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**.

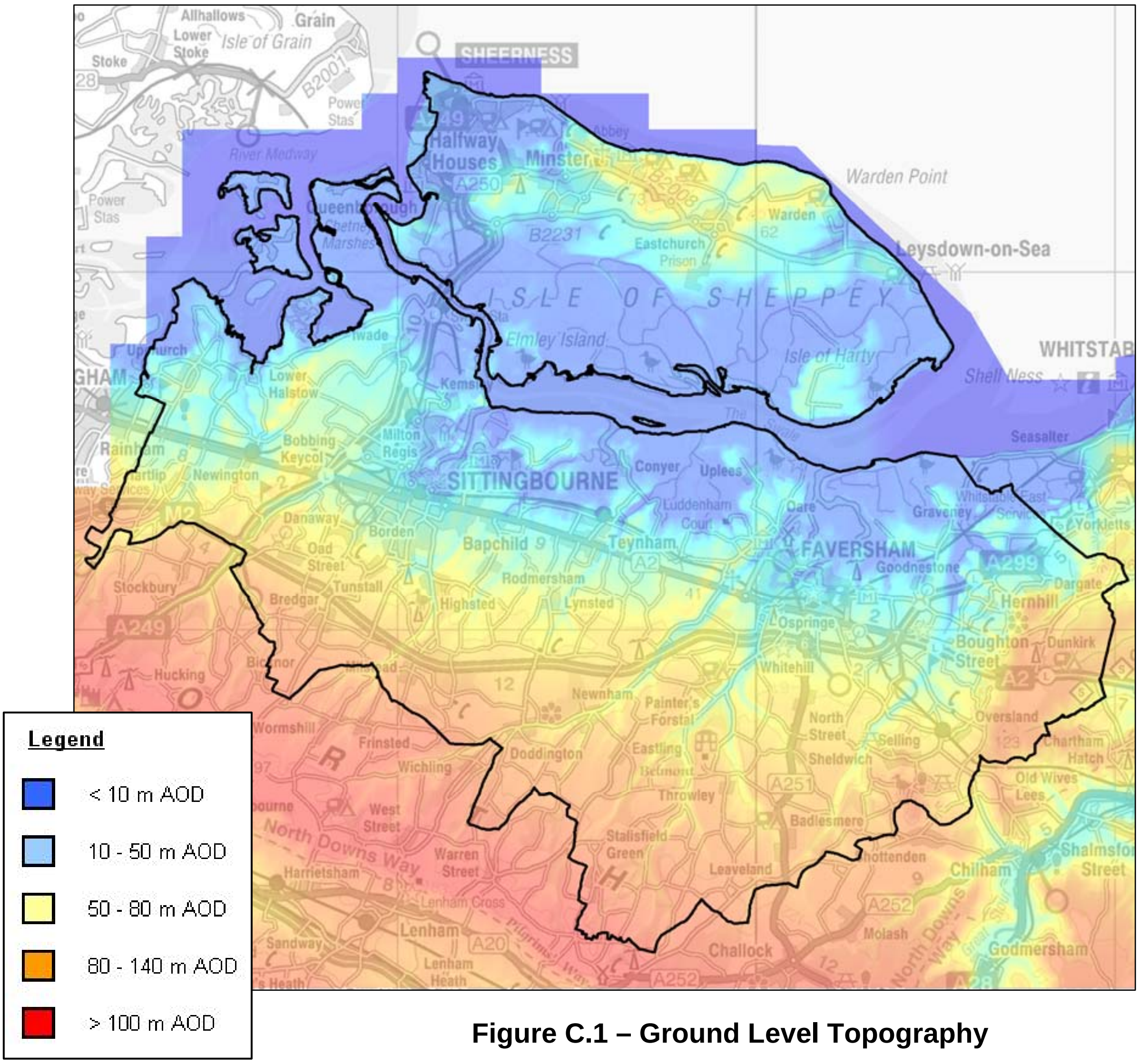

Figure C.1 – Ground Level Topography

C.1.3 The study area is characterised by the elevated hills of the North Downs to the South of the study area with the relatively flat and low lying areas to the north along the coastline and specifically for the Isle of Sheppey. Both urban areas of Sittingbourne and Faversham are situated at a level of between approximately 20-30m AOD.

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.

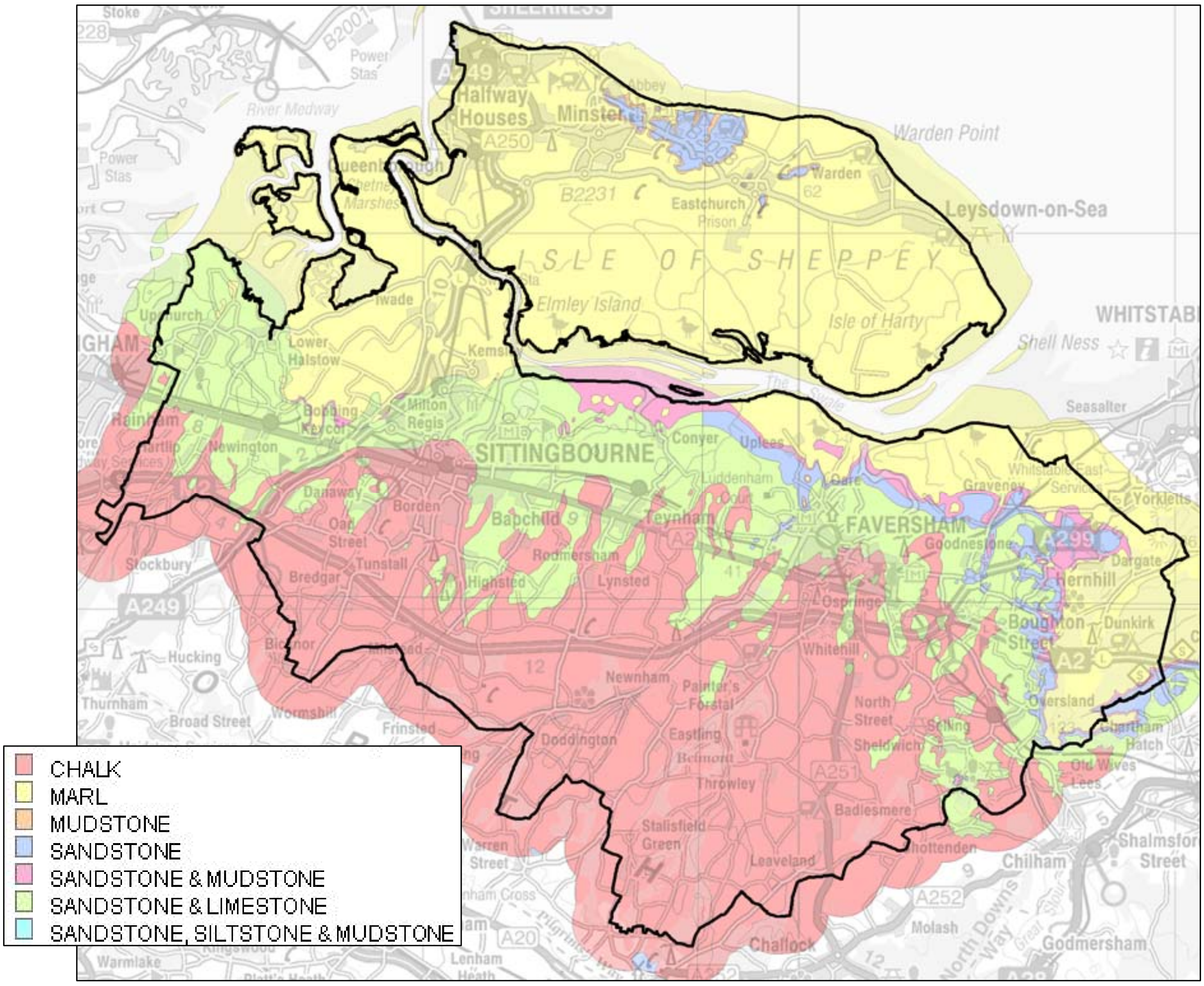

Figure C.2 – Local Geology

C.2.2 The geology map shows that the bedrock runs in a north west – south east direction. Chalk outcrops predominate in the south 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 south. 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** below).

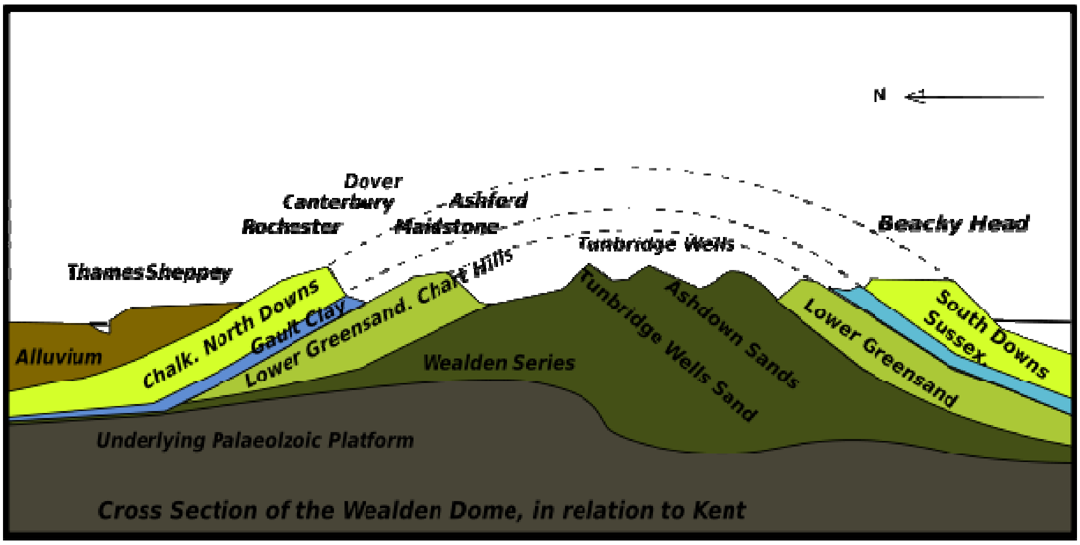

Figure C.3 – Wealden Dome

C.2.3 The permeability of the ground can be summarised as follows: a) the presence of highly permeable chalk ground (to the south), b) the coastal areas and the Isle of Sheppey mainly comprise of Alluvium with some scattered sand and pebble beds.

C.3 Open Spaces and Urbanisation

C.3.1 The study area is dominated by two main towns, namely Sittingbourne and Faversham. The Borough has a total population of approximately 130,000 and a diverse countryside with the coastal marshes and the chalky South Downs.

C.3.2 Key Infrastructure in the study area includes: a) The M2, A2, A249, and A250, b) the main railway stations of Sittingbourne and Faversham, and c) Sheerness Harbour.

C.3.3 It is anticipated that sustainable development will have an important role in assisting in the delivery of SWMPs action plans (aiming at reducing local flood risk within developments and in existing nearby communities) and ultimately the future Kent Local Flood Risk Management Strategy.

C.4 Overview of Local Flood Risk in Swale

C.4.1 The local situation for Swale 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 surface water flood risk from surface 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 Borough.

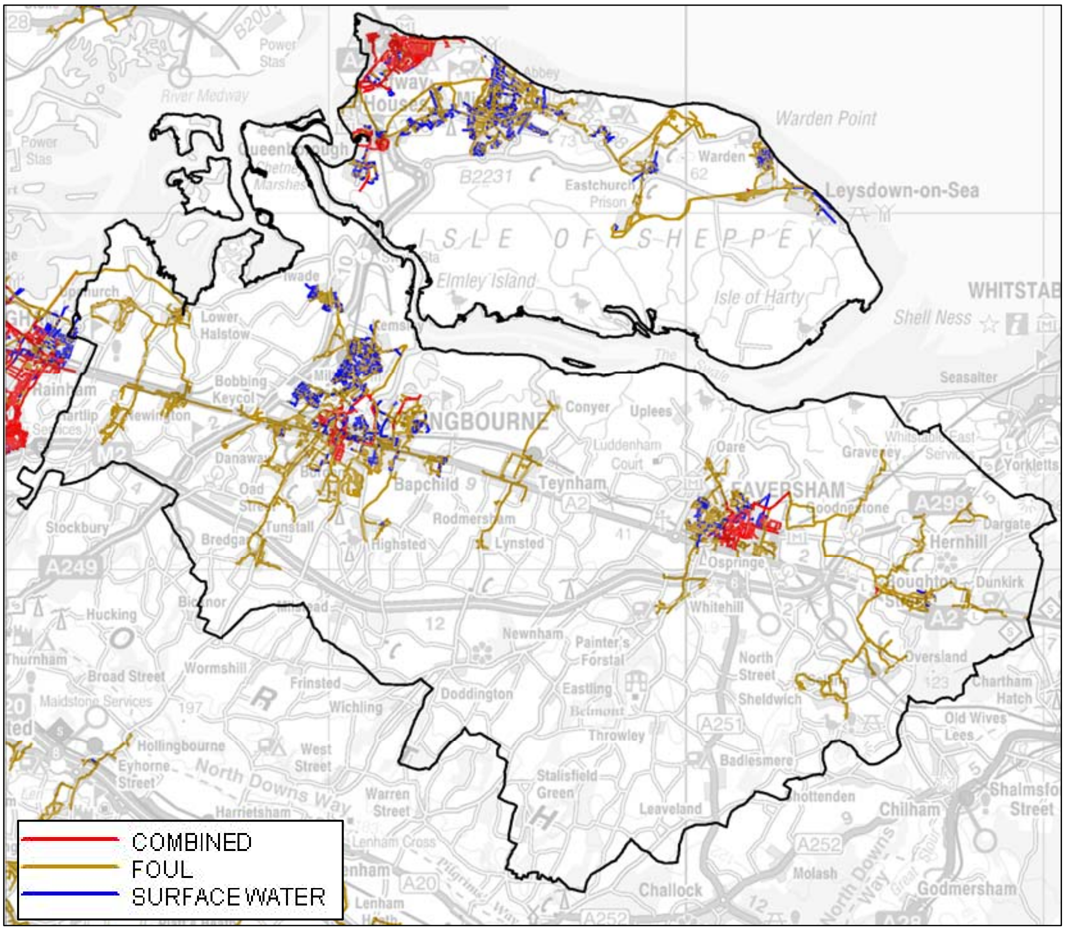

Figure C.6 – Southern Water Network System

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 The control of the water table is dominated by the water levels in the sea. The water table has an average water table level of 0.14m AOD (which is the mean sea level at this location). The water table then follows a dome effect pattern inland. However, there was insufficient data available to identify how the dome effect rises and where it peaks. It is not anticipated, however, that the rise in the water table would be high - potentially up to about 1m above 0.14m AOD.

C.7.6 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.7.7 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.7.8 Future development will not affect groundwater flood risk provided that building foundations do not affect groundwater flow paths.

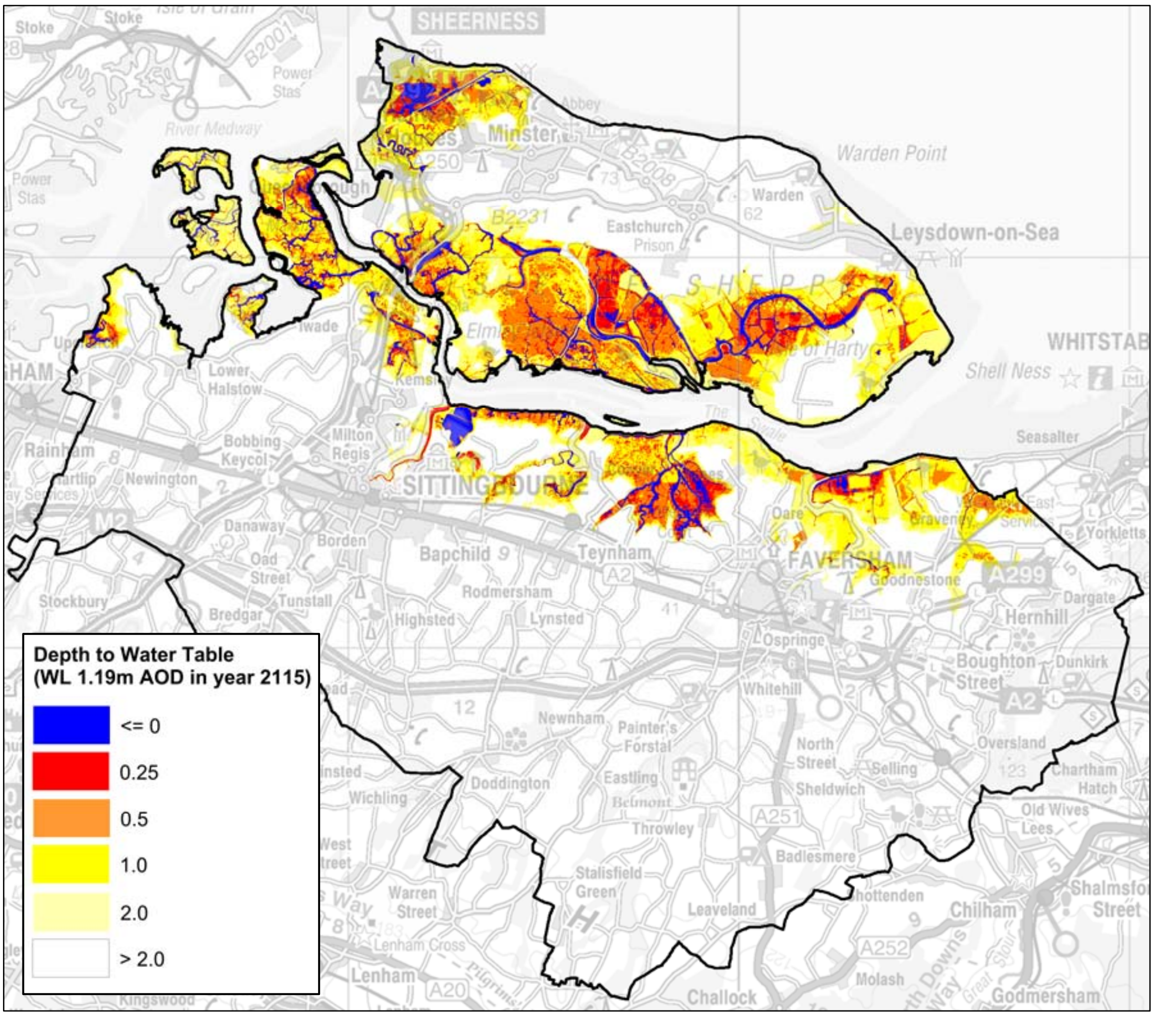

Figure C.7 – Depth to Water Table in year 2115

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.

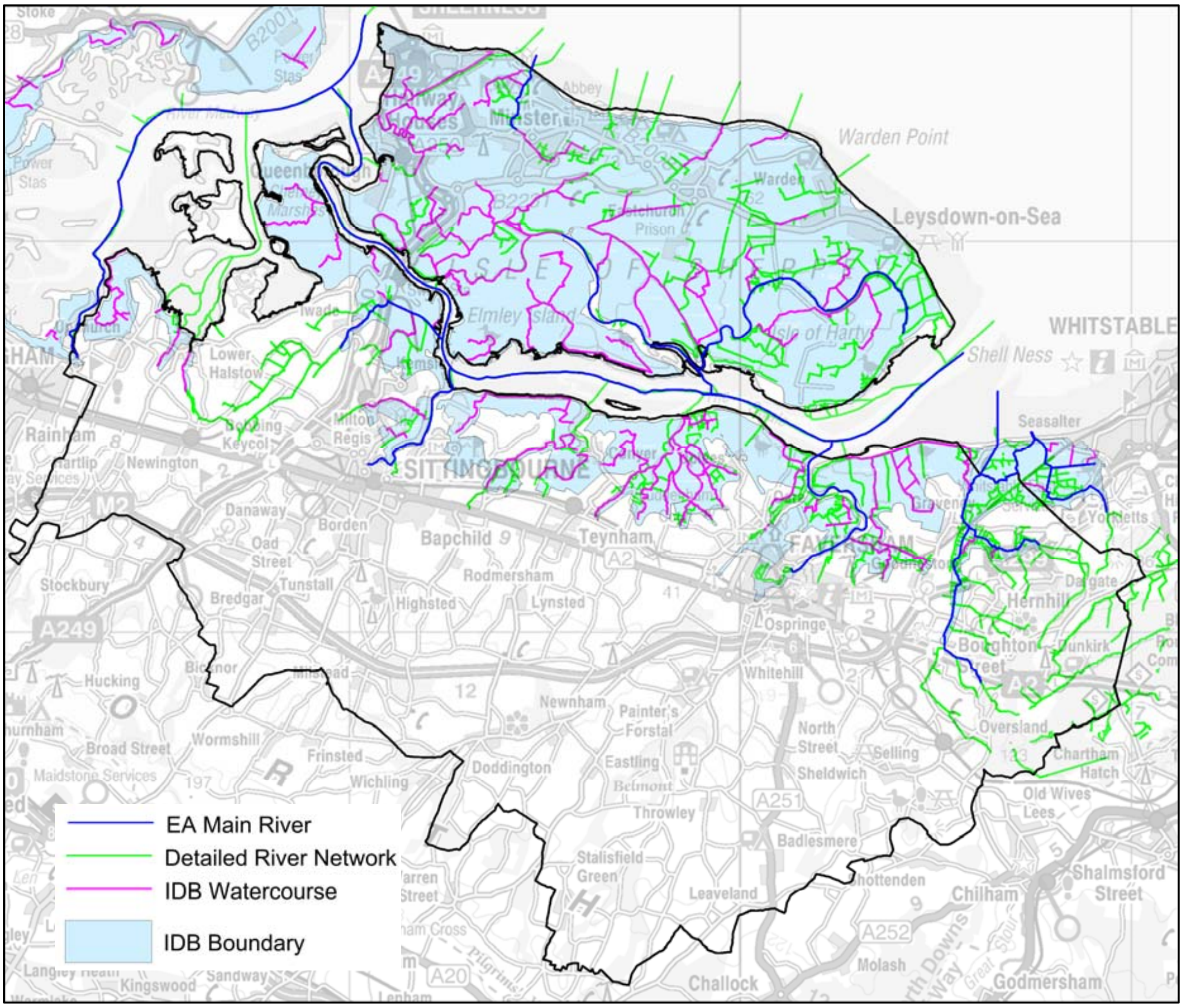

Figure C.8 – Watercourses within the Swale SWMP study area

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 The study area contains several watercourses classified as main rivers, including Coldharbour Fleet, Milton Creek, Faversham Creek and the Graveney Marshes watercourses on the mainland, Windmill Creek, Capel Fleet and the Scrapsgate Drain on the Isle of Sheppey, and the River Medway which flows along the Borough's western border (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 Furthermore, many of the watercourses discharge into the sea or The Swale and therefore water levels in the rivers are also subject to being increased by high tides.

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 this situation unless effective policies are put in place to ensure flood risk is not increased and where possible is reduced.

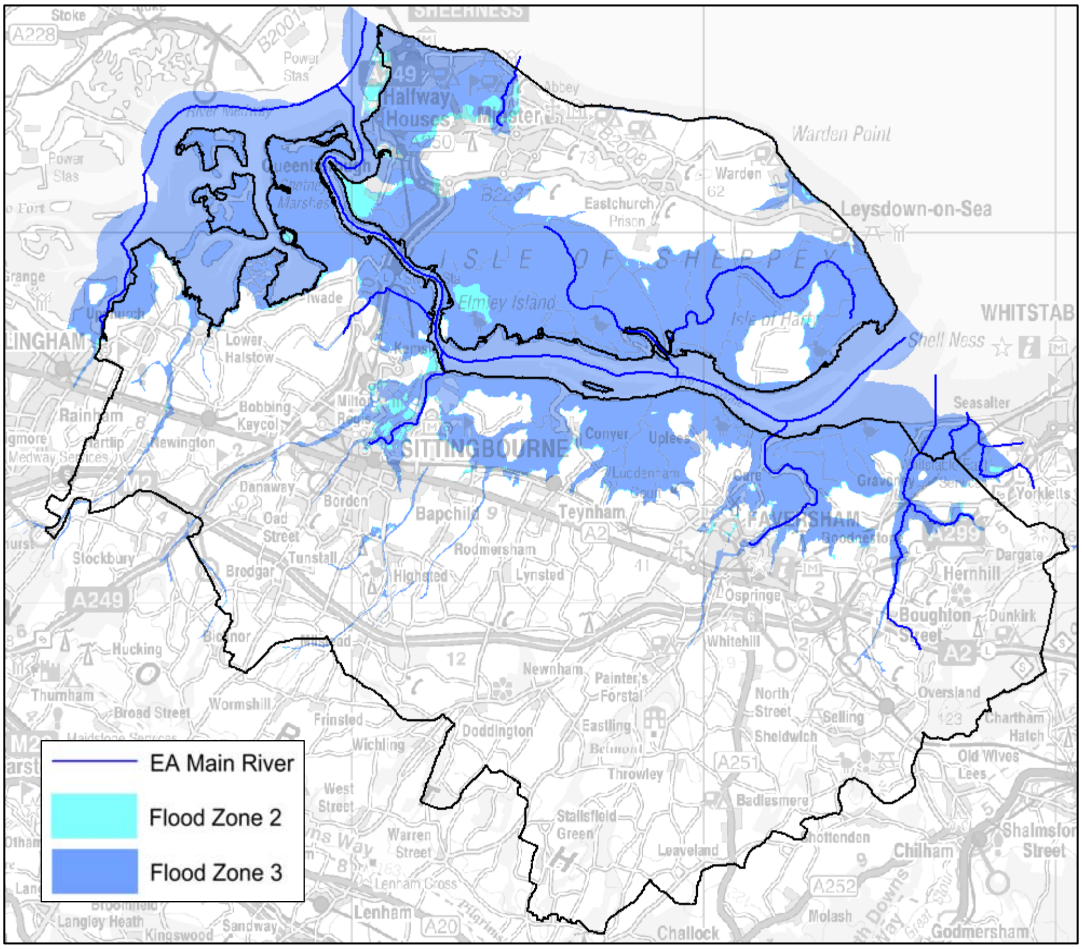

Figure C.9 – Environment Agency Flood Zones and Main Rivers

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 basements in Sittingbourne and Faversham 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
- Swale 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** below.

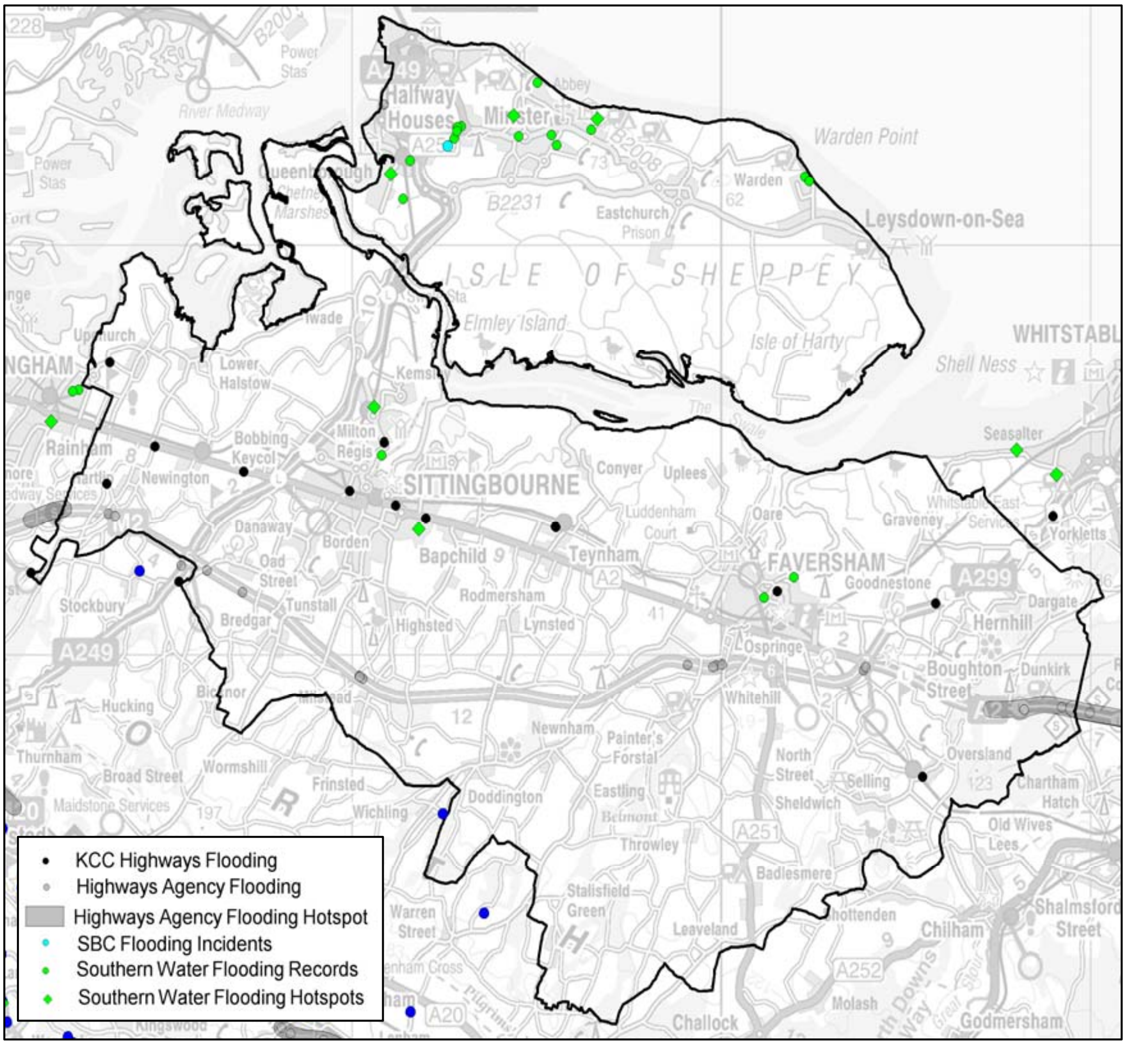

Figure C.10 – Historic Flooding Records