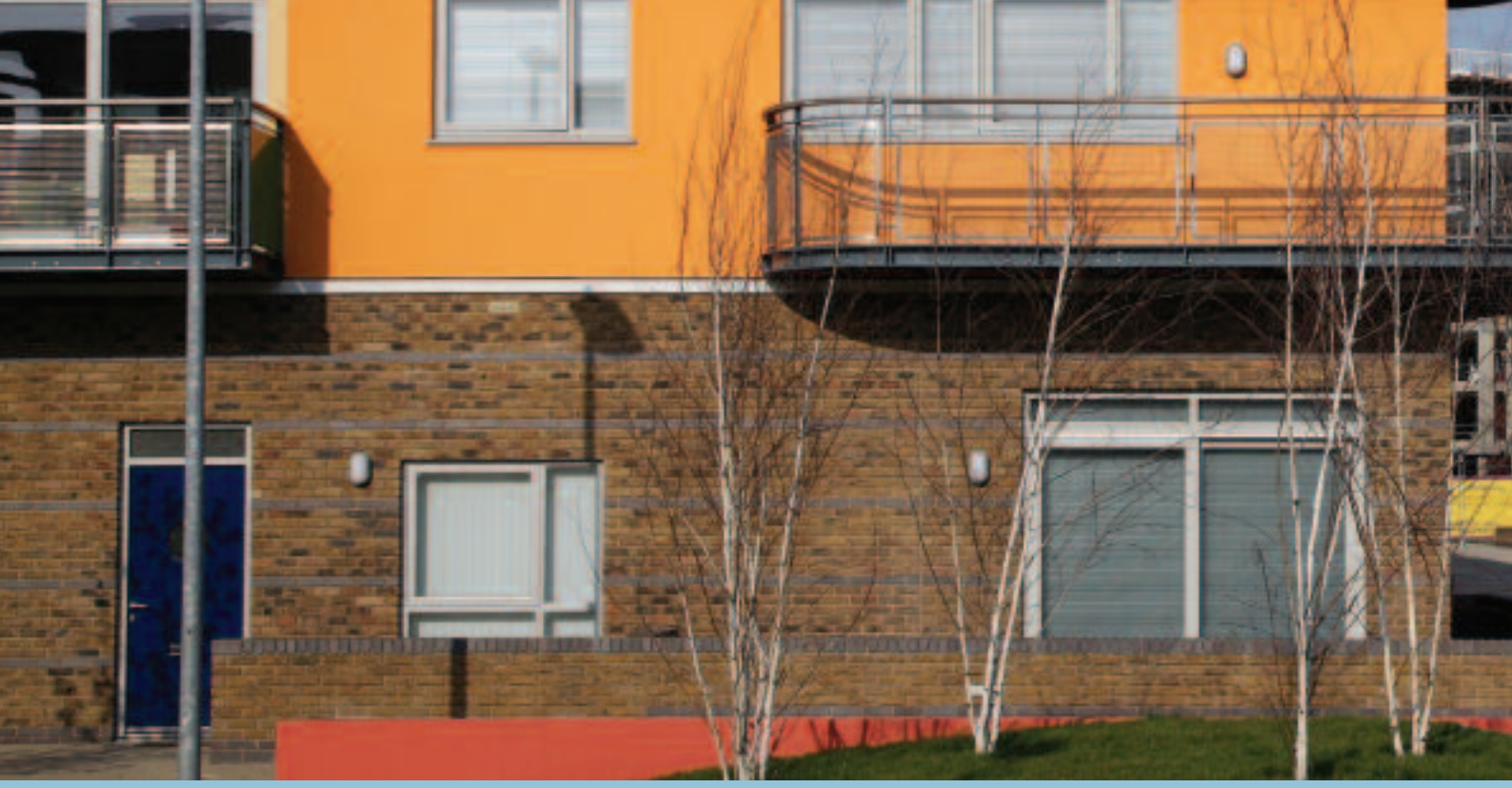
Best Practice Note 27 (revised February 2008) Contamination and Dereliction Remediation Costs

English Partnerships
The National Regeneration Agency



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Foreword

Estimating the cost of preparing a brownfield site for reuse is a complex exercise and one that is fraught with uncertainties. Up-to-date and comprehensive information is essential, to reduce the uncertainty and risk of grossly underestimating the costs of remediation. In this regard nothing can compete with a recent and well executed site investigation that has been designed with full regard for the land use history of a site.

Unfortunately, it is sometimes necessary to take decisions regarding brownfield sites without having the benefit of this important information. Researching the history of a site, over say 200 years of industrial use and designing and executing an intrusive site investigation, all take time and money, both of which may not be available at the inception stage of a project. It was with this in mind that, in 2005, English Partnerships took the decision to prepare an internal Best Practice Note on the costs of remediating contamination in brownfield sites. This document was intended for use by the agency's project managers in the early stages of the decision making process regarding brownfield sites and as a means of cross-checking remediation costs in subsequent tenders.

Since the Best Practice Note was prepared in 2005 it has been recognised that tackling the problems caused by dereliction can be as complex, and often as expensive as treating or removing contamination. HM Treasury has also consulted on the possibility of extending the Land Remediation Relief scheme, which provides for 150 per cent Corporation Tax relief in respect of qualifying decontamination works, so as to include the costs associated with remedying dereliction. In response, English Partnerships decided to revise its internal guidance on contamination costs to include dereliction costs, and to publish a new Best Practice Note so that it can be used by Government agencies, development partners and other stakeholders.

The revised Best Practice Note has been co-ordinated by English Partnerships with consultants from BBP Regeneration, Campbell Reith Hill, and Davis Langdon. Although it has been prepared with the utmost care and consideration, it must be stressed that the Best Practice Note is only intended as guidance and that nothing can substitute for good quality, site specific, information.

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1 Background

English Partnerships is the national regeneration agency helping the Government to support sustainable growth in England. The agency is the Government's specialist advisor on brownfield land, providing expert advice on brownfield land and promoting best practice in regeneration and remediation.

The Brownfield Guide: a practitioner's guide to land reuse in England, published by English Partnerships in 2006, *(the Brownfield Guide)* provides a comprehensive overview, with case studies, of the issues that need to be addressed when reusing land, the regulatory framework and processes that need to be observed. The *Brownfield Guide* also sets out a phased approach to land reuse, which should assist intending developers and investors to ensure that significant issues are not overlooked.

In 1999, English Partnerships, together with other stakeholders, founded the environmental charity **Contaminated Land**: applications in real environments (**CL**:AIRE) to stimulate the regeneration of contaminated land in the UK by raising awareness of, and confidence in, practical sustainable remediation technologies. **CL**:AIRE supports the brownfield industry through research, training and the assessment of new technologies. Further information is contained in Annex A.

2 The purpose of the Best Practice Note

This Best Practice Note (BPN) sets out guidance on assessing the costs of preparing, for redevelopment, previously developed land (PDL) or 'brownfield' sites affected by contamination or dereliction and provides guidance on pre-acquisition site investigations' 'due diligence'. The BPN has been prepared as a stand alone document, but contains a number of cross references to *the Brownfield Guide* which provides a wider perspective on issues affecting reuse of land and examines the policies and other mechanisms available to assist in the process of unlocking sites.

The BPN was initially developed in 2005 to assist English Partnerships project managers and development partners form, at an early stage, an opinion as to the costs associated with the remediation of contamination, for inclusion in a project appraisal, and prior to the appointment of consultants and the provision of site specific advice. This fully-revised edition presents an update on cost estimates for the remediation of land affected by the presence of contaminative substances updated to 2007 tender prices. Regional weightings for the costs have also been provided for guidance.

This revised edition of the BPN includes additional guidance on pre-acquisition site investigations, as part of 'due diligence', and expands the remediation costs to include the problems associated with dereliction. The history of dereliction means, in addition to the remediation of contamination, having to deal with above and below ground demolitions, together with the stopping up and removal of redundant services. Land that has been subjected to works of this nature often requires excavated voids to be backfilled, with crushed arisings (brick and concrete) from the demolitions and/or the import of clean fill material, consolidation and grading/levelling to form development platforms.

This BPN has been prepared by English Partnerships and its consultants. It should be noted that the information and opinions contained in this BPN are for general information purposes only. The BPN is aimed at assisting English Partnerships project managers and development partners and is not intended to constitute professional advice. However, it may prove equally useful for organisations outside English Partnerships, for example, consultants, contractors, developers and local authorities. The BPN has been prepared on the basis of what is known or assumed about site conditions/history and about potential end uses in relation to requirements for UK sites.

The information contained in this BPN should not be relied on or treated as a substitute for specific advice relevant to particular circumstances. The ranges of costs identified within the BPN are for guidance purposes only and should not be relied upon, on their own, for the purpose of commissioning remediation works. Costs derived from the BPN may be helpful at later stages of a project appraisal, for example to provide a comparison with unit costs estimated by a specialist consultant, or to query unit costs which fall significantly outside the relevant ranges set out in this BPN.

3 Policy, regulatory and procedural context

In England, the Government's preferred approach to land affected by contamination or damaged by former usage is that reclamation should be delivered through the development process. Only when significant harm is being caused to human health, to controlled waters (groundwater and surface waters) and the wider environment, or there is a 'significant possibility of significant risk', does legislation intervene to require the appropriate person to remedy the situation.

The principal pieces of legislation impacting on the reuse of brownfield land relate to how land contamination and water pollution are managed. Key legislation is as follows:

- The *Environmental Protection Act 1990* and the *Environment Act 1995* which introduced Part 2A, the 'contaminated land' legislation into the earlier Act – this includes the legal definition of contaminated land and how it is to be identified and dealt with. To assist, DEFRA published Circular 01/2006, which set out details of how the legislative framework regarding contaminated land was to operate. CLAN 5/06 (amended) replaced DETR Circular 01/2000 to promulgate the statutory guidance, as now amended, for radioactivity and sets out the way in which the extended regime is expected to work. The modifications made to the regime do not alter the way Part 2A works for non-radioactive contamination, with the exception of the change to appeals procedures for remediation notices served by a local authority;
- The *Water Resources Act 1991* makes it a criminal offence for a person to cause or knowingly permit pollution of controlled water. It sets out requirements for rectification if pollution has occurred and provides powers for the Environment Agency to take action to prevent or remedy pollution;
- The *Groundwater Regulations 1998* (SI 1998/2746) control the disposal of List I and List II substances to groundwater. List I substances are the most damaging and toxic, and must be prevented from directly or indirectly entering groundwater. They include many pesticides and herbicides, many solvents, mineral oils and hydrocarbons, cadmium and mercury. Activities resulting in indirect discharges may be authorised, following prior investigation. List II substances are less harmful, but must be controlled to prevent pollution of groundwater. They include many metals, such as zinc, lead, copper, many biocides, phosphorus, fluorides, ammonia and nitrates and anything that will make groundwater unfit to drink. The regulators have further information on listed substances and detailed lists of designations;
- The *Landfill (England and Wales) Regulations 2002* (SI 2002/1559) aimed to reduce the pollution potential from landfilled waste that can impact on surface water, groundwater, soil, air, and also contribute to climate change. Liquid wastes were banned from landfill, whilst other wastes must be treated before being consigned to landfill;
- The *Water Act 2003* introduced changes to regulation of the water industry in England and Wales under the *Water Industry Act 1991*, by transferring responsibility for economic regulation from an individual Director General to an Authority – OFWAT. The Act is in three Parts, relating to water resources, regulation of the water industry and other provisions. It aims to improve protection of the environment and to provide a more flexible process of regulation. The changes will be implemented over a number of years;
- The *Hazardous Waste (England and Wales) Regulations 2005* (SI 2005/894) set out the procedures to be followed when disposing of, carrying and receiving hazardous waste. The term special waste became obsolete in England and Wales from July 2005, when the new hazardous waste regime replaces the special waste regime; and
- The *Contaminated Land (England) Regulations 2006* (SI 2006/1380) – these deal with various procedural details such as the description of special sites, public registers, remediation notices and appeals.

The *Brownfield Guide* (Chapter 3) provides a summary of the legislation and regulations affecting contaminated land. However, it is important to note that the regulatory framework is subject to change and any such changes may influence preferred remediation techniques and unit costs.

The various project and design guidance documents produced by English Partnerships describe the processes for appraising and designing projects including those that involve the remediation of PDL. The relevant procedures are designed to reduce the level of risk and uncertainty associated with projects (including the abnormal costs of remediation).

The decision to financially approve public sector expenditure is subject to prior appraisal and due diligence procedures. These procedures are to ensure that decision makers approve the lowest risk and highest value for money projects. English Partnerships has its own appraisal systems, outlined in published and internal documents. If the guidance in these documents is followed, project managers should be able to comply with the guidance on appraisal set down in HM Treasury's Green Book[1] and the then ODPM's *Assessing the Impacts of Spatial Interventions (3Rs)*[2].

Due diligence on the site conditions will be required before English Partnerships commits to securing an interest or investing in the subject land or property. The BPN should not be used on its own for this purpose, without other inputs, but its application may raise issues for due diligence and should be used to inform the specification of terms of reference and the selection of the appropriate consultants.

[1] HM Treasury, 2003 *'Green Book, Appraisal and Evaluation in Central Government'* (TSO)
[2] Office of the Deputy Prime Minister, 2004. *Assessing the Impacts of Spatial Interventions (3Rs)* (HMSO)

4 Guidance on assessing the costs of preparing previously developed land (PDL) affected by contamination

This section presents a model that can be used as a first basis for assessment of the potential costs of preparing sites affected by contamination. The BPN is not to be used for estimating other site preparation and servicing costs. It does not take account of extensive asbestos removal nor does it cover geotechnical activities. For the purpose of this BPN, the remediation of land affected by contaminative substances has been defined as *'activities whose purpose is to prevent, minimise, remedy or mitigate the effects of harm to human health or to the wider environment, or pollution of controlled waters and to restore the land or polluted waters to a state appropriate for its intended end purpose taking account of environmental and/or public health requirements.'*

The benchmark costs can be used to check on cost estimates provided from other sources (e.g. by the project applicant or by consultant engineers). They might provide a basis for querying the estimates if they lie outside the appropriate range taken from Table 1 if the assumptions about site conditions and end use are the same. The BPN is not to be used for estimating full site preparation and servicing costs. It does not take account of asbestos removal nor does it cover geotechnical activities.

The BPN provides benchmark cost ranges for the remediation of contamination on PDL sites. The costs are based on the per hectare cost of remediation and should be applied to the gross area of the site as available from sales documents or site survey. They are not related to actual areas of contamination (as this is unlikely to be known early in appraisal) nor to historic employment floorspace.

Use of the benchmark unit costs will require a level of knowledge and judgement about the site, its location and history and its future uses. It will be necessary to obtain a minimum level of information about the site based on desktop assessment with respect to the following:

- The description of the site and its history: different types of historic uses on the site will have generated particular levels and types of contamination which will tend to determine the appropriate remediation techniques, the likely areas within the site requiring remediation and the likely unit costs of that remediation. Previous uses can often be determined easily by studying historic maps[3] and through reports obtained from commercial sources such as Landmark Information Group.

- The future use of the site: remediation techniques, and hence costs, may vary according to the nature of the proposed end use. It is therefore necessary to take a view about the likely future uses of the site – and this will require the site to be placed within a broader regeneration context. In decreasing order of human health sensitivity are the following developments:
  1 residential properties with gardens (e.g. houses);
  2 residential properties without gardens (e.g. flats);
  3 commercial and/or industrial developments; and
  4 public open space.

- Potential groundwater or surface water sensitivities: if the contaminated site is in an area where there are sensitive receptors on, adjacent to, or under the land, contaminated land regulations may require remediation that is independent of the proposed end use of the site. In such circumstances, unit costs can increase significantly. Equally, some remediation techniques considered adequate in regulatory terms, insofar as they break any pathway between contaminant(s) and receptor(s), may not be sufficient in scope to render the site suitable for redevelopment. Some water sensitivities can be identified and located through looking at appropriate maps[4]. Table 1 provides different ranges of costs, according to whether the site is in an area of high or low water sensitivity. Concerning this, the Environment Agency states the following sensitivities in decreasing order:
  A inner source protection zones (I) for potable water abstractions;
  B outer source protection zones (II) for potable water abstractions;
  C source catchment zones (III) for potable water abstractions;
  D principal aquifers, industrial water supplies (non-source protection zone), private water supplies and rivers;
  E secondary aquifers, water-dependant ecosystems and other controlled waters; and
  F unproductive strata (groundwater).

Table 1 opposite sets out ranges of benchmark costs per hectare for the remediation of PDL sites affected by the presence of contaminative substances. The costs are arranged according to different site descriptions, end uses and surface or ground water sensitivities. Costs are rounded to the nearest £25,000 per hectare. A technical note to the table explains the method used for calculating the cost ranges.

[3] Historic maps available from: www.old-maps.co.uk/

[4] Information and maps about the local environment available from: www.environment-agency.gov.uk/maps/

Table 1: The range of potential remediation costs per hectare of contaminated land according to different site conditions, end uses and risk to ground or surface water

Cost of remediation (£000s)

Spons 2007-Index 500	**Description of site in its historic use** Increasing cost of remediation...			
	Site Category A **Industrial sites, colliery/ mine spoil heaps, factories and 'works'[5]**	**Site Category B** **Garages, pithead sites, railways, textiles, timber treatment and sewage works**	**Site Category C** **Metal workings, scrap yards and shipyards. Paint and solvents**	**Site Category D** **Gas, iron and steel works, chemical works, refineries, ship breaking and building**
Low water risk				
Proposed End Use:				
Public open space	50 to 125	175 to 350	250 to 625	300 to 725
Residential	75 to 200	250 to 625	300 to 725	325 to 825
Employment	50 to 125	200 to 425	250 to 575	300 to 650
Mixed use	50 to 125	225 to 525	300 to 650	325 to 750
High water risk				
Proposed End Use:				
Public open space	125 to 250	400 to 1,025	475 to 1,275	525 to 1,200
Residential	175 to 400	350 to 900	525 to 1,425	700 to 1,725
Employment	125 to 250	250 to 625	500 to 1,200	525 to 1,200
Mixed use	125 to 250	325 to 750	525 to 1,325	600 to 1,375

Technical Note on the calculation of the benchmark unit area costs

The costs have been calculated using different remediation scenarios for each cell in Table 2 combined with some experience and cost estimates based on *Spons Civil Engineering and Highway Works Price Book 2007*. Each scenario is based on a notional development site with a gross area of five hectares and represents a notional remediation scheme based on the site's end use, historical use (based on DEFRA R&D publication CLR 8) and environmental setting. The mixed use scenario is based on an assumption of equivalence to predominantly residential use without gardens and, hence, the cost ranges are close to those for public open space.

The input variables used to define the cost estimates are:

- the broad types of treatment required;
- the depth of treatment for each treatment; and
- the areas to be treated for each treatment (as a proportion of the five hectare site).

In each category, the site has been broken down into components and different remediation techniques with appropriate unit costs applied to each area. Where contamination is not anticipated, a notional cost of £10,000 per hectare has been applied. The costs also include a minimum allowance of £10,000 per hectare for site investigation. Costs are then divided by five to generate per hectare unit costs. Figures are rounded to the nearest £5,000 per hectare.

The scenarios are based on notional sites relating to typical situations and assume a reasonably dense existing development. It is important to note that sites are not homogenous and that different remediation treatments, depths of treatment, and contaminant specific factors will apply in different cases resulting in different unit costs. Annex B describes three case studies which have been used to benchmark the approach.

[5] The classification 'works' is often used in maps to indicate a previous industrial use.

Annex B provides three case studies that demonstrate how to use the benchmark costs in the context of actual sites and their remediation. It will be seen from the case studies how the ranges might be used a) to give a broad indication of likely remediation costs at the outset of an appraisal prior to site investigations and engineering studies and b) to provide a cross check on the cost estimates derived after such investigations and studies had been carried out and to challenge them if they fall significantly outside the expected range.

Guidance in using the benchmark unit costs

The following steps should be followed in using the benchmarks to derive broad-brush estimates of remediation costs at an early stage in appraisal.

1 Based on what is known about the site's existing use, select the best match in columns A to D in Table 1 (e.g. Site Category A).
2 Select an end use for the site (public open space, residential, employment or mixed use).
3 Decide whether there is a high or low risk of contamination dependant upon ground or surface water issues on or adjacent to the site.
4 Read across to the relevant cost range. This provides the upper and lower range of unit area remediation costs.
5 Multiply the per hectare unit area costs by the overall site area, not just the area of contamination (if known or suspected), to estimate the total cost of remediation.

It may be possible to judge whether the costs are expected to be at the higher or lower end of the indicated range along the following lines:

- **Size of the site:** where sites are significantly smaller than five hectares, the upper end of the cost ranges should be considered to allow for the absence of economies of scale. Conversely, the lower end of the ranges should be considered for very large sites.
- **Density of the site:** large sites such as colliery spoil heaps, sewage works and military bases are very unlikely to be remediated over the whole area and so it will be more appropriate to use the lower end of the cost range. Conversely, in dense city centre sites where contamination could be spread over most of the site, the upper cost ranges may be more appropriate.
- **Site context:** in areas where the surrounding sites are known to have needed remediation, it is likely that costs will be greater than the mean cost. Conversely, sites in areas historically clear of problems could result in lower costs.
- **Duration in use:** the longer an area has been used for a particular historical purpose, the more the remediation costs are likely to be higher within the range for that particular use. Sites that have been only in recent use, over say the last two or three decades, may be less contaminated than those used for similar purposes in earlier years. This is due to increased levels of environmental awareness and more stringent environmental regulations.
- **Geology:** after risks to human health, the risk to groundwater or surface water is a primary driver for remediation and the underlying geology will be relevant. If it is known, or can be easily established, that the site lies on areas where the underlying geology is of cohesive material (clays), then the risk of high remediation cost may reduce and lower cost ranges can be used. Conversely, if the site overlies sandstones, chalk or other permeable strata then the use of higher cost ranges should be considered. Of course, it is possible that cohesive materials may overlie a major aquifer and offer some form of protection, which may reduce remediation costs. Therefore, this BPN cannot replace comprehensive site investigation (see Section 7).

The benchmark unit area costs are designed to be used without commissioning studies to interpret them. However, for all projects, particularly those that are large or complex, it must be emphasised that it would be inappropriate to apply this BPN without professional advice even at the early stages of a project. There may be a need to consult experts to carry out desk research to generate enough background information along the above lines to identify the appropriate benchmark cost range and to establish whether the costs were likely to be towards the upper or lower ends of the range. As a general rule, time and resources invested in site investigations and professional advice are unlikely to be wasted.

Sites may have a mixed pattern of intended end uses that span the categories in Table 1. This is reflected in the inclusion of a 'mixed use' range of cost estimates in the table derived on the assumption that this will be equivalent to predominantly residential use without gardens. However, for different proportions of mixed use (say between residential and employment), the cost ranges could be apportioned to generate a new cost range. For example, a new cost range could be estimated for a mixed use site – 50 per cent residential and 50 per cent employment – by taking its lowest bound to be the mid-point of the bottom of the range of unit costs for residential and employment respectively and taking the highest bound to be the mid-point of the high end of the two ranges. Large complex sites with a mix of different past uses and a mix of end uses can be broken down into zones and costs built up from the constituent parts. In order to reduce remedial costs if at all possible it should be the aim to put less sensitive land (e.g. public open space or commercial properties) within the more contaminated parts of the site, whilst more sensitive end uses (e.g. houses) are in the least contaminated areas of the site.

The following qualifications apply to these benchmark costs:

- the costs assume that there is some contamination present. Clearly, if investigation demonstrates the absence of contamination, this section of the BPN will not be applicable;
- they do not cover geotechnical issues – i.e. landfill or changes to ground strata, which are the focus of other BPNs and guidance;
- they do not cover sites with a known radioactivity problem or munitions;
- none of the costs allow for removal or demolition of buildings where there may be additional contamination issues (e.g. asbestos);
- the BPN categorisation classifies mine pithead sites separately from spoil heaps. Pithead sites usually have more expensive treatment needs;
- the unit costs should not be used to determine the level of potential contamination, including costs and liabilities; this can only be done by utilising a multiphase site assessment process;
- users of the BPN should be wary of relying on older site investigation reports as part of desk site investigations. These may not provide an adequate investigation;
- the costs assume that treatment is onsite, and do not reflect exceptional offsite treatment, landfill or insurance costs;
- the figures included within the model assume that no landfill tax is payable. Where such a tax does arise an allowance for this should be made; and
- specialist advice should be taken to ascertain whether tax credits are available.

For site remediation being considered in post 2007 years, adjustments will need to be made to the benchmark costs to reflect inflation rates. It will also be necessary to take into account the effect of changes to regulations.

5 Guidance on assessing the costs of preparing previously developed land (PDL) affected by dereliction

This section presents a model that can be used as a first basis for assessment of the potential costs of preparing sites affected by dereliction. The BPN is not to be used for estimating other site preparation and servicing costs. It does not take account of extensive asbestos removal nor does it cover geotechnical activities. Demolition costs are included to the extent that such works are required to redress dereliction. Infrastructure costs are included only so far as they relate to the stopping up of redundant services at the boundaries of derelict sites (i.e. not off-site works), and the grubbing out of pipes, cables and other utility-related obstructions below the ground. The costs associated with the provision of new site accesses and service infrastructures are not included, as these will apply, more or less equally, to both brownfield and greenfield sites.

Derelict land is defined as *'land so damaged by industrial and other development that it is incapable of beneficial use without treatment'*. Treatment in this context may include demolition, clearing of fixed structures (above or below ground), the removal of redundant services, backfilling and consolidation of the ground and other works required in order to render the site suitable for a proposed hard or soft end use (the model excludes costs associated with the importation of material and specialist compaction techniques).

The model considers a range of works that may be necessary to create a 'development platform' on a piece of derelict land. A development platform is considered to be a site where the necessary works have been undertaken to prepare the site for development for its intended future purpose.

Annex C contains 'Standard' Notional Sites for cost assessment. The sketches shown on these sheets provide brief descriptions of the range of works considered for preparation of the cost estimates, as follows:

- **demolition above ground:** demolition of existing buildings and other structures;
- **demolition below ground:** removal of redundant services and foundations, probing for and removal of obstructions etc including ground and soil restoration though the backfilling of voids with crushed materials arising from site demolitions, and the placing of clean fill, consolidation, grading and levelling to form development platforms (but excluding the importation of new material and the use of specialised compaction techniques);
- **removal of redundant services:** stopping up and removal of gas, water, electricity, drainage, communications; no allowance is made for mains service diversions;
- **fees:** related to the above range of works; and
- **site investigations:** that may include geo-technical, contamination or ordnance surveys.

Sites under consideration have also been categorised in Table 2 and in the 'Standard' Notional Sites according to the following variables:

- **size (of the entire site)** – small sites, up to and including five hectares (Table 2 fixed costs based on average size 2.5 hectares), or large sites greater than five hectares (Table 2 fixed costs based on average size 10 hectares); and
- **complex or non-complex** – see below and also the guidance contained in **Annex C**.

Table 2 also considers the proposed end use of the site i.e. residential, employment, public open space or mixed use.

Costs need to be categorised as 'fixed' or 'variable'. Fixed costs are applied on a per site basis and include stopping up, the removal of redundant services, fees and site investigations. These are shown as unit costs per site because a fixed cost is a more appropriate representation of the level of resource required. Variable costs are applied on a per hectare basis and include demolitions, above ground and below ground (including ground soil restoration but excluding import of new material and the use of specialised techniques).

In general terms, a **complex site** would have all of the features of a special case needing careful consideration and is likely to have some significant infrastructure constraints. Factors to consider include:

- services may need to be cut off at the site boundary and removed from below ground;
- demolitions could be complex and require some shoring and careful working to prevent cross contamination, nuisance etc. Underpinning of adjoining highways and buildings may also be required but is excluded from the present cost modelling;
- obstructions in the ground, such as machinery bases and sub-basements, may need removal and may require a number of specialised techniques; and
- hazardous materials and contaminants may be encountered that had not been revealed by the site investigations, although these have been assumed to comprise a relatively minor proportion of the site preparation costs, otherwise Section 4 above will apply with regards to the treatment of costs for the removal of contamination.

A **non-complex site** may have the following characteristics:

- services stopping up and removal predominantly small and few;
- demolitions above ground would relate to stand alone buildings with little in the way of known contaminants and there would be some residual value in salvaged materials;
- demolition below ground would be related to conventional substructures with little in the way of obstructions to remove;
- the level of specialist advice needed would rely on easily available information; and
- the site would have ready access on more than one side and is unlikely to be in a large urban environment.

Having categorised the site, the applicable costs can then be taken from the relevant range of costs per hectare in the high level summary provided in Table 2 opposite. Within each box, a range of costs is given according to the extent of works anticipated.

Further guidance on how to determine which end of the range is most appropriate and a more detailed method of assessing costs is provided in **Annex C** of this BPN.

Table 2: Derelict land preparation costs: high level summary (£000s)

Mixed Use				
	Small		Large	
	Non-complex	**Complex**	**Non-complex**	**Complex**
Range per ha	125 to 200	225 to 400	75 to 175	200 to 250
Mid-point per ha	**162.5**	**312.5**	**125**	**225**
Fixed cost range	125 to 275	275 to 425	275 to 425	800 to 1,075
Mid-point fixed cost per site	**200**	**350**	**350**	**937.5**
Residential				
	Small		Large	
	Non-complex	**Complex**	**Non-complex**	**Complex**
Range per ha	120 to 200	250 to 400	100 to 200	200 to 250
Mid-point per ha	**160**	**325**	**150**	**225**
Fixed cost range	150 to 275	300 to 475	325 to 500	925 to 1,250
Mid-point fixed cost per site	**212.5**	**387.5**	**412.5**	**787.5**
Public Open Space				
	Small		Large	
	Non-complex	**Complex**	**Non-complex**	**Complex**
Range per ha	100 to 200	225 to 400	75 to 125	200 to 250
Mid-point per ha	**150**	**312.5**	**100**	**212.5**
Fixed cost range	150 to 250	275 to 425	300 to 450	850 to 1,150
Mid-point fixed cost per site	**20**	**350**	**375**	**1,000**
Employment				
	Small		Large	
	Non-complex	**Complex**	**Non-complex**	**Complex**
Range per ha	120 to 200	225 to 400	100 to 175	200 to 250
Mid-point per ha	**160**	**312.5**	**137.5**	**212.5**
Fixed cost range	125 to 225	275 to 400	275 to 425	800 to 1,075
Mid-point fixed cost per site	**175**	**337.5**	**350**	**937.5**

How to Use:

a Decide on the end use and whether small or large.

b For each component decide whether complex or non-complex.

c According to the criteria decide where the costs lie within the given ranges (use mid-point if no further information available.

d For each site apply the appropriate fixed cost estimate.

e For each site apply the appropriate per hectare cost estimate multiplied by the area of the site.

f For each site add **d** to **e**.

NB

The data needs to be indexed for sites outside of London.

Figures quoted in ranges have been rounded to nearest £25,000.

6 Regional variation

As is the case for contaminated land in Section 4, the benchmark costs can be used to check on cost estimates (e.g. by the project applicant or by the consultant engineers). They might provide a basis for querying the estimates if they lie outside the appropriate range taken from the tables.

The benchmark unit area costs are designed to be used without commissioning studies to interpret them. For some projects, particularly those that are large or complex, it must be emphasised that it would be inappropriate to apply this BPN without professional advice. There may be a need to consult experts to carry out desk research to generate enough background information along the above lines to identify the appropriate benchmark cost range and to establish whether the costs were likely to be towards the upper or lower ends of the range. As a general rule, time and resources invested in site investigations and professional advice are unlikely to be wasted.

Sites may have a mixed pattern of intended end uses that span the categories in the tables. This is reflected in the inclusion of a 'mixed use' range of cost estimates in the table derived on the assumption that this will be equivalent to predominantly residential use without gardens. However, for different proportions of mixed use (say between residential and employment), the cost ranges could be apportioned to generate a new cost range. For example, a new cost range could be estimated for a mixed use site – 50 per cent residential and 50 per cent employment – by taking its lowest bound to be the mid-point of the bottom of the range of unit costs for residential and employment respectively and taking the highest bound to be the mid-point of the high end of the two ranges. Large complex sites with a mix of different past uses and a mix of end uses can be broken down into zones and costs built up from the constituent parts. In order to reduce costs if at all possible it should be the aim to put less sensitive uses (e.g. public open space or commercial properties) within areas that have the greatest proportion of underground structures, whilst more sensitive end uses (e.g. houses) are in areas of the site with fewer underground structures.

The following qualifications apply to these benchmark costs:

- costs per hectare are based on a set of assumptions and the model has identified the components that make up the range of cost and the mid-point;
- it should be noted that as the size of the site increases the fixed costs reduce proportional to area;
- certain components of the model may or may not apply to particular sites, for example, the site may have only below ground electric services to stop up, or both overhead and below ground supplies to divert;
- the exceptional cost of offsite works of major diversions is excluded as is supply reinforcement. Assumptions are made related to unit lengths only; and
- below ground obstructions are assumed to be removed within the plane of normal development with obstructions below that depth being left in place.

The benchmark costs in Tables 1 and 2 are based on a database of actual costs held by English Partnerships and its partners indexed to outer London for contamination (Table 1) and non-complex derelict sites (Table 2), and South East England for complex derelict sites (Table 2). The estimates reflect prices prevailing in 2007 (1st Quarter). The costs need to be adjusted for other regions (see Table 3 below) and to take account of future price fluctuations

Table 3: Adjustments for regional variations

Area	Contamination remediation	Dereliction non-complex	Dereliction complex
East of England	0.92	0.92	0.95
East Midlands	0.92	0.92	0.94
London (Outer)	1.00	1.00	1.05
London (inner)	1.07	1.07	1.12
North East	0.95	0.95	1.00
North West	0.91	0.91	0.95
Scotland	0.95	0.95	1.02
South East	0.98	0.98	1.00
South West	0.91	0.91	0.94
West Midlands	0.93	0.93	0.95
Wales	0.91	0.91	0.93
Yorkshire and the Humber	0.95	0.95	0.97

7 Due diligence and site investigations

The purpose of this part of the BPN is to inform English Partnerships project managers and development partners of the key steps and processes involved in undertaking essential site investigations, prior to the acquisition of land/property, as part of a process of due diligence. The site investigations described should be undertaken by an appropriately qualified consultant, but the following sections aim to promote an improved understanding of the processes which can be reflected in briefing material for consultants.

Due diligence investigation is undertaken in order to identify any existing contamination or other related site problems, such as water related risks, that may present a risk to humans, the environment or property. This forms the first stage of a phased assessment process that may lead to land remediation to tackle contamination and/or dereliction. It should be noted that the potential presence of contamination at a site and any proposed mitigation measures will be a material consideration in obtaining planning permission for a proposed development. Regular due diligence site assessment/ investigation is also a requirement for the operation and decommissioning of industrial installations operating under Pollution Prevention and Control Regulations.

Varying legal definitions of 'contamination' exist that provide the context for site remediation. These include definitions established both for 'Land Affected by Contamination' under Planning legislation and 'Contaminated Land' in Part 2A of the *Environmental Protection Act 1990*[6]. In addition it should be recognised that additional legislative, directive or common law definitions may be relevant to the assessment and decision making process. Planning Policy Statement 23[7], *Planning and Pollution Control*, Annex 1, provides a list of such matters for consideration in preparing development plans and consideration in granting planning approval.

The requirement to undertake remediation may present considerable cost and time constraints for the development of a site. As a result, all sites should be fully assessed prior to purchase as part of the due diligence process. This may also form the basis for subtracting 'abnormal costs' from any price for purchase of the site, subject to the agreed definition of these for a project. It is important to note that, should investigation identify significant contamination that presents an on-going risk to statutory receptors (comprising humans, controlled waters and/or property), remediation may be required under Part 2A of the *Environmental Protection Act* regardless of any decisions or timescales for the redevelopment of the site. In order for any redevelopment to be approved by the local planning authority, intrusive investigations and risk assessments are almost always required as a condition of planning permission for a brownfield site.

Appraisal of risk

Contaminated land assessment is based upon the principle of 'risk' assessment rather than the appraisal of 'hazard'. Therefore, in order for a site to pose a defined 'risk' there must be a contaminant source, a receptor sensitive to that contamination, and a pathway between the two. These pollutant linkages (source-pathway-receptor) are fundamental to investigations and risk assessments and are developed within the Conceptual Site Model (CSM) for the site. Normally there must be confidence that pollutant linkages are either absent or do not give rise to significant risks in order for planning permission to be granted or to provide confidence that a site cannot be classified as 'contaminated land' under Part 2A of the *Environmental Protection Act*.

The sensitivity of the development will greatly influence the CSM and the number of potential pollutant linkages. In decreasing order of human health sensitivity are the following developments:

- residential properties with gardens (e.g. houses);
- residential properties without gardens (e.g. flats);
- commercial and/or industrial developments; and
- public open space.

Concerning the wider environment, pollutant linkages must also be considered for offsite human receptors, controlled water receptors (under the remit of the Environment Agency), other ecological receptors (such as Local Nature Reserves), and property.

Pollutant linkages may pre-exist at any site or be introduced by redevelopment. Site investigations provide the basis to assess the significance of these and the likely requirements and costs of remediation.

In order to make best uses of resources any site investigation should be carried out using a phased approach, as recommended within authoritative guidance, published by DEFRA and the Environment Agency Contaminated Land Report 11 (CLR 11)[8]: *Model Procedures for the Management of Land Contamination*.

A Preliminary (Tier 1) Risk Assessment (as described in CLR 11) is the absolute minimum action that should be effected prior to the acquisition of a brownfield site. This will involve a desktop review of available environmental and geotechnical literature information, such as (but not limited to):

- historical maps;
- geological and hydrogeological maps;
- landfill information;
- potential for radon;
- contemporary trade directories; and,
- records of the Coal Authority, local petroleum officer, Environment Agency and local Environmental Health Department.

[6] *The Environmental Protection Act 1990* (HMSO)
[7] *Planning Policy Statement 23, 2004* (HMSO)
[8] DEFRA and The Environment Agency, 2004. *Contaminated Land Report 11 (CLR 11)*

In order to supplement the desktop review, a site reconnaissance survey, or 'walkover', should be carried out, in order to visually assess site conditions. In conjunction with the desktop review the 'walkover' will enable an effective Preliminary (Tier 1) Risk Assessment to be completed and inform the requirements for intrusive investigation and the potential for remedial requirements.

Intrusive investigation will normally require vehicular access to a site and such access arrangements must be confirmed prior to works. The written permission of the current owner of the site to be investigated will be required and under no circumstances should investigation commence without this. Where intrusive investigations take place, the Health and Safety documentation of any appointed contractor should be reviewed and approved prior to the commencement of works. It is noted that 'CDM regulations' apply to investigations where development is foreseeable.

Typically an intrusive investigation could comprise one or more the following components (in order of increasing cost per day):

- hand dug trial pits (generally up to 1.2 m depth without shoring);
- hand augured holes (generally up to 5 m depth depending on ground conditions);
- machine (JCB or similar) excavated trial pits (generally 3.5 – 5 m depth);
- window/windowless-sample (percussive dynamic) holes (generally up to 6 m depth depending on ground conditions);
- cable percussive (or dynamic) boreholes (generally up to 40 m depth or more depending on ground conditions); and,
- rotary cored or open holes (for achieving depth in rock formations).

Please note that other costs may be associated with these works, for example, costs to install monitoring wells and drilling costs per metre, chiselling and standing time, as well as mobilisation.

Any intrusive site investigation works should be supervised by an appropriately qualified geo-environmental scientist/engineer in accordance with the British Standards BS5930 *Code of Practice for Site Investigations*[9], BS10175 *Investigation of Potentially Contaminated Sites*[10] and BS8485 *Code of Practice for the characterisation and remediation from ground gas in affected developments*[11]. The investigation should accurately describe and define (or 'log') the materials encountered, record any in-situ testing undertaken and accurately record the elevation and locations of the exploratory hole positions. Sufficient representative soil samples should be obtained from the various soil strata encountered and stored in an appropriate fashion to limit any contaminant or sample degradation. All samples should be quickly dispatched with a completed 'chain of custody' form to a UKAS accredited analytical laboratory following MCERTs procedures (where appropriate). Under normal circumstances groundwater and ground gas monitoring installations should be installed within window/windowless sample holes, boreholes and/or rotary holes to allow monitoring and sampling of these media on subsequent visits. In order to maximise cost effectiveness, the scope of any intrusive investigation should also include basic geotechnical investigations to inform likely development design and associated abnormal risks.

In order to assess the significance of any potential pollutant linkages, site specific analytical suites for contamination should be determined based on the findings of the Preliminary (Tier1) Risk Assessment. A list of potential contaminants associated with specific industries is presented in CLR 8 (*Potential Contaminants for the Assessment of Land*[12]) and the former Department of the Environment Industry Profiles. As a general guide any soils suite should, as a minimum, include testing for heavy metals, phenol, pH, cyanide, sulphates, hydrocarbons and asbestos.

Should potential pollutant linkages associated with water receptors be identified, groundwater monitoring wells should be installed during the intrusive site investigation and an appropriate monitoring programme completed. Water samples should be obtained during the monitoring programme and scheduled for laboratory analysis at a UKAS accredited laboratory. As with the soils analysis the Preliminary (Tier 1) Risk Assessment will identify the appropriate analytical suite, although those general parameters identified for soils (with the exception of asbestos) should be considered a minimum requirement.

Should potential pollutant linkages involving ground gas be identified, ground gas monitoring (e.g. methane, carbon dioxide, oxygen, hydrogen sulphide and hydrocarbon gasses) should be undertaken. This is normally carried out in conjunction with the groundwater monitoring programme. Any ground gas monitoring programme and reporting should follow the recommendations provided in BS8485:2007 *Code of Practice for the characterisation and remediation from ground gas in affected developments*, CIRIA Report 665: *Assessing Risks Posed by Hazardous Gases to Buildings* and NHBC Guidance on *Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present.* It should be noted that more visits are usually required, over several months, to characterise a site's ground gas regime than may be required to characterise the hydrogeological regime. This is because gas monitoring results are influenced by a range of weather conditions, including atmospheric pressure.

The intrusive investigation should discount or confirm any potential sources of contamination and associated pollutant linkages identified in the Preliminary (Tier 1) Risk Assessment for all media (soil, water and gas). This should be undertaken in accordance with the procedures for a Generic Quantitative (Tier 2) Risk Assessment set out in CLR 11.

[9] BSI, 1999. *Code of Practice for Site Investigations,* (BS5930 HMSO)
[10] BSI, 2001. *Investigation of Potentially Contaminated Sites,* (BS10175 HMSO)
[11] BSI, 2007. *Code of Practice for the characterisation and remediation from ground gas in affected developments,* (BS 8485 HMSO)

[12] DEFRA, 2002. *CLR 8 Potential Contaminants for the Assessment of Land* (Environment Agency)

8 Summary

Should the Generic Quantitative (Tier 2) Risk Assessment identify any potentially significant pollutant linkages it will normally be necessary to undertake a Detailed Quantitative (Tier 3) Risk Assessment (as described in CLR 11) or proceed directly to a remediation.

A Detailed Quantitative (Tier 3) Risk Assessment will seek to establish the significance of any potential pollutant linkages identified following the Generic Quantitative (Tier 2) Risk Assessment by using site specific data. In general terms this comprises the use of site specific and literature based data to quantitatively characterise pathway components of the CSM within a risk assessment package (such as CLEA UK for human health receptors or EA 3.1 Remedial Targets Worksheet for controlled water receptors). This allows Site Specific Assessment Criteria (SSACs) to be developed for acceptable concentrations of contaminants in soils, waters and/or gas. Direct comparison of the results of the intrusive investigation against these SSACs can then be undertaken to reassess the need for a site remediation.

Where issues of risk are identified following this phased approach it is normal practice to implement a process of regulatory consultation and remediation appointment and design.

This Best Practice Note has been prepared to assist the stakeholders involved in the redevelopment and reuse of brownfield land, whether that land is affected by the presence of contaminative substances, or is in a state of dereliction. It will be noted that, whilst the costs of dealing with contamination vary significantly according to both the historic and proposed uses of the site, there is less variation in terms of the costs of tackling dereliction. This is because, in dealing with dereliction, it is not necessary to remove or break contamination pathways. Also, the obstacles arising out of dereliction are, for the most part, likely to hinder land reuse regardless of the eventual form of development.

Whilst English Partnerships' specialist staff and external consultants have used their best endeavours to ensure that this BPN accurately reflects current best practice for dealing with contaminated and derelict land, English Partnerships does not accept any responsibility for any loss which may arise from reliance on information contained in this BPN. All of the cost ranges provided are intended to be indicative and, it must be emphasised, should be used in context with the best site specific information available at any point in a project's life.

References

Acts of Parliament

The Environmental Protection Act 1990 (HMSO)

The Water Resources Act 1991 (HMSO)

The Environment Act 1995 (HMSO)

The Water Act 2003 (HMSO)

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The Hazardous Waste (England and Wales) Regulations 2005 (SI 2005/894 HMSO)

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BSI

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DEFRA and The Environment Agency, 2004. *Contaminated Land Report 11 (CLR 11): Model Procedures for the Management of Land Contamination* (Environment Agency)

English Partnerships, 2006. *The Brownfield Guide: a practitioner's guide to land reuse in England* (English Partnerships, (HMSO)

Environment Agency, 2006. *Remedial Targets Worksheet, v3.1* (Environment Agency)

HM Treasury, 2003. *The Green Book, Appraisal and Evaluation in Central Government* (TSO)

ODPM, 2004. *Assessing the Impacts of Spatial Interventions (3Rs)* (HMSO)

Planning Policy Statement 23, (Planning and Pollution Control) 2004 (HMSO)

Spons, *Civil Engineering and Highway Works Price Book,* 2007. *Spons* (Taylor and Francis)

Wilson, S. & Oliver S. & Mallett, H. & Hutchings H. & Card G, 2007. *Report 665, Assessing Risks Posed by Hazardous Gases to Buildings* (CIRIA)

Annexes

Annex A
Contaminated Land: applications in real environments (**CL**:AIRE)

Annex B
Case studies of previously developed land (PDL) contamination remediation

Annex C
Detailed guidance for modelling the cost of remediating Derelict Sites:

i diagrams of notional sites to illustrate the differentiation between 'complex' and 'non-complex' sites;

ii guidance for determining where a particular site lies within the range of possible costs; and

iii the range of potential remediation costs for preparing derelict land for development according to different site complexity, size and proposed end use.

Annex A: **CL**:AIRE

1 As part of its remit to develop best practice in remediation, English Partnerships and other stakeholders set up **CL**:AIRE (Contaminated Land: applications in real environments) in 1999. English Partnerships has been central to the development of **CL**:AIRE, contributing staff resources and meeting a major part of its core costs. It remains a key supporter of the initiative.

2 **CL**:AIRE is a respected, independent, not-for-profit organisation established to stimulate the regeneration of contaminated land in the UK by raising awareness of, and confidence in, practical and sustainable remediation technologies and reducing the quantity of soil going to landfill.

3 It is an environmental charity and company limited by guarantee. Other stakeholders in **CL**:AIRE include; The Environment Agency, Department of the Environment for Northern Ireland, the Welsh Assembly Government, Soil and Groundwater Technology Association and the Scottish Environmental Protection Agency.

4 **CL**:AIRE is one of the leading organisations within contaminated land in the UK, fulfilling a need for objective, scientifically robust appraisals of remediation technologies and effective methods for monitoring and investigating sites. Its independence allows it to appraise and disseminate innovation in remediation, increasing confidence across the entire industry and driving forward the effective remediation of contaminated land.

5 **CL**:AIRE has an advisory group, the Technology and Research Group (TRG) which draws on leading professionals and academics within the field to provide independent, third party appraisals of remediation technologies and research.

6 **CL**:AIRE has free monthly e-alert keeping stakeholders up to date with contaminated land activities and has published over 80 publications with a number of them free. These can be accessed via their website (www.claire.co.uk). Publications include a series of short technical, case study, site, guidance and research bulletins, and more detailed Technology and Research Project Reports.

Annex B: Case studies of previously developed land (PDL) – contamination remediation

Three case studies are presented as examples to show how the unit cost benchmarks can be used and if they generate the appropriate ranges in real cases. Each is structured in terms of the following:

- scheme and site description;
- choice of unit cost benchmark and the resulting benchmark cost; and
- assessment of the benchmark unit costs as compared with actual.

The cost estimates provided through the benchmarks were derived from benchmark proformas circulated to English Partnerships' own engineering consultants combined with follow up interviews with engineers. The following observations were made in collecting the information which may influence the use and accuracy of actual cost estimates derived through this approach:

- There is a significant concern about confidentiality when discussing costs of remediation programmes. Especially as these often involve non-English Partnerships agents. The cases selected here also do not represent projects involving English Partnerships.
- English Partnerships' engineering consultants are often the designers of schemes and the practical issues, details and costs are often the contractor's responsibility. The designers are not always with the project to completion. Project teams can sometimes be disbanded making it difficult to collect all the knowledge gained and summarise any lessons learned from the project.
- Contamination issues are not always subject to a separate set of contracts, especially if the cost of remediation is small compared to the overall scheme, or the project sponsors take the risk. Some programmes of works such as landscaping or hard standing will be undertaken anyway, so may not be seen as a remediation cost.
- Projects often use existing available surveys and assessments, which may hide the real cost of remediation as our case studies suggested they do not count the sunk costs relating to assessments by others, for example a previous owner.

Case study A: Contaminated areas by an industrial canal

Scheme and site description

The site represents a two hectare severely contaminated area of ground used for 100 years to manufacture a range of chemicals, including arsenic products, organo-chlorinated compounds and pesticides. The site is above a chalk aquifer and adjacent to a canal and residential housing. A recent purchaser of the site planned to redevelop for residential purposes.

Earlier stages of work included reviewing previous information and looking at the history of what had been manufactured on the site. Subsequently £50,000 of preliminary investigation, boreholes, geophysical monitoring, trial pitting, probing and testing was undertaken. On this basis, a remediation strategy was developed with a costed options appraisal. Options varied in cost between £1.5m and £3.5m. The preferred option was projected to cost £2.5m.
A main concern for the strategy was to deal with the site's location above an aquifer, which can lead to contaminants entering wider water sources extending beyond the site. The remediation strategy for the agreed option involved removing solid and aqueous material from within the aquifer. Interlocking sheet metal piles were used to isolate areas of ground above and within the aquifer. From these areas the water was drained, treated and fed to the sewer. The contaminated land itself was removed and disposed of. The resulting hole was filled with a combination of infilling from demolished nearby buildings and re-profiling the overall relief of the site.

In practice the cost of the remediation was around £2.2m (adjusted to £2.4m first quarter 2007 prices), which is significantly less than the projected cost, although there was a large contingency cost of £300,000. The figures include some costs for remediating asbestos from the buildings used to infill (approximately five per cent). Costs also included an insurance cost cap (an insurance product from environmental insurers) to limit the overall costs to £2.5m.

Identification of benchmark cost

Estimated cost based on the BPN categorisation:

- **end use:** Residential
- **current description of site:** Equivalent to a chemical factory
- **water risk:** High

The BPN estimated cost is £700,000 to £1,725,000 (see table).
The actual cost was £1,200,000 per hectare (adjusted to £2.4m first quarter 2007 prices).

Assessment of the benchmark cost compared to actual cost

The actual costs provide a good match to the mid-point of the BPN forecast range.

Identification of benchmark cost (Case study A contaminated canal) (£000s)

Spons 2007-Index 500	**Description of site in its historic use** Increasing cost of remediation...			
	Site Category A **Industrial sites, colliery/ mine spoil heaps, factories and 'works'[13]**	**Site Category B** **Garages, pithead sites, railways, textiles, timber treatment and sewage works**	**Site Category C** **Metal workings, scrap yards and shipyards. Paint and solvents**	**Site Category D** **Gas, iron and steel works, chemical works, refineries, ship breaking and building**
Low water risk				
Proposed End Use:				
Public open space	50 to 125	175 to 350	250 to 625	300 to 725
Residential	75 to 200	250 to 625	300 to 725	325 to 825
Employment	50 to 125	200 to 425	250 to 575	300 to 650
Mixed use	50 to 125	225 to 525	300 to 650	325 to 750
High water risk				
Proposed End Use:				
Public open space	125 to 250	400 to 1,025	475 to 1,275	525 to 1,200
Residential	175 to 400	350 to 900	525 to 1,425	700 to 1,725
Employment	125 to 250	250 to 625	500 to 1,200	525 to 1,200
Mixed use	125 to 250	325 to 750	525 to 1,325	600 to 1,375

[13] The classification 'works' is often used in maps to indicate a previous industrial use.

Case Study B: Contaminated docks

Scheme and site description

This site has an area of 2.9 hectares. It adjoins docks and is to be developed for commercial purposes. Contaminants were found to include hydrocarbon contamination from diesel oils, localised asbestos, imported materials (dredging waste), waste from nearby road construction and other man made materials bulldozed into the dock itself. Only parts of the site were identified as having contamination.

Site investigations identified those areas not contaminated and suitable for future planned uses and those areas in need of remediation, according to a 25 m grid over the area. The process required liaison with the local authority and the Environment Agency. This resulted in a Remediation Action Plan. On this basis areas acceptable for the proposed end uses were more clearly identified.

The remediation approach was to evacuate contaminated land and dispose of at a landfill site. The unit area (hectare) cost for investigation and monitoring was £60,000. Overall, the pre-remediation monitoring costs were around half of the unit area costs of actual remediation (circa £120,000). In practice the remediation costs were reported a little higher than planned, although not necessarily higher than the contingency. This was due to areas of contamination lying along or between the grid monitoring system that were not identified. Although the existence of these was not unexpected, they added to overall remediation costs.

Identification of benchmark cost

Estimated cost based on the BPN categorisation:

- **end use:** Residential
- **current description of site:** Dockside – equivalent to a shipyard
- **water risk:** High

The BPN estimated cost is £525,000 to £1,425,000 per hectare (see table). The actual cost was £660,000 per hectare (adjusted to first quarter 2007 prices).

Assessment of the benchmark cost compared to actual cost

The actual costs provide a good match within the BPN forecast range.

Identification of benchmark cost (Case study B contaminated docks) (£000s)

Spons 2007-Index 500	**Description of site in its historic use** Increasing cost of remediation...			
	Site Category A **Industrial sites, colliery/ mine spoil heaps, factories and 'works'[14]**	**Site Category B** **Garages, pithead sites, railways, textiles, timber treatment and sewage works**	**Site Category C** **Metal workings, scrap yards and shipyards. Paint and solvents**	**Site Category D** **Gas, iron and steel works, chemical works, refineries, ship breaking and building**
Low water risk				
Proposed End Use:				
Public open space	50 to 125	175 to 350	250 to 625	300 to 725
Residential	75 to 200	250 to 625	300 to 725	325 to 825
Employment	50 to 125	200 to 425	250 to 575	300 to 650
Mixed use	50 to 125	225 to 525	300 to 650	325 to 750
High water risk				
Proposed End Use:				
Public open space	125 to 250	400 to 1025	475 to 1,275	525 to 1,200
Residential	175 to 400	350 to 900	525 to 1,425	700 to 1,725
Employment	125 to 250	250 to 625	500 to 1,200	525 to 1,200
Mixed use	125 to 250	325 to 750	525 to 1,325	600 to 1,375

[14] The classification 'works' is often used in maps to indicate a previous industrial use.

Case Study C: Colliery site

Scheme and site description

The site with an area of 1 hectare was previously used as a colliery, and located near a stream and areas of groundwater. Assessments had judged there to be minor sensitivity to aquifers. The proposed end use of the site was for commercial purposes. The programme of works started in 1999.

Identification of unit benchmark

Estimated cost based on the BPN categorisation:

- **end use:** Employment
- **current description of site:** Colliery. Not clear if it is a spoil heap or a pit head site, so it may be more than one category
- **water risk:** Minor based on risk assessments

The BPN estimated cost is £50,000 to £125,000 per hectare for a spoil heap site and £175,000 to £350,000 for a pit head site (see table). The actual cost was £135,000 per hectare (adjusted to first quarter 2007 prices).

Assessment of the benchmark cost compared to actual cost

The actual cost of remediation is between the lowest and highest possible remediation costs. Although the range is very wide. The value of the benchmarking exercise here might be to direct pre-appraisers to ask more detailed questions. In particular, if there is a pithead, and if so, how much of the site it covers.

Identification of benchmark cost (Case study C colliery site) (£000s)

Spons 2007-Index 500	**Description of site in its historic use** Increasing cost of remediation...			
	Site Category A **Industrial sites, colliery/ mine spoil heaps, factories and 'works'[15]**	**Site Category B** **Garages, pithead sites, railways, textiles, timber treatment and sewage works**	**Site Category C** **Metal workings, scrap yards and shipyards. Paint and solvents**	**Site Category D** **Gas, iron and steel works, chemical works, refineries, ship breaking and building**
Low water risk				
Proposed End Use:				
Public open space	50 to 125	175 to 350	250 to 625	300 to 725
Residential	75 to 200	250 to 625	300 to 725	325 to 825
Employment	50 to 125	200 to 425	250 to 575	300 to 650
Mixed use	50 to 125	225 to 525	300 to 650	325 to 750

[15] The classification 'works' is often used in maps to indicate a previous industrial use.

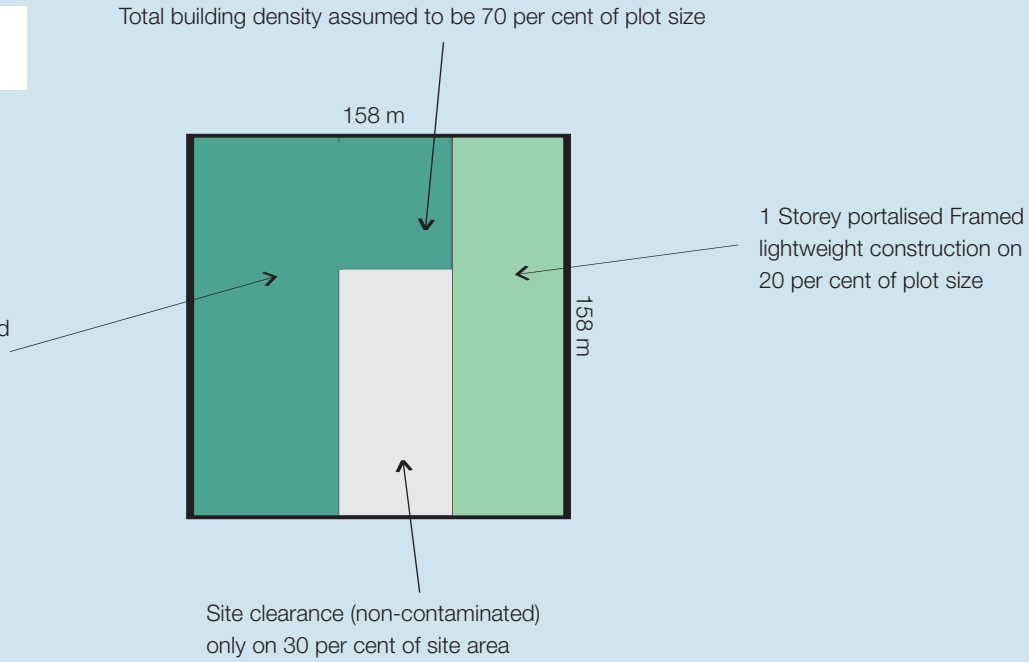
Annex C (i): Illustrative guide to explain complex and non-complex sites

Demolitions above ground

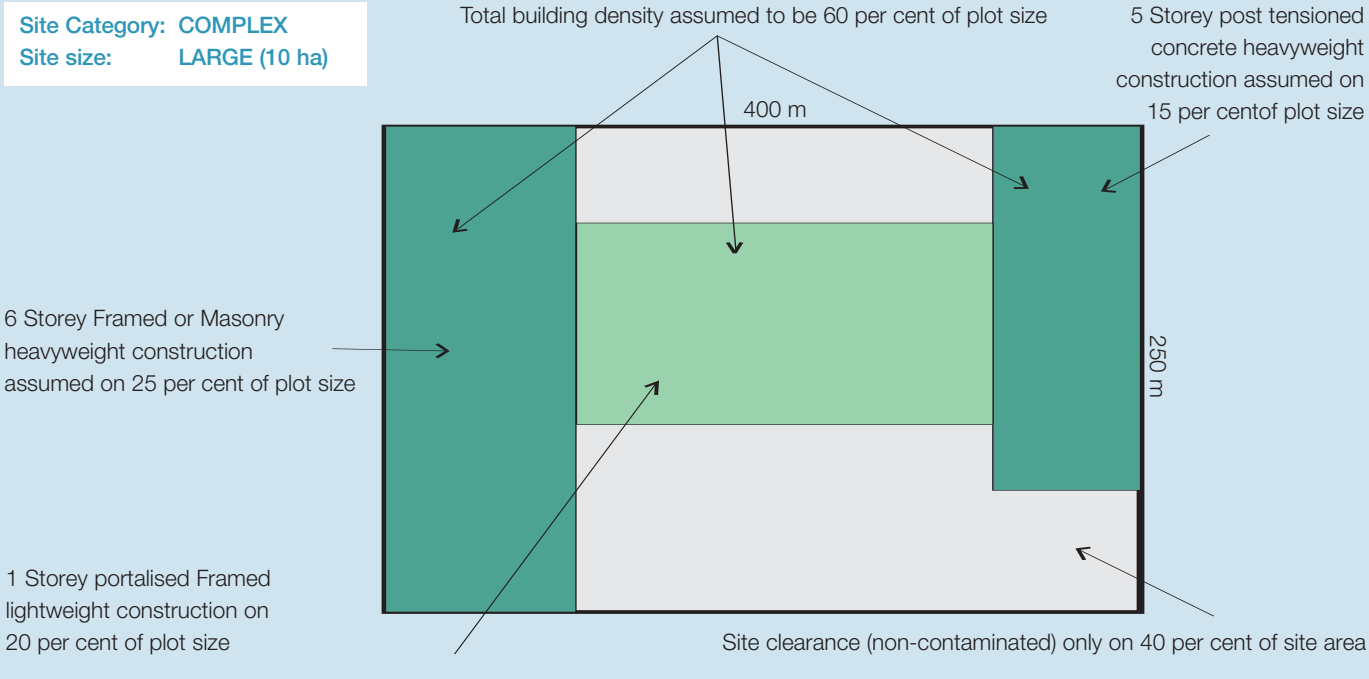
BPN Derelict Land Costs

'Standard' Notional Sites for cost assessment

Site Category: COMPLEX
Site size: SMALL (2.5 ha)



Site Category: COMPLEX
Site size: LARGE (10 ha)



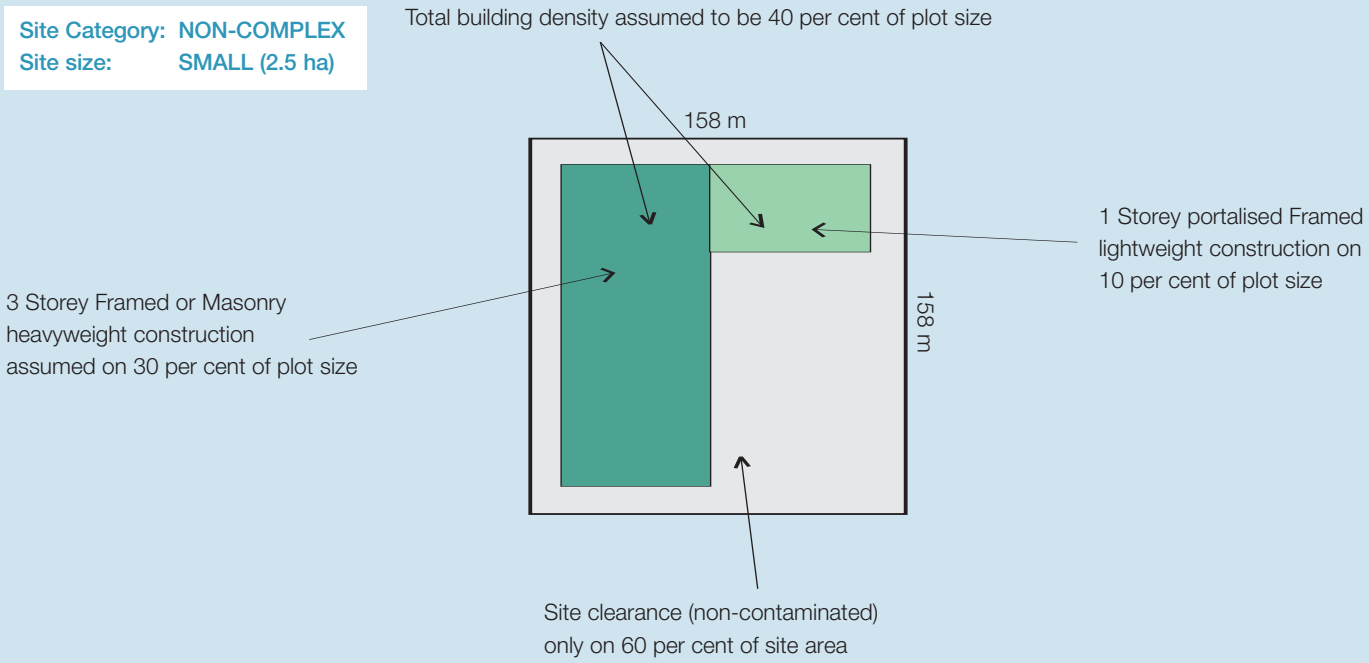
Notional site plans. All pilecaps/columns on notional 7.5 m grid.

Demolitions above ground

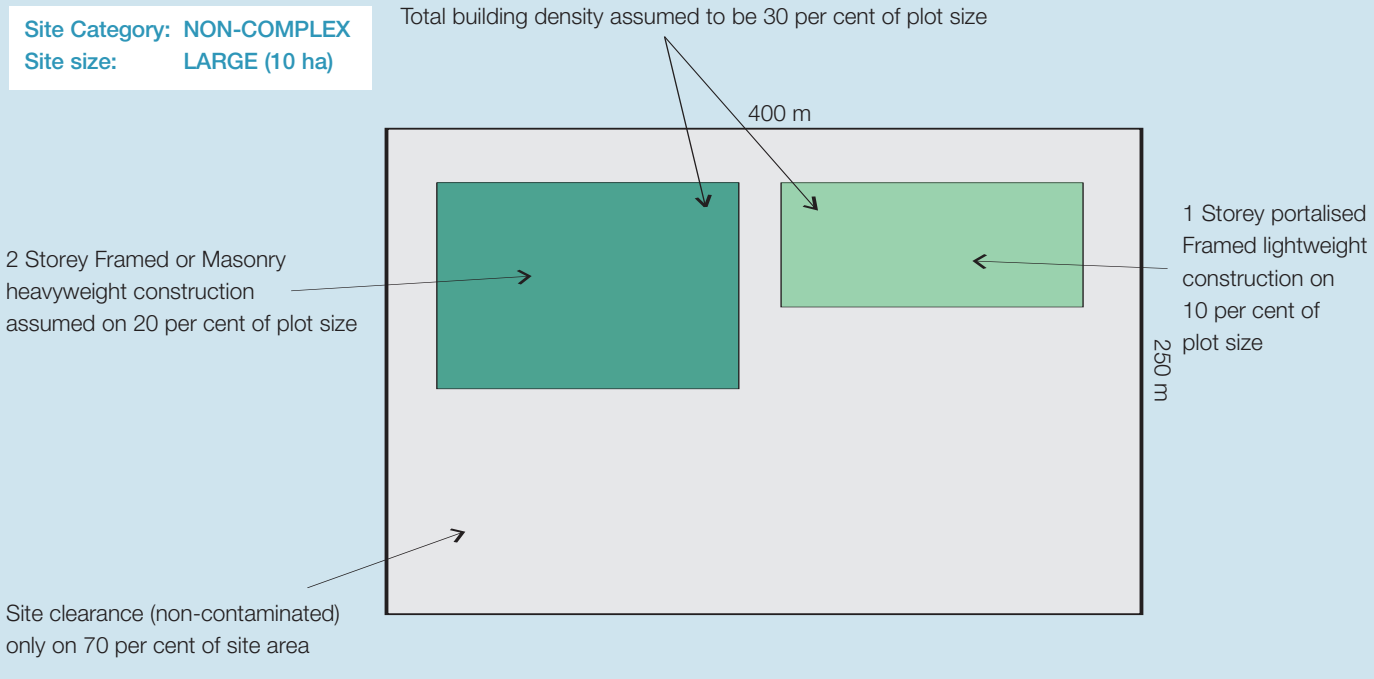
BPN Derelict Land Costs

'Standard' Notional Sites for cost assessment

Site Category: NON-COMPLEX
Site size: SMALL (2.5 ha)



Site Category: NON-COMPLEX
Site size: LARGE (10 ha)



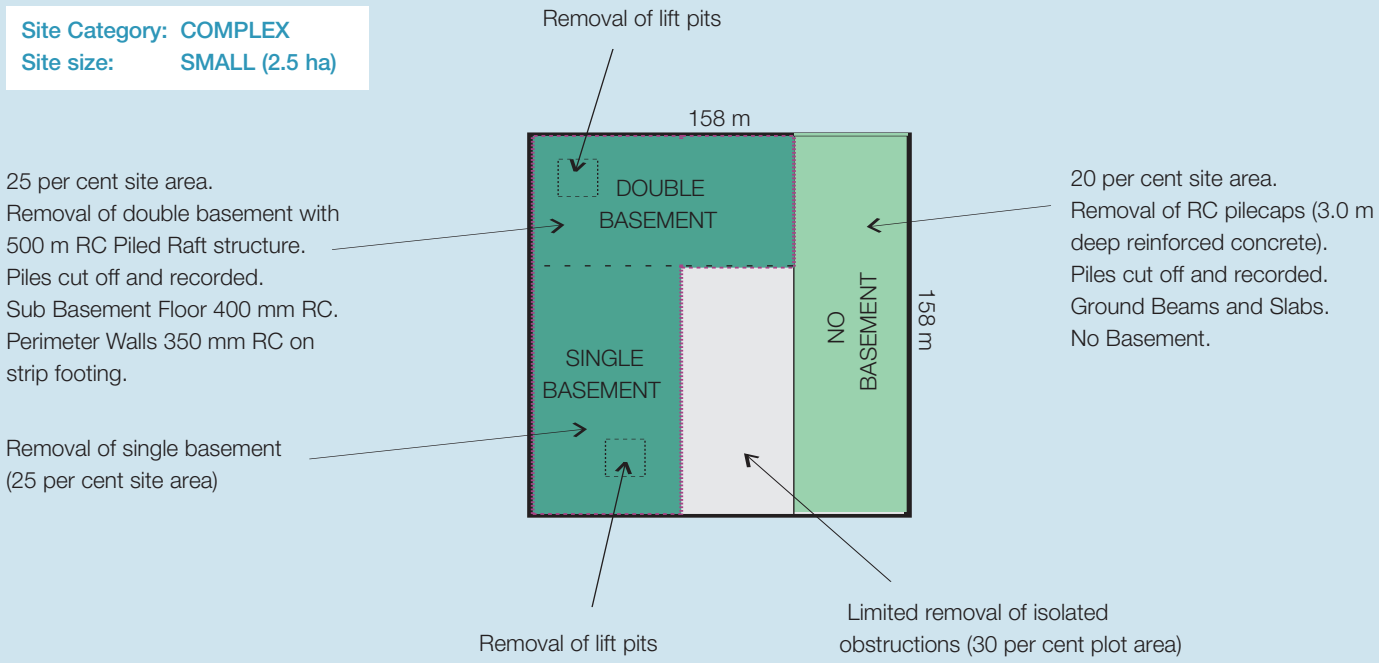
Notional site plans. All pilecaps/columns on notional 7.5 m grid.

Demolitions below ground

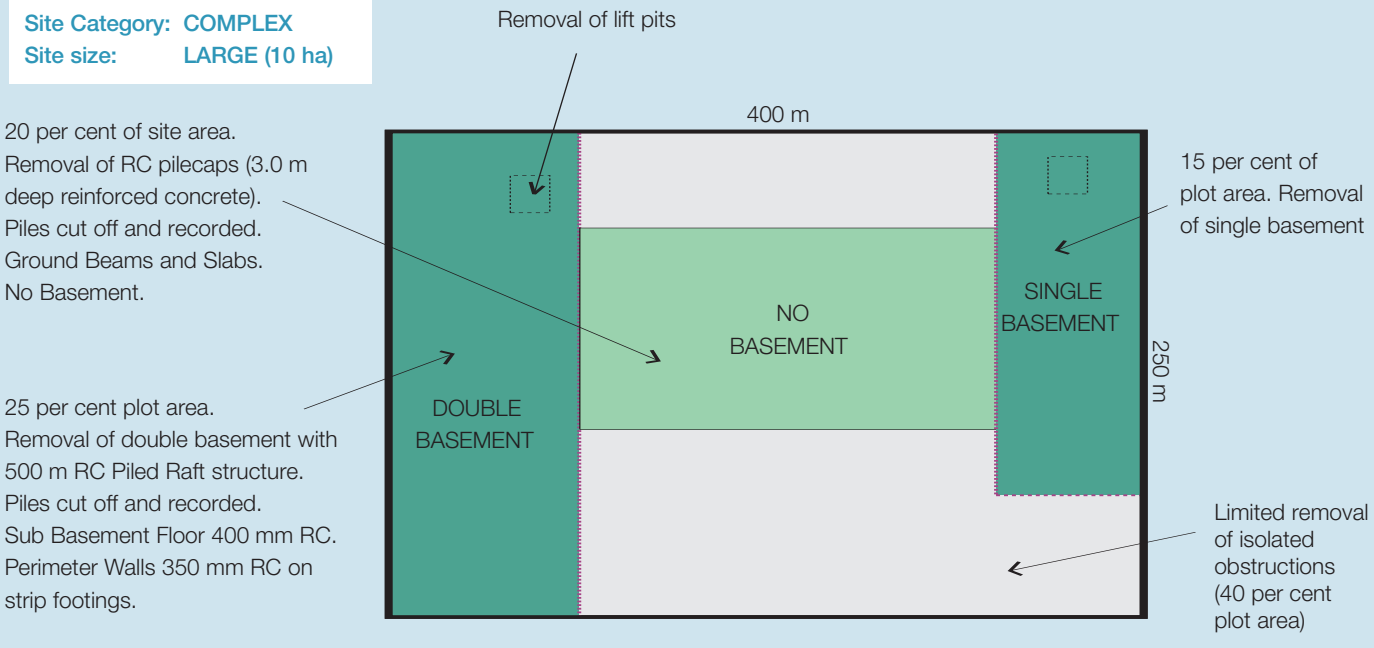
BPN Derelict Land Costs

'Standard' Notional Sites for cost assessment

Site Category: COMPLEX
Site size: SMALL (2.5 ha)



Site Category: COMPLEX
Site size: LARGE (10 ha)



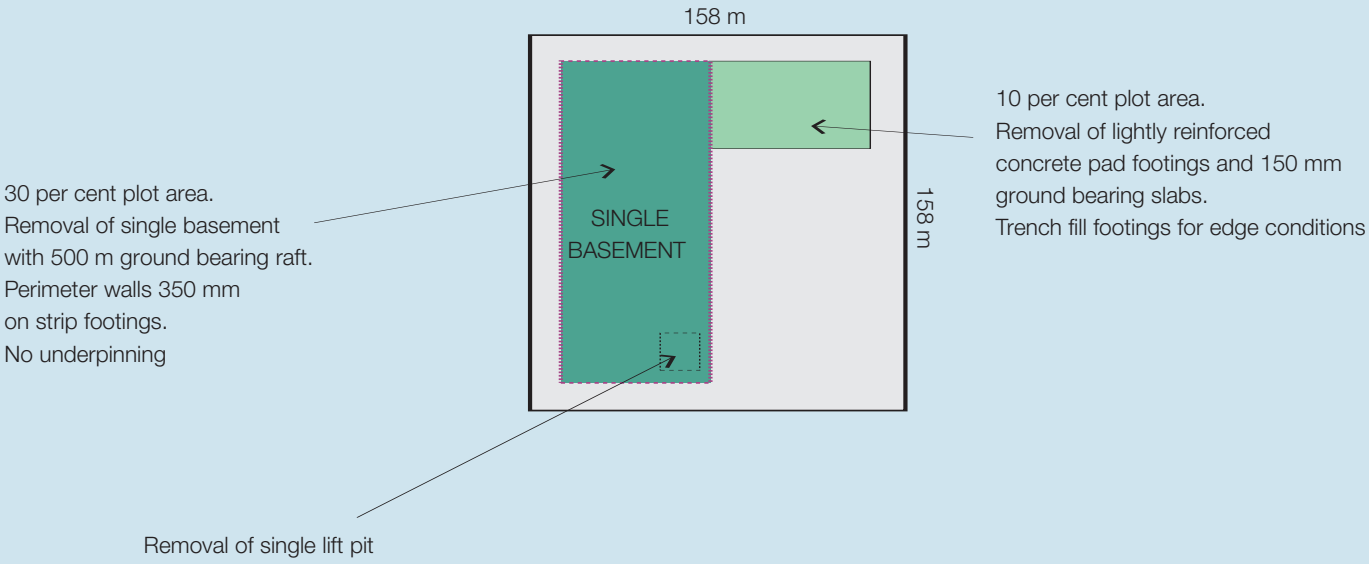
Notional site plans. All pilecaps/columns on notional 7.5 m grid.

Demolitions below ground

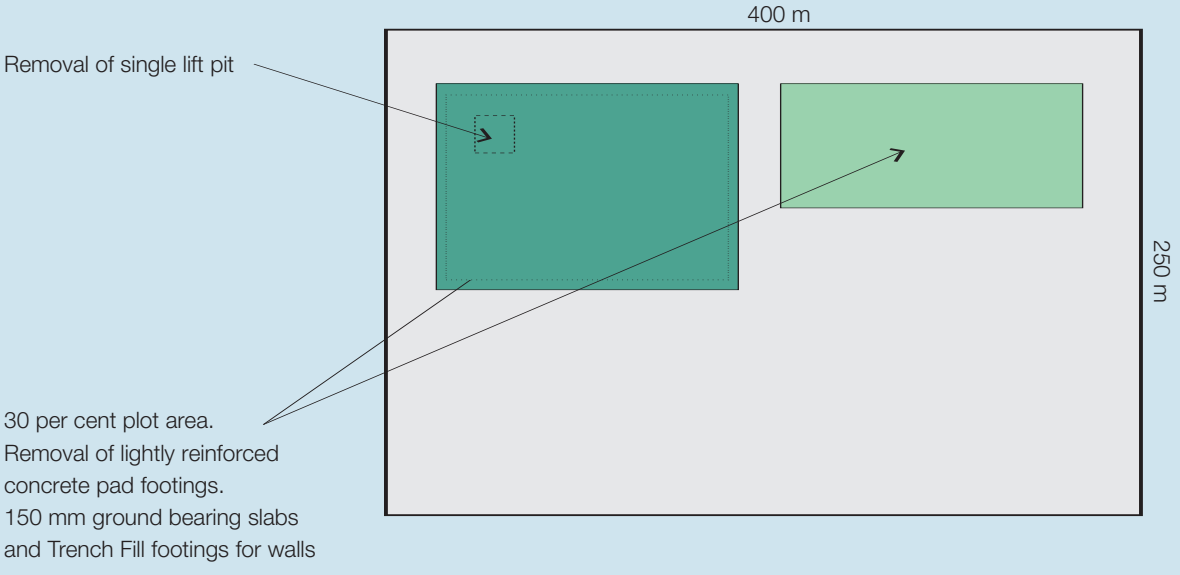
BPN Derelict Land Costs

'Standard' Notional Sites for cost assessment

Site Category: NON-COMPLEX
Site size: SMALL (2.5 ha)



Site Category: NON-COMPLEX
Site size: LARGE (10 ha)



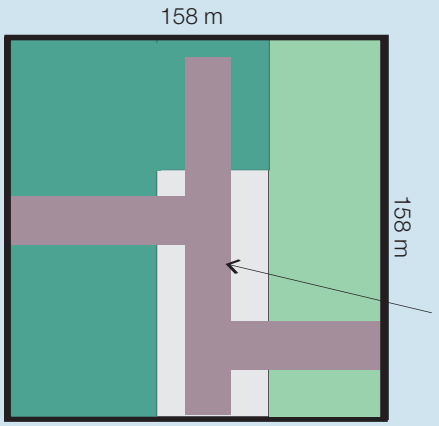
Notional site plans. All pilecaps/columns on notional 7.5 m grid.

Removal of redundant services

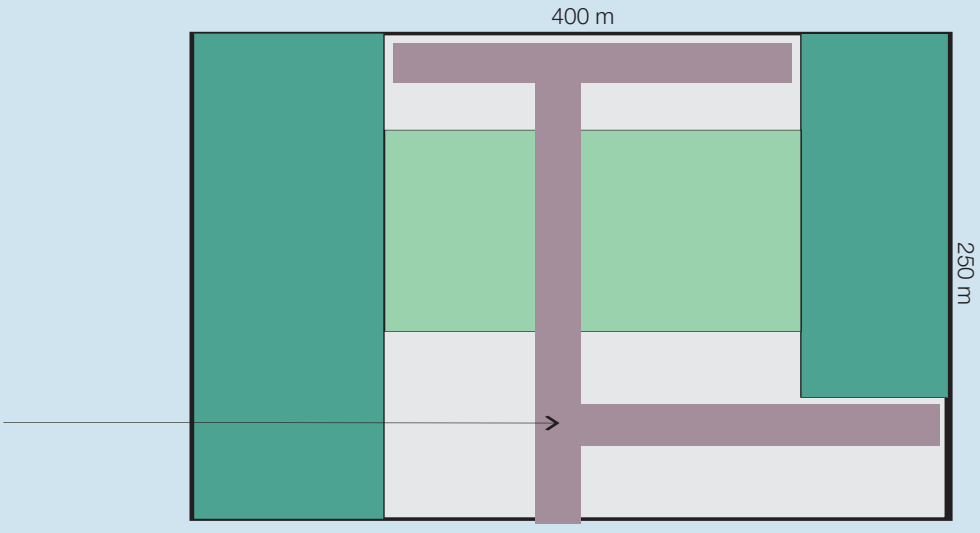
BPN Derelict Land Costs

'Standard' Notional Sites for cost assessment

Site Category: COMPLEX
Site size: SMALL (2.5 ha)



Site Category: COMPLEX
Site size: LARGE (10 ha)

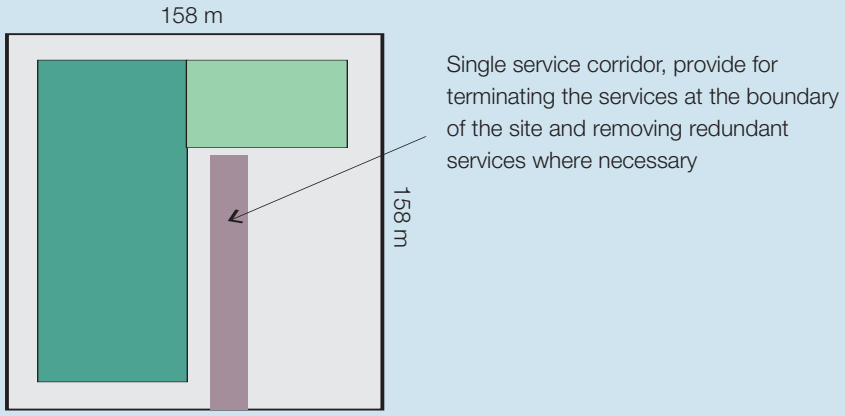


Notional site plans. All pilecaps/columns on notional 7.5 m grid.

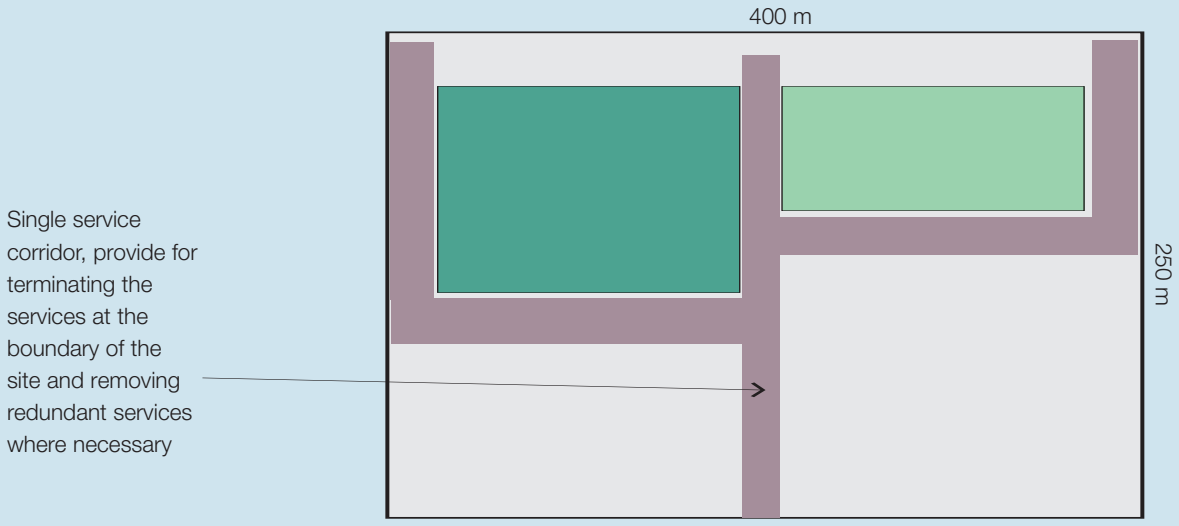
Removal of redundant services

BPN Derelict Land Costs
'Standard' Notional Sites for cost assessment

Site Category: NON-COMPLEX
Site size: SMALL (2.5 ha)



Site Category: NON-COMPLEX
Site size: LARGE (10 ha)



Notional site plans. All pilecaps/columns on notional 7.5 m grid.

ANNEX C (ii): Guidance for determining where a particular site lies within the range of possible costs (applicable to small and large sites)

Demolitions above ground		
	Non-complex	**Complex**
Low	Simple demolition process Building density 30-40 per cent plot coverage 1- 3 storey buildings Predominantly brick/block structures Slab removal to 300 mm below ground	Demolition requires specialised equipment Building density 30-40 per cent plot coverage 1-6 storey buildings Predominantly brick/block structures Slab removal to 300 mm below ground
High	Simple demolition process Building density 30-40 per cent plot coverage 1-3 storey buildings Predominantly concrete framed structures Slab removal to 300 mm below ground	Demolition requires specialised equipment Building density 30-40 per cent plot coverage 1-6 storey buildings Predominantly concrete framed structures Slab removal to 300 mm below ground

Demolitions below ground		
	Non-complex	**Complex**
Low	Simple demolition process Removal of single basements only Removal of single lift pit Ground and soil restoration including the backfilling of voids with crushed materials arising from site demolitions, and the placing of clean fill, consolidation, grading and levelling to form development platforms (but excluding the import of new material and the use of specialised compacting techniques); Removal of limited redundant services in building area Removal of limited building pads or foundations	Demolition requires specialised equipment Limited removal of isolated obstructions Removal of single and double basements Removal of multiple lift pits Ground and soil restoration including the backfilling of voids with crushed materials arising from site demolitions, and the placing of clean fill, consolidation, grading and levelling to form development platforms (but excluding the import of new material and the use of specialised compacting techniques); Removal of limited redundant services in building area Removal of limited building pads or foundations
High	Simple demolition process Removal of single basements only Removal of single lift pit Ground and soil restoration including the backfilling of voids with crushed materials arising from site demolitions, and the placing of clean fill, consolidation, grading and levelling to form development platforms (but excluding the import of new material and the use of specialised compacting techniques); Removal of large proportion of redundant services in building area Removal large proportion of building pads or foundations	Demolition requires specialised equipment Limited removal of isolated obstructions Removal of single and double basements Removal of multiple lift pits Ground and soil restoration including the backfilling of voids with crushed materials arising from site demolitions, and the placing of clean fill, consolidation, grading and levelling to form development platforms (but excluding the import of new material and the use of specialised compacting techniques); Removal of large proportion of redundant services in building area Removal large proportion of building pads or foundations

Removal of redundant services		
	Non-complex	**Complex**
Low	Removal of a single service corridor – terminated at site boundary, redundant services removed where necessary. Gas-low pressure Electricity-low voltage Water-up to 75 mm Drainage-foul-up to 300 mm Drainage-rainwater/storm up to 300 mm Communications-copper	Removal of multiple service corridors corridor – terminated at site boundary, redundant services removed where necessary. Gas-low pressure Electricity-low voltage Water-up to 75 mm Drainage-foul-up to 300 mm Drainage-rainwater/storm up to 300 mm Communications-copper
High	Removal of a single service corridor – terminated at site boundary, redundant services removed where necessary. Gas-high pressure Electricity-high voltage Water-over 75 mm Drainage-foul-300-600 mm Drainage-rainwater/storm between 300-600 mm Decommission and remove governor Communications-fibre	Removal of multiple service corridors corridor – terminated at site boundary, redundant services removed where necessary. Gas-high pressure Electricity-high voltage Water-over 75 mm Drainage-foul-300-600 mm Drainage-rainwater/storm between 300-600 mm Decommission and remove governor Communications-fibre

Fees		
	Non-complex	**Complex**
Low	Activities require a low level of resources to undertake Due Diligence Desktop Appraisal Topographical Architect Engineer-Geotechnical Engineer-Environmental, C Cost Consultant Other inc. laboratory tests	Activities require a high level of resources to undertake Due Diligence Desktop Appraisal Topographical Architect Engineer-Geotechnical Engineer-Environmental, C Cost Consultant Other inc. laboratory tests
High	Activities require a moderate level of resources to undertake Due Diligence Desktop Appraisal Topographical Architect Engineer-Geotechnical Engineer-Civil/Structural Engineer-Environmental Ecologist Services enquiries Archaeologist Cost Consultant Statutory Fees Agent Other inc. laboratory tests	Activities require a very high level of resources to undertake Due Diligence Desktop Appraisal Topographical Architect Engineer-Geotechnical Engineer-Civil/Structural Engineer-Environmental Ecologist Services enquiries Archaeologist Cost Consultant Statutory Fees Agent Other inc. laboratory tests

Site investigations		
	Non-complex	**Complex**
Low	Limited number of basic site investigations required Contamination surveys Geo-environmental investigations	Wide range of site investigations required Contamination surveys Ordnance Geo-environmental investigations
High	High number of basic site investigations required Contamination surveys Geo-environmental investigations	High number and wide range of site investigations required Contamination surveys Ordnance Geo-environmental investigations

Annex C (iii): The range of potential remediation costs (rounded to £10,000) for preparing derelict land for development according to different site complexity, size and proposed end use

All figures in £000s		Small		Large	
	Basis	Non-complex	Complex	Non-complex	Complex
Mixed use					
Removal of redundant services	per site	20 to 100	30 to 110	20 to 100	30 to 160
Demolitions above ground	per ha	110 to 170	190 to 340	70 to 160	150 to 200
Demolitions below ground	per ha	10 to 20	40 to 50	10 to 20	40 to 50
Fees	per site	90 to 110	190 to 230	200 to 240	600 to 670
Site Investigations	per site	10 to 20	40 to 70	60 to 90	170 to 260
Residential					
Removal of redundant services	per site	30 to 110	30 to 130	30 to 110	30 to 180
Demolitions above ground	per ha	110 to 170	190 to 340	70 to 160	150 to 200
Demolitions below ground	per ha	10 to 20	50 to 60	20 to 30	50 to 60
Fees	per site	100 to 120	230 to 260	230 to 270	690 to 770
Site Investigations	per site	20 to 30	50 to 80	70 to 110	200 to 300
Public open space					
Removal of redundant services	per site	20 to 100	30 to 110	20 to 100	30 to 160
Demolitions above ground	per ha	100 to 170	190 to 340	70 to 160	150 to 200
Demolitions below ground	per ha	10 to 20	40 to 50	10 to 20	40 to 50
Fees	per site	100 to 120	210 to 250	210 to 250	650 to 720
Site Investigations	per site	20 to 30	40 to 70	70 to 100	180 to 280
Employment					
Removal of redundant services	per site	20 to 100	30 to 110	20 to 100	30 to 160
Demolitions above ground	per ha	110 to 170	190 to 340	70 to 160	150 to 200
Demolitions below ground	per ha	10 to 20	40 to 50	10 to 20	40 to 50
Fees	per site	90 to 110	190 to 230	200 to 240	600 to 670
Site Investigations	per site	10 to 20	40 to 70	60 to 90	170 to 260

How to Use:

a Decide on the end use and whether small or large.

b For each component decide whether complex or non complex according to the criteria preceding the table.

c According to the criteria decide where the costs lie within the given ranges (use mid-point if no further information available.

d Where cost estimates are provided on a per site basis apply the appropriate fixed (per site) cost estimates.

e Where cost estimates are provided on a per hectare basis multiply the appropriate per hectare cost estimate by the area of the site.

f For each site add **d** to **e**.

NB The data should be indexed to allow for regional variations in respect of sites outside London (non-complex) or the South East (complex) following the guidance in the BPN.

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