

A47 Blofield to North Burlingham Dualling

Scheme Number: TR010040

Volume 6

6.2 Environmental Statement Appendices

Appendix 9.1 – Contaminated Land Preliminary Risk Assessment

APFP Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed
Forms and Procedure) Regulations 2009

December 2020

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning
(Applications: Prescribed Forms and
Procedure) Regulations 2009**

A47 Blofield to North Burlingham
Development Consent Order 202[x]

ENVIRONMENTAL STATEMENT APPENDICES
Appendix 9.1 Contaminated Land Preliminary Risk Assessment

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1. Introduction

1.1. Scope and objectives of the report

- 1.1.1. The principal objectives of this preliminary risk assessment (PRA) are to identify potential sources of contamination, pathways and receptors, by means of a desk study investigation, and present this in the form of a conceptual site model (CSM).
- 1.1.2. The report includes a summary of any historic ground investigations undertaken to date.
- 1.1.3. This report has been prepared following the guidelines set out in the Environment Agency's latest guidance Land Contamination Risk Management (LCRM).
- 1.1.4. LCRM provides the technical framework for structured decision-making about land contamination.

1.2. Description of the project

- 1.2.1. It is proposed to upgrade the existing 2.6km section of single carriageway between Blofield and North Burlingham to a dual carriageway.
- 1.2.2. The new section of dual carriageway with junction improvements is proposed to be constructed to the south of the existing carriageway.
- 1.2.3. At the western end of the Proposed Scheme, the proposed mainline alignment of the A47 dual carriageway departs from the existing alignment of the A47 from Yarmouth Road, and continues parallel to the south of the existing A47, crossing over Lingwood Road and Lingwood Lane (which will both be stopped up) before re-joining the existing alignment east of the existing junction with the B1140 Acle Road.
- 1.2.4. New link roads (connected to the existing A47), junctions, agricultural access tracks, structures, a gas main and other utility diversions and drainage are also being proposed.

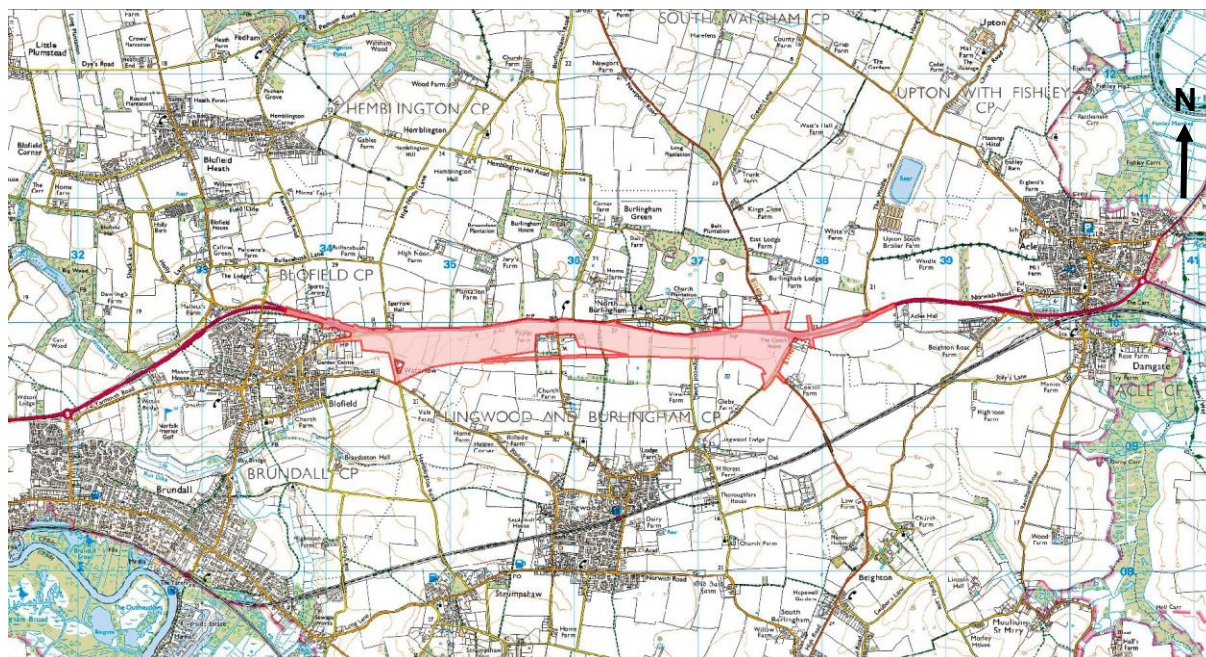


Figure 1-1: Site location and OS 1:25,000 Scale Colour Raster Basemap

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1.3. Study area

1.3.1. The study area identified was based on the following:

- The construction footprint or project boundary (including compounds and temporary land take)
- The location of contamination outside the project boundary or footprint that have the potential to migrate on site and effect receptors
- The location of sensitive off-site receptors (i.e. designated sites) that can be affected by the project, i.e. by re-mobilisation or introduction of contaminants

1.3.2. This PRA considered an area which extends 1km beyond the red line boundary of the Proposed Scheme including all temporary land take to identify any potential contamination sources.

1.4. Site walkover

1.4.1. A walkover survey was undertaken by Mott McDonald Sweco Joint Venture (MMSJV) in February 2018 as part of the preliminary sources study (MSSJV, 2018)

1.4.2. An additional walkover was carried out in August 2018 during the site investigation campaign.

- 1.4.3. Both walkover surveys were carried out by a specialist who has been involved in the production of this PRA.
- 1.4.4. It is noted that there is a limitation in the information provided in Section 1.4 of this report, as the site walkover has been carried out over two years prior to this assessment.
- 1.4.5. The following items of interest were observed during the walkover:
- No visual or olfactory evidence of contamination was identified during the site walkover. No significant deposits of made ground was identified.
 - The site topography is generally slightly undulating at the most westerly extents of the scheme which changes to gently sloping ground, becoming flat going from west to east across the scheme.
 - Soil across the site was observed to be very clayey at the surface with gravel and cobbles of flint. This flint material is indicative of the Lowestoft and Happisburgh Diamicton tills of the area.
 - A gas pipeline is marked at a number of locations along the scheme. These locations generally agreed with the gas pipeline utility information provided with the exception of one location south of Burlingham Green.
 - Standing water and saturated ground were observed across the site at locations.
 - Ponds which will be crossed by the scheme were visited. These are surrounded by heavily vegetated bunds and the water level within these was similar to existing ground level.
 - Topographical lows were identified at the western portion of the scheme which may coincide with a paleochannel. No evidence of a change in soil behaviour was observed other than some standing water.
 - Evidence of slip of the slope ditch of the existing road which is reported could not be seen due to the fact that the ditch slopes were well vegetated. A vario-guard safety barrier is located adjacent to the existing carriageway at this location.
 - Intermittent drainage and infiltration ditches are located adjacent to the existing A47 Road.

2. Phase 1 Desk Study

2.1. Data sources

- 2.1.1. An Envirocheck Report was obtained from Landmark Information Group (LIG, 2017) and reviewed to assist in making a preliminary assessment of potential constraints associated with the proposed development.
- 2.1.2. Due to the size of the site, the Envirocheck Report has been broken into 3 sections, A (western portion), B (middle portion) and C (eastern portion). The report includes the following datasets;
- Historic Ordnance Survey maps ranging between 1885 and 2020;
 - Geological maps derived from the British Geological Society (BGS);
 - Hydrological and Hydrogeological data, including flood risk mapping;
 - Information on any noted hazardous substances;
 - Industrial land uses records;
 - Sensitive land uses records.
- 2.1.3. The BGS online map viewer and Radon Maps UK were also utilised to supplement information provided within the Envirocheck Report.
- 2.1.4. A summary of the Unexploded Ordnance (UXO) risk assessment, which was undertaken by 6 Alpha is included in this desk study.

2.2. Site walkover

- 2.2.1. Historical Ordnance Survey (OS) maps from the period 1882 to 1987 have been reviewed to gain information on the site history. The OS maps that have been evaluated are summarised in Table 2-1.

Table 2 1: Site history summary (Ordnance Survey), A (western portion)

Date	Site Description	Scale
1885 -1887	Most of the site is used as agricultural land. There are a few farms located along the future A47. The village of Blofield is developed to the west of the site.	1:10,560
1908	Little change from previous map. No major development noted. Site is mostly agricultural land.	1:10,560
1928 - 1929	Little change from previous map. No major development noted. Site is mostly agricultural land.	1:10,560

Date	Site Description	Scale
1951	Little change from previous map. No major development noted. Site is mostly agricultural land.	1:10,560
1957	Little change from previous map. No major development noted. Site is mostly agricultural land.	1:10,000
1974 - 1975	Blofield town has grown and developed to the west of the site. The existing "Yarmouth Road" appears to have widened	1:10,000
1987 - 1989	A new bypass has been built, to the north of Blofield, which merges onto the existing road, within the site boundary (Figure 2-1).	1:10,000
2000	Little change from previous map.	1:10,000

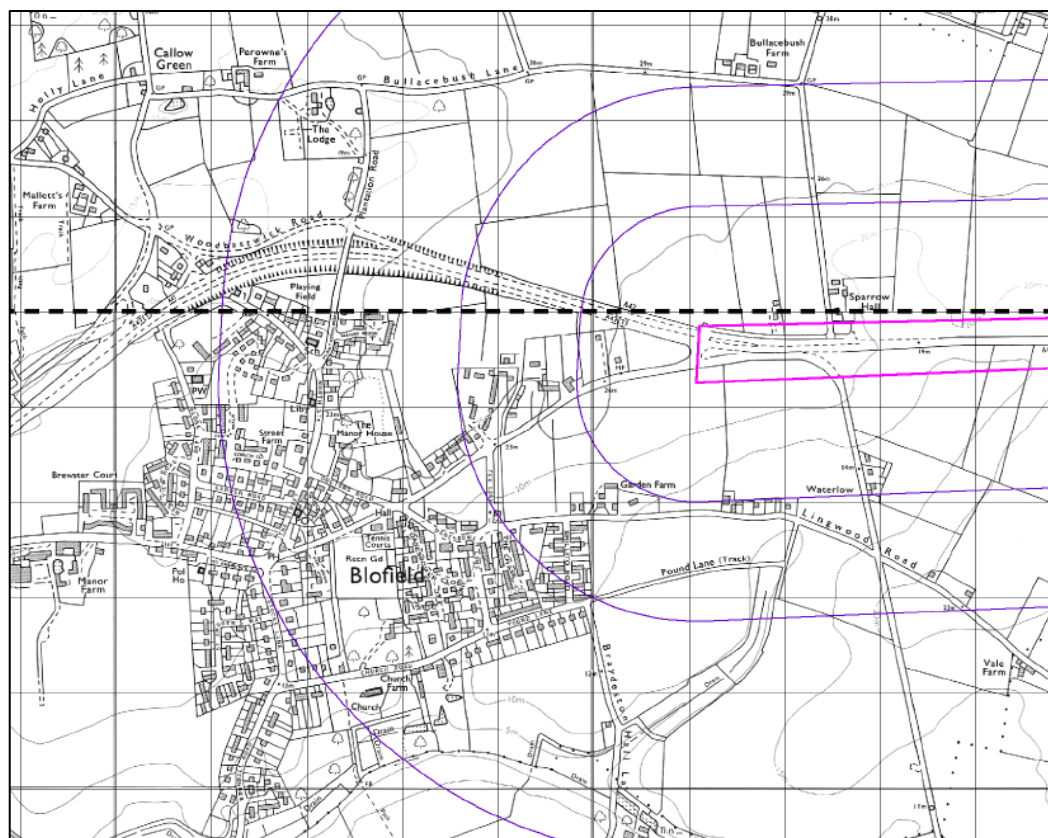
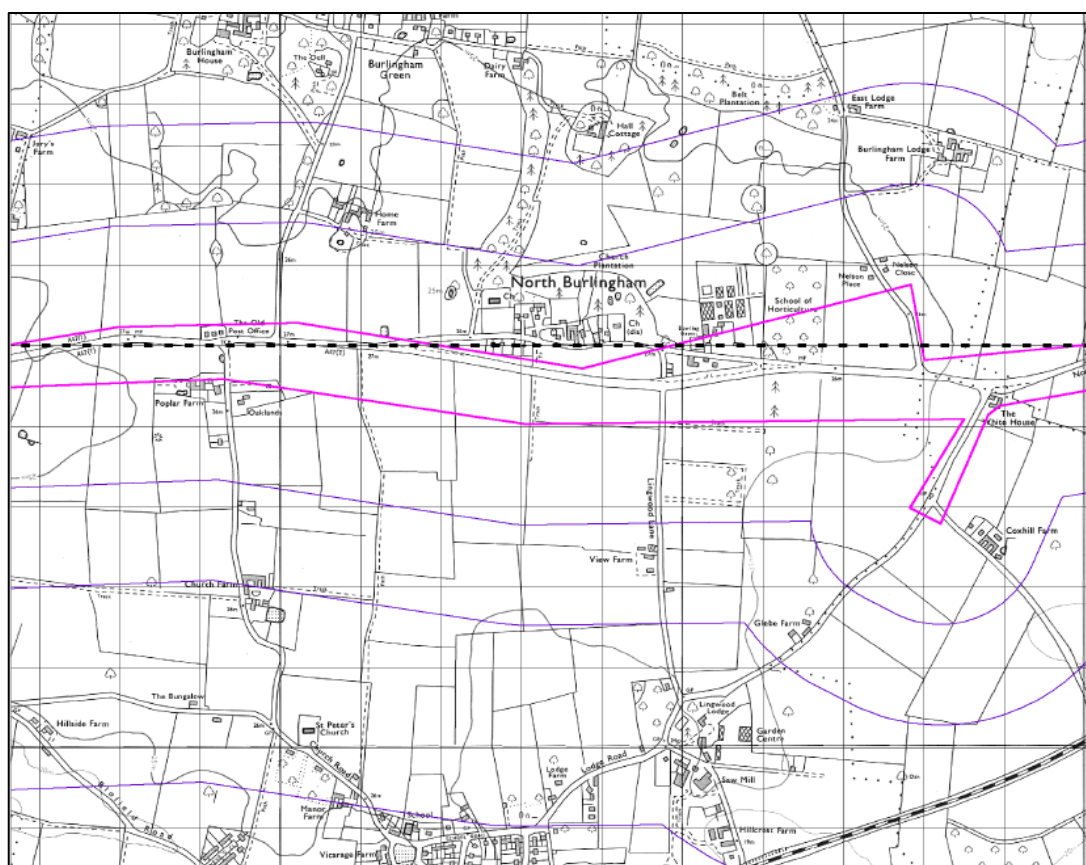


Figure 2-1: Extract from OS Map (1987 – 1989), Site A

Date	Site Description	Scale
1885 - 1887	Most of the site is used as agricultural land. The village of North Burlingham is developed to the north of the site. There is a "Sand Pit" marked on the western portion of the site, indicating quarrying activities have taken place on the site.	1:10,560
1908	Little change from previous map. No major development noted. Site is mostly agricultural land.	1:10,560
1951	Little change from previous map. No major development noted. Site is mostly agricultural land.	1:10,560
1957	Little change from previous map. No major development noted. Site is mostly agricultural land.	1:10,000`
1974 - 1975	Blofield town has grown and developed to the west of the site. The existing "Yarmouth Road" appears to have widened	1:10,000
2000	Little change from previous map.	1:10,000



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2.2.2. Site C covers a small portion of the site area (approximately 500m long).

Table 2-2: Site history summary (Ordnance Survey), C (eastern portion)

Date	Site Description	Scale
1885	Most of the site is used as agricultural land. The villages of Acle and Damgate are developed to the east of the site. There is a railway ("Great Eastern Railway"), located approximately 600m south east of the site (Figure 2-3).	1:10,560
1908	Little change from previous map. No major development noted. Site is mostly agricultural land.	1:10,560
1951	Little change from previous map. No major development noted. Site is mostly agricultural land.	1:10,560
1957	Little change from previous map. No major development noted. Site is mostly agricultural land.	1:10,000
1974 - 1979	Little change from previous map. No major development noted. Site is mostly agricultural land.	1:10,000
2000	Little change from previous map.	1:10,000

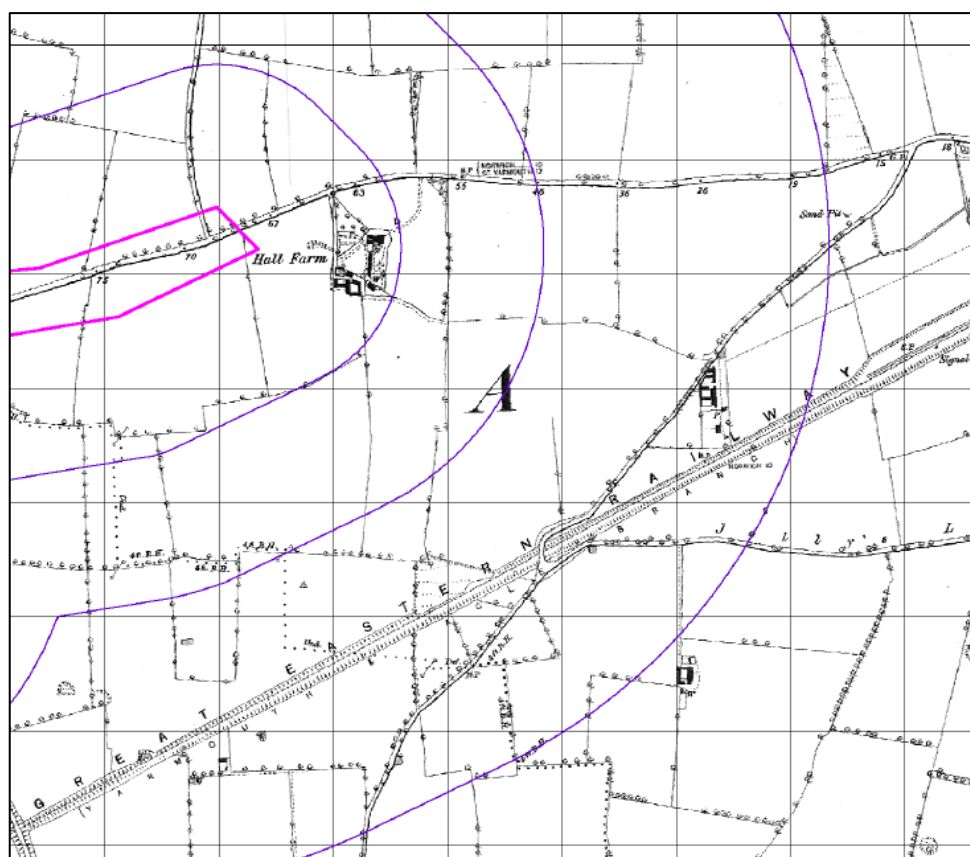


Figure 2-3: Extract from OS Map (1985), Site C

2.3. Historic mining

2.3.1. The area is listed within the Law Society's Guidance Notes and Directory for coal mining searches (1998) as an area not requiring a coal mining

report. The document states that there have been no past or present coal mining activities in the area.

- 2.3.2. The Landmark Envirocheck Report highlights the areas where some small Extractive Industrial Activities have been carried out at four (4No.) locations between 1950 to 1980 in close proximity to the development area, as illustrated in the associated Envirocheck plan(s).
- 2.3.3. No proven areas of significant extractive activities have been encountered in the rest of the site. However, some BGS recorded mineral sites have been recorded at five (5No.) locations, including one sand quarry.
- 2.3.4. No evidence of mineral deposits or mine workings were identified in the Preliminary Sources Study by MMSJV or in the ground investigations carried out in 1992 and 2004.

2.4. Industrial land use

- 2.4.1. LIG completed the Envirocheck Report (LIG, 2017) which included a number of site-specific maps. The Envirocheck Report provides information on present and historic industrial land uses, including records of any waste facilities, hazardous substances, contemporary trade directories and points of interest (for example, commercial services, manufacturing and production, public infrastructure, etc).
- 2.4.2. One industrial land use was found to be within the site perimeter (37B, Furniture Finishers Ltd), which is registered as a paint spraying company.
- 2.4.3. The remaining land uses provided in Table 2-1 are outside the boundary.

Table 2-3: LAPCs within 500m of the Site Boundary

Envirocheck Map ID	Pollution Prevention & Control Name	Process Type
36A	Norwich Vans Ltd	Commercial Car Dealers
36A	Atlantic Affordable Car Centre	Car Dealers
37A	In a spin	Washing Machines – Servicing & Repairs
49A	Progress House	Industrial Features
37B	Furniture Finishers Ltd	Spraying – Paint & Coatings
38B	PDM Autocare	Garage Services
38B	Furniture By Design	Kitchen Furniture Manufacturers

Envirocheck Map ID	Pollution Prevention & Control Name	Process Type
38B	Suffield Engineering	Lawnmowers & Garden Machinery – Sales & Service
38B	Cosy Stoves	Heating Equipment – Sales & Service
39B	D Spooner Concrete Products	Concrete Products
40B	Anglia Woodburner Centre	Woodburning Stoves
43B	PDM Autocare	Vehicle Repair, Testing and Servicing
43B	PDM Autocare	Vehicle Repair, Testing and Servicing
44B	N&G M Adams	Farming
45B	Michael Adams	Farming

2.5. Hydrology

- 2.5.1. The site is located within an interfluvial area between the South Walsham Broad and the River Bure to the north and east, and the Witton Run and the River Yare to the west and south. The Witton Run and its tributaries at Braydeston Hall and Red House are the closest surface watercourses.
- 2.5.2. The catchment boundary between the surface watercourses to the north and east and those to the west and south is considered to fall at around Poplar Farm, approximately in the centre of the study area.
- 2.5.3. Ground elevations along the Proposed Scheme range between approximately 17 and 27m AOD.
- 2.5.4. A low point along the current A47 route coincides with the area upstream of the Braydeston Hall tributary. In this area, the ground falls away from the A47 towards the south-west and the Witton Run.
- 2.5.5. Elsewhere, there is very little variation in ground elevations, both directly below the Proposed Scheme and the surrounding study area.
- 2.5.6. The existing drainage network along the current A47 comprises clusters of soakaway chambers at the eastern and the western extents of the proposed scheme.

- 2.5.7. There are no soakaways present in the central section of the study area, where historical boreholes were carried out.
- 2.5.8. The mining and ground stability maps (LIG, 2017j and 2017k) identify locations of “extractive industries activity from 1960 – 1980” which correspond to the two pond locations identified on-site during the site walkover and 2018 ground investigation.

2.6. Flooding

- 2.6.1. The site maps produced in the Envirocheck Report (LIG, 2017) included details on the risk of flooding from surface water (LIG, 2017a, 2017b, and 2017c).
- 2.6.2. A number of localised areas along the route are described as having “Low” risk of surface water flooding with a “1000 year return” period, namely at chainage extents.
- 2.6.3. Site sensitivity context maps (LIG, 2017d, 2017e, 2017f) indicate that the site has a “limited potential for groundwater flooding to occur”. The site is not subject to fluvial or sea flooding (LIG, 2017t, 2017u, 2017v).
- 2.6.4. It is noted that there is standing water near the location of the proposed western overbridge due to surface runoff saturating the near-surface granular material and perching on the underlying cohesive soils. It is anticipated that clay bands are facilitating the collection of water in the low points, especially during winter and associated periods of high rainfall.
- 2.6.5. Additionally, the percolation and build-up of water through the earthworks at this location could also have a negative effect on the stability of proposed earthworks in the vicinity of the low point; it is noted that two areas of instability are evident on the existing earthworks in this location.

2.7. Hydrogeology

- 2.7.1. The Department for Environment, Food & Rural Affairs (DEFRA) maintain the Environment Agency aquifer designations in the online viewer Multi-Agency Geographic Information for the Countryside (MAGIC) (DEFRA, 2018), along with their extents within the site. A summary of aquifer designations for the site is presented in Table 2-4.
- 2.7.2. Principal aquifers are strata that have high intergranular and/or fracture permeability, and as such usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

- 2.7.3. Secondary A aquifers are permeable layers capable of supporting water supplied at a local, rather than strategic scale, and in some cases, form an important source of baseflow to rivers.

Table 2-4: Summary of aquifer designations (DEFRA, 2018)

Geological Unit	EA Aquifer Designation	Approximate Extents
Lowestoft Formation	Secondary (undifferentiated) aquifer	Outcrops along the majority of the proposed scheme. Absent at western extents and TG 349 099.
Happisburgh Glacigenic Formation - sands	Secondary A aquifer	Present along entire extents of the Proposed Scheme, except between TG 346 099 and TG 350 099. Outcrops in one small area located at TG 346 099.
Happisburgh Glacigenic Formation	Unproductive strata	Entire extents of the Proposed Scheme. Outcrops between TG 346 099 and TG 350 099.
Crag group and Bytham Sand and Gravel	Secondary A aquifer	Extents of Bytham Sand and Gravel Formation not known.
Crag Group	Principal aquifer	Entire extents of the Proposed Scheme (beneath Lowestoft and Happisburgh Glacigenic formations) Present at the surface along the Witton Run and tributaries.

2.8. Sensitive land use

- 2.8.1. As per the Envirocheck Report, the site was found to directly overlie “Nitrate Vulnerable Zones” at various locations across the site. No other sensitive land uses were identified at or near the site.

2.9. Radon

- 2.9.1. Radon is a naturally occurring radioactive gas, formed from the decay of uranium in all rocks and soils.
- 2.9.2. There is a safe background level of radon in the UK (average ~20 Bq m³), however, where levels increase beyond this there is a potential for risk to human health, as a result of the radioactive nature of the gas which damages living tissue, with the potential to cause cancer.
- 2.9.3. Radon maps are available in order to identify whether a site is at risk of increased levels of uranium, and therefore a risk to human health.
- 2.9.4. As stated in the Envirocheck Report, the site is in a lower probability radon area, with less than 1% of homes estimated to be at or above the Action Level.

- 2.9.5. This is corroborated by the online map viewer (available at <https://www.ukradon.org/information/ukmaps>), which demonstrates the site lies within the lowest band of radon potential. As a result, no radon protection measures are therefore deemed necessary in the proposed development.

2.10. Ground gas

- 2.10.1. Due to the nature of this development (road), ground gases are not considered a significant area of concern as no buildings are included in the programme of works associated with this assessment.
- 2.10.2. In the event, however, that buildings or other enclosed structures are to be developed, supplementary gas risk assessments may be necessary.

2.11. UXO

- 2.11.1. There is an Unexploded Ordnance (UXO) Risk present on the site. UXO includes both weapons dropped on-site and materials which may have been left on site. The CIRIA Guide to UXO (CIRIA, 2009) defines these two types of UXO material as:
- “Explosive ordnance that has been primed, fused, armed, or otherwise prepared for use and used in armed conflict. It may have been fired, dropped, launched or projected and should have exploded but failed to do so.”
 - “Explosive ordnance that has not been used during an armed conflict, that has been left behind or dumped by a party to an armed conflict, and which is no longer under control of the party that left it behind or dumped it. Abandoned explosive ordnance may or may not have been primed, fused armed or otherwise prepared for use.”
- 2.11.2. During the review of historical OS maps, no indication of military camps, installations or factories were observed on or in the immediate proximity to the scheme.
- 2.11.3. Zetica’s Regional Unexploded Bomb Risk map for Norfolk (Zetica, 2017) indicates that the area around the proposed preferred route has a low risk for unexploded bombs dropped during the Second World War. The eastern area of Norfolk within proximity of Great Yarmouth is however indicated to have a high risk for unexploded bombs.
- 2.11.4. A Preliminary UXO Threat Assessment by 6 Alpha Associates Ltd. (6AAL) was carried out for the area immediately around the preferred route alignment (6AAL, 2017a). The threat potential for the site indicates No. 3 rating – a medium probability of UXO encounter.

- 2.11.5. As identified in the preliminary assessment, a Detailed UXO Threat Report prepared by 6AAL (2017b) was only required on the western side of the preferred route and therefore, the detailed report focuses on the area between Blofield and Lingwood and Burlingham.
- 2.11.6. The risk level in this area has been described as Very High, posed by one WWII German HE bomb and one British AA – shell. There is also a possibility of encountering Incendiary Bombs.
- 2.11.7. The risk of encountering them is described as residual, which means that although there is a chance that further UXOs may be encountered, it is not likely.
- 2.11.8. Further details can be found in the relevant reports by 6AAL (2017a,b) and the PSSR (MMSJV, 2018). The locations of bomb strikes are presented in Figure 2-4.



Figure 2-4: WWII Consolidated Bomb Strikes (the red point – HE Bomb, the yellow point – Anti – Aircraft Shell) (6AAL, 2017b)

3. Preliminary Conceptual Site Model

- 3.1.1. Potential environmental risks associated with the existing and historic uses of the site have been reviewed as part of the desk study, allowing a preliminary assessment in the form of a CSM to be undertaken.
- 3.1.2. A CSM identifies potential sources of contamination and the potential pathways that these may use, ultimately ending in the impact of a receptor. The receptors are determined by identifying the proposed end use of the site.
- 3.1.3. The preliminary CSM enables a more targeted approach to site investigations and following completion of which, the CSM can be revised using quantitative data.
- 3.1.4. If pathways between source and receptor are identified, recommendations can then be made on how to break them, and therefore reduce the risk to the receptor, be it humans, flora, fauna, buildings and structures, or the water environment.
- 3.1.5. Risk assessment has been undertaken using a very low, low, moderate and high system, depending on the probability of contamination likely to be encountered and the significance of the impact on the end-use of the site, assuming commercial/industrial end-use.

3.2. Sources

- 3.2.1. Based on the review of available data, while made ground may be present on-site, historic land use and other environmental areas of concern have not been identified where significant impact is likely to be present.
- 3.2.2. No specific sources of contaminated land have been identified, however the potential for unidentified contaminated ground should be allowed for in the assessment of risk, identified as Source 1 in the Conceptual Site Model
 - **S1: Unspecified Contamination Discovery (Soils)** – The potential for the discovery of unexpected areas of contamination is possible based on the extent of this road construction project. Generally, contamination would be found in areas of made ground and may be easily identified through odour or visual inspection. No targeted assessment is possible in advance of works in these cases. It is not considered that impacted groundwater will present a source of risk to the site during or post construction.

3.3. Receptors

3.3.1. The desk study and review of historic data has identified the following potential receptors:

- **R1: Human Health** – The risk to human health during the construction phase and during routine maintenance of the road.
- **R2: Ecology** – Flora and fauna in within the site boundary and surrounding area. Flora is sensitive to heavy metals such as nickel, zinc and copper, which are phytotoxic.
- **R3: Buildings, Structures & Services** – Permanent structures proposed as part of future developments.
- **R4: Water Environment** – Groundwater and Surface Water should be considered possible receptors for this site.

3.4. Pathways

3.4.1. Pathways that may be present at the site, following development include:

- **P1:** Direct contact/ingestion and inhalation of dust including asbestos
- **P2:** Accumulation/inhalation of ground gases
- **P3:** Permeation via granular strata
- **P4:** Permeation via services, Or other areas of open or disturbed ground
- **P5:** Plant uptake (impacting plant growth/health)
- **P6:** Impact to groundwater via leaching of contaminants
- **P7:** Surface water run-off

3.4.2. The following table presents the Preliminary CSM, putting those points discussed above into context:

Table 3-1: Preliminary Conceptual Site Model

Potential Sources				Potential Pathway(s)							Potential Receptors			
Source	Matrix			P1	P2	P3	P4	P5	P6	P7	R1	R2	R3	R4
	Soil	Groundwater	Vapour/Gas											
S1: On site contamination	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
S2: Off site contamination														
S3: Ground gas														

* Some metals, metal compounds and organic contaminants can present a risk from vapour, for example, mercury, while asbestos is also considered to pose a risk when inhaled.

Table Index

Receptors	Pathways	
R1: Human Health	P1: Direct contact/Ingestion and inhalation of soils/dust	P5: Plant uptake (impacting plant growth/health)
R2: Ecology	P2: Accumulation/Inhalation of ground gases or vapour	P6: Impacted groundwater via leaching of contaminants
R3: Buildings, Structures & Services	P3: Permeation via granular Made Ground	P7: Surface water run-off
R4: Water Environment	P4: Permeation via services, building construction, trenches, and ducts.	

3.5. Perceived risk

Human health

- 3.5.1. Based on the pollutant pathway linkage assessment, no specific, identified areas of concern have been recorded for the site. In the absence of unexpected contaminated ground being encountered on-site, no human health risk is considered to be present on-site.

Ecology

- 3.5.2. No ecological risk from contaminated ground has been identified on-site based on the available data.

Buildings, structures & services

- 3.5.3. No risk to the Proposed Scheme has been identified on-site based on the available data.

Water environment

- 3.5.4. No identified risk to groundwater or surface water resources from contaminated land have been identified based on the available data.

4. Ground Conditions

- 4.1.1. Although a PRA normally consists of desk study elements only, this report includes a review of historic ground investigations and targeted environmental sampling (2018).
- 4.1.2. It is noted that an earlier investigation that included environmental testing was conducted in 2004 in the development area, however it is considered that these results would not be considered representative of potential risks that may be present currently.
- 4.1.3. The ground conditions across the site can generally be described as the Lowestoft Formation of soft to stiff till with evidence of outwash or abundant/many pocket lenses or laminations of thin red/brown/yellow sands.
- 4.1.4. The Lowestoft Formation is overlying the upper sandy horizon of the Happisburgh Glacigenic (HPGL) which is overlying the thick cohesive soft to stiff till in the HPGL formation.
- 4.1.5. The HPGL formation overlies the Bytham sand and gravel which has a very low fine content.
- 4.1.6. The Bytham formation overlies the Crag group which consists of marine deposited cohesive material and can be identified by the presence of shells.
- 4.1.7. A summary of the superficial geology and solid geology is detailed in Table 4-1.

Table 4-1: Summary of geological units

Geological unit	Description	Elevation at top of strata (m AOD)
Made ground	Brown sandy gravelly silt / clay with inclusions of concrete, brick, clay pipe, clinker, asphalt, and plastic bags.	26-17
Lowestoft formation	Loose to medium dense sand with pockets and lenses of cohesive material, which is consistent with glacial outwash material. Soft to stiff glacial till with pockets, lenses and lamination of sand, which is consistent with glacial outwash material.	28

Geological unit	Description	Elevation at top of strata (m AOD)
Happisburgh Glacigenic – sands and gravels	Yellowish-brown loose to medium dense sand and gravel	17 - 22
Happisburgh Glacigenic - Diamicton	Brown/yellow soft to stiff glacial till	14-22
Bytham sand and gravel formation	Sand and gravel, very low fine content	5-10
Crag group formation	Grey marine deposited cohesive material with shell fragments evident.	Unclear (≈0)

- 4.1.8. The Lowestoft formation generally becomes thicker towards the proposed eastern overbridge location.
- 4.1.9. The Happisburgh Glacigenic (HPGL) formations in Table 4-1 are divided into granular (HPGL – Granular) and cohesive (HPGL – Cohesive) strata.
- 4.1.10. The Bytham formation and Crag group have been combined by the BGS as the CRBY formation to indicate where the two are undifferentiated. This approach has been adopted in this GIR as it was often found difficult or impossible to differentiate the two geologies or identify the exact boundary between each in the boreholes.
- 4.1.11. The lower boundary of this formation and the Happisburgh Glacigenic sand and gravels is often difficult to determine, especially along the eastern portion of the Proposed Scheme.

5. Review of Environmental Testing

5.1. Geo-environmental sampling

- 5.1.1. Samples from soils have been taken from exploratory holes in the made ground and across the site in general during the 2018 investigation including at trial pits and trenches.
- 5.1.2. The soil sampling locations are provided in Figure 5-1, generally there is good coverage, considering the relatively low risk in terms of the PRA outcome and development type.
- 5.1.3. Groundwater samples were extracted from BH01 and BH07 and tested for heavy metals, Polycyclic Aromatic Hydrocarbons (PAH) compounds and (Total Petroleum Hydrocarbons) TPHs (C10 – C40).

5.2. Results – soils (2018)

- 5.2.1. The results of tests on soils (BWB, 2019) indicate TPHs and Total PAHs concentrations below the limit of detection, with some very minor directions for heavy metals.
- 5.2.2. The full set of results are included as Appendix A. Conservative (residential with plan uptake) soil guideline values (Category 4 Screening Levels (C4SL) */ Safe 4 Use Levels (S4UL) 2015) were used as trigger levels for the heavy metal and PAH compounds, with no exceedances detected.
- 5.2.3. It is noted that no pesticide suite was tested for on any of the samples, which may be present in the ground as a result of the agricultural presence in the area.
- 5.2.4. The 2004 investigation did include pesticide analysis and at that time no concentrations of Organo-Chlorine Pesticides (OCP) and Organo-Phosphorus Pesticides (OPP) were recorded at that time.
- 5.2.5. The nature of the development (road) is that human contact with any pesticide contamination in the ground is unlikely and due to the farmland adjoining the road the presence of these compounds in the development zone is unlikely to pose a significant risk to the wider environment and therefore the testing is not considered necessary in this instance.

5.3. Results – groundwaters

- 5.3.1. The results of tests on the two groundwater samples (BWB, 2019) indicate TPHs and Total PAHs concentrations below the limit of detection, with very minor detections of heavy metals, all of which are well below the UK environmental quality standards (EQS) for residential developments.
- 5.3.2. These parameters were compared to residential guideline values, on a conservative basis.

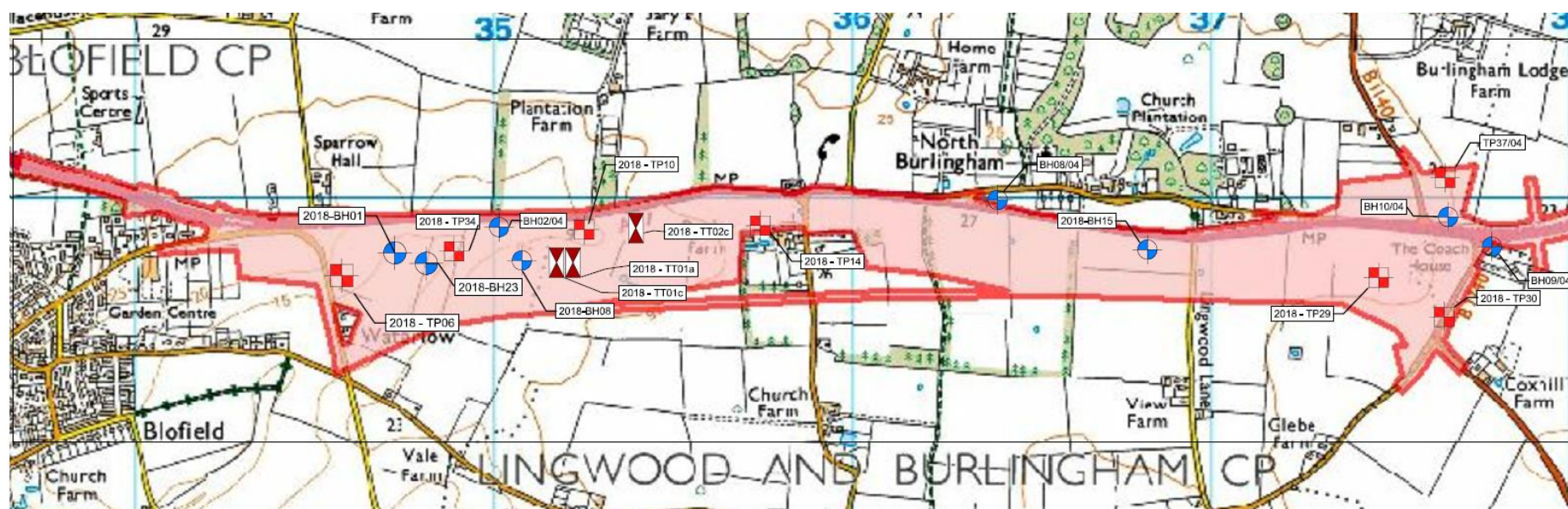


Figure 5-1: 2018 Soil Sampling Locations (OS 1:25,000 Scale Colour Raster Basemap 2020)

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6. Conclusions

- 6.1.1. The findings of the desk study and interpretation of environmental analysis data from samples collected have not identified any areas of concern that would potentially pose a risk to the planned development or wider environment.
- 6.1.2. Using all available information, in the context of the Preliminary Risk Assessment, it has been concluded that a designation of '**Low Risk**' is appropriate for the site.
- 6.1.3. Due to the nature of previously developed areas, it is concluded that there is a potential for unexpected areas of made ground to be encountered that may fall out with the findings of this report.
- 6.1.4. It is, therefore, concluded that consideration of the potential for previously unknown areas of concern to be uncovered during construction be allowed for in construction plans for the development.
- 6.1.5. Based on the findings of this report, no further investigations or assessments are required to satisfy contaminated land assessment conditions for the development.

7. Recommendations

- 7.1.1. The Specification for Highways Work (SHW) and Notes for Guidance (NG) on the Specification for Highway Works for earthworks contained within the Manual of Contract Documents for Highway Works (Volume 1 and 2) and includes instructions for identifying and dealing with contaminated material (referred to as Class U2 unacceptable material) on highway schemes through the provision of the series 600 specification and reference to the following project specific appendices:
- APPENDIX 6/1: Requirements for acceptability and testing of earthworks materials
 - APPENDIX 6/2: Requirements for dealing with class u2 unacceptable material (that is, contaminated material)
- 7.1.2. Based on the conclusions of this report, it is recommended that the instructions contained within the series 600 SHW and NG, together with standard specification appendices, will be appropriate to deal with the level of risk associated with the Proposed Scheme and that additional measures above these are not required.

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Annex A: Laboratory Testing Data

Analytical Report Number: 18-11094
Project / Site name: A47 Blofield

Your Order No: POR020676

Lab Sample Number				1049663	1049664	1049665	1049666	1049667	1049668	1049669	1049670	1049735
Sample Reference				2018-BH20	2018-BH18S	2018-BH13	2018-BH01	2018-BH07	2018-BH04S	2018-BH04D	2018-BH06	BH18D
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018	18/09/2018
Time Taken				AM	AM	AM	AM	AM	AM	AM	AM	None Supplied

Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status									

General Inorganics

pH	pH Units	N/A	ISO 17025	7.2	7.7	7.3	7.1	7.2	7.2	7.5	7.1	7.5
Total Cyanide	µg/l	10	ISO 17025	-	-	-	< 10	< 10	-	-	-	-
Sulphate as SO ₄	µg/l	45	ISO 17025	78300	57300	93300	66500	29400	72100	82400	83200	82000
Sulphate as SO ₄	mg/l	0.045	ISO 17025	78.3	57.3	93.3	66.5	29.4	72.1	82.4	83.2	82.0

Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	-	-	-	< 10	< 10	-	-	-	-
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Acenaphthylene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Acenaphthene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Fluorene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Phenanthrene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Anthracene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Fluoranthene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Pyrene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Benzo(a)anthracene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Chrysene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Benzo(a)pyrene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	-	-	-	< 0.01	< 0.01	-	-	-	-

Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	-	-	-	< 0.16	< 0.16	-	-	-	-
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Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	0.15	ISO 17025	-	-	-	0.54	0.52	-	-	-	-
Boron (dissolved)	µg/l	10	ISO 17025	-	-	-	21	20	-	-	-	-
Cadmium (dissolved)	µg/l	0.02	ISO 17025	-	-	-	0.07	0.02	-	-	-	-
Chromium (dissolved)	µg/l	0.2	ISO 17025	-	-	-	< 0.2	0.9	-	-	-	-
Copper (dissolved)	µg/l	0.5	ISO 17025	-	-	-	0.7	1.5	-	-	-	-
Lead (dissolved)	µg/l	0.2	ISO 17025	-	-	-	< 0.2	< 0.2	-	-	-	-
Mercury (dissolved)	µg/l	0.05	ISO 17025	-	-	-	< 0.05	< 0.05	-	-	-	-
Nickel (dissolved)	µg/l	0.5	ISO 17025	-	-	-	3.9	1.5	-	-	-	-
Zinc (dissolved)	µg/l	0.5	ISO 17025	-	-	-	13	8.3	-	-	-	-

Petroleum Hydrocarbons

TPH1 (C10 - C40)	µg/l	10	NONE	-	-	-	< 10	< 10	-	-	-	-
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U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 18-10640
Project / Site name: A47 Blofield

Your Order No: POR020607

Lab Sample Number				1047281			
Sample Reference				Pond 2			
Sample Number				None Supplied			
Depth (m)				0.00-0.00			
Date Sampled				14/09/2018			
Time Taken				0841			
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status				

General Inorganics

pH	pH Units	N/A	ISO 17025	6.7			
Electrical Conductivity at 20 °C	µS/cm	10	ISO 17025	1300			
Sulphate as SO ₄	µg/l	45	ISO 17025	3570			
Sulphate as SO ₄	mg/l	0.045	ISO 17025	3.6			
Chloride	mg/l	0.15	ISO 17025	320			
Nitrate as N	mg/l	0.01	ISO 17025	0.18			
Alkalinity	mgCaCO3/l	3	ISO 17025	250			
Total Dissolved Solids (Gravimetric)	mg/l	4	NONE	740			
Bicarbonate	mgHCO3/l	10	NONE	< 10			

Heavy Metals / Metalloids

Magnesium (dissolved)	mg/l	0.005	ISO 17025	4.0			
Calcium (dissolved)	mg/l	0.012	ISO 17025	51			
Magnesium (dissolved)	mg/l	0.005	ISO 17025	4.0			
Potassium (dissolved)	mg/l	0.025	ISO 17025	18			
Sodium (dissolved)	mg/l	0.01	ISO 17025	180			

U/S = Unsuitable Sample I/S = Insufficient Sample

[illegible]

Analytical Report Number: 18-10640
Project / Site name: A47 Blofield

Your Order No: POR020607

Lab Sample Number				1047282	1047283			
Sample Reference				2018-TT01b	2018-TT02b			
Sample Number				None Supplied	None Supplied			
Depth (m)				1.00-1.00	0.50-0.50			
Date Sampled				13/09/2018	13/09/2018			
Time Taken				1142	1440			
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status					

General Inorganics

pH	pH Units	N/A	ISO 17025	7.4	6.5			
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10			
Sulphate as SO ₄	mg/l	0.1	ISO 17025	1.1	0.4			

Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10			
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01			
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01			
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01			
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01			

Total PAH

Total EPA-16 PAHs	µg/l	0.2	NONE	< 0.2	< 0.2			
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Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	1.1	ISO 17025	1.1	1.7			
Boron (dissolved)	µg/l	10	ISO 17025	< 10	10			
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08			
Chromium (dissolved)	µg/l	0.4	ISO 17025	1.8	< 0.4			
Copper (dissolved)	µg/l	0.7	ISO 17025	11	6.0			
Lead (dissolved)	µg/l	1	ISO 17025	3.1	< 1.0			
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	1.3			
Nickel (dissolved)	µg/l	0.3	ISO 17025	1.4	9.9			
Zinc (dissolved)	µg/l	0.4	ISO 17025	5.9	2.0			

Petroleum Hydrocarbons

TPH1 (C10 - C40)	µg/l	10	NONE	< 10	< 10			
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