RESIDENTIAL DEVELOPMENT
READING GOLF CLUB,
KIDMORE END ROAD,
EMMER GREEN,
READING,
RG4 8SQ

GROUNDWATER RISK ASSESSMENT

VISTRY THAMES VALLEY

REVISION A
NOVEMBER 2023
REF: SS/23/0275/6452

DOCUMENT CONTROL RECORD

Document Issue:

Rev	Date	Issue Status	Prepared by	Checked by
-	22.05.23	First Issue for comment	S. Smith	C. Pendle
A	13.11.23	Updated to include additional site investigation reports	S. Smith	C. Pendle

Contents

1. Introduction..... 1
2. The Development Site..... 1
3. Potential Sources of Contamination..... 3
4. Pollution Mitigation Proposals..... 5
5. Conclusion..... 7

References

Ground Investigation Report Geo-Environmental 'GE19428-GIR-DEC20' (December 2020)

Letter report on soakage and PLT CBRs 'GE19873 - RG01 – 210428' Geo-Environmental (April 2021)

Supplementary Ground Investigation Report 'GE20079/SGIR/OCT21' Geo-Environmental (October 2021)

Supplementary Ground Investigation Report 'GE21422/SGIRv2.0/APR23' Geo-Environmental (April 2023)

1 Introduction

1.0 Scope

MJA Consulting has been instructed by Vistry Thames Valley to prepare a Preliminary Groundwater Risk Assessment (GRA) to support a planning application for 223No. residential dwellings at Reading Golf Club, Kidmore End Road, Emmer Green, Reading (Ref: 221312).

1.1 The objective of this report is to assess the existing hydrogeological conditions at the site and to identify and evaluate the potential contaminant linkages and the potential risks to groundwater from the development of the site. This assessment will also recommend mitigation measures associated with any identified risks.

1.2 Three ground investigation reports spanning three years have been completed for the site and are used to inform this groundwater risk assessment.

2 The Development Site

2.0 Site Location and Description

The 12 ha site is located at Reading Golf Club to the west side of Kidmore End Road in Emmer Green, north of Reading. It comprises undeveloped golf course grassland and the parcel is bound by housing estates of Eric Avenue to the west and Brooklyn Drive to the east. The site is centred on National Grid Reference SU 71657 76771.

2.1 Topography

The topography of the site falls from the southeast to northwest with levels ranging from 84.20m to 75.05mAOD.

2.2 Geology

The British Geological Survey (BGS) published bedrock geology at the site is recorded as Lambeth Group – Clay, Silt and Sand on the eastern half of the site and Seaford Chalk and Newhaven Chalk Formations of the western half of the site.

2.3 Superficial soils recorded by BGS are that of the Black Park Gravel Member - Sand and Gravel covering much of the site apart from the very north and western areas which have no information recorded.

2.4 Intrusive ground investigations undertaken at the site by Geo-Environmental Services Ltd (Report: GE19428-GIR-DEC20) established the following ground conditions:

- **Topsoil** to depths of between 0.0m and 0.5mBGL and;
- **Made Ground** at depths of 0.0m and 0.4m
- **Black Park Gravel** of fine to medium SAND with varying proportions of gravel as well as GRAVEL with varying proportions of clay, sand and cobbles, and CLAY varying proportions of sand and gravel. At depths of between 0.8mBGL and bottom of pits 5.0mBGL;
- **Lambeth Group** of stiff to very stiff CLAY with varying proportions of silt and sand to bottom of pits 5.0mBGL;
- **Seaford Chalk Formation** of weathered structureless CHALK estimated Grade Dm/Dc (CIRIA C574, 2002) locally to depths of 3.7mBGL.

2.5 Hydrogeology

The Lambeth Group Clay and Black Park Gravel bedrock geology are ‘Secondary A’ Aquifer. The Chalk bedrock formations on the western half of the site are ‘Principle’ Aquifer. The superficial layers associated with the Black Park Gravel are ‘Secondary A’ Aquifer.

2.6 Secondary A aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. Principal Aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

2.7 The site lies with a groundwater source protection zone 3 (SPZ3) – Total Catchment. This is the area around a supply source within which all the groundwater ends up at the abstraction point. This is the point from where the water is taken. This could extend some distance from the source point.

2.8 The site is located within 'Medium - High' to 'High' Groundwater vulnerability and within a Nitrate Vulnerable Zone.

2.9 Soakage testing achieved results of between $5.7x10^{-7}$ m/s and $1.2x10^{-4}$ m/s across the site. Several tests failed due to collapse of the test pits.

2.10 It would be expected that the hydraulic flow of groundwater beneath the site be consistent with the local surface topography with the natural greenfield drainage pathway (surface and groundwater) for the site catchment towards the north-western site boundary.

2.11 The groundwater monitoring carried out by Geo-Environmental between the November 2020 and January 2021 at six locations across the site established a peak groundwater level of 0.55 m. Other results showed varying levels to 4.0 m BGL depending on season and location. The report concludes that "it is considered likely that the water encountered on site is a perched or discontinuous body of water."

2.12 During the supplementary ground investigation in October 2021 groundwater was encountered in BH01, TP307, TP309 and TP312 at depths of 3.4m bgl, 2.40m bgl, 1.57m bgl and 1.40m bgl, respectively. In each case, the water ingress appeared to be associated with more granular strata overlying clay or structureless Chalk and given the limited to sporadic presence, it was considered likely to be discontinuous perched water and not indicative of a single site wide groundwater body.

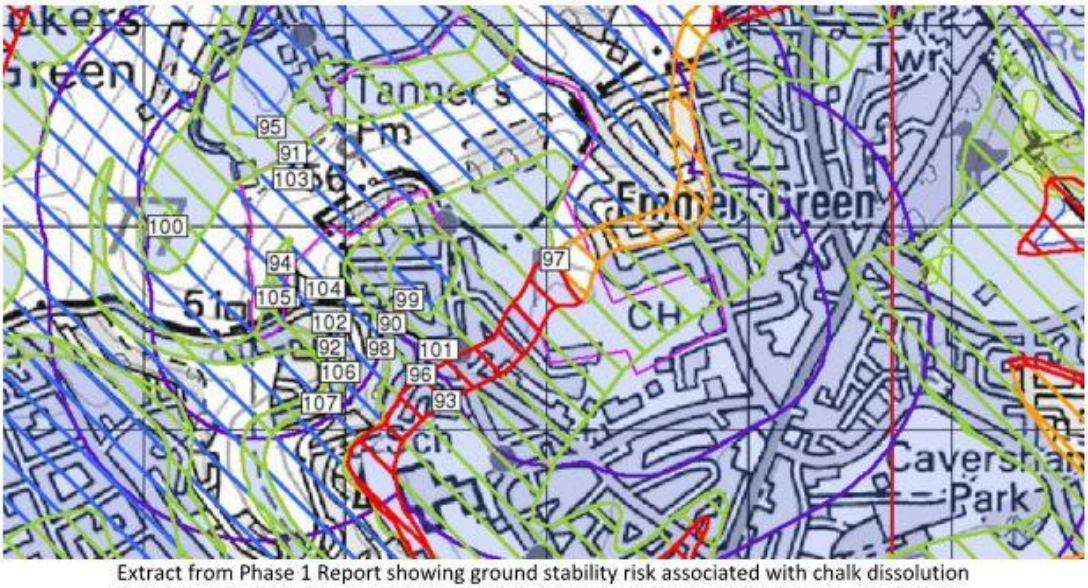
2.13 During further supplementary ground investigations in March 2023 groundwater was not encountered to a depth of 27.29m BGL. From the various site investigations, it can be concluded that any groundwater encountered on site is a localised perched, discontinuous body of water and that groundwater will not be affected by the development.

2.14 The surface water infiltration design targets a band of permeable material within the existing ground which lies above the clay layer and allows a lateral movement of water rather than a traditional vertical infiltration type solution. The underground lateral flow of perched water makes its way 140m north of the site to a valley feature where the water likely re-emerges as overland flow.

2.15 Its pre-developed state is open grassland. Typically, rainfall would land on the surface, drain through the ground to the permeable layer and run laterally. This would be above the clay layer due to the low or extremely limited permeability. Any groundwater below the site would be dependent on rainfall and therefore, the lower clay layer groundwater levels wouldn't fluctuate as they would in the chalk sub-strata.

2.16 Although there are natural and man-made features in the groundwater abstraction catchment these are associated with certain areas of the site. Drawing '6452-MJA-SW-XX-DR-C-22-P1 Infiltration Test Locations and Rates' in appendix A shows two zones, derived from ground investigation report 'GE19428-GIR-DEC20', where chalk dissolution hazards exist.

Figure 1: Shows areas of ground stability risk associated with chalk dissolution.



Extract from Phase 1 Report showing ground stability risk associated with chalk dissolution
(red hatching is high risk, orange- medium risk, green – low risk; yellow line is approximate site boundary)

2.17 Figure one shows a band of medium to high risk of dissolution that runs through the site. There are no infiltration type features, including soakaways, proposed within these areas. Infiltration is only proposed within areas of ground stability and low dissolution risk.

2.18 Placing the developments infiltration features well outside of areas of dissolution risk, ensures groundwater will not be affected by the development.

3 Potential Sources of Contamination

3.0 Existing Site

An assessment has been undertaken using desktop information and site investigation data to identify any existing sources of contamination that may pose a risk to groundwater via remobilisation and lateral migration including leaching of contaminants via reworked in-situ soils.

3.1 The GeoInsight Groundsure data has not indicated the presence of current or historical activities in the vicinity of the site that pose a risk to groundwater. No current evidence of potentially contaminative or hazardous activities or storage features were observed at the site or nearby during a walkover.

3.2 No significant industrial or commercial historic or current land use has occurred at the site and no abnormal ground conditions were encountered during ground investigation works with natural sequences of geology encountered throughout. No current evidence of contamination is identified and soil sampling and contamination analysis of a wide range of chemical determinants has recorded low and acceptable concentrations with the soil chemistry. No unusual stains or odours were noted during the ground investigation works.

3.3 The Geo-Environmental report concluded *'It is considered that no risk mitigation measures are required with respect to groundwater.'*. This includes radon and ground gas protection as well as waste disposal.

3.4 No further assessment is considered necessary, and the existing site is considered environmentally suitable for use. In conclusion, the risk to the underlying principal groundwater aquifer from the existing greenfield site is very low.

3.5 Proposed site

The following proposed activities associated with the development of the site have been highlighted as potential contamination sources. These have been assessed as to their risk to the underlying groundwater via a source-pathway-receptor (SPR) procedure.

Source-Pathway-Receptor			Risk Management	Likelihood	Consequence	Overall Risk
Source of Pollution	**Pathway**	**Receptor**				
Material and aggregates used in the installation of SuDS and other drainage infrastructure	Migration and leaching through soils	Groundwater	All materials and aggregates used are regulated, tested and approved with BBA / BSI / CE certification and constructed / workmanship to BS EN standards.	Very Low	Medium	**Low**
Construction of foundations creating a pathway for buried contamination and exposure to concrete	Migration and leaching through soils	Groundwater	No piling is proposed. Foundations likely to be trench filled (circa 1 - 1.5m deep) and located above groundwater table within un-saturation zone. No source of existing contamination were identified within the native soils within site investigation report. The consistency of the concrete mix should be considered to avoid dilution of the concrete within the underlying principal aquifer.	Low	Medium	**Low**

Source-Pathway-Receptor			Risk Management	Likelihood	Consequence	Overall Risk
Source of Pollution	**Pathway**	**Receptor**				
Accidental spills of fuels/oils during construction phase	Migration and leaching through soils. Overland surface water runoff.	Groundwater	All fuels and oils are stored within sealed containers within a dedicated fenced and secured concrete hardstanding area. Surface water runoff from the hardstanding area is to pass through stilling tanks or an oil interceptor prior to discharge to ground. A shut off valve must be able to isolate the drainage system in the event of a spillage and whole storage area is to be bunded. Spill kits are to be provided. All refuelling to take place within the dedicated area. The fuel storage area is not to be located in an area of high flood risk.	Very Low	High	**Low**
Contaminant within surface water runoff from newly built trafficked areas	Overland surface water runoff Migration and leaching through soils	Groundwater	A dedicated surface water drainage system will manage runoff from all impermeable areas up to the 100y+40%cc rainfall event. A SuDS management train will remove all pollutants including PAH's, oils and sediments prior to discharge to ground. All SuDS and treatment devices will be inspected and maintained in perpetuity.	Very Low	Medium	**Low**
Construction materials including cements, paints, solvents and other toxic chemicals and dust	Migration and leaching through soils Overland surface water runoff	Groundwater	Ensure all waste is correctly disposed of in accordance with the site management procedures Segregate toxic materials in a dedicated location where there is minimal risk of spills and runoff. Use non-toxic paints, solvents and other hazardous material where possible Collect any wastewater generated from site activities in settlement tanks, screen, discharge the clean water, and dispose of remaining sludge according to environmental regulations No burning of materials on site. Control dust through fine water sprays used to dampen down the site.	Low	High	**Low**
Sewer leakages due to defects in sewers Microbiological contaminants and pathogens	Migration and leaching through soils	Groundwater	The new foul drainage network will be designed and constructed to the latest industry regulations and guidance ensuring structural integrity and minimising the risk of sewer collapse or leakage of raw sewage to ground. The depth of the proposed foul water system will less than 2m below existing ground levels within the un-saturated zone of Kempton Park Gravels. There will be no discharge of treated or un-treated effluent directly to ground. No industrial waste present in the flows and no septic tanks or foul storage tanks are to be used Thames Water have confirmed adequate capacity in the existing system to accommodate the proposed development. The foul sewer system will be adopted and maintained by a dedicated facilities management company in perpetuity.	Very Low	Medium	**Low**

4 Pollution Mitigation Proposals

4.0 It is proposed that all runoff from roofs is discharged directly to attenuation basins or stone sub-bases located under driveways and roads. Catchpit chambers will be installed before all soakaways type features to capture residual sediments. The pollution hazard of surface water runoff from residential roofs is very low and direct discharge to the ground via infiltration is acceptable within SPZ 3.

4.1 The pollution hazard of surface water runoff from Individual property driveways, residential car parks, low traffic roads (cul-de-sacs, home zones, general access roads) is low.
It is proposed that all surface water runoff from trafficked areas including driveways and the main development access road will pass through three separate stages of treatment prior to discharging to ground. All surface water runoff will initially drain through trapped road gullies and filtrate through a Type 3 permeable (4/20mm sized OGCR 30% voids) stone sub-base where the majority of contaminants which attached themselves to larger sediments including PAH's and oils are removed from the runoff.

4.2 The CIRIA SuDS Manual 2015 details an approach for establishing the hazard posed by the intended land use activates and the extent to which the proposed SuDS components can reduce and mitigate the contamination risk to the receiving waterbody.

4.3 Referring to Table 26.2 – 'Pollution hazard indices for different land-use classifications' the proposed development and land use results in a low pollution hazard, therefore a 'Simple Index' method can be used to make a qualitative assessment of the proposed SuDS management.

Table 26.2 – '*Pollution hazard indices for different land use classifications*' CIRIA C753, 2015

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4

4.4 To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type):

Total SuDS mitigation index ≥ pollution hazard index (for each contaminant type)

For the development site: TSS = 0.5, Metals = 0.4, Hydrocarbons = 0.4

Table 26.4 – 'Indicative SuDS mitigation indices for discharges to groundwater' CIRIA C753, 2015

TABLE 26.4 Indicative SuDS mitigation indices for discharges to groundwater

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.6[4]	0.5	0.6
A soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.8[4]	0.8	0.8
Proprietary treatment systems[5, 6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

4.5 The proposed development surface water drainage system consists of the following SuDS components:

Primary Treatment - Permeable Paving (with filter geotextile layer)
Using table 26.4 – Mitigation Indices:
TSS = 0.7, Metals = 0.6, Hydrocarbons = 0.7

Total SuDS mitigation for each contaminate:
TSS = 0.7 which is > 0.5 therefore ok.
Metals = 0.6 which is > 0.4 therefore ok.
Hydrocarbons = 0.7 which is > 0.4 therefore ok.

4.6 Tertiary treatment will be provided via the trapped road gullies offering a level of sediment and oil capture. In addition, the permeable filter geotextile membrane surrounding the stone and soakaways and over a 2m zone of unsaturated soil beneath the soakaway tank will offer final polishing of runoff prior to infiltrating into the underlying groundwater body.

4.7 It is proposed that all foul flows from the development discharge via gravity to the existing Thames Water public foul network located along the north western boundary. This sewer is a DN225.

4.8 The new on-site drainage will be designed and constructed to the latest industry regulations and guidance ensuring structural integrity and minimising the risk of sewer collapse or leakage of effluent to ground. There will be no discharge of treated or untreated effluent directly to ground. Thames Water has confirmed adequate capacity in the existing system to accommodate the proposed development.

4.9 The proposed foul sewerage system will be maintained in perpetuity by a dedicated facilities management company.

5 Conclusion

5.0 A review of desktop data including historic land use and detailed site investigations including soil analysis, has established that there is no evidence of contamination or elevated concentrations of determinants identified at the existing site. Therefore, there is no risk to the underlying groundwater environment from the reworking of existing soils at the site as a result of the proposed engineering activities.

5.1 From the various site investigations it can be concluded that any groundwater encountered on site is a localised perched discontinuous body of water and that groundwater will not be affected by the development.

5.2 Placing the developments infiltration features well outside of areas of dissolution risk, ensures groundwater will not be affected by the development.

Appendix A – Drawing '6452-MJA-SW-XX-DR-C-22-P1 Infiltration Test Locations and Rates'

MJA CONSULTING

Civil & Structural Engineers

www.mjaconsulting.co.uk

Ipsum Court
24 The Quadrant
Abingdon Science Park
Abingdon
Oxfordshire
OX14 3YS