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**Report on a
Phase 1 and Phase 2 Investigation
For A Proposed
Metal Recycling Facility
At
Shaw Lane
Barnsley**

**On Behalf of
Stairfoot Metals Ltd**

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Site Location Plans
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- Appendix 1:** GroundSure GeoInsight Report.
- Appendix 2:** Historical Ordnance Survey Maps.
- Appendix 3:** GroundSure EnviroInsight Report.
- Appendix 4:** Exploratory Hole Logs.
- Appendix 5:** Chemical Contamination Test Certificates.

1 Introduction

This report presents the findings of a Phase 1 and 2 investigation undertaken on behalf of the Client, Stairfoot Metals Limited, on the site of a proposed dry metal recycling centre on a parcel of land within the premises of The Recycling Centre on Shaw Lane, Barnsley, S71 3HJ.

At the time of the investigation, the site of interest was being used for the storage of concrete products, comprising entirely of large interlocking blocks, manufactured on the site immediately north of the site of interest.

It is intended to use the site for the recycling dry metal wastes, and excluding the processing of end of life vehicles (ELV).

This report is intended to accompany the planning application for the proposed change of use.

This study described within this report identifies: -

- Potentially contaminative current and historical uses of the site, and potential sources of contamination on the site.
- Potentially contaminative current and historical uses of adjacent sites that may have resulted in cross boundary migration of contamination onto the site.
- Potential risks to human, ecological, groundwater and surface water receptors as a result of any potential sources of contamination identified beneath the site.

This report is based upon archival research including the analysis of historical maps, geological and hydrological data and other relevant Third Party environmental information that CSG Consulting Engineers Ltd have taken to be correct, and no liability can be accepted for any inaccuracies contained within the Third Party information referenced.

This report has been produced on behalf of the Client, and no responsibility is accepted to any Third Party for all or any part of it. This report should not be relied upon or transferred to any other parties without the express written authorisation of CSG Consulting Engineers Ltd. If any unauthorised Third Party comes into possession of this report, they rely on it at their own risk and the authors owe them no duty of care or skill.

2 Site Location and Description

The site of interest is accessed from Shaw Lane, Carlton, S71 3HJ, approximately 5 kilometers north east of Barnsley Town Centre. Site location plans are appended to this report.

The site forms a roughly rectangular area with a linear extension to the west which covers part of a former access road into the site at the north-west corner. The total site area measures 0.22 hectares, measuring approximately 50m north-south, by 30m east-west.

The site is essentially flat and level and largely covered with a concrete pavement, with the exception of a small area in the north-east of the site, where bare soil is exposed at the surface.

There is corrugated steel sheet-clad building in the south-west corner of the site that was mainly empty at the time of the site visit, with a small number of concrete block products stored within it.

The remainder of the site was also largely used to store concrete block products, comprising almost exclusively of a large interlocking block product.

A disused diesel electricity generator is present to the south of the steel sheet-clad building on the site, adjacent to the southern site boundary.

A lorry trailer is currently parked on the part of the access road into the site that is included within the site boundary, and a further on the main site. Other than four skips for general waste storage in the north-east corner of the site, there were no other features considered to present current potential sources of contamination on the site.

The southern, western and eastern site boundaries are defined by steel palisade fencing, but the northern site boundary is not fenced or demarcated.

Photographs of the site are presented below: -



1. View south to north across site, showing concrete block product storage.



2. View from south to north-west across site. A corner of the corrugated steel sheet-clad building is visible on the left-hand side, and the lorry trailer is also shown.



3. Eastern elevation of the on-site structure.



4. Diesel electricity generator located to the south of the on-site structure.



5. View inside disused diesel generator.



6. Eastern/south-eastern part of site showing interlocking concrete products on the concrete pavement.



7. South/south-eastern corner of the site.



8. Palisade fencing along eastern site boundary. The trees are located on a railway embankment rising to the east from the site boundary. The line is disused and the track removed.



9. View from south-east corner of the site looking north along the eastern site boundary.



10. View from the south-east corner of the site looking north-west. The large building in the centre of the photograph is used for the manufacture of the concrete products.



11. View west along the access road which forms part of the site, extending west from the north-west corner of the site. The lorry trailer is located on the site.



12. View inside the corrugated steel sheet clad building on the site.



13. View east along access road into the site. The lorry trailer is located on the site.



14. View east along poorly defined northern-site boundary, from north-western end of the site, at the end of the access road that forms part of the site.



15. Skips within the north-east corner of the site, located within the unpaved area.



16. Alternative access into the site from the north through the yard area to the north of the site.



17. View looking south/south-west into the site from the yard to the north of the site.



18. General view south/south-east across the site from near the northern boundary.



19. Further view south across the site from the northern site boundary.

The site is bordered to the east and south east by a steep wooded bank associated with a disused railway line. The former railway line and embankment are aligned north-south to the immediate east of the site.

Beyond the railway embankment, there is a meadow which also rises to the east to a footpath along the line of an additional former rail track. The ground to the east of this footpath falls sharply to a small brook that flows to the south adjacent to a large open water body immediately east of the water course.

The land immediately to the west of the site is occupied by an end of life vehicle processing facility ('scrap yard'). Further scrap yards are located to south, south-west (W Conway and Sons), and west ('Milton goughs').

Immediately north and north-west of the site, the land is occupied by DTS Waste Management, which undertakes recycling of aggregates, but also manufacture of concrete block products. The site of interest is currently part of the DTS operations, and used for the storage of concrete products.

There is a further scrap/breaker's yards to the north of the DTS site, on Shaw Lane (Carlton Car Breakers).

Photographs of the surrounding land uses are included below: -



20. ELV facility west of the site.



21. As photograph 20.



22. DTS Waste Management yard looking west-north-west from the north-west corner of the site of interest.



23. DTS yard to the north of the site, looking north-east from the site of interest, showing concrete production facility, concrete block storage, and other general building products.



24. DTS yard looking north from north-west corner of the site of interest.



25. View north-west across DTS yard, from near north-west corner of the site of interest showing products and aggregates/soil mounds.



26. Weighbridge pit filled with essentially clear rainwater. Located west of north-west corner of the site of interest, along the access road into the site of interest.



27. Soil/rubble mound on DTS yard to the north of the site of interest.



28. Aggregate storage bins along the eastern boundary of the DTS Waste Management site.



29. View west across DTS Waste Management site, from the aggregate storage bins.



30. Access into DTS Waste Management site, from near Shaw Lane.



31. Access to DTS site, and the 'Milton Goughs' yard.



32. Access to the Carlton Car Breaker's Yard to the north of the DTS Waste Management site.



33. View west along Shaw Lane from the site entrance.



34. View north-north-east along Shaw Lane from the site entrance.

The site of interest lies within a gentle valley trending north-south. The elevation of the site is around 45 metres above Ordnance Datum. A small brook (Shaw Dike) flows from the north down the valley in a southerly direction towards the site. However, at a point around 22 metres north-north-east of the site, the brook changes direction, flowing due east into a culvert beneath the railway embankments to the east of the site, where it joins the Cudworth Dike at a point 50 metres north-east of the site.

The Cudworth Dike meanders east for a further 80 metres around the northern end of a lake, before heading south-south-east. The lake is quite large and is located 76m to 80m due east of the site at its closest point.

There is another small brook located immediately west of the lake, also around 80m from the site, east-south-east. This may be an outlet from the lake.

The industrial/commercial area within which the site of interest is located extends further north along the western side of the valley beyond Shaw Lane, and is occupied by numerous car breakers yards, transport depots, and recycling depots etc.

3 Geology and Hydrogeology

The GroundSure GeolSight report contained within Appendix 1, shows that the site is partial underlain by made ground associated with the railway embankments to the east of the site.

The site is shown to be underlain by Alluvium (clay and silt). These deposits are also shown to the east and west of the site, and occupy the base of the valley, extending to the north and south of the site.

The bedrock beneath the site is shown to comprise Pennine Middle Coal Measures strata (mudstone, siltstone and sandstone).

There are no faults shown crossing the site, or coal seams.

The site is shown to be underlain by colliery workings, likely to have extended from the disused Carlton Main Colliery located 250m to 500m to the south-west of the site.

There are no surface ground workings shown beneath the site.

The nearest surface ground workings are identified 90m north west of the site (unspecified). Within 250m of the site, there is one further record of a surface ground working (pond) 184m south-west of the site.

There are no current ground workings within 250m of the site.

Localised small-scale underground mining may have occurred for bedded iron ore. However, the British Geological Survey advise that the potential for difficult ground conditions are unlikely or localised and are at a level where they need not be considered.

The superficial deposits and bedrock are both classified by the Environment Agency as a Secondary 'A' aquifers. These are 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.

There are no groundwater abstraction licenses, surface water abstraction licenses or potable water abstractions recorded within 2 km of the site. There are no source protection zones within 500m of the site.

There is a culvert shown crossing the north-western corner of the site, but more accurate drainage plans show that this is off-site, and further north.

The Shaw Dike is a secondary river and is identified 17m north/north-east of the site. The nearest primary river is located 258m south-east of the site (Cudworth Dike).

The groundwater flow direction within the natural alluvial soils beneath the site is anticipated to be to the south-east, down the valley within which the Shaw Dike flows. The groundwater flow rate is anticipated to be slow through the alluvium, which is likely to comprise mainly clays and silts with localised discontinuous sand and gravel lenses or 'ribbons' representative of former channels and meanders.

4 Site History

A review of the available historical Ordnance Survey maps has been undertaken to identify any previously potentially significantly contaminative uses, located either on-site, or in the immediate surrounding area.

Potential existing and former on-site contamination sources may have caused contamination beneath the site. Such contamination may also present a risk to future users of the site and building materials, but also to off-site receptors potentially, including controlled waters.

Neighbouring potentially contaminative historical activities may also have impacted on the site, and these may present a risk to future users of the site through on site migration of contamination, or through the deposition of waste materials on the site associated with adjacent activities.

Copies of the historical Ordnance Survey (OS) maps reviewed are located in Appendix 2

The earliest OS mapping of **1854** shows the site to be part of fields located on the western side of the gentle valley of the Shaw Dike which flowed from the north-west to the south-east past the site, at a distance of around 20m from the north-east corner of the site at the closest point. A railway line is shown at this time just over 100m to the west of the site, with tracks running north-north-west to south-south-east.

The OS mapping dated **1893** shows the site to be part of an area of essentially undeveloped land located between two main railway lines running north-north-west to the south-south-east. The railway tracks on land to the east of the site is shown at around 10m from the site boundary at this time, and included a junction (Cudworth South Junction), with a branch heading south-west from the main line at this point, running past the site on embankment.

Shaw Dike flowed from the north towards the site, down the valley. At a point around 20 metres north-north-east of the site, the Dike turned east-south-east into a culvert beneath the railway line. On emerging from the culvert, the Dike is shown to have turned south flowing along the base of the railway embankment for 75 metres, before continuing in a general south-easterly direction.

The north-west corner of the site was shown at this time to be crossed by a ditch flowing to the north-east to discharge into the Shaw Dike near the railway culvert.

Shaw Lane was present to the north-west of the site at the same position it currently occupies.

Other than a set of relatively small buildings linked to the railway network located around 25m to 95m south-west of the site, the area between the two railway lines was largely undeveloped.

The base of the railway line to the west of the site was located around 110m from the site.

Coke ovens are shown from 250m south-west of the site, extending to the south and south-west, with Carlton Main Colliery labelled at a point around 500m south-west of the site.

No development or changes to the site is shown to the site by **1906**, and little changes are shown to the surrounding area. The railway lines linked the buildings 25m to 95m south-west of the site are no longer shown, and some of the buildings had been demolished. The buildings were linked by tracks to Shaw Lane by this time.

The sidings on the railway land to the west had been expanded to the east by this time, along with additional sidings to the south-east of the site.

A row of terraced houses had been constructed to the north-west of the site on Shaw Lane by this time.

By **1918**, a railway track had been constructed along the eastern boundary of the site, and the base of the embankment is shown extending onto the site boundary at this time. This may be a mapping error, as the embankment is currently located immediately beyond the site boundary.

Other than further expansion of the railway sidings to the south-east of the site, no other significant developments had occurred by this time.

The small scale mapping available for the period from **1929** to **1955** reveal little change on the site or surrounding area, other than those associated with Carlton Main Colliery and land between the colliery and the railway line to the west of the site, which shows the loss of the coke ovens and expansion of colliery spoil heaps.

By **1966**, the mapping shows no development on the site or within the immediate surround areas. A new area of railway sidings is shown to the north-west on the opposite side of Shaw Lane, commencing 90m to the north-west of the site, on embankment.

The Shaw Dike is shown to flow through an area of marsh at this time, located to the east of the railway land to the east of the site. There are linear features shown extending into the marsh from the Dike at one point, splaying out into the marsh, and labelled 'Spreads'. These may represent a discharge from the Dike into the marsh potentially.

The land to the south-west of the site is shown to be occupied by two residential properties and out-buildings.

The **1979** mapping shows that the area surrounding the site was occupied by scrap yards by this time. The site is mainly shown to be occupied by marsh land, apart from the area to the north-west of the cross-site drainage ditch.

The railway tracks immediately to the south-east of the site were shown to have been dismantled by this time, and the base of the embankment is shown immediately beyond the site boundary at its current location.

Shaw Dike was shown at this time to terminate in the marsh to the east of the railway land, east of the site, at the point of the 'Spreads' shown on earlier mapping. The marsh is shown to be much larger in extent and is now labelled Carlton Marsh Nature Reserve.

The land extending to the north from Shaw Lane to the north-west of the site is shown to have been developed with Depots and other scrap yards on either-side of the Shaw Dike by this time.

The **1976-1981** map edition is very similar to the 1979 mapping.

The **1993** mapping shows the majority of the site, located to the south-east of the cross-site 'Drain' is occupied by a 'Marsh', and only the small area of the site to the north-west of the drain is shown to be part of the scrap yard to the north west of the site.

Carlton Marsh Nature Reserve to the east of the site is now shown to include a large open water body and a series of other ponds and lakes. The Shaw Dike is shown to have been diverted around the northern end of the main lake, and to enter the Cudworth Dike, which flows to the south east. The Cudworth Dike is probably a man-made feature to convey the Shaw Dike around the nature reserve, connecting to the former channel to the south of the nature reserve.

The later small-scale mapping of **2002**, shows the land to the immediate north/north west of the site to be labelled as a Depot, hence the scrap yard usage may have ceased by this time.

The open drainage ditch crossing the site is no longer shown by this time, and the current drainage plans indicate that the drain was culverted and diverted into a new surface water sewer at a point near Shaw Lane. The surface water drain heads west to east approximately 25m north of the site, and discharges into the Shaw Dike at the culvert beneath the railway line.

The railway sidings formerly shown on the land to the south-south-east of the site, between the main railway line and branch heading south-west past the eastern site boundary, is shown by this time to be occupied by two ponds linked by a surface water feature. It is possible that the former sidings in this inverted 'V' shaped area of land had been excavated, as the area currently forms a valley between the two railway embankments currently present either side of the former sidings.

A large elongate building had also been constructed on land to the west/south-west of the site by this time, between the site and the railway land to the west.

By **2010**, the large structure currently present on the DTS Waste Management site to the north-west of the site had been constructed, and a small building is shown in the south-west corner of the site at the current location of the existing building. Other small buildings are also shown on the land to the west and south west of the site, between the site and the railway sidings.

The **2014** mapping shows no visible changes to the site since 2010.

In summary, the site and immediate surrounding area remained essentially as an undeveloped parcel of land between two railway corridors until sometime between 1966 and the 1979. By 1979, the land immediately surrounding the site was occupied by scrap yards, although the site itself is shown predominantly as marshland, and only a small part of the north-western corner, to the north of a cross site drainage channel, may have been part of a scrap yard.

By 2002 the DTS Waste Management site appears to have replaced the scrap yard, and by 2010, a building had appeared on the site in the south-west corner of the site, at the location of the current building on the site. The large structure in the north of the DTS site used currently to manufacture concrete blocks, had also been constructed by this time.

The land to the west, south and south-west of the site currently remains occupied by scrap metal/vehicle breaker's yards.

5 ENVIRONMENTAL DATA REPORT

A Groundsure Enviro Insight report (refer to Appendix 3) has been obtained and reviewed from the perspective of identifying any recorded current potential sources of contamination, potential receptors that may be impacted by those contamination sources (historical and current), and the potential pathways that may be active, allowing any source contamination to reach the receptors.

5.1 Sources Of Potential Contamination

5.1.1 Historical Land Use

The Enviro Insight report includes 80 entries for potential historical sources of contamination within 250m of the site. These include predominantly railway sidings on-site, and off-site, railway buildings, a Depot to the north-west (89m north-west, 1989), unspecified ground workings (90m north-west, 1978), refuse heaps 143m to 153m, 168m, 193m and 202m south-west, sewage works (158m to 169m west), and tanks further west, presumably associated with the sewage works, 219m to 248m west of the site.

The colliery workings are also identified, but these are a depth in the bedrock beneath the site.

5.1.2 Potentially Infilled Land

The colliery beneath the site and extending west/south-west are identified as potentially infilled land, although the workings are sub-surface.

Other infilled land within 250m of the site includes: -

- Unspecified workings 90m north-west.
- Refuse heap (above ground feature), 153m south-west of the site.
- Sewage works 158m to 169m, and 193m south-west of the site.
- Refuse heap (above ground feature) 168m west of the site.
- Pond 184m south-west.
- Unspecified tips 193m south-west of the site.
- Refuse heap (above ground feature) 202m south-west of the site.

5.1.3 Environmental Permits, Incidents and Registers

Industrial Sites Holding Environmental Permits and/or Authorisations within 250m of the site

There is one entry for a site with operating a PART B activity 180m north-west of the site (CK Beckett, Shaw Lane). This site operates a non-ferrous metal foundry.

5.1.4 Dangerous or Hazardous Sites (COMAH & NIHHS) with 250m of the site

There is a historical NIHHS site 131m west of the site (Manor Bakeries).

5.1.5 Environment Agency Recorded Pollution Incidents

There are 16 entries of pollution incidents within 250m of the site, as summarised below, for incidents above category 4 (no impact).

Distance from site	Date	Impact	Receptor	Pollutant
21m NE	29/4/2009	Water (Cat.2 - significant)	Shaw Dike	Hydrocarbons.
31m S	20/4/2005	Land – (Cat.2 - land).		Oils and fuels, batteries.
32m N	16/3/2011	Water (Cat. 2- significant)	Shaw Dike	Crude sewage.
39m N	10/4/2002	Land (Cat. 3 - minor) Air (Cat.3 - minor)		General biodegradable materials and wastes.
55m N	09/01/2002	Water (Cat.3 - minor)		Not identified.
59 m N	08/09/2006	Water (Cat.2 - significant)	Shaw Dike	General biodegradable materials and wastes.
141m NE	14/06/2009	Water (Cat.2 - significant) Land (Cat.3 - minor)	Cudworth Dike	Oils and fuels, mixed oil wastes.
233m E	13/12/2015	Water (Cat.2 - significant) Land (Cat.3 - minor)	Cudworth Dike	Agricultural material or waste.
236m W	12/07/2004	Water (Cat.1 – major)		Crude sewage.

5.1.6 Sites Determined as Contaminated Land (Part 2A, EPA 1990)

There is no data in the report regarding contaminated land register entries for sites within 500m of the site.

5.1.7 Landfills and Other Waste Sites

There are 17 entries for Environment Agency licensed waste sites within 250m of the site. These are summarised below: -

Distance from site	Details	Date
0m	75kte WEEE Treatment Facility. DTS Shaw Lane. < 25000 tonnes. S R Waste Recycling Ltd.	09/12/2011
31m N	Physical Treatment Facility. Shotties Island Shaw Lane >= 25000 tonnes < 75000 tonnes. DTS Environmental Ltd.	16/12/2003
31m N	As above, but registered to Paul Thackray and David Thackray.	16/12/2003
42m N	Metal Recycling Site. Shaw Lane. <25,000 tonnes. Meynell ME	15/06/1989
63m W	Metal Recycling Site (Vehicle Dismantler) Shaw Lane. <25,000 tonnes. Hennighan & Parkin.	24/04/1992
63m W	Metal Recycling Site. Shaw Lane. <25,000 tonnes. W Conway & Sons.	14/09/1992
147m N	ELV Facility. Shaw Lane. <25,000 tonnes. Armitage, Kathleen.	11/10/2004
181m NW	Metal Recycling Site (Vehicle Dismantler). Shaw Lane. <25,000 tonnes. Hardwick Alan Harry.	15/09/1992
181m NW	Metal Recycling Site (Vehicle Dismantler). Shaw Lane. <25,000 tonnes. Gough Milton.	19/04/1989
181m NW	Metal Recycling Site (Vehicle Dismantler). Boulder Bridge Lane. <25,000 tonnes. Hardwick, A H.	09/15/1992
181m NW	ELV Facility. Shaw Lane. <25,000 tonnes. Newton, Melvin Anthony.	11/10/2004
181m NW	Metal Recycling Site (mixed MRS). Shaw Lane. <25,000 tonnes. Lloyd, Peter.	29/11/1990
181m NW	Metal Recycling Site (mixed MRS). Shaw Lane. <25,000 tonnes Hardwick, Alan Harry.	15/03/1993

181m NW	Metal Recycling Site (Vehicle Dismantler). Shaw Lane. <25,000 tonnes. Gough Milton.	19/04/1989
230m W	Metal Recycling Site (Vehicle Dismantler). Shaw Lane. <25,000 tonnes. Terry Thornton Commercials.	22/11/1996

5.1.8 Current Potentially Contaminative Land Uses

There are 16 entries for current industrial land uses within 250m of the site boundary.

Twelve of these are for scrap yards within a distance of 14m to 245m of the site, located north, north-west, west, south-west and south of the site.

There is a container and storage depot 26m north.

'Tanks' are listed 213m and 230m north of the site.

A 'new-vehicle' business is identified 180m north-west of the site.

5.1.9 Radon

According to the Enviro Check report, radon protective measures are not required in new buildings or extensions to buildings in the area.

5.2 Potential Contamination Environmental Receptors and Pathways

Groundwater and Surface Waters

The superficial and bedrock deposits are both Secondary 'A' aquifers.

There are no surface water, groundwater or potable water abstractions within 2000m of the site.

The site is not within a groundwater abstraction source protection zone (SPZ).

The Shaw Dike is located 17m north east of the site at the closest point to the north-east corner of the site. There is no river quality data within 1500m of the site.

Designated Environmentally Sensitive Sites

Carlton Marsh Nature Reserve is located immediately east of the site, and is shown to include the wooded railway embankment along the eastern site boundary.

5.4 Flood Data

According to the Enviro Insight report, the site is not located within an area affected by flooding (i.e. Environment Agency Flood Zone 2 or Flood Zone 3).

6 Preliminary Conceptual Site Model

6.1 Introduction

A **Site Conceptual Model** is a simplified representation of the ground conditions beneath the site and surrounding area that enables a qualitative or quantitative risk assessment to be carried out. The Site Conceptual Model identifies the potential sources of contamination, the potential contaminant migration pathways and the potential receptors of contamination (i.e. the 'potential pollutant linkages').

Sources of contamination include contaminating current or historical uses, activities, events or substances at the site or within the surrounding area that may impact on underlying soils or groundwater.

Contaminant Migration Pathways are the routes that contaminants follow from sources to receptors.

Receptors of contamination include human and non-human organisms, controlled waters (groundwater or surface water) and building materials (concrete or plastic) that experience adverse effects on exposure to contaminated materials.

A **Pollutant Linkage** occurs when a contaminant is able to travel from a source, via a pathway, to a receptor. Each element may exist in isolation and pose no environmental risk. It is only when all three elements are linked to each other that a pollutant linkage exists, and poses an environmental risk.

6.2 Potential Sources of Contamination

Potential contamination sources may present risks to human health, ecological receptors, building materials and controlled waters (groundwater and surface water) at the site, either from on-site sources or through cross boundary migration from off-site contamination sources onto the site.

On site sources of contamination if present may also impact on off-site receptors through cross boundary migration of contamination.

On site sources

The site walkover survey shows that the site is currently used for open storage of concrete block products on a drained concrete pavement. This use is not considered to present a risk to ground contamination.

Prior to the current use for storage of concrete products, the site was partially occupied by a scrap yard which extended across the extreme northern part of the site, to the north of the cross-site drain that was present previously.

The majority of the site to the south of the former drainage ditch was shown to be occupied by marsh land prior to the current usage, bordered to the south and west by scrap yards.

However, without a hard boundary between the scrap yards and the site, it is anticipated that scrap wastes may have extended across the site. Hence there is potential for leakage of various oils, and fuels from old vehicles, battery acid, sulphate, and metal sludge and old vehicle parts beneath the site.

Made ground may have been imported to the site to raise the site levels up out of the marsh and create a running surface for vehicles and plant, and this may potentially include ash and slag for

example which can often contain asbestos containing materials, elevated toxic heavy metals and polycyclic aromatic hydrocarbons (PAHs).

Off-site potential sources

The current and historical land-uses identified within Section 5 of this report, based on the Enviro Insight report information and historical mapping, and the walk-over survey have been assessed for the potential for impact on or beneath the site, and the following key points noted:

The site and surrounding area remained undeveloped until sometime between 1966 and 1979, by which time the site was bordered to the north, west and south by scrap yards.

Surface run-off from these sites may have caused waste engine oil, lubricating oil, hydraulic oils, acid, and sulphate impacted leachate to cross the boundary onto the site from the adjacent land.

Contaminated groundwater, if present, may extend beneath the site from beneath the adjacent scrap yard to the north and north-west of the site, assuming groundwater flows through the alluvium along the valley from north-west to south-east.

Apart from the scrap yard use, none of the other current or historical land uses in the area surrounding the site are considered likely to have impacted on, or beneath, the site of interest. However, there is likely to be contaminated land beneath the area surrounding the site, across the industrial zone extending to the north of the site, including land to the north of Shaw Lane, and also south and west of the site.

6.3 Potential Receptors and Pathways

The site is almost entirely covered with concrete pavement, hence the future workers will be insulated from contact with hydrocarbon contaminated ground and ground water beneath the site.

The proposed cover of drained hard standing will also act to protect the ground from impact by leachate generation.

The alluvium and bedrock are secondary 'A' aquifers, although there are no abstractions within 2000m of the site, and the site is not located within a Source Protection Zone for any groundwater abstractions.

The nearest surface water course is within 20m of the site, but groundwater flow beneath the site is likely to be to the south-east, following the river valley, through the alluvial deposits.

The alluvium extends beneath the Carlton Marsh Nature Reserve to the east of the site, which includes lakes and ponds, hence water quality is an important consideration.

Hydrocarbon contamination of soils beneath the site, if present, may impact on groundwater quality beneath the site, and result in a dissolved phase groundwater plume extending off-site to the south-east towards the nearest water body within the marsh, approximately 80m east of the site. If the dissolved phase contamination is sufficiently elevated, the surface water within the marsh lakes and ponds may be affected by hydrocarbons such as aromatic and polyaromatic hydrocarbons, aliphatic hydrocarbons, 'reduced' water low in oxygen and high in ammonia and with high oxygen demand.

The infilled ditch across the site may potentially act as a pathway allowing contaminated groundwater to drain towards the Shaw Dike.

6.4 Preliminary Risk Assessment

A summary of the potential pollutant linkages is presented within Table 6.1 below, including an assessment of the degree of risk.

Table 6.1: Preliminary Risk Assessment

Source	Pathway	Receptor	Risk Rating (CIRIA 552)
Asbestos, toxic heavy metals, polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbons, mineral oil, sulphate, acid in soils beneath the site.	i) Ingestion of contaminated soil and dust. ii) Skin contact with soil and dust. iii) Inhalation of fugitive dust.	Workers at the site, and visitors.	Low. Very low following placement across the site of concrete hard surfacing.
Elevated toxic heavy metals, soluble PAHs, soluble and mobile petroleum hydrocarbon fractions, acid, sulphate in soils beneath the site above the water table.	Infiltration of precipitation and leachate generation, and migration of contaminants in solution within groundwater.	Groundwater within the alluvium beneath the site.	Very low. The site is covered with drained concrete hard surfacing.
Elevated toxic heavy metals, soluble PAHs, soluble and mobile petroleum hydrocarbon fractions, acid, sulphate in soils beneath the site, below the water table.	Contact with groundwater resulting in leaching of contaminants.	Lateral transport of dissolved phase contamination towards water bodies within Carlton Marsh Nature Reserve.	Low to moderate. The nearest water body down hydraulic gradient is around 80m from the site, low hydraulic gradients are anticipated and low hydraulic conductivity soils between the site and the receptor.
Infilled former drainage ditch.	Potentially high permeability channel allowing contaminated groundwater to drain off-site.	Shaw Dike, 20m north-east of the site.	Low. Infiltration rates and leachate generation rates are restricted.

The risk ratings are based upon the guidance presented in CIRIA Report C552, (Contaminated land risk assessment – a guide to good practice, 2001), which presents a scheme for developing a risk rating based on the magnitude of the likelihood of the risk occurring, and the magnitude of the potential consequence or severity of the risk occurring. Table 6.2 and 6.3 define the risk rating presented above.

Table 6.2: Description of the classified risks and likely action required.

Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term.

Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Table 6.3: Comparison of consequence against probability.

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High likelihood	Very high risk	High risk	Moderate risk	Moderate/ low risk
	Likely	High risk	Moderate risk	Moderate/ low risk	Low risk
	Low likelihood	Moderate risk	Moderate/ low risk	Low risk	Very low risk
	Unlikely	Moderate/ low risk	Low risk	Very low risk	Very low risk

7 Intrusive Ground Investigation Works

7.1 Scope of Intrusive Ground Investigation Works

Thirteen windowless sampling boreholes (WS1 to WS9, WS9A, WS9B, WS10 and WS11) were drilled beneath the site on 2017 to depths of between 3 metres and 4.45 metres below ground level (m bgl).

However, boreholes WS9 and WS9A were drilled to a metre where they met refusal on obstructions or very dense ground.

The locations of the exploratory holes are shown on the Proposed Site Layout Drawing 759-D-01.

There were no specific targets identified as part of the desk top study or site walkover survey, with the exception of the cross-site infilled former drainage ditch that cut across the north-west corner of the site. However, a manhole was observed at the location where the former drain was likely to enter the site from the west/south-west, and it was considered possible that a drainage pipe was placed in the ditch prior to backfilling. Unfortunately, it was not possible to lift the manhole cover to check whether there was a sewer along the line of the infilled drainage ditch, hence the ditch was not targeted with boreholes in case there is an active drain present.

Boreholes were drilled close to the line of the former ditch (WS1, and WS10), but at a safe distance to ensure that any live sewer was not damaged.

The other boreholes were spread out across the site where access was available to complete site coverage.

Six 50mm diameter standpipes were installed into selected boreholes (WS1, WS2, WS5, WS8, WS9B and WS10) comprising a metre plain section at the top with bentonite surround and 1mm slotted pipe to the base of each hole. The headworks comprise a flush steel cover with rubber bung and gas tap inserted within the top of the pipe.

The exploratory holes were logged and sampled by CSG Consulting Engineers Limited, who attended site full time to supervise the works. The exploratory hole logs are presented in Appendix 4.

Selected representative sub-samples of the soil arisings were taken for chemical analysis and these were placed in amber glass jars and plastic tubs. The samples were stored in cool boxes with ice packs to await collection by the courier for dispatch to the laboratory of QTS Environmental, Kent.

7.2 Strata Encountered

7.2.1 Made Ground

With the exception of boreholes WS1 and WS8, all other boreholes were located in areas with a concrete pavement cover. The concrete was proven to be between 190mm and 225mm deep, overlying predominantly granular made ground with occasional beds of gravelly clay fill.

The made ground extends to depths of between 1.90 metres to 2.50 metres below ground level (m bgl).

The made ground predominantly comprises silty sand with variable percentages of gravel and cobbles of generally 'inert' materials including concrete fragments, brick, natural bedrock fragments (sandstone, mudstone, shale, black shale), angular limestone, quartzite and occasionally coal.

Locally, the made ground includes coal and also combustion residues such as slag, burnt shale, clinker (i.e. 'ash').

Admixed vehicle parts were identified within the made ground at a few locations, often associated with faint odours of aged diesel, and/or black possible oily staining.

The strata where ashy materials were identified, black stained oily materials with aged diesel odours and/or vehicle parts are summarised below: -

Table 7.1: Summary of potentially contaminated soils

Borehole Ref.	Ashy Material inclusions observed	Visual/Olfactory Evidence of potential hydrocarbon contamination observed	Vehicle parts observed
WS1	<u>0.4m-1.32m:</u> Admixed gravel of slag in clay fill.	<u>1.32-1.45m:</u> Black staining of granular fill.	<u>0.4-0.43m:</u> Nuts/bolts, plastic trim fragments.
WS2	<u>1.0m-2.0m:</u> Black sand and gravel of ash.		
WS4	<u>1.20m-1.50m:</u> Clay with admixed slag and coal. <u>1.70m-2.40m:</u> Black sandy gravel of ash		
WS5	<u>2.28-2.40m:</u> Black sand and gravel of ash.	<u>1.30-1.40m:</u> Black sand and gravel of shale with slight diesel/chemical odour. <u>1.90-2.00m:</u> Gravelly clay becoming peaty clay with slight diesel/chemical odour.	
WS6	<u>1.50-1.70m:</u> Admixed granular and clay fills with some slag.	<u>0.9m-1.10m:</u> General granular fill with hydrocarbon odours.	
WS7	<u>1.00-2.00m:</u> General granular fill with burnt shale.	<u>0.5m-1.00m:</u> General granular fill with slight aged diesel odour.	<u>0.5-1.00m:</u> General granular fill with some admixed vehicle parts (rubber, resin block, plastic fragments, electrical components, metal pieces).
WS8	<u>0.6-0.95m:</u> General granular fill with admixed burnt shale. <u>1.50-1.95m:</u> Clayey gravel including occasional clinker.		
WS9	<u>0.8-1.00m:</u> Granular fill with burnt shale.	<u>0.8-1.00m:</u> Granular fill with moderate odour of diesel.	
WS9A		<u>0.6-0.8m:</u> General granular fill with faint hydrocarbon odour.	
WS9B	<u>1.30-1.63m:</u> Sand and gravel of ash.	<u>0.25-0.75m:</u>	

Borehole Ref.	Ashy Material inclusions observed	Visual/Olfactory Evidence of potential hydrocarbon contamination observed	Vehicle parts observed
		Granular fill with faint hydrocarbon odour. <u>0.75m-1.15m:</u> Clayey fine sandy gravelly silt. Faint hydrocarbon odour/tarry odour.	
WS10		<u>1.20m-1.35m:</u> Black fine gravelly sand and silt with moderate odour of aged diesel. <u>2.00m-2.30m:</u> Gravel of brick in a black viscous matrix (probable oil). No odour of hydrocarbons.	
WS11	<u>0.50-1.70m:</u> General granular fill with occasional admixed vesicular slag. Increase in ash content below 1.35m		

The above summary shows that ashy materials are present in the made ground to variable degrees at most locations.

In addition, odours or visual indications of aged diesel or probably waste engine oil were observed in nine of the thirteen locations. The areas free of hydrocarbon impact are located in the south-eastern and north-eastern parts of the site (WS2, WS3 WS4, and WS8)

Vehicle parts (scrap wastes) were only noted in two of the boreholes, at distinct horizons.

7.2.2 Natural Soils

Beneath the made ground, soft organic rich clay, peat and/or pseudo-fibrous peat deposits were encountered at most locations as a thin bed around 100mm deep, grading into firm locally soft to firm, and soft clay, often 'crumb' textured, clay. This is considered to represent Alluvium.

At most locations, there is a lower layer of alluvial clay that includes variable percentages of gravel, typically consisting of fragments of local Coal Measures bedrock.

Strata considered representative of the weathered Coal Measures bedrock were encountered locally (WS4/3.70m bgl; WS5/2.80m bgl (possibly); WS10/3.95m bgl; and WS11/3.80m bgl).

The strata below 3.80m bgl in WS8, and 3.50m in WS10 comprises stiff, very stiff gravelly clay, but, the gravel is rounded mudstone, hence this may be a glacial Till deposit.

7.3 Groundwater Levels

The standing water levels were measured within the standpipe installations on 14th September 2017 prior to sampling. The depths to the water table are summarised below: -

Table 7.2: Groundwater Level Summary

Borehole Standpipe Ref.	Depth to water table (m bgl)	Depth to base of made ground (m bgl)
WS1	1.08	2.5
WS2	1.76	2.30
WS5	1.65	2.40
WS8	1.52	1.95
WS9B	1.37	2.00
WS10	1.50	2.30

It is apparent that the groundwater encountered represents a perched water body above the alluvial clay beneath.

Six samples of groundwater were taken on 14th September 2017 at the end of the day. Each standpipe was purged using a dedicated Teflon bailer. Three times the volume of water was removed from each standpipe prior to sampling.

No free phase layer was present at any location. A discontinuous 'rainbow' sheen was observed on the samples taken from the standpipes in boreholes WS2, WS5 and WS8.

The samples were brown in colour due to suspended fines, but following settlement, the water samples were clear.

No odours of hydrocarbons were apparent during sampling.

7.4 Laboratory Testing

Selected samples of the made ground containing combustion wastes, as identified in Table 7.1, were selected for analysis in accordance with a general contamination screening suite appropriate to the typical range of contaminants associated with such materials, including toxic heavy metals, polycyclic aromatic hydrocarbons and sulphate (total and water soluble).

In addition, selected samples were also subject to analysis for asbestos, pH, total cyanide, sulphide, sulphur, soil organic matter, and total phenols (monohydric).

Samples of the soil materials identified in Table 7.1 with hydrocarbon odours were selected for analysis for petroleum hydrocarbons (banded, and banded with aromatic/aliphatic split).

A summary of the test schedule adopted for the soils, identifying the samples selected is presented below in Table 7.3: -

Table 7.3: Summary of soil chemical testing schedule

Borehole	Sample Depth (m bgl)	pH	TPHCWG+BTEX+MTBE	QTSE Standard Suite	Water Soluble Sulphate	Asbestos screening	%SOM	Speciated PAHs	EPH Banded	Texas Banded Hydrocarbons	VOCs+TICS	EPH Product ID	SVOCs +TICS	Comments
WS2	0.4-0.5	x			x	x								Sub-base. GF
WS2	1.0-2.0			x		x	x							Sand and gravel of 'ash'
WS2	2.3-2.4						x							Clayey PEAT
WS3	0.9-1.0			x	x									Gravelly clay fill
WS3	2.80-3.00						x							Gravelly CLAY
WS5	0.7-0.8			x		x								Ashy granular fill
WS5	1.3-1.4		x					x						Sand and gravel of shale and mudstone with Hydrocarbon Odour
WS5	1.90-2.00									x				Gravelly peaty organic-rich clay fill. Slight diesel odour.
WS5	2.8-2.9								x					Sandy gravelly CLAY
WS6	0.1-0.3	x			x	x								Sub-base. GF. Concrete
WS6	0.9-1.00		x	x	x									Black sand, gravel and cobbles of coal, brick breeze block.
WS6	1.00-1.10									x				Black sand, gravel and cobbles of coal, brick
WS6	2.4-2.5								x					Sandy gravel of mudstone fragments
WS7	0.7-0.85			x	x		x							Black silt to fine gravel of coal mudstone with admixed car parts
WS8	0.3-0.4					x								Gravelly clay fill
WS8	1.55-1.7			x	x		x							Clayey ashy sandy gravel
WS8	3.55-3.7	x			x									Gravelly CLAY
WS10	1.20-1.35		x					x			x			Slightly clayey silty fine sand. Mod odour
WS10	2.0-2.30		x					x				x	x	Gravel of brick in a thick oily matrix.
WS10	2.40-2.50	x			x				x					Organic CLAY
WS9	0.8-1.00		x					x			x			Black silty sandy f-m gravel with odour of
WS9B	0.40-0.50		x	x				x			x			Gravel and cobbles in sandy matrix. Faint odour of hydrocarbons
WS9B	2.60-2.70								x					Organic CLAY
WS9B	0.90-1.00									x				Black clayey sandy gravelly silt. Faint oily odour, tarry odour.
WS11	0.20-0.40					x								Sub-base
No. of tests		4	6	7	8	6	5	5	4	3	3	1	1	

* = samples with hydrocarbon odour

TICs = Tentatively identified compounds

The QTSE Standard Suite includes pH, total cyanide, total sulphate, sulphide, toxic heavy metals (suite of 10), total phenols (monohydric) and speciated polycyclic aromatic hydrocarbons (PAHs).

All six groundwater samples were subject to analysis for banded petroleum hydrocarbons with aromatic/aliphatic split), 'BTEX' (benzene, toluene, ethyl benzene and xylenes), MTBE, pH, toxic heavy metals, free cyanide, volatile organic compounds (five samples), speciated polyaromatic hydrocarbons, ammonia and dissolved oxygen.

The chemical test results are presented in Appendix 5.

8 CONTAMINATION ASSESSMENT

8.1 Assessment Criteria

The laboratory chemical test data for the soils have been compared against published 'Tier 1' generic assessment criteria (GAC) for a commercial land use.

The Tier 1 GAC's adopted comprise the LQM/CIEH S4ULs (Suitable 4 Use Screening Levels) for Human Health Risk Assessment (Copyright Land Quality Management Limited reproduced with permission; Publication No. S4UL3429. All rights reserved).

The S4ULs currently exclude Lead, hence the Defra approved Category 4 Screening Levels¹ (C4SLs) have been adopted. For the proposed development, the C4SL for a commercial use is relevant, for which 2,300 mg/kg is considered acceptable for total Lead in soil. As a minimum requirement for planning, a remediated site cannot be capable of being potentially determined as contaminated land under Part 2A of the Environmental Protection Act, hence compliance with a C4SL in these circumstances will ensure that this minimum requirement is met.

Total cyanide has been screened against an in-house peer-reviewed generic assessment criteria of 40 mg/kg in the first instance.

The groundwater samples have been compared against Environment Agency published surface water environmental quality standards (EQS), as presented within their Chemical Standards Database.

Where a current EQS is unavailable, test results have been compared against current drinking water quality standards for England and Wales, or World Health Organisation standards for drinking water.

8.2 Soil Chemical Contamination Test Results

With respect to the proposed site usage as waste facility, all of the test results are below the adopted generic assessment criteria (GAC), adopting a soil organic matter (SOM) of 1% for organic chemicals dependent on SOM. However, the results for the soil organic matter tests on the made ground range from 5.6% to 9.2%, hence the adopted GAC are conservative. Table A appended to this report presents a summary of all the soil chemical test data and the GACs adopted.

The results for the toxic heavy metals are all significantly below the GAC for commercial land-use and generally below a residential land-use, with minor exceedances for lead in relation to a residential use.

The pH levels are generally elevated with results as high as 11.7 units. This is likely to relate to the concrete fragments within the made ground, and the storage of concrete products on the site. This is not reflected in the groundwater pH results, which are neutral.

Sulphate and sulphide concentrations within the made ground at some locations are elevated, with a maximum concentration of total sulphate of 19,710 mg/kg in one sample. However, the water soluble sulphate concentrations are not elevated in relation to the guidance used to assess protection requirement for buried concrete (CIRIA Special Publication SP1). A maximum concentration of 470 mg/l water soluble sulphate was detected.

¹ CL:AIRE. SP1010. 'Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination.' 20.12.13.

The samples tested for banded petroleum hydrocarbons are indicative of impact by petroleum hydrocarbons within the samples of the made ground selected for analysis on the basis of visual and olfactory evidence, as summarised in Table 7.1 in the previous section.

Whilst the limits for a commercial usage are not exceeded, the results indicate that the made ground samples are saturated with hydrocarbons with respect to one or more phases (soil pore-water, soil vapour and soil adsorbed to solid particles) hence there is a potential for impact on groundwater below the impacted soils, or in direct contact with the hydrocarbons in the soils at or below the water table.

The results for the banded hydrocarbons are summarised below in Table 8.1 over-page.

With reference to Table 8.1, it is apparent that samples with a faint odour of aged diesel contain notably elevated concentrations of petroleum hydrocarbons. The absence of a strong odour of diesel fuel (or gasoline) is in keeping with the aromatic/aliphatic split, which shows that the majority of the hydrocarbons are heavy aliphatic, long-chain hydrocarbons typically associated with lubricating oil.

A product analysis was scheduled on the sample of viscous oily material taken from borehole WS10 at a depth of 2.00m to 2.30m bgl. This shows that the hydrocarbons comprise lubricating oils.

It is considered likely that the hydrocarbons are essentially used engine oils, which are typically contaminated with fuel due to the operation of vehicle engines.

On inspection, the results show the absence of petrol range organics, or other volatile organic compounds other than in trace amounts, with the majority of the hydrocarbons comprising aliphatic compounds above the >C21-C35 range.

Taking the highest result for petroleum hydrocarbons of 22,114 mg/kg (WS10/1.20-1.35m), the total aromatic/aliphatic split is 20%/80% by weight. The percentage of >C21-C35 range hydrocarbons overall is 84% of the total hydrocarbon content, with 80% of this fraction comprising aliphatic compounds.

The results for the 16 USEPA polycyclic aromatic hydrocarbon (PAH) compounds within the soils are below residential GACs for most of the compounds, which supports the aromatic/aliphatic split within the samples tested.

Heavy chain compounds are sparingly soluble in water, hence the groundwater results would be expected to reflect this, as discussed within the following section. However, the soil results are elevated and indicative that the soil may potentially release free phase hydrocarbons due to saturation of soil pore-water phase.

The hydrocarbon impacted made ground is located below the water table at many locations, hence is in direct contact with the groundwater and concentrations of certain fractions would be considered likely to reach equilibrium with the hydrocarbon in the soils.

The following section (Section 8.3) discusses the results of the groundwater sampling and analysis.

Table 8.1: Summary of Petroleum Hydrocarbon Test Results		PP/759/SL B/WS5	PP/759/SL B/WS5	PP/759/SL B/WS5	PP/759/SL B/WS6	PP/759/SL B/WS6	PP/759/SL B/WS6	PP/759/SL B/WS9	PP/759/SL B/WS10	PP/759/SLB/WS10	PP/759/SL B/WS10	PP/759/SLB/WS9B	PP/759/SLB/WS9B	PP/759/SL B/WS9B	No.	Range		GAC
Determinand	Unit	1.30 - 1.40	1.90 - 2.00	2.80-2.90	0.90 - 1.00	1.00-1.10	2.40-2.50	0.80 - 1.00	1.20 - 1.35	2.00 - 2.30	2.40 - 2.50	0.40 - 0.50	0.90-1.00	2.60-2.70		Min	Max	Commercial
		MG: Sand & gravel with slight diesel/chemical odour.	MG: Gravelly clay with very slight diesel/chemical odour	Allivium: Gravelly clay	MG: General granular made ground with hydrocarb on odour	MG: Gravel of mainly coal hydrocarb on odour	MG: Gravel of mudstone and shale.	MG: General granular fill with faint to modertate diesel odour.	MG: Black sandy silt with gravel of glass and moderate odour of diesel	MG: Gravel of red brick in a black, viscous/oily matrix.	Alluvium: Firm organic clay.	MG: General granular fill with faint hydrocarbon odour.	MG: Black clayey sandy silt with gravel including roadstone. Faint oliy odour.	Peat over organic rich alluvial clay.				
									Typical of lubricating oil range organics									
EPH Texas Banded C6-C8			<0.05			< 0.05							< 0.05		3	<0.05	<0.05	
EPH Texas Banded >C8 - C10	mg/kg		3	< 1		8	4				< 1		268	< 1	7	<1	268.00	2000
EPH Texas Banded >C10 - C12	mg/kg		5	< 1		38	3				< 1		652	< 1	7	<1	652	9700
EPH Texas Banded >C12 - C16	mg/kg		10	< 1		236	11				< 1		1849	9	7	<1	1849	36,000
EPH Texas Banded >C16 - C21	mg/kg		16	< 1		316	18				< 1		3142	37	7	<1	3142	28,000
EPH Texas Banded >C21 - C40	mg/kg		270	< 6		591	33				< 6		11264	104	7	<6	11264	28,000
EPH Texas Banded (C6 - C40)	mg/kg		304	< 6		1189	69				< 6		17174	150	7	<6	17174	28,000
Aliphatic >C5 - C6	mg/kg	< 0.01				< 0.01		< 0.01	< 0.01	< 0.01		< 0.01			6	<0.01	< 0.01	3200
Aliphatic >C6 - C8	mg/kg	< 0.05				< 0.05		< 0.05	< 0.05	< 0.05		< 0.05			6	<0.05	< 0.05	7800
Aliphatic >C8 - C10	mg/kg	< 2				13		< 2	< 2	< 2		130			6	< 2	130	2000
Aliphatic >C10 - C12	mg/kg	< 2				62		< 2	8	< 2		351			6	< 2	351	9700
Aliphatic >C12 - C16	mg/kg	< 3				427		72	388	< 3		1359			6	< 3	1359	59,000
Aliphatic >C16 - C21	mg/kg	49				1014		1240	2466	< 3		3226			6	< 3	3226	1,600,000
Aliphatic >C21 - C34	mg/kg	2119				5686		10807	14981	105		7704			6	105	14981	1,600,000
Aliphatic (C5 - C34)	mg/kg	2168				7203		12119	17844	105		12770			6	105	17844	
Aromatic >C5 - C7	mg/kg	< 0.01				0.01		< 0.01	< 0.01	< 0.01		< 0.01			6	<0.01	0.01	2600
Aromatic >C7 - C8	mg/kg	< 0.05				< 0.05		< 0.05	< 0.05	< 0.05		< 0.05			6	< 0.05	<0.05	56,000
Aromatic >C8 - C10	mg/kg	3				2		16	< 2	< 2		26			6	< 2	26	3500
Aromatic >C10 - C12	mg/kg	9				17		45	< 2	< 2		129			6	< 2	129	16,000
Aromatic >C12 - C16	mg/kg	24				175		220	57	< 2		631			6	< 2	631	36,000
Aromatic >C16 - C21	mg/kg	26				456		415	624	6		1212			6	4	1212	28,000
Aromatic >C21 - C35	mg/kg	449				1359		3022	3589	31		2275			6	15	3589	28,000
Aromatic (C5 - C35)	mg/kg	512				2009		3719	4270	37		4272			6	< 21	4272	28,000
Total >C5 - C35	mg/kg	2680				9212		15838	22114	143		17042			6	< 42	17042	

8.3 Groundwater Test Results

Appended Table B presents a summary of all the chemical test results for the groundwater, and includes the available EQS used to assess the results.

None of the six groundwater samples show petroleum hydrocarbon fractions to be present above detection limit (10 ug/l), hence the level impact from the detected hydrocarbons in the soils is below this concentration. There was no evidence of any free phase hydrocarbons other than a discontinuous rainbow sheen on the surface of the purged waters at some locations, which may be related to peat/organic material within the soils in the absence of detectable hydrocarbons in the waters.

The speciated polycyclic aromatic hydrocarbon (PAH) results are above detection limits, but none of the results exceed any of the available EQS. The maximum concentration of any of the 16 individual USEPA priority compounds is 0.15 ug/l (Acenaphthene) within borehole WS1, which is at the up-hydraulic side of the site in the north-west corner of the site, where the groundwater table is shallowest. The total of the 16 USEPA priority compounds is 0.66 ug/l within the sample from WS1, with all other results for individual PAH compounds below this concentration, ranging from <0.01 ug/l to 0.30 ug/l.

The total concentration of the 16 USEPA priority PAH compounds is 0.30 ug/l within the water sample from WS10, which shows the most elevated hydrocarbon concentration within all of the soil samples analysed.

The pH results show the water is essentially neutral and none of the metals exceed the EQS.

The dissolved oxygen content of the groundwater ranges from 4.1% to 6.5%. The surface water EQS for cyprinid waters is 7 mg/l over a 12 month period. The reduction in dissolved oxygen in the groundwater compared to fresh surface water is not unexpected where natural peaty deposits are present, although metabolic action of anaerobic microorganisms using the hydrocarbon as food source may also account for the reduced oxygen levels.

The ammoniacal nitrogen (total ammonia) concentrations are between 0.6 mg/l and 9.3 mg/l for 5 out of 6 samples of the groundwater analysed, which are approximately with the range of 'RE2' to 'RE5' class surface waters, in accordance with the UK Standard for Protection of Inland Freshwaters (i.e. the Surface Waters (River Ecosystem) (Classification) Regulations 1994).

These Regulations prescribe a system of classifying the general quality of inland freshwaters, which are relevant rivers or watercourses (as defined in section 104 of the Water Resources Act 1991 ('the Act')). The system, which consists of five classes ranging in order of decreasing quality from RE1 to RE5, are used for establishing quality objectives under section 83 of the Act.

The result for the sample taken from WS10 for total ammonia is 195 mg/l, which may reflect the high organic content of the sample which included lubricating oil and peaty clay.

Ammonia levels in stagnant waters in contact with soils containing high concentrations of organic matter, such as in peat bogs and marshes can be naturally elevated as a result of the reducing environment and the presence of nitrogen containing compounds within natural organic compounds such as humus, and decaying vegetable matter. Refined petroleum hydrocarbons tend not to contain elevated nitrogen containing compounds which tend to accumulate in the bituminous/resin based fractions remaining after refining crude oil, hence the ammonia is considered more likely to originate from the peaty/organic content of the natural soils.

8.4 Revised Qualitative Risk Assessment

8.4.1 Ground Model

The ground conditions beneath the site comprise a layer of concrete pavement over 1.90m to 2.50m of essentially granular fill with sub-ordinate beds of gravelly clay fill locally.

The granular fill includes variable mixtures of silt, sand, gravel and cobbles of essentially inert materials with some combustion products ('ash') admixed in with the made ground locally in certain layers. Ashy materials were found within most boreholes.

Within some of the boreholes, horizons impacted by predominantly heavy aliphatic petroleum hydrocarbons were detected, at concentrations measured up to 2.2% by weight of total petroleum hydrocarbons, both above, but mainly below, the water table, which lies at shallow depth (1.08m to 1.76m below ground level).

The groundwater is perched above the alluvial clay soils proven beneath the made ground in all boreholes.

In spite of the elevated hydrocarbons in the soils, the impact on groundwater is minimal, with any petroleum hydrocarbons, if present in the groundwater, at concentrations below detection limits, and with low concentrations of polycyclic aromatic hydrocarbons.

Some dissolved oxygen depletion is apparent, and elevated total ammonia concentrations are also evident in the groundwater at several locations, which is considered more likely to be related to the presence of peat layers at the top of the natural alluvial clays in contact with the groundwater.

8.4.2 Human Health Risk Assessment

None of the chemical test results exceed the generic assessment criteria (GAC) for a commercial use, and hence no remedial measures are required in relation to human health risk through accidental ingestion of soil and indoors dust, skin contact with soil, inhalation of dust or vapours.

Standard blue polyethylene (PE) drinking water supply pipes would potentially be in contact with petroleum hydrocarbons in the soils, and whilst the light aromatic fractions are absent, as are the other compounds typically considered to present a risk to PE pipes, it would be prudent to check with the water supply authority if protection is necessary for PE pipes in direct contact with the hydrocarbon impacted soils is advised.

Landfill gas protective measures are not considered necessary, as the existing building comprises a large single skinned steel-clad unit on a concrete base with large, poorly sealed doors with gaps all around, and a significant area of gaps open to the atmosphere between the single sheet cladding panels. Proposed buildings are to comprise portacabins on 'stilts' with a large air gap beneath, resting on the concrete pavement, hence the risk from hazardous ground gas entry is considered minimal.

8.4.3 Groundwater Risk Assessment

The off-site receptors that could potentially be impacted by contamination migration from beneath the site include the Shaw Brook to the north-east (c. 20 metres north-east at its closest), and the lakes and ponds associated with the Carlton Marsh Nature Reserve, located 80m east of the site at the closest point.

The ground between the site and the nearest water body associated with the Carlton Marsh comprises former railway land that it raised above the level of the site, hence there are no closer receptors visible, although groundwater within the alluvial deposits may be considered to be a receptor as a Secondary 'A' aquifer.



View south across former railway sidings to the east and south east of the site. Ground levels rise up to the tops of the former rail embankments to the right (west) and left (east).



View east from a position at the base of the former railway embankment immediately east of the site.



View south-west toward wooded railway embankment immediately east of the site. The site lies beyond the trees.



View south along footpath along the top of the railway embankment at the eastern edge of the railway land to the east of the site, approximately 70m east of the site.



View east down the railway embankment to the nearest water body to the site (80m east of the site) at the base of the railway embankment. The open lake associated with Carlton Marsh is located beyond the base of the embankment.

The groundwater sampled beneath the site is considered to be taken from a perched water body above the alluvial clays which are low permeability deposits through which dissolved phase contamination migration would be very restricted.

Perched water bodies are essentially static, comprising water bodies that can be considered to be buried lakes or discontinuous bodies that expand following periods of infiltration, and shrink during periods of dry weather. Some infiltration into the alluvial clay may occur, but at very low rates. There may be outlets from the granular made ground containing the perched water, including on this site the infilled drainage channel for example, or around the edges where the land surface falls away below the base of a low spot in the made ground deposits, allowing a 'spring' to develop locally.

The groundwater table within the made ground appears to fall from north-west (WS1) to south-east (WS2) from 1.08m to 1.76m bgl, hence there is evidence that there may be groundwater seepage flow within that direction, although a local outlet from the made ground is not apparent as ground levels rise across the former railway land to the east. However, granular fill may be present beneath the railway land and allow groundwater seepage to the south-east and south towards other water bodies within Carlton Marsh.

Figure 8.1 presented at the end of this section of the report shows a Conceptual Site Model including a plan and conceptual geological cross section explaining the relationship between the site and the surface water receptors within Carlton Marsh Nature Reserve, approximately 100m down hydraulic gradient.

There is no evidence to suggest that the infilled drain across the north-west corner of the site is influencing the groundwater flow direction.

Whilst off-site migration of groundwater through the made ground may be occurring, it is not unacceptably impacted by acids, toxic heavy metals, petroleum hydrocarbons or polycyclic aromatic

hydrocarbons (i.e. principal contaminants of concern associated with a scrap yard use) and hence is not considered to present unacceptable risk to the water quality within Carlton Marsh Nature Reserve.

Ammonia concentrations are elevated beneath the site, probably mainly due to natural peat deposits, but at the down gradient side of the site in borehole WS2, ammonia concentrations are at the lowest level detected in all six samples, i.e. 0.6 mg/l total ammonia, which indicates class 'RE2' conditions at the site boundary.

It is concluded that the site does not present an unacceptable risk to the quality of the surface water within the Carlton Marsh Nature Reserve, and hence no remedial works are considered necessary in relation to the proposed development in this respect.

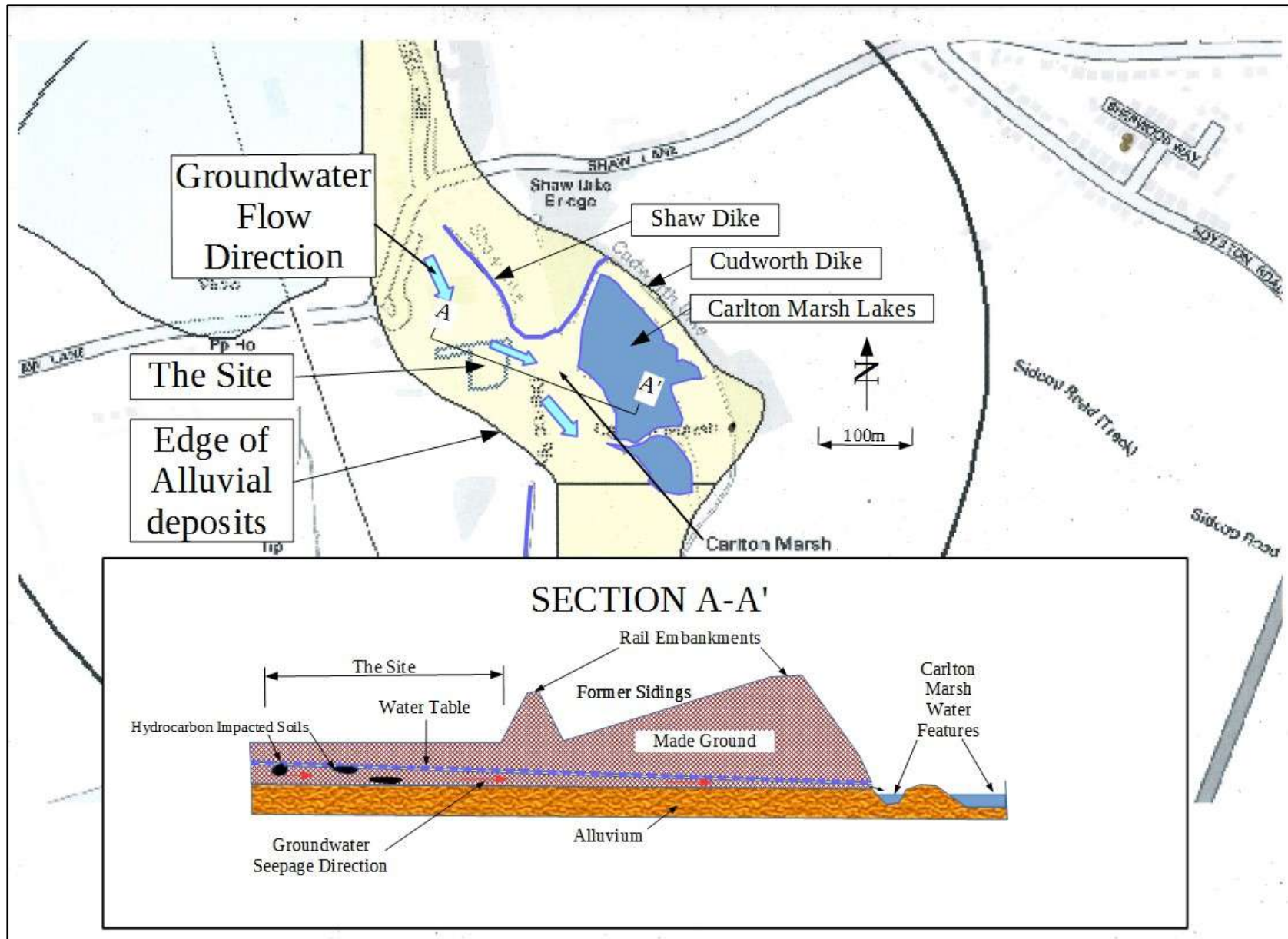


FIGURE 8.1: Conceptual Site Model

9 Key Conclusions and Recommendations

In relation to human health, the site is not considered to require any remedial measures in relation to the proposed development for recycling dry metal wastes. Landfill gas protective measures are not considered necessary.

Protection requirements for drinking water supply pipes may be required as the polyethylene pipes could be in contact hydrocarbon impacted soils. The local water supply authority would be able to advise on the requirements in this respect.

Despite elevated concentrations of petroleum hydrocarbons within the soils, above and below the water table, locally beneath the site, groundwater quality is not unacceptably impacted. This is due to the low solubility of the hydrocarbon compounds present. The hydrocarbons are most likely aged waste engine oils associated with the past use of the surrounding land as scrap yards, which partially extended onto the site.

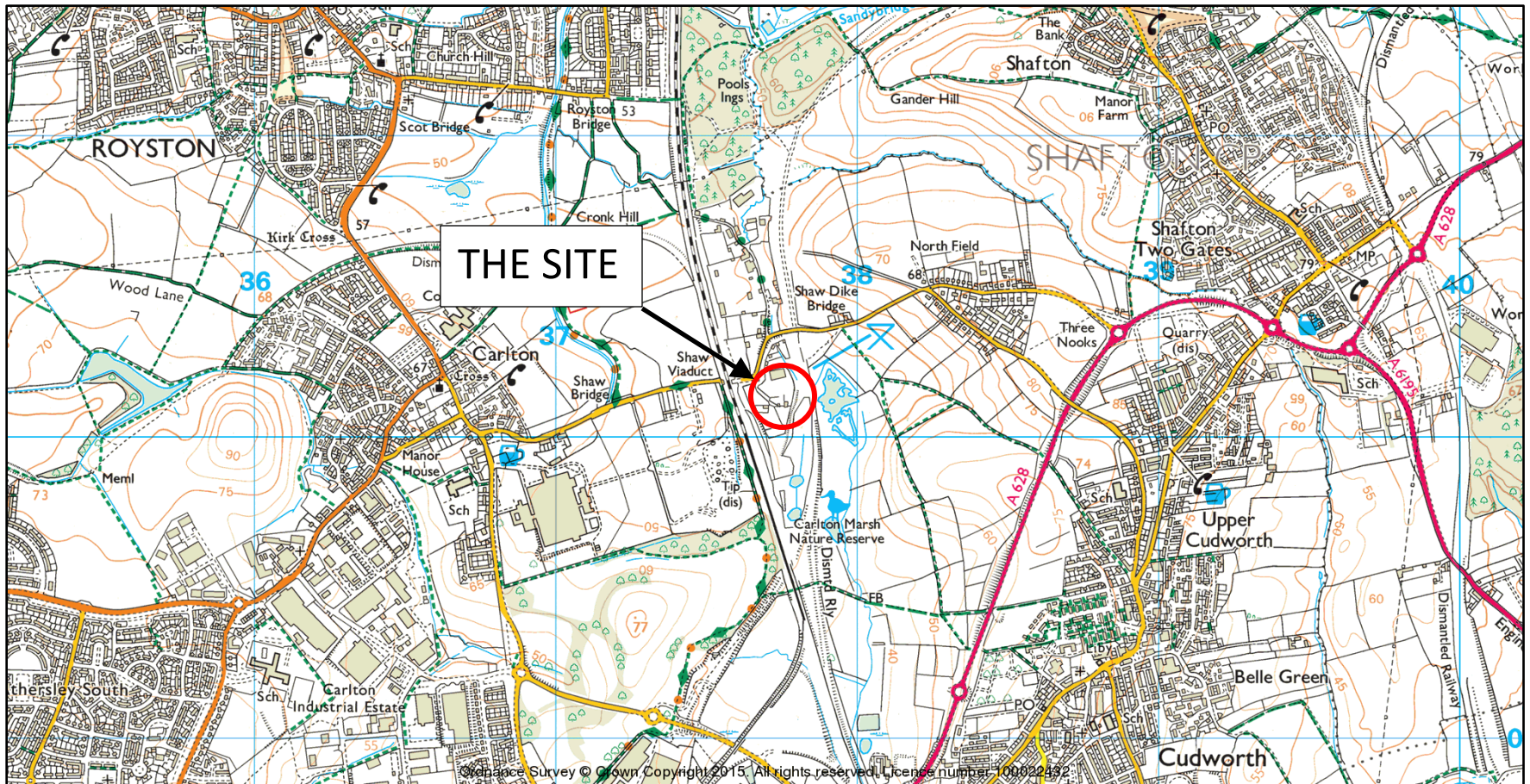
The groundwater tests results however show that the site does not present an unacceptable risk to off-site controlled water receptors, and no remedial measures are considered necessary in this respect.

TABLES

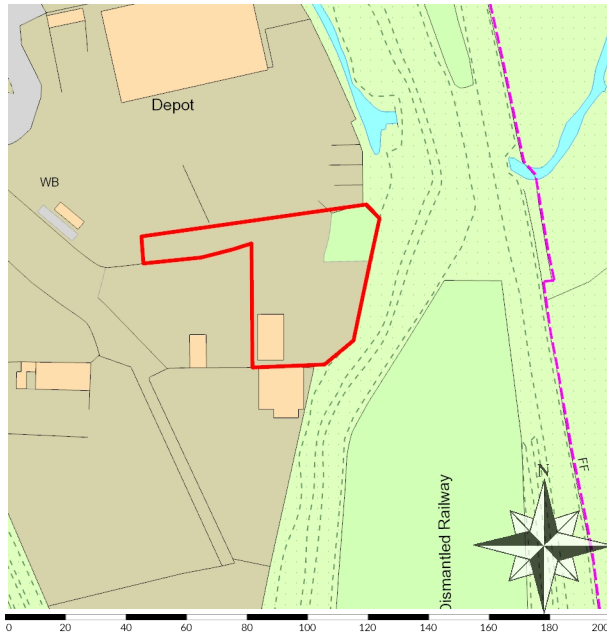
TABLE A: Summary of Soil Chemical Test Results		PP/759/SLB/W S2	PP/759/SLB/W S2	PP/759/SLB/W S2	PP/759/SLB/W S3	PP/759/SLB/W S3	PP/759/SLB/W S5	PP/759/SLB/W S5	PP/759/SLB/W S5	PP/759/SLB/W S5	PP/759/SLB/W S6	PP/759/SLB/W S6	PP/759/SLB/W S6	PP/759/SLB/W S7	PP/759/SLB/W S8	PP/759/SLB/W S8	PP/759/SLB/W S8	PP/759/SLB/W S9	PP/759/SLB/W S10	PP/759/SLB/W S10	PP/759/SLB/W S10	PP/759/SLB/W S9B	PP/759/SLB/W S9B	PP/759/SLB/W S9B	PP/759/SLB/W S11	No.	Range		GAC			
Determinand	Unit	0.40 - 0.50	1.00 - 2.00	2.30 - 2.40	0.90 - 1.00	2.80 - 3.00	0.70 - 0.80	1.30 - 1.40	1.90 - 2.00	2.80-2.90	0.10 - 0.30	0.90 - 1.00	1.00-1.10	2.40-2.50	0.70 - 0.85	0.30 - 0.40	1.55 - 1.70	3.55 - 3.77	0.80 - 1.00	1.20 - 1.35	2.00 - 2.30	2.40 - 2.50	0.40 - 0.50	0.90-1.00	2.60-2.70	0.20 - 0.40	Min	Max	Commercial			
Asbestos Screen	N/a	Not Detected	Not Detected				Not Detected				Not Detected				Not Detected										Not Detected	6	ND	ND				
pH	pH Units	8.9	7.8		7.7		10.0				11.7				8.6		7.5	7.7								7.5	11.6					
Total Cyanide	mg/kg	< 2	< 2		< 2		< 2				< 2				< 2		< 2									7	< 2	< 2				
Total Sulphate as SO ₄	mg/kg		1979		3144		4630				4503			4517			827									7	827	19710		40		
Total Sulphate as SO ₄	%		0.20		0.31		0.46				0.45			0.45			0.08									7	0.080	1.97		1.97		
W/S Sulphate as SO ₄ (2:1)	mg/l	364			91						473			281			26									8	26	281				
W/S Sulphate as SO ₄ (2:1)	g/l	0.36			0.09						0.47			0.28			0.03									8	0.03	0.47				
Sulphide	mg/kg		< 5		< 5		< 5				70			12			324									7	< 5	324				
Organic Matter	%		9.2	5.1			1				5.6			8.2												5	1	8.2				
Arsenic (As)	mg/kg		33		27		8				19			5			22									7	5	27		640		
W/S Boron	mg/kg		3		1.2		2.2				7.3			4.2			4.6									7	1.2	7.3		240,000		
Cadmium (Cd)	mg/kg		0.8		0.5		0.2				2			1.9			0.4									7	0.2	3.2		190		
Chromium (Cr)	mg/kg		15		9		18				51			29			12									7	9	57		8600		
Copper (Cu)	mg/kg		283		51		26				195			206			56									7	26	283		68,000		
Lead (Pb)	mg/kg		111		32		99				131			144			30									7	30	458		2300		
Mercury (Hg)	mg/kg		< 1		< 1		< 1				< 1			< 1			< 1									7	< 1	< 1		58		
Nickel (Ni)	mg/kg		23		23		16				29			19			24									7	16	29		980		
Selenium (Se)	mg/kg		< 3		< 3		< 3				< 3			< 3			< 3									7	< 3	< 3		12,000		
Zinc (Zn)	mg/kg		213		55		62				486			379			75									7	55	587		730,000		
Total Phenols (monohydric)	mg/kg		< 2		< 2		< 2				< 2			< 2			< 2									7	< 2	< 2		760		
Tentative Petroleum Type																																
Naphthalene	mg/kg		0.40		0.35		0.63	0.34			0.62			0.24			0.77		0.13	0.20						11	< 0.1	1.47		190		
Acenaphthylene	mg/kg		< 0.1		< 0.1		< 0.1	< 0.1			< 0.1			0.12			< 0.1		< 0.1	< 0.1						11	< 0.1	0.20		83,000		
Acenaphthene	mg/kg		< 0.1		< 0.1		< 0.1	< 0.1			< 0.36			< 0.1			< 0.1		< 0.1	< 0.1						11	< 0.1	0.79		84,000		
Fluorene	mg/kg		< 0.1		< 0.1		< 0.1	< 0.1			0.77			0.62			< 0.1		< 0.1	0.20						11	< 0.1	1.46		63,000		
Phenanthrene	mg/kg		0.60		0.42		0.74	0.42			2.02			1.45			< 0.1		< 0.1	0.64						11	< 0.1	3.93		22,000		
Anthracene	mg/kg		< 0.1		< 0.1		0.16	0.11			0.42			0.27			< 0.1		0.24	< 0.1						11	< 0.1	0.82		520,000		
Fluoranthene	mg/kg		0.60		0.21		0.70	0.24			1.22			0.59			0.64		0.89	0.63						11	< 0.1	3.86		23,000		
Pyrene	mg/kg		0.49		0.20		0.63	0.22			1.85			2.02			0.44		1.43	0.56						11	< 0.1	4.12		54,000		
Benzo(a)anthracene	mg/kg		0.19		< 0.1		0.28	< 0.1			0.47			0.62			0.14		0.31	0.45						11	< 0.1	1.28		170		
Chrysene	mg/kg		0.22		0.12		0.42	0.14			0.75			1.13			0.23		0.50	0.64						11	< 0.1	1.70		350		
Benzo(b)fluoranthene	mg/kg		0.19		< 0.1		0.38	0.14			0.78			1.38			0.22		0.60	0.91						11	< 0.1	1.96		44		
Benzo(k)fluoranthene	mg/kg		< 0.1		< 0.1		0.17	< 0.1			0.29			0.36			< 0.1		< 0.1	0.25						11	< 0.1	0.70		1200		
Benzo(a)pyrene	mg/kg		< 0.1		< 0.1		0.29	< 0.1			0.48			0.62			0.34		0.54	0.17						11	< 0.1	1.35		35		
Indeno(1,2,3-cd)pyrene	mg/kg		< 0.1		< 0.1		0.17	< 0.1			0.31			0.57			< 0.1		0.23	0.43						11	< 0.1	0.92		500		
Dibenz(a,h)anthracene	mg/kg		< 0.1		< 0.1		< 0.1	< 0.1			< 0.1			< 0.1			< 0.1		< 0.1	< 0.1						11	< 0.1	0.16		3.5		
Benzo(ghi)perylene	mg/kg		< 0.1		< 0.1		0.19	< 0.1			0.31			0.54			< 0.1		0.24	0.35						11	< 0.1	0.78		3900		
Total EPA-16 PAHs	mg/kg		2.7		< 1.6		4.8	1.6			11.1			11.2			3.9		7.2	2.6						11	< 1.6	25.50				
EPH Texas Banded C6-C8									< 0.05			< 0.05														3	< 0.05	< 0.05				
EPH Texas Banded >C8 - C10	mg/kg						3	< 1			8		4													7	< 1	268.00		2000		
EPH Texas Banded >C10 - C12	mg/kg						5	< 1			38		3													7	< 1	652		9700		
EPH Texas Banded >C12 - C16	mg/kg						10	< 1			236		11													7	< 1	1849		36,000		
EPH Texas Banded >C16 - C21	mg/kg						16	< 1			316		18													7	< 1	3142		28,000		
EPH Texas Banded >C21 - C40	mg/kg						270	< 6			591		33													7	< 6	11264		28,000		
EPH Texas Banded (C6 - C40)	mg/kg						304	< 6			1189		69													7	< 6	17174		28,000		
Benzene	ug/kg						< 2				13						< 2		< 2	< 2						6	< 2	13		27,000		
Toluene	ug/kg						< 5				31						< 5		< 5	< 5						6	< 5	31		56,000		
Ethylbenzene	ug/kg						< 2				13						36		< 2	< 2						6	< 2	259		5,700		
p & m-xylene	ug/kg						< 2				46						81		< 2	< 2						6	< 2	408		5,900		
o-xylene	ug/kg						< 2				36						41		< 2	< 2						6	< 2	467		6,600		
MTBE	ug/kg						< 5				< 5						< 5		< 5	< 5						6	< 5	< 5				
Aliphatic >C5 - C6	mg/kg						<																									

TABLE B: Summary of groundwater chemical test results		PP/759/SLB/WS1	PP/759/SLB/WS2	PP/759/SLB/WS5	PP/759/SLB/WS8	PP/759/SLB/WS9	PP/759/SLB/WS10	PP/759/SLB/WS10	UK Drinking Water Standard	Surface Water EQS
Determinand	Depth--> Unit							Water 1		
pH	pH Units	7.7	8.1	7.7	7.3	7.4		7.9	6-9	6-9
Free Cyanide	ug/l	< 5	< 5	< 5	< 5	< 5		< 5		1
Ammonia as NH ₄	ug/l	4060	599	5050	1240	9310		195000		0.25-9 mg/l
Dissolved Oxygen	mg/l	5.5	6.5	5.4	6	4.1		4.2		7
Arsenic (dissolved)	ug/l	11	< 5	9	< 5	6		15	10	25
Barium (dissolved)	ug/l	219	58	102	92	228		468		
Beryllium (dissolved)	ug/l	< 3	< 3	< 3	< 3	< 3		< 3		
Boron (dissolved)	ug/l	291	388	608	181	737		1000	1000	
Cadmium (dissolved)	ug/l	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4		< 0.4	5	2
Chromium (dissolved)	ug/l	< 5	< 5	< 5	< 5	< 5		< 5	50	32 Cr III
Copper (dissolved)	ug/l	< 5	< 5	< 5	< 5	< 5		< 5	2000	5
Lead (dissolved)	ug/l	< 5	< 5	< 5	< 5	< 5		< 5	10	7.2
Mercury (dissolved)	ug/l	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05		< 0.05	1	0.05
Nickel (dissolved)	ug/l	< 5	< 5	< 5	8	< 5		< 5	20	20
Selenium (dissolved)	ug/l	< 5	< 5	< 5	< 5	< 5		< 5	10	
Vanadium (dissolved)	ug/l	< 5	< 5	< 5	< 5	< 5		< 5		
Zinc (dissolved)	ug/l	7	4	2	15	< 2		< 2		40
Tentative Petroleum Type								Typical of diesel range organics		
Naphthalene	ug/l	0.20	0.01	< 0.01	< 0.01	0.10		0.12		1.2 ug/l
Acenaphthylene	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01		
Acenaphthene	ug/l	0.15	< 0.01	< 0.01	< 0.01	0.04		0.06		
Fluorene	ug/l	0.08	< 0.01	< 0.01	< 0.01	< 0.01		0.06		
Phenanthrene	ug/l	0.13	< 0.01	< 0.01	< 0.01	< 0.01		0.06		
Anthracene	ug/l	0.04	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01		0.1ug/l
Fluoranthene	ug/l	0.03	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01		0.1ug/l
Pyrene	ug/l	0.03	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01		
Benzo(a)anthracene	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01		
Chrysene	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01		
Benzo(b)fluoranthene	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01		
Benzo(k)fluoranthene	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01		
Benzo(a)pyrene	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	0.01 ug/l	0.05 ug/l
Indeno(1,2,3-cd)pyrene	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01		
Dibenz(a,h)anthracene	ug/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01		
Benzo(ghi)perylene	ug/l	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008		< 0.008		
Total EPA-16 PAHs	ug/l	0.66	0.01	< 0.01	< 0.01	0.14		0.30		
Aliphatic >C5 - C6	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	15 mg/l	10 ug/l
Aliphatic >C6 - C8	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	15 mg/l	10 ug/l
Aliphatic >C8 - C10	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	300 ug/l	10 ug/l
Aliphatic >C10 - C12	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	300 ug/l	10 ug/l
Aliphatic >C12 - C16	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	300 ug/l	10 ug/l
Aliphatic >C16 - C21	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	No WHO value.	10 ug/l
Aliphatic >C21 - C34	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	No WHO value.	10 ug/l
Total Aliphatic (C5 - C34)	ug/l	< 70	< 70	< 70	< 70	< 70		< 70		
Aromatic >C5 - C7	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	10 ug/l (for Benzene)	10 ug/l
Aromatic >C7 - C8	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	700 ug/l (Toluene)	10 ug/l
Aromatic >C8 - C10	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	300 ug/l Ethyl benzene 500 ug/l Xylenes	10 ug/l
Aromatic >C10 - C12	ug/l	12	< 10	< 10	< 10	< 10		< 10	100 ug/l	10 ug/l
Aromatic >C12 - C16	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	100 ug/l	10 ug/l
Aromatic >C16 - C21	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	90 ug/l	10 ug/l
Aromatic >C21 - C35	ug/l	< 70	< 70	< 70	< 70	< 70		< 10	90 ug/l	10 ug/l
Total Aromatic (C5 - C35)	ug/l	< 140	< 140	< 140	< 140	< 140		< 70		
Total Aromatic and Aliphatic >C5 - C35	ug/l	< 140	< 140	< 140	< 140	< 140		< 140		
Benzene	ug/l	< 1	< 1	< 1	< 1	< 1		< 1	1 ug/l	8 ug/l
Toluene	ug/l	< 5	< 5	< 5	< 5	< 5		< 5	700 ug/l	40 ug/l
Ethylbenzene	ug/l	< 5	< 5	< 5	< 5	< 5		< 5	300 ug/l	
p & m-xylene	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	500 ug/l (Total Xylenes)	30 ug/l (Total Xylenes)
o-xylene	ug/l	< 5	< 5	< 5	< 5	< 5		< 5	500 ug/l (Total Xylenes)	30 ug/l (Total Xylenes)
MTBE	ug/l	< 10	< 10	< 10	< 10	< 10		< 10	15 ug/l (odour threshold)	
Dichlorodifluoromethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Vinyl Chloride	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Chloromethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Chloroethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Bromomethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Trichlorofluoromethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
1,1-Dichloroethene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
MTBE	< 10	< 10	< 10	< 10	< 10	< 10		< 10		
trans-1,2-Dichloroethene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
1,1-Dichloroethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
cis-1,2-Dichloroethene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
2,2-Dichloropropane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Chloroform	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Bromochloromethane	< 10	< 10	< 10	< 10	< 10	< 10		< 10		
1,1,1-Trichloroethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
1,1-Dichloropropene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Carbon Tetrachloride	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
1,2-Dichloroethane	< 10	< 10	< 10	< 10	< 10	< 10		< 10		
Benzene	< 1	< 1	< 1	< 1	< 1	< 1		< 1		
1,2-Dichloropropane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Trichloroethene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Bromodichloromethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Dibromomethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
TAME	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
cis-1,3-Dichloropropene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Toluene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
trans-1,3-Dichloropropene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
1,1,2-Trichloroethane	< 10	< 10	< 10	< 10	< 10	< 10		< 10		
1,3-Dichloropropane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Tetrachloroethene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Dibromochloromethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
1,2-Dibromoethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Chlorobenzene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
1,1,1,2-Tetrachloroethane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Ethyl Benzene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
m,p-Xylene	< 10	< 10	< 10	< 10	< 10	< 10		< 10		
o-Xylene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Styrene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Bromoform	< 10	< 10	< 10	< 10	< 10	< 10		< 10		
Isopropylbenzene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
1,1,2,2-Tetrachloroethane	< 10	< 10	< 10	< 10	< 10	< 10		< 10		
1,2,3-Trichloropropane	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
n-Propylbenzene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
Bromobenzene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
2-Chlorotoluene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
1,3,5-Trimethylbenzene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
4-Chlorotoluene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
tert-Butylbenzene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
1,2,4-Trimethylbenzene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
sec-Butylbenzene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
p-Isopropyltoluene	< 5	< 5	< 5	< 5	< 5	< 5		< 5		
1,3-Dichlorobenzene	< 5	< 5								

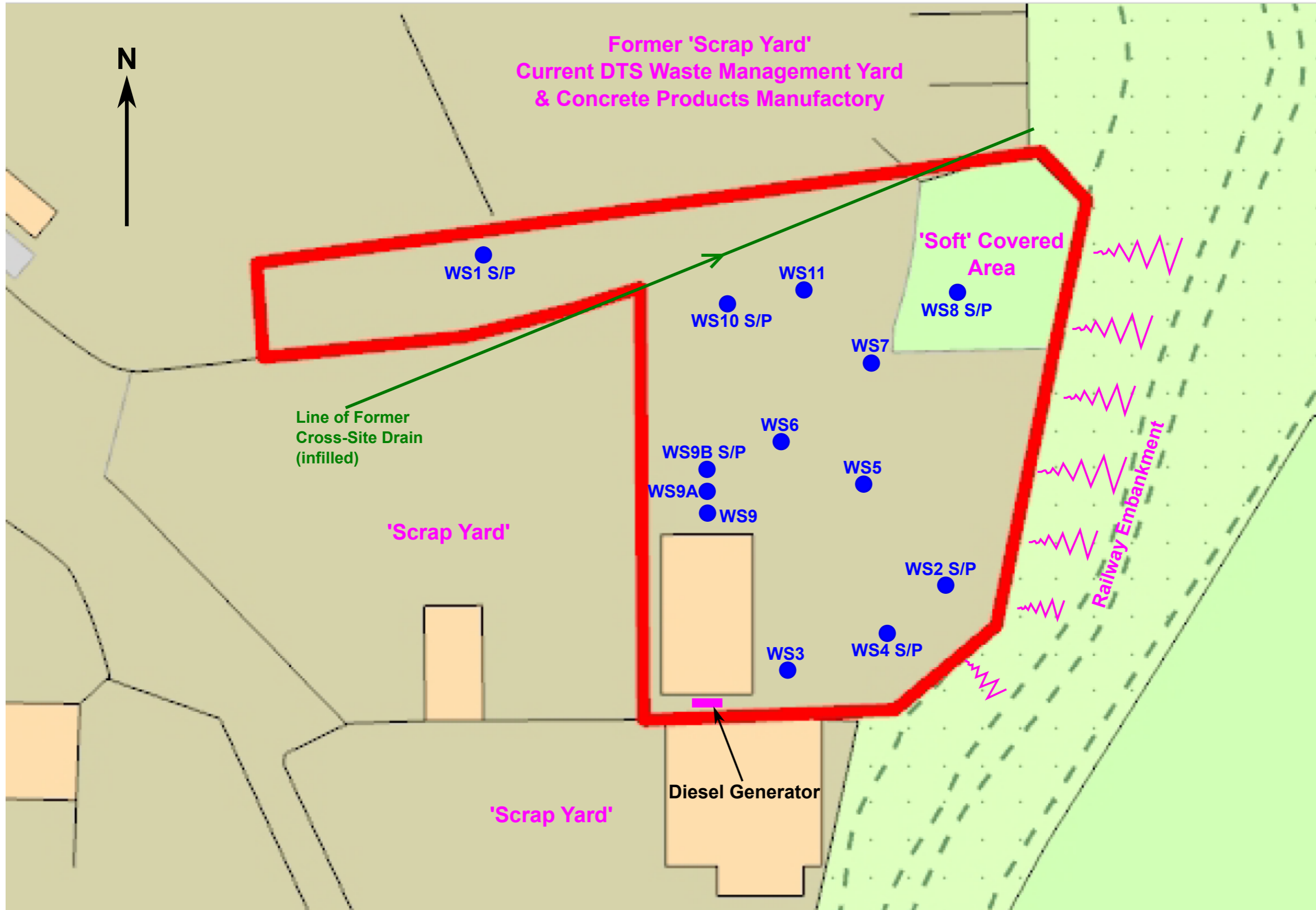
DRAWINGS



Site Location Plan



Scale: 1:2500 | Area 4Ha | Grid Reference: 437780,410124 | Paper Size: A4



- KEY**
- Windowless Sampler Borehole
 - S/P** Monitoring Standpipe Installed

29 Greenlands Business Centre
 Studley Road
 Redditch, B98 7HD
 Tel: 0121 314 5432
 Email: mail@csge.co.uk

CSG
 Consulting Engineers

CLIENT
STAIRFOOT METALS LIMITED

PROJECT
SHAW LANE, BARNSELY

TITLE
BOREHOLE LOCATION PLAN AND KEY FEATURES

DATE	SEPT 2017	DRAWN	DH
SCALE	A3	CHECKED	PP
DRAWING NUMBER	759-D-01	APPROVED	PP
		REVISION	

0m **Scale** 20m