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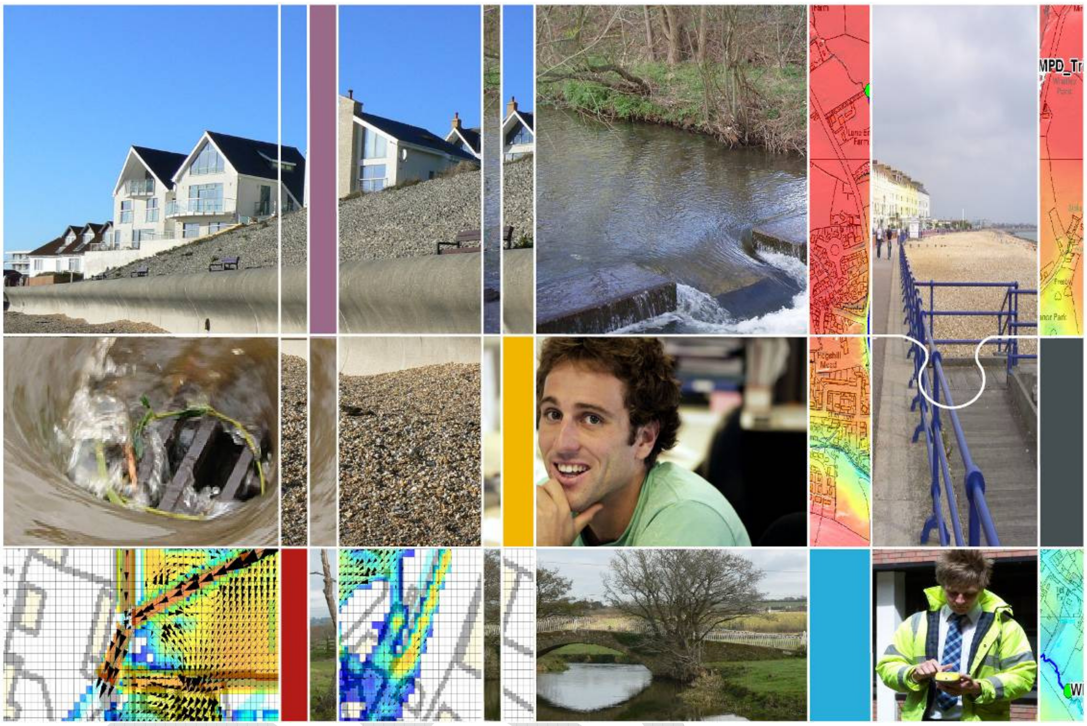

Medway Council Local Flood Risk Management Strategy

Technical Appendix 2:
High Level Assessment of Groundwater Flooding Susceptibility
Final Report

October 2013

CAPITA SYMONDS | URS
Flood Risk Management

Document overview

Capita Symonds with URS Infrastructure and Environment UK Ltd was commissioned by Medway Council in the preparation of their Local Flood Risk Management Strategy as required under the Flood and Water Management Act 2010.

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Document history

Version	Status	Issue date	Prepared by	Reviewed by	Approved by
1	Draft for client review	Jun 2012	Christopher Woolhouse Hydrogeologist	Stephen Cox Principal Consultant Stephen Riley Principal Consultant	Jon Robinson Technical Director Scott Ferguson Technical Director
2	Final	September 2013	Edward Byers Assistant Flood Risk Consultant	Emily Craven Principal Consultant	Jon Robinson Technical Director

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Glossary

TERM	DEFINITION
Aquiclude (or unproductive strata)	Formations that may be sufficiently porous to hold water, but do not allow water to move through them.
Aquifer (secondary and primary)	Layers of rock sufficiently porous to hold water and permeable enough to allow water to flow through them in quantities that are suitable for water supply. The Environment Agency has classified the bedrock and superficial geology aquifers as secondary or primary.
Aquitard	Formations that permit water to move through them, but at much lower rates than through the adjoining aquifers.
Climate Change	Long term variations in global temperature and weather patterns, caused by natural and human actions.
Flood defence	Infrastructure used to protect an area against floods, such as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Floods and Water Management Act	Legislation constituting part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to help protect ourselves better from flooding, to manage water more sustainably and to improve services to the public.
Fluvial flooding	Flooding by a river or a watercourse.
Groundwater	Water that is underground. For the purposes of this study, it refers to water in the saturated zone below the water table.
Pluvial Flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity.
Risk	The product of the probability and consequence of the occurrence of an event.
Sewer flooding	Flooding caused by a blockage, undercapacity or overflowing of a sewer or urban drainage system.
Sustainable Drainage Systems	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques. The current study refers to the 'infiltration' category of sustainable drainage systems e.g. soakaways, permeable paving.

1. Introduction

1.1 Groundwater Flooding

1.1.1 Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from springs. This tends to occur after long periods of sustained rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at shallow depth. Groundwater flooding is known to occur in areas underlain by principal aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels (secondary aquifers).

1.1.2 Groundwater flooding tends to occur sporadically in both location and time, and because of the more gradual movement and drainage of water, tends to last longer than fluvial, pluvial or sewer flooding. When groundwater flooding occurs, basements and tunnels can flood, buried services may be damaged, and storm sewers may become ineffective, exacerbating the risk of surface water flooding. Groundwater flooding can also lead to the inundation of farmland, roads, commercial, residential and amenity areas.

1.2 The Current Report

1.2.1 Medway Council is a designated Lead Local Flood Authority (LLFA) in accordance with the Flood and Management Act (FWMA) 2010. URS has been commissioned to prepare its Local Flood Risk Management Strategy (the 'strategy').

1.2.2 As part of the strategy this report provides a high level assessment of groundwater flooding susceptibility. The following sections outline the geology and hydrogeology in the Medway Council administrative area. From this analysis:

- Potential groundwater flooding mechanisms are identified;
- Evidence for groundwater flooding is discussed (if available);
- Areas susceptible to groundwater flooding are recognised; and
- Recommendations are provided for further investigation

2. Topography and Hydrology

2.1.1 The study area is defined by the administrative area of Medway Council, the Lead Local Flood Authority (LLFA), as shown in Figure 1.

2.1.2 The Hoo Peninsula forms the northern half of the administrative area (approximately 146 km2), largely comprising mud flats and marshlands that separate the Thames and Medway estuaries. The marshlands are close to sea level, although ground elevations are higher inland, reaching 74 maOD at Lodge Hill. A number of surface water courses drain the marshes including Cliffe Creek, Cliffe Fleet, Hope Fleet, Salt Fleet, Decoy Fleet and Yantlet Creek.

2.1.3 The Thames and Medway estuaries and the River Medway are the main surface water features in the administrative area. The tidal River Medway meanders southwest to northeast through the centre of the administrative area, with historic naval dockyards located at Rochester and Chatham.

2.1.4 The main towns of Rochester, Chatham and Gillingham form the southern half of the administrative area. The topographic highs approach 200 maOD and are located to the south near the M2 motorway, forming part of the North Downs. A dry chalk valley system runs northwest towards the tidal River Medway, with Chatham on the western slopes and Gillingham on the eastern slopes.

3. Geology

3.1.1 Figures 2 and 3 provide bedrock and superficial geological information for the administrative area of Medway Council and the surrounding area. Figure 4 presents a geological cross section that has been drawn as part of this study and is used to improve the hydrogeological conceptual understanding of the area.

3.2 Bedrock Geology

3.2.1 The bedrock geology in the study area is detailed in Table 3.1 in lithostratigraphical order, based on the BGS geological sheets 271 and 272. Where available, the regional thickness of the bedrock units is also presented based on the BGS Lexicon database (2012).

3.2.2 The main bedrock geology of the area comprises the Chalk Group of Cretaceous age, overlain by the Thanet Sand Formation (fine grained sand), Lambeth Group (clay mottled in part with beds of sand, pebbles and shells), Harwich Formation (sand with black flint pebbles) and London Clay Formation (clay, silty in part, sandy at the top and base).

3.2.3 The Chalk Group, which comprises several formations (Table 3.1), is found to outcrop at the surface across much of the southern half of the administrative area, along the North Downs. The largely undifferentiated Lewes Nodular Chalk, Seaford Chalk and Newhaven Chalk Formations (part of the White Chalk Subgroup) outcrop at Rochester, Gillingham and Chatham in the south, and also Cliffe on the Hoo Peninsula. Older Chalk formations, including the West Melbury Marly Chalk Formation, outcrop in the southwest corner of the administrative area near Upper Halling. In places the outcrop is obscured by superficial deposits (see Section 3.2).

3.2.4 The bedrock geology dips to the northeast, so that the younger Thanet Sand Formation and Lambeth Group outcrop in a northwest to southeast trending band across the centre of the administrative area, from Wainscott to Lower Rainham, respectively. A local syncline also causes these units to outcrop in the northwest of the administrative area around Cliffe. The outcrop is obscured in some areas by superficial deposits associated with the River Medway, Medway estuary and Thames estuary (see Section 3.2).

3.2.5 The London Clay Formation overlies the Lambeth Group and outcrops in the northern part of the administrative area on the Hoo Peninsula, including Chattenden and High Halstow, where superficial deposits are absent.

Table 3-1 – Bedrock Geology

Geological Units			Description	Regional Thickness
Eocene	London Clay Formation		Mixture of brown, grey, fine, sandy, silty clay and fine sand.	Up to 137m (up to 40m locally)
Paleocene to Eocene	Lambeth Group		Variable, component formations are Upnor Formation (glauconitic fine- to medium-grained sand with beds and stringers of well-rounded, black flint pebbles), Reading Formation (bluey, brown clay and sands) and Woolwich Formation (grey to grey-brown, interlaminated fine-grained sands, silts and clays).	Upnor Formation: 5 -6m Reading Formation: 12 - 16m Woolwich Formation: 11 – 12m Locally the Lambeth Group is up to 20m thick
Paleocene	Thanet Sand Formation		Fine grained sand, clayey and silty in the lower part, coarsening upwards.	21 – 40 m Approximately 37m locally
Cretaceous	White Chalk Subgroup	Newhaven Chalk	Soft to medium hard, smooth white chalks with marl seams and flint bands	45 – 75 m Not known locally
		Seaford Chalk	Firm white chalk with conspicuous semi-continuous nodular and tabular flint seams	55 – 60 m Not known locally
		Lewes Nodular Chalk	Hard, nodular, locally iron stained and flinty. Marl seams up to 0.1m are regular.	35 - 60m Not known locally
		New Pit Chalk Formation	Soft, smooth texture and massively bedded.	35 - 50 m Not known locally
		Holywell Nodular Chalk Formation	Nodular, gritty texture of broken shells. No flints	25 – 35 m Not known locally.
	Grey Chalk Subgroup	Zig Zag Chalk Formation	Marly, massively bedded chalk.	35 – 50 m Not known locally.
		West Melbury Marly Chalk Formation	Grey and off-white, soft, marly chalk and hard grey limestone	15 – 25 m Not known locally.

3.3 Superficial Deposits Geology

3.3.1 The superficial geology of the administrative area consists of Head, Alluvium, Beach and Tidal Flat Deposits, River Terrace Deposits and Clay with Flints Formation.

3.3.2 Head deposits form a significant outcrop in the study area, covering a large proportion of the Hoo Peninsula in the north, including the area of Cliffe, and from Allhallows to Hoo St Werburgh. There are exist ribbons of Head deposits associated with the Chalk valleys in the southern half of the study area. The geological map (Figure 3) for the area indicates that the deposits comprise clay, silt, sand and gravel. The thickness of the deposits is likely to be variable.

3.3.3 Significant Alluvium deposits occur at lower elevations on the Hoo Peninsula, associated with marshland. They also rest within the River Medway valley floor and form small islands within the Medway estuary. The deposits comprise mainly silty, peaty, sandy clay.

3.3.4 Beach and Tidal Flat Deposits are found along the northern coast of the Hoo Peninsula and within the Medway estuary. The deposits comprise mainly clay, silt and sand.

3.3.5 Patchy River Terrace Deposits formed of four terraces are located on the Hoo Peninsula in the area between Allhallows and Hoo St Weburgh, and on the Isle of Grain. Minor deposits can also be found near Wainscott and Gillingham. The River Terrace Deposits are predominantly sand and gravel, although near the edge of the Medway estuary at Hoo St Weburgh they comprise clay and silt.

3.3.6 On higher ground to the south of the study area around Chatham and Gillingham, the Clay with Flints Formation overlies the Chalk. The formation is described as, orange, brown sandy clay with abundant nodules and rounded pebbles of flint (BGS, 2012).

4. Hydrogeology

4.1.1 The hydrogeological significance of the various geological units within the study area is provided in Table 4.1. The range of permeability likely to be encountered for each geological unit is also incorporated in Table 4.1, based on BGS permeability data (BGS 2012b).

Table 4-1 – Geological Units in the Study Area and Hydrogeological Significance

Geological Unit	Table heading	Permeability (BGS)	Hydrogeological Significance (EA)
Superficial Deposits	Head	Very low – High	Secondary (Undifferentiated)
	Alluvium	Very low - Moderate	Secondary (Undifferentiated)
	Beach and Tidal Flat Deposits	Very low - Moderate	Secondary (Undifferentiated)
	River Terrace Deposits (sand and gravel)	High – Very High	Secondary (A) Aquifer
	River Terrace Deposits (clay and silt)	Very low – Low	Unproductive Strata
	Clay with Flints Formation	Very low – High	Unproductive Strata
Bedrock Geology	London Clay Formation	Very low – Low	Unproductive Strata
	Lambeth Group	Low – High	Secondary (A) Aquifer
	Thanet Sand Formation	Low – High	Principal Aquifer
	Chalk Group (except for West Melbury Chalk Formation and Zig Zag Chalk Formation)	Very High – Very High	Principal Aquifer
	Chalk Group (West Melbury Chalk Formation and Zig Zag Chalk Formation)	High – Very High	

The 'Hydrogeological Significance' is based on the Environment Agency (EA) classification:
'Principal Aquifer' - layers that have high permeability. They may support water supply and/or river base flow on a strategic scale.
'Secondary Aquifer (A)' - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
'Secondary (Undifferentiated)' - Been assigned in cases where it has not been possible to attribute either category A or B to a rock type. Previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
'Unproductive Strata' These are rock layers or superficial deposits with low permeability that have negligible significance for water supply or river base flow.

4.2 Bedrock Hydrogeology

Bedrock Hydrogeological Units

4.2.1 The Chalk Group is classified as a principal aquifer by the Environment Agency and permits groundwater flow. The aquifer underlies much of the southern half of the administrative area and forms an important groundwater resource, supporting a number of licensed groundwater abstractions and base flow to the River Medway. The Chalk Group is of significant interest to this current study.

4.2.2 The physical properties for minor aquifers in England and Wales (Jones et al., 2000) suggests the Thanet Sand Formation, Lambeth Group and the Harwich Formation are often considered as a single groundwater unit, which is in hydraulic continuity with the Chalk. The Environment Agency classifies the Thanet Sand Formation as a principal aquifer and the Lambeth Group as a secondary (A) aquifer; they are both of interest to this study.

4.2.3 The London Clay Formation, which underlies the majority of the Hoo Peninsula, is an aquiclude and does not permit groundwater flow. It is classed by the Environment Agency as unproductive strata.

Bedrock Groundwater Levels

4.2.4 Water level data have been provided by the Environment Agency for 13 observation boreholes within the study area, all of which monitor water levels in the Chalk Group. The observation borehole locations are shown on Figures 1, 2 and 3 and the water level plots are presented in Appendix A.

4.2.5 The longest monitoring record is for Ranscombe (EA Ref. 442141001), which dates back to August 1968. This indicates that the highest water levels were experienced in the winter of 2000/01, as demonstrated by many of the other local observation boreholes.

4.2.6 In the area of Cliffe on the Hoo Peninsula, the water table in the Chalk is close to sea level and influenced by local groundwater abstractions, reaching a maximum of around 2 to 3 maOD (see Appendix A for records at APCM Ltd, Simmonds Hole and Cooling Castle). Ground levels reach 13 maOD at Cliffe, although at the margins of the settlement they are close to, or at the same elevation as, the water table in the Chalk.

4.2.7 Within the tidal River Medway valley, water levels in the Chalk are also close to sea level as expected, reaching a maximum of around 3 maOD in the winter of 2000/01 (see Appendix A for records at Cuxton Meter House and Halling Sewage Works). Ground level at the observation boreholes was only around 0.5 to 1.5 m higher than the water table at that time.

4.2.8 The Dene Farm observation borehole monitors water levels within a dry tributary valley of the River Medway to the west of Cuxton, where ground levels are around 12 to 13 maOD. Although the water table is often at least 10 m below ground level and close to sea level, in the winter of 2000/01 it rose to within 2 or 3 m of ground level.

4.2.9 On higher ground within the southern half of the study area, the observation borehole records indicate that the water table is always at significant depth (see Appendix A for records at Brompton, Ranscombe, Sharstead and Wigmore Reservoir).

4.3 Superficial Deposits Hydrogeology

Superficial Deposits and Hydrogeological Units

4.3.1 The Head, Alluvium and Beach and Tidal Flat Deposits are expected to behave as aquitards, although sand and gravel horizons may locally form a perched aquifer depending on their lateral extent and thickness. The coastal and estuarine deposits are likely to be in some hydraulic continuity with the sea, and therefore groundwater levels are expected to demonstrate tidal fluctuations.

4.3.2 The River Terrace Deposits are expected to behave as a Secondary Aquifer (A) due to the dominance of sand and gravels; perched water tables will form within the deposits where they overlie the London Clay Formation aquiclude on the Hoo Peninsula.

Superficial Deposits and Water Levels

4.3.3 Medway Council and the Environment Agency do not monitor groundwater levels in the superficial deposits. However, borehole logs are available from the British Geological Survey and these often provide information on groundwater levels.

4.4 Groundwater / Surface Water Interactions

4.4.1 The published hydrogeological map (Figure 4) indicates that groundwater flow in the Chalk aquifer is towards the tidal River Medway and estuary systems. Therefore, the River Medway will receive significant base flow contributions from the Chalk aquifer.

4.4.2 The River Medway is tidal and much of the study area is estuarine or coastal. As sea and river levels rise and fall with the tides, this will have a local influence on the aquifers, and groundwater levels are expected to demonstrate a tidal response.

4.5 Groundwater Abstractions

4.5.1 The locations of licensed groundwater abstractions were requested from the Environment Agency and these are shown on Figures 1, 2 and 3. However, the larger public water supply abstractions are not shown for security reasons, although their source protection zones are provided on Figure 6.

4.5.2 The public water supply abstractions are located in the southern half of the study area. The smaller licensed abstractions are concentrated on the Hoo Peninsula, and provide irrigation water to farmland.

4.5.3 It is possible that in the future some of these abstractions may reduce or cease, either temporarily or for the longer term. If this occurs it is possible that water levels in the Chalk aquifer will increase, potentially increasing susceptibility to groundwater flooding in some areas.

4.6 Artificial Groundwater Recharge

4.6.1 Water mains leakage data for the Medway Council administrative area were not provided for this study. However it should be noted that recharge to groundwater by leaking mains could result in a local rise in groundwater levels. This rise might not prove significant under dry conditions, but could exacerbate the risk of groundwater flooding following and/or during periods of heavy rainfall.

4.6.2 The drainage/sewer network can act as a further source of artificial recharge. When pipes are installed within principal or secondary aquifers, the groundwater and drainage network may be in partial hydraulic connection. When pipes are empty, groundwater may leak into the drainage network with water flowing in through cracks and porous walls, draining the aquifer and reducing groundwater levels. During periods of heavy rainfall when pipes are full, leaking pipes can act as recharge points, artificially recharging the groundwater table and subsequently increasing groundwater levels with potential impacts on groundwater quality.

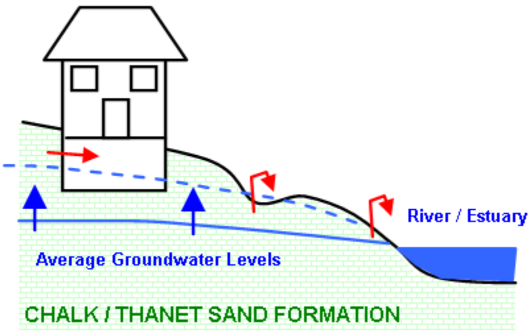
5. Assessment of Areas Susceptible to Groundwater Flooding

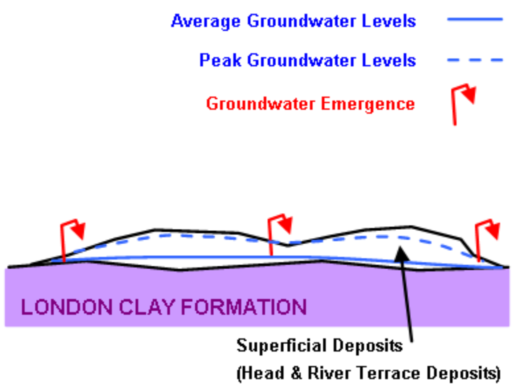
5.1 Groundwater Flooding Mechanisms

5.1.1 Based on the hydrogeological conceptual understanding of the study area, the key groundwater flooding mechanisms that may exist are:

- **Chalk Group and Thanet Sand Formation principal aquifers and Lambeth Group secondary A aquifer outcropping in the south of the study area at Rochester, Gillingham and Chatham, and on the Hoo Peninsula at Cliffe.** Environment Agency groundwater level data indicate a shallow water table in low lying areas, including the River Medway valley and its dry tributary valleys, and coastal / estuarine locations. Basements / cellars in these areas may be at risk from groundwater flooding after prolonged wet periods such as that experienced in the winter of 2000/01. In addition, groundwater springs could emerge within topographic depressions or near the base of tributary valleys that are usually dry (e.g. at Cuxton). Where superficial deposits such as Head and Alluvium overlie the bedrock aquifers (e.g. in the marshlands around Cliffe), these are likely to be in some hydraulic continuity with the bedrock aquifers so that groundwater flooding can still occur. However, the severity of the flooding is likely to be reduced.

- **Superficial deposits not in hydraulic continuity with bedrock aquifers, overlying the London Clay i.e. River Terrace Deposits and Head deposits on the Hoo Peninsula:** Perched water tables may develop within these deposits, through a combination of natural rainfall recharge and artificial recharge e.g. leaking water mains. The properties at risk from this type of groundwater flooding are probably limited to those with basements / cellars following prolonged wet weather. Another potential impact is a temporary loss of agricultural land in low lying areas.





5.2 Evidence of Groundwater Flooding

5.2.1 No specific groundwater flooding incidents have been reported to Medway Council. However, the Environment Agency holds records for 83 generic flood incidents that occurred between 2001 and 2011. The cause of flooding is not identified, although 9 of the records are related to basement or cellar flooding and could therefore be associated with groundwater flooding. All of the recorded historic flood incidents are presented on Figures 2, 3 and 5 and those linked to basement or cellar flooding are numbered 1 to 9.

5.2.2 Flood Incidents 1 to 9 (basement / cellar flooding) are located over the Chalk Group or Thanet Sand Formation aquifers where superficial deposits are sparse. However, only flood incidents 1, 2, 5 and 8 are located in low lying areas where water levels are likely to be close to ground level. Therefore, it is believed that these have the greatest potential to be groundwater flooding events.

5.3 Areas Susceptible to Groundwater Flooding

BGS Groundwater Flooding Susceptibility Maps

5.3.1 The BGS has produced a dataset showing areas susceptible to groundwater flooding based on topography, geological and hydrogeological conditions (see Figure 5).

5.3.2 The main areas within the study area identified as having a 'very high' or 'high' susceptibility to groundwater flooding are the Hoo Peninsula (including Cliffe and the Isle of Grain), the River Medway valley, and the southern margins of the Medway estuary.

5.3.3 None of the historic basement or cellar flood events (labelled 1 to 9) are encompassed by zones of higher susceptibility to groundwater flooding. However, flood events 1, 2, 5 and 8 are close to these zones. This indicates that either the BGS groundwater flooding susceptibility zones may need to be revised, or that these flood events are not associated with groundwater flooding.

5.3.4 In general, based on the available data, it is thought that the approximate areas identified by the BGS as being susceptible to groundwater flooding are as expected. There is lower confidence in the dataset where the London Clay Formation is overlain by Head and River Terrace Deposits on the Hoo Peninsula, as the Environment Agency does not monitor groundwater levels in these superficial deposits.

5.3.5 It is also worth noting that the BGS dataset does not take into account rebound of groundwater levels. There exist a number of groundwater abstractors across the study area. It is possible that if certain key abstractions were reduced or switched off, the areas susceptible to groundwater flooding may increase.

6. Assessment of Areas Suitable for Infiltration SuDS

6.1 Definition of SuDS, Environment Agency Guidance and the Water Framework Directive

6.1.1 In recent times, the installation of sustainable drainage systems (SuDS) has been encouraged for new and existing developments with the aim of reducing overall flood risk. The Flood and Water Management Act 2010 provides a definition of sustainable drainage:

"Sustainable drainage" means managing rainwater (including snow and other precipitation) with the aim of –

- *reducing damage from flooding,*
- *improving water quality,*
- *protecting and improving the environment,*
- *protecting health and safety, and*
- *ensuring the stability and durability of drainage systems.*

6.1.2 Infiltration SuDS rely on infiltration of runoff (from a developed site) into the soil and underlying aquifer e.g. soakaways and permeable paving. They have the potential to impact water levels and water quality in the aquifer, and so the Water Framework Directive (WFD) must be considered.

6.1.3 The European WFD is implemented in England by the Environment Agency through River Basin Management Plans (RBMP). These documents were published by the Environment Agency in December 2009 and they outline measures that are required by all sectors impacting the water environment. They also identify water bodies across England and their current status.

6.1.4 The key RBMP groundwater body within the study area is the North Kent Medway Chalk (GB40601G500300). This is currently in poor status with respect to both chemical (owing to general chemical assessment and drinking water protected area status) and quantitative status (owing to impact on surface waters and resource balance).

6.1.5 Improper use of infiltration SuDS could lead to flooding / drainage issues and also contamination of the underlying superficial deposit or bedrock aquifers; the latter adding to the poor status of the North Kent Medway Chalk water body. However, correct use of infiltration SuDS is likely to help improve the chemical and quantitative status of the water body and reduce overall flood risk.

6.1.6 Environment Agency guidance on the appropriate design of infiltration SuDS is available on their website at: http://www.environment-agency.gov.uk/business/sectors/39909.aspx**.** This should be considered by developers and their contractors, and by Medway Council when approving or rejecting planning applications.

6.1.7 The following Sections provide an overview of the suitability for infiltrations SuDS within the Medway Council administrative area.

6.2 Infiltration SuDS Suitability Map

BGS Infiltration SuDS Suitability

6.2.1 The infiltration SuDS suitability map shown on Figure 6 is largely based on the BGS infiltration SuDS suitability dataset (BGS 2012c). It is understood from the BGS guidance notes that the dataset is derived from the following data:

- Infiltration constraints summary layer
- Superficial deposits permeability
- Superficial deposits thickness
- Bedrock permeability
- Depth to water level
- Geological indicators of flooding

6.2.2 Four score categories have been identified by the BGS for suitability for Infiltration SuDS:

1) **Highly compatible for Infiltration SuDS:** The subsurface is likely to be suitable for free-draining infiltration SuDS
2) **Probably compatible for Infiltration SuDS:** The subsurface is probably suitable for infiltration SuDS although the design may be influenced by the ground conditions
3) **Opportunities for bespoke infiltration SuDS:** The subsurface is potentially suitable for infiltration SuDS although the design will be influenced by the ground conditions
4) **Very significant constraints are indicated:** There is a very significant potential for one or more geohazards associated with infiltration

6.2.3 The areas delineated as 'Highly compatible for Infiltration SuDS' and 'Probably compatible for Infiltration SuDS' on Figure 6 are located over the Chalk Group and Thanet Sand Formation at Cliffe (on the Hoo Peninsula) and in the southern half of the study area. They are also associated with thick and permeable Head and River Terrace Deposits on the Hoo Peninsula.

6.2.4 It is noted that this is a high level assessment and only forms an approximate guide to infiltration SuDS suitability; a site investigation is required in all cases to confirm local conditions. The maximum likely groundwater levels should be assessed, to confirm that soakaways will continue to function even during prolonged wet conditions.

Historic Landfill Sites and Contaminated Land

6.2.5 Where possible, infiltration SuDS should be located away from areas of historic landfill (shown on Figure 6) and areas of known contamination or risk of contamination. This is to ensure that the drainage does not re-mobilise latent contamination and exacerbate the risk to groundwater quality and down gradient receptors, such as abstractors, springs and rivers. A preliminary groundwater risk assessment should be included with the planning application.

Source Protection Zones

6.2.6 Restrictions on the use of infiltration SuDS apply to those areas within Source Protection Zones (SPZ). Developers must ensure that their proposed drainage designs comply with the available Environment Agency guidance. The BGS infiltration SuDS suitability dataset does not consider SPZs and so these are shown on Figure 6.

7. Conclusions and Recommendations

7.1 Conclusions

7.1.1 The following conclusions can be drawn from the current study:

- The bedrock geology underlying the southern half and northwest corner of the study area comprises the Chalk Group and Thanet Sand Formation. Both are classified by the Environment Agency as principal aquifers and are therefore a potential source of groundwater flooding;
- The bedrock geology across much of the northern half of the study area comprises the London Clay Formation, which is unproductive strata with little potential for groundwater flooding. However, between Hoo St Werburgh and Allhallows the superficial geology, which overlies the London Clay Formation, includes Head and River Terrace Deposits. There is potential for a perched water table to develop within these and therefore potential for groundwater flooding.
- Groundwater level monitoring data have been provided by the Environment Agency for the Chalk Group principal aquifer. These indicate that groundwater levels are close to sea level, and at a shallow depth below ground level adjacent to the tidal River Medway, the Medway estuary and on the Hoo Peninsula at Cliffe;
- There are no groundwater level monitoring data available for the superficial deposits, including the Head and River Terrace Deposits on the Hoo Peninsula;
- Flood events data have been collated by the Environment Agency. Unfortunately the type of flooding is not identified, although a number of records are associated with flooding of basements / cellars and could be groundwater related, particularly those in low lying areas;
- Areas susceptible to groundwater flooding have been identified using the BGS groundwater flooding susceptibility dataset. The data indicate a ‘high’ or ‘very high’ susceptibility to groundwater flooding on the Hoo Peninsula (including Cliffe and the Isle of Grain), the River Medway valley, and the southern margins of the Medway estuary. There is a poor correlation between the BGS dataset and those flood events data associated with basement flooding. This indicates that either the BGS dataset needs to be refined, or the basement flood events were not caused by groundwater flooding;
- The BGS groundwater flooding susceptibility dataset does not take into account rebound of groundwater levels. It is possible that if certain key groundwater abstractions were reduced or switched off, the areas susceptible to groundwater flooding may increase;
- In recent times, the installation of sustainable drainage systems (SuDS) has been encouraged for new and existing developments with the aim of reducing overall flood risk. The BGS infiltration SuDS suitability dataset indicates that the areas ‘Highly compatible for Infiltration SuDS’ and ‘Probably compatible for Infiltration SuDS’ are located over the Chalk Group and Thanet Sand Formation aquifers at Cliffe (on the Hoo Peninsula) and in the southern half of

the study area. They are also associated with thick and permeable Head and River Terrace Deposits on the Hoo Peninsula;

- The BGS infiltration SuDS suitability dataset does not consider source protection zones associated with large public water supply abstractions. These are an additional constraint on the use of infiltration SuDS and have been identified as part of this study.

7.2 Recommendations

7.2.1 The following recommendations are made based on the current study:

- The areas identified as having a high susceptibility to groundwater flooding should be compared with those areas identified as being susceptible to other sources of flooding e.g. fluvial, pluvial and sewer. An integrated understanding of flood risk will be gained through this exercise
- Data identifying properties with basements / cellars should be used to improve the understanding of susceptibility to groundwater flooding, if available
- Records of possible groundwater flooding should be corroborated by Medway Council using current data on local groundwater levels and antecedent condition local to potential groundwater flooding events at the time of the event

8. References

Ref 1 - British Geological Survey. 1:50,000 Scale Geology Series [Geological Map] Sheet 271 Morpeth: Bedrock and Superficial Deposits.

Ref 2 - British Geological Survey. 1:50,000 Scale Geology Series [Geological Map] Sheet 272 Tynemouth: Bedrock and Superficial Deposits.

Ref 3 - BGS Lexicon. May 2012. www.bgs.ac.uk.

Ref 4 - DEFRA, March 2010. Surface Water Management Plan Technical Guidance.

Ref 5 - Environment Agency, 2010. Areas Susceptible to Groundwater Flooding. Guidance Document

Ref 6 – BGS Permeability Data. 2012. http://www.bgs.ac.uk/products/hydrogeology/permeability.html

Ref 7 - BGS SuDS Suitability Data. 2012. http://www.bgs.ac.uk/products/hydrogeology/infiltration Suds.html

Ref 8 - Jones, H K, Morris, B L, Cheney, C S, Brewerton, L J, Merrin, P D, Lewis, M A, MacDonald, A M, Coleby, L M, Talbot, J C, McKenzie, A A, Bird, M J, Cunningham, J, and Robinson, V K.. 2000. The physical properties of minor aquifers in England and Wales. British Geological Survey Technical Report, WD/00/4. 234pp. Environment Agency R&D Publication 68.

Appendix A – Environment Agency Observation Borehole Water Level Plots

Appendix B – Figures