Wasing Quarry: Environmental Setting and Site Design

Prepared for Tarmac Trading Ltd

December 2025

CONFIDENTIAL

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Quality Control Sheet

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Revision History

Revision	Details	Prepared by	Checked by	Approved by	Issue Date
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REV02	Update with new data	JH	CDW/AS	CDW	20/06/2025
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1 INTRODUCTION

1.1 Background and Scope

Tarmac Trading Ltd (Tarmac) has planning permission to work sand and gravel mineral in three phases and restore to original ground levels using inert restoration materials at Wasing Quarry (the Site) near Woolhampton, Berkshire. Tarmac proposes to carry out the backfilling and Site restoration under the terms of a Deposit for Recovery Environmental Permit. The application for the Environmental Permit is being made by Envireau Water on behalf of Tarmac.

Tarmac must apply to the Environment Agency for an appropriate Environmental Permit to deposit inert materials at the Site under a deposit for recovery activity, in order to restore the Site. The Environmental Permit application is for a bespoke deposit for recovery activity.

This Environmental Setting and Site Design (ESSD) report has been prepared by Envireau Water to satisfy the requirements of Question 1, Appendix 2 of Part B4 of the Environmental Permit application forms.

The purpose of this report is to describe the regulated facility in relation to the environmental setting, identifying the source terms, pathways and receptors that are used as the basis for the supporting risk assessments, including:

- Environmental Risk Assessment (ERA) (RSK Geosciences, 2022a) – this report assesses risk to the environment and human health from emissions and accidents that may be associated with the proposed recovery operations;
- Hydrogeological Risk Assessment (HRA) (Envireau Water, 2025a) – this report quantitatively assesses risks from the proposed infilling operation on the hydrogeological environment;
- Stability Risk Assessment (SRA) (RSK Geosciences, 2025); and
- Site Monitoring Plan.

This ESSD sets out the pollution control measures that will be incorporated into the Site design to minimise risks to the environment.

1.2 Operator and Agent

Envireau Water (with support from RSK Geosciences) is acting as the Agent on behalf of the Applicant and Operator, Tarmac. On behalf of Envireau Water, RSK Geosciences submitted a Waste Recovery Plan (WRP) to the Environment Agency in October 2022 (RSK Geosciences, 2022b). This included a deposit versus recovery assessment. A copy of the WRP is included with the Environmental Permit Application.

The Environment Agency responded to the WRP on 2 November (ref. EPR/LB3106TY/A001) to agree with the assessment that the proposed activity is classified as a deposit for recovery operation.

1.3 Proposed Activity

The Site was awarded planning permission by West Berkshire Council on 12 August 2013 (ref. 12/01220/MINMAJ) but is yet to be developed and is currently farmland. The decision notice states that the planning permission is for the following:

> *Progressive mineral extraction with restoration using imported inert materials to agriculture, lakes and grassland, the construction of a new access onto A340, together with ancillary buildings (site office/mess room, weighbridge, security compound etc.) and internal roads (including improvements to existing bridge across the River Enborne).*

Figure 1 shows the Site location and surrounding area. At the Site, Tarmac has planning permission to work the sand and gravel mineral in three phases (A, B and C).

Mineral will be excavated dry through dewatering and Tarmac has an abstraction (transfer) licence which was issued in November 2024. Water from the excavation area will be discharged to the River Enborne under a discharge activity permit granted in September 2024. Details of the authorisations are summarised in Table 1.

Table 1 Abstraction and discharge authorisations

Authorisation	Reference	Activity
Abstraction (transfer) licence	TH/039/0022/065	Abstraction of groundwater from sand and gravel excavation with transfer to surface water
Discharge activity permit	EPR/YB3797AN/A001	Discharge of dewatering effluent to River Enborne and other surface water features

Tarmac expects to work the mineral and restore the Site within a 15 year period as per the planning permission. Dewatering will be ongoing during the mineral excavation and infilling, and each phase will be worked and restored consecutively. Tarmac will restore the Site to no more than original ground levels by importing inert restoration materials and Site derived overburden and soils. In accordance with Condition 7 of the planning permission, the imported materials will be restricted to inert construction, demolition and excavation wastes and soils. Tarmac estimates that up to 1,153,000 m^3 of imported material will be needed to complete the Site restoration requirements.

1.4 Data Sources

The information in this report is predominantly based on secondary data analysis associated with the Site and the surrounding land area. The main sources of data are summarised below:

- Proposed development plans provided by Tarmac;
- Geological data from mineral exploration boreholes and monitoring wells provided by Tarmac ;
- Previous reports for the Site prepared in support of the planning, abstraction licence and discharge activity permit applications;
- British Geological Survey (BGS) mapping;

- Ordnance Survey mapping;
- Site visit undertaken by Envireau Water on 15 March 2022;
- Data on designated sites from Natural England and
- Data from the Environment Agency including water quality, rainfall, historical landfill data, LiDAR data, flood mapping, abstraction licences and discharge activity permits.

2 SITE DETAILS

2.1 Site Setting

The Site is located approximately 800 m southeast of Woolhampton, at NGR SU 578658 (approximate Site Centre). The Site setting is shown on Figure 1 and land uses are summarised in Table 2.

The A4 and railway line run east-west 150 m and 300 m north of the Site, respectively. The Site is accessed from the A340 which runs north-south, 300 m east of the Site. The Site is 1.04 km² in area and is undeveloped, currently utilised as arable agricultural land. Brimpton Airfield Ltd operates a 620 m long airstrip in the south of the Site. Wasing Lane and Wasing Lower Farm border the Site to the south. The River Enborne runs alongside the western Site boundary before flowing eastwards through the Site and bordering the north-eastern boundary. Station Road is 100 m west of the Site at its closest approach.

Woodland lies between the Site and the River Kennet to the north and Woolhampton sewage treatment works is immediately north-west. Around 200 m west of the Site is the former Woolhampton Quarry which has been variably restored to form waterbodies and woodland habitats. A solar farm occupies part of the restored quarry 600 m west of the Site.

Aldermaston and Brimpton are located 300 m southeast and 1.4 km southwest of the Site, respectively. Wasing Estate and parkland is located south of the Site, with the main house being around 500 m south. The surrounding land use is variable, being a combination of rural (agricultural land, small villages, and woodland) and urban, including Tadley located 1.6 km south. Atomic Weapons Establishment Ltd (AWE) operates a facility located north of Tadley, 1.6 km south of the Site. Frouds Bridge marina, associated with the River Kennet and Kennet & Avon Canal is located 450 m north-west.

Topography at the Site is relatively flat, with elevations ranging from approximately 62.5 m AOD in the southwest to 55 m AOD in the northeast. The highest ground is in the southwest of the Site and land slopes broadly north-eastwards towards the River Enborne and River Kennet. Topography at the Site is influenced by fluvial processes and palaeochannels are evident in LiDAR data, particularly in the eastern part of the Site.

Regionally, the Site lies within the east-west trending valley of the River Kennet, which is approximately 2.3 km wide. Ground rises more steeply on the northern side of the valley around Woolhampton to elevations in excess of 100 m AOD around 700 m north of the Site. The southern side of the valley has a shallower gradient rising to 100 m AOD around 1.2 km south of the Site.

Table 2 Surrounding Land Uses

Direction	Land Uses
North	The Site is immediately bounded by woodland, which stretches 100 m north of the River Kennet. A railway line runs east-west immediately north of the River Kennet, with the A4 also running east-west 300 m north of the Site. The Woolhampton Sewage treatment works bound the Site to the northwest.
East	The Site is immediately bordered by greenfield agricultural land. Malthouse cottages lie north of the access road. The village of Aldermaston is located 300 m southeast of the Site. Basingstoke Road (A340) runs north-south 300 m east of the Site.

Direction	Land Uses
South	The Site is immediately bordered to the south by Wasing Lane, Wasing Lower Farm and Wasing Lodge. Land south of this is agricultural greenfield land. Woodland lies 300 m south of the Site. The Wasing Estate house is located 500 m south of the Site, with Wasing Estate Parkland extending between the Site and the Estate headquarters.
West	The Site is immediately bound by the River Enborne and agricultural land. Station Road runs north-south, 100 m from the Site where it is closest. The former Woolhampton Quarry (now fully restored to waterbodies and wetlands) is 200 m west of the Site.

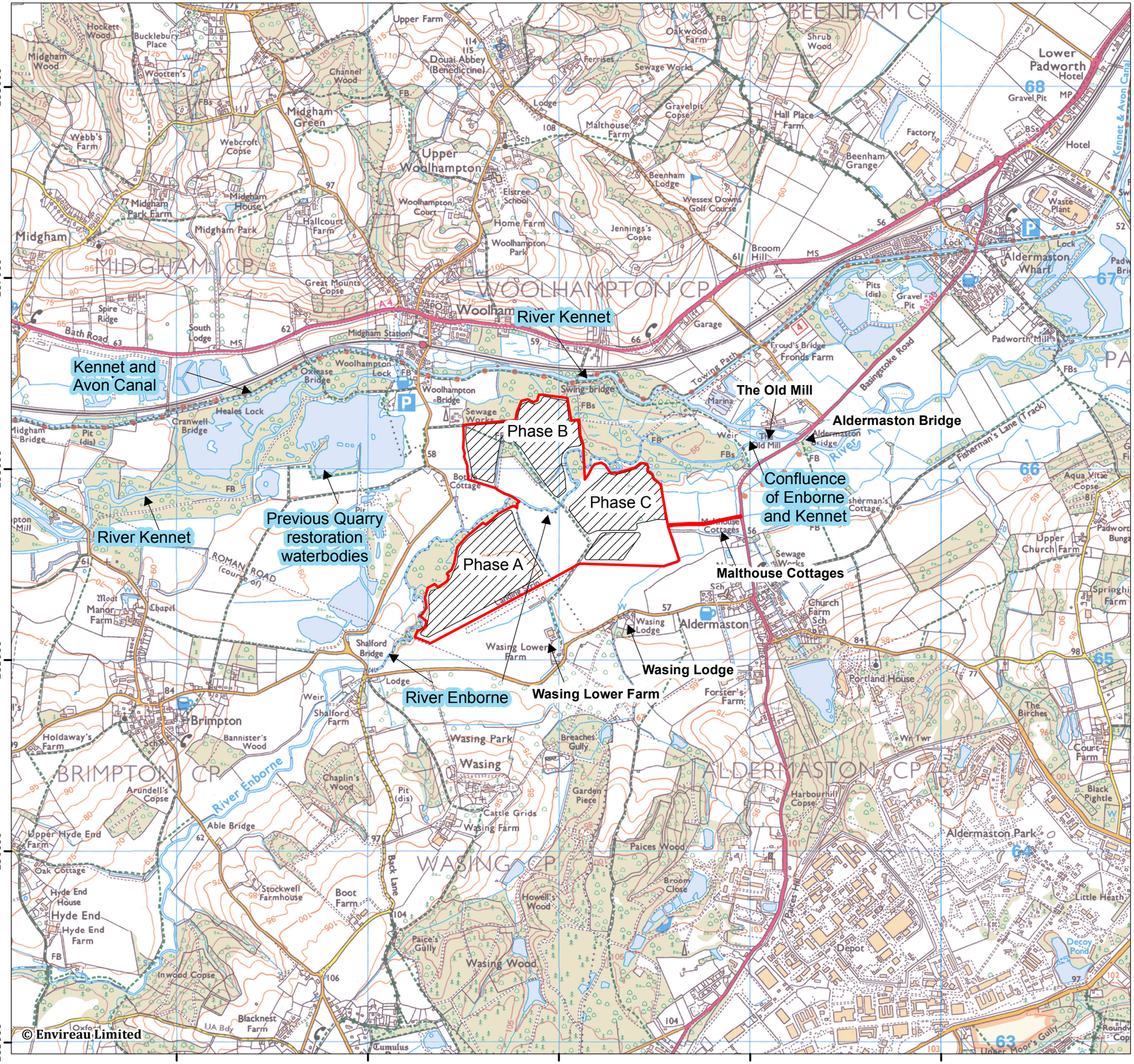
2.2 Proposed Permit Boundary

The proposed Environmental Permit application boundary (the Site) is shown in red on Figure 1.

The proposal is to restore the excavation areas created by mineral extraction by in-filling with imported inert materials within the Permit boundary. The Site will be secure from public access by lockable gates at the Site entrance / exit which will be located on the eastern side of the Site, to the A340 (Basingstoke Road) and will be surrounded by fences and hedgerows.

Figure 1: Site Setting

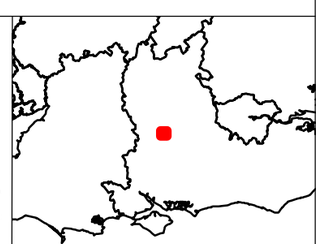
Woolhampton, West Berkshire



Environmental Permit Application Boundary

Phase

Notes:



0 275 550 825 1,100 Meters

Scale: 1:20,000 at A3

19 December 2022

NGR: 458,062 E / 165,690 N

Project No.	3490176
Client:	Tarmac Trading Ltd.
Drawn by:	JH
Ref:	FIG - Site Setting

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3 SOURCE TERM CHARACTERISATION

3.1 Historical Development

Based on historical OS mapping, the Site has remained largely undeveloped greenfield land. Brimpton Airfield was established in the southern part of the Site in 1950 (National Library of Scotland, 2021) and remains operational.

3.2 Historical Landfills

The Site has never been subject to historical mineral extraction or landfilling. Gravel workings have been excavated around the Site as shown in the 1888 – 1913 OS Map (National Library of Scotland, 2021), with the closest being 500 m west. There are no current landfill activities located within 2 km of the Site. There are 15 historical potentially infilled areas of land located within 2 km of the Site, of which are 12 historical landfills as recorded by the Environment Agency. Details of these historical landfill sites are shown in Table 3, based on information from the Environment Agency. The closest historical landfill is 'Sewage Works' located, 460 m east of the Site, there is little information available for this site. The locations of the landfill sites are shown on Figure 2. Back Lane is the only potentially upgradient historical landfill but this is not sited on the sand and gravel and is hydraulically disconnected from the Site.

Table 3 Historical landfills within 2 km of the Site

Site Name	Operator / Licence Holder	Active Dates	Waste Type	Distance from the Site
Sewage Works	-	-	-	460 m east
Fishermans Cottage	-	-	Inert	780 m east
Back Lane	-	-	-	870 m south
Midgham Landfill Site	S Grundon (Waste) Ltd.	17/07/1996 – 27/07/2017	-	1.1 km west
Youngs Landfill No. 5	-	01/01/1985 – 31/12/1988	Inert, Industrial	1.4 km south
Youngs Landfill No. 4	Youngs (Aldermaston) Developments Ltd.	01/01/1988 – 01/06/1993	Inert	1.5 km south
Youngs Landfill No.1	John Stacey and Sons Ltd.	01/01/1986 – 31/12/1988	Inert	1.6 km south
Youngs Landfill No. 2	-	-	-	1.7 km south
Budds Plantation No. 2	-	-	-	1.7 km south
Budds Plantation No. 1	ARC Ltd	31/12/1981 – 31/12/1990	Inert	1.8 km south
Youngs Landfill No. 3	Youngs Developments Limited	31/12/1974 – 31/12/1990	Inert	1.9 km south
Blacks Pit	-	-	-	1.9 km south

Figure 2: Neighbouring Historical Landfills

Woolhampton, West Berkshire

Midgham Landfill Site

Phase A

Phase B

Phase C

Phase C

Fishermans Cottage

Sewage Works

Back Lane

Youngs Landfill 5

Youngs Landfill 4

Youngs Landfill 1

Youngs Landfill 2

Budds Plantation 2

Blacks Pit

Youngs Landfill 3

Budds Plantation 1

1

2

3

Environmental Permit Application Boundary

Phases

2 km from Excavation

Historical Pollution Incident

Landfill Sites

Authorised Landfill Sites

Historical Landfill Sites

Notes:

0 250 500 750 1,000 Meters

Scale: 1:20,000 at A3

06 April 2023

NGR: 457,901 E / 165,765 N

Project No. 3490176

Client: Tarmac Trading Ltd

Drawn by: JH

Ref: FIG - Historical Landfills

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168000 167000 166000 165000 164000

455000 456000 457000 458000 459000 460000

3.3 Operational Landfills

The closest authorised landfill is located 2.3 km north-east of the Site. This landfill is now understood to not be accepting waste but is not yet in definitive closure.

The Environment Agency has provided details of active Waste Management Licences and there are none within 2 km of the Site.

3.4 Historical Pollution Incidents

There are three Category 2 (Significant) water pollution incidences recorded within 2 km of the Site. Two occurred north of the Kennet and Avon Canal and are hydraulically disconnected from the Site. The third is distant from the Site and within the catchment of Stream B. The locations of these pollution incidents are shown on Figure 2, with details described in Table 4.

Table 4 Historical Pollution Incidents within 2 km of the Site

Ref on Fig 2.	Cause	Distance from Site	Date	Watercourse	Pollutant Source	Other impacts
1	Containment and control failure	550 m north	July 2002	Unnamed tributary of the Kennet and Avon Canal	Gas and Fuel Oils	Category 3 (Minor) impact to air
2	Not identified	1.9 km north	March 2005	Unnamed tributary of the Kennet and Avon Canal	Diesel	None
3	Fire	1.6 km south	September 2018	None, within Stream B catchment	Chemically contaminated runoff	Category 3 (Minor) impact to air and land

The Environment Agency has also provided details of Category 3 (Minor) water pollution incidences.

3.5 Proposed Development

3.5.1 Overview

A description of proposed activities at the Site are provided in Section 1.3, this section focusses on the restoration and recovery element. All activities will be undertaken in accordance with the planning permission for mineral extraction and restoration granted by West Berkshire Council in May 2012 (ref. MW.0094/16). The Site will be operated by suitably qualified staff in accordance with Tarmac's Environmental Management System (EMS). Tarmac's EMS is in-line with ISO 14001.

Tarmac staff who will be managing the Site restoration have been assessed to be technically competent for inert waste management operations under the WSMITAB/CIWM Operator Competency Scheme.

3.5.2 Restoration material requirements

An estimated total of 1.7 million tonnes (based on 1.153 million m^3 with a mean density of 1,500 kg/m^3) of inert restoration materials will be used to retore the Site. In accordance with Condition 7 of the planning permission, the imported materials will be restricted to inert construction, demolition and excavation wastes and soils.

All restoration material to be used in the Site restoration will be consistent with that set out in the Waste Acceptance Plan (RSK Geosciences, 2022c). A list of the proposed materials to be accepted is given in Table 5. The wastes in Table 5 will be accepted without testing provided that they are from a single source and there is no reason to suspect the y are contaminated. Only selected construction and demolition wastes will be accepted, and this type of waste must include low contents of other types of materials (e.g., metals, plastics, organics, wood, rubber etc.). The origin of all construction and demolition waste must be known and it must not include waste from buildings treated, covered or painted with materials containing dangerous substances nor waste from buildings polluted with inorganic dangerous substances.

Table 5 Proposed waste types

EWC Code	Description	Restrictions
01	Wastes resulting from exploration, mining, quarrying and physical and chemical treatment of minerals	
01 01	Wastes from mineral excavation	
01 01 02	Wastes from mineral non-metalliferous excavation	Restricted to waste overburden and interburden clay only
01 04	Wastes from physical and chemical processing of non-metalliferous minerals	
01 04 08	Waste gravel and crushed rocks	
01 04 09	Waste sand and clays	
10	Waste from thermal processes	
10 12	Waste from the manufacture of ceramic goods, bricks, tiles and construction products	
10 12 08	Waste ceramics, bricks, tiles and construction products (after thermal processing)	
17	Construction and demolition wastes	
17 01 01	Concrete	Selected construction and demolition waste (see text)
17 01 02	Bricks	
17 01 03	Tiles and ceramics	
17 01 07	Mixtures of concrete, brick, tiles and ceramics	
17 05 04	Soil and stones[1]	Excluding topsoil, peat and material from contaminated sites
19	Waste from waste management facilities	
19 12 09	Minerals (for examples sand, gravel) only	

EWC Code	Description	Restrictions
19 12 12	Other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11	Restricted to crushed bricks, tiles, concrete and ceramics only. Metal from reinforced concrete must be removed. Does not include fines from treatment of any non-hazardous waste or gypsum from recovered plasterboard.
20	Municipal waste (household waste and similar commercial industrial and institutional waste)	
20 02 02	Soil and stones[1]	From garden and park waste; excluding soil and peat

[1]For waste acceptance purposes, this material includes naturally occurring clays, sands, gravels etc.

Tarmac intends to use two waste streams to complete the restoration. The first waste stream will be restricted to cohesive materials that will be used to form a sidewall attenuation layer around the perimeter of each phase. The construction of this sidewall attenuation layer will be with inert materials with a low permeability as set out in the HRA. The second waste stream is less restricted in terms of waste types and will be used to fill the voids. A summary of the two waste streams is provided in Table 6.

Table 6 Proposed waste streams

Stream	Waste codes	Use
Inert cohesive materials	01 04 09, 17 05 04 and 20 02 02	Construction of sidewall attenuation layer, must be of sufficiently low permeability to meet the requirements of Envireau Water set in the Hydrogeological Risk Assessment (2022a)
Inert restoration materials	All those set out in Table 5	Filling the formed excavation area. The top 600 mm of the fill materials will be topsoil.

3.5.3 Operational phasing

Approved development plans are provided in Appendix A. The sand and gravel mineral will be worked dry through dewatering in three phases. Once all the mineral has been extracted within each phase, a sidewall attenuation layer will be constructed from suitable selected restoration materials. The phase will then be filled using imported inert restoration materials. Following filling operations, topsoil and sub soils will be replaced, returning the Site to original ground levels.

3.5.4 Final landform and after use

The approved restoration plan (Appendix A) shows the proposed restoration scheme. The Site is to be restored to no more than existing ground levels. Topography is subdued with a gentle slope towards the River Enborne that flows north-eastwards through the Site. Waterbodies including three ponds and a fishing lake (in the north of Phase B) will provide flood attenuation capacity. The land will be returned to agricultural use.

3.6 Site Engineering

3.6.1 Groundwater protection

There is no specific guidance/legislation for deposit for recovery activities. Although not applicable, to ensure adherence to best practice, the engineering of the Site has been designed with reference to guidance/legislation relating to the landfilling of inert materials (Environment Agency, 2022a).

A sidewall attenuation layer will be constructed for each phase of the restoration, against the in-situ sand and gravel. This attenuation layer will be a least 1 m thick and will have a permeability of no greater than 1 x 10^{-7} m/s. The sidewall attenuation layer will be constructed using selected cohesive inert materials (see Table 6). Once the permit has been issued, a Construction Quality Assurance (CQA) plan will be prepared and followed to ensure that suitable materials are used in the construction of the attenuation layer so that it achieves the thickness and permeability as specified in the HRA. The CQA plan will be prepared in accordance with Environment Agency guidance (Environment Agency, 2022c).

An HRA has been prepared and this shows that groundwater and surface water receptors are at low risk from the proposed Site restoration (Envireau Water, 2025a).

3.6.2 Restoration

Soils (both imported and Site-won(will be placed above the restoration material in each phase. On completion, the surfaces will be prepared and sown with suitable grass seed for agricultural after use. Details of the Site aftercare are provided in Section 5.4.

3.7 Leachate Management and Monitoring

Leachate is generated by rainfall infiltrating through areas of open inert restoration materials. Due to the inert nature of the material, there will be no leachate generated at the Site. Therefore, leachate management or monitoring is not needed.

3.8 Gas Management and Monitoring

A gas risk assessment has not been prepared for the Site, as the guidance states that new inert landfills do not pose a landfill gas hazard (Environment Agency, 2014). Accordingly, management and monitoring infrastructure is not required and will not be installed.

3.9 Site Water Management

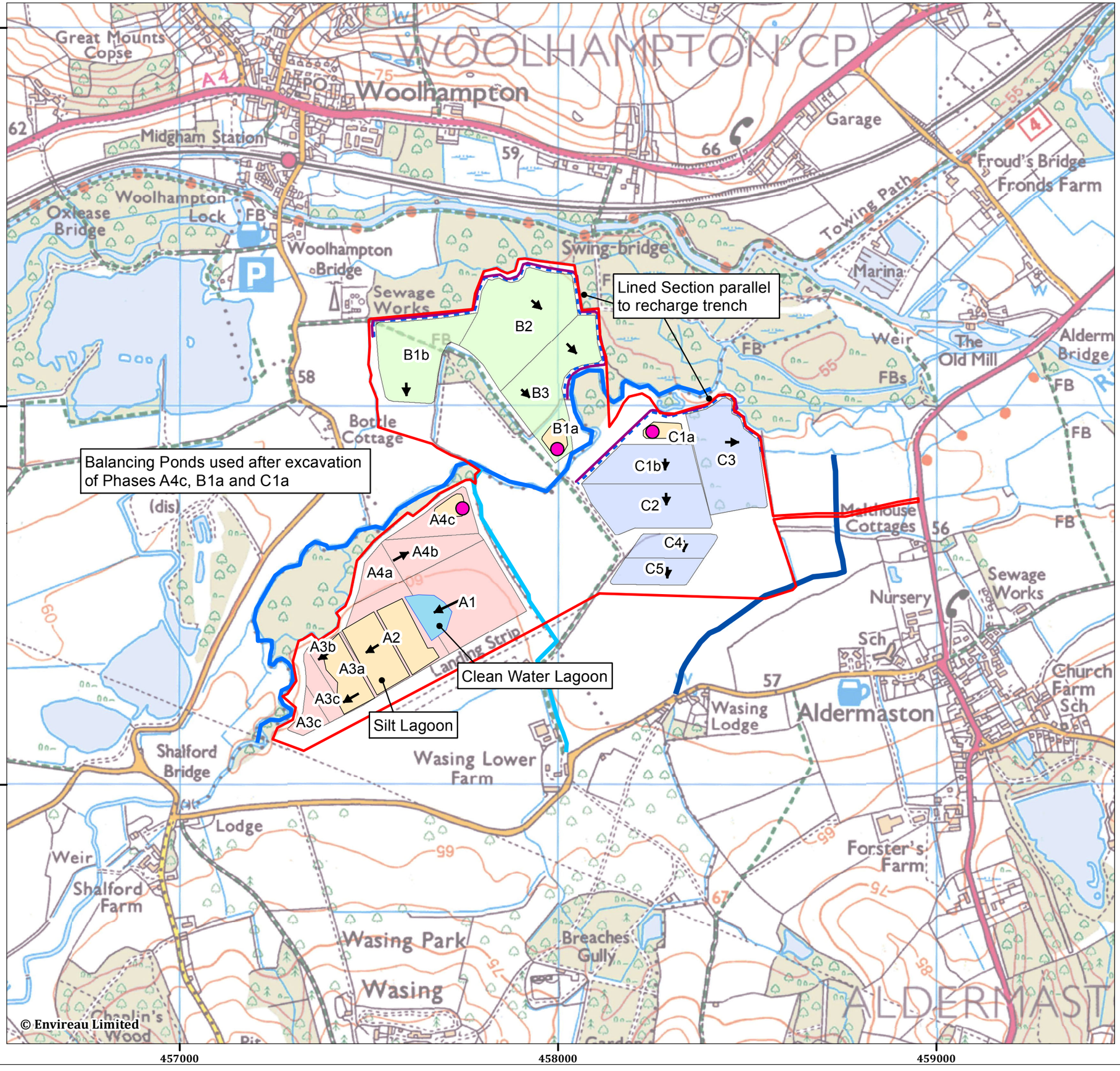
The excavation area will be dewatered sequentially in three phases to facilitate efficient extraction of the sand and gravel mineral and allow restoration materials to be emplaced in dry conditions. Figure 3 shows the proposed water management plan for the Site.

Dewatering will take place year-round when working or infilling below the water table. Each phase will be worked and dewatered as a series of sub-phases, as shown on Figure 3. Water will be pumped from a sump in the topographically lowest part of each phase. The abstracted water will be transferred, via settlement lagoons (the locations of which will vary dependent on the phase), to the River Enborne in the reach that runs through the Site, as shown Figure 3. The discharge will be operated in accordance with the permit (see Section 1.3, and Table 1).

To mitigate impacts on the Woolhampton Woodland LWS, Hafren Water (2012) proposed to line the northern parts of Phase B and Phase C with clay and discharge water to a recharge trench north of Phase B and Phase C. This mitigation is required by the planning permission. The recharge trenches to the north of Phase B and Phase C will only be active whilst these phases are being worked.

Figure 3: Proposed Water Management Plan

Woolhampton, West Berkshire



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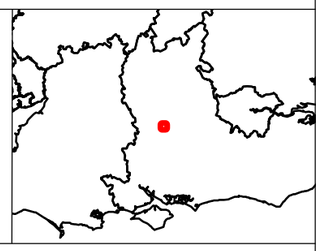
Environmental Permit Application Boundary

- Monitoring Point
- River Enbourne Discharge Reach
- Stream A Discharge Reach
- Stream B Discharge Reach
- Proposed Recharge Trench
- Lined Section
- Clean Water Lagoon
- Settlement Lagoon

Excavation Phase

- Phase A
- Phase B
- Phase C
- Direction of Workings

Notes:



0 125 250 375 500 Meters

Scale: 1:10,000 at A3

21 December 2022

NGR: 458,006 E / 165,691 N

Project No.	3490176
Client:	Tarmac Trading Ltd
Drawn by:	JH
Ref:	FIG - Proposed WMP

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4 PATHWAY AND RECEPTOR CHARACTERISATION

4.1 Climate

4.1.1 Rainfall

The nearest Environment Agency rain gauge is at Kingsclere (ID 269627TP), located 7 km southwest of the Site. The long-term average annual rainfall between 1990-2020 is 771 mm, with a mean monthly rainfall of 66 mm. There is a typical seasonal variation, with the lowest monthly rainfall usually being in July (mean of 49 mm), and maximum monthly rainfall in December (mean of 90 mm).

The Standard Annual Average Rainfall (SAAR) for the Site is 709 mm, the difference between this and the long-term average annual rainfall at Kingsclere is likely because the Kingsclere gauge is on higher ground to the west.

The Cumulative Annual Mean Rainfall Residual (CAMRR), a statistical plot that shows the long-term trend in rainfall relative to historical rainfall, together with the monthly rainfall, is shown on the groundwater hydrographs on Figure 8 . Analysis of the full record shows that from 2000 to 2003, there was a general increase in rainfall relative to the mean. From 2003 to 2012, rainfall then shows a declining trend relative to the mean and since 2012 rainfall has been largely stable.

A Centre for Ecology and Hydrology (CEH) flow gauge on the River Enborne at Brimpton (ID: 39021) has a record of daily flows from 1967 to 2020 (CEH, 2022). The gauge is located 600 m upstream and southwest of the Site. A summary of the available flow data is presented in Table 7. The baseflow index suggests a moderate contribution from groundwater.

Effective precipitation has been estimated using the catchment area and mean flow to be 284 mm/yr. The values given in Table 7 are consistent with those expected at the Site. However, they only provide an approximation of effective precipitation as the calculation assumes that there is no net anthropogenic influence on flows (e.g. from abstraction or discharge).

Table 7 Flow data for the River Enborne at Brimpton

Parameter	Unit	Value
Flow 95% Exceedance (Q_{95})	m^3/s	0.167
Flow 70% Exceedance (Q_{70})		0.38
Flow 50% Exceedance (Q_{50})		0.724
Flow 10% Exceedance (Q_{10})		2.95
Flow 5% Exceedance (Q_5)		4.64
Mean Flow		1.33
Catchment Area	km^2	147.6

4.2 Geology

4.2.1 Regional geology

Bedrock Geology

The bedrock stratigraphy has been characterised based on BGS data (British Geological Survey, 2000), (British Geological Survey, 2020) and BGS borehole Records.

The bedrock geology around the Site consists of the Palaeogene age London Clay Formation (of the Thames Group), underlain by the Reading Formation (Lambeth Group). These Palaeogene strata sit unconformably above the Cretaceous chalk, with the Seaford Chalk Formation outcropping around 3 km to the north, east and west of the Site. The regional bedrock stratigraphy is summarised in Table 8. At topographic highs within the area, sandier strata of the London Clay Formation crop out, with the closest being 560 m south. This sandier unit is assumed to be the Claygate Member of the London Clay Formation.

The stratigraphy regionally dips shallowly to the southeast. There are no faults mapped in the vicinity of the Site.

Table 8 Bedrock stratigraphic sequence

Age	Group	Formation	Member	Description	Local thickness[1]
Palaeogene	Thames Group	London Clay Formation	Claygate Member	Fine sands, with clay and silt.	Outcrops north and south of Site.
			-	Clay, variably silty, with beds of sand, silt and flint pebble seams; variably glauconitic and shelly	Around 10 m at Site.
	Lambeth Group	Reading Formation	-	Sequences of clay, sands and gravels, minor limestones and lignites, and occasional sandstone and conglomerate.	21-23 m thick at Site, outcrops 3 km north east of Site
Cretaceous	Chalk Group	Seaford Chalk Formation		Chalk, nodular with flint seams	Up to 90 m thick, outcrops 5 km north of Site.
		Lews Nodular Chalk		Chalk, nodular with flint seams	Up to 39 m
		Chalk of various formations belonging to White Chalk Subgroup and Grey Chalk Subgroup		Chalk, occasionally nodular and marly	Up to 145 m
	Selborne Group	Upper Greensand Formation		Sandstone, Glaucontic, calcareous	Up to 48 m
		Gault Formation		Mudstone, silty, micaceous	Up to 102 m thick

[1]Based on BGS borehole logs

Superficial Geology

Superficial deposits fill the valley formed by the River Kennet and River Enborne, as shown on Figure 5. The superficial deposits in the Kennet Basin comprise a river terrace system of the Kennet Valley Formation. During times of erosion, the river cuts through these deposits and the older deposits then form a relative topographic high, or terrace, and the younger sediment is deposited on the newly formed river valley, consequently, stratigraphically older deposits sit on the higher topography. Table 9 summarises the stratigraphic sequence. Each of the constituent five terraces of the Kennet Valley Formation directly overlies the Palaeogene bedrock.

Table 9 Superficial geology, stratigraphic sequence

Age	Group	Formation	Member	Description	Local thickness
Quaternary	-	Alluvium	-	Variable composition from clay – gravel	
		Head			
	Britannia Catchments Group (Thames Catchments Subgroup)	Kennet Valley Formation	Beenham Grange Gravel	Gravel, variably clayey and sandy	1 – 6 m, outcrops at the Site
			Thatcham Gravel		3 – 4 m, outcrops 1.1 km west
			Silchester Gravel		1 – 8 m, outcrops 840 m south
			Beenham Stocks Gravel		up to 4 m, outcrops 2.3 km north
			Bucklebury Common Gravel		1 – 5 m, outcrops 2.1 km north

Most of the Site, and the valley floor of the River Kennet Valley is underlain by the Beenham Grange Gravel Member. It outcrops in the southern part of the Site, south of the River Enborne and forms the main economic mineral. Borehole records describe the Beenham Grange Gravel Member as comprising fine to coarse gravel, cobbles and subangular flint, in a sand matrix. It directly overlies the London Clay Formation and is commonly 1 – 6 m thick, with localised deposits up to 10 m thick (BGS Lexicon, 2022). The older Silchester Gravel Member overlies crops out extensively on higher ground around Tadley south of the Site.

Alluvium is associated with the River Kennet and River Enborne, and this overlies the river terrace deposits of the Beenham Grange Gravel Member, covering the northern section of the Site. Polymictic heads deposits comprising gravel, sand and clay are located on topographic highs.

Figure 4: Bedrock Geology

Woolhampton, West Berkshire

Phase B
Phase C
Phase A

168000
167000
166000
165000
164000
163000
456000
457000
458000
459000
460000
461000

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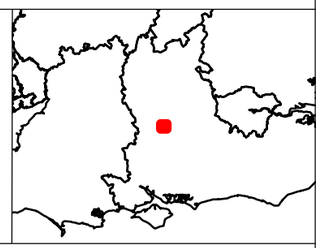
- Environmental Permit Application Boundary
- Phase

Bedrock Geology

- London Clay Formation - Clay, Silt & Sand
- London Clay Formation - Sand
- Lambeth Group - Clay, Silt & Sand

Notes:



0 250 500 750 1,000 Meters

Scale: 1:20,000 at A3

19 December 2022

NGR: 458,108 E / 165,684 N

Project No.	3490176
Client:	Tarmac Trading Ltd.
Drawn by:	JH
Ref:	FIG - Bedrock Geology

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Figure 5: Superficial Geology

Woolhampton, West Berkshire

Phase B
Phase C
Phase A

168000
167000
166000
165000
164000
163000
456000
457000
458000
459000
460000
461000

- Environmental Permit Application Boundary
- Phase

Superficial Deposits

- Alluvium - Clay, Silt, Sand and Gravel
- Head - Clay, Silt, Sand and Gravel
- Beenham Grange Gravel Member - Sand and Gravel
- Thatcham Gravel - Sand and Gravel
- Silchester Gravel Member - Sand and Gravel
- Beenham Stocks Member - Sand and Gravel
- Bucklebury Common Gravel Member - Sand and Gravel
- River Terrace Deposits, 1 to 2 - Sand and Gravel

Notes:

London Clay Formation outcrops over areas not covered by superficial deposits

0 250 500 750 1,000 Meters

Scale: 1:20,000 at A3

19 December 2022

NGR: 458,108 E / 165,684 N

Project No. 3490176

Client: Tarmac Trading Ltd.

Drawn by: JH

Ref: FIG - Superficial Deposits

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4.2.2 Local geology

Information on the geology in the vicinity of the Site has been obtained from the following sources:

- exploration and monitoring well drilling at the Site;
- published geology maps; and
- publicly available borehole logs.

Overburden

The overburden thickness and composition vary spatially across the Site. In the north around Phase B, overburden is described in borehole logs as comprising topsoil and silt, with peaty soil and peat layers present mostly closer to the River Kennet. Overburden thickness is greater and more variable north of the River Enborne compared to the southern part of the Site, Table 10 summarises overburden thickness by phase. Borehole logs for the southern part of the Site describe the overburden as a silty clay transitioning with depth to gravel in a clay matrix and generally being no more than 2 m thick. An area of peat is also located around Phase C. Areas of peat correspond to locations with the thickest overburden. Figure 6 shows the areas where peat has been recorded in the borehole logs.

Mineral

The target economic mineral is sand and gravel of the Beenham Grange Gravel Member. In the north of the Site borehole logs describe the mineral as comprising gravel, flint and sand. In the south of the Site the mineral is silty sand with medium grained gravel and occasional large flints, becoming less silty with depth. Mineral composition varies spatially and with depth due to its fluvial method of deposition.

The mineral is thickest in the northern part of Phase B, where it reaches a maximum thickness of 5.7 m. Contours of mineral thickness are shown on Figure 6, and show a thicker band of mineral running east from Phase A to Phase C and northwards towards the River Enborne. This may be a palaeochannel of the River Enborne. At Phase B, there is evidence of another paleochannel, likely of the River Kennet, as the area of thickest mineral deposit runs east-west. This could be the same paleochannel as that targeted by mineral extraction operations at Woolhampton Quarry, although this had a greater mineral thickness (10 m) (Hafren Water, 2012).

Interburden was identified within the mineral in 9 of the 109 boreholes, this is mostly in the north of Phase A, where it reaches up to 2.6 m thick and in the east of Phase C (up to 3.8 m thick). The interburden is typically described as a silty sand and based on the borehole logs, is not laterally continuous, being confined to small areas of the Site.

The average Particle Size Distribution (PSD) for the mineral shows that 75% is gravel (grain size over 2 mm), with the around 20% sand and the remainder being fines (silts and clays).

Table 10 summarises the thickness of the overburden and mineral at each phase of the Site.

Table 10 Overburden and mineral thickness (based on exploration borehole logs)

Excavation Area	Overburden Thickness (m)		Mineral Thickness (m)	
	Range	Mean	Range	Mean
Phase A	0.1 – 2.1	1.06	0.38 – 5.43	3.28
Phase B	0.44 – 4.27	2.08	0.88 – 5.90	3.15
Phase Ca	0.73 – 3.39	1.59	1.34 – 5.37	2.75
Phase Cb	0.28 – 2.37	1.25	1.68 – 5.09	3.07

Underlying Bedrock

All mineral proving boreholes proved reached the base of the mineral which was found to be clay (often described as a blue clay), interpreted as London Clay Formation. A borehole (BGS ref. SU56NE97) drilled 60 m west of the Site at Woolhampton sewage treatment works proved the London Clay Formation to be 10 m thick. The London Clay Formation is underlain by the Reading Formation, which is 23 m thick at this location, with chalk being encountered below this. Due to the shallow dips, this sequence and thicknesses are considered representative of that at the Site. The Kennet valley is cut into the London Clay Formation and this unit thickens either side of the main channel (see Figure 11).

4.3 Man-made Subsurface Pathways

The Beenham Grange Gravel Member will be worked at the Site to the contact with the London Clay Formation. The London Clay Formation is of very low permeability (see Section 4.5.2) and is expected to isolate the underlying Seaford Chalk Formation which is a Principal Aquifer (see Section 4.5.2).

Monitoring boreholes drilled at the Site are installed within the sand and gravel and do not penetrate through the London Clay Formation. Therefore, there is no possibility of vertical contaminant migration between geological units along vertical pathways created by monitoring well drilling. There could be other that might provide preferential vertical pathways however, this is considered unlikely based on the available data.

There are no historical mineral workings or areas of made ground mapped by the BGS at or immediately around the Site that could act as preferential pathways.

Figure 6: Local Geology

Woolhampton, West Berkshire

Site Boundary

Excavation Areas

Peat

Mineral Thickness (m)

- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- 5 to 6

Mineral Thickness (m): 6, 5.5, 5, 4.5, 4, 3.5, 3, 2.5, 2, 1.5, 1, 0.5, 0

Notes:

0 100 200 300 400

29 March 2022

NGR: 275,089 E / 697,209 N

Project: P21-253
Client: Tarmac Trading Ltd
Drawn by: JH
Ref: FIG 3 Local geology

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166600
166400
166200
166000
165800
165600
165400
165200
165000
164800

457000 457200 457400 457600 457800 458000 458200 458400 458600 458800

4.4 Hydrology

4.4.1 Surface watercourses and waterbodies

Surrounding surface water features are shown on Figure 7. The majority of the Site located in the lower reaches of the River Enborne catchment. The River Enborne is sourced from near Inkpen, 20 km west of the Site and flows westwards towards the Site, forming the southwestern Site border and then flowing through the Site to the northeast. East of the Site the River Enborne flows alongside the Site boundary for around 300 m through woodland before reaching its confluence with the River Kennet, 600 m east of the Site. Where it flows through the Site, the channel adopts a meandering planform and is around 6 m wide. An oxbow lake associated with the River Enborne is located north of Phase C.

The River Kennet is sourced from springs near Avebury around 48 km northwest of the Site and flows past the Site to the north, discharging to the River Thames 16.6 km to the east at Reading. At Hungerford (23 km west), the River Kennet connects with the Kennet & Avon Canal and, in some reaches, including north and downstream of the Site, the canal and river are effectively the same watercourse. The Kennet & Avon Canal runs from Bristol to Reading.

At Woolhampton Lock, 500 m northwest of the Site, the River Kennet and Kennet & Avon Canal join, there is a level difference of around 2.7 m across the lock. Upstream of Woolhampton Lock, the two water features are separate, running parallel to each other. Approximately 400 m north-east of the Site, the canal and River Kennet spilt, re-joining again 4.3 km northeast of the Site. Old Mill weir is located 500 m east of the Site just downstream of the point where the two split. Based on LiDAR data, the River Kennet shows a difference in levels of around 2 m across Old Mill weir.

To the north, around Woolhampton, several tributaries flow southwards to join the River Kennet/Kennet & Avon Canal. The main drainage feature in this area is Spring Ditch, this flows westwards to its confluence with the River Enborne, 310 m east of the Site. There are several small watercourses in the woodland north of the Site. Some of these have been developed to direct any overflowing water from the River Kennet/Kennet & Avon Canal to Spring Ditch.

There are several smaller tributaries of the River Enborne that flow through the Site. The largest of these originate on land to the south and flow northwards east of excavation Phase A and along the southeastern Site boundary. These are referred to as Stream A and Stream B, respectively. Stream A flows northwards through Wasing Wood Ponds and is sourced 2.2 km south of the Site. It flows east of Wasing Farm and is culverted beneath Wasing Lane and Wasing Lower Farm before passing through the Site and discharging to the River Enborne northeast of Phase A. Site visit observations indicate that Stream A is around 1 m wide at the confluence. Stream B is sourced from a waterbody in Paices Wood, 1.2 km south of the Site and flows northwards, it too is culverted beneath Wasing Lane and flows along the southeastern boundary. Within the Site, both Stream A and Stream B have been anthropogenically modified to improve field drainage.

Some minor, mostly southwards flowing field drains drain the land around Phase B and discharge to the River Enborne. During the March 2022 site visit, these features were dry and are therefore likely ephemeral. East of the Site, on low-lying land north of Aldermaston, numerous ditches drain agricultural land.

To the northwest of the Site there is a series of waterbodies that were formed through the restoration of Woolhampton Quarry. Most of these appear not to have an outlet. To the west of the Site and Station Road, are three unnamed waterbodies that are also occupy former sand and gravel workings. Further restored sand and gravel workings are located 1 km northeast of the Site between the Kennet & Avon Canal and the River Kennet. A dammed fishing pond is located in woodland 815 m southeast of the Site and south of Aldermaston.

Numerous small waterbodies are located south of the Site on higher ground at and around Wasing Estate.

4.4.2 Surface water levels

River level data is also available for the River Enborne at Brimpton. A weir is present at the gauging station and levels are recorded upstream and downstream of the weir. This shows that levels at the upstream side of weir are generally around 0.75 m higher than those downstream. The downstream water level varies from 58.53 – 60.99 m AOD and is generally around 58.97 m AOD.

Spring Ditch occupies a channel that is around 1 - 2 m wide and 1.5 m deep (Hafren Water, 2012) which was verified on our site visit.

Based on LiDAR data, the reach of the Kennet & Avon Canal between Woolhampton Lock and the weir downstream of the Site is at an approximate constant elevation of around 55.9 m AOD, and consequently has almost no flow within this reach.

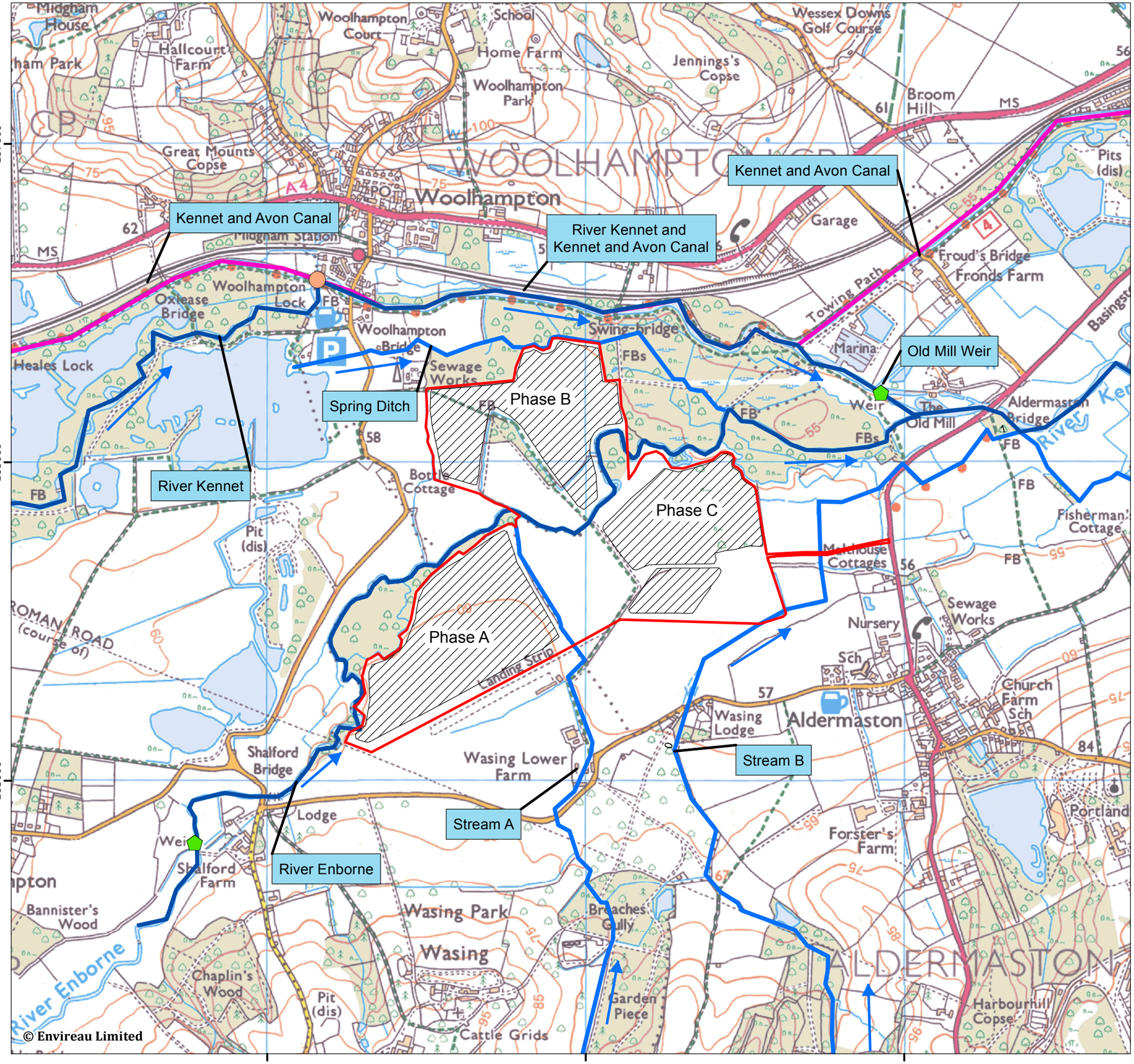
4.4.3 Fluvial flood risk

A Flood Risk Assessment (FRA) was undertaken in 2012 to support the planning application (Hafren Water, 2012). A large proportion of the Site is located within Flood Zone 3b, this encompasses all of Phase B and a large proportion of Phase C (Hafren Water, 2012). Land in Flood Zone 3b has a greater than 5% annual probability of flooding in any given year. Flood Zone 2 (between 1 in 100 and 1 in 1000 annual probability) extends further south and encompasses northern and eastern areas of Phase A, and a small area to the west. Fluvial flooding modelling has been undertaken on behalf of the Environment Agency to determine the flood zones. This indicates that most of the Site covered by Flood Zone 3b actually floods every 5 years (i.e., 20% annual flood probability) (Halcrow, 2017).

The finished scheme will be returned to no more than the original ground levels, and therefore there will be no loss of floodplain storage and no requirement for floodplain compensation.

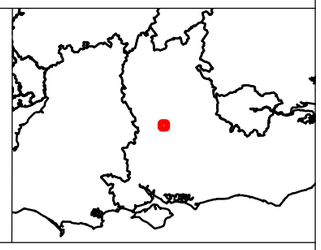
Figure 7: Hydrological Setting

Woolhampton, West Berkshire



- Environmental Permit Application Boundary
- Phase
- Weir
- Woolhampton Lock
- River Kennet
- River Enborne
- Canal
- Spring Ditch
- Stream A
- Stream B

Notes:



0 125 250 375 500 Meters

Scale: 1:12,000 at A3

19 December 2022

NGR: 457,953 E / 165,792 N

Project No.	3490176
Client:	Tarmac Trading Ltd.
Drawn by:	JH
Ref:	FIG - Hydrological Setting

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4.4.4 Surface water quality

Tarmac has monitored surface water quality at six locations (SW1 – SW6) from 2016 to present, with three additional locations sampled from May 2022 (GB1 – GB3). There is a hiatus in the monthly monitoring between May 2019 to July 2020. The locations are shown in Appendix B. Monitoring points SW1, SW2 and GB3 are on the Spring Ditch, SW3-SW6 are on the River Enborne, GB1 is on Stream A and GB2 is on Stream B. A summary of the surface quality data is presented in Table 11, time series charts of selected parameters is presented in Appendix B. Surface Water has been monitored for major ions, metals and hydrocarbons. The data have been compared to the UK Drinking Water Standards (DWS) and the relevant freshwater Environmental Quality Standards (EQS) to give an indication of water quality.

Surface water quality in Spring Ditch, the River Enborne, Stream A and Stream B is good with respect to major ions. However, there are exceedances of some metals and hydrocarbon species at some of the monitoring locations. These exceedances are discussed in further detail below.

Metals

The times series graph (see Appendix B) for nickel shows isolated peaks which exceed the EQS. One exceedance occurs in all the surface water monitoring locations in September 2016. The others occur in SW1 and SW2 (Spring Ditch) in August 2017, and in the River Enborne (SW3 in January 2018 and SW5 in October 2018). There are no exceedances in the May 2022 to February 2024 sampling rounds. In these sampling rounds total and dissolved nickel were both analysed, and the concentrations are the same, indicating that the nickel present is dissolved in the groundwater.

The time series graph (see Appendix B) for zinc also consists of isolated spikes which exceed the EQS. In July 2017, the concentration of zinc at SW2 is 150 µg/l, well above the EQS of 10.9 µg/l. There are five exceedances in SW6 in May 2018, December 2018, June 2021, April 2023 and May 2023, and one at SW5 in October 2018. There are also exceedances in GB1 -3 in May 2022. During this sampling round total zinc and dissolved zinc were both analysed and show that there are no exceedances in the dissolved phase. In September 2022 there are exceedances of zinc in SW2, SW3, SW4, SW5 and SW6. These exceedances all occur in the total, and not the dissolved phase.

There are no other exceedances for metals in the dataset. As the exceedances occur as isolated spikes, they are unlikely to be due to a consistent contamination source and instead could be caused by sampling or laboratory errors or related to differences between total and dissolved metals (i.e., exceedances actually being related to entrained sediment and not water quality per sae.

Hydrocarbons

There are detections of Total Petroleum Hydrocarbons (TPHs) in the range C10 – C40, in all surface water monitoring locations. At all locations, over 70% of the samples collected had detections of TPH. Between September 2016 and May 2019, the detections are an order of magnitude greater than those from July 2020 onwards. The exceedances occur in isolated spikes, with detections followed by non-detections. A time-series chart of the TPH concentration at the monitoring points is presented in Appendix B.

There are also detections of Polycyclic Aromatic Hydrocarbons (PAHs) at all the surface water monitoring locations. At all locations, over 20% of samples collected show detections of PAHs. Any samples where PAHs are detected (i.e., are above the LOD) means an exceedance of the EQS as the LOD is also above the EQS. As with TPH, in many cases the exceedances of PAHs are several order of magnitudes above the LOD.

The detections of TPH and PAHs are, prior to 2020 at least, are consistent and do suggest a consistent and regular source. The detected organics are, for the most part, not in the most mobile and soluble range (i.e., are longer rather than shorter chain hydrocarbons). These chemicals could be sourced from historical spillage incidents, related to the nearby road network, agricultural practices or the runway.

Nitrate and Dissolved Oxygen

Samples were only measured for nitrate concentrations from May to September 2022. These samples show that nitrate as NO3 is present at concentrations of 0.4- 8.7 mg/l which is below the EQS. Concentrations of Dissolved Oxygen (DO) were measured across the full monitoring period range between 1.7 and 12.9 mg/l, with most samples having concentrations between 6 and 11 mg/l. This is within the normal range of DO levels for surface water.

Table 11 Summary of Surface Water Chemistry

Parameter	Unit	DWS	EQS	Statistic	River Enborne (to 3.s.f)	Spring Ditch (to 3.s.f)
Chloride	mg/l	250	250	95th Percentile	45.0	44.85
				Mean	30.2	30.3
Sulphate (a)	mg/l	250	400	95th Percentile	37.1	35.9
				Mean	25.6	24.7
Arsenic	mg/l	0.01	0.05	95th Percentile	0.003	0.004
				Mean	0.00115	0.00144
Antimony	mg/l	0.005		95th Percentile	5.00E-04	6.00E-04
				Mean	4.94E-04	5.19E-04
Barium	mg/l	1.00		95th Percentile	0.03	0.029
				Mean	0.021	0.021
Cadmium	mg/l	0.005	0.0025	95th Percentile	5.00E-05	5.00E-05
				Mean	1.60E-05	1.88E-05
Total Chromium	mg/l	0.05	0.0047	95th Percentile	5.00E-04	0.001
				Mean	4.80E-04	5.26E-04
Copper	mg/l	2.00	0.028	95th Percentile	0.0036	0.00434
				Mean	0.00156	0.00169
Fluoride	mg/l	1.5	5	95th Percentile	0.20	0.20
				Mean	0.076	0.073
Lead	mg/l	0.01	0.0012	95th Percentile	7.00E-04	6.00E-04
				Mean	4.29E-04	3.81E-04

Parameter	Unit	DWS	EQS	Statistic	River Enborne (to 3.s.f)	Spring Ditch (to 3.s.f)
Mercury	mg/l	0.001	5.0E-04	95th Percentile	2.50E-05	5.00E-05
				Mean	2.39E-05	2.30E-05
Molybdenum	mg/l			95th Percentile	0.001	0.001
				Mean	6.98E-04	7.65E-04
Nickel	mg/l	0.02	0.004	95th Percentile	0.004	0.004
				Mean	0.00192	0.00216
Selenium	mg/l	0.01		95th Percentile	0.00101	8.45E-04
				Mean	4.88E-04	4.61E-04
Zinc	mg/l		0.0109	95th Percentile	0.029	0.0168
				Mean	0.00722	0.00553
pH				95th Percentile	8.40	8.40
				Mean	7.63	7.24
Anthracene	µg/l		0.100	95th Percentile	0.005	0.005
				Mean	0.00527	0.00527
Benzo(a)pyrene	µg/l		1.70E-04	95th Percentile	0.01	0.008
				Mean	0.00587	0.00594
Naphthalene	µg/l		2.00	95th Percentile	0.02	0.015
				Mean	0.00708	0.00668
Fluoranthene	µg/l		0.0063	95th Percentile	0.0300	0.0200
				Mean	0.00832	0.0826
PAHs	µg/l			95th Percentile	0.170	0.080
				Mean	0.0321	0.025
Benzene	µg/l		10	95th Percentile	2.50	2.500
				Mean	1.16	0.986
Toluene	µg/l		50	95th Percentile	2.50	2.500
				Mean	0.899	0.986
Ethylbenzene	µg/l		20	95th Percentile	2.500	2.500
				Mean	0.517	0.445
Xylenes	µg/l		30	95th Percentile	5.00	5.00
				Mean	1.99	1.60
TPH	µg/l		10	95th Percentile	166	150
				Mean	37.6	43.5

4.4.5 WFD classification

The majority of the Site lies within the Lower Enborne Catchment (ID: GB106039017340). In 2021, it was classified under the Water Framework Directive (WFD) as having a moderate overall status, with an ecological status of moderate and a chemical status of fail (Environment Agency, 2021). The chemical status of fail is due to the presence of the priority hazardous substances Perfluorooctane Sulphonate (PFOS), Polybrominated Diphenyl Ethers (PBDE), and cypermethrin.

The northernmost part of the Site lies within the Kennet (Lambourn confluence to Enborne confluence) Catchment (ID: GB106039017420). In September 2021 it was classified under the WFD as having a moderate overall status, with an ecological status of moderate and a chemical status of fail (Environment Agency, 2021). The chemical status fail is due to the presence of PBDE.

4.4.6 Discharge permits

Data provided by the Environment Agency in January 2022 shows there are 14 permitted discharges within 2 km of the Site (Figure 12) – the details of which are shown in Table 12. Most of these are discharges of treated sewage.

Table 12 Discharge activity permits

Permit Holder	Start Date	Distance and direction from Site	Discharge Type	Receiving Water Feature	Daily Flow (m^3/day)
Trustees of the Wasing 1975 settlement	17/02/2000	20 m south	Sewage	Wasing Stream	5
White Tower Nursery	13/03/1995	300 m east	Sewage	Sand and gravel aquifer	1
Thames Water (Woolhampton STW)	01/04/2010	500 m west	Sewage – Water company	Spring Drain	n/a
Aster Communities	27/02/2015	500 m northeast	Sewage	Into Land	4
West Berkshire Council	21/12/2012	600 m northeast	Sewage	Sand and gravel aquifer	15
The Old Mill Hotel	27/03/1982	600 m northeast	Sewage	Sand and gravel aquifer	n/a
The Rising Sun, Plots 1-4	04/06/2021	700 m northeast	Sewage	Sand and gravel aquifer	3.6
Wasing Leisure Ltd	28/02/2008	700 m south	Sewage and Trade combined	Unnamed tributary of the River Enborne	22
Thames Water (Aldermaston STW)	01/04/2010	700 m southeast	Sewage – Water company	Fishermans Brook	n/a

Permit Holder	Start Date	Distance and direction from Site	Discharge Type	Receiving Water Feature	Daily Flow (m^3/day)
Castle Windows	06/12/2001	800 m northeast	Sewage	Into Land	5
AWE PLC	26/10/2017	1.4 km, southeast	Trade	Multiple surface water features	n/a
Unknown (Deerbourne)	27/10/2011	1.7 km, northeast	Sewage	River Kennet	1.5
Unknown (Spire Ridge)	06/12/2012	1.8 km, northwest	Sewage	Into Land	4.2

4.5 Hydrogeology

4.5.1 Classification

The Site is not covered by a WFD Groundwater Body (GWB), and so does not have a groundwater WFD Status, instead as the sand and gravel is connected to the surface water environment, the surface water status applies. Approximately 500 m south of the Site is the Aldermaston Bagshot Beds GWB (GW ID: GB40602G601500) that has overall, quantitative, and chemical statuses of "good" (Environment Agency, 2021).

The superficial deposits (the sand and gravels) are designated by the Environment Agency as a Secondary A aquifer. A Secondary A aquifer is defined as comprising permeable layers that can support local water supplies and may form an important source of baseflow to rivers.

The London Clay Formation is classified as an unproductive aquifer by the Environment Agency. An unproductive aquifer is defined as largely unable to provide usable water supplies and unlikely to have surface water and wetland ecosystems dependant on it (Environment Agency, 2017) .

Beneath the London Clay Formation and Reading Formation is the Chalk Group aquifer, which is classified as a Principal Aquifer.

4.5.2 Aquifer properties

Hafren Water (2012) presents a series rising and falling head tests on four piezometers (WMP1, WMP3, WMP4 and WMP5), located around the Site. Results varied from 0.01 to 6.1 m/day.

These results are lower than would be expected for the sand and gravel aquifer based on the geological descriptions. Indeed, results of hydraulic testing at piezometers (P1 – P7), gave hydraulic conductivities that varied from 2 - >1000 m/day. This is consistent with the spatial variability in composition of the sand and gravel unit.

An approximate estimation of hydraulic conductivity can also be obtained from Particle Size Distribution data using Equation 1 (Hazen, 1893):

$$k = C \cdot (D_{10})^2$$

Where: k is hydraulic conductivity (m/s);

D_{10} is the grain size at which 10% of particles in the sample are less than this value (mm); and

C is an empirical correlation factor.

A C value of 0.01 is typically used when grain size is in millimetres and hydraulic conductivity in m/s.

Hydraulic conductivity values for the sand and gravel aquifer have been estimated based on the sample gradings provided by Tarmac, and these are summarised in Table 13. The variation in values is consistent with the variable composition of the sand and gravel strata. The mean value is representative of a well graded sand and gravel with a low silt content and is consistent with the geological descriptions.

Table 13 Hydraulic conductivity based on PSD data

Parameter	Minimum	Mean	Maximum
D_{10} (mm)	0.063	0.375	1.7
Hydraulic conductivity (m/day)	3.4	122	2,500

The available data suggests that the sand and gravel aquifer has a high hydraulic conductivity that can vary widely dependent on its precise composition.

The underlying London Clay Formation has a very low hydraulic conductivity. In a groundwater model of the London Basin, the hydraulic conductivity of this unit was calibrated at 5×10^{-6} m/day (Mott MacDonald, 2003). Data from testing of core samples from the London basin gives a mean hydraulic conductivity of 0.001 m/day (Jones, et al., 2000). The Reading Formation has a variable hydraulic conductivity dependent on the strata type, typically being around 1 – 10 m/day (Jones, et al., 2000).

4.5.3 Groundwater levels and flow

Tarmac monitors groundwater levels on a monthly basis in 22 boreholes screened across the sand and gravel that have been installed at and around the Site and the former Woolhampton Quarry (see Figure 9). Summary groundwater level statistics of the boreholes are summarised in Table 14. Groundwater levels in the area range from 52.1 - 62.8 m AOD.

Figure 8 shows hydrographs of groundwater levels recorded in the boreholes from 2000 - present. River levels for the River Enborne at Brimpton (downstream of the weir) are also shown. Groundwater levels are highest south of the Site (WMP14) and lowest in the north-east and east (WMP5 and WMP16). The CAMRR curve is also shown on Figure 8. Groundwater levels do not follow the same trends as the CAMRR curve particularly the decrease to 2012. This suggests that groundwater levels are not entirely dependent on rainfall recharge.

Boreholes sited in the base of the valley close to watercourses (e.g., WMP5, WMP1) tend to show a lesser seasonal fluctuation, typically of no more than 1 m, than those further from the watercourses where seasonal fluctuations

can be up to 2 m (e.g., WMP14). WMP14 in particular shows a strong seasonal rainfall related signature, whereas boreholes in the base of the valley closer to watercourses show more random fluctuations. Groundwater levels in these topographically lower locations correlate with changes in water levels in the River Enborne and this demonstrates that surface water features are connected to the sand and gravel aquifer.

Levels in boreholes installed in the valley bottom (e.g., WMP3, WMP6, WMP7, WMP10, WMP11 and P7) have exceeded ground surface on at least one occasion. This causes groundwater flooding and is likely related to high flows in the River Enborne, River Kennet/Kennet & Avon Canal or other watercourses. Particularly over winter, ground is often waterlogged in the woodland north of the Site where WMP6, WMP7 and WMP10 are located. This is because groundwater levels tend to be shallower in these areas and also explains the lower fluctuation magnitude.

The waterbodies formed as part of the restoration of the former Woolhampton Quarry have locally altered groundwater levels. Since 2003, P5 and P7 which are downstream of the lake draining to Spring Ditch show limited seasonal fluctuations and are consistently at around 56 m AOD which is the approximate maximum groundwater level recorded prior to lake formation. Levels at this location are likely being moderated by lake levels, which in turn are being controlled by the outfall to Spring Ditch. The lakes are hydraulically connected to groundwater and the data suggests that those closest to (and downstream of) the Site have raised groundwater levels.

Figure 9 and Figure 10 show maximum and minimum groundwater contours for the sand and gravel aquifer. These contours are based on data from 22 December 2020 and 31 August 2018, respectively. Groundwater flow across the Site is generally to the northeast towards the River Kennet and Spring Ditch. Groundwater also discharges to the River Enborne, and locally to the smaller surface water features including Stream A, Steam B and Spring Ditch. These features likely lose to groundwater as the hydraulic gradient reverses during high flow conditions.

Based on LiDAR data, it appears that the Kennet & Avon Canal/River Kennet between Woolhampton Lock and the Old Mill weir downstream of the Site has an approximately constant water level. The canal is not thought to be lined in this reach and, based on this and the groundwater contours, the upstream part of this feature likely gains from groundwater, whilst the downstream part likely loses to groundwater. The point where the behaviour changes likely varies seasonally and cannot be accurately defined. The Kennet & Avon Canal, upstream of Woolhampton Lock, is thought to be lined and does not accept groundwater. The River Kennet upstream of the Lock, gains from groundwater.

The London Clay Formation acts as the base of the sand and gravel aquifer. The London Clay is around 10 m thick beneath the Site and acts as a hydraulic separating layer between the underlying chalk aquifer. This is demonstrated by the Woolhampton Sewage Treatment Works (STW) borehole (ID SU56_117) (NGR: 457430 166230) where recorded groundwater levels are above the London Clay Formation contact and are regularly above ground level at 50 – 59 m AOD (see Figure 8). The lateral edges of the sand and gravel aquifer are defined by the outcrop pattern of the Beenham Grange Gravel member.

Figure 6 shows a potential palaeochannel in the sand and gravel aquifer. This may act as a preferential flow pathway as the aquifer thickness (and therefore likely the transmissivity) is greater in his area. Regionally, it is expected that

historical landfills (where present) will form low hydraulic conductivity areas that, locally at least, will act as barriers to groundwater flow.

Evidence of historical dewatering

P5, P6 and P7 show evidence of dewatering from the former Woolhampton Quarry prior to 2004. P7 shows fluctuations of around 4.5 m between 1995 and 2003 that may be related to seasonal (summer) dewatering, with groundwater levels reaching a low of 52.1 m AOD in October 1999. P5 also shows a similar, but less extreme, pattern, with levels showing fluctuations of 2.5 m.

Table 14 Groundwater monitoring boreholes

Name	Readings From	Readings To	Datum (m AOD)	Ground level (m AOD)	Depth (m)	No. Readings	Groundwater Level (m AOD)			Groundwater Level (m bgl)		
							Minimum	Mean	Maximum	Minimum	Mean	Maximum
P4	25/03/2015	24/10/2023	57.856	57.51	5	61	56.24	56.65	57.38	0.13	0.86	1.27
P5	02/05/1990	24/06/2024	57.923	57.95	5	248	54.16	55.61	57.17	0.78	2.34	3.79
P6	05/07/1990	09/03/1996	57.2	57.83	5	15	53.30	54.64	56.99	0.84	3.19	4.53
P7	02/05/1990	24/06/2024	56.801	56.25	9.5	216	52.13	55.16	56.65	-0.40	1.09	4.12
P8	25/03/2015	28/09/2016	56.83	56.61		11	55.07	56.09	56.35	0.26	0.52	1.54
WMP1	31/05/1990	24/06/2024	56.277	55.64	6	247	54.12	54.85	55.61	0.03	0.79	1.52
WMP2	02/05/1990	24/06/2024	57.42	56.79	5.6	235	54.51	55.37	56.77	0.02	1.42	2.28
WMP3	31/05/1990	24/06/2024	59.64	59.03	4.5	245	56.35	57.70	59.07	-0.04	1.33	2.68
WMP4	24/09/1996	24/06/2024	61.01	60.53	6	169	56.59	58.80	60.07	0.46	1.72	3.94
WMP5	24/09/1996	24/06/2024	55.76	55.72	5	199	53.56	54.13	54.87	0.85	1.59	2.16
WMP7	06/12/2001	24/06/2024	56.23	55.88	9.5	158	54.37	55.43	56.18	-0.30	0.44	1.32
WMP8	06/12/2001	24/06/2024	56.14	56.02	6	142	54.49	55.41	55.91	0.11	0.61	1.53
WMP9	06/12/2001	24/06/2024	56.53	56.14	7	151	54.77	55.62	56.19	-0.05	0.51	1.36
WMP10	16/01/2002	24/06/2024	55.304	55.12	10	142	54.20	54.55	55.13	-0.01	0.57	0.92
WMP14	30/11/2015	24/06/2024	63.78	63.39	5.5	76	61.16	61.94	62.81	0.58	1.45	2.23
WMP15	30/11/2015	24/06/2024	58.21	57.75	5	64	55.20	56.26	57.21	0.54	1.49	2.55
WMP16	30/11/2015	24/06/2024	56.57	56.24	3.3	73	53.73	54.36	55.11	1.13	1.88	2.51
WMP17	30/11/2015	24/06/2024	59.33	58.84	6.2	70	57.09	57.48	58.15	0.69	1.36	1.75

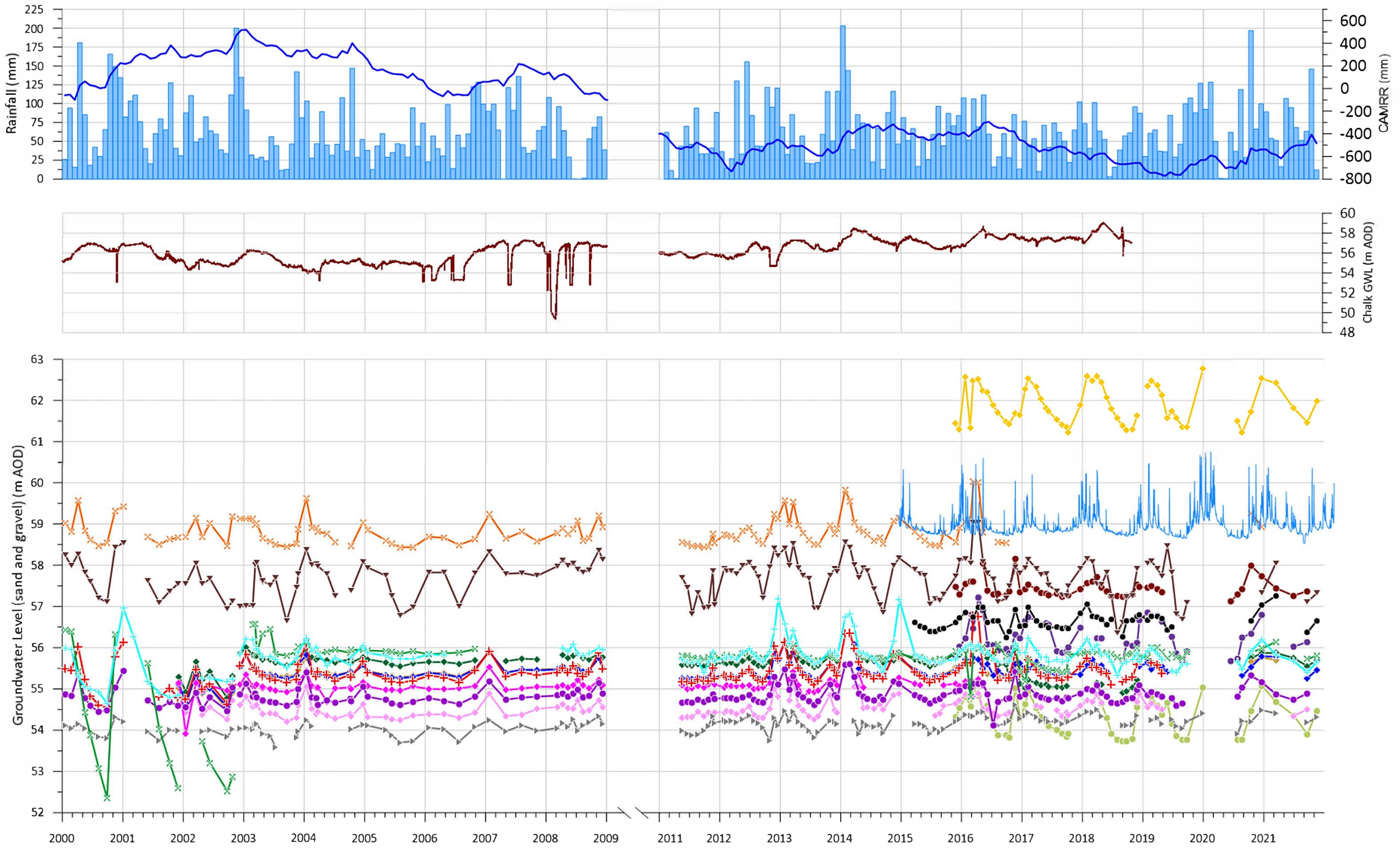


Figure 8: Groundwater Elevation Hydrographs and Rainfall (2000 - present)

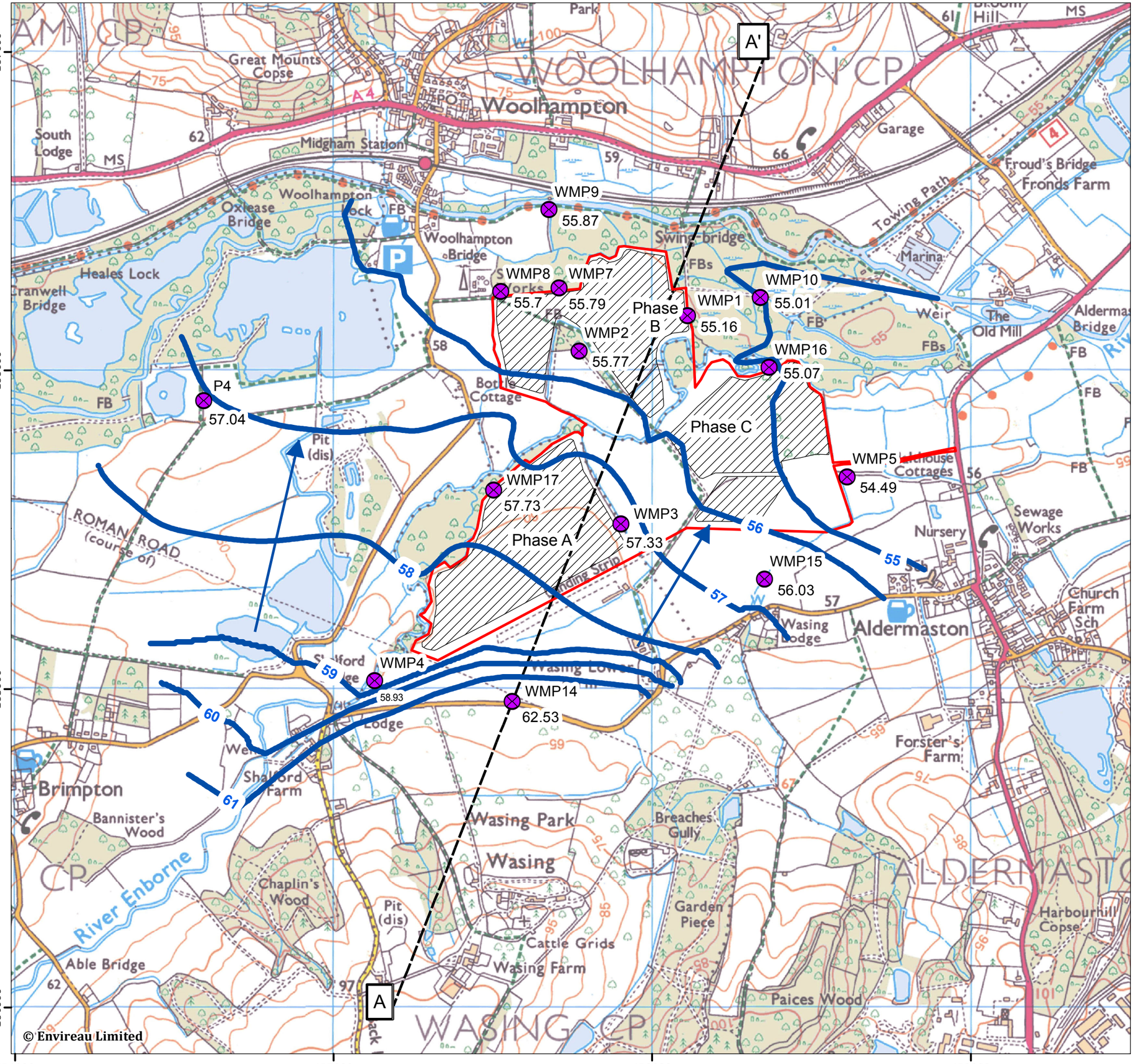
Rainfall at Kingsclere
CAMRR Curve
WMP1
WMP2
WMP3
WMP4
WMP5
WMP6
WMP7
WMP8
WMP9
WMP10
WMP14
WMP15
WMP16
WMP17
P4
P5
P7
River Enborne @ Brimpton
Woolhampton STW (Chalk)

Date:	10 February 2022
Project No.	3490176
Client:	Tarmac Trading Ltd.
Ref:	FIG - GW elevation hydrographs and rainfall
Drawn by:	JH

envireau WATER

Figure 9: Groundwater Contours Maximum

Woolhampton, West Berkshire



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Environmental Permit Application Boundary

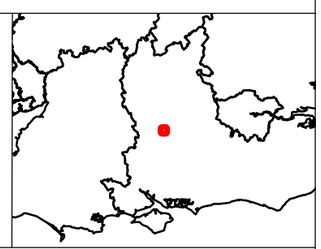
Phase

Monitoring Borehole

Groundwater Contours (Maximum) - 22 Dec 2020

Cross Section Line
Cross section shown on Figure 11

Notes:



0 125 250 375 500 Meters

Scale: 1:12,000 at A3

19 December 2022

NGR: 457,745 E / 165,504 N

Project No.	3490176
Client:	Tarmac Trading Ltd.
Drawn by:	JH
Ref:	FIG - GW Contours Max

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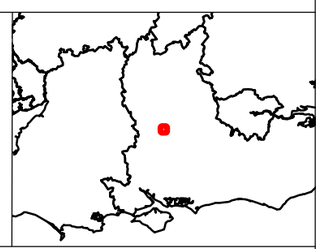
Figure 10: Groundwater Contours Minimum

Woolhampton, West Berkshire

- Environmental Permit Application Boundary
- Phase
- Monitoring Borehole
- Groundwater Contours (Minimum) - 31 Aug 2018
- Cross Section Line
  Cross section shown on Figure 11

Notes:



0 120 240 360 480 Meters

Scale: 1:12,000 at A3

19 December 2022

NGR: 457,750 E / 165,524 N

Project No.	3490176
Client:	Tarmac Trading Ltd.
Drawn by:	JH
Ref:	FIG - GW Contours Min

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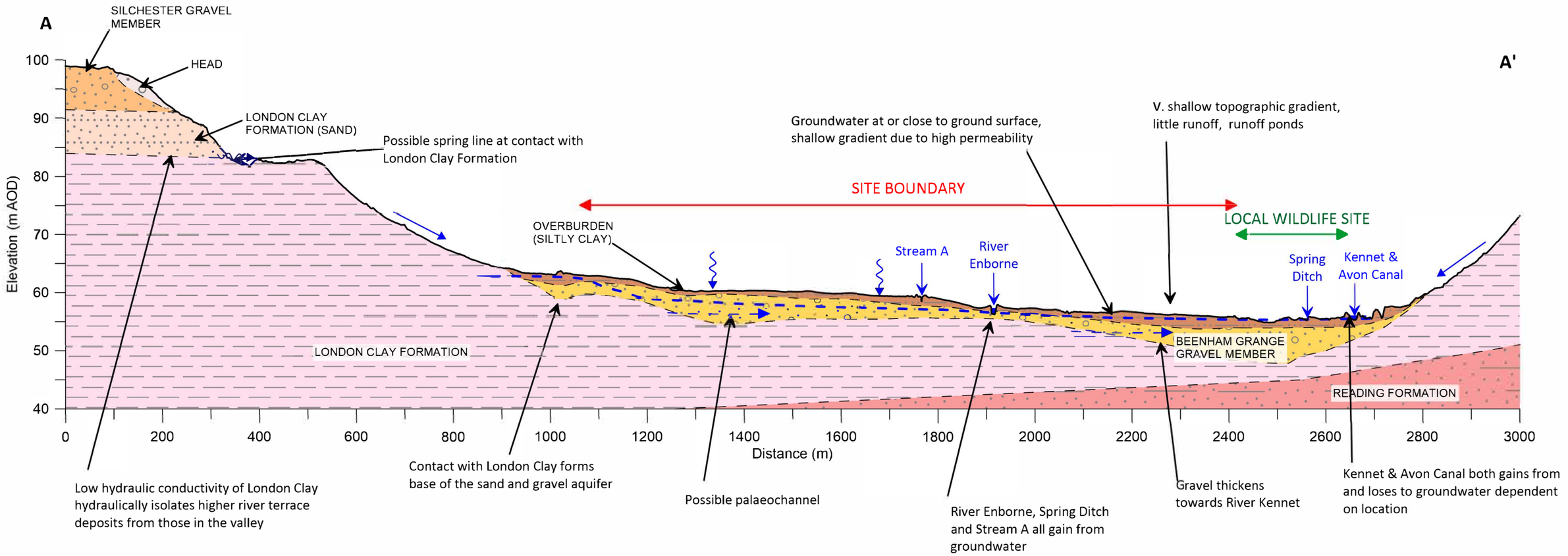


Geology is based on BGS data and site borehole logs.

Vertical exaggeration is 1:12

Refer to Figures 7 and 8 for cross section location

Figure 11: Conceptual Hydrogeological Cross Section

Date:	12 March 2022
Project No.	P21-253
Client:	Tarmac Trading Ltd
Ref:	FIG CSM
Drawn by:	CDW

envireau WATER

4.5.4 Groundwater quality

Groundwater quality has been monitored by Tarmac in 13 boreholes on a monthly basis from May 2016 to April 2024, with a hiatus from May 2019 to July 2020. These boreholes are screened across the sand and gravels. A summary of the groundwater quality is presented in Table 15, and time series charts of selected parameters is presented in Appendix B. Groundwater has been monitored for major ions, metals and hydrocarbons. The data have been compared to DWS and EQS to give an indication of groundwater quality.

Water quality in the sand and gravel aquifer is, for the most part (other than sulphate at two locations), good with respect to the major ions. However, there are exceedances of some metals and hydrocarbons in some of the monitoring locations. These exceedances are discussed in detail below.

The groundwater quality north and south of the River Enborne has been analysed and is shown in Table 15. For most parameters with exceedances, the concentrations are comparable in monitoring boreholes north and south of the River Enborne. Sulphate is the only parameter that shows the most significant difference between quality. This is due to an isolated cause of the high sulphate concentrations, as discussed below.

Metals

The times series graph (see Appendix B) for lead shows isolated exceedances of the EQS. Lead concentrations in boreholes WMP2 and WMP3 exceed the EQS between October 2016 and July 2017, with isolated exceedances between 2017 and 2024. From October 2016 to July 2017, lead concentrations appear to decrease in these boreholes. In September 2016, there are isolated exceedances of lead in WMP1, WMP3, and WMP10. In August 2023 there are isolated exceedances of lead in boreholes WMP2, WMP3, WMP10 and WMP16. There are other isolated exceedances in May 2018 and January 2019. There are several exceedances of lead in WMP2 between April 2023 and February 2024. A graph showing the lead exceedances is presented in Appendix B.

The time series graphs (see Appendix B) for nickel shows that in P5 and WMP3, concentrations are above the EQS from August 2016 to May 2019. Throughout this time period the plot shows a series of peaks and troughs, with no consistent trend. In the same time period WMP1 has several isolated exceedances. In September 2016, there are isolated exceedances of nickel in WMP2, WMP3, WMP5, WMP10, WMP16 and WMP17. WMP2 and WMP17 have no other exceedances throughout the monitoring period. In May 2023 there are isolated exceedances of nickel in WMP5 and WMP10, and in August 2023 there are isolated exceedances of nickel in WMP5 and WMP3. There is a single isolated exceedance of nickel in WMP10 in September 2023. WMP8, has no historical data for nickel and only an isolated exceedance of both total and dissolved nickel in May 2022. The samples from May to September 2022 show that where dissolved nickel is detected there is also total nickel present in the same concentrations or higher. A time-series chart showing the boreholes which have nickel exceedances is included in Appendix B.

The time series graph (see Appendix B) for zinc shows isolated samples above the EQS. These exceedances occur in P5, WMP1, WMP2, WMP3, WMP4, WMP6, WMP14 and WMP16. The exceedance in WMP6 shows a single zinc concentration of 1.43 mg/L in May 2016. This could be a sampling or laboratory error. WMP1, WMP2, WMP3, WMP4, WMP5, WMP10, WMP14 and WMP16 all show exceedances in the samples taken since May 2022. These exceedances occur in the total zinc concentration only, not the dissolved zinc concentration. There is no trend shown in the other zinc data.

Iron and manganese were measured in the May to September 2022 sampling rounds. There are exceedances of manganese above the EQS in WMP1, WMP8, WMP10, and WMP15 in May 2022 and WMP4, WMP5, WMP16 and WMP17 in September 2022. These exceedances are in both total and dissolved manganese. There are also exceedances for iron above the EQS in WMP8, WMP10, WMP15 and WMP17 in May 2022. These exceedances are in both the total and dissolved iron. High concentrations of iron and manganese are not unexpected in sand and gravel aquifers of this type.

The isolated exceedances that occur in lead and nickel in September 2016 also coincides with exceedances of nickel observed at all surface water monitoring locations in September 2016. It is likely that this is due to a sampling or a laboratory error.

Monitoring borehole P5 is located 230 m west of the Site alongside Station Road, and up hydraulic gradient from the Site. The exceedance of nickel in P5 could therefore be related to road runoff. During a sampling round undertaken by Envireau Water in May 2022, P5 (and WMP3) was noted to have a strong hydrogen sulphide odour, indicating reducing conditions (Envireau Water, 2022c).

Sulphate

Concentrations of sulphate above the DWS are present in WMP14 and WMP16. There is an isolated exceedance of sulphate above the DWS standard in WMP14 of 280 mg/l in May 2019. WMP16 has 16 exceedances (30% of samples). Sulphate is sourced from rocks that contain sulphides, such as pyrite, or from sulphate minerals. There is no link between sulphate concentrations and pH in either borehole.

The London Clay Formation is known to contain disseminated pyrite. The sand and gravel is alluvial, and as such will be derived of weathered and eroded bedrock from within the catchment. This could be the source of the elevated sulphate concentrations although it is not clear why such high concentrations are isolated to this location.

The exceedances in WMP16 coincide the low groundwater levels, as shown in the graph in Appendix B. The single exceedance in WMP14 also coincides with low groundwater levels, however the concentration of sulphate in WMP14 is only 280 mg/l, compared to highs of 1,400 mg/l in WMP16. WMP16 is located adjacent to the River Enborne, which is in hydraulic continuity with groundwater in the superficial deposits. In WMP16 groundwater levels fluctuate between highs of ~55 m AOD and lows of ~53 m AOD (see Figure 9 and Figure 10) . When groundwater levels are high, due to rainfall river levels are higher, meaning the River Enborne is losing to the aquifer, this additional water source dilutes sulphate concentrations. However, when groundwater and river levels are low, the opposite occurs, and sulphate concentrations increase. The isolated occurrence of this phenomenon could be due to geological heterogeneity. The presence of sulphide/sulphate minerals in the London Clay Formation is variable, and it is plausible that these minerals are present at this location only.

Hydrocarbons

There are detections of TPHs in all monitored boreholes (see Appendix B). The detections are for TPH, with the largest contribution from hydrocarbons in the range C10 – C40. At all monitoring boreholes, over 70% of the samples have TPH detects, however, in boreholes WMP15 and WMP4 there were only 1 and 3 samples taken, respectively. There is no EQS or DWS for TPHs therefore the presence of TPH above the LOD is considered an exceedance. In most of the samples the detections are over an order of magnitude greater than the LOD. The

detections occur in isolated spikes, with detections followed by non-detections, and no obvious trend present. P5 has concentrations of TPHs up to 2 orders of magnitude greater than the LOD. P5 is located 235 m west of the Site and up hydraulic gradient adjacent to Station Road. Road runoff is a possible source for the TPH at P5.

In addition, there are also detections of PAHs in monitoring boreholes P5 (45% of samples), WMP1 (40%), WMP2 (25%), WMP4 (33%), WMP5 (8%), WMP10 (11%), WMP14 (23%), WMP16 (12%) and WMP17 (21%). Any samples where PAHs are detected (i.e. are above the LOD) is an exceedance of the EQS as the LOD is above the EQS. As with TPH, many of the detections are several orders of magnitude greater than the LOD with the detects being irregular, and often followed by non-detects. There are no obvious trends evident, and the source of the PAHs are unclear.

The detections of TPH and PAHs are, prior to 2020 at least, are inconsistent and do not suggest a consistent source. The detected organics are, for the most part, not in the most mobile and soluble range (i.e., are longer rather than shorter chain hydrocarbons) meaning, if the data are true, any source is likely proximal to the sampled borehole.

Table 15 Summary of Groundwater Chemistry

Parameter	Unit	DWS	EQS	Statistic	North of River Enborne (to 3.s.f)	South of River Enborne (to 3.s.f)
Chloride	mg/l	250	250	95th Percentile	33.0	53.8
				Mean	24.2	30.7
Sulphate (a)	mg/l	250	400	95th Percentile	62.0	6.88
				Mean	40.1	90.9
Arsenic	mg/l	0.01	0.05	95th Percentile	0.002	0.00148
				Mean	7.84E-04	6.30E-04
Antimony	mg/l	0.005		95th Percentile	0.001	5.00E-04
				Mean	5.17-04	4.94 E-04
Barium	mg/l	1.00		95th Percentile	0.046	0.05
				Mean	0.0347	0.0264
Cadmium	mg/l	0.005	0.0025	95th Percentile	2.60E-04	2.08E-04
				Mean	6.39E-05	4.47E-05
Total Chromium	mg/l	0.05	0.0047	95th Percentile	5.00E-04	5.00E-04
				Mean	5.96E-04	7.68E-04
Copper	mg/l	2.00	0.028	95th Percentile	0.0045	0.00534
				Mean	0.00194	0.00178
Fluoride	mg/l	1.50	5.00	95th Percentile	0.210	0.200
				Mean	0.086	0.073
Lead	mg/l	0.01	0.0012	95th Percentile	0.003	0.00257
				Mean	7.49E-04	6.41E-04
Mercury	mg/l	0.001	5.00E-04	95th Percentile	7.90E-05	5.00E-05

Parameter	Unit	DWS	EQS	Statistic	North of River Enborne (to 3.s.f)	South of River Enborne (to 3.s.f)
				Mean	5.77E-05	3.21E-05
Molybdenum	mg/l			95th Percentile	0.001	0.002
				Mean	6.92E-04	8.91E-04
Nickel	mg/l	0.02	0.004	95th Percentile	0.00895	0.006
				Mean	0.00342	0.00239
Selenium	mg/l	0.01		95th Percentile	0.005	0.0019
				Mean	0.00147	7.27E-04
Zinc	mg/l			95th Percentile	0.0686	0.0513
				Mean	0.0168	0.00179
pH				95th Percentile	8.18	8.10
				Mean	7.54	7.45
Anthracene	µg/l		0.100	95th Percentile	0.005	0.005
				Mean	0.00622	0.00614
Benzo(a)pyrene	µg/l		1.70E-04	95th Percentile	0.022	0.00625
				Mean	0.00836	0.00623
Naphthalene	µg/l		2.00	95th Percentile	0.02	0.02
				Mean	0.00837	0.00735
Fluoranthene	µg/l		0.0063	95th Percentile	0.0605	0.02
				Mean	0.0189	0.0102
PAHs	µg/l		1.70E-04	95th Percentile	0.180	0.080
				Mean	0.0525	0.0224
Benzene	µg/l		10.0	95th Percentile	2.50	2.50
				Mean	0.904	0.906
Toluene	µg/l		50.0	95th Percentile	2.50	2.50
				Mean	0.907	0.906
Ethylbenzene	µg/l		20.0	95th Percentile	2.50	2.50
				Mean	0.536	0.576
Xylenes	µg/l		30.0	95th Percentile	5.00	5.00
				Mean	1.42	1.42
TPH	µg/l		10.0	95th Percentile	130	140
				Mean	47.6	40.5

4.6 Receptors

4.6.1 Amenities

Amenity receptors that could be affected by dust and noise from Site activities have been identified in noise and air quality assessments undertaken in support of the planning application (ANV (2011) and Smith Grant Environmental Consultancy (2012), respectively).

4.6.2 Groundwater

The restoration material proposed to be accepted at the Site will ensure that no discernible concentrations of hazardous substances will enter groundwater.

Once groundwater levels have recovered after dewatering ceases, it is expected that groundwater flow within the sand and gravel aquifer will be broadly north-eastwards with local discharge to the various surrounding surface water features. Therefore, the groundwater receptor is taken to be groundwater at the eastern Site boundary.

4.6.3 Surface water

The nearest surface water feature outside of the Site boundary is the River Enborne, which flows north-eastwards. Within the Site, there are several minor tributaries of the River Enborne and waterbodies. These are:

- Stream A, flowing north of Phase A
- Stream B, flowing along the southeastern Site boundary.

4.6.4 Licensed abstractions and SPZs

There are six licenced abstractions within 2 km of the excavation area based on Environment Agency data received in January 2022. Table 16 details the abstractions, distance from the excavation and their purpose. The locations of the licenced abstractions are shown on Figure 12. The closest abstraction is operated by the Environment Agency, this abstraction, together with others operated by the Environment Agency in the region, is used to augment river flows with abstracted groundwater from the chalk aquifer during times of drought.

The entirety of the excavation area lies within Source Protection Zone (SPZ) Zone 3 (i.e., total catchment) of a number of abstractions located to the north, east and west of the Site. The closest SPZ Zone 1 is located 1.8 km northeast of the excavation area associated with licenced abstractions from the Padworth Fish Farm.

Table 16 Licenced Abstractions in 2 km of the excavation area

Map Ref	Name	Source	Operator	Licence ID	Licensed Daily Volume (m^3/day)	Use	Distance from excavation area
A	Woolhampton Groundwater Scheme Borehole	Groundwater (Chalk)	Environment Agency	28/39/22/ 0394	10,000	Transfer between sources	485 m north-west
C	Shalford Farm Groundwater Scheme Borehole	Groundwater (Chalk)	Environment Agency	28/39/22/ 0394	10,000	Transfer between sources	525 m south-west
B	Woolhampton Quarry	Groundwater (Sand and gravel)	Tarmac Aggregates Ltd	28/39/22/ 0039	2,319	Mineral washing	550 m west
D	Lake at Wasing Point A	Surface Water	Wasing Farm Partnership	28/39/22/ 0057	364	Spray irrigation	1.2 km south
E	Aldermaston Court	Groundwater (Chalk)	Dove Crag ltd	28/39/22/ 0434	114	Various domestic purposes	1.4 km south-east
F	Beenham Grange	Groundwater (Chalk)	Copas Brothers (Farms) ltd	28/39/22/ 0494	31.8	Various domestic purposes	1.9 km north-east

4.6.5 Private Water Supplies

A response to a Freedom of Information (FOI) request to West Berkshire Council identified 29 Private Water Supplies (PWS) within 4 km of the excavation area. The locations of the PWS are shown on Figure 12. Details of supplies within 2 km are shown in Table 17.

A water well is marked on OS maps at Wasing Lodge. This was not identified by West Berkshire Council or through a search of BGS water well records and therefore is an unverified PWS. For the purposes of this report, to be conservative, this well is considered to be a PWS.

An FOI request to Basingstoke and Deane Borough Council confirmed that there are no PWSs within this local authority within 6 km of the Site.

Table 17 Private Water Supplies

Name	Distance from excavation area	Type*	BGS Borehole Reference	Use	Depth (m)	Likely Source	Map reference number
Wasing Lodge Water Well	280 m south	Unknown	-	Unknown	-	-	OS Well
Pyford Marina Aldermaston	500 m northeast	Large	SU56NE83		3.2	Sand and gravel	1
Meadow Brook Frouds Lane	800 m northeast	Single	SU56NE37	Domestic	4.6	Sand and gravel	2
Old Mill Hotel, Aldermaston	800 m northeast	Large	SU56NE99	Supplies Hotel	36	Chalk	3
Froud Farm Aldermaston	800 m northeast	Small	SU56NE98	Agriculture	4.3	Sand and gravel	4
Frouds House	800 m northeast	Small	SU56NE126	Domestic	-	-	5
Mill Cottages Frouds Lane	850 m north east	Small	SU56NE127	Domestic			6
Aldermaston 32	1.2 km east	Agriculture		Agriculture		Gravels	7
-	1.4 km north-west		-	-	-	-	8
Mill Bungalow Brimpton Mill	1.9 km west	Single	SU56NE119		1.8	Sand and gravel	9
Brimpton Mill	2 km west	Small	SU56NE27		41.2	Chalk/Reading Bed	10

**Large = average daily volume of 10 – 20 m^3 for domestic properties or water as part of public or commercial supple. Small or Single = average daily volume is less than 10m^3, or where the supply serves a single dwelling*

4.6.6 Designated Sites (habitats)

Nationally/Internationally designated sites

There are six nationally designated sites within 2 km of the excavation area. Woolhampton Reedbed Site of Special Scientific Interest (SSSI) is the closest SSSI, located 170 m north of Phase B. It is designated for its reedbed and fen habitat supporting various bird and insect species. The details of the designated sites are given in Table 18, and the locations are shown on Figure 13.

Table 18 Designated Sites

Name	Designation Type	Distance from excavation area	Reason for Designation	Water Dependent?
Woolhampton Reed Bed SSSI	SSSI	170 m north	Dense reedbeds with fen vegetation and carr woodland. Supporting various passerine and insect species.	Yes
River Kennet SSSI	SSSI	430 m northwest	Species rich river habitat with diverse flora.	Yes
Brimpton Pit	SSSI	560 m west	Geological evidence of environmental changes during Ice Age	No
Wasing Wood Ponds	SSSI	1.2 km south	Ponds, wet ditches and marsh habitats supporting various insect species	Yes
Aldermaston Gravel Pits	SSSI	1.2 km northeast	Mature flooded gravel workings surrounded by dense fringing vegetation. Habitats for breeding birds and wildfowl.	Yes
Old Copse, Beenham	SSSI	2 km north	Species-rich coppice woodland.	Yes

Local Wildlife Sites / BBWOTs

A data request to the Thames Valley Environmental Records Centre (TVERC) in February 2022 showed 18 designated sites within 2 km of the excavation area. These are shown in Table 19 and on Figure 13. The designations given are:

- Local Wildlife Site (LWS), an area of land providing locally important wildlife habitats; and
- Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust (BBOWT) Reserve, nature reserves within Berkshire, Buckinghamshire and Oxfordshire.

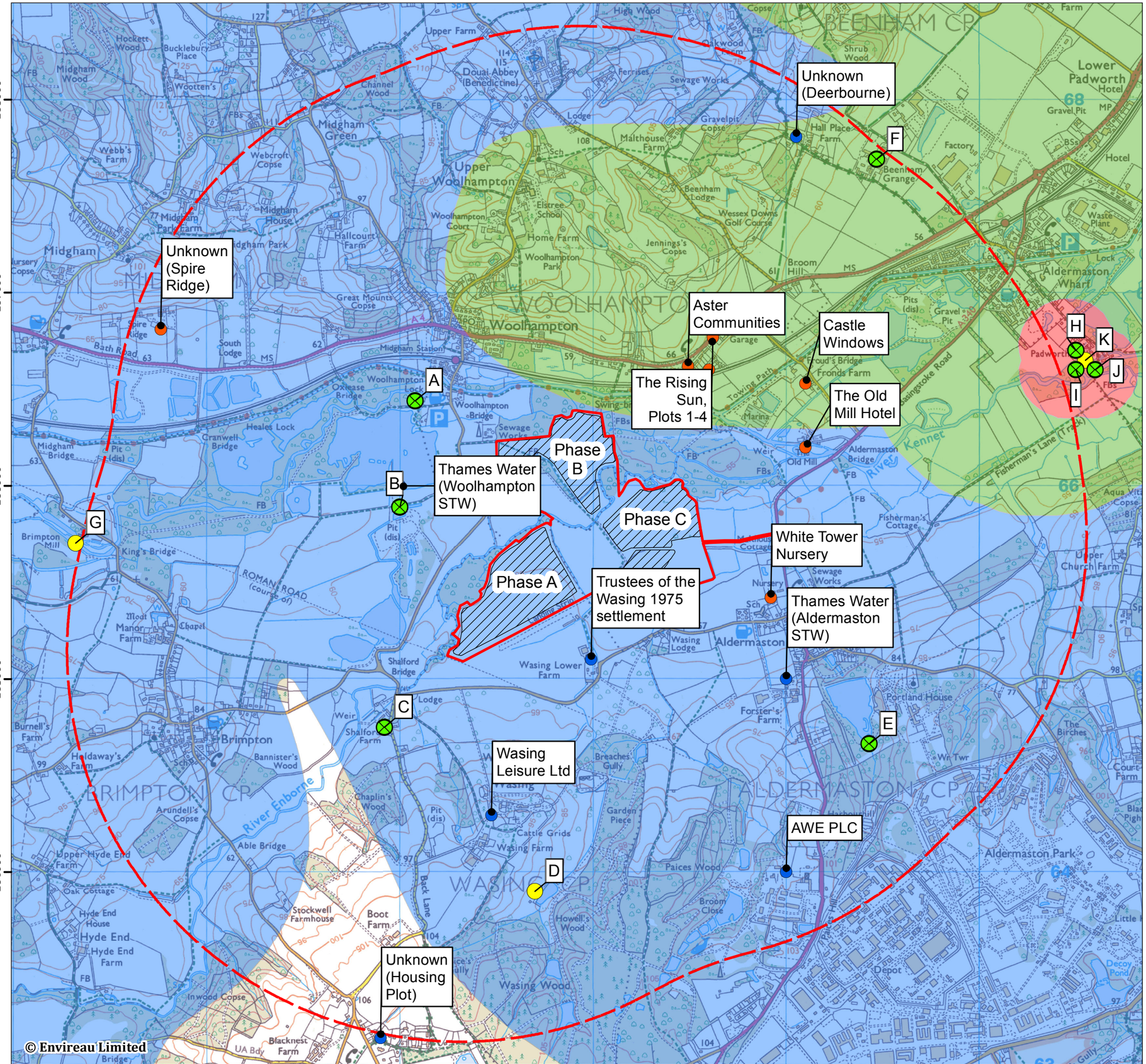
The closest LWS to the excavation area is the Woodland Near Woolhampton, located between the northern boundary of the Site and the River Kennet, and extending just north of the River Kennet. This Site includes Spring Ditch and parts of the River Enborne, deciduous woodland, wet woodland and reedbeds. Based on exploration borehole logs and OS mapping, this LWS is at least partly underlain by peat (see Figure 13). These habitats support common frog (a protected species). This area was marshy at the time of the march site visit.

Table 19 LWS and BBOWT Designated Sites

Name of Site	Designation	Distance from excavation area	Reason for designation	Water dependant?
Woodland Near Woolhampton	LWS	5 m north	Wet woodland and reedbed habitats	Yes
Breaches Gully	LWS	750 m south	Lowland mixed deciduous woodland, wet woodland	Yes
Great Mounts Copse	LWS	770 m northwest	Area of unmanaged damp deciduous woodland.	Yes
Woolhampton Cottage Woods	LWS	880 m north	Deciduous woodland	Yes
Jennings Copse	LWS	1 km north	Ancient woodland that supports wet alder woodland.	Yes
Paices Wood	BBOWT	1.1 km south	Woodland, ponds and open habitats.	Yes
Paices Wood Country Park	Proposed LWS	1.1 km south		Yes
Halton's Corner Copse, Radman's Gully	LWS	1.3 km north-west	Ancient woodland	Yes
Gravelpit Copse	LWS	1.35 km northeast	Semi-natural and wet woodland	Yes
Harbourhill Copse	LWS	1.35 km south-east	Acidic ancient woodland	Yes
Paice's Gully	LWS	1.4 km south	Ancient woodland	Yes
High Wood/Kitchen Copse	LWS	1.6 km north	Ancient woodland	Yes
Channel Wood	LWS	1.7 km north-west	Ancient woodland	Yes
Padworth Mill	LWS	1.7 km east	Wetland habitat	Yes
Arundell's Copse	LWS	1.7 km south-west	Ancient woodland	Yes
Jacob's Gully	LWS	1.7 km east	Ancient gully woodland	Yes
Inwood Copse	LWS	1.8 km south-west	Broadleaves woodland	Yes
Black Pightle	LWS	1.9 km south-east	Woodland supporting insect species	Yes

Figure 12: Receptor Environmental Setting (Existing Abstractions and Permitted Discharges)

Woolhampton, West Berkshire



Environmental Permit Application Boundary

Phase

2 km from Excavation Areas

Licenced Abstractions

- Groundwater
- Surface Water

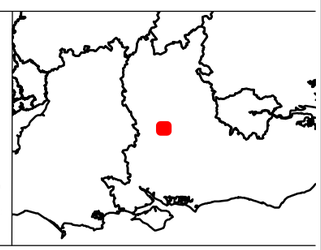
Permitted Discharges

- Groundwater
- Surface water

Source Protection Zone

- Zone 1
- Zone 2
- Zone 3

Notes:



0 250 500 750 1,000 Meters

Scale: 1:20,000 at A3

21 December 2022

NGR: 457,916 E / 165,750 N

Project No. 3490176

Client: Tarmac Trading Ltd.

Drawn by: JH

Ref: FIG - Receptor Environmental Setting

Figure 13: Receptor Environmental Setting Designated Sites

Woolhampton, West Berkshire

- Environmental Permit Application Boundary
- Phase
- 2 km from Excavation Areas

TVERC Designation

- Biodiversity Opportunity
- BBOWT Reserve
- Berkshire Local Wildlife Site
- Berkshire Proposed Local Wildlife Site
- Berkshire Proposed Local Wildlife Site Extension

Designated Sites

- Sites of Special Scientific Interest (SSSI)

Notes:

0 250 500 750 1,000 Meters

Scale: 1:20,000 at A3

19 December 2022

NGR: 457,916 E / 165,750 N

Project No.	3490176
Client:	Tarmac Trading Ltd.
Drawn by:	JH
Ref:	FIG - Receptor Environmental Setting

envireau WATER

5 POLLUTION CONTROL MEASURES

5.1 Site Engineering

5.1.1 Natural basal barrier

The base of the restoration material will be the London Clay Formation. The London Clay Formation forms the base of the sand and gravel aquifer and is around 10 m thick beneath the Site. This very low permeability unit will prevent any downward contaminant migration to the underlying Chalk. Indeed, there is a vertically upwards gradient between the Chalk and sand and gravel aquifer at the Site, meaning impacts cannot occur.

5.1.2 Sidewall attenuation layer

The attenuation layer will be constructed from selected imported wastes, which will have sufficient clay content to achieve the required properties for the attenuation layer with a permeability of no more than 1 x 10^{-7} m/s and a thickness of at least 1 m.

The sidewall Attenuation Layer will be placed dry. Dewatering will be maintained until the restoration material has been placed to a level above natural groundwater levels. The rate of pumping required will be gradually reduced as the Site is filled.

Cross sections of the site infrastructure to be installed are shown in the HRA (Envireau Water, 2025a) and SRA (RSK Geosciences, 2025).

5.1.3 Capping

No capping is proposed or required as the operation is a deposit for recovery activity. On completion of filling, the Site will be capped with up to 1 m of restoration soils comprising at least 0.2 m of topsoil (as per planning condition 53).

5.1.4 CQA and material characterisation testing

A CQA plan will be put in place to ensure that the attenuation layers are of the correct thickness and permeability and are constructed using suitable materials. The CQA plan will be prepared in accordance with the prevailing guidance (Environment Agency, 2022c).

Prior to acceptance onto the Site, all selected cohesive inert materials will be subject to testing to demonstrate that the material is suitable both physically and chemically. Only materials from non-contaminated sources capable of achieving a permeability of no more than 1 x 10^{-7} m/s. Detailed Waste Acceptance Procedures are set out in the Waste Acceptance Plan that accompanies this application (RSK Geosciences, 2022c).

5.1.5 Dust and Noise

Air Quality and Noise assessments were undertaken in support of the planning application. A further noise assessment has been undertaken in support of the permit application (Walker Beak Mason, 2025). The latest noise assessment concludes that

Dust control methods will be employed to minimise dust generation during operations as set out by Smith Grant Environmental Consultancy (2012). Further dust control measures were set out in the response to condition 34 of the planning permission.

The Site will be operated in accordance with planning conditions 27 – 30 to minimise noise during operations.

5.2 Restoration

The Site will be restored to no more than original ground levels in accordance with the restoration plans presented in Appendix C. Following restoration, the Site will be used for agricultural purposes (arable).

There will not be a significant amount of settlement following the completion of the scheme because the imported materials will be inert and not biodegradable. To verify this, a topographical survey will be undertaken as specified in Section 8

5.3 Post-Closure Controls (Aftercare)

All of the restored areas of the Site will be subject to a comprehensive five-year aftercare scheme.

The Site will continue to be operated and regulated in accordance the Environmental Permit during the aftercare period. The Environmental Permit will be surrendered when it can be demonstrated that the Site no longer poses a risk to the environment or human health.

6 MANAGEMENT AND MONITORING

6.1 Leachate

Due to the inert nature of the restoration material to be accepted at the Site, no leachate management or monitoring is proposed at the Site (see Section 3.7).

To ensure that only appropriate inert materials are accepted into the Site, strict waste acceptance criteria will be implemented. These criteria are set out in the Waste Acceptance Plan (RSK Geosciences, 2022c).

6.2 Groundwater and Surface Water

Information relating to the monitoring requirements for groundwater and surface water onsite during the operational phase are included in the Site Monitoring Plan (Envireau Water, 2025b).

6.3 Gas

Due to the inert nature of the material that will be accepted at the site, there is low gassing potential. Therefore, no leachate management or monitoring is proposed at the Site during the operational period.

7 SITE CONDITION REPORT

Environment Agency Guidance states that a Site Condition Report is "not applicable to those parts of a permitted landfill that have permanent deposits of waste" (Environment Agency, 2013). Although this Site will not be a landfill, this guidance is relevant because areas within the proposed Permit Boundary will have a permanent deposit of waste for the purpose of recovery, therefore a Site Condition Report is not required.

8 CLOSURE

There will be a five-year aftercare period following completion of the Site restoration of the Site and Site closure, as required by planning condition 54. Maintenance and monitoring work will be carried out during the aftercare period to ensure that the Site does not cause environmental pollution.

A topographical survey will be completed to demonstrate that the restoration has been completed in accordance with the approved restoration plan. The Site will be operated in accordance with the requirements of the Environmental Permit and planning permission.

In accordance with planning condition 55, an annual report will be submitted to West Berkshire Council. This report will include details of operations carried out at the Site and will identify maintenance and management requirements for the forthcoming year.

Monitoring (i.e. surface water, groundwater, gas and topographical survey) will be continued during the aftercare period in accordance with the requirements of the Permit, unless otherwise agreed with the Environment Agency. Environment Agency guidance will be used to define appropriate completion criteria for the Site (Environment Agency, 2022b). These criteria will be used to determine when to apply to surrender the Environmental Permit.

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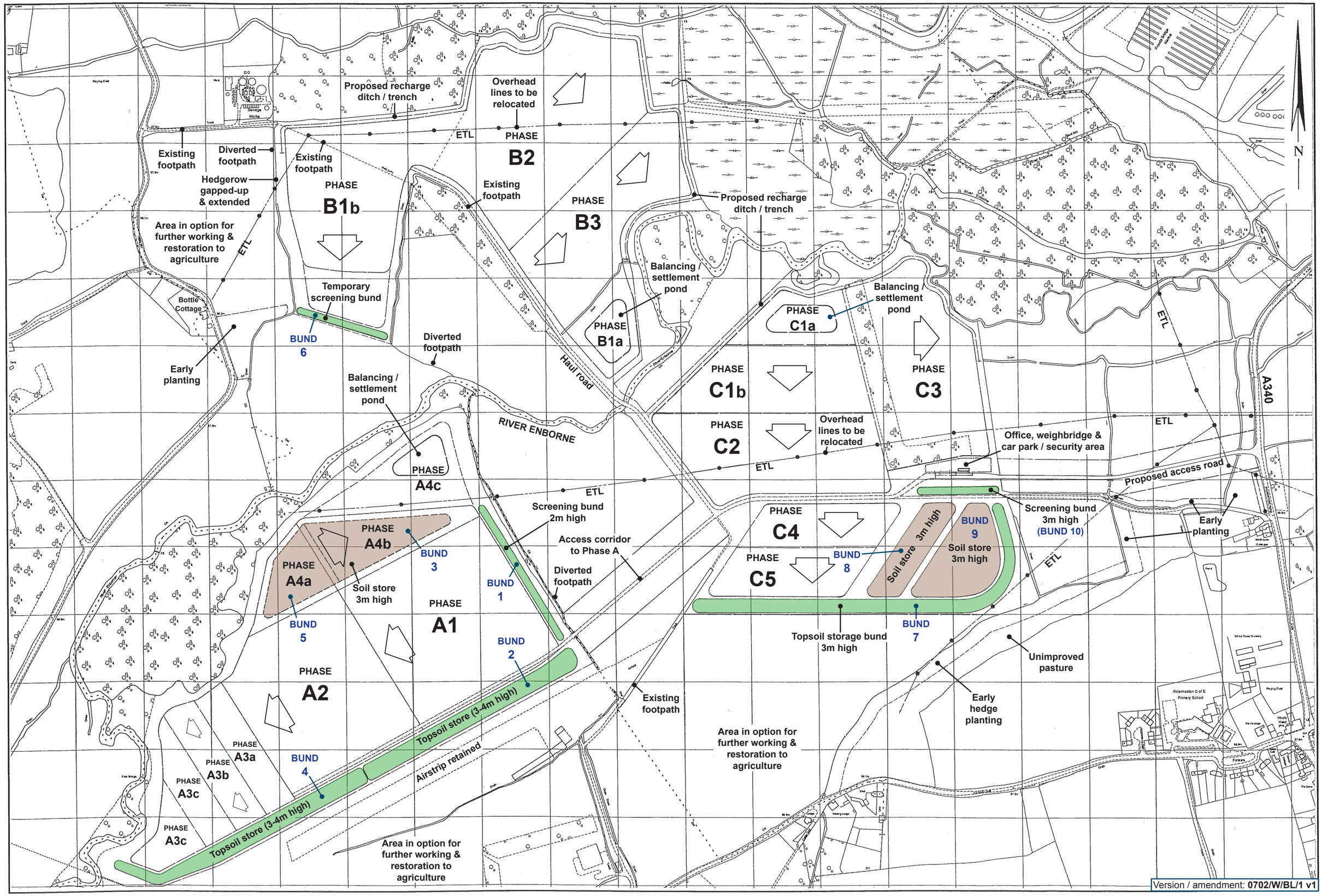
APPENDICES

Appendix A - Approved Development Plans



Version / amendment: **0702/W/BL/1 v1**

D.K. Symes Associates

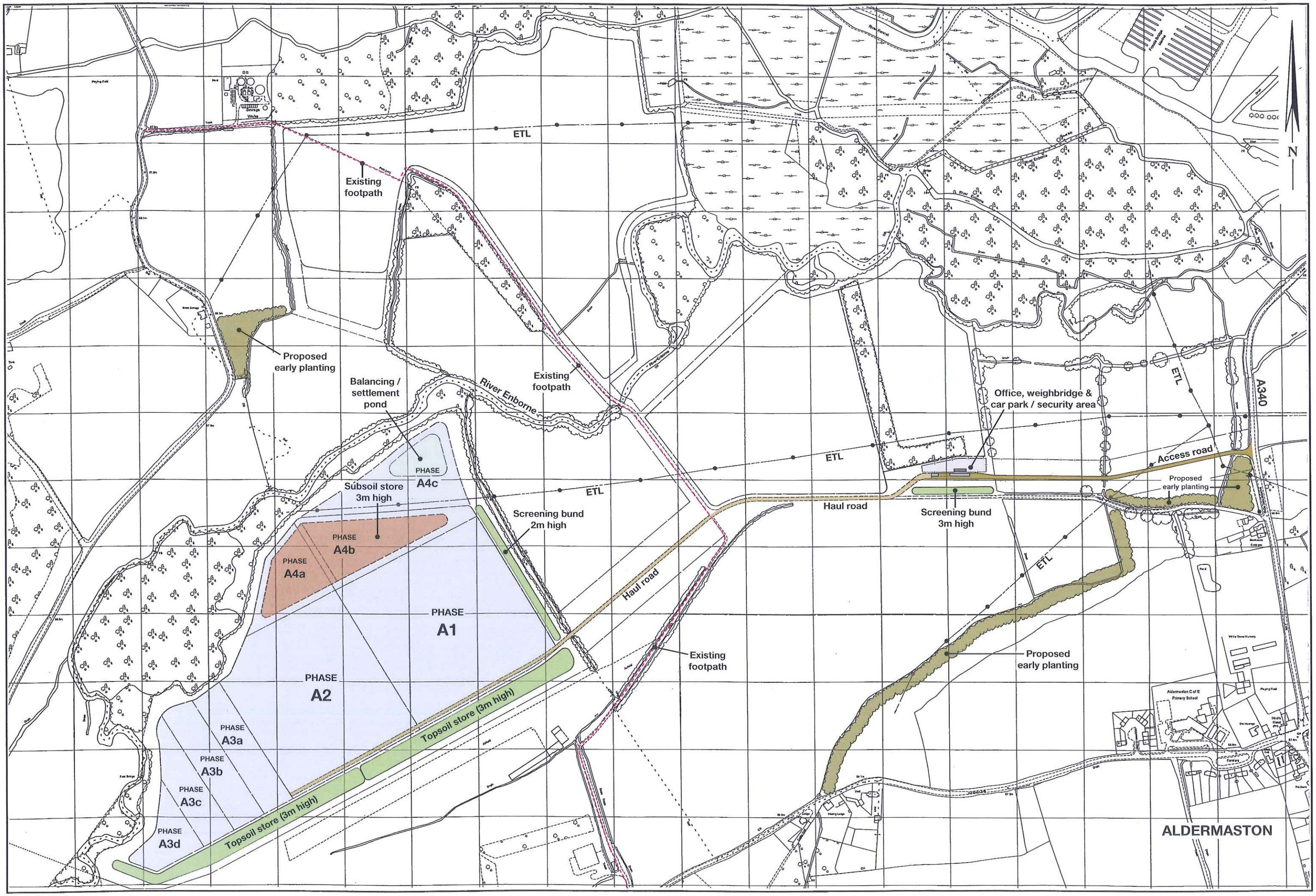
Bund Locations

Scale - **1:5,000** (at A3)

Date - **19-11-2012**

Plan No. **0702/W/BL/1**

Wasing Estate



D.K. Symes Associates

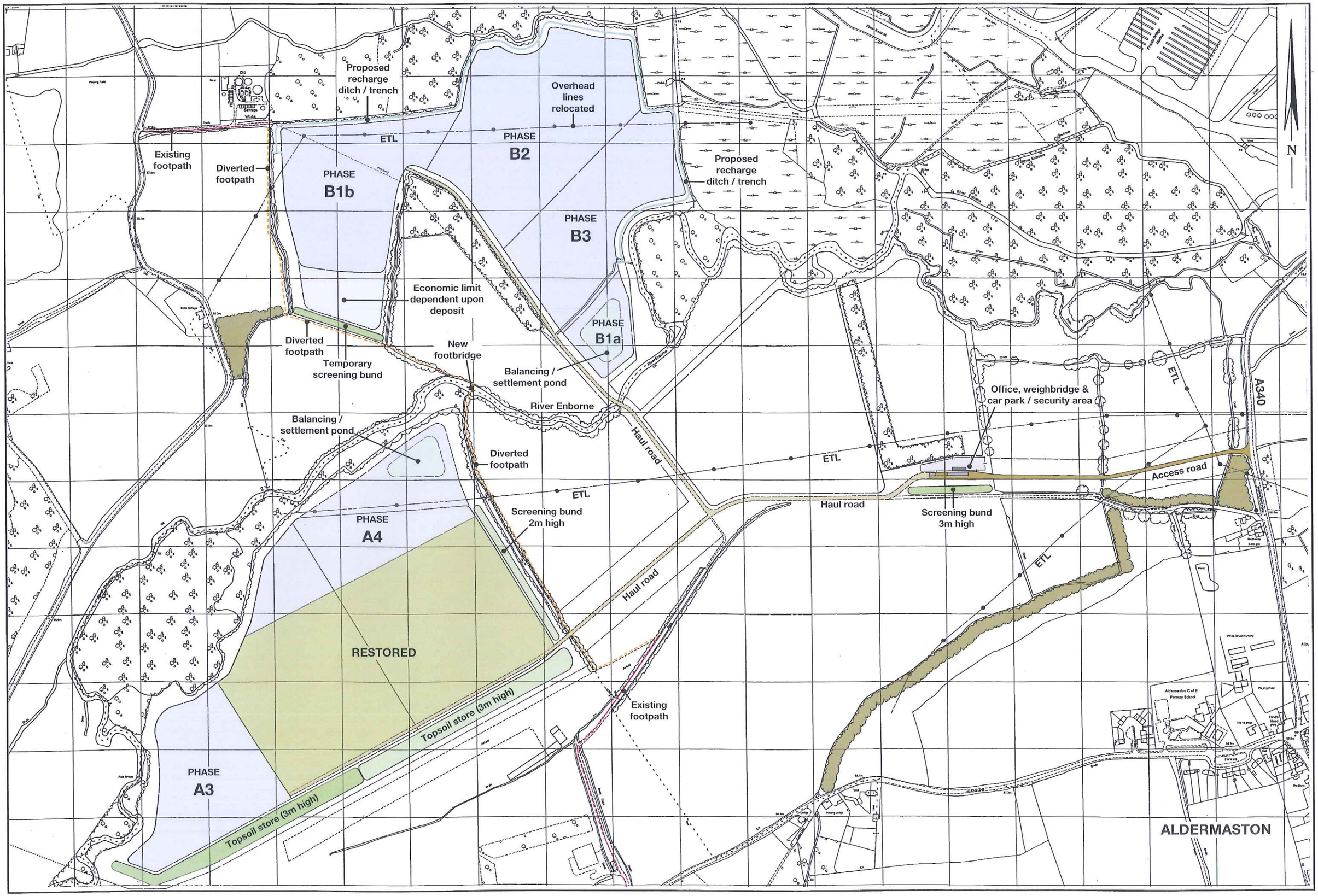
Illustrative Composite Operations - Phase A

Scale - **1:5,000** (at A3)

Date - **25-04-2012**

Plan No. **0702/W/CO/A/1**

Wasing Estate



D.K. Symes Associates

Illustrative Composite Operations - Phase B

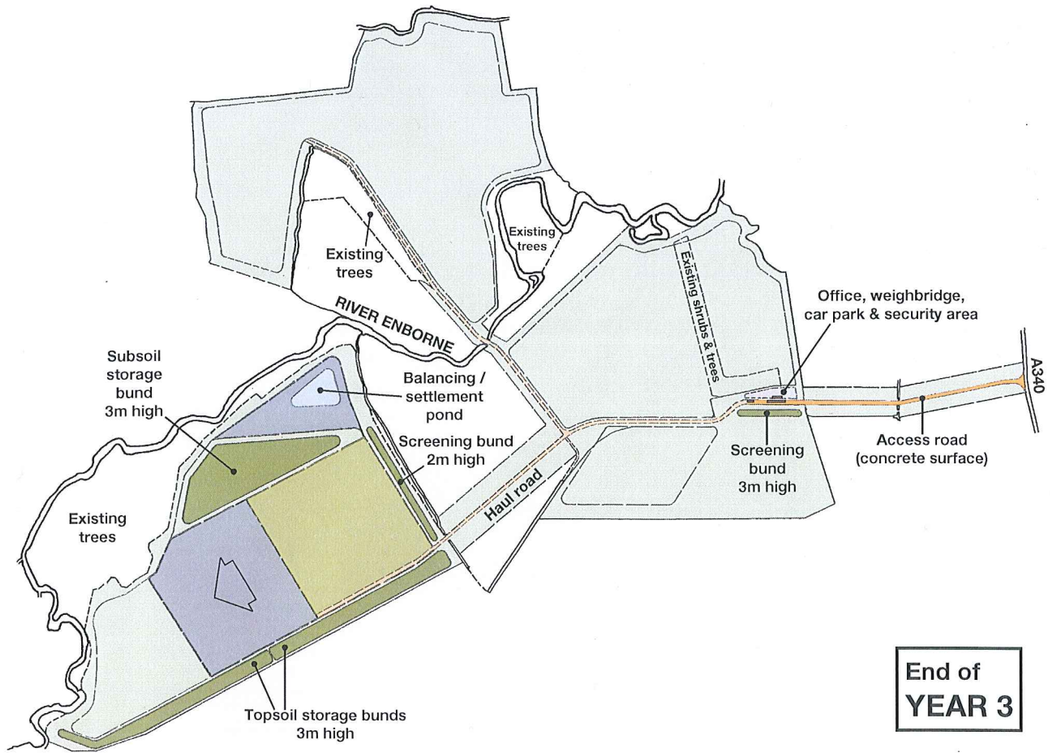
Scale - **1:5,000** (at A3)

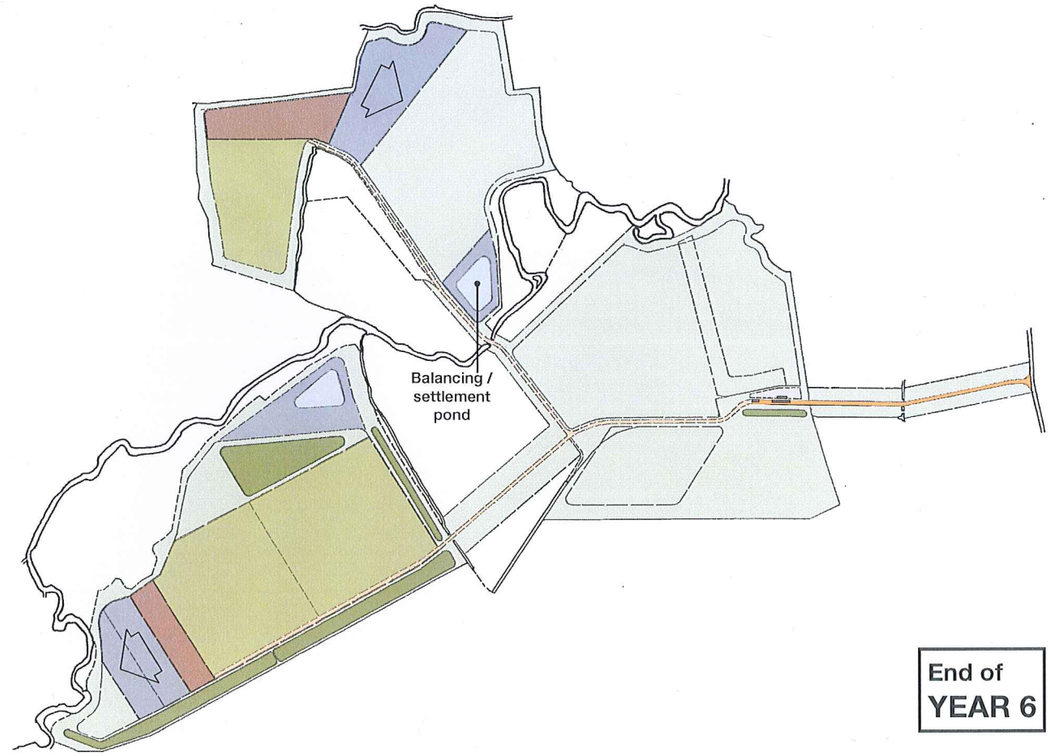
Date - **25-04-2012**

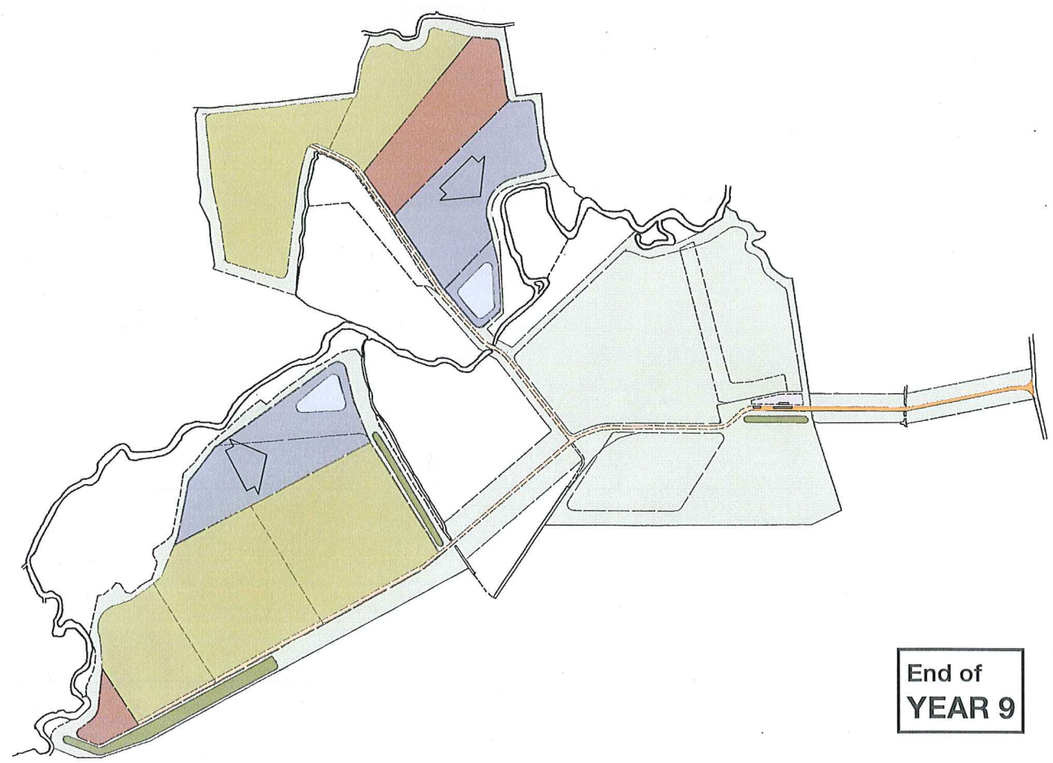
Plan No. **0702/W/CO/B/1**

Overhead lines relocated
RESTORED
Existing footpath
Diverted footpath
PHASE B3
Proposed recharge ditch / trench
Balancing / settlement ponds
PHASE B1a
PHASE C1a
Diverted footpath
New footbridge
River Enborne
Haul road
PHASE C1b
PHASE C3
Office, weighbridge & car park / security area
A340
Overhead lines relocated
PHASE C2
Access road
Pond
ETL
PHASE C4
Screening bund 3m high
Soil store 3m high
Soil store 3m high
PHASE C5
Diverted footpath
RESTORED
Topsoil storage bund 3m high
Existing footpath
ALDERMASTON
N

D.K. Symes Associates | **Illustrative Composite Operations - Phase C** | Scale - **1:5,000** (at A3) | Date - **25-04-2012** | Plan No. **0702/W/CO/C/1**







Existing land

Mineral phase

Reclamation phase

Restored

Soil bunds

Haul road / Access

General direction of operations

N

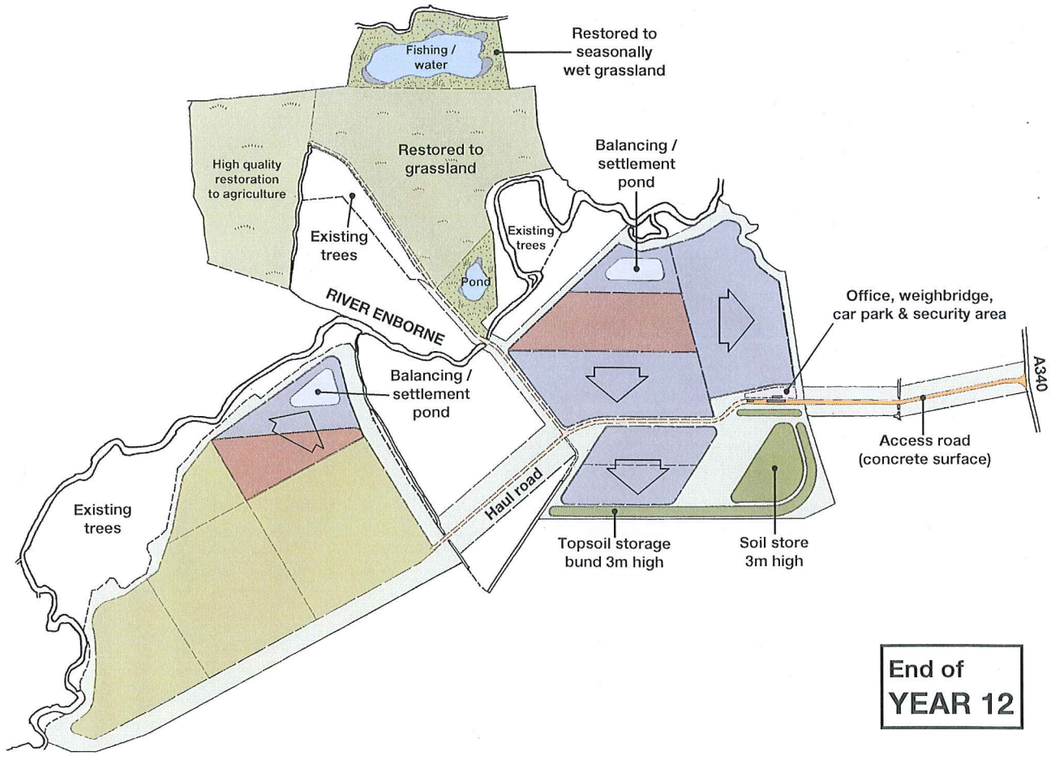
D.K. Symes Associates

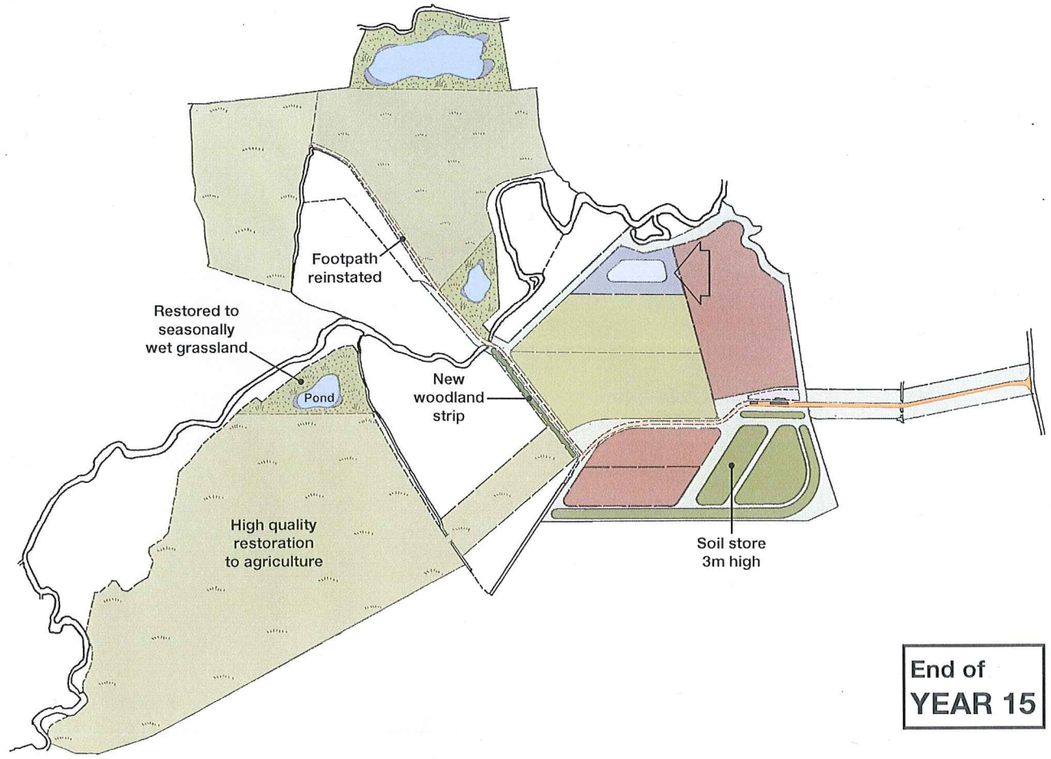
Illustrative Progressive Operations - Years 3-9

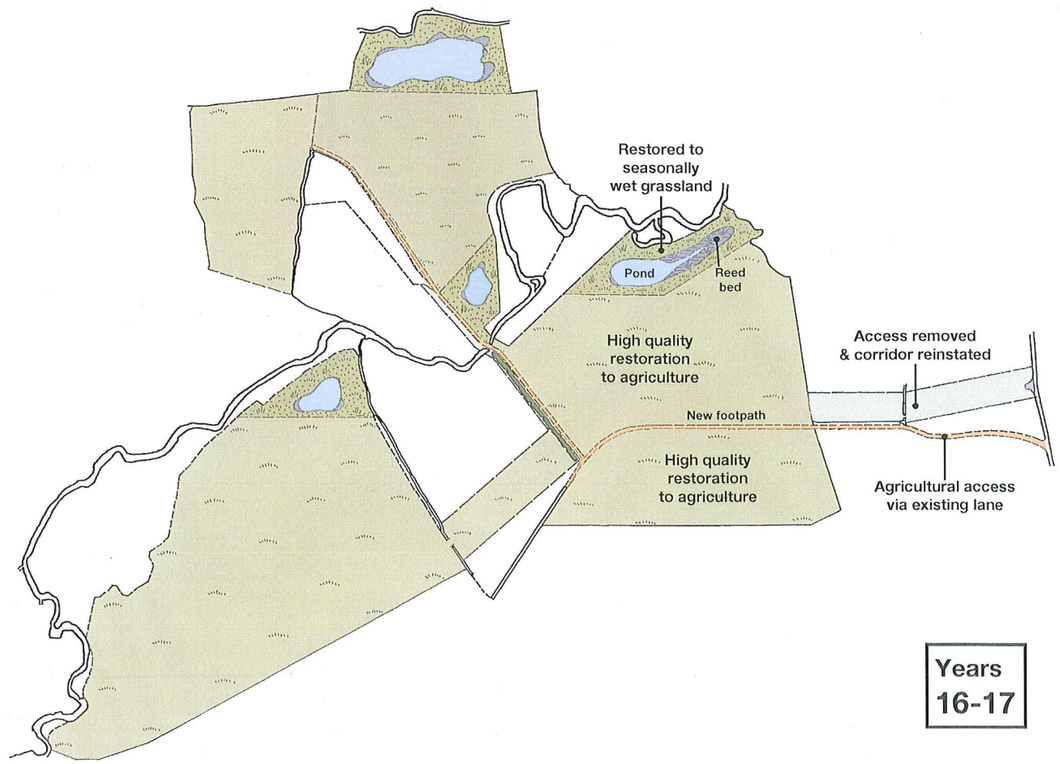
Not to scale

Date - **25-04-2012**

Plan No. **0702/W/PO/1**







Existing land

Mineral phase

Reclamation phase

Restored

Soil bunds

Haul road / Access

General direction of operations

N

D.K. Symes Associates

Illustrative Progressive Operations - Years 12-17

Not to scale

Date - **25-04-2012**

Plan No. **0702/W/PO/2**

Appendix B - Water Quality Graphs

Figure : Water Chemistry Monitoring Locations

Woolhampton, West Berkshire

- Environmental Permit Application Boundary
- Phase
- Groundwater Monitoring Locations
- Surface Water Monitoring Locations

WM12 WM11 WM13 WM9 WM6 WM10 WM1 WM16 WM5 WM15 WM7 WM8 WM2 WM17 WM3 WM14 WM4

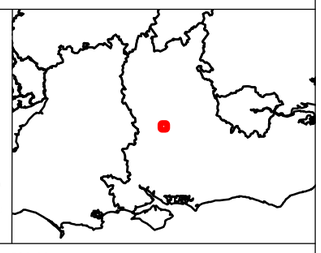
SW1 SW2 SW5 SW6 SW4 SW3

GB3 GB2 GB1

P8 P7 P5 P6 P4

Phase A Phase B Phase C

Notes:



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0 125 250 375 500 Meters

Scale: 1:10,000 at A3

19 December 2022

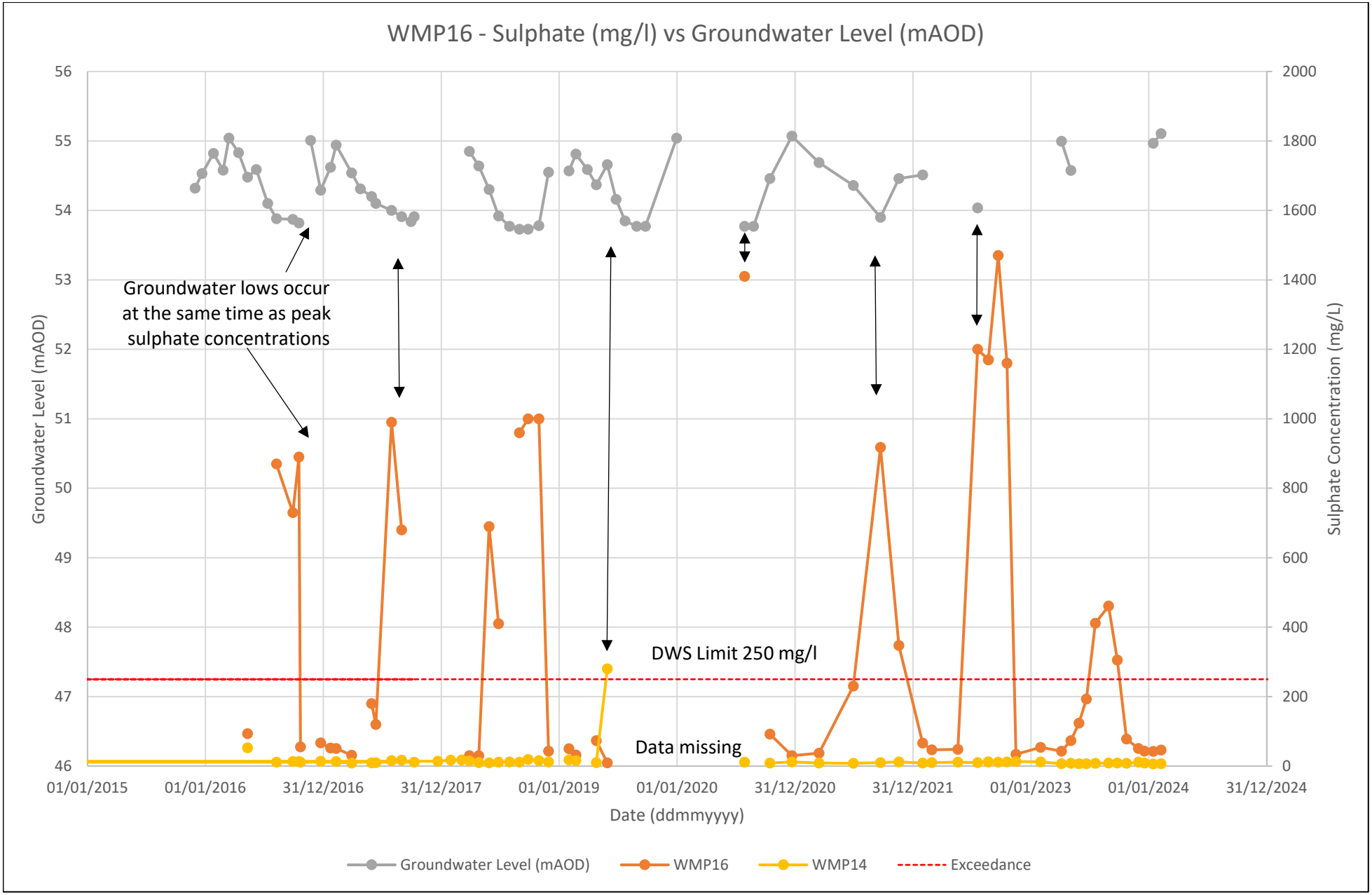
NGR: 457,792 E / 165,790 N

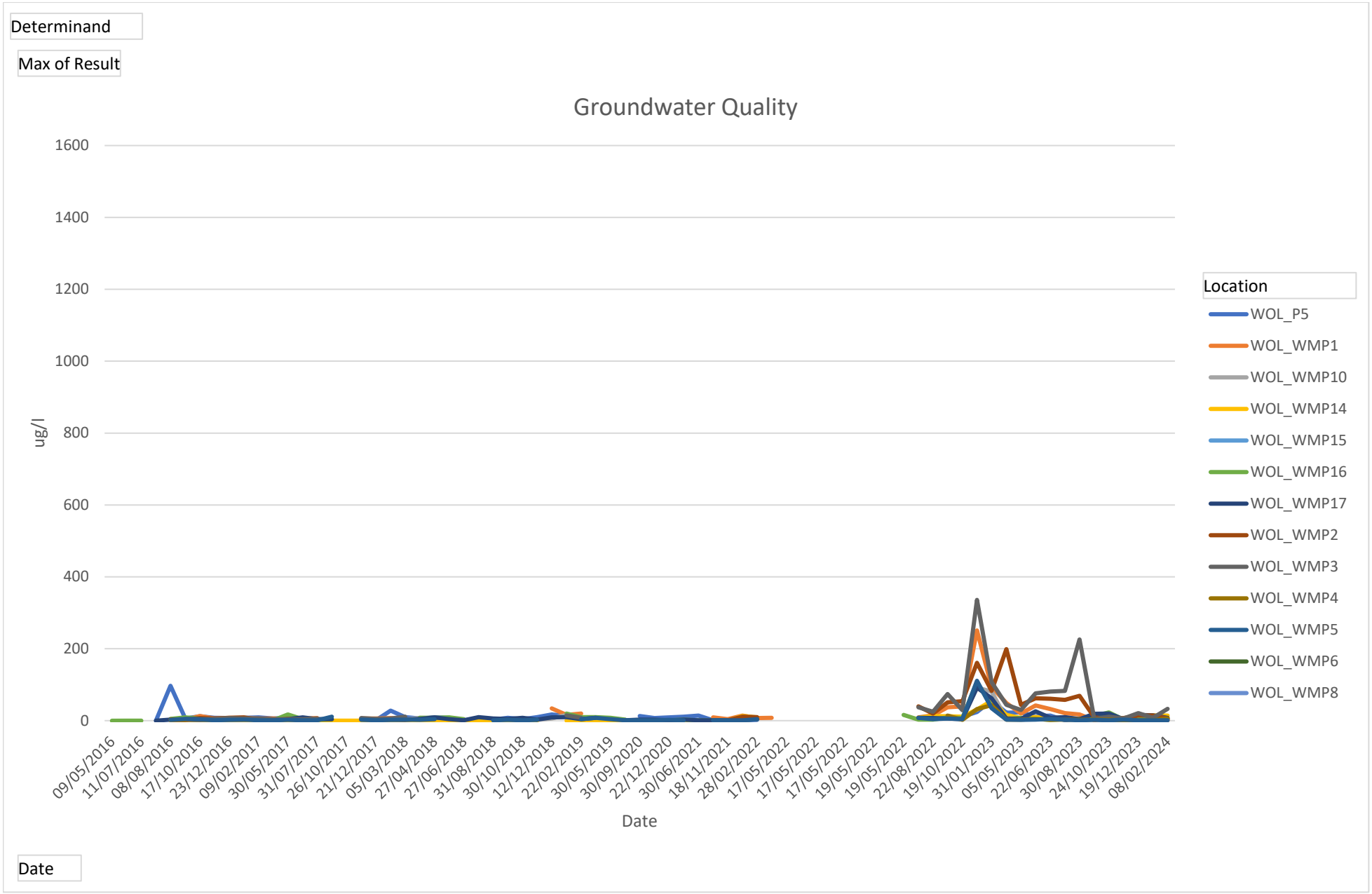
Project No.	3490176
Client:	Tarmac Trading Ltd.
Drawn by:	JH
Ref:	FIG - WQ Monitoring

envireau WATER

167000 166000 165000

457000 458000 459000


WMP16 - Sulphate (mg/l) vs Groundwater Level (mAOD)
Groundwater Level (mAOD)
Sulphate Concentration (mg/L)
Date (ddmmyyyy)
Groundwater lows occur at the same time as peak sulphate concentrations
DWS Limit 250 mg/l
Data missing
Groundwater Level (mAOD)
WMP16
WMP14
Exceedance


Determinand
Max of Result
Groundwater Quality
1600
1400
1200
1000
800
600
400
200
0
ug/l
09/05/2016
11/07/2016
08/08/2016
17/10/2016
23/12/2016
09/02/2017
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31/07/2017
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21/12/2017
05/03/2018
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27/06/2018
31/08/2018
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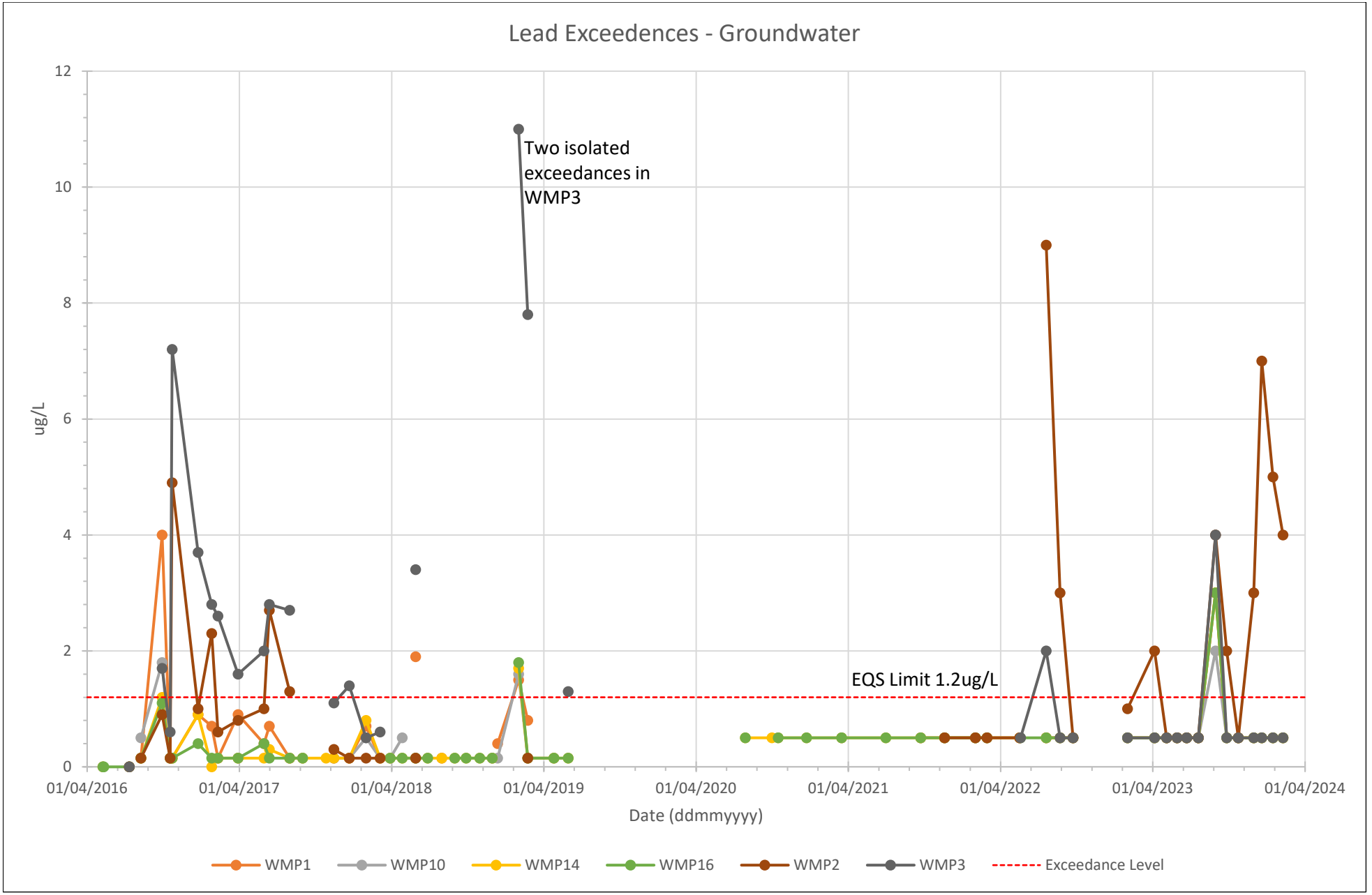
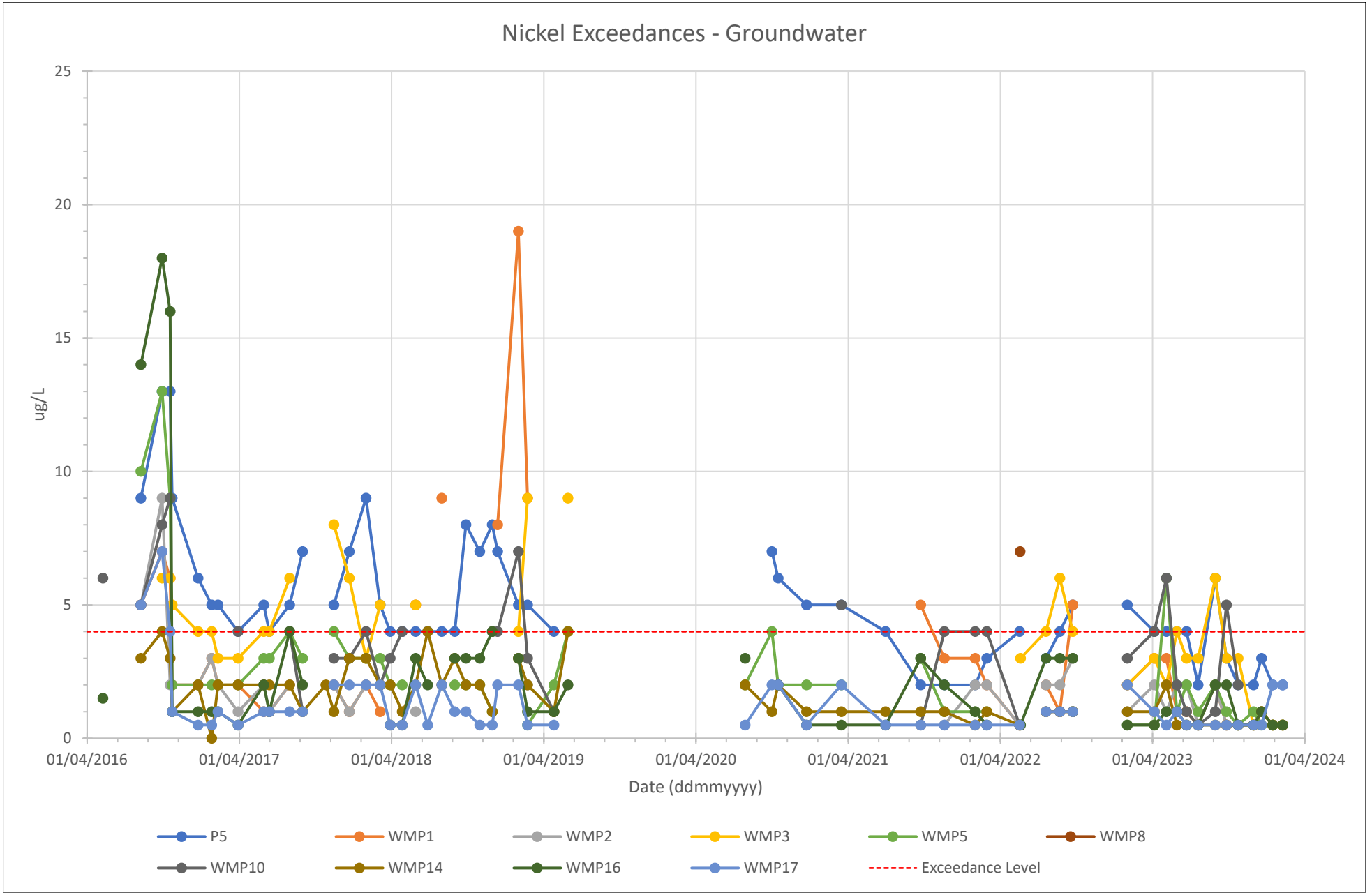
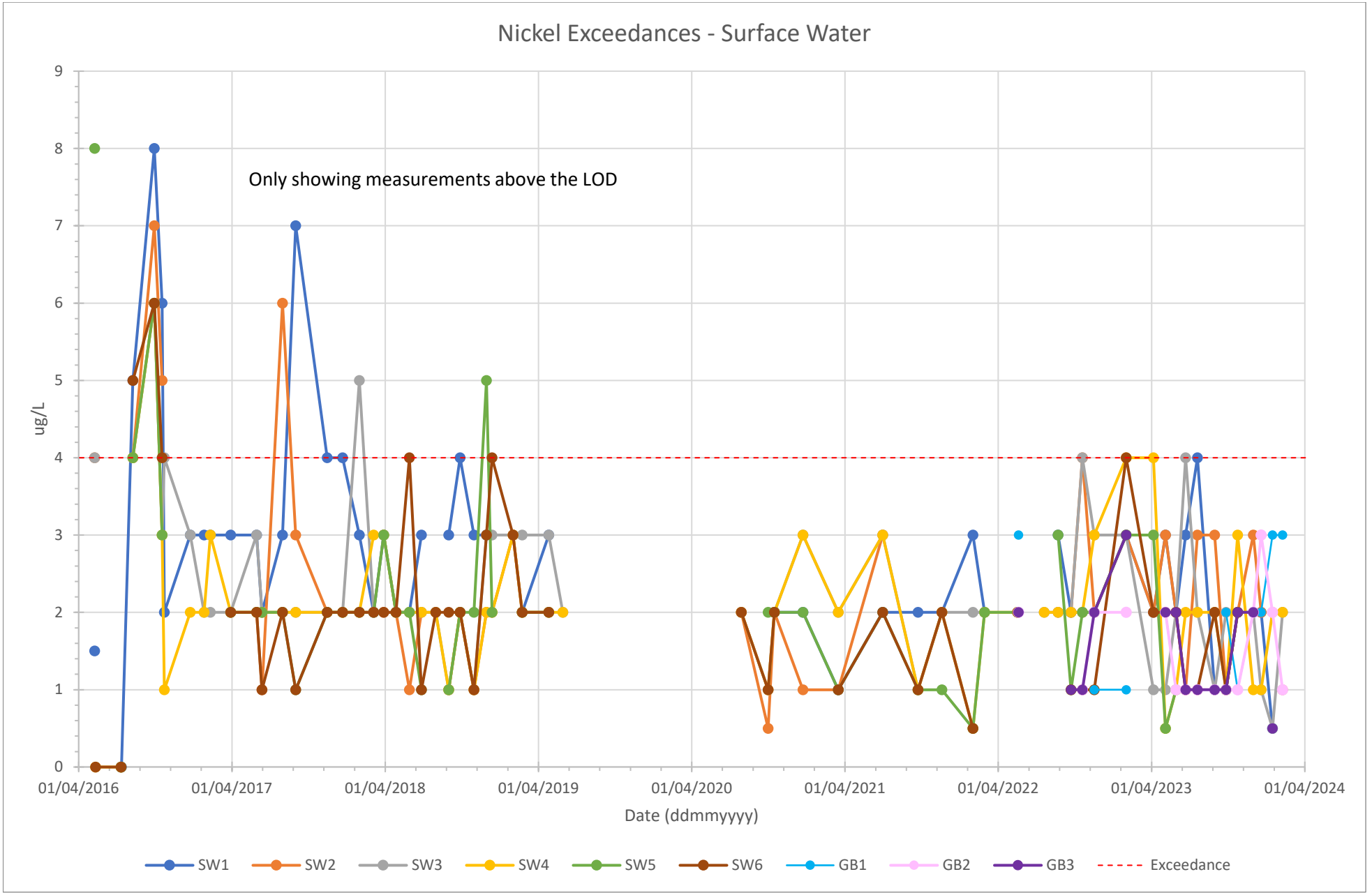
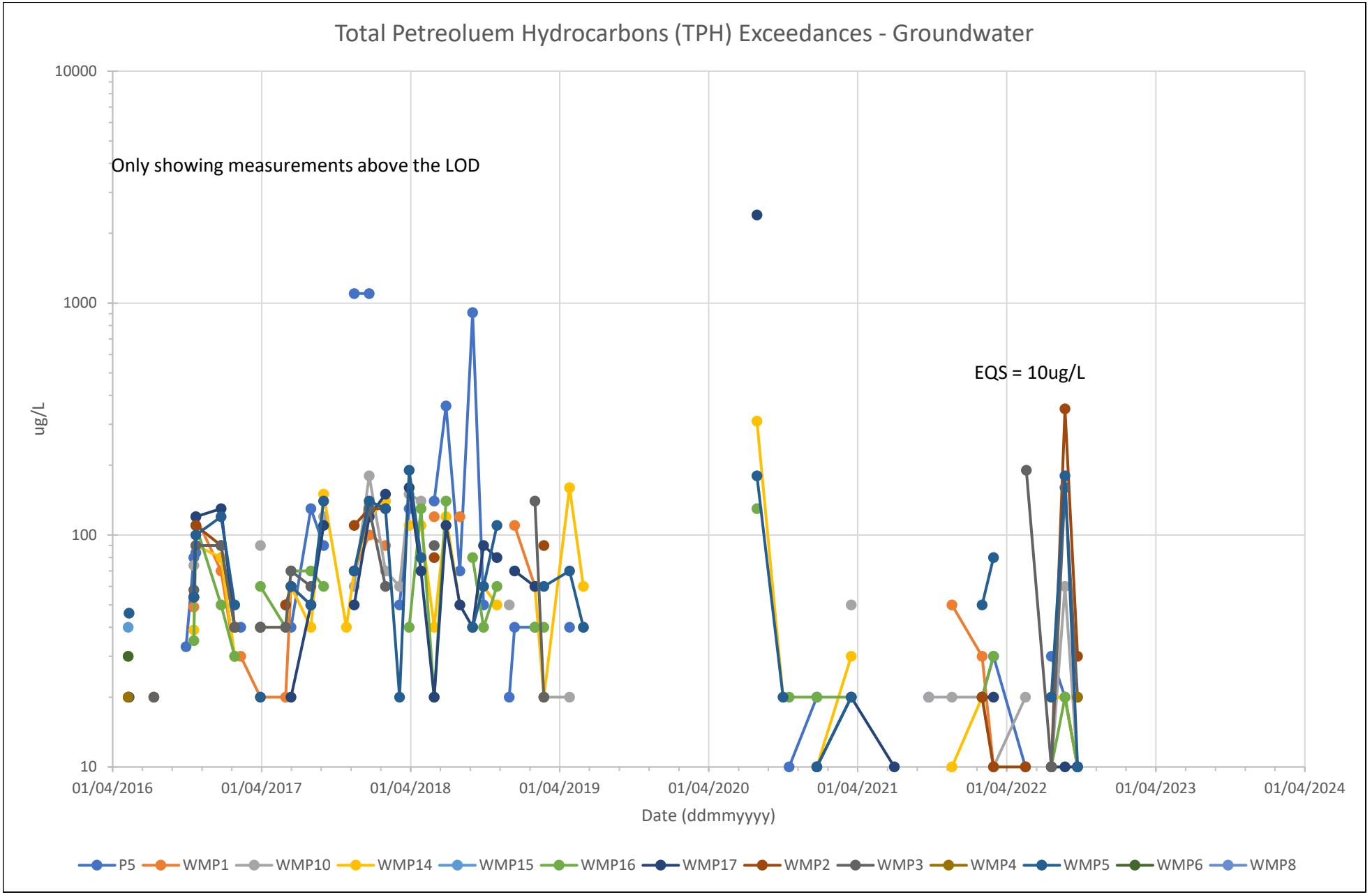
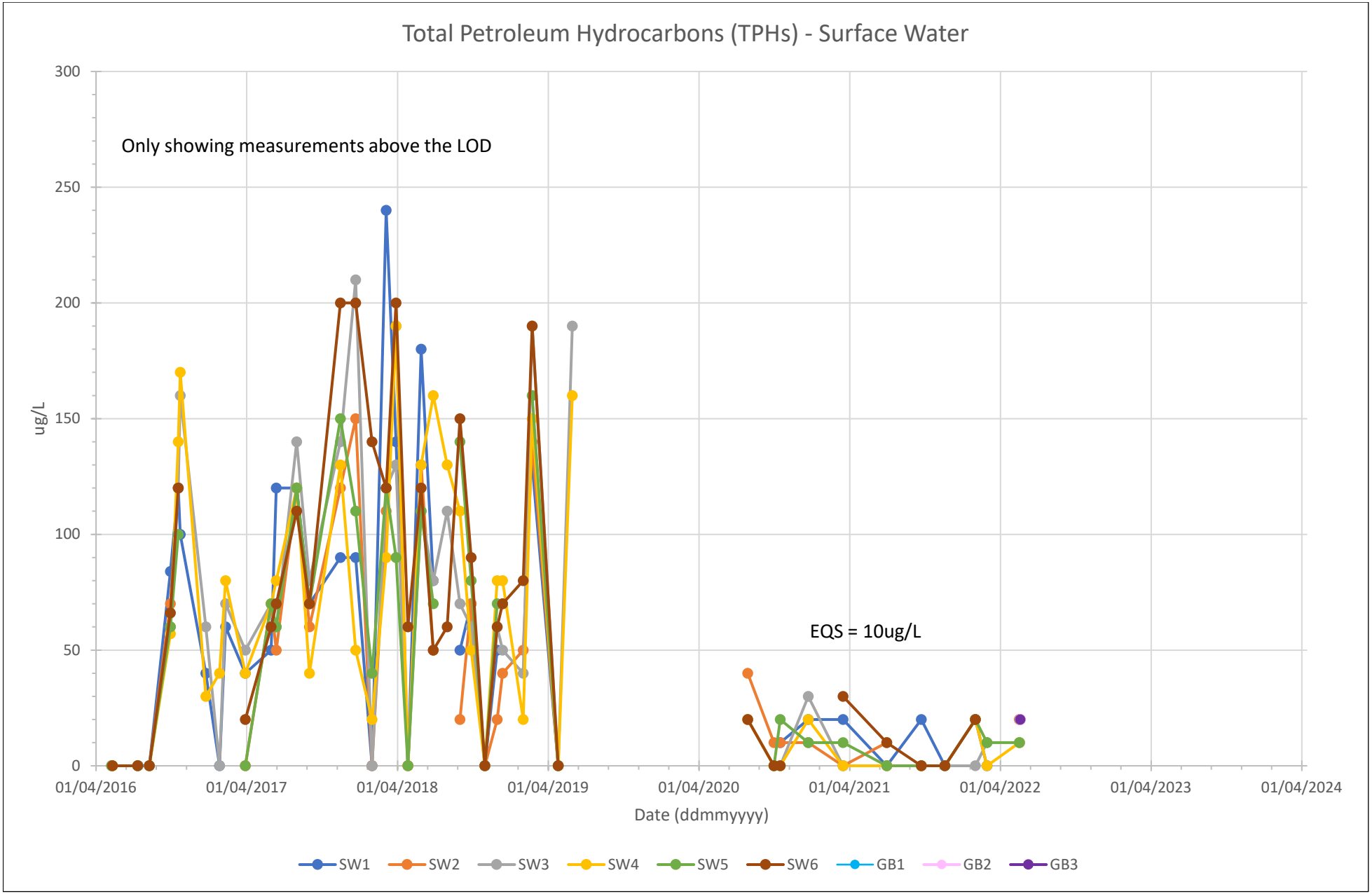
30/06/2021
18/11/2021
28/02/2022
17/05/2022
17/05/2022
17/05/2022
19/05/2022
19/05/2022
22/08/2022
19/10/2022
31/01/2023
05/05/2023
22/06/2023
30/08/2023
24/10/2023
19/12/2023
08/02/2024
Date
Location
WOL_P5
WOL_WMP1
WOL_WMP10
WOL_WMP14
WOL_WMP15
WOL_WMP16
WOL_WMP17
WOL_WMP2
WOL_WMP3
WOL_WMP4
WOL_WMP5
WOL_WMP6
WOL_WMP8
Date

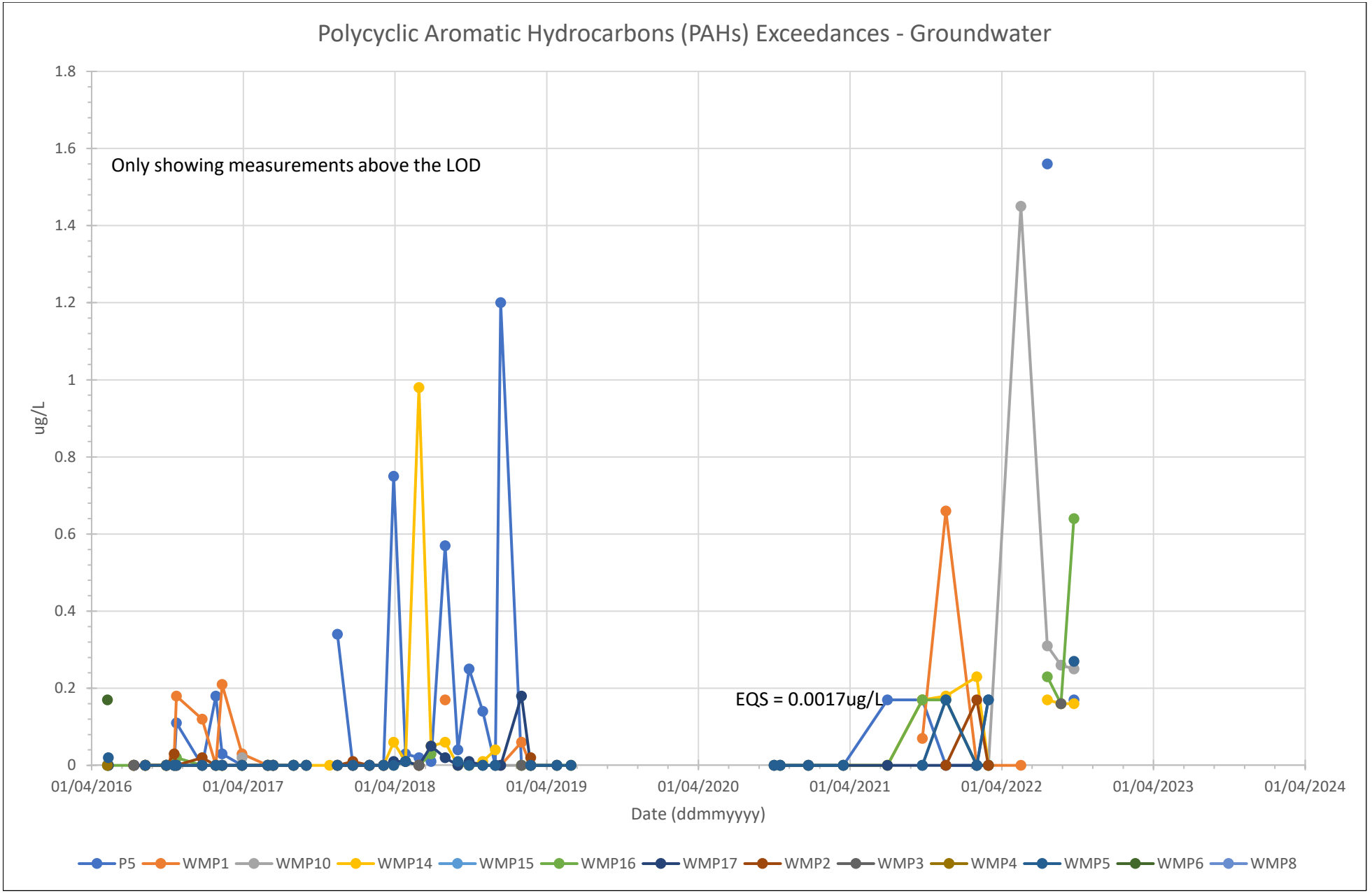

Lead Exceedences - Groundwater
12
10
8
6
4
2
0
ug/L
Two isolated exceedances in WMP3
EQS Limit 1.2ug/L
01/04/2016
01/04/2017
01/04/2018
01/04/2019
01/04/2020
01/04/2021
01/04/2022
01/04/2023
01/04/2024
Date (ddmmyyyy)
WMP1
WMP10
WMP14
WMP16
WMP2
WMP3
Exceedance Level

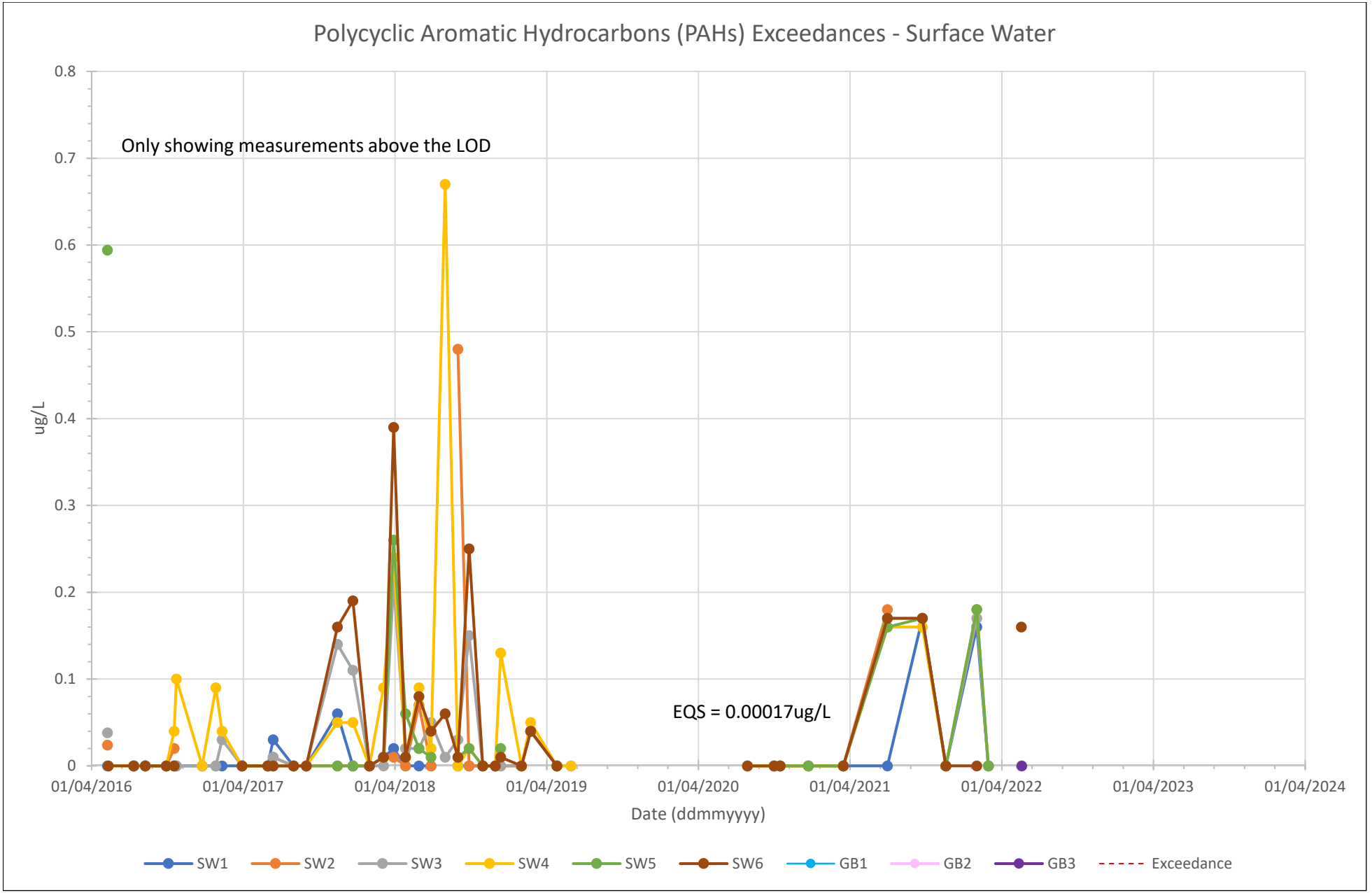

Nickel Exceedances - Groundwater
25
20
15
10
5
0
ug/L
01/04/2016
01/04/2017
01/04/2018
01/04/2019
01/04/2020
01/04/2021
01/04/2022
01/04/2023
01/04/2024
Date (ddmmyyyy)
P5
WMP1
WMP2
WMP3
WMP5
WMP8
WMP10
WMP14
WMP16
WMP17
Exceedance Level

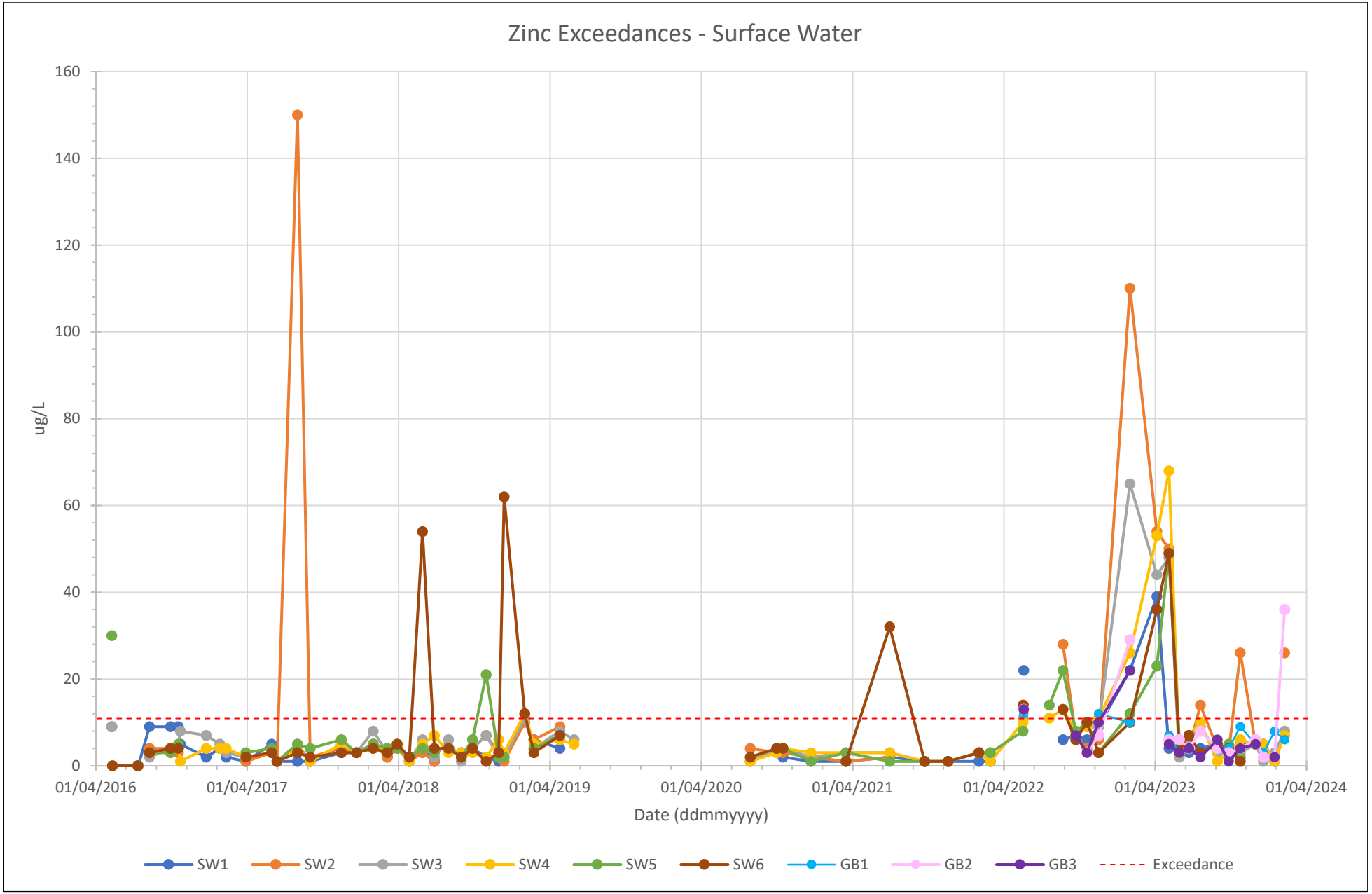

Nickel Exceedances - Surface Water
Only showing measurements above the LOD
ug/L
0
1
2
3
4
5
6
7
8
9
01/04/2016
01/04/2017
01/04/2018
01/04/2019
01/04/2020
01/04/2021
01/04/2022
01/04/2023
01/04/2024
Date (ddmmyyyy)
SW1
SW2
SW3
SW4
SW5
SW6
GB1
GB2
GB3
Exceedance

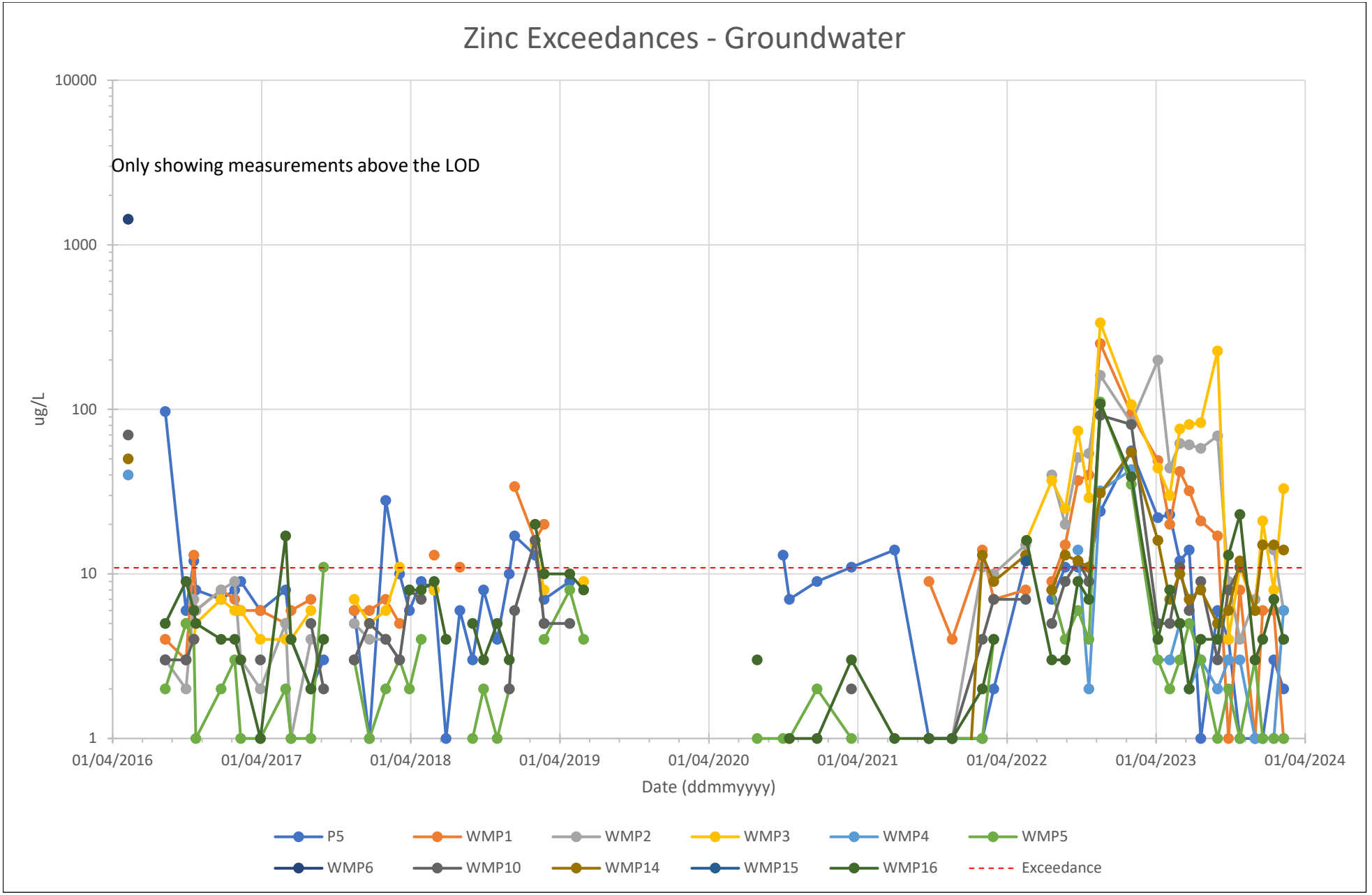

Total Petreoluem Hydrocarbons (TPH) Exceedances - Groundwater
Only showing measurements above the LOD
EQS = 10ug/L
ug/L
10000
1000
100
10
01/04/2016
01/04/2017
01/04/2018
01/04/2019
01/04/2020
01/04/2021
01/04/2022
01/04/2023
01/04/2024
Date (ddmmyyyy)
P5
WMP1
WMP10
WMP14
WMP15
WMP16
WMP17
WMP2
WMP3
WMP4
WMP5
WMP6
WMP8


Total Petroleum Hydrocarbons (TPHs) - Surface Water
Only showing measurements above the LOD
EQS = 10ug/L
ug/L
300
250
200
150
100
50
0
01/04/2016
01/04/2017
01/04/2018
01/04/2019
01/04/2020
01/04/2021
01/04/2022
01/04/2023
01/04/2024
Date (ddmmyyyy)
SW1
SW2
SW3
SW4
SW5
SW6
GB1
GB2
GB3


Polycyclic Aromatic Hydrocarbons (PAHs) Exceedances - Groundwater
Only showing measurements above the LOD
EQS = 0.0017ug/L
ug/L
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
01/04/2016
01/04/2017
01/04/2018
01/04/2019
01/04/2020
01/04/2021
01/04/2022
01/04/2023
01/04/2024
Date (ddmmyyyy)
P5
WMP1
WMP10
WMP14
WMP15
WMP16
WMP17
WMP2
WMP3
WMP4
WMP5
WMP6
WMP8


Polycyclic Aromatic Hydrocarbons (PAHs) Exceedances - Surface Water
Only showing measurements above the LOD
EQS = 0.00017ug/L
ug/L
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/04/2016
01/04/2017
01/04/2018
01/04/2019
01/04/2020
01/04/2021
01/04/2022
01/04/2023
01/04/2024
Date (ddmmyyyy)
SW1
SW2
SW3
SW4
SW5
SW6
GB1
GB2
GB3
Exceedance


Zinc Exceedances - Surface Water
160
140
120
100
80
60
40
20
0
ug/L
01/04/2016
01/04/2017
01/04/2018
01/04/2019
01/04/2020
01/04/2021
01/04/2022
01/04/2023
01/04/2024
Date (ddmmyyyy)
SW1
SW2
SW3
SW4
SW5
SW6
GB1
GB2
GB3
Exceedance


Zinc Exceedances - Groundwater
Only showing measurements above the LOD
10000
1000
100
10
1
ug/L
01/04/2016
01/04/2017
01/04/2018
01/04/2019
01/04/2020
01/04/2021
01/04/2022
01/04/2023
01/04/2024
Date (ddmmyyyy)
P5
WMP1
WMP2
WMP3
WMP4
WMP5
WMP6
WMP10
WMP14
WMP15
WMP16
Exceedance

Appendix C - Site Restoration Plans

Shallows
Fishing / water
Shallows
FP W/12/1
FP W/10/3
FP A/11/1
FP W/9/1
Footpath reinstated
Existing hedge thickened & extended (early planting)
High quality restoration to agriculture
Restored to grassland
FP W/16/1
FP W/17/1
FP BI27/1
New copse (early planting)
Hedgerow retained
Pond
Pond
Reed bed
Seasonally wet grassland
New hedgerow (early planting)
Retained river corridor
Seasonally wet grassland
RIVER ENBORNE
Footpath reinstated
High quality restoration to agriculture
Access removed & area reinstated
FP A/10/1
New hedge with trees (early planting)
New footpath (proposed permissive route)
Pond
Seasonally wet grassland
Retained river corridor
New hedgerow
Agricultural access via existing track
Access removed & area reinstated
High quality restoration to agriculture
Hedgerow thickened (early planting)
Small block of woodland (early planting)
High quality restoration to agriculture
FP WAS/6/1
Airstrip retained
New hedgerow with trees & small spinney (early planting)
Unimproved pasture
New hedge with trees (early planting)
New hedge with trees (early planting)
FP A/9/1
N
Public Footpath (with designation)
Permissive Route
Version / amendment: **0702/W/R/2 v2**

D.K. Symes Associates

Illustrative Restoration Plan

Scale - **1:5,000** (at A3)

Date - **04-12-2012**

Plan No. **0702/W/R/2**