

14. WATER RESOURCES AND FLOOD RISK

Introduction

- 14.1 This chapter of the ES assesses the likely significant effects of the Development on the environment in respect of water resources and flood risk.

Policy Context

National Planning Policy Frameworkⁱ

- 14.2 The NPPF sets out the Government's planning policies for England and how they are expected to be applied. In terms of Water Resources and Flood Risk, the NPPF sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow, with a view to achieving sustainable development.
- 14.3 Footnote 50 to the NPPF (February 2019) states that a site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

Planning Practice Guidanceⁱⁱ

- 14.4 To accompany the NPPF, the web-based Planning Practice Guidance (PPG) provides additional technical guidance on flood risk and coastal change. The PPG retains key elements of former Planning Policy Statement (PPS) 25 Development and Flood Riskⁱⁱⁱ (rescinded on adoption of the NPPF) as an interim measure, pending a wider review of guidance to support planning policy. The original technical guidance published in 2012 has now been replaced by this web-based resource.
- 14.5 In terms of the general planning approach to development and flood risk, the Flood Risk and Coastal Change PPG sets out the following main steps to be followed:
- Assess Flood Risk;
 - Avoid Flood Risk; and

- Manage and Mitigate Flood Risk.

- 14.6 The guidelines also state that in plan-making, local planning authorities apply a sequential approach to site selection so that development is, as far as reasonably possible, located where the risk of flooding (from all sources) is lowest, taking account of climate change and the vulnerability of future uses to flood risk. In plan-making this involves applying the 'Sequential Test' to Local Plans and, if needed, the 'Exception Test' to Local Plans. Guidance on when and how should the 'Sequential' and 'Exception' Tests be applied to planning applications is also provided in the PPG.
- 14.7 In addition, the guidelines reiterate that local planning authorities and developers should seek flood risk management opportunities (e.g. safeguarding land), and to reduce the causes and impacts of flooding (e.g. through the use of sustainable drainage systems in developments).
- 14.8 Additionally, the guidelines note that when considering a major development, as defined in the Town and Country Planning (Development Management Procedure) (England) Order 2015, sustainable drainage systems should be provided unless demonstrated to be inappropriate.
- 14.9 Table 1 within section 25 Flood and Flood Risk Tables, defines the Flood Zones and the respective level of flood risk. Zone 1 depicts an area of low (<1 in 1000 year) probability. In contrast zone 3b represents a functional floodplain, where water has to flow or be stored in times of flooding.
- 14.10 The PPG also contains a section on water supply, wastewater and water quality. This guidance indicates that water supply is unlikely to be a consideration for most planning applications as water supply is normally addressed through the Local Plan. With regards to water quality, the guidance states that it is only likely to be a significant planning concern when a proposal would:
- Involve physical modifications to a water body such as flood storage areas, channel diversions and dredging, removing natural barriers, construction of new locks, new culverts, major bridges, new barrages/dams, new weirs (including for hydropower) and removal of existing weirs; and/or
 - Indirectly affect water bodies, for example:
 - As a result of new development such as the redevelopment of land that may be affected by contamination, mineral workings, water or wastewater treatment, waste management facilities and transport schemes including culverts and bridges; and
 - Through a lack of adequate infrastructure to deal with wastewater.

National Standards for Sustainable Drainage Systems^{iv}, 2011

- 14.11 The Government is working closely with the Environment Agency (EA), Local Authorities and House Builders to develop a set of National Standards for sustainable drainage. The standards aim to reflect the need to reduce flood risk from surface water, improve water quality, improve the environment, and also ensure that the Sustainable Drainage Systems (SuDS) are robust, safe, and affordable and that requirements are predictable. The National Standards for Sustainable Drainage Systems were published for consultation in December 2011 but have not yet been adopted.

Local Planning Policy

Adoption Arun Local Plan 2011-2031 (July 2018)^v

- 14.12 The Arun Local Plan guides future development in the district up to 2031. The policies which are relevant to water resources are summarised below.
- 14.13 Policy W SP1 addresses the quality and availability of water resources. Arun District Council (ADC) highlight that climate change is likely to increase the risk of flooding in the district from rivers and the sea.
- 14.14 Under this policy, development will be encouraged to make active use of surface water as a design feature and permitted where it identifies measures to improve and enhance waterbodies, coastal habitats or provides additional flood relief.
- 14.15 Policy W DM1 covers water supply and water quality. Developments will be permitted where supplies can be provided prior to occupation to serve the development. In addition, the provision a water supply must not be considered detrimental to existing abstractions, river flows, water quality, fisheries, amenity or nature conservation.
- 14.16 To ensure good water quality all major developments must illustrate, where necessary, how they have contributed to the protection and enhancement of waterbodies. Where foul and surface water discharges to existing infrastructure adequate drainage capacity must exist. Any requirement to upgrade facilities must be undertaken prior to the completion and occupation of the development.
- 14.17 Policy W DM2 advises that development in areas at risk of flooding will only be permitted where the following criteria have been satisfied:

- The sequential test in accordance with NPPF has been met;
- A site specific Flood Risk Assessment (FRA) demonstrates that the development will be safe, including access and egress, without increasing flood risk elsewhere and reduce flood risk overall;
- The sustainability benefits to the wider community are clearly identified;
- The scheme identifies adaptation and mitigation measures;
- Appropriate flood warning and evacuation plans are put in place; and
- New site drainage systems are designed to take into account of events which exceed the normal design standard.

14.18 Policy W DM3 requires all developments to incorporate a range of Sustainable Urban Drainage Systems (SuDS) to increase the levels of water capture and storage and improve water quality. Major developments shall integrate SuDS into the overall design within public open spaces and roads.

14.19 Policy W DM4 outlines the requirements for coastal protection and sea defence works.

14.20 The Adoption Arun Local Plan 2011-2031 includes Maps 1 to 4 which identify Strategic Housing Allocation sites.

14.21 The Local Plan advises that in considering new locations for development, and to minimise future risks, it is important that developers consult the latest Strategic Flood Risk Assessment (SFRA) which details the extent of hydraulic modelling, existing flood defences and the extent of fluvial, tidal, historic incidents of sewer flooding and the speeds and depths associated with this, as well as areas prone to flooding in addition to the EA flood maps to ensure that development is avoided in areas at risk from flooding, or likely to be at risk as a result of climate change, or in areas where development is likely to increase flooding elsewhere.

14.22 The current SFRA is the Arun District Council Level 1 and 2 Strategic Flood Risk Assessment Final Report, November 2016, Report Reference Final v5.0, prepared by JBA Consulting ^{vi}.

Legislative Context

Water Framework Directive, 2000^{vii}

14.23 The Water Framework Directive 2000/60/EC (WFD) applies to all European Union (EU) water bodies and aims to make sure they are protected from further deterioration, and that improvements in water quality are made. The assessment and protection of water bodies

should be undertaken irrespective of political or administrative boundaries by implementing River Basin Management Plans to be prepared within a formal series of six year cycles, following the identification of River Basin Districts. In general terms, there is an onus on developers to protect and, if possible, enhance water bodies close to proposed developments.

Flood Directive, 2007^{viii}

- 14.24 The Flood Directive 2007/60/EC came into force in November 2007. This Directive requires Member States to assess whether watercourses and coastlines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk. The Directive requires Member States to carry out a preliminary assessment of flood risk by 2011, to draw up flood risk maps by 2013 and to establish flood risk management plans focused on prevention, protection and preparedness by 2015. The Directive is to be implemented in co-ordination with the Water Framework Directive.

Water Resources Act, 1991 (Amendment) (England and Wales) Regulations, 2009^{ix}

- 14.25 The Water Resources Act (as amended by the Water Resources Act 1991 Regulations 2009) relates to the control of the water environment. The main aspects of the Act (as amended) which are relevant to the Development include provisions concerning land drainage, flood mitigation and controlling discharges to watercourses to prevent water pollution. It also outlines the functions and responsibility of the EA in regulating the water environment.

Water Industry Act, 1991^x

- 14.26 The Water Industry Act consolidates previous legislation on water supply and sewerage services and covers a wide range of activities required of the privatised water companies that were created in 1989. The main relevant provisions relate to trade effluent discharges made to sewer for which the privatised companies act as the regulatory authorities.

Water Act 2003^{xi}

- 14.27 The Water Act 2003 amends the Water Resources Act 1991 and the Water Industry Act 1991. The Act brings about a number of changes, including streamlining arrangements for flood defence organisation and funding and changes to the types of abstraction licences, and places a duty on water companies to conserve water and prepare for drought.

Water Environment (Water Framework Directive) (England and Wales) Regulations 2003^{xii}

- 14.28 This transposes the requirements of the WFD into UK law. Eleven River Basin Districts have been identified in England and Wales. The Regulations include a requirement for water bodies (categorised as: 'rivers'; 'lakes'; 'transitional waters'; 'coastal waters'; or 'groundwaters') to achieve 'good' status with respect to ecology and water chemistry by 2015. Progress is monitored by the EA in its role as the 'competent authority'.

Flood and Water Management Act, 2010^{xiii}

- 14.29 The Flood and Water Management Act implements the recommendations from Sir Michael Pitt's Review of the floods in 2007 and places a series of responsibilities on County and Unitary Councils as Lead Local Flood Authorities (LLFAs) with the intention of improving flood risk management. It also removes the automatic right of connection into public water sewers and places the onus on LAs to adopt SuDS.

Environment Act 1995^{xiv}

- 14.30 The Environment Act 1995 (Section 57) makes provisions for a risk based framework for the identification, assessment and management of contaminated land within the UK. The provisions of the Act came into effect in April 2000 and are aimed at ensuring that actions taken with respect to contaminated land are directed by a technical assessment of risk that exists in the source/pathway/receptor scenario (pollutant linkage). This extends to preventing the contamination of controlled waters.

Assessment Methodology**Baseline Data Collection and Sources***Information Obtained and Reviewed*

- 14.31 The Site has been assessed for water resources and flood risk based on the following information:
- 14.32 **A topographical survey of the Site:** A topographical survey has been carried out by CD Surveys Ltd, Drawing Number WD/1704042/OS, titled Topographical Overall Layout, dated August 2017^{xv}.
- 14.33 **Environment Agency Flood Maps and Modelled Flood Level Data** (Product 4 Detailed

Flood Risk Assessment data) was received from the EA on 18 July 2018^{xvi}. This included:

- Flood Defence Map (Defences EA Maintained);
- Flood Map for Planning (Rivers and Sea);
- Flood Risk Water Level and Depth Data;
- Site Boundary and Node Point Map for Water Level and Depth Data;
- Modelled Flood Outlines (Undefended Tidal) Map; and
- Risk of Flooding from Surface Water Map.

14.34 **A Flood Risk from Reservoirs Map** was obtained from the GOV.UK Long term flood risk information website (<https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>)^{xvii}.

14.35 **Ordnance Survey Mapping to Assess Hydrology**: Ordnance Survey mapping^{xviii} has been used to identify minor or unnamed watercourses which may be present on the Site or in the local area. This has been reviewed against the topographical survey of the Site to confirm the presence of watercourses and ditches.

14.36 **British Geological Survey (BGS) Mapping to Assess Geology**: BGS maps^{xix} were used to initially assess bedrock and superficial geology in the vicinity of the Site. In addition, BGS borehole records, both on site and in the immediate vicinity, were used to clarify ground conditions across the Site.

14.37 **Strategic Flood Risk Assessment (Strategic Environmental Assessment) (SFRA(SEA))**: A review of the SFRA(SEA) has been carried out to understand any significant environmental effects arising from the SFRA. The SFRA(SEA) was prepared for West Sussex County Council (WSCC) in June 2013^{xx}.

14.38 **Local Flood Risk Management Strategy (LFRMS)**: A review of the LFRMS has been carried out to understand how the LLFA proposes to work alongside other risk management authorities to deliver surface water improvement. The LFRMS was prepared for WSCC in May 2014^{xxi}.

14.39 **Strategic Flood Risk Assessment (SFRA) of West Sussex**: The SFRA was reviewed to gain a further understanding of the potential flood sources in the area managed by WSCC. The SFRA was prepared for WSCC in January 2010^{xxii}.

14.40 **The South East River Basin Management Plan (SERBMP)**: The River Basin Management

Plan provides a framework for protecting and enhancing the benefits provided by the water environment. It links to other major plans affecting water management. The SERBMP was prepared by the EA and was updated in December 2015^{xxiii}.

- 14.41 **Arun and Western Stream Catchment Flood Management Plan (CFMP):** The CFMP was reviewed to investigate the possible flood risk from the River Arun and what mitigation methods already exist in the area. A CFMP summary report was prepared by the EA in December 2009^{xxiv}.
- 14.42 **Strategic Flood Risk Assessment of Arun District (SFRA):** The SFRA was reviewed to gain a further understanding of the potential flood sources within the Arun District. The SFRA was prepared for ADC in February 2008^{xxv}.
- 14.43 **Geo-environmental and Geotechnical Site Assessment Report:** This was carried out by RSK Environment Limited (RSK), Report Reference 29228-R01 (00), dated 06 November 2018^{xxvi}. The report provides findings based on an intrusive site investigation consisting of 6 no. deep boreholes and 10 no. shallow boreholes, 56 no. trial pits, concrete coring across the former runway and soil infiltration tests with laboratory analysis of soil samples.
- 14.44 **Southern Water Public Sewer Record Drawings:** The public sewer record drawings show all sewers, manholes, rising mains and any other drainage infrastructure which is adopted and maintained by Southern Water within and local to the Site boundary^{xxvii}.
- 14.45 **Survey and Tracing of the Existing Private Sewerage Systems on site:** The topographical survey located and recorded existing manholes and drainage channels which collect surface water within the Site. CD Surveys were appointed to lift the manhole covers, inspect the incoming sewers and record pipe diameters and depths. The drainage trace and CCTV survey advises on connectivity of the sewers on site and where they discharge off site^{xxviii}.
- 14.46 **Land Use Plan / Proposed Site Layout:** The drainage strategy has been developed based on the Illustrative Masterplan prepared by Barton Wilmore, Drawing Number RG-M-78 Rev P. This drawing is provided in Appendix 14.3.

Assessment Criterion

Fluvial and Tidal Flood Risk

- 14.47 The impact of fluvial and tidal flooding on the Site has been assessed using the EA flood map and modelled flood data^{xvi}. The ground levels at the Site shown on the topographical survey^{xv} have been compared against the modelled flood levels for the 100 year or greater and the 1000 year chance of flooding occurring each year to confirm the areas which are at risk of flooding.

Surface Water Flood Risk

- 14.48 Surface water flooding occurs when rainwater does not drain away through the normal drainage system or infiltrate into the ground, but instead lies on or flows over the ground.
- 14.49 The EA Surface Water Flood Risk Map^{xvi} shows the areas on site at risk.
- 14.50 Areas where surface water flooding is indicated are compared against the ground levels shown on the topographical survey to identify flow paths or low-lying ground, both within the Site and around the boundaries of the Site where water can flow to and from the Site and neighbouring areas.

Foul Water Sewerage Systems

- 14.51 The impact of the Development on foul water sewerage systems has been determined through discussion with Southern Water and by reviewing sewer record drawings and information.

Groundwater

- 14.52 The impact to groundwater levels and flows has been assessed using information contained in the ADC Strategic Flood Risk Assessment 2016^{vi} and by carrying out monitoring on site to understand actual groundwater levels at the Site over a 12-month period.

Water Quality

- 14.53 The water quality assessment considers water from the Development which discharges into the ground, via soakaways and infiltration drainage, and directly to ditches and watercourses.

- 14.54 The assessment considers the use of Sustainable Drainage Systems (SuDS) as part of the surface water system for the Development which captures surface water runoff and provides water quality improvement at source on site.

Technical Consultations

- 14.55 The Statutory Consultees listed in Table 14.1 were consulted to establish the baseline conditions and mitigation measure requirements.

Table 14.1: Technical Consultations

Technical Consultation	Date	Information Discussed
Southern Water (Joff Edevane – Growth Planning Lead & Luis DaSilva Planning Coordinator)	3 December 2019	It was agreed at this meeting that the Ford Wastewater Treatment Works (WWTW) has capacity to receive foul water from the Development and a sewer capacity check is not required as discussed in an email from Luis DaSilva dated 19 December 2019 (as provided in Appendix 14.1).
Southern Water (Stuart Ward - Technical Manager)	5 September 2019	Discharging foul water from the Development to the Ford WWTW, interaction between the Development and the WWTW and future plans for the WWTW.
Arun District Council Drainage & Coastal Department (Laura Gibbons - Engineer)	8 March 2019	Pre- Planning comments on Development and drainage proposals including requirements for planning submission. An email sent by ADC following the meeting, dated 8 March 2019 providing comments on the drainage proposals is provided in Appendix 14.1
Arun District Council Planning Department (David Easton Principal Planning Officer)	8 May 2019	Pre – Planning meeting to discuss strategic allocation and demonstrate how the conceptual design for the drainage strategy and Sustainable Drainage (SuDS) has been developed.
Southern Water (Stuart Ward Technical Manager)	13 May 2018	Further discussion on the Development layout. A letter from Southern Water, dated 05 December 2018, which provides a scoping opinion on the proposed development is provided in Appendix 14.1

Assessment Criterion

- 14.56 In the following section the criteria has been used to assess magnitude, sensitivity and significance.
- 14.57 The magnitude of impacts on the baseline condition have been assessed by considering criteria on the scale/ extent of change and the nature of the impact (with examples criteria obtained from DMRB Volume 11 Section 3 Part 10 HD 45/09)^{xxxiii}. The magnitude of impact criteria is shown in Table 14.2.

Table 14.2: Methodology for Assessing Magnitude

Magnitude of Impact	Criteria for Assessing Impact	Assessment Examples
Major	Total loss or major/substantial alteration to key elements/features of the baseline (pre-Development) conditions such that the post Development character/ composition/attributes will be fundamentally changed.	Increase in peak flood level (1% annual probability) > 100mm. Increase in number of properties experiencing flooding. Water quality impacted by failure of both soluble and sediment bound pollutants and compliance failure with Environmental Quality Standards (EQS) values. Loss or extensive change to an aquifer or groundwater supported designated wetlands. Total failure of utility services as a result of the Development.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post Development character/ composition/ attributes of the baseline will be materially changed.	Increase in peak flood level (1% annual probability) > 50mm. Increase in number of properties experiencing internal/ external flooding. Water quality impacted by failure of both soluble and sediment bound pollutants but compliance with Environmental Quality Standards (EQS) values. Partial loss or change to an aquifer. Partial failure of utility services as a result of the Development.
Minor	A minor shift away from baseline conditions. Change arising from the loss/ alteration will be discernible/detectable but not material. The underlying character/composition/attributes of the baseline condition will be similar to the pre-Development circumstances/ situation.	Increase in peak flood level (1% annual probability) > 10mm. External flooding to more properties but no increase in internal flooding. Failure of either soluble or sediment bound pollutants. Minor effects on groundwater polluted wetlands. Localised pollution incidents at and close to the Site. Failure of utility services limited to the Site and immediate surrounding area as a result of the Development.
Negligible	Very little change from baseline conditions. Change barely distinguishable, approximating to a 'no change' situation.	Negligible change in peak flood level (1% annual probability) < +/- 10mm. No measurable impact upon an aquifer. No / minimal pollution or change in water quality. No / minimal change in utilities or services as a result of the Development.

14.58 The sensitivity of receptor is based on the relative importance of the receptor using the scale in the following table (with examples obtained from DMRB Volume 11 Section 3 Part 10 HD 45/09).

Table 14.3: Methodology for Determining Impact Sensitivity

Sensitivity	Criteria	Assessment Examples
High	The receptor/ resource has little ability to absorb change without fundamentally altering its present character, or is of international or national importance.	Water Framework Directive (WFD) Class 'High'. Site protected / designated under EC and UK habitat legislation (Special Areas of Conservation (SAC), Special Protection Areas (SPA), Site of Special Scientific Interest (SSSI), Water

		Protection Zone (WPZ), Ramsar site, salmonid water) / Species protected by EC Legislation. Principal aquifer providing regionally important resource or supporting site protected under EC and UK habitat legislation. Source Protection Zone (SPZ) 1 Floodplain or defence protecting more than 100 residential properties from flooding.
Moderate	The receptor/ resource has moderate capacity to absorb change without significantly altering its present character, or is of high performance.	WFD Class 'Good'. Species protected under EC or UK habitat legislation. Principal aquifer providing locally important resource or supporting river ecosystem SPZ2. Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding.
Low	The receptor/ resource is tolerant of change without detriment to its character, is of low or local importance.	WFD Class 'Moderate'. Aquifer providing water for agricultural or industrial use with limited connection to surface water. SPZ3. Floodplain or defence protecting 10 or fewer industrial properties from flooding.

- 14.59 The significance of an environmental effect is determined by the interaction of magnitude and sensitivity, whereby the impacts can be beneficial or adverse. The Effect Significance Matrix is set out in Table 14.4.

Table 14.4: Effect Significance Matrix

Magnitude	Sensitivity		
	High	Moderate	Low
Major	Major Adverse/Beneficial	Major – Moderate Adverse/Beneficial	Moderate – Minor Adverse/Beneficial
Moderate	Major - Moderate Adverse/Beneficial	Moderate - Minor Adverse/Beneficial	Minor Adverse/Beneficial
Minor	Moderate – Minor Adverse/Beneficial	Minor Adverse/Beneficial	Minor Adverse/Beneficial - Negligible
Negligible	Negligible	Negligible	Negligible

Limitations and Assumptions

- 14.60 SuDS components have been sized based on measuring the land parcels shown on the Illustrative Masterplan prepared by Barton Wilmore, Drawing Number RG-M-78 Rev P. The drawing is provided in Appendix 14.3.
- 14.61 A total of 9 soil infiltration rate tests were carried out in August 2018. The depths of the tests ranged between 2.3m to 2.8m below existing ground level. The locations of the tests are shown on JNP Group Drawing Number C85228 – SK147, titled Soil Infiltration Rate Test

Locations, provided in Appendix 14.2.

14.62 5 no. tests located towards the west and the centre of the Site failed to achieve infiltration in accordance with BRE 365 and no infiltration rates were provided in the site investigation report. The remaining 4 no. tests located towards the southeast and northeast of the Site returned slow soil infiltration rates which ranged between 2.29×10^{-6} m/s and 4.76×10^{-6} m/s.

14.63 The RSK Site Investigation report (Appendix 15.1)^{xxvi}, advises *"in general, infiltration characteristics across the site were found to be poor with the lack of permeability within the upper cohesive ground conditions rendering some infiltration rates incalculable. Where infiltration was observed across the test period, infiltration rates ranging 2.29E-06 m/s (S1) to 4.76E-06 m/s (S5) – i.e. upper bound of poor drainage characteristics."*

The tests suggest that the majority of the Site is not suitable for deep soakaways. The use of shallow infiltration drainage, e.g permeable paving, will be investigated further by shallow infiltration rate tests, up to 1.5m below existing ground level.

14.64 The shallow testing will provide more detailed information to assess if and where permeable paving will be feasible on site.

14.65 ADC has commented that they require a greater number of shallow soakaway tests to be carried out across the Site between October and February. If shallow infiltration appears feasible this can be carried out for detailed design.

14.66 The infiltration rate tests carried out in the north east of the Site achieved rates of 10^{-6} m/s or greater.

14.67 Whilst infiltration drainage might be considered to be technically feasible, it is often found that excessively large soakaways or deep permeable pavements are required to achieve the half drain down of the storage volume within 24 hours requirement in British Research Establishment (BRE 365) Design Guidance for Soakaways^{xxix}. The use of shallow infiltration drainage will be investigated and used on site, as part of the drainage solution, where it is considered feasible.

14.68 RSK commenced groundwater monitoring at 8 locations across the Site in August 2018 for a 12-month period to establish changes in groundwater levels. The locations of the monitoring wells are shown on JNP Group Drawing Number C85228 – SK148, titled Borehole Monitoring Well Locations, provided in Appendix 14.2.

- 14.69 Based on the groundwater monitoring carried out in August 2018, whilst carrying out the site investigation (Appendix 15.1), RSK advised: *"subsequent monitoring (in September 2018) indicates resting groundwater levels to be potentially shallower (than during the site investigation), particularly towards the south of the site (1.73m bgl/ WS01). Careful consideration must therefore be given to the design of soakaways to ensure that their bases are terminated above the unsaturated zone"*.
- 14.70 Groundwater levels between August 2018 and January 2020 were significantly higher, on average 2.0m, than the summer levels.
- 14.71 Section 4.3.2 of the 2015 CIRIA SuDS Manual C753^{xxv} recommends that a minimum depth of 1m of unsaturated aquifer should be provided between the base of an infiltration system and the maximum likely groundwater level.
- 14.72 ADC has advised that it does not require a clearance depth and it will accept infiltration drainage where the base of the component is above the highest anticipated groundwater level based on 12 months continuous groundwater monitoring.
- 14.73 In order to obtain more information to assist with the detailed design of the shallow infiltration, additional groundwater monitoring wells were installed onsite in September 2019 and December 2019. The locations of the original boreholes and additional monitoring wells are shown on JNP Drawing C85228 D109, titled Supplementary Soakaway Tests Location Plan in Appendix 14.2. The design provided for outline planning is based on assessing all boreholes and monitoring well data which has been recorded since August 2018.
- 14.74 Based on RSK's groundwater findings, the finished ground level in some parts of the Development would need to be raised to provide infiltration SuDS and to ensure the base of the component is above the groundwater level.

Baseline Conditions

Site Use and Ground Conditions

Site Use and Sewer Outfalls

- 14.75 The Site extends to approximately 86.63ha in size. The Site has an impermeable area of approximately 6ha, comprising of airfield runways, hardstandings and existing buildings. The remaining 82ha is permeable land in the form of agricultural fields or woodland/scrub.

- 14.76 Within the Site boundary is the existing Arun Sports Arena and The Flying Fortress indoor children's play facility and associated car parking, which will be retained as part of the Development and will continue to operate post-Development. It will be necessary to connect these two units into the new proposed on site drainage systems.
- 14.77 Immediately east of the Site is a Southern Water Waste Water Treatment Works (WWTW) and the Grundon Waste Management Site. Adoptable sewers and rising mains cross the Site to connect to the sewage works.
- 14.78 The existing concrete runways drain into gravity sewers which cross the Site and discharge into a culvert in the south east corner of the Site. The culvert continues in a south easterly direction and crosses beneath the Rudfield Industrial Estate and discharges into the River Arun.
- 14.79 The access road into the Site off Yapton Road drains into a sewer which discharges into an ordinary watercourse to the west of the Site. This eventually discharges into the Ryebank Rife main river which is approximately 1.2km south of the Site.
- 14.80 Part of the Site discharges surface water into a sewer which runs along Horsemere Green Lane to the south west of the Site. The sewer crosses Yapton Road and discharges into an ordinary watercourse which flows through Stable Barn, which is directly opposite the Site, and eventually discharges to the Ryebank Rife main river.

Topography

- 14.81 The Site and surrounding area is defined by the River Arun valley which lies approximately 500m east of the Site. The Site and surrounding area fall towards the River Arun from west to east. However, the southern end of the Site and the surrounding land fall southwards towards the coast, approximately 2km south of the Site boundary.
- 14.82 Generally, the majority of the Site is gently sloping or flat with gradients in the region of 1 in 100 which rise and fall across the Site.

Geology

- 14.83 British Geological Survey (BGS)^{xix} maps show that the bedrock geology on site comprises of Lewes Nodular, Seaford, Newhaven, Culver and Portsdown Chalk Formations. Superficial

geology of River Terrace Deposits, comprising of sand, silt and clay are shown towards the surface of the Site. The geological map also indicates that Raised Beach Deposits, which are a combination of sand and gravel, are present along the eastern boundary of the Site. The estimated thickness of the superficial deposits are 3 to 4m deep.

Hydrogeology

- 14.84 The EA's aquifer classification system designates the superficial deposits across the Site as Secondary A aquifer meaning the soils could support local water supply.
- 14.85 The chalk bedrock underlying the Site is classified as a Principal aquifer meaning that it may support water supply on a strategic scale.
- 14.86 The Site is not within a Groundwater Source Protection Zone (SPZ) as defined by the EA.
- 14.87 A Geotechnical and Contaminated Land Assessment was carried out by Jacobs Ltd in 2007 at an area of land located directly to the southwest of the former runway (Report Ref B0545500\D2 dated April 2007)^{xxxii}.
- 14.88 Groundwater was encountered within the chalk between 5.5m and 8.5m below ground level. It was noted that groundwater is likely to be partially confined by the overlying superficial deposits.
- 14.89 Further groundwater assessment was carried out by RSK in November 2018 as part of the Geo-environmental and Geotechnical Site Assessment Report (Appendix 15.1). RSK initially carried out groundwater modelling on site between August and September 2018. Groundwater was recorded between 1.73m and 5.5m below ground level.
- 14.90 Groundwater monitoring has since been carried out, to establish the changes in groundwater levels over at least a twelve-month period. To date the worst-case groundwater levels occurred 19 December 2019. Groundwater was recorded between 0.80m and 3.90m below ground level.
- 14.91 The direction of groundwater flow beneath the Site is in an eastern / north eastern direction towards the River Arun.

Groundwater Quality

- 14.92 The RSK Geo-environmental and Geotechnical Site Assessment Report (Appendix 15.1) assessed the potential for groundwater contamination from previous sources on site by providing a conceptual model for risk estimation for potentially complete pollution linkages.
- 14.93 It estimated the risk of previous ground contamination is moderate to low. Where there is a possibility that groundwater contamination has occurred in the past, whilst the airfield was operational, it is likely to have degraded over time. More recent Site uses are deemed unlikely to have a significant impact on ground contamination.
- 14.94 RSK also tested soil and groundwater samples collected on site in August 2018. Groundwater samples were collected from seven boreholes (BH1 to BH6 and WS1), the locations of the boreholes are shown on JNP Group Drawing Number C85228 – SK148, titled Borehole Monitoring Well Locations, provided in Appendix 14.2. Based on the soil sample test results, no significant elevated concentrations of contaminants were recorded that are likely to leach, in sufficient concentrations to impact underlying groundwater.
- 14.95 A comparison of the water results against Environmental Quality Standards (EQS) for transitional estuaries and coastal waters, recorded two exceedances:
- The concentration of Mercury at BH6 was 0.2µg/l against the EQS value of 0.007µg/l; and
 - The concentration of fluoranthene at BH4 was 0.03µg/l against a EQS value of 0.0063µg/l.
- 14.96 It is considered that concentrations recorded in the groundwater beneath the Site are low and following dilution within the aquifer that these concentrations would not cause adverse impact to the surface water. No elevated concentrations of contaminants were recorded in borehole BH5 located hydraulically down gradient of the boreholes.
- 14.97 The results did not record any other exceedances against the EQS values. The concentrations of petroleum hydrocarbon, volatile organic compounds and pesticides were below the detection limit. This indicates that no on or off site source appears to be impacting the underlying groundwater.
- 14.98 The results of the groundwater testing carried out indicate that the groundwater within the underlying chalk aquifer did not appear to have been significantly impacted by any existing or historical on or off site sources.

Flood Risk Assessment

Flood Risk from Rivers (Fluvial)

- 14.99 The Development is located in Flood Zone 1 and therefore has low risk of flooding from fluvial sources (less than 0.1% annual probability).
- 14.100 A very small area inside the northern boundary of the Site, approximately 0.01km² in size, is located in Flood Zone 3 (1.0% or greater annual probability of river flooding or 0.5% greater annual probability of coastal flooding). It is noted that two short localized sections of public road, Ford Lane to the north and Ford Road to the east of the Site (located outside the Site boundary), are located inside Flood Zone 3.
- 14.101 No built residential Development is proposed in the area at risk of extreme fluvial flooding. The area will be public open space and buffer planting.

Groundwater Flood Risk

- 14.102 Groundwater flooding occurs when the water table rises and emerges onto the ground surface. This is most likely to occur in low-lying areas, underlain by permeable geology (aquifers).
- 14.103 The 2016 SFRA for ADC^{vi} shows the Site to be <25% susceptible to groundwater flooding. It is noted that the groundwater susceptibility drawing does not show the likelihood of flooding but assesses geological and hydrogeological conditions to estimate areas where groundwater might emerge.
- 14.104 The historic flooding records map within the 2016 SFRA for ADC^{vi} shows no records of groundwater flooding on site. All other flood risk guidance documents show no historic records of groundwater related flooding on site.
- 14.105 As part of the site investigation works, RSK Limited commenced groundwater monitoring on site in August 2018 and will obtain at least 12 months of groundwater levels data^{xxx}.
- 14.106 To date the worst-case groundwater levels occurred on 19 December 2019. Groundwater was recorded between 0.80m and 3.90m below ground level. Converting groundwater levels to Above Ordnance Datum AOD provides a groundwater range of 4.35m AOD (Borehole BH1) in the south of the Site to 1.75m AOD (Borehole BH5) in the north east of the Site. The locations of the boreholes are shown on JNP Drawing C85228 D109, titled Supplementary Soakaway Tests Location Plan in Appendix 14.2.

14.107 Based on the current site investigation findings, the Site has been found to be at low risk of groundwater flooding.

Surface Water Flood Risk (Overland Flows)

14.108 Surface water flooding occurs when rainwater does not drain away through the normal drainage system or infiltrate into the ground, but instead lies on or flows over the ground.

14.109 The EA Surface Water Flood Risk Map^{xvi} shows localised areas of surface water flooding across the Site at the following locations:

- Along the western boundary of the Site in the vicinity of Ford Industrial Estate. This appears to be flooding from surface water flows generated both off site and on site;
- Towards the northwest corner of the Site, adjacent to the Site boundary, where there is an existing industrial unit. This appears to be flooding from surface water flows generated both off site on site;
- Towards the centre of the Site where there are localized pockets of low ground. This appears to be flooding from surface water flows generated on site;
- Towards the south west of the Site adjacent to Yapton Road and the Ford Air Rifle Ranges. This appears to be flooding from surface water flows generated onsite;
- Offsite to the south of Horsemere Green Lane low risk flooding occurs within the existing housing development. This does not appear to be as a result of flows from the Site;
- In the northeast localised high risk flooding is shown in a low lying area onsite. It appears that offsite flows from Ford Lane may contribute to the flooding, however, the surface water flood map might not allow for the ordinary watercourse which would receive flows from the road. No development is proposed in the area on site which is indicated to be at risk of flooding and therefore no properties either on site or off site are at risk as a result of the Development; and
- All of the above are defined as low risk flooding of each year having a chance of flooding between 1 in 100 (1%) and 1 in 1000 (0.1%) unless stated otherwise.

Coastal and Tidal Flood Risk

14.110 Information relating to flood risk was obtained from the EA. This information included flood extents from a detailed hydraulic tidal model for the River Arun to East Head, which was carried out by JBA Consulting in 2016.

14.111 The only modelled event which caused flooding on site, was the 2115 1 in 200 year, undefended. No residential development is proposed in the area at risk of extreme tidal flooding. However, it is reasonable to locate an attenuation basin in this area and defend the basin from coastal flooding.

14.112 The model shows the tidal flood extent if the River Arun was undefended, however, there are flood defences in the form of embankments along the River Arun. The flood defences protect the area up to the 1 in 200 year event. The information from the EA also states that the condition of the flood defences along the River Arun is estimated to be Good and are expected to be working as expected.

14.113 The EA and Lead Local Flood Authority hold no records of tidal flooding occurring on site.

14.114 The existence of flood defences along the River Arun and no historic records of the Site flooding means that the risk of coastal and tidal flooding at the Site is considered low.

Reservoir Flood Risk

14.115 The EA's Reservoir Flood Map^{xvii} shows no risk to the Site.

Sewer / Drainage Flood Risk

14.116 Sewer flooding occurs when excess surface water run-off enters the drainage network and the surface/foul water network is insufficient to deal with the influx of water. Sewer flooding can also occur due to 'one off' events such as blockages in the network.

14.117 The 2016 SFRA for ADC^{vi} states that there were 20 recorded incidents of sewer related flooding in the same postcode as the Site (these records were taken from the DG5 register and therefore only data from 2006 to 2016 is incorporated into the data set shown). The 2016 SFRA for ADC also notes that the majority of sewer related flooding that occurred within the area is related to the foul sewer network. Southern Water Asset Location Plans^{xviii} for the Site show 3 no. rising mains crossing the Site and connecting into the WWTW.

14.118 Given the presence of the WWTW and rising mains across the Site as well as the known history of sewer flooding in the area, there is a low risk of foul flooding impacting the Site.

Future Baseline

- 14.119 If the Development was not to proceed, and there are no changes to the current on site drainage catchment area, flood risk from the sources discussed above for the baseline would not significantly change.

Likely Significant Effects

- 14.120 This section considers the likely significant effects of the Development in the absence of mitigation.

- 14.121 The Development will provide additional significant areas of impermeable surfacing on site. This will increase the flow and volume of surface water runoff generated by the Site. The impact of not providing mitigation such as attenuation, restricting the flow of water off site and failing to address water quality is considered below.

Construction Phase

Fluvial and Tidal

- 14.122 The Site is located approximately 500m from the River Arun and is in Flood Zone 1 as shown on the EA fluvial flood map. A very small area along the northern boundary of the Site, approximately 0.01km² in size, is located in Flood Zone 3 but no works will be carried out in this area. The construction works will not impact on fluvial flooding and the risk during construction is Negligible.

Surface Water

- 14.123 The Site is generally flat with a small number of potential surface water flow paths to and from the Site and the surrounding areas. In areas where the ground levels will be raised in the southwest of the Site there is an increased risk of surface water flooding to off site areas during significant rainfall events.
- 14.124 Surface water flooding would occur as a result of incomplete earthworks and drainage within the Site and would result in damage to complete and partially complete works on site.
- 14.125 The effect on surface water flood risk during construction is considered to be Minor Adverse and temporary.

Foul Water Sewerage Systems

- 14.126 The existing WWTW is located immediately east of the Site. 3 no. existing Southern Water foul water rising mains cross the Site in all directions to connect to the WWTW. A raw water rising main carries flows away from the WWTW. It is located outside the Site boundary and runs south adjacent to the existing runway and Ford Materials Recycling Facility.
- 14.127 If not correctly managed during construction there is a risk of damaging the existing rising mains either by excavation or increased loads on the pipelines from construction traffic. In the event of a pipe bursting foul water flooding would occur on site. However, part of the off site foul water sewerage network would also be affected and may need to be temporarily shut down or diverted whilst repairs are carried out.
- 14.128 The effect of foul water flooding during construction is considered to be Major Adverse and temporary.

Groundwater

- 14.129 Groundwater monitoring carried since August 2018^{xxx} shows that groundwater did not reach the existing ground surface on site during the winter monitoring period.
- 14.130 During construction it may be necessary to carry out excavations which are deeper than the groundwater table beneath the Site. Localised dewatering and over pumping of some excavations may be required.
- 14.131 The permanent works are not designed to extend beneath or expose the groundwater table. Therefore, groundwater will not be mobilised and will not flow on or offsite during construction.
- 14.132 The construction works will not impact on the recharge and flow regime of groundwater under the Site. Surface water will continue to runoff to ditches/ sewers or partially infiltrate into the ground during construction.
- 14.133 The pre-mitigation impact on Groundwater during construction is Negligible.

Water Quality

- 14.134 The uncontrolled flow of water during the construction phase of the Development, with no mitigation measures to remove pollutants or contaminants, could result in contamination of

local watercourses if debris and pollutants are washed into sewers and ditches on site.

14.135 Construction activities such as excavations for foundations or service trenches can provide new pathways to groundwater receptors.

14.136 The pre-mitigation impact on water quality during construction is considered to be Minor Adverse and temporary.

Operational Phase

Fluvial and Tidal

14.137 The Development is located in Flood Zone 1 and outside the fluvial flood plan. It does not impact on any flood storage or compensation areas.

14.138 A very small area within the Site, which is approximately 0.1km², is shown as Flood Zone 3 on the EA fluvial flood map. No development or change in ground levels will be carried out in this area.

14.139 The effect on fluvial and tidal flood risk from the operational Development is considered to be Negligible.

Surface Water

14.140 The Development will change ground levels across the Site. It will be necessary to raise the ground in some areas to provide gravity sewers which can discharge surface water to new attenuation basins on site without pumping. In private areas, where it is possible to achieve shallow infiltration on site, surface water will discharge directly into the ground using permeable paving. The permeable paving could be constructed with high level overflows which will connect to gravity sewers. During severe or repeated storm events, where the permeable paving has insufficient capacity, water will discharge to the attenuation basins via the gravity sewer network. Due to the flat topography across the existing airfield, surface water from the attenuation basins will be pumped to existing ditch outfalls off site where it is not possible to discharge using gravity sewers.

14.141 Failure to consider pre-Development surface water flow routes on and off site or not to design the finished levels for the Development so that any escape of water or exceedance flow from the drainage system flows away from the properties to areas of lesser risk, would result in surface water flooding both on and off site.

14.142 If the Development does not provide sufficient attenuation storage volume or the storm event exceeds the 1 in 100 year + 40% Climate Change design storm event there is a risk surface water flooding would occur on site.

14.143 The discharge rate for the Development will be restricted to Greenfield runoff rate as agreed with the LLFA. Failure to restrict the discharge rate from the Development, either by discharge into gravity sewers or an increased pumped rate into a watercourse could result in flooding off site. This is due to the increased flow discharging into the watercourse network downstream from the Site.

14.144 The effect on surface water flood risk from the operational development is considered to be Minor Adverse and permanent.

Foul Water Sewerage Systems

14.145 Southern Water has raised no objections to discharging foul water from the Development to the existing Ford WWTW which is located immediately east of the site. Southern Water's development scoping opinion letter is provided in Appendix 14.1.

14.146 The effect on the foul water sewerage network as a result of the Development is therefore considered to be Negligible

Groundwater

14.147 The finished ground levels for the Development will be raised above the groundwater table. Even if shallow infiltration drainage proves feasible and is provided, the Development will not significantly raise groundwater levels at the Site and surrounding area.

14.148 The RSK site investigation report (Appendix 15.1) advises that generally infiltration characteristics across the Site were found to be poor with limited permeability within the upper cohesive ground conditions. This highlights that in some areas water is less likely to rapidly infiltrate into the ground and will need to discharge to positive drainage systems.

14.149 Water which falls on the hard non-permeable surfaces at the Development will be captured and enter sewers which eventually discharge to local watercourses.

14.150 The effect on groundwater as a result of the operational Development is considered to be Negligible.

Water Quality

14.151 Individual property driveways, residential car parks and low traffic roads have the potential for total suspended solids, metals and hydrocarbon pollution which can be washed into the surface water network via gullies and sewers.

14.152 In addition, there is the risk of contamination by residents pouring other pollutants down drains and gullies and into the surface water sewerage network.

14.153 If mitigation measures are not provided the effect on water quality, both for groundwater and watercourses, is Minor Adverse and permanent.

Mitigation Measures

Construction Phase

Fluvial and Tidal

14.154 The impact on fluvial and tidal flooding during construction is negligible. Therefore, no mitigation measures are proposed.

Surface Water

14.155 Effective site management is required to mitigate surface water flooding during the construction phase of the Development. The Development will be phased to enable the volume of surface water to be controlled and managed.

14.156 Adequate surface water attenuation shall be provided on site during construction. The Contractor may decide to construct the main drainage system as one of the first activities on site to provide a route to drain surface water away from working areas.

14.157 Surface water will be captured using gullies, pipelines, surface channels, French drains, temporary cut off walls and pumping as required.

14.158 The flow of surface water off site will be restricted to the Greenfield flow rate agreed with

the LLFA for the Development.

Foul Water Sewerage Systems

- 14.159 The existing rising mains which cross the Site to reach the WWTW will be accurately located and traced prior to undertaking construction works on site.
- 14.160 Site personnel will be made aware of the rising mains as part of the site induction. Any works required in the vicinity of the mains will be carefully managed.
- 14.161 Construction traffic routes which cross the rising mains will be considered. If necessary, additional protection measures can be provided to protect the rising mains. This might involve improving the existing backfill material or increasing the depth of material over the rising mains to provide additional protection.

Groundwater

- 14.162 The impact on groundwater during construction is negligible. Therefore, no mitigation measures are proposed.

Water Quality

- 14.163 Where necessary, desilting will be carried out during construction to prevent silt from entering off site watercourses and sewers. Desilting techniques include using temporary cut off walls and ditches or specialist desilting plant and equipment comprising of pumps and tanks.
- 14.164 Appropriate site management will be undertaken to ensure that potential pollutants, chemicals and plant are correctly stored and used to avoid spills on site and contamination of the groundwater and watercourses.

Operational Phase

Drainage Strategy

- 14.165 The drainage strategy design has assessed mitigation requirements and techniques which will be provided to ensure that the Development does not adversely impact on the environment. The JNP Group Drainage Strategy drawings, Drawing Nos. C85228 D100 and D101, are provided in Appendix 14.3.

14.166 The SuDS Management Train approach, based on guidance within 2015 SuDS Manual CIRIA C753^{xxxi} will be adopted to manage and control peak discharge and treat flows to limit the impact on the environment. The management train incorporates a hierarchy of techniques, including:

- Source control including soakaways, permeable paving, infiltration basins and water butts;
- Site control including swales, pervious paving, tanked paving, detention basins, ponds and attenuation systems; and
- Regional control using wetlands and large retention basins.

14.167 Soil infiltration rate testing carried out by RSK as part of the site investigation report (Appendix 15.1) suggests that deep infiltration rates range from unsuitable to marginal and the use of infiltration drainage is likely to be limited to certain parts of the Site. Infiltration will be used where it is feasible to do so.

14.168 Shallow infiltration rate tests will be carried out to determine where infiltration permeable paving can be used. It is likely, due to slow infiltration rates, it will be provided with overflows to the gravity sewerage system.

14.169 The drainage strategy for the Development will include the use of SuDS techniques comprising of shallow infiltration, infiltration permeable paving, attenuation basins, swales, tanked permeable paving, underground tanks and water butts.

14.170 The adoptable road network and other parts of the Development not served by infiltration will discharge water to attenuation basins on site by gravity sewers. Due to the flat topography and relatively shallow outfall levels, it will be necessary to pump water from attenuation basins to an existing ditch on site, located at the Site entrance off Ford Road. The attenuation basins / tanks in the southwest of the Site will discharge by gravity sewers to the existing 2 no. surface water sewer outfalls in the west (adjacent to Yapton Road) and south west (adjacent to Horsemere Green Lane).

14.171 The off site flows will be restricted to a discharge rate agreed with the LLFA and the EA.

14.172 The ditch, at the site entrance, discharges into the River Arun to the east of the Site. The off site sewers discharge to the Ryebank Rife to the west of the Site.

14.173 The on site sewerage systems will be designed to prevent flooding and protect downstream watercourses and properties for the 1 in 100 year + 40% Climate Change event.

Fluvial and Tidal

- 14.174 The impact on fluvial flooding whilst the Development is operational is negligible. Therefore, no mitigation measures are proposed.

Surface Water

- 14.175 The areas of low risk surface water flooding on site, which are not linked or connected to off site flow paths, will be mitigated by raising the ground levels to remove the existing localised depressions.
- 14.176 The finished levels for the Development will be flood routed so that any exceedance flow from the drainage system flows away from the properties on site to areas of lesser risk such as the road network, green corridors and open spaces.
- 14.177 To prevent the finished levels for the Development increasing surface flood risk elsewhere either on or off site, a drainage strategy utilising SuDS will be installed on site. The drainage strategy will convey, treat, store and discharge surface water run-off across the Development in a sustainable and safe manner. The implementation of formal drainage in areas where off site flows may cause flooding on site will mitigate flood risk by capturing and conveying run-off away before it pools. This form of mitigation will prevent flood risk on site without increasing flood risk off site, and in instances where existing on site flows contribute to off site flooding a betterment on the existing situation will be achieved.

Foul Water Sewerage Systems

- 14.178 No mitigation measures are required for the foul sewerage system(s) which will serve the Development. Southern Water has no objections against the Development discharging to the Ford WWTW which is located immediately east of the Site.
- 14.179 Four foul water pumping stations are proposed to serve the Development. The pumping stations and drainage networks will be adopted by Southern Water.

Groundwater

- 14.180 The impact on groundwater whilst the Development is operational is negligible. Therefore, no mitigation measures are proposed.

14.181 However, as an additional measure it is good practice that finished floor levels (FFLs) of all residential properties will be raised to a minimum of 300mm above the general ground level on site. In doing this, a suitable level of protection is offered in the event of groundwater emergence and flooding.

Water Quality

14.182 As per Table 4.3 of the 2015 SuDS Manual (C753)^{xxxi}, the minimum water quality management requirement for discharges to surface water requires the Simplified Index Approach to be applied. The following SuDS components will be implemented where feasible to achieve the required treatment.

14.183 Attenuation basins will be incorporated into the Development layout to provide the required surface water attenuation volumes. This form of attenuation system will provide amenity value to the Development and assist in removing urban pollutants by settlement.

14.184 Swales will be integrated into the drainage network to convey surface water flows. Swales when designed appropriately can add amenity value to developments, reduce surface water flows and can also improve water quality by assisting in the capture of contaminants.

14.185 Permeable pavements will be included as part of the drainage system. Permeable pavements not only deal with surface water runoff at source, by slowing the rate of runoff and providing temporary storage but are also widely acknowledged to improve water quality. Parking courts and shared access areas lend themselves well to the use of permeable pavements. Where possible, infiltration permeable paving will be provided to discharge water directly to the ground.

14.186 Underground tanks will be used in the form of oversized pipework, box culverts or geocellular tanks. These units are typically laid under the highway network, car parking courts or public open space.

14.187 Water butts are the simplest form of non-potable water re-use and can be cheaply accommodated on an individual plot basis. They are small, off-line storage devices that are designed to capture and store roof runoff.

Development Site Access and Egress

14.188 Although the Site itself is at low risk of fluvial flooding, as shown in the EA's Flood Map for Planning, small localised areas of Ford Lane and Ford Road have been identified as having a high risk of fluvial and tidal flooding. This may pose a risk to the Development in terms of emergency access, because in a fluvial or tidal flooding event these parts of the roads could be impassable. Therefore, an access route at Yapton Road along the south-western boundary of the Site will be provided as this road is at low risk of fluvial and tidal flooding and would provide a safe route for evacuation and emergency services in a flooding event.

Residual Effects

Construction Phase

Fluvial and Tidal

14.189 No mitigation measures are required prior to construction and therefore the residual effect of the Development on fluvial and tidal flooding is Negligible.

Surface Water

14.190 During construction, mitigation measures to control surface water flooding will include good site management to control overland flows and provide adequate surface water attenuation volume within the working areas.

14.191 There is a risk that a severe storm event could inundate the temporary attenuation areas and flooding would occur on site which, if not controlled, could flow off site.

14.192 The residual effect of construction on surface water flooding is considered to be Minor Adverse.

Foul Water Sewerage Systems

14.193 During construction, mitigation measures to protect existing sewerage systems require existing pipelines to be accurately located, communicated to the Site team and protected if required.

14.194 There is a risk that damage to the pipelines could still occur as a result of construction

activities. This could result to flooding on site and an interruption to off site foul water services whilst repairs are undertaken.

14.195 The residual effect of construction activities on groundwater is considered to be Minor Adverse.

Groundwater

14.196 Groundwater will not be affected by construction activities and therefore the residual effect is Negligible.

Water Quality

14.197 During construction, mitigation measures are required to control the flow of water through the working areas. Desilting techniques are required to trap sediments and contaminants before they reach a pathway off site.

14.198 If inadequate measures are provided or an unforeseen storm event occurs contaminants could leach into the groundwater or wash into watercourses.

14.199 The residual effect of construction activities on water quality is considered to be Minor Adverse.

Operational Phase

Fluvial and Tidal

14.200 No mitigation measures are required whilst the Development is operational. Therefore, the residual effect of the Development on fluvial and tidal flooding is Negligible.

Surface Water

14.201 The proposed mitigation measures will remove pre-existing localised depressions in the ground on site where surface water flooding could occur. Permanent exceedance flow routes to divert water to areas of lesser risk will be created.

14.202 The overland flow routes would only become operational for exceedance flows which are greater than the 1 in 100 year +40% Climate Change design storm event, which is considered

to be an extreme event. Exceedance flow might also occur if the sewerage system suffers a collapse or blockage.

14.203 In the extreme event of exceedance flows occurring whilst the drainage system is surcharged, it is envisaged there may be some shallow pockets of surface water, approximately 300mm deep, within the road channel. This is a result of the highways design which requires the road surface to rise and fall to enable surface water to flow and drain into road gullies.

14.204 The water would eventually drain into the underground drainage system as the waters on site subside.

14.205 As this would only occur during extreme circumstances, the residual effect is considered to be Negligible.

Foul Water Sewerage Systems

14.206 The Development will discharge foul water to the Ford WWTW which is located immediately east of the Site. Southern Water has advised that the WWTW currently has capacity for the Development.

14.207 The residual effects on foul water sewerage systems would therefore be Negligible.

Groundwater

14.208 The operational Development will not impact on groundwater and therefore the residual effect would be Negligible.

Water Quality

14.209 It is proposed that the Development will discharge surface water into the ground and existing ditches and sewers which flow into watercourses. SuDS will be used to reduce pollutants at source reducing the likelihood of contaminants entering the water environment.

14.210 Using SuDS, suspended solids can be removed and filtration and biodegradation of organic pollutants, such as petrol and diesel, provided to improve water quality on site.

14.211 The SuDS systems need to be regularly maintained to ensure effectiveness.

14.212 Water quality at the Development could be compromised by a more severe pollution incident,

such as a large oil spill, which could reduce the effectiveness of the SuDS components. In addition, direct pollution of the attenuation basins downstream of the SuDS components could result in polluted water discharging off site.

14.213 Based on the required maintenance of the SuDS the residual effect of the Development on water quality is considered to be Minor Adverse.

Cumulative Effects

Construction Phase

Fluvial and Tidal

14.214 The identified cumulative schemes which surround the Site are all located in Flood Zone 1. Therefore, the schemes are not located in the fluvial or tidal floodplain.

14.215 The cumulative effect on fluvial or tidal flood risk during construction is considered to be Negligible.

Surface Water

14.216 Four of the identified cumulative schemes (as set out in chapter 2) are located within or adjacent to the Site:

- Land to the South of Ford Lane;
- New Access Road for Grundon;
- Arun DC Secondary School Site; and
- Ford Airfield Market Site.

14.217 Should all cumulative schemes proceed at the same time, construction activities on all sites would need to be planned and coordinated to ensure that surface water does not runoff overland between the sites and neighbouring areas.

14.218 The mitigation measures discussed previously for the construction of the Development would also apply to all of the cumulative schemes set out above.

14.219 The cumulative effect of the surrounding schemes on surface water during construction is Negligible based on the scheme providing the appropriate mitigation.

Foul Water Sewerage Systems

14.220 The identified cumulative schemes to the west of Yapton village, which is located to the west of the Site, will discharge foul water to the Lidsey WWTW.

14.221 The following cumulative schemes could potentially discharge foul water to the Ford WWTW which is located immediately east of the Site.

- Land off Burndell Road, Yapton; and
- Arun DC Secondary School Site.

14.222 Southern Water has advised that capacity is currently available at Ford WWTW for Burndell Road and Ford Airfield (including the Arun DC Secondary School) but has not specifically advised on the works that would be required to connect the cumulative schemes to the network.

14.223 The cumulative schemes are very close to the Ford WWTW and therefore any works to the existing network would be localised and relatively minor. However, the construction works will need to be carefully planned and managed to avoid disruption to the existing sewerage system networks.

14.224 The cumulative effect of the surrounding schemes on foul water sewerage systems is Negligible based on appropriate mitigation being provided during construction.

Groundwater

14.225 The identified cumulative schemes will infiltrate surface water into the ground where possible, subject to soil infiltration rate testing and groundwater level assessment.

14.226 With the exceptions of the Arun DC Secondary School site and the Ford Airfield Market site there is separation and distance between the cumulative sites. During construction, discharging surface water into the ground, where feasible, will not impact on the neighbouring or nearby sites. Based on the information available there are no recorded incidents of groundwater emergence at the cumulative sites.

14.227 The cumulative effect on groundwater during construction is therefore considered to be Negligible.

Water Quality

- 14.228 The identified cumulative schemes will either infiltrate surface water into the ground or discharge to nearby ditches or sewers which flow to watercourses.
- 14.229 All cumulative schemes will have mitigation measures in place to reduce pollution incidents occurring during construction and reduce pollutants escaping off site into the water environment.
- 14.230 The cumulative effect on water quality during construction is therefore considered to be Minor Adverse.

Operational Phase

Fluvial and Tidal

- 14.231 The identified cumulative schemes are located in Flood Zone 1 and no development will be carried out in the fluvial and tidal flood plain. The developments will discharge water to the ground by infiltration or to ditches or sewers at Greenfield runoff rate (QBar i.e the mean annual flood flow from a rural catchment).
- 14.232 The cumulative effect on fluvial flood risk during operation is considered to be Negligible.

Surface Water

- 14.233 Four of the identified cumulative schemes (as set out in chapter 2) are located within or adjacent to the Development:

- Land to the South of Ford Lane;
- New Access Road for Grundon;
- Arun DC Secondary School site; and
- Ford Airfield Market site.

- 14.234 The Development will remove any existing low-lying ground areas around the boundary of the Site and provide flood exceedance routes to divert surface water overland to areas of lesser risk such as green corridors and open space. These measures will prevent surface water flooding at the above four cumulative schemes.

14.235 The cumulative effect on surface water flood risk during operation is considered to be Negligible.

Foul Water Sewerage Systems

14.236 The following cumulative schemes will discharge foul sewage to the Ford WWTW either by gravity sewers or rising mains:

- Land off Burndell Road, Yapton; and
- Arun DC Secondary School Site.

14.237 Southern Water has advised that Ford WWTW currently has capacity for the Burndell Road development and the Ford Airfield Development (including the Arun DC Secondary School Site).

14.238 Any additional infrastructure or changes to the network to facilitate the connection of the cumulative schemes will be adopted by Southern Water. During operation, no significant or unusual maintenance procedures will be required.

14.239 The cumulative effect on foul water sewerage systems during operation is therefore considered to be Negligible.

Groundwater

14.240 All of the identified cumulative schemes will infiltrate water into the ground where possible, subject to soil infiltration testing and groundwater level assessment.

14.241 With the exceptions of the Arun DC Secondary School development and Ford Airfield Market Site there is separation and distance between the cumulative sites. Based on information available for the identified sites there are no reports of actual groundwater emergence at any of the sites.

14.242 The cumulative effect on groundwater during operation is considered to be Negligible.

Water Quality

14.243 All of the cumulative schemes will include SuDS to provide water quality improvements at

source when the developments are operational.

14.244 All of the cumulative schemes will need to have a SuDS Management Plan to ensure the SuDS components are regularly maintained to operate effectively.

14.245 Despite providing SuDS systems, there is still a risk that an unforeseen or unplanned pollution incident at any of the cumulative sites could occur which would release contaminants into the water environment.

14.246 The cumulative effect on water quality is considered to be Minor Adverse.

Summary

14.247 The Site has been assessed for water resources and flood risk using flood maps and hydraulic modelling data obtained from the Environment Agency and the 2016 Strategic Flood Risk Assessment prepared for Arun District Council^{vi}.

14.248 Site specific information has also been used, including a topographical survey of the Site prepared by CD Surveys^{xv} and Geo-environmental and Geotechnical Site Assessment report by RSK Environment Limited (Appendix 15.1) which provides the findings of the intrusive site investigation. A Site inspection of the existing ditches and sewers which serve the Site has been carried out by JNP Group.

14.249 The Site is located in Flood Zone 1 and therefore has low risk of flooding from fluvial sources (less than 0.1% annual probability). A very small area within the Site, which is approximately 0.1km², is shown as Flood Zone 3 on the EA Flood Map for Planning (Rivers and Sea). No residential development will be carried out in this area.

14.250 Groundwater monitoring in the RSK Geo- environmental and Geotechnical Site Assessment Report shows the Site has a low risk of groundwater emergence.

14.251 Isolated areas of surface water flooding are shown on the flood map where there are pockets of low-lying ground. No significant overland surface water flow routes are shown running through the Site. The Site has a low risk of surface water flooding.

14.252 The EA flood map for tidal flooding shows that a small area within the Site is at risk of flooding for the 2115 1 in 200 year undefended modelled event. However, no residential development will be carried out in this area. As this is an extreme event and the River Arun has flood

defences in the form of embankments, the risk is considered to be low.

14.253 The EA's Reservoir Flood Map^{xvii} shows no risk to the Site.

14.254 There are some recorded incidents of foul water sewer flooding in the vicinity of the Site.

14.255 The effect on surface water flood risk during construction is considered to be Minor Adverse. This is mainly as a result of temporary earthworks which could block or create surface water flow paths to and from the Site and surrounding areas. Effective Site management and construction to divert surface water flows and providing attenuation areas on site whilst the works are carried out will reduce this risk. However, a significant storm event might overwhelm the measures provided on site and the residual impact is still considered to be Minor Adverse.

14.256 The effect on foul water sewerage systems during construction is assessed as Major Adverse as there are 3 no. existing large rising mains which run through the Site to the Ford WWTW to the east of the Site. If the mains are damaged during construction this would interrupt the off site sewerage systems. The rising mains should be located and protected. By implementing appropriate mitigation measures including careful working procedures, the residual effect is reduced to Minor Adverse.

14.257 Water quality is at risk during construction as a result of contamination and pollutants entering the water environment. The effect has been assessed as Minor Adverse. Mitigation measures to be implemented include using desilting techniques and effective Site management to store and control potential pollutants. However, there remains a risk that an unforeseen pollution incident could occur which overwhelms the mitigation measures provided. The residual effect is Minor Adverse.

14.258 During construction the effect on fluvial and tidal flood risk and groundwater flood risk is considered to be Negligible and no mitigation measures are required.

14.259 The Development will have a Minor Adverse impact on surface water flood risk as a result of potential for uncontrolled surface water runoff. This will be mitigated by providing a suitably designed drainage system for the 1 in 100 year + 40% Climate Change storm event. In addition the finished ground levels for the Development will be designed so that overland water will flow away from the properties towards areas of lower risk, comprising of green corridors, open space and drainage basins. Following the implementation of these measures, the residual effect for surface water flood risk is Negligible.

14.260 If the completed Development does not include the implementation of water quality improvements measures, there is a risk that groundwater and watercourses could be polluted by hydrocarbons from vehicles and spillages of other chemicals and pollutants into the surface water sewerage system by residents. Sustainable Urban Drainage (SuDS) components will be provided to reduce pollutants at source. However, the risk of a large pollution incident which overwhelms the SuDS or pollutants being released directly at the drainage outfall(s) at the Development means the residual effect would remain Minor Adverse.

14.261 The Development will have a Negligible residual effect on fluvial and tidal flood risk, groundwater flood risk and foul water sewerage systems.

14.262 The cumulative effect of the Development and other nearby identified schemes has been assessed as Negligible both during construction and operation, for the following:

- Fluvial and Tidal flood risk;
- Surface Water Flood Risk;
- Foul water Sewerage Systems;
- Groundwater; and
- Water Quality.

14.263 Table 14.5 contains a summary of the likely significant effects of the Development.

Table 14.5: Table of Significance – Water Resources and Flood Risk

Potential Effect	Nature of Effect (Permanent/Temporary)	Significance (Major/Moderate/Minor) (Beneficial/Adverse/Negligible)	Mitigation / Enhancement Measures	Geographical Importance*							Residual Effects (Major/Moderate/Minor) (Beneficial/Adverse/Negligible)
				I	UK	E	R	C	D	L	
Construction											
Fluvial and Tidal	N/A	Negligible	None required.							*	Negligible
Surface Water	Temporary	Minor Adverse	Effective site management and phasing of works. Diversion of existing flow paths by providing additional temporary flow paths to areas of lesser risk and adequate attenuation.							*	Minor Adverse
Foul Water Sewerage System	Temporary	Major Adverse	Accurately trace and locate existing rising mains at the Site. Communicate locations to Site personnel. Protect the mains as required.							*	Minor Adverse
Groundwater	N/A	Negligible	None required.							*	Negligible
Water Quality	Temporary	Minor Adverse	Undertake desilting on site. Effective site management to store and control potential pollutants.							*	Minor Adverse
Completed Development											
Fluvial and Tidal	N/A	Negligible	None required.							*	Negligible
Surface Water	Permanent	Minor Adverse	Finished Site levels to be permanently flood routed so that any escape of water or exceedance flow sheds to lower risk areas of green corridors and open space. Provision of Sustainable Drainage Systems (SuDS) to convey, treat and store surface water on site.							*	Negligible
Foul Water Sewerage System	N/A	Negligible	General maintenance of on-site pumping stations to be carried out.							*	Negligible
Groundwater	N/A	Negligible	None required.							*	Negligible
Water Quality	Permanent	Minor Adverse	SuDS will be provided to remove pollutants at source.							*	Minor Adverse
Cumulative Effects											
Construction	N/A	Negligible	None required							*	Negligible
Operation	N/A	Negligible	None required							*	Negligible

* Geographical Level of Importance

I = International; UK = United Kingdom; E = England; R = Regional; C = County; D = District; L = Local

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- EU Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy
- ^{vii} EU Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks
- ^{viii} HMSO, Water Resources Act 1991
- ^{ix} HMSO, Water Industry Act 1991
- ^x HMSO, Water Act 2003
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- ^{xiii} HMSO, Flood and Water Management Act
- ^{xiv} HMSO, Environment Act 1995
- ^{xv} Topographical Survey Ford Airfield CD Surveys Drawing No. WD/1704042/05
- ^{xvi} EA Flood Maps and Modelled Flood Data - Product 4 (18 July 2018)
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- ^{xxvii} Southern Water Asset Location Plans (June 2018)
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- ^{xxix} BRE 365 Design Guidance for Soakaways, British Research Establishment (2016)
- ^{xxx} Ford Airfield Groundwater Monitoring 2018 – 2019, RSK Limited (ongoing)
- ^{xxxi} CIRIA SuDS Manual C753, CIRIA (2015)
- ^{xxxii} Geotechnical and Contaminated Land Assessment, Jacobs Limited, Report Ref B0545500/D2 (April 2007)
- ^{xxxiii} Design Manual for Roads and Bridges DMRB Volume 11 Section 3 Part 10 HD 45/09