as a perched water table, or the Upper Aquifer. Where there is a slope at the interface between the London Clay and the overlying gravel this water can "flow". (Fig 21) However any flow in the ground water tends to be fairly small. Typically there is a general fall in the ground levels and the levels of the top of the London Clay from north to south towards the Thames. Around Notting Hill, where the topography is steeper and the ground conditions are more complex, groundwater issues can be significant and need much more care. (see Fig 8) There are also two significant historic water courses, Counters Creek and the River Westbourne and there can be a localised ground water flows towards them.

9.4.3 Another consideration relates to houses which are close to the Thames, which is tidal. The river wall is not impervious to flows of water. There is a limited flow through the wall at each tide and this can impact on basements within the affected zone. This only applies to properties close to the river.

9.4.4 The London Clay is underlain by the Lambeth Beds, Thanet Sands and then Chalk. There is a lower aquifer within the Thanet Sands and Chalk at considerable depth below existing ground level at RBKC. Historically this water has been extracted, usually for industrial purposes. The water level in this aquifer fell in the 19th century as a result of this extraction. The rate of extraction of this water has decreased over the last few decades, so the water level in the lower aquifer has been rising. The level of this ground water is carefully monitored as, if it was not controlled, it could start to impact on some of the deep tunnels which contain London's critical infrastructure. It has very little relevance for domestic basement projects. It is this Lower Aquifer which is frequently referred to in reports which state that groundwater levels in London are rising. The water levels in the Upper Aquifer are not rising or changing. There are normal seasonal variations that are rainfall related.

9.4.5 Where the surface geology is London Clay, there is generally no upper aquifer present and no groundwater flow. Water falling on gardens or parks tends to be retained in the topsoil or upper clay layers until it evaporates or is absorbed by vegetation. Some finds its way into drains connected to the sewers.

9.4.6 Basements constructed in clay effectively form a hole in the clay which can fill up with water and which is not able to drain away naturally. Although the hole appears to be completely filled in by the new basement structure which displaces water, the hydrostatic water pressures in the basement are present because of water at the interface between the clay and the basement construction up to the top of the clay or slightly higher than this depending on the ground conditions above the clay. This issue needs to be carefully considered in the design. The structure needs to be designed to resist the hydrostatic pressure unless something is done to relieve it. Flotation can also be an issue, particularly for basements in clay subsoil beneath rear gardens or internal basements with little load on top of them.

9.4.7 Excavations in gravel or sand, which are wholly above the perched water table of the Upper Aquifer, should not impact on any groundwater issues unless the form of construction extends down close to or below the aquifer and creates a cut off to the water. If there was a groundwater flow, it can continue in the ground below the level of the new basement.

9.4.8 Basements which extend through the gravels below the water table into the underlying London Clay should be considered in more detail. While an individual basement is unlikely to cause any significant change in water levels, long term group effects need to be considered. Checks should be carried out on the levels of the London Clay to establish if the water may flow. If a flow is expected, then clearly identified routes should be explored, together with any potential impacts on surrounding buildings.

9.4.9 A long terrace of houses with a significant number of basements through gravel into clay can act as a barrier to the flow of ground water and can change the groundwater regime in an area. If an assessment of the cumulative effect of basements in a terrace shows this to be a possible problem, such changes can be addressed in the design of a basement, by providing drainage or engineered flow arrangements below or around the proposed basement.

9.4.10 Basements which are close to historic water courses require even more detailed checks. The two principal water courses, The Westbourne and Counters Creek are both now culverted and used as sewers. The alignment of the sewers generally follows the original route but not always. Underground water flow is more likely along the historical route. Any proposed basements in these areas need careful checking.

9.4.11 In areas where there are existing houses with basements or lower ground floors and where the existing perched water level is close to the lowest occupied area, a new basement needs very careful consideration. The construction of a new basement could slightly increase groundwater levels "upstream" and on either side of the basement, locally raising the level of the perched water. In certain locations this could cause previously dry basements to become damp or wet. (Fig 22) This can be addressed by the design of the new basement (see 14.4.1d).

9.4.12 There are a number of different names for the gravel beds which relate to the geological process when they were deposited. The area around Notting Hill has a series of terraced gravels with outcrops in London Clay. The perched water in the upper gravel terraces can flow out at the interface with the London Clay causing ground water flooding. Also the surface of the London Clay is not uniform and there are channels in the London Clay which are filled with gravels. Basement proposals in the area around Notting Hill need very careful consideration as the ground water regime is likely to be more unpredictable and complex.

9.4.13 In rare situations where significant groundwater flows exist or where a basement could cause the local raising of the perched groundwater level, which could be significant for adjacent existing construction, measures should be included in the design to equalise the water pressure and levels across the new construction.

9.5 Flooding

9.5.1 Flooding from the Thames

9.5.1.1 The River Thames is protected against a 1:1000 year fluvial flood event by a combination of the river wall and the Thames flood barrier. The critical situation for flooding from the Thames is a combination of prolonged heavy rain in the Thames Valley in conjunction with a storm surge in the North Sea, leading to extremely high tides. The effects of climate change are increasing the risk of flooding and will need to be addressed further in a future flood defence strategy for London.

9.5.1.2 Parts of RBKC close to the River Thames are at risk from overtopping of the river walls in a significant flood event if there was a failure of the Thames Barrier. If a more severe flood occurred, the Thames Barrier itself could overtop and be unable to defend London against the flood. Generally the Thames Barrier is operated to control the river levels in tidal flood conditions so that they do not exceed the height of the river walls in London. The areas of RBKC that are at risk of such flooding are indicated in Fig 23. While statistically this combination of events is a very low probability, the consequences of inundation are extremely serious, so all thresholds to new basements in these areas (i.e. the unprotected access points above the enclosing walls and roof slabs) should where possible be set to prevent water ingress in the event of an overtopping incident, particularly if they accommodate living accommodation.

9.5.1.3 Another event which also needs to be considered is a breach of the river wall i.e. a localised failure of the wall during a high tide. In the event of this occurring, water could flow onto the flood plain behind the wall for several hours before the tide drops. The areas which are affected are very similar to the areas noted in 9.5.1.2 (Fig 24). Again the thresholds of new basements should be set to prevent water ingress, ensuring that both access and egrees will be safe where there is a breach incident. Where such levels cannot be achieved flood management plans can be considered as an alternative approach. These need to deal with safe exit from basements in the event of flooding (amongst other things).

9.5.2 Surface Water Flooding

9.5.2.1 During periods of very heavy rain, rainwater is sometimes unable to soak sufficiently into the ground, partly because of the large areas of impermeable