

Middlewick Ranges, Colchester

Flood Risk, Surface and Foul Water Drainage Scoping Report

On behalf of **Defence Infrastructure Organisation**



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1 Introduction

Peter Brett Associates LLP (PBA) has been instructed by the Defence Infrastructure Organisation (DIO) to establish the baseline flood risk and surface water drainage information for Middlewick Ranges, Colchester. This information is to be used to identify the existing constraints and opportunities in order to develop a masterplan for a residential led mixed use redevelopment scheme. The work undertaken will provide evidence in support of the site allocation within the Colchester Borough Council Local Plan.

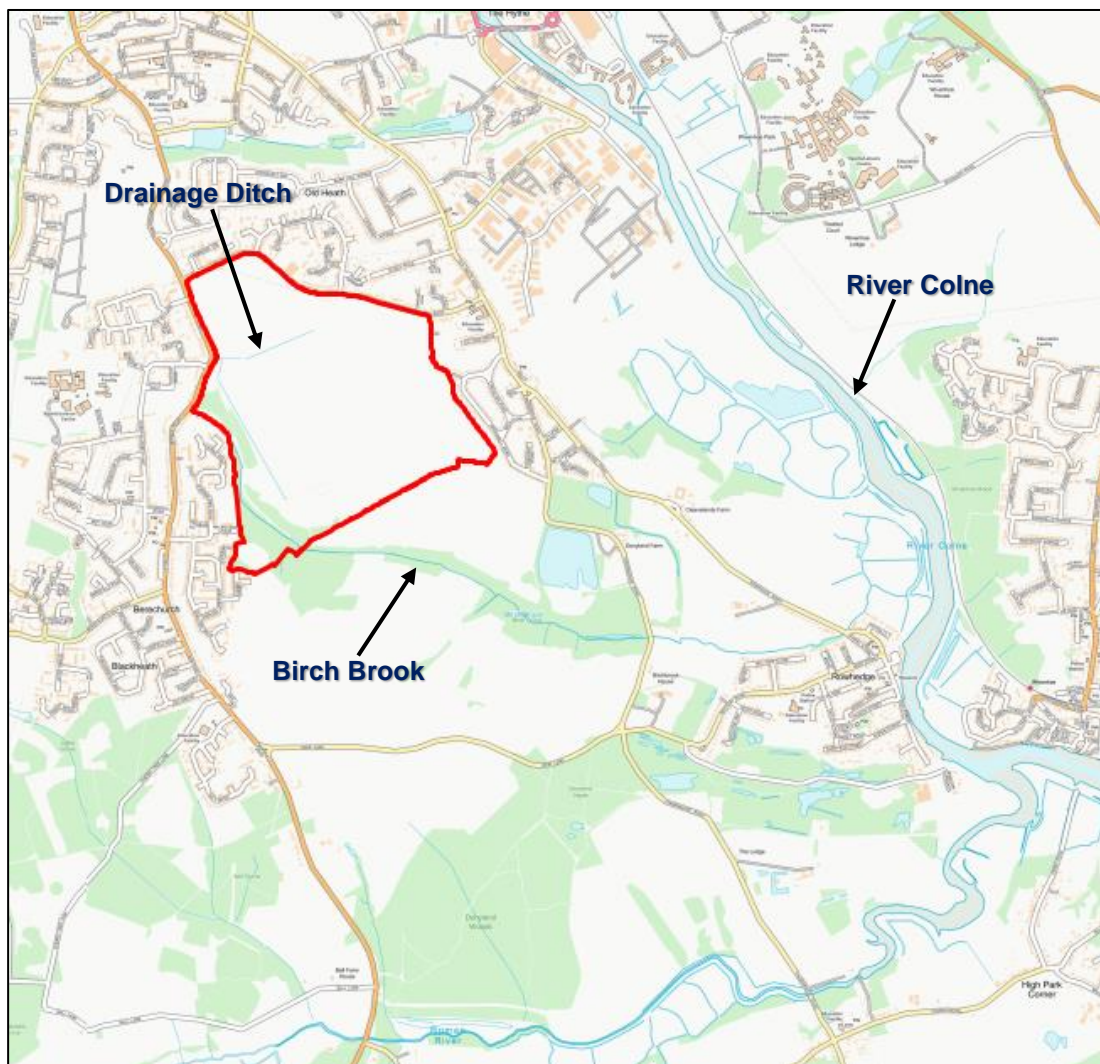
This Scoping Report will:

- Provide background site information;
- Outline the key local planning policy documents applicable to the site;
- Present outcomes of consultation with key stakeholders;
- Outline the development proposals for the site at this initial stage;
- Set out the site's existing hydrological context;
- Assess the baseline flood risk from a range of sources;
- Outline the results from a preliminary assessment of the surface water drainage regime and potential attenuation requirements on site; and,
- Outline the proposed foul drainage strategy for the site.

2 Background

2.1 Site Description

- 2.1.1 Middlewick Ranges is located at Colchester, Essex. The site is located within the Borough of Colchester. The site is centered at National Grid Reference 600953(E), 222738(N). The site boundary is shown in **Figure 2.1**.
- 2.1.2 The total site comprises approximately 198 hectares of public sector land currently used as an operational firing range. The ranges are scheduled to be vacated in 2020.



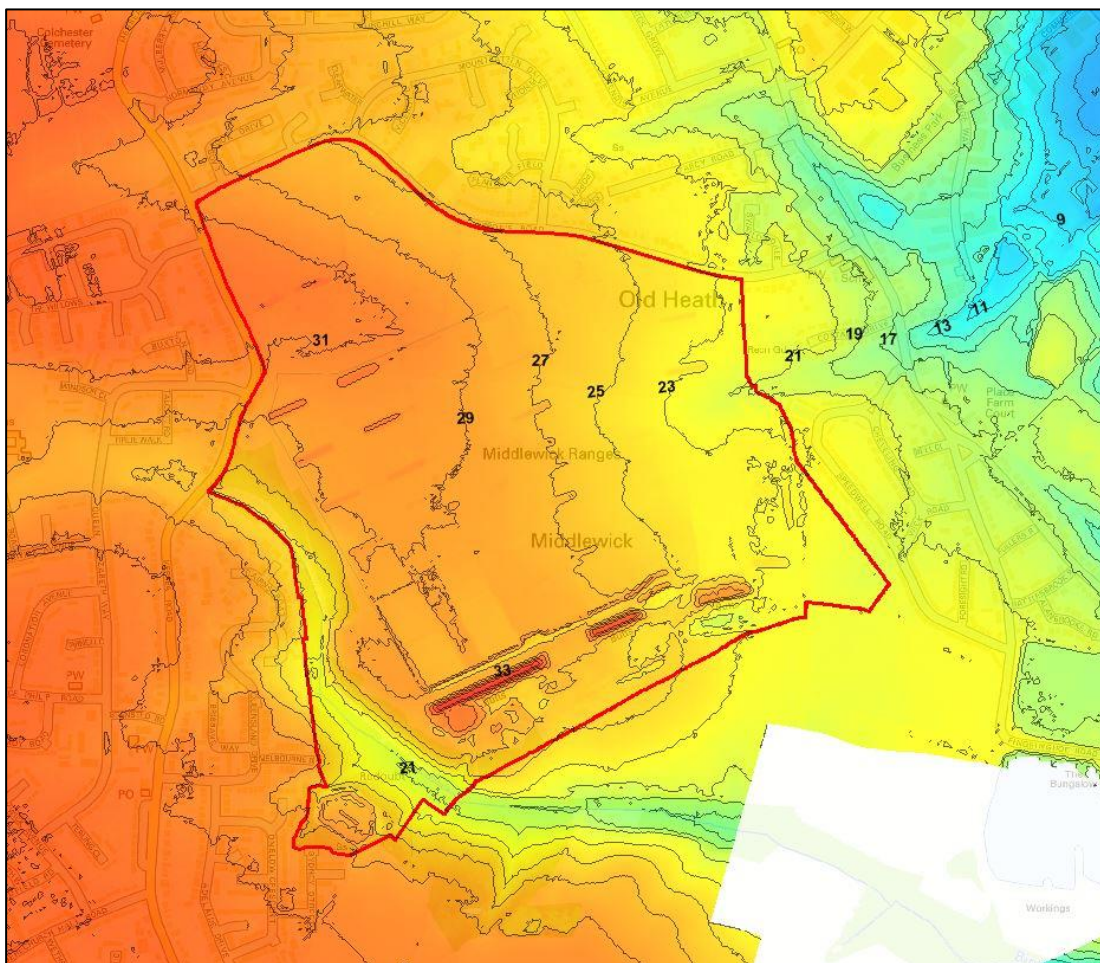
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Figure 2.1 Site Location Plan

2.2 Topography

2.2.1 Topographical survey of the site has not yet been completed. 1m resolution LiDAR data obtained through the Environment Agency Open Data website has been used to assess the topography of the site. The topography is shown in **Figure 2.2**. The LiDAR indicates:

- the site generally falls to the east and south-east;
- At the north western edge of the site ground levels are approximately 31m aOD (above Ordnance Datum).
- Ground levels fall across the site to a level of approximately 21m aOD at the eastern site boundary, and 25m aOD at the southern site boundary.



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LiDAR data downloaded from <https://environment.data.gov.uk/ds/survey/#/survey> July 2018

Figure 2.2 Site Topography (based on 1m resolution LiDAR data)

2.3 Geological Conditions

- 2.3.1 Online British Geological Survey (BGS) mapping indicates the following underlying bedrock geology at the site:
- *London Clay Formation – Clay, Silt and Sand.*
- 2.3.2 BGS mapping indicates the following underlying superficial geology at the site:
- *Kesgrave Catchment Subgroup – Sand and Gravel.*
 - The watercourse corridor associated with the Birch Brook to the south of the site is underlain by *Alluvium – Clay and Silt.*
- 2.3.3 The online Cranfield University Soilscales viewer indicates the site is underlain by:
- *Slightly acid loamy and clayey soils with impeded drainage.*
- 2.3.4 The site is not located within a Groundwater Source Protection Zone (SPZ).
- 2.3.5 The London Clay Formation is designated an Unproductive Aquifer.
- 2.3.6 The Kesgrave Catchment Subgroup is classified as a Second A aquifer.
- 2.3.7 The groundwater vulnerability map indicates that the superficial deposits underlying the site are classified as *Minor Aquifer Intermediate.*

3 Local Planning Policy Documents

3.1.1 The assessment of flood risk along with the drainage requirements at the site has been completed by a review of, and in accordance with, the following policy and guidance:

- National Planning Policy Framework (NPPF), (2018);
- Planning Practice Guidance (PPG), (2014), including climate change guidance published February 2016;
- Essex County Council Preliminary Flood Risk Assessment (PFRA) (January 2011)
- Essex County Council Sustainable Drainage Systems Design Guide (April 2016);
- Essex County Council and Colchester Borough Council Colchester Town Surface Water Management Plan (July 2013);
- Colchester Borough Council Level 1 Strategic Flood Risk Assessment (SFRA) Update (August 2016);
- Colchester Borough Council Level 2 Strategic Flood Risk Assessment (February 2017);
- Colchester Borough Council Flood Risk Sequential Test Report (June 2017).

3.1.2 The following key stakeholders have been consulted to obtain flood risk and existing drainage information for the site:

- Environment Agency (EA);
- Essex County Council (ECC), in their role as Lead Local Flood Authority (LLFA);
- Colchester Borough Council (CBC), in their role as Local Planning Authority (LPA); and,
- Anglian Water (AW).

3.1.3 All correspondence and associated data received from key stakeholders is presented in **Appendix A**.

4 Development Proposals

- 4.1.1 It is understood that the Council has recommended that land at Middlewick Ranges be allocated for residential development, having received information regarding its availability during consultation. A new policy will be drafted promoting up to 1,000 residential dwellings at the site. The policy will include mitigation needed to reflect the constraints on the site and to ensure inclusion of relevant infrastructure to support the allocation.
- 4.1.2 The proposed concept masterplan is shown in **Figure 4.1** (and a copy provided in **Appendix B**).

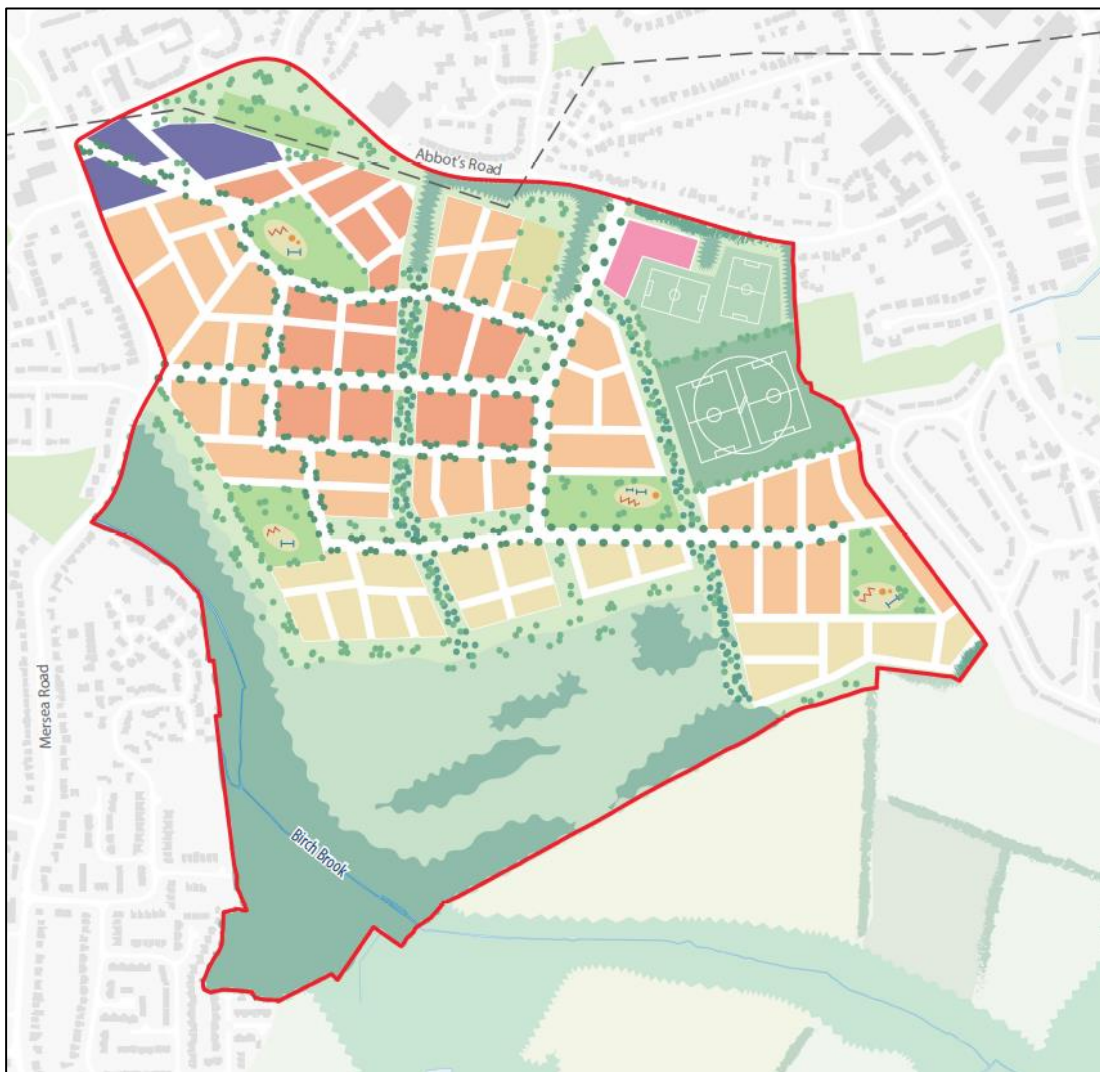


Figure 4.1: Extract of Concept Masterplan (drawing AA6742 SK-02 Rev0)

5 Hydrological Context and Existing Drainage

5.1 Watercourses and Waterbodies

5.1.1 The following watercourses are located within the vicinity of the site and labelled on **Figure 2.1**:

- The Birch Brook, an ordinary watercourse, flows in an easterly direction through and adjacent to the south of the site.
- The Birch Brook becomes Main River downstream of the site and confluences with the River Colne, located approximately 1.3km east of the site.
- There is a drainage ditch on the north and western edges of the existing shooting range within the site. This ditch does not connect or drain into the Birch Brook.

5.1.2 A private fishing lake is located at Donyland to the south-east of the site.

5.2 Existing Drainage Infrastructure

5.2.1 Anglian Water asset plans (**Appendix C**) indicate:

- Two surface water sewers outfall into the head of the Birch Brook adjacent to Mersea Road at the west of the site. One sewer is shown as 825mm diameter. The other sewer size at the outfall is not labelled, however, sewers of 1524mm, 610mm and 375mm diameter all converge at a manhole upstream of the outfall and therefore the sewer is likely to be of significant size. The outfalls are located in a compound to the west of the road (**Figure 5.1**). The sewers serve existing development to the west of the site.



Figure 5.1 Anglian Water outfall compound adjacent to Mersea Road (image taken June 2018)

- A 300mm diameter surface water sewer flows in an easterly direction beneath Abbot's Road at the north of the site. This sewer converges with another surface water sewer at

the junction with Mountbatten Drive and then continues as a 1350mm diameter sewer flowing in an easterly direction at the northern site boundary, adjacent to Abbot's Road. At the north-eastern corner of the site the sewer turns south and flows adjacent to the western site boundary, and then continues south through the site, ultimately outfalling to the Birch Brook at the south of the site. The sewers serve existing development to the north of the site.

- A 914mm diameter brick combined sewer flows in an easterly direction across the northern part of the site. The sewer enters the site at the existing access point on Mersea Road, bisects the site, and continues east through the park area at Old Heath Road east of the site. The sewer conveys flows to the sewage treatment works located approximately 700m east of the site.

5.2.2 The site predominantly comprises open greenfield areas and therefore there is little formal drainage infrastructure present to serve the existing development.

6 Assessment of Flooding

6.1 Fluvial Flooding

- 6.1.1 The EA have provided a copy of their Flood Map for Planning that indicates the site is located in Flood Zone 1. This is land assessed as having a low probability of flooding – less than 1 in 1,000 annual probability of fluvial flooding.
- 6.1.2 There is a small area of the site at the southern boundary within areas of Flood Zones 2 and 3. This flood risk is confined to the watercourse corridor of the Birch Brook and does not impact developable areas of the site.
- 6.1.3 A copy of the Flood Map is provided in **Appendix A**.
- 6.1.4 Mapping in the CBC Level 1 SFRA (2015) confirms the site is located in Flood Zone 1.
- 6.1.5 The site is assessed within the CBC Level 2 SFRA (2017) and states:
- *The River Colne flows to the east of the site. A very small area in the south of the site is subject to medium and high probability of flooding and is classed as Flood Zone 2 and 3, as the Birch Brook runs through the site from west to east. The majority of the large site (99.82%) is located within Flood Zone 1, and is therefore considered to be at low risk from flooding from the River Colne.*
 - *The Birch Brook is not modelled along its entire length, which may impact current flood extents, depths and flows running through the site. It is likely that modelling of the brook may be required to ensure safe design of the site.*
 - *Flood modelling of the ordinary watercourse section of the Birch Brook that passes through the site is derived from high level JFLOW modelling, and therefore output for Flood Zone 3b functional floodplains are not available for this watercourse. Further modelling is required to determine the extent of Flood Zones across the site.*
- 6.1.6 The drainage ditch within the site manages surface water run-off from the small areas of hardstanding within the site and there are no formal connections from this ditch into any of the nearby watercourses. The ditch was observed as dry during a site visit in June 2018. The flood risk from this feature is therefore deemed to be negligible.

6.2 Tidal Flooding

- 6.2.1 The River Colne is tidally influenced and experiences tidal flooding, however, this flooding does not extend up the Birch Brook to impact the site.
- 6.2.2 Tidal flood extents from the River Colne and Blackwater Estuary Model are presented in the CBC Level 2 SFRA (2017) that confirms the site is not impacted by tidal flooding.
- 6.2.3 The Level 2 SFRA states *The area to the south east of the site is protected by the presence of the Colne Barrier at Wivenhoe, which closes during extreme tidal events. A model simulation has been completed to determine the residual risk to the site in the event there is a failure of the Barrier to close. Results for the 0.5% AEP event including an allowance for climate change shows that the site is not at risk of flooding from this source.*

6.3 Surface Water Flooding

- 6.3.1 The EA Map for Flood Risk from Surface Water indicates the site is at very low risk of surface water flooding. There are isolated patches within the site, associated with localised topographic lows shown to be at low, medium and high risk of flooding although these areas are limited and isolated.
- 6.3.2 At the east of the site a surface water flow route is shown to flow east, through the area of parkland at Old Heath Road. This flow route coincides with a minor valley feature identified on the LiDAR data.
- 6.3.3 The existing surface water drainage systems adjacent to the site contribute to the low surface water flood risk.
- 6.3.4 The CBC Level 2 SFRA states:
- *The Risk of Flooding from Surface Water Mapping indicates that whilst the majority of the site is at low risk of surface water flooding (<0.1% AEP), the mapping indicates there may be areas at medium to high risk of surface water flooding, particularly in the south of the site where the Birch Brook runs through the site. There are also some potential flows routes to the north and west of the site boundary.*
 - *The bedrock geology in this area is Thames Group, comprising of clay and silt. This is overlain by sand and gravel of the Kesgrave Catchment subgroup. Underlying clay conditions are typically not very permeable and provide the potential for ponding of surface water on the ground surface during heavy rainfall.*
 - *The northern section of the site is within the study area for the town of Colchester SWMP and is within the 'Old Heath' Critical Drainage Area (CDA).*
- 6.3.5 The northern part of the site is located within a Critical Drainage Area (CDA) in the Colchester Town SWMP. The CDA is referred to as *CDA 01 – Old Heath Area*. The SWMP states:
- *Surface water is predicted to flow generally from west to east towards the River Colne. The pluvial modelling indicates predicted surface water flooding across various locations of the CDA.*
 - *Water flows from the upper catchment in an easterly direction [...] as a result of the preferential flow route for overland sheet run-off – a possible lost watercourse.*
 - *Ponding of surface water occurs as a result of natural valleys, depressions and topographic low spots. The main area of ponding is located east of Old Heath Road and the sewage treatment plant.*
 - *There are two historic flood event within the eastern boundary of the CDA which support the predicted results.*
- 6.3.6 The surface water flow route within the Old Heath CDA identified in the SWMP is primarily along a valley feature beyond the northern site boundary, and there is limited upstream catchment area contributing to this surface water risk from within or immediately adjacent to the site.
- 6.3.7 The SWMP sets out preferred options for managing surface water flood risk in the Old Heath CDA. These recommendations include provision of swales and attenuation areas, potentially located in the northern part of the site, adjacent to Abbot's Road, as a means of collecting diverted overland flows and reducing surface water flood risk within the CDA. These options

have not been incorporated into the preliminary surface water management strategy at this stage.

- 6.3.8 Further consultation with CBC will be required at the planning application stage to ensure that the findings of the SWMP are still relevant and to determine their exact requirements. The proposals do not preclude the inclusion of wider surface water management options being delivered as part of the development.

6.4 Reservoir Flooding

- 6.4.1 The EA Map for Flood Risk from Reservoirs indicates the site is not at risk of flooding in the event of a reservoir failure.

6.5 Groundwater Flooding

- 6.5.1 The Colchester Town SWMP identifies the northern part of the site within the Old Heath CDA. With regards to groundwater flooding the SWMP states:

- *The western portion of the CDA is highlighted to be at a low risk whilst the eastern half is at moderate susceptibility to groundwater flooding.*

- 6.5.2 The CBC Level 2 SFRA states:

- *The AStGWF mapping shows that the site is mostly located within a 1km square of which at least 75% is susceptible to groundwater emergence. The risk of groundwater flooding in the area is therefore generally considered to be high. This will need to be confirmed during site investigation survey.*

- 6.5.3 The EA response (dated June 2018) states:

- *Modelled groundwater flow is generally to the east in the chalk. There is little vertical movement of groundwater due to the confined nature of the chalk in this area by the London Clay.*
- *Modelled groundwater flow in the superficial sands and gravels is not laterally consistent and tends to be towards the nearest watercourse. In the near vicinity the modelled groundwater flow in the sands and gravels is to the east in the general direction the River Colne.*
- *The modelled depth to the water table in this area ranges between approximately 0m and 5m. We have no groundwater monitoring sites in the vicinity that measure the depth to the water table.*
- *Groundwater flooding records have only been kept for report events in our area since 2010. Since this time we have had no reported events.*

6.6 Sewer Flooding

- 6.6.1 AW have confirmed that they hold no records of flooding in the vicinity of the site that can be attributed to capacity limitations in the public sewerage system.

6.7 Historical Flooding

- 6.7.1 The CBC Level 2 SFRA states:

- *There are four historic records of flooding a considerable distance away to the north of the site, but the causes of these incidents are unknown.*

6.8 Summary of Flood Risk

| Source of Flooding | Risk of Flooding to Site | Comment/Justification | Source of data | Mitigation requirements for new development |
|---|--------------------------|--|--|--|
| Fluvial | Low | <p>The site is located almost wholly in Flood Zone 1 – land assessed with less than 1 in 1,000 annual probability of fluvial flooding.</p> <p>There is an area of the watercourse corridor of the Birch Brook in Flood Zones 2 and 3 – although this area is not proposed to be developed.</p> <p>The drainage ditch serves only small areas of existing hard standing and is considered low risk.</p> | <p>EA online Flood Map for Planning</p> <p>CBC Level 1 and Level 2 SFRA</p> <p>Site observations</p> | N/A |
| Land Drainage (i.e. Surface Water/ Pluvial) | Low | <p>The EA surface water flood map indicates the site is almost entirely at 'very low' risk of flooding.</p> <p>There are isolated areas of 'low', 'medium' and 'high' surface water flood risk.</p> <p>The northern part of the site is located within a Critical Drainage Area.</p> | <p>EA Map for Flood Risk from Surface Water</p> <p>CBC Level 2 SFRA</p> <p>ECC & CBC SWMP</p> | <p>Consider in development of surface water drainage strategy</p> <p>Liaise with CBC to determine the implications of the site being partially located within a CDA.</p> |
| Ground water | Medium | <p>The SFRA states the risk of groundwater flooding in the area is considered to be high.</p> <p>The EA state that the depth to groundwater varies between 0-5m below ground level in this area.</p> | <p>EA Consultation</p> <p>CBC Level 2 SFRA</p> | <p>Allow for in floor level recommendations.</p> <p>Investigate groundwater levels through site investigation.</p> |
| Reservoir, Canals, Ponds and Artificial Sources | Low | <p>The EA reservoir flood map indicates none of the site is located in an area at risk of flooding due to reservoir failure.</p> | <p>EA Map for Flood Risk from Reservoirs</p> | N/A |
| Sewers | Low | <p>AW hold no records of historic sewer flooding at the site.</p> | <p>AW Consultation</p> | <p>Investigate the capacity of existing sewer systems as part of a future planning application.</p> |
| Key: | Low | Low/Negligible Risk – No noticeable impact to site and not considered to be a constraint to development | | |
| | Medium | Medium Risk – Issue requires consideration but not a significant constraint to development | | |
| | High | High Risk – Major constraint to development requiring active consideration in mitigation proposals | | |

7 Sequential Test

7.1.1 NPPF PPG 'Flood Risk and Coastal Change' Table 2 confirm the '*Flood risk vulnerability classification*' of a site, depending on the proposed usage. This classification is subsequently applied to PPG Table 3 to determine whether:

- The proposed development is suitable for the Flood Zone in which it is located; and,
- Whether an Exception Test is required for the proposed development.

7.1.2 The proposed residential development is classed as 'More Vulnerable' development.

7.1.3 All new development on site would be located entirely within Flood Zone 1.

7.2 NPPF Sequential Test

7.2.1 The NPPF follows a sequential risk-based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas.

7.2.2 The proposed developable areas of the site are located within Flood Zone 1 and, as such, all new development would be located within Flood Zone 1. Table 3 of the PPG states that all flood risk vulnerability classifications are considered appropriate within Flood Zone 1. The proposed development is therefore appropriate in terms of flood risk and neither the Sequential Test or Exception Test are required.

7.2.3 The CBC Level 2 SFRA states:

- *The proposed development entails More Vulnerable residential development located in Flood Zone 1, which is considered compatible development in accordance with the NPPF. The proposals are therefore not subject to the Exception Test. However, Colchester BC have included this site for assessment as part of the Level 2 SFRA due to the risk of surface water flooding, and based on the strategic assessment of flood risk and the recommendations for mitigation measures set out above, it is considered that proposed development on this site could be suitably designed to satisfy part 2) of the Exception Test.*

7.2.4 The CBC Flood Risk Sequential Test Report states:

- *The majority of Middlewick Ranges falls within Flood Zone 1 therefore proposals are not usually subject to the Exceptions Test. However, the site was assessed in the level 2 assessment due to the risk of surface water flooding. No residential development should be built within areas towards the south of the site that fall within Flood Zone 2 or 3 or in areas at risk from surface water / groundwater flooding. Based on the assessment of flood risk and subject to the above recommendations / mitigations being implemented the Sequential and Exception Tests are passed.*

8 Preliminary Surface Water Drainage Options

8.1 Introduction

8.1.1 This section outlines proposals as to how the surface water run-off from the development could be managed in accordance with national and regional policy requirements, and best practice guidance. The proposals aim to mitigate the risk of surface water flooding on the site and to avoid increasing flood risk elsewhere.

8.2 Policy

National Planning Policy Framework

8.2.1 The NPPF recognises that flood risk and other environmental damage can be sustainably managed by minimising changes in the volume and rate of surface run-off from development sites. It recommends that priority is given to the use of Sustainable Drainage Systems (SuDS) in new development.

8.2.2 As the intention of SuDS is to mimic the natural drainage regime of the undeveloped site, paragraph 80 of NPPF Planning Practice Guidance (PPG) states the following (which is consistent with the Building Regulations H3 hierarchy):

8.2.3 *“The aim should be to discharge surface water run-off as high up the following hierarchy of drainage options as reasonably practicable:*

- *into the ground (infiltration);*
- *to a surface water body;*
- *to a surface water sewer, highway drain or another drainage system;*
- *to a combined sewer.”*

Local Policy

8.2.4 The Lead Local Flood Authority (LLFA) is Essex County Council.

8.2.5 A key guidance document that informs the implementation of surface water drainage infrastructure in accordance with the requirements of NPPF is the current SuDS Manual (CIRIA report C753, 2015). This sets out the ‘Four Pillars’ for SuDS design and implementation; manage quantity, improve quality and provide amenity and biodiversity.

8.2.6 SuDS features are unlikely to be adopted by the LLFA, therefore correspondence with AW is recommended regarding adoption.

Discharge Destination

8.2.7 The geology of the site described in **Section 2.3** indicates the site is underlain by superficial deposits comprising sand and gravels. It is therefore possible that surface water run-off could be managed by infiltration on site. Infiltration testing to the BRE365 standard will be required to confirm the rates of infiltration.

8.2.8 Given there is uncertainty regarding ground conditions until intrusive investigation takes place, an infiltration drainage solution is discounted at this stage. For the purposes of assessing constraints and the deliverability of a scheme this is considered a conservative approach as some contribution from infiltration solutions is anticipated.

- 8.2.9 Where infiltration is not appropriate, the next preference in the Building Regulations H3 Hierarchy is discharge to a watercourse.
- 8.2.10 The Birch Brook flows in an easterly direction to the south of the site. Based on existing topography, only the southern part of the site drains directly towards the brook. Northern and eastern areas of the site drain in an easterly direction. There are no other watercourses located within the vicinity of the site.
- 8.2.11 Anglian Water asset plans indicate the presence of surface water sewers within the northern and eastern boundaries of the site (see **Section 5.2**). These sewers ultimately outfall to the Birch Brook to the south-east of the site.
- 8.2.12 For the southern part of the site it is proposed to discharge surface water run-off to the Birch Brook by gravity connections.
- 8.2.13 For northern and eastern areas of the site it is proposed to discharge attenuated surface water run-off into the existing surface water sewers, which will ultimately drain to the Birch Brook.

8.3 Design Strategy Parameters

Drainage Catchment

- 8.3.1 A surface water drainage network has been identified to serve six sub-catchments on site; shown in drawing 40472-4002-001 in **Appendix D**.

Discharge Rate

- 8.3.2 It is proposed that surface water run-off will be attenuated to greenfield run-off rates. This follows the accordance of BS 8582:2013 Code of Practice (Surface Water Management for Development Sites) which states that, wherever possible, surface water run-off from all previously developed sites should be reduced to the equivalent greenfield run-off rate.
- 8.3.3 The following greenfield run-off rates have been determined from the Greenfield Run-off Tool from HR Wallingford, as included in **Appendix D**. The existing greenfield rates across the site have been determined as follows:
- $Q_{BAR} = 1.39 \text{ l/s/ha}$
 - $Q_{100} = 4.43 \text{ l/s/ha}$
- 8.3.4 Q_{BAR} will be used as the limiting discharge rate for attenuation across site. This discharge rate is a conservative estimate made in lieu of capacity information for the existing sewers. This decision minimises the potential risk of the preliminary attenuation discharge exceeding sewer capacity.

Flood Estimation

- 8.3.5 The surface water attenuation provisions for MicroDrainage modelling have been determined using Flood Estimation Handbook (FEH) data for the area.

Volumetric Run-off Coefficient

- 8.3.6 Volumetric run-off coefficient (C_v) of 0.85 has been utilised in the sizing of the surface water attenuation storage. This provides a factor of safety regarding the estimation of attenuation required, as it simulates an increased level of surface water run-off due to a greater wetness factor of the modelled ground conditions.

Percentage of Impermeable Areas

- 8.3.1 The proposed development areas have been taken from the Draft Concept Masterplan and the conservative percentage impermeable areas have been assumed as shown in **Table 8.1**.

| Development | % Impermeable per ha |
|----------------------------|----------------------|
| Low Density Residential | 50% |
| Medium Density Residential | 60% |
| High Density Residential | 70% |
| Mixed Use | 80% |
| Commercial | 80% |

Table 8.1: Impermeable % for each Catchment Type

- 8.3.2 The Essex County Council SuDS Design Guide (April 2016) states: *An additional 10% of impermeable area should be accounted for to mitigate against urban creep, unless this is not appropriate for the proposed development use.* Given the preliminary nature of the masterplan it is not possible to accurately assess urban creep impacts at this stage. As the masterplan evolves into more detail at the outline application stage, an urban creep allowance will be applied to the measured impermeable areas used within the surface water drainage design.

Climate Change Allowance

- 8.3.3 Correspondence with the LLFA has confirmed that as part of the surface water drainage design, a 1 in 100 year event should be checked with a 40% climate change allowance to account for increases in rainfall intensity. The basins have therefore been preliminarily assessed within MicroDrainage to provide storage at their design level for a 1 in 100 year rainfall event plus 40% climate change allowance. An additional 0.3 meter freeboard has been additionally included in the design as a precautionary safety measure. This is a conservative design and therefore there may be scope to review at a later stage of the project.

8.4 Concept Drainage Strategy

- 8.4.1 Based on assumptions of the existing site drainage; our current drainage strategy proposal is to reuse existing drainage infrastructure for most of the development. The strategy has been illustrated on the Surface Water Strategy Proposal Drawing (40472-4002-001) in **Appendix D**.
- 8.4.2 Sub-catchments have been determined based on the Draft Concept Masterplan and topographical LiDAR information. Surface water run-off is expected to be conveyed within these catchments via a network of pipes constructed to adoptable standards to attenuation storage features.
- 8.4.3 Using the parameters outlined in Section 8.3, the catchments have been modelled through MicroDrainage to determine the required surface water storage. These details can be found in **Table 8.2**.

| Catchment Areas | Total Area [ha] | Total Impermeable Area [ha] | Receiving Basin | Total Discharge Rate [l/s] | Storage Required [m ³] | Basin Outfall |
|--------------------|-----------------|-----------------------------|-----------------|----------------------------|------------------------------------|---------------------|
| 1, 2.1, 3 | 5.96 | 4.19 | Basin A | 5.8 | 4,100 | Surface water sewer |
| 2.2, 7, 11 | 3.98 | 2.39 | Basin B | 3.3 | 2,300 | Birch Brook |
| 4, 19 | 2.56 | 1.54 | Basin C | 2.1 | 1,500 | Surface water sewer |
| 5, 6, 8, 9, 10, 12 | 8.05 | 5.3 | Basin D | 7.4 | 5,200 | Surface water sewer |
| 13 | 2.15 | 1.08 | Basin E | 1.5 | 1,100 | Birch Brook |
| 14, 15, 16, 17, 18 | 7.77 | 4.47 | Basin F | 6.2 | 4,400 | Surface water sewer |

Table 8.2: Surface water attenuation requirements

- 8.4.4 Run-off from catchments will be attenuated to greenfield rates. The basins have been preliminarily designed to attenuate the required storage volume within each sub-catchment.
- 8.4.5 Discharge from the attenuation basins will be limited by Hydro-brake flow control devices at each basin when a maximum head of water is achieved.
- 8.4.6 The majority of the attenuation basins will discharge to the existing surface water sewer which runs through the site; whilst Basin B and E will discharge into Birch Brook which runs east across the southern border of the firing range. The existing surface water sewer will need to be assessed to determine if available capacity.
- 8.4.7 The basins have been assessed with the following principles;
- The side slopes of the basins will be 1 in 3 as recommended by minimum design requirements specified by SuDS Manual (CIRIA report C753, 2015)
 - Preliminary maximum design depths of 1m have been assessed for the basins at this stage. This is within the design requirements specified within the SUDs Manual. This accounts for the surface water storage required for a 1 in 100 year rainfall event with 40% climate change allowance.
 - A freeboard of 0.3 meters has been included within the basin design as a precautionary safety measure
 - The invert levels of the basins should be designed so that it exceeds the water level at the outfall. At this preliminary stage, the water levels at the outfall points aren't known, therefore they cannot be factored into the current assessment. This may have implications on the invert levels and design depths of the basins at later stages of the strategy development, therefore there is an outstanding risk that additional area may be required for attenuation features.

- Wet basins would be desired as to enhance local amenity and biodiversity in accordance to SUDs Manual standards. Dry basins can also be used, where landscape design can provide attractive amenity space. Wet basins will likely take a larger area than dry basins
- Catchment A, C, D and F discharges to the AW sewer in Abbots Road. This ultimately discharges to Birch Brook at South of Site.
- Catchment B and E discharge directly to Birch Brook via new outfalls.

8.4.8 All basins have been assumed to be located on flat ground. The preliminary basin designs as shown on drawing 40472-4002-001 (**Appendix D**) are detailed in **Table 8.3**.

| Basin Reference | Side Slope | Top of Plan Area [m ²] | Design Depth [m] | Design Freeboard [m] | Site Slope |
|-----------------|------------|------------------------------------|------------------|----------------------|------------|
| A | 1 in 3 | 4,800 | 1.0 | 0.3 | Flat |
| B | 1 in 3 | 5,200 | 1.0 | 0.3 | Flat |
| C | 1 in 3 | 2,000 | 1.0 | 0.3 | Flat |
| D | 1 in 3 | 6,000 | 1.0 | 0.3 | Flat |
| E | 1 in 3 | 1,400 | 1.0 | 0.3 | Flat |
| F | 1 in 3 | 5,100 | 1.0 | 0.3 | Flat |

Table 8.3: Preliminary Surface Water Attenuation Basin Design

8.4.9 The strategy has been made in lieu of details regarding the conditions and capacities of the existing drainage infrastructure, and will therefore require validation at a later stage, particularly if infiltration drainage proves to be feasible in any areas of the site.

9 Foul Water Drainage

9.1 Existing Infrastructure

- 9.1.1 The site is located within an area served by Anglian Water (AW) who have provided drainage asset record plans of the site and surrounding area (**Appendix C**). There are foul water, surface water and combined sewers located within and in the immediate vicinity of the site. Details of the surface water and combined sewers are provided in **Section 5.2**.
- 9.1.2 A 225mm diameter foul sewer runs along the northern site boundary, adjacent to the existing AW surface water sewer. The foul sewer continues parallel to the surface water sewer along the eastern site boundary and joins with the combined sewer which bisects the site, to the east of the site.
- 9.1.3 Due to limited information at this stage, the capacity and conditions of this foul water drainage infrastructure is unknown.

9.2 Foul Sewer Loadings

- 9.2.1 In accordance for Sewers for Adoption 7th Edition, design flow rates for dwellings should be 4000 litres/dwelling/day at peak flow. This is based upon an average occupancy of 3 persons per property discharging 200 litres/person/day with a peak multiple flow of 6, and 10% infiltration.
- 9.2.2 Assuming provisions for 1,000 dwellings, this equates to a peak flow of 0.046 l/s per dwelling or 46 l/s approximately from the new development. This value does not account for the existing drainage loadings which may be maintained within the new development

9.3 Concept Drainage Strategy

- 9.3.1 The proposed foul water drainage strategy for the new development is to maintain the current drainage plan. As part of this plan, continued use of the existing combined sewer is proposed, subject to further studies proving there is adequate treatment capacity, and possibly that there is a potential mechanism through which existing private infrastructure could be transferred to Anglian Water.
- 9.3.2 It is recommended that the existing pipe network is maintained where required for areas which will be retained within the new development, as well as the areas serving Middlewick. New pipes will be installed as part of new developments to provide connections to the existing foul drainage network.
- 9.3.3 As referenced in **Section 9.1.3**, the capacities and conditions of the existing foul water drainage infrastructure is currently unknown. As such, at this stage, it is not possible to confirm specific final infrastructure requirements for the drainage of foul effluent from the site and any offsite mitigation works.
- 9.3.4 CCTV surveys would be recommended in order to confirm the condition and size of the existing pipes, and whether their reuse would be suitable.
- 9.3.5 Due to the relatively flat nature of the undeveloped northern area of the site, it is possible that new foul water pumping facilities will be required; in accordance with Sewers for Adoption Edition, adequate consideration must be given for potential constraining associated with a foul pumping stations such as standoff distances from habitable rooms, compound sizes and maintenance access, as well as the possible need to maintain third party connections.

10 Assumptions and Further Work Required

10.1.1 The assessment completed to date is preliminary only and suitable to inform the initial masterplanning of the development. Further technical work will be required in preparation of a Flood Risk Assessment to support an outline planning application.

10.1.2 The following site specific recommendations are set out in the CBC Level 2 SFRA:

- *Fluvial Modelling*

As part of a site specific FRA for this site, a simple hydraulic model may need to be developed to more accurately determine the probability of flooding across the site from the Birch Brook. As part of this assessment, a range of probability events should be compared to determine impact of climate change on the risk of flooding at this location.

Given the current proposals are set back from the Birch Brook to the south of the site, and that there is a significant ground level increase from the brook to the developable areas of the site, it is possible that hydraulic modelling will not be required to demonstrate that the site is at negligible risk of fluvial flooding. Further consultation with ECC and CBC will be undertaken as part of the work to support a planning application to confirm their requirements.

- *Site Layout and Design*

The site is located within Flood Zone 1, low probability of flooding from rivers in which More Vulnerable residential development is considered appropriate. Further assessment should be made of the surface water flowpaths across the site. The drainage strategy for the site must be considered early in the site planning process to ensure adequate inclusion of SuDS.

Development has been identified as being within a CDA. Policies to manage surface water are already in place and should be adhered to. The drainage strategy for the site must be considered early in the site planning process to ensure adequate inclusion of SuDS. They should be considered in accordance with Essex CC's SuDS Design Guide (i.e. considering infiltration measures first wherever possible). Potential to modify the kerb and flow patterns along Abbots Road to divert flows into SuDS measures within the remaining open space south of the road. Would pend investigation.

- *Set-back Distance*

Essex CC, as the LLFA, requires at least a 3m set back on one side of the ordinary watercourse to the east of the site, to provide access for maintenance. Essex CC will need to be consulted and consent obtained for any proposed works that may impact flow within the channel of the watercourse.

- *Finished Floor Levels*

Finished floor levels should be set 300mm above ground level, to provide protection from surface water flooding in accordance with Environment Agency guidance on FRA's.

- *Access / Egress*

Safe dry access to and from the site should be provided, and this should be achievable along the road network to the north west of the site and onto Mersea Road.

- *Emergency Planning*

The site is not shown to be within an Environment Agency Flood Warning Area; however residents may wish to register to receive the warning service associated with the River Colne, into which the nearby Birch Brook feeds, so that they are aware of the flood risk to the area local to where they are located, including key transport routes.

10.1.3 In order to complete a Flood Risk Assessment suitable to inform an outline planning application, the following additional items will also need to be considered:

- Obtain further information/survey of the watercourses on site.
- Infiltration testing on site to the BRE 365 standard at the detailed design stage to confirm whether an infiltration drainage solution may be viable.
- Full topographical survey of the site to confirm existing ground slopes so that the potential land take of attenuation can be confirmed.
- Asset plans showing drainage infrastructure within the site boundary should be obtained from the MOD.
- Correspondence with AW to confirm available capacity within the surface water and foul water drainage infrastructure within the site.

11 Conclusions and Recommendations

- 11.1.1 Overall the risk of flooding to the site from all sources is low. The site is almost wholly located within Flood Zone 1.
- 11.1.2 Some areas of the site are at 'low' to 'high' risk of surface water flooding. It is anticipated that this risk is managed through a suitable surface water drainage strategy, masterplan development (such as locating development outside of watercourse corridors) and setting finished floor levels above surrounding ground level where appropriate.
- 11.1.3 The risk of flooding from other sources (groundwater, reservoir and sewers) is considered to be low.
- 11.1.4 A preliminary surface water drainage strategy has been proposed which discharges surface water run-off at greenfield rates to the Birch Brook and existing Anglian Water sewers. This strategy has been made at a preliminary stage based on known information as of writing, and will require adaption to further investigations and information.
- 11.1.5 It is proposed to utilise existing Anglian Water foul and combined sewer infrastructure within the site.
- 11.1.6 A full Flood Risk Assessment will be needed to support any future planning application with further detailed assessment required, as outlined in **Section 10**.
- 11.1.7 At this stage flood risk, surface water management and foul water drainage is not considered a barrier to development at the site. Based on the information available at this time no significant constraints that have been identified.

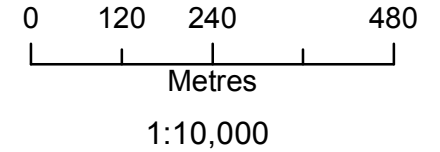
Appendix A Stakeholder Correspondence

Flood Map for Planning centred on CO2 8XJ





Created 29/052018 - Ref: EAn/2018/86194

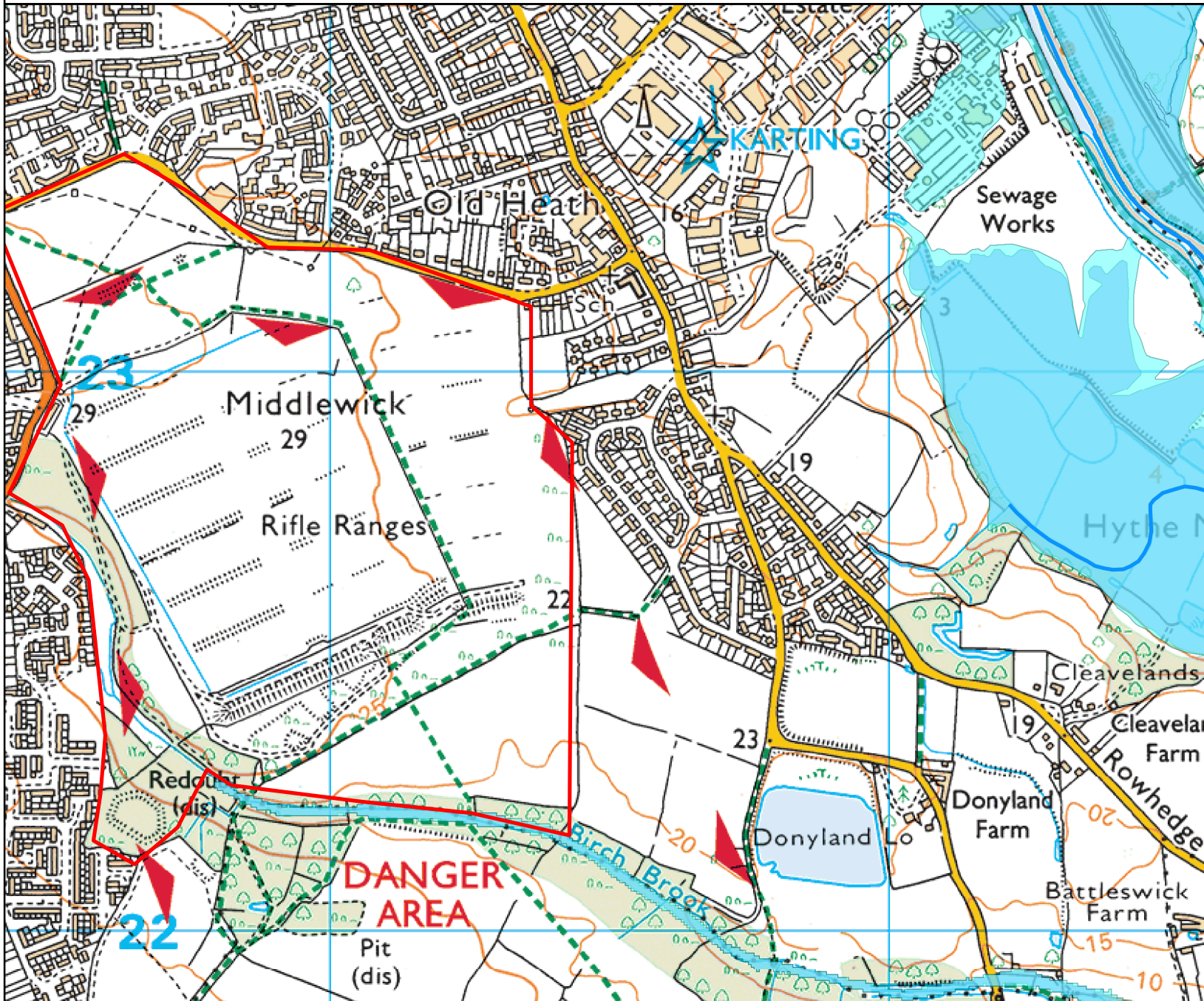


Environment Agency
Iceni House
Cobham Road
Ipswich
Suffolk
IP3 9JD



Legend

-  Site Location
-  Main Rivers
-  flood_zone_2
-  flood_zone_3



Flood Map for Planning (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:

- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Mr Robert Pike
Peter Brett Associates
rpike@peterbrett.com

Our ref EAn/2018/86194
Your ref 40472
Date 13 June 2018

Dear Mr Pike

**Enquiry regarding flood risk information for land at Middlewick Training Area,
Colchester, Essex, CO2 8XJ**

Thank you for your enquiry which was received on 14 May 2018.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

Some of the information is attached and some has been uploaded to the hard-drive you have provided and has been sent out to you by Royal Mail recorded delivery.

This site is in Flood Zone 1. We have supplied a flood map to show this. We have also supplied a product 7 for the Birchwood Brook. Although the model does not cover the site you will be able use this to extend the model.

There are no flood defences that benefit the site.

There have been no remedial works to alleviate flooding in this area and we have no assets that impact upon this site further downstream. As the nearest watercourse is non-main river it may be that the Local Authority have some information on this.

As the site is in Flood Zone 1, we have no flood warning areas/triggers/levels in the vicinity of the site.

Details of aquifers and source protection zones can be found here:

- <http://www.magic.gov.uk/MagicMap.aspx>.

Sensitive aquifers are found under Landscape – Geology and Soils - Aquifer Designation Map (Bedrock) (England) and Aquifer Designation Map (Superficial Drift) (England)

Source Protection Zones can be found under Designations – Non-statutory – Source Protection Zones

Modelled Groundwater flow is generally to the east in the chalk. There is little vertical movement of groundwater due to the confined nature of the chalk in this area by the London Clay. Modelled groundwater flow in the superficial sands and gravels is not laterally consistent and tends to be towards the nearest watercourse. In the near vicinity of the

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supplied NGR modelled groundwater flow in the sands and gravels is to the east in the general direction of the River Colne. The modelled depth to water table in this area ranges between approximately 0m and 5m. We have no groundwater monitoring sites in the vicinity of the supplied NGR that measure the depth to the water table. For further details of ground conditions please refer to <http://www.magic.gov.uk/MagicMap.aspx> or the Geology of Britain Tool from the British Geological Survey (BGS) which displays bedrock and superficial geology and borehole scans available at <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>.

Groundwater flooding records have only been kept for reported events in our area since 2010. Since this time we have had no reported events, and therefore will not be aware of any official groundwater flooding in the majority of cases. Because of the nature of the events, more often than not, those that appear to be groundwater flooding are in fact caused by a leaking/burst water main or surface water flooding where the underlying superficial deposits are impermeable resulting in rain not being able to drain away quickly enough. This can be confused as groundwater flooding when it is surface water flooding. 'Groundwater flooding' occurs when groundwater levels exceed ground level which only happens after significant groundwater recharge in certain hydrogeological conditions (not common in Essex).

A copy of the Flood Risk Assessment (FRA) advisory note is attached to my email.

We are currently undertaking a hydraulic modelling study for the following Essex, Norfolk and Suffolk Coastal areas: Wells, Cromer, Walcott, Thurne, Hickling and Coast, Great Yarmouth, Lowestoft, Kessingland (Lothingland Hundred), Blyth Estuary, Leiston, Alde & Ore Estuary, Deben Estuary, Stour & Orwell Estuary, Clacton, Colne & Blackwater Estuary, Crouch & Roach Estuary, Southend and the Thames.

You may be aware that some Local Planning Authorities have updated their Strategic Flood Risk Assessments (SFRA's) using data from this modelling study. As SFRA's are not updated regularly we agreed that they could use draft outputs as we wanted to ensure that the SFRA's were not out of date as soon as they were published. However although this information was shared with our external partners to assist them with the creation of their SFRA's the data remains unavailable for external practice until model completion. This is because we need to complete all necessary reviews. The project aims to be completed by summer 2018 and will be available for external practice then.

| | |
|---|--|
| Name | Product 4 |
| Description | Detailed Flood Risk Assessment Map |
| Licence | Open Government Licence |
| Information Warning - OS background mapping | <i>The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any</i> |

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|-------------|--|
| Name | Product 5 |
| Description | Birch Brook Flood Risk Study Hydraulic Report August 2006 Mid & North Essex minor watercourses Final Report September 2006 Holland Brook Hydraulic Model Report August 2006 Spicketts Brook Hydraulic Model Report 2006 |
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| | <p>personal data is responsible for any compliance with the Act and so we have no option but to warn you that this means you have responsibility to check that you are compliant with the Act in respect of this personal data.</p> <p>5.0 The location of public water supply abstraction sources must not be published to a resolution more detailed than 1km². Information about the operation of flood assets should not be published..</p> <p>6.1 Where we have supplied model data which may include model inputs or outputs you agree to supply to the Environment Agency copies of any assessments/studies and related outputs, modifications or derivatives created pursuant to the supply to you of the Information, all of which are hereinafter referred to as “the Data”.</p> <p>6.2 You agree, in the public interest to grant to the Environment Agency a perpetual royalty free non-exclusive licence to use the Data or any part thereof for its internal purposes or to use it in any way as part of Environment Agency derivative products which it supplies free of charge to others such as incorporation into the Environment Agency's Open Data mapping products.</p> |
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Data Available Online

Many of our flood datasets are available online:

- Flood Map For Planning ([Flood Zone 2](#), [Flood Zone 3](#), [Flood Storage Areas](#), [Flood Defences](#), [Areas Benefiting from Defences](#))
- [Risk of Flooding from Rivers and Sea](#)
- [Historic Flood Map](#)
- [Current Flood Warnings](#)

Additional information

Please be aware that we now charge for planning advice provided to developers, agents and landowners. If you would like advice to inform a future planning application for this site then please complete our <https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion> and email it to our Sustainable Places team planning.ipswich@environment-agency.gov.uk. They will initially provide you with a free response identifying the following:

- the environmental constraints affecting the proposal;
- the environmental issues raised by the proposal;
- the information we need for the subsequent planning application to address the issues identified and demonstrate an acceptable development;
- any required environmental permits.

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If you require any further information from them (for example, a meeting or the detailed review of a technical document) they will need to set up a charging agreement. Further information can be found on our [website](#).

Please note we have published revised climate change allowances, which are available online. These new allowances will need to be reflected in your Flood Risk Assessment. If you want to discuss this please call our Sustainable Places team on 0203 025 5475.

TEAM2100 is delivering the first 10 years of capital investment in tidal flood defences in London and the Thames estuary, as recommended by the TE2100 plan. For more information, visit [the TEAM2100 website](#) or email team2100@ch2m.com.

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

Yours sincerely

Teresa Chapman

Teresa Chapman
Customers and Engagement Assistant

Direct dial: 02030 255472

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Flood risk assessments: Climate change allowances

Application of the allowances and local considerations

East Anglia; Essex, Norfolk, Suffolk, Cambridgeshire and Bedfordshire

1) The climate change allowances

The [National Planning Practice Guidance](#) refers planners, developers and advisors to the Environment Agency guidance on considering climate change in Flood Risk Assessments (FRAs). This guidance was updated in February 2016 and is available on [Gov.uk](#). The guidance can be used for planning applications, local plans, neighbourhood plans and other projects. It provides climate change allowances for peak river flow, peak rainfall, sea level rise, wind speed and wave height. The guidance provides a range of allowances to assess fluvial flooding, rather than a single national allowance. It advises on what allowances to use for assessment based on vulnerability classification, flood zone and development lifetime.

2) Assessment of climate change impacts on fluvial flooding

Table A below indicates the level of technical assessment of climate change impacts on fluvial flooding appropriate for new developments depending on their scale and location. This should be used as a **guide only**. Ultimately, the agreed approach should be based on expert local knowledge of flood risk conditions, local sensitivities and other influences. **For these reasons we recommend that applicants and / or their consultants should contact the Environment Agency at the pre-planning application stage to confirm the assessment approach, on a case by case basis.** **Table A** defines three possible approaches to account for flood risk impacts due to climate change, in new development proposals:

- **Basic:** Developer can add an allowance to the 'design flood' (i.e. 1% annual probability) peak levels to account for potential climate change impacts. The allowance should be derived and agreed locally by Environment Agency teams.
- **Intermediate:** Developer can use existing modelled flood and flow data to construct a stage-discharge rating curve, which can be used to interpolate a flood level based on the required peak flow allowance to apply to the 'design flood' flow.
- **Detailed:** Perform detailed hydraulic modelling, through either re-running Environment Agency hydraulic models (if available) or construction of a new model by the developer.

Table A – Indicative guide to assessment approach

| VULNERABILITY CLASSIFICATION | FLOOD ZONE | DEVELOPMENT TYPE | | |
|------------------------------|------------|-----------------------------|---------------------|---------------------|
| | | MINOR | SMALL-MAJOR | LARGE-MAJOR |
| ESSENTIAL INFRASTRUCTURE | Zone 2 | Detailed | | |
| | Zone 3a | Detailed | | |
| | Zone 3b | Detailed | | |
| HIGHLY VULNERABLE | Zone 2 | Intermediate/ Basic | Intermediate/ Basic | Detailed |
| | Zone 3a | Not appropriate development | | |
| | Zone 3b | Not appropriate development | | |
| MORE VULNERABLE | Zone 2 | Basic | Basic | Intermediate/ Basic |
| | Zone 3a | Intermediate/ Basic | Detailed | Detailed |
| | Zone 3b | Not appropriate development | | |
| LESS VULNERABLE | Zone 2 | Basic | Basic | Intermediate/ Basic |
| | Zone 3a | Basic | Basic | Detailed |
| | Zone 3b | Not appropriate development | | |
| WATER COMPATIBLE | Zone 2 | None | | |
| | Zone 3a | Intermediate/ Basic | | |
| | Zone 3b | Detailed | | |

Note: Where the table states 'not appropriate development', this is in line with national planning policy. If in exceptional circumstances such development types are proposed in these locations, we would expect a detailed modelling approach to be used.

NOTES:

- Minor: 1-9 dwellings/ less than 0.5 ha | Office / light industrial under 1ha | General industrial under 1 ha | Retail under 1 ha | Gypsy/traveller site between 0 and 9 pitches
- Small-Major: 10 to 30 dwellings | Office / light industrial 1ha to 5ha | General industrial 1ha to 5ha | Retail over 1ha to 5ha | Gypsy/traveller site over 10 to 30 pitches
- Large-Major: 30+ dwellings | Office / light industrial 5ha+ | General industrial 5ha+ | Retail 5ha+ | Gypsy/traveller site over 30+ pitches | any other development that creates a non residential building or development over 1000 sq m.

The assessment approach should be agreed with the Environment Agency as part of pre-planning application discussions to avoid abortive work.

3) Specific local considerations

Where the Environment Agency and the applicant and / or their consultant has agreed that a 'basic' level of assessment is appropriate the figures in Table B below can be used as a precautionary allowance for potential climate change impacts on peak 'design' (i.e. 1% annual probability) fluvial flood level rather than undertaking detailed modelling.

Table B – Local precautionary allowances for potential climate change impacts

Essex, Norfolk and Suffolk

| Hydraulic Model (Watercourse) | Central | Higher Central | Upper |
|---|--|----------------|--------|
| Blackwater & Brain - Blackwater between TL7520925623 and TL7820324314 Brain between TL7373323312 and TL7683821321 | 500mm | 600mm | 900mm |
| Chelmer - between TL6872107082 and TL7161609422 and TL7436306592 | 350mm | 450mm | 750mm |
| Colne (Model Extent) | 450mm | 600mm | 950mm |
| Gipping – Downstream of Needham Market | 400mm | 500mm | 850mm |
| Gipping – Needham Market and upstream including Somersham W/C | 200mm | 250mm | 400mm |
| Norwich Downstream of TG2332009072 | 450mm | 600mm | 950mm |
| Norwich Upstream of TG2332009072 | 600mm | 800mm | 1200mm |
| Wensum (Model Extent) | 400mm | 500mm | 800mm |
| Yare (Model Extent) | 200mm | 250mm | 450mm |
| Broads (2008 Model Extent) Bure and Ant (2012 Model Extent) | Please use the current 1 in 1000 (0.1%) annual probability including climate change allowance | | |
| Other main rivers, tributaries and ordinary watercourses | <p>For other main rivers, tributaries and ordinary watercourses that are not stated above, basic allowances have not been calculated. In this instance you can either:</p> <ul style="list-style-type: none"> • If flow data is available you can request this data from us and can conduct an intermediate assessment yourself • Or alternatively, you can choose to undertake a Detailed Assessment and “perform detailed hydraulic modelling, through either re-running our hydraulic models (if available) or constructing a new model | | |

Cambridgeshire and Bedfordshire

| Watercourse / Model | Central | Higher Central | Upper End |
|--|----------------|-----------------------|------------------|
| Alconbury Brook | 600mm | 700mm | 900mm |
| River Kym | | | |
| Lower Ouse (Model Extent) | 700mm | 800mm | 1100mm |
| Mid Ouse (Cold Brayfield to Bromham – between SP9156852223 and TL0132950919) | 700mm | 800mm | 1100mm |
| Mid Ouse (East of Bedford to Roxton – between TL0791848903 and TL1618854543) | 700mm | 850mm | 1200mm |
| River Hiz and River Purwell | 400mm | 450mm | 550mm |
| River Ivel | 500mm | 600mm | 750mm |
| Pix Brook | 450mm | 500mm | 600mm |
| Potton Brook | 500mm | 600mm | 700mm |
| River Cam and tributaries (excluding the Cam Lodes and the Slade System) | 600mm | 700mm | 950mm |
| Great Barford (ordinary watercourses) | 500mm | 550mm | 650mm |
| Bromham (ordinary watercourse) | 550mm | 650mm | 850mm |

NOTES:

Urban areas excluded from the 'basic' approach: St Ives, Holywell, Godmanchester, Swavesey, Over, Bedford, Newport Pagnell, Buckingham and Leighton Buzzard. More detailed assessment of climate change allowances will need to be undertaken in these locations.

Use of these allowances will only be accepted after discussion with the Environment Agency.

4) Fluvial food risk mitigation

For planning consultations where we are a statutory consultee and our [Flood risk standing](#) advice **does not** apply we use the following benchmarks to inform flood risk mitigation for different vulnerability classifications. **These are a guide only. We strongly recommend you contact us at the pre-planning application stage to confirm this on a case by case basis.** For planning consultations where we are not a statutory consultee or our [Flood risk Standing advice](#) applies we recommend local planning authorities and developers use these benchmarks but we do not expect to be consulted.

- For development classed as '**Essential Infrastructure**' our benchmark for flood risk mitigation is for it to be designed to the '**upper end**' climate change allowance for the epoch that most closely represents the lifetime of the development, including decommissioning.
- For **highly vulnerable** or **more vulnerable developments** in flood zone 2, the '**central**' climate change allowance is our minimum benchmark for flood risk mitigation, and in flood zone 3 the '**higher central**' climate change allowance is our minimum benchmark for flood risk mitigation. In sensitive locations it may be necessary to use the **higher central** (in flood zone 2) and the **upper end** allowance (in flood zone 3).
- For **water compatible** or **less vulnerable** development (e.g. commercial), the '**central**' climate change allowance for the epoch that most closely represents the lifetime of the development is our minimum benchmark for flood risk mitigation. In sensitive locations it may be necessary to use the **higher central** (particularly in flood zone 3) to inform built in resilience.

For a visual representation of the above, please see Tables 1 and 2 overleaf.

5) Development in Tidal Areas

There is no change to the way we respond to sites affected solely by tidal flood risk as the sea level allowances are unchanged.

6) Our Service

Non-chargeable service

We will give a free opinion on:

- What climate change allowance to apply to a particular development type
- Which technical approach is suitable in the FRA

Chargeable service:

- Review of climate change impacts using intermediate and detailed technical approaches (i.e. modelling review)
- Assessment and review of proposals for managed adaptation.

| Table 1 peak river flow allowances by river basin district (use 1961 to 1990 baseline) | | | | | |
|---|---|---|---|---|------------------------|
| River basin district | Allowance category | Total potential change anticipated for '2020s' (2015 to 39) | Total potential change anticipated for '2050s' (2040 to 2069) | Total potential change anticipated for '2080s' (2070 to 2115) | |
| Anglian | Upper end | 25% | 35% | 65% | |
| | Higher central | 15% | 20% | 35% | |
| | Central | 10% | 15% | 25% | |
| Thames | Upper end | 25% | 35% | 70% | |
| | Higher central | 15% | 25% | 35% | |
| | Central | 10% | 15% | 25% | |
| Table 2: Using peak river flow allowances for flood risk assessments | | | | | |
| Flood Zone | Essential Infrastructure | Highly Vulnerable | More Vulnerable | Less Vulnerable | Water Compatible |
| 2 | higher central and upper end allowances | higher central and upper end allowances | central and higher central allowances | central allowance | none of the allowances |
| 3a | upper end allowance | X | higher central and upper end | central and higher central | central allowance |
| 3b | upper end allowance | X | X | X | central allowance |
| <p>X – Development should not be permitted If (exceptionally) development is considered appropriate when not in accordance with flood zone vulnerability categories, then it would be appropriate to use the upper end allowance.</p> | | | | | |

There may be circumstances where local evidence supports the use of other data or allowances. Where you think this is the case we may want to check this data and how you propose to use it.

Use of Environment Agency Information for Flood Risk Assessments

Important

The Environment Agency are keen to work with partners to enable development which is resilient to flooding for its lifetime and provides wider benefits to communities. If you have requested this information to help inform a development proposal, then we recommend engaging with us as early as possible by using the pre-application form available from our website:

<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

We recognise the value of early engagement in development planning decisions. This allows complex issues to be discussed, innovative solutions to be developed that both enables new development and protects existing communities. Such engagement can often avoid delays in the planning process following planning application submission, by reaching agreements up-front. We offer a charged pre-application advice service for applicants who wish to discuss a development proposal.

We can also provide a preliminary opinion for free which will identify environmental constraints related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

In preparing your planning application submission, you should refer to the Environment Agency's Flood Risk Standing Advice and the Planning Practice Guidance for information about what flood risk assessment is needed for new development in the different Flood Zones. This information can be accessed via:

<https://www.gov.uk/flood-risk-assessment-standing-advice>
<http://planningguidance.planningportal.gov.uk/>

You should also consult the Strategic Flood Risk Assessment or other relevant materials produced by your local planning authority.

You should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk Assessment (FRA) where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or surface water runoff. Information produced by the local planning authority referred to above may assist here.
3. Where a planning application requires an FRA and this is not submitted or is deficient, the Environment Agency may raise an objection.

Robert Pike

From: Anglian Water <planningliaison@anglianwater.co.uk>
Sent: 17 May 2018 10:45
To: Robert Pike
Subject: Middlewick Training Area, COLCHESTER - Old Heath Flood Risk Query Response

Robert Pike,

Thank you for your Flood Risk Query you submitted for Middlewick Training Area, COLCHESTER - Old Heath.

Our response to this is: Anglian Water is able to confirm that we have no records of flooding in the vicinity that can be attributed to capacity limitations in the public sewerage system. It is possible that other flooding may have occurred that we do not have records of, other organisations such as the Local Authority, Internal Drainage Board or the Environment Agency may have records.

Should you have any questions relating to this please contact 0345 606 6087 Option 1. Your reference for this enquiry is 00028257.

Kind Regards
Growth and Planning Services Team

This message has been scanned for viruses by Websense

Essex County Council
Environment and Planning
Flood and Water Management Team
E3 County Hall
Chelmsford
CM1 1QH



Mr Pike
4th Floor Waterloo House
Victoria Square
Birmingham
B2 5TB

Date: 06.06.18
Our Ref: FIIR-000169

Dear Mr Pike,

Detailed Information Request – Middlewick Ranges, Colchester

Thank you for contacting us for information held on the above site and can confirm that I have checked our records for reported surface water flooding in the above area.

Please see below the Gov.uk Flood Risk from Surface Water map, which shows a low risk of surface water flooding to your site. However, please be aware that there is a high risk of surface water flooding to the boundary of your site. Furthermore there are three notable flow paths crossing your site; one large flow path to the south of your site flowing from west to east, and a further two on the east of your site crossing Fingringhoe road. Further information can be found on the Gov.uk website: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>

Figure 1: Flood Risk from Surface Water – Middlewick Ranges, Colchester



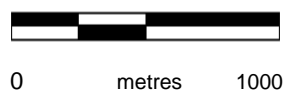
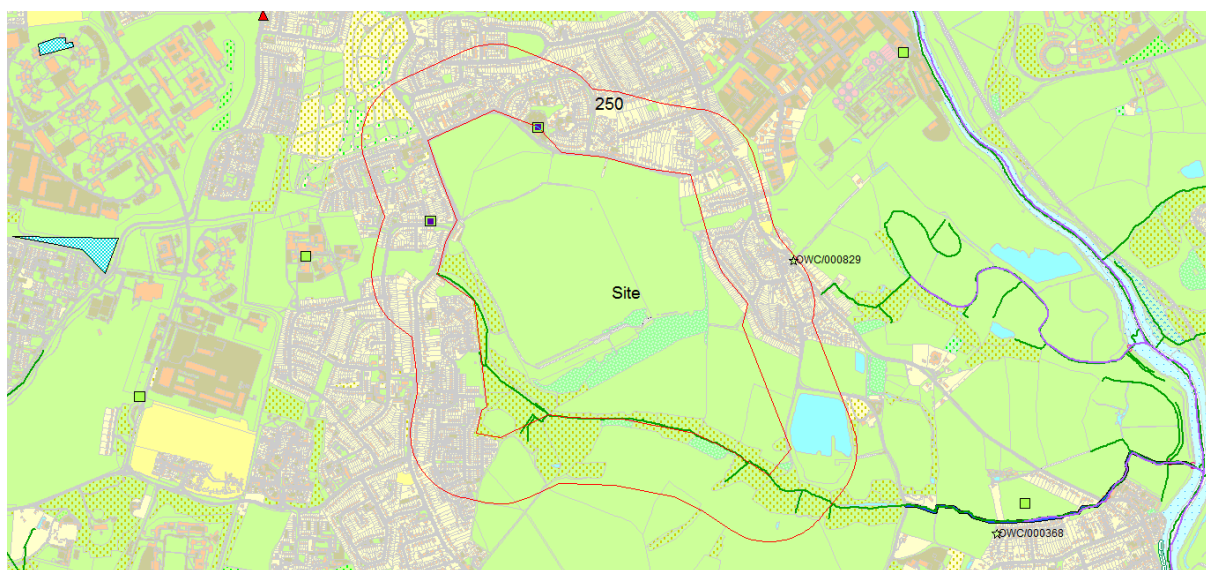
Surface Water Management Plans

The Surface Water Management Plan (SWMP) produces more detailed modelling and identifies Critical Drainage Area's (CDA); highlighting areas most at risk. Essex County Council has completed a SWMP for the Colchester District which will be attached to this report for your reference. The northern part of your site is within a CDA called COL1 as shown in the SWMP. More information can be found within the attached document. COL1 was added on to our Capital Programme for further investigation with no cost beneficial options found.

Watercourses and rivers

Analysis has been completed using all of our data sets to a distance of 250m from the aforementioned site and within the site boundaries itself, as detailed in Figure 2 below.

Figure 2: Site plan including 250m 'buffer zone'



(c) Copyright.

The search has confirmed that there is an ordinary water course within your site as shown in figure 2 as a green line. The water course runs along the boundary of your site from west to east before joining Birch Brook and subsequently the River Colne to the east.

The search has not identified any main rivers within the site, however, Birch Brook and the River Colne lie to the east of your site. Both of these watercourses are designated main rivers and therefore you will need to consult with the Environment Agency for any further information relating with them. For points 1 to 10 you should contact the environment agency on the email below:

enquiries@environment-agency.gov.uk

In answer to point 7, we would require a 3m maintenance strip either side of the ordinary watercourse as part of any development on site.

It should be noted that smaller watercourses are not always mapped, therefore site investigation should be carried out to verify information supplied.

If proposed works entail temporary or permanent alterations to a watercourse, consent will be required. Essex County Council does offer a pre-application advice facility whereby one of our engineers will review your proposed works and offer engineering advice should it be required. Further information can be found on our website using the following link:

<http://flood.essex.gov.uk/change-a-watercourse/apply-for-a-watercourse-consent/>

Flood risk assets

Our database has confirmed the existence one body of water within the 250m buffer zone, located to the south east of your site. As with smaller watercourses, not all flood risk assets will be mapped so further investigation is advised.

Flood Incidents and Investigations

I can confirm that there are no recorded flood incidents within your site, or within the 250m buffer zone, but would advise you to contact the local council (Colchester Borough Council) as they may hold further records of flood incidents within the area.

In response to point 12, due to our limited access to highways flooding records, we have limited access to highway flooding incidents. Please visit their website for further information: <http://www.essexhighways.org/transport-and-roads/tell-us/tell-us-DNGE-surface-water-on-highway.aspx>

In respect of Sustainable Drainage, we hold a record of two consultations within the 250m buffer zone which relates to planning application 170103 to the north of your site, and planning application 171659 to the west of your site.

I would note however that we only have a limited number of records as we have only been a Lead Local Flood Authority since 2010. Whilst we are working to build a comprehensive database of flood incidents, unlike main rivers we have no formal system of monitoring water levels and being aware when flooding occurs. We rely on reports from residents and in particular district councils to report flood incidents to us. As such all we can provide is an indication of the flood history that we have available to us, if we have no recorded incidents then it does not necessarily mean that flooding has never occurred there, merely that it has not been reported to us.

Please note that we do not hold the information for points 1-6 and 10-15.

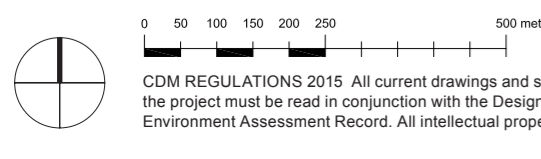
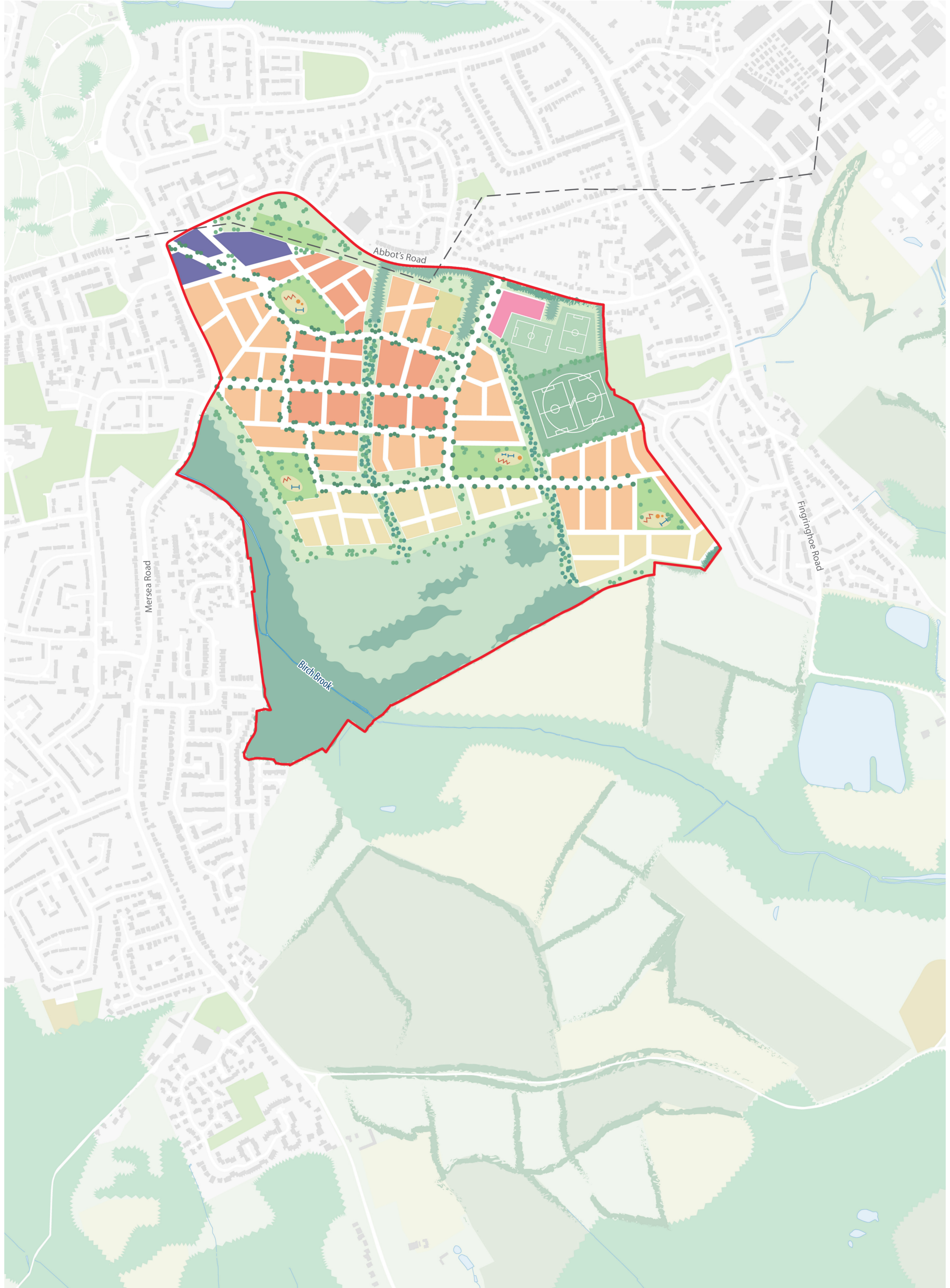
I hope that the above assists you with your enquiry.

Yours sincerely,

Rosalyn Bayes
Essex County Council
Flood and Water Management Team

Please reply to: Flood & Water Management Team
Email: floods@essex.gov.uk
Internet: www.essex.gov.uk/flooding

Appendix B Concept Masterplan



Key

| | | |
|--------------------------------------|-------------------------------------|----------------------------------|
| Site boundary | Allotments | Proposed trees |
| Residential - low density (20dph) | Natural and semi-natural greenspace | Existing woodland |
| Residential - medium density (35dph) | Amenity greenspace | Existing hedgerows |
| Residential - high density (45dph) | Parks and gardens | Existing water features |
| Local centre | Play (children and teenagers) | Existing overhead EHV power line |
| School and associated grounds | Outdoor sports facility | |

| Rev | Date | Description |
|-----|----------|-------------|
| 0 | 19/02/18 | First issue |

| | | | |
|-----|-----|------------|------------|
| Dwn | Ckd | Drawn | AH |
| AH | KR | Checked | KR |
| | | Date | 19/02/2018 |
| | | Scale @ A2 | 1:5000 |

MIDDLEWICK
 INITIAL CONCEPT MASTERPLAN
 OPTION 1

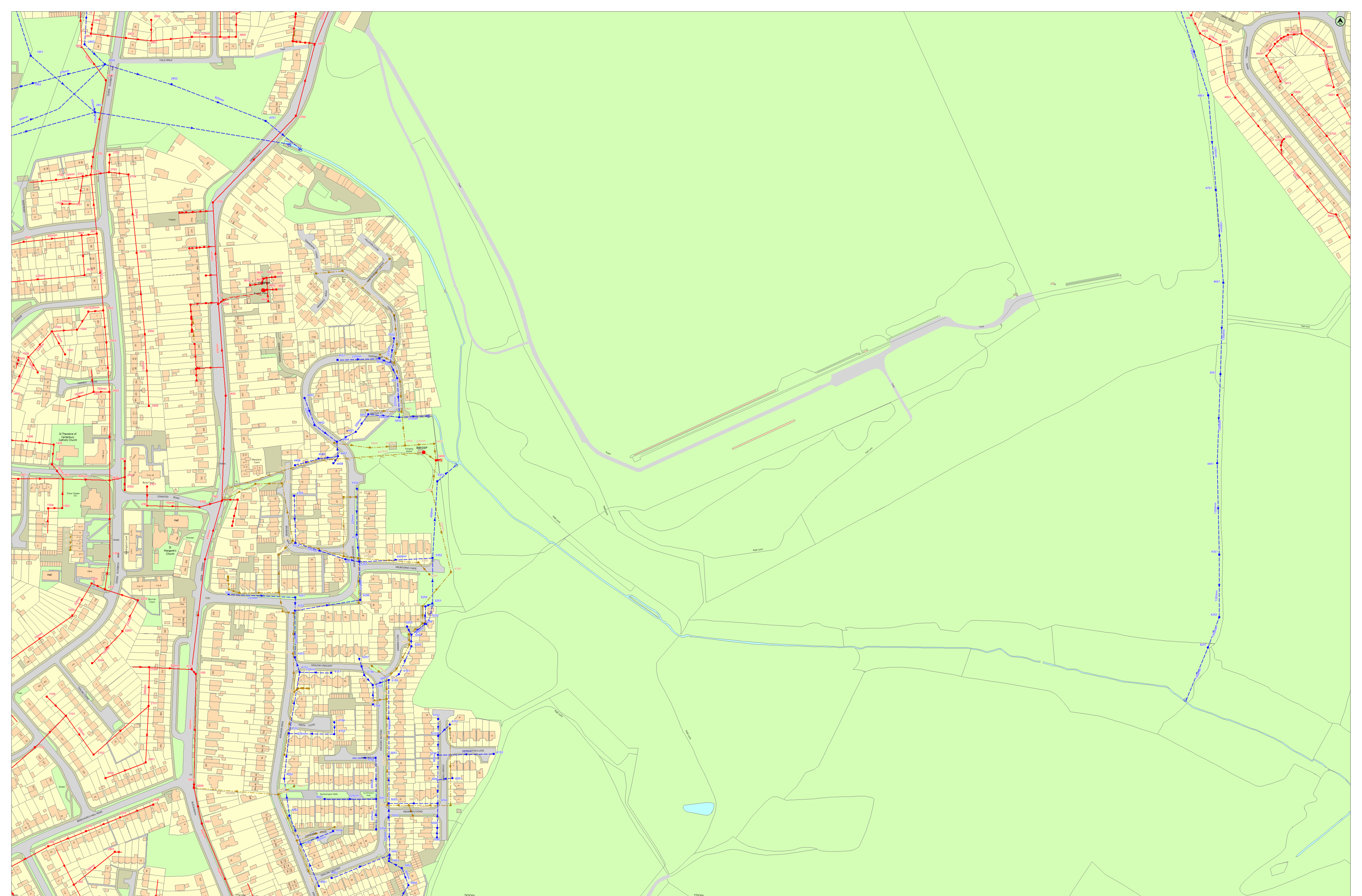
AA6742 SK-02
 REV 0
 FOR INFORMATION



Appendix C Existing Drainage Information

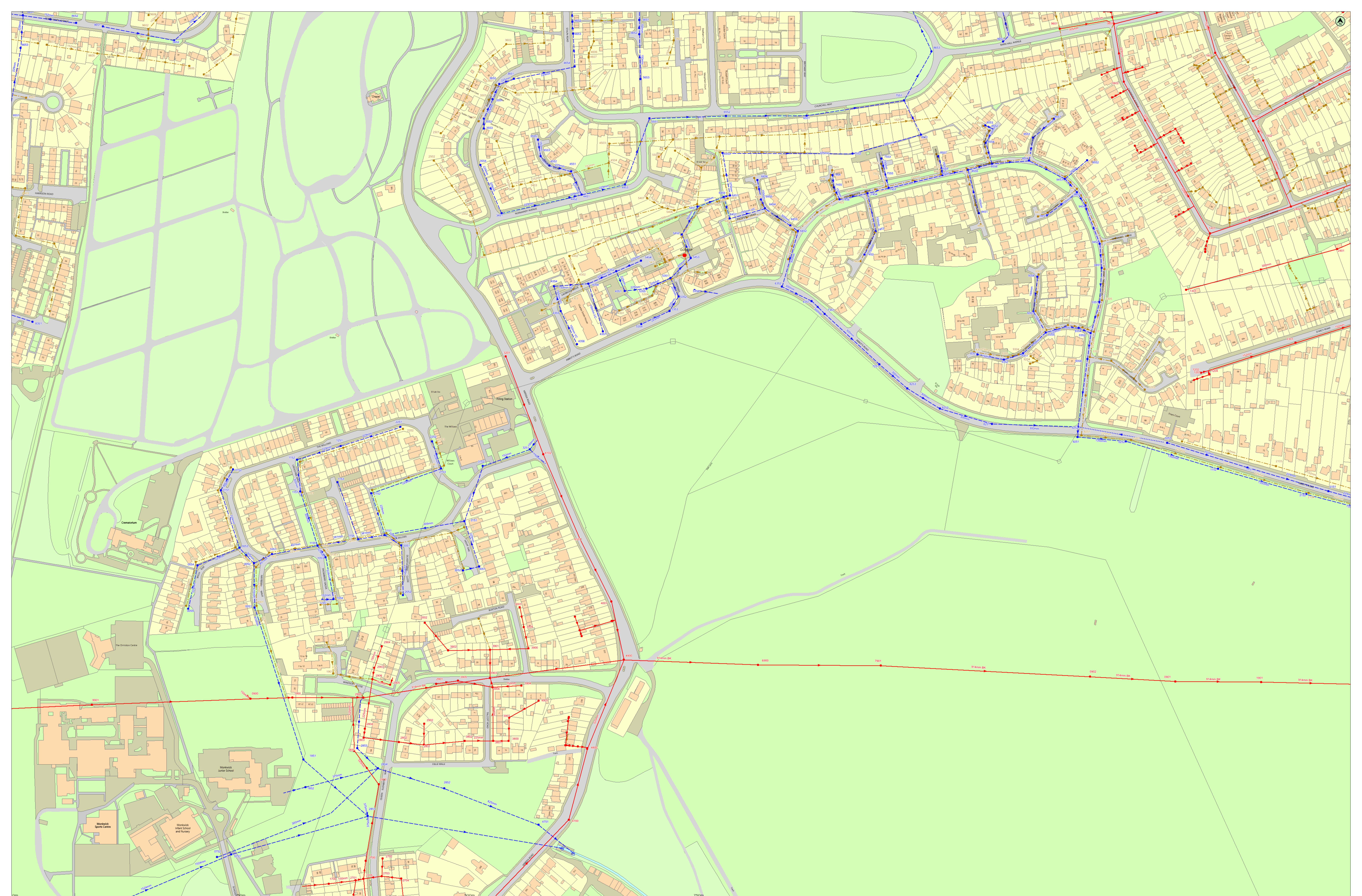
| Manhole Reference | Easting | Northing | Liquid Type | Cover Level | Invert Level | Depth to Invert |
|-------------------|---------|----------|-------------|-------------|--------------|-----------------|
| 0401 | 600347 | 222475 | C | 18.62 | 17.1 | 1.52 |
| 0501 | 600212 | 222545 | C | - | - | - |
| 1202 | 601123 | 223286 | C | 24.35 | 22.71 | 1.64 |
| 1204 | 601132 | 223284 | C | - | - | - |
| 1901 | 601189 | 222949 | C | - | - | - |
| 2301 | 601226 | 223319 | C | 23.13 | 21 | 2.13 |
| 2901 | 601298 | 222946 | C | - | - | - |
| 4301 | 601480 | 223316 | C | 14.57 | 12.13 | 2.44 |
| 4801 | 601458 | 222819 | C | - | - | - |
| 4802 | 601442 | 222876 | C | - | - | - |
| 4803 | 601419 | 222889 | C | - | - | - |
| 4804 | 601492 | 222864 | C | - | - | - |
| 4901 | 601410 | 222908 | C | 22.24 | 20.57 | 1.67 |
| 4902 | 601421 | 222801 | C | - | - | - |
| 4903 | 601443 | 222934 | C | - | - | - |
| 4904 | 601475 | 222916 | C | - | - | - |
| 4905 | 601477 | 222926 | C | - | - | - |
| 4906 | 601412 | 222946 | C | 21.14 | 17 | 4.14 |
| 5001 | 601538 | 223221 | C | 15.758 | 12.658 | 3.1 |
| 5601 | 601598 | 222641 | C | - | - | - |
| 5602 | 601588 | 222691 | C | - | - | - |
| 5701 | 601586 | 222792 | C | - | - | - |
| 5702 | 601588 | 222737 | C | - | - | - |
| 5703 | 601558 | 222777 | C | - | - | - |
| 5704 | 601508 | 222767 | C | - | - | - |
| 5705 | 601509 | 222772 | C | - | - | - |
| 5801 | 601570 | 222821 | C | - | - | - |
| 5802 | 601530 | 222888 | C | - | - | - |
| 5803 | 601555 | 222870 | C | - | - | - |
| 5804 | 601565 | 222830 | C | - | - | - |
| 5805 | 601520 | 222822 | C | - | - | - |
| 5807 | 601596 | 222881 | C | - | - | - |
| 5808 | 601597 | 222869 | C | - | - | - |
| 5809 | 601515 | 222887 | C | - | - | - |
| 5810 | 601508 | 222883 | C | - | - | - |
| 5811 | 601501 | 222877 | C | - | - | - |
| 5812 | 601502 | 222847 | C | - | - | - |
| 5813 | 601507 | 222836 | C | - | - | - |
| 5901 | 601595 | 222867 | C | - | - | - |
| 5902 | 601572 | 222966 | C | - | - | - |
| 5903 | 601546 | 222939 | C | - | - | - |
| 5904 | 601524 | 222934 | C | - | - | - |
| 5905 | 601599 | 222917 | C | - | - | - |
| 5906 | 601514 | 222969 | C | 19.33 | 15.19 | 4.14 |
| 6001 | 601625 | 223002 | C | - | - | - |
| 6002 | 601617 | 223031 | C | - | - | - |
| 6003 | 601610 | 223070 | C | - | - | - |
| 6501 | 601685 | 222570 | C | - | - | - |
| 6502 | 601691 | 222563 | C | - | - | - |
| 6503 | 601653 | 222540 | C | - | - | - |
| 6504 | 601695 | 222518 | C | - | - | - |
| 6601 | 601680 | 222689 | C | - | - | - |
| 6602 | 601682 | 222656 | C | - | - | - |
| 6603 | 601646 | 222660 | C | - | - | - |
| 6604 | 601645 | 222646 | C | - | - | - |
| 6701 | 601679 | 222733 | C | - | - | - |
| 6702 | 601672 | 222715 | C | - | - | - |
| 6703 | 601676 | 222760 | C | - | - | - |
| 6704 | 601656 | 222769 | C | - | - | - |
| 6705 | 601620 | 222751 | C | - | - | - |
| 6706 | 601608 | 222763 | C | - | - | - |
| 6707 | 601620 | 222725 | C | - | - | - |
| 6708 | 601615 | 222714 | C | - | - | - |
| 6709 | 601604 | 222708 | C | - | - | - |
| 6710 | 601654 | 222784 | C | - | - | - |
| 6711 | 601602 | 222774 | C | - | - | - |
| 6801 | 601652 | 222840 | C | - | - | - |
| 6802 | 601621 | 222841 | C | - | - | - |
| 6901 | 601628 | 222996 | C | 16.47 | 13.41 | 3.06 |
| 6902 | 601650 | 222925 | C | 19.48 | 15.27 | 4.21 |
| 6903 | 601618 | 222993 | C | 16.99 | 13.65 | 3.34 |
| 6904 | 601607 | 222933 | C | - | - | - |
| 7001 | 601788 | 223066 | C | 14.52 | 10.66 | 3.86 |
| 7002 | 601745 | 223026 | C | 15.04 | 11.46 | 3.58 |
| 7401 | 601777 | 222478 | C | 5.49 | 2.745 | 2.745 |
| 7402 | 601780 | 222472 | C | - | - | - |
| 7501 | 601746 | 222576 | C | - | - | - |
| 7502 | 601702 | 222581 | C | - | - | - |
| 7503 | 601777 | 222528 | C | - | - | - |
| 7504 | 601754 | 222539 | C | - | - | - |
| 7505 | 601743 | 222561 | C | - | - | - |
| 7601 | 601705 | 222655 | C | - | - | - |
| 7602 | 601718 | 222655 | C | - | - | - |
| 7603 | 601747 | 222637 | C | - | - | - |
| 7604 | 601778 | 222652 | C | 20.5 | 18.7 | 1.8 |
| 7605 | 601793 | 222602 | C | 20.73 | 18.93 | 1.8 |
| 7701 | 601739 | 222746 | C | 19.84 | 18.189 | 1.651 |
| 7702 | 601727 | 222740 | C | - | - | - |
| 7801 | 601705 | 222859 | C | 19.76 | 15.83 | 3.93 |
| 7802 | 601707 | 222854 | C | - | - | - |
| 8506 | 601805 | 222533 | C | 21.38 | - | - |
| 8601 | 601893 | 222616 | C | - | - | - |
| 8602 | 601885 | 222632 | C | - | - | - |
| 8603 | 601840 | 222609 | C | - | - | - |
| 8604 | 601816 | 222611 | C | - | - | - |
| 8605 | 601802 | 222650 | C | - | - | - |
| 8606 | 601856 | 222686 | C | - | - | - |
| 8607 | 601842 | 222678 | C | - | - | - |
| 8608 | 601829 | 222671 | C | - | - | - |
| 8609 | 601872 | 222692 | C | 19.16 | 16.49 | 2.67 |
| 8701 | 601835 | 222721 | C | 19.56 | 18.05 | 1.51 |
| 8702 | 601809 | 222708 | C | - | - | - |
| 8703 | 601822 | 222755 | C | 18.95 | 16.25 | 2.7 |
| 9501 | 601984 | 222578 | C | 17.94 | 16.8 | 1.14 |
| 9505 | 601976 | 222587 | C | 18.08 | 16.83 | 1.25 |
| 9601 | 601921 | 222636 | C | 18.85 | 16.7 | 2.15 |
| 1101 | 601145 | 223183 | F | 25.028 | 19.683 | 5.345 |
| 2101 | 601299 | 223150 | F | - | - | - |
| 2102 | 601296 | 223158 | F | - | - | - |
| 2103 | 601205 | 223185 | F | - | - | - |
| 2104 | 601240 | 223155 | F | 23.758 | 19.243 | 4.515 |
| 2105 | 601295 | 223194 | F | - | - | - |
| 2106 | 601298 | 223185 | F | - | - | - |
| 2107 | 601295 | 223156 | F | - | - | - |
| 2200 | 601295 | 223233 | F | - | - | - |
| 2201 | 601297 | 223222 | F | - | - | - |
| 3001 | 601338 | 223048 | F | 22.802 | 18.537 | 4.265 |
| 3101 | 601347 | 223139 | F | - | - | - |
| 3102 | 601395 | 223187 | F | - | - | - |
| 3103 | 601337 | 223131 | F | 22.739 | 18.854 | 3.885 |
| 3201 | 601357 | 223219 | F | - | - | - |
| 3202 | 601358 | 223264 | F | - | - | - |
| 3203 | 601397 | 223206 | F | - | - | - |
| 3204 | 601325 | 223268 | F | - | - | - |
| 3205 | 601325 | 223256 | F | - | - | - |
| 3303 | 601357 | 223233 | F | 20.77 | 19.47 | 1.3 |
| 3304 | 601358 | 223315 | F | 21.05 | 19.33 | 1.72 |
| 3305 | 601374 | 223306 | F | - | - | - |
| 3901 | 601351 | 222952 | F | 21.266 | 18.221 | 3.045 |
| 4001 | 601488 | 223039 | F | - | - | - |
| 4002 | 601460 | 223031 | F | - | - | - |
| 4101 | 601462 | 223167 | F | - | - | - |
| 4102 | 601441 | 223187 | F | 20.662 | 17.112 | 3.55 |
| 4103 | 601438 | 223185 | F | 20.817 | 17.187 | 3.63 |
| 4104 | 601438 | 223195 | F | 20.419 | 19.109 | 1.31 |
| 4201 | 601465 | 223202 | F | 19.982 | 16.772 | 3.21 |
| 4202 | 601436 | 223201 | F | 20.376 | 19.196 | 1.18 |
| 4203 | 601431 | 223209 | F | 20.221 | 19.321 | 0.9 |
| 4204 | 601435 | 223217 | F | 20.369 | 19.429 | 0.94 |
| 4205 | 601423 | 223208 | F | 20.386 | 19.396 | 0.99 |
| 4206 | 601418 | 223205 | F | 20.709 | 19.559 | 1.15 |
| 4207 | 601413 | 223203 | F | 20.991 | 19.721 | 1.27 |
| 4208 | 601496 | 223223 | F | 17.845 | 14.765 | 3.08 |
| 4209 | 601475 | 223238 | F | 17.548 | 15.518 | 2.03 |
| 4210 | 601460 | 223218 | F | 18.767 | 16.257 | 2.51 |
| 4907 | 601405 | 222951 | F | 21.018 | 17.903 | 3.115 |
| 5001 | 601555 | 223047 | F | - | - | - |
| 5002 | 601518 | 223041 | F | - | - | - |
| 5203 | 601519 | 223247 | F | 16.68 | 13.06 | 3.62 |
| 5204 | 601518 | 223242 | F | 15.5 | 13.4 | 2.1 |

| Manhole Reference | Easting | Northing | Liquid Type | Cover Level | Invert Level | Depth to Invert |
|-------------------|---------|----------|-------------|-------------|--------------|-----------------|
| 6004 | 601630 | 223056 | F | - | - | - |
| 6005 | 601662 | 223068 | F | - | - | - |
| 6006 | 601659 | 223075 | F | - | - | - |
| 6007 | 601629 | 223062 | F | - | - | - |
| 6008 | 601628 | 223070 | F | - | - | - |
| 7101 | 601717 | 223193 | F | 19.7 | 18.48 | 1.22 |
| 7102 | 601723 | 223188 | F | 19.77 | 18.99 | 0.78 |
| 7201 | 601709 | 223233 | F | - | - | - |
| 7202 | 601707 | 223289 | F | - | - | - |
| 7203 | 601785 | 223219 | F | - | - | - |
| 7204 | 601777 | 223282 | F | - | - | - |
| 7303 | 601794 | 223324 | F | - | - | - |
| 8201 | 601802 | 223227 | F | - | - | - |
| 8501 | 601863 | 222586 | F | - | - | - |
| 8502 | 601881 | 222560 | F | 20.92 | 18.64 | 2.28 |
| 8503 | 601848 | 222581 | F | 20.39 | 18.29 | 2.1 |
| 8504 | 601873 | 222535 | F | 20.8 | 18.82 | 1.98 |
| 8505 | 601894 | 222540 | F | 20.76 | 19.06 | 1.7 |
| 9502 | 601978 | 222516 | F | - | - | - |
| 9503 | 601925 | 222546 | F | 20.83 | 19.46 | 1.37 |
| 9504 | 601934 | 222521 | F | 20.98 | 19.49 | 1.49 |
| 0351 | 602088 | 223319 | S | - | - | - |
| 0352 | 602051 | 223336 | S | - | - | - |
| 0552 | 602002 | 222542 | S | - | - | - |
| 1151 | 601174 | 223183 | S | - | - | - |
| 1152 | 601142 | 223182 | S | 25.081 | 20.45 | 4.631 |
| 2151 | 601262 | 223157 | S | - | - | - |
| 2152 | 601238 | 223154 | S | 23.764 | 20.19 | 3.574 |
| 3051 | 601336 | 223023 | S | 22.55 | 19.715 | 2.835 |
| 3151 | 601340 | 223136 | S | - | - | - |
| 3152 | 601397 | 223185 | S | - | - | - |
| 3153 | 601334 | 223129 | S | 22.753 | 19.998 | 2.755 |
| 3154 | 601396 | 223161 | S | - | - | - |
| 3155 | 601372 | 223148 | S | - | - | - |
| 3156 | 601336 | 223149 | S | - | - | - |
| 3251 | 601399 | 223210 | S | - | - | - |
| 3252 | 601355 | 223223 | S | - | - | - |
| 3253 | 601356 | 223262 | S | - | - | - |
| 3353 | 601359 | 223340 | S | 20.61 | 19.9 | 0.71 |
| 3354 | 601359 | 223317 | S | 20.966 | 19.546 | 1.42 |
| 3355 | 601374 | 223310 | S | 21.261 | 19.911 | 1.35 |
| 3951 | 601398 | 222915 | S | 22.243 | 19.393 | 2.85 |
| 3952 | 601350 | 222923 | S | 21.345 | 19.51 | 1.835 |
| 4051 | 601458 | 223040 | S | - | - | - |
| 4052 | 601480 | 223032 | S | - | - | - |
| 4053 | 601454 | 223022 | S | - | - | - |
| 4151 | 601484 | 223177 | S | - | - | - |
| 4152 | 601458 | 223163 | S | - | - | - |
| 4153 | 601405 | 223151 | S | - | - | - |
| 4154 | 601464 | 223198 | S | 19.906 | 17.106 | 2.8 |



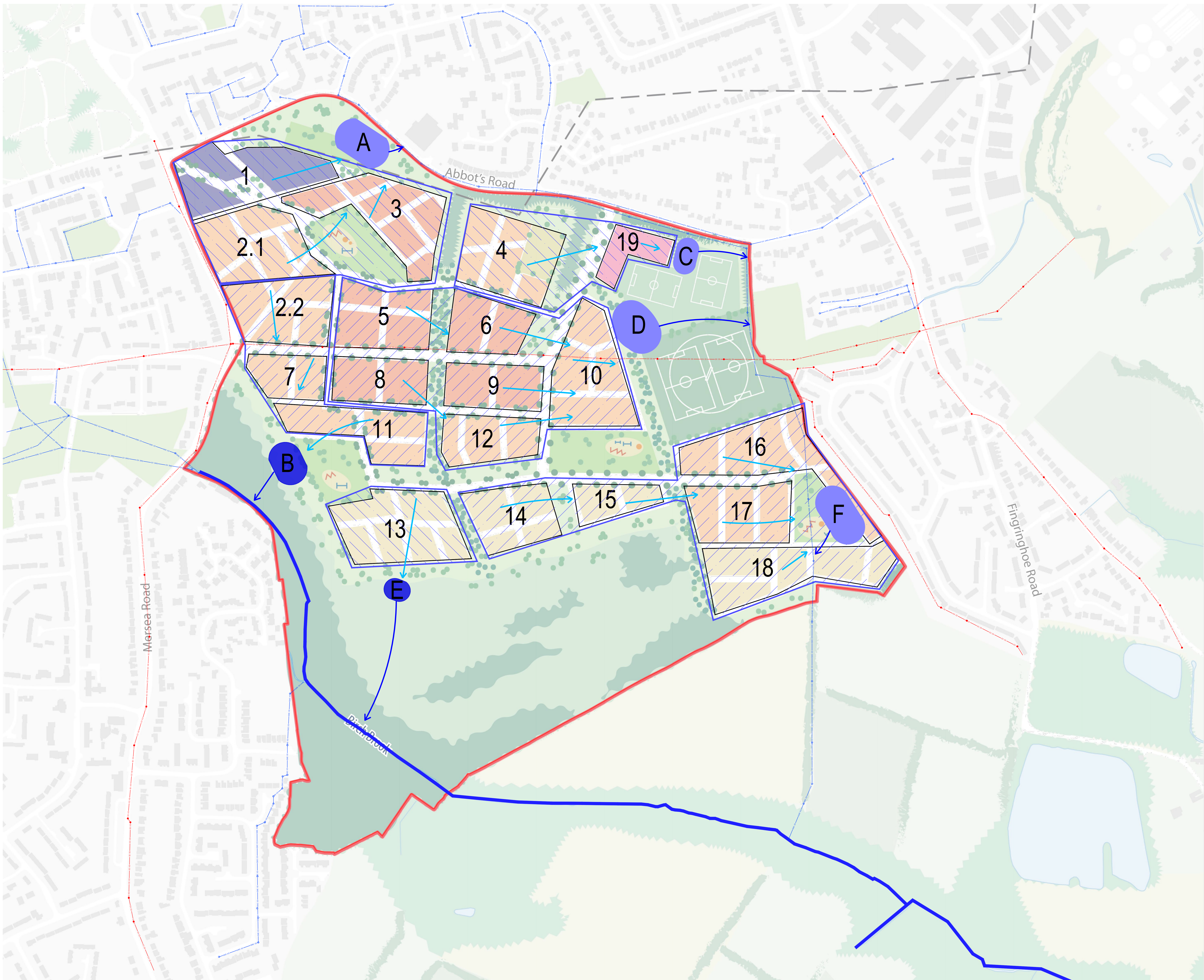
| Manhole Reference | Easting | Northing | Liquid Type | Cover Level | Invert Level | Depth to Invert |
|-------------------|---------|----------|-------------|-------------|--------------|-----------------|
| 1000 | 600163 | 222002 | C | - | - | - |
| 1100 | 600182 | 222144 | C | - | - | - |
| 1101 | 600182 | 222144 | C | - | - | - |
| 1102 | 600148 | 222110 | C | - | - | - |
| 1200 | 600189 | 222254 | C | - | - | - |
| 1303 | 600178 | 222371 | C | 32.43 | 30.22 | 2.21 |
| 1304 | 600163 | 222371 | C | 32.53 | - | - |
| 1401 | 600130 | 222403 | C | 31.71 | 30.9 | 1.4 |
| 1403 | 600179 | 222403 | C | 31.95 | - | - |
| 1404 | 600167 | 222418 | C | 32.18 | 30.67 | 1.51 |
| 1405 | 600169 | 222440 | C | 32.37 | 30.88 | 1.49 |
| 1406 | 600139 | 222444 | C | 32.52 | 31.21 | 1.31 |
| 1500 | 600194 | 222565 | C | - | - | - |
| 1501 | 600181 | 222539 | C | 32.3 | 30.9 | 1.4 |
| 1502 | 600167 | 222564 | C | 32.09 | 30.55 | 1.54 |
| 1503 | 600151 | 222519 | C | 32.49 | 31.01 | 1.48 |
| 1504 | 600141 | 222536 | C | 32.37 | 30.74 | 1.63 |
| 1505 | 600130 | 222532 | C | - | - | - |
| 1600 | 600136 | 222661 | C | 31.16 | - | - |
| 1601 | 600189 | 222668 | C | 31.71 | 30.1 | 1.61 |
| 1700 | 600171 | 222759 | C | 30.18 | 29.1 | 1.08 |
| 1701 | 600196 | 222703 | C | 30.53 | 29.18 | 1.35 |
| 1702 | 600178 | 222703 | C | 30.58 | 29.48 | 1.1 |
| 1800 | 600199 | 222874 | C | - | - | - |
| 1900 | 600191 | 221960 | C | 32.56 | - | - |
| 2000 | 600226 | 222076 | C | - | - | - |
| 2001 | 600269 | 222093 | C | - | - | - |
| 2002 | 600204 | 222018 | C | - | - | - |
| 2003 | 600241 | 222033 | C | - | - | - |
| 2004 | 600277 | 222047 | C | - | - | - |
| 2100 | 600273 | 222197 | C | - | - | - |
| 2101 | 600272 | 222155 | C | - | - | - |
| 2102 | 600212 | 222102 | C | - | - | - |
| 2200 | 600210 | 222289 | C | - | - | - |
| 2201 | 600225 | 222282 | C | - | - | - |
| 2202 | 600261 | 222270 | C | - | - | - |
| 2203 | 600244 | 222236 | C | - | - | - |
| 2204 | 600211 | 222201 | C | - | - | - |
| 2300 | 600271 | 222374 | C | - | - | - |
| 2301 | 600271 | 222394 | C | - | - | - |
| 2302 | 600246 | 222391 | C | - | - | - |
| 2303 | 600230 | 222318 | C | - | - | - |
| 2400 | 600273 | 222482 | C | - | - | - |
| 2401 | 600212 | 222497 | C | 32.04 | 30.81 | 1.23 |
| 2402 | 600230 | 222497 | C | 31.48 | 29.2 | 2.28 |
| 2403 | 600246 | 222422 | C | - | - | - |
| 2404 | 600246 | 222405 | C | - | - | - |
| 2405 | 600230 | 222401 | C | 31.48 | 29.2 | 2.28 |
| 2500 | 600268 | 222560 | C | 31.38 | 29.42 | 1.96 |
| 2501 | 600207 | 222585 | C | 31.71 | 30.1 | 1.61 |
| 2502 | 600223 | 222596 | C | 31.49 | 28.38 | 3.11 |
| 2600 | 600226 | 222551 | C | 31.84 | 28.72 | 3.12 |
| 2600 | 600259 | 222649 | C | 31.05 | 28.52 | 2.53 |
| 2601 | 600216 | 222670 | C | 30.88 | 27.91 | 2.97 |
| 2602 | 600202 | 222625 | C | 31.53 | - | - |
| 2700 | 600212 | 222754 | C | - | - | - |
| 2701 | 600201 | 222753 | C | - | - | - |
| 2702 | 600230 | 222756 | C | 29.11 | - | - |
| 2703 | 600229 | 222737 | C | 29.5 | 28.29 | 1.21 |
| 2704 | 600250 | 222735 | C | 29.78 | - | - |
| 2705 | 600209 | 222734 | C | 30.05 | 27.55 | 2.5 |
| 2800 | 600226 | 222837 | C | - | - | - |
| 2801 | 600275 | 222880 | C | - | - | - |
| 2802 | 600248 | 222884 | C | - | - | - |
| 2803 | 600209 | 222888 | C | - | - | - |
| 2804 | 600211 | 222898 | C | - | - | 2.9 |
| 2801 | 600235 | 221996 | C | 32.57 | - | - |
| 2902 | 600275 | 222903 | C | - | - | - |
| 3000 | 600322 | 222065 | C | 32.25 | 28.6 | 3.65 |
| 3001 | 600330 | 222027 | C | 32.04 | 28.7 | 3.94 |
| 3002 | 600322 | 222069 | C | - | - | - |
| 3100 | 600324 | 222190 | C | 31.73 | 28.26 | 3.47 |
| 3101 | 600319 | 222195 | C | - | - | - |
| 3300 | 600328 | 222372 | C | - | - | - |
| 3301 | 600334 | 222315 | C | 31.39 | 27.9 | 3.49 |
| 3302 | 600352 | 222379 | C | 29.23 | 27.41 | 1.82 |
| 3400 | 600356 | 222493 | C | - | - | - |
| 3500 | 600348 | 222593 | C | 33.09 | 27.04 | 6.05 |
| 3511 | 600354 | 222598 | C | - | - | - |
| 3608 | 600397 | 222621 | C | - | - | - |
| 3609 | 600396 | 222616 | C | - | - | - |
| 3610 | 600383 | 222614 | C | - | - | - |
| 3700 | 600342 | 222704 | C | 29.73 | 26.7 | 3.03 |
| 3800 | 600368 | 222885 | C | - | - | - |
| 3801 | 600351 | 222885 | C | - | - | - |
| 3802 | 600320 | 222885 | C | - | - | - |
| 3907 | 600368 | 222910 | C | - | - | - |
| 4602 | 600402 | 222609 | C | - | - | - |
| 4603 | 600401 | 222622 | C | - | - | - |
| 4604 | 600411 | 222623 | C | - | - | - |
| 4605 | 600412 | 222609 | C | - | - | - |
| 4606 | 600403 | 222597 | C | - | - | - |
| 4700 | 600433 | 222799 | C | 27.69 | 26.37 | 1.32 |
| 4800 | 600453 | 222876 | C | - | - | - |
| 4801 | 601458 | 222819 | C | - | - | - |
| 4802 | 601442 | 222876 | C | - | - | - |
| 4803 | 601419 | 222889 | C | - | - | - |
| 4804 | 601492 | 222864 | C | - | - | - |
| 4901 | 601410 | 222908 | C | 22.24 | 20.57 | 1.67 |
| 5400 | 600586 | 222423 | C | - | - | - |
| 5602 | 601568 | 222691 | C | - | - | 1.295 |
| 5703 | 601558 | 222777 | C | - | - | 1.727 |
| 5704 | 601508 | 222767 | C | - | - | - |
| 5705 | 601509 | 222772 | C | - | - | - |
| 5801 | 601570 | 222821 | C | - | - | 0.786 |
| 5802 | 601530 | 222888 | C | - | - | 2.287 |
| 5803 | 601555 | 222870 | C | - | - | 2.006 |
| 5804 | 601565 | 222830 | C | - | - | 1.219 |
| 5805 | 601520 | 222822 | C | - | - | 1.269 |
| 5809 | 601515 | 222887 | C | - | - | - |
| 5810 | 601508 | 222883 | C | - | - | - |
| 5811 | 601501 | 222877 | C | - | - | - |
| 5812 | 601502 | 222847 | C | - | - | - |
| 5813 | 601507 | 222836 | C | - | - | - |
| 1305 | 600187 | 222325 | F | - | - | - |
| 1306 | 600187 | 222330 | F | - | - | - |
| 1307 | 600188 | 222336 | F | - | - | - |
| 1308 | 600187 | 222342 | F | - | - | - |
| 3200 | 600371 | 222278 | F | - | - | - |
| 3201 | 600360 | 222282 | F | - | - | - |
| 3202 | 600359 | 222292 | F | - | - | - |
| 3203 | 600359 | 222296 | F | - | - | - |
| 3303 | 600389 | 222397 | F | - | - | - |
| 4000 | 600475 | 222023 | F | - | - | - |
| 4001 | 600431 | 222067 | F | - | - | - |
| 4002 | 600414 | 222058 | F | - | - | - |
| 4003 | 600434 | 222038 | F | - | - | - |
| 4100 | 600431 | 222171 | F | - | - | - |
| 4101 | 600421 | 222101 | F | - | - | - |
| 4102 | 600436 | 222174 | F | - | - | - |
| 4103 | 600441 | 222174 | F | - | - | - |
| 4104 | 600447 | 222174 | F | - | - | - |
| 4200 | 600415 | 222279 | F | - | - | - |
| 4201 | 600419 | 222258 | F | - | - | - |
| 4202 | 600431 | 222256 | F | - | - | - |
| 4203 | 600430 | 222212 | F | - | - | - |
| 4300 | 600418 | 222398 | F | - | - | - |
| 4301 | 600414 | 222320 | F | - | - | 2.332 |
| 4302 | 600430 | 222325 | F | - | - | - |
| 4303 | 600485 | 222383 | F | - | - | - |
| 4304 | 600498 | 222383 | F | - | - | - |
| 4305 | 600485 | 222318 | F | - | - | - |
| 4400 | 600475 | 222442 | F | - | - | - |
| 4600 | 600484 | 222629 | F | - | - | - |
| 4601 | 600455 | 222627 | F | - | - | - |
| 5000 | 600533 | 222047 | F | - | - | - |
| 5001 | 600561 | 222035 | F | - | - | - |
| 5002 | 600556 | 222047 | F | - | - | - |
| 5100 | 600543 | 222195 | F | - | - | - |
| 5101 | 600516 | 222198 | F | - | - | - |

| Manhole Reference | Easting | Northing | Liquid Type | Cover Level | Invert Level | Depth to Invert |
|-------------------|---------|----------|-------------|-------------|--------------|-----------------|
| 5102 | 600532 | 222186 | F | - | - | - |
| 5103 | 600519 | 222161 | F | - | - | - |
| 5104 | 600532 | 222163 | F | - | - | - |
| 5105 | 600533 | 222122 | F | - | - | - |
| 5200 | 600571 | 222264 | F | - | - | - |
| 5201 | 600571 | 222245 | F | - | - | - |
| 5202 | 600556 | 222233 | F | - | - | - |
| 5203 | 600591 | 222267 | F | - | - | - |
| 5204 | 600579 | 222298 | F | - | - | - |
| 5205 | 600557 | 222222 | F | - | - | - |
| 5300 | 600581 | 222389 | F | - | - | 2.875 |
| 5301 | 600591 | 222316 | F | - | - | - |
| 5302 | 600567 | 222311 | F | - | - | - |
| 5401 | 600511 | 222477 | F | - | - | - |
| 5402 | 600552 | 222439 | F | - | - | - |
| 5403 | 600548 | 222476 | F | - | - | - |
| 5404 | 600514 | 222437 | F | - | - | - |
| 5405 | 600584 | 222441 | F | - | - | - |
| 5500 | 600547 | 222509 | F | - | - | - |
| 5501 | 600540 | 222529 | F | - | - | - |
| 5502 | 600525 | 222538 | F | - | - | - |
| 5503 | 600543 | 222550 | F | - | - | - |
| 5504 | 600540 | 222581 | F | - | - | - |
| 5600 | 600506 | 222611 | F | - | - | - |
| 5601 | 600535 | 222643 | F | - | - | - |
| 6000 | 600602 | 222047 | F | - | - | - |
| 6100 | 600601 | 222130 | F | - | - | - |
| 6300 | 600602 | 222301 | F | - | - | 4.52 |
| 1851 | 600144 | 222864 | S | - | - | - |
| 1852 | 600146 | 222834 | S | - | - | - |
| 2851 | 600214 | 222803 | S | - | - | - |
| 2852 | 600297 | 222833 | S | - | - | - |
| 2853 | 600302 | 222877 | S | - | - | - |
| 2854 | 600225 | 222855 | S | - | - | - |
| 3251 | 600360 | 222277 | S | - | - | - |
| 4051 | 600465 | 222053 | S | - | - | - |
| 4052 | 600420 | 222076 | S | - | - | - |
| 4053 | 600426 | 222035 | S | - | - | - |
| 4054 | 600474 | 222016 | S | - | - | - |
| 4055 | 600439 | 222004 | S | - | - | - |
| 4151 | 600471 | 222191 | S | - | - | - |
| 4152 | 600437 | 222192 | S | - | - | - |
| 4153 | 600475 | 222124 | S | - | - | - |
| 4154 | 600475 | 222137 | S | - | - | - |
| 4155 | 600425 | 222125 | S | - | - | - |
| 4251 | 600453 | 222273 | S | - | - | - |
| 4251 | 601428 | 222219 | S | 18.781 | 16.079 | 2.702 |
| 4252 | 601440 | 222252 | S | 19.817 | 17.897 | 1.92 |
| 4252 | 600432 | 222259 | S | - | - | - |
| 4253 | 600432 | 222208 | S | - | - | - |
| 4351 | 601440 | 222220 | S | 21.101 | 18.021 | 3.08 |
| 4351 | 600499 | 222342 | S | - | - | - |
| 4352 | 600500 | 222392 | S | - | - | - |
| 4353 | 600487 | 222315 | S | - | - | - |
| 4354 | 600432 | 222333 | S | - | - | - |
| 4355 | 600431 | 222384 | S | - | - | - |
| 4451 | 600499 | 222454 | S</ | | | |



| Manhole Reference | Easting | Northing | Liquid Type | Cover Level | Invert Level | Depth to Invert | Manhole Reference | Easting | Northing | Liquid Type | Cover Level | Invert Level | Depth to Invert | Manhole Reference | Easting | Northing | Liquid Type | Cover Level | Invert Level | Depth to Invert | Manhole Reference | Easting | Northing | Liquid Type | Cover Level | Invert Level | Depth to Invert | Manhole Reference | Easting | Northing | Liquid Type | Cover Level | Invert Level | Depth to Invert | | | | | | | | | | | |
|-------------------|---------|----------|-------------|-------------|--------------|-----------------|-------------------|---------|----------|-------------|-------------|--------------|-----------------|-------------------|---------|----------|-------------|-------------|--------------|-----------------|-------------------|---------|----------|-------------|-------------|--------------|-----------------|-------------------|---------|----------|-------------|-------------|--------------|-----------------|--------|--------|-------|-------|-------|--------|--------|---|-------|-------|------|
| 0501 | 601085 | 223521 | C | 22.79 | 21.27 | 1.52 | 4608 | 600406 | 223646 | F | - | - | - | 3051 | 600335 | 223075 | S | - | - | - | 600318 | 223071 | S | - | - | - | 600373 | 223607 | S | 30.483 | 29.193 | 1.29 | 600357 | 223601 | S | - | - | - | 8.925 | - | - | | | | |
| 0601 | 601087 | 223627 | C | 21.36 | 19.69 | 1.67 | 4609 | 600405 | 223645 | F | 27.329 | 25.51 | 1.819 | 3052 | 600318 | 223071 | S | - | - | - | 600349 | 223612 | F | - | - | - | 600372 | 223606 | S | 28.08 | 26.326 | 1.754 | 600348 | 223611 | S | 27.418 | 26.47 | 0.946 | 28.08 | 26.326 | 1.754 | | | | |
| 0602 | 601039 | 223604 | C | 22.21 | 20.66 | 1.55 | 5302 | 600563 | 223396 | F | 27.35 | 25.78 | 1.57 | 3151 | 600319 | 223125 | S | - | - | - | 600485 | 223397 | S | 28.401 | 27.05 | 1.351 | 4352 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 0604 | 601025 | 223680 | C | 21.42 | 20.35 | 1.07 | 5303 | 600528 | 223381 | F | 27.6 | 25.99 | 1.61 | 3152 | 600339 | 223185 | S | - | - | - | 600424 | 223354 | S | 29.54 | 28.14 | 1.4 | 4356 | 600442 | 223318 | S | 29.41 | 28.82 | 0.59 | 600443 | 223317 | S | 29.41 | 28.82 | 0.59 | 600444 | 223316 | S | 29.41 | 28.82 | 0.59 |
| 0800 | 600086 | 222931 | C | - | - | - | 5304 | 600524 | 223371 | F | 27.65 | 26.165 | 1.485 | 3251 | 600391 | 223203 | S | - | - | - | 600425 | 223355 | S | 29.54 | 28.14 | 1.4 | 4357 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 0901 | 601095 | 222950 | C | - | - | - | 5305 | 600508 | 223363 | F | 27.89 | 26.39 | 1.5 | 3451 | 600360 | 223240 | S | 31.467 | 29.597 | 1.87 | 600426 | 223356 | S | 29.54 | 28.14 | 1.4 | 4358 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 0902 | 601002 | 222955 | C | - | - | - | 5401 | 600577 | 223466 | F | - | 26.137 | - | 3551 | 600350 | 223285 | S | 31.017 | 29.537 | 1.48 | 600427 | 223357 | S | 29.54 | 28.14 | 1.4 | 4359 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1002 | 601123 | 223286 | C | 24.35 | 22.71 | 1.64 | 5403 | 600552 | 223467 | F | - | - | - | 3552 | 600340 | 223264 | S | 31.481 | 29.911 | 1.57 | 600428 | 223358 | S | 29.54 | 28.14 | 1.4 | 4360 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1203 | 601119 | 223290 | C | - | - | - | 5404 | 600595 | 223473 | F | 27.86 | 26.86 | 1 | 3553 | 600341 | 223263 | S | 31.776 | 30.136 | 1.64 | 600429 | 223359 | S | 29.54 | 28.14 | 1.4 | 4361 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1204 | 601132 | 223284 | C | - | - | - | 5406 | 600548 | 223464 | F | - | - | - | 3554 | 600337 | 223253 | S | 32.58 | - | - | 600430 | 223360 | S | 29.54 | 28.14 | 1.4 | 4362 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1301 | 601107 | 223377 | C | 23.95 | 22.57 | 1.38 | 5407 | 600519 | 223477 | F | - | - | - | 3555 | 600400 | 223241 | S | 31.215 | 30.145 | 1.07 | 600431 | 223361 | S | 29.54 | 28.14 | 1.4 | 4363 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1401 | 601133 | 223446 | C | 23.01 | 21.85 | 1.16 | 5408 | 600525 | 223446 | F | - | 27.09 | - | 3651 | 600373 | 223267 | S | 30.483 | 29.193 | 1.29 | 600432 | 223362 | S | 29.54 | 28.14 | 1.4 | 4364 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1501 | 601180 | 223561 | C | 22.03 | 20.48 | 1.55 | 5409 | 600573 | 223470 | F | 27.84 | 26.14 | 1.7 | 3652 | 600357 | 223261 | S | - | - | - | 600433 | 223363 | S | 29.54 | 28.14 | 1.4 | 4365 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1502 | 601191 | 223640 | C | 22.18 | 20.63 | 1.55 | 6001 | 600549 | 223472 | F | 27.86 | 26.14 | 1.7 | 3653 | 600349 | 223262 | S | 28.08 | 26.326 | 1.754 | 600434 | 223364 | S | 29.54 | 28.14 | 1.4 | 4366 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1602 | 601139 | 223635 | C | 20.93 | 19.38 | 1.55 | 5411 | 600538 | 223407 | F | - | - | - | 4352 | 600485 | 223397 | S | 28.401 | 27.05 | 1.351 | 600435 | 223365 | S | 29.54 | 28.14 | 1.4 | 4367 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1700 | 600171 | 222729 | C | 30.18 | 29.1 | 1.08 | 5412 | 600528 | 223403 | F | - | - | - | 4354 | 600417 | 223381 | S | 28.65 | 27.73 | 0.92 | 600436 | 223366 | S | 29.54 | 28.14 | 1.4 | 4368 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1800 | 600199 | 222874 | C | - | - | - | 5413 | 600537 | 223410 | F | - | - | - | 4355 | 600424 | 223354 | S | 29.54 | 28.14 | 1.4 | 600437 | 223367 | S | 29.54 | 28.14 | 1.4 | 4369 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1900 | 600132 | 222932 | C | - | - | - | 5414 | 600535 | 223416 | F | - | - | - | 4356 | 600442 | 223318 | S | 29.41 | 28.82 | 0.59 | 600438 | 223368 | S | 29.54 | 28.14 | 1.4 | 4370 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 1901 | 601189 | 222949 | C | - | - | - | 5415 | 600532 | 223420 | F | - | - | - | 4357 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600439 | 223369 | S | 29.54 | 28.14 | 1.4 | 4371 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 2002 | 600276 | 223014 | C | - | - | - | 5416 | 600529 | 223424 | F | - | - | - | 4358 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600440 | 223360 | S | 29.54 | 28.14 | 1.4 | 4372 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 2201 | 601226 | 223119 | C | 23.13 | 21 | 2.13 | 5417 | 600526 | 223424 | F | - | - | - | 4359 | 600447 | 223281 | S | 30.135 | 29.475 | 0.66 | 600441 | 223361 | S | 29.54 | 28.14 | 1.4 | 4373 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 2401 | 601272 | 223421 | C | - | 20.5 | - | 5418 | 600521 | 223421 | F | - | - | - | 4452 | 600434 | 223478 | S | 30.561 | - | - | 600442 | 223362 | S | 29.54 | 28.14 | 1.4 | 4374 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 2402 | 601221 | 223468 | C | 21.79 | 20.3 | 1.49 | 5501 | 600598 | 223527 | F | - | - | - | 4453 | 600495 | 223492 | S | 29.648 | 28.123 | 1.525 | 600443 | 223363 | S | 29.54 | 28.14 | 1.4 | 4375 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 2601 | 601252 | 223601 | C | 20.2 | 18.71 | 1.49 | 5502 | 600547 | 223541 | F | 29.4 | 28.22 | 1.18 | 4454 | 600436 | 223506 | S | 30.68 | 29.73 | 0.95 | 600444 | 223364 | S | 29.54 | 28.14 | 1.4 | 4376 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 2700 | 600212 | 222754 | C | - | - | - | 5503 | 600598 | 223544 | F | 26.65 | 27.48 | 1.07 | 4455 | 600412 | 223512 | S | 30.97 | 28.84 | 2.13 | 600445 | 223365 | S | 29.54 | 28.14 | 1.4 | 4377 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 2701 | 600201 | 222753 | C | - | - | - | 5504 | 600592 | 223521 | F | - | 27.78 | - | 4456 | 600402 | 223523 | S | 31.07 | 30.01 | 1.06 | 600446 | 223366 | S | 29.54 | 28.14 | 1.4 | 4378 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 2702 | 600230 | 222756 | C | 29.11 | - | - | 5505 | 600578 | 223510 | F | - | 27.92 | - | 4457 | 600437 | 223469 | S | 27.895 | 26.345 | 1.55 | 600447 | 223367 | S | 29.54 | 28.14 | 1.4 | 4379 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 2703 | 600229 | 222737 | C | 29.5 | 28.29 | 1.21 | 5506 | 600549 | 223529 | F | - | - | 1.75 | 4458 | 600438 | 223566 | S | 28.2 | 26.65 | 1.55 | 600448 | 223368 | S | 29.54 | 28.14 | 1.4 | 4380 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 2704 | 600250 | 222735 | C | 29.78 | - | - | 5507 | 600532 | 223522 | F | - | - | - | 4459 | 600440 | 223620 | S | 29.313 | 27.473 | 1.84 | 600449 | 223369 | S | 29.54 | 28.14 | 1.4 | 4381 | 600470 | 223332 | S | 28.95 | 28.4 | 0.55 | 600471 | 223331 | S | 28.95 | 28.4 | 0.55 | 600472 | 223330 | S | 28.95 | 28.4 | 0.55 |
| 2705 | 600209 | 222734 | C | 30.05 | 27.55 | 2.5 | 5602 | 600548 | 223649 | F | 27.298 | 25.268 | 2.03 | 4751 | 600400 | 222793 | S | - | - | - | 600450 | 223650 | S | 29.5 | | | | | | | | | | | | | | | | | | | | | |

Appendix D Preliminary Surface Water Drainage Strategy



- NOTES:**
1. THIS DRAWING ILLUSTRATES THE PRELIMINARY SURFACE WATER DRAINAGE PROPOSAL FOR THE DEVELOPMENT OUTLINED IN THE DRAFT CONCEPT MASTERPLAN (A46742-SK-02 REV'D DATED 19/02/18).
 2. THIS DRAWING HAS BEEN MADE TO COMPLIMENT THE STRATEGY DESCRIBED WITHIN THE MIDDLEWICK RANGES FLOOD RISK, SURFACE AND FOUL WATER TECHNICAL NOTE (A46742-4000-001 DATED SEPTEMBER 2018). DESIGN DETAILS OF CATCHMENTS AND BASINS CAN BE FOUND WITHIN THIS TECHNICAL NOTE.
 3. ASSUMPTIONS REGARDING THE SITE AND THE EXISTING DRAINAGE HAVE BEEN MADE FROM OBSERVATIONS AND PRELIMINARY RESEARCH, INCLUDING A SITE VISIT CONDUCTED IN JUNE 2018.
 4. THE POSITIONS OF EXISTING UTILITIES WERE TAKEN FROM ANGLIAN WATER ASSET PLANS. THE TRUE POSITION AND EXTENT OF THE SERVICES MAY BE DIFFERENT TO THAT SHOWN ON THIS PLAN, WHICH IS INTENDED FOR GENERAL GUIDANCE ONLY.
 5. DETAILED DESIGN OF PROPOSED PIPED DRAINAGE TO BE COMPLETED IN ACCORDANCE TO SEWERS FOR ADOPTION TO ALLOW ADOPTION BY ANGLIAN WATER.
 6. DETAILED DESIGN OF PROPOSED ATTENUATION FEATURES TO BE DESIGNED IN ACCORDANCE WITH CIRA CS99 AND ESSEX COUNTY COUNCIL DESIGN GUIDANCE TO INCLUDE APPROPRIATE POLLUTION CONTROL MEASURES AND TO ALLOW ADOPTION BY ESSEX COUNTY COUNCIL IN THEIR ROLE AS LEAD LOCAL FLOOD AUTHORITY.

- KEY:**
- SITE BOUNDARY
 - BIRCH BROOK
 - FLOW CONVEYANCE
 - BASIN OUTFALL
 - EX CS — EX CS — EXISTING COMBINED SEWER
 - EX CS — EX CS — EXISTING SURFACE WATER SEWER
 - PROPOSED DRAINAGE CATCHMENTS
 - PROPOSED BASIN DISCHARGING INTO EXISTING SEWER
 - PROPOSED BASIN DISCHARGING INTO BIRCH BROOK

| Mark | Revision | Date | Drawn | Chkd | Appd |
|------|----------|------|-------|------|------|
| | | | | | |

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.
 UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

Drawing Issue Status: **PRELIMINARY**

**MIDDLEWICK RANGES
 FLOOD RISK AND SURFACE WATER
 STRATEGY PROPOSAL**

Client: **Essex Infrastructure Organisation**

Date of 1st Issue: 06-09-18 | Designed: - | Drawn: UB
 A0 Scale: 1:2000 | Checked: RP | Approved: -

Drawing Number: **40472-4002-001** | Revision: -

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 BIRMINGHAM Tel: 0121 633 2900

Calculated by: Uzayr Butt
 Site name: Middlewick Ranges
 Site location: Colchester

Site coordinates
 Latitude: 51.86915° N
 Longitude: 0.91726° E

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference: 6413818
 Date: 2018-08-02T09:57:28

| | |
|-------------|-------|
| Methodology | IH124 |
|-------------|-------|

Site characteristics

| | |
|----------------------|---|
| Total site area (ha) | 1 |
|----------------------|---|

Methodology

| | |
|------------------------|-----------------------------|
| Qbar estimation method | Calculate from SPR and SAAR |
| SPR estimation method | Calculate from SOIL type |

| | Default | Edited |
|-------------|---------|--------|
| SOIL type | 2 | 2 |
| HOST class | --- | --- |
| SPR/SPRHOST | 0.3 | 0.3 |

Hydrological characteristics

| | Default | Edited |
|-------------------------------|---------|--------|
| SAAR (mm) | 555 | 555 |
| Hydrological region | 6 | 6 |
| Growth curve factor: 1 year | 0.85 | 0.85 |
| Growth curve factor: 30 year | 2.3 | 2.3 |
| Growth curve factor: 100 year | 3.19 | 3.19 |

Notes:

- (1) Is $Q_{BAR} < 2.0$ l/s/ha?
 Normally limiting discharge rates which are less than 2.0 l/s/ha are set at 2.0 l/s/ha.
- (2) Are flow rates < 5.0 l/s?
 Where flow rates are less than 5.0 l/s consents are usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements
- (3) Is $SPR/SPRHOST \leq 0.3$?
 Where groundwater levels are low enough the use of soakaways to avoid discharge offsite may be a requirement for disposal of surface water runoff.

Greenfield runoff rates

| | Default | Edited |
|----------------------|---------|--------|
| Qbar (l/s) | 1.39 | 1.39 |
| 1 in 1 year (l/s) | 1.18 | 1.18 |
| 1 in 30 years (l/s) | 3.19 | 3.19 |
| 1 in 100 years (l/s) | 4.43 | 4.43 |