Flood Risk Assessment

Archway Filling Station

New Dover Road

Capel-le-Ferne

CT18 7JD

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1. Background and Introduction

This flood risk assessment supports a proposed Local Plan allocation for development at Archway Filling Station, New Dover Road, Capel-le-Ferne, CT18 7JD.

The proposed development is for residential use.

2. Development Location and Description

The site is situated to the north of New Dover Road, Capel-le-Ferne, Figure 1.

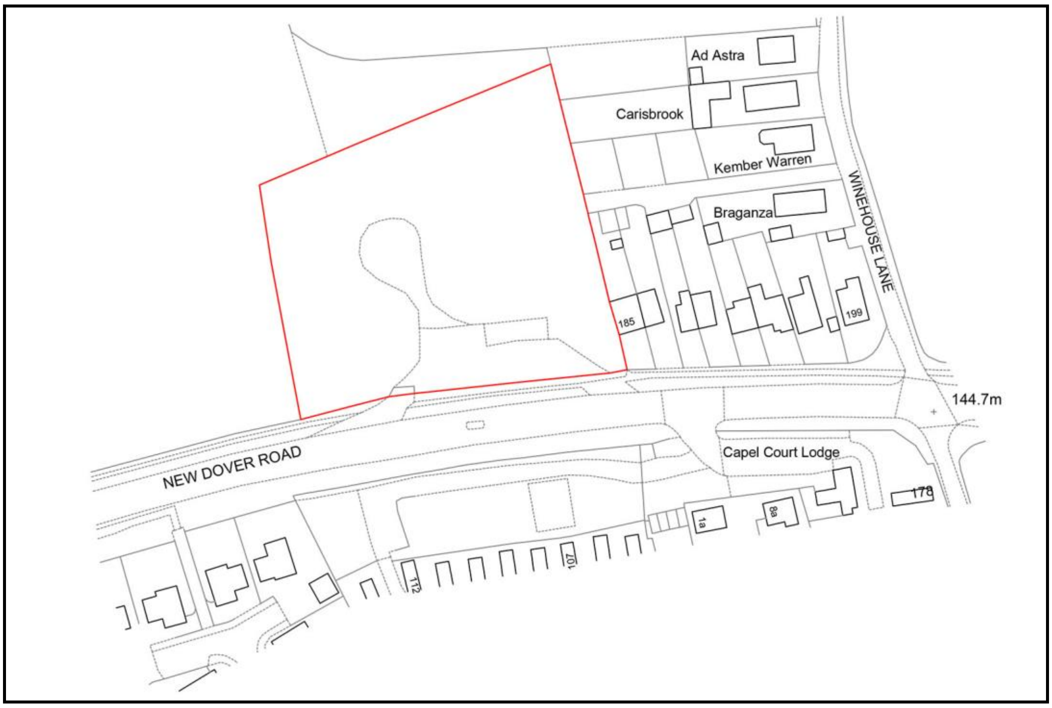


Figure 1. Site location plan.

The existing site was previously used as a fuel filling station. All that remains is an area of hardstanding associated with the filling station plus the original entrance and exit accesses. There are rubble spoil heaps within the site, the remains of the previous development. The site covers approximately 0.65ha.

Development Proposals

The proposed allocation is for residential development for an estimated 18 dwellings.

3. Policy Background

The National Planning Policy Framework

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced.

Chapter 14 Meeting the challenge of climate change, flooding and coastal change states:

Planning and flood risk

159. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

160. Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.

161. All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

a) applying the sequential test and then, if necessary, the exception test as set out below;

b) safeguarding land from development that is required, or likely to be required, for current or future flood management;

c) using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and

d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.

162. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

163. If it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in Annex 3.

164. The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. To pass the exception test it should be demonstrated that:

a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

b) 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.

165. Both elements of the exception test should be satisfied for development to be allocated or permitted.

166. Where planning applications come forward on sites allocated in the development plan through the sequential test, applicants need not apply the sequential test again. However, the exception test may need to be reapplied if relevant aspects of the proposal had not been considered when the test was applied at the plan-making stage, or if more recent information about existing or potential flood risk should be taken into account.

167. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;

b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;

c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;

d) any residual risk can be safely managed; and e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

168. Applications for some minor development and changes of use should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55.

169. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) take account of advice from the lead local flood authority;

b) have appropriate proposed minimum operational standards;

c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and

d) where possible, provide multifunctional benefits.

The aim of the NPPF is to steer new development to areas with the lowest probability of flooding. The flood zones are the starting point for this sequential approach. Zones 2 and 3 are shown on the Flood Map for Planning with flood zone 1 being all the land falling outside zones 2 and 3. These flood zones refer to the probability of sea and river flooding only, ignoring the presence of existing defences:

Zone 1 Low Probability - land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

Zone 2 Medium Probability - land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Zone 3a High Probability - land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Zone 3b The Functional Floodplain - land where water has to flow or be stored in times of flood, land which would flood with an annual probability of 1 in 20 (5%) of greater in any year or designed to flood in an extreme flood.

The Planning Practice Guidance that accompanies the NPPF recognises that the type of development affects its vulnerability to flooding. Table 1 details development vulnerability classification and flood zone compatibility.

Residential development is classified as More Vulnerable and is considered appropriate in flood zones 1, 2 and 3a, providing the Exception Test is passed.

Where there are no reasonably available sites in flood zone 1, local planning authorities allocating land in local plans or determining planning applications for development at any particular location should take into account the flood risk vulnerability of land uses and consider reasonably available sites in flood zone 2, applying the Exception Test if required. Only where there are no reasonably available sites in flood zones 1 or 2 should the suitability of sites in flood zone 3 be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

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.

Flood Risk Vulnerability Classification	Zone 1	Zone 2	Zone 3a	Zone 3b
Essential Infrastructure Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure.	✓	✓	e	e*
Highly Vulnerable Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use.	✓	e	x	x
More Vulnerable Hospitals. Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. Non–residential uses for health services, nurseries and educational establishments. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.	✓	✓	e	x
Less Vulnerable Police, ambulance and fire stations which are not required to be operational during flooding. Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in “more vulnerable”, and assembly and leisure. Land and buildings used for agriculture and forestry.	✓	✓	✓	x
Water Compatible Development Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel working. Docks, marinas and wharves. Water-based recreation (excluding sleeping accommodation). Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.	✓	✓	✓	✓*
Key: ✓ Development is appropriate x Development should not be permitted e Exception Test required NB. Shortened list of development types shown.				

Table 1. Vulnerability classification and flood zone compatibility.

Local Development Documents

Dover District Council Core Strategy 2010

Dover District Council's Local Development Framework Core Strategy was adopted in February 2010. The following policies are relevant to the site.

Policy DM 17

Groundwater Source Protection

Within Groundwater Source Protection Zones, shown on the Proposals Map, the following will not be permitted in Zones 1 and 2 unless adequate safeguards against possible contamination are provided:

i. *Septic tanks, storage tanks containing hydrocarbons or any chemicals, or underground storage tanks;*
ii. *Proposals for development which may include activities which would pose a high risk of contamination unless surface water, foul or treated sewage effluent, or trade effluent can be directed out of the source protection zone;*
iii. *Proposals for the manufacture and use of organic chemicals, particularly chlorinated solvents;*
iv. *Oil pipelines;*
v. *Storm water overflows;*
vi. *Activities which involve the disposal of liquid waste to land; and*
vii. *Sustainable urban drainage systems.*

New graveyards will not be permitted in Zone 1. Farm waste, storage areas, new foul or combined sewerage systems will also not be permitted in Zone 1 unless adequate safeguards are provided.

Dover District Council Strategic Flood Risk Assessment 2019

Dover District Council Strategic Flood Risk Assessment (SFRA) was published in March 2019.

4. Site Characteristics

Geology and Soils - The bedrock geology consists of the New Pit Chalk Formation, chalk. The superficial geology consists of the Clay-with-Flints Formation, clay, silt, sand and gravel. The soils are characterised as loamy and clayey soils with impeded drainage draining to the stream network. Records from a borehole sunk at Great Cauldham Farm, 1km west of the site indicate that the Clay-with-Flints Formation is approximately 9m deep and consists of clay.

Groundwater - The site lies within the Total Groundwater Source Protection Zone (zone 3). Records from the borehole sunk at Great Cauldham Farm indicate a groundwater level of 78.60mAOD (Above Ordnance Datum).

Sewer Record - The nearest public foul sewer is at the southeast corner of the site, Figure 2. The invert level manhole 5702 is 143.36mAOD. There are no public surface water sewers in the vicinity of the site.

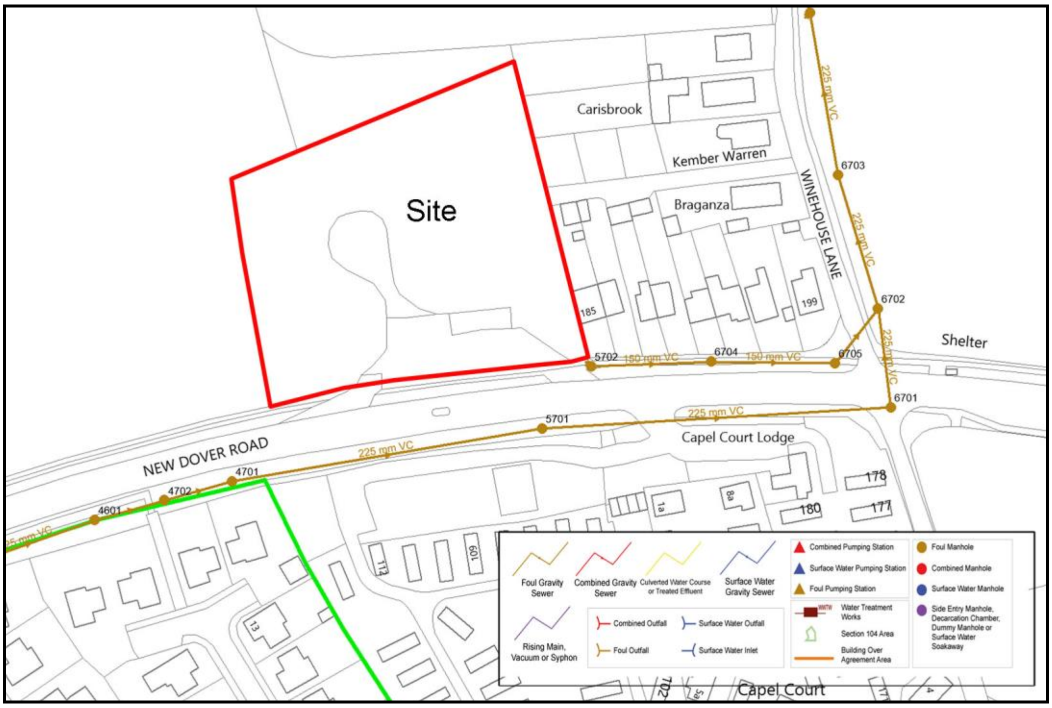


Figure 2. Public sewer record. (© Southern Water).

Site Specific Topographic Data - Contours have been derived from Lidar data. The wider area is shown in Figure 3. The land falls from west to east at a gradient of approximately 1 in 90. The site is at approximately 145 - 146mAOD. Figure 4 shows contours at 0.1m spacing. These contours show the rubble spoil heaps that are left on the site creating artificial high and low points.

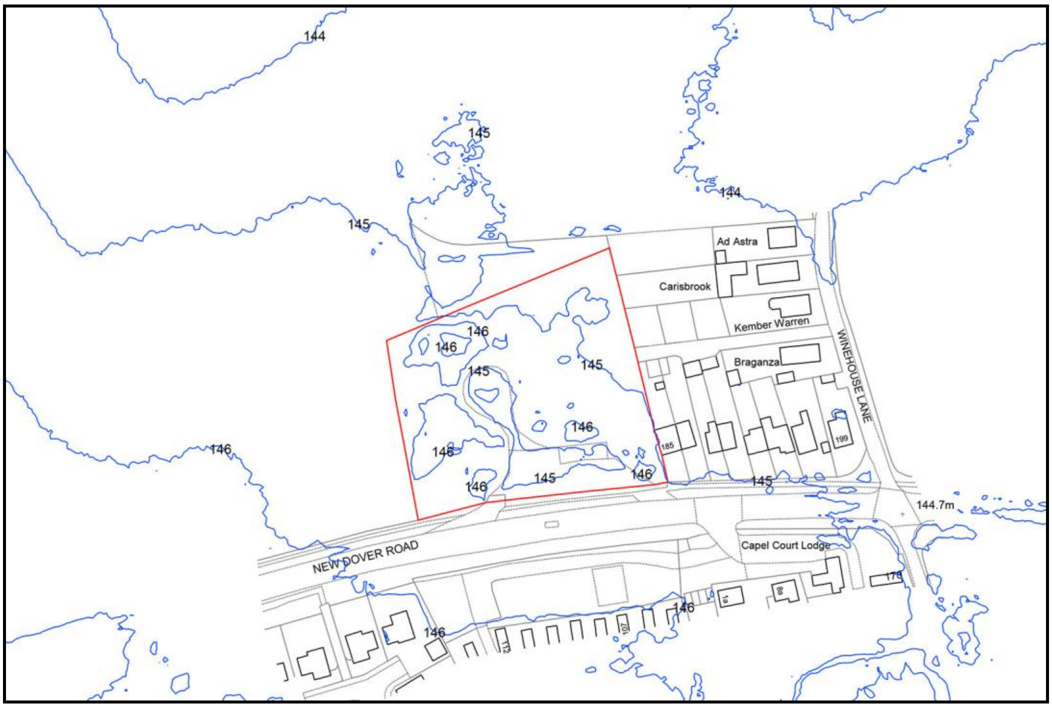


Figure 3. Contours derived from Lidar data.

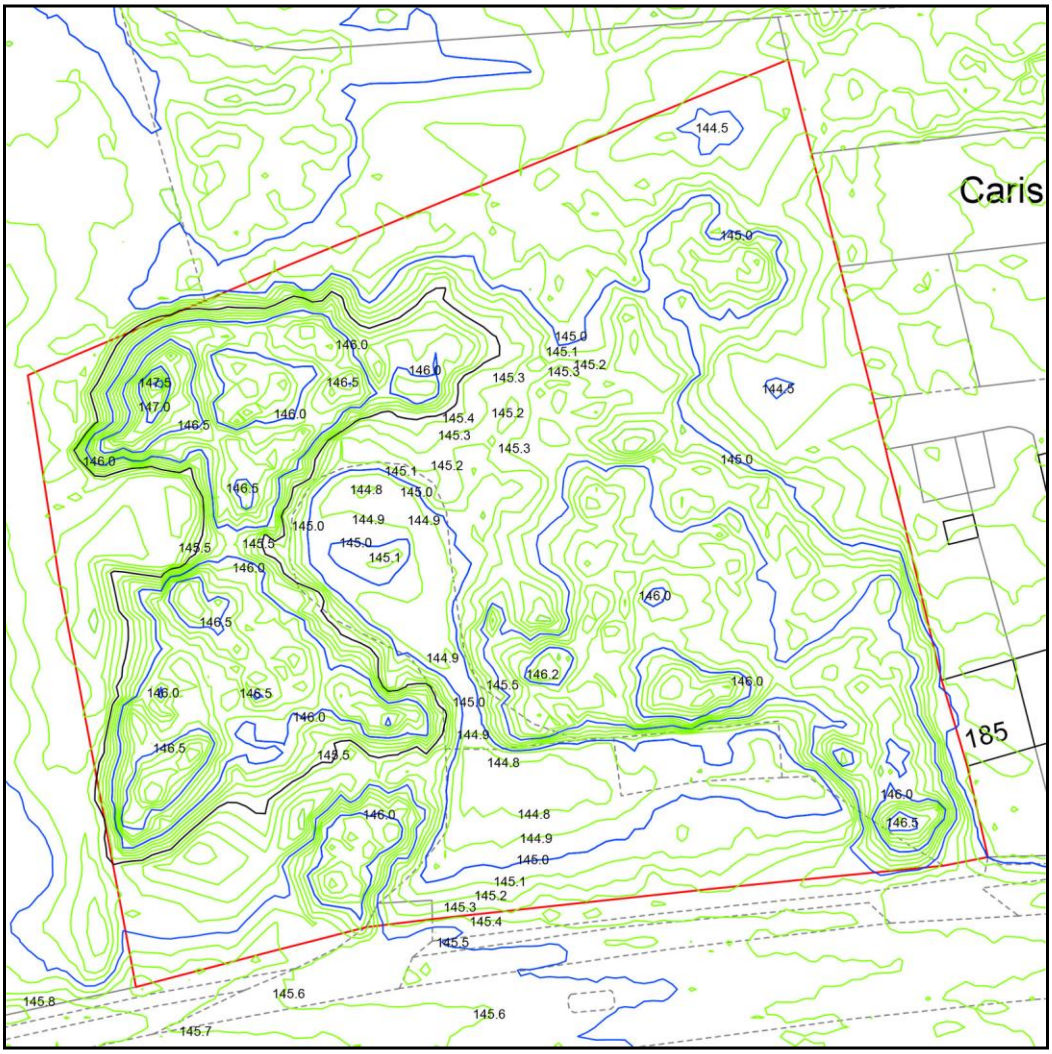


Figure 4. Site contours derived from Lidar data.

Existing Development - The existing site consists of impermeable hardstanding which used to be the filling station access and forecourt plus rubble spoil heaps.

Infiltration Rates - Site investigation has not been carried out. Infiltration rates for common types of soil are shown in Table 2.

Soil Type	Infiltration Rate *f*
gravel	2.8×10^{-3} to 0.28 m/s
sand	2.8×10^{-5} to 0.028 m/s
loamy sand	2.8×10^{-6} to 2.8×10^{-4} m/s
sandy loam	1.4×10^{-5} to 1.4×10^{-4} m/s
loam	2.8×10^{-7} to 2.8×10^{-5} m/s
silt loam	1.4×10^{-7} to 2.8×10^{-5} m/s
chalk	2.8×10^{-7} to 0.028 m/s
sandy clay loam	2.8×10^{-7} to 2.8×10^{-5} m/s
clayey gravels	1.0×10^{-8} to 1.0×10^{-6} m/s
clayey sands	1.0×10^{-9} to 1.0×10^{-6} m/s

Table 2. Infiltration rates for typical soils.

An infiltration rate of 1×10^{-4} m/s has been assumed for deep infiltration structures within the chalk.

Greenfield Runoff Rate - The greenfield runoff rate for the critical storm durations for the site has been calculated using the IH124 method from the greenfield runoff rate estimation tool published online by HR Wallingford at uksuds.com. The peak runoff is shown in Table 3.

Return Period	Runoff Rate Q l/s per ha.
QBar	0.18
1	0.16
30	0.42
100	0.59

Table 3. Greenfield runoff rate for the site.

Rainfall Data - Point rainfall data has been obtained from the Flood Estimation Handbook (FEH) Web Service. The FEH 2022 XML rainfall data has been used in the surface water drainage design. This provides rainfall data for return periods greater than 2 years.

5. Definition of the Flood Hazard

To define the flood hazard, data has been collected from several sources.

Flood Map for Planning - The Flood Map for Planning shows that the site lies in flood zone 1, Figure 5.

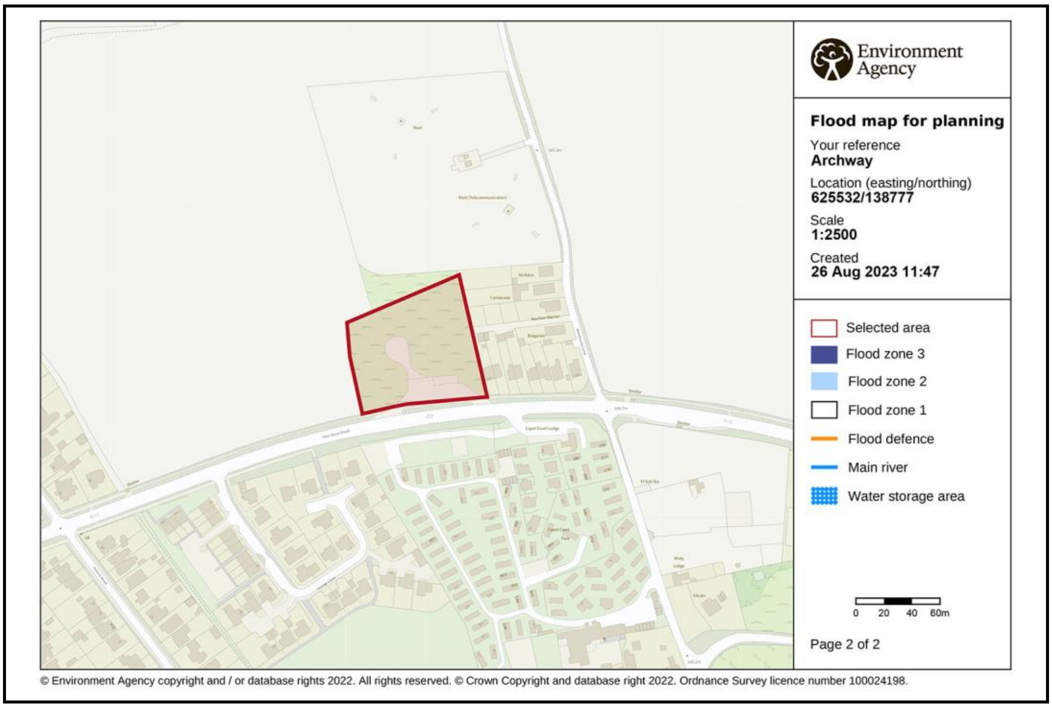


Figure 5. Flood Map for Planning.

The following sources of flooding could affect the site:

Tidal (Sea)

The lowest site level is 144.8mAOD. The site is not at risk of tidal flooding.

Fluvial (River)

The lowest site level is 144.8mAOD. There are no watercourses in the vicinity of the site. The site is not at risk of fluvial flooding.

Surface Water

The Government has published surface water flood risk maps. The site is at very low to medium risk of surface water flooding, Figure 6.

The definition of each category is given below:

Very Low (white) a chance of flooding of less than 1 in 1000 (0.1%)
Low (pale blue) a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%)
Medium (mid blue) a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%)
High (dark blue) a chance of flooding of greater than 1 in 30 (3.3%)

The depth of water associated with the low, medium and high risk surface water flood events is shown in Figures 7 - 9. The definition of each colour is given below:

Below 300mm (light blue)
300-900mm (medium blue)
Over 900mm (dark blue)

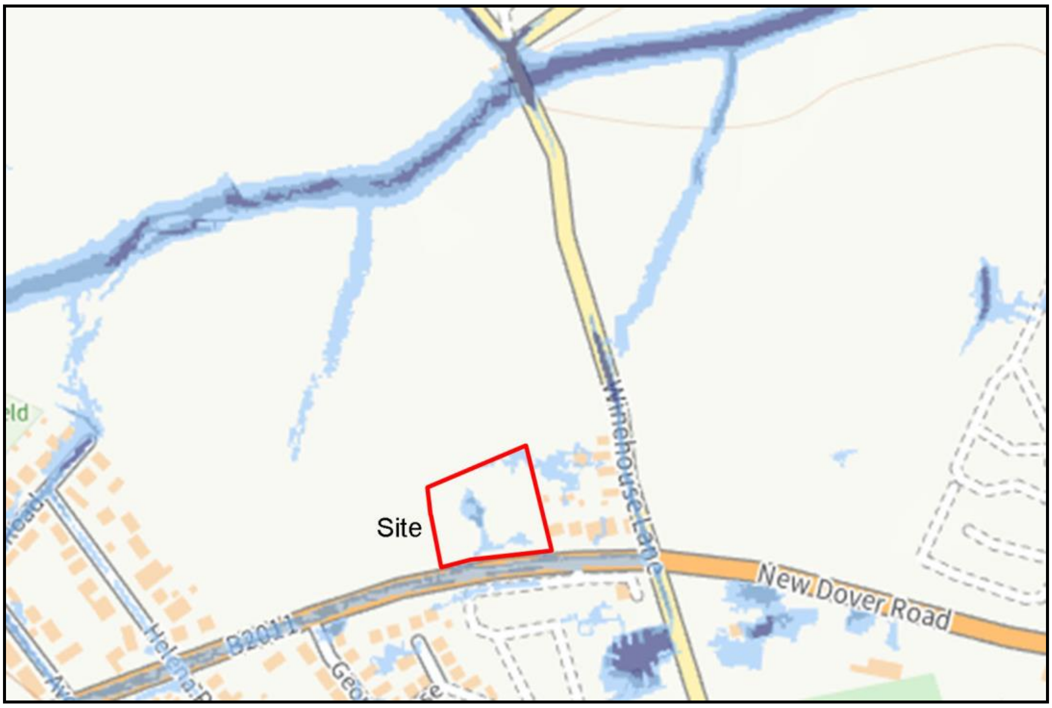


Figure 6. Surface water flood map.

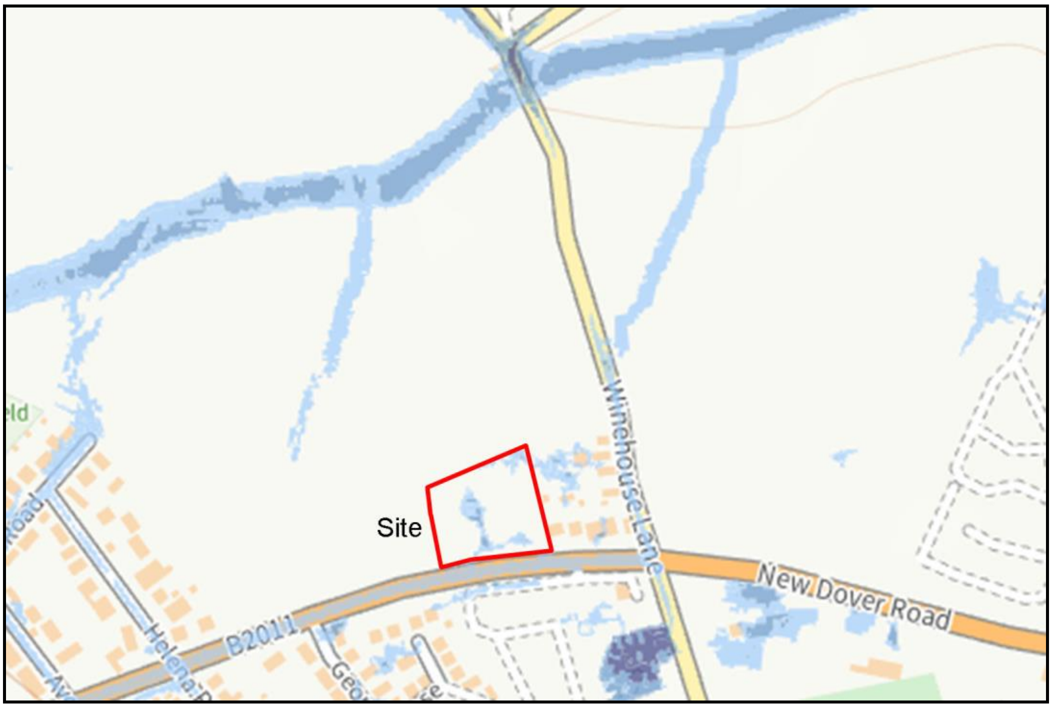


Figure 7. Surface water flood depth map for the low risk flood event.

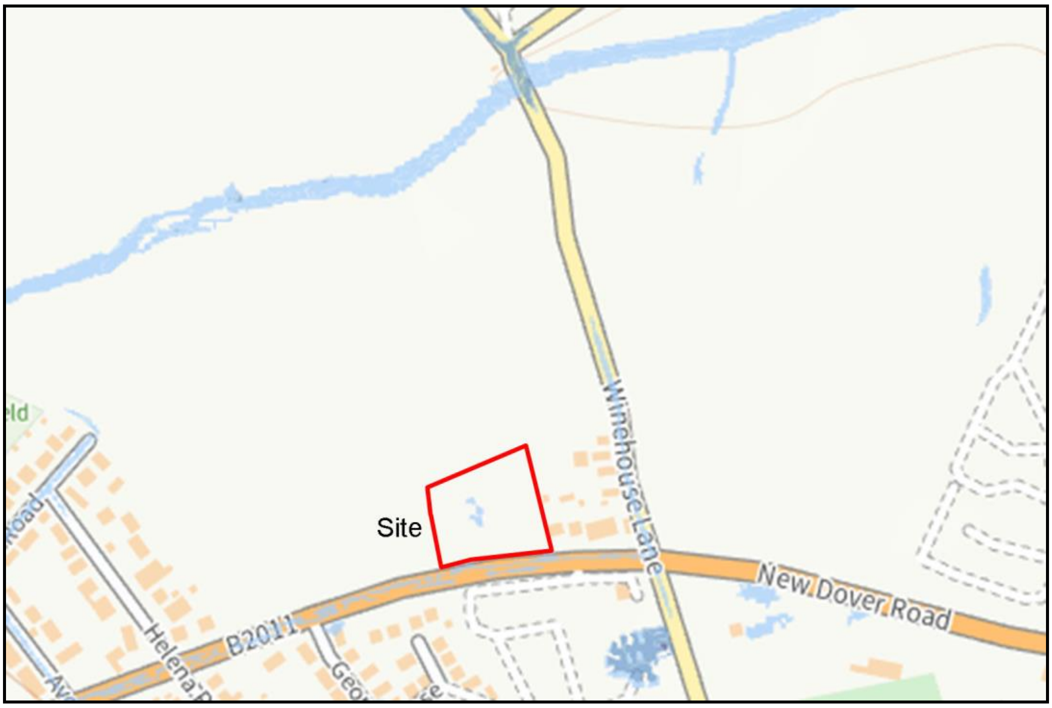


Figure 8. Surface water flood depth map for the medium risk flood event.

Figure 9. Surface water flood depth map for the high risk flood event.

The surface water flood maps also give an indication of velocity and direction of flow, Figure 10. The definition of each colour is given below:

Over 0.25 m/s (dark blue)
Less than 0.25 m/s (light blue)

The surface water flooding is generated within the site. The velocity maps show no link between New Dover Road and the site. Surface water from New Dover Road runs west to east along the road and then north along Winehouse Lane.

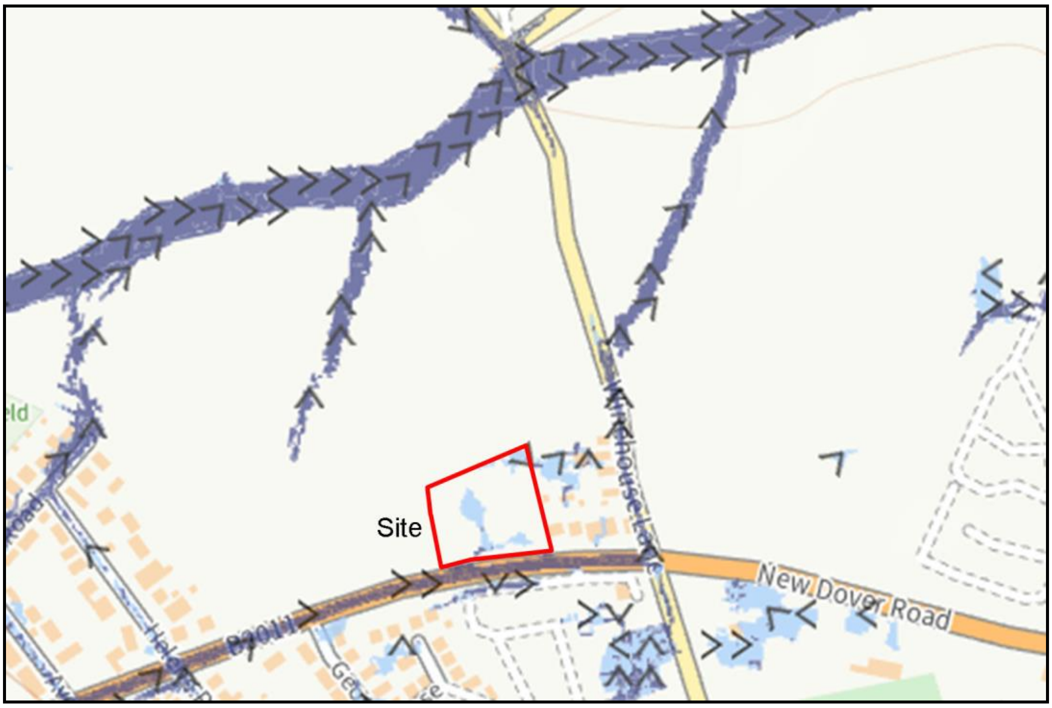


Figure 10. Surface water flood velocity map for the low risk flood event.

The surface water flood depths are available as a GIS dataset. This data splits flood depths into a greater number of categories. The GIS dataset has been overlaid on the site for the medium and low risk flood events, Figures 11 and 12.

Figure 11. Surface water flood mapping from GIS files overlaid on the site for the medium risk flood event.

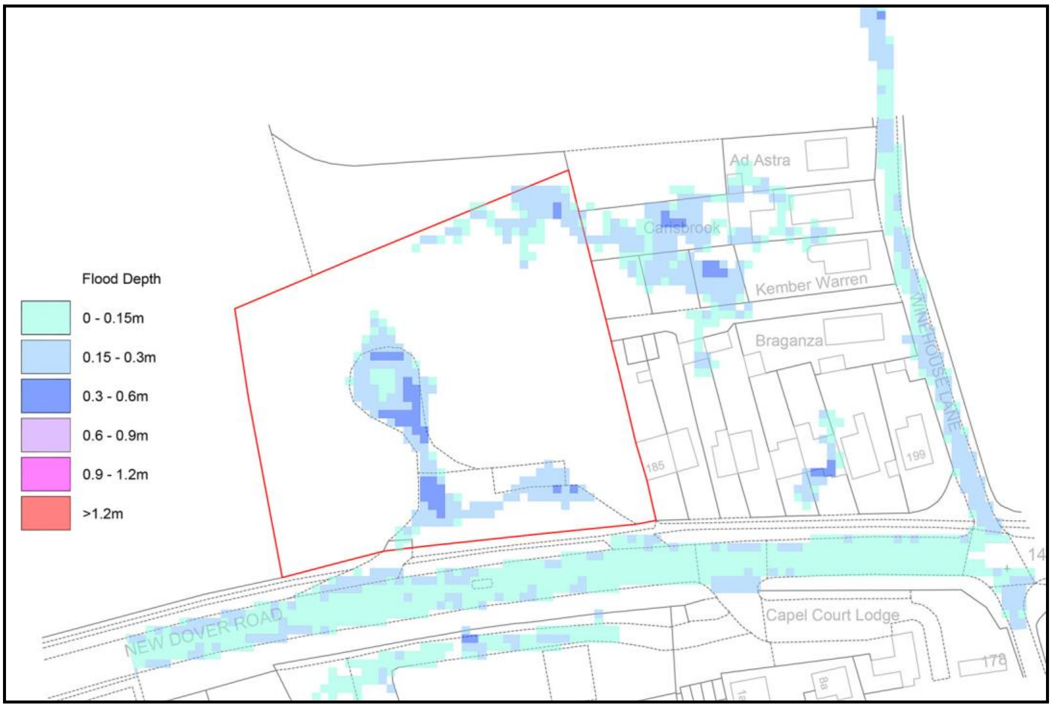


Figure 12. Surface water flood mapping from GIS files overlaid on the site for the low risk flood event.

The design flood event is the 1 in 100 year (1% Annual Exceedance Probability) event plus climate change. The medium flood risk model represents the 1 in 100 year rainfall event. There is only minor flooding to the centre of the site under the modelled 1 in 100 year event to a depth of 0.15 - 0.3m. Under the 1 in 1000 year (0.1% Annual Exceedance Probability) low risk event there is flooding at the centre of the site and to the northeast corner to a depth of 0 - 0.6m.

The surface water flood modelling data is assigned a suitability rating. The suitability ratings are shown in Table 4, with the rating for the site shown highlighted. At the *County to Town* level the modelling is unlikely to be reliable for a local area.

Indicative suitable scale	Indicative suitable use	How reliable is this for a local area?	How reliable is this for an individual property?
National to county - suitable for identifying which parts of countries or counties are at risk, or which countries or counties have the most risk.	Suitable for identifying areas with a natural vulnerability to flood first, deepest or most frequently.	Very unlikely to be reliable for a local area.	Extremely unlikely to be reliable for identifying individual properties at risk.
County to town - suitable for identifying which parts of counties or towns are at risk, or which counties or towns have the most risk.	Suitable for identifying approximate extents, shallower and deeper areas.	Unlikely to be reliable for a local area.	Very unlikely to be reliable for identifying individual properties at risk.
Town to street - suitable for identifying which parts of towns or streets are at risk, or which towns or streets have the most risk.	Suitable for identifying flood extents, approximate depth of flooding, and identifying streets at risk of flooding.	Likely to be reliable for a local area (and so the information is suitable for areas of land, not individual properties).	Unlikely to be reliable for identifying individual properties at risk (and so the information is suitable for areas of land, not individual properties).
Street to parcels of land - suitable for identifying which parts of streets or parcels* of land are at risk, or which streets or parcels of land have the most risk.	Suitable for identifying flood extents, depths and approximate velocities.	Very likely to be reliable for a local area (and so the information is suitable for areas of land, not individual properties).	Likely to be reliable for identifying individual properties at risk (though not whether they flood internally, so the information is suitable for areas of land, not individual properties).
Property (including internal) - suitable for identifying which parts of a property are at risk (including internal / external distinction), or which properties have the most risk.	Suitable for identifying flood extents, depths, velocities, and distinguishing between street and property flooding.	Extremely likely to be reliable for a local area.	Likely to be very reliable at identifying individual properties at risk, including depths of flooding internally (this provides a genuine property level assessment).

Table 4. Surface water flood modelling suitability.

The modelling carried out to produce the surface water flood maps, by necessity, makes broad assumptions. Structures, such as bridges, culverts and weirs, and flood risk management infrastructure, such as defences, are not represented. The modelling includes a general allowance for drainage but does not include specific outlets. The suitability rating indicates that the modelling is considered suitable for identifying approximate extents, shallower and deeper areas.

Groundwater

Records from the borehole sunk at Great Cauldham Farm indicate a groundwater level of 78.60mAOD (Above Ordnance Datum). This is approximately 66.2m below the lowest site level. The risk of groundwater flooding is therefore considered to be very low.

Infrastructure Failure

Public foul sewers run west to east along New Dover Road. A significant volume of water would be required to cause water to break the surface. Should it do so, it would flow east along New Dover Road and north along Winehouse Lane as shown by the surface water modelling, low risk velocity maps. The site is also not at risk from reservoir flooding. The site is at very low risk from flooding from infrastructure failure.

6. Probability of Flooding

The probability of flooding from each source is summarised in Table 5.

Source of Flooding	Probability
Tidal	Very Low
Fluvial	Very Low
Surface Water	Very Low - Medium
Groundwater	Very Low
Infrastructure	Very Low

Table 5. Summary of flood risk.

Surface Water

The greatest risk of flooding at the site is from surface water.

Under the low risk event the surface water flood maps shown no link between New Dover Road and the site. This indicates that the flooding at the centre of the site is entirely generated from within the site. The flood risk maps are based on a ground level generated from Lidar data. This data identifies the rubble spoil heaps as ground level and therefore gives an artificial ground level creating a hollow at the centre of the site which was not originally there nor would be following development.

Once the site is regraded there will not be a depression at the centre of the site and the surface water flow path will be to the northeast following the wider contours.

Positive drainage will be introduced to dispose of runoff from the development, see Chapter 9. The surface water flood modelling does not include drainage. Following development the volume of water generated from within the site that is not captured by drainage will be significantly lower than identified within the modelling.

Once the site has been reprofiled the surface water flooding at the site will be shallow. The residual risk of surface water flooding to buildings will be minimised as the finished ground floor levels will be at least 150mm above the ground level. Roads will be lower than floor levels by at least 250mm allowing for a 100mm kerb height. Roads and landscaping can be designed to maintain flow paths to the northeast under exceedance events and avoid built development. With these measures in place the risk of flooding from surface water will be very low and not provide any restriction on the extent of development.

7. Climate Change

The Environment Agency provides peak rainfall climate change allowances by management catchment. The site falls within the Rother Management Catchment. The peak rainfall allowances for the 2050s and 2070s are shown in Table 6.

Annual Exceedance Event	Central Allowance		Upper End Allowance	
	2050s	**2070s**	**2050s**	**2070s**
3.3%	20%	20%	40%	40%
1%	20%	20%	45%	45%

Table 6. Peak rainfall allowances.

The range is based on percentiles. The 50th percentile is the point at which half of the possible scenarios for peak rainfall intensity fall below it and half fall above it. The Central allowance is based on the 50th percentile whilst the Upper End is based on the 90th percentile.

The Central allowance is 20% and scientific evidence suggests that it is just as likely that the increase in rainfall intensity will be more than 20% as less than 20%. The Upper End allowance is 45% and current scientific evidence suggests that there is a 90% chance that peak rainfall intensity will increase by less than this value, but there remains a 10% chance that peak rainfall intensity will increase by more.

The Planning Practice Guidance suggests that flood risk assessments and strategic flood risk assessments should assess both the Central and Upper End allowances to understand the range of impact.

The surface water management strategy includes an increase of 45% in peak rainfall intensity for the calculation of storage requirements.

8. Detailed Development Proposals

The proposed development will be for residential use. Residential development is classed as more vulnerable and is suitable within flood zone 1.

Sequential Test

Government Guidance *Flood risk assessment: the sequential test for applicants* states:

Developments that don't need a sequential test

You don't need to do a sequential test if one has already been carried out for a development of the type you're planning (eg a residential development) for your site.

In this case, you need to ask your local planning authority for the site allocation reference in their local plan and include it in your planning application. If the local plan hasn't been adopted, check the draft local plan.

You also don't need to do a sequential test if either of the following apply:

- *your development is a minor development*
- *your development involves a change of use (eg from commercial to residential) unless your development is a caravan, camping chalet, mobile home or park home site*

You also don't need to do a sequential test for a development in flood zone 1 unless there are flooding issues in the area of your development. You can check this in your local planning authority's strategic flood risk assessment.

The site lies within flood zone 1. Capel-le-Ferne is not identified within the SFRA as an area at specific flood risk. The sequential test does not need to be considered for the proposed development.

Exception Test

The site lies within flood zone 1. The exception test does not need to be considered for the proposed development.

9. Surface Water Management Strategy

Objectives

The following constraints on a surface water management strategy have been identified.

a. The geology, chalk overlain by clay-with-flints.
b. The engineering properties of chalk.
c. Groundwater levels are very low.
d. There are no watercourses near the site.
e. There are no public surface water sewers near the site.

The following surface water management options are considered below with reference to the above constraints.

a. Infiltration into the chalk via soakaways.

Infiltration into Chalk via Soakaways

Ciria Report C574 Engineering in chalk states:

Control of drainage

Concentrated ingress of water into the chalk can initiate new dissolution features, particularly in low density chalk, and destabilise the loose backfill of existing ones. For this reason, any soakaways should be sited well away from foundations for structures, roads or railways, as indicated below:

- *In areas where dissolution features are known to be prevalent, soakaways should be avoided if at all possible but, if unavoidable, should be sited at least 20m away from any foundations.*

- *Where the chalk is of low density, or its density is not known, soakaways should be sited at least 10m away from any foundations.*

- *Where the chalk is of medium density (or higher) the closest part of the soakaway should be at least 5m away from any foundations.*

Ciria Report C574 indicates that the density of the New Pit Chalk at the North Kent Downs is 1.48 - 1.99Mg/m^3. Low density chalk is defined as having a dry density of < 1.55Mg/m^3. The chalk is therefore likely to be of medium density or higher and any soakaways should be at least 5m from the building foundations.

Records from a borehole sunk at Great Cauldham Farm, 1km west of the site indicate that the Clay-with-Flints Formation is approximately 9m deep and consists of clay. This is unlikely to support shallow infiltration via permeable paving or soakaways. The chalk is likely to support infiltration and therefore disposal of surface water via deep bore soakaways is considered to be the most effective surface water management strategy.

The site area is approximately 0.65ha. Based on 60% of the area being covered by impermeable materials following development, runoff from 3,900m^2 will need to be accommodated.

FLOW software published by Causeway has been used to assess the storage requirements to discharge surface water to ground via infiltration.

The assessment is based on the following assumptions:

- Four deep bore soakaways are installed to dispose of surface water to the chalk below the clay-with-flints.
- An infiltration rate of 1×10^{-4} m/s has been assumed within the chalk.
- Storage is provided within attenuation storage crates.

Based on the above approximately 251m^3 of storage would be required. The calculations are attached at Appendix A.

This analysis indicates that it is possible to dispose of surface water runoff from the site to ground with a design that accommodates the 1 in 100 year + 45% allowance for climate change.

With a suitable surface water management strategy in place the development can minimize the onsite surface water flood risk and reduce flood risk offsite.

10. Conclusion

This flood risk assessment supports a proposed Local Plan allocation for development at Archway Filling Station, New Dover Road, Capel-le-Ferne, CT18 7JD.

The site is situated to the north of New Dover Road, Capel-le-Ferne. The existing site was previously used as a fuel filling station. All that remains is an area of hardstanding associated with the filling station plus the original entrance and exit accesses. There are rubble spoil heaps within the site, the remains of the previous development. The site covers approximately 0.65ha.

The proposed allocation is for residential development for an estimated 18 dwellings.

The Flood Map for Planning shows that the site lies in flood zone 1. The site is not at risk of tidal or fluvial flooding. The site is at very low risk of groundwater or infrastructure flooding. The site is at very low to medium risk of surface water flooding.

The design flood event is the 1 in 100 year (1% Annual Exceedance Probability) event plus climate change. The medium flood risk model represents the 1 in 100 year rainfall event. There is only minor flooding to the centre of the site under the modelled 1 in 100 year event to a depth of 0.15 - 0.3m. Under the 1 in 1000 year (0.1% Annual Exceedance Probability) low risk event there is flooding at the centre of the site and to the northeast corner to a depth of 0 - 0.6m.

Under the low risk event the surface water flood maps shown no link between New Dover Road and the site. This indicates that the flooding at the centre of the site is entirely generated from within the site. The flood risk maps are based on a ground level generated from Lidar data. This data identifies the rubble spoil heaps as ground level and therefore gives an artificial ground level creating a hollow at the centre of the site which was not originally there nor would be following development.

Once the site is regraded there will not be a depression at the centre of the site and the surface water flow path will be to the northeast following the wider contours.

Positive drainage will be introduced to dispose of runoff from the development. The surface water flood modelling does not include drainage. Following development the volume of water generated from within the site that is not captured by drainage will be significantly lower than identified within the modelling.

Once the site has been reprofiled the surface water flooding at the site will be shallow. The residual risk of surface water flooding to buildings will be minimised as the finished ground floor levels will be at least 150mm above the ground level. Roads will be lower than floor levels by at least 250mm allowing for a 100mm kerb height. Roads and landscaping can be designed to maintain flow paths to the northeast under exceedance events and avoid built development. With these measures in place the risk of flooding from surface water will be very low and not provide any restriction on the extent of development.

The sequential test does not need to be considered for the proposed development as the site lies within flood zone 1 and Capel-le-Ferne is not identified within the SFRA as an area at specific flood risk. The exception test does not need to be considered for the proposed development as the site lies within flood zone 1.

Records from a borehole sunk at Great Cauldham Farm, 1km west of the site indicate that the Clay-with-Flints Formation is approximately 9m deep and consists of clay. This is unlikely to support shallow infiltration via permeable paving or soakaways. The chalk is likely to support infiltration and therefore disposal of surface water via deep bore soakaways is considered to be the most effective surface water management strategy. Analysis indicates that it is possible to dispose of surface water runoff from the site to ground with a design that accommodates the 1 in 100 year + 45% allowance for climate change.

With a suitable surface water management strategy in place the development can minimize the onsite surface water flood risk and reduce flood risk offsite.

There are no flood risk issues identified that would restrict the quantity or type of development on the site.

Appendix A - Surface Water Management Strategy Calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	10	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	2.000
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	500.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.130	5.00	145.300	1200	625577.839	138745.011	1.425
2	0.130	5.00	145.500	1200	625498.016	138734.666	1.425
3	0.130	5.00	145.100	1200	625485.605	138789.752	1.425
4			145.000	1350	625529.065	138778.622	1.665
5			144.700	1350	625553.998	138813.919	3.224
5_OUT			144.600	1350	625560.113	138822.577	3.157

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	4	59.233	0.600	143.875	143.410	0.465	127.4	225	5.85	99.7
2.000	2	4	53.816	0.600	144.075	143.410	0.665	80.9	225	5.62	101.4
3.000	3	4	44.863	0.600	143.675	143.410	0.265	169.3	225	5.75	100.5
1.001	4	5	43.215	0.600	143.335	142.376	0.959	45.1	300	6.16	97.7
1.002	5	5_OUT	10.600	0.600	141.476	141.443	0.033	321.2	375	6.34	96.6

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.000	1.157	46.0	35.1	1.200	1.365	0.130	0.0
2.000	1.454	57.8	35.7	1.200	1.365	0.130	0.0
3.000	1.002	39.8	35.4	1.200	1.365	0.130	0.0
1.001	2.348	166.0	103.3	1.365	2.024	0.390	0.0
1.002	1.005	111.0	102.1	2.849	2.782	0.390	0.0

Pipeline Schedule

Link	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)
1.000	59.233	127.4	225	Circular	145.300	143.875	1.200	145.000	143.410	1.365
2.000	53.816	80.9	225	Circular	145.500	144.075	1.200	145.000	143.410	1.365
3.000	44.863	169.3	225	Circular	145.100	143.675	1.200	145.000	143.410	1.365
1.001	43.215	45.1	300	Circular	145.000	143.335	1.365	144.700	142.376	2.024

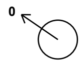
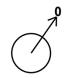
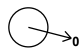
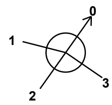
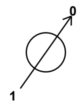
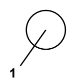
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1200	Manhole	Adoptable	4	1350	Manhole	Adoptable
2.000	2	1200	Manhole	Adoptable	4	1350	Manhole	Adoptable
3.000	3	1200	Manhole	Adoptable	4	1350	Manhole	Adoptable
1.001	4	1350	Manhole	Adoptable	5	1350	Manhole	Adoptable

Pipeline Schedule

Link	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)
1.002	10.600	321.2	375	Circular	144.700	141.476	2.849	144.600	141.443	2.782

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.002	5	1350	Manhole	Adoptable	5_OUT	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
1	625577.839	138745.011	145.300	1.425	1200		0	1.000	143.875	225
2	625498.016	138734.666	145.500	1.425	1200		0	2.000	144.075	225
3	625485.605	138789.752	145.100	1.425	1200		0	3.000	143.675	225
4	625529.065	138778.622	145.000	1.665	1350		1	3.000	143.410	225
							2	2.000	143.410	225
							3	1.000	143.410	225
							0	1.001	143.335	300
5	625553.998	138813.919	144.700	3.224	1350		1	1.001	142.376	300
							0	1.002	141.476	375
5_OUT	625560.113	138822.577	144.600	3.157	1350		1	1.002	141.443	375

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m^3/ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

30	120	240	480	720	1440	2880	5760	8640
60	180	360	600	960	2160	4320	7200	10080

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	20	0	0
100	45	0	0

Node 5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	141.476
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	1020

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	220.0	0.0	1.200	220.0	0.0	1.201	0.0	0.0

Node 5_OUT Deep Bore Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	140.100	Borehole Diameter	0.200
Side Inf Coefficient (m/hr)	0.36000	Time to half empty (mins)	47	Borehole Depth (m)	30.000
Safety Factor	2.0	Diameter (m)	1.200	Inf Depth (m)	25.500
Porosity	1.00	Depth (m)	4.000	Number Required	4

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.22%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	1	18	143.969	0.093	16.6	0.2763	0.0000	OK
30 minute summer	2	18	144.158	0.083	16.6	0.2458	0.0000	OK
30 minute summer	3	18	143.777	0.102	16.6	0.3025	0.0000	OK
30 minute summer	4	18	143.449	0.114	48.9	0.1632	0.0000	OK
240 minute winter	5	192	141.678	0.202	14.6	42.4978	0.0000	OK
240 minute winter	5_OUT	192	141.678	0.235	10.2	11.2829	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	1	1.000	4	16.2	1.056	0.352	0.9089
30 minute summer	2	2.000	4	16.4	1.250	0.284	0.7066
30 minute summer	3	3.000	4	16.3	0.948	0.410	0.7724
30 minute summer	4	1.001	5	48.6	2.027	0.293	1.0374
240 minute winter	5	1.002	5_OUT	10.2	0.648	0.092	0.7055
240 minute winter	5_OUT	Infiltration		3.2			

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.22%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	1	18	144.043	0.168	41.1	0.4978	0.0000	OK
30 minute summer	2	18	144.219	0.144	41.1	0.4246	0.0000	OK
30 minute summer	3	18	143.872	0.197	41.1	0.5809	0.0000	OK
30 minute summer	4	18	143.536	0.201	121.1	0.2871	0.0000	OK
240 minute winter	5	236	142.028	0.552	29.2	116.2007	0.0000	SURCHARGED
240 minute winter	5_OUT	236	142.028	0.585	11.3	13.3686	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	1	1.000	4	40.3	1.299	0.876	1.8448
30 minute summer	2	2.000	4	40.9	1.562	0.707	1.4082
30 minute summer	3	3.000	4	39.9	1.166	1.002	1.5368
30 minute summer	4	1.001	5	120.3	2.506	0.725	2.0777
240 minute winter	5	1.002	5_OUT	11.3	0.665	0.102	1.1691
240 minute winter	5_OUT	Infiltration		3.2			

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.22%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	1	19	144.098	0.223	51.4	0.6587	0.0000	OK
30 minute summer	2	18	144.245	0.170	51.4	0.5037	0.0000	OK
30 minute summer	3	19	143.995	0.320	51.4	0.9460	0.0000	SURCHARGED
30 minute summer	4	19	143.571	0.236	147.3	0.3383	0.0000	OK
480 minute winter	5	456	142.221	0.745	21.6	156.6904	0.0000	SURCHARGED
480 minute winter	5_OUT	456	142.221	0.778	7.3	14.5145	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	1	1.000	4	48.4	1.328	1.051	2.1989
30 minute summer	2	2.000	4	51.0	1.621	0.882	1.6925
30 minute summer	3	3.000	4	48.7	1.242	1.223	1.6713
30 minute summer	4	1.001	5	147.2	2.579	0.887	2.4641
480 minute winter	5	1.002	5_OUT	7.3	0.592	0.066	1.1691
480 minute winter	5_OUT	Infiltration		3.2			

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.22%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	1	19	144.386	0.511	61.7	1.5093	0.0000	SURCHARGED
30 minute summer	2	19	144.298	0.223	61.7	0.6589	0.0000	OK
30 minute summer	3	19	144.243	0.568	61.7	1.6778	0.0000	SURCHARGED
30 minute summer	4	20	143.695	0.360	170.8	0.5147	0.0000	SURCHARGED
600 minute winter	5	570	142.440	0.964	22.2	202.7638	0.0000	SURCHARGED
600 minute winter	5_OUT	570	142.440	0.997	5.9	15.8183	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	1	1.000	4	54.4	1.369	1.183	2.3558
30 minute summer	2	2.000	4	60.2	1.595	1.040	2.1379
30 minute summer	3	3.000	4	56.2	1.413	1.410	1.7842
30 minute summer	4	1.001	5	165.9	2.564	1.000	3.0005
600 minute winter	5	1.002	5_OUT	5.9	0.560	0.053	1.1691
600 minute winter	5_OUT	Infiltration		3.2			

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.22%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
30 minute summer	1	19	144.992	1.117	74.4	3.3030	0.0000	SURCHARGED
30 minute summer	2	19	144.933	0.858	74.4	2.5351	0.0000	SURCHARGED
30 minute summer	3	19	144.803	1.127	74.4	3.3328	0.0000	FLOOD RISK
30 minute summer	4	20	144.049	0.714	187.7	1.0216	0.0000	SURCHARGED
960 minute winter	5	885	143.618	2.142	19.5	253.9703	0.0000	SURCHARGED
960 minute winter	5_OUT	885	143.618	2.175	5.6	22.8383	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)
30 minute summer	1	1.000	4	61.9	1.557	1.347	2.3558
30 minute summer	2	2.000	4	62.7	1.578	1.085	2.1403
30 minute summer	3	3.000	4	63.0	1.585	1.583	1.7842
30 minute summer	4	1.001	5	186.9	2.657	1.126	3.0413
960 minute winter	5	1.002	5_OUT	5.6	0.550	0.050	1.1691
960 minute winter	5_OUT	Infiltration		3.2			