



Colchester Borough Council Level 2 Strategic Flood Risk Assessment

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Glossary of Terms

Glossary	Definition
Annual exceedance probability (AEP)	Chance of occurrence in any one year, expressed as a percentage. For example, a 1% annual probability event has a 1 in 100 chance of occurring in any given year.
Areas Benefitting from Defences (ABD)	Hatched areas on the Environment Agency Flood Map for Planning (Rivers and Sea) behind flood defences, which, if the flood defences were not present, would flood, in the event of a river flood with a 1 per cent (1 in 100) chance of happening each year, or a flood from the sea with a 0.5 per cent (1 in 200) chance of happening each year.
Asset Information Management System (AIMS)	Environment Agency management system of assets associated with main rivers including defences, structures and channel types. Information regarding location, standard of service, dimensions and condition.
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions. The Environment Agency has published guidance setting out the approach for assessing the impact of climate change with respect to flood risk, further detail about which is provided in the Level 1 SFRA.
Critical Drainage Area	A discrete geographic area and usually the contributing hydrological catchment, in which surface water flooding poses risk to properties, business or infrastructure. These areas are identified during the preparation of the Colchester Surface Water Management Plan.
Culvert	A channel or pipe that carries water below the level of the ground.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Exception Test	A method set out in the NPPF to help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available. The two parts to the Test require proposed development to show that it will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.
Flood Defence	Infrastructure used to protect an area against flooding such as floodwalls and embankments.
Resilience measures	Measures designed to reduce the impact of water that enters property and businesses and to promote fast drying and easy cleaning; for example raising electrical appliances, installing tiled flooring.
Resistance measures	Measures to prevent flood water entering a building or damaging its fabric, for example the use of flood guards. This has the same meaning as flood proofing.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).
Flood Zone	Areas defined by the probability of river and sea flooding, ignoring the presence of defences. Flood Zones are shown on the Environment Agency's Flood Map for Planning (Rivers and Sea), available on the Environment Agency's web site.
Fluvial	Relating to the actions, processes and behaviour of a watercourse (river or stream).
Freeboard	The height of a flood defence crest level (or building level) above a particular design flood level.
Functional Floodplain	Land where water has to flow or be stored in times of flood. It is defined by LPAs within SFRAs. Functional floodplain (also referred to as Flood Zone 3b) is not separately distinguished from Zone 3a on the Environment Agency Flood Map for Planning.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Lead Local Flood Authority (LLFA)	As defined by the Flood and Water Management Act, in relation to an area in England, this means the unitary authority or where there is no unitary authority, the county council for the area. Each of the London Boroughs is a LLFA for their respective areas.
Local Planning Authority (LPA)	Body that is responsible for controlling planning and development through the planning system.

Glossary	Definition
Main river	Watercourse defined on a 'main river map' designated by Defra. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for main rivers. However overall responsibility for maintenance lies with the riparian owner.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
National Planning Policy Framework (NPPF)	The National Planning Policy Framework was published on 27 March 2012. It is a framework which sets out the Government's planning policies for England and how these are expected to be applied.
Ordinary watercourse	A watercourse that does not form part of a main river. This includes "all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows" according to the Land Drainage Act 1991.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
Risk	Risk is a factor of the probability or likelihood of an event occurring multiplied by consequence: Risk = Probability x Consequence. It is also referred to in this report in a more general sense.
Sequential Test	An approach to future site planning whereby new development is directed towards areas with the lowest probability of flooding before consideration of higher risk areas. The Sequential Test helps ensure that development can be safely and sustainably delivered and developers do not waste their time promoting proposals which are inappropriate on flood risk grounds.
Sewer Flooding	Flooding caused by a blockage or overflowing of a sewer or urban drainage system.
Surface Water	Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.
Surface Water Management Plan (SWMP)	A plan which outlines the preferred surface water management strategy in a given location. In this context surface water flooding describes flooding from sewers, drains, groundwater and runoff from land, small watercourses and ditches that occurs as a result of heavy rainfall.
Sustainable drainage systems (SuDS)	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Topographic survey	A survey of ground levels.

1 Introduction

1.1 Terms of Reference

AECOM Infrastructure and Environment UK Ltd ('AECOM') has been commissioned by Colchester Borough Council (BC) to review and revise the Level 1 and 2 Strategic Flood Risk Assessment (SFRA) for its administrative area. This report comprises the Level 2 SFRA.

1.2 Level 2 SFRA Scope

The National Planning Policy Framework¹ (NPPF) and associated Planning Practice Guidance for Flood Risk and Coastal Change (PPG)² state that where a Level 1 SFRA shows that land outside flood risk areas cannot appropriately accommodate all necessary future development, it may be necessary to increase the scope of the assessment to a Level 2 to provide the information necessary for application of the Exception Test to specific development sites where required, as indicated by Table 1-1.

The draft Level 1 SFRA for Colchester BC was prepared in June 2016³ and provides a strategic assessment of the risk of flooding from the tidal Blackwater and Colne estuary; fluvial watercourses including the River Colne, River Stour, Layer Brook and Roman River; flooding from ordinary watercourses, surface water, groundwater, as well as reservoirs and the existing drainage infrastructure.

Appendix B of the Level 1 SFRA provides a database of 395 potential development sites that have been identified by Colchester BC through their Call for Sites. For each site, an assessment of the risk of flooding, based on the datasets presented in the Level 1 SFRA, has been undertaken and provided to Colchester BC to enable the direct comparison of sites in the application of the Sequential Test and the subsequent identification of sites that require the Exception Test.

Table 1-1 Flood Risk Vulnerability and Flood Zone 'Compatibility' (PPG, 2014)

	Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test Required	✓	✓
	3a	Exception Test Required	✓	✗	Exception Test Required	✓
	3b	Exception Test Required	✓	✗	✗	✗

✓ - Development is appropriate ✗ - Development should not be permitted

The purpose of the Exception Test is to ensure that where it may be necessary to locate development in areas at risk of flooding, new development is only permitted in Flood Zone 2 and Flood Zone 3 where the flood risk is clearly outweighed by other sustainability factors and where the development will be safe during its lifetime, considering climate change. The NPPF states that for the Exception Test to be passed:

- Part 1 - "It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by the SFRA where one has been prepared; and

¹ Department for Communities and Local Government. 2012. *National Planning Policy Framework*. Available at: <https://www.gov.uk/government/publications/national-planning-policy-framework--2>

² Department for Communities and Local Government. 2014. *Planning Practice Guidance: Flood Risk and Coastal Change*. Available at: <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/>

³ AECOM (June 2016) Colchester Borough Council Level 1 Strategic Flood Risk Assessment – Draft Report.

- *Part 2 - A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

Both elements of the test have to be passed for development to be allocated or permitted.

In order to provide the information necessary to support the application of the Exception Test, a Level 2 SFRA considers the detailed nature of the flood characteristics within a flood zone, which can typically include consideration of aspects such as the probability of flooding, anticipated flood depths, velocities, the rate of onset of flooding and the duration of flooding.

Throughout the preparation of the Preferred Options stage of the New Local Plan, Colchester BC have undertaken the Sequential Test and identified a number of potential development sites which will be required to undergo the Exception Test, and therefore require a Level 2 assessment of flood risk. These areas are listed in Table 1-2 and comprise 27 development sites, the Essex University Employment Zone and two larger proposals for Garden Settlements at Marks Tey and East Colchester.

Table 1-2 Sites identified by Colchester BC for Exception Test and Level 2 SFRA

Site Ref	Site Address	Proposed Use	Dwellings
COL10 (CO79)	St Botolph's Farm, North Braiswick, Colchester	Mixed	50
COL28 (S0008)	Derelict depot at Hythe Station Road between railway line and River Colne, Colchester	Residential	54
COL34 (S0031)	Land at East Bay Mill, Colchester	Residential	22
COL44 (S0065)	Commercial land between Haven Road and River Colne, Colchester	Residential	Collectively 600
COL54 (S0099)	Scrapyard and allotments off Haven Road and Distillery Lane, Colchester	Residential	
COL82 (S0740)	Land between River Colne and Hythe Quay, Colchester	Residential	
RSE03, RSE17 & RSE08 (C033, C144 & C072)	Battlewicks Farm, Rowhedge/ Land off Hillview Close, Rowhedge /	Residential	Collectively 60
RSW10 (C135)	Zoo site, Maldon Road, Colchester	Zoo and related uses, potential to include hotel development	-
STN26 (S0201)	Land east of Queensberry Avenue, Copford	Residential	70
-	Essex University Employment Zone	Employment use*	-
-	Marks Tey Proposed Garden Settlement	Mixed including residential	1,350 within plan period
-	East Colchester Proposed Garden Settlement	Mixed including residential	1.250 within plan period
COL17	Gosbecks Phase 2	Residential	150
RSE08	Rowhedge Business Park, Rectory Road	Residential	
STN06	West of Lakelands	Residential	150
COL98	DSG Site, Flagstaff Road	Residential	100
COL99	Berechurch Hall Road	Residential	500
COL71	Middlewick Ranges	Residential	2000
RNW71	Heathfields	Residential	170
TIP39	Grove Road, Tiptree	Residential	55
WBG16	Cooks Hall Lane	Residential	6
WST21	Godbolt's Farm	Residential	22
WBG17	Nayland Road	Residential	10
COL102	Bakers Lane, Colchester	Residential	100
COL103	Former Sainsbury's Site, Tollgate, Stanway	Residential	200
COL97	Rugby Club, Mill Road, Colchester	Residential	300

EST07	Welshwood Park, Colchester	Residential	100 with reserve for 730)
STN09	London Road, Stanway	Residential	500
MER02	Dawes Lane, West Mersea	Residential	150
MER18	Brierley Paddock, East Road, West Mersea	Residential	50

**The proposals at the Essex University Employment Zone are largely employment uses, which are considered to be Less Vulnerable and therefore in accordance with Table 1-1 would not require the Exception Test. However Colchester BC has included this site at this stage to account for the possibility that residential uses are proposed within the site in the future.*

1.3 Level 2 SFRA Deliverables

Section 2 of this report provides a description of each of the datasets that has been used in the Level 2 SFRA and presented in the mapping in Appendix A.

The Level 2 SFRA includes the development of a tidal breach model to assess the residual risk of flooding associated with a failure of the Colne Barrier, which is detailed further in Appendix B.

Section 3 presents the Level 2 assessment for each of the potential development sites and Garden Settlements identified in Table 1-2.

2 Level 2 SFRA Methodology

2.1 Level 2 SFRA Datasets

This Section describes the additional datasets, (other than those already presented in the Level 1 SFRA), which have been used to inform the Level 2 SFRA.

2.2 Tidal Flood Risk - Colne and Blackwater Estuary Model

As part of the Environment Agency national programme of coastal and fluvial modelling, a model of the Colne and Blackwater Estuary was developed in 2010⁴. In the borough of Colchester, the model extent covers Mersea, Fingringhoe, the tidal part of the River Colne through Colchester upstream to Hythe Station, and the Roman River upstream to Layer de la Haye, (but not as far as Marks Tey), as shown in Figure 2-1.

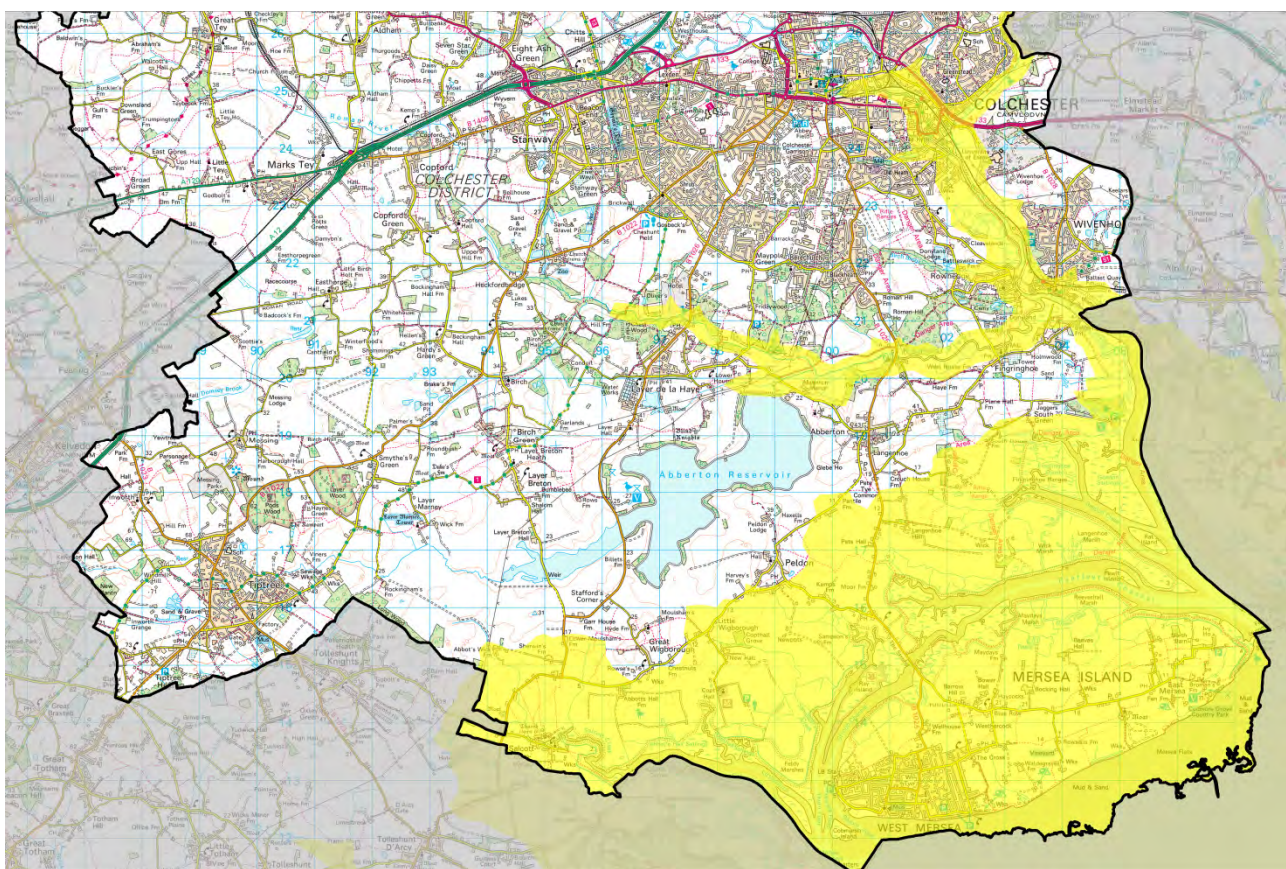


Figure 2-1 Colne and Blackwater Estuary Model Domain

(This map is reproduced from Ordnance Survey Material. Crown copyright 2016).

Outputs from the modelling are used to determine the extent of the Flood Zones, as detailed in Section 4.2 of the Level 1 SFRA. These modelled scenarios ignore the presence of flood defences, in accordance with the Flood Zones definitions set out in the NPPF.

However, there are also outputs from the modelling from defended scenarios, which can be used to determine the probability of flooding to the development sites and areas. Outputs from these defended scenarios have been mapped in **Appendix A Figures A1-A6**.

Section 2.5 and Appendix B describe how the Colne and Blackwater Estuary Model has been used as a starting point from which to develop a smaller model of the Colchester town centre, to assess the residual risk of flooding in the

⁴ CH2MHill (2010) Colne and Blackwater Estuary TuFLOW Model.

event of a failure of the Colne Barrier. As part of the development of this breach model, the original Estuary Model has been re-run using up to date water levels for the present day (2015) and including climate change to 2115. The outputs mapped in Appendix A for the Colne and Blackwater Estuary Model therefore correspond to these revised time horizons.

2.2.1 Maximum Flood Depth

During a flood event, the water depth and velocity can vary considerably across the flooded area. It is therefore important to identify which areas are more likely to be hazardous to people and new development. Mapping of maximum flood depth has been generated, which identifies the maximum depth of flooding experienced at each point in the model domain throughout the entire model simulation. **Appendix A Figures A1-A3** provide maximum flood depth mapping for the following annual exceedance probability (AEP) events:

- Figure A1 Maximum Flood Depth for 0.5% AEP (1 in 200 year) for the present day, 2015.
- Figure A2 Maximum Flood Depth for 0.5% AEP (1 in 200 year) including climate change to 2115.
- Figure A3 Maximum Flood Depth for 0.1% AEP (1 in 1000 year) for the present day, 2015.
- Figure A4 Maximum Flood Depth for 0.1% AEP (1 in 1000 year) including climate change to 2115.

2.2.2 Hazard Rating

The Estuary Model for the Colne and Blackwater was re-run to provide outputs for Flood Hazard Rating. Flood Hazard categorises the danger to people for different combinations of flood water depth and velocity. The derivation of these categories is based on the methodology set out by Defra in Flood Risk Assessment Guidance for New Development FD2320/TR2⁵ using the following equation:

$$\text{Flood Hazard Rating} = ((v+0.5)*D) + DF$$

Where v = velocity (m/s), D = depth (m), DF = debris factor

Table 2-1 Hazard categories based on FD2320, Defra & Environment Agency 2005

Flood Hazard Rating		Description
Low	HR < 0.75	Caution – Flood zone with shallow flowing water or deep standing water
Moderate	0.75 ≥ HR ≤ 1.25	Dangerous for some (i.e. children) – Danger: flood zone with deep or fast flowing water
Significant	1.25 > HR ≤ 2.0	Dangerous for most people – Danger: flood zone with deep fast flowing water
Extreme	HR > 2.0	Dangerous for all – Extreme danger: flood zone with deep fast flowing water

Appendix A Figures A4-A6 provide maximum flood hazard mapping for the following annual exceedance probability (AEP) events:

- Figure A5 Maximum Flood Hazard for 0.5% AEP (1 in 200 year) for the present day, 2015.
- Figure A6 Maximum Flood Hazard for 0.5% AEP (1 in 200 year) including climate change to 2115.
- Figure A7 Maximum Flood Hazard for 0.1% AEP (1 in 1000 year) for the present day, 2015.
- Figure A8 Maximum Flood Hazard for 0.1% AEP (1 in 1000 year) including climate change to 2115.

It is noted that at this time, outputs regarding the rate of onset of flooding and duration of flood have not been extracted from the Environment Agency's Estuary Model for the Colne and Blackwater. However the depth and hazard information provided is considered adequate to inform the Exception Test at this stage.

2.3 Fluvial Flood Risk - River Colne & River Stour Fluvial Models

The Environment Agency has provided hydraulic models of the River Colne and River Stour for the Level 2 SFRA. These are both 1D models and therefore only provide flood extent information without flood depth and velocity information on the floodplain.

⁵ Defra and Environment Agency (2005) FD2320/TR2 Flood Risk Assessment Guidance for New Development

Colchester BC has not identified any sites adjacent to the fluvial River Colne or the River Stour and therefore no further modelling of these watercourses has been undertaken.

At the time of preparing this Level 2 SFRA, the Environment Agency is currently revising the modelling of the River Stour. New outputs are anticipated in 2017, and will include consideration of a range of climate change allowances in accordance with the revised guidance published in February 2016⁶. Further detail regarding the climate change allowances is provided in Section 4.3.7 of the Level 1 SFRA Report.

Revised modelling of the River Colne is also currently being finalised, to consider the impact of the removal of certain structures along the watercourse. However, at this stage, this modelling does not include consideration of the revised climate change allowances. It is anticipated that this will not be incorporated until the next planned update to the model.

The Environment Agency is currently undertaking analysis of 1D modelling for the River Colne with a view to publishing basic levels for climate change that will need to be considered for small scale development (circa <9 residential properties), in areas of growth such as the Colne floodplain.

It is anticipated that future studies will take account of the new allowances, however in the interim period there will be greater emphasis on site specific Flood Risk Assessments to include for additional modelling scenarios to determine the future risk with respect to climate change.

2.4 Fluvial Flood Risk - Roman River, Layer Brook, Birch Brook, Salary Brook

As part of the programme of modelling undertaken by the Environment Agency, hydraulic models have not been developed for a number of the watercourses in the Borough adjacent to potential development sites, such as the Roman River (upstream of Layer de la Haye), the Layer Brook, the Birch Brook or the Salary Brook.

Outputs for these watercourses are limited to the Flood Zones derived from JFLOW modelling.

As part of future planning applications, new modelling will be required for development sites adjacent to these watercourses, to more accurately determine the probability of flooding, and to assess the impact of a range of climate change allowances, as described in Section 4.3.7 of the Level 1 SFRA Report.

For the purpose of the Level 2 SFRA, the Flood Zone information has been used to determine the issues that will need to be addressed in order to demonstrate the satisfaction of the Exception Test.

2.5 Residual Risk – Failure of Colne Barrier

Most of the future proposed development in Colchester town is located upstream of the Colne Barrier and therefore protected from flooding by the flood defence network and the operation of the barrier at Wivenhoe. As part of this updated Level 2 SFRA, revised modelling has been undertaken to provide an up to date assessment of the residual tidal flood risk to Colchester town centre in the event of a breach of the Colne Barrier at Wivenhoe. Details regarding the modelling methodology, assumptions and findings are presented in Appendix B.

The Environment Agency Asset Performance team were consulted to determine the most likely scenario resulting in a failure of the Colne Barrier and to agree the parameters for the breach modelling.

The Asset Performance team confirmed that the Barrier has a number of backup systems and procedures in place, and therefore a failure of the asset is considered highly unlikely. In the event a breach did occur this is most likely to happen on the most frequent tide that would trigger closure of the Barrier. The two counter walls which tie the barrier into high ground also have defences to the front and rear and a review of the design by the Environment Agency Asset Performance team confirms they provide enough resilience to overtopping. The counter walls are recorded to have standard of protection of 1 in 1000 years in the Environment Agency's Asset Information Management System (AIMS).

Although considered unlikely, an assessment of the residual risk of a failure of the barrier was required to inform future development and emergency planning procedures in Colchester. It was therefore agreed with the Environment Agency and Colchester BC to model the impact of failure of the Colne Barrier to close during an extreme tidal flood event.

⁶ Environment Agency (2016) Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/516116/LIT_5707.pdf

2.5.1 Flood Depth and Hazard Mapping

Maximum flood depth and hazard mapping has been provided in **Appendix A Figures A7-A24** for the following scenarios:

0.5% AEP for present day (2015)

Figure A9 Colne Barrier Breach 0.5% AEP for present day (2015) Maximum Depth - View 1

Figure A10 Colne Barrier Breach 0.5% AEP for present day (2015) Maximum Depth - View 2

Figure A11 Colne Barrier Breach 0.5% AEP for present day (2015) Maximum Depth - View 3

Figure A12 Colne Barrier Breach 0.5% AEP for present day (2015) Maximum Hazard - View 1

Figure A13 Colne Barrier Breach 0.5% AEP for present day (2015) Maximum Hazard - View 2

Figure A14 Colne Barrier Breach 0.5% AEP for present day (2015) Maximum Hazard - View 3

0.5% AEP including climate change to 2115

Figure A15 Colne Barrier Breach 0.5% AEP including climate change to 2115 Maximum Depth - View 1

Figure A16 Colne Barrier Breach 0.5% AEP including climate change to 2115 Maximum Depth - View 2

Figure A17 Colne Barrier Breach 0.5% AEP including climate change to 2115 Maximum Depth - View 3

Figure A18 Colne Barrier Breach 0.5% AEP including climate change to 2115 Maximum Hazard - View 1

Figure A19 Colne Barrier Breach 0.5% AEP including climate change to 2115 Maximum Hazard - View 2

Figure A20 Colne Barrier Breach 0.5% AEP including climate change to 2115 Maximum Hazard - View 3

0.1% AEP for present day (2015)

Figure A21 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Depth - View 1

Figure A22 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Depth - View 2

Figure A23 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Depth - View 3

Figure A24 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Hazard - View 1

Figure A25 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Hazard - View 2

Figure A26 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Hazard - View 3

0.1% AEP including climate change to 2115

Figure A27 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Depth - View 1

Figure A28 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Depth - View 2

Figure A29 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Depth - View 3

Figure A30 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Hazard - View 1

Figure A31 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Hazard - View 2

Figure A32 Colne Barrier Breach 0.1% AEP for present day (2015) Maximum Hazard - View 3

2.6 Areas susceptible to tidal flooding

It was also agreed with the Environment Agency and Colchester BC that an assessment is made of those areas of Colchester upstream of the Colne Barrier at a level below the manning and operating thresholds of the Barrier (3.1 Metres Above Ordnance Datum (mAOD) and 3.2mAOD respectively). These areas would be subject to flooding in the following circumstances:

1. Errors in advance storm tide forecasting and Environment Agency forecasting for tidal surge residuals at the barrier;
2. Tidal water inundation of Colchester due to ingress into the surface water drainage network via poorly maintained drainage outfalls (flap valves); or,
3. A rainfall event takes up available storage in the surface water drainage network whilst the system is tide locked.

Appendix A Figure A33 uses mapping of LiDAR topographic data to identify those areas of Colchester upstream of the Colne Barrier that lie at a level below the manning and operating thresholds of the Barrier (3.1mAOD and 3.2mAOD respectively) and could be subject to flooding on a more regular basis.

2.7 Surface Water Runoff

Although the Exception Test is primarily concerned with the definitions of Flood Zones and thereby the risk from tidal and fluvial sources, it is important that surface water management is considered at an early stage in the assessment of the potential development sites identified by Colchester BC.

In order to support this, the following information has been provided as part of the site assessments presented in Section 3:

- A high level assessment of potential surface water flow paths has been made, using the Risk of Flooding from Surface Water mapping (RoFSW), further detail about which is provided in Section 4.4.2 of the Level 1 SFRA.
- Estimated Greenfield runoff rates have been provided for each site based on the Institute of Hydrology IH124 Methodology⁷. A tool on the HR Wallingford UK Sustainable Drainage website⁸ has been used to provide these rates for a range of return periods. (It is noted that this tool applies a minimum flow of 5l/s to any site⁹. In order to provide more accurate greenfield runoff rates, the growth factors have been applied to the QBAR runoff rate to provide runoff rates for the 1 in 1 year, 1 in 30 year and 1 in 100 year runoff rates).
- A high level identification of where surface water could be discharged with reference to Ordnance Survey (OS) mapping and a strategic understanding of the underlying geology¹⁰. Generally the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable. A Red, Amber, Green assessment has been provided to determine the potential for each at a particular development site:
 - Discharge into the ground (shallow infiltration);
 - To a surface water body e.g. watercourse;
 - To a surface water sewer, highway drain, or another drainage system;
 - To a combined sewer.
- An initial indication of the types of sustainable drainage techniques that could be considered within the site.

This information provides a starting point for developers when identifying the issues that will need to be considered when developing a surface water drainage strategy for a particular site.

⁷ The Institute of Hydrology carried out a number of studies on revising the runoff equations produced in the original Flood Studies Report (1975). IH124 was specifically produced to address the runoff from small catchments (Institute of Hydrology, 1994). Although shown to be slightly less accurate than more recent FEH based methods, it is still considered to be an acceptable approach for assessing greenfield runoff rates. The IH124 estimates greenfield runoff based on the mean annual flood flow from a rural catchment, the area of the catchment, the standard average annual rainfall and a runoff coefficient based on the SOIL category. Further information can be found here: http://www.uksuds.com/surfacewaterstorage_is.htm

⁸ http://www.uksuds.com/surfacewaterstorage_is.htm

⁹ Historically 5l/s was applied to an outlet where Qbar was lower than 5l/s, as most devices would require an outlet orifice size smaller than 50mm, which would increase the susceptibility of blockage and failure. There are now vortex flow control devices which can be designed to a lower discharge rate, with 600mm shallow design head and still provide a more than 50mm orifice diameter. Furthermore it is expected by Essex CC that development should incorporate an appropriately designed SuDs system which should remove materials which are likely to cause blockages before water reaches any flow control devices.

¹⁰ With reference to strategic BGS geological mapping accessed via <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

3 Level 2 Strategic Assessment of Flood Risk

3.1 Level 2 Site Assessments

The purpose of the Level 2 SFRA is to determine the potential for a site to pass the Exception Test, and to provide recommendations for the issues that would need to be considered by the LPA and potential developers as the sites come forward for development.

This Section provides the Level 2 assessments for each of the potential development sites and Garden Settlements identified by Colchester BC. For each potential development site, the datasets described in Section 2 have been used to assess the flood risk to the site; any further information that would be required as part of a site specific FRA for the site has been identified; and, recommendations for measures to avoid, manage and mitigate flood risk have been provided in accordance with the guidance presented in Section 6 of the Level 1 SFRA Report.

The potential development sites are presented in the order set out in Table 1-2.

Site Assessment Summary – St Botolph’s Farm

Location: North Braiswick	SHLAA Ref / Ref: COL10 (C079)	Area (ha): 3.09	Proposed Use: Residential (50 dwellings)	Vulnerability Classification: More Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for this site as part of the preparation of the Local Plan Site Allocations.

Fluvial Flood Risk

Flood Zone 1: 86%	Flood Zone 2: 3%	Flood Zone 3a: 11%	Flood Zone 3b: -
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Flood Zones and Flood Defences

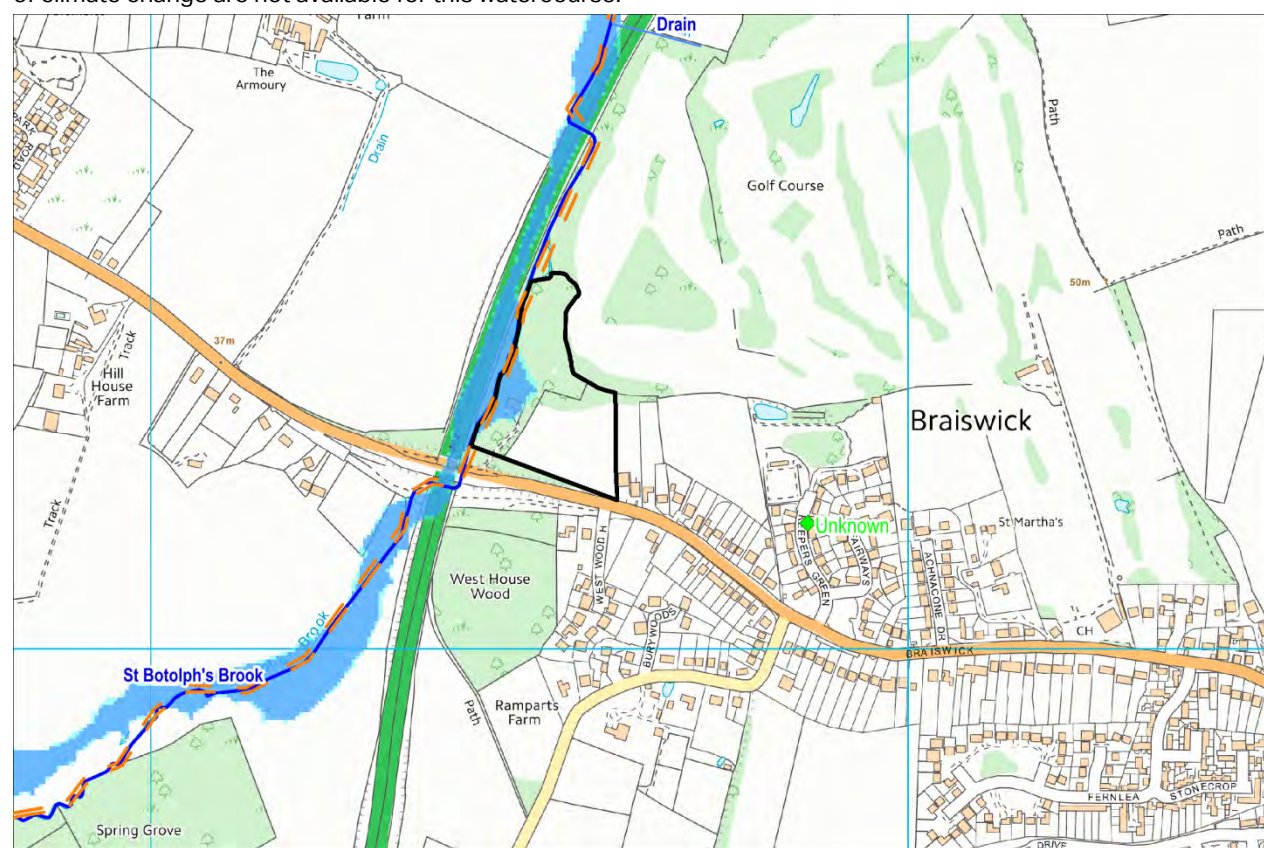
St Botolph’s Brook, a main river and tributary of the River Colne, flows from north to south along the western edge of the site in open channel. The watercourse joins the River Colne 1.6km to the south west between Bourne Barn Farm and the railway line. The majority of the site (86%) is identified as Flood Zone 1. The western edge (11%) is defined as Flood Zone 3a, high probability of fluvial flooding (1% AEP). The AIMS dataset identifies that at this location St Botolph’s Brook flows in a maintained channel with high ground either side.

Functional Floodplain

St Botolph’s Brook was not included in the hydraulic model of the River Colne that was used to inform this SFRA, and therefore outputs for Flood Zone 3b functional floodplain are not available for this watercourse. Further modelling is required to determine the extent of Flood Zones across the site, described further below in the ‘site specific recommendations’ section.

Climate Change

St Botolph’s Brook was not included in the hydraulic model of the River Colne that was used to inform this SFRA, and therefore outputs including an allowance for the impact of climate change are not available for this watercourse.



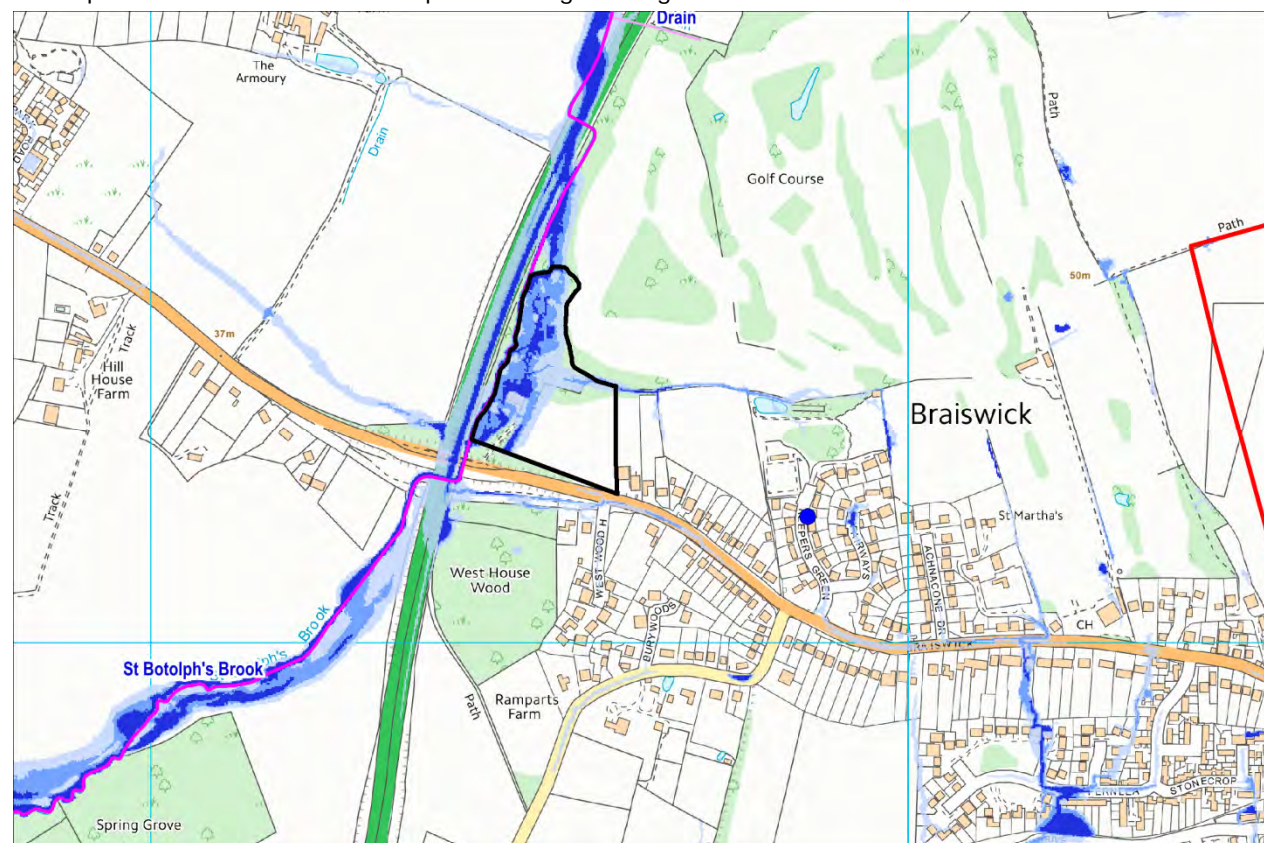
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Figure A Flood Zones

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW)

The RoFSW mapping indicates that the western edge of the site, within the floodplain of St Botolph’s Brook, is the natural topographic low point, and is therefore also susceptible to surface water ponding. There is a contributing flow path that flows from east to west across the development site down the slope. This flow path should be considered carefully in the development of the site layout to ensure that residential dwellings are not placed at surface water flood risk, and that the position of any new development does not divert the flow path to a neighbouring area.



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Figure B Risk of Flooding from Surface Water (RoFSW)

Geology

The underlying geology is London Clay formation, with no recorded superficial deposits overlying. This type of geology comprises clay, silt and sand and is typically not very

Site Assessment Summary – St Botolph's Farm

permeable, resulting in rapid runoff of surface water across the ground surface.

Historic Records

The site is not shown to lie within a Critical Drainage Area (CDA) identified during the preparation of the town of Colchester SWMP. There are several historic flood records in the local area; however the source of flooding for these records is unknown.

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	4.34 l/s	
	1 in 1 year:	6.18 l/s	
	1 in 30 year:	9.98 l/s	
	1 in 100 year:	13.84 l/s	
<i>Drainage Hierarchy</i>	Infiltration to ground		Uncertain due to London Clay geology; subject to on site infiltration testing.
	Discharge to watercourse		Discharge possible to St Botolph's Brook, subject to consultation with the Environment Agency.
	Discharge to surface water sewer		Possible, subject to consultation with Anglian Water.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located within a 1km square of which 25% is susceptible to groundwater emergence. The risk of groundwater flooding in this area is therefore generally considered to be low. This will need to be confirmed during site investigation survey.

Other Sources

The Environment Agency 'Risk of Flooding from Reservoirs' mapping shows that the floodplain of St Botolph's Brook, adjacent to the site, is at risk of flooding in the event of a failure of the Brick Kiln Reservoir which is located approximately 1km north of the site (NGR 597522, 228654). As noted in the Level 1 SFRA report, given the regular inspection of these reservoirs in accordance with the Reservoirs Act 1975, flooding from reservoirs is considered to be a managed risk.

Site Specific Recommendations

Fluvial Modelling

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

Site Layout and Design

Residential development should be avoided in areas defined as Flood Zone 3a on the western edge of the site, and instead lower vulnerability uses including landscaped open space should be located here. The drainage strategy for the site must be considered early in the site planning process to ensure adequate inclusion of SuDS, taking care to consider SuDS features in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible). Storage features should not be located within the floodplain of the ordinary watercourse, as they may be rendered ineffective during times of fluvial flooding.

Set-back Distance

St Botolph's Brook is a main river, and therefore all development should be set back at least 8m from the watercourse. The Environment Agency will need to be consulted and an Environmental Permit obtained for any works within 8m of the watercourse.

Finished Floor Levels

If residential development cannot be avoided within the flood extent for the 1% AEP event including climate change, finished floor levels should be set at least 300mm freeboard above the flood level for 1% AEP event including an appropriate allowance for climate change. In this case, for More Vulnerable development in Flood Zone 3a, the higher central (35%) climate change allowance should be used and should be tested against the upper (65%) climate change allowance also.

Access / Egress

Safe dry access to and from the site should be provided, and this should be achievable to the south of the site onto B1508 Colchester Road.

Floodplain Compensation

Land raising and any built development should be avoided within the floodplain of St Botolph's Brook. Where alterations to the floodplain are proposed, compensatory floodplain storage will need to be provided on a level-for-level and volume-for-volume basis. The land used to provide compensation storage will need to be in hydraulic connectivity with the existing floodplain, but not already part of the floodplain.

Emergency Planning

The site is not shown to be within an Environment Agency Flood Warning Area; however residents should register to receive the warning service associated with the River Colne, into which St Botolph's Brook feeds. Due to the proximity of the site to the watercourse, Flood Response Plans should be prepared by residents of the site.

Summary

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.

Site Assessment Summary – Derelict depot at Hythe Station Road between railway line and River Colne

Location: Colchester	SHLAA Ref /Ref: COL28 (S0008)	Area (ha): 0.73	Proposed use: Residential (54 dwellings)	Vulnerability Classification: More Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for this site as part of the preparation of the Local Plan Site Allocations.

Tidal and Fluvial Flood Risk

Flood Zone 1: 0%	Flood Zone 2: 49%	Flood Zone 3a: 51%	Flood Zone 3b: 0%
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Flood Zones and Flood Defences

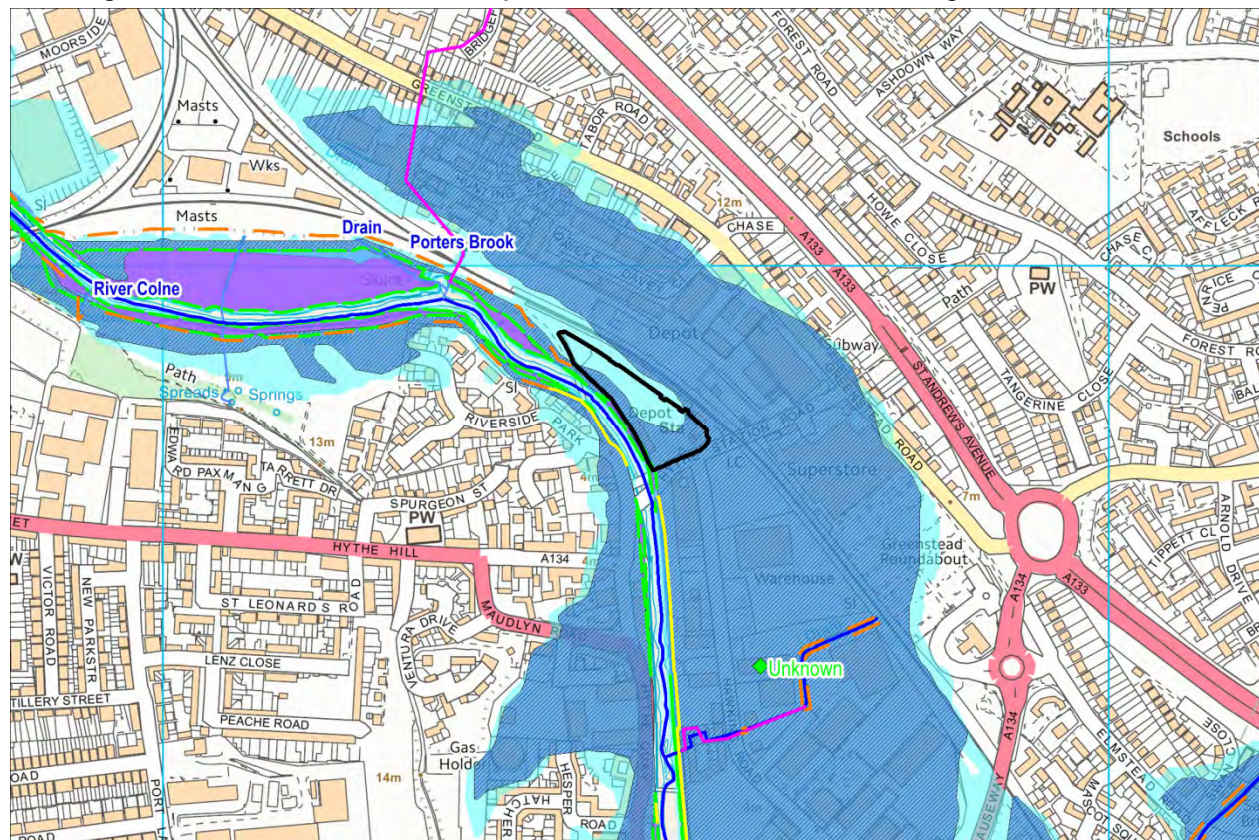
The River Colne flows from north to south along the western edge of the site in open channel. At this location the River Colne is tidally influenced. Approximately half of the site is identified as Flood Zone 2, and the remaining half as Flood Zone 3, high probability of flooding associated with the River Colne. The site is shown to benefit from the presence of defences. Immediately upstream of the site the railway embankment forms high ground which acts as a flood defence. Along the edge of the site itself there were formerly tidal defences until the Colne Barrier was built, but now there are no longer any formal flood defences. The Colne Barrier is located approximately 5.1km downstream at Wivenhoe and provides protection when water levels are forecast to rise greater than 3.2m AOD.

Functional Floodplain

The site is located adjacent to, but not within, the functional floodplain associated with the River Colne.

Climate Change

Modelling of the Colne and Blackwater Estuary shows that water remains in bank during the 0.5% AEP event including an allowance for climate change.



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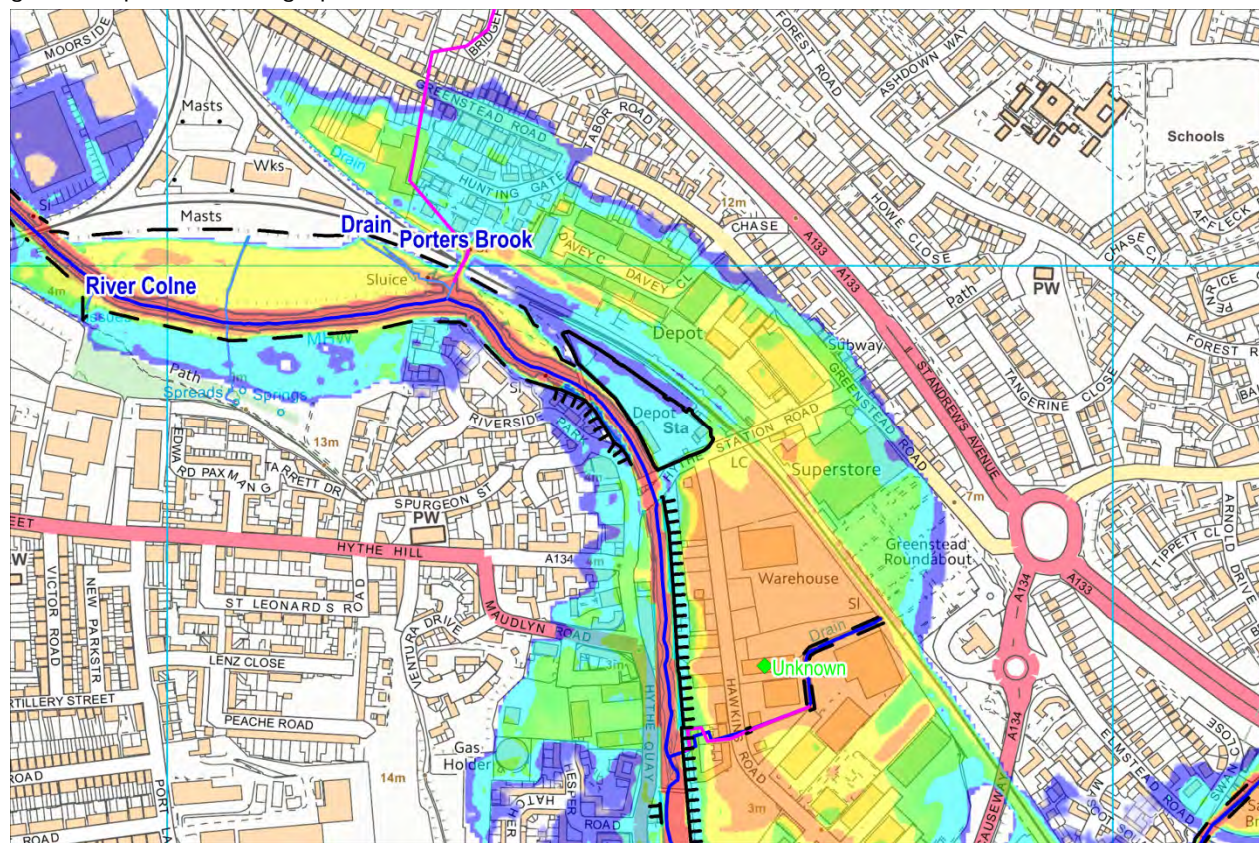
Figure A Modelled Flood Extents

Detailed Flood Risk Information – Maximum Flood Depth and Hazard Mapping

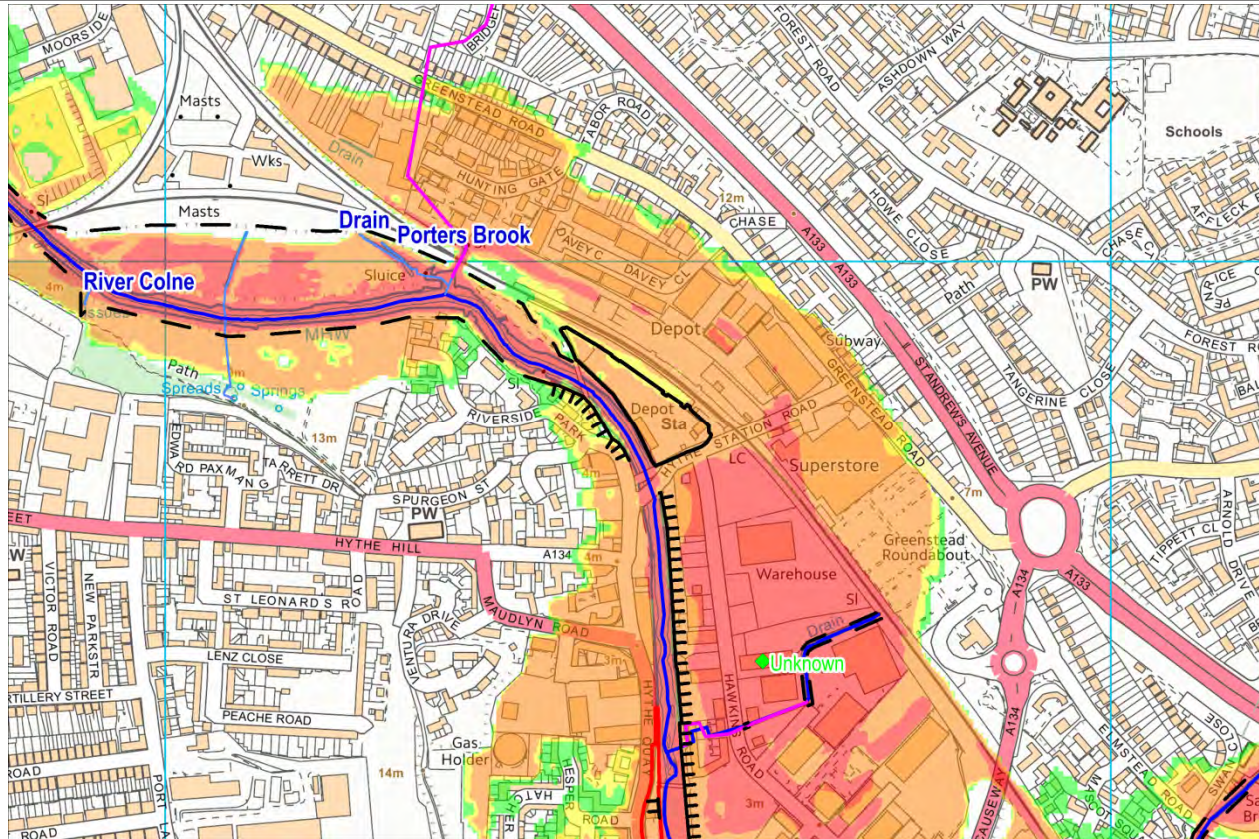
Environment Agency modelling for the Colne and Blackwater Estuary (constructed in 2010 and re-run in 2015 as part of this Level 2 SFRA) identifies that the site itself is not shown to be at risk of flooding during the 0.5% AEP event including an allowance for climate change for the year 2115.

Residual Risk – Failure of the Colne Barrier at Wivenhoe

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 (2115) show that flood depths on the site would be 0.1-1.0m, corresponding to a hazard rating of Significant (danger for most people). Potential access / egress routes for the site would experience greater depths of flooding, up to 2.0m.



Site Assessment Summary – Derelict depot at Hythe Station Road between railway line and River Colne



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Figure B Colne Barrier Breach Assessment; 0.5% AEP including Climate Change, Maximum Flood Depth and Hazard

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW) and SWMP Modelling

The RoFSW mapping and SWMP modelling indicate that the area in which the site is located is at very low risk of surface water flooding (<0.1% AEP). The site is shown to be relatively flat.

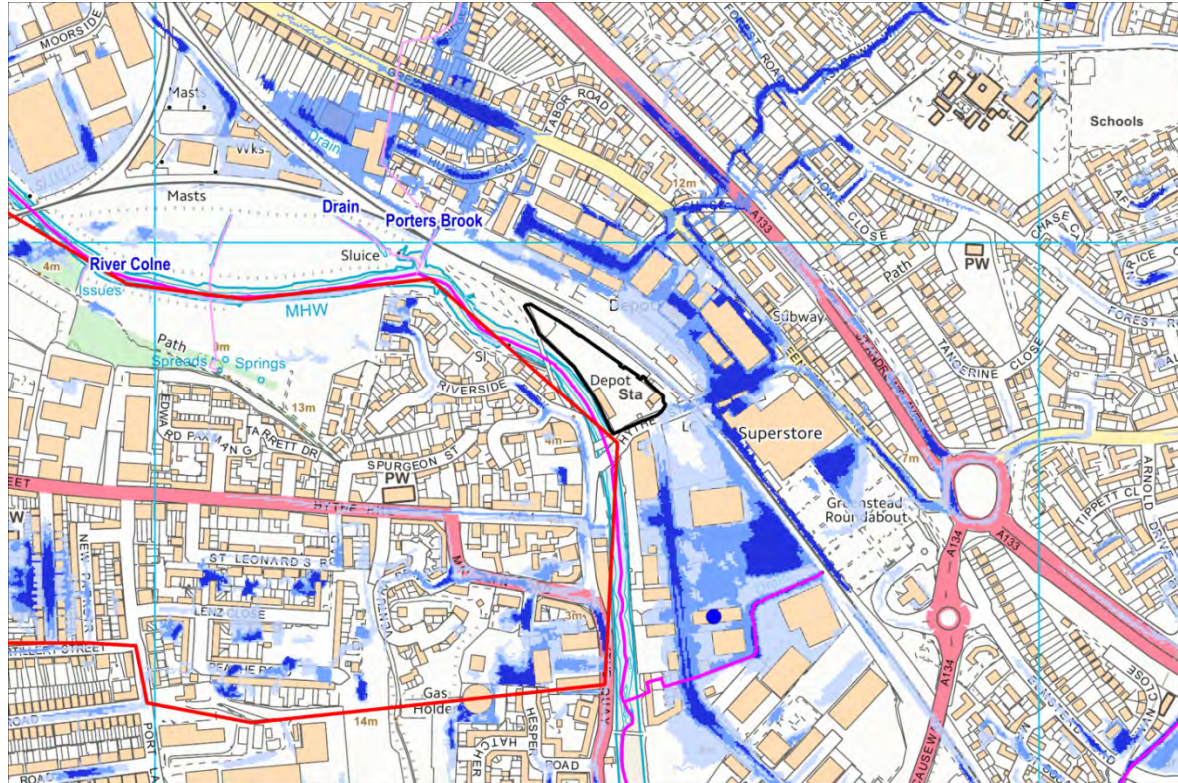
The site layout should be carefully planned to ensure that new development does not result in increased runoff to neighbouring areas.

Geology

The bedrock geology in this area is Thanet Sand Formation and Lambeth Group (undifferentiated), comprising clay, silt and sand. Superficial deposits of alluvium, comprising clay and silt, are present overlying the bedrock. Clayey soils are typically not very permeable and provide the potential for increased surface water ponding.

Historic Records

The site is shown to lie adjacent to (but not within) the Critical Drainage Area (CDA) for Colchester Town Centre identified during the preparation of the town of Colchester SWMP. There are several historic flood records in the local area; however the source of flooding for these records is unknown.



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Figure C Risk of Flooding from Surface Water (RoFSW)

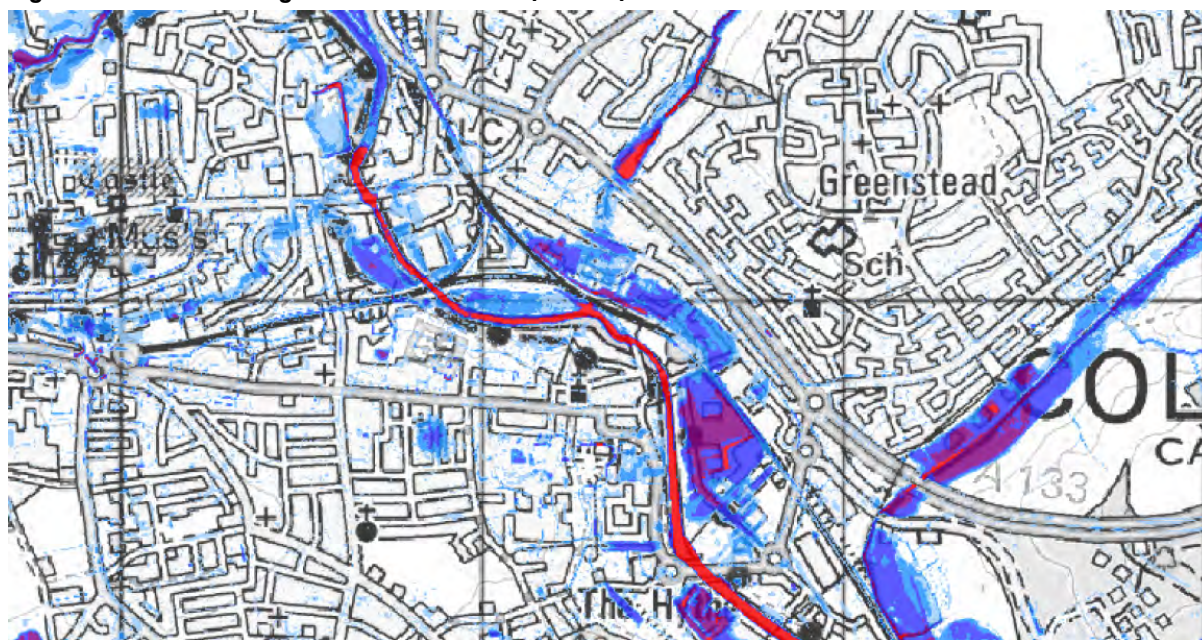


Figure D Town of Colchester SWMP (Capita Symonds 2013), Surface Water Modelling 1% AEP Maximum Flood Depth

Site Assessment Summary – Derelict depot at Hythe Station Road between railway line and River Colne

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	1.02 l/s	
	1 in 1 year:	0.87 l/s	
	1 in 30 year:	2.35 l/s	
	1 in 100 year:	3.25 l/s	
<i>Drainage Hierarchy</i>	Infiltration to ground		Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse		Discharge possible to the River Colne, subject to consultation with the Environment Agency.
	Discharge to surface water sewer		Possible, subject to consultation with Anglian Water.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located within a 1km square of which 25-50% is susceptible to groundwater emergence. The risk of groundwater flooding in this area is therefore generally considered to be low. This will need to be confirmed during site investigation survey.

Other Sources

The Environment Agency 'Risk of Flooding from Reservoirs' mapping shows that the floodplain of the River Colne including the site, is at risk of inundation in the event of a failure of the following reservoirs: Ardleigh (NGR (603487, 228024); Abberton Central and Western Arm (NGR 598901, 219790); and Abberton (NGR 598780, 219734). As noted in the Level 1 SFRA report, given the regular inspection of these reservoirs in accordance with the Reservoirs Act 1975, flooding from reservoirs is considered to be a managed risk.

Site Specific Recommendations

Site Layout and Design

Residential development should be steered towards areas defined as Flood Zone 2 away from the edge of the River Colne. The drainage strategy for the site must be considered early in the site planning process to ensure adequate inclusion of SuDS and adequate provision for the management of surface water during high tide conditions. SuDS should be considered in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible). The site is in close proximity to the Colchester Town Centre CDA; opportunities should be sought for the development to contribute to the proposed scheme for surface water management in this area and Essex CC should be consulted to confirm the current status of this work. A summary of the initial preferred option for the CDA, as set out in the SWMP, is provided in Section 4 of this Report.

Set-back Distance

All development should be set back 16m from the edge of the River Colne. The Environment Agency will need to be consulted and an Environmental Permit obtained for any works within 16m of the watercourse.

Finished Floor Levels

The Environment Agency will seek Finished Floor Levels for new development set 300mm above the 0.5% AEP flood level including an allowance for climate change. The modelled flood level in the event of a failure of the Colne Barrier during the 0.5% AEP flood event including climate change to 2115 in this location is 4.6mAOD. Based on LiDAR topographic survey, the ground levels across the site vary between approximately 3.5-4.3mAOD.

Access / Egress

Safe dry access to and from the site should be provided where possible, and this is likely to be provided to the east of the site via Hythe Station Road and Greenstead Road. When considering the residual risk to the site, flood depths of up to 2m are modelled to occur along this route, corresponding to a hazard rating of Significant (danger to most). It will therefore be necessary to include provision of a place of safe refuge for residents of the residential development above the 1 in 1000 annual probability flood level with an allowance for climate change.

Emergency Planning

The site is shown to be within an Environment Agency Flood Warning Area for the Tidal Colne upstream of the Colne Barrier; residents should register to receive the warning service. To manage the residual risk of flooding associated with a failure of the Colne Barrier, Flood Response Plans should be prepared by residents of the site including details of egress routes and place to safe refuge.

Summary

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.

Site Assessment Summary – Land at East Bay Mill

Location: Colchester	SHLAA Ref /Ref: COL34 (S0031)	Area (ha): 0.5	Proposed use: Residential (22 dwellings)	Vulnerability Classification: More Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for this site as part of the preparation of the Local Plan Site Allocations.

Tidal and Fluvial Flood Risk

Flood Zone 1: 0%	Flood Zone 2: 30%	Flood Zone 3a: 70%	Flood Zone 3b: 0%
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Flood Zones and Flood Defences

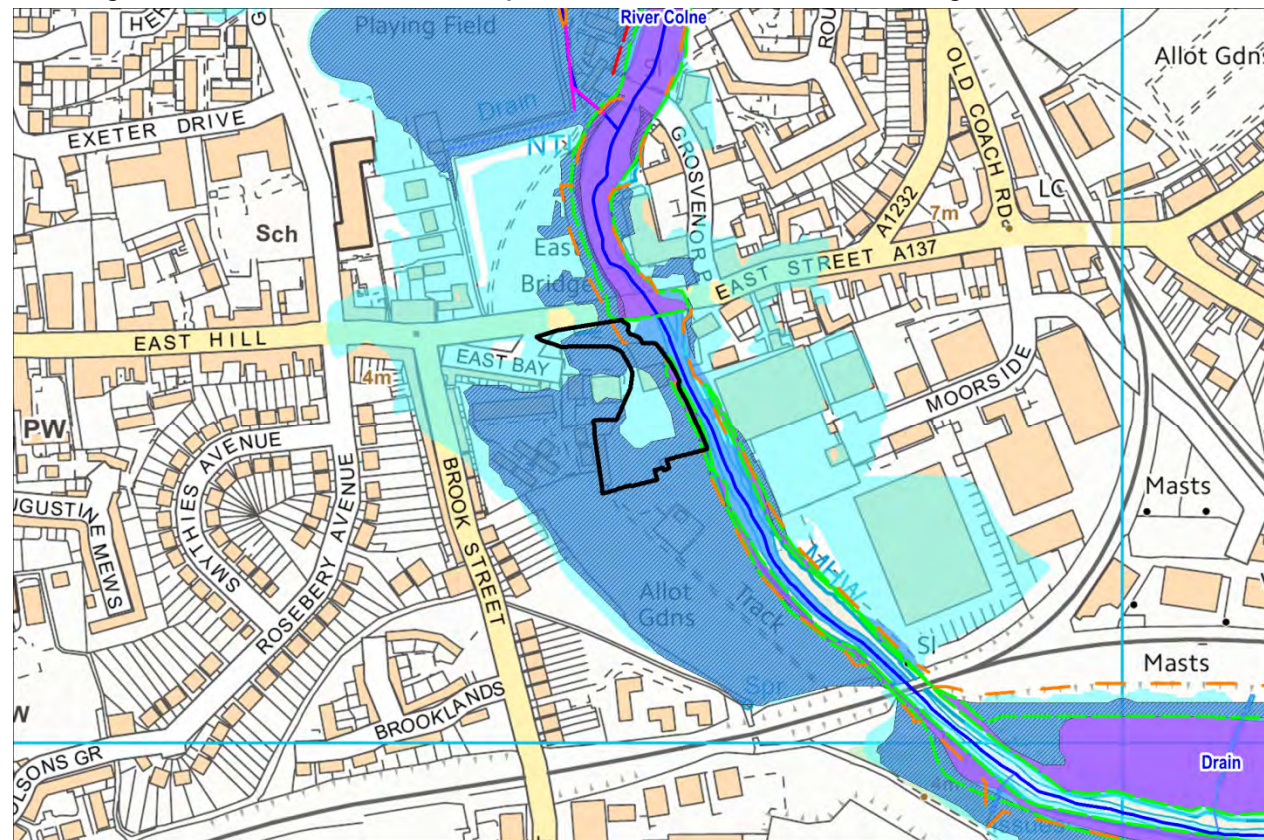
The River Colne flows from north to south along the eastern edge of the site in open channel. At this location the River Colne is tidally influenced. The large majority of the site (70%) is identified as Flood Zone 3b functional floodplain and 3a high probability of flooding associated with the River Colne, and the remaining part as Flood Zone 2. The site is shown to benefit from the presence of defences. Along the edge of the site the AIMS dataset identifies that high ground acts as a flood defence. The Colne Barrier is located approximately 5.9km downstream at Wivenhoe and provides protection when water levels are forecast to rise greater than 3.2m AOD.

Functional Floodplain

The eastern edge of site is located within the functional floodplain associated with the River Colne. This is where water must be stored in times of flood; development is not permitted in this area.

Climate Change

Modelling of the Colne and Blackwater Estuary shows that water remains in bank during the 0.5% AEP event including an allowance for climate change.



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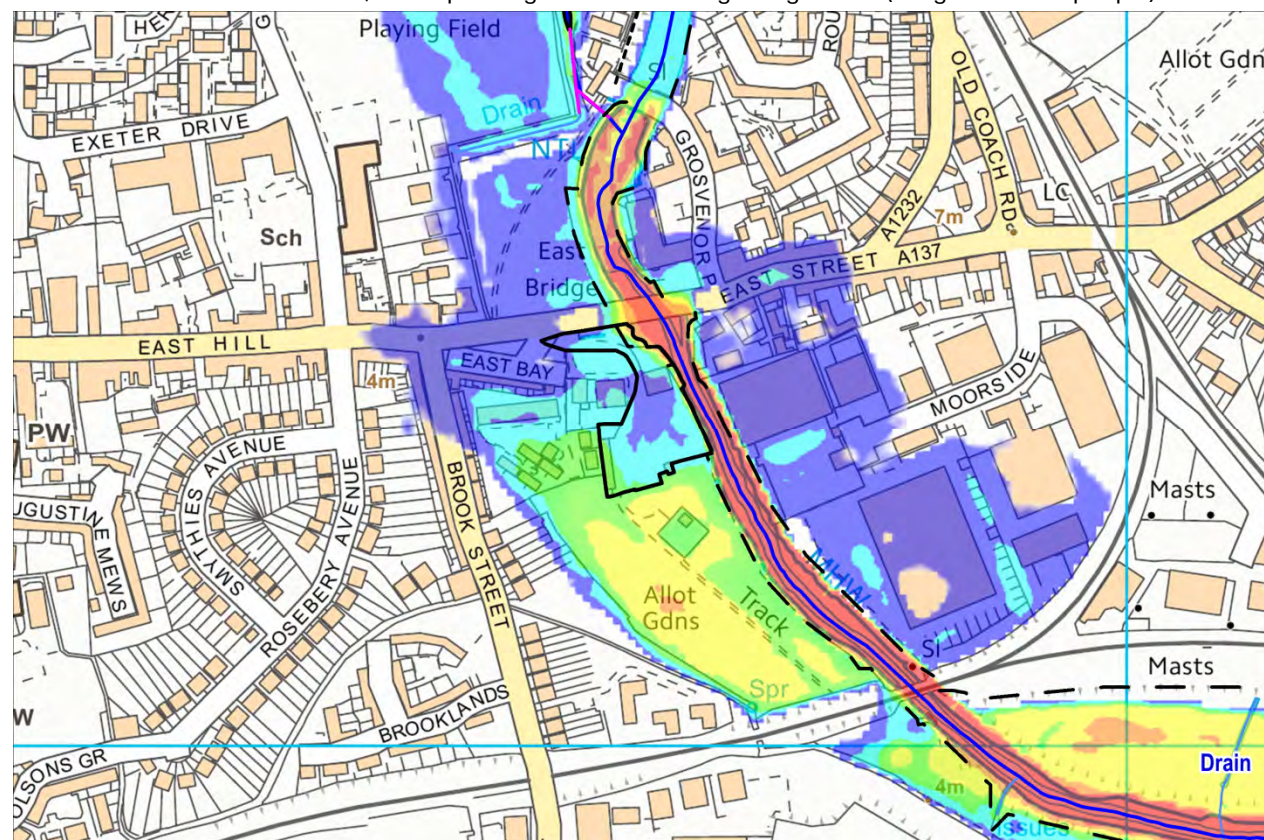
Figure A Modelled Flood Extents

Detailed Flood Risk Information – Maximum Flood Depth and Hazard Mapping

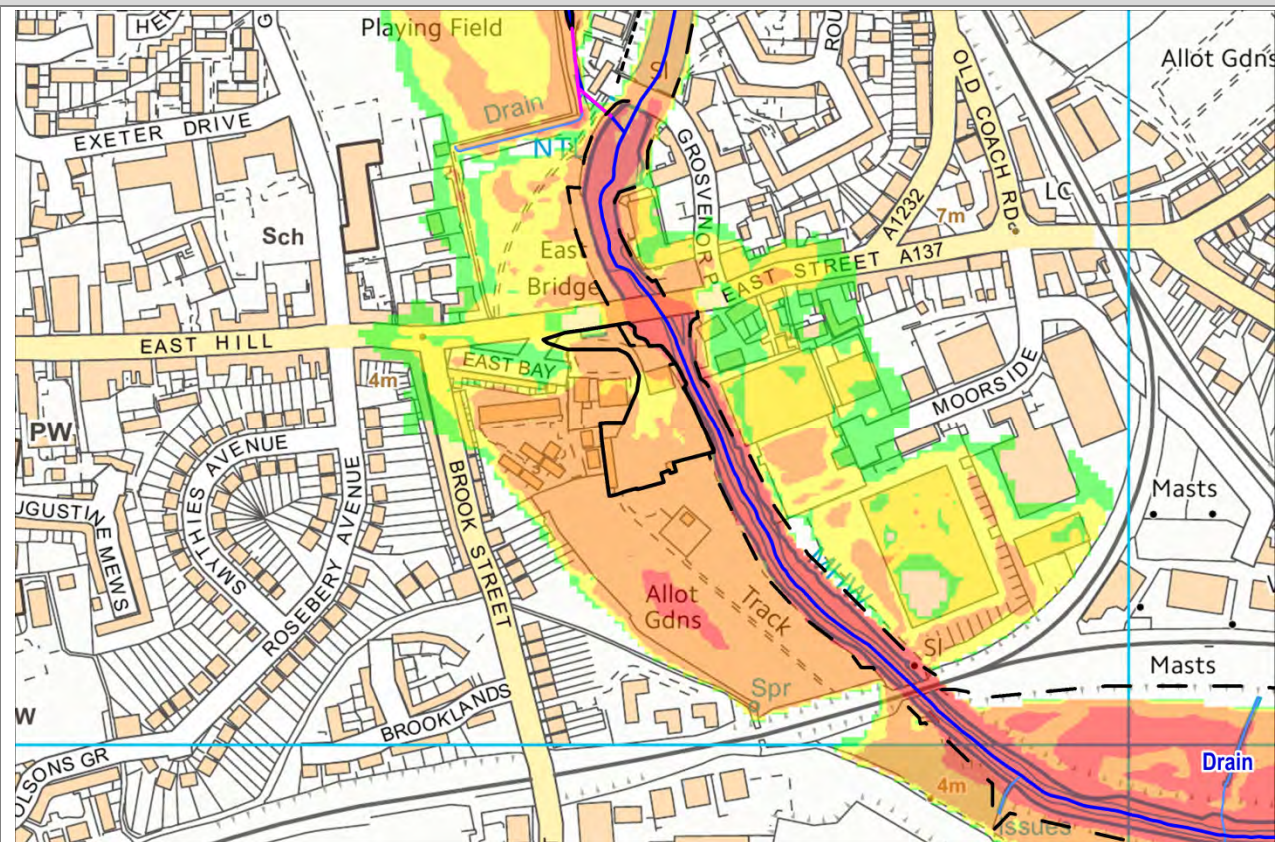
Environment Agency modelling for the Colne and Blackwater Estuary (constructed in 2010 and re-run in 2015 as part of this Level 2 SFRA) identifies that the site itself is not shown to be at risk of flooding during the 0.5% AEP event including an allowance for climate change for the year 2115.

Residual Risk – Failure of the Colne Barrier at Wivenhoe

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 show that flood depths on the site could reach 0.5-1.5m, corresponding to a hazard rating of Significant (danger for most people).



Site Assessment Summary – Land at East Bay Mill



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Figure B Colne Barrier Breach Assessment; 0.5% AEP including Climate Change, Maximum Flood Depth and Hazard

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW) and SWMP Modelling

The RoFSW mapping indicates that parts of the area in which the site is located are at high risk of flooding (>3.3% AEP). The SWMP modelling identifies that the north of the site is at risk of surface water flooding up to 0.5m during the 1% AEP event. To the south and north of the site there are areas shown to be at risk of flooding up to 1m during the 1% AEP modelled event.

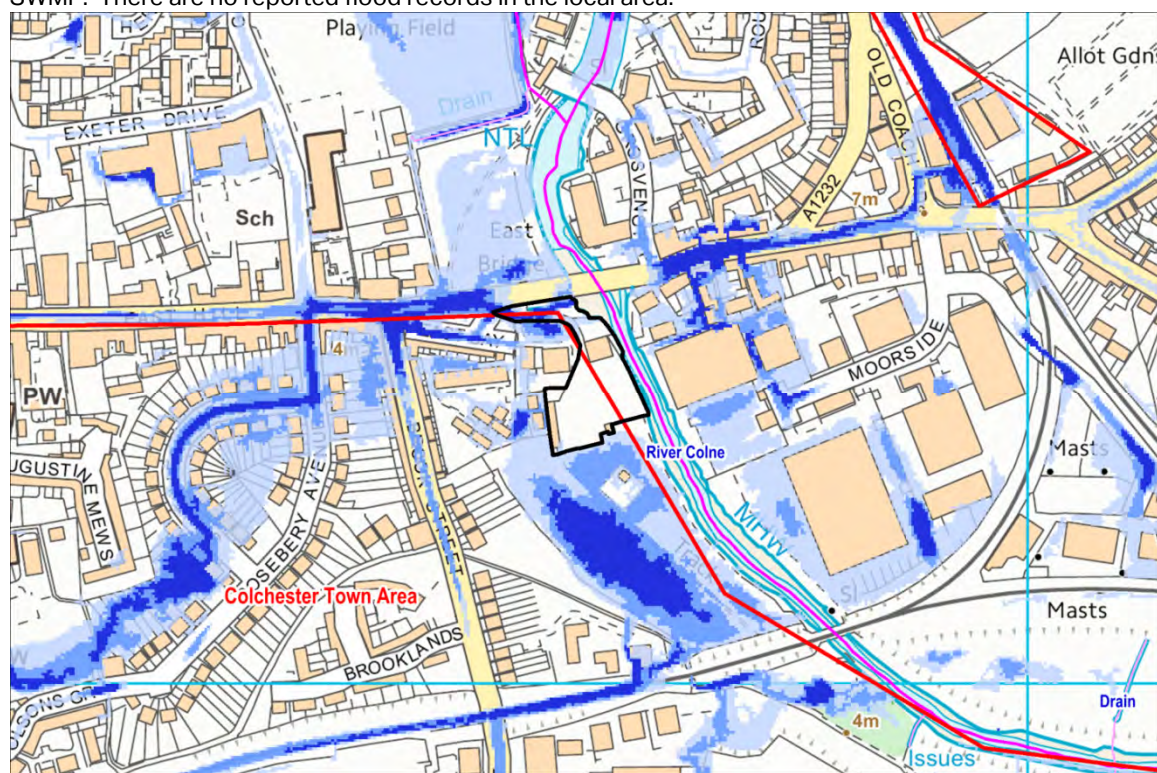
The site layout should be carefully planned to ensure that residential dwellings are not placed at surface water flood risk, and that the position of any new development does not divert the flow path to a neighbouring area.

Geology

The bedrock geology in this area is Thames Group, comprising clay and silt. Superficial deposits of alluvium, comprising clay and silt, are present overlying the bedrock. Clayey soils are typically not very permeable and provide the potential for increased surface water ponding.

Historic Records

The western half of the site is shown to lie within the Critical Drainage Area (CDA) for Colchester Town Centre identified during the preparation of the town of Colchester SWMP. There are no reported flood records in the local area.



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


Figure C Risk of Flooding from Surface Water (RoFSW)



Flood Depth (m)	
[White box]	< 0.1m
[Light blue box]	0.1m to 0.25m
[Medium blue box]	0.25m to 0.5m
[Dark blue box]	0.5m to 1.0m
[Purple box]	1.0m to 1.5m
[Red box]	> 1.5m

Site Assessment Summary – Land at East Bay Mill

Figure D Town of Colchester SWMP (Capita Symonds 2013) Surface Water Modelling, 1% AEP Maximum Flood Depth

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	0.7 l/s	
	1 in 1 year:	0.60 l/s	
	1 in 30 year:	1.61 l/s	
	1 in 100 year:	2.23 l/s	
<i>Drainage Hierarchy</i>	Infiltration to ground		Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse		Discharge possible to the River Colne, subject to consultation with the Environment Agency.
	Discharge to surface water sewer		Possible, subject to consultation with Anglian Water.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located within a 1km square of which 25-50% is susceptible to groundwater emergence. The risk of groundwater flooding in this area is therefore generally considered to be low. This will need to be confirmed during site investigation survey.

Other Sources

The Environment Agency 'Risk of Flooding from Reservoirs' mapping shows that the floodplain of the River Colne including the site, is at risk of inundation in the event of a failure of the following reservoirs: Ardleigh (NGR (603487, 228024); Abberton Central and Western Arm (NGR 598901, 219790); and Abberton (NGR 598780, 219734). As noted in the Level 1 SFRA report, given the regular inspection of these reservoirs in accordance with the Reservoirs Act 1975, flooding from reservoirs is considered to be a managed risk.

Site Specific Recommendations

Set-back Distance

All development should be set back 16m from the edge of the River Colne. The Environment Agency will need to be consulted and an Environmental Permit obtained for any works within 16m of the watercourse.

Site Layout and Design

The drainage strategy for the site must be considered early in the site planning process to ensure adequate inclusion of SuDS and adequate provision for the management of surface water during high tide conditions. SuDS should be considered in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible). The site is within the Colchester Town Centre CDA; opportunities should be sought for the development to contribute to the proposed scheme for surface water management in this area and Essex CC should be consulted to confirm the current status of this work. A summary of the initial preferred option for the CDA, as set out in the SWMP, is provided in Section 4 of this Report.

Given the residual flood risk posed to the site, it may be prudent to consider residential accommodation at first floor level and above.

Finished Floor Levels

At this location upstream of the Barrier, the Environment Agency will seek Finished Floor Levels for new development set 300mm above the 0.5% AEP flood level including an allowance for climate change. The modelled flood level in the event of a failure of the Colne Barrier during the 0.5% AEP flood event including climate change to 2115 in this location is 4.6m AOD. Based on LiDAR topographic survey, the ground levels across the site vary between approximately 3-4.2m AOD.

Access / Egress

Safe dry access to and from the site should be provided where possible, and this is likely to be provided to the north of the site via East Street. When considering the residual risk to the site, flood depths of up to 2m are modelled to occur along this route, corresponding to a hazard rating of Significant (danger to most). It will therefore be necessary to include provision of a place of safe refuge for residents of the residential development which is located above the extreme flood level with climate change and is internally accessible.

Emergency Planning

The site is shown to be within an Environment Agency Flood Warning Area for the Tidal Colne upstream of the Colne Barrier; residents should register to receive the warning service. To manage the residual risk of flooding associated with a failure of the Colne Barrier, Flood Response Plans should be prepared by residents of the site including details of egress routes and place to safe refuge.

Summary

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.

Site Assessment Summary – Commercial land between Haven Road and River Colne

Location: Colchester	SHLAA Ref /Ref: COL44 (S0065)	Area (ha): 7.07	Proposed use: Residential (600 dwellings across COL44, COL54 and COL82)	Vulnerability Classification: More Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for this site as part of the preparation of the Local Plan Site Allocations.

Tidal and Fluvial Flood Risk

Flood Zone 1: 8%	Flood Zone 2: 22%	Flood Zone 3a: 67%	Flood Zone 3b: 3%
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Flood Zones and Flood Defences

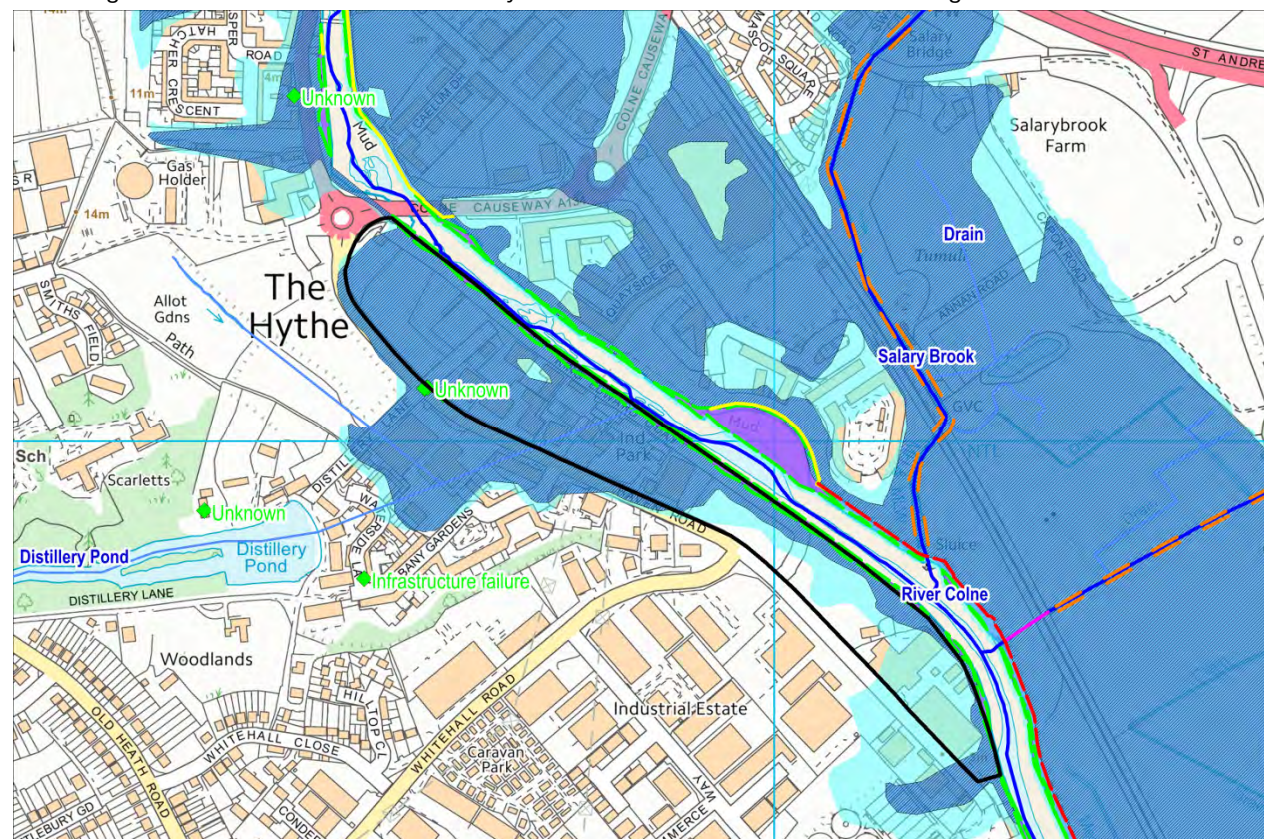
The River Colne flows from north to south along the eastern edge of the site in open channel. At this location the River Colne is tidally influenced. The large majority of the site (70%) is identified as Flood Zone 3a high probability of flooding and Flood Zone 3b Functional Floodplain associated with the River Colne, and the remaining part as Flood Zone 2 and 1. The site is shown to benefit from the presence of defences. Along the edge of the site the AIMS dataset does not identify any formal flood defences. The Colne Barrier is located approximately 4 km downstream at Wivenhoe and provides protection when water levels are forecast to rise greater than 3.2m AOD.

Functional Floodplain

The site is not located with the functional floodplain associated with the River Colne.

Climate Change

Modelling of the Colne and Blackwater Estuary shows that water remains in bank during the 0.5% AEP event including an allowance for climate change.

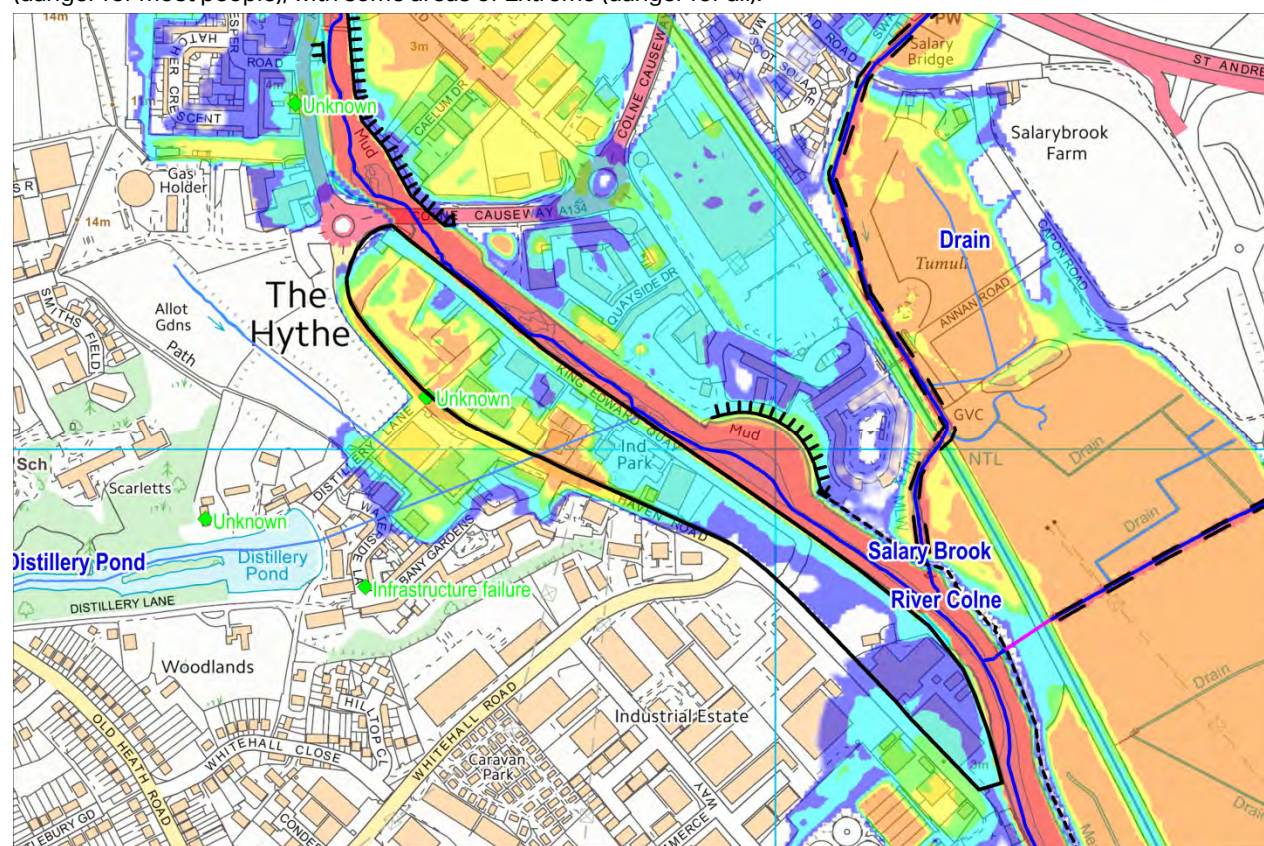


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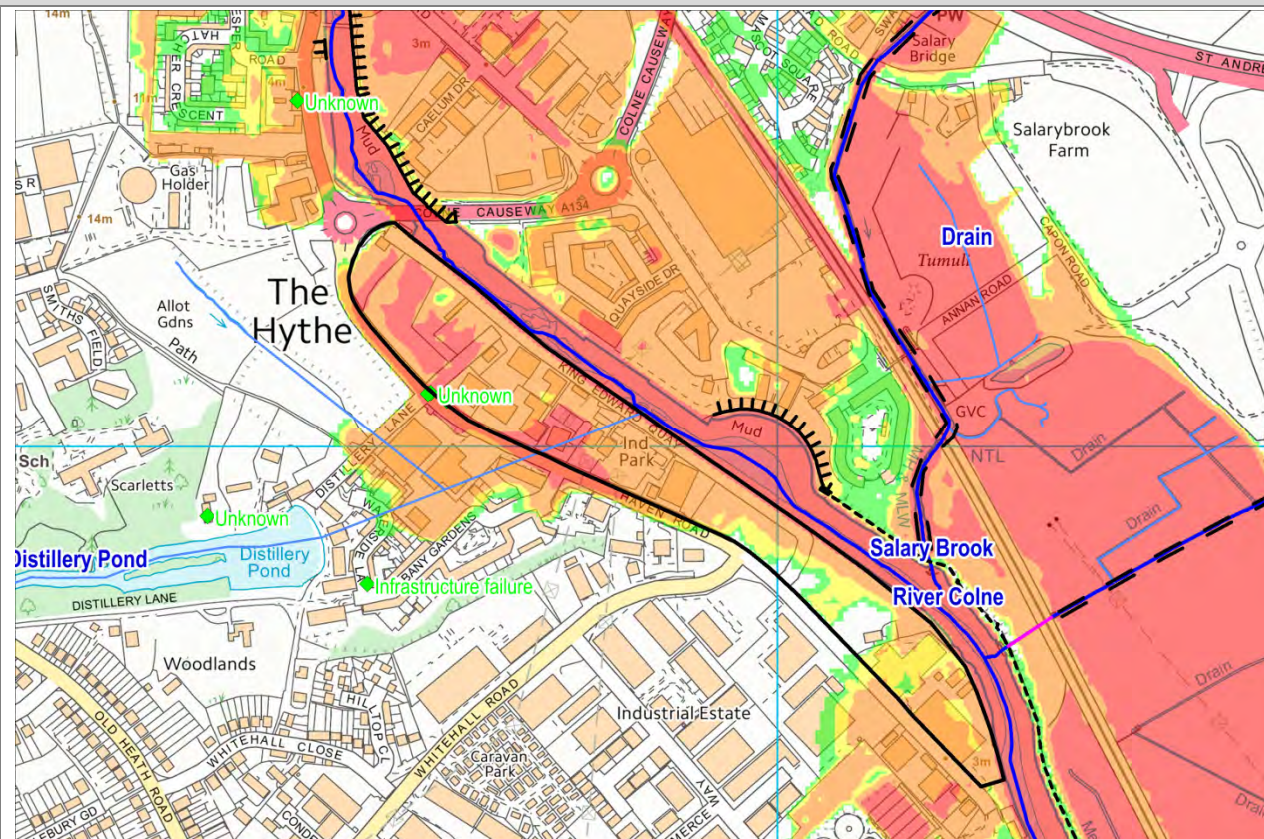
Figure A Modelled Flood Extents

Residual Risk – Failure of the Colne Barrier at Wivenhoe

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 show that flood depths on the site vary between 0.1-1.0 in the southern part of the site, with greater depths of up to 1.5-3.0m in the north western part. The hazard rating across the site is predominantly Significant (danger for most people), with some areas of Extreme (danger for all).



Site Assessment Summary – Commercial land between Haven Road and River Colne



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Figure B Colne Barrier Breach Assessment; 0.5% AEP including Climate Change, Maximum Flood Depth and Hazard

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW) and SWMP Modelling

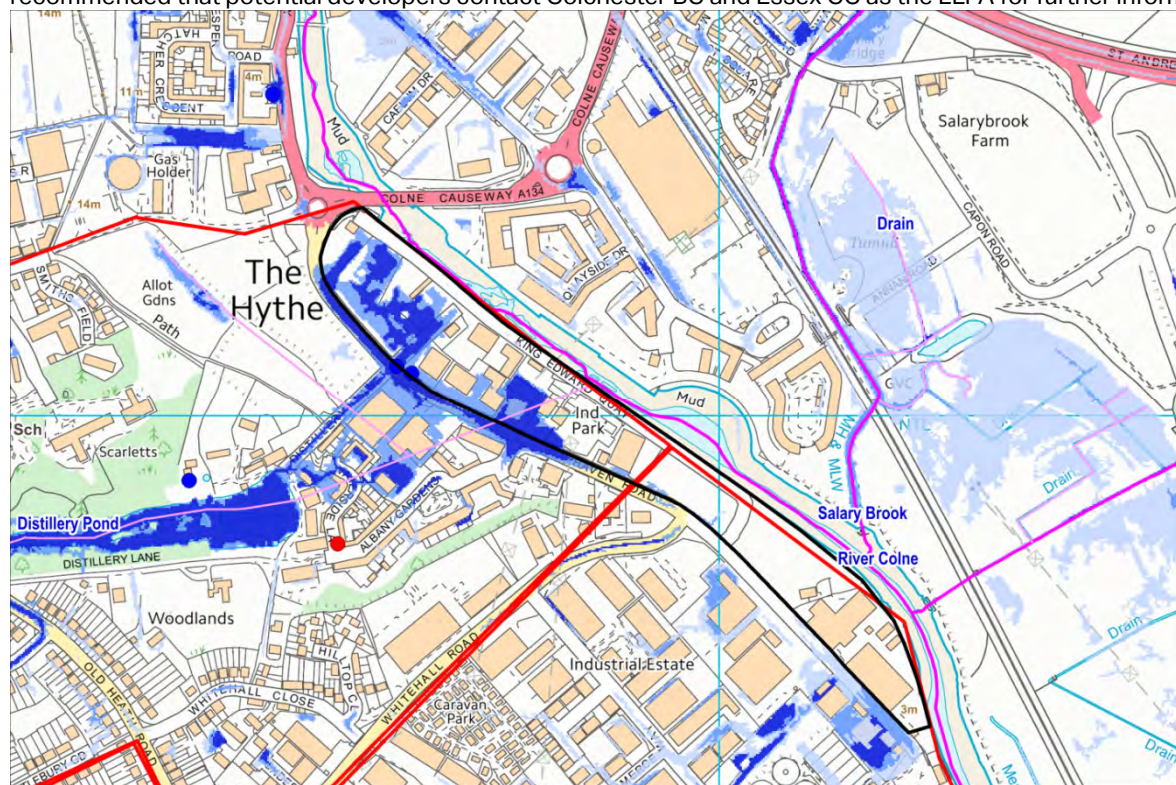
The RoFSW mapping indicates that parts of the site and local area are at high risk of surface water flooding (>3.3% AEP), during which flood depths of 300-900mm could be experienced on the site. The SWMP modelling identifies the potential for depths of 1-1.5m on the site during the 1% AEP event. Careful assessment of the flow paths and areas susceptible to ponding should be made prior to the development of the site layout to ensure that new development is not placed at surface water flood risk, and that the position of any new development does not divert the flow path to a neighbouring area.

Geology

The bedrock geology in this area is Thames Group, comprising clay and silt. Intertidal deposits, comprising clay and silt, are present overlying the bedrock. Clayey soils are typically not very permeable and provide the potential for increased surface water ponding.

Historic Records

The site is shown to lie within the Critical Drainage Area (CDA) for the Hythe Area, identified during the preparation of the town of Colchester SWMP. There are records of reoccurring flooding problems along Haven Road and Distillery Lane. In 2013 Colchester BC and associated risk management authorities undertook a Flood Investigation¹¹ in this area. Haven Road is low lying, and is at risk of tidal flooding. During heavy rainfall conditions surface water outfalls become tide locked, exacerbating the problem. In addition, Distillery Pond, located to the west of the site, drains a large upstream catchment, and the outlet for this pond is considered to be inadequate, thereby resulting in additional surface water reaching the Haven Road area. Actions resulting from the study are still undergoing review by the relevant risk management authorities at the time of this SFRA. It is recommended that potential developers contact Colchester BC and Essex CC as the LLFA for further information prior to taking forward site specific plans.



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Figure C Risk of Flooding from Surface Water (RoFSW)

¹¹ Colchester Borough Council (2013) Flooding in Haven Road.

Site Assessment Summary – Commercial land between Haven Road and River Colne

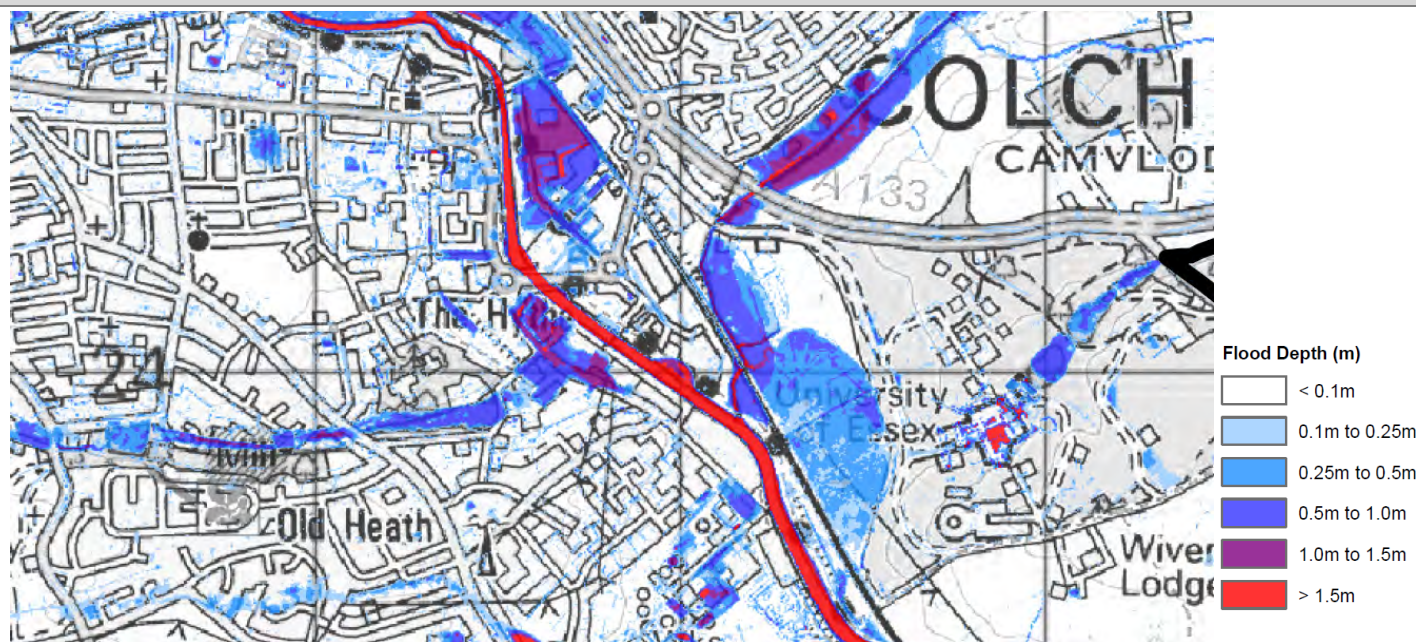


Figure D Town of Colchester SWMP (Capita Symonds 2013) Surface Water Modelling, 1% AEP Maximum Flood Depth

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	9.86 l/s
	1 in 1 year:	8.38 l/s
	1 in 30 year:	22.68 l/s
	1 in 100 year:	31.46 l/s
<i>Drainage Hierarchy</i>	Infiltration to ground	 Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse	 Discharge possible to the River Colne, subject to consultation with the Environment Agency and subject to confirmation that this will not exacerbate the surface water flooding already regularly experienced at Haven Road.
	Discharge to surface water sewer	 Possible, subject to consultation with Anglian Water and subject to confirmation that this will not exacerbate the surface water flooding already regularly experienced at Haven Road.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located within 1km squares of which 25-50% are susceptible to groundwater emergence. The risk of groundwater flooding in this area is therefore generally considered to be low. This will need to be confirmed during site investigation survey.

Other Sources

Environment Agency 'Risk of Flooding from Reservoirs' mapping shows that the floodplain of the River Colne including the site, is at risk of inundation in the event of a failure of the following reservoirs: Ardleigh (NGR (603487, 228024); Abberton Central and Western Arm (NGR 598901, 219790); and Abberton (NGR 598780, 219734). As noted in the SFRA report, given the regular inspection of these reservoirs in accordance with the Reservoirs Act 1975, flooding from reservoirs is considered to be a managed risk.

Site Specific Recommendations

There are already known reoccurring flooding issues in this location. The suitability of allocating this site in the Colchester BC Site Allocations rests on the ability of the risk management authorities to work together to deliver a solution for the flooding on Haven Road and Distillery Lane.

Set-back Distance

All development should be set back 16m from the edge of the River Colne. The Environment Agency will need to be consulted and an Environmental Permit obtained for any works within 16m of the watercourse.

Site Layout and Design

Residential development should be preferentially located in the south eastern part of the site which is defined as Flood Zone 2. Lower vulnerability uses forming part of the development scheme such as landscaped open space could be provided in those areas defined as Flood Zone 3a and Extreme hazard (with respect to residual tidal flood risk) in the northern part of the site. The drainage strategy for the site must be considered early in the site planning process to ensure adequate inclusion of SuDS. SuDS should be considered in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible). The site is within The Hythe CDA; opportunities should be sought for the development to contribute to the proposed scheme for surface water management in this area and Essex CC should be consulted to confirm the current status of this work. A summary of the initial preferred option for the CDA, as set out in the SWMP, is provided in Section 4 of this Report.

Finished Floor Levels

At this location upstream of the Colne Barrier, the Environment Agency will seek Finished Floor Levels for new development set 300mm above the 0.5% AEP flood level including an allowance for climate change. The modelled flood level in the event of a failure of the Colne Barrier during the 0.5% AEP flood event including climate change to 2115 in this location is 4.6mAOD. Based on LiDAR topographic survey, the ground levels across the site vary between approximately 3.5-5mAOD.

Access / Egress

Where possible safe dry access to and from the site should be provided. The site is located on the edge of the floodplain and therefore an egress route away from the site into an area of lower flood risk should be achievable along Whitehall Road. Given the residual risk to the site, resulting in hazard ratings of Significant and Extreme across the site, safe egress from the site may not be possible. Safe refuge should therefore be provided, via internal access, at a level above the 0.1% AEP flood level including an allowance for climate change, which is 5.2mAOD in this location.

Emergency Planning

The site is shown to be within an Environment Agency Flood Warning Area for the Tidal River Colne upstream of the Colne Barrier; residents should register to receive the warning service. To manage the residual risk of flooding associated with a failure of the Colne Barrier, Flood Response Plans should be prepared by residents of the site.

Summary

The key issue for the proposed site is the surface water flood risk posed to the site itself and access/egress route along Haven Road and Distillery Lane. As noted above, the suitability of allocating this site in the Colchester BC Site Allocations rests on the ability of the risk management authorities to work together to deliver a solution for the flooding on Haven Road and Distillery Lane. 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, subject to the implementation of effective measures to manage the flood risk issues on Haven Road and Distillery Lane.

Site Assessment Summary – Scrapyard and allotments off Haven Road and Distillery Lane

Location: Colchester	SHLAA Ref /Ref: COL54 (S0099)	Area (ha): 3.91	Proposed use: Residential (600 dwellings across COL44, COL54 and COL82)	Vulnerability Classification: More Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for this site as part of the preparation of the Local Plan Site Allocations.

Tidal and Fluvial Flood Risk

Flood Zone 1: 97%	Flood Zone 2: 1%	Flood Zone 3a: 2%	Flood Zone 3b: 0%
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Flood Zones and Flood Defences

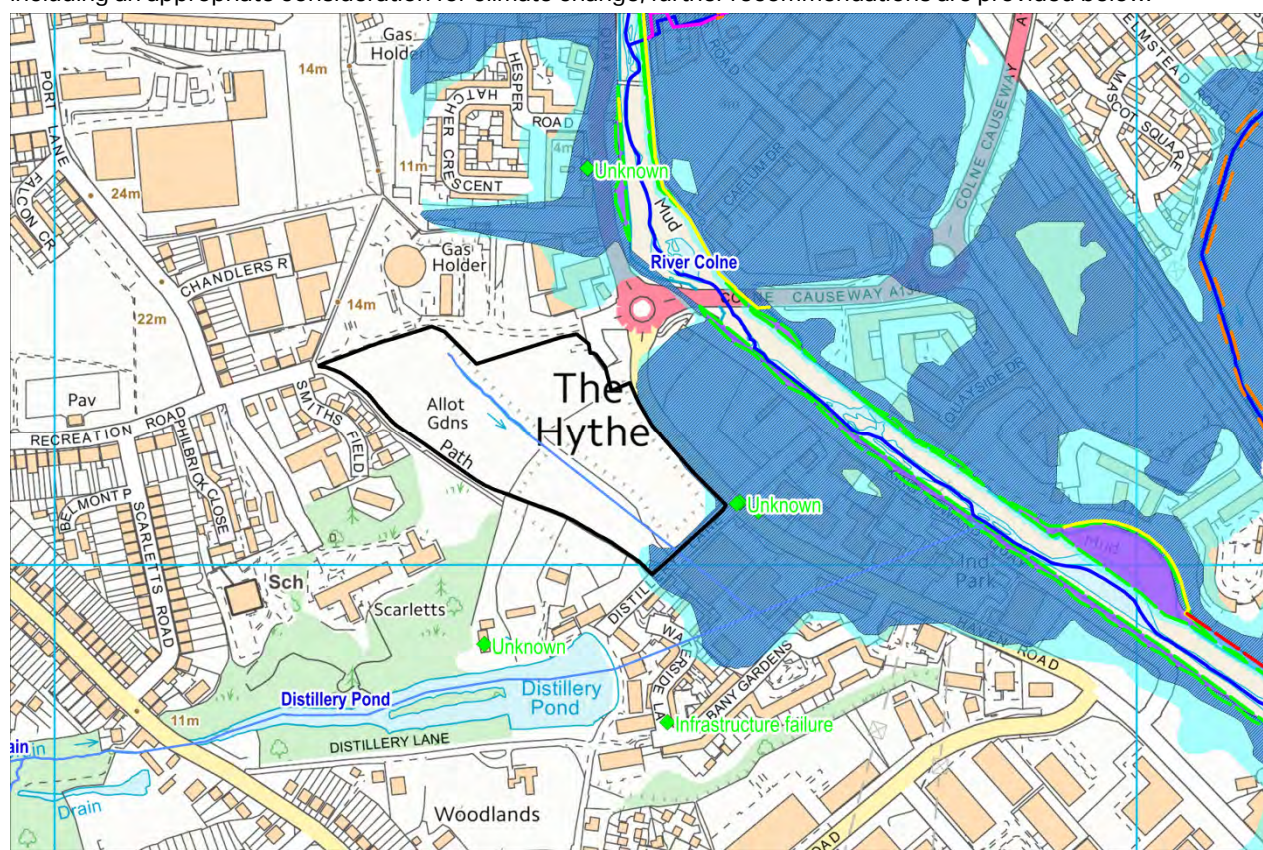
An ordinary watercourse passes through the centre of the site; there are no modelled flood zones for this watercourse. The River Colne flows from north to south in open channel approximately 150m to the east of the site. At this location the River Colne is tidally influenced. The large majority of the site (97%) is identified as Flood Zone 1 low probability of flooding associated with the River Colne; the southern fringe of the site is identified as Flood Zones 2 and 3a and is shown to benefit from the presence of defences. The AIMS dataset does not identify any formal flood defences along the western bank of the River Colne at this location. The Colne Barrier is located approximately 4.3km downstream at Wivenhoe and provides protection when water levels are forecast to rise greater than 3.2m AOD.

Functional Floodplain

The site is not located within the functional floodplain associated with the River Colne. Modelling is not available for the ordinary watercourse that passes through the site; modelling will need to be undertaken to determine the floodplain definition across the site, further recommendations provided below.

Climate Change

Modelling of the Colne and Blackwater Estuary shows that tidal flood water remains in bank for the 0.5% AEP flood event (with defences) including an allowance for climate change. Modelling is not available for the ordinary watercourse that passes through the site; modelling will need to be undertaken to determine the floodplain definition across the site, including an appropriate consideration for climate change, further recommendations are provided below.

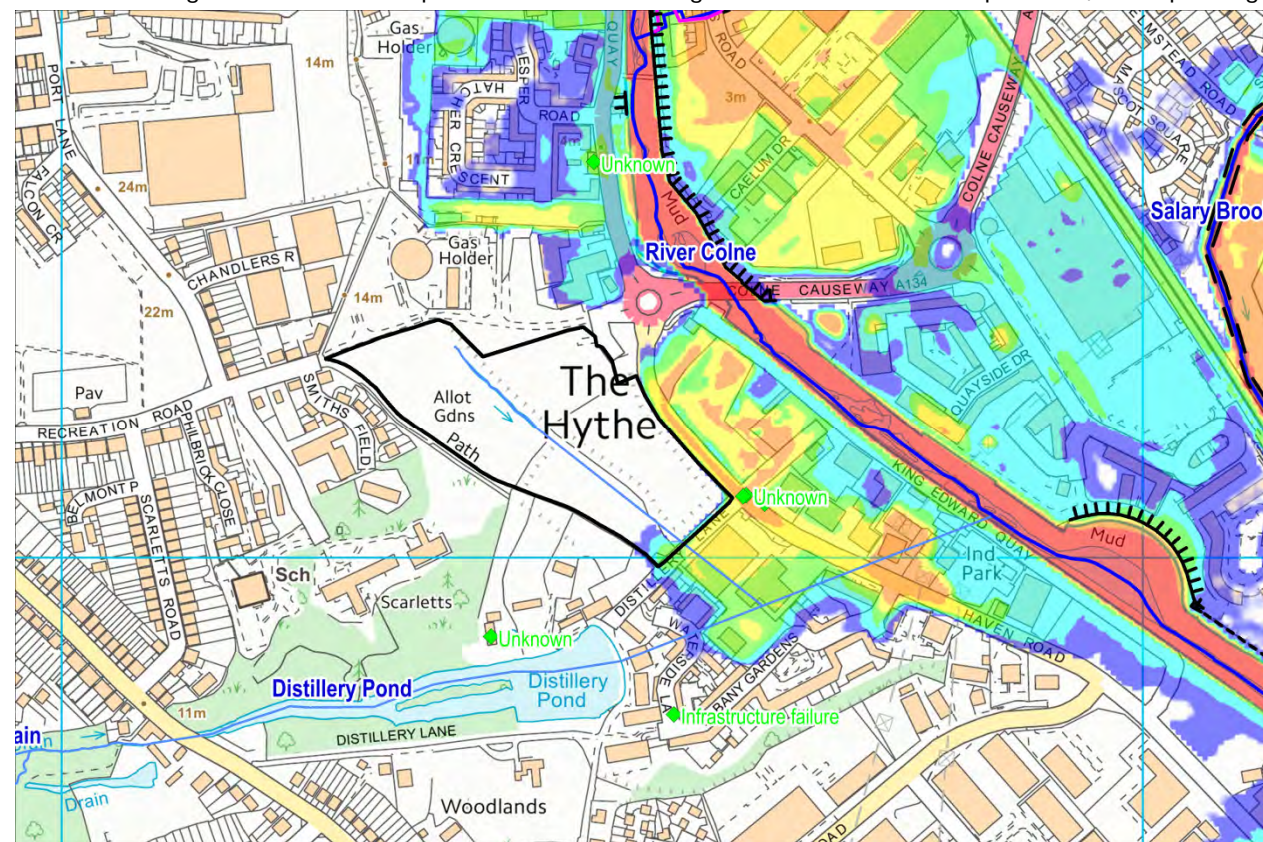


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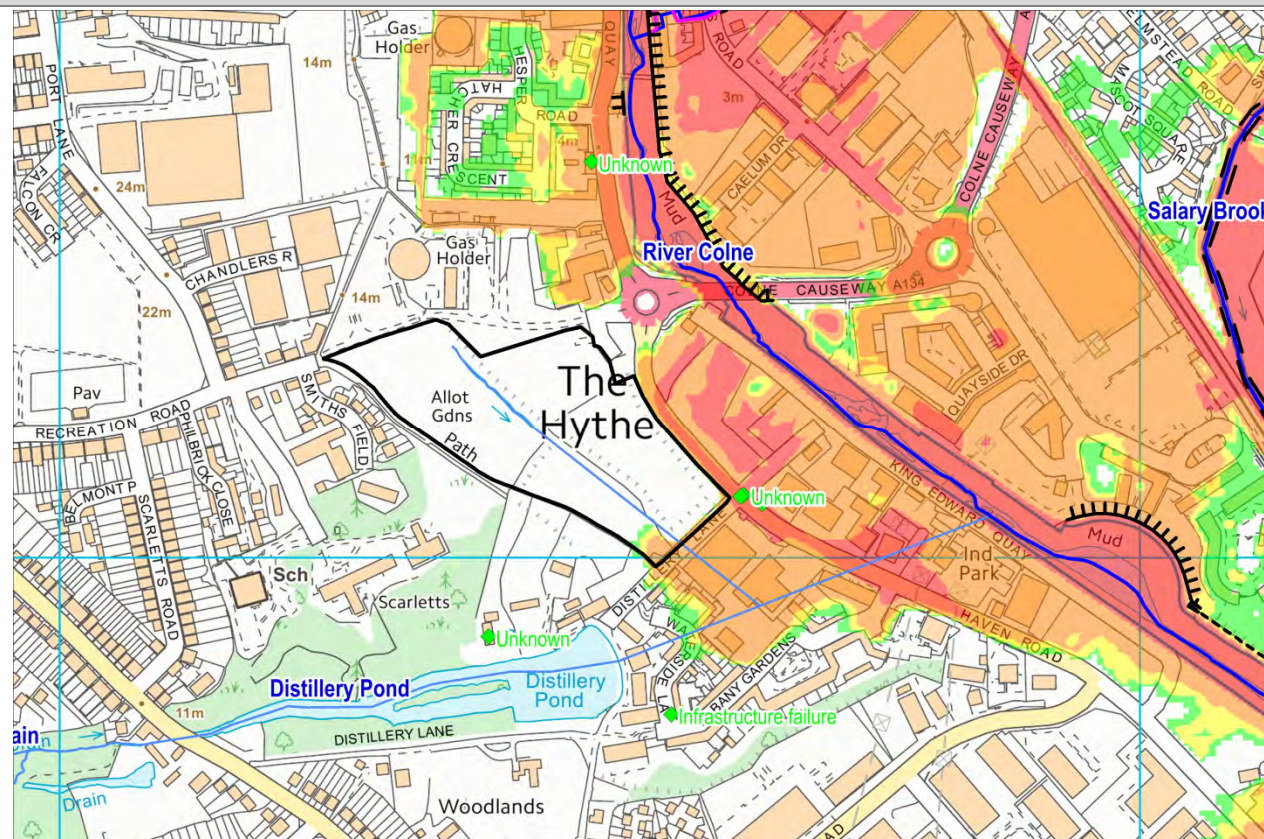
Figure A Modelled Flood Extents

Residual Risk – Failure of the Colne Barrier at Wivenhoe

The southern fringe of the site and the surrounding area 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 show that flood depths on the southern fringe of the site could reach up to 1.5m, corresponding to a hazard rating of Significant (danger for most people).



Site Assessment Summary – Scrapyard and allotments off Haven Road and Distillery Lane



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Figure B Colne Barrier Breach Assessment; 0.5% AEP including Climate Change, Maximum Flood Depth and Hazard

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW) and SWMP Modelling

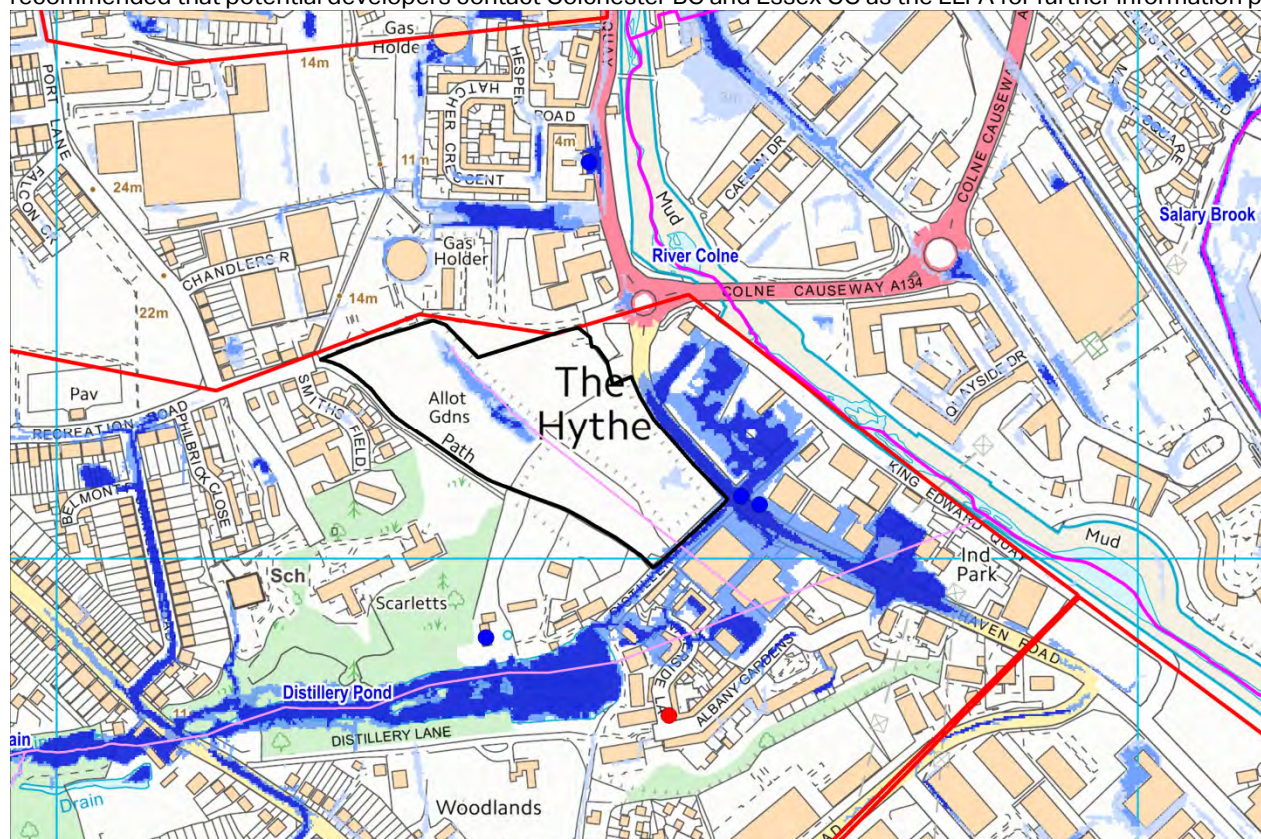
The RoFSW mapping indicates that the majority of the site is at very low risk of surface water flooding (<0.1% AEP). There is some ponding adjacent to the ordinary watercourse that flows through the site, which is also shown in the SWMP modelling. The site layout should be carefully planned to ensure that residential dwellings are not placed at surface water flood risk, and that the position of any new development does not divert the flow path to a neighbouring area. The area downstream of the site is shown to be at high risk of flooding, with modelling of flood depths up to 1.5m during the 1% AEP event.

Geology

The bedrock geology in this area is Thames Group, comprising clay and silt. There are no recorded superficial deposits in this location as it is just outside the floodplain of the River Colne with the associated intertidal deposits. Clayey soils are typically not very permeable and provide the potential for increased surface water ponding.

Historic Records

The site is shown to lie within the Critical Drainage Area (CDA) for the Hythe Area identified during the preparation of the town of Colchester SWMP. There are records of reoccurring flooding problems along Haven Road and Distillery Lane. In 2013, Colchester BC and associated risk management authorities undertook a Flood Investigation¹² in this area. Haven Road is low lying, and is at risk of tidal flooding. During heavy rainfall conditions surface water outfalls become tide locked, exacerbating the problem. In addition, Distillery Pond, located to the west of the site, drains a large upstream catchment, and the outlet for this pond is considered to be inadequate, thereby resulting in additional surface water reaching the Haven Road area. Actions resulting from the study are still undergoing review by the relevant risk management authorities at the time of this SFRA. It is recommended that potential developers contact Colchester BC and Essex CC as the LLFA for further information prior to taking forward site specific plans.



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Figure C Risk of Flooding from Surface Water (RoFSW)

¹² Colchester Borough Council (2013) Flooding in Haven Road.

Site Assessment Summary – Scrapyard and allotments off Haven Road and Distillery Lane

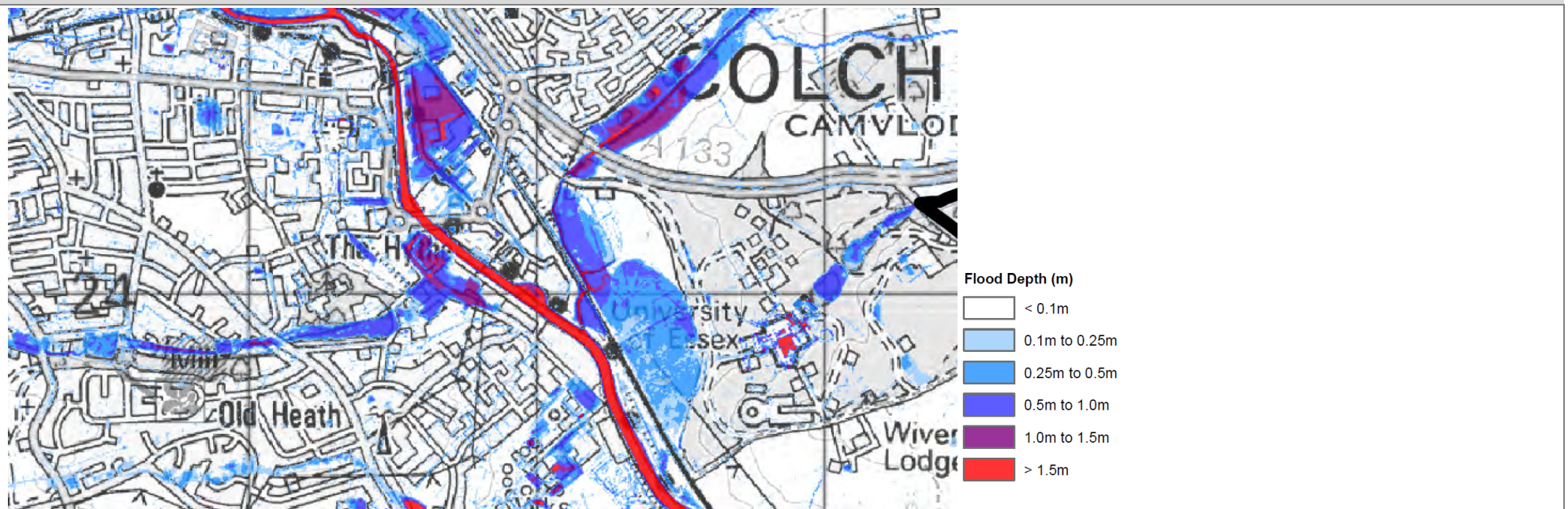


Figure D Town of Colchester SWMP (Capita Symonds, 2013) Surface Water Modelling, 1% AEP Maximum Flood Depth

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	5.45 l/s
	1 in 1 year:	7.82 l/s
	1 in 30 year:	12.54 l/s
	1 in 100 year:	17.40 l/s
<i>Drainage Hierarchy</i>	Infiltration to ground	 Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse	 Discharge possible to the ordinary watercourse that flows through the site, subject to consultation with Essex CC and subject to confirmation that this will not exacerbate the surface water flooding already regularly experienced at Haven Road.
	Discharge to surface water sewer	 Possible, subject to consultation with Anglian Water and subject to confirmation that this will not exacerbate the surface water flooding already regularly experienced at Haven Road.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located within a 1km square of which 25-50% is susceptible to groundwater emergence. The risk of groundwater flooding in this area is therefore generally considered to be low. This will need to be confirmed during site investigation survey.

Other Sources

The Environment Agency 'Risk of Flooding from Reservoirs' mapping shows that the floodplain of the River Colne including the southern fringe of the site, is at risk of inundation in the event of a failure of the following reservoirs: Abberton Central & Western Arm (NGR 598901, 219790); and Abberton (NGR 598780, 219734). As noted in the Level 1 SFRA report, given the regular inspection of these reservoirs in accordance with the Reservoirs Act 1975, flooding from reservoirs is considered to be a managed risk.

Site Specific Recommendations

There are known reoccurring flooding issues in this location. The suitability of allocating this site in the Colchester BC Site Allocations rests on the ability of the risk management authorities to work together to deliver a solution for the flooding on Haven Road and Distillery Lane.

Fluvial Modelling

As part of a site specific FRA for this site, a simple hydraulic model should be developed to more accurately determine the probability of flooding across the site from the ordinary watercourse that passes through the site. 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.

Site Layout and Design

Residential development should be avoided in areas within the 1% AEP flood extent of the ordinary watercourse (as defined from the preparation of a simple hydraulic model), and instead lower vulnerability uses including landscaped open space should be located here. The drainage strategy for the site must be considered early in the site planning process to ensure adequate inclusion of SuDS. SuDS should be considered in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible). The site is within The Hythe CDA; opportunities should be sought for the development to contribute to the proposed scheme for surface water management in this area and Essex CC should be consulted to confirm the current status of this work. A summary of the initial preferred option for the CDA, as set out in the SWMP, is provided in Section 4 of this Report.

Set-back Distance

A 3m wide set-back distance should be retained on at least one side of the ordinary watercourse to provide access for maintenance. Essex CC, as the LLFA, 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

If residential development cannot be avoided within the flood extent for the 1% AEP event including climate change associated with the ordinary watercourse, finished floor levels should be set at least 300mm freeboard above the flood level for 1% AEP event including an appropriate allowance for climate change. In this case, for More Vulnerable development in Flood Zone 3a, the higher central (35%) climate change allowance should be used.

At this location upstream of the Barrier, the Environment Agency will also seek Finished Floor Levels for new development set 300mm above the 0.5% AEP flood level including an allowance for climate change for tidal flooding associated with the River Colne. The modelled flood level in the event of a failure of the Colne Barrier during the 0.5% AEP flood event including climate change to 2115 in this location is 4.6m AOD. Based on LiDAR topographic survey, the ground levels across the southern fringe of the site vary between approximately 3-4.4m AOD.

Access / Egress

Safe dry access to and from the site should be provided. The current access for the site is along Distillery Lane and Haven Road. This area is susceptible to significant surface water flooding problems. This route is also at residual risk of flooding in the event of breach of the Colne Barrier, with hazard ratings of Extreme and Significant (during the 0.5% AEP event including climate change). Assessment of alternative access/egress routes should be made in order to determine whether this site can deliver development that is safe for its lifetime and thereby satisfy the requirements of the Exception Test.

Emergency Planning

The site is not shown to be within an Environment Agency Flood Warning Area; it is strongly recommended that occupants of the site should register to receive the warning service for the Tidal River Colne upstream of the Colne Barrier given that proximity to the River Colne and the risk posed to the potential access/egress route for the site. To manage the residual risk of flooding to the egress route associated with a failure of the Colne Barrier, Flood Response Plans should be prepared by residents of the site.

Summary

Based upon the strategic review of the flood risk posed to the site, and the recommendations set out above, it is likely that the proposed development itself could be suitably designed to protect the site and occupants from the risk of flooding. One of the key issues for the proposed site is the surface water flood risk, (and the residual tidal flood risk), posed to the existing access/egress route along Haven Road and Distillery Lane. As noted above, the suitability of allocating this site in the Colchester BC Site Allocations rests on the ability of the risk management authorities to work together to deliver a solution for the flooding on Haven Road and Distillery Lane.

Site Assessment Summary – Land between River Colne and Hythe Quay

Location: Colchester	SHLAA Ref /Ref: COL82 (S0740)	Area (ha): 0.31	Proposed use: Residential (600 dwellings across COL44, COL54 and COL82)	Vulnerability Classification: More Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for this site as part of the preparation of the Local Plan Site Allocations.

Tidal and Fluvial Flood Risk

Flood Zone 1: 0%	Flood Zone 2: 0%	Flood Zone 3a: 82%	Flood Zone 3b: 18%
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Flood Zones and Flood Defences

The River Colne flows from north to south in open channel along the eastern edge of the site. At this location the River Colne is tidally influenced. The eastern strip (18%) is defined as Flood Zone 3b functional floodplain, and the remainder of the site (82%) is identified as Flood Zone 3a high probability of flooding associated with the River Colne. This area of Flood Zone 3a is shown to benefit from the presence of defences. The AIMS dataset identifies a 20m length of concrete river wall adjacent to part of the site. The Colne Barrier is located approximately 4.5km downstream at Wivenhoe and provides protection when water levels are forecast to rise greater than 3.2m AOD.

Functional Floodplain

The eastern part of the site is located with the functional floodplain associated with the River Colne. This area is required to store water in time of flood; development is not permitted in this area.

Climate Change

Modelling of the Colne and Blackwater Estuary shows that the eastern edge of the site, which is located in the floodplain, is at risk of flooding during the 0.5% AEP flood event including an allowance for climate change, but water does not come out of bank and impact the rest of the site.

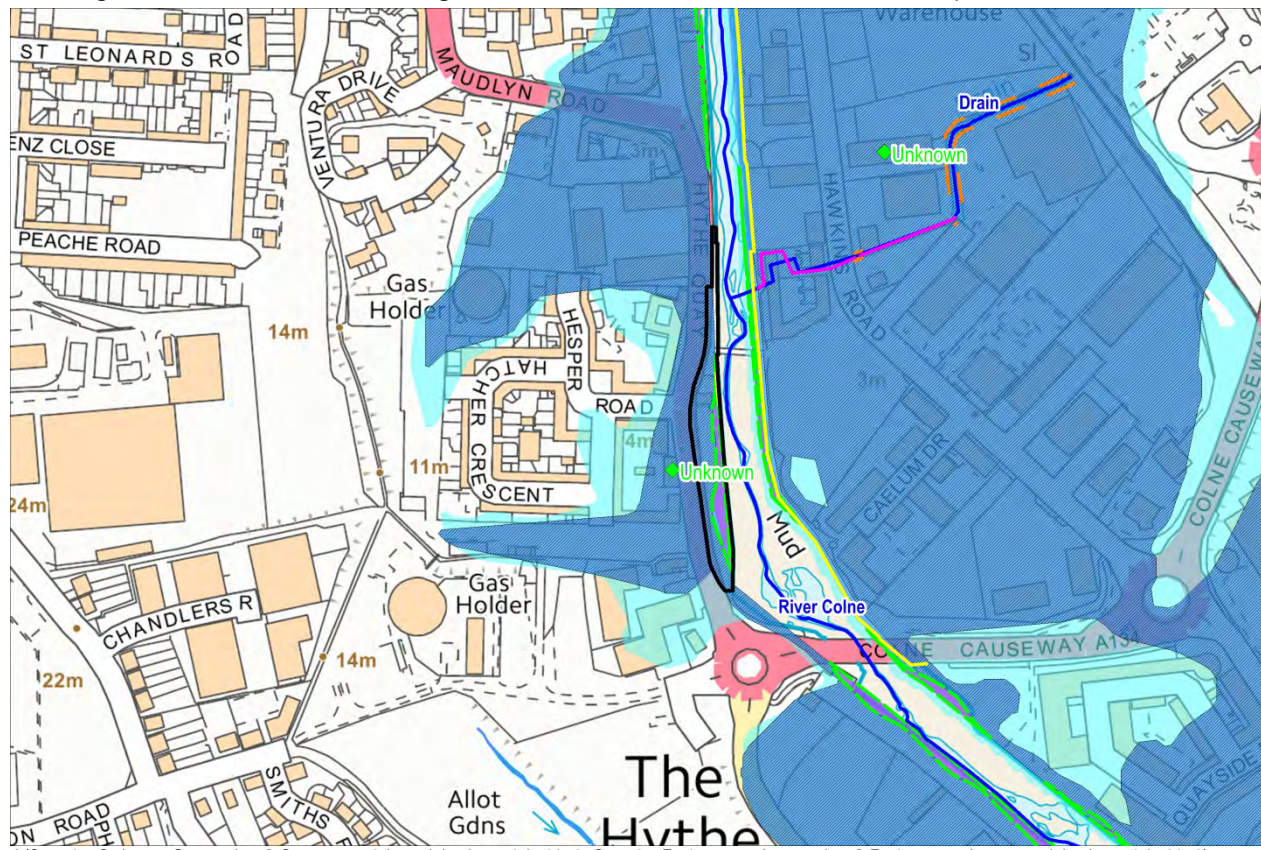
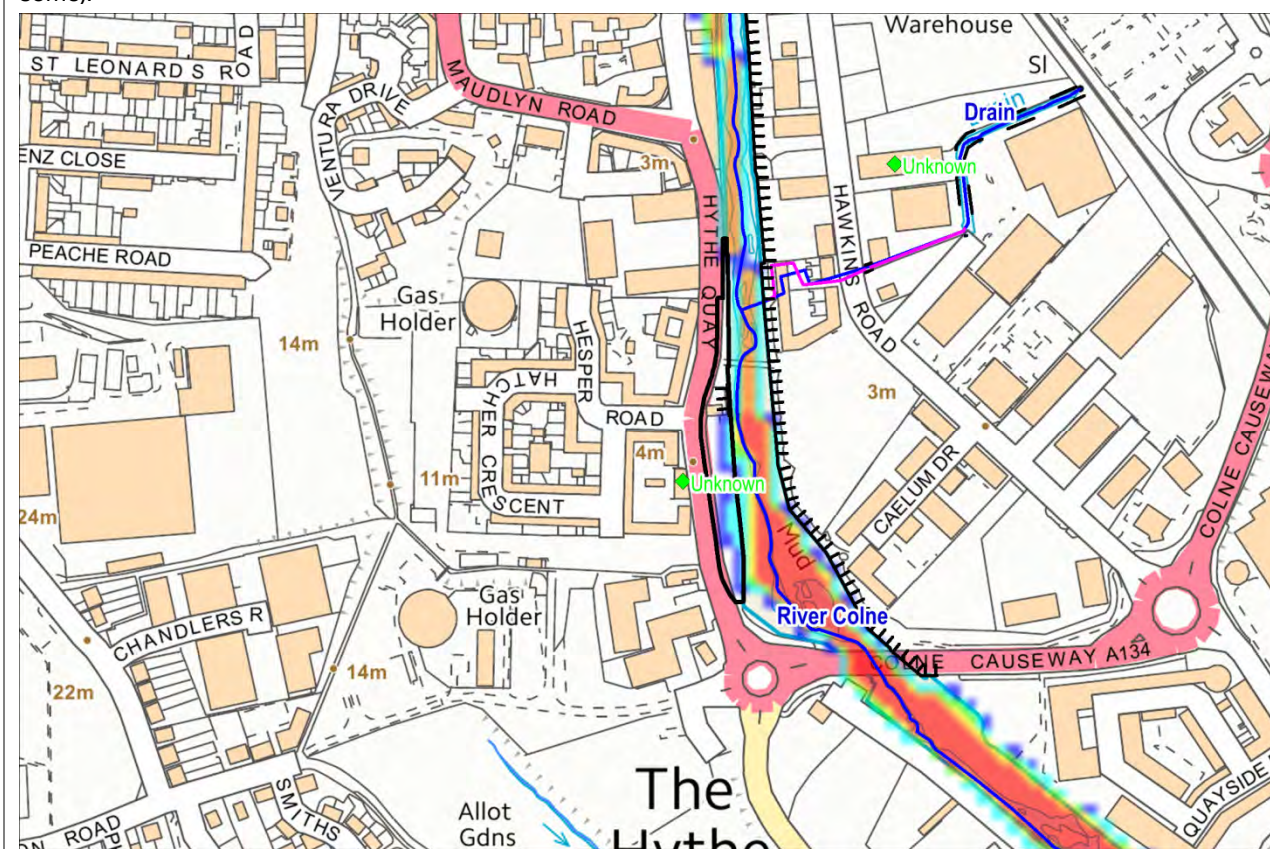


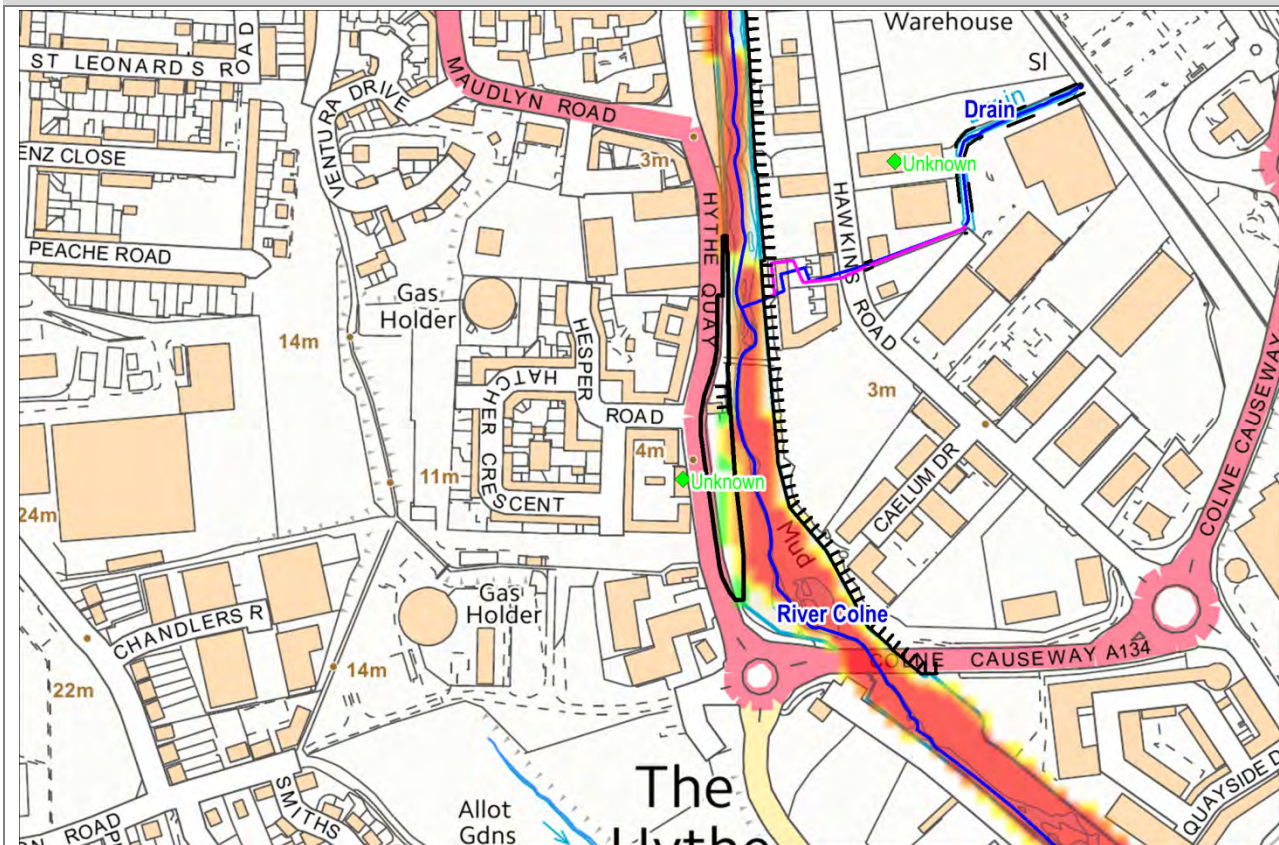
Figure A Modelled Flood Extents

Detailed Flood Risk Information – Maximum Flood Depth and Hazard Mapping

Environment Agency modelling for the Colne and Blackwater Estuary provides further detail regarding the flood risk to the site. During the 0.5% AEP event including an allowance for climate change, maximum flood depths on the site of 0.1-0.7m are modelled to occur, corresponding to a flood hazard rating of Low to Moderate (danger for some).



Site Assessment Summary – Land between River Colne and Hythe Quay

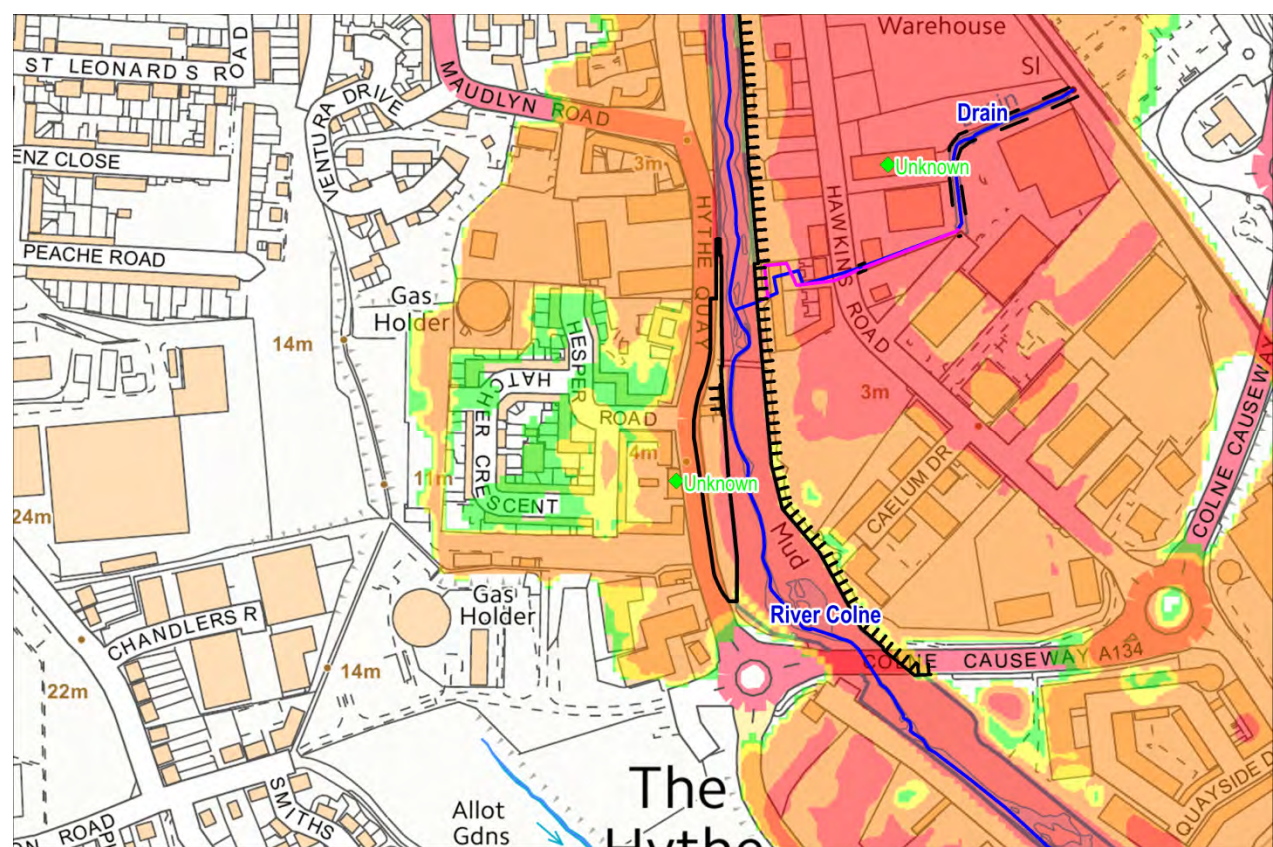
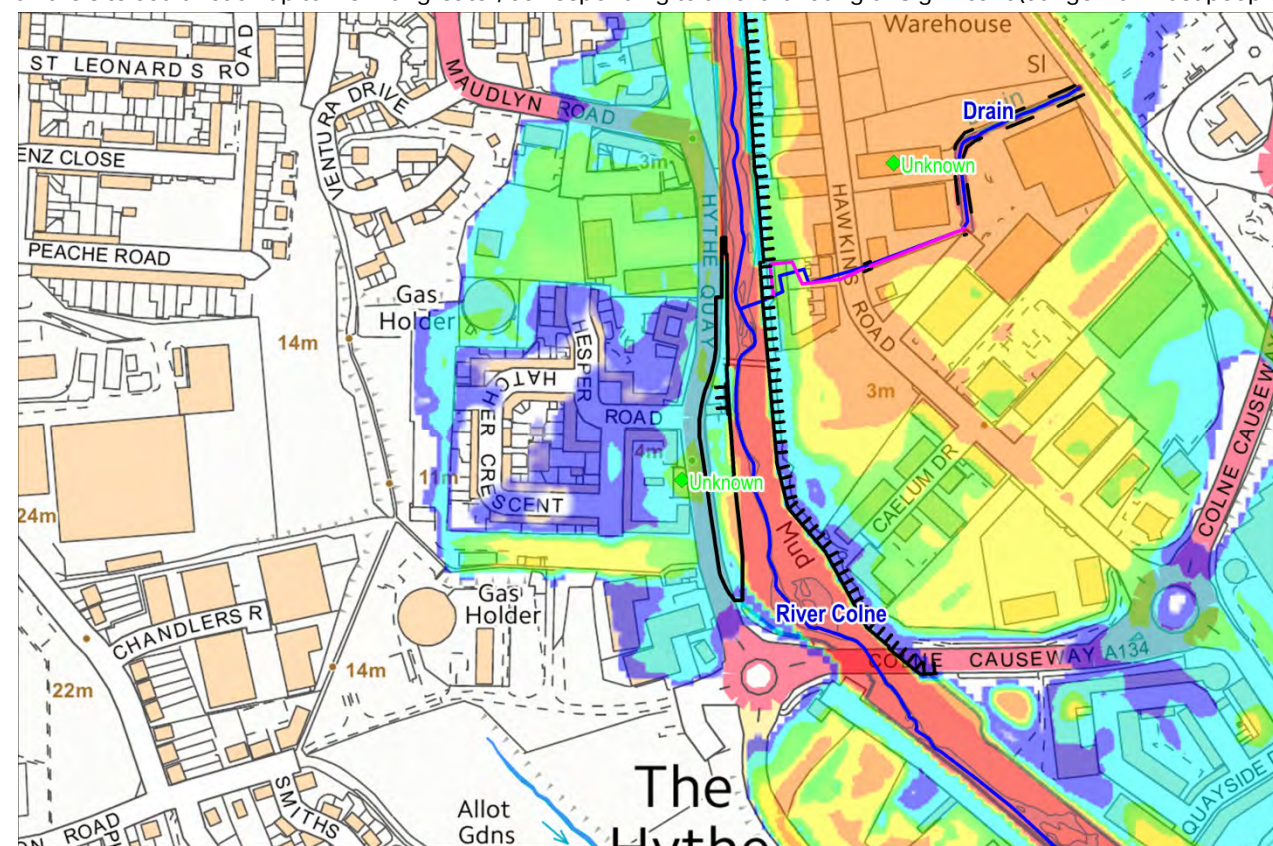


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Figure B Colne and Blackwater Estuary Modelling including Defences; 0.5% AEP including Climate Change, Maximum Flood Depth and Hazard

Residual Risk – Failure of the Colne Barrier at Wivenhoe

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 show that flood depths on the site could reach up to 1.5m or greater, corresponding to a hazard rating of Significant (danger for most people) increasing to Extreme (danger for all).



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Figure C Colne Barrier Breach Assessment; 0.5% AEP including Climate Change, Maximum Flood Depth and Hazard

Site Assessment Summary – Land between River Colne and Hythe Quay

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW) and SWMP Modelling

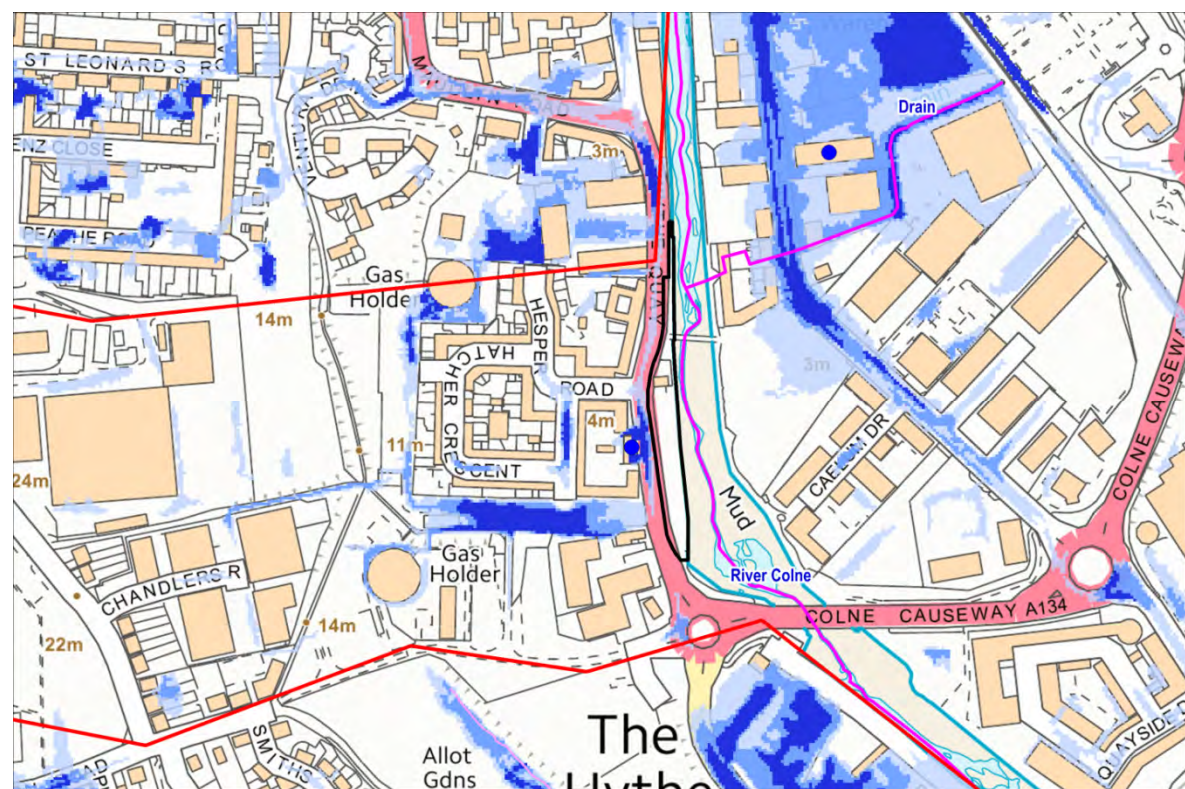
The SWMP modelling indicates that the site is at risk of surface water ponding, with flood depths of up to 1m adjacent to the River Colne. The site layout should be carefully planned to ensure that residential dwellings are not placed at surface water flood risk, and that the position of any new development does not divert the flow path to a neighbouring area.

Geology

The bedrock geology in this area is Thames Group, comprising clay and silt which are overlain by alluvial clays and silts associated with the River Colne. Clayey soils are typically not very permeable and provide the potential for ponding of surface water on the ground surface during heavy rainfall.

Historic Records

The site is not shown to lie within a Critical Drainage Area (CDA) identified during the preparation of the town of Colchester SWMP. There are historic records of flooding near the site and in the local area; however the source of flooding is not recorded. To the south of the site, there are reoccurring flooding problems along Haven Road and Distillery Lane. Colchester BC has undertaken a Flood Investigation in this area. Haven Road is low lying, and is at risk of tidal flooding. During heavy rainfall conditions surface water outfalls become tide locked, exacerbating the problem. In addition, Distillery Pond, located to the south west of the site, drains a large upstream catchment, and the outlet for this pond is considered to be inadequate, thereby resulting in additional surface water reaching the Haven Road area. Actions resulting from the study are still undergoing review by the relevant risk management authorities.



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Figure D Risk of Flooding from Surface Water (RoFSW)

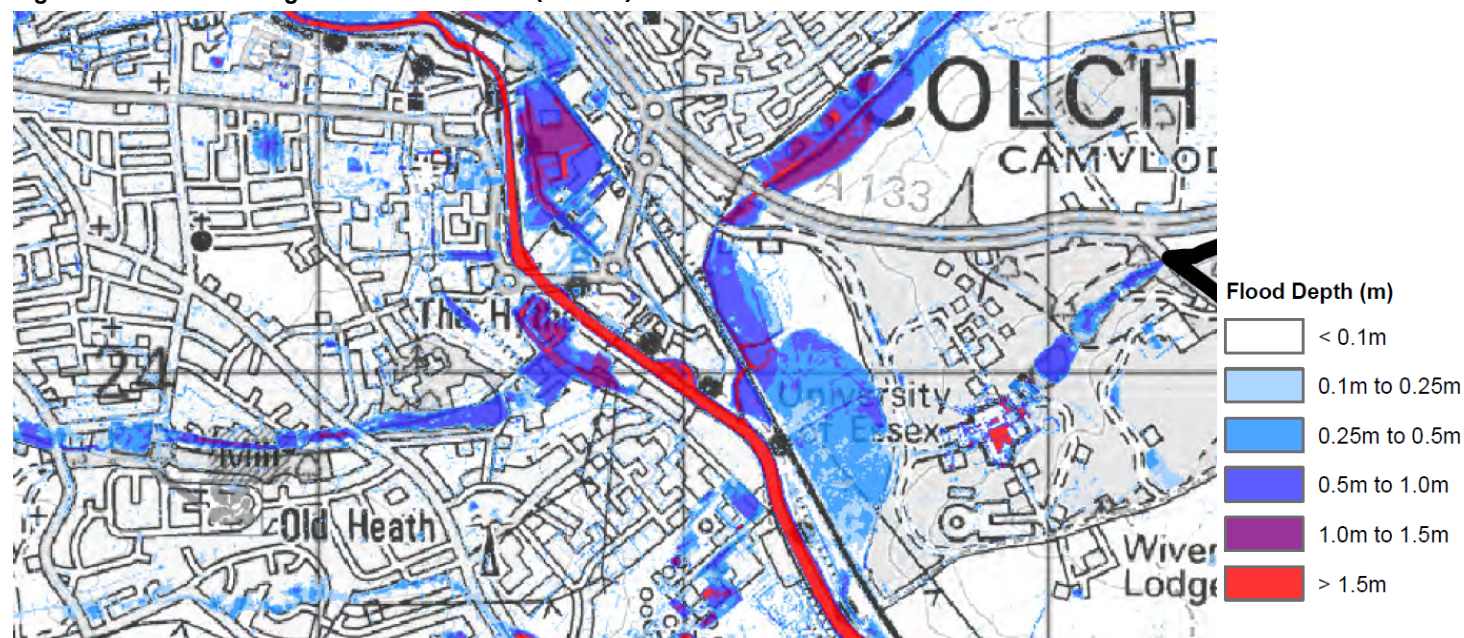


Figure D Town of Colchester SWMP (Capita Symonds, 2013) Surface Water Modelling, 1% AEP Maximum Flood Depth

Estimated Greenfield Runoff Rates (IH124 Results).	QBAR:	0.43 l/s
	1 in 1 year:	0.37 l/s
	1 in 30 year:	0.99 l/s
	1 in 100 year:	1.37 l/s
Drainage Hierarchy	Infiltration to ground	Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse	Discharge possible to the River Colne, subject to consultation with the Environment Agency and subject to confirmation that this will not exacerbate the surface water flooding already regularly experienced in the local area (Haven Road and Distillery Lane).
	Discharge to surface water sewer	Possible, subject to consultation with Anglian Water and subject to confirmation that this will not exacerbate the surface water flooding already regularly experienced in the local area (Haven Road and Distillery Lane).

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located within a 1km square of which 25-50% is susceptible to groundwater emergence. The risk of groundwater flooding in this area is therefore generally considered to be low. This will need to be confirmed during site investigation survey.

Other Sources

The Environment Agency 'Risk of Flooding from Reservoirs' mapping shows that the floodplain of the River Colne including the site, is at risk of inundation in the event of a failure of the following reservoirs: Ardleigh (NGR 603487, 228024); Gosfield Lake (NGR 577620, 229183); Abberton Central and Western Arm (NGR 598901, 219790); and Abberton (NGR 598780, 219734). As noted in the Level 1 SFRA report, given the regular inspection of these reservoirs in accordance with the Reservoirs Act 1975, flooding

Site Assessment Summary – Land between River Colne and Hythe Quay

from reservoirs is considered to be a managed risk.

Site Specific Recommendations

Site Layout and Design

The site is very narrow and the hazard rating across the site is fairly uniform and therefore there is little scope to apply the sequential approach within the site. Development should be set as far back from the River Colne as possible. The drainage strategy for the site must be considered early in the site planning process to ensure adequate inclusion of SuDS. SuDS should be considered in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible).

Set-back Distance

All development should be set back 16m from the tidal River Colne. The Environment Agency will need to be consulted and an Environmental Permit obtained for any works within 16m of the river.

Finished Floor Levels

At this location upstream of the Barrier, the Environment Agency will seek Finished Floor Levels for new development set 300mm above the 0.5% AEP flood level including an allowance for climate change. The modelled flood level in the event of a failure of the Colne Barrier during the 0.5% AEP flood event including climate change to 2115 in this location is 4.6mAOD. The LiDAR data suggests ground levels on the site vary between 2-4mAOD. Depending on the precise ground levels on the site, this may be more effectively delivered by providing habitable accommodation at first floor level and above, with lower vulnerability uses (for example car parking) at ground level.

Access / Egress

Safe access to and from the site should be provided. The access for the site along the A134 Hythe Quay is not shown to be at risk during the 0.5% AEP event including an allowance for the climate change. However, the route is shown to be at residual risk in the event of a failure of the Colne Barrier with hazard rating of Significant. It is therefore necessary to consider the provision of safe refuge for any proposed development on this site. Safe refuge should therefore be provided, via internal access, at a level above the extreme flood level.

Emergency Planning

The site is within the Environment Agency Flood Warning Area for the Tidal River Colne upstream of the Colne Barrier; occupants of the site must register to receive the warning service given the proximity to the River Colne and the risk posed to the potential access/egress route for the site. To manage the residual risk of flooding to the egress route associated with a failure of the Colne Barrier, Flood Response Plans should be prepared by residents of the site which should include details of places of safe refuge.

Summary

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.

Site Assessment Summary – Battlewicks Farm / Land off Hillview Close / Rowhedge Business Park

Location: Rowhedge	SHLAA Ref /Ref: RSE03, RSE17 & RSE08 (C033, C144 & C072)	Area (ha): Collectively 20.87ha	Proposed use: Residential (60 dwellings)	Vulnerability Classification: More Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for these sites as part of the preparation of the Local Plan Site Allocations.

Tidal and Fluvial Flood Risk

Flood Zone 1: 92%	Flood Zone 2: 1%	Flood Zone 3a: 7%	Flood Zone 3b: 0%
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Flood Zones and Flood Defences

The Birch Brook flows from west to east through site RSE17 and RSE03. The watercourse is defined as an ordinary watercourse in the west of the site, and is then designated main river in the east of the site. The Birch Brook adjoins the River Colne approximately 500m to the east of the site. The majority of the site is defined as Flood Zone 1 low probability of flooding from rivers.

A small portion of the site (4%), where the Birch Brook is main river, is shown to benefit from the presence of flood defences; this area would be at risk of tidal flooding from the River Colne during the 0.5% AEP event, if there were no defences. The AIMS dataset identifies high ground either side of the Birch Brook. The Colne Barrier is located approximately 1.5km downstream at Wivenhoe and provides protection from tidal flooding along the River Colne floodplain.

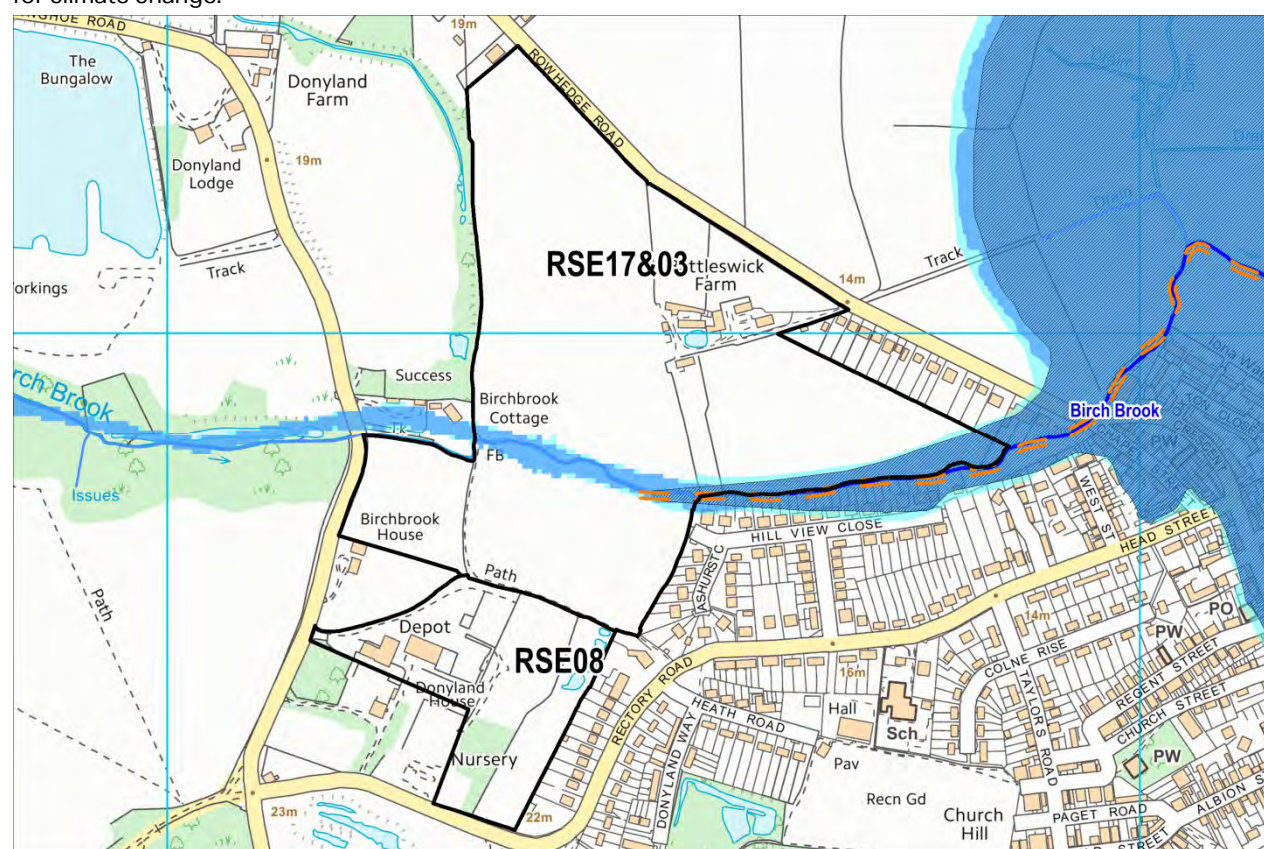
Functional Floodplain

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 outputs for Flood Zone 3b functional floodplain are not available for this watercourse. Further modelling is required to determine the extent of Flood Zones across the site, described further below in the 'site specific recommendations' section.

Climate Change

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 outputs including an allowance for the impact of climate change are not available for this watercourse.

Modelling of the Colne and Blackwater Estuary shows that water remains in bank of the River Colne during the 0.5% AEP tidal flood event (with defences) including an allowance for climate change.

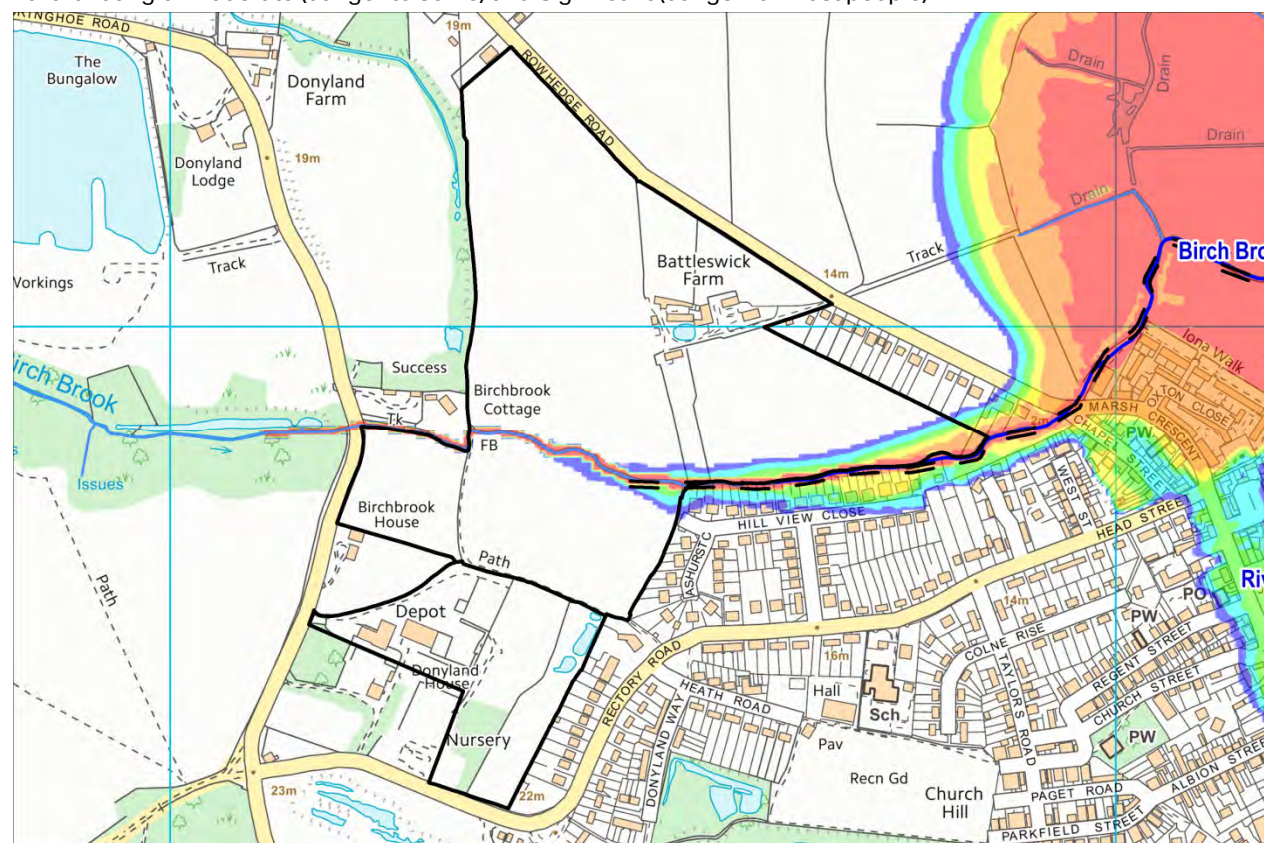


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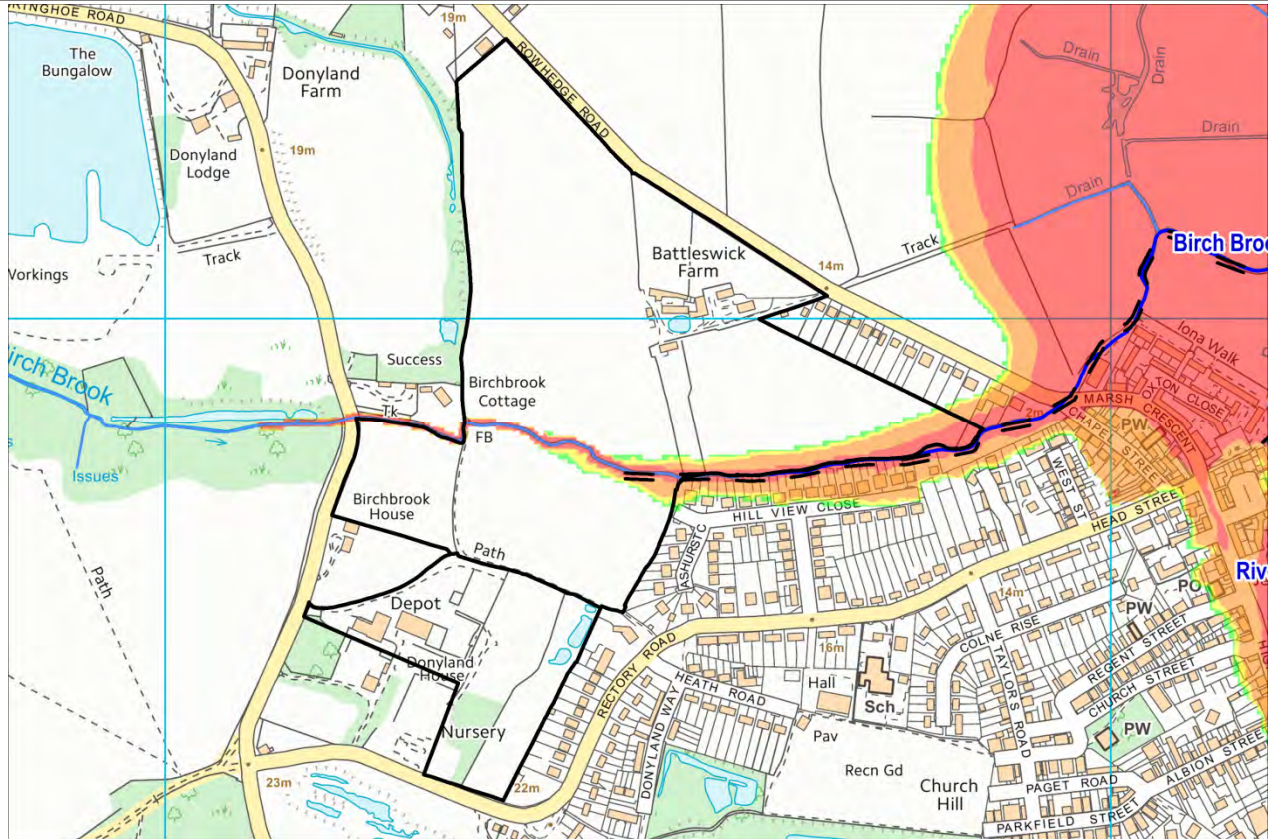
Figure A Modelled Flood Extents

Residual Risk – Failure of the Colne Barrier at Wivenhoe

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 show that flood water may inundate the channel of the Birch Brook, and impact the very eastern fringe of the site. Flood depths in this area are shown to reach between 0.1 -1.0m, corresponding to a hazard rating of Moderate (danger to some) and Significant (danger for most people).



Site Assessment Summary – Battlewicks Farm / Land off Hillview Close / Rowhedge Business Park



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Figure B Colne Barrier Breach Assessment; 0.5% AEP including Climate Change, Maximum Flood Depth and Hazard

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW) and SWMP Modelling

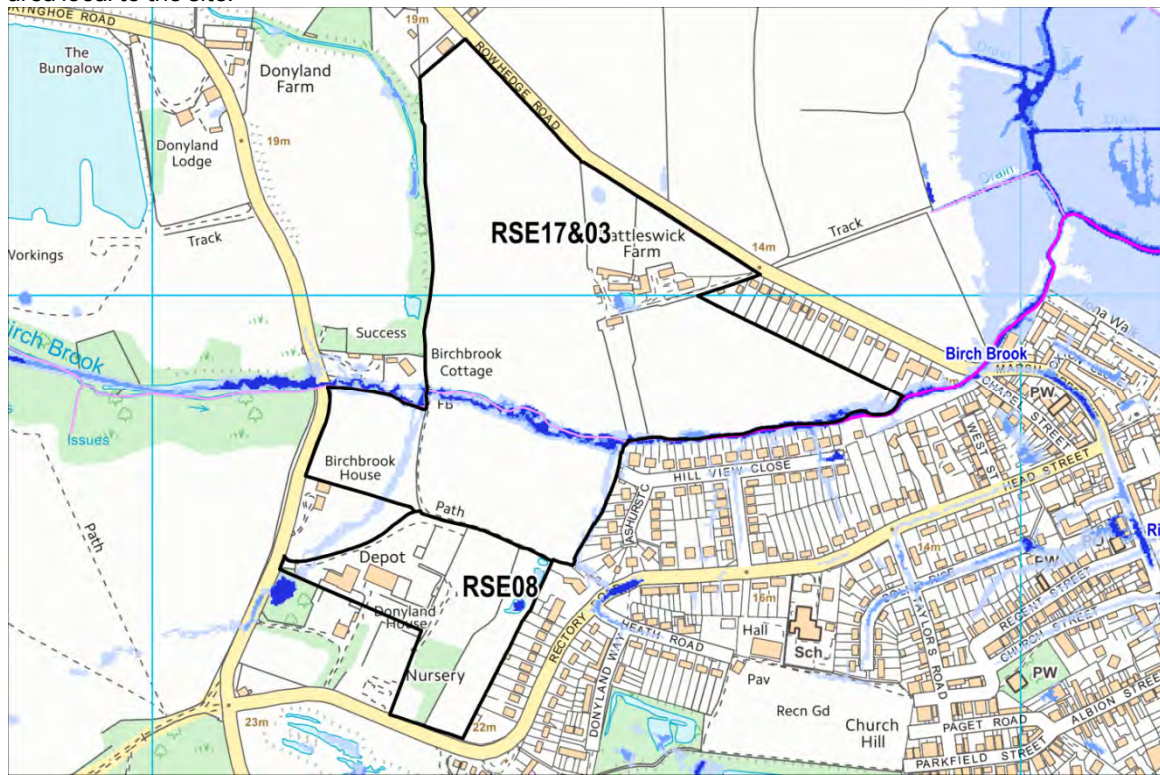
The RoFSW mapping and SWMP modelling indicate that the majority of the site is at very low risk of surface water flooding (<0.1% AEP). Surface water ponding is shown, as expected, along the channel and natural floodplain of the Birch Brook. The site layout should be carefully planned to incorporate SuDS at a strategic scale and carefully manage surface water to ensure that residential dwellings are not placed at surface water flood risk, and that the position of any new development does not divert the flow path to a neighbouring area.

Geology

The bedrock geology in this area is Thames Group, comprising clay and silt. Adjacent to the Birch Brook, this is overlain by alluvial clays and silts associated with the river environment. Further to the north and south of the Birch Brook, there are bands of Kesgrave catchment subgroup, comprising sand and gravel. Clayey ground is typically not very permeable and provides the potential for ponding of surface water on the ground surface during heavy rainfall.

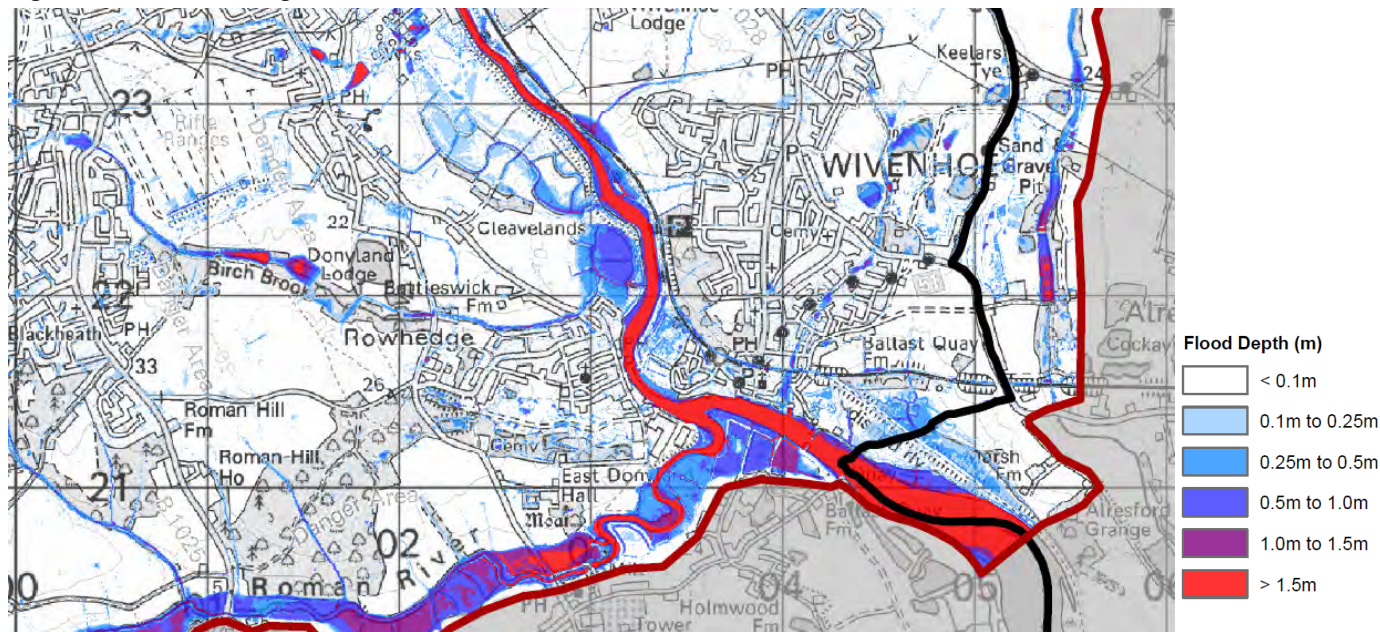
Historic Records

The site is not within the study area for the town of Colchester SWMP and is therefore not within a Critical Drainage Area (CDA). There are no historic records of flooding in the area local to the site.



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Figure C Risk of Flooding from Surface Water (RoFSW)



Site Assessment Summary – Battlewicks Farm / Land off Hillview Close / Rowhedge Business Park

Figure D Town of Colchester SWMP (Capita Symonds, 2013) Surface Water Modelling, 1% AEP Maximum Flood Depth

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	28.62 l/s	<i>(Rates have been provided for the total 20.87 hectare area).</i>
	1 in 1 year:	41.74 l/s	
	1 in 30 year:	65.83 l/s	
	1 in 100 year:	91.31 l/s	
<i>Drainage Hierarchy</i>	Infiltration to ground		Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse		Discharge possible to the Birch Brook, subject to consultation with the Environment Agency and/or Essex CC (depending on the location for discharge along the course of the river).
	Discharge to surface water sewer		Possible, subject to consultation with Anglian Water.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located within a 1km square of which 25-50% is susceptible to groundwater emergence. The risk of groundwater flooding in this area is therefore generally considered to be low. This will need to be confirmed during site investigation survey.

Other Sources

The Environment Agency 'Risk of Flooding from Reservoirs' mapping shows that the floodplain of the Birch Brook that passes through the site, is at risk of inundation in the event of a failure of the following reservoirs: Abberton Central and Western Arm (NGR 598901, 219790); and Abberton (NGR 598780, 219734). As noted in the Level 1 SFRA report, given the regular inspection of these reservoirs in accordance with the Reservoirs Act 1975, flooding from reservoirs is considered to be a managed risk.

Site Specific Recommendations

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.

Site Layout and Design

The majority of the site is defined as Flood Zone 1, low probability of flooding from the Birch Brook, and therefore it should be possible to locate all proposed development within Flood Zone 1. Residential development should be avoided in areas defined as Flood Zone 3a through the centre of the site, and instead lower vulnerability uses including landscaped open space should be located here. The drainage strategy for the site must be considered early in the site planning process to ensure adequate inclusion of SuDS. SuDS should be considered in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible). Storage features should not be located within the floodplain of the ordinary watercourse, as they may be rendered ineffective during times of fluvial flooding.

Set-back Distance

The Birch Brook is partially defined as an ordinary watercourse, and partially as main river. Essex CC, as the LLFA, requires at least a 3m set back on one side of ordinary watercourses 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. The Environment Agency will need to be consulted and an Environmental Permit obtained for any works within 8m of the main river section of the watercourse.

Finished Floor Levels

If residential development cannot be avoided within the flood extent of the Birch Brook for the 1% AEP event including climate change, finished floor levels should be set at least 300mm freeboard above the flood level for 1% AEP event including an appropriate allowance for climate change. In this case, for More Vulnerable development in Flood Zone 3a, the higher central (35%) climate change allowance should be used and tested against the upper (65%) climate change allowance also.

Access / Egress

Safe dry access to and from the site should be provided, and this should be achievable to the north and south of the site via Rowhedge Road and Rectory Road respectively.

Floodplain Compensation

Land raising and any built development should be avoided within the floodplain of the Birch Brook. Where alterations to the floodplain are proposed, compensatory floodplain storage will need to be provided on a level-for-level and volume-for-volume basis. The land used to provide compensation storage will need to be in hydraulic connectivity with the existing floodplain, but not already part of the floodplain.

Emergency Planning

The site is not shown to be within an Environment Agency Flood Warning Area; however residents should register to receive the warning service associated with the River Colne, into which the Birch Brook feeds. Due to the proximity of the site to the watercourse, Flood Response Plans should be prepared by residents of the site.

Summary

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.

Site Assessment Summary – Zoo Site, Maldon Road

Location: Colchester	SHLAA Ref /Ref: RSW10 (C135)	Area (ha): 173.5	Proposed use: Zoo expansion; potential for hotel development to be included in the proposals.	Vulnerability Classification: Hotel development is classified as More Vulnerable.
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for these sites as part of the preparation of the Local Plan Site Allocations.

Tidal and Fluvial Flood Risk

Flood Zone 1: 97%	Flood Zone 2: 0%	Flood Zone 3a: 3%	Flood Zone 3b: 0%
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Flood Zones and Flood Defences

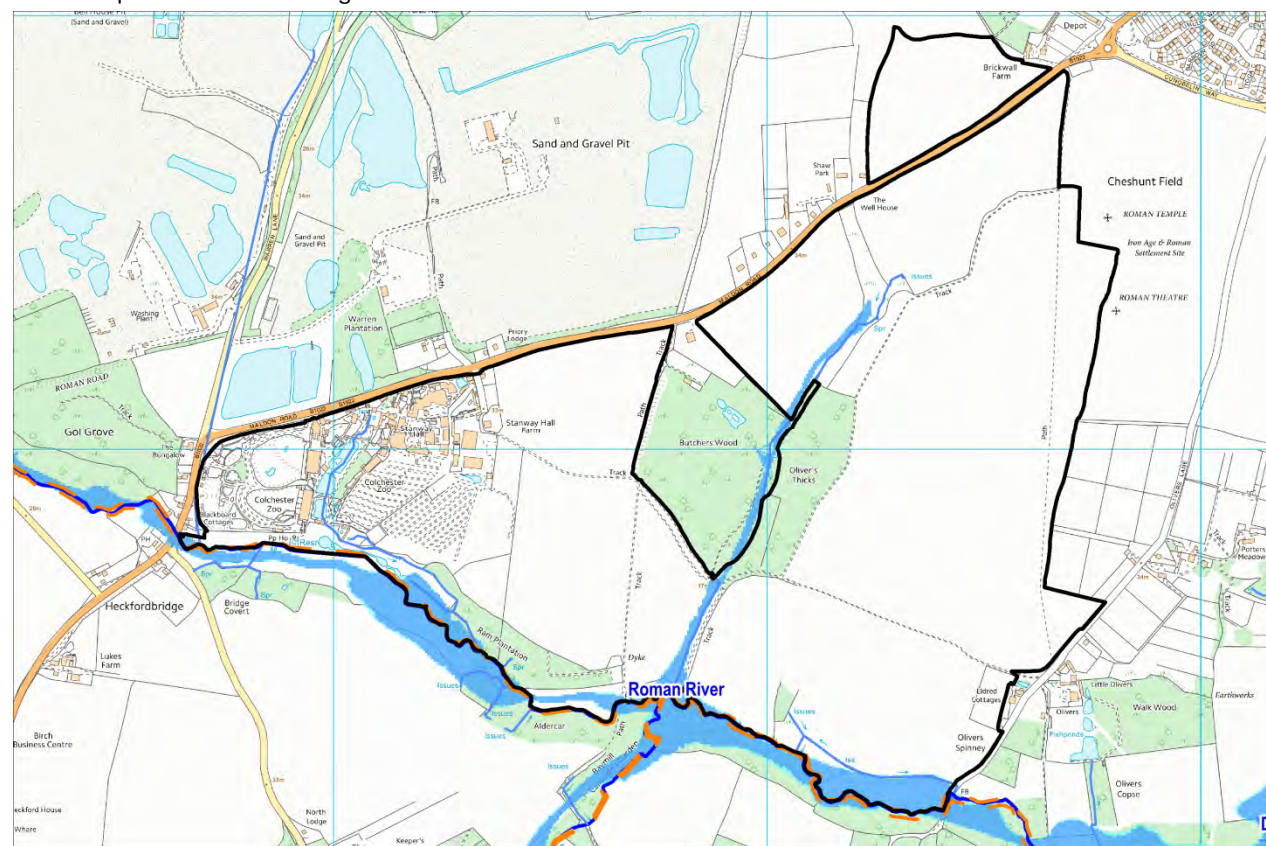
A tributary of the Roman River flows through the site from north to south, to join the Roman River, which flows from west to east along the southern boundary of the site. The vast majority of the site is defined as Flood Zone 1, low probability of flooding from these watercourses. The AIMS dataset identifies the presence of high ground adjacent to the Roman River along the southern edge of the site.

Functional Floodplain

Flood modelling of the ordinary watercourse and the Roman River, in this location, is derived from high level JFLOW modelling, and therefore outputs for Flood Zone 3b functional floodplain are not available for this watercourse. Further modelling is required to determine the extent of Flood Zones across the site, described further below in the 'site specific recommendations' section.

Climate Change

Flood modelling of the ordinary watercourse and the Roman River, in this location, is derived from high level JFLOW modelling, and therefore outputs including an allowance for the impact of climate change are not available for this watercourse.



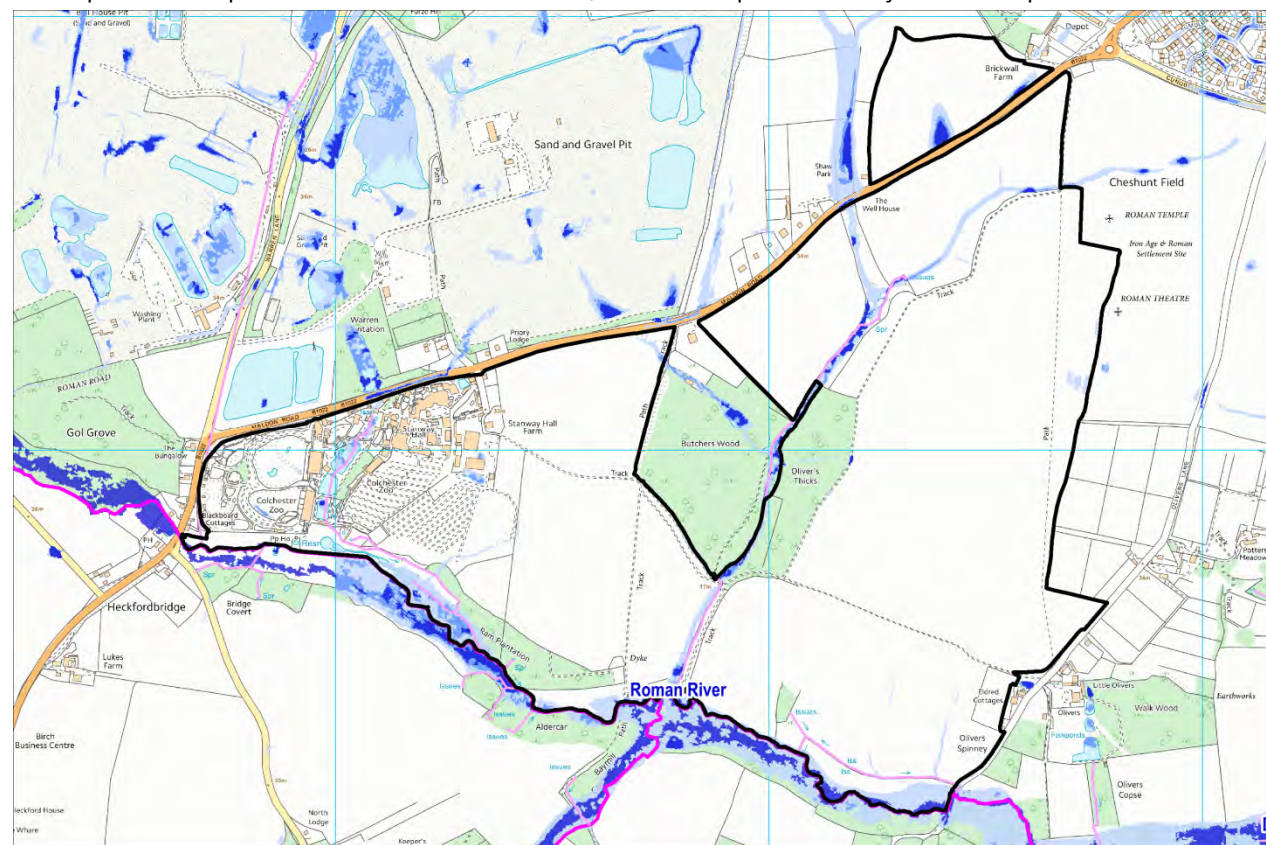
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Figure A Modelled Flood Extents

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW) and SWMP Modelling

The RoFSW mapping and SWMP modelling indicate that the vast majority of the site is at very low risk of surface water flooding (<0.1% AEP). The mapping shows that the risk of surface water flooding is concentrated in areas adjacent to the watercourses and their contributing flow paths. The site layout for any new elements within the zoo site should be carefully planned to tie into existing SuDS features and opportunities to retrofit SuDS as part of the development should be taken. It should be ensured that new development is not placed at surface water flood risk, and that the position of any new development does not divert the flow path to a neighbouring area.



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Figure B Risk of Flooding from Surface Water (RoFSW)

Site Assessment Summary – Zoo Site, Maldon Road

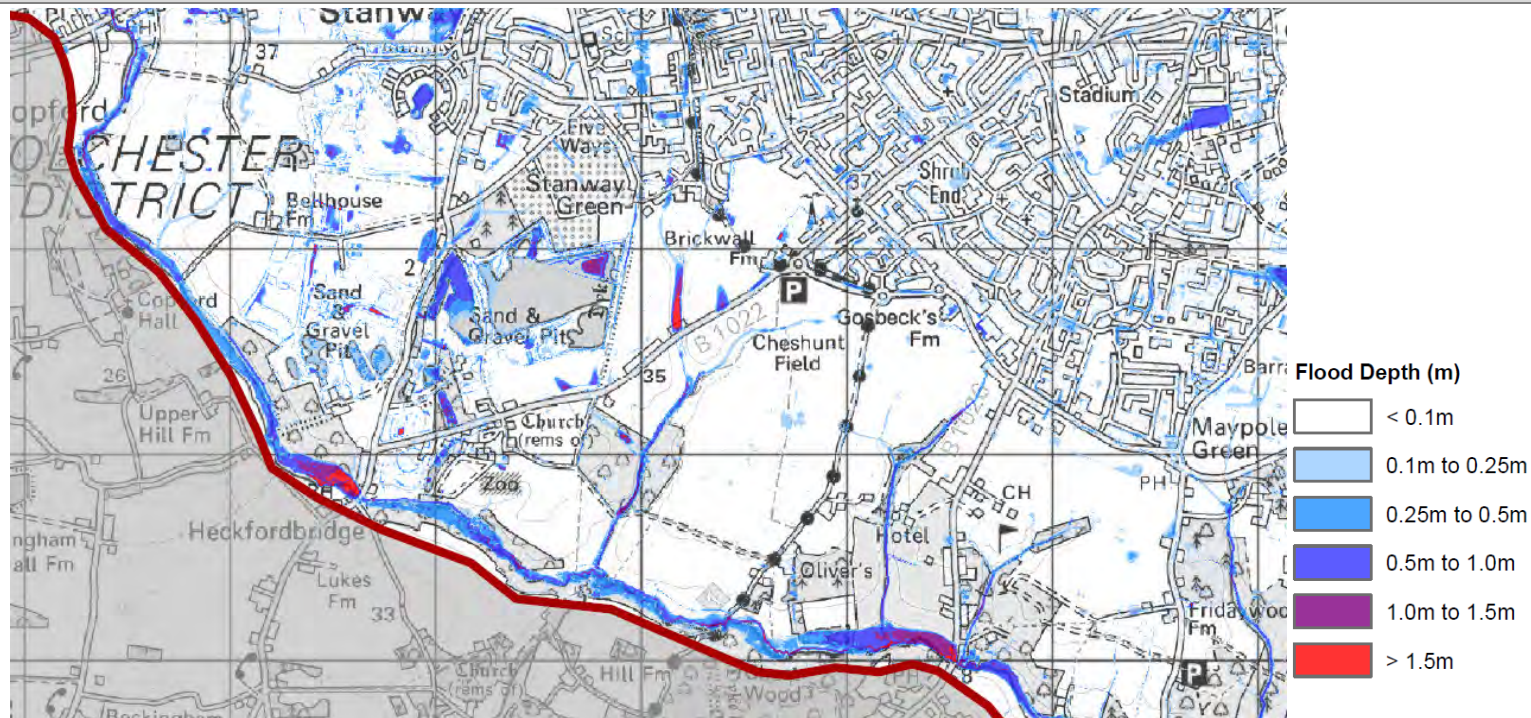


Figure C Town of Colchester SWMP (Capita Symonds, 2013) Surface Water Modelling, 1% AEP Maximum Flood Depth

Geology

The bedrock geology in this area is London Clay Formation, comprising clay, silt and sand. This is overlain by a number of different superficial geologies; immediately adjacent to the Roman River is alluvium, comprising clay, silt, sand and gravel; a band of Head, comprising clay, silt, sand and gravel is then present following the course of the ordinary watercourse that flows through the site; a band of Kesgrave catchment subgroup is also present adjacent to this watercourse, comprising sand and gravel. The rest of the site is overlain by Cover Sand, comprising clay, silt and sand.

The underlying presence of clay presents a ground surface that is typically not very permeable and may provide the potential for ponding of surface water on the ground surface during heavy rainfall.

Historic Records

The site is not within the study area for the town of Colchester SWMP and is therefore not within a Critical Drainage Area (CDA). There are no historic records of flooding in the area local to the site.

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	207 l/s
	1 in 1 year:	347 l/s
	1 in 30 year:	477 l/s
	1 in 100 year:	662 l/s
<i>Drainage Hierarchy</i>	Infiltration to ground	Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse	Discharge possible to the Roman River, subject to consultation with the Environment Agency.
	Discharge to surface water sewer	Possible, subject to consultation with Anglian Water.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located across a number of 1km squares with a broad range of groundwater emergence from <25% in the centre of the site, to >75% in the north east. The risk of groundwater flooding in this area is considered to be variable and more detailed information regarding the conditions will need to be confirmed during site investigation survey.

Other Sources

The Environment Agency 'Risk of Flooding from Reservoirs' mapping shows that the floodplain of the Roman River adjacent to the southern edge of the site, is at risk of inundation in the event of a failure of the following reservoirs: Abberton Central and Western Arm (NGR 598901, 219790); and Abberton (NGR 598780, 219734). As noted in the Level 1 SFRA report, given the regular inspection of these reservoirs in accordance with the Reservoirs Act 1975, flooding from reservoirs is considered to be a managed risk.

Site Specific Recommendations

Fluvial Modelling

Depending on the location of the new elements of development proposed for the zoo site, a simple hydraulic model may need to be developed to more accurately determine the probability of flooding across the site from the tributary of the Roman River. 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.

Site Layout and Design

The majority of the site is defined as Flood Zone 1, low probability of flooding from the ordinary watercourse, and therefore it should be possible to steer new development towards areas within Flood Zone 1. More vulnerable development (i.e. hotel development) should be avoided in areas defined as Flood Zone 3a. The drainage strategy for the new development must be considered early in the site planning process to ensure adequate inclusion of SuDS, and retrofitting of SuDS where possible. SuDS should be considered in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible).

Set-back Distance

In the southern part of the site, development must be set back at least 8m from the Roman River (main river). The Environment Agency will need to be consulted and an Environmental Permit obtained for any works within 8m of the watercourse.

All development should be set back from the ordinary watercourses. Essex CC, as the LLFA, requires at least a 3m set back on one side of the watercourses 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

If More Vulnerable hotel development cannot be avoided within the flood extent of the Roman River and its tributary for the 1% AEP event including climate change, finished floor levels should be set at least 300mm freeboard above the flood level for 1% AEP event including an appropriate allowance for climate change. In this case, for More Vulnerable development in Flood Zone 3a, the higher central (35%) climate change allowance should be used and tested against the upper (65%) climate change allowance also.

Access / Egress

It is assumed that access to the site is provided to the west and the north, via Maldon Road (B1022). This route is located in Flood Zone 1 and will therefore provide a safe dry access route to and from the site.

Floodplain Compensation

Land raising and any built development should be avoided within the floodplain of the ordinary watercourses and Roman River. Where alterations to the floodplain are proposed, compensatory floodplain storage will need to be provided on a level-for-level and volume-for-volume basis. The land used to provide compensation storage will need to be in hydraulic connectivity with the existing floodplain, but not already part of the floodplain.

Site Assessment Summary – Zoo Site, Maldon Road

Emergency Planning

The site is not shown to be within an Environment Agency Flood Warning Area. Due to the proximity to the watercourses, flood response planning should be considered by the zoo management, as part of their emergency planning procedures.

Summary

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.

Site Assessment Summary – Land east of Queensberry Road

Location: Copford	SHLAA Ref /Ref: STN26 (S0201)	Area (ha): 3.03	Proposed use: Residential (70 dwellings)	Vulnerability Classification: More Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for these sites as part of the preparation of the Local Plan Site Allocations.

Tidal and Fluvial Flood Risk

Flood Zone 1: 100%	Flood Zone 2: 0%	Flood Zone 3a: 0%	Flood Zone 3b: 0%
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Flood Zones and Flood Defences

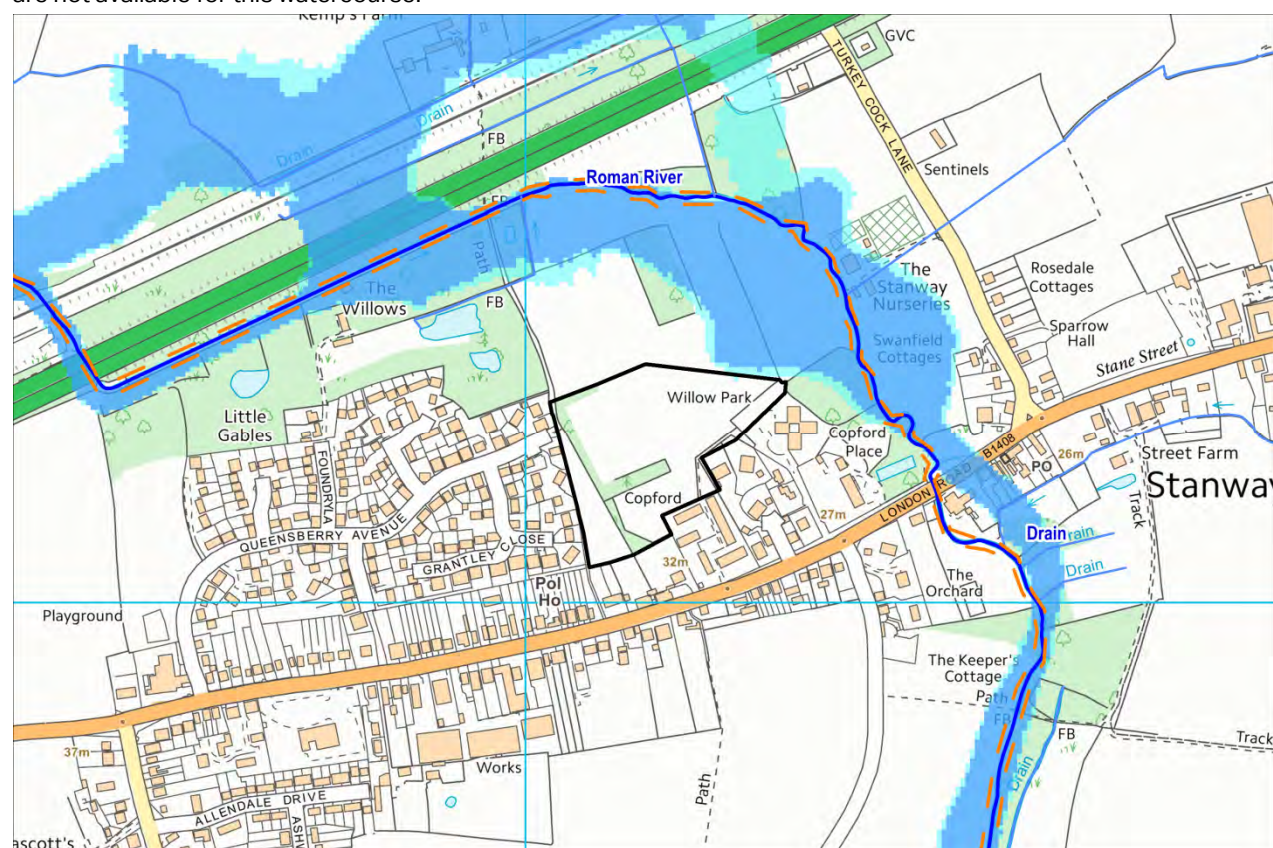
The Roman River flows from north to south in open channel approximately 100-150m to the north and east of the site. The site borders areas defined as Flood Zone 3a high probability of flooding from the Roman River. The AIMS dataset identifies the presence of high ground either side of the Roman River at this location. The site is located entirely within Flood Zone 1, and is therefore currently considered to be at low risk of flooding from the Roman River. This designation is based on high level JFLOW modelling, which may need to be reviewed as part of a site specific FRA, as described further below.

Functional Floodplain

Flood modelling of the Roman River in this location is derived from high level JFLOW modelling, and therefore outputs for Flood Zone 3b functional floodplain are not available for this watercourse. Further modelling is required to determine the extent of Flood Zones across the site, described further below in the 'site specific recommendations' section.

Climate Change

Flood modelling of the Roman River in this location is derived from high level JFLOW modelling, and therefore outputs including an allowance for the impact of climate change are not available for this watercourse.



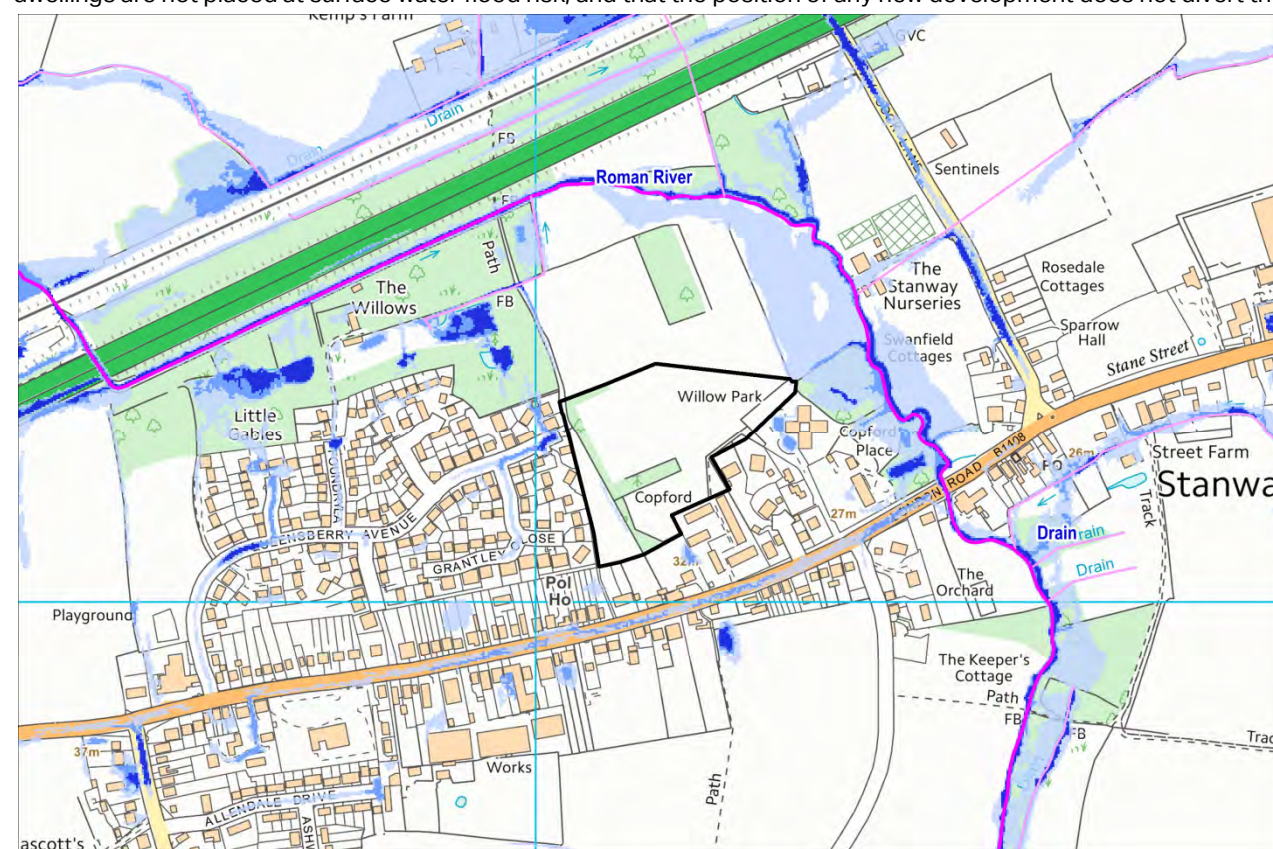
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Figure A Modelled Flood Extents

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW)

The RoFSW mapping indicates that the site is at very low risk of surface water flooding (<0.1% AEP). The site layout should be carefully planned to ensure that residential dwellings are not placed at surface water flood risk, and that the position of any new development does not divert the flow path to a neighbouring area.



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Figure B Risk of Flooding from Surface Water (RoFSW)

Geology

The bedrock geology in this area is London Clay Formation, comprising clay, silt and sand, which is overlain by clay, silty and sandy Cover Sand. Underlying clay conditions are typically not very permeable and provide the potential for ponding of surface water on the ground surface during heavy rainfall.

Historic Records

Site Assessment Summary – Land east of Queensberry Road

The site is not within the study area for the town of Colchester SWMP and is therefore not within a Critical Drainage Area (CDA). There are no historic records of flooding in the area local to the site.

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	4.16 l/s
	1 in 1 year:	6.06 l/s
	1 in 30 year:	9.56 l/s
	1 in 100 year:	13.26 l/s

<i>Drainage Hierarchy</i>	Infiltration to ground		Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse		Discharge possible to the Roman River, subject to consultation with the Environment Agency.
	Discharge to surface water sewer		Possible, subject to consultation with Anglian Water.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located within a 1km square of which 25-50% is susceptible to groundwater emergence. The risk of groundwater flooding in this area is therefore generally considered to be low. This will need to be confirmed during site investigation survey.

Other Sources

The site is not shown to be at risk of inundation in the event of a failure of a reservoir on the Environment Agency 'Risk of Flooding from Reservoirs' mapping.

Site Specific Recommendations

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 Roman River. 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.

Site Layout and Design

The site is currently defined as Flood Zone 1, low probability of flooding from the Roman River, and therefore it should be possible to locate all proposed development within Flood Zone 1. This will need to be verified following revised modelling of the Roman River. The drainage strategy for the site must be considered early in the site planning process to ensure adequate inclusion of SuDS. SuDS should be considered in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible).

Finished Floor Levels

Following the preparation of hydraulic modelling for the Roman River, if residential development cannot be avoided within the flood extent of the Roman River Brook for the 1% AEP event including climate change, finished floor levels should be set at least 300mm freeboard above the flood level for 1% AEP event including an appropriate allowance for climate change. In this case, for More Vulnerable development in Flood Zone 3a, the higher central (35%) climate change allowance should be used and tested against the upper (65%) climate change allowance also.

Access / Egress

Safe dry access to and from the site should be provided, and this should be achievable to the south of the site via London Road. The Roman River passes beneath this road to the south east of the site, and therefore egress away from the site may need to be along London Road to the west.

Floodplain Compensation

Land raising and any built development should be avoided within the floodplain of the Roman River. Depending on the results of the hydraulic modelling for the Roman River, where alterations to the floodplain are proposed, compensatory floodplain storage may need to be provided on a level-for-level and volume-for-volume basis. The land used to provide compensation storage will need to be in hydraulic connectivity with the existing floodplain, but not already part of the floodplain.

Emergency Planning

The site is not shown to be within an Environment Agency Flood Warning Area. Depending on the results of the hydraulic modelling, and the flood risk to the site from the Roman River, Flood Response Plans may be required for residents of the site.

Summary

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.

Site Assessment Summary – Essex University Employment Zone

Location: Colchester	SHLAA Ref /Ref: -	Area (ha): 11.77	Proposed use: Employment uses	Vulnerability Classification: Less Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for these sites as part of the preparation of the Local Plan Site Allocations.

Less Vulnerable development proposed in areas of Flood Zone 3a is not subject to the Exception Test. However, Colchester BC is including a Level 2 site assessment for this site at this stage to cover the possibility that the proposals may include residential development in the future.

Tidal and Fluvial Flood Risk

Flood Zone 1: 84%	Flood Zone 2: 11%	Flood Zone 3a: 5%	Flood Zone 3b: 0%
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Flood Zones and Flood Defences

The Salary Brook flows from north to south round the north west edge of the site, and joins the River Colne approximately 450m to the south of the site. The Salary Brook is a designated main river in this location, and the AIMS dataset identifies the presence of high ground either side of the watercourse in this area. The Colne Barrier is located approximately 3.5km downstream at Wivenhoe and provides protection when water levels are forecast to rise greater than 3.2mAOD.

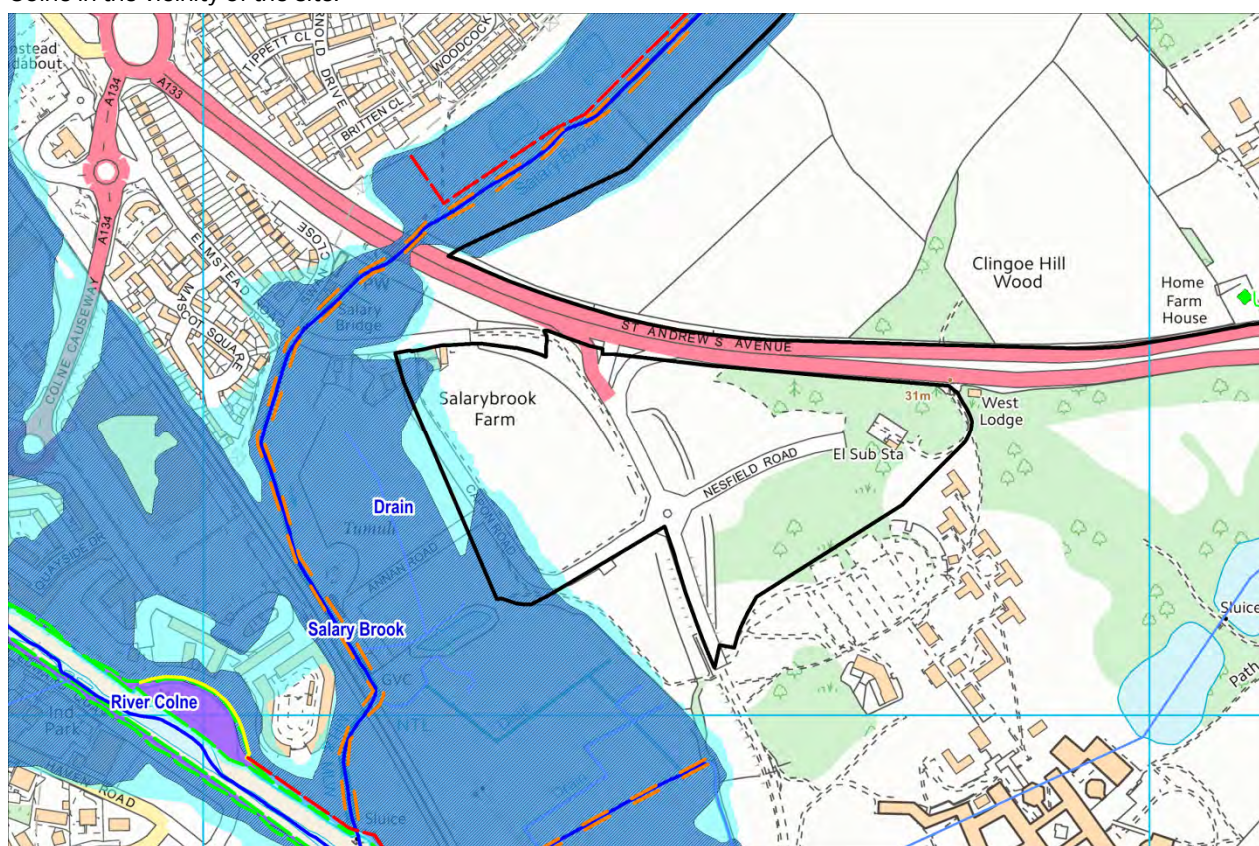
Functional Floodplain

The current modelling of the Salary Brook did not include a scenario to delineate the functional floodplain. Outputs for Flood Zone 3b functional floodplain are not currently available for this watercourse. Further modelling is required to determine the extent of Flood Zones across the site, described further below in the 'site specific recommendations' section.

Climate Change

The current modelling of the Salary Brook did not include a scenario to determine the probability of flooding including an allowance for climate change. Outputs including an allowance for the impact of climate change are not currently available for this watercourse.

Modelling of the Colne and Blackwater Estuary shows that during the 0.5% AEP flood event, including an allowance for climate change, tidal water remains in bank of the River Colne in the vicinity of the site.

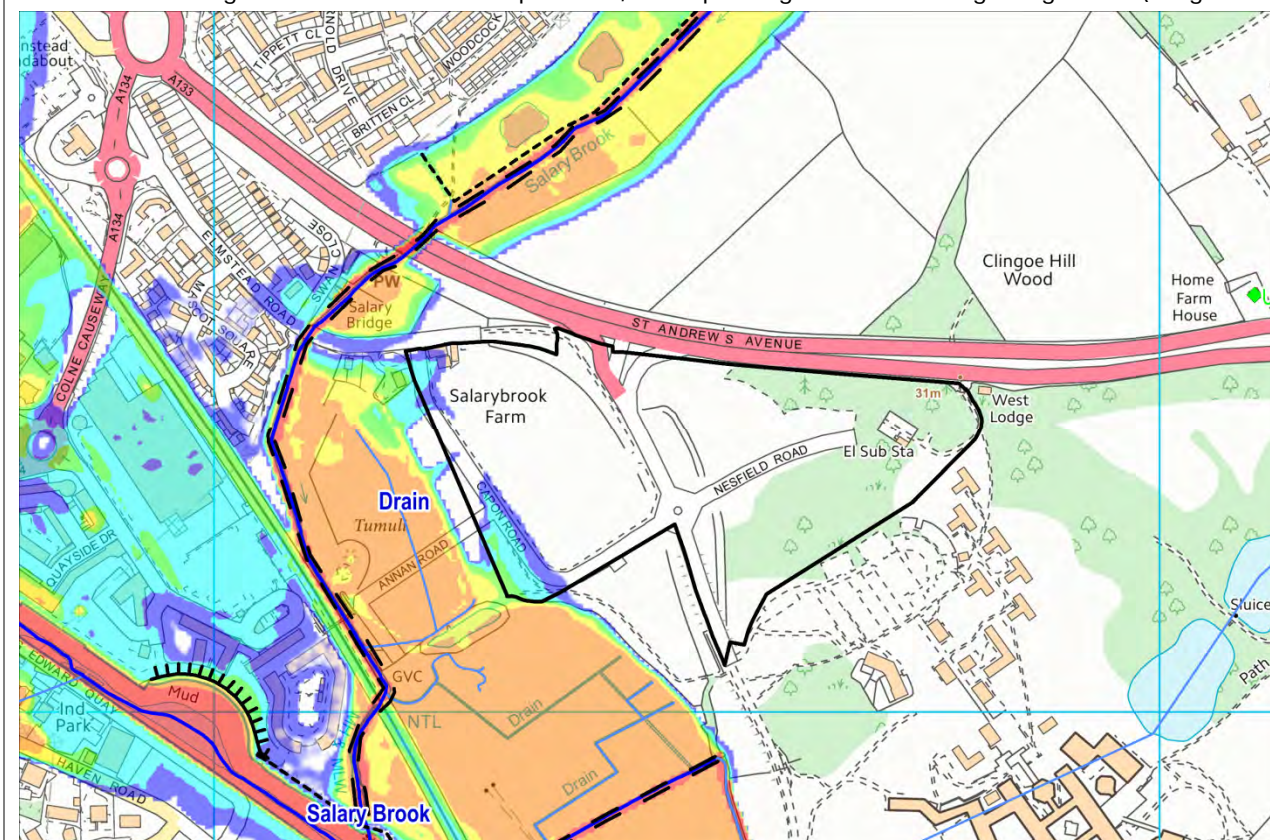


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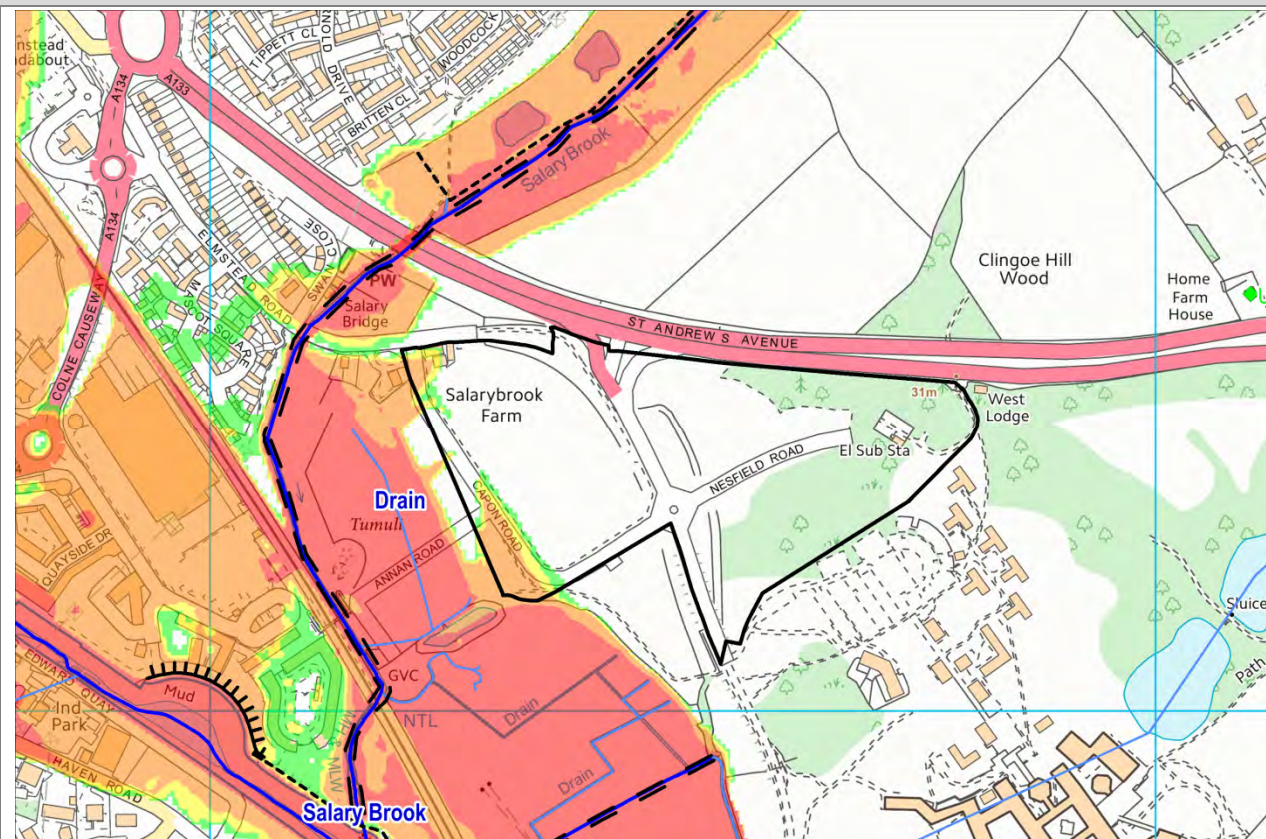
Figure A Modelled Flood Extents

Residual Risk – Failure of the Colne Barrier at Wivenhoe

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 show that flood depths on the western fringe of the site could reach up to 1.5m, corresponding to a hazard rating of Significant (danger for most people).



Site Assessment Summary – Essex University Employment Zone



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Figure B Colne Barrier Breach Assessment; 0.5% AEP including Climate Change, Maximum Flood Depth and Hazard

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW) and SWMP Modelling

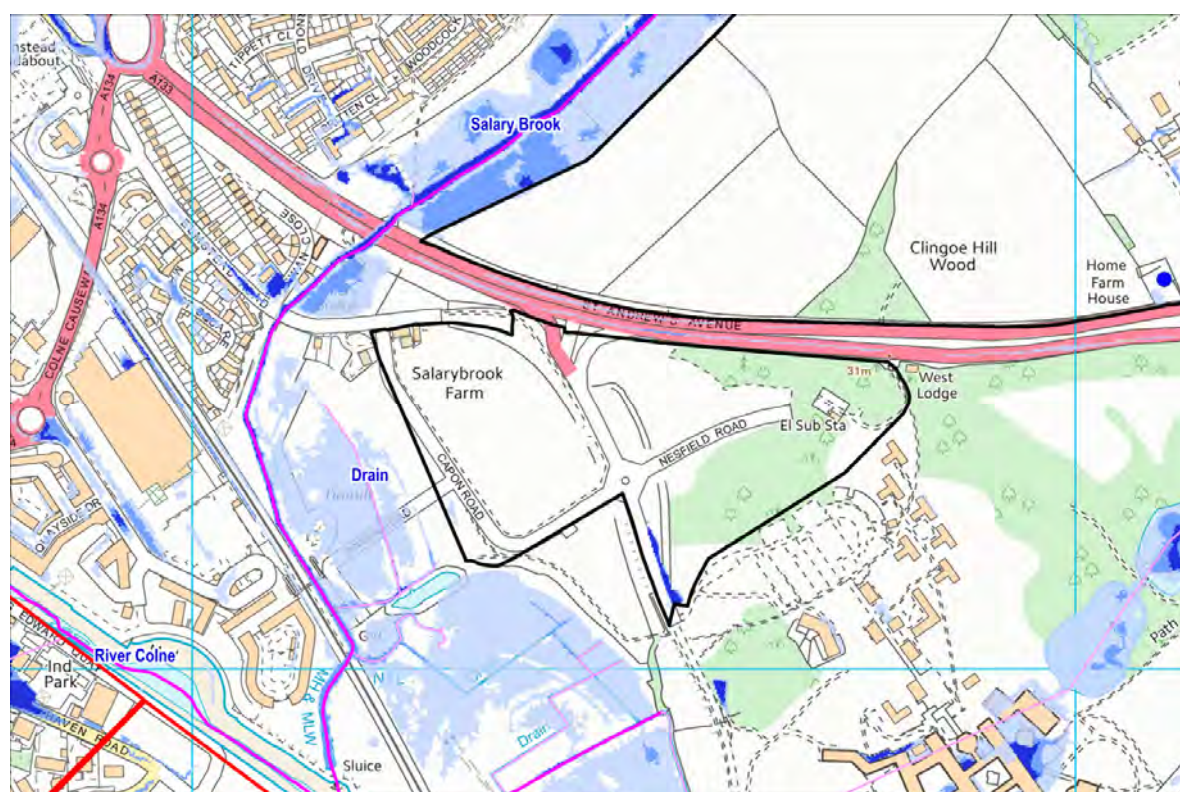
The RoFSW mapping and SWMP modelling indicate that the majority of the site is at very low risk of surface water flooding (<0.1% AEP). The site layout should be carefully planned to ensure that new development is not placed at surface water flood risk, and that the position of any new development does not divert the flow path to a neighbouring area.

Geology

The bedrock geology in this area is Thames Group, comprising clay and silt. This is generally overlain by Cover Sand across the site, with a narrow band of Kesgrave Catchment subgroup (comprising sand and gravel) also running through the site near the route of the Salary Brook. Clayey ground formation is typically not very permeable and may provide the potential for ponding of surface water on the ground surface during heavy rainfall.

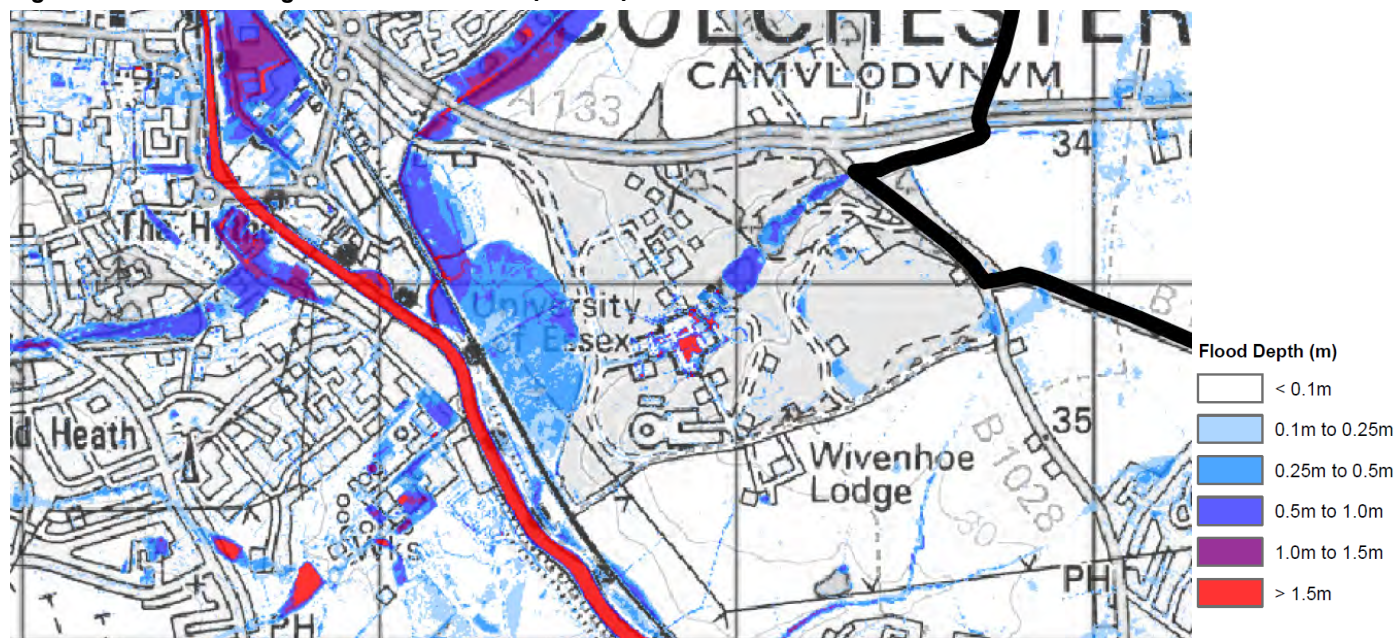
Historic Records

The site is not shown to lie within a Critical Drainage Area (CDA) identified during the preparation of the town of Colchester SWMP. There are historic records of flooding to the north east of the site; however the source of flooding is not recorded.






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Figure C Risk of Flooding from Surface Water (RoFSW)



Site Assessment Summary – Essex University Employment Zone

Figure D Town of Colchester SWMP (Capita Symonds, 2013) Surface Water Modelling, 1% AEP Maximum Flood Depth

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	16.14 l/s
	1 in 1 year:	23.54 l/s
	1 in 30 year:	37.13 l/s
	1 in 100 year:	51.49 l/s
<i>Drainage Hierarchy</i>	Infiltration to ground	 Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse	 Discharge possible to the Salary Brook, subject to consultation with the Environment Agency.
	Discharge to surface water sewer	 Possible, subject to consultation with Anglian Water.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located within 1km squares, less than 25% of which and 25-50% of which are susceptible to groundwater emergence. The risk of groundwater flooding in this area is therefore generally considered to be low. This will need to be confirmed during site investigation survey.

Other Sources

The Environment Agency 'Risk of Flooding from Reservoirs' mapping shows that the floodplains of the River Colne and Salary Brook, which flow adjacent to the site, are at risk of inundation in the event of a failure of the following reservoirs: Ardleigh (NGR 603487, 228024); Abberton Central and Western Arm (NGR 598901, 219790); and Abberton (NGR 598780, 219734). As noted in the Level 1 SFRA report, given the regular inspection of these reservoirs in accordance with the Reservoirs Act 1975, flooding from reservoirs is considered to be a managed risk.

Site Specific Recommendations

Fluvial Modelling

As part of a site specific FRA for this site, a simple hydraulic model may need to be developed for the Salary Brook, to more accurately determine the probability of flooding across the site and to inform appropriate finished floor levels for any proposed More Vulnerable development. 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.

Site Layout and Design

In accordance with the sequential approach, development should be steered away from those areas identified as Flood Zone 3a. The drainage strategy for the new elements of the site should be considered early in the site planning process to ensure adequate inclusion of SuDS. New development on this site is likely to be delivered in phases, however it will be important that SuDS design is considered at a strategic scale for the entire development area, to maximise the effectiveness of the strategy. SuDS should be considered in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible).

Finished Floor Levels

For any new More Vulnerable (e.g. residential development) that may be proposed within the floodplain of the Salary Brook, finished floor levels should be set at least 300mm freeboard above the flood level for 1% AEP event including an appropriate allowance for climate change. In this case, for More Vulnerable development in Flood Zone 3a, the higher central (35%) climate change allowance should be used and tested against the upper (65%) climate change allowance also.

Access / Egress

Safe dry access to and from the site should be provided, and this should be achievable via St Andrews Avenue (A133), to the north of the site. This route is not shown to be at residual risk of tidal flooding in the event of a breach of the Colne Barrier.

Emergency Planning

The western fringe of the site is within the Environment Agency Flood Warning Area for the Tidal River Colne upstream of the Colne Barrier. Occupants of the site may wish to register to receive the warning service given the proximity to the tidal River Colne and the risk posed to the local area.

Summary

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.

Area Assessment Summary – Marks Tey (West Colchester) Garden Settlement

Location: Marks Tey, West Colchester	SHLAA Ref /Ref: -	Area (ha): 1,209	Proposed use: Mixed including residential – 1,350 dwellings towards end of LP period	Vulnerability Classification: More Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for this area as part of the preparation of the Local Plan Site Allocations.

Tidal and Fluvial Flood Risk

Flood Zone 1: 94%	Flood Zone 2: 3%	Flood Zone 3a: 3%	Flood Zone 3b: 0%
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Flood Zones and Flood Defences

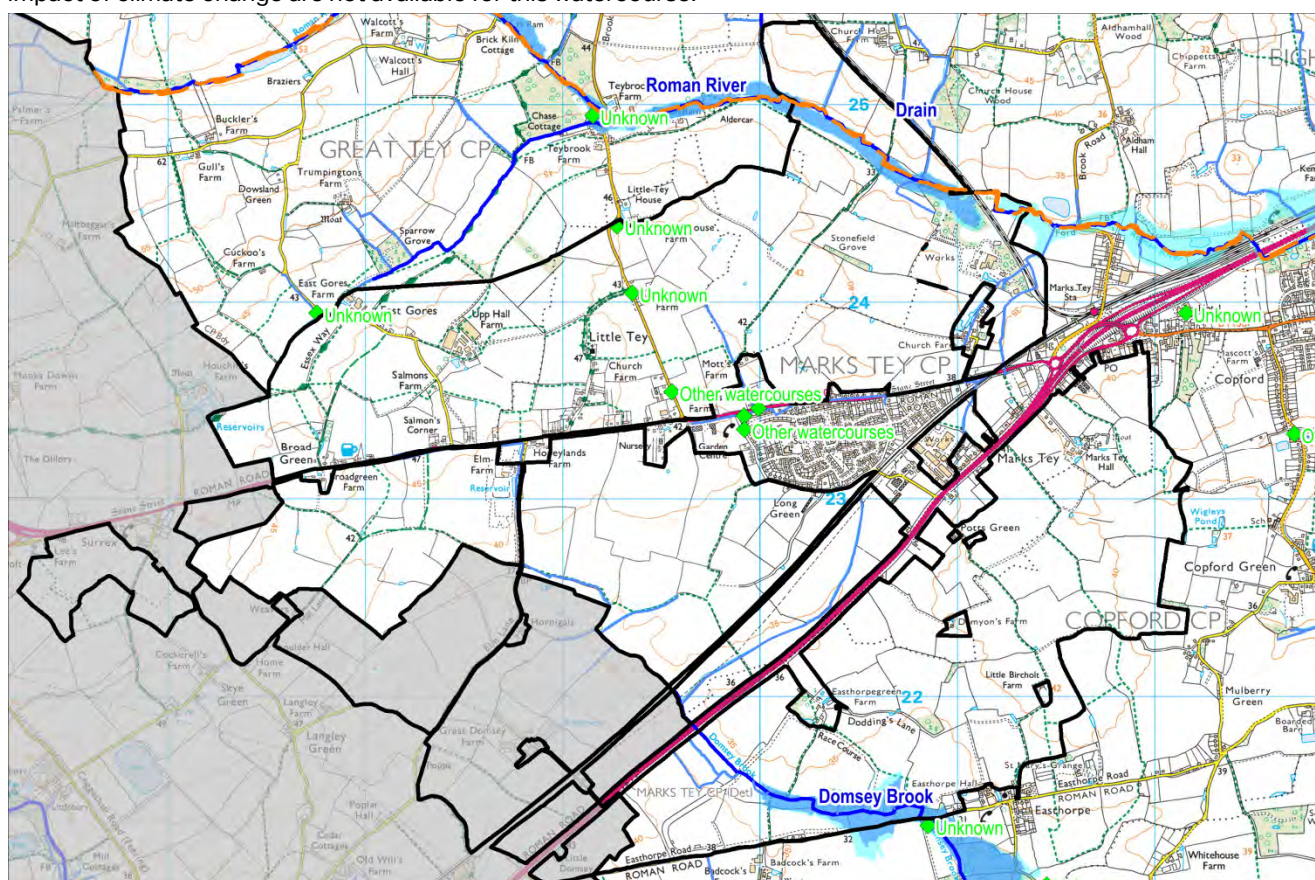
The Garden Settlement area is predominantly located in Flood Zone 1, low probability of flooding from fluvial watercourses. The Roman River flows from west to east through the northern part of the site. The AIMS dataset identifies the presence of high ground either side of the watercourse. The Domsey Brook flows from north west to south east through the south of the site close to the boundary with Braintree DC. The floodplains associated with these watercourses are approximately 100-150m wide. There are a number of tributaries that feed into these watercourses throughout the proposed Garden Settlement area.

Functional Floodplain

Flood modelling of the Roman River and Domsey Brook in this location is derived from high level JFLOW modelling, and therefore outputs for Flood Zone 3b functional floodplain are not available for this watercourse. Further modelling is required to determine the extent of Flood Zones across the site, described further below in the 'site specific recommendations' section.

Climate Change

Flood modelling of the Roman River and Domsey Brook in this location is derived from high level JFLOW modelling, and therefore outputs including an allowance for the impact of climate change are not available for this watercourse.



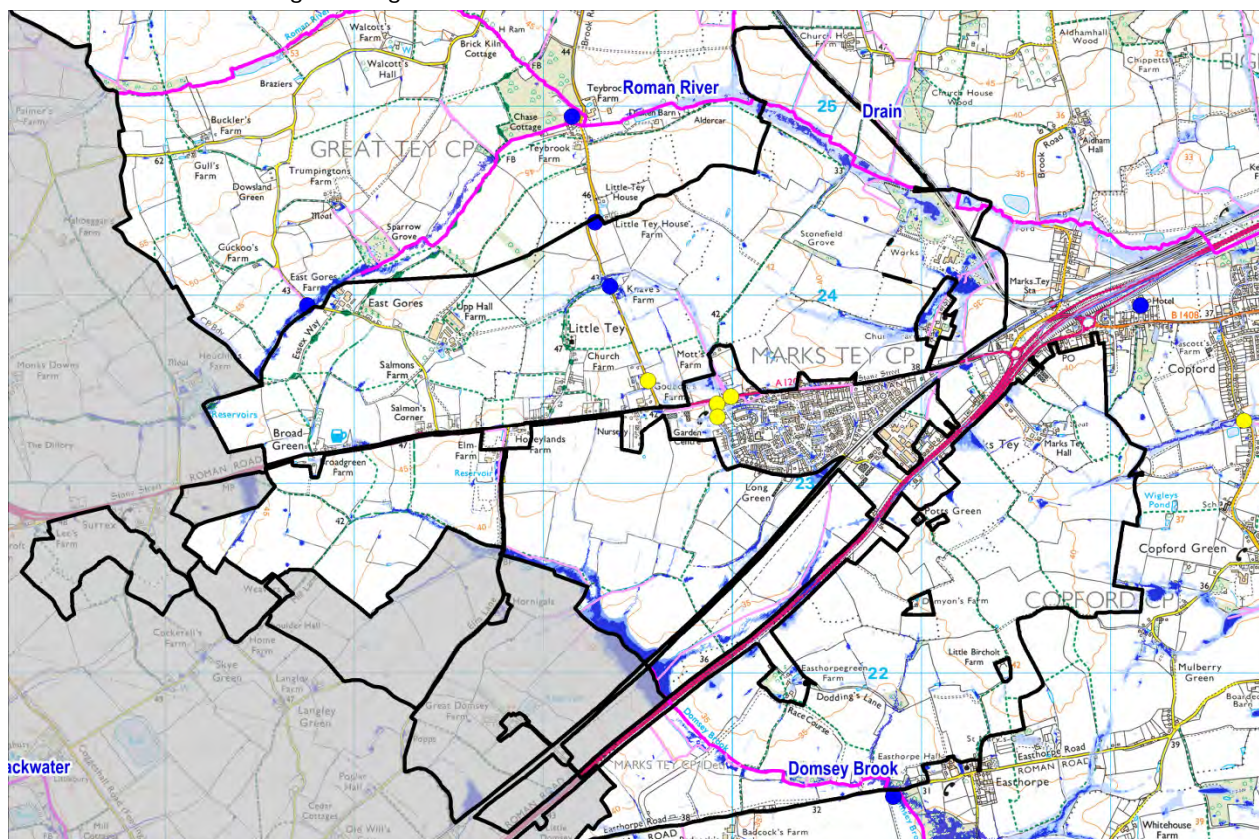
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Figure A Modelled Flood Extents

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW)

The RoFSW mapping indicates that the floodplain of the Domsey Brook and smaller watercourses are susceptible to the ponding of surface water, and some of these areas are at high risk of surface water flooding (>3.3% AEP). The management of surface water throughout the entire Garden Settlement area should be considered early in the master planning process to ensure that adequate provision is made, taking into account the impact of climate change on the frequency and intensity of future rainfall events. The site layout should be carefully planned to ensure that new development is not placed at surface water flood risk, and not contribute to diversion of flowpaths and/or increased flood risk to neighbouring and/or downstream areas.



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Area Assessment Summary – Marks Tey (West Colchester) Garden Settlement

Figure B Risk of Flooding from Surface Water (RoFSW)




Geology

The bedrock geology in this area is London Clay Formation comprising clay, silt and sand. The majority of the area is overlain by sand and gravel superficial deposits that form the Lowestoft Formation. There are some alluvial deposits (clay, silt, sand and gravel), present along the floodplains of the Roman River in the north of the site, and the Domsey Brook in the south. Underlying clay geology is not very permeable and may provide the potential for ponding of surface water on the ground surface during heavy rainfall.

Historic Records

The Marks Tey area is not within the study area for the town of Colchester SWMP and is therefore not within a Critical Drainage Area (CDA). There are approximately 11 historic records of flooding near the site and in the local area. As detailed in the Section 4.4 of the Level 1 SFRA Report, flooding at this location has led to the internal flooding of at least one property and one commercial property on more than one occasion (in 2008 and 2009) and the gardens/outhouses of a large number of properties. Additionally there is regular highway flooding of Mott's Lane, Godmans Lane and Wilsons Lane. Following heavy and prolonged rainfall events, surface water is observed overtopping the banks of two ordinary watercourses¹³.

An Essex CC Flood Investigation Report identifies that flooding is likely to be due to the constricted nature of the two ordinary watercourses which enter a sewer system within the developed area of Marks Tey before opening back into an open channel. The condition of the majority of the open sections of ordinary watercourse and at least one culvert within the flood investigation area was reported to be poor and the Flood Investigation Report recommended these should be cleared, cleansed and where applicable re-graded.

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	1,167 l/s	
	1 in 1 year:	2,418 l/s	
	1 in 30 year:	2,686 l/s	
	1 in 100 year:	3,725 l/s	
<i>Drainage Hierarchy</i>	Infiltration to ground		Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse		Discharge possible to the Roman River in the north of the site, and to the Domsey Brook in the south of the site, subject to consultation with the Environment Agency. Discharge possible to ordinary watercourses, subject to consultation with Essex CC.
	Discharge to surface water sewer		Possible, subject to consultation with Anglian Water.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the western part of the Garden Settlement Area is located within 1km squares in which no part is identified as being susceptible to groundwater flooding. The northern, southern, and eastern parts of the area are within 1km squares in which <25% or 25-50% may be susceptible to groundwater emergence. In combination with the presence of the underlying London clay geology, the risk of groundwater flooding in this area is therefore generally considered to be low. This will need to be confirmed during site investigation surveys through the area.

Other Sources

This area is not shown to be at risk of inundation in the event of a failure of a reservoir on the Environment Agency 'Risk of Flooding from Reservoirs' mapping.

Site Specific Recommendations

Fluvial Modelling

As part of a site specific FRA for this area, a simple hydraulic model should be developed to more accurately determine the probability of flooding from the Roman River and Domsey Brook, and their contributing tributaries. 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.

Site Layout and Design

Residential development should be avoided in areas defined as Flood Zone 3a or 3b adjacent to the Roman River and Domsey Brook. The strategy for surface water management across the Garden Settlement area must be considered early in the site master planning process to ensure adequate inclusion of SuDS. SuDS should be considered in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible).

Set-back Distance

The Roman River and the Domsey Brook are main rivers, and therefore all development should be set back at least 8m from these watercourses. The Environment Agency will need to be consulted and an Environmental Permit obtained for any works within 8m of the watercourse. Essex CC, as the LLFA, requires at least a 3m set back on one side of ordinary watercourses 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

If residential development cannot be avoided within the flood extent for the 1% AEP event including climate change for any of the watercourses in the area, finished floor levels should be set at least 300mm freeboard above the flood level for 1% AEP event including an appropriate allowance for climate change. In this case, for More Vulnerable development in Flood Zone 3a, the higher central (35%) climate change allowance should be used and tested against the upper (65%) climate change allowance also.

Access / Egress

Safe dry access to and from new development should be provided. Given the general low risk of fluvial flooding through the area this should be achievable.

Floodplain Compensation

Land raising and any built development should be avoided within the floodplain. Where alterations to the floodplain are proposed, compensatory floodplain storage will need to be provided on a level-for-level and volume-for-volume basis. The land used to provide compensation storage will need to be in hydraulic connectivity with the existing floodplain, but not already part of the floodplain.

Emergency Planning

The site is not shown to be within an Environment Agency Flood Warning Area. Depending on the proximity of new development to the local watercourses, Flood Response Plans may need to be prepared by residents of the site.

Summary

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.

¹³ Essex County Council, 2013. *Marks Tey Flood Investigation Report*

Area Assessment Summary – East Colchester Garden Settlement

Location: East Colchester	SHLAA Ref /Ref: -	Area (ha): 154	Proposed use: Mixed incl. Residential (1,250 dwellings in Colchester within LP period)	Vulnerability Classification: More Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for this area as part of the preparation of the Local Plan Site Allocations.

Tidal and Fluvial Flood Risk

Flood Zone 1: 94%	Flood Zone 2: 3%	Flood Zone 3a: 3%	Flood Zone 3b: 0%
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Flood Zones and Flood Defences

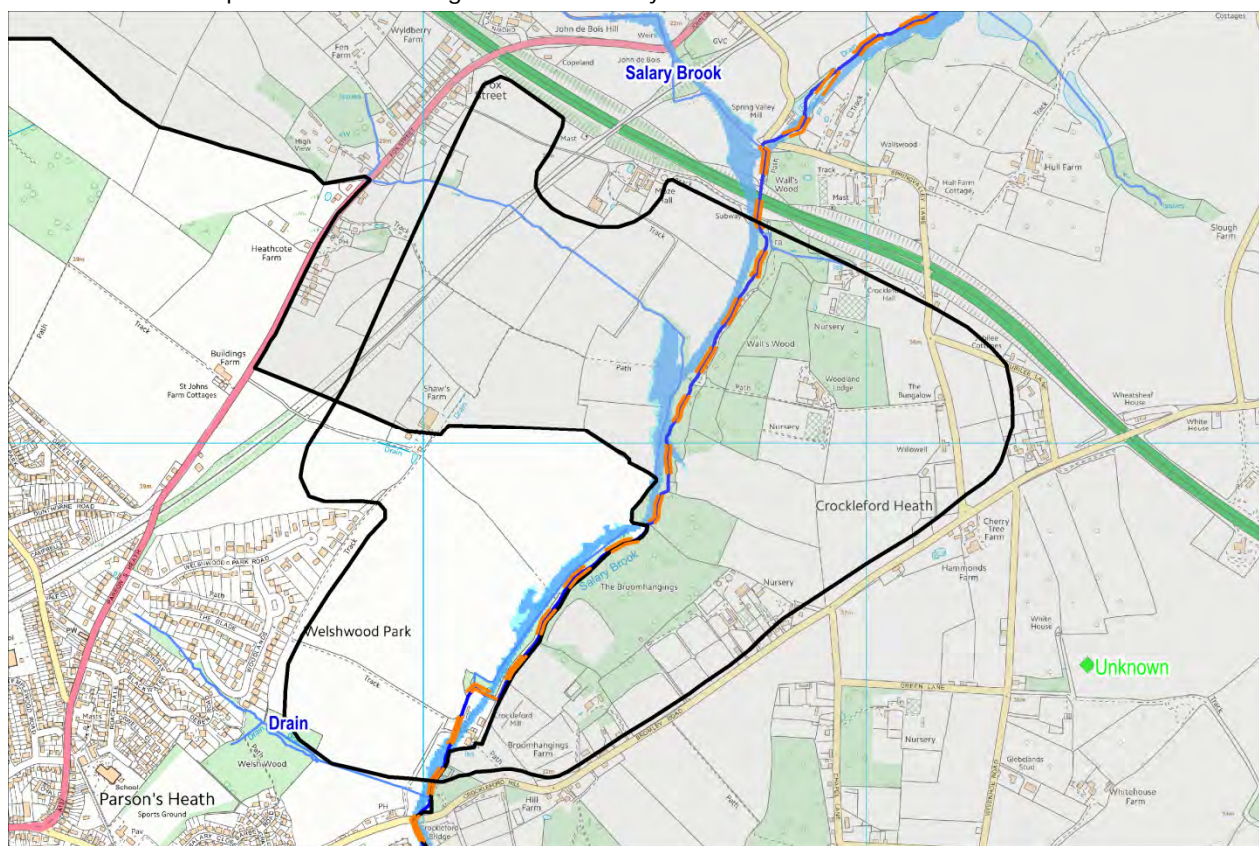
The Salary Brook flows from north to south in open channel through the centre of the potential Garden Settlement area, which is partially located within the administrative area of Tendring DC. The AIMS dataset identifies the presence of high ground either side of the Salary Brook in this location. There is also an ordinary watercourse tributary of the Salary Brook which flows through the north west of the site, and a short section of ordinary watercourse that joins the Salary Brook at the north of the site. Flood zones are not available for these watercourses.

Functional Floodplain

The current modelling of the Salary Brook did not include a scenario to delineate the functional floodplain. Outputs for Flood Zone 3b functional floodplain are not currently available for this watercourse. Further modelling is required to determine the extent of Flood Zones across the site, described further below in the 'site specific recommendations' section.

Climate Change

The current modelling of the Salary Brook did not include a scenario to determine the probability of flooding including an allowance for climate change. Outputs including an allowance for the impact of climate change are not currently available for this watercourse.



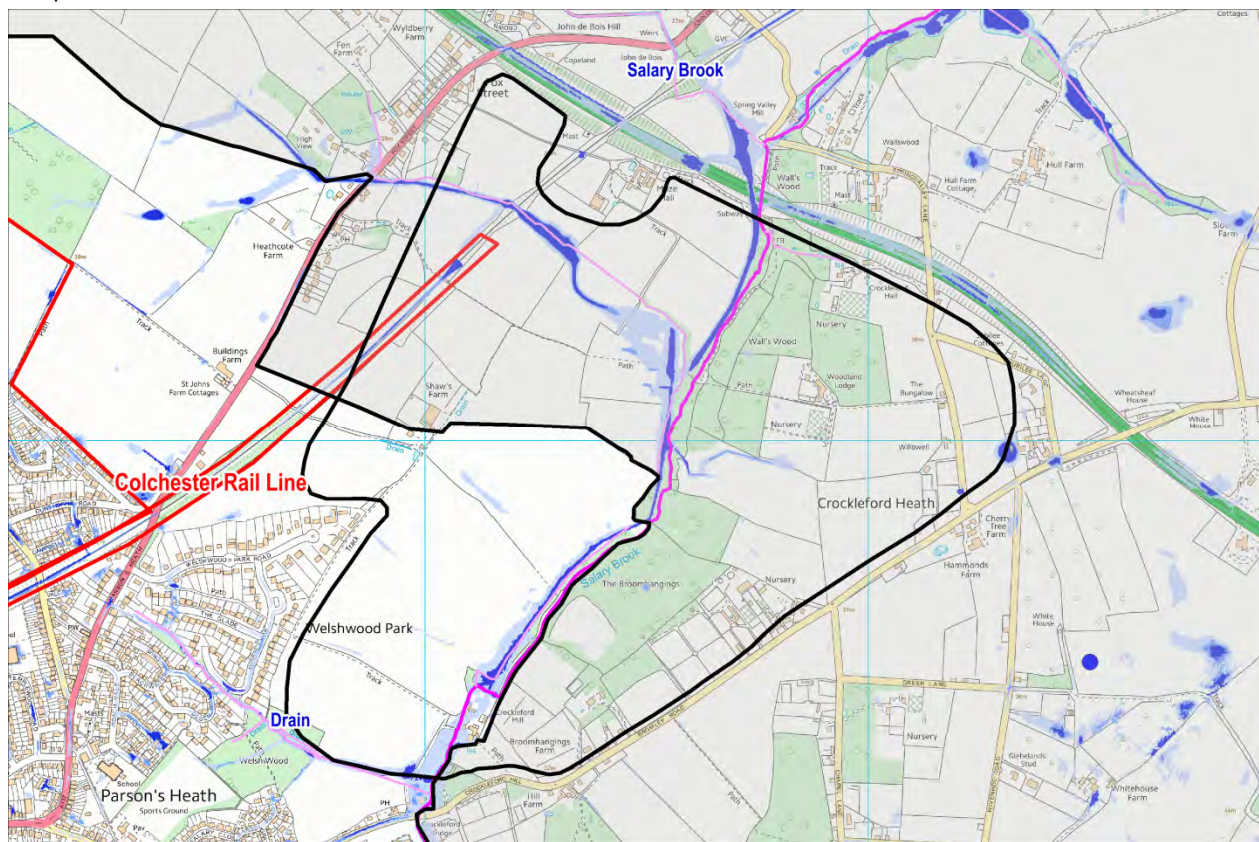
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Figure A Modelled Flood Extents

Surface Water Flood Risk

Risk of Flooding from Surface Water (RoFSW)

The RoFSW mapping indicates that parts of the area are at high risk of surface water flooding (>3.3% AEP), these mainly correlate with the floodplain of the Salary Brook and contributing tributaries. The management of surface water throughout the entire Garden Settlement area should be considered early in the master planning process to ensure that adequate provision is made, taking into account the impact of climate change on the frequency and intensity of future rainfall events. The site layout should be carefully planned to ensure that new development is not placed at surface water flood risk, and not contribute to increased flood risk to neighbouring and/or downstream flowpaths and areas.



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Figure B Risk of Flooding from Surface Water (RoFSW)

Geology

Area Assessment Summary – East Colchester Garden Settlement

The bedrock geology in this area is Thames Group, comprising clay and silt. This is overlain by alluvial clays and silts adjacent to the course of the Salary Brook. A band of Kesgrave Formation (sand and gravel) also passes through the site, and the eastern part of the site is overlain by Cover Sand (clay, silt and sand). Underlying clayey conditions are typically not very permeable and provide the potential for ponding of surface water on the ground surface during heavy rainfall.

Historic Records

The Critical Drainage Area (CDA) for Colchester Rail Line identified during the preparation of the town of Colchester SWMP is shown to be located partially within the area. There are historic records of flooding near the site and in the local area; however the source of flooding is not recorded.

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	186 l/s
	1 in 1 year:	308 l/s
	1 in 30 year:	429 l/s
	1 in 100 year:	595 l/s

<i>Drainage Hierarchy</i>	Infiltration to ground		Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse		Discharge for parts of the site may be possible to the Salary Brook, subject to consultation with the Environment Agency. Drainage may be possible to the ordinary watercourses, subject to consultation with Essex CC.
	Discharge to surface water sewer		Possible, subject to consultation with Anglian Water.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located across 1km squares of which none, or <25% is susceptible to groundwater emergence. The risk of groundwater flooding in this area is therefore generally considered to be low. This will need to be confirmed during site investigation survey.

Other Sources

The Environment Agency 'Risk of Flooding from Reservoirs' mapping shows that the floodplain of the Salary Brook that passes through the site, is at risk of inundation in the event of a failure of the following reservoirs: Ardleigh (NGR 603487, 228024); Abberton Central and Western Arm (NGR 598901, 219790); and Abberton (NGR 598780, 219734). As noted in the Level 1 SFRA report, given the regular inspection of these reservoirs in accordance with the Reservoirs Act 1975, flooding from reservoirs is considered to be a managed risk.

Site Specific Recommendations

Fluvial Modelling

As part of a site specific FRA for this area, a simple hydraulic model should be developed to more accurately determine the probability of flooding from the Salary Brook and its contributing tributaries. 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.

Site Layout and Design

Residential development should be avoided in areas defined as Flood Zone 3a or 3b adjacent to the Salary Brook. The strategy for surface water management across the Garden Settlement area must be considered early in the site master planning process to ensure adequate inclusion of SuDS. SuDS should be considered in accordance with the hierarchy of SuDS (i.e. considering infiltration measures first wherever possible).

Set-back Distance

The Salary Brook is a main river, and therefore all development should be set back at least 8m from these watercourses. The Environment Agency will need to be consulted and an Environmental Permit obtained for any works within 8m of the watercourse. Essex CC, as the LLFA, requires at least a 3m set back on one side of ordinary watercourses 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

If residential development cannot be avoided within the flood extent for the 1% AEP event including climate change for any of the watercourses in the area, finished floor levels should be set at least 300mm freeboard above the flood level for 1% AEP event including an appropriate allowance for climate change. In this case, for More Vulnerable development in Flood Zone 3a, the higher central (35%) climate change allowance should be used and tested against the upper (65%) climate change allowance also.

Access / Egress

Safe dry access to and from new development should be provided. Given the general low risk of fluvial flooding through the area this should be achievable.

Floodplain Compensation

Land raising and any built development should be avoided within the floodplain. Where alterations to the floodplain are proposed, compensatory floodplain storage will need to be provided on a level-for-level and volume-for-volume basis. The land used to provide compensation storage will need to be in hydraulic connectivity with the existing floodplain, but not already part of the floodplain.

Emergency Planning

The site is not shown to be within an Environment Agency Flood Warning Area. Depending on the proximity of new development to the local watercourses, Flood Response Plans may need to be prepared by residents of the site.

Summary

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.

Site Assessment Summary – Gosbecks Phase 2

Location: Colchester	SHLAA Ref /Ref: COL17	Area (ha): 6.79	Proposed use: Residential (150 dwellings)	Vulnerability Classification: More Vulnerable
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Sequential Test Status:

The Sequential Test has been undertaken by Colchester BC for this site as part of the preparation of the Local Plan Site Allocations.

Tidal and Fluvial Flood Risk

Flood Zone 1: 100%	Flood Zone 2: 0%	Flood Zone 3a: 0%	Flood Zone 3b: 0%
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Flood Zones and Flood Defences

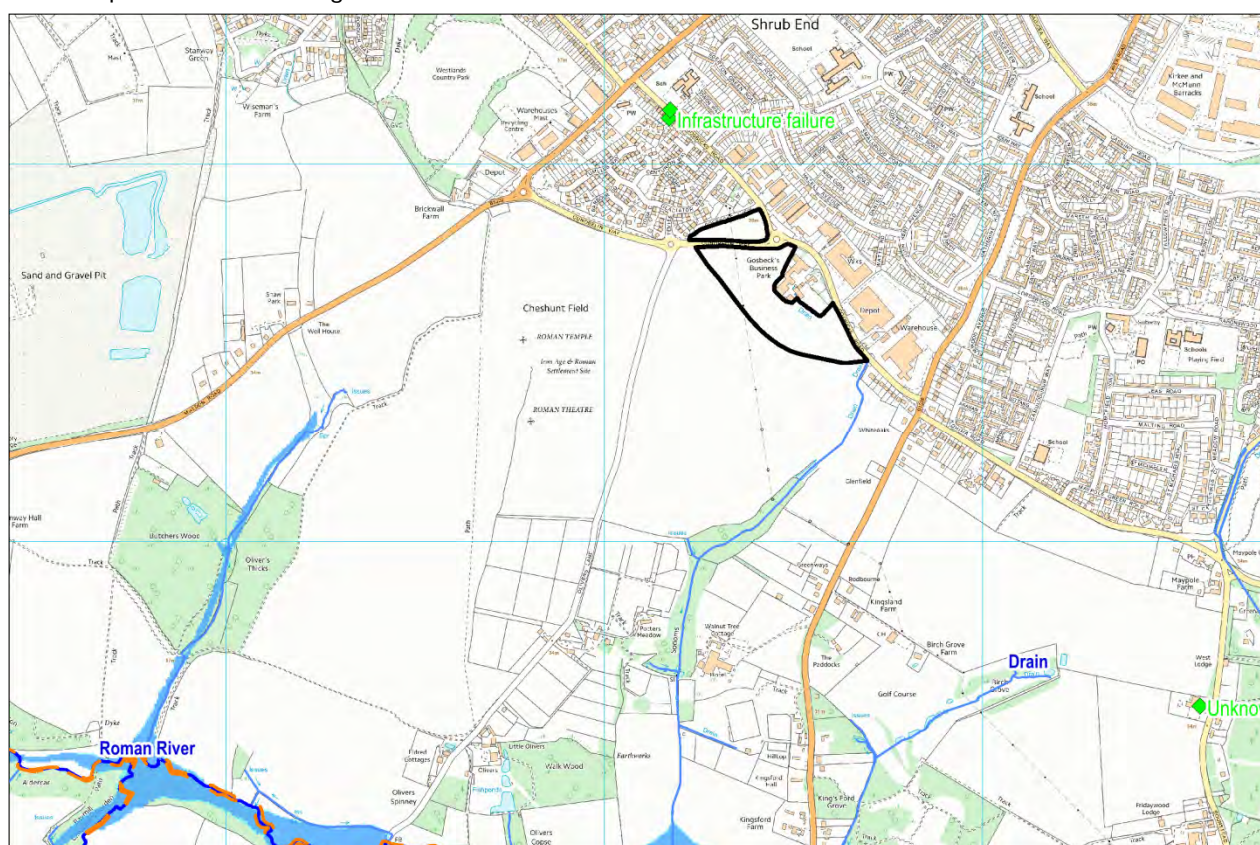
The site is located entirely within Flood Zone 1, which is defined as low probability of flooding from rivers. The Environment Agency Detailed River Network identifies an ordinary watercourse that flows south from the eastern edge of the site. The watercourse flows south and forms a tributary of the Roman River which flows from west to east approximately 1.6km south of the site.

Functional Floodplain

Flood modelling of the ordinary watercourse in this location, is derived from high level JFLOW modelling, and therefore outputs for Flood Zone 3b functional floodplain are not available for this watercourse. Further modelling is required to determine the extent of Flood Zones across the site, described further below in the 'site specific recommendations' section.

Climate Change

Flood modelling of the ordinary watercourse and the Roman River, in this location, is derived from high level JFLOW modelling, and therefore outputs including an allowance for the impact of climate change are not available for this watercourse.



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Figure A Modelled Flood Extents

Surface Water Flood Risk

Risk of Flooding from Surface Water and SWMP Modelling

The RoFSW and SWMP modelling indicate that the site itself is at low risk of surface water ponding, however there may be a risk to Cunobelin Way, which passes through the two portions of the site.

In accordance to the National Planning Policy Framework, proposed development should not have unacceptable adverse impacts on the flow and quantity of surface water. Therefore the site layout should be carefully planned to ensure that residential dwellings are not at risk from surface water flooding and the position of new development does not divert flow paths to the vicinity of the site.

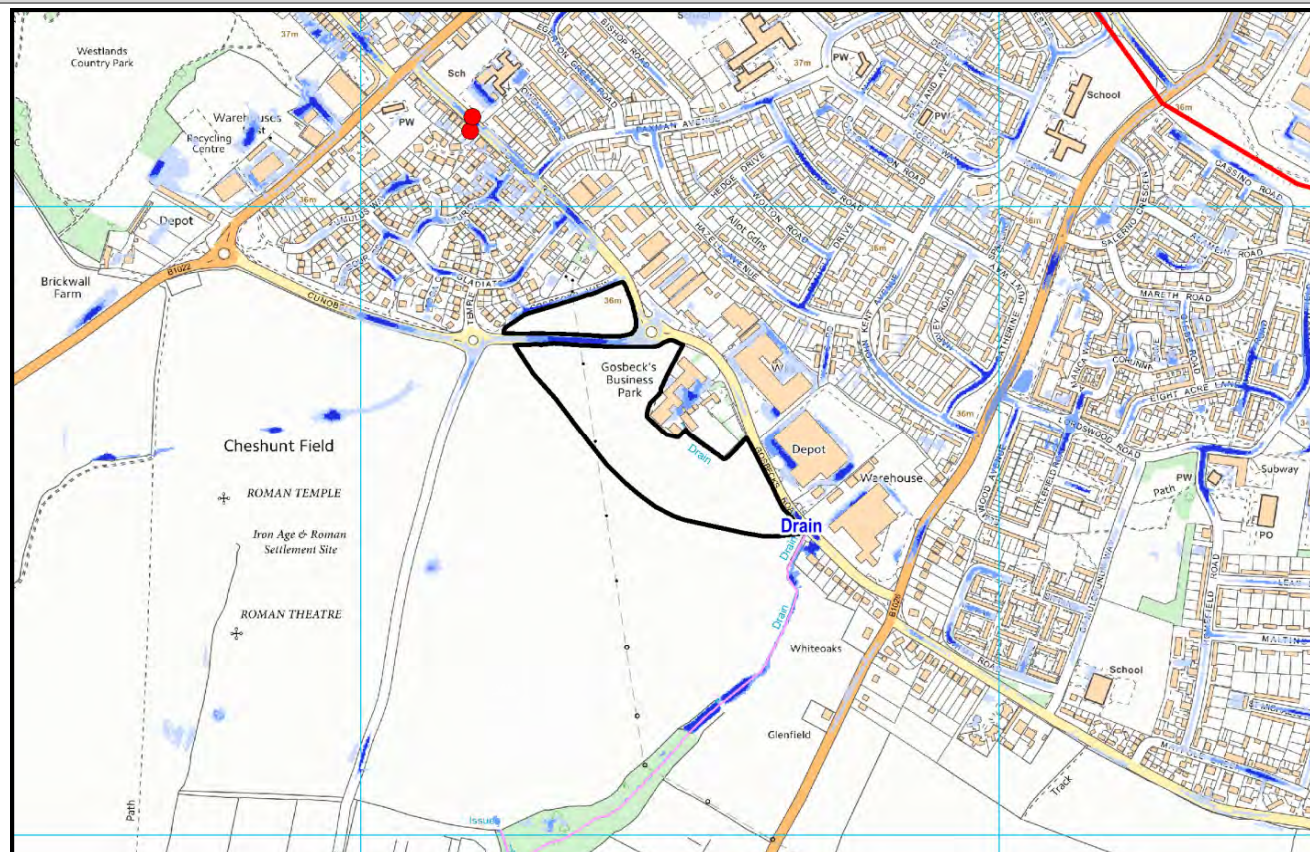
Geology

The bedrock geology in this area is Thames Group, comprising clay and silt which are overlain by alluvial clays and silts, which is overlain by clay, silty and sandy Cover Sand. Underlying clay conditions are typically not very permeable and provide the potential for ponding of surface water on the ground surface during heavy rainfall.

Historic Records

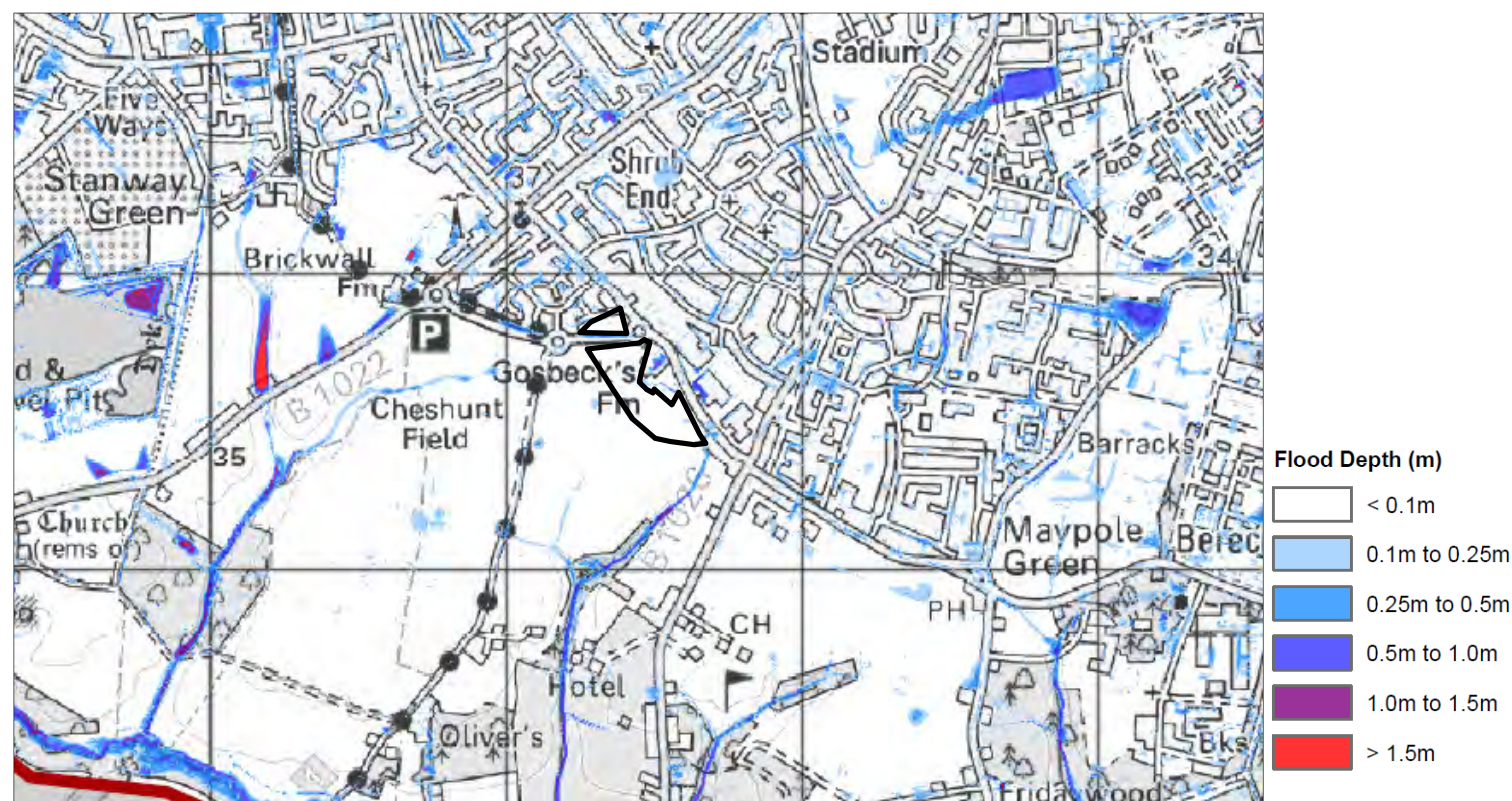
The site is not shown to lie within a Critical Drainage Area (CDA) identified during the preparation of the town of Colchester SWMP. There are historic records of flooding to the north of the site; the source of which is recorded to be infrastructure failures, however no further details are known.

Site Assessment Summary – Gosbecks Phase 2



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Figure B Risk of Flooding from Surface Water (RoFSW)



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Figure C Town of Colchester SWMP (Capita Symonds, 2013) Surface Water Modelling, 1% AEP Maximum Flood Depth

<i>Estimated Greenfield Runoff Rates (IH124 Results).</i>	QBAR:	9.5 l/s
	1 in 1 year:	13.6 l/s
	1 in 30 year:	21.9 l/s
	1 in 100 year:	30.3 l/s
<i>Drainage Hierarchy</i>	Infiltration to ground	Uncertain due to geology; subject to on site infiltration testing.
	Discharge to watercourse	Discharge possible to the ordinary watercourse, subject to consultation with Essex CC.
	Discharge to surface water sewer	Possible, subject to consultation with Anglian Water.

Groundwater Flood Risk

The AStGWF mapping (Level 1 SFRA Appendix A Figure 5) shows that the site is located within a 1km square of which >75% is susceptible to groundwater emergence. The potential for groundwater flooding in this area will need to be confirmed during site investigation survey.

Other Sources

The site is not shown to be at risk of inundation in the event of a failure of a reservoir on the Environment Agency 'Risk of Flooding from Reservoirs' mapping.

Site Specific Recommendations

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 ordinary watercourse. 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.

Site Layout and Design

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 Guide¹⁴. (I.e. considering infiltration measures first wherever possible).

¹⁴ https://www.essex.gov.uk/Environment%20Planning/Environment/local-environment/flooding/View-It/Documents/suds_design_guide.pdf

Site Assessment Summary – Gosbecks Phase 2

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's¹⁵.

Access / Egress

Access to the site is provided via Cunobelin Way which is shown to be susceptible to surface water ponding in the SWMP modelling. Further assessment of access routes to the site and potential surface water flood risk should be made during the preparation of proposals for the site, and opportunities taken to improve the capacity of surface water drainage infrastructure along this route where possible.

Summary

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.

¹⁵ <https://www.gov.uk/guidance/flood-risk-assessment-standing-advice>