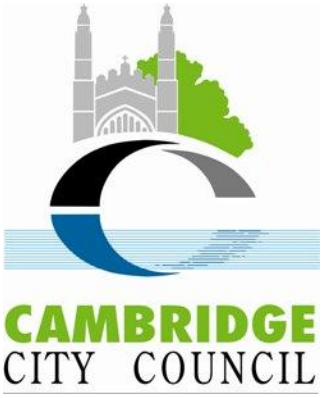
Cambridge Northern Fringe East

Area Flood Risk Assessment

August 2014



1. Introduction

The Cambridge Northern Fringe East area is focused on the land between Cowley Road, the A14 to the north and the Cambridge to Ely railway line to the east. It includes the Anglian Water Milton Waste Water Treatment Works, Network Rail's Chesterton rail sidings and a number of industrial and other commercial uses.

The area is a major development priority for Cambridge and the wider area. Both the City Council and South Cambridgeshire District Council have committed to its redevelopment through respective policies in their new Local Plans, which both propose the preparation of a joint Area Action Plan. An Area Action Plan is a document that provides specific planning policy and guidance for an area where significant regeneration needs to be managed. It will address the specific challenges of the area and have a strong focus on delivery and implementation, and form a statutory component of the development plan for Cambridge and South Cambridgeshire.

This assessment of the flood risk to the area will inform the development of the Area Action Plan, highlight the level of risk and recommend suitable mitigation approaches where applicable.

2. Background Information

2.1. National Planning Policy Framework and National Planning Practice Guidance

The National Planning Policy Framework (NPPF) advises that "Local Plans should take account of climate change over the longer term, including factors such as flood risk, coastal change, water supply and changes to biodiversity and landscape" (paragraph 99). It goes on to advise that "Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk taking account of the impacts of climate change, by:

a. Applying the Sequential Test;

b. If necessary, applying the Exception Test;

c. Safeguarding land from development that is required for current and future flood management;

d. Using opportunities offered by new development to reduce the causes and impacts of flooding; and

e. 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 facilitate the relocation of development, including housing, to more sustainable locations."

(Paragraph 100, NPPF, 2012)

The National Planning Practice Guidance advises that "Local planning authorities undertake a Strategic Flood Risk Assessment to fully understand the flood risk in the area to inform Local Plan preparation" and that "In areas at risk of flooding or for sites of 1 hectare or more, developers undertake a site-specific flood risk assessment to accompany applications

for planning permission (or prior approval for certain types of permitted development)." When defining the Sequential, risk-based approach it explains "This general approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The aim should be to keep development out of medium and high flood risk areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible."

The Sequential Approach/Test and Exception Test is discussed further in section 5.

2.2. Methodology

This Area Flood Risk Assessment provides a greater level of area detail than a Strategic Flood Risk Assessment, but does not have the level of detail contained within a Site Specific Flood Risk Assessment because the development proposals have yet to be determined.

The methodology used for this assessment is:

- Undertake a literature search for appropriate data sources;
- undertake an assessment of the data sources to determine the level of risk present within the area;
- apply the Sequential Approach to the area to ensure development proposals are located in the areas of lowest risk for all sources of flooding; and
- if needed apply the Exception Test.

2.3. Data Sources

The following data sources were examined:

- Environment Agency Flood Maps;
- Cambridge and South Cambridgeshire Level 1 Strategic Flood Risk Assessment (2010);
- Cambridge and Milton Surface Water Management Plan (2011);
- Cambridgeshire Surface Water Management Plan (2011);
- Cambridgeshire Surface Water Management Plan North Chesterton Detailed Assessment and Options Appraisal Report (2014);
- Binnie Black and Veatch, Cambridge First Public Drain (1999)
- British Geological Society Susceptibility to Groundwater Flooding Maps; and
- Local Authority officer knowledge

2.4. The Site

The boundary of the area action plan is show in figure 1.

The area is currently occupied by a number of different uses including:

- Light industrial units;
- used and disused railway sidings;
- a former park and ride site, which is now used for bus parking on a temporary permission;
- a golf driving range;
- Anglian Water's water recycling centre;

- Lafarge Tarmac, a supplier of aggregates, asphalt and ready mixed concrete;
- the future Cambridge Science Park Station.

Previous uses within the area:

- Up until the end of the 19th century the area was predominately agricultural;
- aggregate extraction;
- the water recycling centre has previously occupied a larger footprint.

Anglian Water's Cambridge Water Recycling Centre serves the whole of Cambridge and a number of surrounding villages.

The River Cam is towards the east of the site and the First Public Drain flows through the area. The area is generally flat with a gradual fall toward the east and the River Cam.

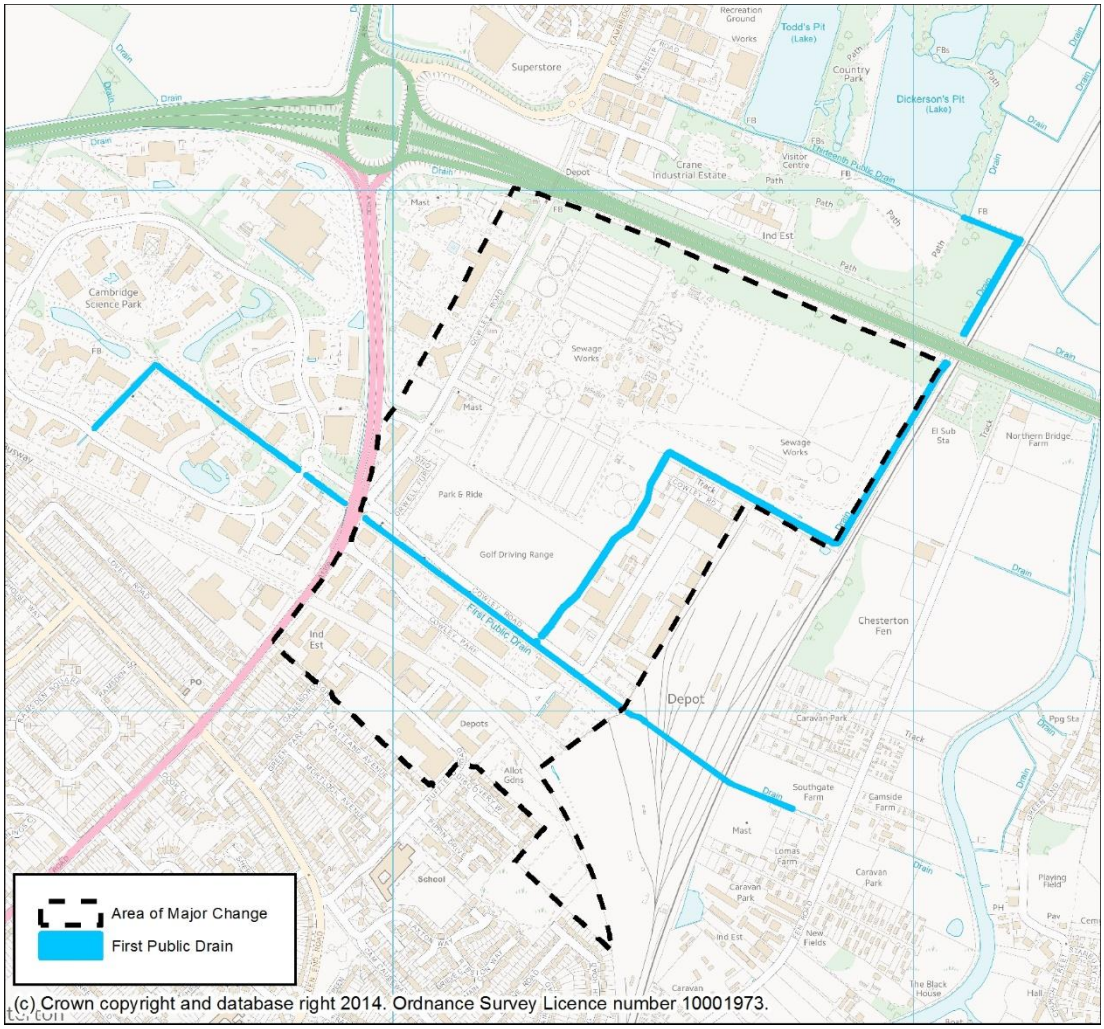


Figure 1- Location Plan

The First Public Drain flows through the area and provides the surface water drainage for the whole of the area under consideration. It flows from west to east through the Science Park, under Milton Road and then heads north east along the boundary to the Water Recycling Centre. It then passes underneath the A14 and then under the main railway line and flows towards the Cam. There is a semi-redundant tributary that continues the line from the

Science Park and heads directly towards the Cam under the main railway line. This is only utilised in high flows, the main flow heads north east.

3. Assessment of Flood Risk

The general principle of assessing all forms of flood risk at every stage of development is a principle that was established in Planning Policy Guidance Note 25 and was continued through to Planning Policy Statement 25, and is now embedded within the National Planning Policy Framework and the National Planning Practice Guidance. Local authorities are encouraged to have a proactive approach in managing flood risk.

Flood risk is generally assessed on the basis of the potential source of flooding, with fluvial (river), pluvial (surface water), groundwater, sewers and reservoirs being the main potential sources. These are discussed below.

3.1. Fluvial Flood Risk

There are two sources of potential fluvial flood risk to the area; these are the River Cam and the First Public Drain. The River Cam is designated as a main river under the Land Drainage Act 1991 and flood risk information is held by the Environment Agency and displayed on their website. The First Public Drain is an ordinary watercourse that has been 'awarded' to Cambridge City Council under the 'Inclosures Act' of the late 1800s.

3.1.1. The River Cam and the Environment Agency Flood Map

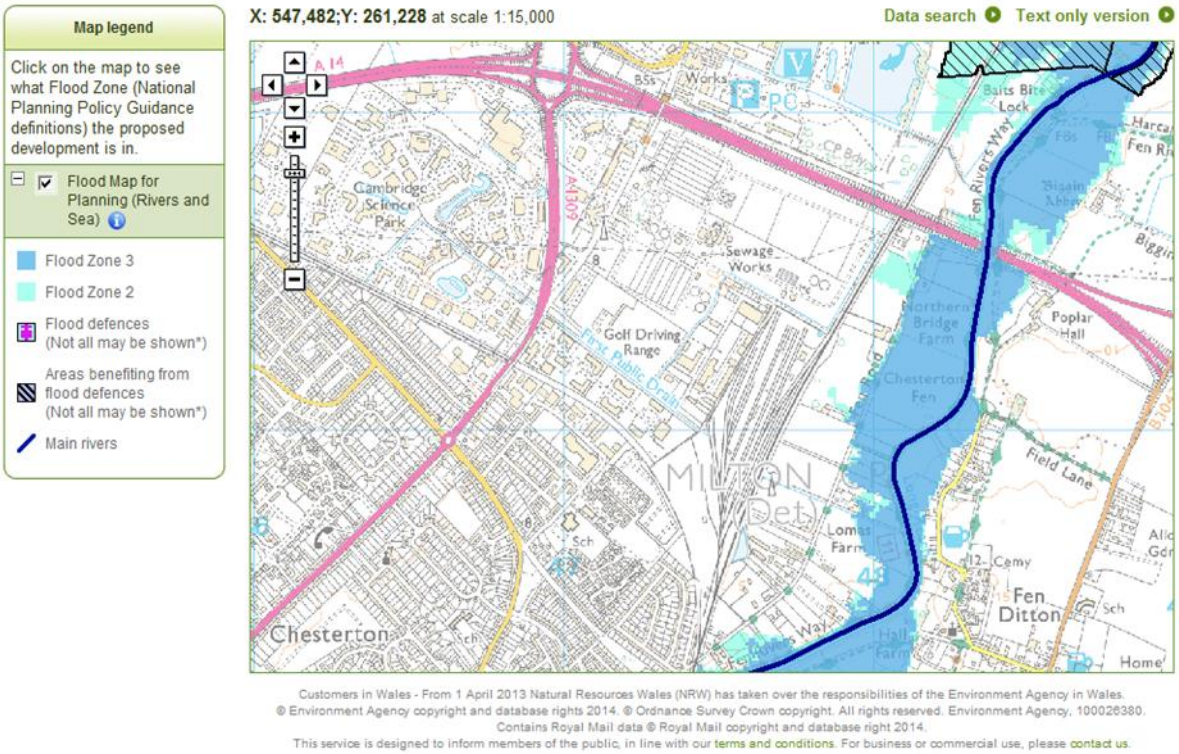


Figure 2- Environment Agency Flood Map

In Figure 2 above, Flood Zone 3 which comprises land defined as having a 1 in 100 (1%) or greater annual probability of fluvial flooding is represented as a blue shading. The lighter blue areas show the extent of Flood Zone 2 which comprises

land defined as having between a 1 in 100 and a 1 in 1000 (1% to 0.1%) annual probability of fluvial flooding. Areas not shaded comprise Flood Zone 1 and indicate that the land has a 1 in 1000 (0.1%) or less probability of fluvial flooding. The extents are based on hydraulic modelling and are only indicative and they do not take into account any man-made structures such as railway embankments and roads or flood defences.

This indicates that the entire area of the action plan is located within the Environment Agency's Flood Zone 1. This is the Zone with the lowest risk of fluvial flooding.

3.1.2. Cambridge and South Cambridgeshire Level 1 Strategic Flood Risk Assessment 2010

Although the Strategic Flood Risk Assessment provides a greater refinement of the data, the actual extent of flood risk does not differ from the Environment Agency's flood map. This can be seen in Figure 3, which breaks down the flood zones into a greater number of categories and includes climate change as an addition to the flood zone outlines. This also indicates that the entire action plan area is an area of low fluvial flood risk.

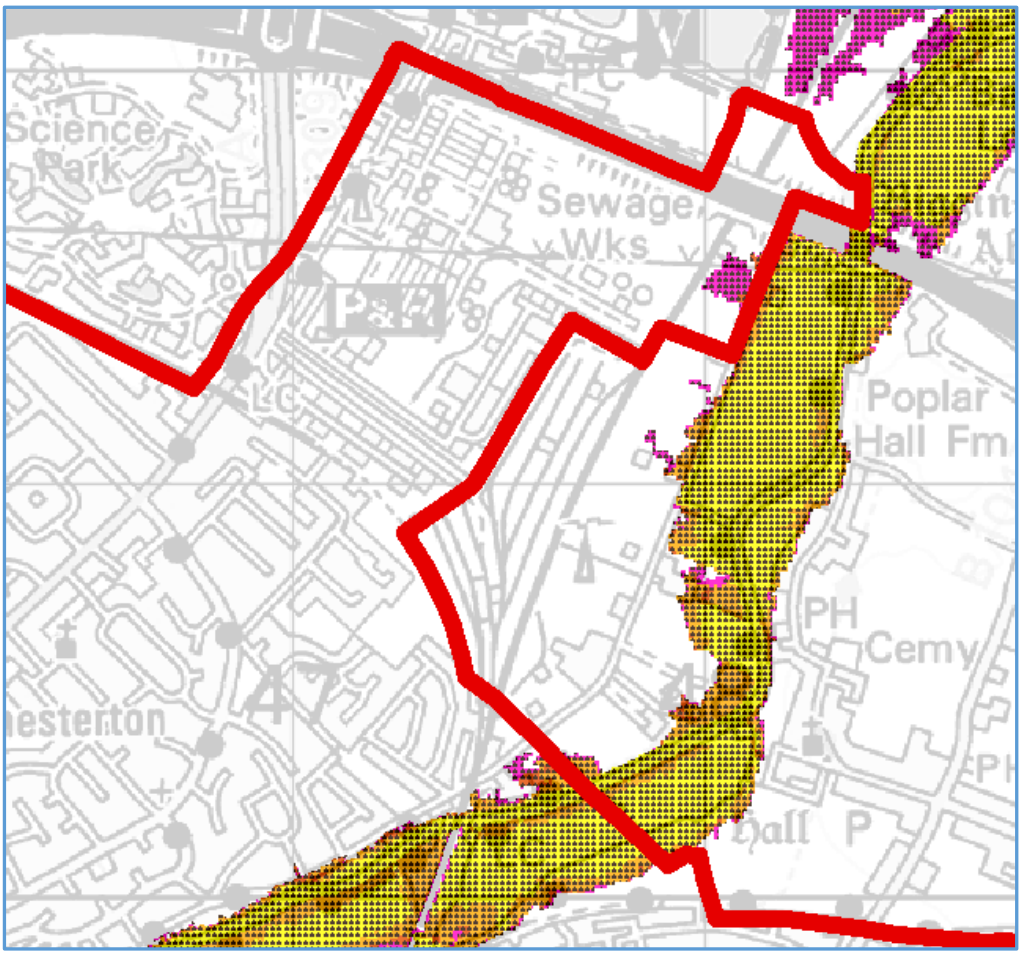
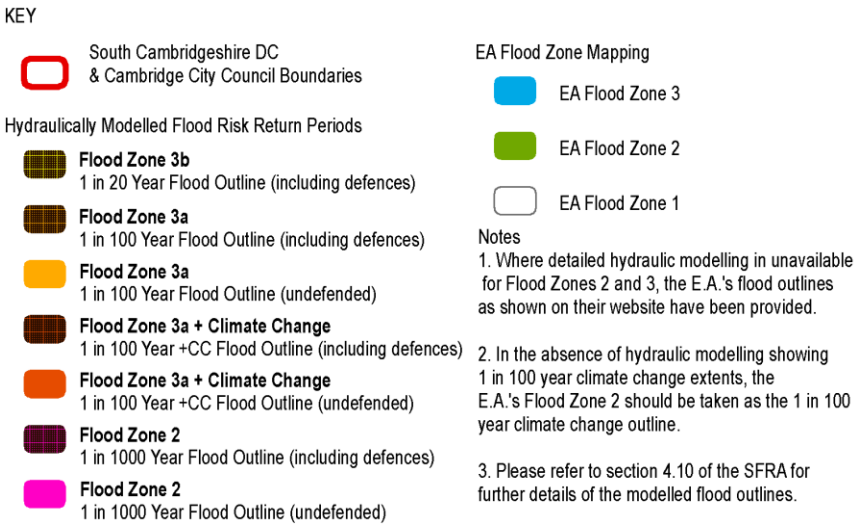


Figure 3- SFRA Appendix D 1.5 Flood Risk Constraints ©Crown copyright and database rights 2014 Ordnance Survey Licence number 10001973



The Strategic Flood Risk Assessment also contains historical data, replicated as Figure 4, which indicates that in 1947 an area of the Water Recycling Centre and the rail sidings flooded. The Flooding appears to have come out of bank from the First Public Drain, the route of which has changed significantly since 1947. The accuracy of this data is also not known and features such as the A14 have been constructed since this event. The return period of the event is also not known. The confidence in this data is therefore fairly low.

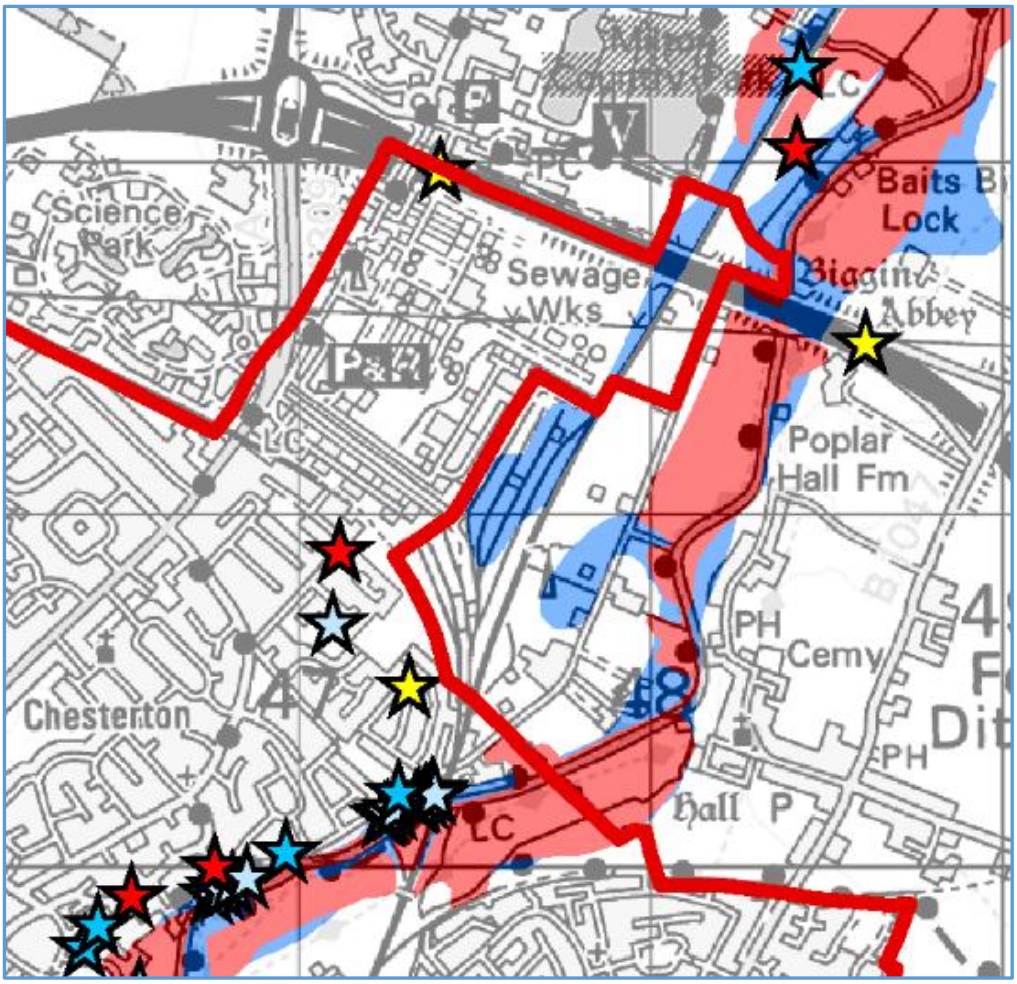


Figure 4- SFRA Appendix B 3.5 Historical Data ©Crown copyright and database rights 2014 Ordnance Survey Licence number 10001973

KEY

South Cambridgeshire DC & Cambridge City Council Boundaries

Historical Flooding Events

- Fluvial
- Ground Water
- Pluvial
- Sewer
- Oct 2001 Flooded Locations
- Oct 2001 Survey

Historical Flood Outlines

- March 1947
- September 1968
- May 1978
- May 1981
- October 1993
- Easter 1998
- October 2001

3.1.3. The First Public Drain

The First Public Drain flows parallel with Cowley Road before turning north between the golf driving range and a number of light industrial units. It then turns east and then north along the boundary to the Water Recycling Centre before passing beneath the A14 and then finally discharging into the River Cam below Baits Bite Lock.

The First Public Drain is a significant watercourse for Cambridge. As well as the Science Park, a large portion of north Cambridge drains into this watercourse. Although the watercourse is not designated as a main river and does not appear on the Environment Agency's Flood Maps it is considered within this assessment as a fluvial flood risk and the pluvial flood risk is considered below.

In 1999 hydraulic modelling was undertaken on the watercourse by Binnie Black and Veatch. The findings of this were:

- The watercourse in a well maintained state does not pose a significant restriction in the performance of the piped system discharging into it.
- No flooding was predicted from the watercourse within the boundary of the Area Action Plan.
- The only flooding predicted for the First Public Drain was at the confluence with the Thirteenth Public Drain, which is outside of the study area and located within Milton Country Park.

The watercourse has been more recently modelled as part of the Cambridgeshire Surface Water Management Plan - North Chesterton Detailed Assessment and Options Appraisal Report. This found that for a 1 in 200 (0.5%) event, no flooding occurred from the First Public Drain.

The fluvial flood risk from the First Public Drain is therefore considered to be low but due to the pluvial flood risk, discussed in section 5.2 below, culverting sections would increase the flood risk in the area. Culverting is not to be undertaken lightly and should only be undertaken if there is no other option due to the increased flood risks and detrimental impacts on biodiversity that culverting poses.

3.2. Pluvial (Surface Water) Flood Risk

A Surface Water Management Plan for Cambridge and Milton was undertaken in 2011 at the same time as an assessment of the surface water flood risk in Cambridgeshire. The key finding of these reports was that surface water flooding is a significant source of flood risk for Cambridge and Milton. The Surface Water Management Plan identified the areas at the highest risk of surface water flooding, known as 'wet spots'.

The Environment Agency has produced a number of surface water flooding maps based on increasingly refined modelling, and the table below compares the results of each iteration of the maps against the results of the Cambridge and Milton Surface Water Management Plan modelling and mapping. The modelling associated with the Surface Water Management Plan is still considered to be superior to the latest iteration produced by the Environment Agency and therefore these are the results that will be considered within this document.

Data source	Extent	Number of properties predicted to be affected
Areas Susceptible to Surface Water Flooding	More	43
	Intermediate	2,763
	Less	7,523
Flood Maps for Surface Water	Deep	611
	Shallow	4,432

Updated Flood Maps for Surface water	3.3% (1 in 30)	N/A
	1% (1 in 100)	N/A
	0.1% (1 in 1000)	N/A
Surface Water Management Plan Modelling	0.5% (1 in 200) - Flood Depth over 0.3m	1,607
	0.5% (1 in 200) - Flood Depth 0.1-0.3m	9,454

The Surface Water Management Plan wetspots in descending order of risk are:

1. King's Hedges and Arbury area
2. Cherry Hinton/Coleridge area
3. North Chesterton area
4. Bin Brook area
5. South Chesterton area
6. Milton area
7. Castle School area
8. City Centre area
9. Cherry Hinton Village area
10. Vicar's Brook area
11. Coldham's Common area

As a continuation to the Cambridgeshire Surface Water Management Plan further modelling was undertaken to produce a Detailed Assessment and Options Appraisal Report for North Chesterton. An extract of the modelling can be seen in figure 5. Although the area of the assessment falls outside of the Appraisal Report, the modelling extended north to the A14. From this it can be seen that there is a risk of pluvial flooding present within the area boundary. The majority of the flooding is 0.1m to 0.3m in depth. There are fewer isolated areas of 0.3m to 0.5m which corresponds to localised depressions in the topography, such as features within the Waste Water Treatment Works that are below ground level. This level of flood risk is consistent with the majority of Cambridge outside of the top 11 wetspots listed above. Outside of these wetspots Cambridge is typified by small intermittent areas of surface water flood risk.

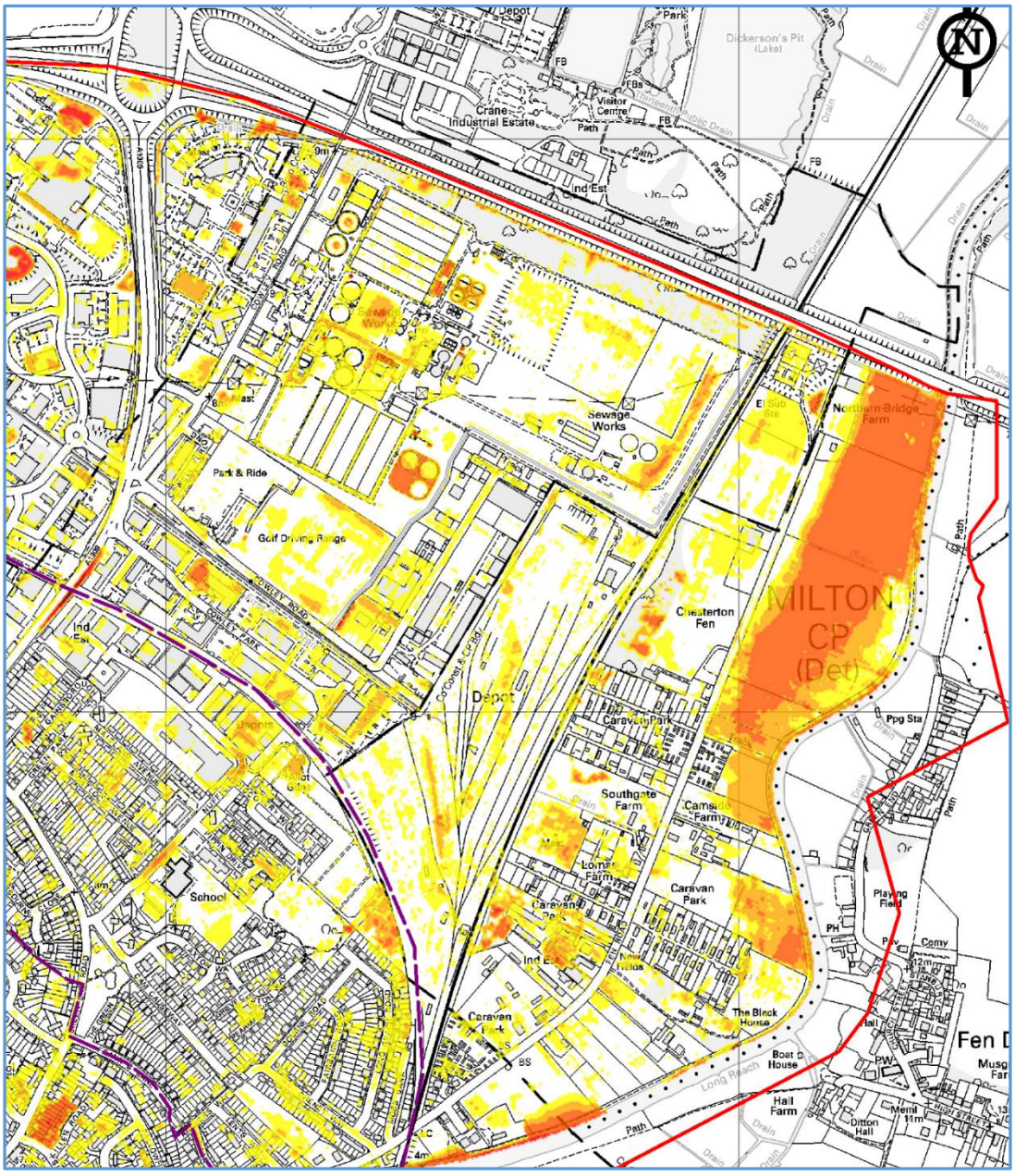


Figure 5 - 0.5% (1 in 200 year) do minimum. Extract from North Chesterton Detailed Surface Water Management Plan ©Crown copyright and database rights 2014 Ordnance Survey Licence number 10001973

Any development proposals would have to take this level of risk into consideration and could be mitigated against with a carefully designed surface water management system and finished floor levels set to appropriate levels to avoid the areas of pluvial flood risk.

3.3. Groundwater Flood Risk

Groundwater flood risk is a reflection of the underlying geology of the area. The area is generally made up of Gault Clay overlain by superficial deposits of River Terrace Gravels. The Gault Clay has low permeability with essentially no groundwater. The River Terrace Gravels are generally highly permeable and have high levels of groundwater.

The British Geological Society Susceptibility to Ground Water Flooding maps indicate that the area is classified as being at 'high risk' of groundwater flooding.

The British Geological Society note that "The susceptibility data is suitable to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. In all cases it is strongly recommended that the confidence data is used in conjunction with the groundwater flooding susceptibility data". In addition, "the susceptibility data should not be used on its own to make planning decisions at any scale, and, in particular, should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding".

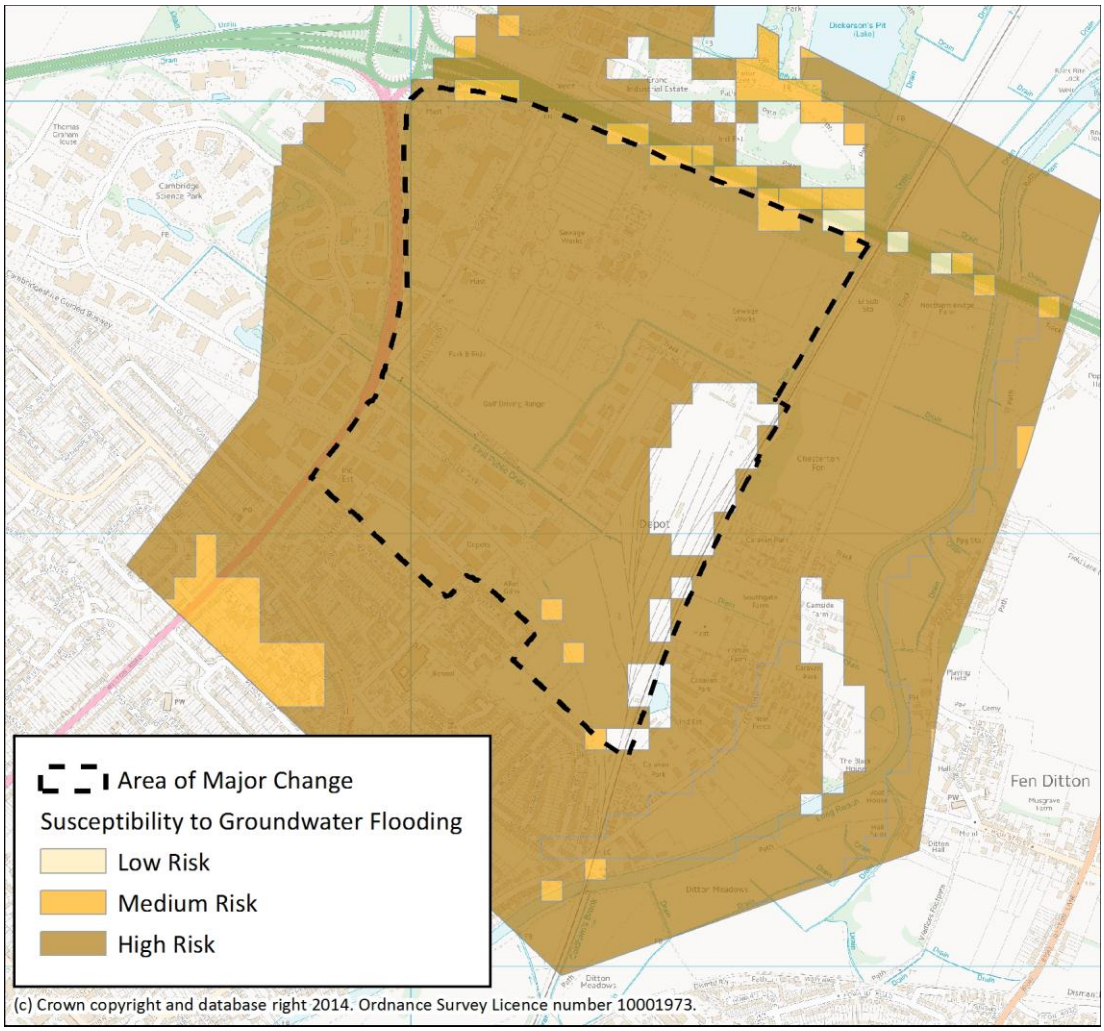


Figure 6 - BGS Susceptibility to groundwater flooding

Bramblefields Local Nature Reserve has ponds which are fed by ground water and the levels rise during periods of heavy rainfall indicating that the groundwater level is reactive to rainfall events.

Although levels of groundwater are known to be high and the British Geological Society Maps indicate a level of risk, there are no recorded instances of groundwater flooding with the area boundary.

High groundwater is likely to have an impact of the proposed method of surface water disposal, but is not necessarily a flood risk and should be regarded more as a constraint that would be dealt with through onsite mitigation.

Infiltration potential was included with the Cambridge and South Cambridgeshire Strategic Flood Risk Assessment and taken from relevant British Geological Society maps. It indicates that there is an 'uncertain potential' for infiltration. An extract of this is shown in figure 6.

Site specific investigations should be undertaken at the time of any development to determine infiltration potential and long-term monitoring of ground water levels should be undertaken.

The previous and current uses of the site indicate that ground contamination is likely to be an issue. Although this is not a flood risk issue, it will have an impact on the type of surface water management regime that should be utilised by any development proposal. Adequate site investigations will need to be undertaken to determine the level of contamination, locations and level of risk. This will define appropriate surface water management solutions.

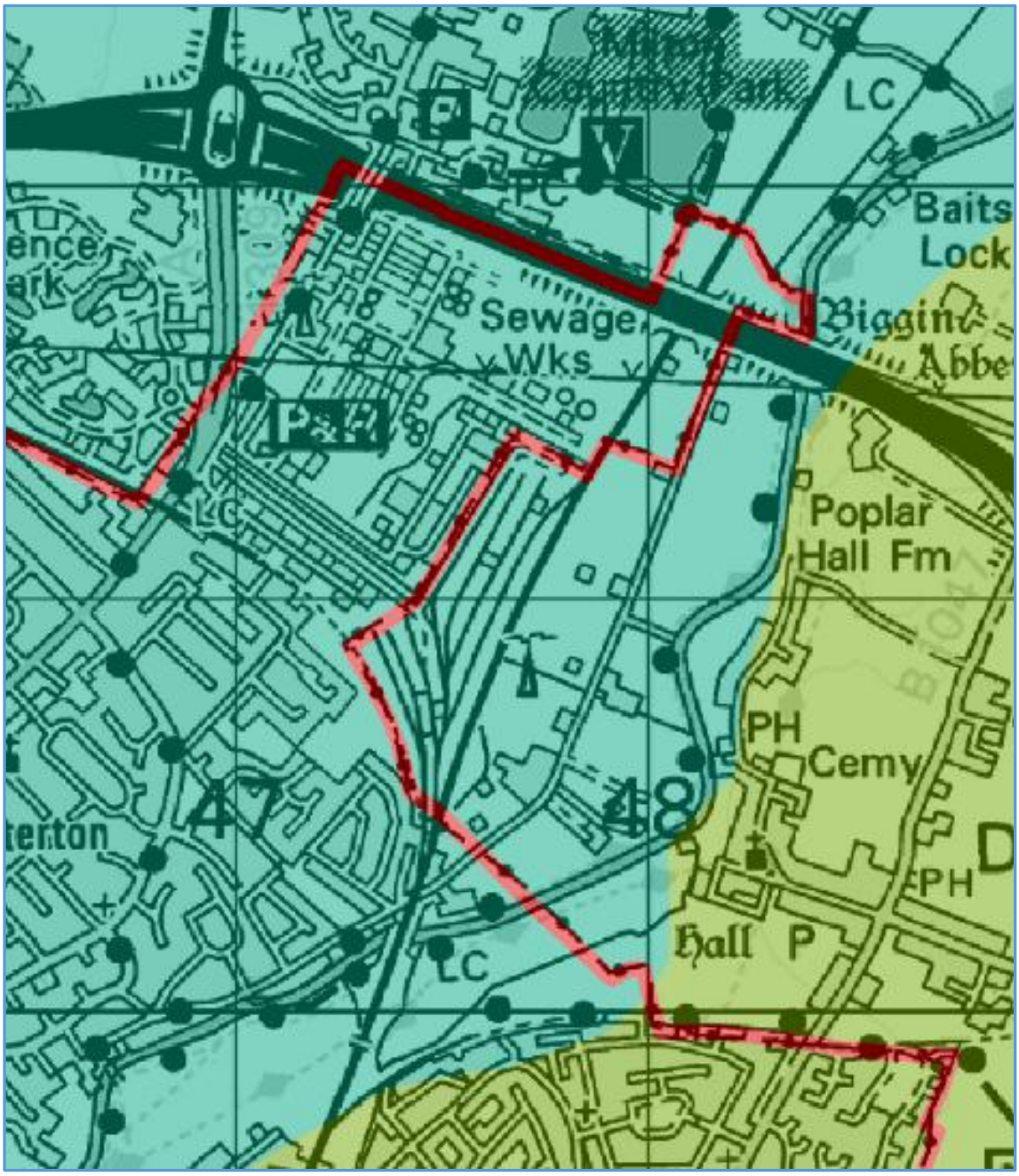


Figure 7 – SFRA Appendix C-2.5 SuDS Infiltration Feasibility ©Crown copyright and database rights 2014 Ordnance Survey Licence number 10001973

KEY

- South Cambridgeshire DC & Cambridge City Council Boundaries
- Low Potential for Infiltration
- Uncertain Potential for Infiltration
- High Potential for Infiltration

NOTES

1. This drawing looks at the infiltration potential within the South Cambridgeshire and Cambridge City Boundaries. SuDS hierarchy must be applied to all potential developments. Intrusive ground investigations to determine the viability of infiltration must still be undertaken as part of a site specific FRA. Should infiltration devices prove to be unviable based on intrusive ground investigations and BRE 365 Soakage Tests then alternative SuDS should be used.

2. In areas with potential infiltration, reference should be made to the location of the various Source Protection Zones, as shown in Appendix C.

3. This plan has been produced using information transcribed from the British Geological Survey; Solid and Drift Editions 204, 205, 206, 187, 188, and 189.

4. This plan should be read in conjunction with Section 8 of the Cambridge City and South Cambridgeshire SFRA.

3.4. Other sources

Other sources of flood risk includes reservoirs and sewers.

3.4.1. Reservoirs

There are no reservoirs in the area and therefore no flood risk associated with these.

3.4.2. Sewers

The proximity of Anglian Water's Water Recycling Centre is a potential source of flood risk. The centre is the end point for all sewerage generated in Cambridge. There are a number of historic combined sewers across Cambridge, which carry a combination of sewerage and surface water. During storm events the proportion of surface water coming into the centre increases and is stored on the surface in temporary lagoons. The capacity of the temporary storm water storage lagoons is not known.

In the event of a storm exceeding the capacity of these lagoons, the topography of the site means water would enter into the First Public Drain before posing a risk to any adjacent area.

3.5. Flooding from the development itself

There is a potential for any development to increase the flood risk downstream unless an adequately designed surface water management scheme is incorporated into the proposals.

Any proposals will be restricted to 2 litres per second per hectare, which has been defined through modelling of the River Cam.

Any redevelopments should also demonstrate an overall reduction in peak flows and volumes from the previously developed site and therefore reduce the overall flood risk to the area.

There are flood risks associated with the area but none that would preclude the design of an acceptable system, so therefore the risk associated with this source is low.

4. Impact of Climate Change

Climate change will have an impact on the flood risk to the area. The following figures illustrate results from the 2009 UK climate projections for key climate variables related to flood risk for a 25km grid square containing Cambridge:

- Annual rainfall of about the same as present up to the 2080s[1];
- Wetter winters, with 7% more winter rainfall by the 2020s and 27% more by the 2080s;
- More intense rainfall during autumn, winter and spring, with rainfall on the wettest windier days 6% higher by the 2020s and 24% higher by the 2080s;

[1] 2080s = the thirty year period 2070-2099

The effect of climate change on fluvial has been modelled and incorporated into the Strategic Flood Risk Assessment. This does not indicate an increase in risk to the area under consideration. Climate change will have an impact on pluvial flood risk as the frequency of extreme events that will lead to this type of flooding will increase. This can be mitigated against through good design, through the integration of sustainable drainage features into the master planning and detailed design of the Northern Fringe East.

5. The Sequential Test and the Exception Test

5.1. The Sequential Test

As stated in the National Planning Policy Framework: 'The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. The Strategic Flood Risk Assessment will provide the basis for applying this test. A sequential approach should be used in areas known to be at risk from any form of flooding' (paragraph 101). The area is entirely located within Flood Zone 1 and it is therefore in the lowest area of fluvial risk in Cambridge, and as such can be considered to pass the Sequential Test in this regard. However, the area is not in the lowest area of pluvial flood risk or groundwater potential flood risk. Therefore the Exception Test could be considered as being applicable.

5.2. The Exception Test

For the Exception Test to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and

- a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

This area flood risk assessment provides a greater level of area specific detail and more current information that is included with the Strategic Flood Risk Assessment. Although there is flood risk associated with the area, from pluvial and to a much lesser extent groundwater sources, the risk is not so great that it could not be mitigated against through good design and careful level finished flood level management. High groundwater is more of a constraint than a flood risk, but if there are any significant reductions in above ordnance datum levels of any development proposals then it may become more of a flood risk. As each development proposal comes forward a site specific flood risk assessment will be required.

Development proposals in the area will be served by the new Science Park Train Station and the Guided Busway. A regionally important employment sector is in close proximity to the proposed development area. The area is also largely previously used. Therefore because of locational sustainability, this area outweighs the level of flood risk associated with the area.

As such, it is considered that the Exception Test has been passed.

6. Water Quality and the Water Framework Directive

Although not strictly an issue associated with flood risk, water quality will need to be addressed through the design of surface water management features associated with any development proposals. An appropriate number of treatment stages, in accordance with the CIRIA Sustainable Drainage Manual (C697), should be employed for all surface water drainage systems.

Also outside of the scope of this document is the Water Framework Directive, which places a duty on public bodies to actively seek improvements to the quality of water bodies. Improvements to the First Public Drain should be actively sought through any development proposals.

7. Conclusions

Although the area is totally within the Environment Agency's Flood Zone 1, there is a level of flood risk associated with the area. This is pluvial flood risk that has been defined and modelled by recent surface water management planning. The risk is confined to small local areas that can be mitigated against through good design and careful master planning of any development proposals.

A Sequential Approach has been taken to the proposed area and the area is at the lowest risk of fluvial flooding. As it is however at risk of pluvial flooding, an Exception Test was undertaken and it was deemed that the flood risk was able to be mitigated against and individual proposals will be required to be accompanied by a site specific flood risk assessment. The wider sustainability benefits of the development are also thought to outweigh this flood risk. The area can therefore be considered suitable for development in this regard.

However, pluvial flood risk does remain a constraint on any development proposals and areas of open space will be required to manage this risk, which may have an impact on the deliverable density of any proposals and therefore should be considered early in any master planning work.

Contamination and high groundwater will also have an impact on development proposals when the surface water management solution are designed to serve the area.