TECHNICAL NOTE

DATE:	16 June 2023	**CONFIDENTIALITY:**	Confidential
SUBJECT:	Hydrogeological Risk Assessment for Southern Water Public Water Supply wells at Patcham		
PROJECT:	Patcham Court Farm, Royal Mail Group	**AUTHOR:**	Toby Sanderson
CHECKED:	Melanie Cross	**APPROVED:**	Richard Lansley

INTRODUCTION

Royal Mail Group (RMG) are proposing the development of a storage and distribution centre with associated access, parking, landscaping, re-grading of land, enclosures and infrastructure works including two sub-stations and an express vehicle maintenance facility. The development site (Site) is in Patcham to the north of Brighton and set north of Vale Avenue at NGR TQ 30204 09272. The Site is currently a disused agricultural holding with many of the associated buildings in disrepair. The topography of the Site ranges from 69 m above ordnance datum (AOD) in the south to 76 m AOD in the north.

The Proposed Development falls within SPZ1 for Southern Water's (SW) Public Water Supply (PWS) abstractions Brighton A and Brighton B. There are three wells in total: Brighton A (assumed to be Well 2), Brighton B (Well 1) and a pumping well (assumed to be Well 3) that abstract water from the principal Chalk aquifer. From the Environment Agency (EA) licence abstraction data, Well 1 has a total depth not exceeding 68.89 m BGL, Well 2 a total depth not exceeding 59.75 m BGL and Well 3 a total depth not exceeding 74.99 m BGL. The EA has specified the maximum quantity to be abstracted in any one day of twenty-four hours (as a combined total) is 17,500 cubic meters per day.

Southern Water have identified that the wells also extend laterally via an adit that is running 150 m north of the Site. The Chalk aquifer receives recharge from where the unit outcrops (where superficial deposits are not present). Figure 1 illustrates the location of the proposed development in relation to SPZ 1 which is defined as a 50-day travel time from any point below the water table to the source.

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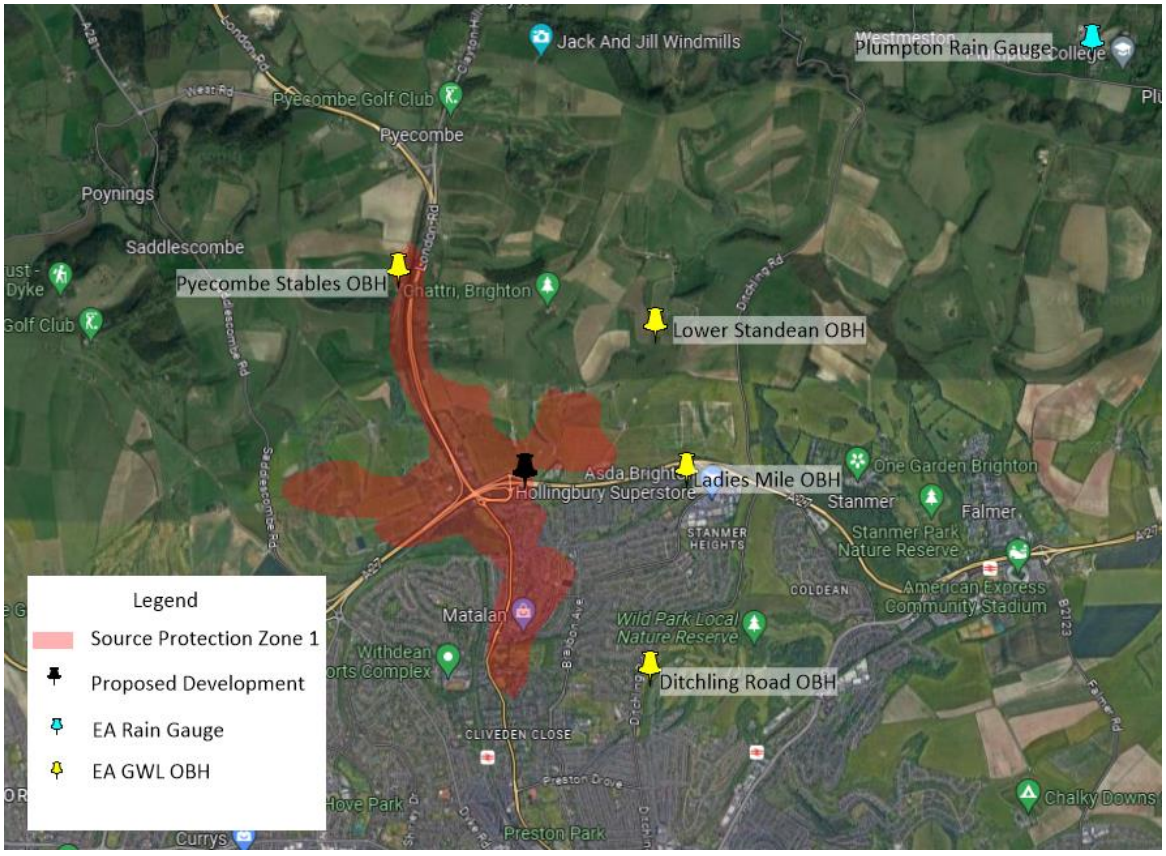
Figure 1- Locations of Environment Agency OBH boreholes and Rain Gauges within the wider catchment



As part of the planning process, developers that are proposing schemes that present potential risk to groundwater resources, quality or abstractions must provide an acceptable HRA to the EA and local planning authority. Any activities that can adversely affect groundwater must be considered, including physical disturbance of the aquifer. If the HRA identifies unacceptable risks then the developer must provide appropriate mitigation (Environment Agency, 2018). Statutory consultation has highlighted the requirement for a Hydrogeological Risk Assessment (HRA) relating to the development at this Site. The potential impacts on water quality and quantity of the proposed development must therefore be assessed and (if necessary) mitigated to ensure that the PWS abstractions are protected.

SCOPE AND OBJECTIVES

This HRA is being undertaken following statutory consultation comments by Southern Water, dated 16 August 2022, in which they summarised the following concerns based on the current design proposal:

- No superficial deposit cover to the principal Chalk aquifer (Seaford Chalk Formation)
- The Site is situated within groundwater SPZ 1 relating to Southern Water PWS wells located approximately 600m west of the proposed development
- The Site is within 150m laterally of a below ground adit that is connected directly to Southern Water's PWS well Brighton A.
- Existing contamination of the Site and management of this risk during demolition/construction. Any disturbance of legacy contamination could lead to groundwater contamination and impacts to Southern Water's PWS wells.
- Unclear if the current proposed drainage strategy is lined and potential impact to groundwater resources

Based on high level information from the current outline design proposal and drainage strategy, the objectives of the HRA are to:

1. Quantitatively assess the impact to the groundwater recharge zone and SPZ for Southern Water's PWS abstractions as a result of the proposed development
2. Assess contamination risks during the construction phase and operational phase of the proposed development and suggest appropriate mitigation measures (where required).

This report has been developed using relevant EA Guidance and a template which has been adapted based on the proposed development. The following data sources have been used by WSP to support the HRA:

- Landmark Envirocheck Report[1]
- British Geological Survey (BGS) GeoIndex Online Database[2]
- Department for Environment, Food and Rural Affairs (DEFRA) Magic Map[3]
- Previous desk studies and survey reports as well as outline planning documents available from the Brighton and Hove City Council planning portal in relation to planning reference BH2022/02232

CONSULTATION

A summary of consultation had to date with statutory and non-statutory bodies, and the data provided by each to supplement this report is provided below. The site of interest was defined by the location of the Proposed Development area (NGR TQ 30203 09279) and a 2.5km buffer was applied from the central point of the development area to define the groundwater catchment and any groundwater monitoring (level and quality) observation boreholes (OBH) that may be present.

[1] Landmark Envirocheck Report (2023) Patcham Court Farm, reference 307961654_1_1. Accessed March 2023.
[2] British Geological Survey. (2023) BGS GeoIndex. Accessed March 2023. Available From: https://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSBoreholes&_ga=2.200833959.883641586.1679047827-423589811.1679047827
[3] DEFRA (2023) MAGIC Map Application. Accessed March 2023. Available From: https://magic.defra.gov.uk/MagicMap.aspx

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Environment Agency (EA) – via email 11 January 2023 and 8 March 2023

WSP initially submitted a query on 11 January 2023 for groundwater level and groundwater quality data to the EA within the defined Study Area. No groundwater quality data was available within the defined Study Area. Groundwater level data was provided for four OBH (approx. 2.3km north-west (Pyecombe Stables), approx. 1.9km north-east (Lower Standean), approx. 1.6km east (Ladies Mile) and approx. 2.0km south-east (Ditchling Road)) were identified. Continuous groundwater level data is only available for Ditchling and Ladies Mile, and manual dips are provided for all OBH. The groundwater level data provides representative information/data on the wider catchment groundwater system for the Principal Chalk aquifer. The groundwater level data has been used indicatively to identify a response in groundwater level and rainfall. The EA provided rain gauge data for Ditchling Road (NGR TQ 31486 07647 approx. 2.0km south-east) and Plumpton (NGR TQ 35718 13590 approx. 7.0km north-east) at daily and hourly intervals respectively between 1983 and 2023.

The EA also provided information/data on licensed abstractions in the area however, details are redacted where considered sensitive. Some details on borehole construction (total depth in m BGL) and maximum quantities of water abstractions (cubic meters per day) are available for Patcham.

Southern Water (SW) – via email on 16 February 2023 and 17 April 2023

WSP initially submitted a query for groundwater level and quality data to Southern Water (SW) for their strategic water supplies (Brighton A and Brighton B). Southern Water requested additional time to provide WSP the requested data, which was provided on 12 April 2023. Data was only provided for their Brighton B PWS and is considered representative of the wider catchment groundwater system for the principal Chalk aquifer.

Southern Water provided WSP details on their mitigation and monitoring strategy for their strategic water supplies. They also provided a redacted risk assessment for Brighton B PWS. Groundwater quality data was requested 17 April 2023 and untreated groundwater quality data (for Brighton B PWS only) was provided to WSP 20 April 2023.

Southern Water – via Microsoft Teams on 15 March 2023 and 29 March 2023

Two consultations with Southern Water (SW) were held on 15 March and 29 March 2023, that included representatives from RLB, WSP and SW (Asset Hydrogeologist and Catchment Hydrogeologist respectively). For both consultations, the development proposal and preliminary conceptual understanding of the site was outlined/discussed, including WSP approach to the HRA. The initial consultation with SW (Asset Hydrogeologist) concluded that the overall risk profile for the development was satisfactory, with the major concern relating to the deterioration of the quality of the supply rather than loss of yield, hence the reduction in recharge area from the development is screened out of this report at this point. The subsequent consultation with SW (Catchment Hydrogeologist) confirmed that the WSP approach to the HRA was satisfactory but a presentation of the conceptual understanding of the groundwater regime and

contamination risk (construction / operational phases of the Proposed Development and preliminary drainage strategy) was required.

British Geological Survey (BGS) – via email 01 March 2023

WSP submitted a query to the BGS for information/data on confidential boreholes TQ20NE307 (NGR 29530,09270), TQ20NE26/A-D (NGR TQ 29500,09200) and TQ20NE306 (NGR TQ 29450,09150). The BGS provided a response on 09 March 2023 identifying that this information can only be released to the EA or Water Utility Companies due to the data being held in protect managed status.

GROUND CONDITIONS

The data below provides some indication of the ground conditions for the Site and wider catchment area (2.5km radial buffer) and have been used in conjunction with historical borehole logs available from the BGS website[2]. In addition to desk-based information, two Ground Investigations (GI) were carried out in 2016 (Geo-environmental Services) and 2019 (Ridge and Partners LLP) that provide additional detail on the ground conditions for the site.

1. Geo-environmental Services undertook a GI in 2016[4] where six window sample holes were drilled to depths ranging from 1.10 metres below ground level (m bGL) to 2.50 m bGL. A standpipe was installed into one sample location (WS2) to enable monitoring of ground-gas.The investigation was undertaken to provide data for quantitative risk assessments.
2. Ridge and Partners LLP[5] undertook an investigation to consider ground condition issues that may affect the redevelopment of the site from a geotechnical or contamination aspect. The investigation included nine window sample holes drilled to depths ranging from 2.00 m bGL to 4.00 m bGL. In addition three trial pits were dug to depths ranging from 0.9 m bGL to 2.00 m bGL. The trial pits were dug to facilitate in-situ testing and to observe in-situ geology[5].

SUPERFICIAL GEOLOGY

No superficial deposits are present on the Site, and this was confirmed through the 2016 and 2019 GI's. Both GIs identified a thin layer of topsoil (between 0.1m below ground level (m BGL) and 0.4m BGL) that was not considered extensive across the Site. The topsoil was described as dark brown, sandy silt, sand is fine to medium and abundant roots are present.

[4] Geo-environmental Services. (2016) Ground Appraisal Report- Patcham Court Farm. Document Reference: GE15640 – GARv2AP071116

[5] Ridge and Partners LLP (2019) Ground Condition Assessment Brighton MPU. Document Reference: 5010922-RDG-XX-ST-DOC-C-01-GCA.

ARTIFICIAL GROUND

Concrete hardstanding and Made Ground, that largely consists of reworked locally derived materials, were presented in the 2016 and 2019 GI's. Made Ground is present across much of the Site, underlying both topsoil and concrete hardstanding, and a thickness of 0.2m to 0.9m was recorded.

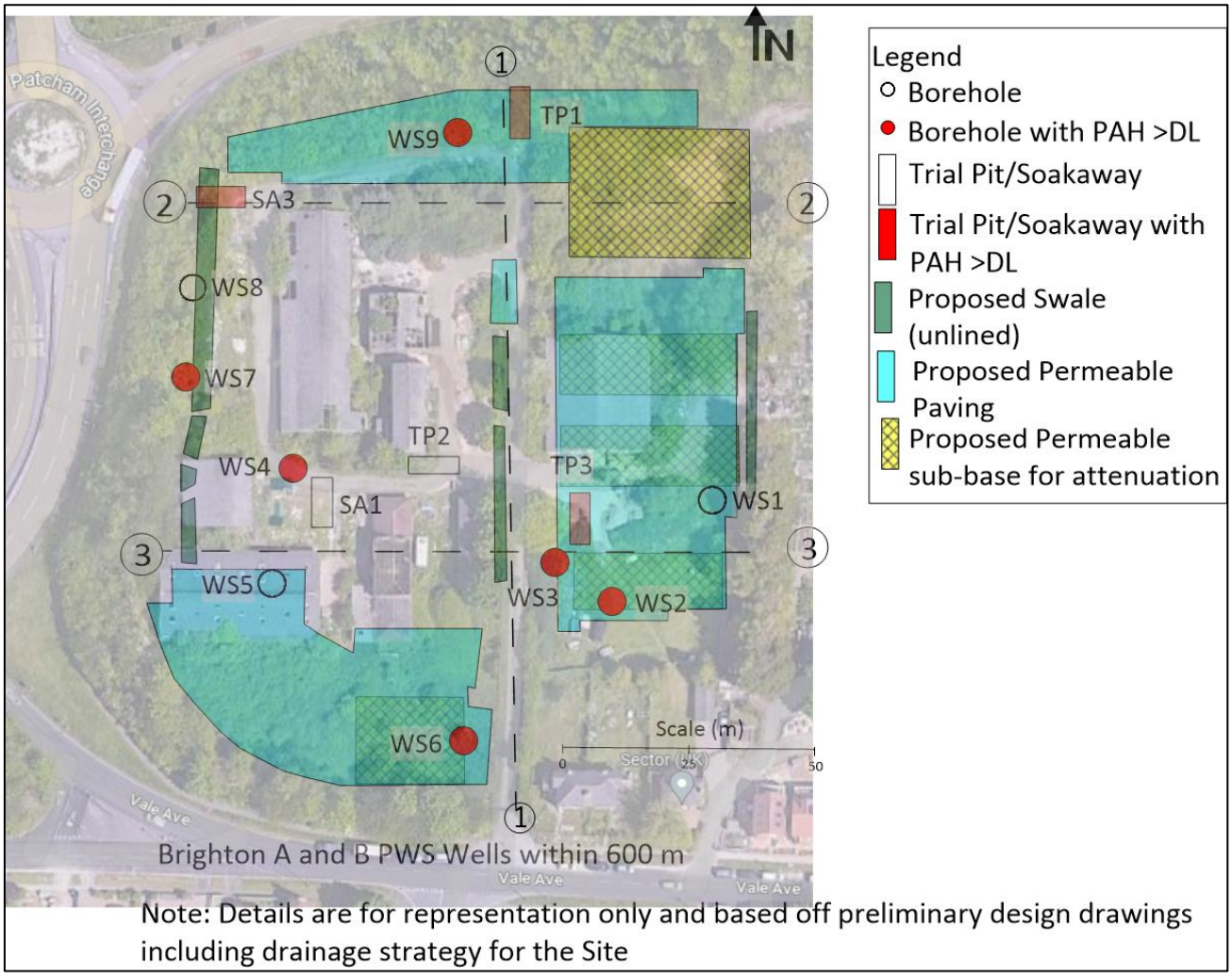
BEDROCK GEOLOGY

The Seaford Chalk Formation, comprising firm white chalk with conspicuous semi-continuous nodular and tabular flints[2] directly underlies the Site. The 2016 and 2019 GI's completed boreholes to a depth of 4.0m BGL and intercepted the Seaford Chalk Formation. The GI described the Chalk as being structureless, composed of silty angular to sub-rounded fine and medium gravel (weak to low density) with angular fine gravel of flint. The depth to base of the Chalk has not been proven on site but the thickness of the Chalk can range between 50m and 80m in the Sussex area[2].

Figure 2 presents the ground investigation locations from 2016 and 2019.

LAND QUALITY

Figure 2- Ground Investigation locations with preliminary drainage design details overlain



Across the Site, the most frequently detected substances identified from the ground investigations are Polycyclic Aromatic Hydrocarbons (PAH). PAH compounds are widely distributed across the Site, with detections in the north, south and west of the Site. The ground investigation locations where PAH compounds were detected above the laboratory detection limit are presented in Figure 2. Concentrations of metals were identified in soils; however, they did not exceed the human health Generalised Acceptance Criteria for commercial developments. Total Petroleum Hydrocarbon - Criteria Working Group analysis (TPH-CWG) was undertaken also, with detection of heavy end (C21-C34 Aliphatic, C16-C21 Aromatic and

C21 -C35 Aromatic), petroleum hydrocarbons. Additionally, aromatic hydrocarbons were typically at higher concentrations than aliphatics.

PAH compounds are present widely across Site, as presented in Figure 2. The frequent yet sporadic occurrences of PAH compounds, accompanied by the shallow depths to which they are detected is indicative of a series of surface dispersals or spills over time. Soil samples are of a limited number, with samples taken from a shallow depth, the deepest soil sample scheduled for laboratory analysis was taken from 0.6 m bGL, with samples most frequently taken between 0.10 and 0.30 m bGL. As a result, any assessment of contamination at depth has not been undertaken and may require verification sampling and analysis during further works at the Site.

HYDROGEOLOGY

The Seaford Chalk Formation is designated as a Principal Aquifer that supports water supply and/or river base flow on a strategic scale[6]. The Aquifer Properties Manual[7] and Hydrogeological Map[8] provides information on aquifer properties in the absence of site-specific information. As with most chalk aquifers it is the zone of water table fluctuation that is believed to be most important for groundwater flow in the South Downs and active fractures (conduit system) at different depths that are present[7]. The Chalk of the South Downs shows some evidence of karstic development and in several catchments groundwater flow is extremely rapid and associated with relatively few, large diameter fractures[7]. The degree of fissure development, which largely controls yields, which from the Upper Chalk (Seaford Chalk Formation) commonly range from 3 to 264 l/s[8] (litres per second).

An extensive adit system was built within the Chalk aquifer during the second half of the nineteenth century and early part of the twentieth century[9]. Southern Water have confirmed that one of their PWS wells is intercepted by this is extensive adit system and have identified that an easterly trending adit roof is located at 7.11m AOD (approx. 49.50m BGL) in the area. The Southern Water adit broadly trends in an easterly direction from their PWS well (approx. 600m from the Site) to the eastern boundary of Patcham Caravan Park (approx. 350m north-east of the site).

The Site is located within SPZ 1 (Figure 1) which is defined as a 50-day travel time from any point below the water table to the source (in this case, Southern Water PWS wells) or a minimum 50-metre radius from

[6] BGS (2023) Aquifer Designation Dataset for England and Wales. Accessed March 2023 online at https://www.data.gov.uk/dataset/616469ae-3ff2-41f4-901f-6686feb1d5b6/aquifer-designation-dataset-for-england-and-wales

[7] Allen, DJ., Brewerton, LJ., Coleby, LM., Gibbs, BR., Lewis, MA., MacDonald, AM., Wagstaff, SJ., and Williams, AT (1997) The physical properties of major aquifers in England and Wales. British Geological Survey Technical Report WD/97/34. Environment Agency R&D Publication 8

[8] BGS Hydrogeological Map Sheet of the South Downs and adjacent areas. Accessed March 2023 online at https://largeimages.bgs.ac.uk/iip/mapsportal.html?id=1003976

[9] Mustchin CJ (1974) Brighton's water supply from the Chalk 1834 – 1956: A history and description of the heading systems. Brighton Corporation Water Department, Brighton

the source, whichever is larger[10]. It is usually located immediately adjacent to the well, although in karst terrain can be remote. The Site is also located within a Nitrate Vulnerable Zone and falls within a high groundwater vulnerability risk which means that the ground at this location is at risk of contamination from surface contaminants. The BGS Hydrogeological Map Sheet[8] identifies a public water supply at approx. NGR TQ 29557 09319 which is assumed to represent Southern Water's PWS well. No additional information on yields (daily/annually) are provided on the map sheet but it is evident that the groundwater contours within the Chalk are strongly influenced by public water supplies within the wider catchment area.

GROUNDWATER LEVEL

No groundwater was encountered during the 2016 and 2019 GI's therefore groundwater at the Site is deeper than investigated.

BGS Hydrogeological Map Sheet[8] illustrates groundwater contours within the Chalk and identifies groundwater elevations around Proposed Development to be between 40m AOD and 50m AOD. Groundwater contours for the Chalk are strongly influenced by pumping within the catchment area.

The EA provided continuous groundwater level monitoring data for two OBH (Ditchling and Ladies Mile) and manual groundwater level dips for all OBH within the wider catchment area (Figure 1).Although this data is not considered to be directly representative of groundwater conditions on the site, it has been used to identify the scale of seasonal response in groundwater level that may be occurring within the wider catchment under similar hydrogeological conditions.

Continuous and manual dip data are available between 2001 and 2023, however this report has focused on the last five years (2018 – 2023). Lower Standean has been excluded from any interpretation where monthly manual dips are only available for 2001. The EA also provided rain gauge data for the Plumpton and Ditchling Road rain gauges (Figure 1). Considering the distance from the Site and frequency of data (daily records between 1983 and 2023), Ditchling Road rain gauge has been used to identify any seasonal response in groundwater level.

Groundwater level hydrographs for Ditchling Road and Ladies Mile have been plotted against the total monthly rainfall for Ditchling Road between 2018 and 2023. The data was plotted to identify the response in groundwater level to rainfall. From the data presented on Figure 3 the Chalk aquifer appears to be sensitive to precipitation with a typical time lag of approximately two months.

[10] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/822402/Manual-for-the-production-of-Groundwater-Source-Protection-Zones.pdf

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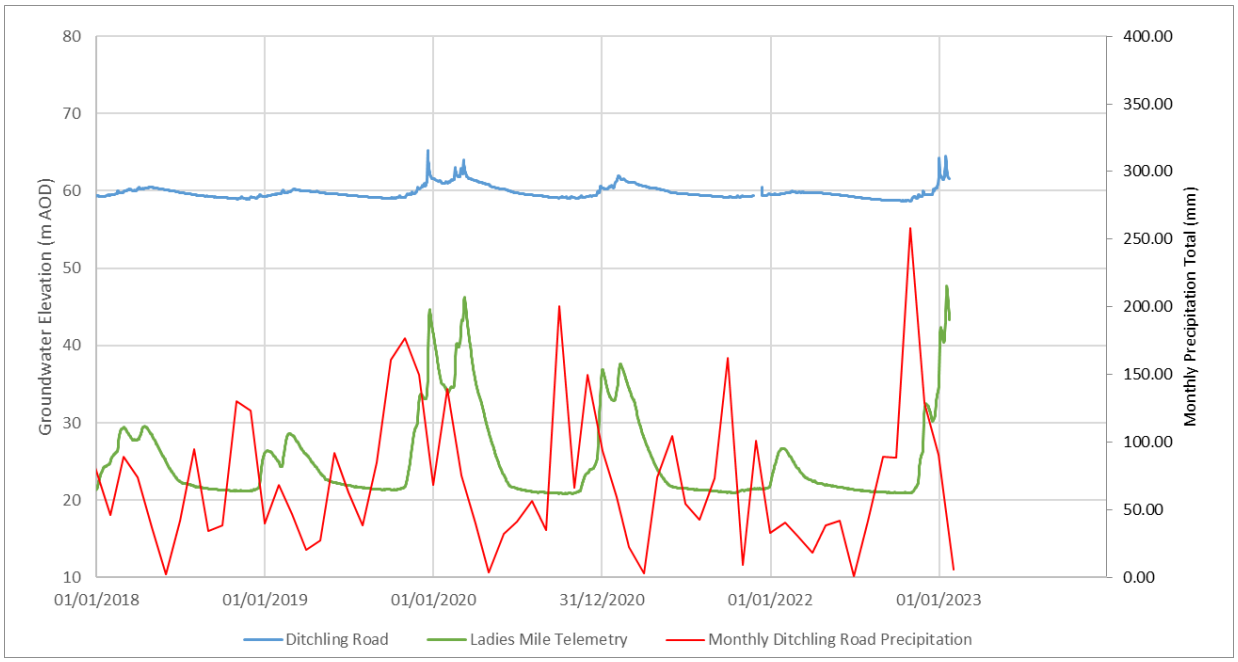
The variability in groundwater elevations between Ditchling Road and Ladies Mile are substantially different and may reflect the influence of boundary conditions or differing degrees of aquifer storage.

Figure 3- Comparison of Groundwater Elevations for Ditchling Road and Ladies Mile OBH and Rain Gauge data for Ditchling Road



Southern Water provided continuous groundwater level monitoring data and manual groundwater level dips for the Brighton B public water supply well (Figure 4) between 2004 and 2023. Groundwater elevations have fluctuated between a minimum elevation of 6.52 m AOD and a maximum elevation of 50.25 m AOD. Groundwater elevations are typically highest in winter months with a minimum towards late summer months. The 5th and 95th percentile groundwater elevations are 9.35 m AOD and 38.13 m AOD respectively.

No matching rain gauge data has been obtained for Brighton, with confirmation of the absence of this data obtained in the consultee meeting on 29 March 2023. For indicative purposes, the Brighton B WSW groundwater elevations have been plotted against the Ditchling Road rain gauge (Figure 4Figure 4).

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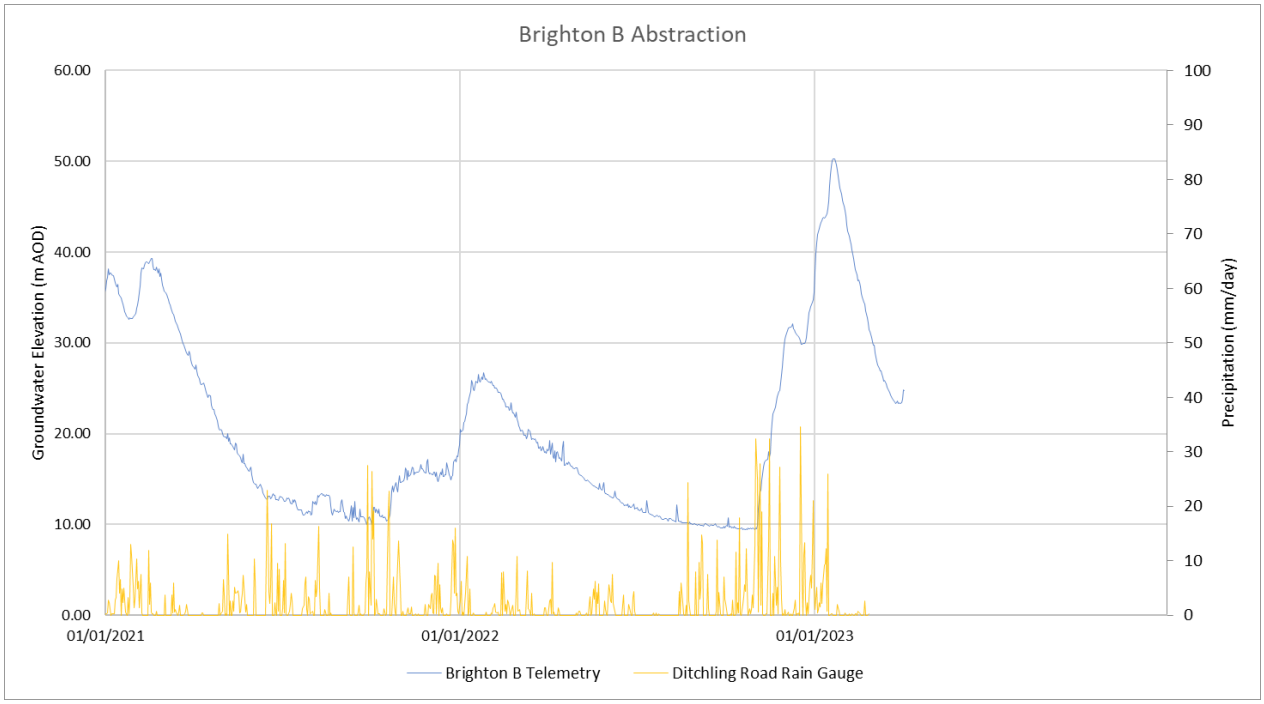
Figure 4- Comparison of Brighton B Public WSW Groundwater Elevations and Ditchling Road Rain Gauge



The data was plotted to identify the seasonal variation in groundwater level in response to rainfall. It is shown on Figure 4 that there is a seasonal response of groundwater elevation at the Site that principally responds to variations in rate of recharge. In such a system, recorded groundwater levels typically rise following heavy rainfall and decrease as rainfall decreases. Nonetheless, the principal Chalk aquifer appears to be sensitive to precipitation with a typical time lag of approximately two months.

The responses observed at Brighton B WSW corroborate the responses observed at Ditchling Road and Ladies Mile EA OBH Sites.

A two-month lag in recharge effects being observed is indicative of the time taken for the recharge to pass through the unsaturated zone of the Chalk.

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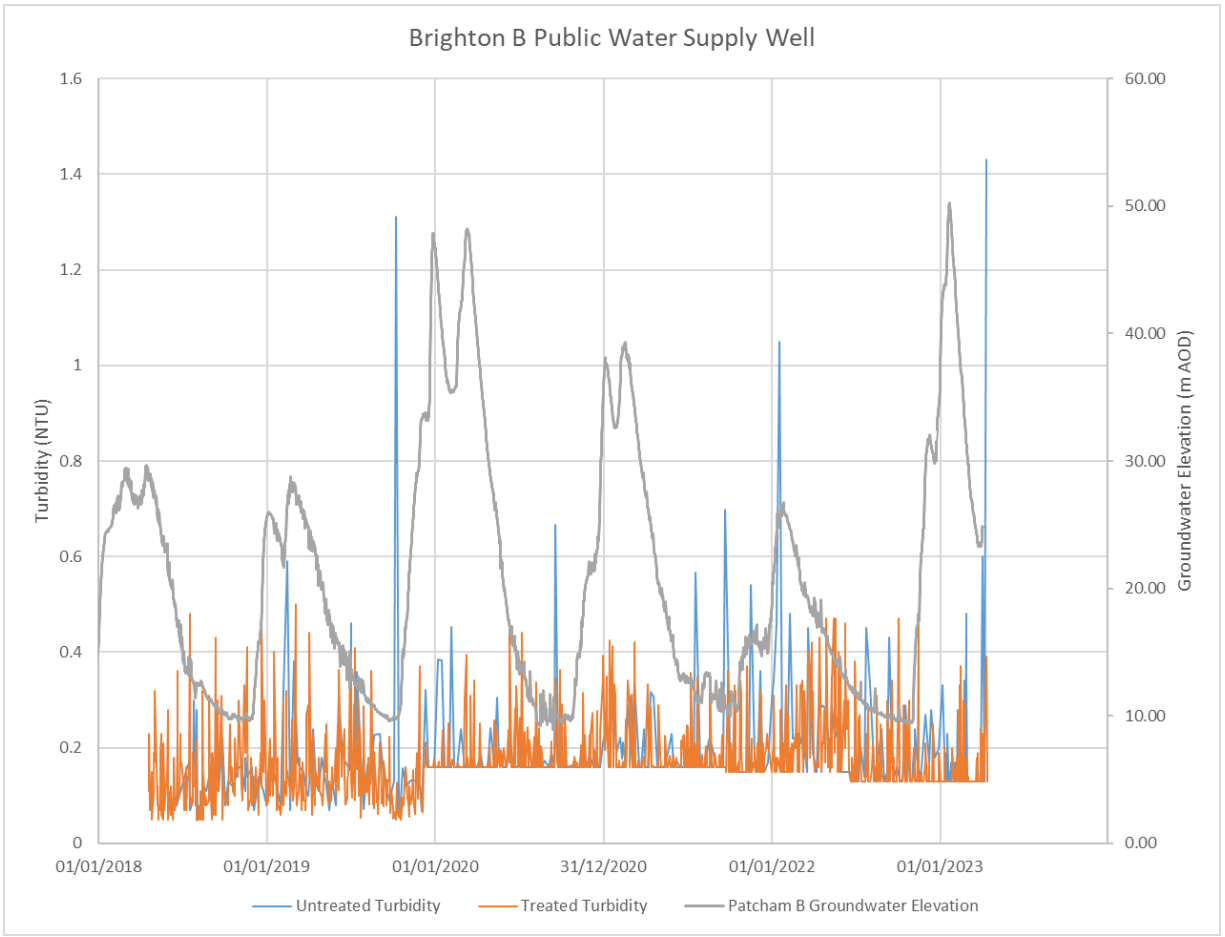
GROUNDWATER QUALITY

Groundwater quality data are available for Brighton B PWS. Southern Water provided pre and post treatment water quality data and this report focuses specifically on turbidity. SW implement an alarm system at 0.5, 0.7, and 1.0 NTU, with shutdown protocols if turbidity exceeds these levels. To maintain acceptable turbidity levels in abstracted water, a network of Amazon Filters is installed. Pre and post filtration turbidity in abstracted groundwater are presented in Figure 55. Pre and Post treatment turbidity concentrations have been included for comparison purposes.

Figure 5- Comparison of Pre and Post treatment Turbidity at Brighton B Public Water Supply Well against Groundwater Elevations



Raw (untreated) turbidity concentrations are typically low, with mean concentrations of 0.20 NTU (2 d.p) for the period 1 April 2018 to 1 April 2023, with a median concentration of 0.16 NTU. Both these concentrations are below the lowest alarm level of 0.5 NTU. Nine laboratory turbidity measurements exceed the lowest alarm level of 0.5 NTU, and three measurements exceed the 0.7 and 1.0 NTU alarm levels. The maximum untreated turbidity measurements have been measured at 1.43 NTU.

Pre-treatment turbidity concentrations have been compared to groundwater elevation rates to analyse the impact that the groundwater elevation has on the turbidity concentrations. Based on a visual analysis of the data, whilst a visible correlation is present it is considered likely that this may be linked in part to the rate of recharge which is also correlated to groundwater elevation.

Whilst there are sporadic alarm exceedances for turbidity in untreated groundwater, post treatment turbidity concentrations have remained below the minimum alarm levels across the monitoring period.

HYDROGEOLOGICAL CONCEPTUAL MODEL

A cross-section depicting the conceptual model for the Site is presented in Appendix A.

Source

Following a review of the conceptual site model, the presence of contaminants within the Made Ground on the development Site is considered to be a source. This source term for the site is characterised by detectable PAH concentrations as well as long chain aliphatic and aromatic petroleum hydrocarbons. Figure 2 illustrates where concentrations of PAH above the laboratory detection limit were located from the 2016 and the 2019 ground investigations. Detected PAH concentrations were typically found in the northern and southern portions of the Site, with the highest concentrations found at borehole WS6 in the north of the Site. Made Ground is also deepest at this location with belief that this Made Ground was used to backfill a former pond.

Use of plant and vehicles can provide a source of contaminants of fuel and lubricants associated with refuelling, maintenance and accidents for example by spills or damage to hydraulic pipework.

The excavation of Made Ground, excavation of Chalk, stockpiling and construction works can generate sediment which can be mobilised in runoff. Sediment once in groundwater can increase the turbidity of the water.

Pathway

The pathway between surface processes at the Site and the underlying Chalk aquifer is approximately 20m of unsaturated Chalk. An indicative two-month lag has been observed between rainfall and groundwater elevation response. This indicates that typically in the catchment the recharge is passing through the unsaturated Chalk to the aquifer rather than by bypass flow through preferential flow pathways such as fissures, fractures and karst.

During the earthworks the surface of the Chalk will be excavated in some areas. This could include the excavation of impermeable ground coverings, weathered Chalk and Chalk with infilled fissures. The removal of these layers could expose fissures, fractures and karstic solution features to the formation level of the excavation. These new preferential pathways may allow more rapid infiltration to ground than

previously and hence reduce the attenuation capacity of the unsaturated zone with regard to dissolved phase contaminants and sediment.

Receptor

The site is located within a SPZ 1, which is characterised as having a 50-day travel time to the receptor. The receptor is the public water supply wells (Brighton A and B) at the Waterhall pumping station, located 600m west of Site. These are located in the Principal Aquifer of the Seaford Chalk Formation.

Southern Water have detailed an adit associated with the wells which aligns in an east-west orientation 150m north of the Site boundary. The adit has a roof elevation of 7.11m AOD which is in the order of 50m below the Site.

The Primary receptor is the Chalk groundwater which is estimated to be in the order of 20m below the Site. A Secondary receptor is the adit to the PWS which is located 50m below and 150m of the Site.

IMPACT FROM PROPOSED DEVELOPMENT

A conceptual understanding of the groundwater conditions at the Site during its lifecycle is provided. The Conceptual Site Model (CSM) forms the basis for discussions about the potential interaction and hydraulic connectivity of the Proposed Development and underlying principal Chalk aquifer.

Construction Phase Impacts

The following construction phase risks over the current site setting are identified:

- Excavation of ground potentially exposes dissolution features that would have been previously covered. This could allow for more rapid infiltration directly to the dissolution feature which could either mobilise sediment already present in the Chalk or by allowing more rapid infiltration a reduction in the attenuation capacity of the unsaturated zone.
- Spills associated with the refuelling of plant increase the risk to the asset without mitigation.
- Spills of hydraulic fluid due to damage to plant increases the risk to the asset without mitigation.
- Stockpiling of excavated Made Ground has the potential to contain contaminants identified to be present by the site investigation. Infiltration and runoff from the stockpiles have the potential to allow migration of these contaminants to dissolution features or preferential pathways which could impact on groundwater quality without mitigation.
- Stockpiling of excavated Made Ground and Chalk has the potential to allow migration of sediment in runoff to enter dissolution features or preferential pathways which could impact on groundwater turbidity without mitigation.

Operational Phase Impacts

The potential risks during the Operational Phase have been screened to be related to the management of runoff and infiltration. The preliminary drainage strategy for the Site is discussed in Mott MacDonald's Stage 2 Report[11] and Flood Risk Assessment[12]. The design makes use of green roofs, permeable paving, geocellular storage and swales. The preliminary drainage strategy is currently unlined. The design limits the peak flow rate as close to greenfield runoff rates as is reasonably practicable using a series of orifice plates and vortex flow controls to limit the flow to 5.0L/s in critical 1 in 100 year (+25% climate change event), before discharging to the combined sewer under Vale Avenue[12]. This is owned/operated by SW and a discharge rate is yet to be agreed with the Local Authority and SW.

The following operational phase risks over the current site setting are identified:

- Use of Permeable paving materials on carparks and access roads which will carry conventional combustion engine vehicles will have the potential to discharge hazardous pollutants from fuel spills or oil leaks into groundwater.
- Alignment of swales and permeable surfaces along the alignment of current hotspots in Polycyclic Aromatic Hydrocarbons. Increased infiltration associated with SuDS drainage features may permit mobilisation of contaminants to groundwater.

MITIGATION MEASURES

Construction Phase

During the Construction Phase there are several work practices that can be employed to provide mitigation of the identified risks. These are detailed below:

- To mitigate the risk potential of existing ground contamination in the Made Ground, all Made Ground will be stripped from the Site a part of preparatory works. The Made Ground will not be stockpiled or stored at the Site for extended periods of time. This will remove the long-term risk of ground contamination associated with the Made Ground and remove the potential for turbidity risk associated with runoff from open stockpiled areas.
- Potential pathways to ground, for example monitoring boreholes will be decommissioned to eliminate potential discharge of contaminants to below ground. Decommissioning of the monitoring well with bentonite grout to ensure the potential pathways are sealed.

[11] Mott MacDonald (2021) RMG Brighton DO Stage 2 Report. Reference: BDO-MMD-XX-XX-RP-S-0001
[12] Mott MacDonald (2022) RMG Brighton Flood Risk Assessment

- During excavation of the Chalk a working brief will be adopted to document, where present, the existence of fissures, fractures and karst in the Chalk that could form a preferential pathway for bypass flow through the unsaturated zone. Where identified they will be documented and mapped. If necessary, the construction phase drainage will be altered to prevent runoff containing sediment to enter them by the establishment of temporary bunds or swales.
- Excavations for the reprofiling of the Site, foundation excavations and drainage features should be undertaken over summer months when dry weather is expected to prevail. These precautionary measures will reduce the potential likelihood of contaminants entering the Principal Aquifer whilst also reducing the likelihood of mobilisation and suspension of fine particles, thus increasing the turbidity of water within the aquifer.
- Communication of Site activities with Southern Water should be undertaken to ensure that appropriate protection measures at the Public WSW are in place. Southern Water have detailed that Amazon Filters are in place at Brighton A and B, however increased testing of water quality may be advised during periods of groundworks to ensure the maintained quality of groundwater.
- All refuelling of plant machinery is to be undertaken in designated area of Site. All fuel containers to be fully bunded. Spill pads/plant nappies to be utilised on all plant machinery where applicable. All refuelling to be undertaken as detailed in Construction Environmental management Plan (CEMP) which is to be agreed with Southern Water. All plant machinery is to be operated within its Safe Working Loads, with hydraulics to be inspected on a route basis.
- In the event of an environmental incident, for example a hydraulic oil spill from damaged plant, the spill will be contained and removed. Southern Water will be notified within an agreed timescale.

Operational Phase

During the Operational Phase there are a number of design and work practices that can be employed to provide mitigation of the identified risks. These are detailed below:

- Runoff will be managed through the use of permeable paving and swales for all but the HGV (heavy goods vehicle) area of the site[12]. Runoff from the HGV area will be drained using a separate collection system and is proposed to pass through a full retention separator[12] in order to mitigate risk from sources of contaminants associated with this area.
- If the use of access roads or carparks are for delivery vehicles, which are all proposed to be electric, then permeable paving is considered to be adequate. Where roads or carparks are to be used for combustion engine vehicles, then lining the permeable system or impermeable surfaces will be sought in order to mitigate risk from potential fuel or oil leaks.

RISK SCREENING

The potential impacts from construction and operational phases of the development; and their mitigations summarised above have been incorporated into a risk screening tool.

The significance level attributed to each effect has been assessed based on the magnitude of change due to the proposed development and the importance of the affected receptor. The importance of the affected receptor is assessed on a scale of very high, high, medium and low, and the magnitude of change is assessed on a scale of major, moderate, minor and negligible.

The significance of a specific potential effect is derived from both the importance of the receptor and the magnitude of the change. Table 1 outlines the significance matrix that will be used to determine the extent of the effect on each receptor.

Table 1. Significance Matrix

Importance/Value of Receptor		**Very High**	**High**	**Medium**	**Low**
Magnitude of effect	Major	Major	Major/Moderate	Minor/Moderate	Negligible
	Moderate	Major/Moderate	Moderate	Minor	Negligible
	Minor	Moderate	Moderate/Minor	Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

The risk screening for the construction phase is presented in Table 2.

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CHECKED:	Melanie Cross	**APPROVED:**	Richard Lansley

Table 2- Initial Qualitative Risk Assessment- Construction Phase

Activity	Initial Risk			Mitigation Measures	Revised Risk		
	Value of Receptor	Magnitude of Effect	Significance		Value of Receptor	Magnitude of Effect	Significance
Presence of disused monitoring well (WS2) that are a potential pathway to ground.	High	Minor	Moderate/ Minor	Ensure boreholes are decommissioned with bentonite grout to ensure possible pathway is sealed.	High	Negligible	Negligible
Refuelling of plant machinery leading to potential spills to ground.	Very High	Moderate	Major/ Moderate	All refuelling to be undertaken in designated area of Site. All fuel containers to be fully bunded. Spill pads/plant nappies to be utilised on all plant machinery where applicable. All refuelling to be undertaken as detailed in Construction Environmental Management Plan (CEMP)	Very High	Negligible	Negligible
Loss of hydraulic oil to ground through burst hydraulic pipes	Very High	Moderate	Major/ Moderate	All works to be undertaken as detailed in Construction Environmental management Plan (CEMP). All plant to work within its safe operating loads. Hydraulic pipes to be inspected daily. In the event of an environmental incident the spill will be contained and removed, and Southern	Very High	Negligible	Negligible

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Activity	Initial Risk			Mitigation Measures	Revised Risk		
	Value of Receptor	Magnitude of Effect	Significance		Value of Receptor	Magnitude of Effect	Significance
				Water notified within an agreed reasonable timescale.			
Excavation of material leading to increased infiltration.	High	Moderate	Moderate	Excavate in discrete phases with restoration of phase prior to moving to next phase. Earthworks management to include the diversion of runoff from excavated surfaces.	High	Negligible	Negligible
Stockpiling of potentially contaminated materials, resulting in increased leaching of contaminants	High	Minor	Moderate/ Minor	Prevention of large stockpiles of material on Site. When excavating made ground or potentially contaminated material, undertake efficient stockpile management to be undertaken with appropriate material removal from site.	High	Negligible	Negligible
Increased turbidity associated with disturbance through earthworks, or increased infiltration of clean water mobilising fines within the fractured chalk.	Very High	Major	Major	PWS has a criteria of 3 NTU to comply with water framework directive for potable drinking water. Ensure appropriate and clear communication with Southern Water to increase testing during earthworks.	Very High	Minor	Moderate

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Activity	Initial Risk			Mitigation Measures	Revised Risk		
	Value of Receptor	Magnitude of Effect	Significance		Value of Receptor	Magnitude of Effect	Significance
				Southern Water to ensure Amazon Filters are in place			
Use of site derived material as fill for creation of level platform for founding slab.	Medium	Moderate	Minor	Ensure material excavated is appropriately characterised and sampled. Soils and Chalk to be appropriately segregated. Clean chalk to be segregated for use as fill material.	Low	Minor	Negligible
Fissures, fractures and karstic dissolution features within the chalk being uncovered during excavation.	Very High	Major	Major	Ensure a watching brief is implemented during all excavation works. If a karstic feature, or suspected feature, is encountered, excavation works to cease, and contact to be made with a Hydrogeologist and Southern Water. Review Construction Phase Drainage Strategy on-site if karstic features encountered.	Very High	Minor	Moderate

The risk screening for the operational phase is presented in Table 3.

Table 3- Initial Qualitative Risk Assessment- Operational Phase

Activity	Initial Risk			Mitigation Measures	Revised Risk		
	Value of Receptor	Magnitude of Effect	Significance		Value of Receptor	Magnitude of Effect	Significance
Fuel leaks from combustion engine vehicles	Very High	Moderate	Major/ Moderate	Ensure staff park vehicles in designated staff car park. Ensure staff car park s of impermeable/lined design. Ensure main access road/areas where Heavy Goods Vehicles will access are impermeable/lined in design. RMG Vehicles are proposed to be electric. No risk of fuel leaks from these.	Very High	Negligible	Negligible
Potential ground contamination impacting groundwater.	Very High	Minor	Moderate	Contaminated material to be removed and disposed of off-site during the construction phase. Fill material to be derived of clean chalk, thus preventing contamination being laid down. Areas of potential above ground contamination to be lined or impermeable.	Low	Negligible	Negligible

Fissures, fractures and karstic dissolution features within the chalk being uncovered during excavation.	Very High	Major	Major	If a karstic feature, or suspected feature, is encountered during construction review the Drainage Strategy of the constructed site and its operation.	Very High	Negligible	Negligible
Surface water drainage from car parking areas and roads has the potential to contain pollutants and hazardous substances	Very High	Moderate	Major/ Moderate	In the event of an environmental incident in an area where recharge has the potential to enter the surface water management system the spill will be contained and removed, and Southern Water notified within an agreed reasonable timescale.	Very High	Negligible	Negligible

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CONCLUSIONS AND RECOMMENDATIONS

In the absence of Site based groundwater data, a qualitative Hydrogeological Impact Assessment of the proposed development at Patcham Court Farm has been undertaken that takes in to account local groundwater data to define a Conceptual Site Model for the Site during its Construction and Operational Phases.

Risks to the quality of supply of the Brighton A and Brighton B assets have been considered for the Construction and Operational phase. Where the screening of risk has identified that the potential for risk to these assets has exceeded Moderate, then mitigation has been proposed to reduce the risk to within acceptable limits.

Based on the preliminary design drawings, a greater level of detail is required, with conversations to be had between RLB, developers, and Southern Water. It was accepted during the first consultation meeting with Southern Water (15 March 2023) that greater detail on car parking and drainage designs need to be provided, notably for the staff car park where combustion engine vehicles may be present. In addition details on where SuDS features are unlined or lined should go some way to clarify and ease concerns.

A clear and robust communication network between RLB, developers and Southern Water needs to be implemented prior to any works commencing, with communications of expected dates and timelines of earthworks being undertaken. All works bulk earthworks should be undertaken during summer months where practicable to coincide with expected drier conditions, thereby reducing potential leaching of contaminants , and reducing potential mobilisation of sediment and increasing turbidity of water at the asset.

Completion of a CEMP must be undertaken prior to works commencing, with sign-off and confirmation of satisfactory protection measures from Southern Water.

Earthworks should be undertaken in an efficient and timely manner, with restoration and infill to the level required for the development platform prior to advancing.

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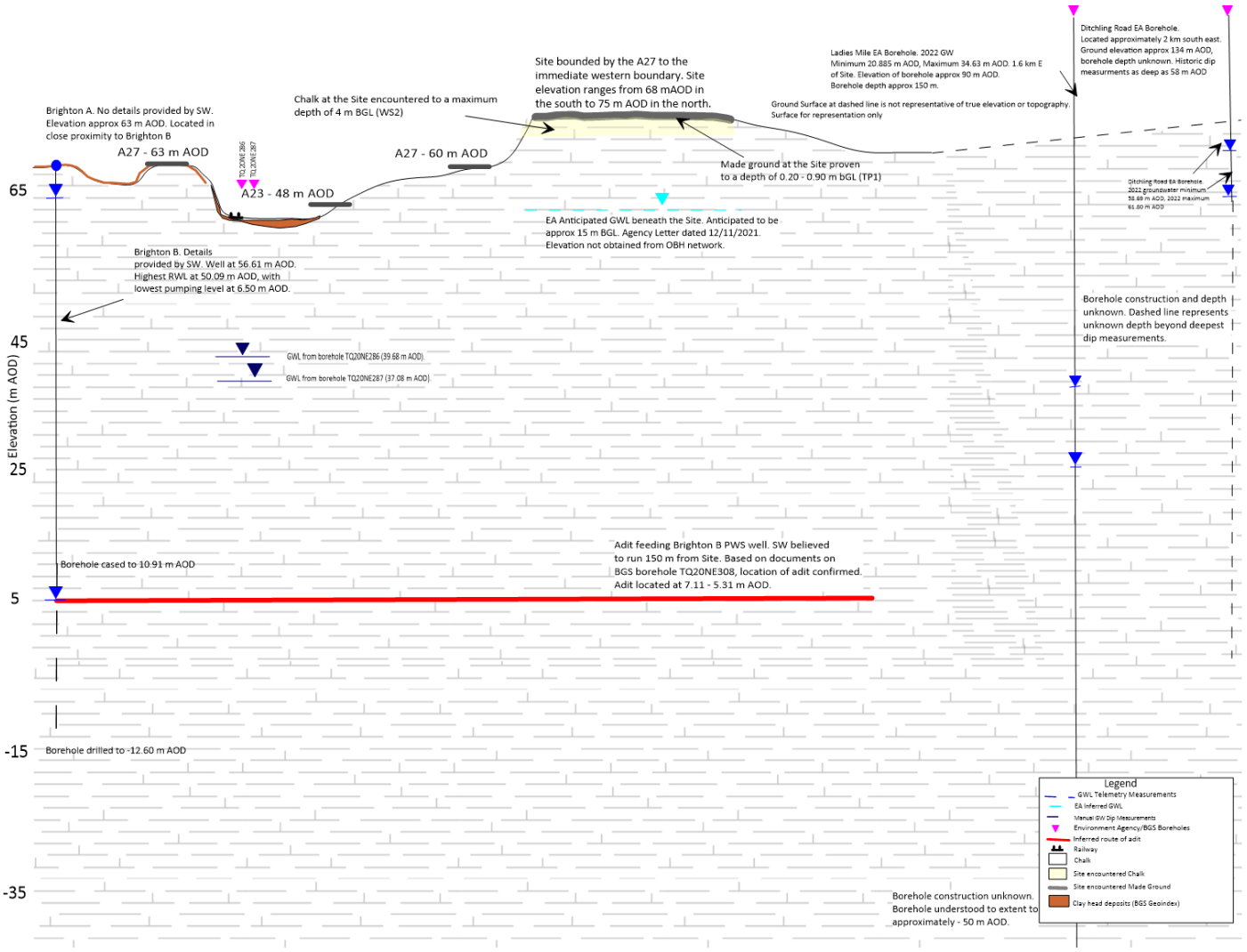
APPENDIX A – CONCEPTUAL SITE MODEL



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APPENDIX B – CROSS SECTIONS OF SITE CONSTRUCTION