Nutrient Neutral (South Hampshire)

Review of the Need for Nutrient Neutral Development in the Budds Farm Wastewater Treatment Works catchment

Report for Havant Borough Council, Portsmouth City Council, East Hampshire District Council, and Winchester City Council

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Executive Summary

New housing development within the Budds Farm Wastewater Treatment Works (WwTW) has the potential to increase the nutrient loading on sensitive habitats within Langstone Harbour and habitats connected to the wider East Solent system. A study group comprising East Hampshire District Council, Havant Borough Council, Portsmouth City Council and Winchester City Council, are reviewing the revised advice on nutrient neutral development issued by Natural England in March 2020 and determining whether there is evidence to conclude an adverse effect through the Habitats Regulations on the Solent designated sites. This report contains a review of relevant available literature and data to support these decisions.

The Solent coastal system is internationally designated for its unique marine and estuarine habitats and species, and important assemblages of waterfowl. Langstone Harbour, into which a number of Combined Sewer Overflows (CSOs) discharge from Budds Farm WwTW, is designated as part of the Solent Maritime Special Area of Conservation (SAC), the Chichester and Langstone Harbours Special Protection Area (SPA) and Ramsar site, and supports a coastal lagoon at Farlington Marshes which is part of the Solent and Isle of Wight Lagoons SAC. Langstone Harbour is connected to Chichester Harbour via a linking channel and Portsmouth Harbour via Ports Creek. The latter harbour is designated separately as the Portsmouth Harbour SPA and Ramsar. The wider East Solent is designated as part of the Solent and Dorset Coast SPA and parts of the north east of the Isle of Wight are designated as the Solent and Southampton Water SPA and Ramsar.

Langstone Harbour is currently achieving good Water Framework Directive status for macroalgae and analysis of temporal trends in macroalgae cover[22] has indicated a generally decreasing trend in recent years, although high levels persist in the north east of the harbour close to the Budds Farm outfall. However, the separate reporting process for Sites of Special Scientific Interest (SSSI) favourable condition demonstrates that a large proportion of the designates sites in the Solent, notably the estuarine systems, are either in unfavourable – no change or unfavourable – recovering condition, with high levels of opportunistic macroalgal growth persisting during the winter months. The original Government target was that 95% of the total area of SSSIs should be in favourable condition by 2010. The ‘recovery’ of Langstone Harbour in the condition assessment process has largely been attributed to the significant reduction in nutrient inputs through diversion of wastewater offshore through the Eastney Long Sea Outfall. It is not clear however whether this is enough to substantially prevent the growth of dense macroalgae mats in parts of the harbour and therefore Langstone Harbour is considered to be ‘at risk’.

New housing development, and development generating additional overnight stays or significant volumes of wastewater discharge (e.g. spas), is leading to continued and increased inputs of nitrogen and phosphorous into the wastewater treatment system and contributing via direct runoff. Despite the relatively small contributions of wastewater discharge to the coastal system, there is insufficient evidence to conclude with certainty that new housing development in the Budds Farm WwTW catchment will not cause a deterioration in condition or hinder the improvement in condition of the designated sites, when combined with small sources of nitrogen from other sewage treatment work discharging to the Solent.

The potential pathways for impact have been examined, and there is a risk that the CSO will be used more frequently as the volume of wastewater and surface runoff generated by new housing developments increases, exceeding the capacity of the sewerage system more quickly and frequently during storm events. The Budds Farm CSO and Court Lane Group CSO are located in the north east of Langstone Harbour and directly discharge to habitats sensitive to changes in nutrient levels; mudflats and sandflats, saltmarsh, mixed sediments, eelgrass beds. Water transfer from Langstone Harbour into Farlington Marshes could also affect the water quality of the Shut Lake coastal lagoon.

Discharges from the new housing development to the Eastney Long Sea Outfall (LSO) are not considered to give rise to adverse effects alone. This has been determined based on location of the outfall in relation to the most sensitive habitats, the contribution of the nitrogen load that Budds Farm WwTW makes to Langstone Harbour (≤1%) and the growth predictions and calculated capacity that remains at the WwTW to accommodate the proposed new housing development until 2036. A source apportionment study for the wider Solent has not been completed, and therefore the percentage contribution of nitrogen that Budds Farm WwTW makes to this wider coastal system is not known. However, the Solent waterbody has not been classified as a eutrophic waterbody by the Environment Agency and therefore new housing development is not considered to be an issue if considered as a source alone.

However, there is a residual or discernible effect from the continued and increased adding of nitrogen into the wastewater system and the risk that the existing nitrogen stripping processes in place at Budds Farm WwTW will become less efficient as the Dry Weather Permit (DWF) is reached. Depending on the occupancy rate used in the assessment of new housing development growth (e.g. 2.5 or 5 people per household), this DWF at Budds Farm could be exceeded somewhere between 2030 and 2036. The predicted increase in nitrogen loading with the proposed growth still results in Budds Farm WwTW contributing ≤1% to the Langstone Harbour nitrogen budget, however in-combination with other sewage treatment work sources this cumulates to 4-6%. Southern Water's dispersion modelling from Eastney LSO shows the wastewater stream is confined to the main channel of the East Solent. However, the Environment Agency's Water Framework Directive Dissolved Inorganic Nitrogen (DIN) and Ecological Impact Investigations (2014) have shown that Budds Farm WwTW contributes ≤1% of nitrogen to Chichester and Portsmouth Harbours. Again, when this residual or discernible effect is added to the other offshore sewage treatment work sources, the contribution increases to 4-5% at Chichester Harbour and 5-6% at Portsmouth Harbour. Therefore, given the uncertainty in spatial extent of dispersion of the wastewater from Budds Farm WwTW, and level at which continued nitrogen loading will cause further deterioration in site condition, the whole of the Solent European Marine Site could be impacted by the in-combination effects.

In order to address the potential adverse effects of the use of the CSOs and in-combination effect of the nitrogen loading resulting from the new housing development, mitigation must be provided, and the nitrogen budget used to evidence a nutrient neutral development. The mitigation must be targeted, demonstrated to be effective, timely and deliverable for the perpetuity of the development, with a suitable monitoring plan in place. Mitigation should be onsite where possible, using improvements in water efficiency measures, Sustainable Drainage Systems (SUDS), sewerage capacity improvements, on-site treatment works, to demonstrate nutrient neutrality. Where necessary, offsite 'credits' could be achieved by taking existing agricultural land out of intensive use.

With application of suitable mitigation the report has identified that adverse effects on the qualifying features of the Solent designated sites can be avoided or reduced, such that there will be no risk (either alone or in combination) to the ability of the site to achieve its conservation objectives or maintain its integrity as a result of the new housing development proposed in the Budds Farm WwTW catchment.

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1 Introduction

1.1 Background and Purpose of the Report

The water environment within the Solent region is internationally important for its wildlife and is protected under the Water Environment Regulations (Water Framework Directive) and The Conservation of Habitats and Species Regulations 2017 (as amended, hereafter referred to as the Habitats Regulations), as well as national protection for many parts of the coastline and sea.

There are high levels of nitrogen and phosphorus input to this water environment with concerns that these nutrients are causing eutrophication of the Solent designated sites. These nutrient inputs, primarily nitrogen, are mainly caused by agricultural sources, with wastewater from housing being a much smaller component of terrestrial nutrient sources.

It is Natural England's view that there will be a likely significant effect on the internationally designated sites (Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Ramsar sites and potential SPAs and SACs, collectively referred to as European designates sites in the Solent from additional wastewater generated by new development, as outline in their revised guidance "*Advice on achieving nutrient neutrality for new development in the Solent region"* (March 2020).

This report, produced by Ricardo Energy and Environment (REE) on behalf of the Study Group comprising Havant Borough Council (BC), Portsmouth City Council (CC), Winchester CC and East Hampshire District Council (DC), looks to establish the source-pathway-receptor from new housing development, and assess the significance of any effects on the European designated sites (including Ramsar sites). A meeting was held with Natural England on 4 March 2020 to discuss the findings, and subsequent comments provided by Natural England have been addressed where relevant within this report (see Appendix B for comments and responses).

1.2 The Nutrient Neutral Issue

Despite legislative requirements to try and reduce nutrient loading into sensitive estuarine waters, nitrogen and phosphorous levels remain high. The three linked harbour systems of Portsmouth Harbour, Langstone Harbour and Chichester Harbour are all designated as Nitrate Vulnerable Zones (NVZ). The areas are designated Sensitive Area (Eutrophic) under the Urban Waste Water Treatment Directive (UWWTD), and Polluted Water (Eutrophic) under the Nitrates Act 2008. Changes in wastewater discharge and statutory and voluntary measures to reduce diffuse agricultural inputs have led to some improvements; Langstone Harbour is now classified as having 'Good' status under the Water Framework Directive (WFD).

Elevated levels of nitrogen and phosphorous can lead to increases in opportunistic macroalgal growth, and algal blooms. Evidence from the three harbours suggests that these algal blooms can persist into the winter months. Eutrophication, with the increase in density and coverage of algal weed and phytoplankton blooms, can lead to smothering of mudflats, displacement of eelgrass, reductions in dissolved oxygen and blocking of light. Species abundance and diversity will be reduced as a result.

The effects of nutrient and water quality were subject to recent case law, with a European Court of Justice (ECJ) judgement in late 2018 (known as the 'Dutch Case'), relating to the application of fertiliser to agricultural land and grazing of cattle in the Netherlands, and considering this as a project under the Habitats Directive, and the use of strategic measures to address the impact. As part of the case, it was recognised that where the conservation status of a habitat is already unfavourable, the authorisation of

activities which could add further nitrogen loading may affect the "ecological situation"[1], however the use of thresholds to exclude proposals from further assessment is acceptable in principle[2].

In response to this judgement, Natural England issued an advice note in June 2019 to planning authorities on achieving nutrient neutrality for new development in the Solent region. This advised that planning permission should not be granted for any new development involving, or generating additional, overnight stays, unless the impact from the proposed development will not add to the existing nutrient burdens. Natural England states that such proposals should be appropriately assessed and that the Appropriate Assessments undertaken must conclude that there are no adverse effects on internationally designated habitat sites for Council's decisions to be legally compliant. A revised advice note was issued in March 2020 (version 3) which provides clarity on the types of development to which the nutrient neutral methodology applies, the fluvial catchments for each of the main watercourses/harbours entering the Solent, and the locations where mitigation is deemed appropriate (i.e. when offsite mitigation such as on the Isle of Wight), can be considered.

This advice has led to the temporary halting of a large number of planning permissions being granted in the Solent area, since April 2019. However, Local Planning Authorities (LPAs) are required to develop their local development plans (2016-2036), meet housing targets and determine applications for development in a timely manner. Future development, however, needs to consider the nature conservation designation protection, and legal compliance with the Habitats Regulations is critically important. The Study Group has sought to be proactive in addressing these matters: for example, Havant BC, Winchester CC, and East Hampshire DC have adopted Position Statements on nutrient neutral development and in November 2019 Portsmouth City Council adopted an Interim Nutrient Neutral Mitigation Strategy.

1.3 The Study Area

The study area, shown in **Figure 1.1**, is the estimated catchment of the Budds Farm Waste Water Treatment Works (WwTW)[3] and comprises the southern parishes of East Hampshire DC (south of the South Downs National Park); all of Havant BC except Emsworth (which drains to Thornham WwTW); all of Portsmouth CC and the Denmead and Waterlooville areas of Winchester CC.

A zone of influence for the study has been identified using information on the outfalls from the Budds Farm WwTW, the indicative modelled dispersion plume from the Eastney Long Sea Outfall (LSO) provided by Southern Water and nitrogen source apportionment modelling completed by the Environment Agency.

The European designated sites to be considered are:

- Chichester and Langstone Harbours Special Protection Area (SPA)
- Chichester and Langstone Harbours Ramsar site
- Solent Maritime Special Area of Conservation (SAC)
- Solent and Dorset Coast Potential Special Protection Area (SPA)
- Portsmouth Harbour SPA
- Portsmouth Harbour Ramsar
- Solent and Isle of Wight Lagoons SAC

[1] Para 102 of the case states "In this regard, it should be noted that under Article 1(e) of the Habitats Directive, the conservation status of a natural habitat is considered to be 'favourable' when, inter alia, its natural range and the areas it covers within that range are stable or increasing and the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future".
[2] DTA Publications (December 2018) The Habitats Regulations Assessment Journal: Issue 11 Farming and Natura 2000 Ammonia special. Accessed at https://www.dtapublications.co.uk/handbook/downloads/Issue%2011%20Dec%202018.pdf
[3] No map of the Budds Farm WwTW catchment has been provided by Southern Water although requested.

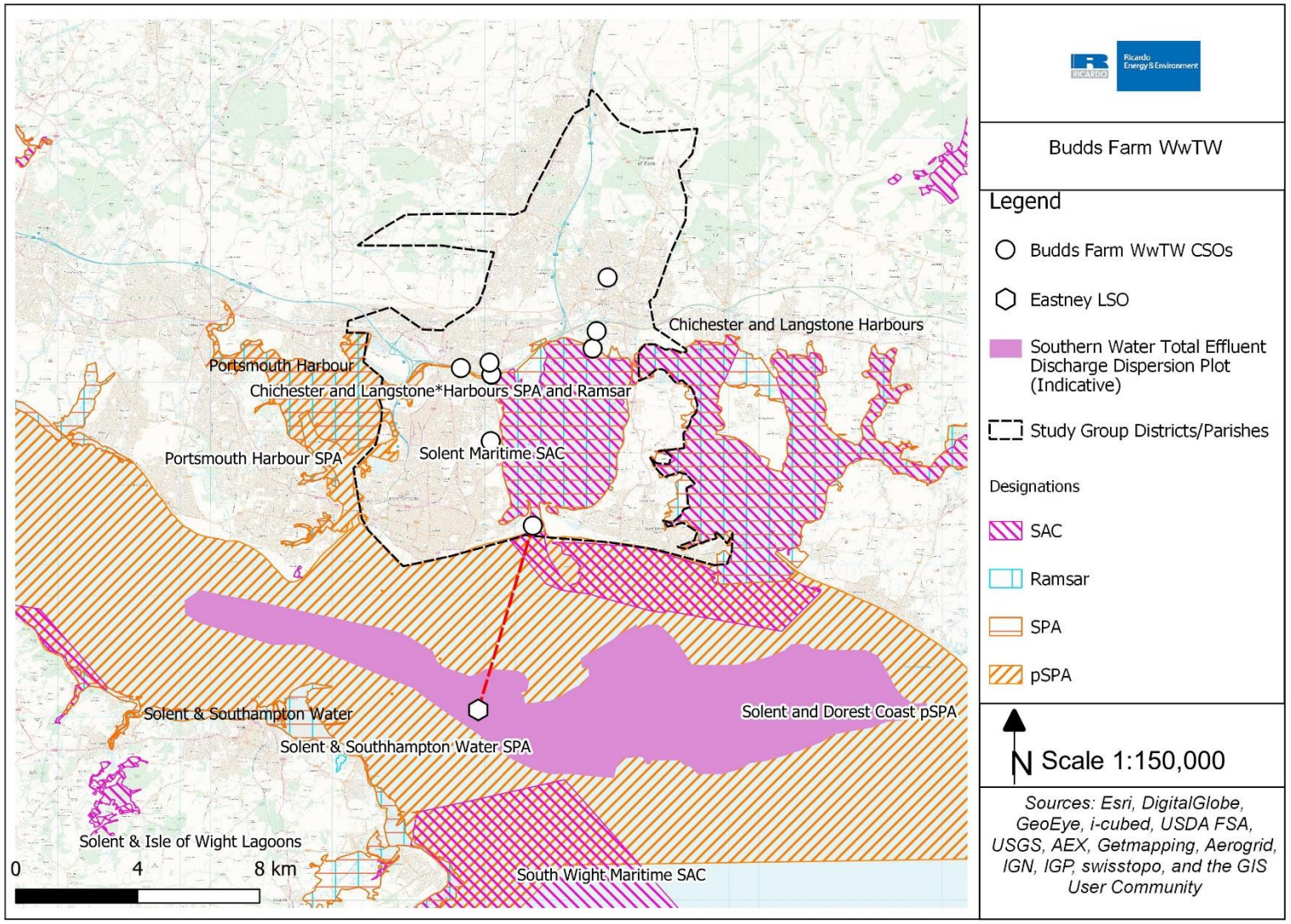
- Solent and Southampton Water SPA
- Solent and Southampton Water Ramsar

1.4 Report Structure

This report is divided into the following sections:

- Section 2: Legislation and Policy
- Section 3: How Budds Farm Wastewater Treatment Works (WwTW) Operates
- Section 4: Water Quality Baseline
- Section 5: Potential Effects to be Mitigated
- Section 6: Review and Assessment of Natural England's Advice
- Section 7: Conclusions and Next Steps

Figure 1.1: Budds Farm WwTW Catchment (estimated) and European Designated Sites[4]



[4] The Solent and Dorset Coast SPA was fully classified in January 2020, however the available GIS shapefiles from www.gov.uk have not been updated yet.

2 Legislation, Policy and Previous Studies

A number of key directives and policies provide a legislative framework within which the nutrient neutrality issue sits. These directives and policies range from European Union (EU)-wide legislative instruments to local policy making by Local Authorities. This section first describes the relevant EU directives, followed by relevant national policy and local policy.

2.1 EU Directives taken forward in domestic (EU Exit) Regulations

2.1.1 The EU Water Framework Directive (WFD)

The WFD (2000/60/EC) came into force in December 2000, providing an overarching legislative driver for the improvement of the water environment. At the core of the WFD is the ecological and chemical protection of EU surface waterbodies[5]. To show ecological and chemical protection, surface waters are classified with two elements: ecological status and chemical status. The WFD mandates that, unless there are overriding policy objectives, all surface waters must be brought up to "good" ecological and chemical status. For each waterbody, good ecological status combines the quality of the biological community, and the hydrological and chemical characteristics. Good chemical status is defined by compliance with environment quality standards (EQS) for scheduled chemical substances. In the present context, the requirement of nutrient neutrality for new developments in the Budds Farm WwTW catchment is relevant to achieving good ecological status, but nutrient compounds are not specified as scheduled substances and thus good chemical status is not relevant.

Nutrient enrichment of surface waters can lead to eutrophication and subsequent blooms of macroalgae. These blooms can have various deleterious impacts on the ecological status of a waterbody due to smothering of benthic flora and fauna and increased oxygen demand caused by biological degradation of macroalgae. As such, the UK Technical Advisory Group (UKTAG) on the WFD has set limits on dissolved inorganic nitrogen (DIN)[6] in coastal and transitional waterbodies (**Table 2.1**)[7]. Note that no nitrogen standards have been set for rivers in the UK, nor for phosphorous in coastal and transitional waterbodies.

Table 2.1: Dissolved inorganic nitrogen WFD standards for coastal and transitional waterbodies

Area	Salinity (ppt)	Dissolved Inorganic Nitrogen (winter mean)			
		Reference value (High – Good status boundary		Threshold value (Good – Moderate status boundary)	
		µmol/l	mg/l	µmol/l	mg/l
Coastal	30 – 34.5	12	0.168	18	0.252
Transitional	< 30	20	0.28	30	0.42

2.1.2 Urban Waste Water Directive

The Urban Waste Water Treatment Directive was adopted in May 1991. The Directive has an objective of protecting the water environment through the requirement to provide sewerage and standards for sewage treatment. Urban waste water is defined in the Directive as the mixture of domestic waste water from kitchens, bathrooms and toilets, the waste water from industries discharging to sewers and rainwater run-off from roads and other impermeable surfaces such as roofs, pavements and roads

[5] See: https://ec.europa.eu/environment/water/water-framework/info/intro_en.htm, accessed 22/01/2020
[6] Dissolved inorganic nitrogen is the sum of ammonium, nitrite and nitrate.
[7] UKTAG. 2008. UK Environmental Standards and Conditions (Phase 2)

draining to sewers. The general principle of the Directive is to provide treatment of sewage from the largest discharges first, and to protect sensitive waters.

Sensitive areas are identified as: freshwater bodies, estuaries and coastal waters which are eutrophic or which may become eutrophic if protective action is not taken; surface freshwaters intended for the abstraction of drinking water which contain or are likely to contain more than 50 mg/l of nitrates; and areas where further treatment is necessary to comply with other Council Directives such as the Bathing Water Directive. Where a sensitive area has been designated, more stringent wastewater treatments are required. The Directive sets secondary treatment as the normal standard, but requires tertiary treatment where discharges affect sensitive areas. For eutrophic waterbodies, this additional treatment includes the removal of phosphorus and/or nitrogen in the treatment plants.

2.1.3 Habitats and Birds Directives

The Habitats Directive (92/43/EEC) was adopted in 1992 and is the primary legislative tool for the conservation of natural habitats and of wild fauna and flora. Article 3 of the Habitats Directive requires the establishment of a European network of important high-quality conservation sites that will make a significant contribution to conserving the 189 habitat types and 788 species identified in Annexes I and II of the Directive (as amended). The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds). Of the Annex I habitat types, 78 are believed to occur in the UK. Of the Annex II species, 43 are native to, and normally resident in, the UK[8]. The aim of the directive is to sustain or achieve 'favourable conservation status' of habitats and species and establishes a network of protected sites, Natura 2000 sites, which encompasses all Special Areas of Conservation (SAC) and Special Protection Areas (SPA). Article 6 of the Habitats Directive is the provision by which the Natura 2000 sites are managed and protected. Article 6(2) ensures measures are taken to avoid the deterioration of habitats and the habitats of species, as well as the disturbance of the species for which the areas have been designated.

Article 6(3) and Article 6(4) have been transposed into domestic legislation to form the key components of the Habitats Regulations Assessment (HRA) process (through the Conservation of Species and Habitats 2017 (as amended)). Article 6(3) provides the legislative process by which any plan or project not directly connected with or necessary to the management of the sites, likely to have a significant effect against the site's conservation objectives, must be subject to an appropriate assessment to ascertain whether it will have an adverse effect on site integrity. Article 6(4) provides the derogations process whereby alternative solutions, and in the absence of alternative solutions, imperative reasons of overriding public interest, are assessed and compensatory measures provided.

The Birds Directive aims to protect all 500 wild bird species naturally occurring in the European Union. The Directive was adopted in 1979 and amended in 2009. Annex I of the Directive identified 194 species and sub-species which are particularly threatened. Member States must classify the most suitable 'territory' (land, water and sea) for the protection of endangered, rare and vulnerable species or large assemblages, especially migratory species. These areas are designated as SPAs.

2.2 National Policy

2.2.1 The National Planning Policy Framework (NPPF)

The NPPF[9] sets out the Government's planning policies for England, providing a framework within which local authority Local Plans for housing and other development can be produced. Various aspects of the NPPF are relevant to the Study Group's nutrient neutrality issue. Sustainable development requires environmental objectives to protect or enhance the natural environment through development projects. These requirements also include the need to minimise waste and pollution and make effective

[8] https://sac.jncc.gov.uk/
[9] Department for Housing, Communities and Local Government. 2019. National Planning Policy Framework

use of land. Making effective use of land is linked to the "delivery of a sufficient supply of homes". To meet government housebuilding targets, there is a need to target building on brownfield land. Small brownfield sites are noted to be important in the mix of sites targeted for development due to having quick buildout times. Thus, unless stating a reason why, the NPPF states local authorities need to have at least 10% housing development on brownfield sites ≤ 1 ha. Linked to this requirement is a more general preference under the NPPF for development on brownfield sites. It is noted, however, that these brownfield developments should not cause harm to internationally designated sites for wildlife.

Other environmental considerations in the NPPF state that developments should include sustainable drainage solutions (SUDS) to help ameliorate flood risk, unless there is clear evidence that the application of SUDS would be inappropriate. It is also stated that developments in the coastal zone should pursue Integrated Coastal Zone Management approaches, although the majority of guidance on this issue relates to the siting of developments in Coastal Change Management Areas where considerations are based around physical changes to the shoreline[10]. Other relevant considerations are found in NPPF guidance on "conserving and enhancing the natural environment", whereby new developments must not contribute to unacceptable levels of water pollution and, where possible, should try and improve water quality in accordance with River Basin Management Plan goals.

2.3 Regional Studies and Advice

2.3.1 Partnership for South Hampshire (PfSH) Integrated Water Management Study

PfSH is a partnership with Hampshire County Council, the unitary authorities of Portsmouth, Southampton and the Isle of Wight and eight district authorities of Eastleigh, East Hampshire, Fareham, Gosport, Havant, New Forest, Test Valley and Winchester. In 2008, an Integrated Water Management Study (IWMS) was produced to provide an evidence base to demonstrate that planned growth in the area would not adversely affect the water environment, thereby supporting the provision for increased housing. Since the original study, the condition of the baseline environment has changed, legislative processes have been tightened, and houses have been built and land allocated. An updated IWMS was therefore produced in March 2018 to take account of these changes, to support the production of Local Plans and ensure compliance with the National Planning Policy Framework, the Water Framework Directive and Habitats Regulations.

As part of the study, the existing capacity of the Wastewater Treatment Works (WwTW) that discharge to the Solent, and ability to accommodate both residential and employment growth (commercial and retail) was assessed. All WwTWs are permitted to discharge a set volume of treated effluent based on the population size they serve, which is referred to as the Dry Weather Flow (DWF). The DWF was used in the study as an indicator of when a WwTW is reaching its volumetric design capacity and requires an upgrade. Two residential occupancy rates were used; 2.5 and 5 based on a worst case scenario in order to identify the worst level of impact that could be expected.

The study concluded that the Budds Farm WwTW had capacity to meet the projected growth within the lifetime of the Local Plans (to 2036) however after this time capacity upgrades may be required. A risk of increased sewer network overflows was also identified, with improvements potentially being required.

2.3.2 Natural England Advice on Achieving Nutrient Neutrality for New Development in the Solent Region

In response to the issue of nutrient neutrality raised by The Dutch Case, Natural England released advice in June 2019 on the contextual factors surrounding the issue, as well as a methodology for nitrogen budget calculations to assess the amount of mitigation that may be required by new development. A revised advice note was issued in March 2020 providing additional information on the

[10] Royal Haskoning DHV. 2019. *Coastal Change Management Areas: Opportunities for more sustainable solutions in areas subject to coastal change.* Natural England Commissioned Reports, Number 275.

types of development to which the nutrient neutral methodology applies, the fluvial catchments for each of the main watercourses/harbours entering the Solent, and the locations where offsite mitigation may be deemed appropriate. The advice note is available to support Local Authorities when undertaking the role as the Competent Authority in the Habitats Regulations Assessment process, and provides a framework which can be used to assess new housing development through the Stage 2 Appropriate Assessment, and determine whether the integrity test is met before approving planning applications.

The nutrient neutral methodology uses occupancy rates in Stage 1 to calculate the additional population. Natural England has recommended the use of the average national occupancy rate of 2.4, as calculated by the Office for National Statistics (ONS), as this can be consistently applied across all affected areas and has been a stable figure (over the last 10 years). As such, it is considered by Natural England to be an appropriate figure as a proxy for in perpetuity trend[11]. The occupancy rates in the IWMS were used to determine capacity issues with the WwTW and are therefore not appropriate to apply to planning applications for new housing.

The nutrient neutral methodology only needs to be applied to commercial and industrial cases in exceptional circumstances. The precautionary buffer included in the methodology accounts for incremental increases in wastewater associated with retail, commercial and other employment uses.

2.4 Local Council's Positions on Nutrient Neutral Development

The four councils comprising this Study Group have all identified their positions in terms of nutrient development. These are summarised here for clarity and to summarise synergies and differences between their approaches primarily due to their geographical and urban density position.

2.4.1 Havant Borough Council's Position

A position statement from Havant BC[12] on the issue of nutrient neutral development states that Havant BC are committed to sustainable development including relevant environmental protections. This encompasses consideration of potentially detrimental effects on the Solent's water quality in the context the designated sites. Havant BC states that no change has occurred to the level of nitrogen emissions from new development and urban nitrogen emissions are relatively small. They recognise the changes to assessment of significant effects under the HRA process resulting from the Dutch Case and that under this new assessment regime, it is likely that new overnight accommodation would likely cause a significant effect on several designated sites. As the cause of the nutrient neutral issue is recent case law, Havant BC state that the issue should be addressed by one or a combination of the following:

- A national review of the nitrogen discharge consents of wastewater treatment works to include increases in nitrogen as a result of new development.
- Government provided 'mitigation banking', potentially through a delivery arm such as Homes England.

However, failing a central solution, Havant BC recognise the need for a solution across the Partnership for South Hampshire (PfSH) and Solent area, though both central and regional solutions are noted to be long-term, with short-term solutions needed to enable planning permissions for new house building. Thus, Havant BC accepts that short-term nutrient mitigation will be required to enable development to continue in the borough. Havant BC also recognise that a nitrogen neutral Local Plan will need to be prepared and longer team mitigation options explored.

[11] Personal communication. Rachel Jones (Natural England) to David Hayward and Gill Glover (Havant Borough Council) 12 March 2020.
[12] Havant Borough Council. 2019. Position statement on nutrient neutral development

To support the update of the Local Plan 2036, Havant BC's position statement[12] has included an initial nitrogen budget that estimates an increases of 2942 kg/total nitrogen/yr to 2036. This provides an initial estimate of the annual nitrogen load that needs to be mitigated. Havant BC have indicated that sufficient mitigation options are available in the borough that would mitigate nitrogen loading from all development up to 2036. These options include:

1. Apply the optional water efficiency standard of 110 litres per person per day (l/pp/d) to all new development – this mitigation option has already been included within The Nitrogen Budget. As such all residential development will be expected to meet this standard
2. Taking land out of agricultural use and converting it to a use that does not artificially increase the nitrogen load of the land
3. Create wetland environments that act as a nitrogen sink and remove nitrogen from rivers and streams (catchment management solutions)
4. Increase the requirement for open space/ Suitable Alternative Natural Green Space (SANGS) for development on agricultural land
5. Agreement with Southern Water that they will increase the nitrogen removal rate at the receiving Waste Water Treatment Works beyond consented levels
6. Contribute to taking land out of agricultural use and catchment management solutions within the river catchment area for the impacted protected site
7. Development of the Havant Thicket Reservoir
8. Implementation of Brent Goose and Wader refuges

Havant BC owns land suitable for various mitigation options that should allow for the delivery of strategic mitigation options and they intend on providing a mitigation package from the available options that will allow accommodation of unforeseen windfall development. The specifics of the mitigation scheme will be detailed in an "Implementation Plan" linked to the Havant BC position statement. Havant BC also state an assumption that any significant effect resulting from increased nutrient loading takes place at the point a development is occupied, rather than at commencement of construction.

In an additional analysis of the issues surrounding nutrient neutrality[13], Havant BC discuss adherence to the Precautionary Principle in the HRA process. Due to the uncertainties surrounding effects on designated sites that may result from nutrient loading by new developments, it is noted that the Precautionary Principle places a significant burden on developers due to the difficulties of showing no likely significant effects. Added to this issue, in-combination effects from multiple developments are likely to increase the risk of significant effects on designated sites. Havant BC also note the HRA process places an onus on the developers or competent authority to show no impact on designated sites identified in the screening process. Due to the Solent and Portsmouth, Langstone and Chichester Harbour all being European designated sites and the presence of the Precautionary Principle as a legal requirement of the HRA process, it is likely to be difficult to show beyond scientific doubt that new developments will have no impact. Havant BC also recognise that Natural England's approach to assessment of the nutrient neutrality issue is at a Solent-wide scale, leaving assessment of the impacts of developments on each designated site to the relevant competent authority.

Havant BC has provided comments on Natural England's method for assessing nutrient neutrality,[14] noting that inputs to the method are conservative so as to address uncertainty and ensure compliance with the Precautionary Principle. The result is certain assumptions, such as all people moving to new developments and contributing to nutrient loading coming from outside the Budds Farm catchment, which is unlikely to be the case; and an agreement by Natural England and the Environment Agency to

[13] Havant Borough Council. 2019. The need for nutrient neutral development in South East Hampshire
[14] Natural England. 2019. Advice on Achieving Nutrient Neutrality for New Development in the Solent Region

use 90% of the consented nitrogen discharge concentration from Budds Farm, with Havant BC suggesting that using the full consent limit for nitrogen concentrations would still be in-keeping with the Precautionary Principle. The Natural England nitrogen budget methodology also recommends adding a further 20% buffer nitrogen load calculations. Natural England provided further background to the purpose of the 20% precautionary buffer at a meeting with the study group on 4 March 2020. The buffer has been used to account for unknowns or uncertainties that cannot be easily rectified e.g. pipeline misconnections, and the different forms of nitrogen as highlighted above. The buffer also includes the potential for indirect atmospheric deposition and incremental increases in wastewater discharge from commercial, retail and other industrial developments (except in exceptional cases where the nutrient neutral methodology would need to be applied).

2.4.2 Portsmouth City Council's Nutrient Neutral Strategy

Portsmouth CC has released a strategy document outlining an interim approach to ensuring nutrient neutrality of new developments in their planning area[15]. This document recognises the requirement for nutrient neutral development mandated by the Dutch Case. Owing to the requirements under the HRA process now necessitated by the Dutch Case, Portsmouth CC has recognised the need for mitigation measures to mitigate increases nutrient loading to the Solent Area. Whilst mitigation is currently necessary on a development-by-development basis, Portsmouth CC also note that in a broader context, solutions involving improved wastewater treatment and working with government agencies on a long-term strategy will be necessary. However, Portsmouth CC is also aware of recent EA technical guidance that states no further investment to tighten nitrogen outputs from wastewater treatment is needed for WwTWs in the Solent Area, assuming the receiving WwTWs for new developments have capacity to take increased wastewater discharges. This provides the context within which Portsmouth CC developed their strategy and confirms the need for an interim strategy for nitrogen mitigation.

Portsmouth CC has thus provided three options for developers to mitigate nitrogen export from new developments:

1. Offsetting against existing land use and water use at a development site – under this option developers will be able to use changes to land use at the development site that reduce nitrogen export or changes to the development that reduce water use and thus wastewater.
2. Other bespoke direct or in-direct mitigation measures – the use of SUDS at development sites or using off-site schemes like conversion of farmland to non-agricultural land use to reduce the associated nutrient inputs.
3. Portsmouth CC's 'Nutrient Neutral' Mitigation Credit – if developers can do neither option 1 or 2, a third option will be to purchase mitigation credits from a bank of credits built up by Portsmouth CC through water efficiency improvements to their housing stock.

2.4.3 East Hampshire District Council's Position on Nutrient Neutrality

East Hampshire DC's position[16] on the nutrient neutrality issue is framed in the context by the requirement under the NPPF to significantly boost the supply of homes, the geography of the planning authority that places it within the Solent catchment area and the Dutch Case with its attendant requirements for nutrient neutrality under the HRA process. East Hampshire DC notes that whilst it is committed to sustainable development, a relatively small number of areas under its authority are affected by the change in case law and that contribution of nutrients from new developments is very small relative to diffuse and coastal background sources.

East Hampshire DC recognises that owing to the requirement of the HRA to show no likely significant impact on designated sites impacted by a development, the ruling of the Dutch Case makes the link

[15] Portsmouth City Council. 2019. Interim Nutrient Neutral Mitigation Strategy for New Dwellings.
[16] East Hampshire District Council. 2019. Position statement on nutrient neutral development

between increased nutrient loading and likely significant effects on designated sites. As such, new developments need to be nutrient neutral to comply with habitat regulations.

Due to the potential impacts on designated sites resulting from increases nutrient loading from new developments, East Hampshire DC note the advice from Natural England that implicates water quality impacts from new developments in the Appropriate Assessment stage of the HRA process. East Hampshire DC's position recognises that although there have been no changes to the amount wastewater that will be derived from new developments, the change to way in which wastewater is assessed under an HRA means they now need to pursue nutrient neutral development. Nutrient neutrality can be achieved using local mitigation strategies whilst a long-term national strategy is in development.

East Hampshire DC's position on avoidance and mitigation measures suggests various potential mitigation solutions that fall broadly into categories of water efficiency measures, catchment management and improvements at WwTWs. They note that they would work with Havant BC to use land owned by Havant BC to provide immediate mitigation solutions. The ability to use Grampian Conditions to ensure developers pursue mitigation options has been stated and East Hampshire DC also highlight the requirement for ongoing monitoring of nitrogen loads from mitigation schemes to feed into better nitrogen budgeting.

2.4.4 Winchester City Council's Position on Nutrient Neutrality

Winchester CC's position[17] on nutrient neutral development is framed in the guidance provided by Natural England in response to the Dutch Case and HRA requirements. They are aware of the new need to address water quality issues resulting from nutrient enrichment of designated sites in the HRA process. As a competent authority, Winchester CC is cognisant of the links made between nutrient enrichment of designated sites resulting from wastewater coming from new developments, the potential for likely significant effects under the Habitat Regulations and the subsequent issues this raised around granting planning permission.

Winchester CC's local plan has promoted sustainable development whilst also meeting NPPF requirements to boost housing growth. A review of the local plan will include a nitrogen budget produced in-line with guidance from Natural England. As well as production of nitrogen budget, Winchester CC are aware of the Natural England's advice mitigation measures to address nutrient surpluses from new developments will be needed and that these measures can be either "direct", e.g. water use efficiencies or WwTWs upgrades, or "indirect", e.g. catchment management and taking land out of agricultural production over the life-time of a development (normally 80-125 years).

Whilst Winchester CC are taking steps to provide nutrient mitigation strategies for new developments, they are also calling for a strategy at a national level. Failing a central solution, Winchester CC have stated their desire to work at a regional level with other competent authorities that have been impacted by this issue. As part of this solution, Winchester CC will be requiring applicants for planning permission to submit nitrogen budgets for their developments, along with their planning applications. Nitrogen budgets will feed into mitigation plans and mitigation will considered in respect of an HRA and consultation with Natural England to determine whether planning consent can be granted. Mitigation may be required offsite and the use of Grampian Conditions is stated as an option to ensure mitigation measures are enacted.

Winchester CC has identified different potential mitigation options that can be either on-site, e.g. water efficiency measures or on-site open space that has low nitrogen export rates, or off-site, e.g. catchment management solutions. Monitoring will also take place of schemes which are able to achieve nitrogen

[17] Winchester City Council. 2019. Position statement on nitrate neutral development.

neutrality or a deficit on-site, which will feed into a nitrogen budget and inform the local plan review to 2036.

3 How Budds Farm Wastewater Treatment Works (WwTW) Operates

The following section provides a brief overview of information made available on Budds Farm Wastewater Treatment Works (WwTW) by Southern Water. The information used was taken from Southern Water's Management of Wastewater in Portsmouth and Havant case study, the article on the improvements at the works taken from the Wastewater and Sewerage report (article by Andrew Collett), a presentation on bathing water quality given by Southern Water to Havant BC in November 2018, and correspondence between Southern Water and Havant BC relating to the nutrient neutrality issue (December 2019 and March 2020).

Budds Farm WwTW serves a catchment of nearly 410,000 homes across Portsmouth, Hayling Island, Cosham, Paulsgrove, Waterlooville, Horndean and Hambledon[18]. In storm conditions it can treat up to 200 Ml/d of waste water. Flows to Budds Farm from Portsmouth are pumped under Langstone Harbour from Eastney Pumping Station. Following treatment, treated wastewater from all developments in the Budds Farm catchment is pumped back via Eastney Pumping Stations and discharged at Eastney long sea outfall (LSO), 5.7 km offshore in the Solent (**Figure 3.1**).

Effluent at Budds Farm is treated using the Bardenpho processes for biological nutrient removal, which was incorporated into the wastewater treatment process in 2007[18]. Previously, treatment used an activated sludge process (ASP), with 8 lanes flowing through an anoxic and aerated zone before effluent entered the final sedimentation tanks. The ASP was modified and expanded to increase total nitrogen removal, with an additional ASP tank added and the Bardenpho method chosen for further nitrogen stripping. Modification of the ASP tanks was needed to incorporate the Bardenpho method, with these additional processes aiming to achieve 9.7mg/l total nitrogen in the final effluent.

The Bardenpho process is a process of biological nutrient removal where wastewater is mixed with sludge and introduced to aerobic conditions for phosphorus uptake. It then goes though denitrification in an anoxic zone before being aerated, simultaneously causing phosphorus uptake, carbonaceous oxidation and nitrification. The process is cycled through the aerobic zone to the anoxic zone to increase rates of denitrification until it enters a final anoxic zone to complete denitrification. Denitrification occurs in low oxygen conditions were bacteria reduce nitrate instead of oxygen to create energy, using nitrate or nitrite as an alternative electron acceptor to respire carbon. Finally, effluent briefly enters another aerobic tank to inhibit anaerobic conditions in the sedimentation tank. The sedimentation process produces waste sludge and final effluent with reduced nutrient concentrations that, under normal conditions, is discharged from the Eastney LSO.

[18] Southern Water. No date. Management of Wastewater in Portsmouth and Havant.

Figure 3.1: Location of Southern Water outfalls in Langstone Harbour[18]

As a fallback option to discharge from the Eastney LSO, Southern Water also have a consented discharge point to Langstone Harbour at Budds Farm (**Figure 3.1**). This outfall is activated if Eastney Pumping Station is unable to cope with the volume of treated wastewater coming from Budds Farm. Other discharges to Langstone Harbour can occur due to Portsmouth's combined sewer system that mixes stormwater with foul water. When wastewater flows to Budds Farm exceed its 200 ML/d capacity, stormwater is stored in tanks at Fort Cumberland and Budds Farm with 40 ML and 7 ML capacity, respectively. If storage capacity is exceeded, a mix of untreated stormwater and foul water is discharged directly to Langstone Harbour and the Solent through combined sewer overflows (CSOs). Southern Water estimate that CSO discharges are generally between 99.90-99.98% surface water

runoff and 0.1-0.02% raw sewage[19]. Southern Water have a total of 12 permitted discharges into Langstone Harbour either directly (via either treatment works, pumping stations or storm tanks) or into other watercourses which lead to the harbour (CSOs). The storm discharges may only be used when the defined rate of flow in the sewer is exceeded due to rainfall and/or snowmelt. Six of the 12 are screened to 6mm. The location of the CSOs is shown in **Figure 1.1**.

[19] Bathing water presentation to Havant Borough Council November 2018 states 0.1%, Southern Water Management of Wastewater in Portsmouth and Havant technical note states 0.02%.

4 Water Quality Baseline

The following section provides a brief overview of water quality in Langstone Harbour, with a focus on concentrations of nitrogenous compounds. The data used for this baseline was taken from a master's dissertation research that utilised historic EA datasets,[20] the EA Open Data water quality dataset[21] and data collected for Nitrate Vulnerable Zone designations[22] and WFD investigations[23,24,25]. A summary of the nutrient issues faced by Portsmouth and Chichester Harbours is also provided as there is a pathway for impact via dispersion of effluent from the Eastney LSO via the East Solent. This is followed by a closer analysis of the spatial and temporal patterns in nitrogen concentrations in Langstone Harbour.

4.1 Nutrient Issues in Langstone Harbour

4.1.1 Nitrogen Inputs

Source apportionment data for Langstone Harbour shows a considerably larger proportion of nitrogen inputs to this harbour are derived from freshwater sources, though since the Budds Farm STW discharge was relocated to the Eastney LSO, freshwater inputs of DIN to Langstone Harbour from STWs are ostensibly 0% (**Table 4.1**). However, a closer analysis of nitrogen concentrations and macroalgal cover in the area around consented outfalls for Budds Farm that operate when the Eastney LSO cannot cope with discharge rates due to storm events suggests some STW contribution to nitrogen loading in Langstone Harbour (see below). Assuming there is some contribution from sporadic discharges from Budds Farm directly to Langstone Harbour, they are not sufficient cause failure of WFD standards for DIN and macroalgae, which were both classified as Good status in 2015, though it is noted that DIN has fluctuated between Good and Moderate status between 2009-2015. Of the freshwater nitrogen load to Langstone Harbour, the majority is derived from diffuse pollution of river flows from agriculture, with a significant groundwater contribution also noted. It has been suggested that water quality and associated eutrophication and macroalgal problems in Langstone Harbour are slowly recovering after the relocation of the main Budds Farm discharge to the Eastney LSO and in response to catchment measures to reduce diffuse pollution, though more long-term monitoring is required to confirm this. As with Chichester and Portsmouth Harbours, the majority of nitrogen loading to Langstone Harbour is from marine sources, with the coastal background again predominant and indirect STW inputs causing a minority of the marine load (**Table 4.1**). The Telemac modelling (detailed via EA correspondence) shows that Budds Farm (via the long sea outfall) contributes 0.78% of the total sources from the Solent, at Langstone Harbour entrance. The Langstone Harbour CPM model shows that 64% of the nitrogen into Langstone Harbour comes from outside the harbour, through the entrance/mouth. Therefore, the percentage of nitrogen from Budds Farm LSO contributing to algal growth within Langstone Harbour is 0.50%.

[20] Glover, G. 2018. Comparative analysis of nitrate levels as an indicator of water quality, in relation to the spatial variation of sources between Langstone, Portsmouth and Chichester harbour

[21] See: https://environment.data.gov.uk/water-quality/view/landing

[22] Environment Agency. 2016. Datasheet: Nitrate vulnerable zone (NVZ) designation 2017 – Eutrophic Waters (Estuaries and Coastal Waters)

[23] Udal, I., Rees-Jones, S., Robinson, K. 2014. Chichester Harbour Water Framework Directive DIN and Ecological Impact Investigations. Environment Agency.

[24] Rees-Jones, S., Robinson, K., Udal, I. 2014. Langstone Harbour Water Framework Directive DIN and Ecological Impact Investigations. Environment Agency.

[25] Udal, I., Rees-Jones, S., Robinson, K., Schroeder, S. 2014. Portsmouth Harbour & Wallington Water Framework Directive DIN and Ecological Impact Investigations. Environment Agency.

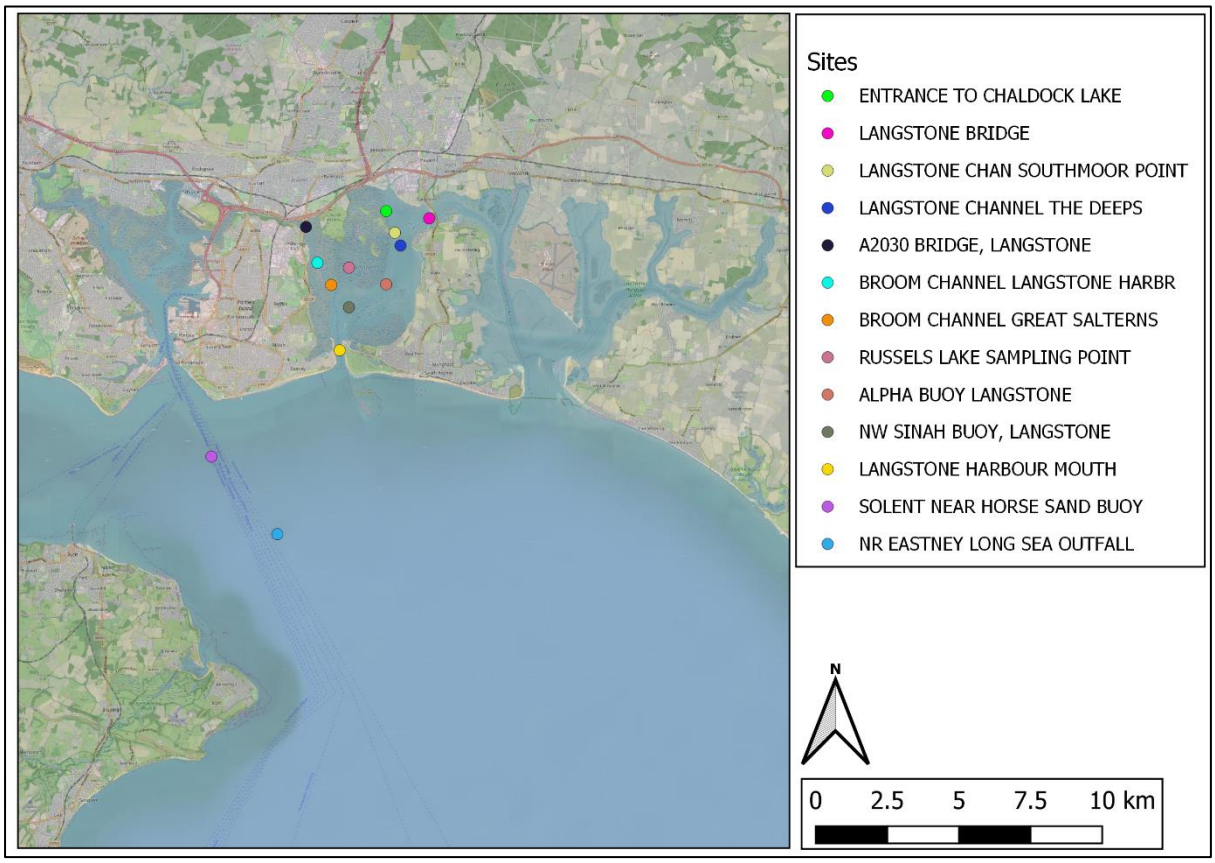
Table 4.1: Source apportionment of nitrogen loads to Langstone Harbour[26]

Nitrogen source	Langstone Harbour
Freshwater	**36%**
Riverine	28%
STW	0%
Urban diffuse	8%
Marine	**64%**
Coastal background	40%
Indirect riverine	19%
Indirect STW	5%

4.1.2 Spatial and Temporal Patterns in Nitrogen Concentrations in Langstone Harbour

The following analysis shows temporal fluctuations in nitrogen concentrations at sampling locations around Langstone Harbour, with the locations of sampling points shown in **Figure 4.1**.

Figure 4.1: Environment Agency sampling locations in Langstone Harbour and the Solent

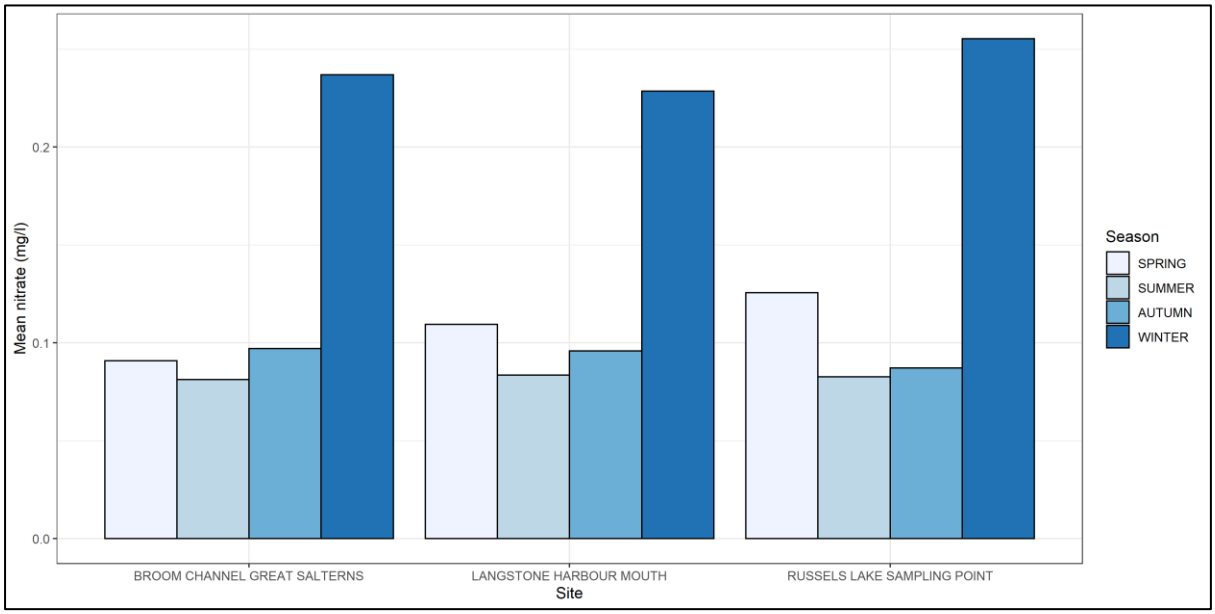


Error! Reference source not found. shows average seasonal nitrate concentrations for sites in L angstone Harbour representing a site towards the middle of the harbour (Russel's Lake), a site closer to the western edge of the harbour (Broom Channel) and a site at the harbour mouth (Langstone Harbour Mouth). All sites show considerably higher winter average nitrate concentrations, which feed into the greater average spring nitrate concentrations seen at Langstone Harbour Mouth and Russell's

[26] Note the STW (direct) refers to discharge of treated effluent directly into a harbour, as opposed to via an LSO, e.g. Budds Farm STW. Taken from the Environment Agency's WFD DIN and Ecological Impact Investigations report (2014).

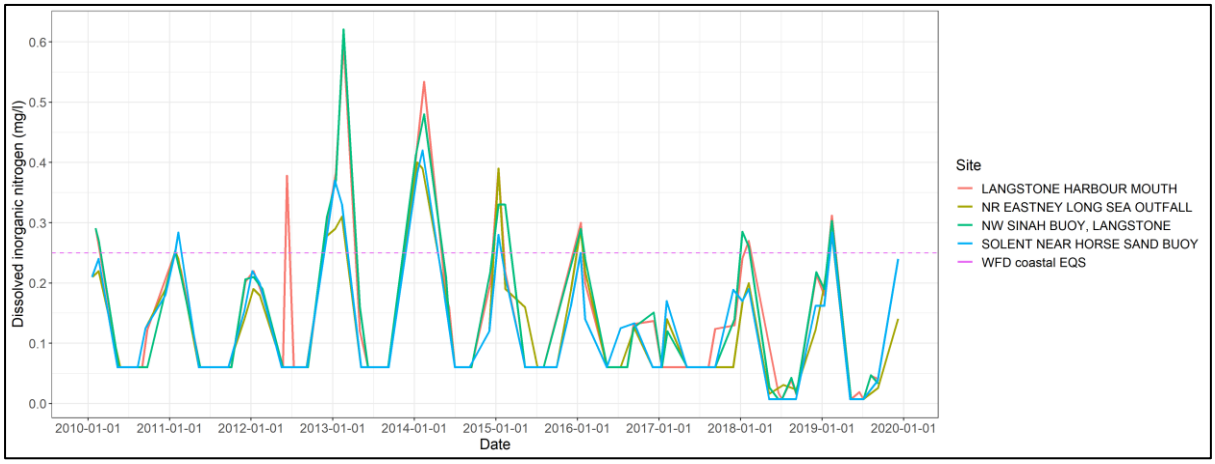
Lake. A closer analysis[20] of seasonal variation in nitrate concentrations at 11 sites distributed across Langstone Harbour showed that nitrate concentrations peak at all sites in winter.

Figure 4.2: Seasonal average nitrate concentrations at sites in selected sites in Langstone Harbour



Seasonal patterns in nitrate concentrations (Error! Reference source not found.) are also seen in t emporal variations in total DIN, with winter peaks observed at four sites for which data are available in the EA Open WIMS dataset (Error! Reference source not found.). It is worth noting that DIN c onentrations at the “Nr Eastney Long Sea Outfall” site are generally lower than those observed at sites within or at the mouth of Langstone Harbour. DIN concentrations at the “Nr Eastney Long Sea Outfall” are also very similar to those observed at the “Solent Near Horse Sand Buoy” site that is located 3.8 km away, suggesting that the coastal background DIN concentrations in the Solent are the main driver of fluctuations in nitrogen levels in the Solent. All sites shown in Error! Reference source not found. h ave average salinities of 34 ppt and thus are assessed against the WFD Coastal DIN standard. Over the past 10 years, sites within the harbour (“NW Sinah Buoy, Langstone”) and at the harbour mouth (“Langstone Harbour Mouth”) have breached the WFD Good – Moderate status boundary eight times, with the sites in the Solent breaching the Good – Moderate status boundary seven times. Breaches tend to occur concurrently at all sites during the winter months, likely due to increased seasonal rainfall.

Figure 4.3: Seasonal variation in total dissolved nitrogen concentrations at EA Open WIMS sampling points in Langstone Harbour. All sites have average salinities of 34 ppt and thus the dashed line shows the WFD good – moderate status boundary for coastal waterbodies



Assessment of dissolved available inorganic nitrogen (DAIN) for the purposes of Nitrate Vulnerable Zone designation[22] provides further evidence from sites across Langstone Harbour that ntirogen levels in the harbour peak in winter (Error! Reference source not found.). Within the harbour, there is distinct s patial variation in the location of sites that show DAIN conentrations that exceed the WFD good – moderate status boundary for transitional waterbodies (0.42 mg/l DIN). The only sites exceeding this threshold are found in a cluster towards the north-east of Langstone Harbour and in close proximity to the Budds Farm outfall. Salinity for these sites is not available but as they are found at the landward end of the harbour, it is assumed that they would be classed as transitional waterbodies. Any available water quality monitoring data at the CSOs by Southern Water should be obtained for further analysis as part of the wider PfSH Water Quality Group study.

4.2 Nutrient Issues in Portsmouth and Chichester Harbours

Portsmouth and Chichester harbours have very similar nutrient issues related to the spatial locations of freshwater inputs and balance between these inputs and nutrient inputs derived from coastal sources. Both harbours comprised two separate waterbodies during WFD Cycle 1, with a small transitional waterbody area and large coastal waterbody area, and both harbours had these areas combined to be treated as one waterbody in WFD Cycle 2. The harbours are hypernutrified and nitrogen limited and thus nitrogen is the key nutrient of concern for the promotion of inhibition of macroalgal growth. Both harbours have also shown consistent failures of WFD standards for dissolved inorganic nitrogen (DIN) and macroalgae, being classed as Moderate since the first classifications in 2009. The nitrogen limitation seen in both harbours means failure of the WFD DIN standard is likely linked to the high macroalgal growth that causes failure of the WFD macroalgae standard. This macroalgal growth is in turn enough to cause ecological impacts. There is a strong spatial component to the macroalgal growth problems in both Portsmouth and Chichester harbours, with problem growth of macroalgae seen primarily in the intertidal zone. This issue is most pronounced in the transitional waterbody areas of both harbours, where a combination of diffuse riverine and sewage treatment works (STW) sources of DIN tend to result in these small areas of each harbour having higher average DIN concentrations and greater macroalgal biomass. However, these freshwater inputs of DIN still comprise a minority of the DIN loading to the combined waterbodies.

For both Chichester and Portsmouth Harbours, < 20% of nitrogen loading is derived from freshwater (riverine, STW or urban diffuse) sources and only 6% and 1% of freshwater nitrogen inputs come from STWs to each harbour, respectively (**Table 4.2**). The vast majority of nitrogen loading to these harbours is from the offshore marine environment and within this marine load, only 8% and 5% is derived from other rivers/indirect STW inputs to Chichester and Portsmouth Harbours, respectively (**Table 4.2**). On

review of the different information available which assigns a proportion of the nitrogen load to each STW, the EA dataset provided to the Study Group and NVZ datasheets would suggest no significant contribution from Budds Farm WwTW to either Chichester or Portsmouth Harbour. However, a review of the EA's Telemac modelling (summary only) shows that Budds Farm WwTW contributes approximately 1% of the nitrogen source at the harbour entrances. The CPM modelling then looks at the relative contribution of the nitrogen sources to algal growth. Within Chichester Harbour (total) 83% of nitrogen comes from offshore marine sources, and for Portsmouth Harbour (combined) 89%. Therefore, the actual percentage of nitrogen in Chichester Harbour and Portsmouth Harbour from Budds Farm WwTW contributing to algal growth is less than 1%for both.

As a consequence of the low proportion of nitrogen loading from STWs to these harbours, cost-benefit analysis for measures to tackle WFD failures for DIN and macroalgae has suggested that the significant costs of moving STW outfalls offshore would be matched by an appropriate reduction in nutrient loading from freshwater sources. Instead, catchment measures to tackle diffuse pollution and the eventual decrease in nitrogen loading from groundwater once groundwater nitrogen peak have been suggested as key to tackling the nutrient loading problems seen in Chichester and Portsmouth Harbours.

Table 4.2: Source apportionment of nitrogen loads to Chichester and Portsmouth Harbours[27]

Nitrogen source	Chichester Harbour	Portsmouth Harbour
Freshwater	**17%**	**11%**
Riverine	11%	6%
STW (direct)	6%	1%
Urban diffuse	0%	4%
Marine	**83%**	**89%**
Coastal background	54%	67%
Indirect riverine	21%	17%
Other rivers/indirect STW	8%	5%

[27] Note the STW (direct) refers to discharge of treated effluent directly into a harbour, as opposed to via an LSO, e.g. Budds Farm STW. Taken from the Environment Agency's WFD DIN and Ecological Impact Investigation reports (2014).

5 Potential Adverse Effects to be Mitigated

5.1 Legislative Context: Habitats Regulations Assessment

Under Article 6(3) of the Habitats Directive, and Regulation 63 of The Conservation of Habitats and Species Regulations 2017 (as amended), any plan or project which is likely to have a significant effect on a European site (either alone or in combination with other plans or projects) and is not directly connected with or necessary for the management of the site, must be subject to an Appropriate Assessment (Stage 2) to determine the implications for the site in view of the site's conservation objectives. The objective of an Appropriate Assessment is to determine whether it is possible to ascertain that the proposal will have no adverse effect on site integrity, or not, and is dependent on site-specifics, including conservation status and conservation objectives.

All new developments within the Study Group's jurisdiction will be required to complete a HRA Stage 1 Screening and Stage 2 Appropriate Assessment under the Conservation of Habitats and Species Regulations 2017 (amended) given the risk of increases in nutrient loading affecting the European designated sites of the Solent. An overview of the process is provided below and summarised in **Figure 5.1**.

The Stage 1 Screening assessment is a relatively short exercise used to determine whether there is a 'possibility' or 'risk' of a significant effect, in the absence of any mitigation, that requires further consideration through the Stage 2 Appropriate Assessment. The conservation objectives of the site, conservation status and site condition are used to inform this decision. High level conservation objectives are available for each designated site, along with Supplementary Advice to the Conservation Objectives (SACO) which provide details of attributes and targets that when met, ensure the habitat or species across the suite of European sites are in favourable condition. At a site level, the condition assessments for the underlying Site of Special Scientific Interest (SSSI) can be used to determine whether the habitats are in favourable condition. This information is provided in Appendix A for the relevant sites being considered in this report.

The Stage 2 Appropriate Assessment's scope should be constrained to the potentially significant effects on the qualifying features likely to be affected. To determine this, the sources and pathways for increases in nutrients should be identified, as should the 'receptors' i.e. the qualifying features likely to be sensitive to changes in nutrient levels, and whether these are present in the zone of influence.

In-combination effects must also be considered. Although a plan or project may not have an adverse effect alone (including mitigation where necessary), there may be a residual or discernible effect which might act in combination with other plans or projects resulting in an adverse effect.

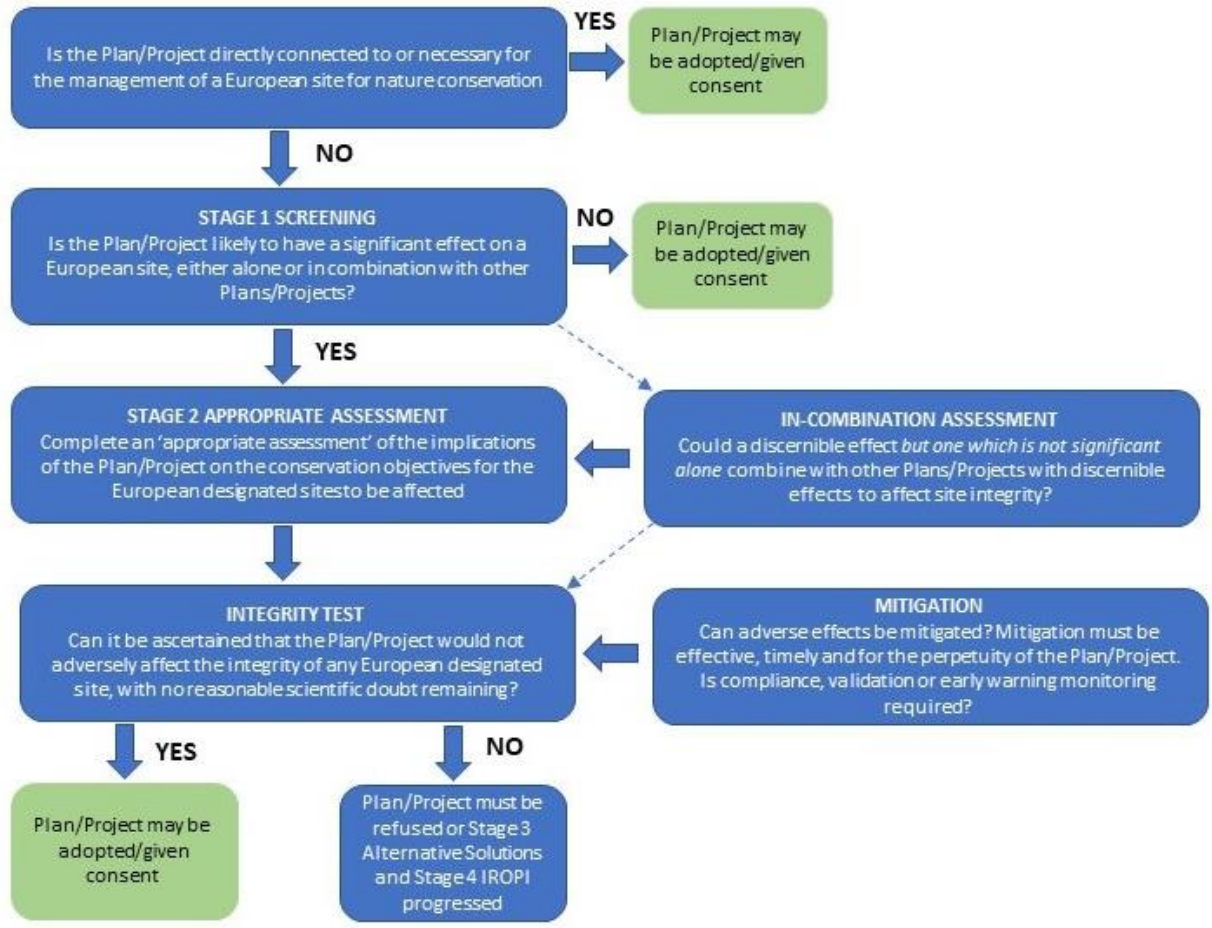
When determining whether there will be an adverse effect to site integrity, guidance available on the Habitats Regulations Assessment process states that *"….In order to avoid an adverse effect on integrity, the conservation status of a habitat must, if favourable, be preserved and, if unfavourable, must not be further harmed or rendered more difficult to restore to a favourable status."*[28] The duration of the effects must be considered (short, medium and long-term) as well as the reversibility.

Local planning authorities, as the competent authorities for approving plans and projects under the Habitats Regulations, need to determine whether a plan or project will adversely affect the designated sites conservation objectives and overall site integrity. It is up to the applicant to provide such information deemed necessary by the competent authority for the purposes of the assessment, or to enable it to determine whether an Appropriate Assessment is required. The relevant Statutory Nature

[28] Tylesdsley, D., and Chapman, C, (2013) The Habitats Regulations Assessment Handbook, (December 2019) edition UK: DTA Publications Limited.

Conservation Body, in this case Natural England, need to be consulted on the assessment and due regard given to any representations made.

Figure 5.1: Summary of Habitats Regulations Assessment Process



5.2 Summary of Qualifying Features within the Zone of Influence and Sensitivity to Changes in Nutrient Levels

The zone of influence for the Budds Farm WwTW is defined in Section 1.3 and **Figure 1.1**, noting however that the wider East Solent needs to be considered for potential offsite effects[29], to be addressed by the HRA process. Seabed habitat mapping using the Defra MAGIC website[30] and the EMODnet Seabed Habitats website[31] has been used to identify where the qualifying features occur within the zone of influence, and are therefore more likely to be susceptible to impacts from the new housing development, as the Eastney LSO and CSOs have direct discharges to them. Literature review, including that contained on The Marine Life Information Network[32], has been used to determine the likely sensitivity of the habitats and species to changes in nutrient levels.

As such, the following qualifying features are considered to be at risk from an effect, with full details provided in Tables 1 to 6 in Appendix A:

[29] Natural England (February 2016) Natural England Commissioned Report NECR207 Functional linkage: How areas that are functionally linked to European sites have been considered when they may be affected by plans and projects - a review of authoritative decisions.
[30] Accessed at https://magic.defra.gov.uk/MagicMap.aspx
[31] Accessed at https://www.emodnet-seabedhabitats.eu/
[32] Accessed at https://www.marlin.ac.uk/

- Solent Maritime SAC
    - 1130 Estuaries (sub-features subtidal mixed sediments (A5.4), subtidal seagrass beds (A5.53), intertidal sand and muddy sand (A2.2), intertidal mud (A2.3), intertidal mixed sediment (A2.4), intertidal seagrass beds (A2.61), Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (H1330), *Salicornia* and other annuals colonising mud and sand (H1310) and Spartina swards (*Spartinion maritimae*)(H1320))
    - 1320 Spartina swards (*Spartinion maritimae*)
    - 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
    - 1110 Sandbanks which are slightly covered by sea water all the time
    - 1140 Mudflats and sandflats not covered by seawater at low tide
    - 1310 Salicornia and other annuals colonizing mud and sand
- Solent and Isle of Wight Lagoons SAC
    - 1150 Coastal lagoons
- Chichester and Langstone Harbour SPA and Ramsar:
    - All bird species – direct impacts from location of CSOs into Langstone Harbour predominantly on feeding areas. Sensitivity of bird species will be determined by response of prey items to eutrophication.
    - Ramsar habitats – Langstone Harbour predominantly, impacts to Chichester Harbour would be dependent on amount of flow from Langstone Harbour.
- Portsmouth Harbour SPA and Ramsar:
    - Impacts to bird species and Ramsar habitats would be dependent on amount of flow from Langstone Harbour.
- Solent and Dorset Coast SPA
    - All three tern species (common, sandwich and little tern) could be affected as the Eastney LSO discharges directly into this designated site and adverse water quality conditions could affect the availability and abundance of fish (prey).
- Solent and Southampton Water SPA and Ramsar:
    - Potential impacts to all offshore feeding bird species as the Eastney LSO discharges into offsite functional habitat and adverse water quality condition could affect the availability and abundance of fish (prey). The Ramsar habitat likely to be affected would be the intertidal sands and muddy sands (A2.2) found at Ryde which are in closest proximity to the wastewater dispersion plume from the Eastney LSO.

5.3 Baseline Condition Data and Implications for Stage 2 Appropriate Assessment Integrity Test

5.3.1 Environment Agency Data

The evidence presented in the Environment Agency's datasheet for the classification of Langstone Harbour as a NVZ33 concludes that nutrient levels are elevated in the winter months, influenced by wet winters, but are lower during the summer season. Nutrient concentrations are highest to the north east of the estuary where the River Lavant and River Hermitage discharge, concentrations are lower in the wider estuary and at the mouth, therefore suggesting high riverine nutrient loading. Under the WFD classification system, Langstone Harbour achieved Good status in the 2015 classification (although borderline). The three surveys undertaken in 2009, 2011 and 2014 confirm Langstone Harbour has now achieved Good status for macroalgae (yearly EQR* scores of 0.59 and 0.67 and 0.63 respectively).

[33] Environment Agency (2016) DATASHEET: Nitrate vulnerable zone (NVZ) designation 2017 – Eutrophic Waters (Estuaries and Coastal Waters) NVZ Name: Langstone Harbour NVZ Id: ET2.

When using the UWWTD criteria[34,35] the percentage of intertidal area covered by macroalgae was between 256 and 412ha, equating to 18% and 28% which is borderline on the criteria for eutrophication. Further monitoring was recommended in the review, to determine whether this was part of a long-term improvement or as a result of annual variation in macroalgal growth.

5.3.2 Natural England Data

Langstone Harbour is predominantly in unfavourable-recovering condition (91.05% from underlying SSSI unit summary), with only a small proportion in favourable condition (8.39% - Farlington Marshes which is neutral grassland habitat). The latest SSSI condition assessment for Units 3, 6, 9, 13 and 14 (September 2018) states[36]:

"*Assessed in combination with other Langstone Harbour units, this part of the harbour achieves WFD Good (borderline) status on mean winter inorganic nitrogen, WFD High status on phytoplankton and WFD Good (borderline) status on opportunistic green macroalgae. However, in this unit there can be areas with a dense cover of opportunistic green macroalgae (>75% cover density), more so than in some parts of the harbour. The water environment of the unit is assessed as unfavourable for the interest features on the weight of evidence on inorganic nitrogen and biological indication of eutrophication shown by the abundance of macroalgae, but recovering on the basis of a large reduction in nutrient inputs through diversion of wastewater. There remains a significant nitrogen load input carried by tidal flow from the Solent and less so by minor rivers into the head of the harbour. The unit is considered 'at risk' of not recovering to a favourable situation on the water environment as it is unclear whether the nutrient status will become adequate to substantially prevent the growth of dense macroalgae mats in this part of the harbour."*

The condition of the habitats most vulnerable to eutrophication and reductions in dissolved oxygen; estuaries, mudflats and sandflats, *Spartina*, saltmarsh, *Salicornia*, sandbanks, are stated as being bad and deteriorating for structure and function and future prospects (across the natural range of the qualifying feature)[37]. Key threats and pressures listed include water pollution and discharges. The Site Improvement Plan for the Solent European Marine Site identifies water pollution as the fourth priority threat (out of 17) to be addressed for the site through the implementation of the Diffuse Water Pollution Plan, and further investigation into other sources of pollution.

Offshore feeding grounds within the East Solent used by the qualifying bird species of the Chichester and Langstone Harbours SPA, Solent and Southampton Water SPA and Solent and Dorset Coast SPA are not designated as SSSIs and therefore the underlying site condition cannot be ascertained.

5.3.3 Informing the Stage 2 Appropriate Assessment Integrity Test

Although the Environment Agency's WFD and NVZ information provide invaluable data to inform the baseline situation in the relevant harbours, the use of the WFD classes to acknowledge a change in waterbody status due to a betterment or deterioration in water quality are assessed against a different set of parameters, and not the conservation objectives for the designated site.

[34] The criteria for the Urban Waste Water Treatment Directive (UWWTD), stated that a symptom of the potential start eutrophication is when: (i) 25% of the available intertidal habitat has green macroalgae and (ii) at least 25% of the sediment (i.e. 25% in a quadrat) is covered.

[35] WFD UK (2012) Practitioners Guide to the Opportunistic Macroalgal Blooming Tool Version 08. Water Framework Directive: Transitional and Coastal Waters.

[36] Natural England Designated Sites View Langstone Harbour SSSI unit condition assessments. Accessed at https://designatedsites.naturalengland.org.uk/UnitDetail.aspx?UnitId=1030407

[37] Taken from JNCC Article 17 reporting.

The conservation objectives of the designated sites must be met to sustain favourable condition. Each of the qualifying features listed for all the designations being considered[38] has a similar feature target in the Supplementary Advice to Conservation Objectives (SACO) for water quality/nutrients[39]:

"*Restore water quality to mean winter dissolved inorganic nitrogen levels at which biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features*".

The target is for restoration, rather than to maintain, as achievement of favourable conservation status is already being hindered by the existing elevated nutrient levels. Any further deterioration, which although may not result in a change in WFD class, will impede the ability to achieve the restoration target. Therefore, to avoid adverse effects to site integrity, the SACO advises that the following parameters should be monitored, using the WFD opportunistic macroalgae and phytoplankton quality assessment tools:

- Opportunistic macroalgae levels should be restored so there is no adverse effect to the feature through limited algal cover (< 15 %) and low biomass (< 500 g m^2) of macroalgal blooms in the available intertidal habitat. The area of available intertidal habitat affected by opportunistic macroalgae should be less than 15 %.
- There should also be limited (< 5 %) entrainment of algae in the underlying sediment (all accounting for seasonal variations and fluctuations in growth).
- Phytoplankton levels should be restored to above a WFD assessment tool score of 0.6, where there is only a minor (a) decline in species richness, and (b) disturbance to the diatom-dinoflagellate succession in the spring bloom compared to reference conditions.

The evidence available from Natural England demonstrates that the Solent designated sites are not in favourable condition and that the current discharges and diffuse pollution into the coastal systems are contributing to an impacted and deteriorating baseline. With regards to the HRA process and Stage 2 Appropriate Assessment, when determining whether there will be an adverse effect to site integrity, guidance available on the Habitats Regulations Assessment process states that:

"….In order to avoid an adverse effect on integrity, the conservation status of a habitat must, if favourable, be preserved and, if unfavourable, must not be further harmed or rendered more difficult to restore to a favourable status."[40]

Therefore, if based on best available and scientific evidence it cannot be concluded with certainty that no adverse effect alone or in-combination to site integrity will occur, then the precautionary principle applies, and the plan or project must not be approved.

Any planning application for development in the Study Groups' area must therefore be supported by an Information to Inform an Appropriate Assessment document, setting out the adverse effects of the development and the mitigation necessary to avoid an adverse effect to site integrity.

[38] Note that Ramsar sites do not have Supplementary Advice to Conservation Objectives, but the habitats and species are generally covered by the SAC and SPA designations.
[39] With the exception of the Solent and Dorset Coast SPA which has only recently been fully classified (January 2020) and as such the final conservation objectives and Supplementary Advice on Conservation Objectives is not yet available.
[40] Tylesdsley, D., and Chapman, C, (2013) The Habitats Regulations Assessment Handbook, (December 2019) edition UK: DTA Publications Limited.

5.4 Adverse Effects from the operation of Budds Farm WwTW Combined Sewer Overflows (CSOs)

5.4.1 Source and Pathway for Impacts

During normal operation, under dry weather flows, there are no releases to Langstone Harbour, treated wastewater is released via the LSO. However, during heavy rainfall, to increase the capacity of the LSO, treated wastewater is released into the north of the harbour from Budds Farm WwTW. In total, Southern Water has 12 outfalls connected to the wastewater network which release directly or indirectly into Langstone Harbour to prevent flooding in the catchment, as permitted by the Environment Agency. In addition to the outfall at Budds Farm WwTW, there is the Court Lane group CSO in the north west of the harbour, and Fort Cumberland at the mouth. Stormwater is a mixture of wastewater (typically 0.02-0.1% human waste) and rainwater from a combined sewer network, which is released to the environment to prevent flooding. The requirement to use the CSOs is triggered by storm events and will therefore vary from year to year.

Dispersion plumes for *Ecoli*, generated for bathing water quality assessments, are available for the Budds Farm WwTW and Court Lane group CSOs[41]. Discharge from Budds Farm CSO is concentrated in Broad Lake, north of Long Binness Island and Long Island, and extends east to approximately Langstone Bridge. Discharge from Court Lane group CSOs discharges into Broom Channel, west of Farlington Marshes.

Discharges from the CSOs therefore provide a point source of nitrogen input to Langstone Harbour, with an estimate of 0.02-0.1% raw sewage. The risk of using the CSOs increases over time due to climate change, with an increased number and severity of storm events. If the additional housing development within the Budds Farm WwTW catchment increases surface water runoff into the system, the risk of using the CSOs increases further, leading to a potential flux of nitrogen into Langstone Harbour from this pathway.

5.4.2 Receptors

5.4.2.1 Solent Maritime SAC

A review of the location of the qualifying features within the designated site, and sensitivity to changes in nutrient levels has concluded that the following could be adversely effected; 1130 Estuaries (including some sub-features, see Section 5.2), 1320 Spartina swards (*Spartinion maritimae*), 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), 1110 Sandbanks which are slightly covered by sea water all the time, 1140 Mudflats and sandflats not covered by seawater at low tide and 1310 *Salicornia* and other annuals colonizing mud and sand.

As discussed in Section 5.3 despite the WFD good status being met, the specific conservation objective for the qualifying features of the designated sites, to achieve favourable condition is: "*Restore water quality to mean winter dissolved inorganic nitrogen levels at which biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features*".

The risk of an impact from new development comes from the potential increased use in the CSOs, leading to greater volumes of wastewater receiving only primary treatment being discharged and potentially resulting in increases in algal cover. The increases in surface water runoff and wastewater generated by new development has the potential to cause the capacity of the Eastney LSO to be exceeded more quickly, and with climate change, at a greater occurrence.

New developments on brownfield sites are required under NPPF guidance and in accordance with flood risk considerations to reduce runoff rates to greenfield rates, whilst greenfield development must not

[41] Southern Water presentation to Havant Borough Council, November 2018.

exceed greenfield runoff rates. Assuming these planning considerations and conditions are upheld, new developments will have either a neutral or net beneficial impact on surface water drainage rates to combined sewers. This will in turn have either a neutral or positive impact on the probability of CSO discharges and the flux of nitrogen from this pathway. It is noted that greenfield runoff rates for developments should be secured through suitable drainage strategies at the planning stage to allow consideration in the Stage 2 Appropriate Assessment. Consented drainage strategies that cause net increases in runoff from development sites could, however, have a negative impact on the runoff rates to a combined sewer system, with negative impacts on CSO discharge frequencies and nitrogen fluxes, thus requiring further mitigation.

These requirements are already evident in local planning policy with Havant BC's Pre-submission draft Local Plan (working document) including the policy of E20: Drainage infrastructure in new development. It notes that the existing drainage structure across the Borough, particularly in Emsworth, is under significant pressure. Planning applications for new development will only be authorised if;

"*Run-off rates have been reduced to below the pre-development rate, or, if this is not possible, there is no net increase in surface water run-off compared with the pre-development rate*"[42].

Portsmouth City Council have a similar policy (PCS12) and are drafting a new policy to reduce this further. The sewerage provider, Southern Water, will also review the capacity of the storage in its sewer network as part of planning applications. If new development would lead to an increase in the base flows to a treatment works, then the Environment Agency would require storage to be increased either in the sewer network, or at the WwTW to ensure the average spills from the CSOs do not increase[43].

Therefore, assuming adequate mitigation is approved through the planning process in terms of reducing runoff from the site (taking into account climate change), for example through SUDS, upgrades to the storage of wastewater within the site itself and local sewer network, the volume of runoff from the new developments can be controlled such that an increase in the use of CSOs is avoided. This will have to be a combined effort from developers, LPAs and Southern Water to ensure the mitigation is secured.

5.4.2.2 Solent and Isle of Wight Lagoons SAC

Shut Lake, lies within Farlington Marshes, and almost all drainage from the marshes exits via the sluice at the south of Shut Lake. However, the sluice leaks and lets saline water from Langstone Harbour into the lake, the bank itself also allows a throughflow of saline water and receives saline water during spring tides[44].

Although unlikely to be affected by discharges from the offshore LSO, the Court Lane group CSO discharges just to the north west. Water intake from Broom Channel could therefore increase nutrient levels within the lagoon and, as such, adversely affect the qualifying features. However, as stated in Section 5.5.1 Solent Maritime SAC, mitigation measures are available to avoid new development increasing runoff and wastewater flows during periods where capacity in the sewerage system is quickly reached, resulting in an increased use of the CSOs. Implementing such mitigation measures can also avoid an adverse effect to Shut Lake by ensuring any use of the CSOs, notably the Court Lane group, is not a result of new development.

5.4.2.3 Chichester and Langstone Harbour SPA and Ramsar

All the bird species are sensitive to changes in nutrient levels as eutrophication can affect the availability of prey items by smothering benthic invertebrates on the mudflat and sandflat habitats, outcompeting

[42] Havant Borough Council (2019) Appendix 1: Havant Borough Local Plan 2036 Pre-Submission Plan For public consultation from 4 February 2019 to 18 March 2019. Accessed at: https://havant.moderngov.co.uk/documents/s26271/Cabinet%20Report%20-%20Pre-submission%20Local%20Plan%202036%20-%2030-01-19%20-%20Appendix%201.pdf

[43] Personal communication, Charlotte Mayall Southern Water Regional Planning Lead. Date 29.01.2019.

[44] Bryant M (1967) The Flora of Langstone Harbour and Farlington Marshes.

eelgrass habitats and by altering dissolved oxygen concentrations in the water column, reducing the availability of fish nursery habitat.

As detailed for the Solent Maritime SAC, the point source impact arises from the increased use of the CSOs that discharge into Langstone Harbour. There is a known net flow of water between Chichester Harbour and Langstone Harbour at high water, with the harbours considered to represent one hydrographic unit, and exchange occurs with the East Solent, with water entering the harbours at flood tide. Modelling completed for the East Solent Shoreline Management Plan in 1997 showed that westward ebb flows were stronger than eastward flood flows[45], and therefore it is considered that impacts from the CSOs are likely to be confined to Langstone Harbour. Assuming the quantity of runoff and wastewater flows are controlled such that an increase in the use of the CSOs is avoided, no adverse effects to the qualifying features are considered likely.

5.4.2.4 Portsmouth Harbour SPA and Ramsar

Langstone Harbour is connected to Portsmouth Harbour via the small Ports Creek. A very small volume of water has been found to move from Langstone Harbour into Portsmouth Harbour[46]. The dispersion modelling undertaken by Southern Water also shows that flows from the Court Lane group CSO do not transfer to Portsmouth Harbour, ceasing at approximately Portscreek Junction. It is therefore considered unlikely that discharges from the CSO are adversely affecting the Portsmouth Harbour designations.

5.5 Adverse Effects from the operation of Budds Farm WwTW Eastney Long Sea Outfall (LSO)

5.5.1 Impact from New Housing Development

Southern Water and the Environment Agency have issued a position statement and technical note respectively, regarding the issue of nitrates in the Solent. Both have confirmed that no further upgrade of the Budds Farm WwTW is required to meet a tighter nitrogen limit (discharge consents granted under the provisions of the Water Industry Act 1991). The Environment Agency technical note goes on to state;

"*Where new development can be accommodated within the current water discharge activity permit limits of individual Wastewater Treatment Works, i.e. that there is capacity to take the extra wastewater flows from new development whilst still treating effluent to the same standard, then we consider the development would be acceptable".*

The PfSH Integrated Water Management Study (2018) used the projected housing development within the Budds Farm WwTW catchment to identify when the capacity of the WwTW would be reached. Two housing occupancy rates (5 people per house and 2.5 people per house) were used in a dry weather assessment (Appendix E), and the baseline DWF of 91,691m^3 for the period 2013-2015 was used. Using the 5 people per house occupancy rate, it was determined that Budds Farm WwTW would reach capacity to treat the increase in wastewater arising from the proposed housing development, between 2030 and 2036. If the smaller rate of occupancy was used, Budds Farm WwTW would not exceed capacity for the lifetime of the Local Plan.

However, communications with Southern Water (28 January 2020) has identified that the company uses a different dry weather flow calculation to inform the 5 yearly business plans. For Southern Water's calculations, to determine when capacity at Budds Farm WwTW will be reached, an assumption of 500

[45] HR Wallingford (June 1997) East Solent Shoreline Management Plan. Volume 1 The Open Coast. Accessed at http://www.environmentdata.org/archive/ealit:1890/OBJ/20002515.pdf

[46] New Forest District Council (2017). 2012 Update of Carter, D., Bray, M., & Hooke, J., 2004 SCOPAC Sediment Transport Study, www.scopac.org.uk/sts.

litres of wastewater generated per property per day is used. The dry weather flow from the period 2016-2018 is 89,793m^3 whilst the dry weather flow permit allows for 108,853m^3. The remaining headroom, at a wastewater input of 500l/property/day would equate to over 38,000 properties. The estimated number of properties to be built in the Budds Farm WwTW catchment is 31,492 between the period 2016 and 2036.

As advised by Southern Water, the amount of headroom available at the WwTW is not a fixed number and will fluctuate depending on the prevailing weather conditions e.g. less room if wetter year, and the calculations do not account for climate change. However, there would appear to be sufficient time to plan for upgrades to the WwTW before the capacity is reached (2-3 investment plan periods), with Southern Water continually reviewing the growth forecasts based on adopted/revised Local Plans and as new population forecasts become available. This position should be clarified with Southern Water.

5.5.2 Pathway for Impact

The majority of nutrient discharge from the Budds Farm WwTW is via the Eastney LSO (approximately 5.7km offshore). The discharge is continuous as the Solent is a dispersive environment. A dispersion plume for the LSO, made available by Southern Water, shows the concentration of the total effluent discharged to be dispersed in the mid-Solent, extending no further west than Gilkicker Point and no further east than Selsey Bill (see **Figure 1.1**). Southern Water have provided further information on the modelling work in response to an information request (March 2020)[47]: "*The discharge from the Eastney outfall was modelled[48] using the average daily flow from that outfall and a concentration of 100 units/m3 over a period of around 1 month in order to allow it to reach a dynamic equilibrium. This was carried out so that we could understand what percentage of the effluent from Eastney could reach Langstone Harbour. It was modelled using a conservative parameter (something that doesn't decay – so not E.coli). This presents a more pessimistic view than modelling bacteria as the bacteria will die-off as well as being advected and dispersed before they reach the mouth of the harbour. While the modelled release was not intend*[ed] *to represent any particular parameter, it is most similar to Nitrogen as this typically does not change in the environment, although some nitrogen may be lost to the atmosphere. The maximum extent shows the area where more than 1% of the discharge from Eastney is predicted to be evident in the water column. As the modelling was carried out over a long time period, it is not expected that the maximum extent will change."*

The measured average DWF from Budds Farm WwTW between 2013 and 2015 was 91,691m^3/d and therefore within the consented discharge of 108,853m^3/d. The baseline nitrogen loading is currently 463kg/day, and with the predicted new housing development in the catchment this will increase by 103kg/day[49]. Depending on the occupancy rate used in the growth predictions (2.5 or 5 people per dwelling) the DWF capacity at Budds Farm WwTW could be exceeded between 2030 and 2036 (assuming 5 people per dwelling). Therefore, although nitrogen limits are set for the Eastney LSO discharge (9.7mg/Tn/l), a c18% increase in the discharge rate is likely with the proposed housing growth. The WFD Good-Moderate status boundary at sites within the harbour ("NW Sinah Buoy, Langstone") and harbour mouth ("Langstone Harbour Mouth") have been breached eight times and

[47] Southern Water to Havant Borough Council (March 2020) The Environmental Information Regulations 2004 Request for Information.

[48] The hydrodynamics of the coastal model were calibrated and validated against measured tidal level and current speed data collected at eight locations. In addition, the model was validated against published Admiralty tidal diamond current speeds and directions at a further 18 locations. Sets of drogues were released from 5 locations and tracked over a tidal cycle. The model was further validated against these drogue tracks to demonstrate that the model accurately reproduced the tidal excursion and tracks of these drogues. (A drogue is a buoy with a 'sail' attached to the bottom of the buoy (typically 3 to 5m). The sail means that the drogue follows the tidal current, rather than just being blown about by the wind). Three sets of dye releases were carried out. The advection and dispersion of these dye releases were simulated in the coastal model to demonstrate that the model was fit for purpose to simulate the impact of releases in this area.

[49] Partnership for South Hampshire (2018) Integrated Water Management Study: Appendix B Review of Pressures and Mitigation Measures. Prepared by Amec Foster Wheeler. Accessed at https://www.push.gov.uk/wp-content/uploads/2018/07/IWMS-Appendix-1.pdf, Appendix B available from Havant Borough Council.

sites within the Solent seven times (mainly occurring during the winter months) under baseline conditions, and the condition of Langstone Harbour is unfavourable-recovering.

The spatial extent of the Budds Farm WwTW effluent (via Eastney LSO) was assessed as part of the Environment Agency's Review of Consents process (2005)[50] which concluded an in-combination effect on Chichester and Langstone Harbours SPA from the following STWs; Budds Farm, Peel Common, Sandown, Millbrook, Slowhill Copse, Portswood, Woolston, Ashlett Creek, Pennington, Fairlee, Andover, Romsey Greenhill, Eastleigh and Harestock[51], and to Portsmouth Harbour SPA the following STWs; Budds Farm, Peel Common, Sandown, Millbrook, Slowhill Copse, Portswood, Woolston, Ashlett Creek, Pennington, Fairlee, Chichester, Thornham, Andover, Romsey Greenhill, Eastleigh and Harestock (Note: these will have been refined by the latest source apportionment modelling (June 2019)). This work led to a tightening of the nitrogen standards on the effluent from Budds Farm WwTW to 9.7mg/TN/l.

As part of work to designate areas as NVZs, the Environment Agency assessed the percentage contributions of nitrogen to Portsmouth Harbour, Langstone Harbour and Chichester Harbour using a range of modelling techniques, as discussed in Section 4. To summarise, the Eastney LSO is shown to contribute a small percentage ≤1% of nitrogen to each harbour (measured at the entrance). When the relative contribution to algal growth is assigned through the CPM modelling, this is <1% for all harbours. However, in-combination, the nitrogen contribution of offshore STWs to the three harbours equates to 6% for Langstone, 5-6% for Portsmouth and 4-5% for Chichester. For all harbours, the contribution of nitrogen from indirect STWs are the least significant nitrogen input[52,53,54]; the work concluded that 43% of the nitrogen contribution to Langstone Harbour was from diffuse agricultural sources, 28% being from the catchments of the River Lavant and River Hermitage. The second biggest source was the offshore coastal background, 40%, however the historic contribution of STWs to this figure cannot be determined[55].

No nitrogen contributions have been identified to the eutrophic estuaries of the Isle of Wight (e.g. Medina, Bembridge Harbour) or within Southampton Water (e.g. Hamble). The status of the Solent waterbody itself is unclear; the WFD assessment suggests the waterbody has in Good status (macroalgae, phytoplankton and algae) and is at low risk from eutrophication due to its physical characteristics. There are no underlying SSSIs for the Solent to determine status against favourable condition and source apportionment for the larger Solent waterbody has not currently been undertaken, however Natural England suggests that around 30% of all nitrogen emissions to the water environment in England come from development sector sources (although this will have been lowered by the nitrogen reduction processes introduced in several waterbodies)[56]. Further information may become available as part of the Supplementary Advice for the Solent and Dorset Coast SPA which can be used to confirm that there are no eutrophication issues in the wider Solent.

[50] Environment Agency (2005) Review of Consents Chichester and Langstone Harbour SPA Appropriate Assessment: Part B Functional Assessments: Water Quality.
[51] Chichester STW, Thornham STW and Bosham STW have direct impacts.
[52] Udal, I., Rees-Jones, S., Robinson, K. 2014. Chichester Harbour Water Framework Directive DIN and Ecological Impact Investigations. Environment Agency.
[53] Rees-Jones, S., Robinson, K., Udal, I. 2014. Langstone Harbour Water Framework Directive DIN and Ecological Impact Investigations. Environment Agency.
[54] Udal, I., Rees-Jones, S., Robinson, K., Schroeder, S. 2014. Portsmouth Harbour & Wallington Water Framework Directive DIN and Ecological Impact Investigations. Environment Agency.
[55] This study has been updated since the draft version to take account the modelling reported in the WFD DIN and Ecological Impact Investigations reports provided by the Environment Agency, following a request for information in March 2020. The NVZ datasheets (2016) and original Environment Agency dataset (June 2019) used to inform the draft assessment in this report did not show a contribution from Budds Farm WwTW/Eastney LSO to Portsmouth Harbour and Chichester Harbour. However, upon review of the WFD DIN and Ecological Impact Investigations a ≤1% contribution is evident.
[56] Personal communication, R Jones Thames Solent Area Team, Natural England (March 2020).

With the predicted housing growth, the nitrogen contribution from Budds Farm WwTW to the three harbour systems remains ≤1%[57]. Despite such a small contribution of nitrogen alone, there is a spatial overlap of similar discernible effects from other STWs discharging directly or indirectly to the Solent. Natural England has provided Havant BC clarifications to several questions sought with regards the likely impacts and implementation of the nutrient calculator[58] and this alluded to the complex issue of the cumulative effects of nitrogen within the Solent. When considered in-combination, there is an additive effect of all discernible STW contributions (not significant alone) which totals a larger proportion of the nitrogen input on-top of the existing coastal background concentrations (i.e. an impacted baseline) that is impeding the ability for the favourable condition targets to be met across the Solent European Marine Site; noting that the target for water quality/nutrients is to restore rather than maintain.

The significance of the nitrogen inputs from STWs also increases when the coastal background, which cannot easily be attributed to sectors, is removed as a source, and predicted long-term trends are considered. Currently, the biggest nitrogen contributor is diffuse pollution from agriculture. However, long-term trends are likely to shift the significance of the sources as agricultural practices improve, but continued housing development maintains or increases the nitrogen load from this source. The future baseline during the lifetime of the housing developments (80-125 years) is therefore likely to be different to that currently monitored.

It is concluded that there is an additive in-combination effect from the proposed new housing development, and other STW nitrogen sources within the Solent. A low-level impact but with a potential long-term effect (retention time in system, although exact duration currently unknown), could arise from continued and increased nitrogen loading of the wastewater treatment system, which on discharge, adds to the existing background concentrations of nitrogen in the wider Solent system. The continued excess of nitrogen in the system and nutrient enrichment may therefore lead to the stimulation of phytoplankton blooms, predominantly in shallow coastal waters, which may reduce light availability to sea grass beds and during decomposition cause de-oxygenation of the water column adversely impacting populations of small fish. Increased growth of *Enteromorpha/Ulva* spp can form dense mats which smother benthic invertebrates on the intertidal sediments and lower pioneer saltmarsh species. Mats can be dislodged and washed further onto the saltmarsh habitats during high tides causing die back. The exact levels of impacts and attribution to continued housing growth is difficult to quantify, and therefore mitigation is required until the uncertainty can be removed through further scientific evidence.

5.5.3 Receptors

5.5.3.1 Solent Maritime SAC

A review of the offshore location of the qualifying features within the designated site, and sensitivity to changes in nutrient levels has concluded that the following could be adversely affected; 1110 Sandbanks which are slightly covered by sea water all the time. Priority habitat mapping shows areas of subtidal sand and subtidal mixed sediment extending off the coastline between Eastney and West Wittering.

Although the available dispersion plume from the Eastney LSO does not show an interaction with the designated habitat, the proximity and known prevailing wind direction would suggest there could be occasions where the plume shifts to cover these habitats. Without detailed modelling it is not possible to say how often this would occur, or the duration which the habitats would be exposed to higher concentrations of nitrogen. The EA source apportionment modelling suggests that nitrogen contributions from the Eastney LSO at the mouth of Langstone Harbour are ≤1%, however in-

[57] Partnership for South Hampshire (2018) Integrated Water Management Study: Appendix B Review of Pressures and Mitigation Measures. Prepared by Amec Foster Wheeler. Accessed at https://www.push.gov.uk/wp-content/uploads/2018/07/IWMS-Appendix-1.pdf, Appendix B available from Havant Borough Council.
[58] Personal communication, R Jones Thames Solent Area Team, Natural England (December 2019).

combination indirect STWs represent 6% of the offshore inputs[59]. Therefore, the continued loading of nitrogen onto an impacted baseline, with spatial overlapping of similar discernible effects from other STWs, could hinder the restoration of the water quality target. The exact level of deterioration that may occur because of housing growth is uncertain (difficult to attribute and quantify) and therefore mitigation is required.

5.5.3.2 Solent and Dorset Coast SPA

The Solent and Dorset Coast SPA covers the offshore feeding areas of Common, Little and Sandwich tern and extends to the mouth of Langstone Harbour. The survey work completed for the Departmental Brief for the Solent and Dorset Coast potential Special Protection Area (pSPA), produced by Natural England as part of recommendations to designate the area[60], concluded that the majority of feeding activity for the tern species was contained within Langstone and Chichester Harbours.

The Eastney LSO discharges into this designated site. The Environment Agency's 2005 Review of Consents process led to a tightening of the nitrogen standards on the effluent from Budds Farm WwTW to 9.7mg/l. The Water Industry National Environment Programme 3 (WINEP) defined Southern Water's obligations in terms of meeting a number of standards e.g. Water Framework Directive, Urban Waste Water Treatment Directive for its Business Plan (2018). Within this, reductions in phosphorous were identified to meet WFD objectives, whilst increase in flow capacity and storm tank sizing were identified to meet UWWTD objectives[61].

It is concluded that adverse effects on the tern species are unlikely to arise from an increase in housing development from discharges via the LSO alone for the following reasons:

- The main prey species of the tern species likely to be found in this offshore area (fish) are considered to be less sensitive to changes in nutrient levels.
- The key feeding grounds of the tern species are within the harbours themselves, rather than offshore in the mid-Solent where the LSO effluent is dispersed.

Assuming the quantity of runoff and wastewater flows are controlled such that an increase in volume of wastewater generated by new development can be treated at Budds Farm WwTW and discharged via the Eastney LSO, no significant adverse effects to the qualifying features alone are considered likely.

However, increases in CSO spillages could give rise to adverse effects and in-combination effects of residual impacts from the continued and increased loading of nitrogen into the wastewater and wider Solent coastal systems from multiple sources is likely. The Solent waterbody is currently not recognised under the WFD as being eutrophic, and favourable condition information is not available as there are no offshore SSSIs. Given the circulation and mixing within this waterbody, and lower sensitivity of the prey in these offshore waters to nutrient levels, effects are considered unlikely. However, the tern species do feed offsite within the harbours, where eutrophication is an issue, and as discussed in Section 5.4.2 there is uncertainty as to whether housing development will cause further deterioration in water quality or continue to hinder the achievement of favourable condition, mitigation measures are required. Further consideration of eutrophication issues within the East Solent waterbody and achievement of favourable condition should be made when supplementary advice is available for the Solent and Dorset Coast SPA.

[59] Rees-Jones, S., Robinson, K., Udal, I. 2014. Langstone Harbour Water Framework Directive DIN and Ecological Impact Investigations. Environment Agency.

[60] Natural England (2016) Departmental brief: Solent and Dorset Coast potential Special Protection Area (pSPA). Accessed at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/560622/solent-dorset-departmental-brief.pdf

[61] Southern Water (2019) TA.12.WW06 Wastewater Environmental Programme Business Case Version 1.0 September 2018 Accessed at https://www.southernwater.co.uk/media/1962/ta12ww06-business-case-wastewater-environmental-programme.pdf

5.5.3.3 Solent and Southampton Water SPA and Ramsar

The Solent and Southampton Water SPA and Ramsar site is located primarily within Southampton Water and the north east coast of the Isle of Wight where areas of mudflats and sandflats extend offshore from Ryde. A tidal simulation model; the South Coast and Solent model, developed by ABPmer for the Cowes Harbour Commission simulates preferential flows and water circulation patters in the wider Solent. The tidal simulations suggest water is predominantly retained in the East Solent, and therefore areas of the SPA and Ramsar within Southampton Water are unlikely to be impacted by new housing development draining to Budds Farm WwTW. Based on the available dispersion plume from the Eastney LSO, it is also considered unlikely that the offshore mudflats and sandflats at Ryde habitats would be directly impacted, as the plume is retained in the mid-channel rather than being pushed towards the coast of the Isle of Wight, and the prevailing wind direction being from the west/south west.

The Solent waterbody is currently not recognised under the WFD as being eutrophic, and favourable condition information is not available as there are no offshore SSSIs. Given the circulation and mixing within this waterbody, and lower sensitivity of the prey in these offshore waters to nutrient levels, effects are considered unlikely. However, the tern species do feed offsite within the harbours, where eutrophication is an issue, and there is uncertainty as to whether housing development will cause further deterioration in water quality or continue to hinder the achievement of favourable condition, mitigation measures are required. Further consideration of eutrophication issues within the East Solent waterbody and achievement of favourable condition should be made when supplementary advice is available for the Solent and Dorset Coast SPA.

5.5.3.4 Chichester and Langstone Harbours SPA and Ramsar, and Portsmouth Harbour SPA and Ramsar

Priority habitat mapping shows large areas of offshore subtidal sandbanks between Eastney and Earnley (to the east) which are classified as marine SPA supporting habitats for the Chichester and Langstone Harbours SPA. Habitats for the Ramsar are confined within the harbours. No offshore habitats are identified for the Portsmouth Harbour SPA and Ramsar with the majority of habitats mapped in the northern part of the harbour, north of Whale Island.

The available dispersion plume from the Eastney LSO does not show an interaction with Portsmouth Harbour, however, does extend across part of the offshore sandbank at East Wittering with a % concentration of between 1 and 2%. The known prevailing wind direction would suggest there could be occasions where the plume shifts further east to cover more of these habitats. Without detailed modelling it is not possible to say how often this would occur, or the duration which the habitats would be exposed to higher concentrations of nitrogen. The EA source apportionment modelling and NVZ datasheets suggest that nitrogen contributions from the Eastney LSO at the mouth of Langstone, Chichester and Portsmouth Harbours are ≤1%, however in-combination indirect STWs represent 4-6% of the offshore inputs to Langstone Harbour, 4-5% of offshore inputs to Chichester Harbour and 5-6% of offshore inputs to Portsmouth Harbour[62]. Therefore, the continued loading of nitrogen onto an impacted baseline, with spatially overlapping effects, could hinder the restoration of water quality. The exact level of deterioration that may occur because of housing growth is uncertain (difficult to attribute and quantify) and therefore mitigation is required.

5.6 Summary

Table 5.1 provides a summary of the impacts considered to arise for each designated site. Mitigation options for these potential impacts are also provided in **Table 5.1**, with mitigation for CSO discharges required to be effective within Langstone Harbour itself, due to the direct nature of the impact. Owing to the known flows of water between Chichester Harbour and Langstone Harbour, and exchange with the East Solent and wider Solent waterbody, where onsite options are not available to mitigate for

[62] Note, the percentages for offshore STW inputs to the harbours differ between the modelling reports (2014) and the Nitrogen Vulnerable Zone datasheets (2016) therefore the range is provided.

development within the Budds Farm WwTW catchment and discharge via the Eastney LSO, offsite land use change to generate nitrogen credits is appropriate in a number of catchments connected via the East Solent (e.g. Wootton Creek, Medina Estuary). This is detailed in Natural England's revised advice note March 2020, Section 5.

Table 5.1: Summary of potential impacts from new housing in Budds Farm WwTW catchment

Designated Site	Activity	Effect	Mitigation Required?	Mitigation Options Available	Indication only as to effect on site integrity[63]: based on limited information and expert judgement
Combined Sewer Overflows					
Solent Maritime SAC	Increased use of Budds Farm WwTW CSOs	Nitrogen loading directly into the northern part of Langstone Harbour, increasing potential for opportunistic macroalgal growth leading to impacts to the following habitats found in the north of the harbour; mudflats and sandflats, saltmarsh and eelgrass.	Yes	Water efficiency measures to be installed in all LPA owned properties to meet 110l/person/day consumption rate or lower if achievable. Water efficiency measures or grey water harvesting etc to be targeted on private developments. Post-development discharge rates to be managed through SUDS, upgrades to capacity of sewerage network or other measures as appropriate for each specific site to ensure discharge rates are below baseline.	No adverse effect on the conservation objectives or site integrity subject to sufficient mitigation being secured following a project-level Stage 2 Appropriate Assessment.
Solent and Isle of Wight Lagoons SAC	Increased use of Budds Farm WwTW CSOs, notably the Court Lane group	An indirect effect could occur whereby nutrient laden water enters the lagoons at spring tide, leading to eutrophication. The Court Lane groups CSO is directly to the west of the lagoon.	Yes		
Chichester and Langstone Harbours SPA and Ramsar	Increased use of Budds Farm WwTW CSOs	Net flow is from Chichester Harbour into Langstone Harbour therefore it is considered unlikely that the Ramsar habitats within Chichester Harbour will be affected. The effects on the habitats within Langstone Harbour are the same as those detailed for the Solent Maritime SAC. Those bird species that feed on the mudflats, sandflats, eelgrass and saltmarsh could be affected. Species feeding within the water column less likely to be impacted as effect is more dispersed.	Yes		
Solent and Dorset Coast SPA	Increased use of Budds Farm WwTW CSOs	Tern species feed predominantly within the harbours, and are therefore at risk from CSO spillages, although feeding preferences (use of water column) would suggest a lower vulnerability to nutrient level changes as the effect is more dispersed.	Yes		
Portsmouth Harbour SPA and Ramsar	Increased use of Budds Farm WwTW CSOs	Negligible flow of water along Ports Creek from Langstone Harbour to Portsmouth Harbour. Impacts from CSO discharges are therefore considered unlikely.	No	Not required	No adverse effect on the conservation objectives or site integrity, subject to confirmation through a

[63] This is an indication only and not legally binding. Each application will need to be subject to a project level Habitats Regulations Assessment and the integrity test undertaken using information on the actual mitigation measures available for each development.

					project level Stage 2 Appropriate Assessment
Long Sea Outfall					
Solent Maritime SAC	Indirect, in-combination, long-term addition of nitrogen into Solent system and dispersion into harbour (uncertain)	Given the proximity of the offshore sandbanks to dispersion plume and possibility that the plume extent could on occasions move given prevailing south westerly winds, there is uncertainty as to whether the habitats would be adversely impacted. The dispersion plume of total effluent discharge (Southern Water, treated final effluent contains 9.7 mg/l nitrogen) and tidal circulation model (ABPmer) shows little transfer of water into the harbour, and EA modelling suggests ≤1% of the marine nitrogen load at the harbour entrances (Langstone and Chichester) is from the LSO discharge. However, when combined with other indirect STWs this equates to 4-6% of the nitrogen load across the Solent European Marine site. The site is currently not achieving favourable condition due to water quality/nutrients and therefore there is uncertainty as to whether the continued nitrogen input from development will further undermine the achievement of the target when combined with other sources.	Yes – indirect LSO discharge in-combination	Provision for affordable housing must demonstrate no net increase in population in the Budds Farm WwTW catchment to reduce the requirement for mitigation measures. Developments must use Natural England's nitrogen budget to demonstrate nutrient neutrality. Where there is a nitrogen surplus, mitigation must be provided which could include; offsetting through land use change to release nutrient budget credits, provision of SUDS, wetlands and water efficiency measures, upgrades to WwTW or onsite technologies. The mitigation hierarchy must be applied (avoid, reduce, offset) before 'credits' are obtained from offsite areas of agricultural land being taken out of intensive use.	No adverse effect on the conservation objectives or site integrity, subject to confirmation through a project level Stage 2 Appropriate Assessment
Chichester Harbour SPA and Ramsar Portsmouth Harbour SPA and Ramsar	Indirect, in-combination, long-term addition of nitrogen into Solent system and dispersion into harbour (uncertain)	The dispersion plume of total effluent discharge (Southern Water, treated final effluent contains 9.7 mg/l nitrogen) and tidal circulation model (ABPmer) shows little transfer of water into the harbour, and EA modelling suggests ≤1% of the marine nitrogen load at the harbour entrances (Langstone, Portsmouth and Chichester) is from the LSO discharge. However, when combined with other indirect STWs this equates to 4-6% of the nitrogen load at Langstone Harbour entrance, 4-5% of the nitrogen load at Chichester Harbour entrance and 5-6% at Portsmouth Harbour. The sites are currently not achieving favourable condition due to water quality/nutrients and therefore there is uncertainty as to whether the continued nitrogen input from development will further undermine the achievement of the target when combined with other sources.	Yes – indirect LSO discharge in-combination	Provision for affordable housing must demonstrate no net increase in population in the Budds Farm WwTW catchment to reduce the requirement for mitigation measures. Developments must use Natural England's nitrogen budget to demonstrate nutrient neutrality. Where there is a nitrogen surplus, mitigation must be provided which could include; offsetting through land use change to release nutrient budget credits, provision of SUDS, wetlands and water efficiency measures, upgrades to WwTW or onsite technologies. The mitigation hierarchy must be applied (avoid, reduce, offset) before 'credits' are obtained from offsite areas of agricultural land being taken out of intensive use.	No adverse effect on the conservation objectives or site integrity, subject to confirmation through a project level Stage 2 Appropriate Assessment

Solent and Dorset Coast SPA	Indirect, in-combination, long-term addition of nitrogen into Solent system and dispersion into harbours (uncertain)	There is currently no supplementary advice for the designation, but it is assumed a similar water quality/nutrient target will apply. The impacts within harbours are considered under the other designations above. Feeding preferences of the tern species and use of water column would suggest a lower vulnerability to nutrient level changes as the effect is more dispersed. Although the discharge from the LSO is currently within Environment Agency permits, with capacity to accept flows from proposed new housing (until ~2030) and no requirement to improve treatment, this is in the context of the WFD legislation. Small contribution of nitrogen from WwTW, when considered in-combination with other continued sources of input (other WwTWs, agricultural sources etc), could hinder the baseline water quality targets for favourable condition being met – assuming these same targets are applied to the wider Solent waterbody.	Yes – indirect LSO discharge in-combination	Provision for affordable housing must demonstrate no net increase in population in the Budds Farm WwTW catchment to reduce the requirement for mitigation measures. Developments must use Natural England's nitrogen budget to demonstrate nutrient neutrality. Where there is a nitrogen surplus, mitigation must be provided which could include; offsetting through land use change to release nutrient budget credits, provision of SUDS, wetlands and water efficiency measures, upgrades to WwTW or onsite technologies. The mitigation hierarchy must be applied (avoid, reduce, offset) before 'credits' are obtained from offsite areas of agricultural land being taken out of intensive use.	No adverse effect on the conservation objectives or site integrity, subject to confirmation through a project level Stage 2 Appropriate Assessment
Solent and Southampton Water SPA and Ramsar	Indirect, in-combination, long-term addition of nitrogen into Solent system (uncertain)	The dispersion plume of total effluent discharge from the LSO (Southern Water) and tidal circulation model (ABPmer) show little transfer of water close to the Ramsar habitats or into Southampton Water. Small contribution of nitrogen from WwTW, when considered in-combination with other continued sources of input (other WwTWs, agricultural sources etc), could hinder the baseline water quality targets for favourable condition being met, and could affect the offshore feeding areas.			

6 Review and Assessment of Natural England's advice

In response to the issue of nutrient neutrality raised by The Dutch Case, Natural England have released advice on the contextual factors surrounding the issue, as well as nitrogen budget calculations to assess the amount of mitigation that may be required by new development[64]. This section first reviews the advice provided by Natural England, followed by an assessment of the nitrogen budget calculations.

6.1 Review of Natural England's Advice on Nutrient Neutrality

The 2018 PfSH Integrated Water Management Study reports uncertainty on the impact that Local Plan growth may have on designated sites, as well as uncertainty on the efficacy of catchment measures and/or upgrades to Budds Farm WwTW to mitigate these impacts. Natural England is thus advising all new developments that may result in an increased flow of wastewater to WwTWs need nutrient budgets to assess whether they are nutrient neutral. These assessments need to consider the issue over the lifetime of a development (80-125 years). Nutrient budgets are suggested to feed into Appropriate Assessments in the HRA process for a development, in order to show beyond "reasonable scientific doubt" that the development and any required mitigation has no impact on designated sites. Natural England's position is framed by The Dutch Case and the associated need for certainty that mitigating measures will achieve their aims, with nutrient neutrality cited as a means of ensuring nutrient loading does not impact designated sites.

Natural England recognises that achieving nutrient neutrality may be harder for smaller developments, developments on brownfield land and developments that are well progressed in the planning system, though they stop short of offering derogations for these types of development. Instead, it is advised that Borough-wide or strategic approaches are set up to enable continued development.

In reference to ongoing catchment working to reduce nutrient loading from different land uses, it is stated that high nutrient inputs to the water environment result from both existing housing and agricultural sources, though no reference is made to source apportionment of these nutrient sources. The Environment Agency estimate that, on average, 12% of nitrogen inputs to the Solent's waterbodies from WwTWs, whereas 45% is derived from agricultural sources[65]. Natural England notes that Catchment Sensitive Farming approaches to tackling diffuse sources of nutrient pollution are being used within the Solent river catchments but makes no reference to the potential reduction in agriculturally derived nutrients that this approach may bring.

Eutrophication resulting from nutrient loading is primarily attributed to an excess of nitrogen in the Solent's waterbodies, with strong phosphorous limitation only observed in the Medina Estuary. As such, Natural England advises that the focus of efforts to reduce nutrient loading in the Solent Harbours is on nitrogen. As such, the nutrient budget calculations provided by Natural England are focussed on the reduction of total nitrogen (TN), i.e. both organic and inorganic nitrogen which represent the sum of available nitrogen for plant growth. TN is the sum of inorganic – nitrate (NO_3), nitrite (NO_2), ammonia (NH_4) – and organically bonded nitrogen. It is noted that for estimates of nitrogen coming from different farm types, reports measure nitrate, not TN, though nitrate is normally the largest component of TN. However, Natural England recognise that the land use change element of the nutrient budget calculations will underestimate TN export from farmland and thus a precautionary buffer approach is recommended.

[64] Natural England. March 2020. Advice on achieving nutrient neutrality for new development in the Solent region
[65] Environment Agency source apportionment data received Jan 2020.

The precautionary buffer on TN export from farmland is to be used in nutrient budget calculations that Natural England advise as part of achieving nutrient neutrality as a means of addressing the uncertainty surrounding the impacts of new developments on designated sites in the Solent Harbours. Nutrient budgets will show either that a development avoids harm to protected sites or provide the level of mitigation required to avoid adverse effects. It is stated that the assumptions in the nutrient budget calculations are based on best-available scientific evidence, but that there is degree of uncertainty in the inputs. In accordance with the Precautionary Principle, Natural England thus advise planning authorities to address this uncertainty by choosing the most precautionary option in all cases and building in appropriate buffers.

6.2 Assessment of Natural England's Nitrogen Budget Calculator

The calculations provided by Natural England to assess nutrient neutrality have been worked through, considering the inputs and their attendant assumptions and the following assessment is broken down into the stages detailed in Natural England's advice.[6564]

At the meeting held with Natural England on 4 March 2020, the various issues raised in this section with regards the application of the advice and nitrogen budget calculator were discussed. These issues are retained here as part of the audit trail, as are the conclusions of the discussions held with Natural England at the meeting.

6.2.1 Stage 1

Stage 1 calculates the estimated TN load from the new housing development. It requires the following inputs and assumptions:

- The number of people per dwelling – Natural England assumes 2.4 people per dwelling, based on data from the Office for National Statistics, though this number can be changed if evidence is provided;
- The number of proposed dwellings;
- The water use per person – Natural England assumes a value of 110 l/pp/d based on optional regulation standards, though this number can be changed if evidence is provided;
- 90% of the total nitrogen consent limit for the receiving WwTW – Natural England, in combination with EA, advise using a figure of 90% of the consent limit as this is closest a water company can operate a WwTW to its consent without risk of breaching it.

The above inputs are used to calculate the total wastewater nitrogen load from a development in kg/total nitrogen (TN)/year.

Where Natural England has had to assume values for inputs to the nitrogen load calculations, there is potentially room to revise the input figures given by the assumptions to reduce the TN load estimated per development. This could include:

- Providing evidence that the average number of people per dwelling is < 2.4;
- Committing to better water efficiency to go below the 110 l/d per person water use assumption, though this would need engagement with Southern Water. Natural England would also need to be sure that keeping per person water use below 110 l/d is possible over the life cycle of property, in accordance with the Precautionary Principle.

There is also an assumption that the additional population is added through developments on greenfield sites, which may have larger average dwelling sizes. Brownfield developments with smaller average

dwelling sizes may therefore result in smaller population increases and thus smaller TN loads estimated from a given development. Brownfield developments may then in turn require less mitigation in the short-term, though this will be dependent on the greenfield land use being converted to urban land, e.g. if the conversion to urban land use is not from agricultural land with high nitrogen export rates. It is also noted that Havant BC has questioned Natural England's assumption that all new housing development in the borough will result in increases to the population from inward migration and thus associated increases in TN discharge from Budds Farm. Havant BC state that some of the population moving to new developments will be due to relocation of people within the borough and that in the case of affordable housing, all residents of new affordable housing are mandated to come from within the borough.

Internal relocation within the boundaries of competent authorities will inevitably comprise part of the total population in new developments. However, it is also possible that both the new developments and older housing that people move from remain inhabited. As such, new developments would still be assumed to result in a net increase in the borough's population, regardless of the type of housing, e.g. affordable or commercial. It has been indicated the under certain circumstances, residents moving between local authority and affordable housing stock will not result in a net increase in population within a given local authority area. Therefore, Natural England's lack of accounting for internal relocation is in keeping with the precautionary approach to nitrogen budget estimation. However, should a competent authority be able to provide evidence that internal relocation to new developments within the borough does not result in net population increases then this could be included in the nutrient budget calculations, lessening or removing the nutrient load associated with the new development.

6.2.2 Stages 2 and 3

Stages 2 and 3 of the nutrient budget calculations provide a means to offset the nutrient budget for changes in land use resulting from the development. In general, conversion of agricultural land to urban or SANG land uses will result in a reduction of the nitrogen loss per hectare. The nitrogen load adjustment calculations take inputs of:

- An area of agricultural land lost;
- The nitrate loss for the farm type on that agricultural land – nitrate loss is provided based on Farmscoper assessment;
- The new area of urban land on the development;
- The new area of SANG on the development;
- Values of TN loss from urban and SANG land uses – Natural England specify these as 14.3 and 5 kg/TN/ha/yr respectively.

The output from these stages is the annual nitrate export for the area of land under agricultural use that is being lost to development and the annual TN export from the same area of land after development. Natural England provide default values for use in these calculations, e.g. default nitrate export for a specific farm type and for urban and SANG land use post-development. Providing evidence is given, different values that either increase the default nitrate loss for each farm type or decrease the default TN loss stated for urban and SANG land use would lower the nitrogen budget output and reduce the required mitigation. This evidence would be monitoring of nitrogen export rates from different farm types and land uses or literature review evidence providing robust data from previous research on nitrogen export for specific farm types and land uses. The evidence for revised nitrogen export for a given land use would have to be very strong in order to meet the Precautionary Principle.

6.2.3 Stage 4

Stage 4 is simply the calculation of the nitrogen budget for the new development. This takes the net change in nitrogen export from land use change, e.g. conversion of agricultural to urban/SANG land and adds it to the new TN export from the development calculated in stage 1. If the net land use change

nitrogen export is negative, it may be sufficient to balance the increase in TN resulting from the development.

After the nitrogen budget figure has been calculated using the outputs from stages 1-3, Natural England then recommend adding an additional 20% buffer. This buffer is intended to counter uncertainty in the inputs to the calculations in stages 1-3, in line with the precautionary approach to the nutrient budget calculation. Havant BC has questioned application of the 20% buffer given the assumption that a WwTW will only be discharging at 90% of its TN consent limit as well as the conservative nature of other inputs to the calculations. It seems pertinent to raise Natural England's statement on the need to include a buffer on the TN export from farmland, as the inputs provided in Natural England's advice only account for nitrate export. Natural England states (paragraph 3.17)[64] that the Farmscoper estimates of nitrogen loss from farmland *only* accounts for nitrate, not TN that includes other inorganic and organic forms of nitrogen. As such, the nitrogen export values from agriculture in the stage 2 calculations are underestimates of the TN load being lost from agricultural land. Natural England references research that has shown that not accounting for the organic nitrogen fraction in TN in the River Test catchment would result in a 13% underestimate of TN concentrations in the Test estuary. There is also the need to account for nitrite and ammonia, which would increase the underestimate. Consequently, it appears reasonable for the estimates of nitrogen loss from agricultural land in stage 2 of Natural England's nitrogen budget methodology to be taken as the minimum nitrogen export from this land use, which would reduce the actual amount of mitigation required if a new development results in surplus nitrogen export after land use change is accounted for.

Whilst it appears logical to assume Natural England's nitrate budget methodology may be overly conservative in terms of estimating the TN loss from agricultural land, the requirements to account for uncertainty under the Precautionary Principle require evidence on the likely increase to TN exports that could be expected for a given farm type if all fractions of TN are taken into account. It is also worth noting that assuming some TN mitigation for a development is required, it needs to be robust enough to remove the TN load calculated by the TN budget for 80-125 yrs, which Natural England states is the general length of time development will last.

6.2.4 Outcomes of discussion with Natural England

6.2.4.1 Occupancy rate

The Office for National Statistics latest information was used in deriving the 2.4 value, and Natural England note that this figure is stable (over the last 10 years) and is, in their view, an appropriate figure as a proxy for in perpetuity trend. This number is also consistent with the number used by water companies in their Water Resources Management Planning process, which use population forecasts to secure water supply measures for the next 25 years. A bespoke calculation of occupancy would need sufficient evidence to support its application. Natural England advocated during the meeting that the occupancy rate used with planning applications going forward be led by the LPAs rather than the developer. Although the most appropriate occupancy rate may differ between Boroughs and Council's, the LPA will have a more strategic oversight of development coming forward and therefore the best occupancy rate to use.

6.2.4.2 Precautionary buffer

Natural England provided further advice on the purpose of the 20% precautionary buffer at the meeting on 4th March 2020. The buffer has been used to account for unknowns or uncertainties that cannot be easily rectified e.g. pipeline misconnections, and the different forms of nitrogen as highlighted above. The buffer also includes the potential for indirect atmospheric deposition and is sufficiently precautionary to incorporate potential residual/discernible effects of atmospheric deposition to the mudflats, sandflats and saltmarsh, such that an in-combination assessment with air quality impacts is not required.

7 Conclusions and Next Steps

New housing development provides a source of nitrogen, through increases in wastewater production and surface water runoff. Through the two options of sewer system, the old 'combined sewer system' where rainfall runoff and wastewater are combined into the same sewerage system, and the newer system separating the rainfall runoff from the wastewater, wastewater is transferred to a wastewater treatment works for treatment prior to discharge to a river, estuarine or marine waterbody.

7.1 Budds Farm WwTW Capacity

For the study area, the wastewater discharges to Budds Farm WwTW, which during dry weather flows is discharged offshore into the Eastern Solent via the Eastney LSO. Calculations completed by the PfSH group for the Integrated Water Management Strategy, concluded that the capacity of Budds Farm WwTW would be reached between 2030 and 2036 (assuming a 5-person occupancy per house). Separate calculations completed by Southern Water assume an input of 500l/property/day of wastewater into the system and are predicting capacity to be exceeded in 10-15 years' time. Levels of nitrogen treatment at Budds Farm WwTW have not been raised as an issue by the Environment Agency in its WINEP3 study, and therefore there is no requirement on Southern Water to change the treatment processes within their next Business Plan.

Key point: *Studies from Southern Water and PfSH related to capacity have indicated no requirement to change treatment process at Budds Farm WwTW with in next business plan.*

7.2 Long Sea Outfall Nitrogen Loading

A high level of nitrogen exists in both Langstone Harbour and the wider Solent, with peaks during the winter months and persistence of algal blooms which have occupied between 18 and 28% of the available intertidal area in Langstone Harbour. Source apportionment for nitrogen within Langstone Harbour attributes 4-6% to sewage treatments works (from all catchments in the Solent into Langstone Harbour), with the greatest contribution from diffuse agriculture and the existing background marine contribution, largely attributed to inputs from the English Channel. Environment Agency Water Framework Directive DIN and Ecological Impact Investigations show that a small proportion of nitrogen from Budds Farm WwTW (≤1%) contributes to the nitrogen loads at the entrances of Portsmouth and Chichester Harbours. The contribution of nitrogen loading with predicted housing growth remains at ≤1%, however when taken cumulatively with other indirect offshore sources of nitrogen, accounts for a greater proportion of the nitrogen load. Housing development in the Budds Farm WwTW catchment will result in a continued and potentially increased nitrogen loading of the wastewater treatment system, which has an additive effect to the overall nitrogen loading of the Solent system, and spatially overlaps with numerous other small sources of nitrogen, which could potentially continue to undermine the conservation objectives, although the level of deterioration attributable to this is uncertain.

Key point*: The greatest nitrogen contribution is from agriculture with 4-6% from sewage treatment works in the Solent, but housing development with continued nitrogen input to the Solent system could hinder the improvement of baseline water quality in the three harbour systems.*

7.3 Combined Sewer Overflow Use

Depending on the type of sewerage system being adopted for the new housing development, there is a risk that the increase in volume of wastewater and runoff, combined with climate change, could result in the capacity of the outfall being reached more quickly during storm events and at a greater frequency, thereby promoting the use of the CSOs which discharge directly into Langstone Harbour. The discharge

is of wastewater which has only been through an initial screening treatment stage and therefore is about 0.02-0.1% human waste. It should be noted that this is the last measure taken by Southern Water when operating under higher flows/volumes in wet weather conditions to avoid flooding. To increase the outfall's capacity during heavy rain, treated wastewater is released into the north of the harbour from Budds Farm. Excess flows are also stored at storm tanks at Fort Cumberland and Budds Farm, which can store 47Ml of stormwater. However, without mitigation, this is a potential pathway for impacts.

Key point: *New housing development in the Budds Farm WwTW catchment, with climate change, could lead to the CSOs being used on a more frequent basis, as capacity is reached more quickly.*

7.4 Favourable Condition Status

Although WFD Good status is being met in Langstone Harbour, it is suggested that the environmental permit for nitrogen removal at Budds Farm WwTW is designed to continue to meet this target, rather than the restoration target that has been identified to achieve favourable conservation status for the qualifying features of the European designated sites. The majority of Langstone Harbour is in unfavourable recovering condition, with water quality and in particular nitrogen loading a risk. As such, given the potential impact pathways identified, and without further information to conclude that these will not arise or will not hinder the achievement of the conservation objectives, mitigation will be required for new housing development to avoid an adverse effect to site integrity.

Key point: *The targets for water quality differ; there is a more stringent requirement as part of the designated site favourable condition targets compared to the WFD. New housing development must not impede the achievement of the favourable condition targets.*

7.5 Summary

All new housing development within the Solent area is required to provide a nutrient budget to show that the development and any required mitigation has no adverse effect on the designated sites. This information will be used by the competent authority (normally the local planning authority) to produce a Stage 2 Appropriate Assessment. Natural England has recognised that the achievement of nutrient neutral housing will be harder for smaller developments, those that are on brownfield land and those already within the planning system, however, offer no derogations for these types of development. It is therefore suggested that a level of proportionality be applied to these developments in determining the requirement for mitigation.

The mitigation hierarchy should be used when determining the measures required; avoid, reduce and offset. Site-based mitigation measures should be sought above offsite measures, for example higher water efficiency measures to achieve 110l/pp/day or Southern Water's Target 100l/pp/day, grey water harvesting, the retention of runoff achieved through the use of Sustainable Drainage Systems (SUDS) with nitrogen trapping on a site, principles which are already included in local policies; the thresholds however may need to be increased to provide more retention. Where SUDS are not promotable, for example in Portsmouth CC's jurisdiction, alternative measures will be required, for example increasing capacity within the sewerage network, and therefore early planning discussions will be required with Southern Water to address this. These measures should ensure no net increase in wastewater requiring treatment and retain runoff and wastewater such that the capacity of the Eastney LSO is not exceeded during wet weather conditions, such that the use of the CSOs will be increased.

Where sufficient on-site mitigation is not available, nutrient neutrality can be achieved by purchasing and taking land out of intensive agricultural use, and banking the 'credits' against the development, the balance of which will need to be demonstrated by applying Natural England's nutrient calculator.

A more strategic mitigation option could be developed at the Budds Farm WwTW, through contributions from planning applications to Southern Water to improve the nitrogen stripping capability at the works and improve storage retention at the storm water tanks or in the sewer network. Other measures could include construction of WwTW filter wetlands to remove the additional nitrogen and 'polish' the wastewater before discharge. Southern Water are required to produce a Drainage and Wastewater Management Plan (DWMP) setting out how water and wastewater provisions will be extended, improved and maintained, for publication in draft by summer 2022. The DWMPs will inform the subsequent Business Plan submissions for the next price review (allowing funding to be secured) in 2024. As with Water Resource Management Plans and Drought Plans, it is considered likely that the DWMP will be accompanied by a Strategic Environmental Assessment and Habitats Regulations Assessment, through which the impacts of the continued output of nitrogen from the WwTW will be reviewed. As such, there are additional legislative requirements between now and the exceedance of capacity at Budds Farm WwTW, during which the mitigation for nitrogen loading into the Solent can be reassessed.

Key points: *Mitigation for new housing development in the Budds Farm WwTW catchment is required. The mitigation should be proportional to the scale of effect on the site. Site based mitigation including water efficiency and SUDS measures should be advocated before an offsite nitrogen 'credit' system is used, whereby intensive agricultural land is taken out of use. A more strategic option such as strategic catchment management schemes and sewerage upgrades, could be contributed to when available. Within the lifetime of the Local Plan (to 2036) there are opportunities to reassess the level of mitigation required and how strategic contributions can be made, with further involvement of the wastewater provider, Southern Water.*

The next steps are to therefore consider informing applicants of the information the Local Planning Authorities will require to undertake an Appropriate Assessment (as competent authority), including completed nutrient budgets using Natural England's calculator, how the mitigation options can be implemented for different sizes of development (for example Portsmouth CC have an Interim Nutrient Neutral Mitigation Strategy (November 2019)) and how it can be demonstrated that these mitigation measures will avoid adverse effects to the designated sites.

Appendices

Appendix A: Designated Sites Tables
Appendix B: Natural England Review Comments (March 2020)

Appendix A – Designated Sites Tables

Appendix B – Natural England Review Comments (March 2020)

Comment	How and where addressed in final report
Section 1 Section 1.2 – I think this may be a misunderstanding of the new information that has been issued in Version 3 of Natural England's advice note. Hopefully the circulation of the updated methodology can be used to update this section.	Section 1.2 updated to reflect the information contained in the revised advice note March 2020 (version 3).
Section 2 Section 2.1 - To avoid misunderstandings over application of EU Directives post Brexit, this section would be better titled as 'EU Directives taken forward in domestic (EU Exit) Regulations'. A number of key Directives are absent that provide the legislative framework within which the nutrient neutrality issue sits. We suggest the following are also included: 1. The Urban Wastewater Treatment Directive in relation to discharge standards for nitrogen from WwTWs and requirements for urban sewage collection systems on overflows. (Reference to ECJ cases on interpretation, especially sewer overflows, would be useful here) 2. Habitats and Species and Birds Directives e.g. in Regulations, the requirements on competent authorities under Regulation 9 for European marine sites.	Updated to reflect the directives suggested by Natural England.
It would be useful if Table 2.1 WFD class thresholds for inorganic nitrogen are set in context for the different turbidity status categories applied to Solent water bodies and salinity.	Added text around salinity and turbidity impacts on standards and updated table.
It would be useful if the report included further information on the difference between the water quality assessment needed for a WFD assessment and a Habitats Regulations Assessment. As you know, the WFD assessment records deterioration in a water body when there is a degradation between classes, for example from good to moderate or moderate to poor. For the Habitats Regulations Assessment, consideration needs to be given to whether the site is in favourable condition and whether the conservation objectives of the site are being met (for example to restore water quality). If this is not the case and the conservation objectives are failing due to water quality, then any deterioration (even if there is no degradation between WFD classes) could lead to an adverse effect on the integrity of the site. This also helps to provide the context for section 5.3.1 and the WFD assessments that have been undertaken.	Text added into Section 2 and Section 5 to make clearer.

It would be useful to explain the different purposes of the IWMS report and Natural England's more recent NN methodology, as this explains the reason for different assessments of the capacity of WwTW and dry weather flows and the occupancy figures used. The IWMS report published March 2018 examined the population equivalents for each WwTW. This included commercial and retail development as well as overnight accommodation – mainly because the purpose of the report was broader than a HRA assessments. It was also looking at future capacity of each of the WwTWs so that upgrades can be planned. As you are aware, the NN methodology covers overnight accommodation and only exceptional commercial / industrial cases, rather than all increases in wastewater that will come from wider growth in South Hampshire. There will be incremental increases in wastewater associated with employment and other commercial uses, retail development, schools etc and this is one of the factors considered by the precautionary buffer.	New section included in Section 2 to provide an overview of the IWMS and Natural England methodology, and how the two differ in their objective and applicability of occupancy rates.
Paragraph 2.3.1 - we discussed the precautionary buffer at the meeting to help explain the balance between precaution and pragmatism that has been used in Natural England's NN methodology.	Additional information added from meeting on 4th March 2020. However, the section is reflecting the position statement available from Havant Borough Council on nutrient neutrality, the update of which is not part of this study.
Section 3 Reference is made to 2 consented discharges and section 5.5 refers to 9 outfalls. It would be useful to include further information about these discharges and why some are consented and others are not.	Section 3 was referring to the main discharges used during normal operation. All discharges are consented, and further information has been included in Section 3 to reflect latest information provided by Southern Water (March 2020).
Section 4 It would be useful if the Langstone Harbour water quality sampling points used in the water quality analysis are included in Figure 3.1 or elsewhere.	Map made and added to section
It is unclear whether the dashed line showing the WFD good – moderate status boundary on inorganic nitrogen for transitional waterbodies in the charts is a generic line for transitional water bodies or the actual line used by EA for WFD classification of this water body based also on turbidity class and salinity. The Good status boundary line shown in the charts, well above recorded DIN concentrations, does not sit easily with EAs reporting[66] of Moderate class on inorganic nitrogen for the early part of the data set shown and being on the Good/Moderate	Checked the salinities for the sites and noted that they are all coastal for sites in Figure 4.2 – correct standards now applied on that graph and text updated to reflect this. Figure 4.3 sites do not have salinities so included both standards on plot and made amendments to text.

[66] EA (2014) Langstone Harbour Water Framework Directive DIN and Ecological Impact Investigation; EA (2016) Langstone Harbour Nitrate vulnerable zone (NVZ) designation 2017 – Eutrophic Waters (Estuaries and Coastal Waters)

borderline and fluctuates between Moderate and Good status for DIN between 2009 and 2015.	
More detailed spatial, time series analysis of DIN given by EA in these references could usefully be brought into the report, the more recent is available on line at [see link in footnote[67]]	Most sites show little to no pattern of change over time. Some sites show very vague general patterns but there is so much scatter in the data that any conclusions drawn from them may be somewhat spurious and add little to the analysis of average DIN concentrations in Figure 4.3, which also highlights spatial differences in DIN at different locations around the harbour.
Section 5.4 Adverse Effects from the operation of Budds Farm WwTW Eastney Long Sea Outfall (LSO) Further information is requested on what the dispersion plume for the LSO, made available by Southern Water, is actually showing and what sampling it is based or calibrated against. Is it based/calibrated against nitrogen sampling or something else? Is it saying nitrogen from the outfall does not travel beyond the plume boundary? Is the plume boundary some point at which, in the model, the plume become indistinguishable from the background but nitrogen from the outfall will continue to disperse over a wider area adding to the 'background' Solent concentration? These clarifications are needed to understand the relationship between the long sea outfall and other Solent estuaries and harbours. As you are aware, the sources within the background levels (coastal background) is an area of further work that would be very useful to inform the wider Solent nutrient issue.	Additional information provided by Southern Water on 24 March 2020 has been included. The maximum extent shows the area where more than 1% of the discharge from Eastney is predicted to be evident in the water column. The parameter used in the modelling would be comparable to the dispersion of nitrogen from the outfall.
Reference is made to the predicted dry weather flow levels at Budds Farm. The updated IWMS also included recent data on dry weather flow rates at Southern Water's works in the Solent. It may be worth referring to this work.	Reference to this work included in Section 2.3.1
On page 20, reference is made to the reasons why it is concluded that adverse effects are considered unlikely to arise. We suggest that the first two bullet points are removed as these are more context rather than reasons to support this conclusion.	Removed.
We advise that further consideration is given to the different modelling that has been undertaken to support the conclusions in section 5.4.2 and with reference to the Portsmouth Harbour SPA and Ramsar site and the Chichester and Langstone Harbours SPA and Ramsar site.	The more detailed results of the CPM and Telemac modelling have been made available by the Environment Agency and these have been reviewed. These suggest that Budds Farm WwTW contributes ≤1% of the offshore inputs to both Portsmouth and Chichester

67 http://apps.environment-agency.gov.uk/static/documents/nvz/NVZ2017_ET2_Chichester_Langstone_Portsmouth_Datasheet.pdf

	Harbours. The assessment has therefore been updated to reflect this, with the proposed mitigation applied to the other Solent designations equally applicable to Portsmouth Harbour SPA and Ramsar and Chichester and Langstone Harbour SPA and Ramsar.
Section 5.5 Reference is made to estimated levels of percentage human waste and raw sewage and is linked to the combined sewer overflows. If possible, it would be useful to understand how this relates to levels of Total Nitrogen that is associated with this pathway.	This information would have to be provided from monitoring by Southern Water, if it exists. Furthermore, planning considerations mean surface runoff rates will either maintain or decrease present surface runoff rates, thus having a net beneficial impact on the probability of CSO discharges and the TN flux from this pathway, though it is noted that this positive impact needs to be secured through planning considerations if not secured may require mitigation. Text updated to reflect this.
Section 5.6 In-combination Effects of Continued or Increased Discharges We advise that the following sentence is clarified - 'however Natural England suggests that around 30% of all ongoing source emissions into the Solent water environment could be from development sector sources'. Generically across England about 30% of nitrogen emissions to water come from development sources. Yearly development source emissions to the Solent as a whole, in the context of total annual source emissions to the Solent from its landward catchments, is not currently available but will have been lowered by N reduction treatment introduced at several coastal WwTWs.	Sentence amended to reflect Natural England's clarification.
Section 5.7 Summary Table 5.1: Summary of potential impacts from new housing in Budds Farm WwTW catchment - The model results used for informing this table should also include those undertaken for the EA using the marine Telemac model and reported by EA (2014) in Water Framework Directive DIN and Ecological Impact Investigations for each of the Solent harbours and estuaries. The latter suggests a much wider influence of the Budds Farm long sea outfall than given in this table. This could potentially significantly change the geographical scale for mitigation requirements identified in the table. Comments above on section 5.4 are also relevant here.	Reference made to the Telemac model findings from the EA (2014) reports but it has been noted that despite the potential low-level spread of N from Budds Farm WwTW via Eastney LSO to Portsmouth, Langstone and Chichester Harbours, the mitigation advocating nutrient neutral development within the Budds Farm WwTW catchment will be applicable to all designated areas given the common pathway of the East Solent.
In Table 5.1, it would be useful to explain the difference in effect from the dispersion of LSO effluent into the	Updated to reflect this information.

harbour and cumulative, long term addition of nitrogen into the Solent system. If there is effluent transferring into the harbours, presumably this would also include nitrogen? The additional information from EA modelling may be useful in this respect.	
The table identifies a mitigation requirement for the CSOs for only Langstone Harbour in relation to the Solent Maritime SAC and SPA but a wider mitigation requirement for in-combination impact of the long sea outfall discharge on Solent and Southampton Water SPA. This appears inconsistent especially as the SAC extends further than the SPA into the Solent and closer to the long sea outfall off Langstone and Chichester Harbours. If mitigation of the long sea outfall is required for the SPA then there is a case that it should also be required for the SAC.	This has been updated to reflect the offshore component of the Solent Maritime SAC more clearly, which comes into closer proximity with the outfall dispersion plume than the SPA.
Also, with regard to the mitigation options available, it states that development must use NE's nutrient budget to demonstrate nutrient neutrality. Please could you clarify - is it assumed that all development will achieve nutrient neutrality and additional measures are also needed in relation to CSOs?	Yes; there are two pathways for impact with both the CSOs requiring mitigation and the LSO. An impact from the LSO alone on the Solent Maritime SAC offshore habitat has been made clearer, given the proximity of the dispersion plume. The in-combination effect of continued nitrogen loading within the East Solent and those harbour systems connected to this pathway which exhibit eutrophication issues has also been made clearer.
Section 6 Section 6.2 – we have provided further advice at the meeting [4 March 2020] on occupancy rates and net increase in population as well as the precautionary buffer. Those discussions hopefully help to provide the context for the approach taken by Natural England in the advice.	Reference made to discussions held at meeting.

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To support any assessment of the potential impacts to a European designated site, the following information needs to be reviewed:

- Qualifying features
- Conservation objectives
- Favourable conservation status
- Condition of features
- Site condition

A.1 Qualifying Features

The designated sites cover a range of features and over a large area, and therefore not all of the qualifying features will be present in the zone of influence of the Budds Farm WwTW outfalls or be sensitive to changes in nutrient levels. The qualifying features of the sites are associated with the complex estuarine and marine environment, influenced by a "double tidal" regime with long periods of tidal stand at high water and low tide. Habitats within the estuaries include extensive areas of mudflats and sandflats, intertidal areas supporting eelgrass *Zostera* spp., saltmarshes, pioneer cordgrass communities and drift line vegetation. The habitats support nursery grounds for fish and important assemblages of nesting, roosting and feeding birds. Salinities are variable with lower salinities in the upper estuaries and fully marine conditions found in Chichester and Langstone Harbours. Full details of the qualifying features for each site can be found in Tables 1 to 6.

A.2 Conservation Objectives

The Habitats Regulations require that the Appropriate Assessment is of "*the implications for the site in view of that site's conservation objectives.*" The development of conservation objectives is required by the Habitats Directive. In accordance with the Directive, the objectives aim to achieve the 'favourable conservation status' of the habitat and species features for which a European site is designated, see Figure A below.

Conservation objectives for SPAs and SACs have been developed by Natural England and provide a description of what is considered to be the favourable conservation status (see Figure A) of the feature within the whole site area.

Figure A ***Favourable conservation status as defined in Articles 1(e) and 1(i) of the Habitats Directive***

"*The conservation status of a natural habitat is the sum of the influences acting on it and its typical species that may affect its long-term natural distribution, structure and functions as well as the long term survival of its typical species. The conservation status of a natural habitat will be taken as favourable when:*

• Its natural range and areas it covers within that range are stable or increasing;

• The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future and;

• The conservation status of its typical species is favourable.

The conservation status of a species is the sum of the influences acting on the species that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' when:

• Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats;

• The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future and;

• There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis."

Although there aren't any formal conservation objectives for Ramsar sites, the features are often overlapping with those covered by SACs and SPAs and the objectives are relatively generic. Therefore, those same objectives can be applied.

A.3 Favourable Conservation Status and Site Condition

There are several pieces of information that can be used to understand the existing condition of the features across their UK range, the condition of the habitats at the site level, and the threats and pressures affecting the feature.

A.3.1 Feature Level

The fourth UK Habitats Directive Report was published in 2019[1], and considered the Conservation Status of all terrestrial and marine habitats listed under Annex I of the Directive, and all terrestrial and marine species listed under Annexes II, IV and V of the Directive that were present within the UK during the reporting period (2013 to 2018). Each habitat was assessed in terms of the following parameters; range, area, structure and function whilst each species was assessed for range, population, habitat for the species and future prospects.

A similar process is undertaken for the SPAs, with the 11th Article 12 report published in October 2019[2]. The report contains information on; population size and trend (short and long term); breeding distribution and trend (short and long term); species action plans; and information on pressures, threats, conservation measures and population size inside the SPA network.

A.3.2 Site Level

At a site level, the condition of the underlying Sites of Special Scientific Interest (SSSI) can be used to provide an indication as to whether the site itself is achieving favourable condition. Supporting the

[1] JNCC (2019) Fourth Article 17 UK Habitats Directive Report (2019): The UK Approach to assessing Conservation Status for the 2019 Article 17 reporting under the EU Habitats Directive 2019. Accessed at https://hub.jncc.gov.uk/assets/6420776d-2a25-4575-8b6f-1922a6a13806

[2] JNCC (2019) Article 12 Birds Directive Report 2019. Accessed at https://jncc.gov.uk/our-work/article-12-report-2019/

SSSIs are Favourable Condition Tables. These FCTs provide a number of measures and targets of condition for the SSSI, against which Natural England determine whether the features are in favourable condition. The conservation objectives and definitions of favourable condition for features of the SSSI can be used to inform the Appropriate Assessment under the Habitats Regulations where the features are the same.

Site Improvement Plans (SIPs) have also been produced for each European designated site, encompassing both SACs and SPAs. Ramsar sites are not specifically covered, however features often overlap with the SAC and SPA designations. The SIPs were developed in England as part of the Improvement Programme for England's Natura 2000 sites (IPENS). The SIPs provide a high-level overview of the issues (both current and predicted) affecting the condition of the Natura 2000 features on the site(s) and outlines the priority measures required to improve the condition of the features. The plans do not cover issues where remedial actions are already in place or the ongoing management activities which are required for maintenance of the status.

Table 1 Solent Maritime SAC: Qualifying Features, condition and vulnerability to changes in nutrients

Designated site name:	**Solent Maritime**	
Designation type: (SAC, SPA, Ramsar):	SAC	
Qualifying features (those in bold considered to be within the zone of influence and sensitive to changes in nutrient levels):	Feature	Vulnerability to changes in nutrients:
	1130 Estuaries	Langstone Harbour is a bar-built estuary with nearly fully marine conditions supporting the estuarine habitats and species. The Solent Maritime SAC estuaries comprise the following sub-features: subtidal coarse sediment (A5.1), subtidal sand (A5.2), **subtidal mixed sediments (A5.4)**, **subtidal seagrass beds (A5.53)**, intertidal coarse sediment (A2.1), **intertidal sand and muddy sand (A2.2), intertidal mud (A2.3), intertidal mixed sediment (A2.4)**, **intertidal seagrass beds (A2.61)**, **Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (H1330), *Salicornia* and other annuals colonising mud and sand (H1310) and Spartina swards (*Spartinion maritimae*)(H1320)**[3]. A number of these sub-features are considered separately below, consideration in this section is therefore given to the vulnerability of subtidal coarse sediment, subtidal mixed sediments, subtidal seagrass beds and intertidal coarse sediment. Subtidal coarse sediment Representative subtidal coarse sediment biotopes in the Solent include A5.13 Infralittoral coarse sediment, A5.14 Circalittoral coarse sediment and A5.141 *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles. There is no quantified baseline extent for subtidal coarse sediment in the Solent Maritime SAC available from the time of site designation. The current extent of subtidal coarse sediment within the site is 59.32 hectares and is found primarily along the open coast of the north-west Isle of Wight and in tide swept channels such as the estuary mouths of Langstone and Chichester Harbours[4]. There is evidence from survey or monitoring that shows the feature to be in a good condition and/or currently un-impacted by anthropogenic activities. Sensitivity to nutrient enrichment is considered to be low, with the WFD high ecological status providing sufficient protection. Some studies show tolerance of enhanced nutrient levels and a slight increase in nutrient levels potentially being beneficial for barnacles and other suspension feeders by promoting growth of phytoplankton and therefore increasing food supplies[5]. **Subtidal mixed sediments** Representative subtidal mixed sediment biotopes in the Solent include A5.421 *Aphelochaeta* species and *Polydora* species in variable salinity infralittoral mixed sediment and A5.422 *Crepidula fornicata* and *Mediomastus fragilis* in variable salinity infralittoral mixed sediment. There is no quantified baseline extent for subtidal mixed sediment in the Solent Maritime SAC available from the time of site designation. The current extent of subtidal mixed sediment within the site is 2,619.08 hectares. Mixed sediments are widespread in the subtidal channels of the harbours and estuaries of the Solent Maritime SAC. There is evidence from survey or monitoring that shows the feature to be in a good condition and/or currently un-impacted by anthropogenic activities. The A5.421 biotope occurs in muddy mixed sediment, in reduced and variable/low salinities that are experienced due to its locations in estuaries and marine inlets. Nutrient enrichment may reduce the abundance of *Aphelochaeta marioni* while *Polydora* is probably resistant. However, the biotope is considered not sensitive assuming compliance with good status as defined by the WFD[6]. The A5.422 biotope occurs in the lower estuary where the hydrodynamic regime allows a suitable environment to develop. Nutrient enrichment can lead to significant shifts in community composition in sedimentary habitats. However, as with A5.421 the biotope is considered not sensitive assuming compliance with good status as defined by the WFD[7]. **Eelgrass** The estuary supports extensive eel grass beds (*Zostera* spp.) which an important food source for the overwintering dark-bellied brent goose[8]. In 1987, the estimated area of *Zostera* in Chichester and Langstone Harbours alone was 560 hectares (Tubbs, 1999)[3]. Excessive nutrients and / or high turbidity can lead to a drop in DO, especially in warmer months. *Zoestra* spp. have a high intolerance to nutrient enrichment with high nitrate concentrations leading to a decline of *Zoestra marina*. The adverse effects of increases in nitrate has been shown to be exacerbated by the level of salinity, with estuarine habitats being more intolerant than marine habitats. Den Hartog (1994) reported the growth of a dense blanket of *Ulva radiata* in Langstone Harbour in 1991 that resulted in the loss of 10ha of *Zostera marina* and *Zostera noltii*; by summer 1992 the *Zostera* sp. were absent, however this may have been exacerbated by grazing by Brent geese[9]. Intertidal coarse sediment A study conducted in 2005 found A2.111 barren littoral shingle to be one of the dominant biotopes of the Solent Maritime SAC, occurring extensively within Langstone Harbour. There is evidence from survey or monitoring that shows the feature to be in a good condition and/or currently un-impacted by anthropogenic activities[3]. The bioptope is characterised by a lack of species due to high sediment mobility, therefore it is not considered to be sensitive to nutrient enrichment[10].
	1320 Spartina swards (Spartinion maritimae)	Pioneer saltmarsh have an intermediate tolerance to increases in nutrient with a low sensitivity, however long term increases in nutrient levels could result in a decline in species diversity. Poor evidence base to support this conclusion.

[3] https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0030059&SiteName=solent&SiteNameDisplay=Solent+Maritime+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality=0

[4] https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0030059&SiteName=solent&SiteNameDisplay=Solent+Maritime+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality=0

[5] Tillin, H.M., Tyler-Walters, H. & Garrard, S. L. 2016. [Spirobranchus triqueter] with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-01-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/177

[6] De-Bastos, E. & Tyler-Walters, H., 2016. [Aphelochaeta] spp. and [Polydora] spp. in variable salinity infralittoral mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-01-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/114

[7] Readman, J.A.J. & Rayment, W.J. 2016. [Crepidula fornicata] and [Mediomastus fragilis] in variable salinity infralittoral mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-01-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/52

[8] English Nature (2001) Solent European Marine Site comprising: Solent Maritime candidate Special Area of Conservation Solent and Southampton Water Special Protection Area & Ramsar Site Chichester and Langstone Harbours Special Protection Area & Ramsar Site Portsmouth Harbour Special Protection Area & Ramsar Site English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994 18th October 2001

[9] Tyler-Walters, H., 2008. Zostera (Zostera) marina Common eelgrass. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-01-2020]. Available from: https://www.marlin.ac.uk/species/detail/1282

[10] Tillin, H.M., Budd, G. & Tyler-Walters, H. 2019. Barren littoral shingle. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-01-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/143

	1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	Generally tolerant with low sensitivity, but algal mats washed onto vegetation could smother, higher nutrient enrichment could be favoured by particular species leading to a reduction in diversity and higher enrichment could reduce oxygen levels in the sediment. Poor evidence base to support this conclusion[11].
	1110 Sandbanks which are slightly covered by sea water all the time	This habitat consists of soft sediment types that are permanently covered by shallow sea water, typically at depths of less than 20 metres below chart datum [REG 33]. Subtidal sand can be found in the mouth of Langstone Harbour with subtidal muddy sand found in the northern half[12]. Changes in nutrient status may indirectly affect this biotope where these result in changes in diatom production and inputs of macroalgal debris. Primary production is low and the biotope is species poor, with characterising species may be present at low abundances (depending on wave exposure). The biotope is considered not sensitive assuming compliance with good status as defined by the WFD[13].
	1140 Mudflats and sandflats not covered by seawater at low tide	Sub-features found within Langstone Harbour are intertidal mud communities, intertidal muddy sand communities and intertidal sand communities. Long-term nutrient enrichment may alter the biotope if high biomass of algal mats persists. If the benchmark for compliance is set at the WFD criteria for good status, based on nitrogen concentration, then changes to the habitat are considered unlikely as the benchmark is relatively protective and is set at a level to avoid blooms of green algae on the sediment[14].
	1150 Coastal lagoons	The coastal lagoon feature for the Solent Maritime SAC has been recorded at Newtown Quay, Borrow Dyke in Yarmouth Harbour and Stuart's Pond at the base of Hurst Spit. These are sufficiently distant from the zone of influence such as not to be impacted from the increased housing development.
	1210 Annual vegetation of drift lines	Within the zone of influence, AVDL is found on the southern coast of Hayling Island[12]. Shingle islands are also found in the harbour. However, the habitat type occurs on deposits of shingle lying at or above mean high-water spring tides. It is therefore considered unlikely that the habitat would be adversely affected by changes in nutrient levels in the waterbody.
	1220 Perennial vegetation of stony banks	This habitat typically occurs where shingle (cobbles and pebbles) and gravel form elevated ridges or banks above the highest astronomical tide mark and are therefore unlikely to be adversely affected by changes in nutrient levels in the water.
	1310 Salicornia and other annuals colonizing mud and sand	The vegetation of this habitat type is dominated by areas of glasswort (*Salicornia*) or annual sea-blite (*Suaeda maritima*) and generally comprises a very small number of species[12]. As with Spartina, the pioneer saltmarsh communities have an intermediate tolerance to increases in nutrient with a low sensitivity, however long term increases in nutrient levels could result in a decline in species diversity. There is a poor evidence base to support this conclusion.
	2120 "Shifting dunes along the shoreline with Ammophila arenaria ("white dunes")"	This habitat typically occurs above the highest astronomical tide mark and excludes the lower, embryonic dunes where occasional exposure to saltwater flooding constrains the growth of marram grass[15]. The habitat is therefore unlikely to be adversely affected by changes in nutrient levels in the water.
	1016 Desmoulin`s whorl snail *Vertigo moulinsiana*	Upon review of the Regulation 33 information for the European Marine Site, it is understood that the Desmoulin's whorl snail (*Vertigo moulinsiana*) population has only been recorded in one location; historically present in the freshwater fen, swamp and brackish reedbeds at the top of Fishbourne Channel in Chichester Harbour. This is to the very east of Chichester Harbour, approximately 13km from Budds Farm WwTW. Therefore, LSEs from increased housing development in the Budds Farm WwTW catchment are considered unlikely.
Current conservation status (Article 17):	Estuaries: bad and deteriorating (range: favourable, area: favourable, structure and function: bad and deteriorating, future prospects: bad and deteriorating). Main pressures and threats: fish and Shellfish Aquaculture; professional fishing; fixed location fishing; leisure fishing; bait digging; taking / removal of fauna, general; taking / removal of flora, general; hunting, fishing or collecting activities not referred to above; sand and gravel extraction; urbanised areas, human habitation; industrial or commercial areas; discharges; port areas; energy transport; pipe lines; shipping; nautical sports; motorised vehicles; pollution; water pollution; trampling, overuse; landfill, land reclamation and drying out, general; polderisation; reclamation of land from sea, estuary or marsh; infilling of ditches, dykes, ponds, pools, marshes or pits; removal of sediments (mud...); canalisation; flooding; modification of hydrographic functioning, general; modification of marine currents; management of water levels; dumping, depositing of dredged deposits; dykes, embankments, artificial beaches, general; sea defence or coast protection works; erosion; drying out / accumulation of organic material; eutrophication; acidification; invasion by a species; interspecific faunal relations; interspecific floral relations; genetic pollution. Spartina swards (*Spartinion maritimae*): bad and deteriorating (range: bad and deteriorating, area: bad and deteriorating, structure and function: bad and deteriorating, future prospects: bad and deteriorating). Main pressures and threats: discharges; water pollution; air pollution; soil pollution; military manoeuvres; reclamation of land from sea, estuary or marsh; drainage; flooding; modification of marine currents; sea defence or coast protection works; erosion; submersion; invasion by a species; competition; Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*): bad and deteriorating (range: favourable, area: inadequate and deteriorating, structure and function: bad and deteriorating, future prospects: bad and deteriorating). Main pressures and threats: grazing; abandonment of pastoral systems; discharges; water pollution; soil pollution; military manoeuvres; reclamation of land from sea, estuary or marsh; drainage; flooding; modification of marine currents; sea defence or coast protection works; erosion; submersion; invasion by a species; competition. Sandbanks which are slightly covered by sea water all the time: bad and deteriorating (range: favourable, area: favourable, structure and function: bad and deteriorating, future prospects: bad and deteriorating). Main pressures and threats: fish and shellfish aquaculture; professional fishing; trawling; drift-net fishing; leisure fishing; sand and gravel extraction; exploration and extraction of oil or gas; urbanised areas, human habitation;	

[11] Tyler-Walters, H., 2004. [Puccinellia maritima] salt-marsh community. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-01-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/350

[12] English Nature (2001) Solent European Marine Site comprising: Solent Maritime candidate Special Area of Conservation Solent and Southampton Water Special Protection Area & Ramsar Site Chichester and Langstone Harbours Special Protection Area & Ramsar Site Portsmouth Harbour Special Protection Area & Ramsar Site English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994 18th October 2001

[13] Ashley, M., 2016. Sublittoral sand in variable salinity (estuaries). In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-01-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/1014

[14] Ashley, M. & Budd, G.C., 2020. [Hediste diversicolor] and oligochaetes in littoral mud. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-01-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/268

[15] 2120 Shifting dunes along the shoreline with Ammophila arenaria ('white dunes'): Description and ecological characteristics. Accessed at: https://sac.jncc.gov.uk/habitat/H2120/

	industrial or commercial areas; discharges; port areas; energy transport; pipe lines; shipping; pollution; water pollution; Modification of hydrographic functioning, general; modification of marine currents; dumping, depositing of dredged deposits; sea defence or coast protection works; erosion; eutrophication; invasion by a species; interspecific faunal relations; other forms or mixed forms of interspecific faunal competition; introduction of disease; genetic pollution; Mudflats and sandflats not covered by seawater at low tide: bad and deteriorating (range: favourable, area: favourable, structure and function: bad and deteriorating, future prospects: bad and deteriorating). Main pressures and threats: fish and shellfish aquaculture; professional fishing; fixed location fishing; leisure fishing; bait digging; urbanised areas, human habitation; industrial or commercial areas; discharges; port areas; sport and leisure structures; nautical sports; motorised vehicles; pollution; water pollution; trampling, overuse; dykes, embankments, artificial beaches, general; erosion; eutrophication; invasion by a species; interspecific faunal relations; interspecific floral relations; genetic pollution. Coastal lagoons**:** inadequate (range: favourable, area: favourable, structure and function: favourable, future prospects: inadequate). Main pressures and threats: pollution to surface waters, change in biotic conditions, other human intrusions and disturbances, human induced changes in hydraulic conditions, changes in abiotic and biotic conditions. Annual vegetation of drift lines: bad and deteriorating (range: unknown, area: inadequate and deteriorating, structure and function: bad and deteriorating, future prospects: bad and deteriorating). Main pressures: abandonment of pastoral systems; removal of beach materials; walking, horse-riding and non-motorised vehicles; motorised vehicles; air pollution; modification of marine currents; sea defence or coast protection works; erosion; other natural processes. Main threats: removal of beach materials; walking, horse-riding and nonmotorised vehicles; motorised vehicles; air pollution; erosion; biocenotic evolution; other natural processes. Perennial vegetation of stony banks: bad but improving (range: favourable, area: inadequate and deteriorating, structure and function: bad but improving, future prospects: bad but improving). Main pressures: abandonment of pastoral systems; removal of beach materials; walking, horse-riding and non-motorised vehicles; motorised vehicles; air pollution; modification of marine currents; sea defence or coast protection works; erosion; other natural processes. Main threats – same as main pressures. Salicornia and other annuals colonizing mud and sand: bad and deteriorating (range: favourable, area: inadequate and deteriorating, structure and function: bad and deteriorating, future prospects: bad and deteriorating). Main pressures and threats: discharges; water pollution; air pollution; soil pollution; military manoeuvres; reclamation of land from sea, estuary or marsh; drainage; flooding; modification of marine currents; sea defence or coast protection works; erosion; submersion; invasion by a species; competition. "Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")": bad (range: favourable, area: inadequate, structure and function: bad, future prospects: inadequate). Main pressures: removal of beach materials; urbanised areas, human habitation; industrial or commercial areas; disposal of household waste; disposal of industrial waste; walking, horse-riding and non-motorised vehicles; motorised vehicles; air pollution; sea defence or coast protection works; erosion. Main threats – same as pressures but also includes submersion. Desmoulin`s whorl snail (*Vertigo moulinsiana*): Bad **–** range; favourable, population; bad, habitat for the species; inadequate, future prospects; bad. Main threats and pressures: human induced changes in hydraulic conditions, abiotic (slow) natural processes, grazing, pollution to groundwater (point sources and diffuse sources) and fertilisation.
Conservation objectives:	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring; • The extent and distribution of qualifying natural habitats and habitats of qualifying species • The structure and function (including typical species) of qualifying natural habitats • The structure and function of the habitats of qualifying species • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely • The populations of qualifying species, and, • The distribution of qualifying species within the site.
SSSI Condition assessment:	• Langstone Harbour SSSI: 8.39% favourable, 91.05% unfavourable recovering, 0.56% unfavourable-no change. • Chichester Harbour SSSI: 15.26% favourable, 3.56% unfavourable recovering, 81.18% unfavourable no change. • Portsmouth Harbour SSSI: 2.58% favourable, 25.70% unfavourable-recovering, 71.21% unfavourable-no change, 0.15% unfavourable-declining, 0.35% destroyed.
Site Improvement Plan (only actions that could be impacted by new housing development included):	1. Public Access/ Disturbance - Little Egret, Dark-bellied Brent Goose, Common shelduck, Wigeon, Eurasian teal, Pintail,) Shoveler, Red-breasted Merganser, Ringed Plover,Grey Plover, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Common redshank, Turnstone, Mediterranean Gull, Sandwich Tern, Roseate Tern, Common Tern, Little Tern, Annual vegetation of driftlines, Coastal shingle vegetation outside the reach ofwaves, Waterbird assemblage - Reduce disturbance through access management, awareness raising and wardening 4. Water Pollution - Little Egret, Dark-bellied Brent Goose, Common shelduck, Wigeon, Eurasian teal, Pintail, Shoveler, Red-breasted Merganser, Ringed Plover, Grey Plover, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Common redshank, Turnstone, Mediterranean Gull, Sandwich Tern, Roseate Tern, Common Tern, Little Tern, Estuaries, Intertidal mudflats and sandflats, Glasswort and other annuals colonising mud and sand, Cord-grass swards, Atlantic salt meadows, Waterbird assemblage- Implement actions in the Diffuse Water Pollution Plan, and investigate further pollution. 13. Air Pollution: impact of Pressure Not yet determined atmospheric nitrogen deposition - dark-bellied brent goose, wigeon, pintail, Black-tailed Godwit, Curlew, Common greenshank, SandwichTern, Roseate Tern, Common Tern, Little Tern, Estuaries, Coastal lagoons, Glasswort and other annuals colonising mud and sand, Atlantic salt meadows, Shifting dunes with marram

Table 2 Solent and Isle of Wight Lagoons SAC: Qualifying Features, condition and vulnerability to changes in nutrients

Designated site name:	**Solent and Isle of Wight Lagoons**	
Designation type: (SAC, SPA, Ramsar):	SAC	
Qualifying features:	Feature	Vulnerability to changes in nutrients
	1150 Coastal lagoons (priority feature) The Solent on the south coast of England encompasses a series of coastal lagoons, including percolation, isolated and sluiced lagoons. The site includes a number of lagoons in the marshes in the Keyhaven – Pennington area, at Farlington Marshes in Chichester Harbour, behind the sea-wall at Bembridge Harbour and at Gilkicker, near Gosport.	Shut Lake is an isolated lagoon in marsh pasture that, although separated from the sea by a sea-wall, receives sea water during spring tides. No valid benthic biotope typical of coastal lagoons was recognised at Shut Lake Lagoon in surveys in 2013 due to the low density and diversity. There was also no submerged vegetation found at the site. The community at Shut Lake is very sparse, dominated by insect larvae and the oligochaete *H. costata* reflecting the low salinity regime of the site [16]. Average salinity for a lagoon is expected to be between 15 and 40; this incorporates the optimal salinity ranges for the majority of lagoon specialist species. The salinity at Shut Lake ranged from 4 to 5, and the pH ranged from 8.0 to 8.1. The survey evidence would suggest the lagoon no longer supports the characteristics, or species, of coastal lagoon habitat. However, with intake from the Langstone Harbour waterbody, there is a potential pathway for increases in nitrogen to get into the lagoon.
Current conservation status (Article 17)[17]:	Unfavourable, inadequate (range: favourable, area: favourable, specific structure and functions: unfavourable-inadequate, future prospects: unknown). Main pressures and threats: pollution to surface waters, agricultural pollution, changes to the coastline, invasive alien species, human induced changes in hydraulic conditions, climate change responses.	
Conservation objectives:	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring; • The extent and distribution of qualifying natural habitats • The structure and function (including typical species) of qualifying natural habitats, and • The supporting processes on which qualifying natural habitats rely Supplementary Advice on the conservation objectives is currently unavailable.	
SSSI Condition assessment:	• Brading Marshes to St Helens Ledges SSSI: 32.18% favourable, 46.69% unfavourable recovering, 9.32% unfavourable no change, 11.80% unfavourable declining. • Gilkicker Lagoon SSSI: 100% favourable. • Hurst Castle and Lymington River Estuary SSSI: 21.46% favourable, 75.66% unfavourable recovering, 2.88% unfavourable declining. • Langstone Harbour SSSI: 8.39% favourable, 91.05% unfavourable recovering, 0.56% unfavourable-no change.	
Site Improvement Plan (only actions that could be impacted by new housing development included):	1. Hydrological changes – coastal lagoons - improve monitoring at SAC and individual lagoon level to inform management and consider boundary change. 5. Air Pollution: risk of atmospheric nitrogen deposition – coastal lagoons - investigate potential atmospheric nitrogen impacts on the site.	

[16] Solent and Isle of Wight Lagoons SAC Last updated: 14th September 2018 Supplementary advice. Accessed at: https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0017073&SiteName=Solent+and+Isle+of+Wight+Lagoons&SiteNameDisplay=Solent+and+Isle+of+Wight+Lagoons+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAAr ea=&NumMarineSeasonality=

[17] European Community Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) Fourth Report by the United Kingdom under Article17 on the implementation of the Directive from January 2013 to December 2018 Conservation status assessment for the habitat:H1150-Coastal lagoons. Accessed at https://jncc.gov.uk/jncc-assets/Art17/H1150-UK-Habitats-Directive-Art17-2019.pdf

Table 3 Chichester and Langstone Harbours SPA and Ramsar: Qualifying Features, condition and vulnerability to changes in nutrients

Designated site name:	**Chichester and Langstone Harbours**	
Designation type: (SAC, SPA, Ramsar):	SPA and Ramsar	
Qualifying features:	Feature	Vulnerability to changes in nutrients
	Article 4.1 **During the breeding season;** Little Tern *Sterna albifrons*, 100 pairs representing up to 4.2% of the breeding population in Great Britain (5 year mean, 1992-1996) Sandwich Tern *Sterna sandvicensis*, 158 pairs representing up to 1.1% of the breeding population in Great Britain (1998) **Article 4.2** **Over winter;** Bar-tailed Godwit *Limosa lapponica*, 1,692 individuals representing up to 3.2% of the wintering population in Great Britain (5 year peak mean 1991/2 - 1995/6) Dark-bellied Brent Goose *Branta bernicla bernicla*, 17,119 individuals representing up to 5.7% of the wintering Western Siberia/Western Europe population (5 year peak mean 1991/2 - 1995/6) Dunlin *Calidris alpina alpina*, 44,294 individuals representing up to 3.2% of the wintering Northern Siberia/Europe/Western Africa population (5 year peak mean 1991/2 - 1995/6) Grey Plover *Pluvialis squatarola*, 3,825 individuals representing up to 2.5% of the wintering Eastern Atlantic - wintering population (5 year peak mean 1991/2 - 1995/6) Redshank *Tringa totanus*, 1,788 individuals representing up to 1.2% of the wintering Eastern Atlantic - wintering population (5 year peak mean 1991/2 - 1995/6) Ringed Plover *Charadrius hiaticula*, 846 individuals representing up to 1.7% of the wintering Europe/Northern Africa - wintering population (5 year peak mean 1991/2 - 1995/6) Over winter, the area regularly supports 93,142 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: Wigeon *Anas penelope*, Bar-tailed Godwit *Limosa lapponica*, Dark-bellied Brent Goose *Branta bernicla bernicla*, Ringed Plover *Charadrius hiaticula*, Grey Plover *Pluvialis squatarola*, Dunlin *Calidris alpina alpina*, Black-tailed Godwit *Limosa limosa islandica*, Redshank *Tringa totanus*, Little Grebe *Tachybaptus ruficollis*, Little Egret *Egretta garzetta*, Shelduck *Tadorna tadorna*, Curlew *Numenius arquata*, Teal *Anas crecca*, Pintail *Anas acuta*, Shoveler *Anas clypeata*, Red-breasted Merganser *Mergus serrator*, Oystercatcher *Haematopus ostralegus*, Lapwing *Vanellus vanellus*, Knot *Calidris canutus*, Sanderling *Calidris alba*, Cormorant *Phalacrocorax carbo*, Whimbrel *Numenius phaeopus*.	The vulnerability of the bird species to changes in nutrients will depend on the impact to their preferred prey. Nesting and roosting opportunities are considered unlikely to be adversely affected. Bird species that feed on eelgrass (dark-bellied brent goose) and mudflat and sandflat habitats are likely to be highly sensitive to the impacts of eutrophication. Those species that feed on prey in the main water column are considered to be less sensitive, as this prey are mobile and less likely to be smothered. Reductions in dissolved oxygen could result in temporary changes in species availability. There is a net water volume input from Chichester Harbour into Langstone Harbour via the Chichester Channel[18]. This preferential flow, and the location of the Budds Farm WwTW CSOs to the north and north west of Langstone Harbour, are considered to limit the impacts on habitats and feeding grounds within Chichester Harbour itself. As such, information on distribution below is presented primarily for Langstone Harbour, where impacts could occur. The information has been taken from Natural England's designated views site, other information sources are referenced where used: <u>Little tern:</u> forage alone in shallow water often within 1km of their breeding colony for small fish, crustaceans, and insects. Little terns take food from near the surface of the water by plunge diving, often following hovering, or by 'contact dipping', where only the bill enters the water and the bird remains in flight throughout (Natural England, 2012). They forage throughout the harbours, in the harbour mouths and into the Solent (Rowsell, 2017 Pers Comm), (MacCallum and Smith, 2017 Pers Comm) and (Hughes, 2017 Pers Comm). <u>Common tern:</u> Common terns forage alone or in small flocks for small fish and crustaceans, terrestrial insects and occasionally squid. They take food from near the surface of the water by plunge diving to a depth of 1-2m, often following hovering. Prey might also be gathered by 'contact dipping': where only the bill enters the water and the bird remains in flight throughout (Natural England, 2012). They forage throughout the harbours, in the harbour mouths and into the Solent (Rowsell, 2017 Pers Comm), (MacCallum and Smith, 2017 Pers Comm) and (Hughes, 2017 Pers Comm). <u>Sandwich tern:</u> prey species are more varied than that of the other terns, including sandeels, herring and sprats, as well as crustaceans and small squid. Sandwich terns forage alone or in small flocks taking prey from near the surface of the water by plunge-diving to a depth of 2m (Natural England, 2012). Foraging behaviour is seen throughout the harbours with a stronger tendency to feed at the harbour mouths. At high tide in Langstone Harbour, they form groups to forage south of South Binness island (Rowsell, 2017 Pers Comm), (MacCallum and Smith, 2017 Pers Comm) and (Hughes, 2017 Pers Comm). <u>Bar-tailed godwit:</u> feed throughout both harbours on intertidal sediments but show a preference for sandier substrates. Polychaete worms can make up around 95% of their winter diet (Smith, 1975). In Chichester Harbour, their main foraging areas are at Pilsey Sands and north of Black Point and in Langstone Harbour, there is an important feeding area around Sword Sands (Frost et al., 2017) and (Rowsell, 2017 Pers Comm). <u>Dark-bellied brent goose:</u> Low tide feeding distribution maps show dark-bellied brent geese have been spotted most often on the intertidal around Farlington Marshes and the northern harbour, but there are many counts in the southern intertidal particularly next to the Hayling Billy Line19.The main food sources for dark-bellied Brent goose in the harbours are the green algae (Ulva species) and seagrass beds growing on the intertidal sediments (Rowcliffe and Mitchell, 1996). Green algae is found throughout the harbours, whilst seagrass beds are located in more limited areas such as Sinah Lake and Mallard Sands in Langstone Harbour and the Hayling Island coast, West Thorney, West Chidham, East Head and the Horsepond in Chichester Harbour (Thomas et al., 2016) and (Rowsell, 2017 Pers Comm). <u>Curlew:</u> Curlew feed on marine worms, shellfish and shrimps found in the intertidal sediments within the sheltered harbours (Royal Society for the Protection of Birds (RSPB), 2017). They forage throughout both harbours, in low densities and can be seen south of Farlington Marshes and south of Bedhampton Wharf in Langstone Harbour (Frost et al., 2017), (Rowsell, 2017 Pers Comm), (MacCallum and Smith, 2017 Pers Comm) and (Hughes, 2017 Pers Comm).

[18] New Forest District Council (2017). 2012 Update of Carter, D., Bray, M., & Hooke, J., 2004 SCOPAC Sediment Transport Study, www.scopac.org.uk/sts.
[19] Natural England (2017) Access and Sensitive Features Appraisal Coastal Access Programme: Portsmouth to South Hayling.

		Dunlin: At low tide, dunlin spread out, feeding in groups on the intertidal sediments throughout the harbours, particularly south of Thorney Island and in the Emsworth Channel. They select snails, worms and shrimps from within and on top of the mudflats (Royal Society for the Protection of Birds (RSPB), 2017). Grey plover: Grey plover feed on cockles, lugworm, ragworms and small crustaceans but will also take surface prey such as sea slugs on the intertidal sediments (British Trust for Ornithology (BTO), 2017), (Royal Society for the Protection of Birds (RSPB), 2017) and (Durell and Kelly, 1990). Grey plover feed in low densities throughout both harbours Pintail: Pintail feed at the surface of the water by dabbling (submerging the head) for vegetation (The Wildlife Trusts, 2017). They feed throughout the harbours but particularly favour the Nutbourne Bay area and north of the Thorney Channel in Chichester Harbour (Rowsell, 2017 Pers Comm) and (Frost et al., 2017). Red-breasted merganser: Red-breasted merganser feed and roost on the water in both harbours. They dive and swim to forage on fish and aquatic invertebrates in the water column (The Wildlife Trusts, 2017). In Chichester Harbour, they favour deep-water areas such as Thorney Deeps, south of Pilsey Island, and north Hayling / Sweare Deep. In Langstone Harbour, they favour the deeper waters to the east of Farlington Marshes and towards Langstone Bridge (Rowsell, 2017 Pers Comm), (MacCallum and Smith, 2017 Pers Comm) and (Hughes, 2017 Pers Comm) Redshank: Redshank feed on invertebrates, both inland and in estuaries. Prey includes earthworms and crane fly larvae as well as crustaceans, molluscs and marine worms (British Trust for Ornithology (BTO), 2017). In Chichester and Langstone Harbours, they feed throughout and are seen regularly at Texaco Bay and the Kench (Rowsell, 2017 Pers Comm). Ringed plover: Ringed plover feed on invertebrates found on sand and shingle shores, mudflats, saltmarshes, short grassland and flooded fields (Joint Nature Conservation Committee (JNCC), Unk), throughout the harbours in low densities. Important areas for such habitat are Pilsey Sands, East Head, north of Black Point, Hayling Beach and Sword Sands (Rowsell, 2017 Pers Comm), (MacCallum and Smith, 2017 Pers Comm), and (Hughes, 2017 Pers Comm). Sanderling: Sanderlings feed in small groups at the edge of the tide, chasing the waves as they go out to collect crustaceans, worms, fish and jellyfish (The Wildlife Trusts, 2017). They feed in the site in area including: Pilsey Sands; East Head; north of Black Point; Hayling Beach; Sword Sands and Eaststoke Beach (Rowsell, 2017 Pers Comm) and (MacCallum and Smith, 2017 Pers Comm). Shelduck: Shelduck feed on marine snails, invertebrates and small shellfish found within intertidal sediments (Royal Society for the Protection of Birds (RSPB), 2017) and (Royal Society for the Protection of Birds (RSPB), 2017) .They forage throughout the site but particularly prefer the Fishbourne, Thorney and Bosham Channels as well as the Warblington Coast in Chichester Harbour (Rowsell, 2017 Pers Comm), (MacCallum and Smith, 2017 Pers Comm) and (Hughes, 2017 Pers Comm) Shoveler: Shoveler feed by sweeping their wide, long bills through the water to filter out invertebrates and plant matter (The Wildlife Trusts, 2017). They feed throughout the harbours but are regularly seen on mudflats to the south of Southmoor in Langstone Harbour and in low numbers in Nutbourne Bay and adjacent to Tournerbury Farm in Chichester Harbour (Rowsell, 2017 Pers Comm) and (MacCallum and Smith, 2017 Pers Comm). Teal: Teal feed on small invertebrates and seeds (Royal Society for the Protection of Birds (RSPB), 2017). In Chichester Harbour, they forage in the Thorney Channel, at Snowhill Creek and at Mill Rythe / Yacht Haven. They favour Farlington Marshes in Langstone Harbour (Rowsell, 2017 Pers Comm), (MacCallum and Smith, 2017 Pers Comm) and (Hughes, 2017 Pers Comm). Turnstone: Turnstone forage on intertidal sediment and rocky substrates. The prey on a wide variety of foods including crustaceans, barnacles and bivalves often found by turning over stones and seaweed (Sussex Inshore Fisheries Conservation Authority (IFCA), 2017). However, they will also feed upon bird eggs, corpses and even chips (The Wildlife Trusts, 2017). In Chichester and Langstone Harbours, they feed in low densities throughout (Rowsell, 2017 Pers Comm) and (MacCallum and Smith, 2017 Pers Comm). Wigeon: Wigeon feed on grazing marsh, seagrass (Zostera species) and other aquatic plants and roots, often at night (Royal Society for the Protection of Birds (RSPB), 2017) and (Rowsell, 2017 Pers Comm). Their favoured areas in the harbours include the Emsworth and Thorney Channels, the northern tips of the Bosham and Chichester Channels, Eames Farm, Thorney Deeps, Tournerbury Farm, School Rithe and Farlington Marshes (Rowsell, 2017 Pers Comm) and (MacCallum and Smith, 2017 Pers Comm).

	Ramsar criterion 1 Two large estuarine basins linked by the channel which divides Hayling Island from the main Hampshire coastline. The site includes intertidal mudflats, saltmarsh, sand and shingle spits and sand dunes. Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 76480 waterfowl (5 year peak mean 1998/99-2002/2003). Assemblages of international importance: Qualifying Species/populations (as identified at designation): Species with peak counts in spring/autumn: Ringed plover, Europe/Northwest Africa 853 individuals, representing an average of 1.1% of the population (5 year peak mean 1998/9-2002/3) Black-tailed godwit, *Limosa limosa islandica*, Iceland/W Europe 906 individuals, representing an average of 2.5% of the population (5 year peak mean 1998/9-2002/3) Common redshank, *Tringa totanus totanus*, 2577 individuals, representing an average of 1% of the population (5 year peak mean 1998/9-2002/3) Species with peak counts in winter: Dark-bellied brent goose, 12987 individuals, representing an average of 6% of the population (5 year peak mean 1998/9-2002/3) Common shelduck, NW Europe 1468 individuals, representing an average of 1.8% of the GB population (5 year peak mean 1998/9-2002/3) Grey plover, E Atlantic/W Africa -wintering 3043 individuals, representing an average of 1.2% of the population (5 year peak mean 1998/9-2002/3) Dunlin W Siberia/W Europe 33436 individuals, representing an average of 2.5% of the population (5 year peak mean 1998/9-2002/3) Species/populations identified after designation for possible future consideration under criterion 6. Species regularly supported during the breeding season: Little tern, *Sterna albifrons albifrons*, W Europe 130 apparently occupied nests, representing an average of 1.1% of the breeding population (Seabird 2000 Census)	Covered above (Ramsar criteria 5 and 6) or as part of the Solent Maritime SAC designation (Ramsar criterion 1).
Current conservation status (Article 12)[20]:	• Bar-tailed Godwit: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Black-tailed Godwit: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Dark-bellied Brent Goose*:* Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Insufficient • Dunlin (breeding): Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Insufficient • Grey Plover: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Little Egret: Population numbers: Insufficient, Range coverage: Insufficient, Ecological sufficiency: Insufficient • Little Tern: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Redshank (non-breeding): Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Ringed Plover (breeding): Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Ringed Plover (non-breeding): Population numbers: Insufficient, Range coverage: Insufficient, Ecological sufficiency: Sufficient • Sandwich Tern (breeding): Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Sandwich Tern (non-breeding): Population numbers: Insufficient, Range coverage: Insufficient, Ecological sufficiency: Insufficient	
Conservation objectives:	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring; • The extent and distribution of the habitats of the qualifying features • The structure and function of the habitats of the qualifying features • The supporting processes on which the habitats of the qualifying features rely • The population of each of the qualifying features, and, • The distribution of the qualifying features within the site.	
SSSI Condition assessment:	• Langstone Harbour SSSI: 8.39% favourable, 91.05% unfavourable recovering, 0.56% unfavourable-no change. • Chichester Harbour SSSI: 15.26% favourable, 3.56% unfavourable recovering, 81.18% unfavourable no change.	
Site Improvement Plan (only actions that could be impacted by new housing development included):	1 Public Access/ Disturbance - Little Egret, Dark-bellied Brent Goose, Common shelduck, Wigeon, Eurasian teal, Pintail,) Shoveler, Red-breasted Merganser, Ringed Plover, Grey Plover, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Common redshank, Turnstone, Mediterranean Gull, Sandwich Tern, Roseate Tern, Common Tern, Little Tern, Annual vegetation of driftlines, Coastal shingle vegetation outside the reach ofwaves, Waterbird assemblage - Reduce disturbance through access management, awareness raising and wardening 4.Water Pollution - Little Egret, Dark-bellied Brent Goose, Common shelduck, Wigeon, Eurasian teal, Pintail, Shoveler, Red-breasted Merganser, Ringed Plover, Grey Plover, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Common redshank, Turnstone, Mediterranean Gull, Sandwich Tern, Roseate Tern, Common Tern, Little Tern, Estuaries, Intertidal mudflats and sandflats, Glasswort and other annuals colonising mud and sand, Cord-grass swards, Atlantic salt meadows, Waterbird assemblage- Implement actions in the Diffuse Water Pollution Plan, and investigate further pollution. 13. Air Pollution: impact of Pressure Not yet determined atmospheric nitrogen deposition - dark-bellied brent goose, wigeon, pintail, Black-tailed Godwit, Curlew, Common greenshank, Sandwich Tern, Roseate Tern, Common Tern, Little Tern, Estuaries, Coastal lagoons, Glasswort and other annuals colonising mud and sand, Atlantic salt meadows, Shifting dunes with marram	

[20] Ramsar condition is not currently reported on. The features are normally covered by the SAC and SPA which are reported on, and as part of European Marine Sites.

Table 4 Portsmouth Harbour SPA and Ramsar: Qualifying Features, condition and vulnerability to changes in nutrients

Designated site name:	**Portsmouth Harbour**	
Designation type: (SAC, SPA, Ramsar):	SPA and Ramsar	
Qualifying features (those in bold considered most sensitive to changes in nutrient levels):	Feature	Vulnerability to changes in nutrients
	Article 4.2 Over winter: **Dark-bellied Brent Goose *Branta bernicla bernicla*,** 2,847 individuals representing at least 0.9% of the wintering Western Siberia/Western Europe population (5-year peak mean 1991/2 - 1995/6)	Dark-bellied Brent geese roost on the water in Portsmouth Harbour at night. During the day they generally do not roost. Instead at high tide they feed on grassland and wheat fields near to the harbour and at low tide they feed on the harbour seagrass beds and green algae, particularly in the north and west at Paulsgrove Lake, Portchester and Forton Lake. As eelgrass beds are a major food source, and this habitat is susceptible to impacts from changes in nutrient input (see Ramsar criterion 3 below), dark-bellied brent goose are also considered to be sensitive[21]. In Portsmouth Harbour SPA, Red-breasted merganser feed throughout the channels in the harbour, favouring Paulsgrove Lake and utilise the shallow coastal waters within the site, feeding primarily on fish and aquatic invertebrates[21,22]. Given their feeding preferences, it is considered that the species is less sensitive to changes in nutrient levels. The main roost sites for black-tailed godwit are Pewit Island, the saltmarsh shore below RNAD Gosport, Bedenham and Farlington Marshes in Langstone Harbour. In wet weather, black-tailed godwits also move between Portsmouth Harbour and Titchfield Haven in the Meon Valley along the coast to the west. As well as feeding at low tide on the intertidal sediment in the north western part of the harbour, black-tailed godwit also feed during wet winters on the wet grassland at RNAD Gosport, Bedenham[21]. Black-tailed godwits feed on intertidal sediments, with ragworm and bivalve molluscs being important prey items. Mudflats and sandflats are susceptible to changes in nutrient levels (see Solent Maritime SAC for details), and therefore black-tailed godwit are considered to be sensitive. The main roost sites for dunlin are on pontoons near Wicor Shore, on saltmarsh below RNAD Gosport, Bedenham and on the island by Priddy's Hard. Some birds also fly back to Langstone Harbour to roost. At low tide, dunlin feed on the intertidal mudflats in the north west of the harbour around Cams Bay and Wicor Lake and in the west of the harbour at Forton Lake[21]. Mudflats and sandflats are susceptible to changes in nutrient levels (see Solent Maritime SAC for details), and therefore dunlin is considered to be sensitive.
	Red-breasted merganser *Mergus serrator* 100 individuals, 1% of GB population	
	Black-tailed godwit *Limosa limosa* 70 individuals, over 1% of GB population	
	Dunlin *Calidris alpina* 8,010, over 1% of GB population	
	Ramsar criterion 3 The intertidal mudflat areas possess extensive beds of **eelgrass** *Zostera angustifolia* and *Zostera noltei* which support the grazing dark-bellied brent geese populations. The mud-snail *Hydrobia ulvae* is found at extremely high densities, which helps to support the wading bird interest of the site. Common cord-grass *Spartina anglica* dominates large areas of the saltmarsh and there are also extensive areas of green algae *Enteromorpha* spp. and sea lettuce *Ulva lactuca*. More locally the **saltmarsh** is dominated by sea purslane *Halimione portulacoides* which gradates to more varied communities at the higher shore levels. The site also includes a number of saline lagoons hosting nationally important species.	There are approximately 77 ha of seagrass beds in Portsmouth Harbour, which are found mainly in the north-west of the harbour. These beds include both *Zostera marina* (found on the low shore) and *Zostera noltii* (on the upper to mid shore). Excessive nutrients and / or high turbidity can lead to a reduction in dissolved oxygen, especially in warmer months. *Zoestra* spp. have a high intolerance to nutrient enrichment with high nitrate concentrations leading to a decline of *Zoestra marina*. The adverse effects of increases in nitrate has been shown to be exacerbated by the level of salinity, with estuarine habitats being more intolerant than marine habitats. Den Hartog (1994) reported the growth of a dense blanket of *Ulva radiata* in Langstone Harbour in 1991 that resulted in the loss of 10ha of *Zostera marina* and *Zostera noltii*; by summer 1992 the *Zostera* sp. were absent, however this may have been exacerbated by grazing by Brent geese[23]. Although Langstone Harbour and Portsmouth Harbour are linked, the habitats in Portsmouth Harbour would only be adversely effect if there was a significant input of water from Langstone Harbour into Portsmouth Harbour to allow the transfer of nutrients. Two brackish lagoons are located adjoining Haslar Lake in the south-west of the harbour. Both, Little Anglesey Lake and Cockle Pond, support populations of both the starlet sea anemone *Nematostella vectensis* and the lagoon sand shrimp *Gammarus insensibilis*[24]. The lagoons are located at sufficient distance from Langstone Harbour, at the head of Haslar Marina, to be impacted by detectable increases in nutrients from the proposed housing development in the Budds Farm WwTW catchment.
	Ramsar criterion 6 – species/populations occurring at levels of international importance. Qualifying Species/populations (as identified at designation): Species with peak counts in winter: Dark-bellied brent goose, *Branta bernicla bernicla*, 2105 individuals, representing an average of 2.1% of the GB population (5 year peak mean 1998/9-2002/3)	As above for the SPA.
Current conservation status (Article 12):	• Black-tailed Godwit: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Dark-bellied Brent Goose*:* Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Insufficient • Red-breasted merganser: • Dunlin: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Insufficient	
Conservation objectives:	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring; • The extent and distribution of the habitats of the qualifying features	

[21] Portsmouth Harbour SPA Last updated: 14th September 2018 Supplementary advice. Accessed at: https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK9011051&SiteName=Portsmouth+Harbour&SiteNameDisplay=Portsmouth+Harbour+SPA&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality=4%2c4

[22] English Nature (2001) Solent European Marine Site comprising: Solent Maritime candidate Special Area of Conservation Solent and Southampton Water Special Protection Area & Ramsar Site Chichester and Langstone Harbours Special Protection Area & Ramsar Site Portsmouth Harbour Special Protection Area & Ramsar Site English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994.

[23] Tyler-Walters, H., 2008. Zostera (Zostera) marina Common eelgrass. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 25-01-2020]. Available from: https://www.marlin.ac.uk/species/detail/1282

[24] Portsmouth Harbour SSSI citation (1993). Accessed at https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1003174.pdf

	• The structure and function of the habitats of the qualifying features • The supporting processes on which the habitats of the qualifying features rely • The population of each of the qualifying features, and, • The distribution of the qualifying features within the site.
SSSI Condition assessment:	Portsmouth Harbour SSSI: 2.58% favourable, 25.70% unfavourable-recovering, 71.21% unfavourable-no change, 0.15% unfavourable-declining, 0.35% destroyed.
Site Improvement Plan (only actions that could be impacted by new housing development included):	1 Public Access/ Disturbance - Little Egret, Dark-bellied Brent Goose, Common shelduck, Wigeon, Eurasian teal, Pintail,) Shoveler, Red-breasted Merganser, Ringed Plover,Grey Plover, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Common redshank, Turnstone, Mediterranean Gull, Sandwich Tern, Roseate Tern, Common Tern, Little Tern, Annual vegetation of driftlines, Coastal shingle vegetation outside the reach of waves, Waterbird assemblage - Reduce disturbance through access management, awareness raising and wardening 4.Water Pollution - Little Egret, Dark-bellied Brent Goose, Common shelduck, Wigeon, Eurasian teal, Pintail, Shoveler, Red-breasted Merganser, Ringed Plover, Grey Plover, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Common redshank, Turnstone, Mediterranean Gull, Sandwich Tern, Roseate Tern, Common Tern, Little Tern, Estuaries, Intertidal mudflats and sandflats, Glasswort and other annuals colonising mud and sand, Cord-grass swards, Atlantic salt meadows, Waterbird assemblage- Implement actions in the Diffuse Water Pollution Plan, and investigate further pollution. 13. Air Pollution: impact of Pressure Not yet determined atmospheric nitrogen deposition - dark-bellied brent goose, wigeon, pintail, Black-tailed Godwit, Curlew, Common greenshank, Sandwich Tern, Roseate Tern, Common Tern, Little Tern, Estuaries, Coastal lagoons, Glasswort and other annuals colonising mud and sand, Atlantic salt meadows, Shifting dunes with marram

Table 5 Solent and Dorset Coast SPA: Qualifying Features, condition and vulnerability to changes in nutrients

Designated site name:	**Solent and Dorset Coast**	
Designation type: (SAC, SPA, Ramsar):	SPA (marine)	
Qualifying features:	Feature	Vulnerability to changes in nutrients
	Sandwich tern *Sterna sandvicensis* (Breeding) 441 pairs (882 breeding adults) (2008 - 2014), 4.01% of GB breeding population Common tern *Sterna hirundo* (Breeding) 492 pairs (984 breeding adults) (2009 - 2014), 4.77% of GB breeding population Little tern *Sternula albifrons* (Breeding) 63 pairs (126 breeding adults) (2009 - 2014) 3.31%	Sandwich tern and common tern foraging areas are predominantly confined to the Langstone and Chichester Harbours (of relevance to the new development in Havant BC), with some foraging offshore between the mainland and the Isle of Wight. Little tern foraging areas were confined to the Langstone and Chichester Harbours, rather than further offshore[25]. Nesting of all three species occurs on extensive shingle ridges and islands within Langstone Harbour. At the North East side of the harbour abandoned oyster beds off of Hayling Island provide an artificial lagoon which provides foraging and nesting habitat for the terns. Within Chichester Harbour, little tern nest on the shingle banks near to the harbour entrance. Common, little, and Sandwich terns feed in shallow coastal waters mainly on small fish (e.g. sandeel, sprats etc.) and crustacea (shrimps, prawns, and crabs etc.), as well as worms and molluscs in shallow waters overlying sediment[26]. Increases in nutrients in important feeding areas could therefore change the diversity and abundance of prey, and as such, the tern species are considered sensitive to changes in nutrients, although to a lesser extent than those bird species feeding directly on the mudflats and sandbanks.
Current conservation status (Article 12):	• Sandwich tern: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Common tern: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Little tern: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient	
Conservation objectives:	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring; • The extent and distribution of the habitats of the qualifying features • The structure and function of the habitats of the qualifying features • The supporting processes on which the habitats of the qualifying features rely • The population of each of the qualifying features, and, • The distribution of the qualifying features within the site.	
SSSI Condition assessment:	• Langstone Harbour SSSI: 8.39% favourable, 91.05% unfavourable recovering, 0.56% unfavourable-no change. • Chichester Harbour SSSI: 15.26% favourable, 3.56% unfavourable recovering, 81.18% unfavourable no change. • Portsmouth Harbour SSSI: 2.58% favourable, 25.70% unfavourable-recovering, 71.21% unfavourable-no change, 0.15% unfavourable-declining, 0.35% destroyed.	
Site Improvement Plan (only actions that could be impacted by new housing development included):	Not available yet, only recently designated in January 2020, assume similar actions to those covered in the Solent SIP.	

[25] Natural England (January 2016) Departmental brief Solent and Dorset Coast potential Special Protection Area (pSPA). Accessed at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/560622/solent-dorset-departmental-brief.pdf
[26] English Nature (2001) Solent European Marine Site comprising: Solent Maritime candidate Special Area of Conservation Solent and Southampton Water Special Protection Area & Ramsar Site Chichester and Langstone Harbours Special Protection Area & Ramsar Site Portsmouth Harbour Special Protection Area & Ramsar Site English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994.

Table 6 Solent and Southampton Water SPA and Ramsar: Qualifying features, condition and vulnerability to changes in nutrients

Designated site name:	**Solent and Southampton Water**	
Designation type: (SPA, Ramsar):	SPA and Ramsar site	
Qualifying features:	Feature:	Vulnerability to changes in nutrients:
	Article 4.1: During the breeding season; common tern *Sterna hirundo*, 267 pairs representing at least 2.2% of the breeding population in Great Britain; little tern *Sterna albifrons*, 49 pairs representing at least 2.0% of the breeding population in Great Britain; Mediterranean gull *Larus melanocephalus*, 2 pairs representing at least 20.0% of the breeding population in Great Britain; roseate tern *Sterna dougallii*, 2 pairs representing at least 3.3% of the breeding population in Great Britain; sandwich tern *Sterna sandvicensis*, 231 pairs representing at least 1.7% of the breeding population in Great Britain. Article 4.2: Over winter; Black-tailed godwit *Limosa limosa islandica*, 1,125 individuals representing at least 1.6% of the wintering Iceland - breeding population; dark-bellied brent goose *Branta bernicla bernicla*, 7,506 individuals representing at least 2.5% of the wintering Western Siberia/Western Europe population; ringed plover *Charadrius hiaticula*, 552 individuals representing at least 1.1% of the wintering Europe/Northern Africa - wintering population; teal *Anas crecca*, 4,400 individuals representing at least 1.1% of the wintering Northwestern Europe population. Assemblage qualification: A wetland of international importance. Over winter, the area regularly supports 53,948 individual waterfowl including: gadwall *Anas strepera*, teal *Anas crecca*, ringed plover *Charadrius hiaticula*, black-tailed godwit *Limosa limosa islandica*, little grebe *Tachybaptus ruficollis*, great crested grebe *Podiceps cristatus*, Cormorant *Phalacrocorax carbo*, dark-bellied brent goose *Branta bernicla bernicla*, wigeon *Anas penelope*, redshank *Tringa totanus*, Pintail *Anas acuta*, shoveler *Anas clypeata*, red-breasted merganser *Mergus serrator*, grey plover *Pluvialis squatarola*, lapwing*Vanellus vanellus*, dunlin *Calidris alpina alpina*, curlew *Numenius arquata*, shelduck *Tadorna tadorna*.	The vulnerability of the bird species to changes in nutrients will depend on the impact to their preferred prey. Nesting and roosting opportunities are considered unlikely to be adversely affected. Bird species that feed on eelgrass (e.g. dark-bellied brent goose) and mudflat and sandflat habitats are likely to be highly sensitive to the impacts of eutrophication. Those species that feed on prey in the main water column are considered to be less sensitive, as these prey are mobile and less likely to be smothered. Reductions in dissolved oxygen could result in temporary changes in species availability. Tidal circulation patterns viewed in ABPmer's South Coast and Solent model suggest that water is retained within the Eastern Solent, rather than significantly entering Southampton Water. The offshore area that could be affected is around Ryde, Isle of Wight. A review of Natural England's designated views site suggests that Ryde is not a key feeding ground for the qualifying species.
	Ramsar criterion 1: The site is one of the few major sheltered channels between a substantial island and mainland in European waters, exhibiting an unusual strong double tidal flow and has long periods of slack water at high and low tide. It includes many wetland habitats characteristic of the biogeographic region: saline lagoons, saltmarshes, estuaries, intertidal flats, shallow coastal waters, grazing marshes, reedbeds, coastal woodland and rocky boulder reefs. Ramsar criterion 2: Important assemblage of rare plants and invertebrates. At least 33 BRDB invertebrates and at least eight BRDB plants are represented on site. Ramsar criterion 5: Assemblages of international importance: Species with peak counts in winter: 51343 waterfowl. Ramsar criterion 6: Qualifying Species/populations (as identified at designation): Species with peak counts in spring/autumn: ringed plover, *Charadrius hiaticula*, Europe/Northwest Africa 397 individuals, representing an average of 1.2% of the GB population. Species with peak counts in winter: dark-bellied brent goose, *Branta bernicla bernicla*, 6456 individuals, representing an average of 3% of the population, Eurasian teal, *Anas crecca*, NW Europe 5514 individuals, representing an average of 1.3% of the population, black-tailed godwit, *Limosa limosa islandica*, Iceland/W Europe 1240 individuals, representing an average of 3.5% of the population.	Covered above (Ramsar criterion 5 and 6) or as part of the Solent Maritime SAC designation (Ramsar criterion 1 and 2).
Current conservation status (Article 12):	• Mediterranean gull: Population: Insufficient, Range coverage: Insufficient, especially in northern parts of the range. Ecological sufficiency: Sufficient • Sandwich tern: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Common tern: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Little tern: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Roseate tern: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Dark bellied brent geese: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: insufficient • Teal: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Ringed plover: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient • Black-tailed godwit: Population numbers: Sufficient, Range coverage: Sufficient, Ecological sufficiency: Sufficient	
Conservation objectives (SPA):	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring; • The extent and distribution of the habitats of the qualifying feature • The structure and function of the habitats of the qualifying features • The supporting processes on which the habitats of the qualifying features rely • The population of each of the qualifying features • The distribution of the qualifying features within the site. Supplementary Advice to the conservation objectives is not currently available, however Regulation 33 advice is available[27].	
SSSI condition assessment:	Lower Test Valley SSSI: 100% favourable Medina Estuary SSSI: 100% favourable Newtown Harbour SSSI: 89.34% favourable, 10.31% unfavourable recovering, 0.35% unfavourable declining. Diffuse pollution affecting littoral sediment is being addressed through the Isle of Wight Catchment Sensitive Farming Project, whilst the unit in unfavourable-declining condition consists of neutral grassland which has been improved and overgrazed.	

[27] Solent European Marine Site comprising: Solent Maritime candidate Special Area of Conservation, Solent and Southampton Water Special Protection Area & Ramsar Site, Chichester and Langstone Harbours Special Protection Area & Ramsar Site, Portsmouth Harbour Special Protection Area & Ramsar Site. English Nature's advice given under Regulation 33(2) of the Conservation (Natural Habitats &c.) Regulations 1994. Accessed at http://publications.naturalengland.org.uk/publication/3194402.

	Yar Estuary SSSI: 83.15% favourable, 16.85% unfavourable recovering. Key issues for unfavourable recovering condition include dominance of ragwort, public disturbance issues, overgrazing by rabbits and coastal squeeze.
Site Improvement Plan (only actions that could be impacted by new housing development included):	1 Public Access/ Disturbance - Little Egret, Dark-bellied Brent Goose, Common shelduck, Wigeon, Eurasian teal, Pintail,) Shoveler, Red-breasted Merganser, Ringed Plover,Grey Plover, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Common redshank, Turnstone, Mediterranean Gull, Sandwich Tern, Roseate Tern, Common Tern, Little Tern, Annual vegetation of driftlines, Coastal shingle vegetation outside the reach of waves, Waterbird assemblage - Reduce disturbance through access management, awareness raising and wardening 4.Water Pollution - Little Egret, Dark-bellied Brent Goose, Common shelduck, Wigeon, Eurasian teal, Pintail, Shoveler, Red-breasted Merganser, Ringed Plover, Grey Plover, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Common redshank, Turnstone, Mediterranean Gull, Sandwich Tern, Roseate Tern, Common Tern, Little Tern, Estuaries, Intertidal mudflats and sandflats, Glasswort and other annuals colonising mud and sand, Cord-grass swards, Atlantic salt meadows, Waterbird assemblage- Implement actions in the Diffuse Water Pollution Plan, and investigate further pollution. 13. Air Pollution: impact of Pressure Not yet determined atmospheric nitrogen deposition - dark-bellied brent goose, wigeon, pintail, Black-tailed Godwit, Curlew, Common greenshank, Sandwich Tern, Roseate Tern, Common Tern, Little Tern, Estuaries, Coastal lagoons, Glasswort and other annuals colonising mud and sand, Atlantic salt meadows, Shifting dunes with marram