



Client: CLAN Developments LLP

Flood Risk Assessment for the
Proposed Development at Brenzett
Place Farm, Ivychurch Road, Brenzett,
Romney Marsh, Kent

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Canterbury Office

Unit 6 & 7
Barham Business Park
Elham Valley Road
Barham
Canterbury
Kent
CT4 6DQ
Tel 01227 833855

London Office

6-8 Bonhill Street
London
EC2A 4BX

www.herringtonconsulting.co.uk

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Road, Brenzett, Romney Marsh, Kent

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		Director Sign Off:	Simon Maiden-Brooks	

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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 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 deal with these effects and risks are appropriate
- whether the site will pass the second element of the Exception Test (where applicable).

Herrington Consulting has been commissioned by CLAN Developments LLP to prepare a Flood Risk Assessment for the proposed development at **Brenzett Place Farm, Ivychurch Road, Brenzett, Romney Marsh, Kent, TN29 0EE.**

This appraisal has been undertaken in accordance with the requirements of the National Planning Policy Framework (2018) and the National Planning Practice Guidance Suite (March 2014) that has been published by the Department for Communities and Local Government. The *Flood Risk and Coastal Change* planning practice guidance included within the Suite represents the most contemporary technical guidance on preparing FRAs. In addition, reference has also been made to Local Planning Policy.

To ensure that due account is taken of industry best practice, this FRA has been carried out in line with the CIRIA Report C624 'Development and flood risk - guidance for the construction industry'.

2 Development Description and Planning Context

2.1 Site Location

The site is located on the southern side of Ivychurch Road just outside the village of Brenzett. In total the site covers an area of approximately 0.6 hectares and is currently in use as a farm. The location of the site in relation to the surrounding area and the Brenzett Sewer (drainage ditch) is shown in Figure 2.1. The site plan included in Appendix A.1 of this report gives a more detailed reference to the site location and layout.



Figure 2.1 – Location map (Contains Ordnance Survey data © Crown copyright and database right 2018)

2.2 The Development

The proposals for development at Brenzett Place Farm comprise the conversion of one of the existing barns into 3 residential units, and the conversion of a second barn into 1 residential unit, (4 units total). The development site was previously granted planning permission for the same proposals in 2013, which has since lapsed.

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

2.3

The Sequential Test

Local Planning Authorities (LPA) are encouraged to take a risk-based approach to proposals for development in or affecting flood risk areas through the application of the Sequential Test and the objectives of this test are to steer new development away from high risk areas towards those at lower risk of flooding. However, in some areas where developable land is in short supply there can be an overriding need to build in areas that are at risk of flooding. In such circumstances, the application of the Sequential Test is used to ensure that the lower risk sites are developed before the higher risk ones.

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 flood zone maps. 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 20 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.

The location of the site is shown on the Environment Agency's flood zone map in Figure 2.2 and the information provided by this map has been interrogated and summarised in Table 2.2 below.

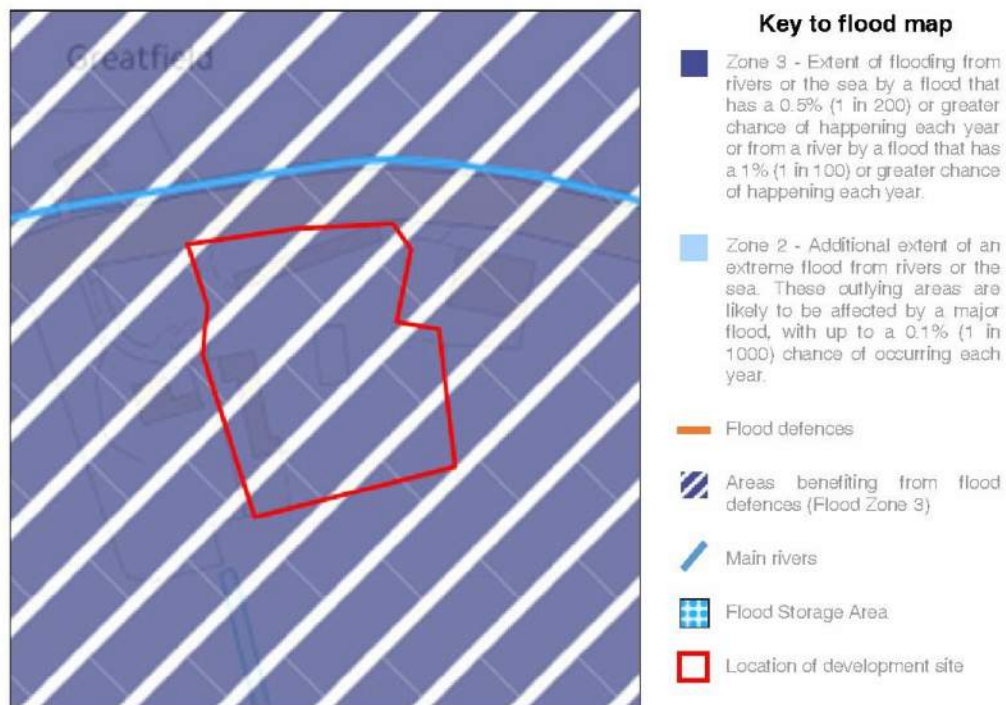


Figure 2.2 – Flood zone map showing the location of the development site (© Environment Agency)

The above mapping shows the development site to be located within Flood Zone 3 and to be benefiting from existing flood defences that have been constructed in the last 5 years. This mapping does not distinguish between high risk areas and the functional floodplain, i.e. Zones 3a and 3b. This is an important differentiation that needs to be made by the FRA because the NPPF states that development other than essential transport and utilities infrastructure should not be located within the functional floodplain.

The functional floodplain is defined by the NPPF as land where water has to flow or be stored in times of flood during events that have a probability of occurrence of 1 in 20 (5%) or greater in any one year. The Technical Guidance goes on to further clarify this by adding the following definition:

The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain. Areas which would naturally flood with an annual exceedance probability of 1 in 20 (5%) or greater, but which are prevented from doing so by existing infrastructure or solid buildings will not normally be defined as functional floodplain.

Based on information provided by the Environment Agency and that derived as part of this appraisal, the following functional floodplain test is applied:

Do predicted flood levels show that the site will be affected by an event having a return period of 1 in 20 years or less?	X
Is the site defended by flood defence infrastructure that prevents flooding for events having a return period of 1 in 20 years or greater?	✓
Does the site provide a flood storage or floodwater conveyance function?	X
Does the site contain areas that are 'intended' to provide transmission and storage of water from other sources?	X
Is site within the functional floodplain (Zone 3b)?	No

Table 2.1 – Functional floodplain test

The flood zone mapping and associated information has been summarised in Table 2.2 below.

Flood Zone (percentage of site within zone)		Source of flooding	Benefiting from existing flood defences*
Zone 1	0%		
Zone 2	0%		
Zone 3a	100%	Sea	Yes
Zone 3b	0%		
(*) The flood zone maps only recognise defences constructed within the last 5 years			

The NPPF states that the Local Planning Authority 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 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. This requires a comprehensive knowledge of development sites within the district and is generally applied as part of the Local Development Framework (LDF) process. However, when applying the test to sites that have not been assessed as part of the LDF it is necessary to apply a bespoke test.

In this case a Sequential Test assessment has not been undertaken in support of this FRA, however, when considering that the site has previously been granted planning permission for residential development, this supports the assumption that the requirements of the Sequential Test will be met.

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 Folkestone & Hythe District 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 site's topography 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 following the application of the sequential test it is not possible, consistent with wider sustainability objectives, for the development to be located in zones of lower probability of flooding, the exception test can be applied.

As part of this process it is necessary to consider the type and nature of the development. The Technical Guidance to NPPF defines the type and nature of different development classifications in the context of their flood risk vulnerability. This has been summarised in Table 2.3 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	x	x
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	x
Less vulnerable – Shops, offices, restaurants, general industry, agriculture, sewerage treatment plants	✓	✓	✓	x
Water compatible development – Flood control infrastructure, sewerage infrastructure, docks, marinas, ship building, water-based recreation etc.	✓	✓	✓	✓
Key : ✓ Development is appropriate x Development should not be permitted e Exception Test required Shaded cell represents the classification of this development				

Table 2.3 - Flood risk vulnerability and flood zone compatibility

From Table 2.3 above it can be seen that the development falls into a classification that requires the Exception Test to be applied. For the Exception Test to be passed it should be demonstrated that:

- the development would provide wider sustainability benefits to the community that outweigh the flood risk; and
- 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 will have to be passed for development to be allocated or permitted.

Demonstrating that the development provides wider sustainability benefits to the community that outweigh flood risk is outside the scope of this report, nevertheless, reference is made to the SFRA to establish the key risks associated with flooding to help demonstrate that this objective can be achieved. The key focus of this FRA is therefore to establish whether the site is likely to pass the second element of the Exception Test.

3 Definition of Flood Hazard

3.1 Site Specific Information

In addition to the high level flood risk information shown in the Environment Agency flood zone maps, additional data from detailed studies, topographic site surveys and other information sources is referenced. This section summarises the additional information collected as part of this FRA.

Site specific flood level data contained within the SFRA – The Folkestone & Hythe District Council SFRA (2015) contains detailed mapping of flood extents from a wide range of sources. This document has been referenced as part of this site-specific FRA.

Site specific topographic surveys – Inspection of the site specific topographic survey shows that the land levels across the site vary between 2.2m and 2.7m Above Ordnance Datum Newlyn (AODN).

Geology – Reference to the British Geological Survey map shows that the underlying solid geology in the location of the subject site is Hastings Beds. Overlying this are superficial deposits of Alluvium.

Historic flooding – The Folkestone & Hythe District Council Strategic Flood Risk Assessment highlights areas of historic flooding within the district. These maps do not highlight any areas of historic flooding in close proximity to the site.

3.2 Potential Sources of Flooding

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

Flooding from Rivers (Fluvial) – Areas within the Walland, Denge and Romney Marshes are all at risk of flooding from fluvial events. These events arise as a consequence of long duration, high intensity rainfall, which can last for several days. The 'Brenzett Sewer' has the potential to be a source of fluvial flooding to the site, as this channel is hydraulically connected to a large network of ditches which drain the surrounding land. The last major fluvial flood event in the region occurred in 1979 and was the result of several days of heavy rainfall. This flood event mostly affected the western Walland Marsh, near Ivychurch and Brookland, however, the subject site was not affected.

One explanation for this is that the vast network of drainage ditches actually provided some form of attenuation of floodwater, thereby reducing the potential impact on the site and extent of a fluvial flood event from the Brenzett Sewer.

Following the recorded flooding events in November 1960, the Lower Rother Area Drainage Improvement Scheme was constructed, which included bank raising and the installation of a

number of pumps to drain the Marshes. Rainfall records for October-November 2000 show a very similar rainfall pattern to those exhibited during the rainfall event in 1960. Despite this, the event in 2000 did not result in major flooding of the Marshes. This suggests that the Drainage Improvement Scheme operated as planned and reduced the risk of flooding to the surrounding area.

Due to the expansive and low-lying nature of the Marsh, the area affected by a large flood event is likely to be vast. Whilst this flooding would be widespread, as a consequence of the large volume of storage available within the flood compartment, any flooding would be relatively shallow. When the topography of the site and the surrounding area is considered in more detail, it can be seen that if fluvial flooding were to occur it is likely that this would only affect the very lowest parts of the site away from the area of proposed development. Consequently, the risk of flooding to the residential dwellings from this source is considered to be *low*.

Flooding from Ordinary or Man-made Watercourses – Natural watercourses that have not been enmained and man-made drainage systems such as irrigation drains, sewers or ditches could potentially cause flooding.

Inspection of OS mapping of the site and surrounding area reveals that the low-lying land in this location is drained by a network of man-made land drains. The primary role of these artificial watercourses is to reduce the groundwater level within the surrounding land, with pumps or tidal sluices being used to discharge flows to the sea.

Extreme rainfall, the failure of a pumping station or the tide-locking of the tidal outlet can prevent the system from discharging, which may result in increased water levels in the network of drains and ditches. However, due to the large and relatively flat nature of the land that is drained, the consequence of such an event is likely to be water logging of the ground and shallow flooding in the lower-lying areas. Review of aerial height data reveals that the land to the north and south of the site is lower lying. Consequently, in the event that water was to exit the drainage ditches in this location (i.e. following an extreme pluvial event), floodwater will be directed away from the site towards these lower lying areas.

Furthermore, reference to the historic records within the SFRA indicate the site has not been subject to flooding in the past. Therefore, taking the above into consideration, the risk of flooding to the site from this source is considered to be *low*.

Flooding from the Sea – The site lies within a coastal Flood Zone 3 as shown on the Environment Agency's flood zone map. The flood zone maps are used as a consultation tool by planners to highlight areas where more detailed investigation of flood risk is required. The fact that the site lies within Flood Zone 3 means that the risk of flooding from this source is examined in more detail in this FRA.

Flooding from Land (overland flow and surface water runoff) – 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 flooding mechanism 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.

Figure 3.1 below is an extract of the Environment Agency's 'Flood Risk from Surface Water' map which can be interrogated to identify whether the site is located in an area at risk of surface water flooding.

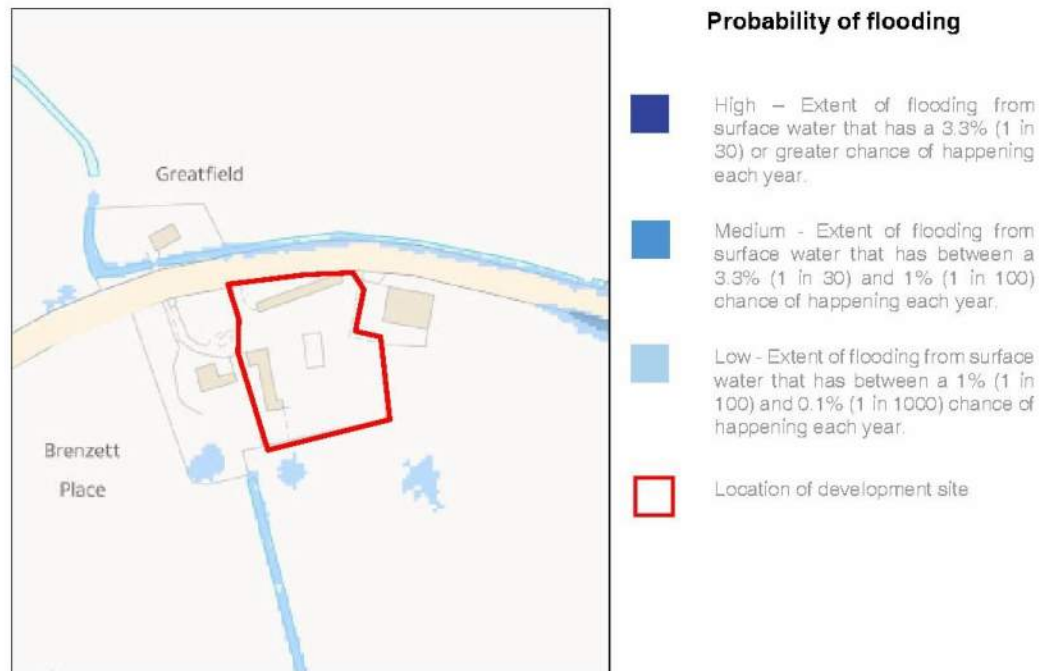


*Figure 3.1 – Surface water flooding map showing the location of the development site
(© Environment Agency)*

A review of the above mapping identifies that the site is located within an area at 'very low' risk of surface water flooding. Inspection of the site and its surrounding area shows that land levels fall naturally across the site in a southerly direction towards the lower lying land to the south. There are no large areas of impermeable land that have a direct or indirect drainage path that could give rise to large surface water runoff volumes that would be directed towards the site.

Furthermore, the proposals do not show local on-site routes for overland flow to be obstructed, which could cause water to pond. It is therefore considered that flooding through this mechanism is unlikely in this area. In addition, there is no historical evidence that suggests that overland flow has been the cause of flooding in this area in the past. Therefore, taking the above into consideration the risk of flooding from this source 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). Where land that is prone to groundwater flooding has been built on, the

effect of a flood can be very costly, and because groundwater responds slowly compared with rivers, floods can last for weeks or months.

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 Hastings Beds overlain by Alluvium, which can be associated with groundwater flooding under certain conditions. Given the low-lying nature of this area and the proximity to a watercourse, there is potential for this ground to become waterlogged and for the groundwater table to become elevated. However, the land drainage network in this area will ensure that groundwater levels remain below ground level.

This is supported by the detailed mapping on groundwater emergence provided as part of the Defra Groundwater Flood Scoping Study (May 2004), which shows that no groundwater flooding events were recorded during the very wet periods of 2000/01 or 2002/03. The same study shows that the site itself is not located within an area where groundwater emergence is predicted. Furthermore, inspection of the historic flood records within the SFRA indicate that the site has not been subject to groundwater flooding in the past. Consequently, it is considered that the site-specific risk of groundwater flooding is *low*.

Flooding from Sewers – In urban areas, rainwater is frequently 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 is of inadequate capacity, and will continue until the water drains away. However, there are no combined, surface water, or foul sewers that serve the site or the surrounding area. Therefore, the risk of flooding from this source is 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, operational and redundant industrial processes including mining, quarrying and sand and gravel extraction, as they may increase floodwater depths and velocities in adjacent areas. The potential effects of flood risk management infrastructure and other structures also need to be considered. 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 Environment Agency’s ‘Flood Risk from Reservoirs’ website shows that the site is not within an area considered to be at risk of flooding from reservoirs. As such, the risk of flooding to the site from artificial sources is considered to be *low*.

Source of flooding	Initial Level of risk	Appraisal method applied at the initial flood risk assessment stage
Rivers	Low	OS mapping and Environment Agency flood zone map
Sea/Estuaries	Appraised further in Section 5	OS mapping and Environment Agency flood zone map
Ordinary and man-made watercourses	Low	OS mapping and aerial height data and the historic records within the SFRA
Overland flow	Low	Environment Agency 'Flood Risk from Surface Water' flood maps, inspection of the historic records contained within the SFRA, OS mapping and aerial height data
Groundwater	Low	Defra Groundwater Flood Scoping Study, BGS geological data, OS mapping, aerial height data and the historic records within the SFRA
Sewers	Low	Site based appraisal
Artificial sources	Low	Site based appraisal, OS mapping and Environment Agency 'Flood Risk from Reservoirs' flood maps

Table 3.1 – Summary of flood sources and risks (denotes the principal flood risks to the site)*

3.3 Existing Flood Risk Management Measures

The Folkestone and Hythe District shoreline is approximately 41km long and much of this is defended to protect the lower-lying, rich and fertile land that forms part of the Romney, Walland and Denge Marshes. The land levels in these marsh areas are generally below the Mean High Water Springs level and consequently without the protection of the existing sea defences much of this land would be permanently inundated.

In 2001, the Folkestone to Rye Coastal Defence Strategy Plan recognised the relatively low standard of protection and state of deterioration of the seawalls that protect the Dymchurch, St Mary's Bay and Littlestone frontages and recommended a phased scheme of improvement works.

The first scheme was at Littlestone-on-Sea, which is fronted by a concrete seawall backed by a strip of shingle backshore. In April 2003, work on the Littlestone to St Mary's Bay sea defence scheme started. This involved improvement works to the seawall itself and the importation of 240,000 cubic metres of shingle. The scheme is now complete and the area benefits from a 1 in 200 year standard of protection, although this can be reduced at times when beach levels are drawn down.

In 2005, work started on the improvement works to the Dymchurch seawall between the Redoubt and Martello Tower number 23 and this included placing a rock armour revetment along the lower apron of the seawall, improvements to the concrete upper section and raising the seawall crest. These works are now complete and provide a standard of protection of 1 in 200 years. Following these works the scheme was extended to meet the St. Mary's Bay defences and comprise a concrete revetment and rear wave return wall. These works were completed in 2012.

The current defence along the Dymchurch frontage comprises a high embankment, with a stepped concrete revetment. The crest is protected by an asphaltic concrete pavement and there is a rear return wall with a crest of approximately 7m AODN. The rear wall has a number of flood gates to enable access to the beach, and the landward face consists of a steep embankment.

4 Climate Change

When the impact of climate change is considered it is generally accepted that the standard of protection provided by current defences will reduce with time. 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 of the type responsible for the recent UK flooding 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 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. The accompanying Planning Practice Guidance Suite to the NPPF provides allowances for the regional rates of relative sea level rise and these are shown in Table 4.1.

Administrative Region	Net Sea Level Rise (mm/yr) Relative to 1990			
	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
East of England, East Midlands, London, SE England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South West	3.5	8.0	11.5	14.5
NW England, NE England (north of Flamborough Head)	2.5	7.0	10.0	13.0

Table 4.1 – Recommended contingency allowances for net sea level rise from the NPPF

From these values it can be seen that the extreme flood level at the site will change with time and that this change is not linear. The 1 in 200 year flood level at the site has therefore been calculated for four time steps between the current day and the year 2115 and these values are shown in Table 4.2 below.

Year	1 in 200 year extreme water level (m AODN)
Current day (year 2008)	4.75
2025	4.82
2055	5.07
2075	5.31
2085	5.43
2115	5.88

Table 4.2 – Climate change impacts on extreme flood levels

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 and therefore the extreme sea level is taken as 5.88m AODN.

Peak Rainfall Intensity

The recommended allowances for increases in peak rainfall intensity are applicable nationally. There is a range of values provided which correspond with the central and upper end percentiles (the 50th and 90th percentile respectively) over three time epochs. The recommended allowances are shown in Table 4.3 below.

Allowance Category (applicable nationwide)	Total potential change anticipated for each epoch		
	2015 to 2039	2040 to 2069	2070 to 2115
Upper End	+10%	+20%	+40%
Central	+5%	+10%	+20%

Table 4.3 – Recommended peak rainfall intensity allowance for small and urban catchments (1961 to 1990 baseline)

For a residential development a design life of 100 years is assumed and therefore an increase of 20% in peak rainfall intensity has been applied to the calculations in the surface water management strategy (refer to Section 8).

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' to establish depths, velocities and the rate of rise of floodwater under such conditions. 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 event for this site is the 1 in 200 year (0.5% AEP) event for sea or tidal flooding, including an appropriate allowance for climate change.

Site specific flood level data has been referenced, this data has been extracted from the Romney Marsh Mapping Study 2017. The results show two modelled scenarios; undefended and defended. It is recognised that the site is currently protected by flood defence infrastructure and as such, it is evident that the undefended scenario does not present a realistic representation of the actual risk of flooding.

When the results of the defended scenario are considered, the site is shown to be protected from an extreme coastal event with a 1 in 200 year return period. However, the data provided for the defended scenario does not include an allowance for climate change. Consequently, in absence of this information, the coastal modelling from the Folkestone & Hythe District Council SFRA has been interrogated.

In 2015, the whole Romney, Walland and Denge Marsh area was numerically modelled using TUFLOW hydrodynamic numerical modelling software as part of the revised SFRA commissioned by Folkestone & Hythe District Council. Within the SFRA 12 scenarios were considered in order to ascertain the risks associated with coastal flooding, which included an allowance for climate change and the defence infrastructure currently in place. These scenarios comprise 7 breach and 5 overtopping events.

These scenarios have been investigated as part of this FRA, in order to examine the impacts on the study site from 'actual' and 'residual' risk events.

Actual Risk of Flooding – Wave Overtopping

Five of the scenarios modelled as part of the SFRA strategic modelling show the impact of waves overtopping the localised defences surrounding the Romney Marsh. This type of flood event is classified as 'actual risk', as there is no reliance on the failure of the sea defences for flooding to take place. Reference to the model results identifies the site is located outside the extents of flooding for all wave-overtopping scenarios, including an allowance for 100 years of climate change. Consequently, the *actual* risk of flooding to the site from the sea is considered to be *low*.

Residual Risk of Flooding – Breach

When considering the residual risk of flooding, analysis of the 7 single breach scenarios tested as part of the SFRA modelling identifies that a breach at the Hythe Ranges (B7) has the potential to partially affect the development site (Figure 5.1).

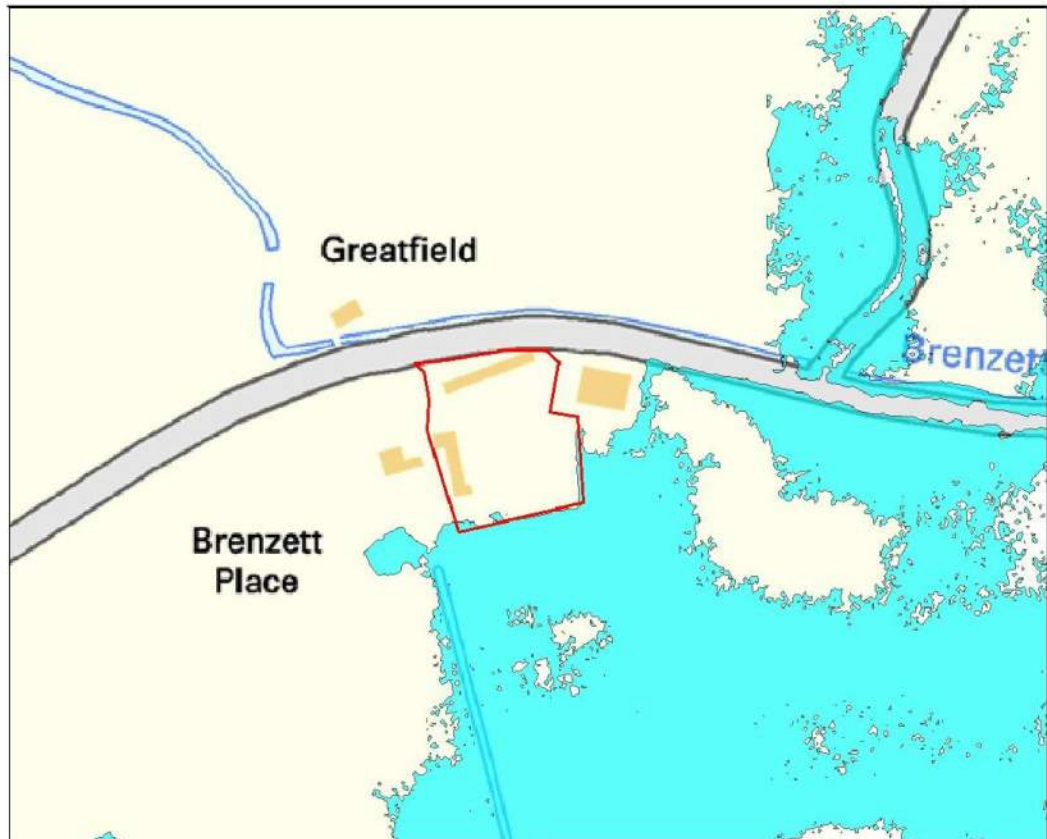


Figure 5.1 – Predicted flood extents from Breach Scenario 7 - 1 in 200 [2115] (Contains Ordnance Survey data © Crown copyright and database right 2018).

Inspection of the modelled outputs reveal that only the very southern edge of the site is shown to be marginally affected by flooding under a breach scenario. The majority of the site, including the area of proposed development, is shown to remain dry under such an event. The maximum modelled flood level under this scenario is **2.37m AODN**. Comparison of this modelled flood level with land levels in the southern part of the site show that the predicted flood depths would be less than 0.04m.

5.2 Rate of Rise and Velocity of Floodwater

As well as the source of flooding, the size and nature of the flood compartment has a major influence on the rate of rise of floodwater. For a small, steep sided compartment, the rate of rise will be rapid, whereas for a compartment that is relatively large with respect to the source of flooding and has shallow sloping sides, the rate of rise will be more gradual. The flood compartment in which the proposed development is located fits the description of the latter and therefore it is likely that the rate of rise of floodwater will not be rapid.

In addition, the site is located over 8km from the sea defences and therefore, there will be a residual delay between the defences breaching and the floodwater reaching the southern edge of the site, as such the rate of rise of floodwater will be gradual. With regard to flow velocities, the SFRA model has been interrogated and the results show flow velocities at the southern site boundary are less than 0.25m/s.

Notwithstanding the above, given that the majority of the site including the proposed residential dwellings are located outside the area affected by flooding under a breach event, the rate and rise and velocity of floodwater is not of direct concern.

6 Offsite Impacts

6.1 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 Environment Agency's requirement for an 8m buffer zone between the river bank and any permanent construction such as buildings or car parking etc. This is to allow access for maintenance, to provide biodiversity opportunities and also to provide room for the river banks to erode without threatening any development. Consequently, prior consent from the EA is required for any development within the bye-law distance and this consent is in addition to planning permission.

The development site is located approximately 9m from the Brenzett Sewer drainage ditch (main river) and this watercourse is also separated from the site by Ivychurch Road. The site is also located over 7.5km from the nearest coastline. As such, the development proposals will not compromise any of the EA's maintenance or access requirements.

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.

It can be seen that the proposed residential dwellings and the access road to/from the site are both located outside of the predicted design flood extents. Consequently, safe access and escape to/from the site can be achieved throughout the entire duration of the flood event.

6.3 Displacement of Floodwater

The construction of a new building 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.

The proposed development is located outside of the extents of flooding for both the *actual* and *residual* risk tidal event, and as such, the development will not displace floodwater.

6.4 Impact on Coastal Morphology & Impedance of Flood Flows

In terms of the way in which the development would interact and modify flood flows, its location and size with respect to the flood risk area and the flow path has to be considered. The site has, however, been shown to be located entirely outside of the predicted flood extents and therefore development in this area does not have the potential to impede or change flood flow regimes.

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	x	See Section 7.1
Raising floor levels	x	See Section 7.2
Land raising	x	Not required
Flood resistance & resilience	✓	See Section 7.3
Flood Warning	✓	See Section 7.4
Alterations/ improvements to channels and hydraulic structures	x	Not required
Flood defences	x	Not required
Compensatory flood plain storage	x	Not required
Management of development runoff	✓	See 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.

In this instance, the scheme layout takes advantage of the higher ground as much as other site constraints allow, with the proposed residential dwellings being located outside the predicted flood extents for both the *actual* and *residual* risk flood events.

7.2 Raising Floor Levels & Land Raising

The proposed development has been shown to be located outside of the predicted design flood extents and not to be at significant risk from other sources of flooding. Consequently, floor raising and land raising are not considered to be a necessary form of mitigation at this site.

7.3 Flood Resistance and Resilience

During a flood event, floodwater can find its way into buildings through a variety of routes including:

- Ingress around closed doorways.
- Ingress through airbricks and up through the ground floor.
- Seepage through the external walls.
- Seepage through the ground and up through the ground floor.

Since flood management measures only manage the risk of flooding rather than eliminate it completely, flood resilience and resistance measures may need to be incorporated into the design of the buildings. The two possible alternatives are:

Flood Resistance or 'dry proofing', where flood water is prevented from entering the building. For example using flood barriers across doorways and airbricks, 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.

It has, however, been demonstrated as part of this FRA that the risk of flooding to the proposed development is very low and consequently, the use of flood resilient or flood resistant construction is not considered to be necessary in this instance. Nevertheless, flood resilience measures could be considered for incorporation into the design of the buildings as a precautionary measure where practicable.

To retrofit flood resistant and resilience measures into an existing building requires a survey of the flood performance of the existing building to identify potential locations where floodwater could ingress. Details of an appropriately qualified surveyor can be found at the Blue Pages:

<http://bluepages.org.uk/>

The National Flood Forum provides advice to property owners on flood resistance and resilience measures which can be retrofitted into an existing building. Advice can be found on their website at:

<https://nationalfloodforum.org.uk/>

7.4

Flood Warning

The EA operate a flood forecasting and warning service in areas at risk of flooding from rivers or the sea, which relies on direct measurements of rainfall, river levels, tide levels, in-house predictive models, rainfall radar data and information from the Met Office. This service operates 24 hours a day, 365 days a year.

Whilst the probability of an event of sufficient magnitude to cause floodwater to reach the levels discussed in this report is 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 occupants within the flood risk area to receive early flood warnings.

This forewarning could be sufficient to either allow occupants 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;

<https://www.gov.uk/sign-up-for-flood-warnings>

8 Surface Water Management Strategy

8.1 Background and Policy

The general requirement for all new development is to ensure that the runoff from the development is managed sustainably and that the drainage solution does not increase the risk of flooding at the site, or within the surrounding area.

For brownfield sites, drainage proposals are typically measured against the existing performance of the site, although it is preferable (where practicable) to provide runoff characteristics that are similar to greenfield behaviour.

Policy CSD5 of the Shepway Core Strategy highlights that SuDS should be included in all developments where possible, to ensure peak discharge rates never exceed existing runoff rates. Water efficiency measures should also be explored for all new development. The Policy also states that developments should not rely on tank storage and open, green SuDS should be incorporated where possible for conveyance and attenuation.

In accordance with the NPPF (2018), SuDS should be included within the proposed development scheme where it is practicable to do so. Moreover, the NPPF requires that all development does not increase the risk of flooding elsewhere.

8.2 Surface Water Management Overview

The main characteristics of the site that have the potential to influence surface water drainage are summarised in Table 8.1 below.

Site Characteristic	Value
Total area of site	0.586 ha
Impermeable area (existing)	2610 m²
Impermeable area (proposed)	Total= 2610 m²
Current site condition	Brownfield site

Table 8.1 – Site characteristics.

8.3

Existing Drainage

The site is currently drained via a series of rainwater pipes and gullies, which are assumed to discharge surface water directly into the watercourse located to the south west of the site. Due to the age of the development, it is likely that the existing drainage system pre-dated any requirements to include SuDS and therefore, is assumed to discharge to the watercourse at an unattenuated rate. Figure 8.1 (below) shows an extract from the Ordinance Survey mapping, which shows the location of the watercourse within close proximity to the site. An existing connection to the watercourse is therefore assumed to be present on site.



Figure 8.1 – Extract from OS mapping indicating location of nearby watercourses.

Synthetic rainfall data has been derived from the Flood Studies Report (FSR) to calculate brownfield runoff rates for the existing site using Causeway Flow+ software. A summary of the calculations are shown in Table 8.2 below.

Return Period	Brownfield Runoff Rate
1 year	51.9 l/s
30 year	127.3 l/s
100 year	165.1 l/s

Table 8.2 – Summary of Causeway Flow+ calculations for existing brownfield runoff rates.

8.4 Opportunities for Managing Surface Water Runoff

The following opportunities for managing the surface water runoff discharged from the development site are listed in order of preference:

Water Re-use – Water re-use 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. It is likely that the demand for potable water from development will exceed the supply that would be available if a water re-use system is fitted. It is therefore concluded that using a water-reuse system to collect all of the surface water runoff from the development would not present a viable solution for the proposed development.

Infiltration – A desktop evaluation of the sites geological data has been carried out based on the British Geological Surveys maps of Britain and Defra's soilscape mapping. The geology at the site is predominantly made up loamy, clayey soil with naturally high groundwater. Additionally, the development lies within an area where the groundwater is vulnerable to contaminants. Therefore, it is concluded that discharging surface water into the ground using infiltration is unlikely to be a viable option for managing surface water runoff from the development.

Watercourse – A direct connection could be made to the watercourse to the south west of the site (shown in figure 8.1). Ordinary watercourse consent must be sought prior to the construction of any connections to the watercourse. It is therefore assessed that the proposed drainage system will discharge surface water to the nearby watercourse.

Public Sewer System – Discharging surface water to a watercourse is the preferred option in the hierarchy of discharge options and as such, takes precedent over a connection to a public sewer. On this basis, the opportunity to discharge to a public sewer has been discounted.

8.5 Sustainable Drainage Systems (SuDS)

Appropriately designed SuDS can be utilised such that they not only attenuate runoff but also provide a level of improvement to the quality of the water passed on to watercourses or into the groundwater table. This is known as source control and is a fundamental part of the SuDS philosophy.

A range of typical SuDS that can be used to improve the environmental impact of a development is listed in Table 8.3 below, along with the relative benefits of each feature and the appropriateness for the subject site.

SuDS	Environ- mental benefits	Water quality improve ment	Suitability for low permeability soils (k<10-6)	Ground- water recharge	Suitable for small/ confined sites?	Site-specific restrictions	Appropri- ate for subject site?
Wetlands	✓	✓	✓	X	X	Insufficient space	No
Retention ponds	✓	✓	✓	X	X	None	Yes
Detention basins	✓	✓	✓	X	X	None	Yes
Infiltration basins	✓	✓	X	✓	X	Possible High groundwater	No
Soakaways	X	✓	X	✓	✓	Possible High groundwater	No
Underground storage	X	X	✓	X	✓	None	Yes
Swales	✓	✓	✓	✓	X	None	Yes
Filter strips	✓	✓	✓	✓	X	Insufficient space	No
Rainwater harvesting	X	✓	✓	✓	✓	None	Yes
Permeable paving	X	✓	✓	✓	✓	Possible High groundwater	No
Water butts	✓	X	✓	X	✓	None	Yes
Green roofs	✓	✓	✓	X	✓	Dependant on proposed roof construction	Unknown

Table 8.3 – Suitability of SuDS.

From Table 8.3 it can be seen that there is some opportunity to utilise SuDS within the development. The SuDS features which are considered suitable and which are proposed for this development are discussed below.

8.6 Proposed Surface Water Management Strategy (SWMS)

The drainage strategy set out below discusses each of the different elements of the proposed scheme, along with calculations that have been undertaken to demonstrate how the overall objectives can be achieved. This does not represent a detailed surface water drainage design; it is simply an assessment to demonstrate that the objectives and requirements of the NPPF can be met at the planning stage.

8.7 Drainage Options for Hardstanding and Roof Drainage

The surface water runoff from the hardstanding and roof areas will be intercepted by gullies and rainwater pipes before being discharged to a pond. The pond has been designed to provide attenuation and provide benefits to the quality of the surface water discharged into the watercourse.

A vortex flow control can be used to reduce peak discharge rates to 1 l/s, which will provide a significant betterment when compared to the existing scenario. A summary of the Causeway Flow+ analysis for the pond is shown in Table 8.4 below.

Parameter	Value (1:100yr+20%cc event)
SuDS	Attenuation Pond
depth	~1200 mm
Total area draining to pond	2610m ²
Infiltration	None (lined system)
Critical storm duration	960 minutes
Half drain time	~1200 minutes
Flooded volume	0 m ³
Flow restriction device	Vortex Flow Control

Table 8.4 – Summary of Causeway Flow+ analysis for the 100 year + 20%cc.

Table 8.4 demonstrates that the proposed drainage system is unlikely to flood in a rainfall event with a 1 in 100 year return period, including a 20% allowance for climate change.

A comparison of the pre and post development discharge rates for the site can be found in Table 8.5 below.

Discharge rates	Pre-development brownfield runoff rates	Post-development discharge rates	Difference (A-B)
1 year	51.9 l/s	0.8 l/s	51.1 l/s (reduction)
30 year	127.3 l/s	0.9 l/s	122.4 l/s (reduction)
100 year	165.1 l/s	0.9 l/s	164.2 l/s (reduction)
100 year +20%cc	N/A	1.0 l/s	124.1 l/s (reduction when compared to 1:100 no cc)

Table 8.5 – Comparison of pre and post development flow rates.

From Table 8.5 above, it is evident that the rate that runoff is discharged from the proposed development is significantly lower than the existing runoff rate. As such, the requirements stated within the policy CSD5 can be met.

8.8 Indicative Drainage Layout Plan

Figure 8.2 below is an indicative drainage layout plan delineating how the proposed SuDS can be incorporated into the scheme proposals.

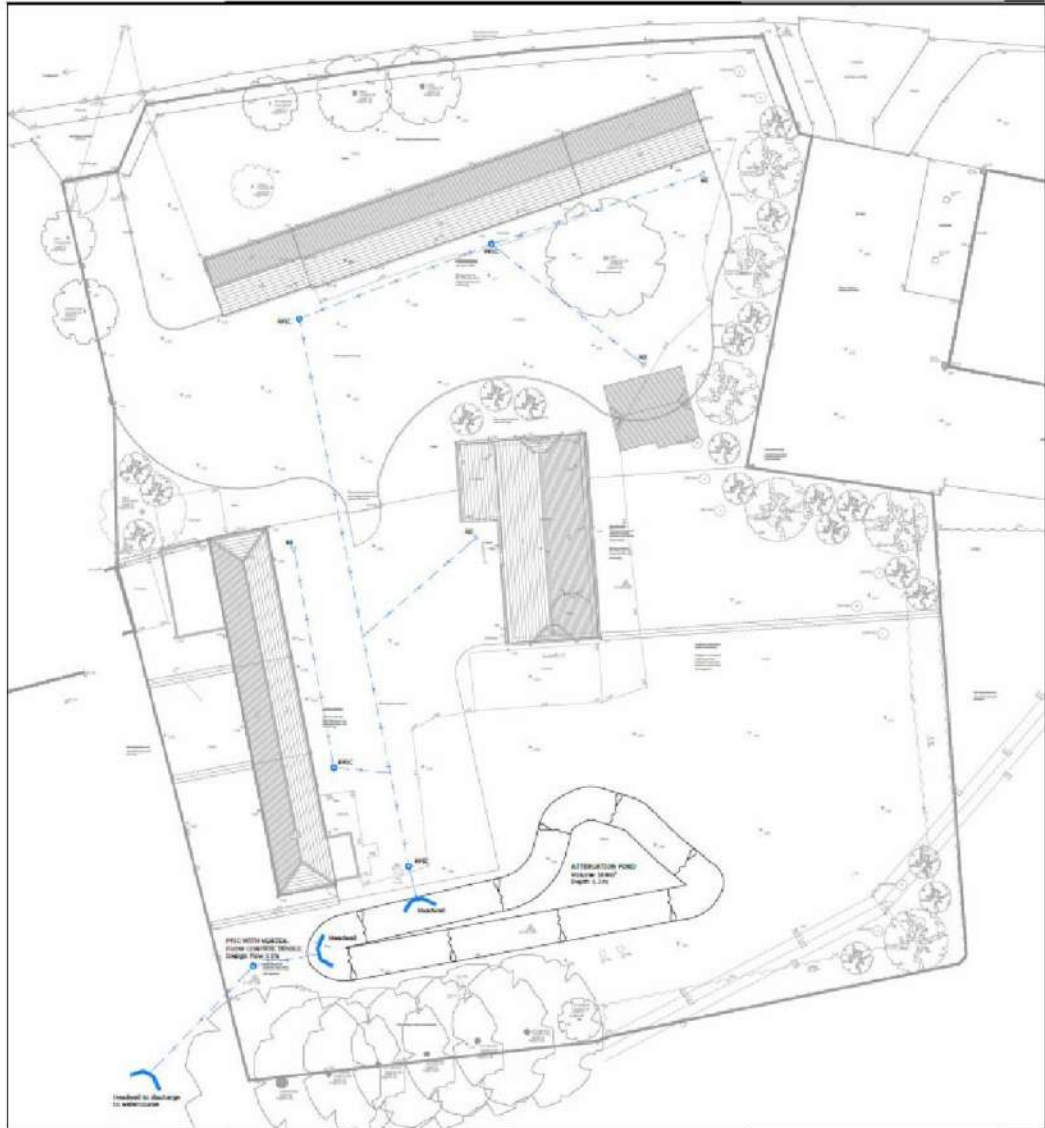


Figure 8.2 - Indicative drainage layout plan showing the proposed location of SuDS.

A full copy of this layout is located in Appendix A.2 of this report.

8.9 Additional Opportunities for SuDS

Water Butts

To reduce the developments reliance on potable water supply there is the potential to incorporate water butts within the communal garden area, which can be used for external use. Typical sizes and dimensions of water butts are outlined below.

Typical house water butt options	Dimensions of a typical house water butt	Volume of storage provided (litres)
Type 1 (wall mounted – Small)	1.22m high x 0.46m x 0.23m	100
Type 2 (Standard house water butt)	0.9m high x 0.68m diameter	210
Type 3 (Large house water butt)	1.26m high x 1.24m x 0.8m	510
Type 4 (Column tank – Very large)	2.23m high x 1.28m diameter	2000

Table 8.6 – Estimated storage capacity of available water butts.

In this case the demand for potable water from each of the gardens is likely to be relatively small and as a result, a standard house water butt (210 litre units) is considered to be the most appropriate size for inclusion within the scheme.

It is recognised that each of the water butts will need to overflow into the main drainage system for the site, to ensure that in the event that the water butt is full prior to the onset of the design rainfall event, water can be discharged away from the properties without increasing the risk of flooding.

8.10 Management and Maintenance

For any surface water drainage system to operate as originally designed, it is necessary to ensure that it is adequately maintained throughout its lifetime.

The key requirements of any management regime are routine inspection and maintenance, when the development is taken forward to the detailed design stage an 'owner's manual' will need to be prepared. This should include:

- A description of the drainage scheme,
- A location plan showing all of the SuDS features and equipment such as flow control devices etc.
- Maintenance requirements for each element, including any manufacturer specific requirements
- An explanation of the consequences of not carrying out the specified maintenance
- Details of who will be responsible for the ongoing maintenance of the drainage system.

For the SuDS features recommended by this assessment, the most obvious maintenance tasks will be the management of vegetation within the pond and the de-silting of manholes.

A typical pond maintenance schedule can be found in Appendix A.4 for reference and this schedule provides detailed information on how to maintain the system at different points following installation.

8.11 Sensitivity Testing and Residual Risk

It is necessary to ensure that the drainage proposals will not increase the risk of flooding if the drainage system becomes blocked, or if there is a rain storm which exceeds the design rainfall event.

In the event of a blockage, surface water would overflow from the pond and would flow away from the development into the greenfield land to the south west, where it would enter the watercourse adjacent to the site.

The surface water drainage system has been designed to accommodate the runoff generated under an extreme rainfall event with a 1 in 100 year return period, including a 20% allowance for climate change (to account for the impacts of climate change). Nonetheless, based on the EA's current climate change guidance, an Upper End climate change allowance of 40% has also been applied to account for any uncertainties associated with the predictions of future climate change, and to test the sensitivity of the proposed drainage system.

A summary of the Causeway Flow+ calculations is provided below (refer to Table 8.7), which can be used to measure the performance of the proposed drainage system for a rainfall event with a year return period of 100 years, including a 40% allowance for climate change.

Parameter	Value
Critical storm duration	720 minutes
Freeboard	0mm (surcharged)
Flooded volume	47.2 m ³
Peak discharge rate	1.0 l/s

Table 8.7 - Summary of Causeway Flow+ analysis for the pond, including a 40% allowance for climate change.

The analysis in Table 8.7 shows that the proposed drainage system will flood if the peak rainfall intensity is increased to 40%. The gravel car park proposed in the centre of the site will be utilised as offline storage for an exceedance event. The car park area could be installed with standard HB2 kerbs to provide 125mm of upstand within the hardstanding. The flooded volume of 47.2m³ would pond within the car park and would flood to a depth of 30mm. This demonstrates that the flooding for the stated exceedance event would present a low risk to residents.

9 Conclusions

The key aims and objectives for a development that is to be sustainable in terms of flood risk are summarised in the following bullet points:

- the development should not be at a significant risk of flooding, and should not be susceptible to damage due to flooding
- the development should not be exposed to flood risk such that the health, safety and welfare of the users of the development, or the population elsewhere, is threatened
- normal operation of the development should not be susceptible to disruption as a result of flooding and safe access to and from the development should be possible during flood events
- the development should not increase flood risk elsewhere
- the development should not prevent safe maintenance of watercourses or maintenance and operation of flood defences by the Environment Agency
- the development should not be associated with an onerous or difficult operation and maintenance regime to manage flood risk; the responsibility for any operation and maintenance required should be clearly defined
- the development should not lead to degradation of the environment
- the development should meet all of the above criteria for its entire lifetime, including consideration of the potential effects of climate change.

In determining whether the proposals for development at Brenzett Place Farm are sustainable in terms of flood risk and compliant with the NPPF and its Technical Guidance, all of the above have been taken into consideration as part of this FRA.

In this case a Sequential Test assessment has not been undertaken in support of this FRA, however, when considering that the site has previously been granted planning permission (which has since lapsed) for the same residential development, this supports the assumption that the requirements of the Sequential Test will be met.

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 Table 2.3 it can be seen that the proposed development is situated within Flood Zone 3 and is a development type that is classified as being 'more vulnerable'. Consequently, it has been necessary to apply the Exception Test to determine whether suitable and appropriate mitigation can be incorporated into the design of the scheme to ensure that it is sustainable in terms of flood risk.

The risk of flooding has therefore 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 has been demonstrated that the proposed development is located outside the predicted flood extents for both an actual risk (wave overtopping) and residual risk (breach) flood event.

Furthermore, this FRA has demonstrated that the development will not increase flood risk elsewhere and by incorporating appropriate mitigation measures and SuDS features within the design of the surface water drainage system, it will be possible to limit the impact with respect to surface water runoff.

The analysis has shown that discharging surface water runoff from the proposed development to the nearby watercourse will be the most viable solution. The proposed drainage system is designed to intercept surface water runoff using rainwater pipes and gullies, before directing water into an attenuation pond located to the south of the site. In order to restrict the rate of discharge from the development, a vortex flow control is proposed, which is designed to provide a significant betterment when compared to the existing brownfield runoff rates. The pond will provide attenuation storage for the design return period. The calculations provided within this report clearly demonstrate that the rate of runoff under an extreme pluvial event with a 1 in 100 year return period, including a 20% allowance for climate change, can be restricted to meet the requirements of local planning policy.

Maintenance schedules of the proposed SuDS are enclosed in Appendix A.4, and these maintenance tables provide details on how the drainage system can be managed to ensure the system will remain operational throughout the lifetime of the development.

In conclusion, following the recommendations of this report, the occupants of the development will be safe and the development will not increase the risk of flooding elsewhere. Consequently, it has been demonstrated that the development can pass the second element of the Exception Test and will therefore meet the requirements of the NPPF.

10 Recommendations

The findings of this report conclude that the development will not increase the risk of flooding at the site, or elsewhere. There are, however, a number of mitigation measures and recommendations that could further reduce the risk to the development and other areas within the floodplain.

- Flood resilience measures should be considered for incorporation into the design of the building where possible, as a precautionary measure.
- The owner and occupants of the proposed dwellings should sign up to the EA's floodline warnings.
- The surface water management strategy for the development will need to be developed to a detailed design stage and this will need to take into account the requirements set out in Section 8.
- 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.
- The use of appropriate SuDS as discussed in Section 8 should be considered for incorporation into the scheme design. For this development the use of a pond is recommended.
- If additional surface water is to be discharged into the nearby watercourse then consent will be required from the EA.

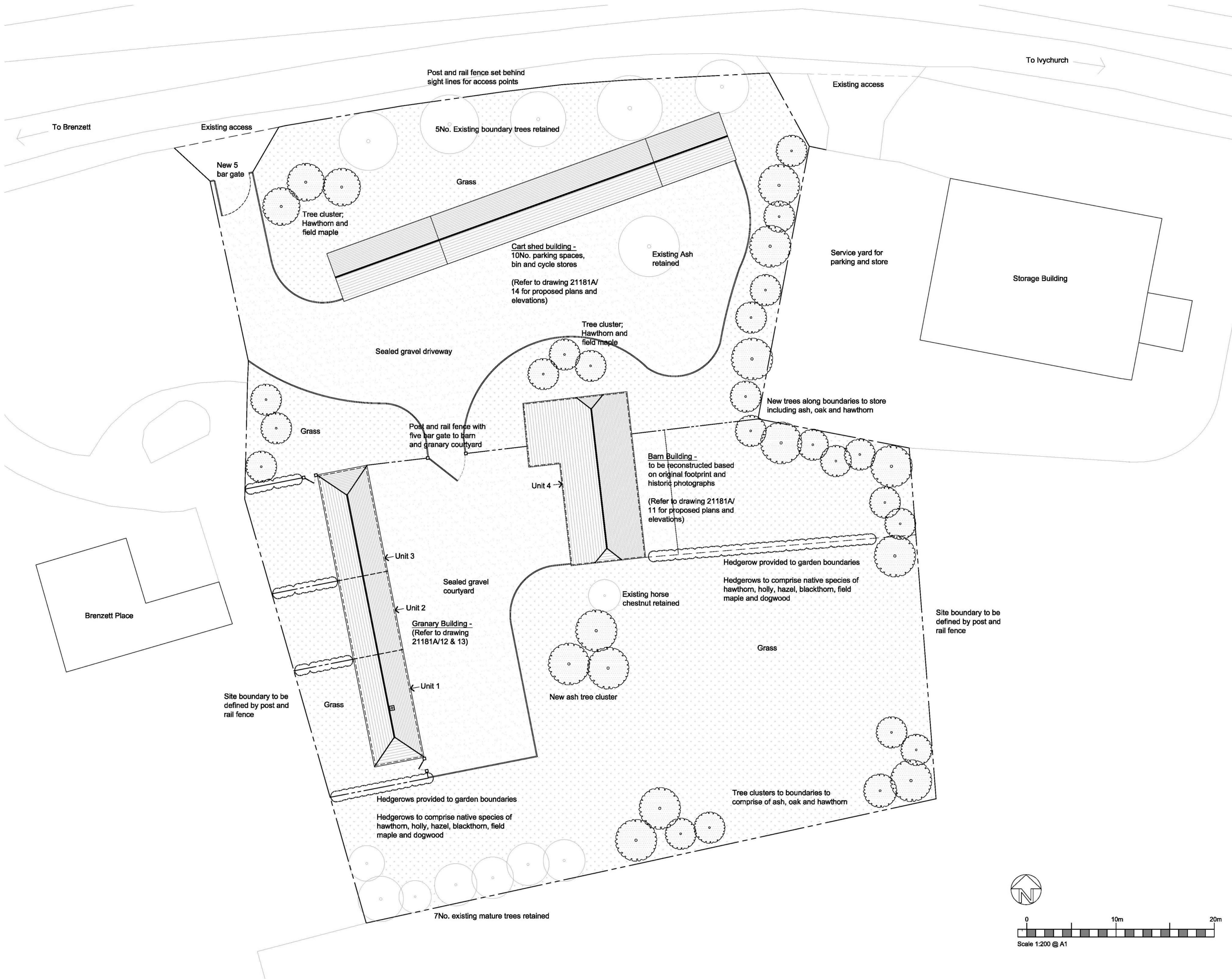
11 Appendices

Appendix A.1 – Drawings

Appendix A.2 – Surface Water Management Calculations

Appendix A.3 – Indicative Drainage Layout

Appendix A.1 – Drawings



NOTES:

Do Not Scale.

Report all discrepancies, errors and omissions.

Verify all dimensions on site before commencing any work on site or preparing shop drawings.

All materials, components and workmanship are to comply with the relevant British Standards, Codes of Practice, and appropriate manufacturers recommendations that from time to time shall apply.

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Project Title

Proposed Residential Conversion at
Brenzett Place Farm
Brenzett
Kent

Drawing Description

Proposed Site Plan

Scale	Drawn by
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Date	Checked by
May 2012	JF


CLAGUE

62 BURGATE CANTERBURY KENT CT1 2BH
TELEPHONE 01227 762060 FAX 01227 762149

13 NORTH STREET ASHFORD KENT TN24 8LF
TELEPHONE 01233 624354 FAX 01233 610018

1 KINGSOURNE COURT LUTON ROAD
HARPENDEN HERTFORDSHIRE AL5 3BL
TELEPHONE 01582 785102 FAX 01582 462149

ARCHITECTS	HISTORIC BUILDING CONSULTANTS
INTERIOR DESIGNERS	URBAN DESIGNERS

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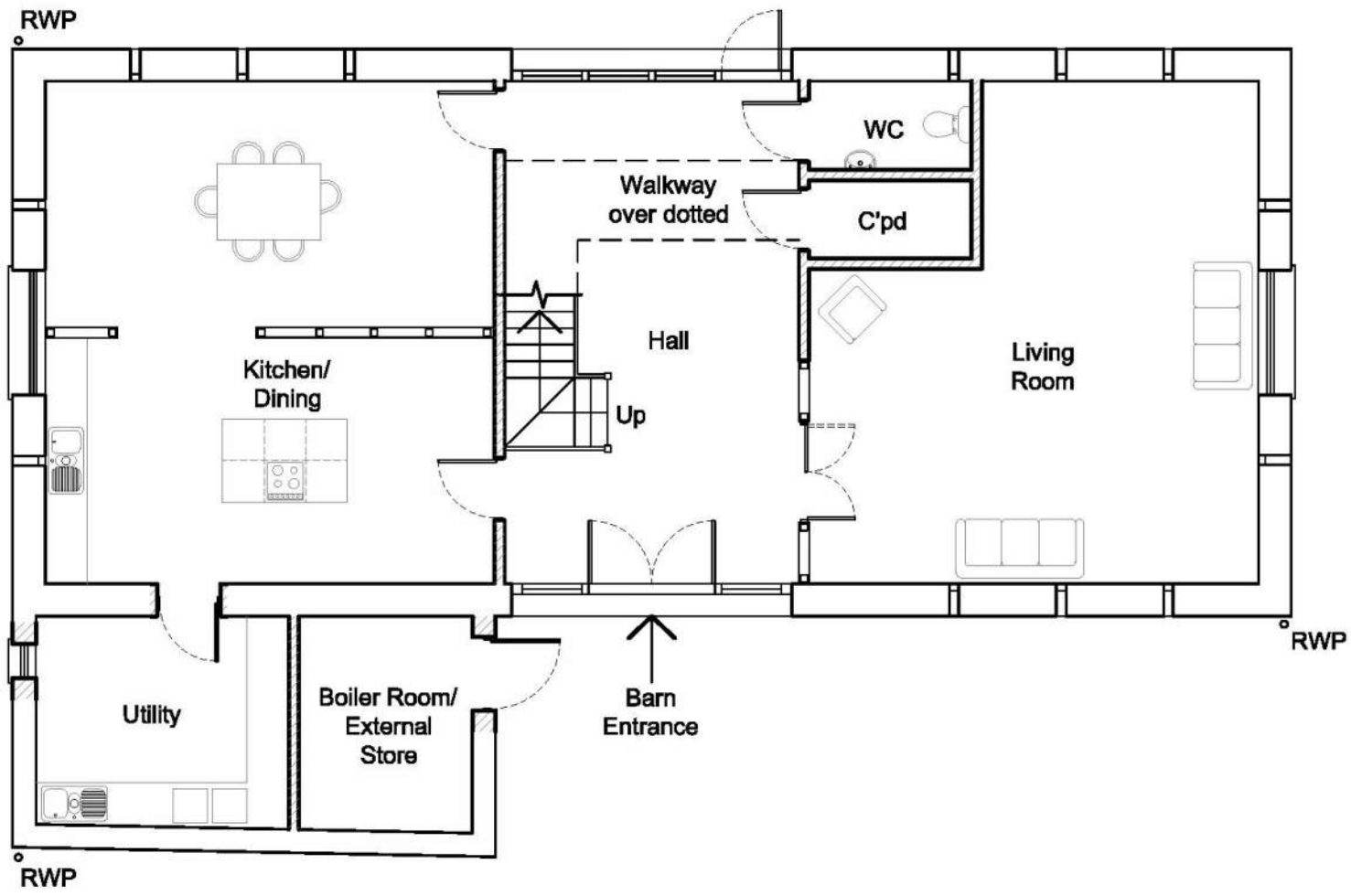
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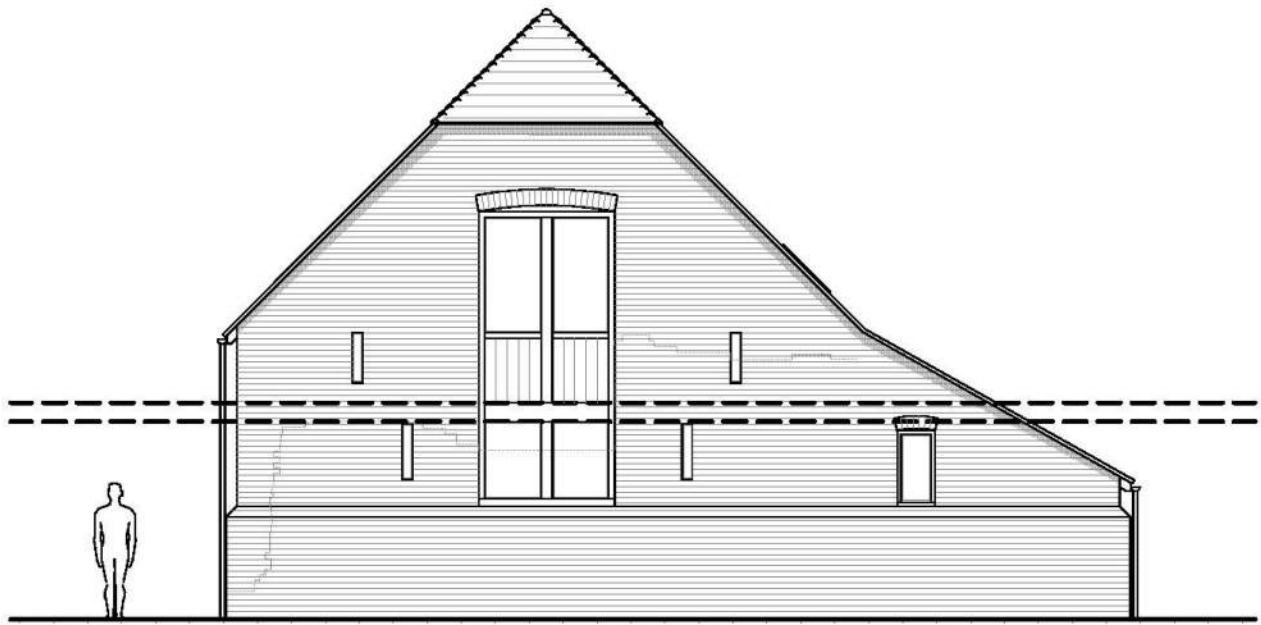
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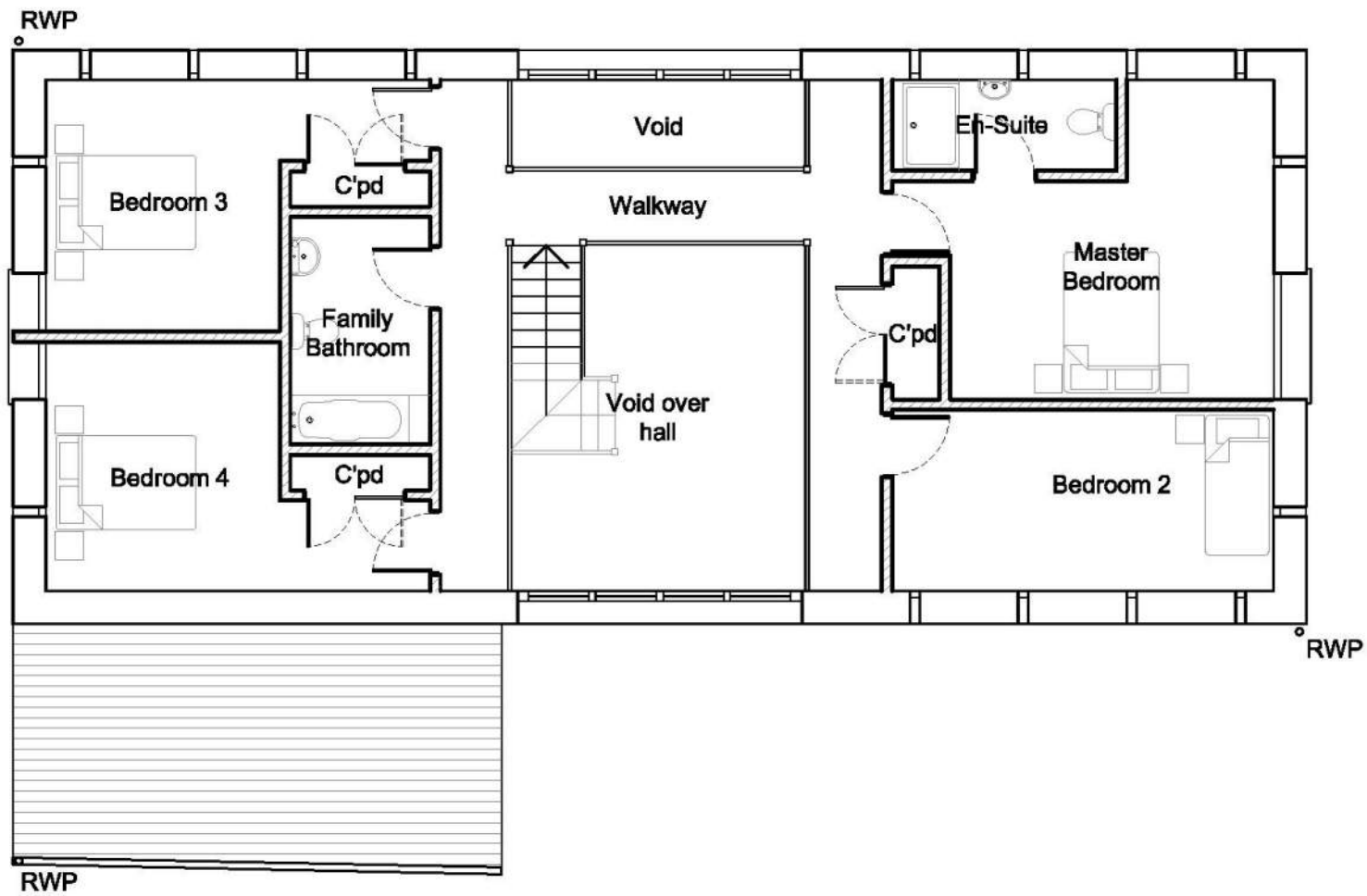
GROUND FLOOR PLAN



NORTH ELEVATION



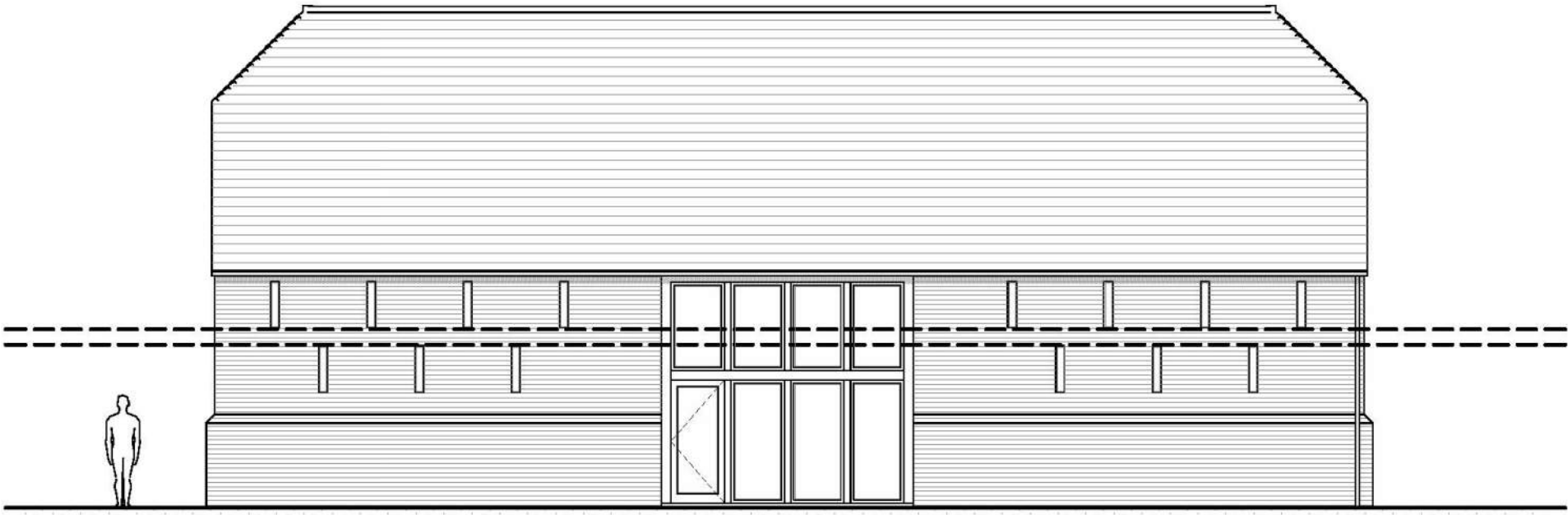
WEST ELEVATION



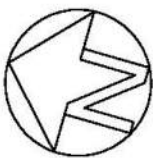
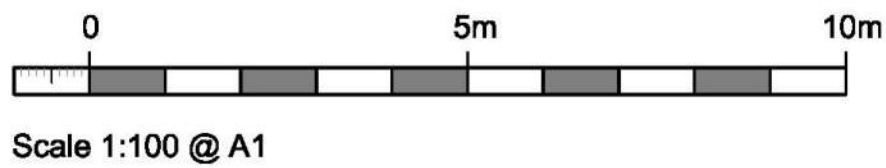
FIRST FLOOR PLAN



SOUTH ELEVATION



EAST ELEVATION



MATERIALS SCHEDULE:

Walls: Reclaimed brickwork in Flemish bond, plinth special to be provided at ground floor level

Roofs: Kent peg tiles throughout with hogsback ridge provided

Rainwater: Cast iron gutters and downpipes. Painted black

Goods

Joinery: Oak joinery finished with 10mm double glazed units

ACCOMMODATION SCHEDULE:

Barn: 4 Bedroom unit (1 with en suite) - Total Area = 118m²



Denotes new structure



Denotes existing structure removed

Project Title

Proposed Residential Conversion at
Brenzett Place Farm
Brenzett
Kent

Drawing Description

Proposed Barn Floor Plans and Elevations

Scale	Drawn by
1:100 @ A1	SRB
Date	Checked by
May 2012	JF



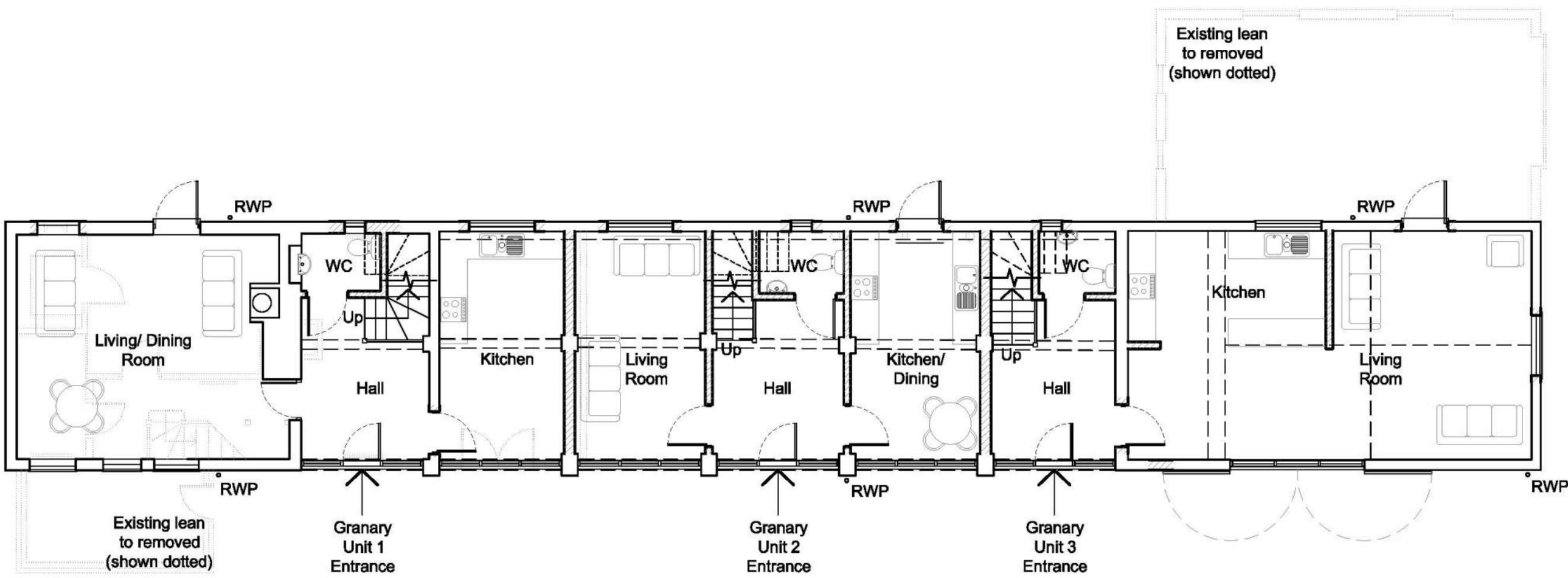
62 BURGATE CANTERBURY KENT CT1 2BH
TELEPHONE 01227 762060 FAX 01227 762149

13 NORTH STREET ASHFORD KENT TN24 8LF
TELEPHONE 01233 624354 FAX 01233 610018

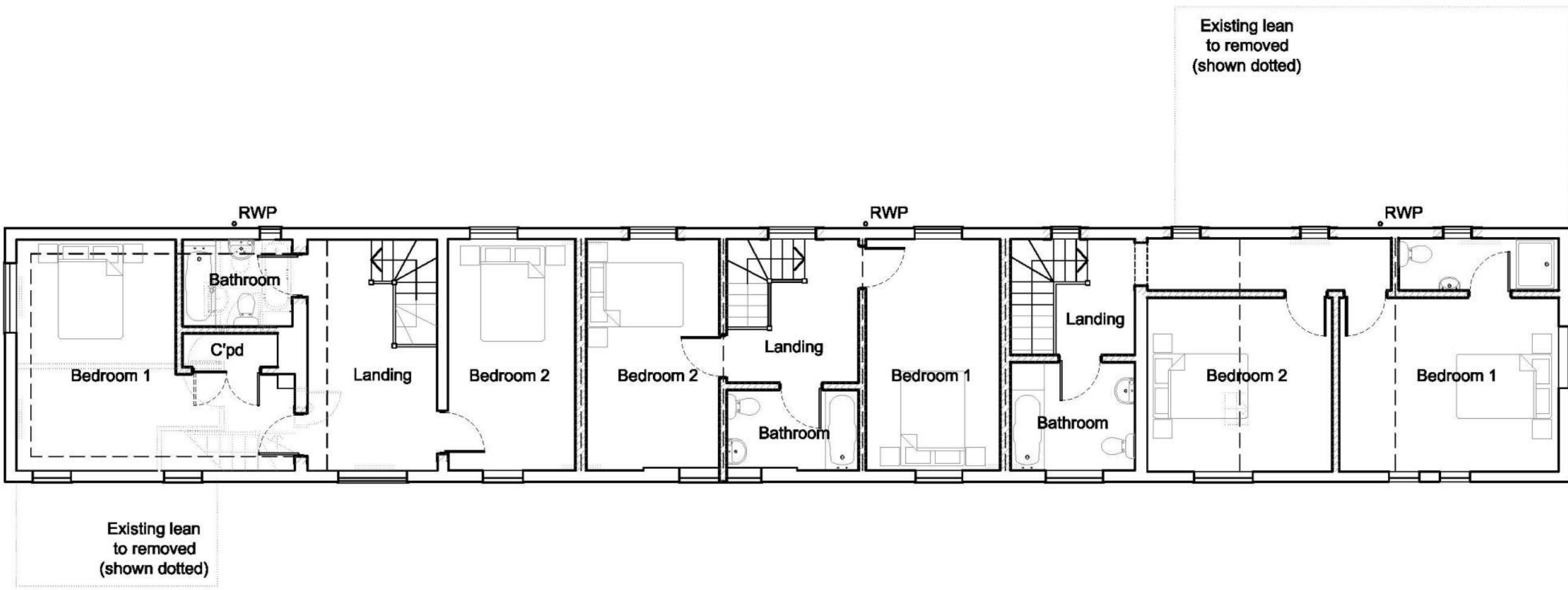
1 KINGSOURNE COURT LUTON ROAD
HARPENDEN HERTFORDSHIRE AL5 3BL
TELEPHONE 01582 785102 FAX 01582 462149

ARCHITECTS	HISTORIC BUILDING CONSULTANTS
INTERIOR DESIGNERS	URBAN DESIGNERS

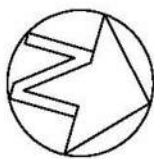
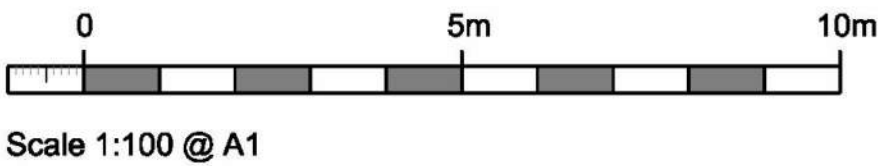
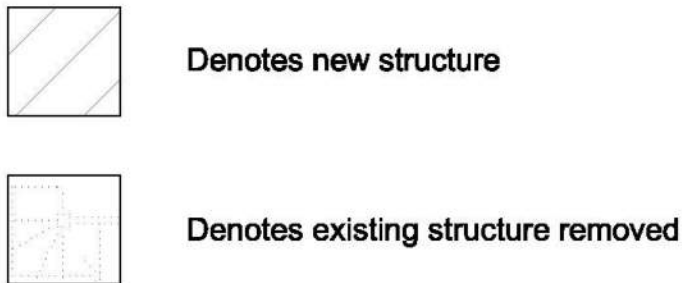
Drawing Number	Revision
21181A/11	



GROUND FLOOR PLAN



FIRST FLOOR PLAN



ACCOMMODATION SCHEDULE:

Granary:	
Unit 1	2 Bedroom - Total Area = 112m ²
Unit 2	2 Bedroom - Total Area = 85m ²
Unit 3	2 Bedroom (1 En Suite) - Total Area = 114m ²

NOTES:

Do Not Scale.

Report all discrepancies, errors and omissions.

Verify all dimensions on site before commencing any work on site or preparing shop drawings.

All materials, components and workmanship are to comply with the relevant British Standards, Codes of Practice, and appropriate manufacturers recommendations that from time to time shall apply.

For all specialist work, see relevant drawings.

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Rev	Date	Description
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Project Title

Proposed Residential Conversion at
Brenzett Place Farm
Brenzett
Kent

Drawing Description

Proposed Granary Floor Plans

Scale	Drawn by
1:100 @ A1	SRB
Date	Checked by
May 2012	JF



CLAGUE

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TELEPHONE 01227 762060 FAX 01227 762149

13 NORTH STREET ASHFORD KENT TN24 8LF
TELEPHONE 01233 624354 FAX 01233 610018

1 KINGSBOURNE COURT LUTON ROAD
HARPENDEN HERTFORDSHIRE AL5 3BL
TELEPHONE 01582 785102 FAX 01582 462149

ARCHITECTS	HISTORIC BUILDING CONSULTANTS
INTERIOR DESIGNERS	URBAN DESIGNERS

Drawing Number	Revision
21181A/12	

Appendix A.2 – Surface Water Management Calculations

Drainage Design Report

Flow+

v7.0

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Network	Storm Network
Filename	S:\LIVE Project Files\700 - Brenzett Place Farm\2018 Update\Analysis\Causeway\Proposed.pfd
Username	Stephen Hayward (stephen@herringtonconsulting.co.uk)
Last analysed	24/12/2018 10:56:45
Report produced on	24/12/2018 10:57:49

Causeway Sales

Tel:	+44(0) 1628 552000
Fax:	+44(0) 1628 552001
Email:	marketing@causeway.com
Web:	www.causeway.com

Technical support web portal:

<http://support.causeway.com>

	Name	Area (ha)	T of E (mins)	Cover Level (m)	Node Type	Width (mm)	Easting (m)	Northing (m)	Depth (m)
	SWMH1	0.102	4.00	2.400	Manhole				1.075
	SWMH2	0.027	4.00	2.500	Manhole				1.210
	SWMH3	0.019	4.00	2.400	Manhole				1.144
	SWMH4	0.045	4.00	2.500	Manhole				0.925
	SWMH5	0.017	4.00	2.500	Manhole				1.332
	SWMH6			2.500	Manhole				1.341
	SWMH7			2.400	Manhole				1.254
	Gravel Overflow	0.051	4.00	2.500	Manhole				0.850

	Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Pro Depth (mm)	Pro Velocity (m/s)
	1.000	SWMH1	SWMH2	0.751	82.9	18.4	0.700	0.835	0.700	0.835	0.102	120	0.607
	1.001	SWMH2	SWMH3	0.759	83.9	23.3	0.835	0.769	0.769	0.835	0.129	135	0.654
	1.002	SWMH3	SWMH5	0.753	83.1	26.7	0.769	0.957	0.769	0.957	0.148	146	0.673
	1.003	SWMH5	SWMH6	0.761	84.1	47.2	0.957	0.966	0.957	0.966	0.261	201	0.783
	1.004	SWMH6	SWMH7	0.774	85.4	47.2	0.966	0.879	0.879	0.966	0.261	199	0.792
	2.000	SWMH4	SWMH5	1.483	59.0	8.1	0.700	0.957	0.700	0.957	0.045	56	1.044
	3.000	Gravel Overflow	SWMH5	1.140	20.2	9.2	0.700	0.957	0.700	0.957	0.051	71	1.115

Link Name	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)	US Node Name	Dia (mm)	Width (mm)	Node Type	DS Node Name	Dia (mm)	Width (mm)	Node Type
1.000	20.000	571.4	375	Circular	2.400	1.325	0.700	2.500	1.290	0.835	SWMH1	1350		Manhole	SWMH2	1350		Manhole
1.001	19.000	558.6	375	Circular	2.500	1.290	0.835	2.400	1.256	0.769	SWMH2	1350		Manhole	SWMH3	1350		Manhole
1.002	50.000	566.2	375	Circular	2.400	1.256	0.769	2.500	1.166	0.957	SWMH3	1350		Manhole	SWMH5	1350		Manhole
1.003	5.000	555.6	375	Circular	2.500	1.166	0.957	2.500	1.159	0.966	SWMH5	1350		Manhole	SWMH6	1350		Manhole
1.004	7.000	536.5	375	Circular	2.500	1.159	0.966	2.400	1.146	0.879	SWMH6	1350		Manhole	SWMH7	1350		Manhole
2.000	20.000	77.6	225	Circular	2.500	1.575	0.700	2.500	1.316	0.957	SWMH4	1200		Manhole	SWMH5	1350		Manhole
3.000	20.000	77.6	150	Circular	2.500	1.650	0.700	2.500	1.393	0.957	Gravel Overflow	1200		Manhole	SWMH5	1350		Manhole

Node Name	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Node Type		Link ID	IL (m)	Dia (mm)	Link Type
SWMH1			2.400	1.075	1350		Manhole					
								0	1.000	1.325	375	Circular
SWMH2			2.500	1.210	1350		Manhole	1	1.000	1.290	375	Circular
								0	1.001	1.290	375	Circular
SWMH3			2.400	1.144	1350		Manhole	1	1.001	1.256	375	Circular
								0	1.002	1.256	375	Circular
SWMH4			2.500	0.925	1200		Manhole					
								0	2.000	1.575	225	Circular
SWMH5			2.500	1.332	1350		Manhole	1	3.000	1.393	150	Circular
								2	2.000	1.318	225	Circular
								3	1.002	1.168	375	Circular
								0	1.003	1.168	375	Circular
SWMH6			2.500	1.341	1350		Manhole	1	1.003	1.159	375	Circular
								0	1.004	1.159	375	Circular
SWMH7			2.400	1.254	1350		Manhole	1	1.004	1.146	375	Circular
Gravel Overflow			2.500	0.850	1200		Manhole					

								0	3.000	1.650	150	Circular

Rainfall Methodology	FSR		Return Period (years)	Climate Change (%)
FSR Region	England and Wales		1	0
M5-60 (mm)	26.250		30	0
Ratio-R	0.400		100	0
Summer CV	1.000		100	20
Winter CV	1.000		100	40
Analysis Speed	Normal			
Drain Down Time (mins)	240			
Additional Storage (m³/ha)	20.0			
Storm Durations (mins)	15			
	30			
	60			
	120			
	180			
	240			
	360			
	480			
	600			
	720			
	960			
	1440			
Check Discharge Rate(s)	x			
1 year (l/s)				
30 year (l/s)				
100 year (l/s)				
Check Discharge Volume	x			
100 year 360 minute (m³)				

Hydro-Brake®													
Node	Flap Valve	Online / Offline	Downstream Link	Replaces Downstream Link	Loop to Node	Invert Level (m)	Design Depth (m)	Design Flow (l/s)	Objective	Sump Available	Product Number	Min Outlet Diameter (m)	Min Node Diameter (mm)
SWMH6	x	Online				1.159	1.200	1.0	(HE) Minimise upstream storage		CTL-SHE-0045-1000-1200-1000	0.075	1200

Depth/Area/Inf Area											
Node	Base Inf Coefficient (m/hr)	Side Inf Coefficient (m/hr)	Safety Factor	Porosity	Invert Level (m)	Time to half empty (mins)	Depth (m)	Area (m²)	Inf. Area (m²)		
SWMH5	0.00000	0.00000	2.0	1.00	1.400		0.000	6.0	0.0		
							1.000	275.0	0.0		
Carpark											
Node	Base Inf Coefficient (m/hr)	Side Inf Coefficient (m/hr)	Safety Factor	Porosity	Invert Level (m)	Time to half empty (mins)	Width (m)	Length (m)	Slope (1:X)	Depth (m)	Inf Depth (m)
Gravel Overflow	0.00000	0.00000	2.0	0.30	1.650		26.100	20.000	350.0	0.600	

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.35%															
Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute winter	SWMH1	690	1.815	0.490	2.1	1.6312	0.0000	SURCHARGED	1.000	SWMH2	2.0	0.183	0.025	2.2059	
720 minute winter	SWMH2	690	1.815	0.525	2.6	0.9659	0.0000	SURCHARGED	1.001	SWMH3	2.6	0.199	0.031	2.0956	
720 minute winter	SWMH3	690	1.815	0.559	3.0	0.9861	0.0000	SURCHARGED	1.002	SWMH5	3.0	0.134	0.036	5.5149	
720 minute winter	SWMH4	690	1.815	0.240	0.9	0.5049	0.0000	SURCHARGED	2.000	SWMH5	0.8	0.346	0.014	0.7954	
720 minute winter	SWMH5	690	1.815	0.647	4.4	26.7472	0.0000	SURCHARGED	1.003	SWMH6	0.8	0.223	0.010	0.5515	
720 minute winter	SWMH6	690	1.815	0.656	0.8	0.9387	0.0000	SURCHARGED	Hydro-Brake®	SWMH7	0.8				40.7
15 minute summer	SWMH7	1	1.146	0.000	0.7	0.0000	0.0000	OK							
720 minute winter	Gravel Overflow	690	1.815	0.165	2.8	21.7155	0.0000	SURCHARGED	3.000	SWMH5	-1.7	0.427	-0.086	0.3521	

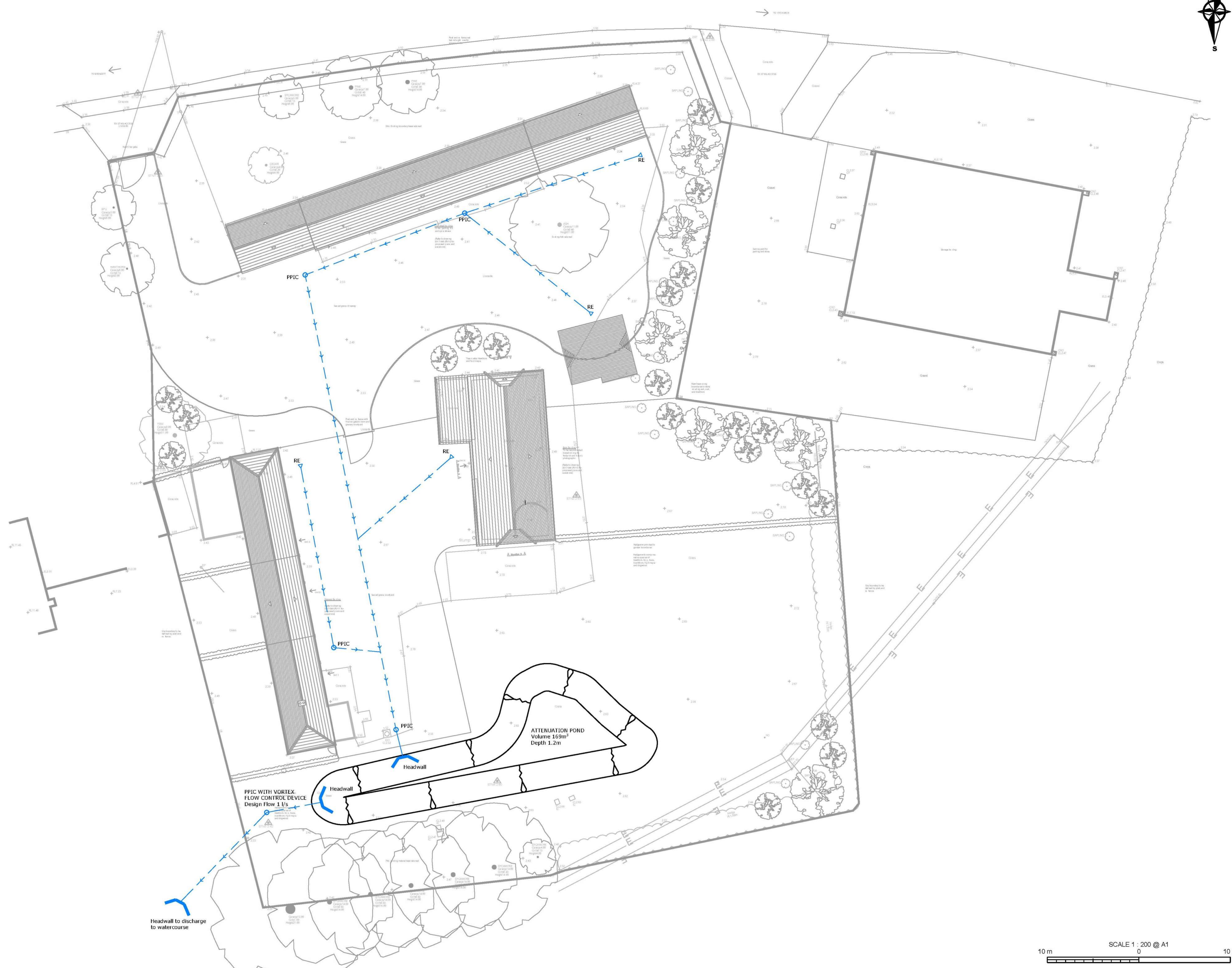
Results for 30 year Critical Storm Duration. Lowest mass balance: 96.35%															
Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute winter	SWMH1	930	2.090	0.765	3.4	2.5467	0.0000	SURCHARGED	1.000	SWMH2	3.3	0.203	0.040	2.2059	
960 minute winter	SWMH2	930	2.090	0.800	4.2	1.5024	0.0000	SURCHARGED	1.001	SWMH3	4.2	0.211	0.050	2.0956	
960 minute winter	SWMH3	930	2.090	0.834	4.8	1.4712	0.0000	SURCHARGED	1.002	SWMH5	4.7	0.151	0.057	5.5149	
960 minute winter	SWMH4	930	2.090	0.515	1.5	1.0835	0.0000	SURCHARGED	2.000	SWMH5	1.4	0.385	0.025	0.7954	
960 minute winter	SWMH5	930	2.090	0.922	6.8	69.7319	0.0000	SURCHARGED	1.003	SWMH6	0.9	0.224	0.011	0.5515	
960 minute winter	SWMH6	930	2.090	0.931	0.9	1.3322	0.0000	SURCHARGED	Hydro-Brake®	SWMH7	0.9				56.8
15 minute summer	SWMH7	1	1.146	0.000	0.6	0.0000	0.0000	OK							
960 minute winter	Gravel Overflow	930	2.090	0.440	4.2	65.3636	0.0000	SURCHARGED	3.000	SWMH5	-2.5	0.414	-0.125	0.3521	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.35%															
Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute winter	SWMH1	945	2.215	0.890	4.2	2.9619	0.0000	FLOOD RISK	1.000	SWMH2	4.1	0.215	0.049	2.2059	
960 minute winter	SWMH2	945	2.215	0.925	5.2	1.7367	0.0000	FLOOD RISK	1.001	SWMH3	5.1	0.235	0.061	2.0956	
960 minute winter	SWMH3	945	2.215	0.959	5.9	1.6912	0.0000	FLOOD RISK	1.002	SWMH5	5.9	0.154	0.071	5.5149	
960 minute winter	SWMH4	945	2.215	0.640	1.9	1.3460	0.0000	FLOOD RISK	2.000	SWMH5	1.8	0.388	0.031	0.7954	
960 minute winter	SWMH5	945	2.215	1.047	8.4	85.9395	0.0000	FLOOD RISK	1.003	SWMH6	1.0	0.118	0.011	0.5515	
960 minute winter	SWMH6	945	2.215	1.056	1.0	1.5108	0.0000	FLOOD RISK	Hydro-Brake®	SWMH7	0.9				59.4
15 minute summer	SWMH7	1	1.146	0.000	0.6	0.0000	0.0000	OK							
960 minute winter	Gravel Overflow	945	2.215	0.565	5.0	85.1860	0.0000	FLOOD RISK	3.000	SWMH5	-2.9	0.450	-0.145	0.3521	

Results for 100 year +20% Critical Storm Duration. Lowest mass balance: 99.35%															
Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	SVMH1	1410	2.384	1.059	3.7	3.5254	0.0000	FLOOD RISK	1.000	SVMH2	3.6	0.198	0.044	2.2059	
1440 minute winter	SVMH2	1410	2.384	1.094	4.6	2.0545	0.0000	FLOOD RISK	1.001	SVMH3	4.6	0.198	0.055	2.0956	
1440 minute winter	SVMH3	1410	2.384	1.128	5.3	1.9898	0.0000	FLOOD RISK	1.002	SVMH5	5.2	0.099	0.063	5.5149	
1440 minute winter	SVMH4	1410	2.384	0.809	1.6	1.7021	0.0000	FLOOD RISK	2.000	SVMH5	1.6	0.387	0.026	0.7954	
1440 minute winter	SVMH5	1410	2.384	1.216	7.4	138.1868	0.0000	FLOOD RISK	1.003	SVMH6	1.0	0.065	0.012	0.5515	
1440 minute winter	SVMH6	1410	2.384	1.225	1.0	1.7530	0.0000	FLOOD RISK	Hydro-Brake®	SVMH7	1.0				85.8
15 minute summer	SVMH7	1	1.146	0.000	0.9	0.0000	0.0000	OK							
1440 minute winter	Gravel Overflow	1410	2.384	0.734	4.0	91.1718	0.0000	FLOOD RISK	3.000	SVMH5	-2.2	0.414	-0.110	0.3521	

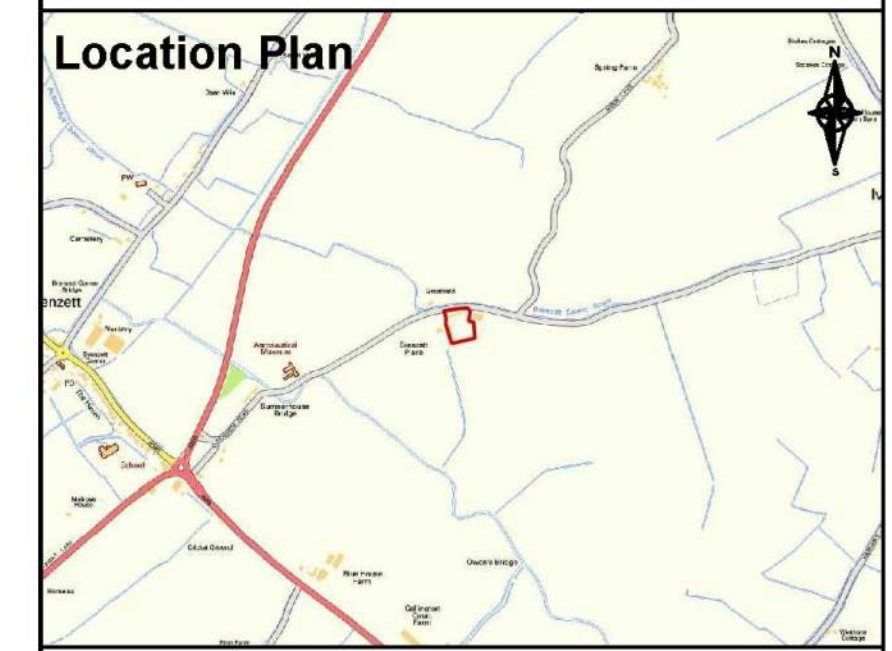
Results for 100 year +40% Critical Storm Duration. Lowest mass balance: 99.35%															
Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	SVMH1	960	2.400	1.075	4.3	3.5787	25.1932	FLOOD	1.000	SVMH2	4.2	0.202	0.051	2.2059	
960 minute winter	SVMH2	645	2.400	1.110	7.4	2.0846	0.0000	FLOOD RISK	1.001	SVMH3	7.3	0.244	0.087	2.0956	
720 minute winter	SVMH3	510	2.400	1.144	10.6	2.0180	23.8996	FLOOD	1.002	SVMH5	10.6	0.158	0.127	5.5149	
720 minute winter	SVMH4	510	2.402	0.827	3.3	1.7410	0.0000	FLOOD RISK	2.000	SVMH5	3.2	0.449	0.054	0.7954	
720 minute winter	SVMH5	510	2.402	1.234	15.0	143.2266	0.0000	FLOOD RISK	1.003	SVMH6	1.0	0.083	0.012	0.5515	
720 minute winter	SVMH6	510	2.402	1.243	1.0	1.7792	0.0000	FLOOD RISK	Hydro-Brake®	SVMH7	1.0				50.8
15 minute summer	SVMH7	1	1.146	0.000	0.9	0.0000	0.0000	OK							
720 minute winter	Gravel Overflow	510	2.404	0.754	8.2	91.2180	0.0000	FLOOD RISK	3.000	SVMH5	-4.5	0.511	-0.225	0.3521	

Appendix A.3 – Indicative Drainage Layout



PRIVATE DRAINAGE AND LEVELS KEY	
	PROPOSED BANK
	SURFACE WATER DRAIN
	SURFACE WATER PPIC - 450mm DIA
	SURFACE WATER RODDING EYE

- Notes**
1. Contains Ordnance Survey data © Crown copyright and database right 2018.
 2. All dimensions are in metres unless otherwise stated elsewhere.
 3. Proposed drainage positions will be subject to detailed design.
 4. All drainage systems will need to be installed and designed for suitable loading requirements.



herrington
CONSULTING LIMITED

Unit 6-7 Barham Business Park
Elham Valley Road
Canterbury
Kent CT4 6DQ

Tel: 01227 833655
enquiries@herringtonconsulting.co.uk
www.herringtonconsulting.co.uk

P1	First issue	LA	SB	20/12/2018
Rev	Description	Made	Checked	Date
CLIENT				
CLAN Developments LLP				
PROJECT				
BREZZETT PLACE FARM, BREZZETT				
SCALE	PROJ REF	ORIGINATOR	CHECKED BY	
1:200	0700	LA	SB	
DWG REF			DWG No	
INDICATIVE DRAINAGE LAYOUT			HC-0700-501	