Oval Homes
St Peter's Park, Radstock
Desk Study Report

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EXECUTIVE SUMMARY

Area of interest	Summary of main text
Introduction	Following instruction from Mr Bryn Hillier of Oval Homes a desk study was undertaken upon the proposed development site known as St Peter's Park in Radstock. The purpose of this Report is to assess for the potential presence of contamination and determine whether or not any intrusive investigations are considered necessary in order to establish the likely environmental condition of the site.
Site Location & Description	The study area occupies an area of approximately 2.57 hectares (ha) and is centred at National Grid Reference 367630 153810. It is located c.2km to the south-west of the centre of Radstock with the nearest post code being BA3 3BX. The proposed development area is irregular in shape with approximate maximum dimensions of 230m x 180m. The southern section has been stripped of its topsoil but the northern area is covered by rough grass land. Along the southern boundary there is a steep embankment (c.8m) along the base of which a stream flows. There is also a water treatment plant located in the south-eastern corner by the stream, which it is understood services discharge from the adjacent residential development.
Geology	The published BGS map indicates that the site is underlain by mudstone and limestone interbedded from the Langport Member and Blue Lias Formation. The nearest faults are c.500m to the south-east of the site and are orientated north-east/south-east and north/south.
Hydrogeology	The underlying bed rock has been classified as a Secondary–A Aquifer although there are no licensed groundwater abstractions within a 1km radius of the site.
Hydrology	The nearest surface water features are the streams that flow along the southern and south-eastern boundaries of the site that discharge into Snails Brook, which in 2000 had a GQA grade A. The nearest licensed surface water abstraction is from the River Somer 696m to the north-west where water is used for irrigation spray. The site is not within an area that is liable to flood but the Environment Agency flood maps indicate the floodplain for the stream that flows along the southern boundary extends to within 46m south-east of the site.
Radon	Full radon protection measures will be necessary within the construction of new dwellings.
Mining	The south-eastern section of the site was formerly an opencast quarry for limestone until around the 1930's after which it was backfilled with unknown material and was no longer evident on the 1989 plan. The site is within an area of known historic deep coal mine workings although the Coal Authority state any ground movement from these workings should have now ceased.

Area of interest	Summary of main text
Site History	The site has never been developed although a quarry and associated limekilns were present in the south-eastern section, which at its peak around 1900 occupied about a quarter of the site area. The void left by the opencast quarrying works was backfilled in the 1960's. The north-western corner of the site also appears to have been incorporated into the car parking area for the adjacent factory from the late 1980's until around 2010. Also a spur access "hammer head" was built in the south-western corner c.2010. In the wider area the predominant land use was agricultural on the first available map although over the years Radstock and Midsomer Norton have expanded so that to the north-east the site is abutted by residential properties and to the north-west and south-west there is a factory and Westfield Industrial and Trading Estate respectively.
Preliminary Conceptual Site Model	Potential on-site contaminant sources include: 1. Possible presence of contaminated or putrescible made ground being imported when the site was used as a landfill. 2. Possible contaminated soils within the fly tipped material that was noted around the site. 3. Naturally occurring elevated concentrations of contamination. 4. Potential contamination resulting from the previous quarrying and limekiln operations undertaken in the south-eastern section of the site. No potentially significant off site sources of contamination were identified.
Recommendations	• This report should be forwarded to the regulators for their review and approval to ensure they are in agreement with the findings and conclusions. • With consideration of the proposed residential end use of the site the identified potential contaminant sources and associated potential exposure scenarios warrant further investigation in order to more adequately characterise the risks posed. The full scope of the proposed works should be agreed with the Bath and North East Somerset Council's Contaminated Land Officer. • It is known that there is a surface water drainage treatment system located in the south-eastern corner of the site on the lower level near the stream, although there is no record of a discharge consent within the Envirocheck report. This is believed to indicate that there is limited sewer capacity in the vicinity of the site and therefore it is recommended that the Local Authority are consulted with regard the determining the most suitable drainage system for any proposed development.

Desk Study Report

1.0 INTRODUCTION

1.1 Contract Details

Following instruction from Oval Estates Ltd. a desk study was undertaken upon the proposed development site known as the northern section of "Housing Site 2" on the "St. Peter's Park" scheme in Radstock. The purpose of this Report is to assess for the potential presence of contamination and determine whether or not any intrusive investigations are considered necessary in order to establish the likely environmental condition of the site. The current development proposal comprises a mixed end use with the eastern area of the site area being for residential detached, semi-detached and terraced houses with private gardens and a residential home for the elderly within the smaller south-western area.

This report also considers the information contained within a previous Robson Liddle Limited report, which covers the whole of the "Housing Site 2" area, produced in December 2006.

1.2 Scope of Works

In general accordance with the discussions held between Geo-Testing Services (GTS) and Steve manning of BANES, the scope of works comprised the following:

- Review of the existing reports pertaining to the site;
- Obtain and review an Envirocheck Report to provide historical and background environmental information;
- Obtain a Coal Authority Coal Report;
- Preparation of a desk study report presenting the findings of the review of the available data and a determination as to whether future investigation works are likely to be necessary to clarify the extent of any suspected contamination issues and to provide design data for the proposed future construction works.

1.3 Previous Third Party Reports

The adjacent site has been subjected to previous investigations undertaken by Robson Liddle Ltd, as detailed in Table 1.3.1 below; although only the Supplementary Ground Investigation Report dated 2006 has been made available to GTS.

Table 1.3.1 Previous Known Reports Relating to the General Site

Date	Title	Client	Reference	Author
February	Desk Study	-	RDP/ML/02146/DSR1	Robson Liddle

2005				Ltd
December 2006	Supplementary Ground Investigation Report	Barratt Bristol Ltd	RDP/02146/ML/R2A	Robson Liddle Ltd

From a review of the Robson Liddle report it can seen that the current study area has undergone some intrusive investigations comprising the excavation of trial pits and drilling of boreholes. However apart from the locations of the exploratory holes being indicated upon a plan no further details relating to these investigations have been made available to GTS.

Therefore following discussions with Mr Steve Manning of BANES it was agreed that a site specific desk study should be produced for the current study area.

1.4 Report Limitations

The recommendations, interpretations and conclusions of this report are based solely on the historical and third party information relating to the site condition and general observations made during the site walkover undertaken on the 10th November 2010. No responsibility can be accepted for the accuracy of third party information or reference data contained within the Envirocheck Report or associated historical plans.

2.0 CURRENT SITE DESCRIPTION AND LOCATION

2.1 Site Location

The current study area, which occupies an area of around 2.57 hectares (ha), is located approximately 2km to the south-west of the centre of Radstock and centred at National Grid Reference 367630 153810. The nearest postal address for the site is St. Peters Park, Cobblers Way, Radstock, BA3 3BX. A site location plan, proposed development layout and an aerial photograph of the study area are presented in Appendices A and B respectively.

2.2 Site Description

Access to the site in via a spur on the newly constructed Cobblers Way located in the south-western corner.

The study area is irregular in shape with maximum dimensions of approximately 230m north/south and 180m east/west. At the time of the GTS walkover the southern section of the site had been stripped of topsoil whist the northern area was covered with rough grass with a number of mature trees along the boundary.

Generally the site is level with a slight slope falling from north to south apart from adjacent to the southern boundary where there is a steep embankment falling approximately 8m to a level area where a new water treatment facility is present for the adjacent residential development.

To the north and east of the site there are residential properties whilst to the north-west there is an existing factory with associated parking/storage areas. A new residential development is present to the south-west, which occupies the area of the previous Robert Liddle investigations. The southern boundary is formed by a stream that flows along the base of the embankment.

There was no evidence of fuel storage within the study area at the time of the site walkover but part of the site appeared to have been used for storage of building materials during the development of the new housing estate to the south-west.

From discussions with the site owners it is known that the southern part of the current study area was used as a landfill, which has resulted in the steep embankment along the southern boundary. In addition there was some evidence of fly tipping of waste/rubbish around the site.

2.3.1 Site Inspection Observations

An electricity sub-station was noted within the site area however as it was recently constructed PCB's will not have been used within the transformers and therefore it is not considered to represent a potential source of contamination.

1.5 Potential Sources or Signs of Contamination

Based upon the site walkover no obvious potential sources of hydrocarbon contamination were noted. However due to the anecdotal evidence of the former use as a landfill and the evidence of fly tipping it is possible that as this material may be from unknown sources there is the potential for it to contain elevated concentrations of contamination.

The presence of an electricity sub-station within the site is not considered to represent a possible source of contamination because due to the date of its construction PCBs will not have been used within its transformers. This is because the substation was recently constructed as part of the new residential development and the manufacture of PCB's ceased in 1977 in the United Kingdom and by 30th June 1986 its ongoing use was only permitted in existing PCB cooled transformers until the end of their service life with no permitted resale on the second hand market.

Table 2.3.1: Potential Sources of Contamination on Site Determined from the Site Walkover

APC No	***Details***	***Metals, semi-metals, non-metals, inorganic chemicals and others***	***Organic Chemicals***	***Gas Generation***
1	*<u>On site</u>* - *Made ground present within the former landfill located in the southern section of the site*	*Possible*	*Possible*	*Possible*
2	*<u>On site</u>* - *Possible presence of contamination within the fly tipped material present on the site*	*Possible*	*Possible*	*n/a*

2.0 ENVIRONMENTAL SETTING

2.1 Published Geology

The small scale 1:625,000 BGS Solid Geology Map indicates that the site straddles a geological boundary and is underlain by two different strata comprising *"Triassic mudstones (including Keuper Marl, Dolomitic Conglomerate and Rhaetic)"* and *"Lower Lias"*. Although the more detailed 1:50 000 scale BGS Map Sheet N^{o} 281 Frome shows that the bedrock is the *"Langport Member and Blue Lias Formation (Undifferentiated)"*, which comprises mudstone and limestone interbedded from the Sinemurian-Rhaetian ages.

A full copy of the Envirocheck Geological Report is contained in Appendix C but a summary is detailed in Table 3.1.1 with further information provided in the following sub-sections..

Table 3.1.1: Summary Geology

Shallow depth soils anticipated	*Topsoil / Made Ground in the northern section of the site.* *Made ground in the former landfill area in the southern section of the site.*
Superficial deposits	*None shown on the map.*
Solid Geology	*Langport Member and Blue Lias Formation (Undifferentiated) – mudstone and limestone interbedded.*

2.1.1 Artificial Ground

The BGS Artificial Ground and Landslip Map indicates that the site is not underlain by 'made ground (undivided), worked ground (undivided), in-filled ground or landslide deposits'. However, from the historical mining maps, which are discussed later in this report, it is known that the south-eastern part of the site was a former opencast quarry that was in-filled with unknown material in the 1980's. Therefore deep made ground is anticipated within this area.

2.1.2 Superficial Ground

The BGS Sheet shows that there are no superficial drift deposits beneath the site or within its general vicinity. The nearest deposits are a narrow linear line of clay, silt, sand and gravel (alluvium) along the line of Wellow Brook approximately 1km to the north.

2.1.3 Bedrock

The BGS 1:625,000 scale solid geology indicates that the site overlies a geological boundary between "Triassic mudstone" and "Lower Lias". However and the more detailed 1:50,000 scale Bedrock and Faults map indicates the site is underlain by "Langport Member and Blue Lias Formation" (LMBL) with "Mercia Mudstone Group" (MMG) c.500m to the north and "Westbury Formation and Cotham Member" (WBCT) c.30m to the south-east. All these strata are predominately mudstone although the LMBL and WBCT are interbedded with limestone whilst the MMG also contains Halite-stone.

The Lithological Description of the Langport Member and Blue Lias Formation has been sourced from the BGS Lexicon of Named Rock Units (http://www.bgs.ac.uk/lexicon/home.cfm) which states that *"See the Lithology descriptions for the component units."*

The definition for Blue Lias is given as "*Thinly interbedded limestone (laminated, nodular, or massive and persistent) and calcareous mudstone or siltstone (locally laminated). Individual limestone's are typically 0.10-0.30m thick. In some areas, intervening mudstone units with relatively few limestone beds. Also includes littoral limestone facies of the Radstock Shelf - Mendip area and South Wales".*

A definition for the Langport Member could not be sourced from the BGS web page.

The nearest faults are shown on the Envirocheck Geological Report Bedrock and Faults Map are located c.500m to the south-east, which run north-east/south-west and north-south from the site.

The information supplied by Envirocheck indicates that there is only one BGS borehole within 500m radius of the site that extends to in excess of 30m depth. However this is located c.495m to the west and therefore it is considered to be too distant from the site for any information obtained to be relevant to the current study area.

2.2 Hydrogeology

With reference to the Envirocheck Report the text describes the bedrock beneath the site is identified as a Secondary Aquifer – A (formerly known as a Minor Aquifer), which the Environment Agency web page describes as:

"…permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers…"

The soils beneath the site associated with the secondary aquifer, as identified on the Groundwater Vulnerability map have been deemed to fall into two categories with the majority being classified as having a high leaching potential (U) as described by the Envirocheck Report:

"*soils information for restored mineral workings and urban areas is based upon fewer observations than elsewhere. A worst case vulnerability classification (H) is assumed, until proven otherwise*".

Although the south-western section of the site just encroaches onto an area of soils designated as having a high leaching potential H1 and this is described as:

"soils which readily transmit liquid discharges because they are either shallow or susceptible to rapid by-pass flow directly to rock, gravel or groundwater."

In addition to the above from a review of the Environment Agency map 'Groundwater Vulnerability of East Somerset and South West Wiltshire Sheet 43' it would appear that the very south-western corner of the site, adjacent to the H1 leaching potential soils, just extends onto a Non-Aquifer, which the Environment Agency describe as:

"Unproductive Strata: These are rock layers or drift deposits with low permeability that has negligible significance for water supply or river base flow".

There are no licensed groundwater abstractions listed within the Envirocheck Report that are within 1km of the site the nearest was 1,503m to the south. There is a single licensed discharge consent to groundwater in the form of a soakaway located 706m to the south-west for final/treated effluent from Prattens Sports & Social Club. Full details of the above can be found in the Envirocheck Report contained in Appendix C.

2.3 Hydrology

The nearest surface water feature is referenced within the Envirocheck report as being located on the site, which from the Site Sensitivity Map would be stream that flows eastwards along the southern boundary and a spring that emerges on the south-eastern boundary and flows southwards to join the stream.

The Environment Agency flood map indicates that the site does not lie in area likely to be affected by flooding although the small stream along the southern boundary is shown to flood to within 46m of the south-eastern corner.

Water quality sampling has been undertaken within the vicinity of the site and Snails Brook, into which the stream adjacent to the site flows, recorded a River Quality GQA Grade A in 2000.

There is one licensed surface water abstraction within 1km of the site located at 696m to the north-west from the River Somer where the water used is designated as *"horticultural and nurseries: spray irrigation - direct"*. The Envirocheck Report also indicates that there were 13N^{o} discharge consents to surface water within a 1km radius, the nearest being 398m to the south-west for "storm sewage overflow" being permitted to enter Snails Brook/Waterside.

The Envirocheck Report did not identify any pollution incidents or prosecutions relating to Controlled Waters within 1km of the site.

2.4 Radon

The British Geological Survey (BGS), National Geoscience Information Service states that the site is within a radon affected area; as greater than 30% of homes are above the action level. Therefore at this level the BGS conclude that full radon protection measures are necessary in the construction of new dwellings.

2.5 Sensitive Land Uses

The Envirocheck Report indicates that the site is within a nitrate vulnerable zone however based under Part IIa, as detailed in Table A of Annex 3, these are not considered to be potential receptors and therefore have not been considered as such within this report.

There are no other areas of sensitive land uses listed within 1km of the site.

2.6 Environmental Searches

The Envirocheck Report provides details of a database search of information collated from various regulatory bodies, local authorities and other organisations. The full Envirocheck report is enclosed as Appendix C. The most salient points identified within it are outlined in Table 3.6.1 below.

Table 3.6.1: Summary of the Envirocheck Environmental Searches

Data Type	***0n Site***	***0m to 500m***	***501m to 1,000m***	***Discussion***
Agency & Hydrological				
Contaminated Land Register Entries and Notices	*0*	*0*	*0*	*-*
Enforcement & Prohibition Notices	*0*	*0*	*0*	*-*
Integrated Pollution Controls	*0*	*0*	*0*	*-*

Data Type	***0n Site***	***0m to 500m***	***501m to 1,000m***	***Discussion***
Integrated Pollution Prevention and Control	*0*	*0*	*0*	*-*
Local Authority Integrated Pollution Prevention and Control	*0*	*0*	*1*	*Alcan Packaging 716m to the west holds a permit for "Printing of flexible packaging".*
Local Authority Pollution Prevention and Controls	*0*	*7*	*7*	*Clarks International was permitted to undertake di-isocyanate processes 42m to the north-west but the authorisation has been revoked. Therefore the nearest authorised permit is for MG Edgell Motors 46m to the south to operate waste oil burners.*
Local Authority Pollution Prevention and Control Enforcements	*0*	*0*	*0*	*-*
Prosecutions Relating to Authorised Processes	*0*	*0*	*0*	*-*
Registered Radioactive Substances	*0*	*0*	*0*	*-*
Water Industry Act Referral	*0*	*0*	*0*	*-*
Waste				
BGS Recorded Landfill Sites	*0*	*1*	*0*	*Waterside Tip on Charlton Lane 425m south.*
Historical Landfill Sites	*0*	*1*	*1*	*The nearest relates to Waterside Tip (425m south), which was licensed to accept industrial and commercial waste between 01.09.1968 and 26.11.1971.*
Integrated Pollution Control Registered Waste Sites	*0*	*0*	*0*	*-*
Licensed Waste Management Facilities (Landfill boundaries)	*0*	*0*	*0*	*-*
Licensed Waste Management Facilities (Locations)	*0*	*1*	*3*	*The nearest is operated by Bidwell Robbins who dismantled vehicles in the Fourth Avenue Trading Estate c.479m to the south-west .*
Local Authority Recorded Landfill Sites	*0*	*2*	*3*	*The closest site is 255m to the east although no other information is available.*
Registered Landfill Sites	*0*	*0*	*1*	*Wessex Water Authority had a licence to deposit "Surplus Excav'Ns Ex Flood All'N Scheme" at Ham Gardens 610m to the north-west although this has now lapsed/cancelled.*
Registered Waste Transfer Sites	*0*	*0*	*4*	*These are all located on Radstock Road 929-970m north of the site of which only the BANES and Bristol City Council licenses are still operational.*
Registered Waste Treatment or Disposal Sites	*0*	*1*	*1*	*This relates to Bidwell's scrap yard on Forth Avenue 73m to the south.*
Control of Major Accident Hazards Sites (COMAH)	*0*	*0*	*0*	*-*
Explosive Site	*0*	*0*	*0*	*-*
Notification of Installation Handling Hazardous Substances (NIHHS)	*0*	*0*	*0*	*-*
Planning Hazardous	*0*	*0*	*0*	*-*

Data Type	*0n Site*	*0m to 500m*	*501m to 1,000m*	*Discussion*
Substance Consents				
Planning Hazardous Substance Enforcements	*0*	*0*	*0*	*-*

The Envirocheck report identified 4 N^{o} fuel stations the nearest of which is TCS Elm Tree a Total petrol station on the Wells Road 164m to the north-west of the site. The remaining three garages (677m NE, 820m NW and 847m NE) are all indicated as being obsolete.

In addition a total of 155N^{o} contemporary trade entries were listed within 1km of the site with 39N^{o} being between 0-250m, 48N^{o} between 251-500m and 68N^{o} 501-1,000m radius. Of the trades within 250m the nearest is MG Edgell (garage services) 46m to the south. The other active trades include: Freight forwarders; MOT testing centre; Cleaning services; Printers; Potteries equipment supplies; Packaging & wrapping suppliers; Engineers; Furniture manufacturers; Foam products and a Confectionery manufacturers.

Information supplied by the British Geological Survey is included within the Envirocheck Report regarding the underlying geology and the associated mining and other natural hazards. Again full details are contained in Appendix C but the most pertinent points relating to the site are highlighted in Table 3.6.2 below.

Table 3.6.2: Summary of the Envirocheck Geological Searches

Potential Hazard	*Risk to the Site/ Hazard Potential*
BGS Recorded Mineral Sites	*Norton Hill Colliery Quarry was located in the south-eastern corner of the site from which limestone was excavated. Other opencast quarries were located 473m E, 526m S, 533m N, 633m W, 746m W, 830m W, 852m N, 870m SE and 962m S, which were predominantly for Limestone although two number were for Common Clay and Shale. All the quarrying works are indicated as having ceased.* *Deep Coal mines were present 460m W, 692m NW, 805m NE and 898m all of which have now ceased.*
Coal Mining	*As demonstrated above the site is within an area which may be affected by Coal Mining.*
Mining Instability	*Information obtained from Ove Arup indicates "Inconclusive Coal Mining".*
Natural Cavities	*606m east there are Gulls/Fissures due to cambering within the Blue Lias Formation, Mercia Mudstone Group, Upper Rhaetic, Westbury Formation.*
Collapsible Ground Stability	*- No hazard listed on site.*
Compressible Ground Stability	*- No hazard listed on site.*
Ground Dissolution Stability	*- Very Low hazard listed on site.*
Landslide Ground Stability	*- Very low and low hazard listed on site.* *- 216m east Moderate hazard indicated.*
Running Sand Ground Stability	*- No hazard listed on site.*
Shrinking or Swelling Clay Ground Stability	*- No hazard listed on site.* *- 177m south-east very low hazard indicated.*

2.7 Mining Searches

As the site is within a known coal mining area a "Mining and Ground Stability Report" was obtained from Envirocheck and a "Non-Residential Coal and Brine Report" for the site commissioned from the Coal Authority. Copies of these reports are contained in Appendices C and E respectively although the salient points are discussed below.

The Coal Authority Report confirmed that the site is in the likely zone of influence from workings in five seams last worked in 1965 at depths of between 370m and 630m although there are no known coal mine entries on the site or within 20m of its boundary. No notice under section 46 of the Coal Mining Subsidence Act 1991 of the risk of land being affected by subsidence has been issued and the Coal Authority have not received a damage notice or claim in relation to coal-mining subsidence within the site since 1st January 1984. Therefore they conclude that *"any ground movement from these coal workings should have stopped by now"*.

There are no records of mine gas emissions within the site that required the Coal Authority to undertake remedial works.

The Envirocheck Mining and Ground Stability Report confirms that the south-eastern section of the site was formerly the Norton Hill Colliery Quarry, which was an opencast quarry that from the old plans seems to have been worked from prior to the first published map (1886) and was last shown on the 1930 plan. During this period the layout and extent of the quarry changed with it occupying the largest area between 1893 and 1915. The quarry also had limekilns associated with it through out its history.

The historic maps indicate that the quarry was backfilled on the 1989 map although there is no information relating to the type of material used.

There are three motion sensors placed upon the factory building immediately to the north-west of the site (12-20m distant) two of which have indicated the ground is stable with movements of up to 1.5mm/year but one has shown movement of +1.9mm, which is classified as upward movement.

2.8 Summary Sources On and Off Site Determined From Environmental Setting

Based upon the available information relating to the environmental setting of the site the known presence of a former quarry on the site that has been backfilled with unknown material represents a potential source of contamination and possible landfill gas generation.

In addition there is the possibility that naturally occurring elevated contaminant concentrations, as detailed in Table 3.8.1 below may exist upon the site.

Although other former quarries and landfills were identified they were generally in excess of 250m from the site boundary and therefore are not considered to represent potentially significant off site sources of contamination or landfill gases.

An active fuel station was identified c.168m from the site however although this will have below ground fuel storage tanks it is considered that due to its distance from the site any spillages or leakages of oils/fuels are unlikely to migrate onto the site in sufficient quantities as to pose a significant risk. Therefore the fuel filling station has not been considered further as a potential source of contamination.

Table 3.8.1: Potential off site Sources of Contamination Determined from Environmental Setting

APC N^{o}	***Details***	***Metals, semi-metals, non-metals, inorganic chemicals and others***	***Organic chemicals***	***Gases***
*1**	*<u>On site</u>* *Made ground present within the former landfill located in the southern section of the site*	*Possible*	*Possible*	*Landfill gas-possible*
3	*<u>On site</u>* - *Naturally occurring elevated concentrations of contamination*	*Possible*	*Possible*	*Radon Gas – very likely*

** previously identified in Section 2.0*

3.0 SITE HISTORY

The history of the site has been developed from an internet search and a study of the available Town Plans, County Series Plans and Ordnance Survey maps commissioned from Landmark by Geo-Testing Services Ltd. The historical plans referred to in the text are included within Appendix D, with the approximate outline of the site marked on each map.

The site has never been developed although a quarry and associated limekilns were present in the south-eastern section which at its peak, around 1900, occupied about a quarter of the site area. The void left by the opencast quarrying works was backfilled in the 1960's. In addition it would appear the car parking area associated with the factory to the west of the site was extended so it occupied the north-western corner of the site from around 1989 until 2010. Also around 2010 it would appear the spur road was constructed in the south-eastern corner to provide access to the site.

In the wider area the predominant land use was agricultural on the first available map although over the years Radstock and Midsomer Norton have expanded so that to the north-east the site is abutted by residential properties and to the north-west and south-west there is a factory and Westfield Industrial and Trading Estate respectively.

Table 4.1.1: Historical Development from Map Information

Map Edition	***Key Features on Site***	***Key Features within 500m off Site***
Somerset 1886 1:2,500 1884-85 1:10,560	*The site occupies part of two larger fields with a quarry and associated limekiln located in the south-eastern section of the site that appeared to be accessed via a footpath from the south-east.*	*The surrounding area was primarily in agricultural use although there was a smallpox hospital (Westfield House) c.150m to the north-west fronting the Fosse Way.* *Norton Hill Colliery was present c.250m to the west. Old Welton, Wellsway and Kilmersdon Collieries were c.950m-1km north, north-east and east of the site.* *The towns of Radstock and Midsomer Norton were present c.1km to the north-east and north-west respectively.* *A stream appeared to start at the quarry (although no spring was noted) and flowed south to the end of the site boundary before turning east.* *The Somerset and Dorset Railway line was present c.550m to the north-west which ran north-east/south-west between Radstock and Midsomer Norton.*
Somerset 1904 1:2,500	*The quarry had increased significantly in size to occupy the south-eastern corner of the site (c.25% of area) with two limekilns.* *A track was present crossing the site from the Fosse Way providing access to the quarry.*	*Midsomer Norton and Radstock had expanded.* *New blocks of terraced houses had been built on the northern side of the Fosse Way facing Westfield House, which was noted as being an "Isolation Hospital".* *The original Norton Hill Colliery had been renamed (No2) and a new Norton Hill Colliery (No1) was shown c.750m to the north-west near the railway line.*
Somerset 1930 1:2,500 1931& 1938 1:10,560	*The quarry was no longer labeled and the legend would appear to indicate that although the void remained it was a refuse heap. Also the kilns were identified as "Old Limekilns".*	*Old Wells and Wells Way Collieries were listed as being disused.* *Westfield House was no longer identified as a hospital.* *Midsomer Norton and Radstock had continued to expand and there were additional new terraced blocks of houses along the Fosse Way.*
Ordnance Survey Plan 1961 1:10,000	*The site appeared to have remained unaltered.*	*Over the intervening years there had been significant development with a factory located c.50 to the west.* *The three remaining collieries were shown as "mines".*

Map Edition	*Key Features on Site*	*Key Features within 500m off Site*
Ordnance Survey 1970 & 1977 1:2,500 1972-77 1:10,000	*The quarry and limekilns were no longer shown although the new footpath route appeared to follow the edge of the top of the embankment. A drain had been constructed that followed the southern boundary to connect into the existing stream at the south-eastern corner.*	*There had been extensive residential developments and by 1970 the rear gardens of the new properties extended to the north-eastern edge of the site. The expansion of Radstock continued and by 1977 the properties abutted the full length of the eastern boundary. A tank of unknown use was present at the rear of the factory, which appears to be identified as "Boot and Shoe Factory" c. 65m to the west of the site. In addition an electrical sub-station was also shown adjacent to the factory c.100m from the site. An electrical sub-station was also present within the grounds of "Westfield House". On the Wells Road (Fosse Way) c.150m to the north-east of the site there is a building shown that could possibly be a petrol station forecourt. Only Kilmersdon Colliery appeared to remain active. The railway line to the north-west was shown as dismantled.*
Ordnance Survey 1982 1:1,250 198910,560	*The stream that flowed from the site was identified as a "spring". The only other change noted was that the footpath was no longer present on the site.*	*The suspected petrol station c.150m to the north-east of the site was labelled as a "filling station". There had been further residential development to the east. Westfield Industrial and Trading Estate was present c.75m to the south-east.*
Large-scale National Grid Data 1992 1:1,250	*The car parking area associated with the factory to the west, which had been substantially expanded, appeared to extend into the north-western corner of the site. Also the field pattern had been slightly amended to show a new enclosure in the northern section of the site.*	*The factory to the west, as discussed opposite, had been substantially expanded. c.100m to the north-west of the site there was a large circular tank, of unknown use, with a bunded and raised landscaped area. There had been continued development and expansion of Radstock and Midsomer Norton. Also the remaining Kilmersdon colliery was no longer shown and the area had been redeveloped.*
10K Raster Mapping 1999 1:10,000	*The site appeared to have remained unchanged.*	*The large circular tank c.100m to the north-west appears to be covered as it was indicated as a circular building.*
10K Raster Mapping 2006 1:10,000	*No changes were noted on site.*	*There did not appear to have been any significant development or changes in the vicinity of the site.*
10k Raster Mapping 2010 1:10,000	*In the south-western corner of the site it appeared as if the spur road had been constructed to provide access to the site from the new residential development in that vicinity.*	*The new residential development had been constructed to the west of the site and a new large rectangular building was present in the old parking area for the factory.*

On reviewing the historic maps it has been identified that the site has not been developed and has been in agricultural use from the time of the first map, (1884). Therefore it is possible that pesticides and herbicides may have been used on the site although this is considered to be a very low risk because these compounds were not designed to be persistent in the environment and do not generally pose a long term risk as detailed in DEFRA publication CLAN4/04 which states that *"pesticides applied according to their approved use do not constitute a significant contamination risk".* Therefore the presence of pesticides and herbicides has not been considered further as a potential risk.

Due to the known quarrying and backfilling operations there will be significant quantities of made ground present upon the site, especially across the south-eastern section. Therefore as the imported soils are of unknown provenance it is possible that they may contain elevated levels of contamination or have the potential to generate landfill gases.

In addition it is possible that there is residual contamination present upon the site from the old limekilns that were present upon it. However although this risk remains it is considered to be low as the kilns appeared to have been in the base of the quarry and this area is now buried with a substantial thickness of made ground, which will effectively cap it.

Two tanks were identified the nearest being c.65m to the west and was associated with the factory and although this is/was likely to contain oil/fuel due to its small capacity and distance from site within a hard landscaped area it is not considered to be potential source of contamination that could pose a risk to the site. With regard to the larger tank within the earthwork mound, which was constructed in the late 1980's/early 1990's, from the aerial photograph obtained from the internet (www.bing.com) it is believed this is more likely to be associated with a drainage system than fuel storage. This reflects that it is set at ground level with a concrete cover and what appears to the control house adjacent to it. As a result it has been deemed not to represent a potential source of contamination and therefore has not been considered further within this report.

Also two electricity sub-stations were identified within 100m of the site, however, as discussed within section 2.0 of this report, due to their age (early 1970's) it is possible that PCB's were not used within their associated transformers. Notwithstanding this due to their relative distances c.90-100m from the site they are not considered to have the potential to significantly impact the site and therefore have been discounted as possible contamination sources.

Based upon consideration of the historic maps the following potential contaminant sources have been identified.

Table 4.1.2: Potential Sources of Contamination on Site Determined From Historical Maps

APC N^{o}	***Details***	***Metals, semi-metals, non-metals, inorganic chemicals and others***	***Organic chemicals***	***Gas Generation***
*1**	*<u>On site</u>* *- Made ground present within the former landfill located in the southern section of the site*	*Possible*	*Possible*	*Possible*
4	*<u>On Site</u>* *- Potential contamination resulting from the previous quarrying and limekiln operations undertaken in the south-eastern section of the site*	*Possible*	*Possible*	*n/a*

** Previously identified in Section 2.0*

4.0 PRELIMINARY CONCEPTUAL SITE MODEL: POTENTIAL SOURCE-PATHWAY-RECEPTOR RELATIONSHIPS

4.1 General

Prior to commencing any intrusive site investigation works it is appropriate to undertake a qualitative risk assessment with respect to any potential sources, pathways and receptor relationships which may exist on site. The guide to Qualitative Risk Assessment, as taken from '*Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008'*, is attached as Appendix F. This approach is comparable to a Tier 1 human health risk assessment and identifies where a potential pollutant linkage relationship exists and if present, an estimate of the risk that defined receptors will suffer harm.

It is currently proposed that the development of the site will comprise an area of residential properties comprising houses with private gardens and a residential care home for the elderly with communal soft landscaped areas.

4.2 Contaminant Sources

4.2.1 Site Sourced Contamination

The following have been identified through the desk study phase of this report as areas of potential concern (APC):

1. Possible presence of contaminated or putrescible made ground being imported when the site was used as a landfill.
2. Possible contaminated soils within the fly tipped material that was noted around the site.
3. Naturally occurring elevated concentrations of contamination.
4. Potential contamination resulting from the previous quarrying and limekiln operations undertaken in the south-eastern section of the site.

4.2.2 Cross Boundary Contaminant Migration

Based upon the findings and assessment of the results of this desk study no significant potential off site sources of contamination have been identified.

4.3 Potential Receptors

The likely receptors identified from the desk study have been detailed below.

4.3.1 Human Health

- 0-6 year old child residing in new residential dwelling – **critical receptor within residential development area.**
- Adult resident within the care home – **critical receptor within the residential home.**

4.3.2 Controlled Waters

- Surface water – a drain flows along the southern boundary that discharges in the stream that flows along the south-eastern boundary, which issues from a spring in the vicinity of the former quarry area. These flow into Snails Brook, which in 2000 had a River Quality GQA Grade A.

  With reference to *Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008'*, the sensitivity of the surface water is considered to be Very High (H1).

- Groundwater – the site is underlain by a Secondary Aquifer-A with the soils beneath being classified as having a high leaching potential. The site is not within a designated Source Protection Zone and there are no groundwater abstraction points within a 1km radius of the site.

  With reference to *Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008'*, the sensitivity of the groundwater is considered to be Moderate (M2).

4.3.3 Other Environmental Receptors

- Property associated with proposed development.
- Flora

4.4 Potential Pathways

4.4.1 Human Health

- Soil ingestion.
- Dermal contact.
- Vegetable Uptake.
- Inhalation of contaminant vapours/dust.

4.4.2 Buildings

- Direct contact with underlying contaminants.

4.4.3 Groundwater

- Leaching from the shallow made ground into the underlying Secondary Aquifer-A.

4.4.4 Surface water

- Leaching from the made ground into the underlying secondary aquifer-A with lateral migration within groundwater to the watercourses in the vicinity.
- Runoff from the site directly into the watercourses around the southern site boundaries.

4.4.5 Flora

- Plant root uptake.

4.5 Summary of Source – Pathway – Receptor Relationships

Table 5.5.1 highlights the source-pathway-receptor relationships that are considered viable across the site at this stage in which the qualitative risk evaluation is based upon the '*Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008'*, (see Appendix F).

In addition a schematic layout of the site specific conceptual model is included within Appendix A.

Table 5.5.1: Potential Source – Pathway – Receptor Relationships

APC No.	Source	Pathway (s)	Receptor	Classification of Consequence	Classification of Probability	Classification of Risk
1	On site Possible presence of contaminated or putrescible made ground being imported when the site was used as a landfill.	Oral ingestion	Future Occupiers	Medium	Likely	Moderate Risk
		Vegetable Uptake	Future Occupiers	Medium	Likely	Moderate Risk
		Vapour and dust inhalation	Future Occupiers	Medium	Likely	Moderate Risk
		Dermal contact	Future Occupiers	Medium	Likely	Moderate Risk
		Downward migration	Groundwater	Medium	Likely	Moderate Risk
		Via groundwater	Surface Water	Medium	Likely	Moderate Risk
		Direct contact	Buildings and Underground Services	Medium	Likely	Moderate Risk
		Migration of hazardous gases	Future Occupiers and Buildings	Medium	Likely	Moderate Risk
		Uptake via root system	On-site flora	Mild	Likely	Moderate/Low Risk
2	On Site Possible contaminated soils within the fly tipped material that was noted around the site.	Oral ingestion	Future Occupiers	Medium	Unlikely	Low Risk
		Vegetable Uptake	Future Occupiers	Medium	Unlikely	Low Risk
		Vapour and dust inhalation	Future Occupiers	Medium	Unlikely	Low Risk
		Dermal contact	Future Occupiers	Medium	Unlikely	Low Risk
		Downward migration	Groundwater	Medium	Unlikely	Low Risk
		Via groundwater	Surface Water	Medium	Unlikely	Low Risk
		Direct contact	Buildings and Underground Services	Medium	Unlikely	Low Risk
		Uptake via root system	On-site flora	medium	Unlikely	Low Risk
3	On Site Naturally occurring elevated concentrations of contamination	Oral ingestion	Future Occupiers	Medium	Unlikely	Low Risk
		Vegetable Uptake	Future Occupiers	Medium	Unlikely	Low Risk
		Vapour and dust inhalation	Future Occupiers	Medium	Unlikely	Low Risk
		Dermal contact	Future Occupiers	Medium	Unlikely	Low Risk
		Downward migration	Groundwater	Mild	Unlikely	Very Low Risk
		Via groundwater	Surface Water	Mild	Unlikely	Very Low Risk
		Direct contact	Buildings and Underground Services	Medium	Unlikely	Low Risk
		Radon gases	Future Occupiers and Buildings	Severe	Likely	High Risk
		Uptake via root system	On-site flora	Mild	Unlikely	Very Low Risk
4	On Site Potential contamination resulting from the previous	Oral ingestion	Future Occupiers	Medium	Unlikely	Low Risk
		Vegetable Uptake	Future Occupiers	Medium	Unlikely	Low Risk
		Vapour and dust inhalation	Future Occupiers	Medium	Unlikely	Low Risk
		Dermal contact	Future Occupiers	Medium	Unlikely	Low Risk

APC N$^{o.}$	***Source***	***Pathway (s)***	***Receptor***	***Classification of Consequence***	***Classification of Probability***	***Classification of Risk***
	quarrying and limekiln operations undertaken in the south-eastern section of the site	*Downward migration*	*Groundwater*	*Medium*	*Unlikely*	*Low Risk*
		Via groundwater	*Surface Water*	*Medium*	*Unlikely*	*Low Risk*
		Direct contact	*Buildings and Underground Services*	*Medium*	*Unlikely*	*Low Risk*
		Uptake via root system	*On-site flora*	*medium*	*Unlikely*	*Low Risk*

4.6 Uncertainties and Assumptions

The site history indicates that future occupiers and the environment may possibly be at risk primarily from the presence of deep made ground within the former quarry area of the site, as previously detailed within Table 5.5.1.

Therefore based upon the proposed future end use of the site, a mixture of residential houses with gardens and a care home, these potential contaminant sources and associated exposure scenarios are considered to warrant an intrusive investigation to more adequately characterise the risks posed and/or undertake precautionary mitigation works to be protective of human health.

5.0 CONCLUDING DISCUSSION

5.1 Conclusions

The desk study has revealed the following:

- The published geological maps indicate that there are no superficial deposits and the shallow bed rock is limestone and mudstone interbedded.
- The British Geological Survey (BGS), National Geoscience Information Service states that the property is within a radon affected area and as a result full radon protection measures are necessary in the construction of new dwellings.
- The underlying soils have been classified as a Secondary Aquifer-A with the soils beneath being classified as having a high leaching potential. The site is not within a defined Source Protection Zone and there are no licensed groundwater abstractions within a 1km radius.
- A spring issues from adjacent to the south-eastern corner and flows along the site boundary before it merges with a drain that flows along the southern boundary. These discharge into Snails Brook, which had a GQA Grade A in 2000.
- Based upon the available historic maps the site has never been developed although there was a quarry in the south-eastern corner that at its peak covered about a quarter of the site area, which has now been backfilled. Within the quarry there were also limekilns. In recent years a small section of the north-western corner was used for car parking and a "hammer head" spur has been constructed in the south-western corner to provide access.
- Potential on-site contaminant sources include: (i) deep made ground associated with the backfilled quarry; (ii) possible contamination associated with fly tipped material present upon site; (iii) naturally occurring elevated concentrations of contaminants within the underlying natural soils and (iv) possible contamination associated with the former quarrying and limekiln operations undertaken on the site.
- Based upon the information obtained as part of this desk study it is considered that there is a very low to high risk to human health or other environmental receptors from the identified potential sources of contamination upon the site.

5.2 Recommendations

Based upon the findings of the desk study the following actions are recommendations:

- This report should be forwarded to the regulators for their review and approval to ensure they are in agreement with the findings and conclusions.

- With consideration of the proposed residential end use of the site the identified potential contaminant sources and associated potential exposure scenarios warrant further investigation in order to more adequately characterise the risks posed. The full scope of the proposed works should be agreed with the Bath and North East Somerset Council's Contaminated Land Officer.

- However it is considered that the Phase 2 investigation should be carried out in two parts. The first of these should be to undertake trenching to accurately locate the quarry/filled area. Once this is defined it will be possible to target the areas required for further investigation.

- It is known that there is a surface water drainage treatment system located in the south-eastern corner of the site on the lower level near the stream, although there is no record of a discharge consent within the Envirocheck report. This is believed to indicate that there is limited sewer capacity in the vicinity of the site and therefore it is recommended that the Local Authority are consulted with regard the determining the most suitable drainage system for any proposed development.