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Contents

Tables

Figures

Summary

Mott MacDonald Limited was appointed by Anglian Water Services Limited to provide a Preliminary Risk Assessment for the proposed relocation and construction of the Cambridge Waste Water Treatment Plant (WWTP). A site selection process, comprising a number of detailed appraisal steps was developed to identify sites that may be suitable for the relocation of the WWTP to replace the existing Cambridge WWTP. The preferred site option, site 3, is located 1.3km to the east of the existing Cambridge WWTP, within the administrative boundary of South Cambridgeshire District.

The Proposed Development comprises the following components:

- A new WWTP, at site 3. The proposed WWTP will include inlet works, several sets of above-ground tanks and buildings for various purposes in the treatment process, digesters, a gas holder and flare stack, as well as offices. The proposed WWTP will require an operational footprint of up to 22 hectares (22ha);
- Proposed landscaping around the proposed WWTP, including surface water drainage features, which would be in addition to the 22ha operational footprint;
- A tunnel transferring waste water from the existing Cambridge WWTP to the proposed WWTP;
- Shafts associated with the transfer tunnel. The shafts would be located at the existing Cambridge WWTP and at the proposed WWTP, and at intermediate locations as required for tunnel construction.
- Discharge pipelines, or a tunnel (with associated shafts), transferring the treated effluent from the new WWTP to an outfall on the River Cam.
- A new outfall for discharge of the treated effluent close to the location of the existing outfall on the River Cam, just downstream of the A14 crossing.
- Access to the WWTP site via the existing road network and any new private access roads required.
- A new transfer pipeline bringing waste water from the proposed development of Waterbeach New Town, which lies to the north of Cambridge, to the new WWTP. The existing Waterbeach water recycling centre (WRC) does not have sufficient capacity to accommodate the additional flows.

The pipeline routes will likely be a mix of open cut trenches and ~~horizontal directional drilling (HDD~~trenchless techniques~~)~~. They will be at an average depth of 2 to 5m with the exception of the crossing points beneath the River Cam and the Fen Line railway which will be deeper.

The site of the existing Cambridge WWTP is being assessed only in terms of the infrastructure on the site that will connect to the proposed WWTP as part of the development. The final proposed site use for the existing Cambridge WWTP (residential land use) is outside the scope of this report.

The preliminary ground investigation in the area of the proposed WWTP indicates that the ground conditions are anticipated to be:

- Topsoil and superficial deposits (comprising River Terrace Deposits) (to 0.8m below ground level (bgl)) – Brown slightly clayey or silty, gravelly fine to medium sand.

- West Melbury Marly Chalk Formation (to 10.9mbgl) – Weak, low to medium density, off white Chalk with infilled fractures. Areas of extremely weak rock throughout, although the geological log does not refer specifically to any marl being recovered in the core.
- Gault Formation (to base of borehole, completed at 30.2mbgl) – Stiff fissured grey silty calcareous clay.

Groundwater was not encountered during drilling but was recorded within the Chalk at depths between 5.14 and 5.7m bgl (5.15 to 4.59m AOD (Above Ordnance Datum)) during monitoring.

BGS GeoIndex data suggests that the likely geology that would be encountered along the proposed Waterbeach Pipeline comprises:

- Superficial River Terrace Deposits North of Horningsea and form Clayhythe northwards, peat along the northern section of the proposed pipeline route and Alluvium associated with the presence of River Cam.
- West Melbury Marly Chalk Formation in the south and some of the central part of the route with Gault Formation beneath the remainder.

In addition, a cover of made ground associated with previous development may be expected locally.

A preliminary qualitative risk assessment was undertaken for the site and proposed Waterbeach Pipeline as detailed in this report, which indicates the following contamination risks:

- The risk to construction workers, final end users (WWTP workers) and occupants of nearby residential properties is determined to be very low, as no significant sources of contamination are anticipated to be present based on the site history and preliminary ground investigation results. It is assumed that appropriate mitigation measures will be in place:
  - A Construction Environmental Management Plan (CEMP) will be implemented prior to construction to ensure that impacts to construction workers and offsite migration of dusts, surface runoff etc during development are minimised.
  - As part of the construction and operation of the site it is assumed that workers adhere to a site-specific risk assessment and method statement.
- The risk to controlled waters is assessed as moderate/low (groundwater) to low (surface water). Risks to groundwater will need to be further assessed through a Foundation Works Risk Assessment (FWRA) to ensure that man-made contaminant transport pathways (such as pipelines, tunnels and shafts) do not create additional pathways to the aquifers that could result in adverse effects to groundwater quality. A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised (such as turbidity during shaft construction).
- Buried structures and infrastructure are at very low risk, assuming materials are designed for the prevailing ground conditions, following ground investigation.
- Risks to flora and fauna are assessed as very low since, with appropriate mitigation measures in place (CEMP), it is unlikely that the proposed works will increase the contamination risk to surrounding flora and fauna.

The following recommendations are proposed:

- Dewatering operations during development must ensure the appropriate disposal or discharge of groundwater should be informed by analysis of groundwater samples as groundwater may not be appropriate for disposal directly back to ground or surface waters.
- A Foundation Works Risk Assessment will likely be required to ensure piled foundations, pipelines, tunnels and shafts do not create additional contaminant pathways and any potential impacts on the underlying aquifers, such as turbidity, are managed. This should be completed once construction methods are confirmed and ground investigation data are available.
- Further assessment and appropriate management of excavated materials will be required during the works. Materials should be assessed for reuse in the development to minimise disposal requirements, and then be managed appropriately (e.g. under a materials management plan or waste exemption.

1 Introduction

1.1 Project background

1.1.1 A site selection process, comprising a number of detailed appraisal steps was developed to identify sites that may be suitable for the relocation of the waste water treatment plant (WWTP) to replace the existing Cambridge WWTP.

1.1.2 One of the first steps was an Initial Options Appraisal, which examined the strategic issues to be considered in investigating relocation options, and also identified the most appropriate area in which to search for new WWTP sites. The Initial Options Appraisal concluded that the preferred solution for the relocation of the existing Cambridge WWTP would comprise a single new WWTP, within a Study Area covering the existing Cambridge and Waterbeach drainage catchment areas (Mott Macdonald, 2020).

1.1.3 The next steps in the process were Stage 1 – Initial Site Selection, Stage 2 – Coarse screening, and Stage 3 – Fine Screening of the shortlisted site areas. These steps have progressively looked in finer detail at each site option for the relocated WWTP. The site selection exercise has assessed the suitability of potential site locations for the relocated WWTP including, in broad terms, the potential transfer infrastructure corridors to serve each site.

1.1.4 The final stage of the site selection process, Stage 4, applied the finest grain of screening to the three remaining shortlisted site areas and associated infrastructure requirements. The Stage 4 assessment used the information collated during the first three stages of the site selection process combined with the results of further technical feasibility assessments, initial environmental walkover surveys and phase one consultation to assess each of the site area options against one another. The remaining shortlisted sites to be assessed were I, J and L, which are now referred to as site areas 1, 2 and 3, respectively. This Preliminary Risk Assessment covers the preferred site option, site 3 alongside associated infrastructure. The site location and Scheme Order Limits can be seen in Appendix A, Figure A.1.

1.2 Scope of works

1.2.1 The objectives of this report are to:

- Establish the geological and hydrogeological conditions using existing available information;
- Identify site specific geo-environmental hazards/constraints to the Proposed Development;
- Produce a contamination conceptual site model (CSM) and preliminary qualitative risk assessment; and

- Provide recommendations with regards to ground investigations and any other surveys or assessments required.

1.3 Primary sources of information

1.3.1 Several reports and online resources have been reviewed as part of preparation of this report, including:

- Envirocheck Report by Landmark (2021), Order Number: 285568096_1_1
- Envirocheck Report by Landmark (2019), Order Number: 225020744_1_1
- Envirocheck Report by Landmark (2018), Order Number: 172033276_1_1
- British Geological Survey: Geoindex (2021), [online]
- British Geological Survey, BGS Boreholes Records (2021), [online]
- Atlas for Mott MacDonald (2021), [online]
- Zetica (2021) – online risk assessment tool and pre-desk study assessment
- AF Howland Associates (2020) A Report on a Ground Investigation for Cambridge Waste Water Treatment Plant Relocation, Cambridgeshire (Factual) (App Doc Ref 5.4.14.9)
- ~~Mott MacDonald, (2020) Cambridge WWTP Relocation, Stage 2 Coarse Screening~~
- ~~Mott MacDonald, (2020) Cambridge WWTP Relocation, Stage 3 Fine Screening~~
- ~~Mott MacDonald, (2021) Cambridge WWTP Relocation, Stage 4 Final Site Selection~~
- Mott MacDonald, (2021) Cambridge WWTP Relocation, Hydrogeological Impact Assessment (HIA) report (App Doc Ref 5.4.20.9)
- Mott ~~Macdonald~~ MacDonald (2018) Cambridge Water Recycling Centre, Geo-environmental Preliminary Risk Assessment.

1.4 Limitations

1.4.1 To the extent that this document is based on information obtained in previous or recent ground investigations, persons using or relying on it should recognise that any such investigation can examine only a fraction of the subsurface conditions. In any ground investigation there remains a risk that pockets or “hot-spots” of contamination or other hazards may not be identified, because investigations are necessarily based on sampling at localised points. Certain indicators or evidence of hazardous substances or conditions may have been outside the portion of the subsurface investigated or monitored, and thus may not have been identified or their full significance appreciated.

1.4.2 This document is issued for the party which commissioned it and for specific purposes connected with the above-captioned project only. It should not be relied upon by any other party or used for any other purpose.

1.4.3 We accept no responsibility for the consequences of this document being relied upon by any other party, or being used for any other purpose, or containing any error or omission which is due to an error or omission in data supplied to us by other parties.

1.4.4 This document contains confidential information and proprietary intellectual property. It should not be shown to other parties without consent from us and from the party which commissioned it.

1.4.5 Mott MacDonald is not insured for, and therefore will not undertake surveys to identify asbestos or provide any guidance on the treatment of asbestos, or similarly for toxic mould. Should the presence of asbestos or toxic mould be suspected during the course of the study, Mott MacDonald would recommend the appointment of a specialist contractor to address the issue and would not provide advice on risk or remedial measures.

2 Proposed Development

2.1 CWWTPR Project Description

2.1.1 In summary the Proposed Development will comprise of:

- an integrated waste water and sludge treatment plant.
- a shaft to intercept waste water at the existing Cambridge WWTP on Cowley Road and a tunnel/ pipeline to transfer it to the proposed WWTP and terminal pumping station. Temporary intermediate shafts to launch and recover the micro-tunnel boring machine.
- a gravity pipeline transferring treated waste water from the proposed WWTP to a discharge point on the River Cam and a pipeline for storm water overflows.
- a twin pipeline transferring waste water from Waterbeach to the existing Cambridge WWTP, with the option of a connection direct in to the proposed WWTP when the existing works is decommissioned.
- ancillary on-site buildings, including a Gateway Building with incorporated Discovery Centre, substation building, workshop, vehicle parking including electrical vehicle charging points, fencing and lighting.
- environmental mitigation and enhancements including substantial biodiversity net gain, improved habitats for wildlife, extensive landscaping over 72 ha, a landscaped earth bank enclosing the proposed WWTP, climate resilient drainage system and improved recreational access and connectivity.
- Renewable energy generation via anaerobic digestion which is part of the sludge treatment process that produces biogas designed to be able to feed directly into the local gas network to heat homes, or as an alternative potential future option burnt in combined heat and power engines.
- renewable energy generation via solar photovoltaic and associated battery energy storage system.
- other ancillary development such as internal site access, utilities, including gas, electricity and communications and connection to the site drainage system.
- a new vehicle access from Horningsea Road including for Heavy Goods Vehicles (HGV's) bringing sludge onto the site for treatment and other site traffic.

2.1.2 The pipeline routes will likely be a mix of open cut trenches and ~~horizontal directional drilling (HDD)~~trenchless techniques. They will be at an average depth of 2 to 5m with the exception of the crossing points beneath the River Cam and the Fen Line railway which will be deeper.

2.1.3 The existing Cambridge WWTP is being assessed only in terms of the infrastructure on the site that will connect to the proposed WWTP. The final proposed site use for

the existing Cambridge WWTP (residential land use) is outside the scope of this report and have been assessed within a separate report (Mott Macdonald, 2018).

2.1.4 The precise routes of proposed tunnels and pipelines, and locations of the outfalls may vary but these will be located within the Scheme Order Limits, as shown in Appendix A, Figure A.1.

2.2 Site description and topography

2.2.1 The site location and Scheme Order Limits can be seen in Appendix A, Figure A.1. The site description has been separated into four sections:

- The proposed WWTP which is located in the south east
- The existing Cambridge WWTP which lies in the south west
- Infrastructure associated with proposed WWTP which lies between the existing Cambridge and proposed WWTP. This includes:
  - the wastewater transfer tunnel which connects from the existing Cambridge WWTP to the proposed WWTP (and shafts associated with the wastewater transfer tunnel)
  - the treated effluent pipeline which connects from the proposed WWTP to the River Cam where the effluent will discharge.
- The Waterbeach Pipeline.

2.2.2 The description of these four sites are detailed below.

Proposed WWTP

2.2.3 The preferred site option, site 3, is located 1.3km to the east of the existing Cambridge WWTP, within the administrative boundary of South Cambridgeshire District Council. The site (Scheme Order Limits in Appendix A, Figure A.1) the size of the proposed WWTP covers a total area of 127ha.

2.2.4 The proposed WWTP lies between the villages of Horningsea to the north, Stow Cum Quy to the east and Fen Ditton to the south east. The A14 extends along the south western boundary of the site and Low Fen Drove Way, an unclassified road and public byway, follows parts of the eastern and north eastern boundary of the site area. Beyond Low Fen Drove Way, the open farmland extends to the north east towards and beyond Stow Cum Quy Fen (a SSSI), and to the east, towards Stow Cum Quy village. To the west of the proposed WWTP lies Junction 34 of the A14, a junction intersected by Horningsea Road which extends north, parallel to the western boundary of the site area. Horningsea Road connects Fen Ditton to the south and the village of Horningsea in the north.

2.2.5 The site itself is open farmland with large arable fields defined by boundary hedges and ditches. A dismantled railway, designated as a County Wildlife Site (CWS),

crosses the south eastern end of the site area and overhead powerlines cross the northern section and include six transmission towers within the site area.

2.2.6 Ordnance Survey mapping indicates that proposed WWTP site is located around the 10 mAOD contour on the east side of the River Cam. There is a general elevation reduction from west to east across the proposed WWTP, towards a set of drainage features connected to Black Ditch. Black Ditch discharges to the north along the boundary of Stow-cum-Quy Fen to Bottisham Lode ditch. Quy Water, located to the east of the site, and the Black Ditch, are the main watercourses contributing to Bottisham Lode ditch. Bottisham Lode discharges to the River Cam near Waterbeach, about 5 km downstream of the A14 crossing.

Existing Cambridge WWTP

2.2.7 The existing Cambridge WWTP is being assessed only in terms of the infrastructure on the site that will connect to the proposed WWTP. The final proposed site use for the existing Cambridge WWTP (residential land use) are outside the scope of this report and have been assessed within a separate report (Mott Macdonald, 2018).

2.2.8 The existing Cambridge WWTP lies within the administrative boundary of Cambridge City Council. The site is located approximately 3.5km to the north of Cambridge City Centre. The site is bounded by Cowley Road to the south, the A14 to the north, Milton Road to the west (A1309) and the railway line to the east. Surrounding site uses include industrial estates, a golf driving range and a former park and ride which is currently used as a waste transfer site.

2.2.9 The site is currently occupied by Anglian Water WWTP. There are Anglian Water offices along the western boundary and tanks, buildings, access roads and filter beds associated with the WWTP across the remainder of the site.

2.2.10 Ordnance Survey mapping indicates that the existing Cambridge WWTP is flat lying at approximately 8m AOD. A drainage ditch (“First Public Drain”) runs directly adjacent to the east of the site boundary and south of the site. This flows from west to east, towards the River Cam. The River Cam is located approximately 300m east of the site and there are two ponds (Todd’s Pit and Dickerson’s Pit) approximately 250m north of the site.

Infrastructure associated with proposed WWTP

2.2.11 Infrastructure proposed as part of the WWTP relocation is detailed in Section 2.1 above. The infrastructure will be located between the existing Cambridge and proposed WWTP. This area lies within the South Cambridgeshire District Council administrative boundary.

2.2.12 The majority of this site is open farmland with associated farmhouses. The A14 and Horningsea Road are present west of the proposed WWTP.

2.2.13 Ordnance Survey maps indicated there is a gentle reduction in elevation from 8m AOD in the west to the River Cam, which lies at approximately 3m AOD. There is a steeper increase in elevation from the River Cam to the proposed WWTP in the east,

which lies at approximately 10m AOD. The River Cam runs south to north between the existing Cambridge and proposed WWTP.

Infrastructure associated with Waterbeach Pipeline

2.2.14 A new pipeline (rising main) is required from Waterbeach to the new WWTP in order support the development of Waterbeach New Town as there is insufficient capacity within the current network to accommodate these flows.

2.2.15 The majority of the route is open farmland with associated farmhouses including Mulberry House Farm and Eye Hall Farm. Some residential development is present associated with the village of Horningsea with the closest houses located approximately 200m from the site. Waterbeach WRC is located north of the pipeline.

2.3 Site history

2.3.1 The history of the proposed site, associated infrastructure, and the existing Cambridge WWTP, has been summarised from the available 1:10,560, 1:10,000,1:2:500, 1:1:500, 1:500 land use mapping (from 1886 - 2019), provided within the Envirocheck Reports (Landmark, 2019) (Landmark, 2018) (Landmark, 2021), Appendix B. This can be seen in Table 2 1 below.

2.3.2 It should be noted that, although the site history of the existing Cambridge WWTP has been summarised here, the future site use will only be assessed in terms of the proposed WWTP location and infrastructure. The final site use risks for the existing Cambridge WWTP (residential land use) are outside the scope of this report and have been assessed within a separate report (Mott Macdonald, 2018).

2.3.3 In addition, Google Earth Pro (Google Earth Pro, 2021) provides aerial views of the site and surrounding area dated between 1945 and 2021. This information indicates that the proposed Waterbeach Pipeline, proposed WWTP footprint and infrastructure within the Scheme Order Limits has not changed significantly since 1945. Changes have been noted along the proposed Waterbeach Pipeline and existing Cambridge WWTP since 1945, as noted within the site history table.

Table 2-1: Site history

Date (scale)	Proposed WWTP footprint	Existing Cambridge WWTP	Associated Infrastructure	Waterbeach Pipeline
1886 - 1888 (1:2500)	The site's current land use is undeveloped rural agricultural land. A hop ground building, and associated	The Cambridge railway line runs north-south along the eastern boundary of the current WWTP.	The land use is predominantly agricultural with public drains and roads present. Biggin Abbey and Poplar Hall are present east	The Great Eastern Railway line runs north to the south located to the west of the proposed Waterbeach Pipeline. The railway intersects the pipeline to the north.

Date (scale)	Proposed WWTP footprint	Existing Cambridge WWTP	Associated Infrastructure	Waterbeach Pipeline
	pump, is located approximately 350m south of snout corner. The Cambridge and Mildenhall railway line runs northeast-southwest within the Scheme Order Limits, 250m south-east of the proposed site footprint.		of present-day Horningsea Road. A clay pit is present 100m north east of Poplar Hall and a coprolite pit is present 300m south of Poplar Hall, adjacent to Field Lane.	Rural, agricultural and farmland predominantly occupy the land along the Waterbeach Pipeline. The River Cam runs in a north-south direction intersecting the proposed pipeline location near Towing Park. Biggin pin plantation 500m east of the proposed pipeline located to the south of the Waterbeach Pipeline.
1886-1888 (1:10,560)	No significant changes.	The sites land use is agricultural land with public drains.	No significant changes.	No significant changes.
1904 (1:10,560)	No significant changes.	Site is a sewage farm.	Coprolite pit and clay pit are noted as disused.	Addition of farmhouses along the route. Brick works and old clay pit located near Horningsea within 250m west of the site.
1927 (1:10,560)	No significant changes.	Sewage farm has expanded within the site boundary.	No significant changes.	Roman pottery Kilns and other archaeological finds found 250m west of pipeline route near Horningsea.
1927 (1: 2,500)	No significant changes.	Sludge beds on site and sewage	No significant changes.	No significant changes.

Date (scale)	Proposed WWTP footprint	Existing Cambridge WWTP	Associated Infrastructure	Waterbeach Pipeline
		carrier pipes from site to south east.		
1971-1972 (1:2500)	Railway has been dismantled.	Pump house at the western site boundary.	No significant changes.	Vicarage within 250m west of the proposed pipeline near Horningsea.
1973-1974 (1:10,000)	No significant changes.	Modifications to sewage works with the addition of buildings and large tanks.	No significant changes.	Burial ground 500m east, located along the southern section of the proposed pipeline
1969-1988 (1: 1,250)	No significant changes.	Large tanks are shown as settling tanks. Pump house and square storage tanks on site.	No significant changes.	Clayhithe cottages located west of the proposed pipeline near Horningsea. Waterbeach barracks 750m west of the proposed pipeline.
1979 (1: 1,250)	No significant changes.	Electricity substation near north eastern site boundary.	No significant changes.	No significant changes.
1981-1985 (1:10,000)	The A45 (now A14) has been constructed which runs northwest-southeast along the south western boundary of the proposed WWTP site.	Modifications to sewage works. Addition of large tanks. Agricultural machinery market southern edge of site.	A45 trunk road (now A14) is now present on site, running west to south east, crossing the River Cam and Horningsea Road.	Sewage works (now Waterbeach Water Recycling Centre (WRC) located at the north end of the pipeline. Bannold Road located to the west of the pipeline just south of the sewage works. Ferry house located east of the proposed pipeline along Bannold Road.

Date (scale)	Proposed WWTP footprint	Existing Cambridge WWTP	Associated Infrastructure	Waterbeach Pipeline
1992 (1:1,250)	No significant change	Tanks are shown as settling tanks.	No significant changes.	No significant changes.
1992 (1:10,000)	No significant changes.	Car park at the southern west corner of site.	Electricity sub station is present east of the current WWTP, south of the A14.	No significant changes.
1993 (1: 1,250)	No significant changes.	Gas holder tanks and gas burner on site.		No significant changes.
2000 (1:10,000)	No significant changes.	Agricultural machinery market is now a golf driving range.	Several electricity pylons across the site, running towards the substation in the west, 50m east of existing Cambridge WWTP.	Development along River Cam.
2019 (1:10,000)	No significant changes.	No significant changes.	No significant changes.	Addition of farmhouses west of the site near Horningsea.

Source: (Landmark, 2019) and (Landmark, 2018) (Landmark, 2021). Note: associated infrastructure includes the pipelines and tunnels which are within the Scheme Order Limits (Appendix A, Figure A.1). Maps with no significant changes have been excluded from the table

3 Geology

3.1 Sources of information

3.1.1 The geology beneath the site has been summarised from the available 1:50,000 digital mapping provided by the British Geological Survey (BGS) in the Envirocheck Reports (Landmark, 2019) (Landmark, 2021), BGS historical borehole records (British Geological Survey, 2021) and a ground investigation factual report prepared as part of a preliminary ground investigation (AF Howland Associates, 2020).

3.2 Geology (proposed and existing Cambridge WWTP area)

Artificial Ground

3.2.1 No artificial or made ground is indicated on the BGS GeoIndex (British Geological Survey, 2021). However, this only records where made ground is greater than 2.5m thick. Made ground is likely to be present on parts of the site associated with previous development, such as the existing Cambridge WWTP, roads and railway lines.

Superficial Deposits

3.2.2 Superficial River Terrace Deposits (RTD), comprising sand and gravel, overlie the bedrock at the existing Cambridge WWTP and alongside the River Cam where the associated infrastructure lies, as shown in Appendix A, Figure A.2. The mapping does not indicate superficial deposits present on the footprint of the proposed WWTP site.

3.2.3 BGS mapping indicates that Alluvium, comprising clay, silt, sand and gravel, is present along the floor of the River Cam, with River Terrace Deposits at a slightly higher elevation, particularly along the western flank of the River Cam valley. Borehole logs (British Geological Survey, 2021) indicate that sandy clay and peat are present to a depth of 6 to 7 m near where the A14 crosses the River Cam, overlying sand and gravel to a depth of up to about 9 m. About 0.5 km further downstream, however, the superficial deposits have a depth of approximately 3.2 m, indicating that there is considerable variability in thickness (and composition) of superficial deposits along the river valley. The River Terrace Deposits on the western side of the river valley have a recorded depth of nearly 7m at one location but are more typically 2.5 to 4m in depth. Peat is present in some areas outside of the Scheme Order Limits: there are deposits noted east of Waterbeach and a narrow band is present east of the proposed WWTP site.

Solid Geology

3.2.4 The bedrock geology beneath the site is shown in Appendix A, Figure A.2. It comprises the following sequence, listed from youngest to oldest formations:

- Grey Chalk, comprising the West Melbury Marly Chalk Formation;

- Gault Formation;
- Lower Greensand (Woburn Sands Formation); and
- Kimmeridge Clay Formation.

3.2.5 The West Melbury Marly Chalk Formation is located towards the base of the Chalk Group (in the Grey Chalk Sub-group) and is described as grey, or dark grey, and marly in several borehole logs (British Geological Survey, 2021) in the vicinity of the proposed WWTP. The Cambridge Greensand Member (previously known as the Upper Greensand) may also be present at the boundary with the underlying Gault Formation.

3.2.6 The Cambridge Greensand Member is not present in outcrop in the Cambridge area but is described by British Geological Survey (BGS) in the Hydrogeological Map of the area between Cambridge and Maidenhead (British Geological Survey, 1984) as comprising glauconitic, micaceous, calcareous, fine grained sandstones or siltstones elsewhere in the region. There is, however, no indication of any distinctive sandstone or siltstone in geological logs for existing boreholes which have been drilled previously through the contact between the Grey Chalk and Gault Formation in the vicinity of Site 3 (British Geological Survey, 2021).

3.2.7 BGS mapping indicates the boundary between the Gault and the Chalk to be adjacent to the east of the River Cam with the existing Cambridge WWTP underlain by Gault Formation and the proposed WWTP underlain by Chalk. The Gault Formation, which underlies the existing Cambridge WWTP, comprises a pale grey marl to dark grey silty clay, with a basal bed of glauconitic or phosphatic nodules. The total thickness of the Gault Formation in the area is about 35m based on geological logs for boreholes close to the contact with the overlying Grey Chalk.

3.2.8 The Lower Greensand (Woburn Sands Formation) underlies the Gault Formation but is not indicated as outcropping within the Scheme Order Limits. The BGS (British Geological Survey) describes the formation generally as comprising a fine- to coarse-grained rounded marine quartz sandstone (or loose sand), glauconitic in part, commonly silty with few clay seams, typically grey or greenish grey, weathering to ochreous yellow-brown. The Lower Greensand is underlain by the Kimmeridge Clay. However, this was not encountered by BH01.

3.3 Waterbeach Pipeline geology

Artificial Ground

3.3.1 No artificial or made ground is indicated along the Waterbeach Pipeline Envirocheck report (Landmark, 2021). However, this only records where made ground is greater than 2.5m thick. Made ground is likely to be present on parts of the route associated with previous development.

Superficial Geology

3.3.2 Mapping suggests no superficial geology for the majority of the Waterbeach Pipeline. River Terrace Deposits underlie the region of the proposed Waterbeach pipeline to the north of Horningsea and from Clayhythe northwards. Where the pipeline protrudes to the east from the STW peat is encountered and overlies the River Terrace Deposits for a small section of the pipeline route. Alluvium associated with the presence of the River Cam underlies route of the Waterbeach Pipeline south of the STW and overlies the River Terrace Deposits , Peat can be found to the east and west of the pipeline route located near Northfields Farm.

Bedrock Geology

3.3.3 Gault Formation bedrock underlies the northern section of the pipeline until Clayhithe where a localised outcrop of West Melbury Marly Chalk Formation overlies the Gault Formation. The Gault Formation bedrock continues to directly underlie the route between this outcrop and Horningsea where the younger West Melbury Marly Chalk Formation is present to the southern end of the pipeline route.

3.4 Borehole data

3.4.1 Information from BGS boreholes located around the site have been included in the summary above.

3.4.2 A preliminary ground investigation, comprising dynamic sampling and rotary cored boreholes, was carried out to assess the geological, hydrogeological and geotechnical conditions at the three proposed sites, prior to site selection (this does not include the Waterbeach Pipeline). The investigation was carried out between August and October 2020 and consisted of five wireline rotary cored boreholes, referenced BH01 to BH05. The final depths of these boreholes range between 30.0 and 40.5mbgl (AF Howland Associates, 2020). Details of the strata encountered, piezometer installations, in-situ and laboratory testing, and groundwater monitoring were all recorded.

3.4.3 The cored borehole locations can be seen in Appendix A, Figure A.3. One borehole (BH01) was located within site 3 (the preferred site). The geology encountered comprised:

- Topsoil and superficial deposits (comprising River Terrace Deposits) (to 0.8m below ground level (bgl)) – Brown slightly clayey or silty, gravelly fine to medium sand.
- West Melbury Marly Chalk Formation (to 10.9mbgl) – Weak, low to medium density, off white Chalk with infilled fractures. Areas of extremely weak rock throughout, although the geological log does not refer specifically to any marl being recovered in the core.
- Gault Formation (to base of borehole, completed at 30.2mbgl) – Stiff fissured grey silty calcareous clay.

3.4.4 The Lower Greensand and Cambridge Greensand were not encountered in BH01.

3.4.5 A 3D geological model was constructed with Leapfrog Works software utilising borehole data obtained from freely available BGS data (British Geological Survey, 2021) and the additional five boreholes drilled during the ground investigation. Two cross sections were drawn perpendicularly through the centre of each site, based on the model. These cross sections assist with predicting what ground conditions could be expected during construction. Based on the modelling, the top of the Lower Greensand is expected at 50 to 51mbgl at Site 3. For further details, the Hydrogeological Impact Assessment report should be referred to (Mott Macdonald, 2021).

3.4.6 Groundwater in BH01 was not encountered during drilling but was later recorded within the Chalk at depths between 5.14 and 5.7m below ground level (bgl) (5.15 to 4.59m AOD (above Ordnance Datum)) during monitoring in October and November 2020.

3.4.7 Chalk was not encountered within any other boreholes drilled as part of the preliminary ground investigation. There are five Environment Agency monitoring boreholes located within a 2km radius of the larger study area (for all proposed WWTP sites), all of which are within the Lower Greensand Formation. The groundwater level in these boreholes ranges from about 2.6 mAOD to 6.5 mAOD, or 1.5 m bgl to 7.1 m bgl. There are no nearby Environment Agency monitoring boreholes penetrating the Chalk, the closest is over 6km from the larger study area.

4 Environmental Information

4.1 Hydrogeology

4.1.1 The River Terrace Deposits and Alluvium are classified by the Environment Agency as Secondary A aquifers. Peat is classified as Unproductive Strata.

4.1.2 The Chalk is classified by the Environment Agency as a Principal aquifer. However, based on available geological logs in the study area, significant aquifer horizons are unlikely to be present in the West Melbury Marly Chalk Formation which underlies Site 3 and parts of the Waterbeach Pipeline. This is due to the marly nature, low permeability, and low transmissivity of the Chalk (Mott Macdonald, 2021). The Gault Formation is classified by the Environment Agency as Unproductive Strata (effectively a non-aquifer).

4.1.3 The site, including the Waterbeach Pipeline, does not lie within a groundwater Source Protection Zone (SPZ). The Water Framework Directive (WFD) status of the groundwater body on site (Cam and Ely Ouse Chalk: GB40501G400500) has an overall “poor” rating from the year 2019 (Environment Agency).

4.2 Hydrology and flooding

4.2.1 There are several surface water features on site. The River Cam is a main river, and designated “moderate” status under the Water Framework Directive (GB105033042750) (Environment Agency) as of 2019. The River Cam runs south to north between the existing Cambridge WWTP and the proposed WWTP. Final effluent from the existing Cambridge WWTP currently discharges into the River Cam and current proposals include future discharge of effluent from the proposed WWTP into the River Cam. A section of tunnel will be built for the Waterbeach Pipeline near Northfields Farm cottages where the River Cam intersects with the proposed Waterbeach Pipeline.

4.2.2 The First Public Drain runs adjacent to the east of the existing Cambridge WWTP and drains to the River Cam. There are several small drains between the River Cam and the proposed WWTP which flow into the River Cam. In addition, there are several drains east of the proposed WWTP which feed into the Black Ditch which is located approximately 300m east of the site boundary.

4.2.3 Flood risk maps indicate that the majority of the proposed WWTP site is at low risk of flooding from rivers and surface water (Environment Agency). However, the River Cam located west of the Waterbeach Pipeline and intersects proposed Waterbeach Pipeline near Northfields Farm cottages is within flood risk zone 3 – this is land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) (Envrionment Agency). Flood zones can be seen within Appendix A, Figure A.4.

4.3 Environmental records

4.3.1 Full environmental records can be found within the Envirocheck Reports (Landmark, 2019) (Landmark, 2018) (Landmark, 2021).

Soil chemistry

4.3.2 The Envirocheck reports (Landmark, 2019) (Landmark, 2018) (Landmark, 2021) indicate the estimated soil chemistry at the site based on British Geological survey (BGS) records. This is intended to be indicative of general background levels and may not represent actual values present on site.

Table 4-1: Estimated Soil Chemistry

Chemical	Concentration (mg/kg)
Arsenic	<15
Cadmium	<1.8
Chromium	40 – 60
Lead	<100
Nickel	30 – 45

Environmental permits, incidents and registers

4.3.3 The Envirocheck Reports (Landmark, 2019) (Landmark, 2018) (Landmark, 2021) indicated that there are several discharge consents within 500m of the site. The majority of these are for sewage discharges of either storm tanks or final effluent which discharge to the River Cam or its tributaries.

4.3.4 There are 13 abstraction licenses within 500m of the site boundary. These are detailed below in Table 4 2. The location of these can be found within Appendix A, Figure A.4.

Table 4-2: Abstraction Licences

Name	Location	Licence No.	Use and abstraction type
Borehole N of Fen Ditton*	50m N of site, at Biggin Abbey	6/33/33/*G/0039	Groundwater abstraction for general farming and domestic
Well N of Milton*	400m west of existing Cambridge WWTP	6/33/33/*G/0044	Groundwater abstraction for general farming and domestic
Lake C at Milton*	490m west of existing Cambridge WWTP	6/33/33/*G/0069	Groundwater abstraction for general farming and domestic
Lake A at Milton*	290m west of existing Cambridge WWTP	6/33/33/*G/0069	Groundwater abstraction for

Name	Location	Licence No.	Use and abstraction type
			general farming and domestic
H Gingell Ltd River Cam north of Horningsea	90m northeast of proposed Waterbech pipeline (Horningsea)	6/33/33/*s/040	Groundwater abstraction for spray irrigation
H Gingell Ltd Borehole B at Horningsea	155m south of proposed Waterbech pipeline (Horningsea)	6/33/33/*g/018	Groundwater abstraction for general agriculture
P K Bell Borehole S at Horningsea	215m northwest of proposed Waterbech pipeline (Horningsea)	6/33/33/*G/0027	Groundwater abstraction
P. J. Biggs Borehole at Horningsea	262m southwest of proposed Waterbech pipeline (Horningsea)	6/33/33/*g/004	Groundwater abstraction for general agriculture
H Gingell Ltd well at Horningsea	299m north of proposed Waterbech pipeline (Horningsea)	6/33/33/*G/0038	Groundwater abstraction for domestic and general farming
H Gingell Ltd Borehole A at Horningsea	304m north of proposed Waterbech pipeline (Horningsea)	6/33/33/*g/018	Groundwater abstraction for domestic and agricultural purposes
Cambridge Garden Plants Bore at Horningsea	335m southwest of proposed Waterbech pipeline (Horningsea)	6/33/33/*G/0073	Groundwater abstraction for spray irrigation
G & N Buchdahl Bore at Horningsea	335m southwest of proposed Waterbech pipeline (Horningsea)	6/33/33/*G/0064	Groundwater abstraction for general agriculture and spray irrigation
H Gingell Ltd River Cam north of Horningsea	389m northwest of proposed Waterbech pipeline (Horningsea)	6/33/33/*s/040	Groundwater abstraction for spray irrigation

Note: Asterisk indicates that the licence is deregulated. It is not known whether the lakes at Milton, which are man-made, use groundwater to fill them or whether water is abstracted from the lakes.

4.3.5 The Envirocheck Reports have recorded several pollution incidents to controlled waters within 500m of the site. The majority of these are category 3- minor

incidents. Three category 2 incidents (significant incident) are noted in Table 4 3 below.

Table 4-3: Category 2 - significant pollutant incidents

Pollutant	Cause of incident	Distance to site	Date of incident	Receiving water
Chemical pesticides	Accidental Spillage/Leakage	103m northeast of proposed Waterbech pipeline	08/03/1997	Unnamed Ditch; Tributary of River Cam
Unknown	Unknown	138m north of the existing Cambridge WWTP	02/12/1992	Groundwater
Unknown	Unknown	162m west of the existing Cambridge WWTP	18/03/1992	Not given
Oil/ diesel	Unknown	232m northeast of proposed Waterbech pipeline	11/09/1997	River Cam
Miscellaneous - Unknown	Unknown	256m northeast of proposed Waterbech pipeline	19/09/1998	River Cam
Oil/ diesel	Unknown	269m northeast of proposed Waterbech pipeline	28/10/1994	Fresh water stream/river
Unknown	Unknown	295m west of the existing Cambridge WWTP	13/12/1993	Surface water - No. 1 Public Drain
Organic wastes animal carcasses.	In River works	303m north of proposed Waterbech pipeline	11/08/1994	Tributary of River Cam

Landfills and mining

4.3.6 There are four historical landfills within 500m of the Scheme Order Limits.

- Winship Industrial Estate is located 330m north of the existing Cambridge WWTP. This was used for inert waste between 1974 and 1980.
- Quy Mill Hotel is located 200m east of the Scheme Order Limits. This was used for inert waste between 1989 and 1992.
- Quy Bridge is located 200m east of the Scheme Order Limits. This was used for inert waste between 1990 and 1992.
- Cayhithe Cottage located 172m north of the Scheme Order Limits along the proposed Waterbeach Pipeline. This was used for inert waste between 1989 and 1992. Upon its closure Northfields Farm, Clayhithe, located 112m east of the Scheme Order Limits along the proposed Waterbeach Pipeline was opened. This was used for inert waste dating back to 1992 (end date of use not specified).

4.3.7 The locations can be seen in Appendix A, Figure A.4. Full details can be found within the Envirocheck Reports (Landmark, 2019) (Landmark, 2018) (Landmark, 2021).

4.3.8 There are two authorised landfill within 500m of the site.

- Milton Landfill is located 550m north west of the existing Cambridge WWTP and 450m north west of the Scheme Order Limits. This is an active landfill with a capacity of >25,000 tonnes. Further details of risks from this landfill have been assessed within the Hydrogeological Impact Assessment (Mott Macdonald, 2021).
- Eversden Landfill (Quy Landfill) is located 400m east of the Scheme Order Limits. This has been accepting “non-biodegradable wastes” since 1993 but is now closed.

4.3.9 Locations of these authorised landfill sites can be seen within Appendix A, Figure A.4

4.3.10 The Envirocheck Reports (Landmark, 2019) (Landmark, 2018) (Landmark, 2021) indicate that there are seven man-made mining cavities present. The details of these are in Table 4 4 below. The locations can be seen in Appendix A, Figure A.4.

Table 4-4: Man-made mining cavities

Cavity Type	Location	National Grid Reference
Coprolite Mining – details unknown	48m northeast of the Scheme Order Limits for the proposed Waterbeach Pipeline.	550400, 264200
Coprolite Mining – details unknown	50m east of Scheme Order Limits, near Low Fen Drove Way	550500, 261200
Coprolite Mining – details unknown	418m south east of the Scheme Order Limits for the proposed Waterbeach Pipeline.	549800, 261600

Cavity Type	Location	National Grid Reference
Coprolite Mining – details unknown	464m west of the Scheme Order Limits for the proposed Waterbeach Pipeline.	549000, 261000
Coprolite Mining – details unknown	622m north of the Scheme Order Limits for the proposed Waterbeach Pipeline.	551100, 265300
Coprolite Mining – details unknown	On site, approximately 700m east of Horningsea Road, adjacent to Snout Corner	549800, 261600
Coprolite Mining – details unknown	997m south of the Scheme Order Limits for the proposed Waterbeach Pipeline.	551200, 263500

Sensitive land uses

4.3.11 The Envirocheck reports (Landmark, 2019) (Landmark, 2018) (Landmark, 2021) indicate that a local nature reserve, Bramblefields, is located 433m south of the existing Cambridge WWTP (Appendix A, Figure A.4). A dismantled railway, designated as a County Wildlife Site, crosses the south eastern end of the site area. This can be seen in Appendx A, Figure A.4 as a dismantled railway.

4.3.12 Stow-cum-Quy Fen (SSSI) is located 1km north east of the proposed. Wilbraham Fens (SSSI) is located 600m east of the Scheme Order Limits, where the site access to the proposed WWTP is to be located.

4.3.13 The site and Waterbeach Pipeline are located within a Nitrate Vulnerable Zone (NVZ). The proposed WWTP and proposed Waterbeach Pipeline lies within an area of adopted green belt.

4.4 Contemporary land uses

4.4.1 The Envirocheck Reports indicate numerous active contemporary trade directories within 500m of the existing Cambridge and proposed WWTP. These are largely based near the existing Cambridge WWTP where there are several industrial sites, works, electrical sub stations and the Cambridge Science Park. There are two fuel stations within 500m of the site, of which one is obsolete. There is an open fuel station located at Tesco in Milton, approximately 260m north west of the Scheme Order Limits. Full details of these land uses can be found within the Envirocheck Reports (Landmark, 2019) (Landmark, 2018).

Contemporary Land uses Waterbeach Pipeline

4.4.2 The Envirocheck report indicates two active contemporary trade directories within 500m of the proposed Waterbeach Pipeline. These include a food product manufacturer 161m north and a garage 95m south of the proposed pipeline. The Envirocheck report also indicates one inactive contemporary trade directory entry

within 500m of the proposed Waterbeach Pipeline. This comprises a commercial cleaning service 378m north of the Waterbeach Pipeline. Full details of these land uses can be found within the Envirocheck Report (Landmark, 2021).

4.5 Radon

4.5.1 The study area including along the Waterbeach Pipeline is located in a Lower probability radon area (Landmark, 2019) (Landmark, 2018) (Landmark, 2021) (less than 1% of homes are estimated to be at or above the Action Level). No radon protective measures are necessary in the construction of new dwellings or extensions.

4.6 Unexploded Ordnance (UXO)

4.6.1 The Zetica UXO online maps (Zetica) (Appendix C) indicate that the site is in a low risk area for unexploded bombs. This is defined as an area incurring strikes of 10 bombs/km2 or less. The presence of Waterbeach barracks located west of the route along the northern end of the proposed pipeline may have been a target for bombing, therefore the risk in this area may be higher.

5 Qualitative Contaminated Land Assessment

5.1 Qualitative risk assessment framework

5.1.1 Preliminary qualitative risk assessment is part of a phased approach as set out in UK guidance including CIRIA C552 (2001) (CIRIA, 2001) and Environment Agency Land Contamination Risk Management (LCRM) (2020) (Environment Agency, 2020), the first stage requires development of a conceptual model that takes consideration of the environmental site setting and identifies potential contaminant sources, pathways and receptors, this allows potential pollutant linkages to be identified. The qualitative risk assessment follows on from this and is presented in the sections below.

5.2 Conceptual model

Hazard Identification

5.2.1 For the proposed development, the potential sources, pathways and receptors of contamination have been identified in the conceptual site models below.

5.2.2 It is assumed that a robust environmental management plan will be adopted during the construction works and as a result, no contamination will occur as a result of leaks and spills during construction.

Risk Estimation and Risk Evaluation

5.2.3 The term risk is widely used in different contexts and circumstances, often with differing definitions. In UK Government publications about the environment, the standard definition is that “Risk is a combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence” (LCRM (Environment Agency, 2020)).

5.2.4 Following the development of the conceptual model and the identification and assessment of potential pollutant linkages, a preliminary assessment can be made of risk estimation and risk evaluation, as discussed in LCRM (Environment Agency, 2020) and CIRIA C552 (CIRIA, 2001), to determine whether an unacceptable contamination risk is likely to exist.

5.2.5 LCRM defines risk estimation as predicting the magnitude (or consequence) and probability of the risk occurring that may arise as a result of that hazard. This is also identified in CIRIA C552 in which the risk assessment methodology uses qualitative descriptors of consequence, probability and thus risk. These descriptors are adopted for the purposes of this risk assessment. A description of the risk assessment methodology adopted is given in Appendix D.

Process of Developing Conceptual Model

5.2.6 A key element of an environmental risk assessment is the development of a conceptual model which is done by undertaking a Source –Pathway – Receptor analysis of the Site:

- Sources (S) are potential or known contaminant sources e.g. a former land use;
- Pathways (P) are environmental systems thorough which a contaminant could migrate e.g. air, groundwater;
- Receptors (R) are sensitive environmental receptors that could be adversely affected by a contaminant e.g. Site occupiers, groundwater resources.

5.2.7 Where a source, relevant pathway and receptor are present, a pollutant linkage is considered to exist whereby there is a circumstance through which environmental harm could occur and a potential environmental liability is considered to exist. The sources, pathways and receptors expected on the site are summarised in this section.

5.2.8 For the purposes of this risk assessment, the site has been split into four zones:

- The proposed WWTP site (footprint).
- Associated infrastructure including:
  - Effluent pipelines which connect from the proposed WWTP to the River Cam discharge location
  - Waste water transfer tunnels (and associated shafts) which connect from the existing Cambridge WWTP to the proposed WWTP.
- Waterbeach Pipeline.

5.2.9 The risks to future residential land use development on the existing Cambridge WWTP site have been assessed within a separate report (Mott Macdonald, 2018).

5.3 Preliminary qualitative risk assessment

5.3.1 For each potential pollutant linkage identified within the conceptual model, the potential risk has been evaluated for ecological receptors, construction/maintenance workers and the final end users using a Preliminary Qualitative Risk Assessment. This is based on the probability of the pollution event, and the severity it may have on site users and the environment.

5.3.2 The conceptual site model is presented in Figure 5.1 (p.g. 27 below) and the Preliminary Qualitative Risk Assessment is presented in Table 5 2 (page 28, below). The methodology for the assessment is presented in Appendix D (page 50, below).

5.3.3 Mott MacDonald is not insured to advise on risk arising from asbestos, and therefore will not assess risk or give advice relating to risks associated with it. It is recommended that a specialist is consulted regarding mitigation or remedial measures required relating to the presence of asbestos at the site.

Contaminants of concern

5.3.4 Based on information obtained on the site and surrounding area, limited contaminants of concern are likely to be present on site. Those potentially present within 250m of the site have been summarised in Table 5 1.

Table 5-1: Potential contaminants

Land use	Location	Potential contaminants
Agricultural land	Proposed WWTP site and locations of associated infrastructure.	Pesticides, fertilisers, ammonium.
Railways works and sidings	Eastern boundary of existing Cambridge WWTP, running north-south and, historically, 250m south east of the proposed WWTP footprint.	Asbestos, metals, inorganic chemicals, polycyclic aromatic hydrocarbons (PAHs), poly chlorinated biphenyls (PCBs), solvents, ash and fill, coal, petroleum hydrocarbons.
Sludge beds (historical), Waterbeach WRC and WWTP	Within Scheme Order Limits for proposed infrastructure	Organic compounds, metals, solvents, ash and fill.
Historical quarries	Within Scheme Order Limits for proposed infrastructure (clay pit 100m NE of Poplar Hall and coprolite pit 300m south of Poplar Hall, adjacent to Field Lane)	Asbestos, metals, metalloids, inorganic compounds, fuels and oils.
Roads / vehicles / heavy goods vehicles	Within Scheme Order Limits for proposed infrastructure (A14, B1047/Horningsea Road)	Organic compounds e.g. petrol, diesel, methyl tertiary butyl ether (MTBE), hydrocarbons; heavy metals.
Electricity substations	Within Scheme Order Limits for proposed infrastructure 50m east of existing Cambridge WWTP	Polychlorinated biphenyls, metals and metal compounds.
Industrial estate including works, factories, warehouses and garage	Off site (south eastern boundary of existing Cambridge WWTP and 130m north of existing Cambridge WWTP)	Asbestos, metals, inorganic chemicals, PAHs, solvents, ash and fill, coal, petroleum hydrocarbons.
Historical landfills	Off site (200m east of Scheme Order Limits, 330m north of existing Cambridge WWTP, 172M north of Scheme	Ground gases, organic and inorganic contaminants, volatile organic compounds (VOC), PAHs, metals,

Land use	Location	Potential contaminants
	Order Limits along Waterbeach Pipeline.)	metalloids, ammonium and asbestos.

Sources of Contamination

5.3.5 On site (proposed WWTP footprint)

- S1: Contamination associated with presence of agricultural land on site of proposed WWTP.
- On site (associated infrastructure)
- S2: Historical contamination associated with railway works and sidings, sludge beds on existing Cambridge WWTP and quarries.
- S3: Contamination associated with current site uses including railway lines, roads and electricity substations.
- S4: Contamination created by tunnel and shaft construction (grout, additives and turbidity)
- Off-site (proposed WWTP and associated infrastructure)
- S5: Off-site contamination associated with existing industrial estates, existing roads, historical railway lines, historical quarries and landfills.
- On site (Waterbeach Pipeline)
- S1: Contamination associated with presence of agricultural land on site of proposed pipeline route.
- ~~Contamination associated with W.~~
- S4: Contamination created by tunnel and shaft construction (grout, additives and turbidity)
- S7: Contamination associated with Waterbeach WRC.
-
- Off site (Waterbeach Pipeline)
- S6: Contamination associated with Historical landfill located off-site.

Pathways

5.3.6 The following potential pathways for contamination have been identified:

- P1: Human Uptake pathways:
  - P1a: Direct soil and dust ingestion.
  - P1b: Dermal contact (indoor and outdoor).

  - P1c: Inhalation of dust, vapours and ground gas (indoor and outdoor).
- P2: Production and vertical migration of leachates in unsaturated zone.
- P3: Vertical and horizontal migration of contaminants in saturated zone.
- P4: Direct contact with buried structures and infrastructure.
- P5: Man-made contaminant transport pathways including utilities, piling for foundations, tunnels, and pipelines.
- P6: Surface run-off.
- P7: Plant uptake.

Receptors

5.3.7 The following potential contamination receptors have been identified:

- R1: Final end users – WWTP workers.
- R2: Construction and maintenance workers.
- R3: Occupants of nearby residential and commercial properties and users of footpaths near site.
- R4: Groundwater within Principal aquifer (Chalk), Secondary A aquifers (Superficial deposits) and local abstractions.
- R5: Surface water – River Cam, drains located east of the proposed WWTP and surface water features proposed as part of the landscaping.
- R6: Buried structures and infrastructure: water supply pipe infrastructure, concrete structures (e.g. foundations), and tunnels.
- R7: Flora and fauna.

Qualitative Risk Assessment

5.3.8 The qualitative contaminated land risk assessment is shown in Table 5 2 (proposed WWTP), Table 5-3 (infrastructure) and Table 5-4 (Waterbeach Pipeline). The Conceptual Site Model for the proposed WWTP is shown in Figure 5.1 below.

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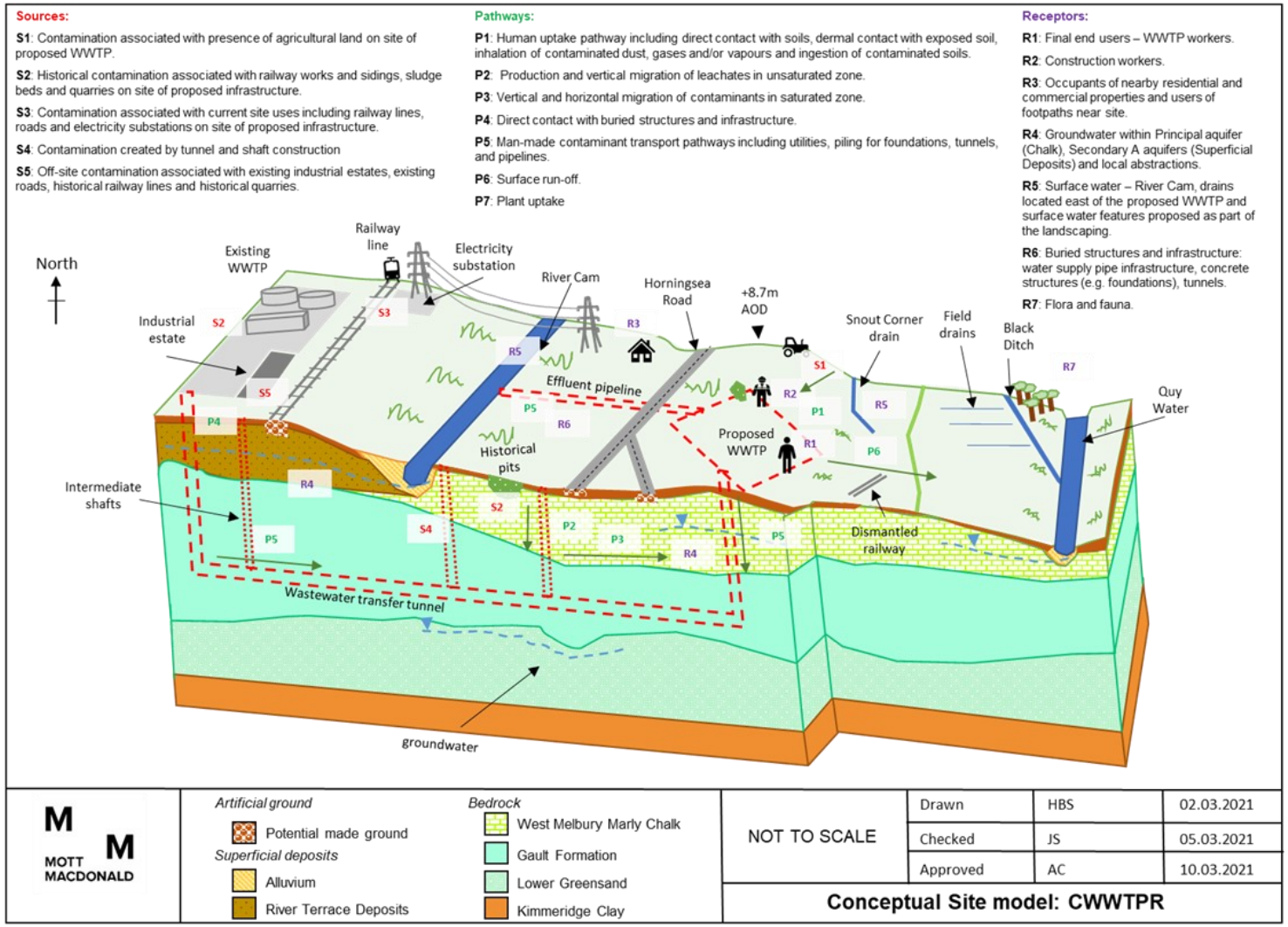

Figure 5.1: Conceptual Site Model

Table 5-2: Preliminary Qualitative Risk Assessment for the proposed WWTP

Source	Pathway	Receptor	Consequence	Mitigated risk		Comments/ Mitigation Measures
				Probability	Risk	
S1: Contamination associated with presence of agricultural land on site of proposed WWTP.	P1a: Direct soil and dust ingestion P1b: Dermal contact (indoors & outdoors) P1c: Inhalation of dust (indoors & outdoors)	R1: Final end users – WWTP workers.	Mild	Unlikely	Very low	Historical and current site uses pose a very minor contamination threat to soils and groundwater. Construction workers may possibly come into contact with potentially contaminated soil or groundwater during construction. A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers and offsite migration of dusts, surface runoff etc during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement. With appropriate measures in place, the risk to construction workers and final end users (WWTP workers) should be classified as very low. Excavation may be required for foundations etc. Further assessment and appropriate management will be required during the works. Materials should be assessed for reuse in the development to minimise disposal requirements, and then be managed appropriately, e.g. under a materials management plan. Final end users (WWTP workers) are unlikely to come into contact with soil or groundwater on the site as the site will largely comprise hardstanding at ground level, providing a barrier to any potential contaminants that may be present.
		R2: Construction workers.	Mild	Unlikely	Very low	
		R3: Occupants of nearby residential and commercial properties.	Mild	Unlikely	Very low	
	P2: Production and vertical migration of leachates in unsaturated zone. P3: Vertical and horizontal migration of contaminants in saturated zone. P5: Man-made contaminant transport pathways including utilities, piling for foundations, tunnels, and pipelines.	R4: Groundwater within Principal aquifer (Chalk), Secondary A aquifers (Superficial deposits) and local abstractions.	Medium	Unlikely	Low	The proposed works may involve contact with potentially contaminated made ground, superficial deposits, and the Chalk. Significant contamination in made ground is unlikely on the proposed WWTP. If contaminants are present in the made ground, these could naturally leach into the bedrock aquifer. However, man-made contaminant transport pathways such as piled foundations could create additional pathways to the aquifer. A Foundations Works Risk Assessment (FWRA) will likely be required to assess impacts to the groundwater from the proposed construction methods (piled foundations and deep excavations). This should be completed once designs are confirmed and ground investigation data is available. A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised. Assuming that appropriate mitigation measures are undertaken, including recommendations within the FWRA, the risk could be assessed as low.
	P6: Surface run-off.	R5: Surface water – River Cam, drains located east of the proposed WWTP and	Medium	Unlikely	Low	A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised.

Source	Pathway	Receptor	Consequence	Mitigated risk		Comments/ Mitigation Measures
				Probability	Risk	
		surface water features proposed as part of the landscaping.				
	P4: Direct contact with buried structures and infrastructure. P5: Man-made contaminant transport pathways including utilities, piling for foundations, tunnels, and pipelines.	R6: Buried structures and infrastructure: water supply pipe infrastructure, concrete structures (e.g. foundations), and tunnels.	Medium	Unlikely	Very low	Made ground and significant contamination is unlikely to exist on the proposed WWTP site. Further assessment of the ground conditions through intrusive investigation should inform the materials requirements in the design phase, which should lower the risk to buried infrastructure.
	P7: Plant uptake	R7: Flora and fauna.	Mild	Unlikely	Very low	Landscaping is proposed as part of the proposed WWTP. Significant contamination is unlikely to exist on the proposed WWTP site. With appropriate mitigation measures in place (CEMP), it is unlikely that the proposed works will increase the risk to flora and fauna.
S5: Off-site contamination associated with existing industrial estates, existing roads, historical railway lines, historical quarries and landfills.	P2: Production and vertical migration of leachates in unsaturated zone and P3: Vertical and horizontal migration of contaminants in saturated zone then P1a: Direct soil and dust ingestion P1b: Dermal contact (indoor and outdoor) P1c: Inhalation of dust, vapours and ground gas (indoor and outdoor)	R2: Construction workers.	Medium	Unlikely	Low	Potential contaminants have been identified from various land uses (e.g. existing roads, historical quarries, landfills railway lines) but these are considered unlikely to represent gross contamination. Lateral migration of contaminants is unlikely due to the low permeability of the Chalk and the distance to the off-site sources. A CEMP should be implemented prior to construction to ensure that impacts to construction workers during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement
	P2: Production and vertical migration of leachates in unsaturated zone and P3: Vertical and horizontal migration of contaminants in saturated zone then P5: Man-made contaminant transport pathways	R4: Groundwater within Principal aquifer (Chalk), Secondary A aquifers (Superficial deposits) and local abstractions.	Medium	Unlikely	Low	The proposed works may involve contact with potentially contaminated made ground, superficial deposits, and the Chalk. Significant contamination in made ground is unlikely on the proposed WWTP. If contaminants are present in the made ground, these could naturally leach into the bedrock aquifer. However, man-made contaminant transport pathways such as piled foundations could create additional pathways to the aquifer. A Foundations Works Risk Assessment (FWRA) will likely be required to assess impacts to the groundwater from the proposed construction methods (piled foundations and deep excavations). This should be completed once designs are confirmed and ground investigation data is available.

Source	Pathway	Receptor	Consequence	Mitigated risk		Comments/ Mitigation Measures
				Probability	Risk	
	including utilities and piling for building foundations and structures					A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised. Assuming that appropriate mitigation measures are undertaken, including recommendations within the FWRA, the risk could be assessed as low.
	P6: Surface run-off.	R5: Surface water – River Cam, drains located east of the proposed WWTP and surface water features proposed as part of the landscaping.	Mild	Unlikely	Very low	A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised.

Table 5-3: Preliminary Qualitative Risk Assessment for the associated infrastructure (pipelines, tunnels and shafts)

Source	Pathway	Receptor	Consequence	Mitigated risk		Comments/ Mitigation Measures
				Probability	Risk	
S2: Historical contamination associated with railway works and sidings, sludge beds and quarries on site of proposed infrastructure. S3: Contamination associated with current site uses including railway lines, roads and electricity substations on site of proposed infrastructure.	P1a: Direct soil and dust ingestion P1b: Dermal contact (indoors & outdoors) P1c: Inhalation of dust (indoors & outdoors)	R1: Final end users – WWTP workers.	Mild	Unlikely	Very low	Various historical and current site uses pose a minor contamination threat to soils and groundwater. Construction workers may possibly come into contact with potentially contaminated soil or groundwater during construction. A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers and offsite migration of dusts, surface runoff etc during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement. With appropriate measures in place, the risk to construction workers and final end users (WWTP workers) should be classified as very low. Excavation may be required for foundations etc. Further assessment and appropriate management will be required during the works. Materials should be assessed for reuse in the development to minimise disposal requirements, and then be managed appropriately, e.g. under a materials management plan. Final end users (WWTP workers) are unlikely to come into contact with soil or groundwater on the site as the site will largely comprise hardstanding at ground level, providing a barrier to any potential contaminants that may be present.
		R2: Construction workers.	Mild	Unlikely	Very low	
		R3: Occupants of nearby residential and commercial properties.	Mild	Unlikely	Very low	
	P2: Production and vertical migration of leachates in unsaturated zone.	R4: Groundwater within Principal aquifer (Chalk), Secondary A aquifers (Superficial	Medium	Low likelihood	Moderate/ low	The proposed works may involve contact with potentially contaminated made ground, superficial deposits, the Chalk and the Gault Formation. Significant contamination in made ground is unlikely based on historical site uses.

Source	Pathway	Receptor	Consequence	Mitigated risk		Comments/ Mitigation Measures
				Probability	Risk	
	P3: Vertical and horizontal migration of contaminants in saturated zone. P5: Man-made contaminant transport pathways including utilities, piling for foundations, tunnels, and pipelines.	deposits) and local abstractions.				Contaminants in the made ground could naturally leach into the bedrock aquifer. However, man-made contaminant transport pathways such as shafts. tunnels and pipelines could create additional pathways to the aquifer. A Foundations Works Risk Assessment (FWRA) will likely be required to assess impacts to the groundwater from the proposed construction methods (pipelines, shafts and tunnels). This should be completed once designs are confirmed and ground investigation data is available. A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised. Assuming that appropriate mitigation measures are undertaken, including recommendations within the FWRA, the risk could be assessed as low.
	P6: Surface run-off.	R5: Surface water – River Cam	Medium	Unlikely	Low	A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised.
	P4: Direct contact with buried structures and infrastructure. P5: Man-made contaminant transport pathways including utilities, piling for foundations, tunnels, and pipelines.	R6: Buried structures and infrastructure: water supply pipe infrastructure, concrete structures (e.g. foundations), and tunnels.	Medium	Unlikely	Very low	There is potential for made ground on the proposed infrastructure sites due to current and historic site uses such as roads. Further assessment of the ground conditions through intrusive investigation should inform the materials requirements in the design phase, which should lower the risk to buried infrastructure.
S4: Contamination created by tunnel and shaft construction (grout, additives and turbidity)	P3: Vertical and horizontal migration of contaminants in saturated zone. P5: Man-made contaminant transport pathways including utilities, piling for foundations, tunnels, and pipelines.	R4: Groundwater within Principal aquifer (Chalk), Secondary A aquifers (Superficial deposits) and local abstractions.	Medium	Low likelihood	Moderate/ low	There is potential for contamination to be created within the Chalk aquifer during shaft construction. Turbidity during construction and the use of cement/grout (if required) may cause water quality problems for local abstractions. However, the closest local abstraction is located 250m from the wastewater transfer tunnel corridor and so impacts are likely to be temporary and not significant. A Foundations Works Risk Assessment (FWRA) will likely be required to assess impacts to the groundwater from the proposed construction methods (pipelines, shafts and tunnels). This should be completed once designs are confirmed and ground investigation data is available. A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised. Assuming that appropriate mitigation measures are undertaken, including recommendations within the FWRA, the risk could be assessed as low.

Source	Pathway	Receptor	Consequence	Mitigated risk		Comments/ Mitigation Measures
				Probability	Risk	
S5: Off-site contamination associated with existing industrial estates, existing roads, historical railway lines historical quarries and landfills.	P2: Production and vertical migration of leachates in unsaturated zone and P3: Vertical and horizontal migration of contaminants in saturated zone then P1a: Direct soil and dust ingestion P1b: Dermal contact (indoor and outdoor) P1c: Inhalation of dust, vapours and ground gas (indoor and outdoor)	R2: Construction workers.	Mild	Unlikely	Very Low	Potential contaminants have been identified from various land uses (e.g. industrial estates) but these are considered unlikely to represent gross contamination. A CEMP should be implemented prior to construction to ensure that impacts to construction workers during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement
	P2: Production and vertical migration of leachates in unsaturated zone and P3: Vertical and horizontal migration of contaminants in saturated zone then P5: Man-made contaminant transport pathways including utilities and piling for building foundations and structures	R4: Groundwater within Principal aquifer (Chalk), Secondary A aquifers (Superficial deposits) and local abstractions.	Medium	Unlikely	Low	The proposed works may involve contact with potentially contaminated made ground, superficial deposits, the Chalk and the Gault Formation. Although significant contamination is unlikely. Contaminants in soils could naturally leach into the bedrock aquifer. However, man-made contaminant transport pathways such as tunnels and pipelines could create additional pathways to the aquifers below. A Foundations Works Risk Assessment (FWRA) will likely be required to assess impacts to the groundwater from the proposed construction methods (pipelines, shafts and tunnels). This should be completed once designs are confirmed and ground investigation data is available. A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised.
	P6: Surface run-off.	R5: Surface water – River Cam and drains to the east of the proposed WWTP.	Mild	Unlikely	Very low	A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised.

Table 5-4: Preliminary Qualitative Risk Assessment for Waterbeach Pipeline.

Source	Pathway	Receptor	Consequence	Mitigated risk		Comments/ Mitigation Measures
				Probability	Risk	
S1: Contamination associated with presence of agricultural land on	P1a: Direct soil and dust ingestion P1b: Dermal contact (indoors &	R2: Construction workers.	Moderate	Unlikely	Low	Due to the historical land use it is unlikely that a significant source of contamination exists. Construction workers may come into contact with potentially contaminated soil or groundwater during construction. A Construction Environmental
		R3: Occupants of nearby residential and	Mild	Unlikely	Very low	

Source	Pathway	Receptor	Consequence	Mitigated risk		Comments/ Mitigation Measures
				Probability	Risk	
site of proposed Waterbeach Pipeline.	outdoors) P1c: Inhalation of dust (indoors & outdoors)	commercial properties.				Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers and offsite migration of dusts, surface runoff etc during development are minimised. Excavation/ trenching may be required for tunnelling. Further assessment and appropriate management will be required during the works. Materials should be assessed for reuse in the development to minimise disposal requirements, and then be managed appropriately, e.g. under a materials management plan if required.
	P2: Production and vertical migration of leachates in unsaturated zone. P3: Vertical and horizontal migration of contaminants in saturated zone. P5: Man-made contaminant transport pathways including utilities, piling for foundations, tunnels, and pipelines.	R4: Groundwater within Principal aquifer (Chalk), Secondary A aquifers (Superficial deposits) and local abstractions.	Medium	Unlikely	Low	The proposed works will involve contact with any made ground, superficial deposits, the Chalk and the Gault Formation. Significant contamination in made ground is unlikely based on historical site uses. Contaminants in the soils could naturally leach into the bedrock aquifer under existing conditions. However, man-made contaminant transport pathways such as shafts. tunnels and pipelines could create additional pathways to the aquifer. This should be assessed through appropriate risk assessment following ground investigation. A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised.
	P6: Surface run-off.	R5: Surface water – River Cam	Medium	Unlikely	Low	A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised.
	P4: Direct contact with buried structures and infrastructure. P5: Man-made contaminant transport pathways including utilities, piling for foundations, tunnels, and pipelines.	R6: Buried structures and infrastructure: water supply pipe infrastructure, concrete structures (e.g. foundations), and tunnels.	Medium	Unlikely	Very low	There is unlikely to be a significant source of contamination at the site. This assessment should be confirmed following ground investigation which will inform the materials requirements in the design phase.
S4: Contamination created by grout and additives during tunnel and shaft construction.	P3: Vertical and horizontal migration of contaminants in saturated zone. P5: Man-made contaminant transport pathways including utilities, piling for	R4: Groundwater within Principal aquifer (Chalk), Secondary A aquifers (Superficial deposits) and local abstractions.	Medium	Low likelihood	Moderate/ low	There is potential for contamination to be created within the Chalk aquifer during shaft construction. Turbidity during construction and the use of cement/grout (if required) may cause water quality problems for local abstractions. The closest local abstraction is located in close proximity to the pipeline and potentially the shafts (to be confirmed once designs are completed).

Source	Pathway	Receptor	Consequence	Mitigated risk		Comments/ Mitigation Measures
				Probability	Risk	
	foundations, tunnels, and pipelines.					A Risk Assessment will likely be required to assess impacts to the groundwater from the proposed construction methods (pipelines, shafts and tunnels). This should be completed once designs are confirmed and ground investigation data is available. A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised. Assuming that appropriate mitigation measures are undertaken the risk could be assessed as low.
S6: Contamination associated with historical landfill located off-site.	P2: Production and vertical migration of leachates in unsaturated zone and P3: Vertical and horizontal migration of contaminants in saturated zone then P1b: Dermal contact (indoor and outdoor) P1c: Inhalation of dust, vapours and ground gas (indoor and outdoor)	R2: Construction workers.	Mild	Unlikely	Very Low	The landfill could be a source of leachate or ground gas which may migrate beneath the site. However due to the distance of the landfill and the inert nature of the deposits, this is considered unlikely. A CEMP should be implemented prior to construction to ensure that impacts to construction workers during development are minimised. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement.
S7: Contamination associated with existing Waterbeach WRC	P1a: Direct soil and dust ingestion P1b: Dermal contact (indoors & outdoors) P1c: Inhalation of dust (indoors & outdoors)	R1: Final end users – WRC and maintenance workers. R2: Construction workers.	M~~edium~~ild	Unlikely	~~L~~Very low	No below ground construction works are proposed in the Waterbeach WRC as part of the Proposed Development. The site may be used as a laydown area for construction materials which should not alter any existing contamination risks. As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statements. With appropriate measures in place, the risk to construction workers and final end users (WRC workers) should be classified as very low.
	P2: Production and vertical migration of leachates in unsaturated zone.	R4: Groundwater within Principal aquifer (Chalk), Secondary A aquifers (Superficial deposits) and local abstractions.	Medium	Low likelihood	Moderate/ low	No below ground works are anticipated in connection with the Proposed Development at the existing Waterbeach WRC. As such there are unlikely to be any change in risks to controlled waters associated with the existing WRC which is operated under an existing Environmental Permit.

Source	Pathway	Receptor	Consequence	Mitigated risk		Comments/ Mitigation Measures
				Probability	Risk	
	P3: Vertical and horizontal migration of contaminants in saturated zone. P5: Man-made contaminant transport pathways including utilities, piling for foundations, tunnels, and pipelines. P6: Surface run-off.	R5: Surface water – River Cam	Medium	Unlikely	Low	A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater and surface water receptors during development are minimised.

6 Conclusions and Recommendations

6.1.1 This section contains an overview of the key findings and conclusions of this report. However, no reliance should be placed on any part of this summary without referring to the relevant sections of this report.

6.2 Ground conditions

6.2.1 The preliminary ground investigation for the study area indicates that the ground conditions at the proposed WWTP, based on BH01 located on the site of the proposed WWTP, are anticipated to be:

- Topsoil and superficial deposits (comprising River Terrace Deposits) (to 0.8m bgl) – Brown slightly clayey or silty, gravelly fine to medium sand.
- West Melbury Marly Chalk Formation (to 10.9mbgl) – Weak, low to medium density, off white Chalk with infilled fractures.
- Gault Formation (to base of borehole, completed at 30.2mbgl) – Stiff fissured grey silty calcareous clay.

6.2.2 The underlying Lower Greensand and Cambridge Greensand were not encountered in BH01.

6.2.3 Made ground is not anticipated to be encountered on the site of the proposed WWTP but is likely be encountered on the existing Cambridge WWTP site and potentially where associated infrastructure are located. However, the majority of the infrastructure will not come into contact with the made ground, except in shaft locations.

6.2.4 Groundwater in BH01 was not encountered during drilling but was recorded within the Chalk at depths between 5.14 and 5.7m below ground level (bgl) (5.15 to 4.59m AOD) during monitoring.

6.2.5 The expected geology likely to be encountered along the proposed Waterbeach Pipeline include:

- Superficial River Terrace Deposits North of Horningsea and form Clayhythe northwards, peat along the northern section of the proposed pipeline route and Alluvium associated with the presence of River Cam.
- West Melbury Marly Chalk Formation in the south and some of the central part of the route with Gault Formation beneath the remainder.

6.2.6 In addition, a cover of made ground associated with previous development may be expected locally.

6.3 Contamination risks

6.3.1 A preliminary qualitative risk assessment has been undertaken for the site, which has indicated the following contamination risks:

Proposed WWTP

- The risk to construction workers, final end users (WWTP workers) and occupants of nearby residential and commercial properties have been determined to be very low assuming appropriate mitigation is in place:
  - A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers and offsite migration of dusts, surface runoff etc during development are minimised.
  - As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement.
- The risk to controlled waters has been assessed as low. Risks to groundwater will need to be further assessed through a Foundation Works Risk Assessment (FWRA) to ensure that man-made contaminant transport pathways such as piled foundations and deep excavations do not create additional pathways to the aquifers.
- Buried structure and infrastructure are at very low risk, assuming materials are designed for the prevailing ground conditions, following ground investigation.
- Risks to flora and fauna have been assessed as very low since, with appropriate mitigation measures in place (CEMP), it is unlikely that the proposed works will increase the risk to flora and fauna.

Associated Infrastructure

- The risk to construction workers, final end users (WWTP workers) and occupants of nearby residential and commercial properties have been determined to be very low assuming appropriate mitigation is in place:
  - A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers and offsite migration of dusts, surface runoff etc during development are minimised.
  - As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement.
- The risk to controlled waters has been assessed as moderate/low (groundwater) to low (surface water). Risks to groundwater will need to be assessed further through a Foundation Works Risk Assessment (FWRA) to ensure that man-made contaminant transport pathways (such as pipelines, tunnels and shafts) do not create additional pathways to the aquifers. A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised (such as turbidity during shaft construction).

- Buried structure and infrastructure are at very low risk, assuming materials are designed for the prevailing ground conditions, following ground investigation.

Waterbeach Pipeline

- The risk to construction workers, final end users (WWTP workers) and occupants of nearby residential and commercial properties have been determined to be very low assuming appropriate mitigation is in place:
  - A Construction Environmental Management Plan (CEMP) should be implemented prior to construction to ensure that impacts to construction workers and offsite migration of dusts, surface runoff etc during development are minimised.
  - As part of the construction and operation of site it is assumed that workers adhere to a site-specific risk assessment and method statement. The risk to controlled waters has been assessed as moderate/low (groundwater) to low (surface water).
- A risk assessment will likely be required to assess impacts to the groundwater from the proposed construction methods (pipelines, shafts and tunnels). This should be completed once designs are confirmed and ground investigation data is available. A CEMP should be implemented prior to construction to ensure that impacts to sensitive groundwater receptors during development are minimised (such as turbidity during shaft construction).
- Buried structure and infrastructure are at very low risk, assuming materials are designed for the prevailing ground conditions, following ground investigation.

6.4 Recommendations

6.4.1 The following recommendations are given:

- An intrusive ground investigation should be undertaken with the following scope and aims:
  - geo-environmental testing of made ground and underlying natural materials through targeted and representative soil sampling;
  - Testing of soils should be carried out for a range of contaminants including heavy metals, asbestos and hydrocarbons (TPH, polycyclic aromatic hydrocarbons, BTEX). Testing should be taken in line with the UKWIR (Water Industry Research) standards to determine the suitability of proposed pipelines;
  - Groundwater level monitoring should be undertaken monthly for a minimum of 12 months in order to ensure seasonal fluctuations are understood.

  - Groundwater samples should be obtained from the standpipes on the first three visits and tested for a range of contaminants including heavy metals and hydrocarbons (TPH, PAH, BTEX).
  - No significant ground gas source has been identified at the site and made ground is not anticipated to be encountered across the majority of the site (excluding the existing Cambridge WWTP). If significant made ground is encountered during ground investigation in areas where enclosed spaces are proposed, ground gas monitoring should be considered.

- If dewatering operations are required during development, the requirements for disposal should be informed by analysis of groundwater samples as groundwater may not be appropriate for disposal directly back to ground or surface waters.
- A Foundation Works Risk Assessment will likely be required to ensure piled foundations, pipelines, tunnels and shafts do not create additional contaminant pathways and any potential impacts on the underlying aquifers, such as turbidity, are managed. This should be completed once construction methods are confirmed and ground investigation data is available.
- Further assessment and appropriate management of excavated materials will be required during the works. Materials should be assessed for reuse in the development to minimise disposal requirements, and then be managed appropriately (e.g. under a materials management plan or waste exemption as necessary).

7 References

AF Howland Associates. (2020). A Report on a Ground Investigation for Cambridge Waste Water Treatment Plant Relocation, Cambrigdeshire (Factual).

British Geological Survey. (1984). Hydrogeological map of the area between Cambridge and Maidenhead.

British Geological Survey. (2021, February 19). GeoIndex. Retrieved from https://www.bgs.ac.uk/geoindex/

British Geological Survey. (online). BGS Lexicon, BGS. Retrieved February 17, 2021, from https://www.bgs.ac.uk/Lexicon/

CIRIA. (2001). Contaminated Land Risk Assessment- A Guide to Good Practice, CIRIA Report C552. London: CIRIA.

Environment Agency. (2020, October 08). Land contamination risk management (LCRM): How to access and manage the risks from land contamination. Retrieved March 03, 2021, from https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm

Environment Agency. (online). Catchment Data Explorer. Cam Overview. Retrieved February 19, 2021, from https://environment.data.gov.uk/catchment-planning/WaterBody/GB105033042750

Environment Agency. (online). Catchment Data Explorer: Cam and Ely Ouse Chalk Overview. Retrieved February 17, 2021, from https://environment.data.gov.uk/catchment-planning/WaterBody/GB40501G400500

Environment Agency. (online). Long Term Flood Risk Information. Retrieved February 22, 2021, from https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

Envrionment Agency. (online). Flood map for planning. Retrieved February 22, 2021, from https://flood-map-for-planning.service.gov.uk/

Google Earth Pro. (2021). Google Earth Pro 7.3.3.7786.

Landmark. (2018). Envirocheck Report for Cambridge Water Recycling Centre, Order Number: 172033276_1_1.

Landmark. (2019). Envirocheck Report (Site L), Order Number: 225020744_1_1.

Landmark. (2021). Envirocheck Report - Waterbeach pipeline. Order Number 285568096_1_1.

Mott Macdonald. (2018). Cambridge Water Recycling Centre, Geo-environmental Preliminary Risk Assessment .

Mott Macdonald. (2020). Cambridge Waste Water Treatment Plan Relocation - Initial Options Appraisal.

Mott Macdonald. (2021). Cambridge WWTP Relocation Hydrogeological Impact Assessment.

Zetica. (online). Zetica UXO Risk Map. Retrieved February 23, 2021, from https://zeticauxo.com/downloads-and-resources/risk-maps/

8 Appendices

8.1 Appendix A: Figures

8.2 Appendix B: Envirocheck Reports

8.3 Appendix C: Zetica UXO Risk Map

8.4 Appendix D: Contaminated land risk methodology

8.4.1 The assessment of contamination risk has adopted R&D Publication 66:2008 Guidance for the Safe Development of Housing on Land Affected by Contamination published jointly by the National House-Building Council, Environment Agency and the Chartered Institute of Environmental Health [i]. The methodology differs from that presented in CIRIA C552 [ii], particularly in terms of the definitions of classification of consequence, which include a consideration of the immediacy of hazards.

8.4.2 The key to the classification is that the designation of risk is based upon a consideration of:

- the magnitude of the potential consequence (severity) - (considers the potential severity of the hazard and the sensitivity of the receptor);
- the magnitude of probability (likelihood) - (considers the presence of the hazard and receptor and the integrity of the pathway)

8.4.3 The potential consequences of contamination risks occurring at this site are classified in accordance with Table 8-1 below.

Table 8-1: Classification of Consequence

Classification	Definition
Severe	Highly elevated concentrations likely to result in "significant harm" to human health as defined by the EPA 1990, Part 2A, if exposure occurs. Equivalent to EA Category 1 pollution incident including persistent and/or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce. Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long-term maintenance of the population. Catastrophic damage to crops, buildings or property.
Medium	Elevated concentrations which could result in "significant harm" to human health as defined by the EPA 1990, Part 2A if exposure occurs. Equivalent to EA Category 2 pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce. Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long-term maintenance of the population. Significant damage to crops, buildings or property.
Mild	Exposure to human health unlikely to lead to "significant harm".

Classification	Definition
	Equivalent to EA Category 3 pollution incident including minimal or short-lived effect on water quality; marginal effect on amenity value, agriculture or commerce. Minor or short-lived damage to aquatic or other ecosystems, which is unlikely to result in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long-term maintenance of the population. Minor damage to crops, buildings or property.
Minor	No measurable effect on humans. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects of damage to buildings, structures and services.

Source: R&D66:2008 Table A4.3

8.4.4 The probability of contamination risks occurring at the site is classified in accordance with Table 8-2.

8.4.5 Note: A pollution linkage must first be established before probability is classified. If there is no pollution linkage, then there is no potential risk and no need to apply tests for probability and consequence.

Table 8-2: Classification of Probability

Classification	Definition
High likelihood	There is a pollutant linkage and an event that either appears very likely in the short term or almost inevitable over the longer term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollutant linkage and all elements are present and in the right place which means it Is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long-term.
Low Likelihood	There is a pollutant linkage and circumstances are possible under which an event would occur. However, it is by no means certain that even over a longer period such event would take place, and it is less likely in the shorter term.
Unlikely	There is a pollutant linkage, but circumstances are such that it is improbable that an event would occur even in the very long-term.

Source: R&D66:2008 Table A4.4

8.4.6 For each possible pollution linkage (source-pathway-receptor) identified, the potential risk can be evaluated based upon the following probability x consequence matrix shown in Table 7 3.

Table 8-3: Description of Risk Levels

Term	Description
Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without remediation action.

Term	Description
High risk	Harm is likely to arise to a designated receptor from an identified hazard at the site without remediation action.
Moderate risk	It is possible that without appropriate remediation action harm could arise to a to a designated receptor. It is relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely that such harm would be mild.
Low risk	It is possible that harm could arise to a designated receptor from identified hazard. It is likely that, at worst, if any harm was realised the effects would be mild.
Very low risk	The presence of an identifies hazard does not give rise to the potential to cause harm to a designated receptor.

Source: R&D66:2008 Table 1.9

8.5 Appendix E: Site walkover

8.5.1 A site walkover survey of the Waterbeach Pipeline route was required for areas identified as potential sources of contaminated land. This included:

- Waterbeach Water Recycling Centre (WRC);
- Historical landfill site at Northfields Farm (ref LS 132); and
- Historical landfill site at Claytithe Cottage (ref LS 95).

8.5.2 The locations of these can be seen below in Figure 8.1 and Figure 8.2.

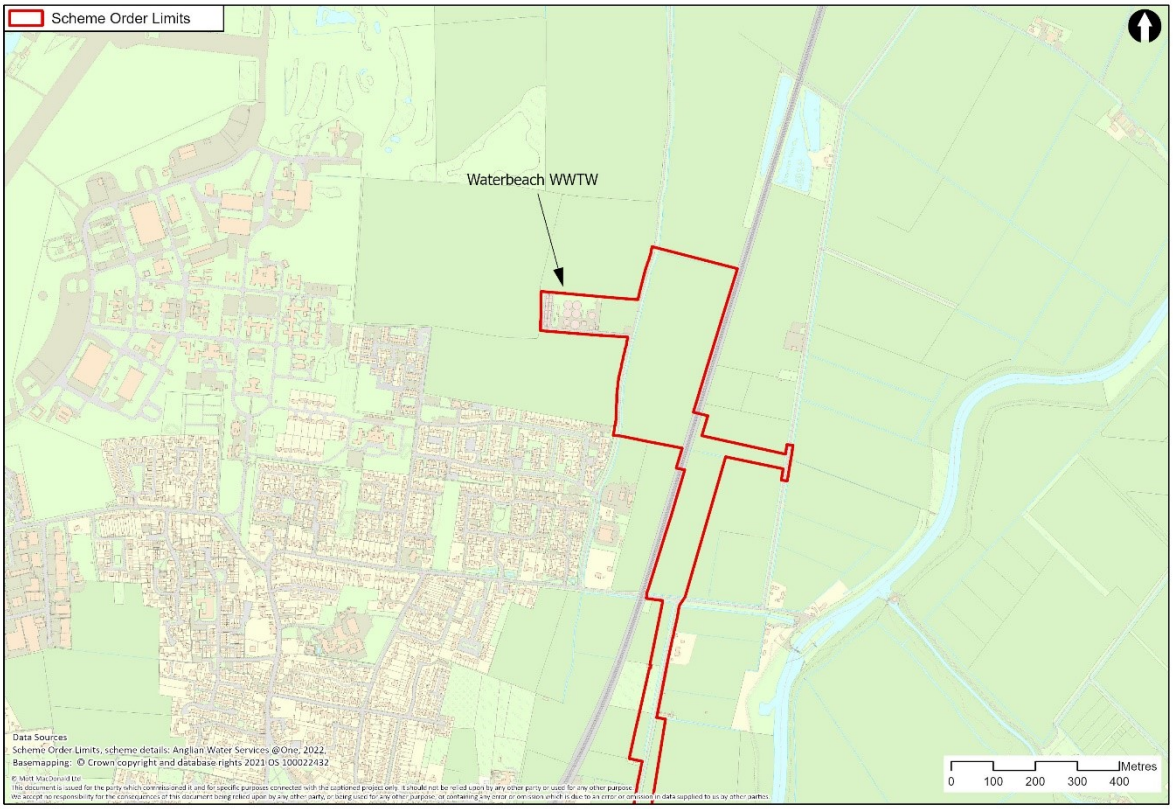

Figure 8.1: Waterbeach WRC

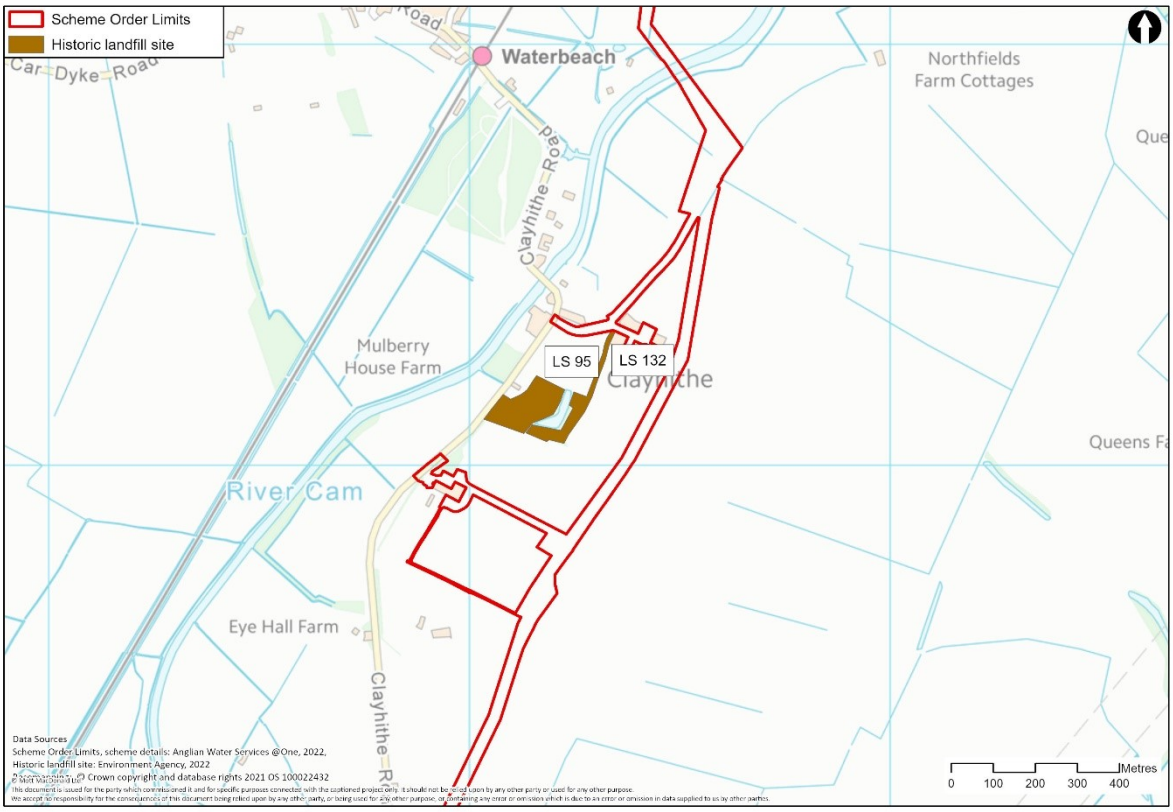

Figure 8.2: Historical landfill site locations

Waterbeach WRC

Access and security

8.5.3 The Waterbeach WRC is fenced and gated. Access was provided by a representative from Anglian Water. Access is via a track north of Bannold Road.

Surrounding land use

8.5.4 The site is surrounded by arable fields.

Site condition and topography

8.5.5 The site is currently used as a WRC for the town of Waterbeach. The site is a mixture of grassland and hardstanding. The main site uses are presented visually on Figure 8.3.

8.5.6 The surrounding site is flat. The majority of the site is flat except for raised embankments surrounding the redundant tanks. It is likely that this is a result of material being excavated from site for the redundant drying beds and this material being used as fill around the redundant tanks.

8.5.7 The main area of contaminated land concern is the fuel storage tank to the east of the site (photo 1). This was bunded. However, the Anglian Water site representative

noted that there have been several attempted thefts of fuel and so it is likely that this has resulted in small spillages of fuel to ground.

8.5.8 The site building (redundant) was noted to contain a sign on the door stating that asbestos was present.

Figure 8.3: Schematic of the Waterbeach WRC

Photo 1: Waterbeach WRC fuel tank

Historical landfill sites

Access and security

8.5.9 The historical landfill sites were accessed on foot via a private road to Claytithe Farm, located east of Claytithe Road. Site LS 132 is access via a private track,

although the site is not fenced. The site LS 95 was viewed from the edge of site LS 132.

Surrounding land use

8.5.10 Arable fields lie to the north, south and west of the historical landfill sites. Residential properties and Claytithe Road lies to the west.

Site condition and topography

8.5.11 The historical landfill site LS 132 is a small mud track leading up to an area covered in grass and other vegetation. There was a field drain present west of the track. The site LS 93 was viewed from LS 132 and was noted to contain grass, vegetation and tress.

8.5.12 There is a pond between the two historical landfill sites. The site lies generally flat, although the pond lies below the natural ground level. Pond depth was unable to be determined.

8.5.13 A small area of fly tipping and burning of waste material was noted on the eastern edge of LS 132 (see Photo 2).

Photo 2: Fly tipping at historical landfill LS 132