A Report on the Potential Impact of Large Scale Housing Developments on the River Adur.

An Analysis of Water Environment, Resource, and Wastewater Implications

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For: River Adur Parishes Group**:-** Parish Councils: Albourne/ Ashurst / Bramber/ Cowfold / Henfield / Shermanbury / Twineham / Woodmancote.

Executive Summary

The River Adur Parishes Group (RAPG) commissioned a report on the River Adur following concerns raised by many of the Parishes from the Inter Parish Group in relation to proposed large scale developments. These concerns are primarily focused on the risk of flooding within the proposed development area as well as those communities downstream which are already at high risk of flooding. In addition, there are concerns regarding the ecological impact on the watercourse itself, already under pressure from numerous sources and failing to meet the Good Ecological Status that current legislation demands and the impact of such large scale development on waste water infrastructure and the potential for increased pollutants in the watercourse. Where these are from Waste Water Treatment plants this can have a detrimental impact on human health, as well as the ecology of the area. These concerns are of particular importance considering future climate change predictions in terms of sea level rises and increased frequency of intense rainfall events, particularly during the summer months.

Concerns regarding flood risk apply to those areas already considered, or shown, to be at risk as well as those which are within close proximity to the existing flood zones but is particularly important in terms of local infrastructure such as road networks which are already frequently flooded as a result of the combination of surface water, tidal inundation and groundwater influences. These concerns are particularly pertinent since the year 2000 where local residents have often observed incidents of flooding whilst being told there is no flood risk within the area. This existing attitude towards flood risk on the Adur does not represent the situation seen across communities and there are particular pinch points at Mock Bridge and Beeding Bridge which result in extensive flooding around the locations Shermanbury – Albourne and areas. As such there are major concerns that any development which does not adequately consider flood risk beyond the existing flood maps for planning will risk a serious impact on existing infrastructure and people's homes within the wider catchment.

There is further concern that whilst seen as a blanket solution within the development framework, SUDS (Sustainable Urban Drainage Scheme) which seek to mitigate the impact of large scale development are likely to be inappropriate and lacking in a comprehensive and funded management plan into the future. Within this area the geology is likely to be a constraining factor in the development of a functioning SUDS scheme and it is difficult to visualise an aesthetic to this which would accommodate the amount of surface water generated over such an area whilst maintaining health and safety and a pleasant environment for local residents during frequent drought conditions. SUDS schemes are effective based on their ability to hold back water and allow it to drain relatively quickly in order to have capacity for the next event, replicating floodplain environments. There are concerns that a SUDS scheme for substantial development may not be adequately considered or appropriately investigated as to its suitability.

Alongside the concerns regarding flood risk within the area and how this may be mitigated, there are significant concerns as to the impact that development would have on the ecological function of the river and the detriment this would have to both the wildlife, which depends on it, but also the local groups who benefit from interactions with a healthy environment (such as anglers). The concerns are two-fold in that the volume of waste water being generated from substantial development

would need appropriate investment in new, state of the art treatment facilities rather than being attached to existing infrastructure that has previously failed due to overloading, especially during high rainfall events.

The waterbodies this development will inevitably impact upon are already failing Water Framework Directive standards specifically due to levels of phosphate and diminished fish populations, both of which are likely to worsen as a result of large scale development. As such, in permitting this development, the council will be failing in its duties to have regard to the Water Framework Directive and contravening both the NPPF and your own planning policy (Policy 38 of the HDPF). Whilst understanding that SUDS can ameliorate some issues, the sheer number of people, cars, road and waste water requirements will be very hard to mitigate in terms of adequate protection to the watercourses and, when combined with the risks of urban pollution such as rubbish and other debris, we are further concerned that these already pressurised environments will be further degraded.

Any development should be considering not just the short term implications of its approval but the long term impacts against a backdrop of climate predictions and water resource availability which will inevitably put increased pressure on the South East in terms of flood and drought risk and ecological degradation.

Therefore we would like to see this report noted and actioned as part of Flood and Ecology concerns to the local environment. In addition we would recommend that, for any large scale development, flood risk, wastewater and the entire ecological function of the catchment must be fully considered and have full and comprehensive study / reports commissioned before further consideration for development is submitted or approved.

Flooding and Surface Water

The local drainage system is shown on the attached plan. The River Adur, which is classed as “Main River” and the responsibility of the Environment Agency, its watercourses and associated tributaries, all form part of the “River Adur Catchment”. Figure 1 is a map of main watercourses. The principal river network of the River Adur are the Adur West Branch, which rises in the parishes of Slinfold and West Grinstead, and the Adur East Branch which rises on Ditchling Common and thence flows north and west to pass between Haywards Heath and Burgess Hill.

Over the past 20 to 30 years development, climate change and changes to surface water and in-channel river management has contributed to increase water levels and flows in the catchment at times of long periods of rainfall, especially during intense summer rainfall events which are becoming more frequent and are particularly concerning due to dry conditions and associated rapid runoff causing localised flooding. Tidal conditions impact upstream water levels, hindering the discharge of surface water to the sea. The tidal defences far down the River Adur estuary at Shoreham affect Parishes from Bramber inland in the Lower Adur catchment (see map below) up to

Cowfold / Albourne in the Upper Adur catchment due to the tidal prism effect of interactions between tides, ground water and increased surface water flows from development in the Adur East Branch (see map) Burgess Hill / Haywards Heath and the Adur West Branch (see map) towards Southwater, as well as historic river management which has facilitated rapid discharge from the upper catchment to the sea.

A network of streams connects to the River Adur East Branch. These are: Cowfold Stream, Shermanbury Mill Stream, Bolney Sewer, Sake Ride Sewer, Chess Stream, Herrings Stream, Pook Bourne Stream, Copyhold Gill, Valebridge Pond and Copyhold Gill.

River Monitoring

The River Adur level monitoring in the Upper Catchment is at Sakeham Weir and the nearest village is Shermanbury. Under "normal" river levels this gauging station records, in average weather conditions, 0.16m – 1.35m. It has sat between these levels for 90% of the time since monitoring began. The most recent high level recorded was 2.50m on 24th December 2013 at 4.45am. The highest level ever recorded at Sakeham Weir is 2.90m, reached on 12th October 2000 at 10.15am. Reference ID:E9130, Map Ref. 50 57' 26.7" N 0 15'57.5"W. Other River Level Monitoring Stations on the River Adur are Beeding Bridge (which will be mentioned later) and Shoreham.

The River Adur level monitoring in the Lower Catchment is at River Adur Beeding Bridge where flooding with evidence has taken place the nearest villages are Upper Beeding and Bramber. The river level has reached within 0.3m of the top of bridge when Spring tides and high rainfalls coincide. Under "normal" river levels, in average weather conditions, the readings are between 0.11m – 3.32m (being heavily influenced by tidal conditions). It has sat between these levels for 90% of the time since monitoring began. The highest level ever recorded at Beeding Bridge is 3.77m, reached on 6th December 2013 at 02.00am. Reference ID:E9140, Map Ref. 50 52' 58.2" N 0 18' 24.6"W.

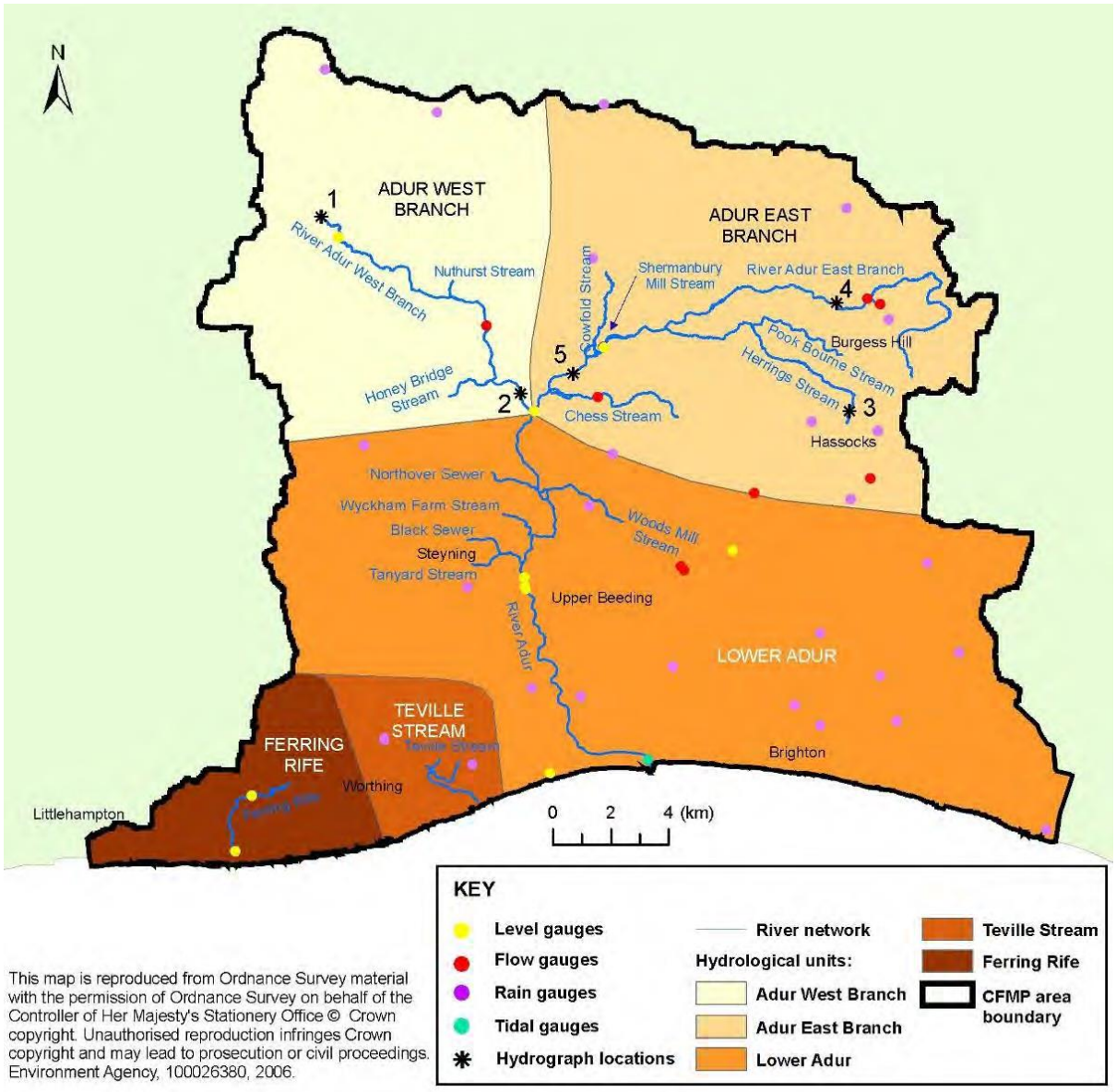

Figure 1 - River Adur - Main Watercourses in the Adur Catchment Map

As a result of the confluence of the river as various watercourses in the vicinity of Sakeham Weir the start of the Adur Eastern Branch, there will be at a far greater risk of flooding in the Albourne, Wineham, Shermanbury and the Henfield area if there is any increase in water levels than currently takes place. There is, therefore, a significantly increased need for flood risk management of the water catchment. The confluence with the Adur East Branch and the Lower Adur lies to the west of Henfield is a major pinch point. The River Adur is tidally influenced up to Bines Green at Shermanbury to the north of Henfield.

Flooding that takes place in the upper catchment area (Adur East and West Branches from Henfield / Shermanbury to Burgess Hill), sees a significant amount of water held within the associated floodplains but also within many areas of surrounding land which is not recorded or referenced by computer modelled flood maps and is therefore overlooked by local authorities. Local people are only too aware of the flooding that takes place with flooding , in the Lower Adur catchment as far as Albourne on the Adur East Branch with evidence of incidents shown in Appendix. Bramber is at high

risk of flooding, sitting within both flood zone 2 and 3 and any increase in water levels in or around this location would have a significant impact on the Bramber residents and surrounding infrastructure.

River Adur catchment topography

Figure 2 below shows that the majority of the main River Adur flows through the Low Weald where gradients are generally shallow. However, some of the upstream tributaries of the Adur East Branch do originate in the High Weald where the ground elevations are more than 200m Above Ordnance Datum (AOD).

The tributaries of the Adur West Branch only reach ground elevations of approximately 100m AOD. Where these two branches of the River Adur meet, the ground elevations are considerably lower, at only approximately 3m AOD. The Lower Adur has a very low gradient, with elevations that range from only 3m AOD at the confluence with the two branches down to 0m AOD at the coast. The gradients of the West Branch, East Branch and Lower River Adur main rivers are shown in figure 3.

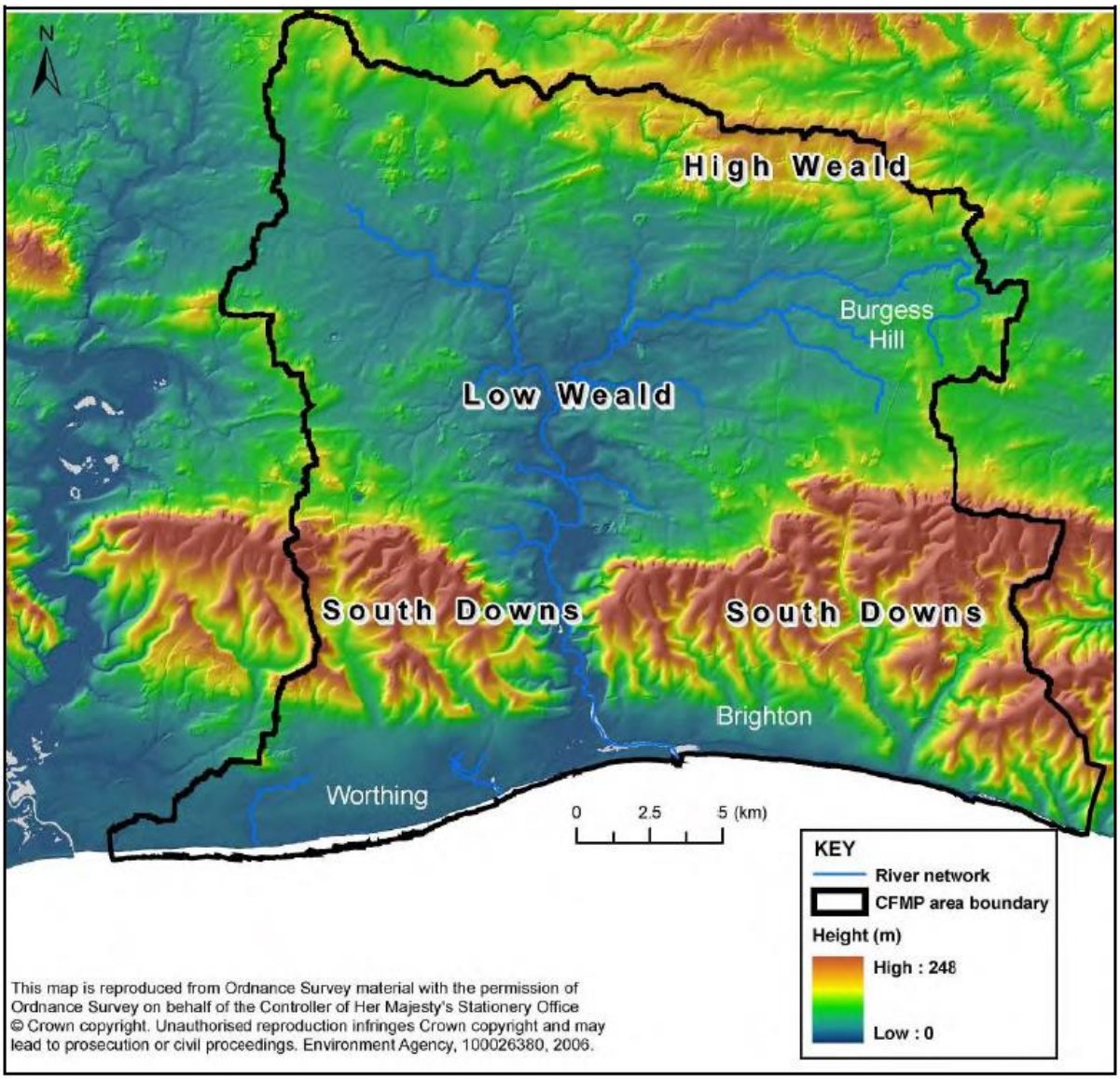

Figure 2 – River Adur catchment topography

Channel slope of the River Adur (Main River only)

The channel slopes of the River Adur contribute to the timings of the flood flows. Figure 3 below clearly shows the difference in the channel slopes of the East and West Branches of the River Adur compared to the Lower Adur. It is these channel slopes which contribute to the timings and velocities of peak flows.

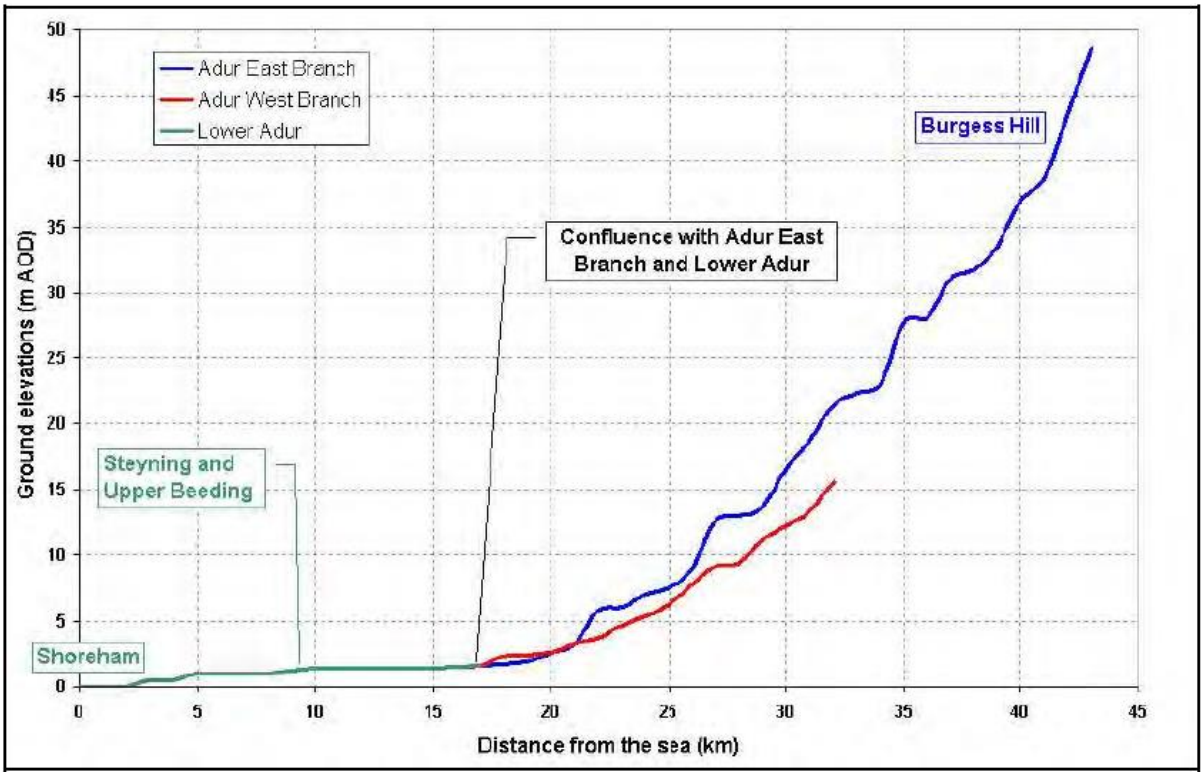

Figure 3 – Channel slope of the River Adur (Main River only)

The Adur East Branch takes approximately eight hours between the peak of the rainfall and the peak of the flood in the river, just above the confluence. Whereas the Adur West Branch is slightly slower, taking approximately ten hours before it reaches the peak of the flood flow after a rainfall event.

Rainfall

These physical characteristics of the River Adur play an important role in the highly valued landscape character of the area. The topography, as well as the geology, shown in Figure 4 below, directly affects the hydrology of the catchment and how it responds to rainfall.

The topography can also indicate potential locations for future flood risk management options, for example, the broad flat floodplain areas of the Lower Adur could provide a suitable location for flood storage as is often seen across 'The Brooks' near Henfield during flood events .

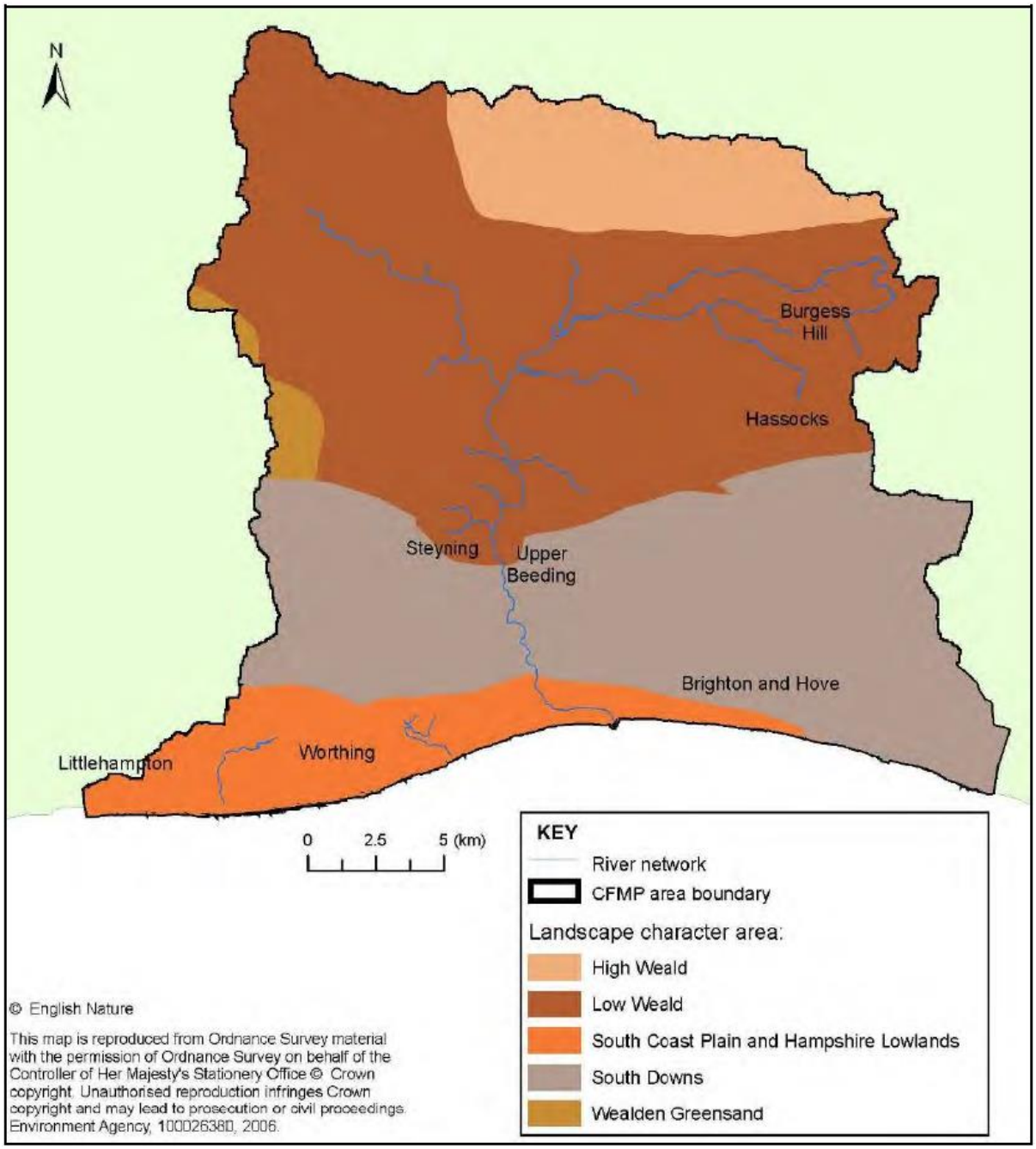

Figure 4 – Geology summary of the River Adur catchment main watercourses

The Adur East Branch drains 167 km2. The upper parts of this catchment (notably the High Weald) are drained by a relatively dense network of small streams. Some of these small tributaries respond fairly rapidly to rainfall and run-off arrives at the main river relatively quickly.

The main tributaries in the Adur East Branch of the catchment are Pook Bourne Stream and Herrings Stream, which flow through Burgess Hill and Hassocks respectively and as such are already restricted in their ability to connect with their associated floodplains due to intense urbanisation. In addition, approximately 3 km of the main river from the confluence with the Lower Adur and the Adur West Branch, upstream to Shermanbury, is influenced by the tide.

The Adur West Branch drains 143 km2 and includes the major tributaries of the Nuthurst Stream and Honeybridge Stream as well as approximately 10 km of the main River Adur. This catchment is predominantly rural with some scattered villages and isolated properties.

The confluence with the Adur East Branch and Lower Adur lies to the west of Henfield and south of Partridge Green. The tide continues to influence the river to Bines Green, approximately 1 km upstream of the confluence.

The Lower Adur is the section of the River Adur flowing from the confluence with the East and West Branches through Steyning and Upper Beeding to the coast at Shoreham. This entire section of the River Adur is heavily influenced by the tide. The major tributaries in this reach are the Tanyard Stream, Black Sewer and Woods Mill Stream. Steyning, Bramber and Upper Beeding are at risk of flooding from these rivers and stream.

The River Adur catchment area has varying ground slopes, annual rainfall, soil types, geology, land use, and sub-catchment sizes. The way that the River Adur catchment responds during a storm event depends on these factors as well as a myriad of other factors which cannot be predicted or modelled, hence the difficulty in managing flood risk and why no two rainfall events result in the same outcome. The type and duration of a storm that causes the most flooding in a particular location is called the 'critical duration' and this varies throughout the catchment.

For example, on the Adur East Branch, a short period of heavy rainfall will cause the most severe flooding. However, in other areas a long period of lighter rainfall will cause the most extensive flooding, for example in the Lower Adur catchment. Four critical storm durations that best represent these characteristics have been applied to the broad scale models to determine the resultant flows and flooding extents.

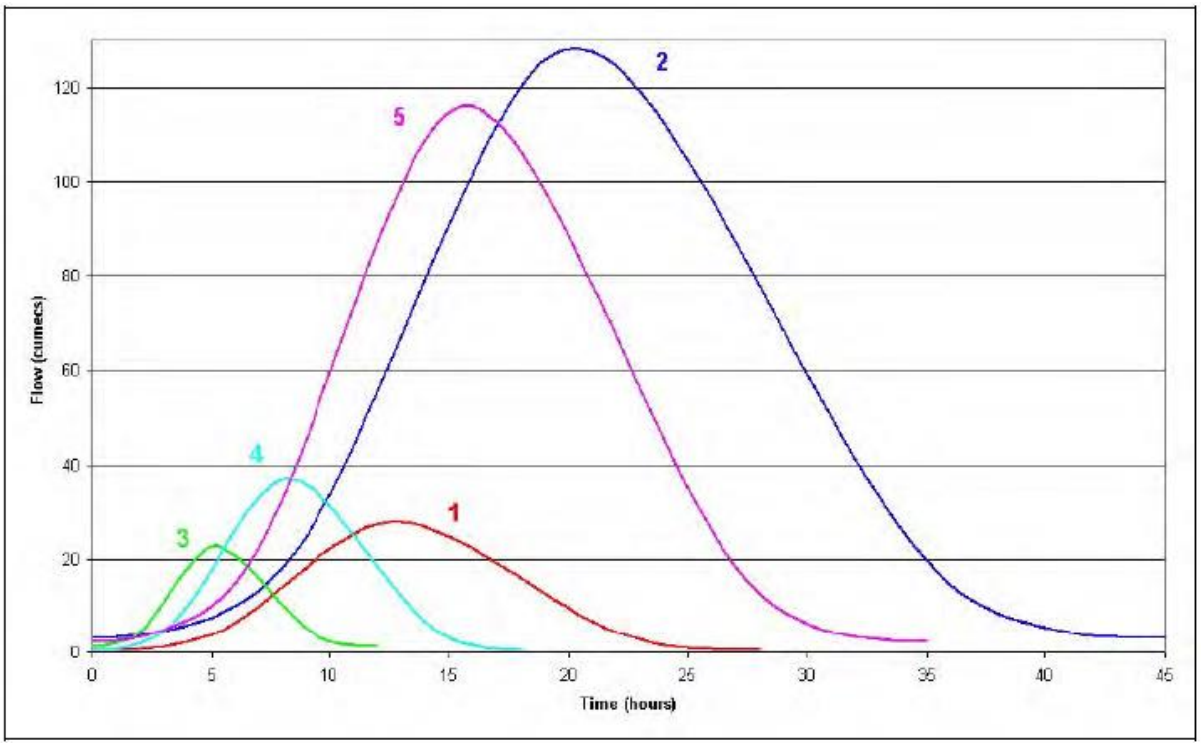

Figure 5 – Hydrographs for the River Adur (1% annual probability fluvial flood event)

Figure 5 shows the estimated flow hydrographs for the 1% annual probability fluvial flood and/or rainfall event at five locations in the Adur catchment. This was obtained using the Flood Estimation Handbook (FEH) Rainfall Runoff method. The hydrographs highlight the diverse scale, timings and range of peak flows throughout the upper Adur catchment, and highlight the relative timing of flow progression down the catchment.

Hydrograph 1 shows the flows in the upper reaches of the Adur West Branch. The catchment is largely rural and less steep than the East Branch, and so it responds slower to a rainstorm, taking approximately 12 hours to reach its peak.

Hydrograph 2 shows the flows in the lower reaches of the Adur West Branch, by which stage the flow is more than 120 cubic metres a second. It takes approximately 20 hours for this arm of the River Adur to reach its peak.

Hydrograph 3 shows the flows in the upper reaches of the Adur East Branch. This part of the catchment responds relatively fast to rainfall, which reflects the catchment's geology and topography and is partly due to the greater percentage of urban land cover. It takes less than five hours to reach its peak.

Hydrograph 4 shows a similar response to hydrograph 3 and is located on the upper Adur East Branch, with a relatively quick response to a heavy rainfall event (approximately seven hours). Again, this is due to the land cover, topography and geology of the area.

Hydrograph 5 shows the flow in the Adur East Branch. The total discharge from the eastern branch is significantly less than the Adur West Branch (indicated by comparing the area under the two hydrographs) and the peak flow is slightly lower (approximately 115 cubic metres a second).

The rate of response is more rapid, taking around 15 hours to reach the peak in the Adur East Branch compared with around 22 hours in the Adur West Branch.

For example, slowing the water down in one of the tributaries may benefit downstream by altering the timing of the flood peaks from the two River Adur Branches and thus reducing the flood peak in the Lower Adur. Natural Flood Management in the Upper Reaches of catchment reduces downstream flood risk and therefore should not be altered.

The National Standards on sustainable drainage requires surface water run-off to be discharged to the ground (infiltration), unless the likely rate of surface water run-off exceeds the capacity of the soil to absorb water (the infiltration rate). This exceedance of capacity might occur where the subsoil is heavy clay (and does not drain freely). This is particularly significant in a catchment on an impermeable clay base such as the Adur. SUDS will not always work when placed in areas of high soil moisture and groundwater conditions as there will be limited capacity to contain the necessary amount of flood water.

Relying on the collection of surface water run-off through the installation of SUDS does not necessarily provide a "cure-all" solution to the issues of localised flooding as, whilst retention ponds and lakes will collect surface water runoff, unless they are able to drain quickly they are not able to collect additional water from a following rainfall event. This situation is more likely to occur in lowland, clay geology area where soil moisture levels remain high following rainfall events due to the lack of permeability in the substrate. This situation is exacerbated by the regular lack of consideration to ongoing management and maintenance of SUDS schemes which can be costly due to the nature of sediments which collect within them. Additionally, whilst Sustainable Urban Drainage Schemes (SUDS) are often proposed and accepted, these do not work effectively in situations where a high level tide restricts discharge, whether direct to the watercourse or through permeation into the soil.

The existing surface water and channel slopes contribute to the timings of flood flows. SUDS on a larger scale development could, if not adequately designed with a long term management plan, upset what is a balanced water level management system. The importance of the Flood Risk Assessment and the potential to increasing flood risk to existing property and infrastructure must be considered in more detail by the developers and local authority before making decisions based on outdated and incorrect flood maps generated through computer models.

Concerns

Proposed significant developments near to the River Adur East Branch of the catchment increase local flooding potential, e.g. the Northern Arc in the Burgess Hill area, are situated with only Pook Bourne Stream, Copyhold Gill and Valebridge Pond in the vicinity. Similar impact is also evident on the Adur West Branch with development from Partridge Green and as far as Southwater / Coolham areas.

Over the past 30/40 years the amount of surface water that rapidly enters the watercourse has increased in the upper catchment due, in part, from developments such as Burgess Hill, Wivelsfield, Haywards Heath, Henfield and Partridge Green to name a few. Due primarily to development during the same period the flood plain area has decreased and rivers and streams are disconnected from their natural floodplains. This results in water being constrained in channels which are too deep and wide and used purely for the rapid conveyance of water downstream where inevitably pinch points are met, often in built up areas as a result of infrastructure such as road bridges, and water floods into people's homes and disrupts day to day activities.

As a result roads are flooding with increased frequency and whilst only water entering a property is considered in terms of flood defence erection, the disruption to local travel and risk to people's health should not be overlooked by events outside of people's properties. Examples are that roads are flooded on the A281 at Shermanbury and roads at Sayers Common, Wineham and Twineham as well as the A2037 at Woods Mill. The writer has experienced water on the floor of the No.17 bus crossing the bridge at Shermanbury and is aware of a time when a bus was unable to steer and floated on the bridge. The A281 road often floods at Mock Bridge Shermanbury, as does the A2037 at Woods Mill, the B2116 from Henfield and the roads eastwards to the A23 through Wineham and Albourne roads.

There are several cases of people being rescued from their property, even taken out through the window by the services and cars being rescued from the flood waters particularly in the Henfield, Small Dole, and Shermanbury, Wineham, Twineham, Albourne, Bolney, and Sayers Common areas. Fire and Rescue recorded 131 incidents relating to flooding between April 2009 and March 2013.

A major concern of many landowners and farmers is that the Environment Agency were forced to withdraw from operating the Internal Drainage Board, an integral aspect of water level management, and non main river Ordinary Watercourses which have become the responsibility of landowners as the 'Riparian Owner' overseen by the local authority. There is the potential for increased flood risk if these are not correctly maintained and holistically throughout the catchment.

Water level management is important for the farming practices, specifically for irrigation, abstraction, and livestock. Some landowners are in wetland management schemes or have long term stewardship agreements which require activities relating to current water behaviour to be undertaken. All of this needs to be balanced with the tidal impact and considered alongside the lack of upstream catchment management to reduce flood risk further down in the catchment.

We are in the early stages of a new devolved arrangement to manage the historic Internal Drainage Board area, with the exception of Bramber where special measures were put in place due to the exceptionally high flows that can occur in the lower catchment (WSCC taking on responsibility for St Mary's watercourse). This also takes place up stream of the River Adur as far a Shermanbury but is not currently considered as critical as Bramber due to reduced numbers of at risk properties.

No account has been taken by any significant development of the wider impact it will have on in-channel conditions including quantity and velocity of water in the channel at any one time or what the potential impact could be to places such as Bramber, especially in light of the various sea level rises which are predicted over the next few decades. An example is from the South East Catchment Plan that the River Adur responds fast to heavy rainfall increasing river flow and river levels, especially when at high tide conditions and extreme storm surge events the floodplains rapidly operate to full capacity. Thus no development should be allowed in Flood Zones 2 and 3.

Currently the Environment Agency has commissioned a Floodplain Remodelling project which will be significant and should inform on future development within the catchment and this application should not be being considered until the results of these updated flood models have been made publically available. It is recognised by the Horsham Strategic Flood Risk Assessment (SFRA) that watercourses in the upper catchment and the West Branch of the Adur catchment respond rapidly to rainfall due to the generally impermeable surface (Weald clay). The same applies to the Adur Eastern Branch, part of which is in Mid Sussex DC area and includes the Bolney Sewer, Herrings Stream, Copyhold Gill, Pook Bourne Stream near Burgess Hill, and Valebridge Pond near Haywards Heath.

It is unacceptable for developers and Authorities to decide that there is no significant history of flooding in this catchment area, whilst the Horsham SFRA also suggests there is no significant history of flooding. Certainly local landowners, farmers and residents of the community are aware of flooding as can be seen from the various letters that were received by West Sussex County Times. However, Horsham SFRA notes that there is a potential for direct runoff of steeper slopes and I would add this applies across the River Adur East Branch and the wider upper catchment area of the

Low Weald into the Mid Sussex DC. The river within the Low Weald forms a low gradient with deep incisive valleys in places with wet grazing meadows and pockets of wet woodland, all of which are regionally rare habitats which depend on water levels being maintained.

It should be obvious that property owners are reluctant to report flooding to authorities due to the potential impact of an insurance increase or refusal and also to avoid a detrimental record on their property when it comes to sale value etc. Thus no reported records are held by authorities of flooding in certain areas where flooding exists and properties have flooded. However, local community knowledge needs to be considered along with any records, or paucity of, that exist of flood events as this local knowledge is of greater worth than local authority records.

Whilst the authorities indicate no record of flooding, the correct indication to the question of whether there is a flood risk in Upper Adur Catchment area is Yes. When tide locked river is tide locked and flood water cannot flow down the River Adur due to high tide level, there will be further impact on flooding of the upper catchment area due to any increase in development. Currently flooding occurs, which is unable to effectively discharge surface flood water to the Lower Adur. Also the fluvial flooding of the tributaries of the River Adur East Branch in the Upper Catchment, particularly around Wineham, Shermanbury Henfield, and Bramber will be significantly impacted by any future further development and runoff.

Another consideration is the June 2014 Meteorological Office report into future climate change over the next 15 years and other recent world wide Climate Change reports which suggest the impact will be wetter summers and greater intensity of rainfall as well as drought, therefore we should look forward 30 – 60 years and beyond in making assessments about development in such proximity to complex river systems.

No updated River Adur Catchment Management Plan exists from the authorities. The last one was March 2008 and a critical factor is to reduce current flood risk through increased floodplain connectivity in places to reduce the impact flooding. Any significant development reduces the availability of floodplain areas and prevents future proofing against flood risk for existing infrastructure and the towns and villages within the local area.

The Local Water Environment

The National Planning Policy Framework (paragraph 170e) states that

'*Planning policies and decisions should contribute to and enhance the natural and local environment by: preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans*'

The South East River Basin Management Plan indicates that 43% of water bodies in the River Basin District are affected by physical modifications which alter natural flow levels, cause excessive build up of sediment, and cause the loss of habitat. In addition, 40% of water bodies are affected by pollution from waste water, specifically where sewage treatment technology to remove enough of

the phosphorus and harmful chemicals doesn't exist, from leakages from privately owned septic tanks and, in wet weather, storm overflows can discharge untreated sewage directly into a watercourse. Furthermore 9% of water bodies are already impacted by pollution from towns, cities and transport with rooftop, road and pavement runoff carrying pollutants, including grit, bacteria, oils, metals, vehicle emissions, detergent and road salt drains to surface waters.

The development of 7,000 new houses within close proximity to surface waterbodies within the Adur catchment will increase pressure on the water environment and this proposal fails to appropriately take into account recommendations within the South East River Basin Management Plan such as making improvements to conditions of river channels and beds/banks, reducing point source pollution from urban runoff and reducing diffuse pollution pathways to receptors.

Policy 38 of the current Horsham District Council Planning Framework states '*Development proposals will: Be in accordance with the objective of the Water Framework Directive, and accord with the findings of the Gatwick Sub Region Water Cycle Study in order to maintain water quality and water availability in rivers and wetlands and wastewater treatment requirements*.'

Current plans under the proposal to significantly develop within close proximity of the Chess Stream and Adur East (Sakeham) waterbodies which are classified as being at "Moderate" and "Poor" ecological status respectively. In addition the downstream waterbody Adur (Lockbridge) is also classified as "Poor". All of these waterbodies fail to meet the criteria for Good Ecological Status due to both Biological and Physico-Chemical issues, specifically levels of phosphate and diminished fish populations. These waterbodies should not be put under further pressure or further degraded but rather enhanced and protected. Three of the eight (Chess Stream) and two of the seven (Sakeham) reasons for not achieving Good Ecological Status are cited as being from point source pollution attributed to sewage discharges and further discharges or higher discharge loads would be of detriment to the local and wider catchment water environment.

Article 1.a of the Water Framework Directive unequivocally prevents "further deterioration" of aquatic ecosystems and this legal requirement has not been considered adequately by this proposal. Whilst the developers have followed both NPPF and Local Plan requirements for SUDS and the potential for water quality risks to be mitigated by these measures if appropriately installed. However, the success of these initiatives is entirely dependent on not only a working scheme in the first place but also the requirement for ongoing management and maintenance to keep them in working condition.

Therefore, we are concerned that, by permitting a development of this scale, the council will be failing in its duties to have regard to the Water Framework Directive and contravening both the NPPF and your own planning policy (Policy 38 of the HDPF). Whilst understanding that SUDS can ameliorate some issues, the sheer number of people, cars, road and waste water requirements will be very hard to mitigate in terms of adequate protection to the watercourses and, when combined with the risks of urban pollution such as rubbish and other debris, we are further concerned that these already pressurised environments will be further degraded.

Landscape Character

The landscape character areas (LCA) - See Fig. 4 above. The northwest and central Adur catchment area is dominated by the Low Weald, an area of low-lying and gently undulating clay vales creating a more enclosed small-scale character.

The landscape here is a mixture of fields and hedgerows, well mixed with woodland. Surface water features are more frequent, with an abundance of ponds and small streams with associated sparse pockets of wet woodland habitat. The character is predominantly rural with scattered small settlements and villages. The central catchment of the Low Weald contains noticeably fewer habitat types and has poor natural habitat cover.

Rivers within the Low Weald form deep incisive valleys with some wet grazing meadows and pockets of wet woodland. This contrasts with the drier upland areas with a lack of habitat due to intensive farming and associated drainage works, and the historical modification of the river channel.

Wealden Greensand is a small pocket of this landscape type near the western edge of the catchment area. The South Downs is the chalk outcrop that rises gently from the coast with a characteristic north facing scarp and distinctive chalk cliffs forming at the coast.

Natural habitat areas are more abundant within the South Downs than the adjacent Low Weald, with areas of coastal and floodplain grazing marsh associated with the River Adur valley and a narrow band of varying habitat types along the dip slope of the chalk block, which lays within the Beeding Hill to Newtimber Hill a Site of Special Scientific Interest.

Coastal Plain is the eastern edge of this type of landscape falls within the area, the most significant presence is to the west of the catchment area tapering out near Shoreham. The major urban areas of Worthing, and Brighton and Hove dominate this area.

This LCA is exposed to south-westerly winds, with relatively warm temperatures and high quality soils resulting in a long growing season and intensive farming. Large arable fields dominate the extensive and treeless lower plain. The lower plain is cut by southward-flowing streams, known locally as ‘rifes’, which have seasonally dry headwaters over the upper plain and into the Chalk dip slope of the South Downs.

Main species rich habitat groups

The South Downs is designated as a National Park under the National Parks and Access to the Countryside Act 1949, as amended by the Environment Act 1995. National Park status gives the South Downs greater protection through special powers under this designation.

Fisheries of the River Adur or its tributaries, however significant, have stretches that are designated. Designations of appropriate freshwater rivers and lakes fall into two categories: those suitable for Salmonids (fish that prefer clear faster flowing water such as Salmon and Trout but also Grayling)

and those suitable for Cyprinids (fish suited to slower flowing deeper water including Carp, Tench, Bream, Roach, Chub and Minnows). The River Adur catchment is an important sea trout spawning ground with many of the tributaries and feeder streams forming vital spawning areas for this species.

Out of bank river flow may cause fish to be displaced, stranding them in old water meadows and drainage ditch networks. Flooding can also impact on still water fisheries and fish farms within the floodplain and fish can be washed out of lakes and ponds into the river. This is of particular concern if non-native species are introduced to the river system.

Spring flood events can impact upon fish migration as Cyprinid and Salmonid juvenile fish can be washed out of the watercourse or washed above structures, where they can become trapped when levels drop again. Sediment washed into rivers during flood events can affect gravels and smother spawning and nursery areas.

The angling and Trout fishing offered by the River Adur, its tributaries and the still water bodies within the catchment are a major attraction and provide recreational access to the river as well as income to the local economy.

Wastewater

The planned loading on the Wastewater treatment plants (WwTP) is already allocated for development that has received planning approval. Any increase of a discharge to the watercourse from development at WwTPs will undoubtedly place further loading on the river due to discharge standards. Any increase in discharge of effluent to the watercourse will be of significant detriment to the watercourse, but further discharge from 7,000 new homes should be considered inappropriate in this location due to significant phosphate loads already seen (Ouse & Adur Rivers Trust Chemical Water Testing of the River Adur, Eastern Arm 2016-2019). This is particularly pertinent in low flow conditions when concentrations of pollutants are intensified, but also in high rainfall events when WwTPs can't process inputs and storm overflows allow untreated effluent to enter watercourses. Existing wastewater infrastructure is already overloaded and without a brand new, state of the art treatment plant being constructed there is a significant risk that 7000 new homes in this area would cause unacceptable damage to the water environment and the species which rely on it.

When the average velocity of a river or watercourse is altered by development the stability of the watercourse bed is upset. Any WwTP development must be designed not to upset the stability of the watercourse unless protection is given to watercourse and banks.

Risk and Mitigation

Risk	Mitigation Action (In place or planned)
Climate Change, rising sea and river levels, increase rainfall, long dry spells, declining groundwater water resources. Flooding and impact of potential large scale development that will affect the River Adur and watercourses / or the damage the environment with suffering that will occur as a result**.**	The Councils and Authorities address all aspects of climate change, consider the various reports, flood mapping/predictions and forecasts relating to climate change and development and address the issues and obligations to take action in preventing flooding and damage to the local environment.

Conclusion

The report endeavours to outline the various aspects of flooding, wastewater and the local environment of the River Adur which are of particular concern to the River Adur Parishes Group. It sets out various aspects as to how the river functions at times of various river conditions, the aim has been to briefly outline principles and cover concerns raised, in particular to focus on the impact of potential development and show how the climate conditions of rising sea levels and extreme rainfall events could impact the population, land and local environment.

This report shows how finely balanced the operating and maintenance activities of the river Adur and tributaries in the Upper and Lower water catchment areas are and the change to climate conditions will require to be addressed to prevent flooding and maintain the ecology of the area within the Parishes.

Recommendation

That the report be noted and actioned as part of Flood and Ecology concerns to the local environment of any proposed significant or large scale development.

If any large scale development is planned then flood risk, wastewater and the entire ecological function of the catchment must be fully considered and have full and comprehensive study / reports commissioned before further consideration for development is submitted or approved due to the delicate nature of the River Adur, its watercourses and the importance of protecting the local environment and communities.

Report by: John Donaldson from Water Industry experience and Peter King Director Ouse & Adur Rivers Trust September 2019

For: River Adur Parish Group**:-** Parish Councils: Albourne/ Ashurst / Bramber/ Cowfold / Henfield / Shermanbury / Twineham / Woodmancote.

Appendix

Photos

Flooding at Mock Bridge Shermanbury

Floodplain in action at Shermanbury above, below road towards Allbourne

Albourne Road

Albourne January 2015

Shermanbury

References:

South East River Basin Management Plan (2015)
HDC Strategic Flood Risk Assessment (FRA) April 2010
HDC FRA Sequential Test Planning Framework April 2014
WSCC West Sussex Preliminary Flood Risk Assessment May 2011
WSCC Local Flood Risk Management Strategy Report June 2013
EA Strategic Flood Risk Assessment
EA Water for life and livelihoods - South East River Basin District Updated 2015
EA River Adur Catchment and River Adur East Branch ad Streams Oct. 2014
MSDC Landscape Character Assessment Low Weald Area 2005
Sussex Wildlife Trust
Rive Ouse and Adur Trust - Various catchment reports
Bramber PC - Assessment of the Flooding report of Bramber Nov. 2009

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River Adur Project Group
A Report of the impact of Building Large Developments Adjacent to the River Adur
Appendix 1 - West Sussex Flood Event 18th – 22nd December 2019

Major disruption and extensive floods with weather warnings took place during December 2019 with hundreds of flood warnings and alerts as the Britain continued to be battered by torrential rain, causing travel chaos for some due to heavy rain, flooded roads and surrounding land and in certain cases properties flooded amid the torrential weather conditions.

At Woodmancote and on the A281 near Shermanbury, West Sussex, cars became trapped during the night in flood water on 19th December and rescued by WSCC Henfield Fire Service. The Environment Agency said it is monitoring the situation and advised people to remain vigilant of the floods and major disruption due to high water tables and flood water in the West Sussex area.

Floodwater December 2019 near Henfield, West Sussex downstream of proposed Market Town

On the Friday 20th December the Environment Agency monitored the situation and the public were advised to continue remain vigilant. Pavements in Haywards Heath, West Sussex, came apart in the floods. Widespread flooding across fields in Burgess Hill and Shermanbury area took place with transport and bus services disrupted for 3 days whilst the A281 at Mock Bridge Shermanbury and Wineham Lane were closed on the 20th December due to the high water levels due to flooding of roads and surrounding land.

The Environment Agency issued 45 flood warnings and 192 flood alerts across large swathes of southern England and the Midlands where flooding closed roads, railways, homes and business premises flooded. The M23 was closed in both directions after it became badly flooded from the river Mole and flood water from nearby housing development.

Yellow weather warnings were issued by the Met Office for heavy rain that stayed in place until Sunday 22nd. Warnings that homes and businesses could be flooded, travel is likely to be severely disrupted – with some communities finding themselves cut off by flooded roads as the rush to get home for Christmas. Further rain arrived in the south through the nights of 20th and 21st December 2019.

Mock Bridge near Henfield, December 2019

The water levels of the River Adur at Sakeham Weir (near Shermanbury) in more extreme weather conditions are between 0.16m and 1.35m. So far it has been between these levels for 90% of the time since monitoring began and the river is tidal near this point.
A previous high level was 2.50m, reached on Tuesday 24th December 2013 at 4:45 am. This time the event on 21st December 2019 reached 2.51m at 10.45am.
If this event occurred at a spring high tide this would have very likely passed the highest level ever recorded at the River Adur at Sakeham Weir of 2.90m, previously reached on Thursday 12th October 2000 at 10:15 am.

At Bramber there was concern that the rising river level which was above the arch of the bridge and backing up, the Environment Agency were monitoring the situation of floodplain capacity. Temporary pumps were used at Mock Bridge near Shemanbury to reduce the flood water coming downstream approaching the bridge due to the severity of flooding and the risk to properties. Wineham was also severely flooded and the temporary No 17 bus service diversion from Shermanbury (which lasted 3 days) through Wineham was also suspended at times due to high flood water on the road at times.

The flooding of roads is of particular significance for future strategic planning as whilst houses may be built above future flood plains, roads and bridges will remain and become susceptible to flooding, the floodplain and land drainage capacity inadequate, causing severe disruption to local communities.

Coastal Flood levels for the 1 in 200-year event including the effects of climate change are predicted to rise in 2115 by 0.75m at current Shoreham Harbour Flood Defence Improvement Scheme (ref: Coast to Capital Strategic Economic Plan 2015 - JB Consultants). The difference between existing levels and the potential of 1 in 200 year event demonstrate the significant impact of flooding that is possible in the next 100 years from extreme events of predicted coastal levels as a result of climate change.

Fluvial Flooding as a result of housing development and climate change in the upper catchment of the River Adur is highly likely to be impacted by an increase flood levels predicted in coming years. This will occur due to the combined effect of river level and coastal sea levels rising and also the added discharges from new housing development.
New developments increase the discharge to rivers by as much of 4000 litres per dwelling per day. *Note*: *This is design peak flow rate not daily average water usage, and represents the peak flow rate from a number of appliances. Reducing daily water does not necessarily reduce peak flow rate (Water UK March 2019 / Sewers for Adoption 7th Edition).*

The December 2019 published Hydrological Summary for seven consecutive months confirmed that the UK rainfall has been above average, notably in the impoundments in southern Britain as a result water resources look healthy. High river flows, saturated soils, an early start to the water recharge season and exceptional high groundwater levels increase the risk of further fluvial and groundwater flooding during over the months of the water recharge season. In the River Adur catchment this is notable due to the reports of the catchment being continuously wet also throughout the summer period, thus leading to a greater potential for flooding.

The river Adur is rapidly responsive to rainfall due to the catchment of Weald Clay. Although no substantial abstraction takes place, the increase of water from new developments upstream at Burgess Hill, Cuckfield and Haywards Heath areas on the eastern arm have a substantial impact on flows and particularly at times of consistent rainfall. Climate change has increased frequency of winter and summer flooding (NRFA Dec.2019) a contributory factor along with new development.

Approaches to design and manage surface water that take account of volume of water (flooding), water quality (pollution), biodiversity (wildlife and plants) and amenity are collectively referred to as Sustainable Urban Drainage Systems (SuDS). Such drainage systems not only help in preventing floods, but also improve water quality. In addition they can enhance the physical environment and wildlife habitats in urban areas.

A key characteristic of many artificial urban drainage systems, as compared with natural systems, is a more rapid build-up of flows and higher peaks, causing an increase in flood risk. It is possible to return the catchment response to a more natural state by using more natural methods of drainage. These use the infiltration and storage properties of semi-natural devices such as infiltration trenches and swales or ponds, all of which slow down the catchment response, reducing the peak outflow and thus lowering the flood risk provided they are correctly designed and approved.

SuDS devices are most effective in combination, in the form of a ‘management train’. Wherever possible, stormwater should be managed in small, cost-effective landscape features located within small sub-catchments, rather than being conveyed to and managed in large systems at the bottom of drainage areas. Water should be conveyed elsewhere only if it cannot be dealt with locally.

Drainage systems, SuDS are designed to provide capacity for a storm event of a particular frequency. For more extreme events, exceedance flows are likely to be generated and must be carried by the major drainage system. In the case on floodwater attenuation it will not drain on a clay catchment and particularly where the discharge is under a tidal influence such as Shermanbury area. In such the cases

where the catchment cannot freely discharge drainage water a further increased flooding of surrounding land takes place.

This is why the floodplains essential for storage of flood waters and additional storage of flood water on the floodplain will reduce flooding downstream. Schemes to increase floodplains and remove embankments need to be a high priority and considered and modelling take place in the strategic flood planning before new development takes place.

All water discharges from developments and SuDS must be designed and constructed to operate within the highest industry and regulation / authority standards and be formally and independently checked and approved in order to limit the impact of flooding and discharges to the watercourses. This also applies to all development relating to the environment and discharges to the River Adur Upper and Lower Catchments and watercourses particularly up stream of the confluence at Henfield and Shermanbury.

September 2019
Photos below are examples of River Adur at Upper Beeding Bridge around 29th/30th September 19. High tide approx. 6.9 metres. Local flooding and the river level are near maximum flow with little capacity remaining between the water and the top of the bridge arch. The rainfall was not particularly excessive and the catchment levels will rise further during the winter months when undoubtedly a greater rainfall is likely to result in extensive flooding.

A Report on the Potential Impact of Large Scale Housing Developments on the River Adur.

An Analysis of Water Environment, Resources and Wastewater Implications - Appendix 2

Planning

NPPF includes ensuring that flood risks are taken into account at all stages of the planning process. All forms of flooding need to be addressed to and from the development and it needs to be demonstrated how these flood risks will be managed so that the development remains safe throughout the lifetime, taking into account climate change and future flood risk.

For a Sequential Test of Flood Risk and the Flood Zones it needs to be demonstrated that within the local district (Horsham DC) and all adjoining Districts and those in the River Adur water catchment that there are no alternative sites with a lower risk of flooding that could be used for the proposed development.

NPPF classifies flood risk into four different zones of probability flood zone 1 (low probability), flood zone 2 (medium probability), flood zone 3a (high probability) and flood zone 3b (functional floodplain). These zones are set out in Strategic Flood Risk Assessments which are used to inform decisions regarding development and flood risk. Current planning laws direct development away from flood risk areas, however there remains an emphasis on development and the economy.

Summary of River Adur Catchment Flood Management Plan
(Managing Flood Risk- Environment Agency)

Policy 6 – Upper Adur is to reduce the risk in Steyning and Upper Beeding by creating wetland habitat achieved primarily through changes in the way land is used and managed. Changing practices in the way that land has been used and the river managed to reduce soil erosion and run-off. Land use changes will result in more flood plain being wet grassland of high value to wildlife. River allowed behaving naturally with more flooding in the floodplain and more natural features. The additional storage of flood waters on the flood plains will reduce flood risk downstream.

Policy 4 – Burgess Hill Implementing policy will support urban growth needed in the Burgess Hill area. Implications are in the hands of planning authority. An important part of the policy working with planning authorities was to achieve sensible and sustainable responses to flood risk, including the impact of surface water flooding.

Climate Change

The effect of climate change needs to be given serious consideration in the development plans with the impact from rising coastal sea levels and increase of large scale housing development resulting in wastewater and surface water discharges to the River Adur upper catchment area around Henfield, Shermanbury and Wineham areas.

As an example of climate change and impact of future sea levels are being taken into account in the design of coastal wall defences at the estuary of the River Adur to prevent flooding. The scheme has flood mitigation options to further increase the height of flood walls and even considered a form of barrage, such forward planning of flood prevention is needed in development and infrastructure.

Examples are sea levels are predicted to rise at Shoreham Western Harbour Arm Defences by 0.75meter by 2115 (Adur DC appointed JBA consultants -2015).

The new 1.9km scheme recently completed in 2019 has designed for 1 in 200year event to include climate change to protect Shoreham. The significant depth of flooding possible looking ahead 100 years at an extreme event based on Still Water Levels at Sussex Yacht Club : increase over the years are:- 2016 4.33m AOD, 2035 4.45m AOD, 2070 4.69m AOD, 2082 4.79m AOD and 2115 5.08m AOD.

A similar approach should be taken by a strategic flood risk for any construction of large developments adjacent to the river Adur, when local planning authorities consider applications. Development will result in a significant impact on the capacity and floodplains of the River Adur to function particularly at the times of high tides in extreme flood conditions.

Potential development to fully implement the effect of climate change, address flooding and surface water along with the protection of designated wet grassland land, farming and wildlife all acting as a natural water catchment and habitat.

Characteristics

The river Adur contains 55 miles of main river, 30 miles of which is embanked and there is 30 miles of drainage ditches of which 1.7 miles are embanked. The main river is split into two branches east and west to the west of Henfield, the west branch drains the north side of the South Downs from Washington north to Itchingfield taking in Southwater along the north ridge to West Grinstead. The eastern Arm drains from West Grinstead along the north ridge to Lower beeding along to Haywards Heath then south to Ditching taking in Cuckfield, Burgess Hill and along the north side of the Downs to Shoreham and other villages such as Cowfold, Bolney , Hurstpierpoint etc.

The river Adur is known as a flashy river and rapidly responds to rainfall due to the impermeable nature due to the characteristic of the catchment predominately being underlain by Weald Clay (SFRA Horsham DC).

The river Adur discharges at Shoreham which is tidal up to Partridge Green near Henfield. Several wastewater works discharge, 14 in total the largest is Cuckfield Goddards Green and several other significant works at Southwater, Steyning, Henfield along with others and private plants discharge to numerous tributaries and surface water drains which all add to the flows particularly on the eastern arm down river to Upper Beeding and Bramber.

The river Adur is tidal up to near Partridge Green and spring tides and sea conditions with a severe wind and storm surge have a significant impact on flooding in the catchment area especially following periods of heavy rain, which in the past 20 years has become more frequent. This has an even greater impact on the eastern arm of the river Adur from Shermanbury / Henfield up to Burgess Hill and Haywards Heath again there has been an increased level of flooding due to the development that has taken place over the past 50 years.

Following the period of floods in the 30s – 70s that emphasis was placed on dredging the river to gain maximum capacity for the discharge of flood water within the river Adur and eventually out to sea at Shoreham.

The river Adur restrictions are at the greatest following heavy rain in the upper catchment area and the restriction of bridges across the river on the A281 at Mock Bridge near Shermanbury and also the at the Upper Beeding Bridge and Bramber Bridge, all of which in a flood event at result in severely restricting the flow of flood water discharging down the Adur at times of high tide during such exceptional conditions. These flood events now occur more frequently that in the period of the last century.

Flood Events

Following the flooding events from 1980s to 2005 the government commissioned the 2008 Pitt Review which highlighted the potential to work with natural processes in catchments and hold back water. The report followed several flood events to look at ways of alternative and Natural River management in which was adopted in the river Adur. A new way of river management by retaining water in the upper catchment, by natural vegetation and barriers of undergrowth. This has made significant contribution to conservation with increased habitat and the conservation of wet area and catchments of the natural river environment, as opposed to the previous hard dredging regime by machine of the river bed and cutting of banks. This has resulted in increased river levels due to the channel bed being no longer dredged along with a number of the existing sluices and gates being removed to benefit the wetter catchments and wet grassland for habitat and conservation. It also retains flood water in the upper catchment for slow release and prevents flooding downstream.

Weather Events

The impact of all the existing development along with the climate change that's taken place has increased river levels and flow resulting in the upper catchments consequently a greater increased in use of the floodplains over the past 30/40 years which just about manage to hold the flood water as they were designed. This occurs more often say every 3/5 years where flood water due to heavy rainfall and surface water floods roads and land extensively due to the river and floodplains being no longer capable to deal with the flood water.

With the increase in wetter catchments and river levels a combination resulting from a reduction in dredging the river bed and sides, increase in rainfall and intensity and at times along with the volume has increased the flood events. Additional discharges of surface and wastewater from development that has taken place has increased the flood levels dramatically in the past 20 years particularly in the eastern arm.

In the December 2019 flood event due to the tidal conditions preventing the flood water to discharge along with the flood water coming down the river from the upper catchment, at the turn of the tide the river height remained at the same level of at least an hour and half before the river level came off maximum height. This was due in part to the heavy rainfall, volume of flood water over a vast area around Shermanbery/ Wineham and up towards Burgess Hill and the ground conditions being totally waterlogged on the Weald Clay for a long period preceding of weeks before the flood event of high water table.

The impact of the Environment and Climate Change in Future Infrastructure and Demand Natural Infrastructure Commission (NIC) June 2917 made various recommendations. The NIC

recommendations on “Reducing the risk of drought and flooding- Chapter No. 5 on Building resilience in the face of climate change National Infrastructure Assessment mentions:-

- The Environment Agency should update plans for all catchments and coastal cells in England before the end of 2023. These should identify how risk can be managed most effectively using a combination of measures including green and grey infrastructure, spatial planning and property level measures

As the proposed the large scale development will fall within the recommendation and it is therefore essential that a strategic approach is now being considered for the entire river Adur catchment in full consultation with planners, District and Parish Councils, particularly following recent floods and development proposals.

Flood Mitigation

Flood mitigation is to plan and deal with flooding and increase in volume of flood water for the entire river Adur catchment, undertake surveys and flood mapping to address the issue to allow planned new development take place and remain safe throughout the lifetime, taking into account climate change and future flood risk. Place restrictions to protect the lower sections of the eastern and western arms from development impact on the river Adur and localised flooding and not to allow any increase the flooding downstream.

Naturalise the upper parts of the river Adur catchments to retain water and increase habitat and groundwater and retain water, plan to increase floodplain storage.

Develop a catchment flood strategy to retain and hold in floodplain effectively the flood water that is already coming from Haywards Heath and Burgess Hill developments that is only likely to increase over the next 15/20 years. Take off the excess flows into new floodplains and attenuation to deal with the volume of water local to the source.

Such a strategy will therefore relieve the current pressure on the areas downstream and allow containing the impact upstream from increased river levels resulting from climate change sea level / tidal increase and new development.

As the sea levels increase over the coming years so will the tidal limit move up river from the present tidal point at Partridge Green, which will increase the river level up to the new tidal points up the western Adur arm and particularly the eastern Adur arm. Particularly significant where we already have widespread flooding of land and use of floodplains at times of extreme weather that’s become more frequently in the past 20 years.

Wastewater

An example of the wastewater from a development of 7,000 homes as well as commercial, health and educational facilities etc. calculated in accordance with the Sewers for Adoption 7th Edition will be a Dry Weather Flow of 4,200 cume / day. This does not consider additional site facilities and surface water that will also impact of the river levels.

The hydraulic and ecological impact the watercourse and Henfield WwTW is unknown. This will considerably increase the size of the existing WwTW and the treated water quality and discharge to

the watercourse. There will be potential issues (particularly in dry weather summer flows) and impact on the water environment and receiving watercourse.

Any wastewater (WwTW) infrastructure and effluent discharge to the watercourse and river will require stringent consent by Environment Agency with Southern Water, and is likely to have the potential of a negative impact on the water quality and habitat of the watercourse.

Summary

Currently there is no infrastructure for dealing with the new development in terms of wastewater and surface water drainage discharges that impact on flooding, water catchment ecology and the various issues of potential increase water on the River Adur and adjoining watercourses.

In outline DERFA and particularly the local and farming community, Ouse and Adur Rivers Trust, Natural England, Sussex Wildlife, West Sussex Local Flood Authority and Environment Agency along with the planning authorities have all been working to reducing flooding. However due to climate change, the amount of development that has taken place, planning for the future with an updated strategic flood risk plan is required with forward thinking planning.

The existing Flood Risk Plans and Catchment Plans need to be updated. The need for a better understanding and impact of new development with the main authorities/bodies, planners on climate change and flood risk of the river Adur catchment.

Strategic plans that will avoid extreme flooding in areas of high and medium probability, linked to the protection of the ecology and habitat. Address the use of additional storage of flood water to deal with the surface water management or mitigate SuDS technique in Weald Clay.

End. v2 4.3.2020