

Project Name: Manor Farm, Dry Hill Lane, Sundridge, TN14 5AA

Flood Risk Assessment and Drainage Strategy

Date: 30th June 2021

Project Number: A5466



Contents

1 [Document Status and Signatures	2
Execu	utive Summary	3
	ntroduction	4
	Development Description and Location	5
2.1		
2.2		6
2.3		
2.4		6
2.5		6
2.6		
2.7		6
3 I	Flood Zones	8
3.1	Introduction	8
3.2	Sequential Test	9
3.3	Appropriate Uses	9
4 9	Site Specific Flood Risk Assessment	10
4.1	Sources of Flooding	10
4.2		
4.3		
4.4	Overland Flows	11
4.5	Groundwater	13
4.6	Flooding from Sewers and Drainage	14
4.7	Flooding from Development Drainage	15
4.8	Summary of Flood Risk	16
5 I	Development Surface Water Drainage Strategy	17
5.1	Surface Water Drainage Design	17
5.2	Greenfield Run-off Rate	17
5.3	Proposed Peak Run-Off	17
5.4	Proposed Sustainable Surface Water Drainage Strategy	18
6 I	Foul Water Drainage Strategy	20
7 1	Maintenance of SuDS Components	21
	Flood Resilient Measures	
	Conclusions	

Appendices:

Appendix A – Topographic Survey

Appendix B – Area Plans

Appendix C – Proposed Surface and Foul Water Drainage Strategy

Appendix D – Flood Screening Report and Maps

Appendix E – Surface Water Drainage Calculations

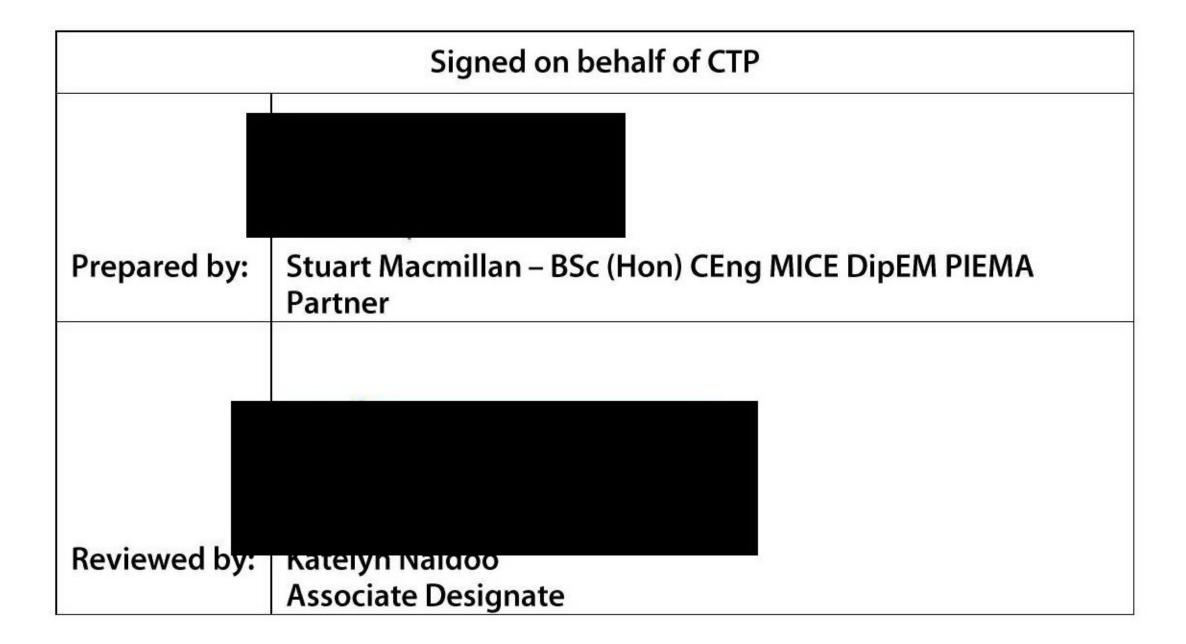
• Greenfield Run-Off Calculations



1 Document Status and Signatures

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Executive Summary

CTP has prepared a site-specific flood risk assessment as part of the planning submission to Sevenoaks District Council, for the proposed development on the site of existing agricultural buildings located at Manor Farm, Dry Hill Lane, Sundridge, TN14 5AA.

The Flood Risk Assessment has been prepared in compliance with guidance given in the National Planning Policy Framework (NPPF) and Technical Guidance (July 2018).

A summary of the assessment of the risks are as follows:

- The Environment Agency Flood Risk maps indicate that the proposed development site is partly situated in Flood Zone 3a. The sequential test confirms the need for an exception test to be carried out.
- The risk of flooding from all key sources has been assessed. This assessment has deemed that the risk of flooding from all sources due to this development to be moderate to high.
- There are no adopted public sewers in the near vicinity.
- A surface water management scheme comprising of a series of SuDS components have been proposed in order to mitigate the increase in surface water run-off rates. These SuDS measures will result in the peak surface water flows being decreased a rate of 2l/s for all storms up to and including the 1 in 100-year storm event including a 40 % allowance for climate change so that the risk of flooding from this source will also be low.
- It is proposed for the foul water to flow through a proprietary treatment plant and the resulting clean water discharging into the existing stream.



1 Introduction

- 1.1 CTP have been instructed by Pentar Design Partnership to prepare a site-specific flood risk assessment as part of the planning submission to Sevenoaks District Council, for the proposed development on the site of the existing site at Manor Farm, Dry Hill Lane, Sundridge, TN14 6AA. The proposed redevelopment is to convert the unused agricultural buildings into residential accommodation.
- 1.2 This Flood Risk Assessment (FRA) has been prepared in accordance with guidance given in the National Planning Policy Framework (NPPF) and Technical Guidance (July 2018).
- 1.3 The assessment covers the identification of all sources of flooding, their impact on the development, their residual risk and mitigation. A strategy for surface water drainage has also been included.
- 1.4 CTP Consulting Engineers are appropriately qualified professionals with the skills and experience to design surface water drainage systems to incorporate Sustainable Drainage (SuDS) and to carry out Flood Risk Assessments.
- 1.5 CTP has no responsibility to any other parties to whom this report may be circulated, in part or in full, and any such parties rely on the contents of this report solely at their own risk.
- 1.6 All copyright and other intellectual rights in and over this report and its contents shall remain vested in CTP. Pentar Design Partnership and any person authorised by them is granted an irrevocable royalty free licence to use and reproduce this report for all purposes relating to the property but CTP shall not be liable for any use of the report for any purpose other than that for which it was originally prepared.



2 Development Description and Location

2.1 Description of Existing Site

- 2.1.1 The proposed development site is located to the south of Sundridge in Kent. The site is situated at the end of Dryhill Lane, off Westerham Road. The site location is shown in Figure 1.
- 2.1.2 There is a stream running just to the south of the site. The stream loops around the site and flows to the north to join with the River Darent.

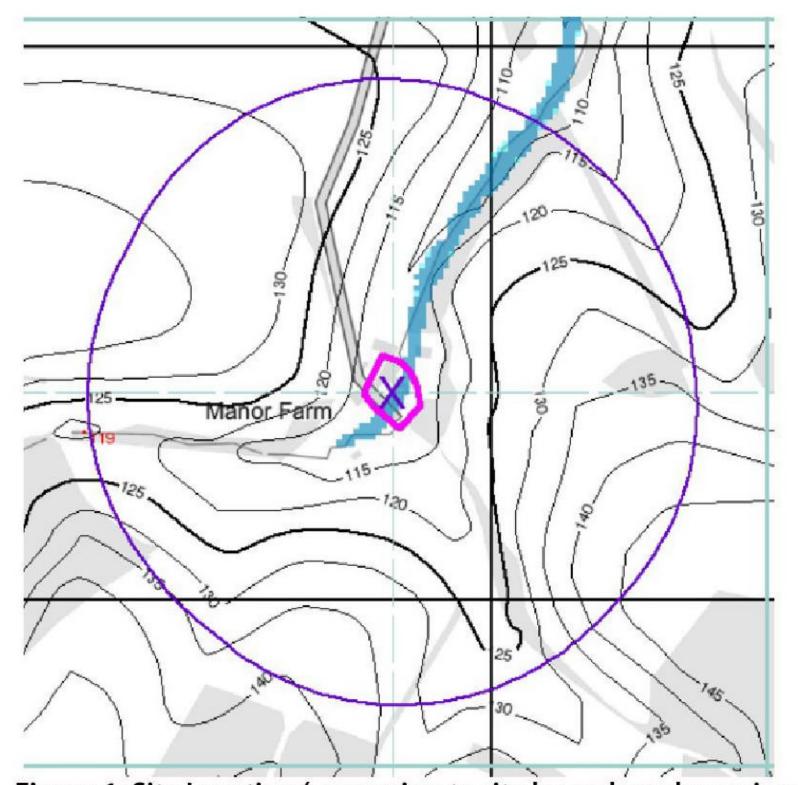


Figure 1: Site Location (approximate site boundary shown in red)



2.2 Permeable and Impermeable Areas

2.2.1 The existing site is a partially developed site with several agricultural buildings on it.

With reference to the Topographical Survey (S18/6583/01) included in Appendix A of this document a summary of the existing development site areas (within the red boundary) is as follows:

Total Site Area:	1102 m
Permeable Area:	457 m ²
Total Existing Permeable Area:	457 m ²
Existing Building Area: Existing Hardstanding Area:	423 m ² 222 m ²
Total Existing Impermeable Area:	645 m ²

2.3 Topographic Survey

2.3.1 A topographic survey of the existing site has been undertaken. This shows that the site falls from approximately 112.5m AOD at the north-western corner of the site to 110.5 at the south-eastern boundary corner of the site. The topographic survey of the site is included in Appendix A.

2.4 Southern Water Records

2.4.1 Public sewer records of the site have not been obtained as it is known that there is no adoptable drainage within the vicinity of the site.

2.5 Existing Drainage Survey

2.5.1 There is an existing river running from west to east around the southern side of the site which leads into the River Darent. There does not appear to be any foul drainage existing on site.

2.6 Ground Investigation

2.6.1 An intrusive site investigation is not required at this stage as infiltration is not proposed.

2.7 Proposed Development

2.7.1 The proposed development comprises the regeneration of 2 existing agricultural buildings, turning them into residential accommodation.



2.7.2 The proposed building footprints and landscaped areas are to remain as existing. So there will be no change in the impermeable and permeable areas due to the proposed development.



3 Flood Zones

3.1 Introduction

- 3.1.1 The Environment Agency uses Flood Zones to determine the vulnerability of every new development. These Flood Zones refer to the probability of river or sea flooding affecting the proposals, ignoring the presence of defences. A full set of Flood Maps are located in Appendix D.
- 3.1.2 It can be seen from an extract from this interactive map (Figure 3) that part of the proposed site is partly located in Flood Zone 3. Land in this zone is assessed as having a 1 in 100 or greater annual probability of river flooding, or a 1 in 200 or greater annual probability of flooding from the sea in any given year.

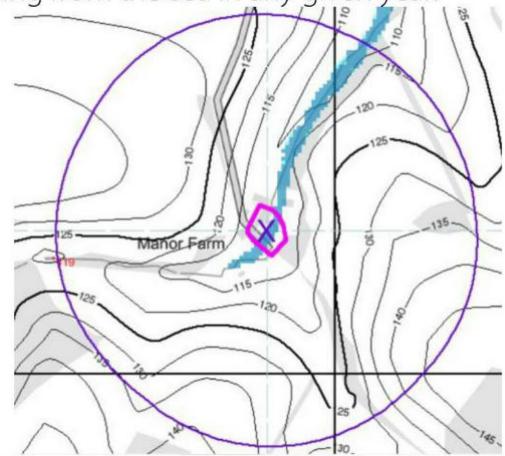


Figure 3: Extract from EA Risk of Flooding from Rivers and Sea map





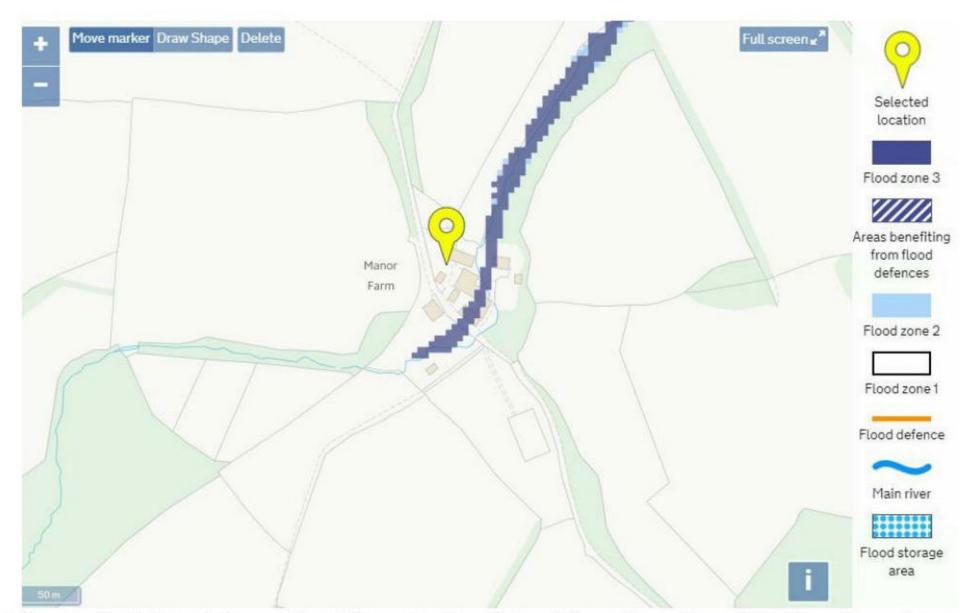


Figure 4: Extract from the EA website risk of flooding for planning flood map

3.2 Sequential Test

- 3.2.1 According to the flood maps in Appendix D, the proposed development site is partly located within Flood Zone 3a, the zone with the highest probability of flooding. Therefore, the NPPF requires that the Local Planning Authority apply the sequential test.
- 3.2.2 The sequential test is in place to ensure the that developments are located in the most appropriate area in terms of use and flood risk. The proposed works will be taking place on an existing building that is already currently located in Flood Zone 3 therefore it would be impractical to relocate the works elsewhere.

3.3 Appropriate Uses

- 3.3.1 With reference to Table 2 of the NPPF, the proposed development use would be classified as "More Vulnerable".
- 3.3.2 Table 3 of the NPPF shows that a 'More Vulnerable' development in Flood Zone 3 will require an Exception Test to be carried out.



4 Site Specific Flood Risk Assessment

4.1 Sources of Flooding

- 4.1.1 The NPPF lists the key sources of flooding which could potentially affect the development site. An assessment of how these forms of flooding may affect the site and details on how they will be managed safely if required, within the development are considered in the following sections.
 - 1. Flooding from Water Infrastructure
 - 2. Flooding from Rivers and the Sea
 - 3. Overland flows
 - 4. Groundwater
 - 5. Flooding from Sewers and Drainage
 - 6. Flooding from Development Drainage

4.2 Flooding from Water Infrastructure

4.2.1 According to the Flood Maps located in Appendix D, they indicate that the site is outside the area that would be flooded in the event of failures of canals or other manmade water structures – See Figure-4.

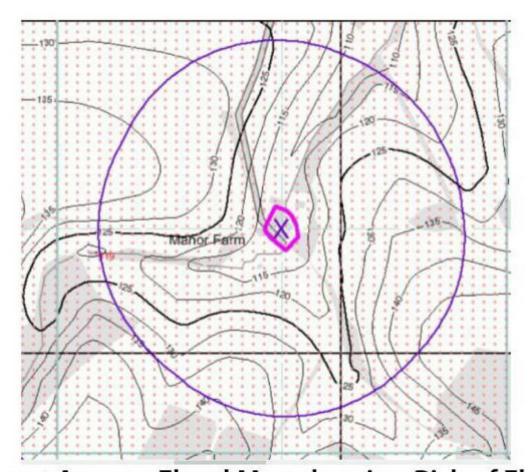


Figure-4: Environment Agency Flood Map showing Risk of Flooding from Canals

4.2.2 The risk of flooding from this source is assessed as being low.

4.3 Flooding from Rivers and the Sea

4.3.1 As shown in Figure 3 the Environment Agency Flood Risk Map indicates that the proposed development site is located within Flood Zone 3a (high risk of flooding). The risk of flooding from this source is assessed as being high.



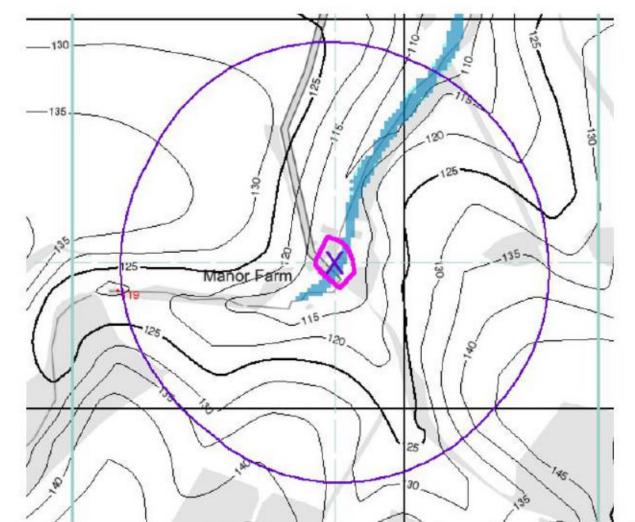
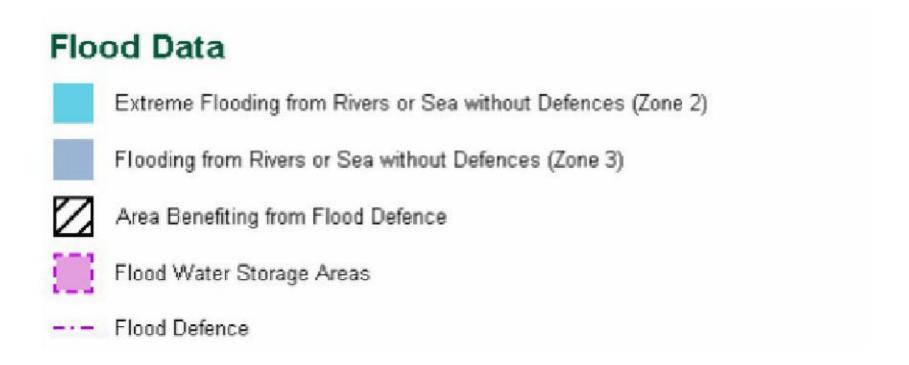


Figure 5: Extract from EA Map showing Flooding from Rivers and Sea



4.3.2 Based on the above, the risk of flooding from this source is assessed as being high.

4.4 Overland Flows

- 4.4.1 Flooding from the land would be caused by the slope of the site and any 'upstream' land that may cause overland flows during periods of heavy rainfall.
- 4.4.2 The Environmental Agency map shows the risk of flooding from surface water to be negligible across the developed site see Figure 6.



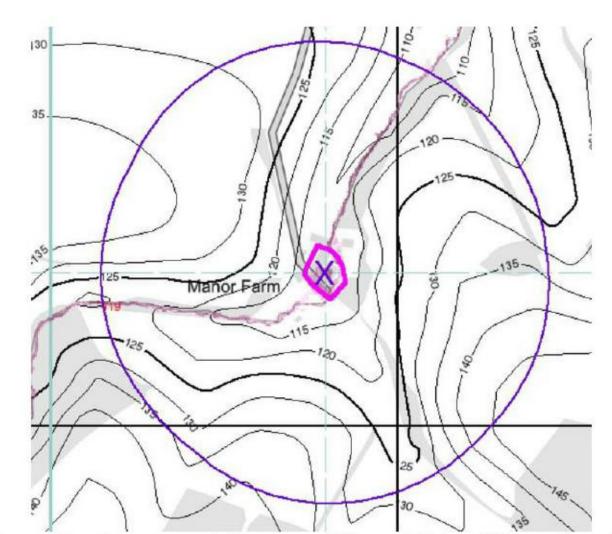


Figure 6: Extract from Environment Agency Map - Risk of flooding from surface water



- 4.4.3 This map shows that the proposed development site is located in an area that is defined as having moderate risk of flooding from surface water. This moderate risk definition means that each year the site has a chance of flooding from surface water of less than 1 in 100 (0.1%).
- 4.4.4 Based on the above the risk of flooding from this source is assessed as being moderate.



4.5 Groundwater

- 4.5.1 Groundwater flooding occurs where water levels in the ground rise above surface elevations. In general, it is most likely to occur in low-lying areas underlain by permeable rocks and in areas where permeable strata overlay and are surrounded by impermeable strata.
- 4.5.2 With reference to GeoSmart Flood map see Figure 7a, the proposed development site is located in an area with high risk (purple) of groundwater flooding to occur.

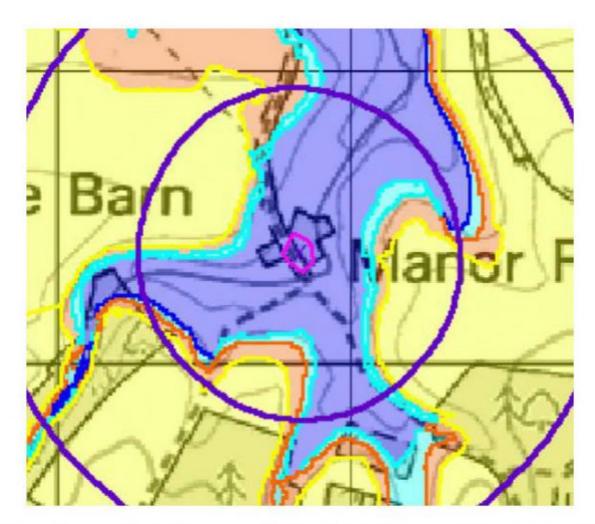
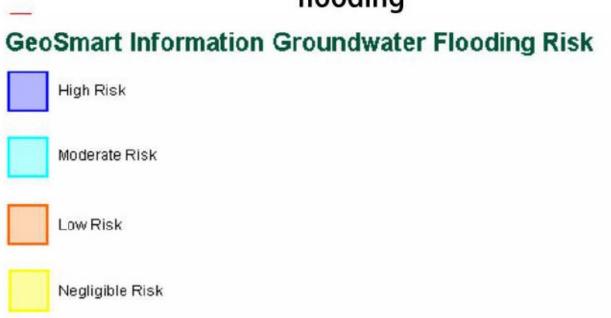


Figure 7a: Extract from GeoSmart Map showing areas susceptible to groundwater flooding



4.5.3 With reference to the BGS flood map, the majority of the site is shown to be located in an area of 'Potential for groundwater flooding to occur at surface' (purple).



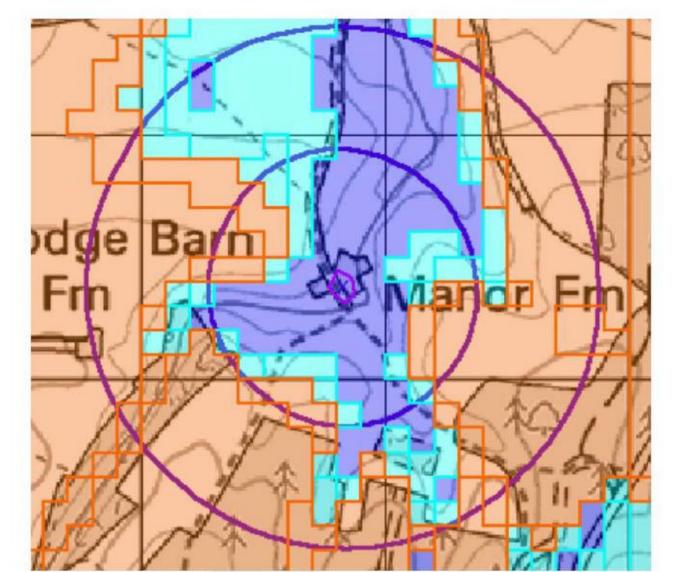


Figure 7b: Extract from BGS Map showing areas susceptible to groundwater flooding

4.5.4 Based on the above, the risk of flooding for the majority of the site from this source, is assessed as being high.

4.6 Flooding from Sewers and Drainage

- 4.6.1 Southern Water Sewer Records for the area in the vicinity of the development site have not been obtained as it is known that there are no public sewers in this area.
- 4.6.2 There are no recorded events of flooding due to the sewers or drainage.

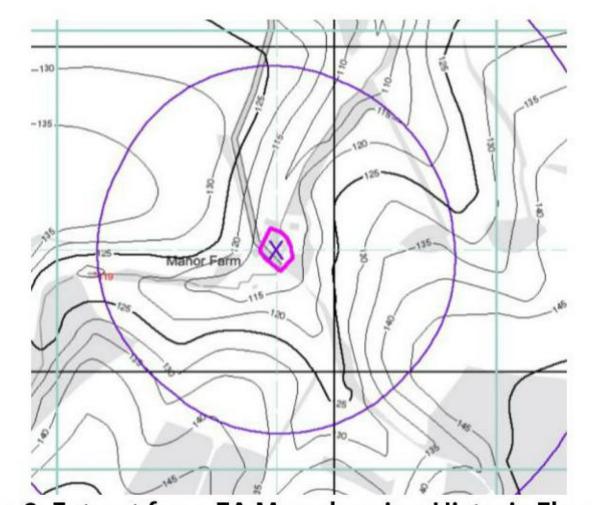


Figure 8: Extract from EA Map showing Historic Flooding Events

4.6.3 Based on this, the risk of flooding from this source is therefore assessed as being low.



4.7 Flooding from Development Drainage

- 4.7.1 A surface water drainage assessment has been included in this report which outlines the proposed mitigation measures to reduce the peak rate of run-off from the proposed development to existing levels and to mitigate any increased risk of flooding from this source.
- 4.7.2 As a result of the proposed mitigation measures, the existing surface water run-off flow rate will be reduced as the flow will be attenuated before discharging into the stream.
- 4.7.3 Following mitigation, the risk of flooding from this source is assessed as low.



4.8 Summary of Flood Risk

4.8.1 An assessment of key sources of flooding has been carried out and is summarised below:

•	Flooding from Rivers and the Sea	High Risk
•	Flooding from Groundwater	High Risk
•	Flooding from Overland Flows	Moderate Risk
•	Flooding from Sewers and Drainage	Low Risk
•	Flooding from Artificial Sources	Low Risk
•	Flooding from Development	Low Risk following mitigation

4.8.2 A management and maintenance plan for the surface water drainage system is also included in this document. This plan aims to reduce the risk of potential problems with the surface water drainage system.



5 Development Surface Water Drainage Strategy

5.1 Surface Water Drainage Design

5.1.1 The management of the surface water run-off from the proposed development would comprise of the use of Sustainable Drainage System (SuDS).

5.2 Greenfield Run-off Rate

5.2.1 Reference is made to the attached area plans in Appendix B|. The existing site surface water peak run-off has been estimated for the development site. The run-off has been calculated using the ICP SUDS Mean Annual Flood method with the existing impermeable area of 645 m² presented in Section 2.2 for a 1, 30- and 100-year return period storm. The results of the calculations, which are included in Appendix G, are summarised as follows:

Storm Event	Greenfield run-off (litres/ second) ICP SuDS method
Qbar	0.3
1 in 1-year	0.3
1 in 30-year	0.7
1 in 100-year	0.9

5.3 Proposed Peak Run-Off

- 5.3.1 With reference to the attached area plans in Appendix B, the proposed site surface water peak run-off has been estimated for the development site. Using the Windes Micro-Drainage, for the proposed impermeable area stated in Section 2 of 645m², the storage volume required has been calculated using a quick storage estimate for the run-off for a 1, 30, 100-year storm event and a 100 year plus 40 % allowance for climate change.
- 5.3.2 The calculations are based on the total proposed impermeable area without mitigation for a discharge rate of 2l/s. The results of the calculations, which are included in Appendix E, are summarised as follows:

Storm Event	Proposed Storage Volume (m3)
1 in 1-year	8
1 in 30-year	24
1 in 100-year	33
1 in 100-year + 40% climate change	50



5.4 Proposed Sustainable Surface Water Drainage Strategy

- 5.4.1 The proposed development will be constructed on pre-developed land. The permeable and impermeable areas of the site will be remaining the same as existing.
- 5.4.2 It is proposed to attenuate the surface water run-off and limit the discharge via a flow control device to a rate of 2l/s for all storms periods up to a 1 in 100-year storm event plus an allowance of 40% for climate change. The rate of 2l/s has been chosen due to the very small greenfield run off rate values which would be impractical to match. The surface water run-off from the impermeable areas will be dealt with by sustainable surface water (SuDS) methods. Based on this concept and with reference to the attached proposed plan (Appendix C), the suitability of the following SuDS methods to meet the above objectives for the site and proposed development have been considered as follows:

Rainwater harvesting

Rainwater harvesting could be considered on this site for grey water usage, which would further reduce surface water run-off. Rainwater harvesting has not been considered at this stage due to all surface water run off being attenuated in the design.

Green / brown roofs

Currently the buildings all have pitched roofs. The pitched roofs do not allow for the provision of green or brown roofs. In addition, pitched green or brown roofs would provide less potential storage capacity than flat roofs. It is therefore unlikely that the provision of green or brown roofs on the proposed buildings would provide any significant decrease in downstream attenuation volume requirements especially when taking into account that these roofs are likely to become saturated after a prolonged period of wet weather in the winter and their storage volume would be unavailable. In addition, the provision of green or brown roofs would result in an increase of the structure size. Green or brown roofs therefore have not been considered for the development site.

<u>Infiltration</u>

It is not proposed to use infiltration in this design due to the close proximity of the stream.

Attenuation and limited discharge to the steam

It is proposed that the run-off from the hardstanding and roof areas will be totally discharged into the existing stream via a pumping main to take the run-off passed the neighbouring property to avoid increasing the existing flooding problem.

The discharge would be limited to 2l/s for all storm return periods up to and including the 1 in 100-year storm event including an allowance of 40 % for climate change.



Prior to discharging off site, it is intended to allow the surface water to be stored in underground modular storage crates.

Preliminary storage volumes have been estimated based on the information provided to date, but these volumes will be confirmed during detailed design.

5.4.3 Summary of Drainage Design

The proposed drainage layout is included in Appendix C of this report. With reference to that layout a summary of the sustainable drainage design is as follows:

Proposed SuDS methods:	Cellular storage tanks
Treatment:	Catchpits shall be provided to collect debris from roof drainage prior to discharge to the tanks or granular fill.
Discharge:	Discharge shall be limited to 2l/s for storm events up to and including the 1 in 100-year storm event including a 40% allowance for climate change.

5.4.4 Based on the proposed drainage scheme attached in Appendix C, there will be no additional surface water run-off from the proposed development site for all storm events up to and including the 1 in 100-year event including an allowance of 40 % for climate change.



6 Foul Water Drainage Strategy

- 6.1.1 Based on the information available to us it appears there is no existing foul drainage located within the development site.
- 6.1.2 The preferred option for dealing with the foul water would be to install a foul treatment plant to clean the water before it is discharged into the nearby stream using the same pumping main as for the surface water.



7 Maintenance of SuDS Components

7.1 This section provides general management and maintenance procedures for the various components comprising the proposed surface water drainage system serving the proposed development. This section has been produced in accordance with current best practice and the recommendations and guidance set out in CIRIA C753 'The SuDS Manual'.

7.2 <u>Soakaway / Attenuation Tank</u>

Regular inspection of the storage structures is required to ensure effective long-term performance of the system. Maintenance needs of the system should be monitored and schedules adjusted to suit the specific requirements of the development.

7.3 The following maintenance regime is recommended as a minimum but actions and frequencies should be adjusted to suit the specific requirements of the development. Manufacturer's specific recommendations should also be followed.

Maintenance Schedule	RECILIFECT WORKS/ACTION	
Regular Maintenance	 Inspect and identify incorrect operation. Debris removal from catchment area using sweeping and vacuuming. Removal of silt and debris from rain water gutters Removal of sediment from pretreatment components i.e catchpits and outlets. 	 Monthly 3 monthly 6 monthly 6 monthly

7.4 Current best practice suggests that underground cellular soakaway and attenuation tank systems are constructed with access possibilities to ease future maintenance. These accesses allow the annual removal of any silts or sediments directly from the tank ensuring effective long-term performance.

7.5 <u>Catchpit and Flow Control Chambers</u>

- 7.6 Regular inspection of these chambers is required to ensure effective long-term performance of the system. Maintenance needs of the system should be monitored and schedules adjusted to suit the specific requirements of the development.
- 7.7 The following maintenance regime is recommended as a minimum but actions and frequencies should be adjusted to suit the specific requirements of the development. The flow control manufacturer's specific recommendations should also be followed.



Maintenance Required Works/Action Frequency Schedule Monthly Regular Inspect chambers and identify incorrect operation. Maintenance Removal of sediment from pre-3 monthly treatment components i.e. catchpits. Removal of silt and debris from 6 monthly rain water gutters Regular inspection by Annually manufacturer

7.8 <u>Permeable Pavements</u>

Permeable surfaces need to be regularly cleared of silt and other debris to ensure their permeability is preserved. Current advice suggests a minimum of three surface sweepings per year. However, manufacturer's specific recommendations should always be followed. We have not considered permeable pavements within the current design however have included them in this maintenance regime encase they are adopted at a later date for the existing impermeable hardstanding areas.

- 7.9 A smaller precinct sweeper, should be used and the sweeping regime should be as follows:
 - 1. End of winter (April) to collect winter debris
 - 2. Mid-summer (July/August) to collect dust and flower other plant type deposits
 - 3. End of autumn (November) to collect leaf fall.
- 7.10 In addition to surface sweeping and vacuuming the following maintenance regime would also be recommended:

Maintenance Schedule	Required Works/Action	Frequency
Regular Maintenance	Brushing and Vacuuming.	Three times a year as above or as required following further monitoring
Occasional Maintenance	Removal of weed growth.	3 Monthly
Ongoing Monitoring	 Inspection for evidence of poor operation or ponding marks. 	3 Monthly, 24-48h after a storm
	 Inspect debris accumulation on surface and adjust sweeping regime if necessary. 	Annually
		Annually



•	Inspect	silt	accumulation	in
	inspection chambers and remove as			e as
	necessar	У.		

7.11 Rehabilitation of the surface laying course should be carried out if evidence of poor performance is observed during the quarterly inspections.



8 Flood Resilient Measures

- 8.1 Electrical Sockets: The height of all electrical sockets on the ground floor will set at a higher level to ensure that they will not be adversely affected by potential higher flood levels. This level will be confirmed when the structural floor level is calculated.
- 8.2 Separate Circuits: Each floor will have separate circuits to minimise any potential disruption.
- 8.3 Floor Sumps: Sumps can be provided in the communal areas to allow any flood water to recede more quickly.
- 8.4 Plaster/plasterboard: The plasterboard will be layered horizontally or resilient plaster will be specified.
- 8.5 Kitchen units: Kitchen units will be fitted on legs with a removable boarding.
- 8.6 Flooding Plan: For each building situated within the high risk of flooding zone, a bespoke Flooding Plan will be produced which will clearly show the safe route for evacuating the property and where the safe place of refuge is located.
- 8.7 Wall Insulation: Closed cell insulation will be specified up to the first-floor level.





9 Conclusions

- 9.1 CTP has prepared a site-specific flood risk assessment as part of the planning submission to Sevenoaks District Council, for the proposed development on the site of existing agricultural buildings located at Manor Farm, Dry Hill Lane, Sundridge, TN14 5AA.
- 9.2 This Flood Risk Assessment (FRA) has been prepared in accordance with guidance given in the National Planning Policy Framework (NPPF) and Technical Guidance (July 2018).
- 9.3 The Environment Agency Flood Risk maps indicate that the proposed development site is situated in Flood Zone 3a. The Environment Agency Flood Risk maps indicate that part of the proposed development site is situated in Flood Zone 3a. The sequential test confirms the need for an exception test to be carried out.
- 9.4 Section 8 states a number of flood resilience measures are recommended for use in the construction of the project.
- 9.5 The risk of flooding from different key sources has been assessed. This assessment has deemed that the risk of flooding from all sources at the site are moderate to high.
- 9.6 A proposed drainage scheme has been included in this report. The development proposals does not result in an increase in impermeable area. A water management scheme comprising of a series of SuDS components have been proposed. These SuDS measures will mimic natural surface water disposal into the ground and result in the peak surface water flows from the additional impermeable area being decreased to 2l/s run-off rates for all storms up to and including the 1 in 100-year storm event including a 40 % allowance for climate change so that the risk of flooding from this source will also be low.
- 9.7 It is proposed for the foul water to flow through a proprietary treatment plant and the resulting clean water discharge into the existing stream after the neighbouring property.



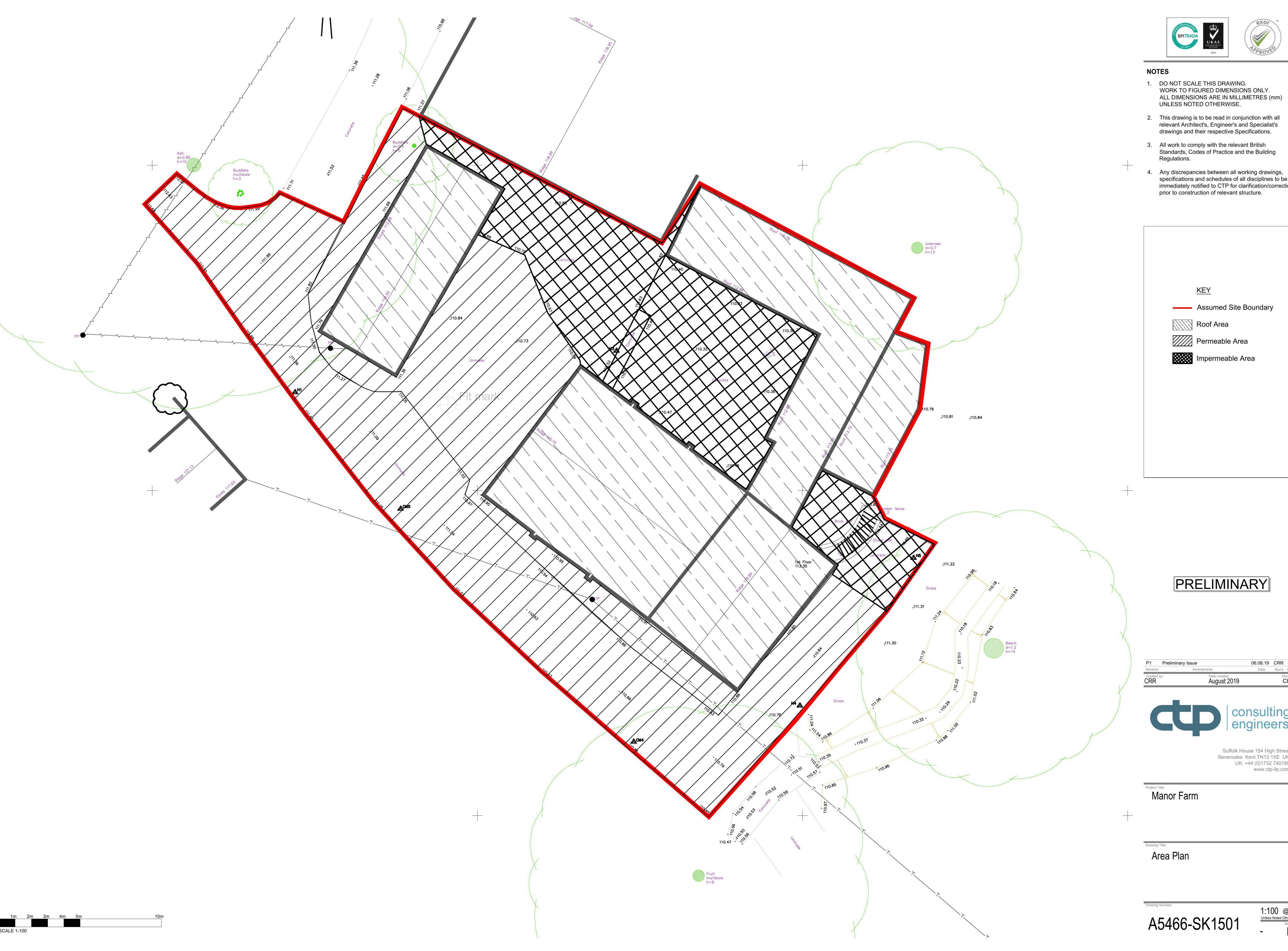
Appendix A – Topographical Survey







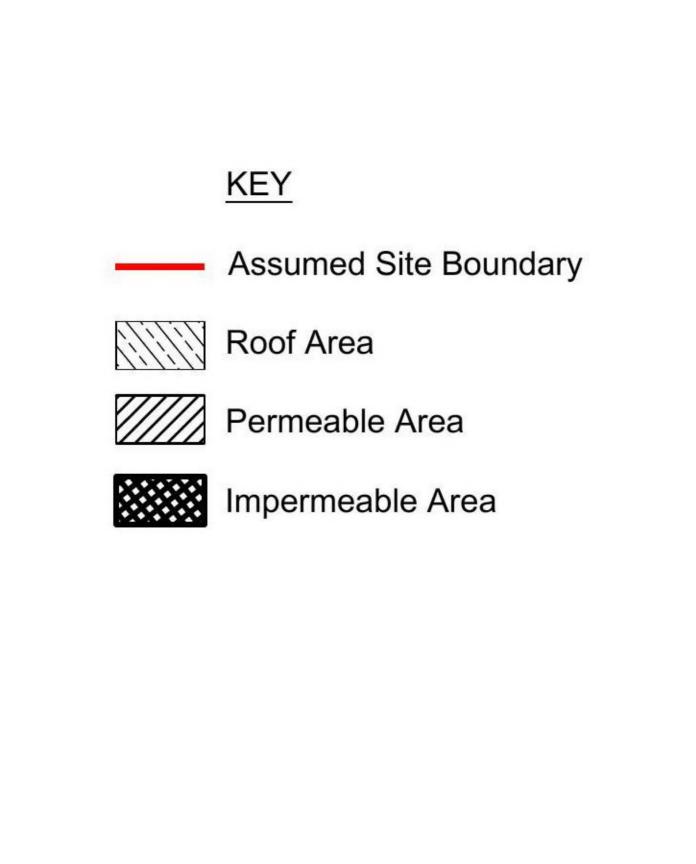
Appendix B – Area Plans





- DO NOT SCALE THIS DRAWING. WORK TO FIGURED DIMENSIONS ONLY. ALL DIMENSIONS ARE IN MILLIMETRES (mm)

- Any discrepancies between all working drawings, specifications and schedules of all disciplines to be immediately notified to CTP for clarification/correction prior to construction of relevant structure.



PRELIMINARY



