Appendix C – Summary of Strategic Assessment

C.1 Topography

C.1.1 LiDAR data of 5m resolution was provided by the Environment Agency (through KCC) which covered the entire study area. LiDAR data is topographic data captured with laser technology usually from airplanes and helicopters. This data is generally to a vertical resolution of 50mm accuracy and is filtered, meaning buildings, trees and other raised features have been stripped from the raw data.

C.1.2 The LiDAR data has been processed in a GIS to create a digital representation of the ground terrain, as shown in **Figure C.1 – Ground Level Topography**.

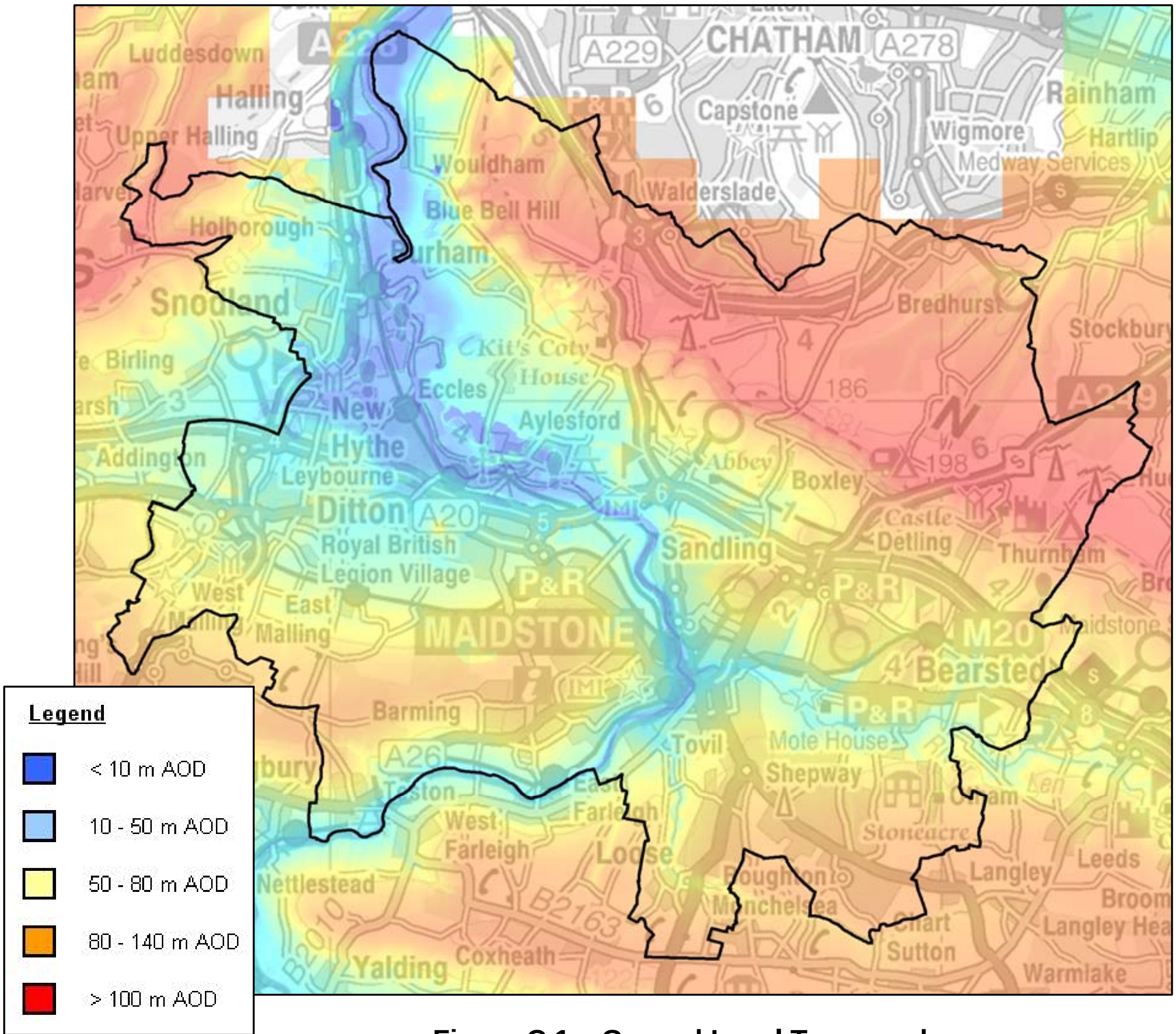

Figure C.1 – Ground Level Topography

C.1.3 The study area covers the Maidstone and Malling area. The area is characterised by the elevated hills of the North Downs to the North East of the study area with the relatively flat and low lying area running through the centre of the study area, at the centre of which runs the river Medway. The LiDAR data confirms this, as a large proportion of the study area to the North West is low lying, ranging between 0 – 50 m AOD indicating the river path. The land quickly rises from the river to <100m AOD along the north east border of the study area. Maidstone itself is situated on two hills at roughly 50 – 80m AOD the more easterly one containing the town centre. The low lying areas and path of the Medway River can be seen to extend to the west of Maidstone, with the River Len extending to the east and the River Loose to the south.

C.2 Geology

C.2.1 An overview of the study area geology (see **Figure C.2 – Local Geology**) was obtained from the British Geological Survey Solid and Drift Geology maps.

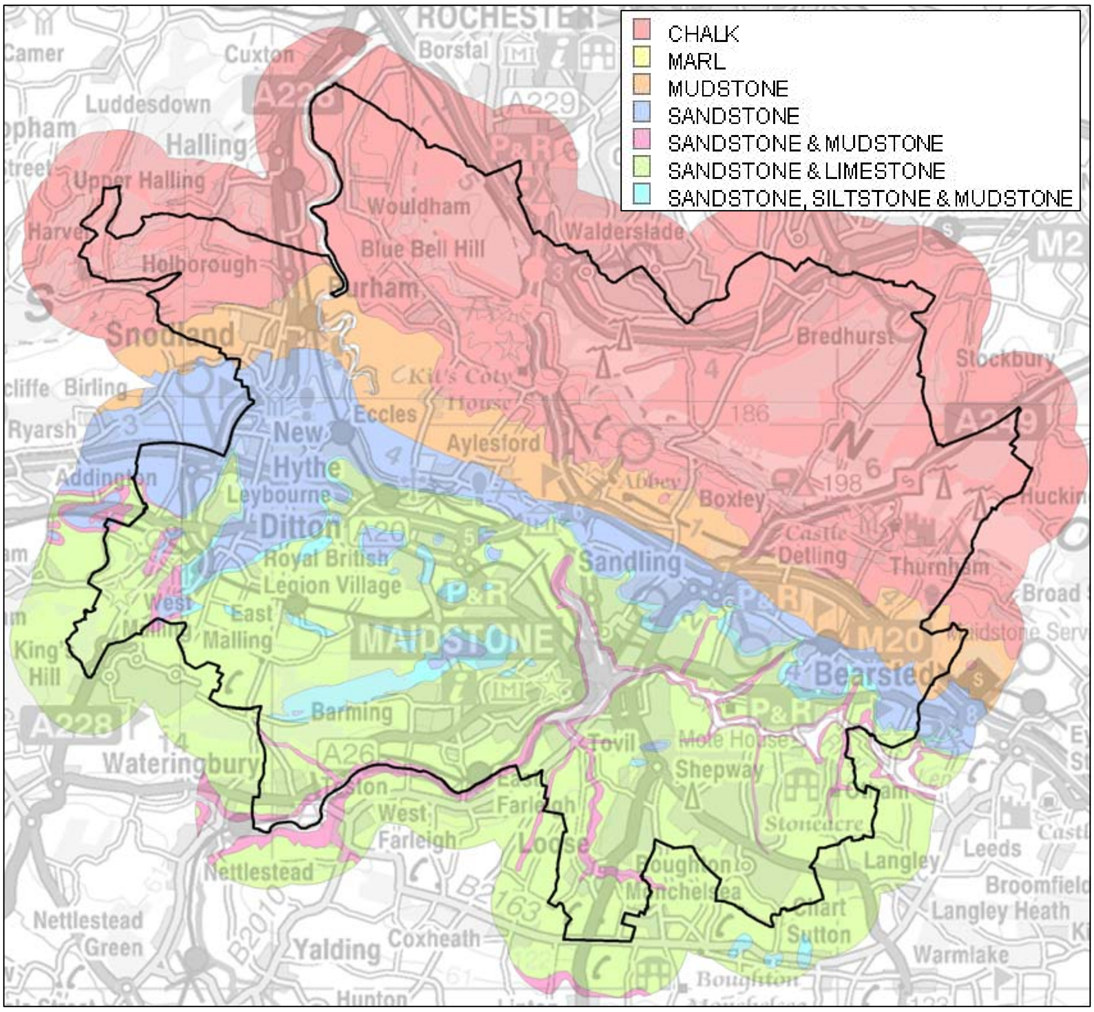

Figure C.2 – Local Geology

C.2.2 The geology map shows that the bedrock runs in a north west – south east direction. Chalk outcrops predominate in the north of the study area and form the North Kent Downs. This outcrop of highly permeable ground allows the creation of many springs which form part of an extensive aquifer to the north. The chalk then dips deeper underground to the north. The Chalk which formed the dome of the Wealden anticline has been eroded away to reveal the older beds of mudstone/Gault clay and Sandstone which are exposed further south (see **Figure C.3**).

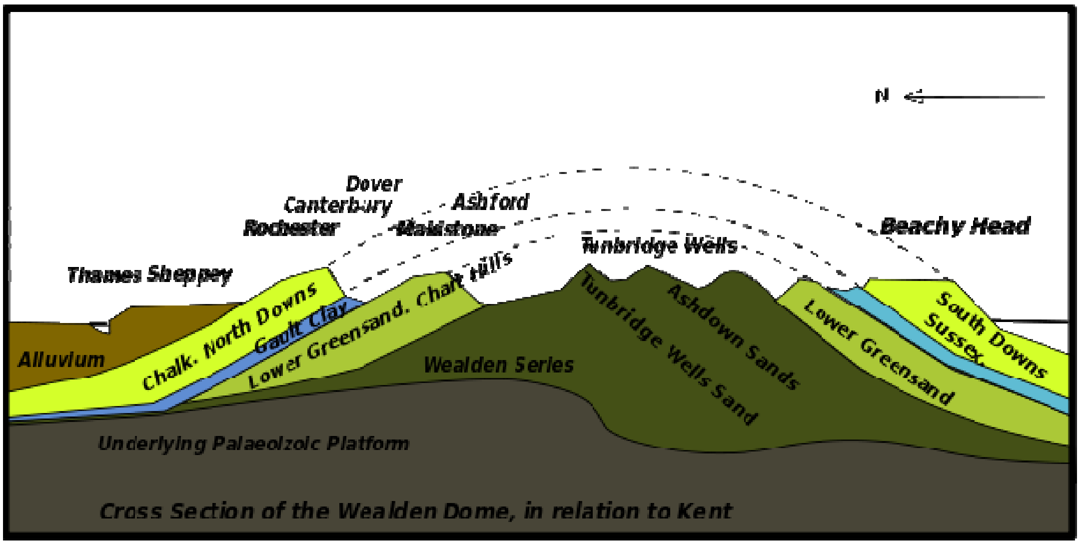

Figure C.3 – Wealden Dome

C.2.3 The permeability of the ground can be summarised as follows: a) the presence of highly permeable chalk ground (to the north and north east), b) a low permeability mudstone strip along the centre of the study area running north west to south east and c) relatively permeable inter-bedded sandstone and limestone ground across the lower southern part of the study area.

C.3 Open Spaces and Urbanisation

C.3.1 The study area is dominated by the large urbanised district of Maidstone town to the south east. With its mix of business, commercial and private property, industrial estates and shopping and recreational centres it is much like any other county town of a similar size. The remaining area within the study boundary is composed of land for farming and agriculture. This area includes the hills of the North Downs, woodland and the low lying areas of the River Medway and its tributaries (Len and Loose). The countryside is sparsely populated and dotted with numerous villages ranging in size from medium to little hamlets.

C.3.2 Maidstone was at one time a centre of industry: brewing and paper making being among the most important. Nowadays smaller industrial units encircle the town.

C.3.3 Key Infrastructure in the study area includes: a) The M20, M2, A20, A26, A228, A229, and A249, b) the main railway stations of Maidstone East and Maidstone West c) Maidstone General Hospital and D) The River Medway and its recreational facilities.

C.4 Overview of Local Flood Risk in Maidstone & Malling

C.4.1 The local situation for Maidstone and Malling in terms of flooding originating from surface runoff and overflowing of manholes and gullies, is that for small size storms (of the order of 20mm rainfall depth) only shallow flooding would occur.

C.4.2 Deep flooding and widespread damage to property and infrastructure are, however, anticipated for large size storms. In the same way as the Environment Agency considers extreme events for fluvial and tidal flooding, LLFAs also need to be concerned with large size storms (events similar to the Hull and Gloucester storms in 2007) and their effect on local flooding.

Figure C.4 – Photos of Surface Runoff Flooding

C.5 Surface Water Flooding from Surface Runoff

C.5.1 This is the main mechanism of surface water flooding, however, it is exacerbated by the lack of maintenance of assets. These may be owned by risk management authorities and/or riparian owners.

C.5.2 The impact of historic urban creep, with the expansion of impermeable surfaces (roof and paved areas), has resulted in increased runoff volumes and peak flows reaching sewers. This increase has in many cases exceeded the available capacity of the sewer networks (which were not originally designed for extreme storm events) and has severely increased the surface water flood risk.

C.5.3 Current estimates in the National Planning Policy Framework (NPPF) indicate that peak rainfall intensities could increase by up to 30% by the year 2115. Any mitigation proposals in this study therefore need to be sufficiently resilient to allow for such increases.

C.6 Surface Water Flooding from Surcharged Manholes and Gullies

C.6.1 The photos in **Figure C.5** show a typical situation where the water pressures in a pipe network system are sufficiently high to remove manhole covers.

Figure C.5 – Photos showing flooding out of manholes

C.6.2 In addition to flood risk from runoff (see **Section C.5**), surface water flooding can also occur as a result of water flowing out of manholes and gullies. This is the result of extreme storm events where the pipe network system becomes overwhelmed. Water then escapes at critical low points in the network through surcharged manholes and gullies as shown in **Figure C.5**.

C.6.3 Flooding out of manholes and gullies can originate from surface water drains, combined sewers or foul sewers. These are defined below.

C.6.4 Surface water drains carry only surface water originating from roofs, pavements and roads. They do not carry foul water.

C.6.5 Foul sewers normally carry only foul water but on some occasions surface runoff may be able to enter the foul system, which can result in surcharging manholes and internal property flooding.

C.6.6 Combined sewers carry both foul water and surface water originating from roofs, pavements and roads.

C.6.7 **Figure C.6** shows the distribution between surface water drains, foul sewers and combined sewers in the Maidstone & Malling study area.

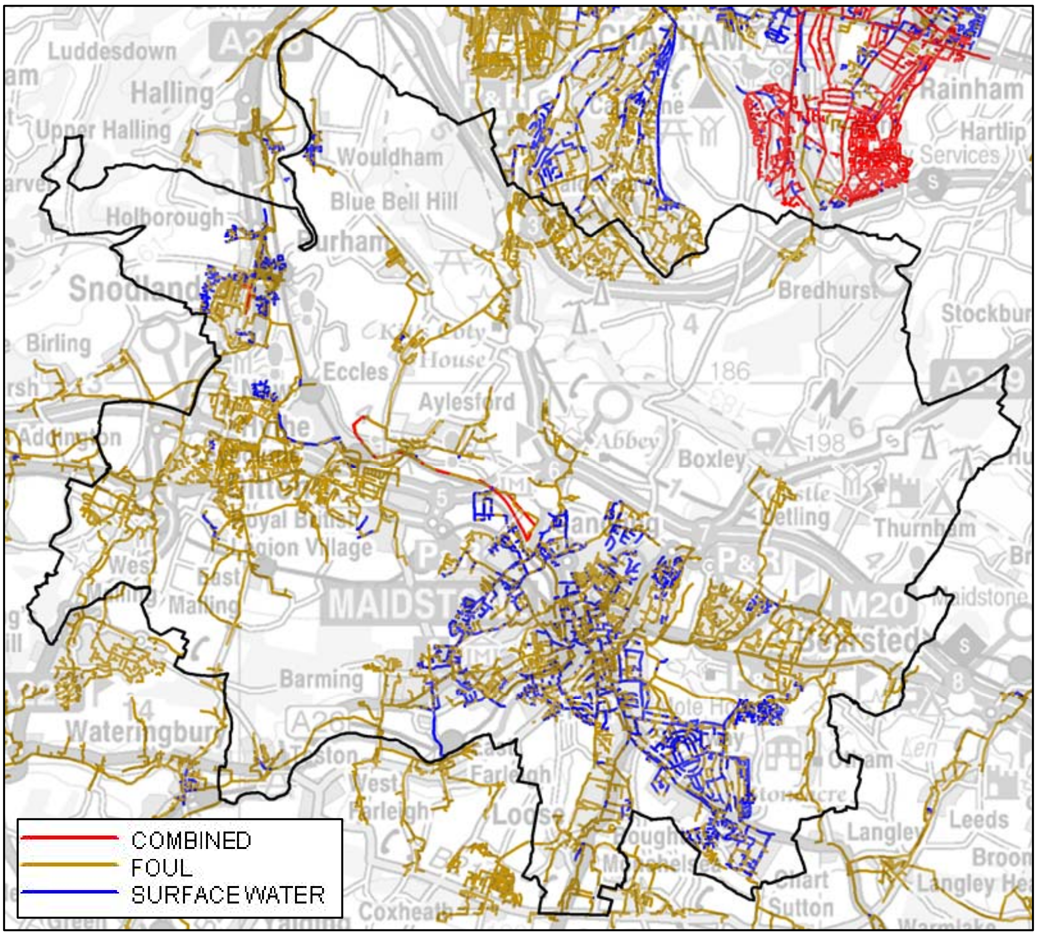

Figure C.6 – Southern Water Network System

C.6.8 The same effects of climate change and future development proposals are applicable to this form of flood risk (from overflowing manholes and gullies) as for surface water flooding from surface runoff.

C.7 Flood Risk from Groundwater

C.7.1 Groundwater flooding occurs when the water table rises above the ground surface, which is normally the result of persistent rainfall over a long period.

C.7.2 The water table is the level at which the ground changes from saturated (where the soil contains as much water as it can hold) to unsaturated (where the soil has some spare capacity). Rainfall soaks into the soil and, if sufficiently persistent, eventually fills it up so that it cannot hold any further water; in this case distinguishing between whether it is surface water flooding because it cannot infiltrate, or groundwater flooding because the water table has reached the surface becomes something of a grey area.

C.7.3 Groundwater flooding need not occur after a local rainfall event; rainfall falling further away may cause groundwater levels to rise over a much wider area, e.g. due to an extensive aquifer, and thus cause groundwater flooding at other locations. Again, if the ground is already saturated and causing groundwater flooding, then any further local rainfall will be unable to infiltrate and result in surface water flooding.

C.7.4 High groundwater levels can also cause springs to occur, where water travelling through permeable rocks emerges from a hillside, or where it reaches a more impermeable rock and is forced to the surface. This is the case on the mainland where a number of springs are present from a large aquifer that extends throughout Kent.

C.7.5 If sea water levels rise by 1.05m over the next 100 years (in accordance with the latest climate change guidance from the National Planning Policy Framework), then the water table within the study area will also rise by a similar amount. **Figure C.7** shows the effect that the increase in water table will have as a result of climate change (the map shows the difference between ground levels and the future water table).

C.7.6 At locations where the water table is near ground level, it is likely the sewerage system is surrounded by groundwater which can enter the sewers through any poorly sealed joints, thus reducing the capacity of the drainage system.

C.7.7 Future development will not affect groundwater flood risk provided that building foundations do not affect groundwater flow paths.

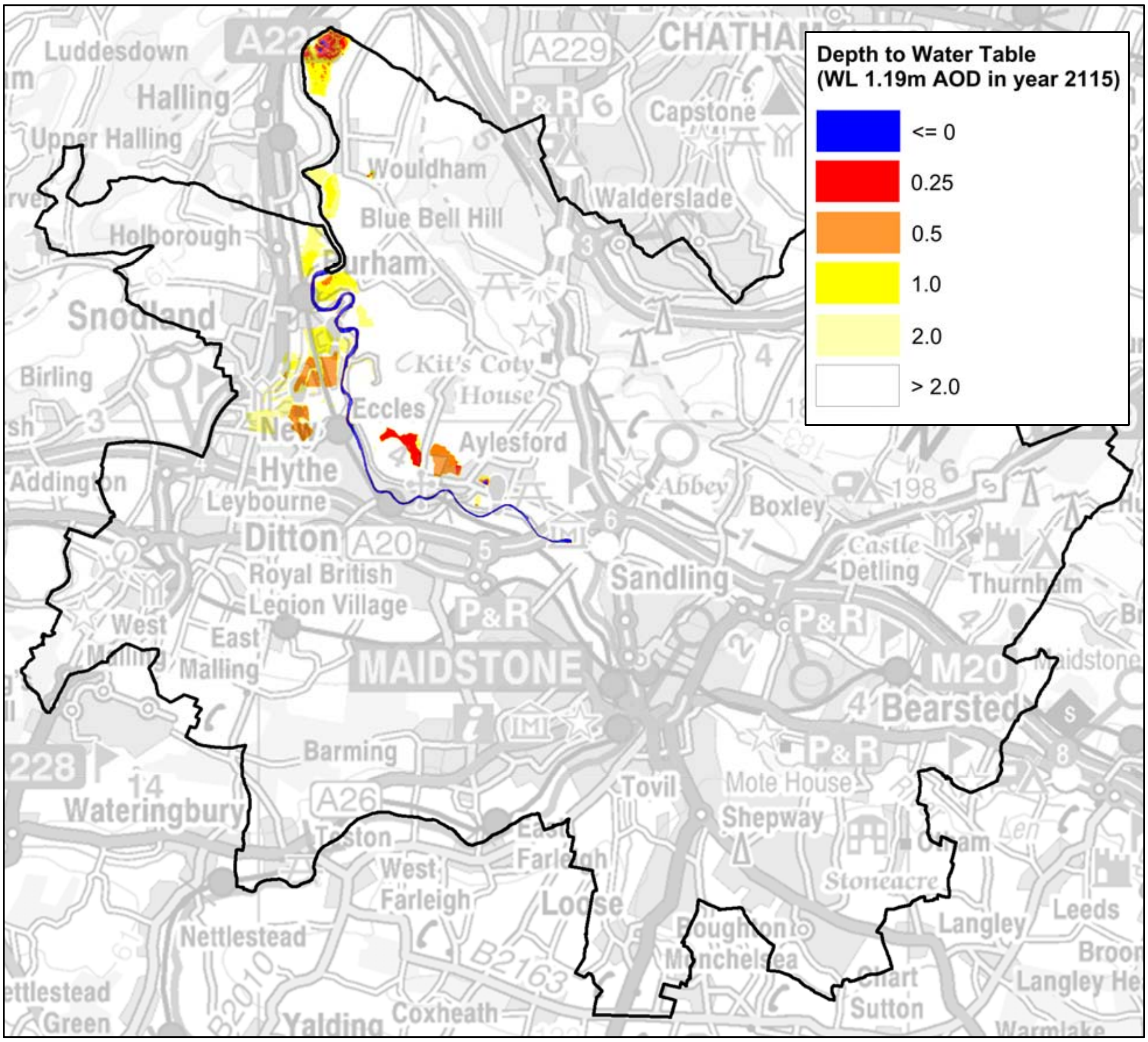

Figure C.7 – Depth to Water Table in year 2115

C.8 Flood Risk from Ordinary Watercourses, lakes and ponds

C.8.1 **Figure C.8** identifies the locations of watercourses within the study area.

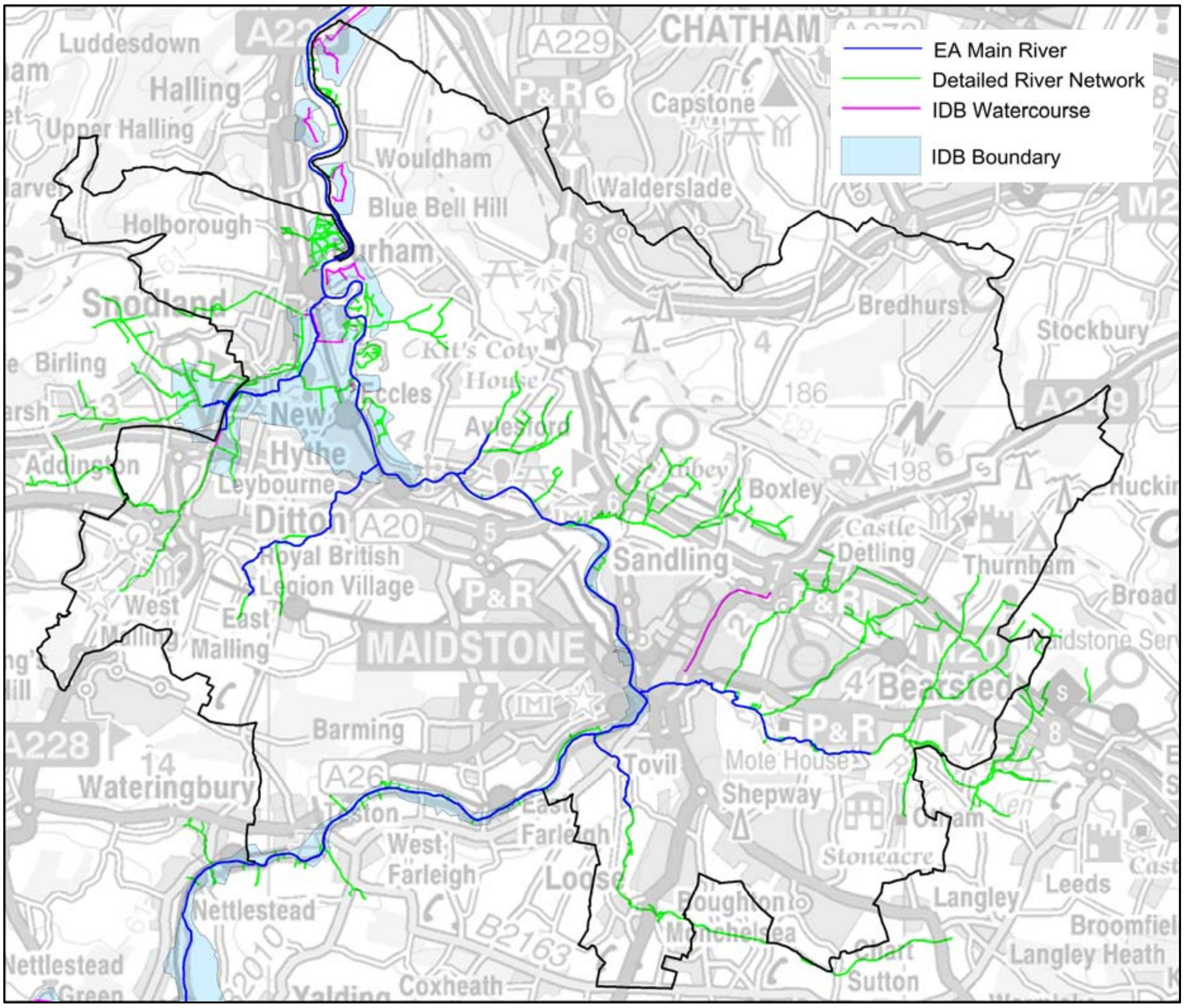

Figure C.8 – Watercourses within Maidstone and Malling SWMP study area

C.8.2 Ordinary watercourses are all watercourses that are not designated Main River (watercourses where the Environment Agency has responsibilities and powers). The Medway Internal Drainage Board is responsible for all ordinary watercourses within their administrative boundary while Kent County Council have powers and responsibilities for all other ordinary watercourses.

C.8.3 There are numerous ordinary watercourses within the study area including many short lengths of land drains and ditches, which do not have any known history of flooding. It will, however, be important for the Council to identify these assets in the future (low priority) in parallel to the task of populating the risk asset registers. Kent County Council and The Medway Internal Drainage Board are responsible for enforcement in relation to ordinary watercourses and recognises that the maintenance of watercourses and ditches by riparian owners is significant in managing surface water within the council area.

C.8.4 According to the National Planning Policy Framework, climate change will increase peak flows in watercourses by about 20% over the next 50 to 100 years. This implies the capacity of watercourses, ponds and lakes may not be sufficient in the future. Future development could also worsen this situation unless effective policies are put in place to ensure flood risk is not increased and where possible is reduced.

C.9 Flood Risk Interactions with Surface Water

C.9.1 Surface water flood risk can be worsened as a result of high groundwater levels, high fluvial levels and high tidal levels.

C.9.2 The interaction with high groundwater levels has already been described in **Section C.7**. The interaction with high fluvial levels is described in **Section C.10**.

C.10 Effect of High Tide & Fluvial Levels on Surface Water Flooding

C.10.1 There are several main rivers including the Rivers Len, Loose, Wateringbury Stream, Buelt and Tiese which discharge into the River Medway which flows north through Rochester before discharging to the sea (see **Figure C.9 – Environment Agency Flood Zones and Main Rivers**). High water levels in these main rivers could potentially reduce the discharge capacity of surface water drains that outfall into them. This occurs when river levels are so high that the surface water drain outfalls are partially or fully submerged below the river levels.

C.10.2 The tidal extent of the River Medway is to Allington Lock which is situated immediately north of Maidstone (highlighted by a red circle in **Figure C.9**).

C.10.3 The fluvial influence will worsen with climate change as peak flows are estimated to increase by 20% over the next 50 to 100 years, and predicted tide level rise could be around 1.05m AOD in 100 years time. Future development could also worsen the situation unless effective policies are put in place to ensure flood risk is not increased and where possible is reduced.

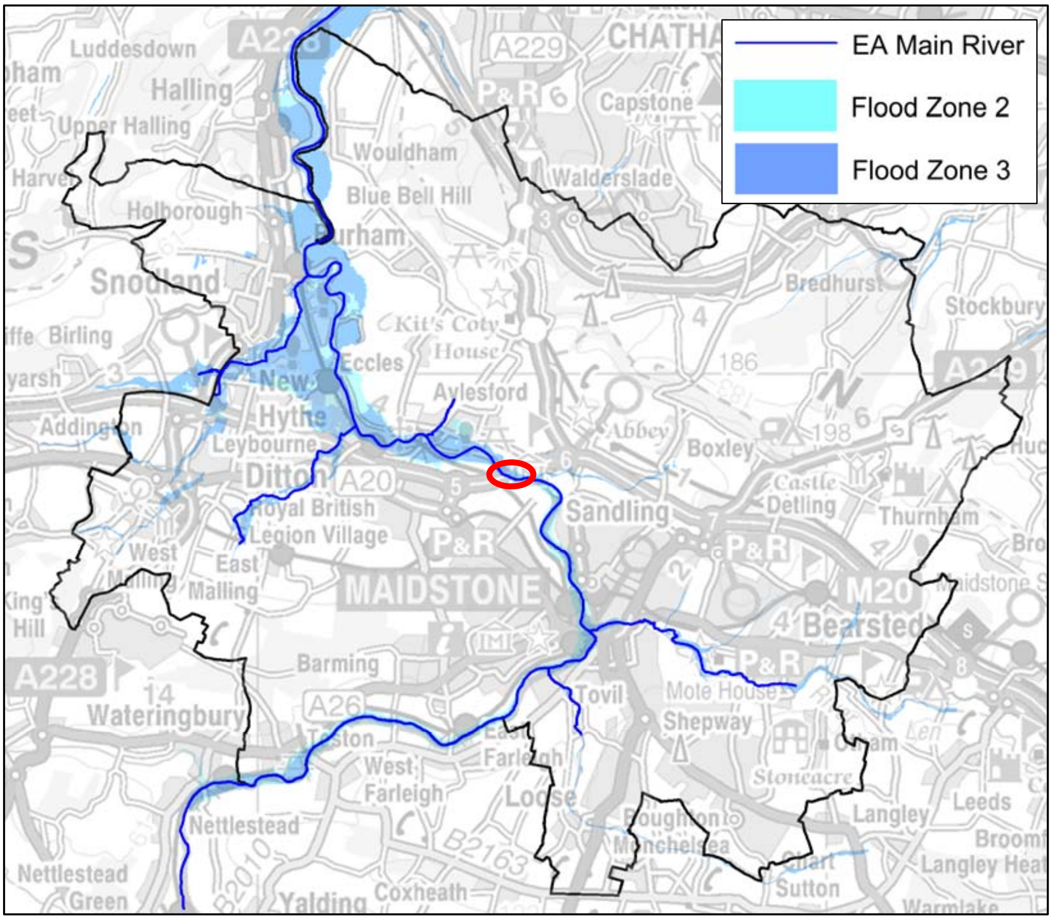

Figure C.9 – Environment Agency Flood Zones and Main Rivers

C.11 Residual Flood risk

C.11.1 Residual flood risk exists where the infrastructure that is designed to deal with flooding fails due to poor maintenance or when a storm event is above the standard of protection to which an asset has been designed for. Residual flood risk for local flooding can therefore be the result of drain, pipe or gully blockages caused by lack of maintenance as well as pump failure and pipe collapse.

C.12 Flooding of Basements

C.12.1 Flooding of basements can originate from the following flood mechanisms (assuming there is an external low level entrance to a basement):

a. direct rainfall accumulating by the basement entrance and air bricks,

b. surface runoff which overtops kerbs and/or steps (if any) into a basement entrance,

c. overflows from the combined sewer system as a result of a rainfall event, which overtop kerbs and/or steps (if any) into a basement entrance,

d. the combined sewer surcharges and backflows through its connection into a basement toilet,

e. infiltration of water from a broken sewer affecting basement walls or entering through a basement entrance and potentially causing internal flooding,

f. infiltrated rainfall wetting the basement walls and potentially causing internal flooding,

g. a high water table.

C.12.2 As there are many basements in Maidstone it will be important to identify in the SWMP action plan those locations which are susceptible to surface water flood risk as the depths of flooding could be high.

C.13 Historic Surface Water Flooding

C.13.1 Through the data collection process and consultation with all partners and key stakeholders a suite of historical surface water flooding incidents was collected to assist with the intermediate risk assessment phase of the SWMP process. The historical flooding incident datasets collected are the following:-

- Kent County Councils Highway flooding records
- Highway Agency flooding records
- Highway Agency known flooding hotspot areas
- Maidstone Borough Councils flooding records
- Tunbridge & Malling Borough Councils flooding records
- Southern Water's SIRF (Sewer Incident Report Form) flooding incidents
- Southern Water's flooding hotspot areas

C.13.2 All of the historic flooding incidents have been mapped in **Figure C.10** overleaf.

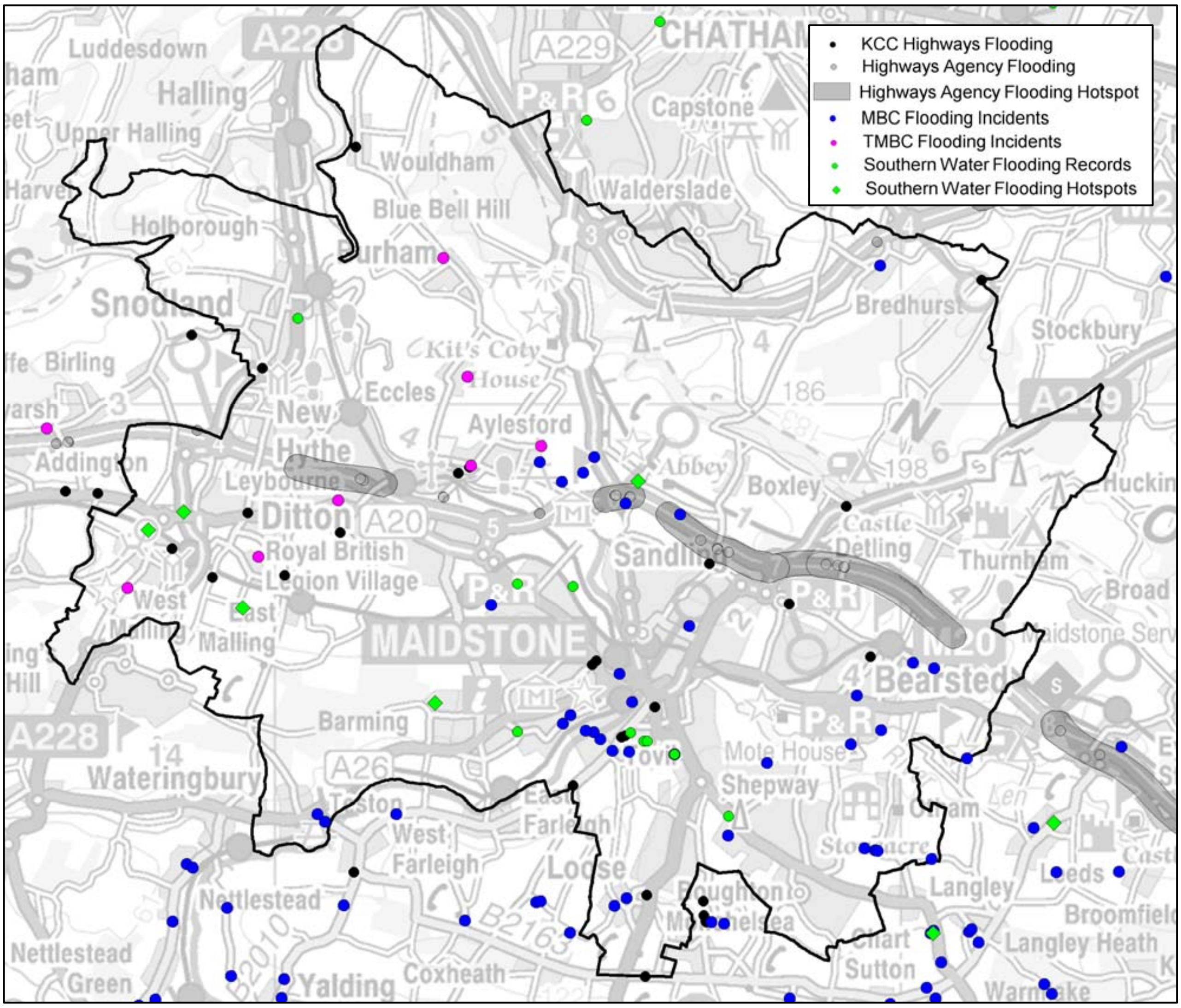

Figure C.10 – Historic Flooding Records