Client: Mr Terry Norton
Flood Risk Assessment for the
Proposed Development at Worth Farm,
The Street, Worth, Deal, Kent

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1 Background and Scope of Appraisal

Flooding is a major issue in the United Kingdom. The impacts can be devastating in terms of the cost of repairs, replacement of damaged property and loss of business. The objectives of the Flood Risk Assessment (FRA) are therefore to establish the following:

- whether a proposed development is likely to be affected by current or future flooding from any source.
- whether the development will increase flood risk elsewhere within the floodplain.
- whether the measures proposed to address these effects and risks are appropriate.
- whether the site will pass Part B of the Exception Test (where applicable).

Herrington Consulting has been commissioned by **Mr Terry Norton** to prepare a Flood Risk and Sustainable Drainage Assessment for the proposed development at **Worth Farm, The Street, Worth, Deal, Kent, CT14 0DF.**

A Flood Risk Assessment (FRA) appraises the risk of flooding to development at a site specific scale, and recommends appropriate mitigation measures to reduce the impact of flooding to both the site and the surrounding area. New development has the potential to increase the risk of flooding to neighbouring sites and properties through increased surface water runoff and as such, an assessment of the proposed site drainage can help to accurately quantify the runoff rates, flow pathways and the potential for infiltration at the site. This assessment considers the practicality of incorporating Sustainable Drainage Systems (SuDS) into the scheme design, with the aim of reducing the risk of flooding by actively managing surface water runoff.

This report has been prepared to accompany a full planning application and has been prepared in accordance with the requirements of both national and local planning policy. To ensure that due account is taken of industry best practice, reference has also been made to, CIRIA Report C753 'The SuDS Manual' and any relevant local planning policy guidance.

2 Development Description and Planning Context

2.1 Site Location and Existing Use

The site is located at OS coordinates 633780, 156248, off The Street in Worth. The site covers an area of approximately 0.1 hectares and currently comprises of undeveloped greenfield land behind the existing farm (Worth Farm). The location of the site in relation to the surrounding area and watercourses are shown in Figure 2.1.

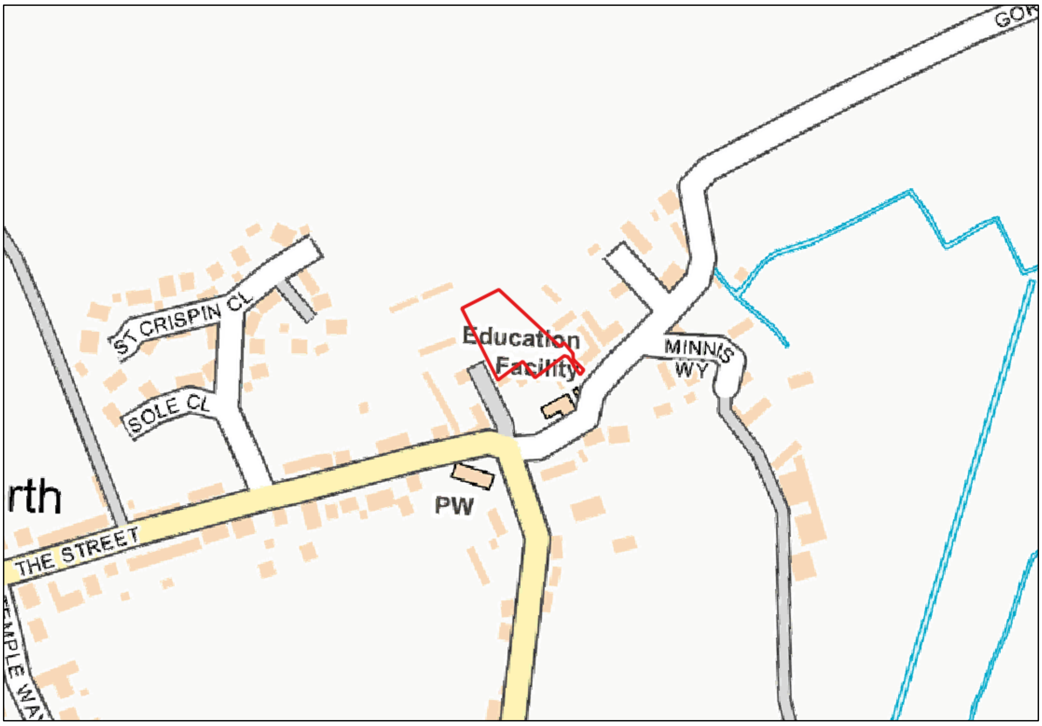
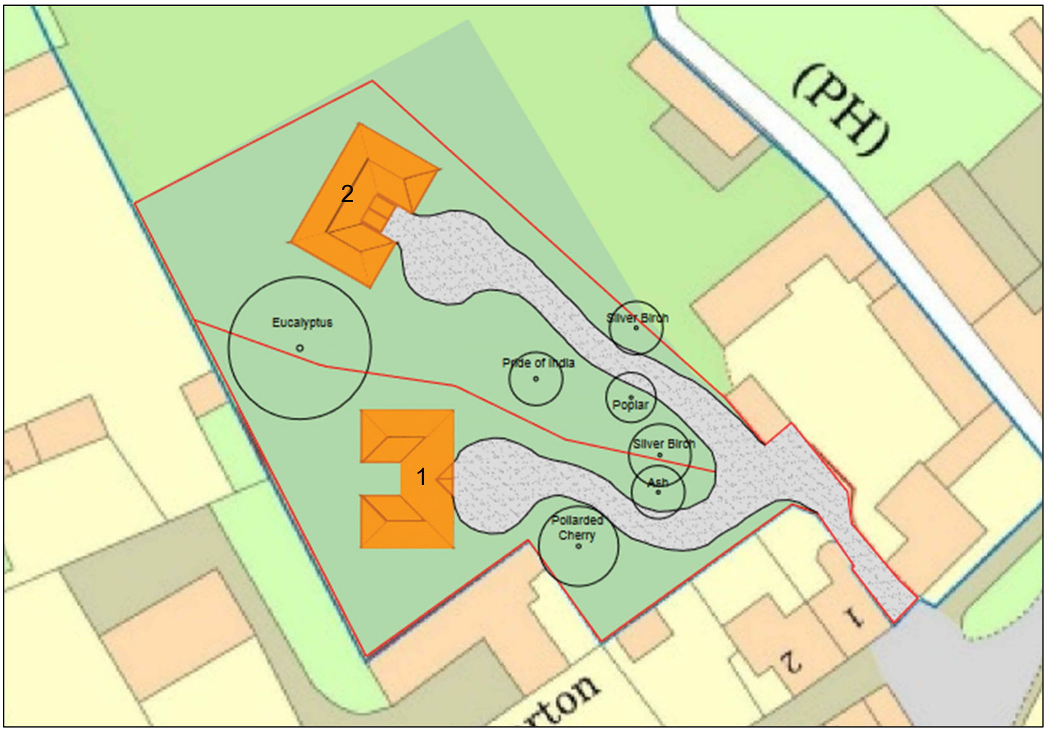


Figure 2.1 – Location map (contains Ordnance Survey data © Crown copyright and database right 2024).

The site plan included in Appendix A.1 of this report provides more detail in relation to the site location and layout.

2.2 Proposed Development

The proposals for development comprise the construction of 2no. new residential houses. Both dwellings have the same configuration, with the ground floor comprising of a sitting room, kitchen, plant/utility room, pantry, dining room, and a washroom. The first floor contains four bedrooms and two bathroom (Figure 2.2).



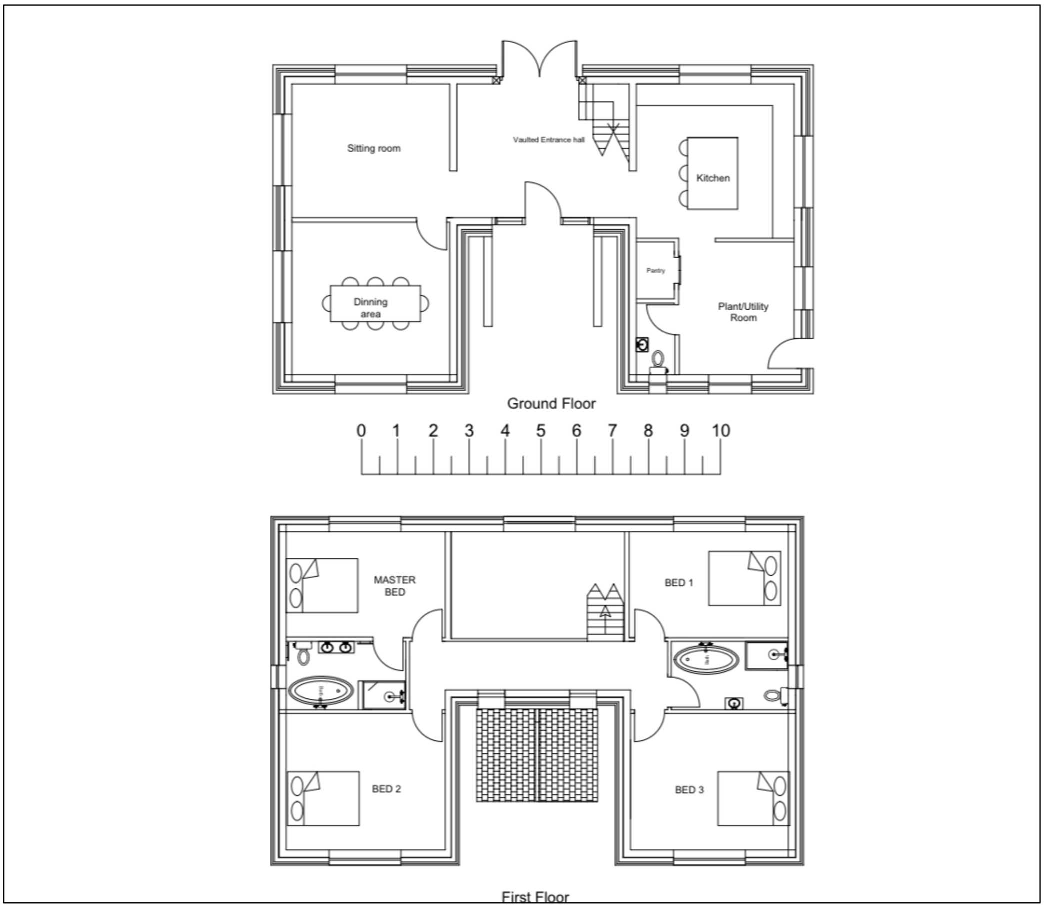


Figure 2.2 – Proposed site layout.

Drawings of the proposed scheme are included in Appendix A.1 of this report.

2.3 The Sequential Test

The National Planning Policy Framework (NPPF) requires the Sequential Test to be applied at all stages of the planning process and generally the starting point is the Environment Agency's (EA) 'Flood Map for Planning' (Figure 2.3). These maps and the associated information are intended for guidance and cannot provide details for individual properties. They do not take into account other considerations such as existing flood defences, alternative flooding mechanisms and detailed site-based surveys. They do, however, provide high level information on the type and likelihood of flood risk in any particular area of the country. The Flood Zones are classified as follows:

Zone 1 – *Low probability of flooding* – This zone is assessed as having less than a 1 in 1000 annual probability of river or sea flooding in any one year.

Zone 2 – *Medium probability of flooding* – This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding or between 1 in 200 and 1 in 1000 annual probability of sea flooding in any one year.

Zone 3a – *High probability of flooding* - This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding or 1 in 200 or greater annual probability of sea flooding in any one year.

Zone 3b – *The Functional Floodplain* – This zone comprises land where water has to flow or be stored in times of flood and can be defined as land which would flood during an event having an annual probability of 1 in 30 or greater. This zone can also represent areas that are designed to flood in an extreme event as part of a flood alleviation or flood storage scheme.

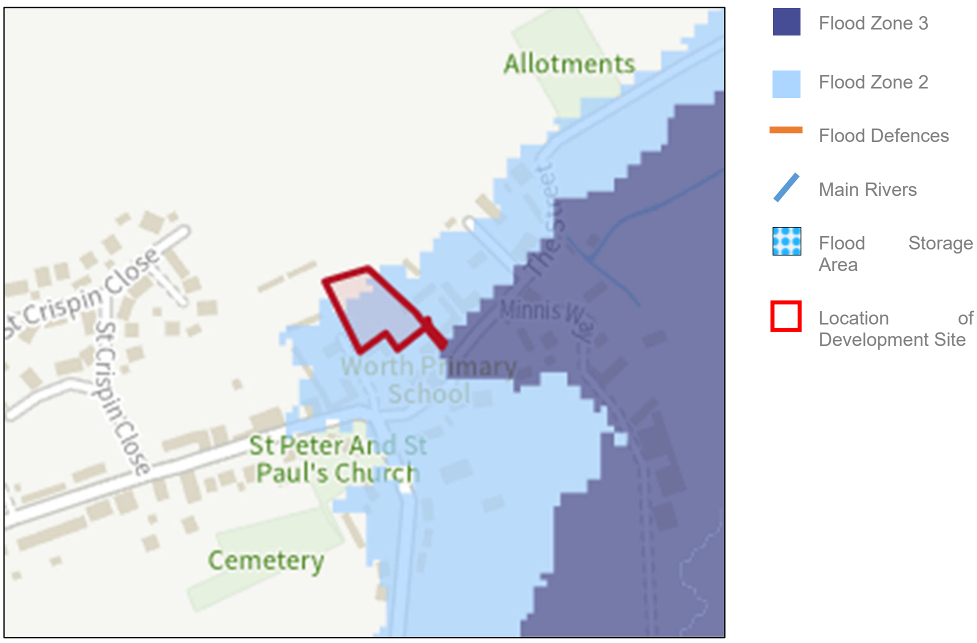


Figure 2.3 – EA's 'Flood Map for Planning' (© Environment Agency).

Figure 2.3 shows the majority of the development site is located within Flood Zones 1 and 2. However, a small area at the access road is shown to be situated within Flood Zone 3.

The NPPF states that the Local Planning Authority (LPA) should apply the sequential approach as part of the identification of land for development in areas at risk from flooding. The overarching objective of the Sequential Test is to ensure that lower risk sites are developed before sites in higher risk areas. When applying the Sequential Test, it is also necessary to ensure that the subject site is compared to only those sites that are available for development and are similar in size.

Whilst a Sequential Test assessment has not been undertaken in support of this FRA, it is possible to use the evidence from the work that has been undertaken as part of this site-specific appraisal in the application of the Sequential Test.

The second level of appraisal is through the application of the more detailed and refined flood risk information contained within the Strategic Flood Risk Assessments (SFRA). Such a document has been prepared for the Dover District Council and this has been referenced as part of this site-specific FRA.

The most detailed stage at which the sequential approach can be applied is at a site-based level. Careful consideration of the topography of the site and development uses can provide opportunities to locate more vulnerable buildings on the higher parts of the site and placing less vulnerable elements such as car parking or recreational use in the areas exposed to higher risk. This approach is examined later on in this FRA.

2.4 The Exception Test

According to the NPPF, if it is not possible, consistent with wider sustainability objectives, for the development to be located in areas at lower risk, the Exception Test may have to be applied. The application of the Exception Test will depend on the type and nature of the development, in line with the Flood Risk vulnerability classification set out in the NPPG. This has been summarised in Table 2.1 below.

Flood Risk Vulnerability Classification	Zone 1	Zone 2	Zone 3a	Zone 3b
Essential Infrastructure – Essential transport infrastructure, strategic utility infrastructure, including electricity generating power stations.	✓	✓	e	e
High Vulnerability – Emergency services, basement dwellings, caravans and mobile homes intended for permanent residential use.	✓	e	×	×
More Vulnerable – Hospitals, residential care homes, buildings used for dwelling houses, halls of residence, pubs, hotels, non-residential uses for health services, nurseries and education.	✓	✓	e	×
Less Vulnerable – Shops, offices, restaurants, general industry, agriculture, sewerage treatment plants.	✓	✓	✓	×
Water Compatible Development – Flood control infrastructure, sewerage infrastructure, docks, marinas, ship building, water-based recreation etc.	✓	✓	✓	✓

Key :
✓ Development is appropriate
× Development should not be permitted
e Exception Test required
Shaded cell represents the classification of this development

Table 2.1 - Flood risk vulnerability and flood zone incompatibility.

The proposed residential units are situated within Flood Zones 1 and 2 and therefore, the Exception Test would not typically be applied. Nevertheless, it is recognised that a small part of the proposed access road is shown to be located within Flood Zone 3. Consequently, the principles of Part B of the Exception Test have still been considered as part of this appraisal.

3 Definition of Flood Hazard

3.1 Site Specific Information

Information from a wide range of sources has been referenced to appraise the true risk of flooding at this location. This section summarises the additional information collected as part of this FRA.

Site specific flood level data provided by the EA – The EA has provided the model results of the East Kent Coast Modelling and Mapping Study carried out in 2018 (by others), which have been referenced as part of this appraisal.

Information contained within the SFRA – The Dover District Council SFRA (2019) contains detailed mapping showing historic flood records for a wide range of sources. This document has been referenced as part of this site-specific FRA.

Information provided by Southern Water – Southern Water has provided the results of an asset location search for the site. The response is included in Appendix A.2.

Site specific topographic surveys – A site-specific topographic survey has not been undertaken at this stage; however, inspection of aerial height data (LiDAR) records show that the land level of the site varies between 1.86m and 3.79m Above Ordnance Datum Newlyn (AODN). Ground levels gradually fall from northwest to southeast.

Geology – Reference to the British Geological Survey (BGS) map shows that the underlying solid geology in the location of the subject site is Margate Chalk Member (chalk). Overlying this are superficial deposits of Head (clay and silt).

Historic flooding – The SFRA shows that whilst the wider surrounding area was affected by tidal flooding in 1953, the site itself is shown to be located outside the historic flood extent. In addition, both the SFRA and EA's Historic Flood Map GIS data shows no historic records of the site or immediate surrounding area having been affected by flooding from any sources.

3.2 Potential Sources of Flooding

The main sources of flooding have been assessed as part of this appraisal. The specific issues relating to each one and its impact on this development are discussed below. Table 3.1 at the end of this section summarises the risks associated with each of the sources of flooding.

Flooding from the Sea – The site lies within Flood Zone 2 as shown on the EA's 'Flood Map for Planning' (Figure 2.3). The flood zone maps are used as a consultation tool by planners to highlight areas where more detailed investigation into the risk of flooding is required. The fact that the site lies within Flood Zone 2 means that the risk of flooding from this source is examined in more detail in Section 5 of this FRA.

Flooding from Rivers, Ordinary or Man-Made Watercourses – Inspection of the OS mapping has identified that the closest main river is The Delf which is located approximately 1.3km to the east of the development site. The Delf is connected to a series of drainage ditches which are designed to reduce groundwater levels within the surrounding land. The Delf discharges into the tidal River Stour over 2.3km further to the northwest of the site. Further interrogation of aerial height data reveals that the lower-lying area to the east which surrounds The Delf and associated drainage network is approximately 1.5m below the lowest part of the site. Consequently, if water levels within the river network were to become elevated as a result of an extreme rainfall event or elevated groundwater, flooding is likely to be restricted to the lower-lying land and not encroach onto the site. Consequently, the risk of flooding from this mechanism is considered to be *low*.

It is recognised that the river network discharges into the tidal River Stour which is influenced by increases in sea level. As such, the tidal risk of flooding from these watercourses will be appraised as part of the analysis in Section 5.

Flooding from Surface Water – Surface water, or overland flooding, typically occurs in natural valley bottoms as normally dry areas become covered in flowing water and in low spots where water may pond. This mechanism of flooding can occur almost anywhere but is likely to be of particular concern in any topographical low spot, or where the pathway for runoff is restricted by terrain or man-made obstructions.

The EA's 'Flood Risk from Surface Water' map (Figure 3.1) shows the majority of the development site is located in an area classified as having a 'very low' risk of surface water flooding. It is only the access road which is shown to be at 'medium' risk of surface water flooding.

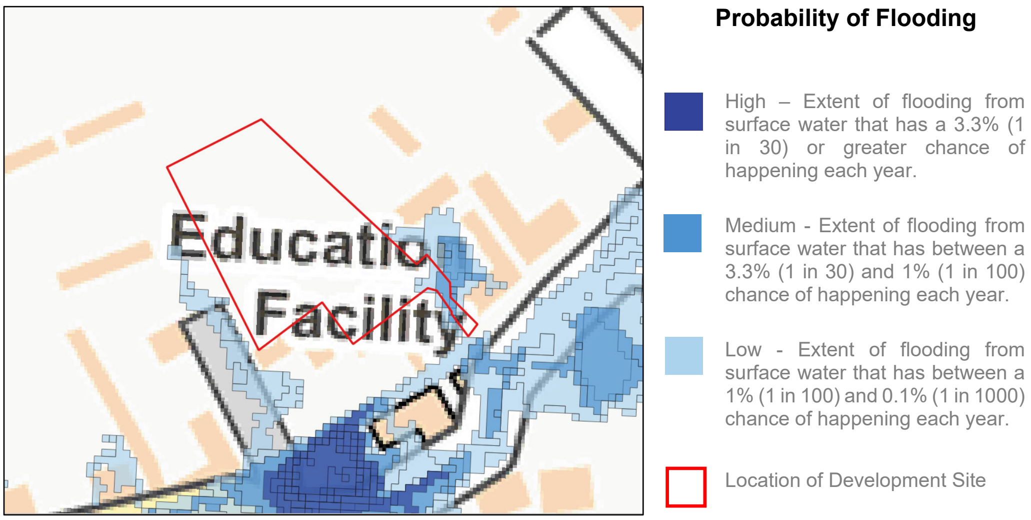


Figure 3.1 – EA's 'Flood Risk from Surface Water' map (© Environment Agency and contains Ordnance Survey data © Crown copyright and database right 2024).

The EA's maps would suggest that under a 'medium' and 'low' risk scenario, surface water is accumulating on the neighbouring site to the east and flowing across the entrance towards the south. However, further interrogation of the EA's data and aerial height data shows that the predicted depth of flooding is relatively shallow, i.e. less than 200mm. In addition, water would continue to flow away from the site towards the lower-lying land to the east. Consequently, the risk of surface water flooding to the development is considered to be *low*.

Flooding from Groundwater – Water levels below the ground rise during wet winter months, and fall again in the summer as water flows out into rivers. In very wet winters, rising water levels may lead to the flooding of normally dry land, as well as reactivating flow in ‘bournes’ (streams that only flow for part of the year).

Groundwater flooding is most likely to occur in low lying areas that are underlain by permeable rock (aquifers). The underlying geology in this area is Margate Chalk Member (chalk). This type of geology is typically permeable and therefore can be associated with groundwater flooding.

Mapping on groundwater emergence provided as part of the Defra Groundwater Flood Scoping Study (May 2004) shows that no groundwater flooding events were recorded during the very wet periods of 2000/01 or 2002/03 although the site itself is shown to be located within an area where groundwater emergence is predicted.

In addition to the above, the purpose of the surrounding drainage network is to maintain low groundwater levels. Inspection of aerial height data for the surrounding area shows that land levels fall away from the site in a south-easterly direction towards the lower-lying land. Therefore, in the unlikely event that groundwater flooding was to occur in this area, it is likely to be intercepted by the drainage network and confined to these lower lying regions to the southeast.

Taking the above into consideration and the fact that the Dover District Council SFRA also identifies that there are no historic records that the site and immediate surrounding area have been subject to groundwater flooding in the past, the risk of groundwater flooding is considered to be *low.*

Flooding from Sewers – In urban areas, rainwater is typically drained into surface water sewers or sewers containing both surface and wastewater known as “combined sewers”. Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked, or has inadequate capacity; this will continue until the water drains away.

Inspection of the asset location mapping provided by Southern Water (Figure 3.2) identifies that the sewers in this area are foul only.

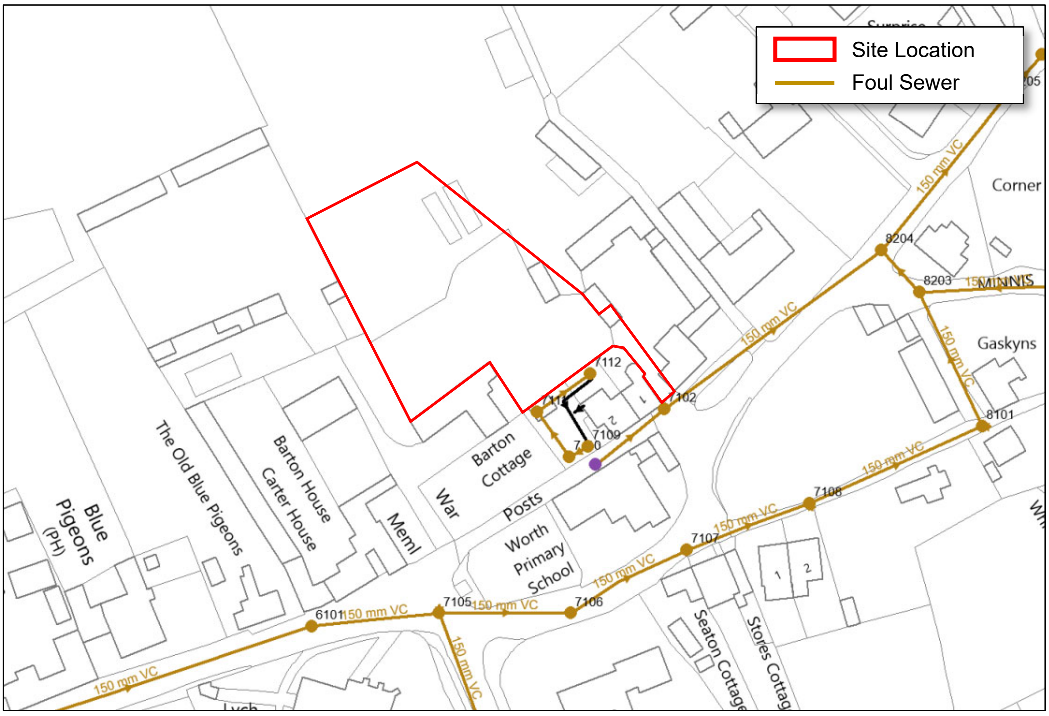


Figure 3.2 - Asset location mapping provided by Southern Water (a full scale copy can be found in Appendix A.2).

From Figure 3.4 above, it is evident that the nearest sewers are situated to the south of the development site, where land levels are lower. Consequently, if water was to exit the sewer network, i.e. as a result of an extreme rainfall event or blockage, water would not be directed towards the site but instead would flow away in a south-easterly direction where land levels are lower. This is supported by the SFRA which shows that there are no historic records of flooding from sewers at the site or surrounding area. Consequently, the risk of flooding from this source is therefore considered to be *low*.

Flooding from Reservoirs, Canals and Other Artificial Sources – Non-natural or artificial sources of flooding can include reservoirs, canals, and lakes, where water is retained above natural ground level. In addition, operational and redundant industrial processes including mining, quarrying, and sand or gravel extraction, may also increase the depth of floodwater in areas adjacent to these features.

The potential effects of flood risk management infrastructure and other structures also needs to be considered. For example, reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure.

Inspection of the OS mapping for the area shows that there are no artificial sources of flooding within close proximity to the site. In addition, the EA's 'Flood Risk from Reservoirs' map shows that the site is not within an area considered to be at risk of flooding from reservoirs. Therefore, the risk of flooding from this source is considered to be *low.*

A summary of the overall risk of flooding from each source is provided in Table 3.1 below.

Source of Flooding	Initial Level of Risk	Appraisal method applied at the initial flood risk assessment stage
Sea	Appraised further in Section 5	OS mapping and the EA's 'Flood Map for Planning'
Rivers, Ordinary and Man-Made Watercourses	Low	OS mapping, EA's 'Flood Map for Planning' and aerial height data
Surface Water	Low	EA's 'Flood Risk from Surface Water' map, and historic records contained within the Dover District Council SFRA, aerial height data, and OS mapping.
Groundwater	Low	BGS groundwater flood hazard maps, Defra Groundwater Flood Scoping Study, site-specific geological data, aerial height data, OS mapping, and historic records in the Dover District Council SFRA
Sewers	Low	Aerial height data, OS mapping, historic records in the Dover District Council SFRA and asset location data provided by Southern Water.
Artificial Sources	Low	OS mapping and EA's 'Flood Risk from Reservoirs' map

Table 3.1 – Summary of flood sources and risks.

3.3 Existing Flood Risk Management Measures

A formal flood defence is present along the coastline which provides protection to the development site. A recurved concrete sea wall and rock armour were constructed from Sandown Castle to Deal Castle as part of the Deal Coastal Flood Defence Scheme in 2013. This scheme provides a 1 in 300 year standard of protection. The shingle beach also provides an additional level of protection by reducing bank erosion and wave overtopping, as well as the revetment at Sandown Castle and Sandwich Bay Estate providing a 1 in 200 year standard of protection.

4 Climate Change

The global climate is constantly changing, but it is widely recognised that we are now entering a period of accelerating change. Over the last few decades there have been numerous studies into the impact of potential changes in the future and there is now an increasing body of scientific evidence which supports the fact that the global climate is changing as a result of human activity. Past, present, and future emissions of greenhouse gases are expected to cause significant global climate change during this century.

The nature of climate change at a regional level will vary: for the UK, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall and more frequent periods of long-duration rainfall could be expected.

These effects will tend to increase the size of Flood Zones associated with rivers, and the amount of flooding experienced from other inland sources. The rise in sea level will change the frequency of occurrence of high water levels relative to today's sea levels. It will also increase the extent of the area at risk should sea defences fail. Changes in wave heights due to increased water depths, as well as possible changes in the frequency, duration and severity of storm events are also predicted.

4.1 Planning Horizon

To ensure that any recommended mitigation measures are sustainable and effective throughout the lifetime of the development, it is necessary to base the appraisal on the extreme flood level that is commensurate with the planning horizon for the proposed development. The NPPF and supporting Planning Practice Guidance Suite state that residential development should be considered for a minimum of 100 years, but that the lifetime of a non-residential development depends on the characteristics of the development. The development that is the subject of this FRA is classified as residential therefore a design life of 100 years has been assumed.

4.2 Potential Changes in Climate

Extreme Sea Level

Global sea levels will continue to rise, depending on greenhouse gas emissions and the sensitivity of the climate system. The relative sea level rise in England also depends on the local vertical movement of the land, which is generally falling in the south-east and rising in the north and west.

Reference to guidance published by the EA specifies allowances for different epochs and regions across England. The predicted rates of relative sea level rise for the 'South East' region, relevant to the subject site, are shown in Table 4.1. These values which correspond with the Higher Central and Upper End percentiles (the 70th and 90th percentile respectively).

Administrative Region	Allowance Category	Net Sea Level Rise (mm/yr) (Relative to 2000)			
		2000 to 2035	**2036 to 2065**	**2066 to 2095**	**2096 to 2125**
South East	Higher Central	5.7	8.7	11.6	13.1
	Upper End	6.9	11.3	15.8	18.2

Table 4.1 – Recommended contingency allowances for net sea level rise.

From these values, the extreme sea level at the site can be seen to change with time and this change is not linear. The 1 in 200 year extreme sea level at the site has therefore been calculated for a number of steps between the current day and the year 2125 and these values are shown in Table 4.2 below.

Year	'Higher Central' Scenario	'Upper End' Scenario
Current Day (year 2017)	4.64	4.64
2035	4.74	4.76
2065	5.00	5.10
2085	5.24	5.42
2115	5.58	5.89
2125	**5.71**	**6.08**

Table 4.2 – Climate change impacts on extreme sea levels for a 1 in 200 year return period event based on values taken from the EA's Coastal Flood Boundary Condition database.

The development that is the subject of this FRA is classified as residential and therefore the extreme sea level is taken as 5.71m AODN in the 'Higher Central' scenario, and 6.08m AODN in the 'Upper End' scenario.

It is recognised that the East Kent Coast Modelling Study undertaken in 2018 was completed before the latest guidance on climate change was published. The model is therefore based on previous estimates of sea level rise as opposed to the values stated in Table 4.1. However, in the absence of detailed modelling which references the latest guidance, the East Kent Coast Modelling has been referenced in Section 5 of this report in order to quantify the risk of flooding to the development site.

Offshore Wind Speed and Extreme Wave Height

As a result of increased water depths resulting from changes in the climate, wave heights may change. The climate change allowances for offshore wind speed and wave height are shown in Table 4.3 below and where appropriate have been applied as part of this appraisal. These figures are applicable around the entire English coast and are relative to a 1990 baseline. They also include a sensitivity allowance which should be used to show that the range of impact of climate change is understood.

Parameter	2000 to 2055	2056 to 2125
Offshore wind speed allowance	+5%	+10%
Offshore wind speed sensitivity test	+10%	+10%
Extreme wave height allowance	+5%	+10%
Extreme wave height sensitive test	+10%	+10%

Table 4.3 – Recommended climate change allowance and sensitivity ranges for offshore wind speed and extreme wave height (relative to 1990).

The East Kent Coast Modelling Study, which has been referenced as part of this appraisal, includes the appropriate 10% allowance for both offshore wind speed and extreme wave height.

Peak Rainfall Intensity

Recognising that the impact of climate change will vary across the UK, the allowances were updated in May 2022 to show the anticipated changes to peak rainfall across a series of management catchments. The proposed development site is located in the **Stour Management Catchment**, as defined by the 'Peak Rainfall Allowance' maps, hosted by the Department for Environment, Food and Rural Affairs. Guidance provided by the EA states that this mapping should be used for site-scale applications (e.g. drainage design), in small catchments (less than $5km^2$), or urbanised drainage catchments. For large rural catchments, the peak river flow allowances should be used.

The development site lies within a small drainage catchment and therefore, the Peak Rainfall Allowances for the Stour Management Catchment should be applied.

For each Management Catchment, a range of climate change allowances are provided for two time epochs and for each epoch, there are two climate change allowances defined. These represent different levels of statistical confidence in the possible scenarios on which they are calculated. The two levels are as follows:

- Central: based on the 50^{th} percentile
- Upper End: based on the 90^{th} percentile

The EA has provided guidance regarding the application of the climate change allowances and how they should be applied in the planning process. The range of allowances for the Management Catchment in which the development site is located are shown in Table 4.4 below.

Management Catchment Name	Annual exceedance probability	Allowance Category	2050s	2070s
Stour	3.3 %	Central	20%	20%
		Upper End	40%	40%
	1 %	Central	20%	20%
		Upper End	45%	45%

Table 4.4 – Recommended peak rainfall intensity allowances for each epoch for the Stour Management Catchment.

For a development with a design life of 100 years the Upper End climate change allowance is recommended to assess whether:

- there is no increase in flood risk elsewhere, and;
- the development will be safe from surface water flooding.

From Table 4.4 above, it can be seen that the recommended climate change allowance for this site is a 45% increase in peak rainfall.

All of the above recommended allowances for climate change should be used as a guideline and can be superseded if local evidence supports the use of other data or allowances. Additionally, in the instance where flood mitigation measures are not considered necessary at present, but will be required in the future to account for changes in the climate, a “managed adaptive approach” can be adopted. This approach allows appropriate mitigation measures to be incorporated into the development in the future to combat the impacts of climate change.

5 Probability and Consequence of Flooding

5.1 The Likelihood of Flooding

When appraising the risk of flooding to new development it is necessary to assess the impact of the 'design flood event'. Flood conditions can be predicted for a range of return periods, and these are expressed in either years or as a probability, i.e., the probability that the event will occur in any given year, or Annual Exceedance Probability (AEP). The design flood event is taken as the 1 in 200 year (0.5% AEP) event for sea or tidal flooding, including an appropriate allowance for climate change (refer to Section 4.2).

5.2 The Actual Risk of Flooding

The EA has provided the modelling results from the East Kent Coast Modelling Study (2018), which includes defended and undefended scenarios. The site currently benefits from the presence of existing defence infrastructure (as outlined in Section 3.3) and therefore, the undefended outputs would provide an unrealistic representation of the actual risk to the site.

When the results of the defended scenario are considered, the site is shown to be located outside the predicted extent of flooding during both a 1 in 30 year return period event (i.e., the functional floodplain), and a 1 in 200 year return period event.

It is recognised that the EA's model was completed prior to the release of the new climate change allowances and therefore, only includes outputs up to the future year 2115 opposed to the future year 2125 which defines the design flood event. However, the EA's sea level which has been applied to the 1 in 200 year flood event (2115) is 5.73m AODN. When this is compared to Table 4.2, it is evident that this level is commensurate with the predicted sea level for the future year 2125 under a 'Higher Central' allowance. Consequently, it is considered appropriate to reference the EA's model outputs to appraise the risk of flooding under design event conditions.

The results show that even when an allowance for climate change is considered (i.e., the design flood event), the site is shown to remain dry. Consequently, it is concluded that the actual risk of flooding to the development from the sea is *low*.

5.3 The Residual Risk of Flooding

Whilst the tidal defences in this area provide a very high standard of protection and are also maintained to a safe and serviceable standard, there is always the risk that a small section of this infrastructure could fail; either as a result of structural failure, or through less predictable mechanism such as ship impact or an act of terrorism. This is known as the residual risk of flooding.

The EA has modelled several breach locations along the coast as part of the East Kent Coast Modelling Study. The results show that the site could be affected by floodwater from one of these breach scenarios: a breach at Sandown castle. The maximum predicted flood level for a breach in the defences under design event conditions is **3.29m AODN**. When this level is compared to the aerial height data, the maximum depth that floodwater could reach at the proposed development is 0.8m at building 1 and 0.3m at building 2 (Figure 5.1). It is only the access road which could flood to higher depths.

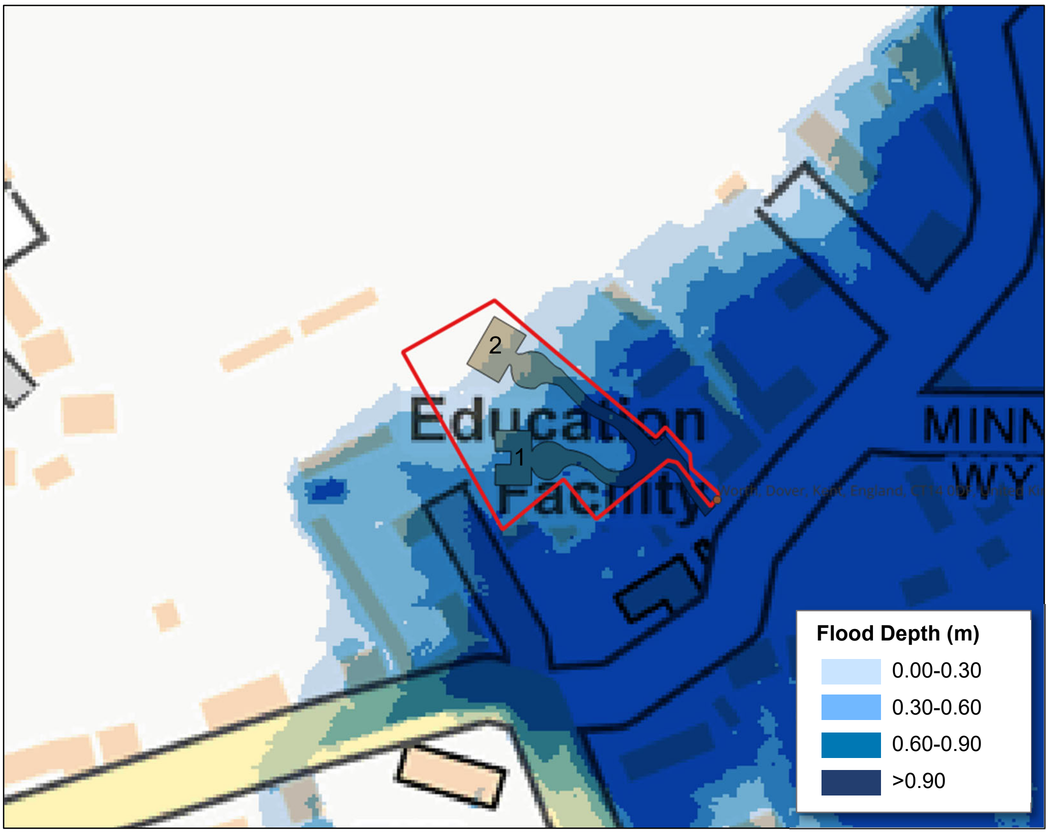


Figure 5.1 – Maximum predicted extent and depth of flooding during a breach in the defences at Sandown Castle under design event conditions, plotted using 1m aerial height data (contains Ordnance Survey data © Crown copyright and database right 2024).

5.4 Time to Inundation

The site is located almost 3km from the sea defences and therefore there will be a residual delay between the defences breaching and floodwater reaching the site. Temporal results from the EA breach model are not available, although reference to the model data for the 'undefended' climate change scenario suggests that it would take in excess of 7 to 8 hours before water is expected to reach the site.

6 Offsite Impacts and Other Considerations

6.1 Displacement of Floodwater

The construction of two new buildings within the floodplain has the potential to displace water and to increase the risk elsewhere by raising flood levels. A compensatory flood storage scheme can be used to mitigate this impact, ensuring the volume of water displaced is minimised.

However, where development is proposed in tidal floodplains such as is the case here, it is generally accepted by the EA that raising the ground or building on the floodplain is unlikely to impact on maximum tidal levels.

6.2 Public Safety and Access

The NPPF states that safe access and escape should be available to/from new developments located within areas at risk of flooding. The Practice Guide goes on to state that access routes should enable occupants to safely access and exit their dwellings during design flood conditions and that vehicular access should be available to allow the emergency services to safely reach the development.

When the proposed development is considered, it can be seen that the site is currently protected from tidal flooding by sea defence infrastructure. Even when climate change is taken into account the site is predicted to remain dry. Consequently safe access and escape from the proposed development can be achieved.

It is only in the extremely unlikely event of a breach (residual risk event) that the site could be affected by flooding. It is therefore recommended that residents sign up to the EA's Early Flood Warning System (refer to Section 7.4 below). This should provide residents with sufficient time to prepare the site and evacuate if necessary to an area outside the flood extent (i.e., 170m to the west of the site). Nevertheless, in the unlikely event that there is insufficient time to evacuate the site, safe and dry refuge can be found on the first floor and can be accessed via an internal staircase.

6.3 Proximity to Watercourse and Flood Defence Structures

Under the Water Resources Act 1991 and Land Drainage Byelaws, any proposals for development in close proximity to a 'main river' would need to take into account the EA's requirement for an 8m buffer zone between the river bank and any permanent construction such as buildings or car parking etc. This buffer zone increases to 16m for tidal waterbodies and sea defence infrastructure.

The development site is located more than 770m from the fluvial River Dour and over 2.96km from the coastline. As such, the proposed development will not compromise any of the EA's maintenance or access requirements.

7 Flood Mitigation Measures

The key objectives of flood risk mitigation are:

- to reduce the risk of the development being flooded.
- to ensure continued operation and safety during flood events.
- to ensure that the flood risk downstream of the site is not increased by increased runoff.
- to ensure that the development does not have an adverse impact on flood risk elsewhere.

The following section of this report examines ways in which the risk of flooding at the development site can be mitigated.

Mitigation Measure	Appropriate	Comment
Careful location of development within site boundaries (i.e., Sequential Approach)	✓	Refer to Section 7.1
Raising floor levels	✓	Refer to Section 7.2
Land raising	x	Not required
Compensatory floodplain storage	x	Not required
Flood resistance & resilience	✓	Refer to Section 7.3
Alterations/ improvements to channels and hydraulic structures	x	Not required
Flood defences	x	Not required
Flood warning	✓	Refer to Section 7.4
Surface water management	✓	Refer to Section 8

Table 7.1 – Appropriateness of mitigation measures.

7.1 Application of the Sequential Approach at a Local Scale

The sequential approach to flood risk management can also be adopted on a site based scale and this can often be the most effective form of mitigation. For example, on a large scheme this would mean locating the more vulnerable dwellings on the higher parts of the site and placing parking, recreational land or commercial buildings in the lower lying and higher risk areas.

For the development that is the subject of this FRA it can be seen that this approach has been adopted. The 'more vulnerable' elements (i.e., sleeping accommodation) is located on the first floor and the 'less vulnerable' elements (i.e., living accommodation) is located on the ground floor.

7.2 Raising Floor Levels

Inspection of the scheme drawings shows that all sleeping accommodation will be located on the first floor, above the minimum floor levels stated above.

With regards to the ground floor, correspondence with the client has confirmed that the ground floor will be raised a minimum of 250mm above the existing ground level. The ground floor for dwelling 2 will be situated at a minimum level of 3.35m AODN, above the maximum predicted flood level under a breach scenario. For dwelling 1, the ground floor will be situated at a minimum level of 2.75m AODN which is below the maximum predicted flood level of 3.29m AODN.

It should be recognised that the site is currently protected from a tidal flood event by flood defence infrastructure, and therefore the actual risk of tidal flooding at the development site is very low. It is only in the extremely unlikely event that the existing defences were to fail that the ground floor of dwelling 1 could be subject to flooding. Consequently, it is proposed to include flood resistance and resilience measures to prevent the ingress of floodwater (see Section 7.3).

7.3 Flood Resistance and Resilience

Flood Resistance or 'dry proofing', where flood water is prevented from entering the building. For example, using flood barriers across doorways, or raising floor levels. These measures are considered appropriate for 'more vulnerable' development where recovery from internal flooding is not considered to be practical.

Flood Resilience or 'wet proofing', accepts that flood water will enter the building and allows for this situation through careful internal design for example raising electrical sockets and fitting tiled floors. The finishes and services are such that the building can quickly be returned to use after the flood.

Flood proofing measures which can be implemented to reduce the damage to buildings and property are becoming more common in areas that are subject to flooding. Correspondence with the client has confirmed that the following flood resistance and resilience measures can be included:

- Plastic, wooden or metal flood barriers/gates in front of windows and doors on the ground

- The use of small pumps in conjunction with flood barriers and sandbags, which are only needed in an emergency when floodwater has seeped past the barrier.
- Move valuable and electronic possessions such as electrical rings to the 1st floor and if possible, place important documents in dry proof sealable bags.
- Raise all gas and electrical meters as well as electrical sockets and telephone points above the predicted floor level and encase them in plastic sealed housing were possible.
- Add weighted or secured covers to manholes on site.
- The use of one-way values within sewer and water piping systems to stop backflow along pipes.
- Orientate plasterboards horizontally to prevent upper plasterboards from becoming damaged.
- Water-resistant plaster/tiles on the kitchen walls of the ground floor.
- The use of corrosion resistant materials such as galvanised copper and steal for the hinges along doors and windows on the ground floor
- Adding damp proof membranes to the floor and walls of the ground floor to stop water seepage.
- Using solid timber for the staircases leading to the first floor.

With the inclusion of flood resistance measures, it is possible to protect dwelling 1 up to a flood level of 3.35m AODN which is above the maximum predicted flood level. Consequently, if installed correctly, the dwelling would remain dry under this scenario. Flood resistance measures can be incorporated into the design of dwelling 2 up to a level of 3.95m AODN.

Details of flood resilience and flood resistance construction techniques can be found in the document '*Improving the Flood Performance of New Buildings; Flood Resilient Construction'*, which can be downloaded from www.gov.uk.

A Code of Practice (CoP) for Property Flood Resilience (PFR) has been put in place to provide a standardised approach for the delivery and management of PFR. Further information on the CoP and guidance on how to make a property more flood resilient can be accessed, and downloaded, from the Construction Industry Research and Information Association (CIRIA) Website:

https://www.ciria.org/Resources/Free_publications/CoP_for_PFR_resource.aspx

7.4 Flood Warning

The nature of the flood mechanism in this location is tidal flooding associated with a tidal surge in the North Sea. Such an event is dependent on meteorological conditions that can be monitored reliably and therefore it is likely that a minimum of 12 hours warning could be given. This forewarning should be sufficient to allow the users of the site to prepare the buildings for a flood event and to evacuate the site themselves.

Whilst the probability of an event of sufficient magnitude to cause floodwaters to reach the levels discussed in this report is very low, the risk of such an occurrence is always present. With the sophisticated techniques now employed by the EA to predict the onset of flood events the opportunity now exists for all residents within the flood risk area to receive early flood warnings.

This forewarning could be sufficient to either allow residents to evacuate the area or prepare themselves and their property for a flood event. It is therefore recommended that the occupants of the site sign up to the EA's Flood Warning Service either by calling 0345 988 1188, or by visiting;

www.gov.uk/sign-up-for-flood-warnings

The flood warning service could also be used in combination with a robust Flood Warning and Evacuation plan (FEP) for the site. An FEP could be issued to each of the residents and would need to be reviewed on an annual basis.

7.5 Surface Water Management

The general requirement for all new development is to ensure that the runoff is managed sustainably, and that the development does not increase the risk of flooding at the site, or within the surrounding area. In addition, the NPPF states that sustainable drainage systems should be incorporated in areas at risk of flooding and therefore, use of SuDS has been considered with the aim of minimising the risk of flooding both on and off site.

Opportunities to Discharge Surface Water Runoff

Part H of the Building Regulations summarises a hierarchy of options for discharging surface water runoff from developments. The preferred option is to infiltrate water into the ground, as this deals with the water at source and serves to replenish groundwater. If this option is not viable, the next option is for the runoff to be discharged into a watercourse. The water should only be conducted into the public sewer system if neither of the previous options are possible.

Water Re-Use – Water re-use systems should ideally be considered to reduce the reliance on the demand for potable water. However, such systems can rarely manage 100% of the surface water runoff discharged from a development, as this requires the yield from the building and hardstanding area to balance perfectly with the demand from the proposed development. Consequently, whilst rainwater recycling systems can be considered for inclusion within the scheme, an alternative solution for attenuating storm water will still be required.

Infiltration – The soil and underlying geology at this location has been analysed using the BGS mapping. The geology of the site is made up of Margate Chalk Member (chalk). The above-mentioned strata is likely to have a high permeability, capable of discharging surface water runoff. Notwithstanding this, it is noted that there are superficial deposits which could impact the infiltration rates in this area and therefore, it is recommended that site investigations are carried out at detailed design stage to confirm infiltration rates and the depth of the groundwater table.

Discharge to Watercourses – There are no watercourses located within close proximity to the site, which show onward connectivity to a main river, the sea, or any other large surface water body. As a result, there is no opportunity to discharge surface water runoff from the development to an existing watercourse.

Discharge to Public Sewer System - Inspection of the asset location mapping identifies that there are only foul sewers in the area. However, should it not be possible to discharge surface water runoff from the site via infiltration, the only alternative discharge method is into the public sewer system. Due to the network being dedicated as foul sewers, it will be necessary to restrict any discharge rates into the sewer and provide attenuation on site.

A range of typical SuDS that can be used to improve the environmental impact of a development is listed in Table 7.2 below along with the relative benefits of each feature and the appropriateness for the subject site.

SuDS	Description	Constraints/Comments	Appropriate for site?
Rainwater Harvesting Systems	Collecting of rainwater and storing for reuse on site, e.g., in form of water butts	No known constraints	Yes
Green Roofs	Provide landscaping and planting at roof level to reduce surface water runoff rates	Unsuitable roof design	No
Infiltration Systems	Allow water to percolate into the ground at a controlled rate via natural infiltration	Unlikely to be sufficient space to due existing trees.	Unknown
Filter Strips	Wide, gently sloping, densely planted areas promoting sedimentation and filtration	Unlikely to be sufficient space to due existing trees.	Unknown
Filter Drains	Trenches infilled with stone/gravel providing attenuation, sedimentation and filtration	Unlikely to be sufficient space to due existing trees.	Unknown
Swales	Broad, shallow channels that convey and store runoff, and allow infiltration	Unlikely to be sufficient space to due existing trees.	Unknown
Bioretention Systems / Rain Gardens	A shallow landscaped depression allowing runoff to pond temporarily on the surface or planters/tree crates designed specifically to intercept and store stormwater	No known constraints	Yes
Pervious Surfacing	Runoff is allowed to soak into structural paving and stored, potentially being allowed to infiltrate	No known constraints	Yes
Attenuation Storage Tanks	Large, below ground voided spaces, which can be used to temporarily store stormwater	No known constraints	Yes
Detention Basins	A landscaped depression for attenuation with a restricted runoff	No known constraints	Yes
Ponds and Wetlands	A permanent pool of water which can be used for attenuation and controlled outflows by water levels	Insufficient space on site due to building covering entire curtilage of site	No

Table 7.2 – Suitability of SuDS.

A storage estimate has been undertaken using Causeway Flow+ software and the variable obtained from the Flood Estimation Handbook (FEH) online web service. The total proposed impermeable area is 859m² and the results show that the approximate volume of storage required to store rainfall runoff from the site during a 1 in 100 year rainfall event, including a 45% allowance for climate change is 85m³. Inspection of the scheme drawings would indicate that it might be possible to include a pond and permeable surfacing within the access road to provide sufficient storage for surface water runoff. However, due to the sloping topography of the land and existing trees, the viability of these SuDS features should be considered further as part of a detailed design.

In addition to the features stated above, it is recommended that the opportunity to include water butts, or planters is explored where possible. The primary aim of specifying SuDS would be to reduce the rate of discharge from the site where possible and ensure there is no increase in risk of flooding offsite as a result of the development in accordance with the principles promoted by the NPPF.

8 Conclusions and Recommendations

The overarching objective of this report is to appraise the risk of flooding at Worth Farm, The Street, Worth, to ensure that the proposals for development are acceptable and that any risk of flooding to the occupants of the proposed residential units is appropriately mitigated. In addition, the NPPF also requires the risk of flooding offsite to be managed, to prevent any increase in flood risk as a result of the development proposals. This report has therefore been prepared to appraise the risk of flooding from all sources and to provide a sustainable solution for managing the surface water runoff discharged from the development site, in accordance with the NPPF and local planning policy.

It has been recognised that it may be necessary for the planning authority to demonstrate that the development can pass the Sequential Test. As discussed in Section 2.3, without having comprehensive knowledge of the land that is available for development in the district it is not possible for this FRA to comment in detail on the Sequential Test. Nevertheless, the evidence provided within this report can be used to support the application of the Sequential Test.

In addition to the Sequential Test it is also necessary to consider the type and nature of the development and whether the Exception Test is applicable. From Figure 2.3 it can be seen that the area of proposed development is situated within Flood Zone 2 and is a development type that is classified as being ‘more vulnerable’. For such a combination of risk and vulnerability, the NPPF does not typically require the Exception Test to be applied. However, it is recognised that a small area of the access road is situated within Flood Zone 3 and therefore, the principles of the Exception Test have been considered as part of this assessment.

The risk of flooding has been considered across a wide range of sources and it is only the risk of coastal flooding that has been shown to have any bearing on the development. However, when this risk is examined in detail, it is evident that the proposed development currently benefits from existing defence infrastructure. These defences are shown to continue to protect the site even if an allowance for climate change is taken into account over the lifetime of the proposed development.

It is only in the unlikely event if the defences were to fail that the site could be affected by flooding. Consequently, the following mitigation measures have been proposed to manage the risk of flooding to the proposed development;

- ***Sequential Approach for all dwellings*** – All sleeping accommodation is proposed to be situated on the first floor, above the maximum predicted flood level. It is only less vulnerable elements (such as living accommodation and kitchen) which are proposed to be situated on the ground floor.

- ***Dwelling 1*** – It is proposed to raise the ground floor a minimum of 250mm above the existing ground. This means that for dwelling 1, the ground floor will be situated at 2.75m AODN. It is recognised that this is below the maximum predicted flood level under a breach scenario and therefore, flood resistance measures are proposed to be included to prevent the ingress of floodwater up to a level of 3.35m AODN which is above the flood level.

- ***Dwelling 2*** – The ground floor will be raised to a minimum level of 3.35m AODN which is situated above the design flood level. In addition, flood resistance measures are proposed to further improve the flood performance of the building up to a level of 3.95m AODN.

- ***Flood resilience measures*** – For both dwellings, it is proposed to incorporate flood resilience measures (refer to Section 7.3).

- ***Flood Warning and Evacuation*** – It is recommended that the residents of the dwellings sign up to the EA's Early Flood Warning Service to receive a forewarning of a potential flood event and evacuate the site if required. This flood warning should be used in combination with a Flood Warning and Evacuation Plan which should be issued to all residents. This should form part of planning conditions.

- ***Surface Water Management*** **–** It has been identified that the development will increase the impermeable areas and therefore, surface water runoff will need to be managed. A surface water management strategy for the development will need to be developed to a detailed design stage. At this stage, it is envisaged that surface water runoff can be infiltrated into the ground through a combination of ponds and permeable surfacing. However, It will be necessary to undertake site-specific investigations at the detailed design stage in order to quantify the available infiltration, the groundwater level and the level of contamination that may be present in the soils.

With the above mitigation measures incorporated into the design of the development, it will be possible to manage the risk of flooding to the development and ensure that the risk of flooding is not increased elsewhere.

9 Appendices

Appendix A.1 – Drawings

Appendix A.2 – Southern Water Asset Location Data

Appendix A.1 – Drawings

Scale 1:500

General Notes

NOTES:

Proposed site layout

Two new oak framed houses positioned as drawn.

Driveways to be porous sub-base with gravel topping.

Houses to be built on reinforced raft, to take into account the new flood risk zone maps.

Existing trees to retained as shown.

No.	Revision/Issue	Date
	NT/CR	

Firm Name and Address

NORTON TIMBER Ltd.

Project Name and Address
Mr & Mrs C Rooke
Worth Farm,
The Street,
Worth,
Deal,
Kent
CT14 0DF

Project: Two oak framed houses

Date: 28th November 2023

Scale: 1:500 A3

Sheet: 4

General Notes

NOTES:

All land owned by the applicant outlined in blue and the proposed site outlined in red.

No.	Revision/Issue	Date
	NT/CR	

Firm Name and Address

NORTON TIMBER Ltd.

Project Name and Address
Mr & Mrs C Rooke
Worth Farm,
The Street,
Worth,
Deal,
Kent
CT14 0DF

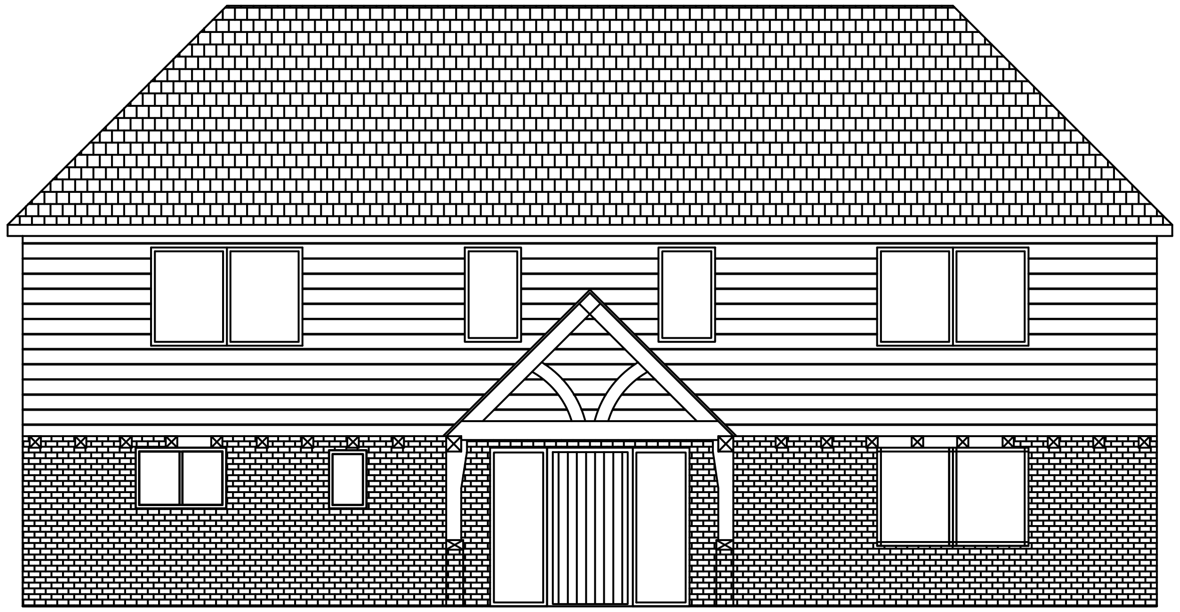
Project: Two oak framed houses

Date: 28th November 2023

Scale: 1:1250 A3

Sheet: 5

South



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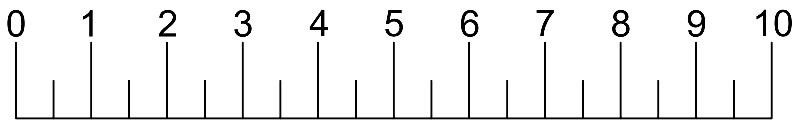

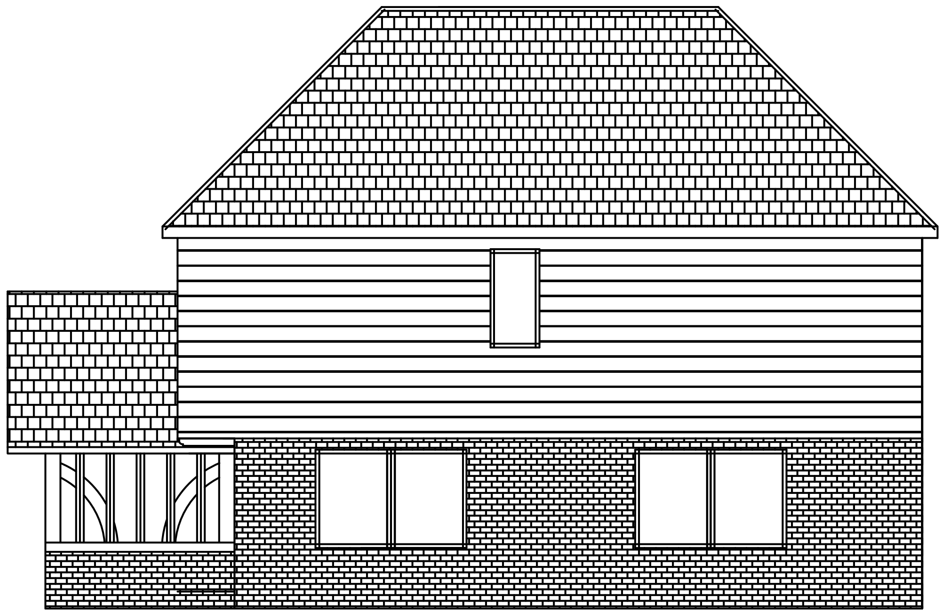

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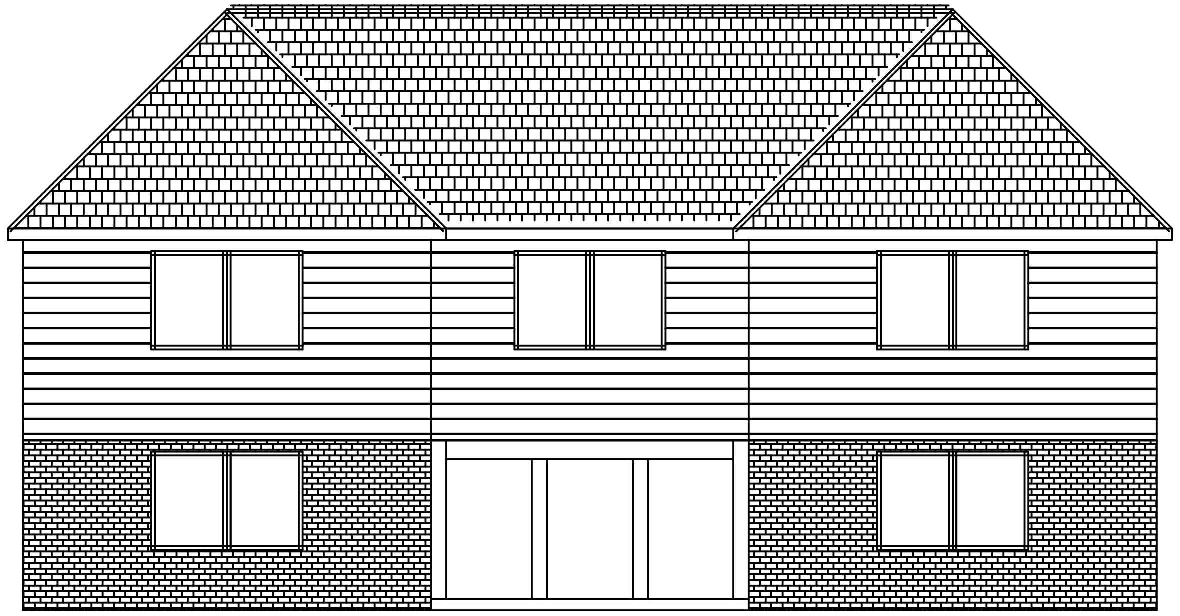


West

General Notes

NOTES:

Proposed house 1 elevations.

Brick ground floor.

Weatherboard first floor.

Heritage clay tiled roof

No.	Revision/Issue	Date
	NT/CR	

Firm Name and Address

NORTON
TIMBER Ltd.

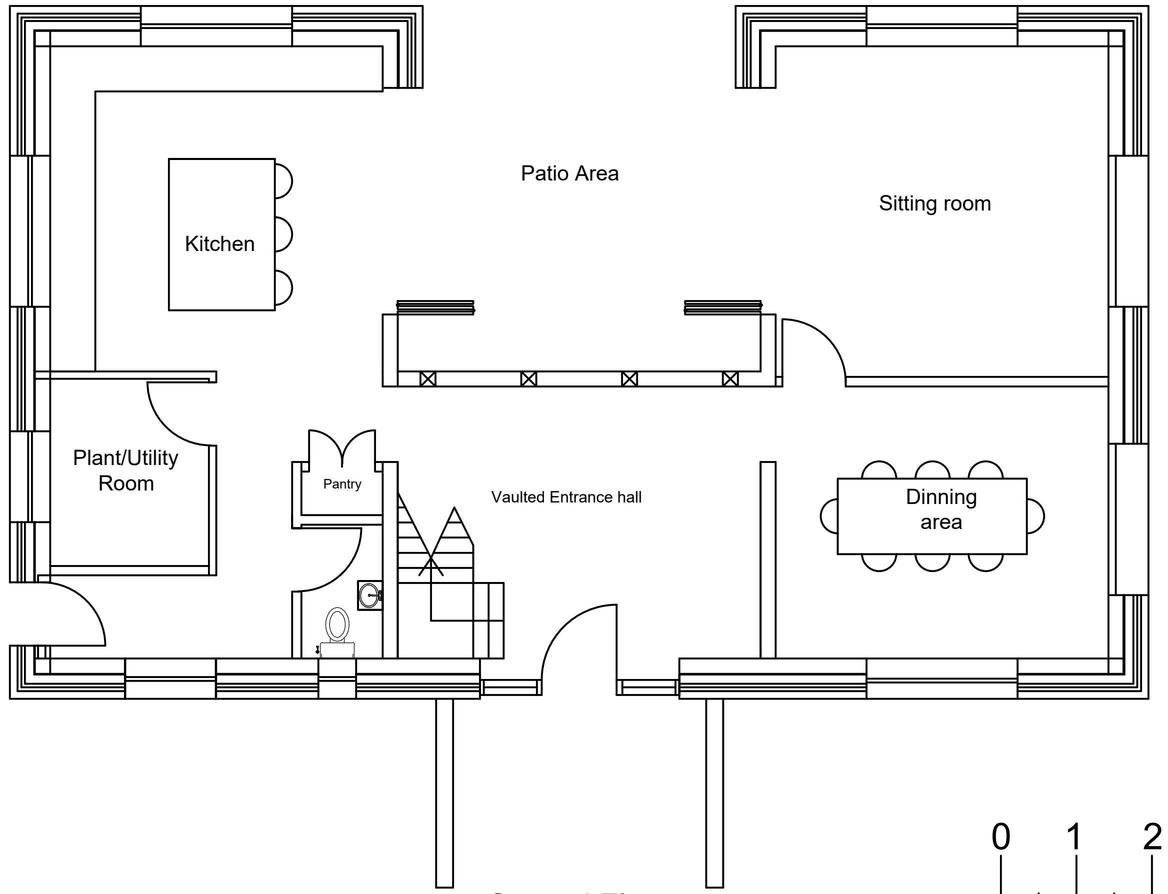
Project Name and Address
Mr & Mrs C Rooke
Worth Farm,
The Street,
Worth,
Deal,
Kent
CT14 0DF

Project: Two oak framed houses

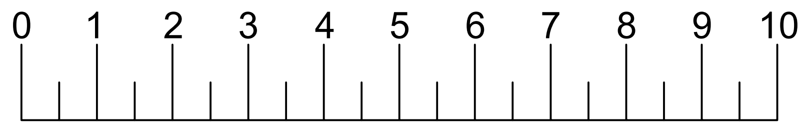
Date: 28th November 2023

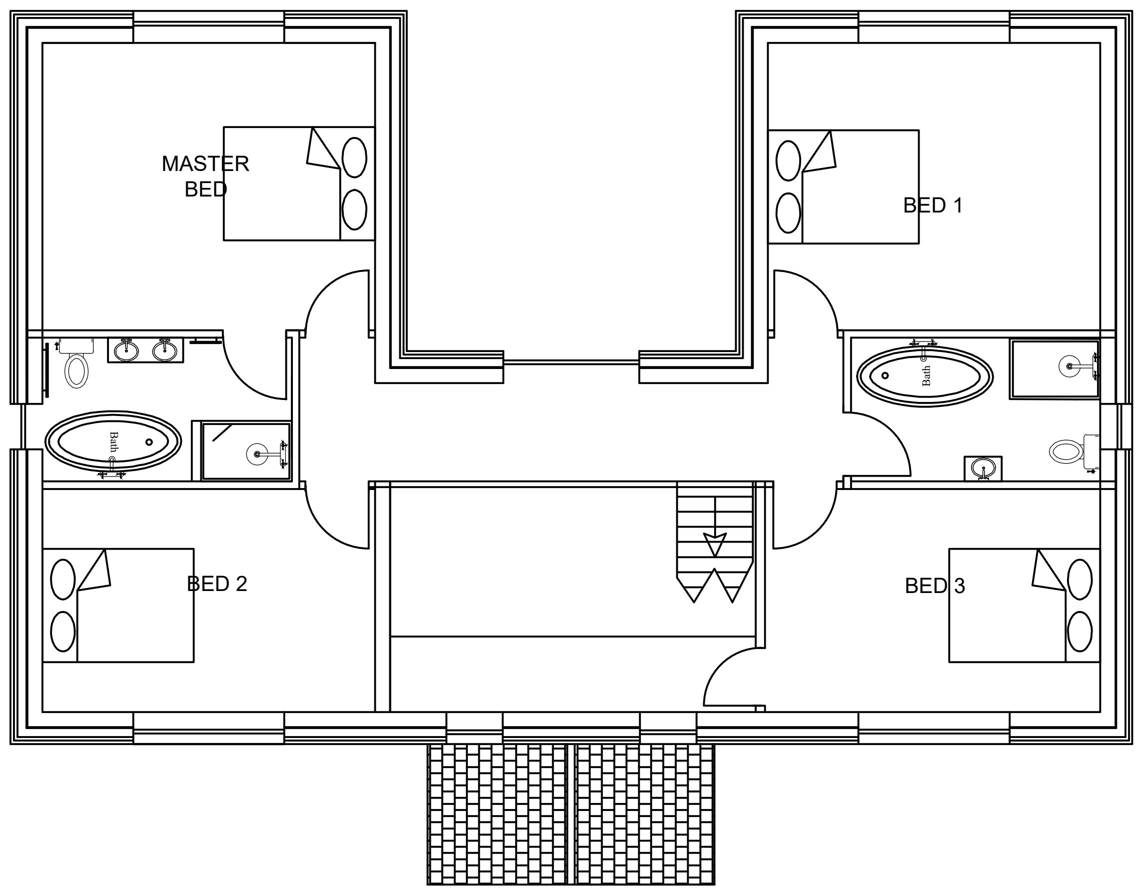
Scale: 1:100 A3

Sheet: 9



Ground Floor





First Floor

General Notes

NOTES:

Proposed house 1 floor plans.

No.	Revision/Issue	Date
	NT/CR	

Firm Name and Address

NORTON
TIMBER Ltd.

Project Name and Address
Mr & Mrs C Rooke
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Worth,
Deal,
Kent
CT14 0DF

Project
Two oak framed houses

Date
28th November 2023

Scale
1:100 A3

Sheet
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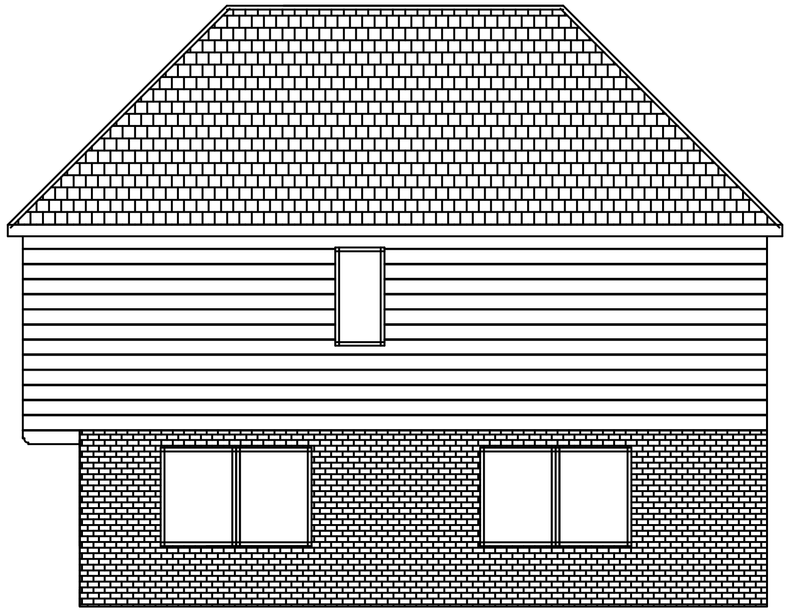
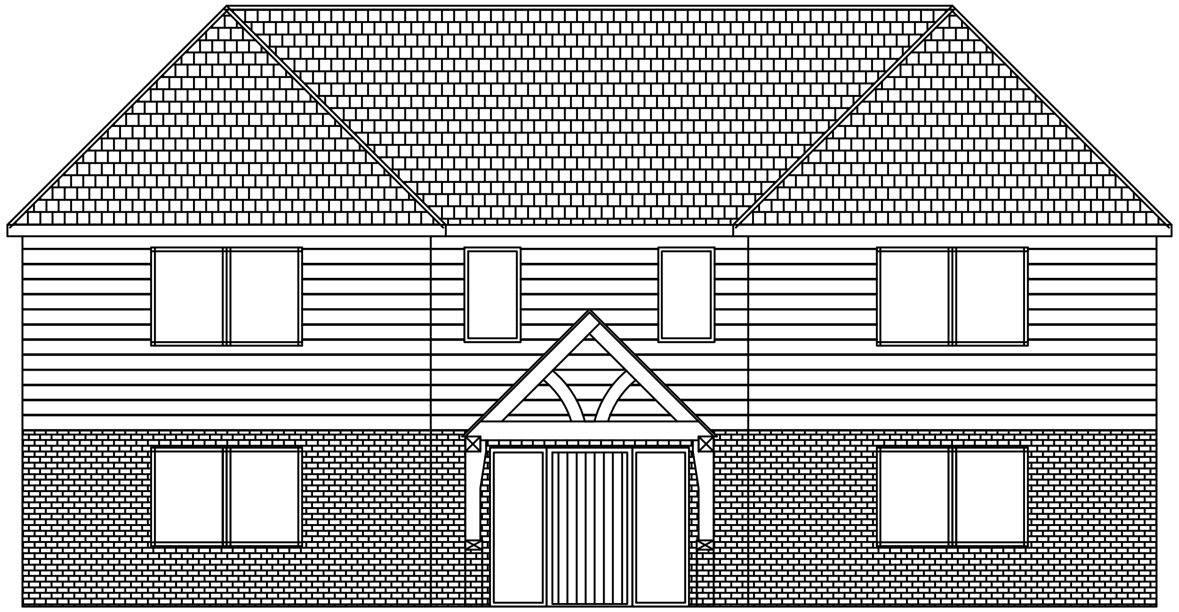


South West



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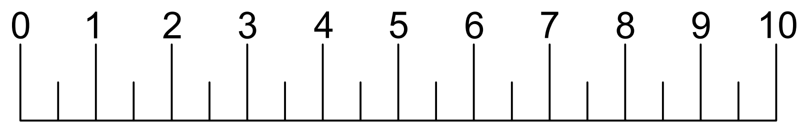
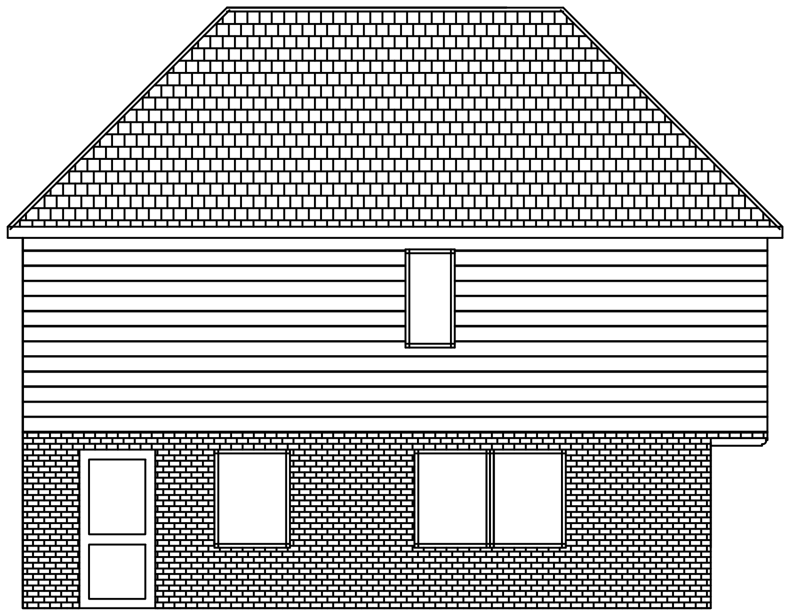
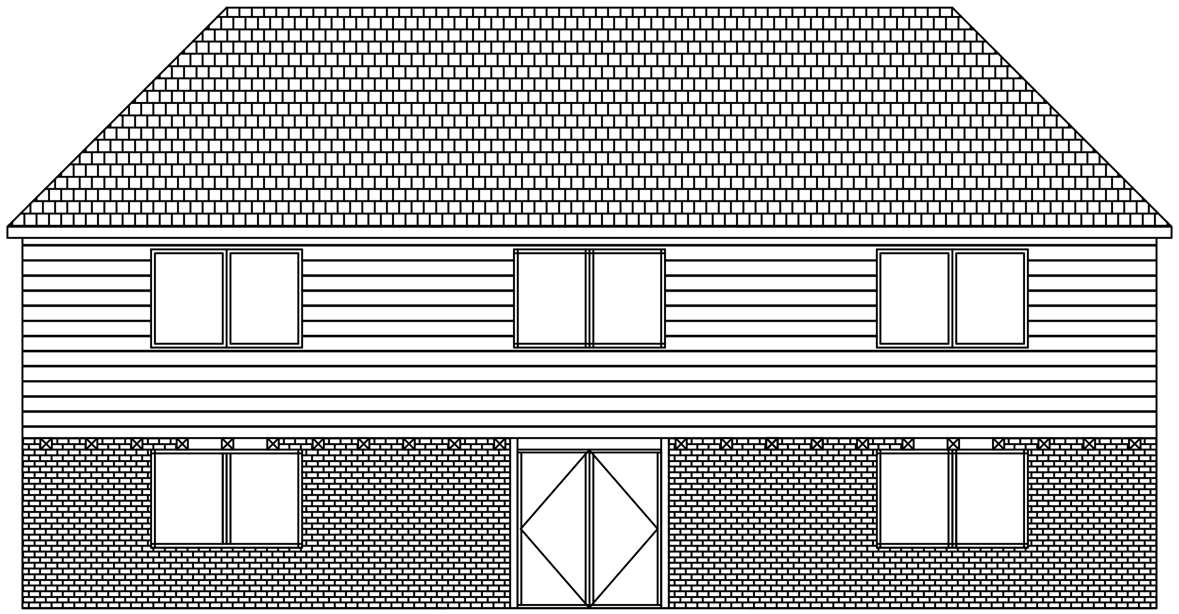




North East



North West

General Notes

NOTES:

Proposed house 2 elevations.

Brick ground floor.

Weatherboard first floor.

Heritage clay tiled roof

No.	Revision/Issue	Date
	NT/CR	

Firm Name and Address

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Two oak framed houses

Date
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Scale
1:100 A3

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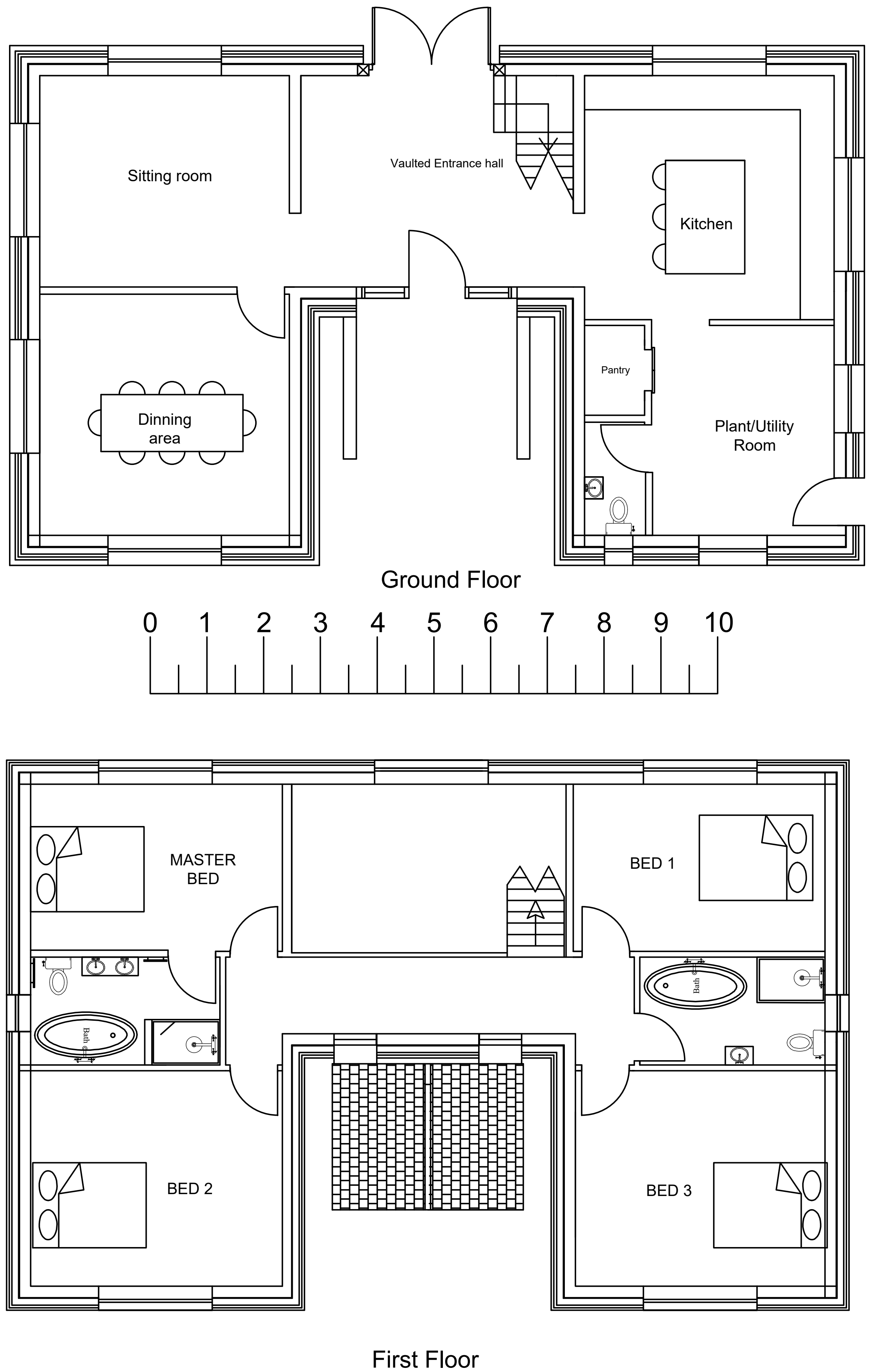

General Notes

NOTES:

Proposed house 2 floor plans.

No.	Revision/Issue	Date
	NT/CR	

Firm Name and Address

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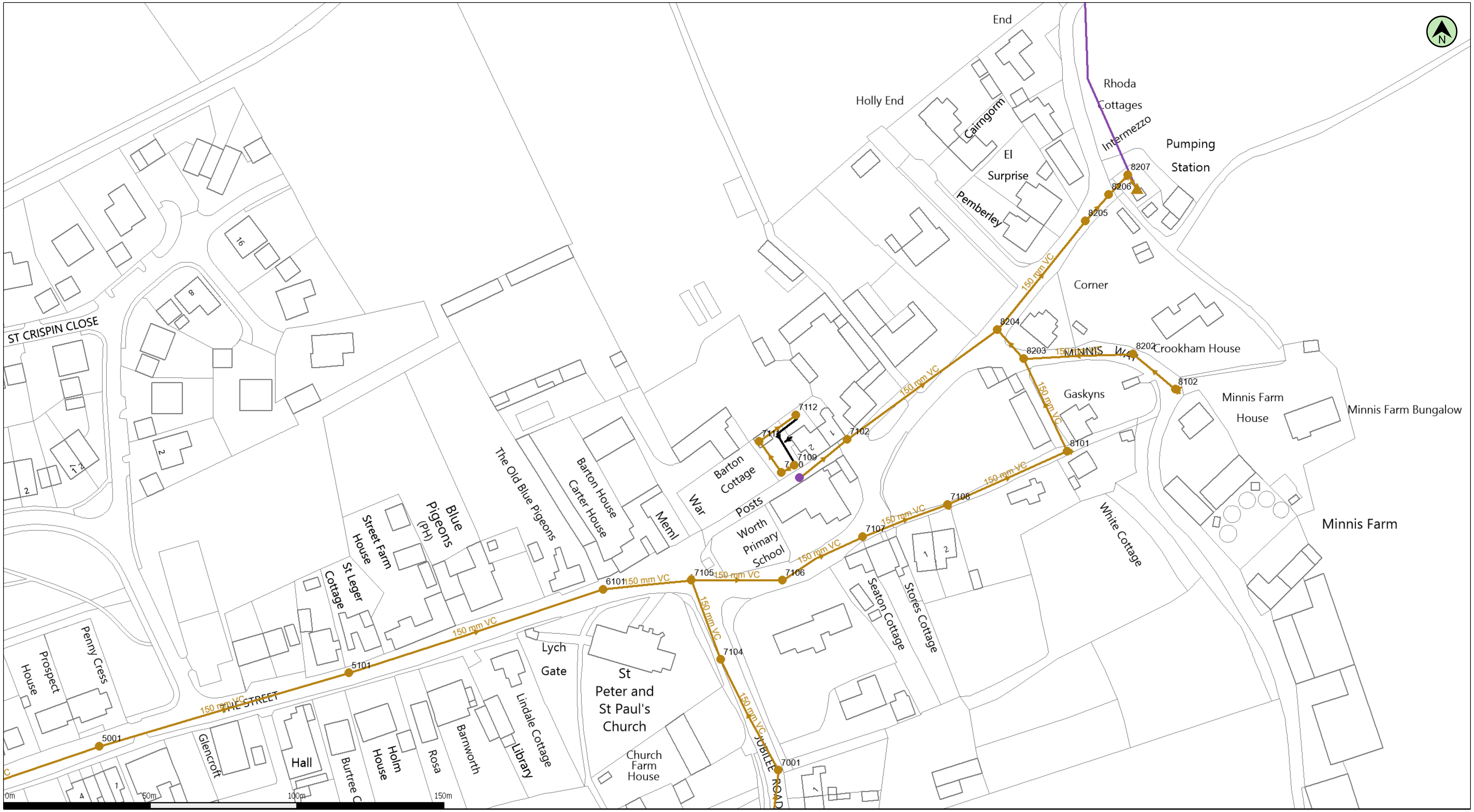
Date: 28th November 2023
Scale: 1:100 A3
Sheet: 13

Appendix A.2 – Southern Water Asset Location Data



(c) Crown copyright and database rights 2024 Ordnance Survey 100031673	Date: 04/01/24	Scale: 1:1250	Map Centre: 633719,156194	Data updated: 21/11/23	Our Ref: 1358141 - 1	Wastewater Plan A3

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2023 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Foul Gravity Sewer
Combined Gravity Sewer
Culverted Water Course or Treated Effluent
Surface Water Gravity Sewer
Rising Main, Vacuum or Syphon
Combined Outfall
Surface Water Outfall
Foul Outfall
Surface Water Inlet
Combined Pumping Station
Surface Water Pumping Station
Foul Pumping Station
WWTW Water Treatment Works
Section 104 Area
Building Over Agreement Area
Foul Manhole
Combined Manhole
Surface Water Manhole
Side Entry Manhole, Decarcation Chamber, Dummy Manhole or Surface Water Soakaway

flood@herringtonconsulting.co.uk

JA/3916

WATER for LIFE from Southern Water.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
5001	F	5.24	2.15	
5101	F	4.07	1.65	
6101	F	2.73	1.10	
7001	F	3.12	0.80	
7102	F	1.97	0.76	
7104	F	3.17	0.73	
7105	F	2.19	0.59	
7106	F	2.12	0.40	
7107	F	2.25	0.27	
7108	F	2.08	0.12	
7109	F	2.08	1.51	
7110	F	2.08	1.57	
7111	F	2.05	1.63	
7112	F	2.09	0.00	
8101	F	1.75	-0.12	
8102	F	1.55	0.24	
8202	F	1.60	0.10	
8203	F	1.88	-0.24	
8204	F	1.92	-1.00	
8205	F	1.79	-1.33	
8206	F	1.76	-1.36	
8207	F	2.00	-1.37	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert